Developing Java Web Services

Developing Java Web Services
Trainer's Guide

APTECH LIMITED

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First Edition - 2014

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Dear Learner,

We congratulate you on your decision to pursue an Aptech Worldwide course.

Aptech Ltd. designs its courses using a sound instructional design model – from conceptualization to execution, incorporating the following key aspects:

- Scanning the user system and needs assessment

Needs assessment is carried out to find the educational and training needs of the learner.

Technology trends are regularly scanned and tracked by core teams at Aptech Ltd. TAG* analyzes these on a monthly basis to understand the emerging technology training needs for the Industry.

An annual Industry Recruitment Profile Survey# is conducted during August - October to understand the technologies that Industries would be adapting in the next 2 to 3 years. An analysis of these trends & recruitment needs is then carried out to understand the skill requirements for different roles & career opportunities.

The skill requirements are then mapped with the learner profile (user system) to derive the Learning objectives for the different roles.

- Needs analysis and design of curriculum

The Learning objectives are then analyzed and translated into learning tasks. Each learning task or activity is analyzed in terms of knowledge, skills and attitudes that are required to perform that task. Teachers and domain experts do this jointly. These are then grouped in clusters to form the subjects to be covered by the curriculum.

In addition, the society, the teachers, and the industry expect certain knowledge and skills that are related to abilities such as *learning-to-learn, thinking, adaptability, problem solving, positive attitude etc***. These competencies would cover both cognitive and affective domains.**

A precedence diagram for the subjects is drawn where the prerequisites for each subject are graphically illustrated. The number of levels in this diagram is determined by the duration of the course in terms of number of semesters etc. Using the precedence diagram and the time duration for each subject, the curriculum is organized.

- Design & development of instructional materials

The content outlines are developed by including additional topics that are required for the completion of the domain and for the logical development of the competencies identified. Evaluation strategy and scheme is developed for the subject. The topics are arranged/organized in a meaningful sequence.

The detailed instructional material – Training aids, Learner material, reference material, project guidelines, etc.- are then developed. Rigorous quality checks are conducted at every stage.

- Strategies for delivery of instruction

Careful consideration is given for the integral development of abilities like thinking, problem solving, learning-to-learn etc. by selecting appropriate instructional strategies (training methodology), instructional activities and instructional materials.

The area of IT is fast changing and nebulous. Hence, considerable flexibility is provided in the instructional process by specially including creative activities with group interaction between the students and the trainer. The positive aspects of Web based learning –acquiring information, organizing information and acting on the basis of insufficient information are some of the aspects, which are incorporated, in the instructional process.

- Assessment of learning

The learning is assessed through different modes – tests, assignments & projects. The assessment system is designed to evaluate the level of knowledge & skills as defined by the learning objectives.

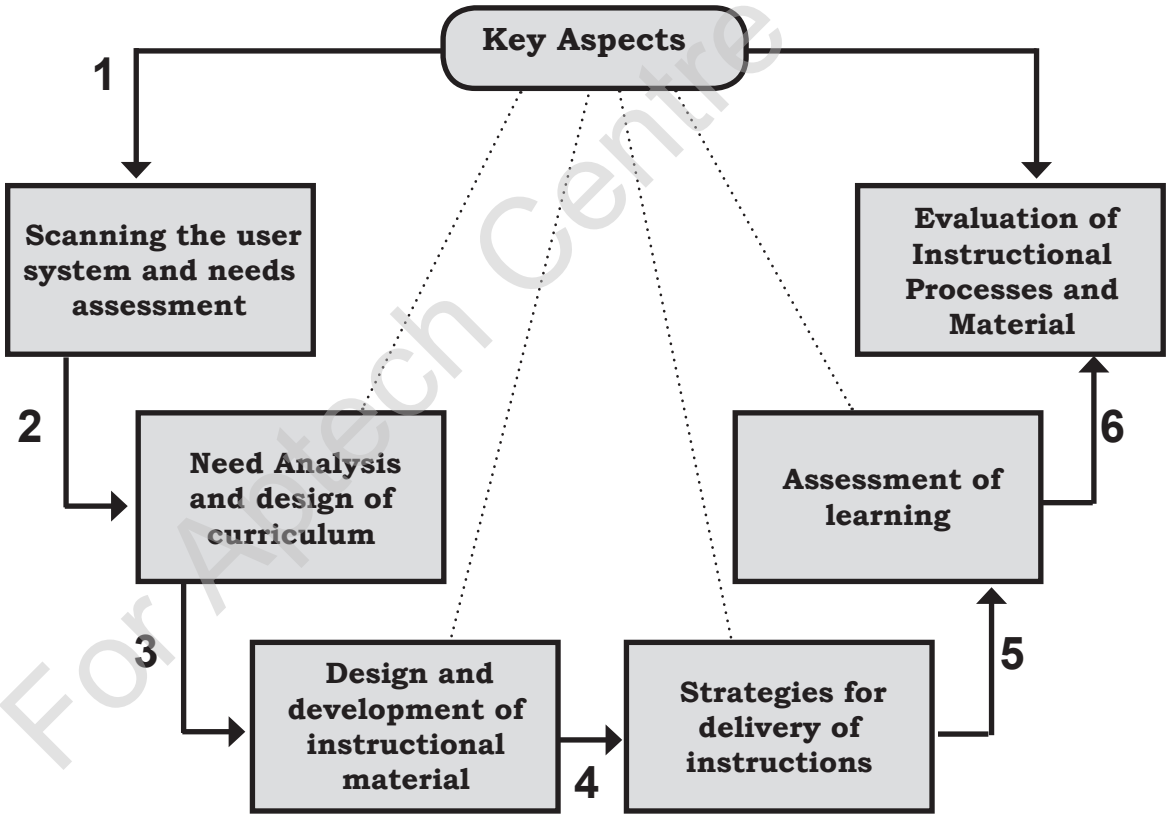
- Evaluation of instructional process and instructional materials

The instructional process is backed by an elaborate monitoring system to evaluate - on-time delivery, understanding of a subject module, ability of the instructor to impart learning. As an integral part of this process, we request you to kindly send us your feedback in the reply pre-paid form appended at the end of each module.

*TAG – Technology & Academics Group comprises of members from Aptech Ltd., professors from reputed Academic Institutions, Senior Managers from Industry, Technical gurus from Software Majors & representatives from regulatory organizations/forums.

Technology heads of Aptech Ltd. meet on a monthly basis to share and evaluate the technology trends. The group interfaces with the representatives of the TAG thrice a year to review and validate the technology and academic directions and endeavors of Aptech Ltd.

Aptech New Products Design Model



A little learning is a dangerous thing,

but a lot of ignorance is just as bad

Preface

The book 'Developing Java Web Services' Trainer's Guide' serves understanding on the features and functionalities of Java EE 7 for creating Web services and Web service clients. The faculty/trainer should teach the concepts in the theory class using the slides. This Trainer's Guide will provide guidance on the flow of the session and also provide tips and additional examples wherever necessary. The trainer can ask questions to make the session interactive and also to test the understanding of the students.

This book is the result of a concentrated effort of the Design Team, which is continuously striving to bring you the best and the latest in Information Technology. The process of design has been a part of the ISO 9001 Certification for Aptech-IT Division, Education Support Services. As part of Aptech's quality drive, this team does intensive research and curriculum enrichment to keep it in line with industry trends.

We will be glad to receive your suggestions.

Design Team

Table of Contents

Sessions

“The future depends on what we do in the present.”

Session 1: Introduction to Web Services

1.1 Pre-Class Activities

You should familiarize yourself with the concept of Web services. You should be able to explain the Service Oriented Architecture (SOA) and Java APIs for XML Web services (JAX-WS). You should be able to make learners understand how Java APIs can be used for XML Processing (JAXP). In addition, you should also be able to explain concepts of Java APIs for XML Registry (JAXR), SOAP with Attachment API for Java (SAAJ), and Java Architecture for XML Binding (JAXB).

Familiarize yourself with the topics of the current session in-depth.

1.1.1 Objectives

After the session, learners will be able to:

- Define Web services and describe their purpose
- Describe Service Oriented Architecture (SOA)
- Describe role of XML, SOAP, Registry standards, and WSDL in Web services
- Describe purpose of using JAXP in processing XML documents
- Explain parsing of XML document using SAX and DOM
- Describe JAX-WS
- Explain JAXR architecture, its components, and its interfaces
- Describe the purpose and features of SAAJ
- Describe purpose and limitations of JAXB and its components
- Explain the marshalling and unmarshalling processes

1.1.2 Teaching Skills

To teach this session, you should be well versed with the concept of Web services, SOA, JAXP, JAX-WS, SAAJ, and JAXB. You should know about the various Web service APIs of Java EE platform that support and implement Web services.

You should teach the concepts in the theory class using the images provided. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

1.1.3 In-Class Activities:

Follow the order given here during In-Class activities.

Review of Previous Session

You should begin with a brief recap or review of previous session. Since this is the first session, you can skip doing this.

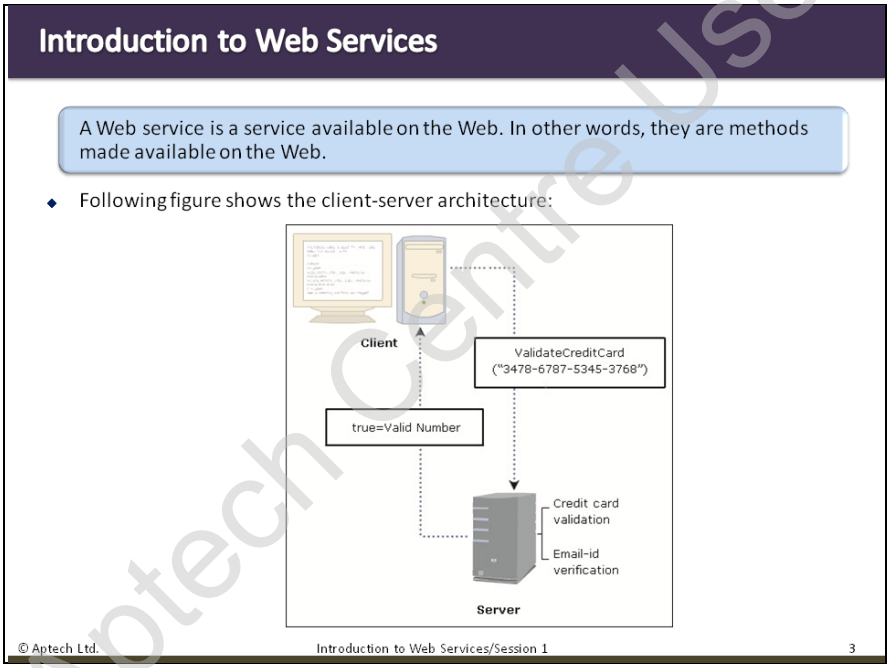
Overview of the Session

Then, give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session introduces them to the concept of Web services. Tell them that this session also explains in detail the SOA. Tell the students that this session introduces them to the purpose of using JAXP in processing XML documents and use of JAX-WS. It also introduces the students to the JAXR architecture and its components and its interfaces. Further, the session describes the purpose of SAAJ and JAXB.

1.2 In-Class Explanations

Introduction to Web Services

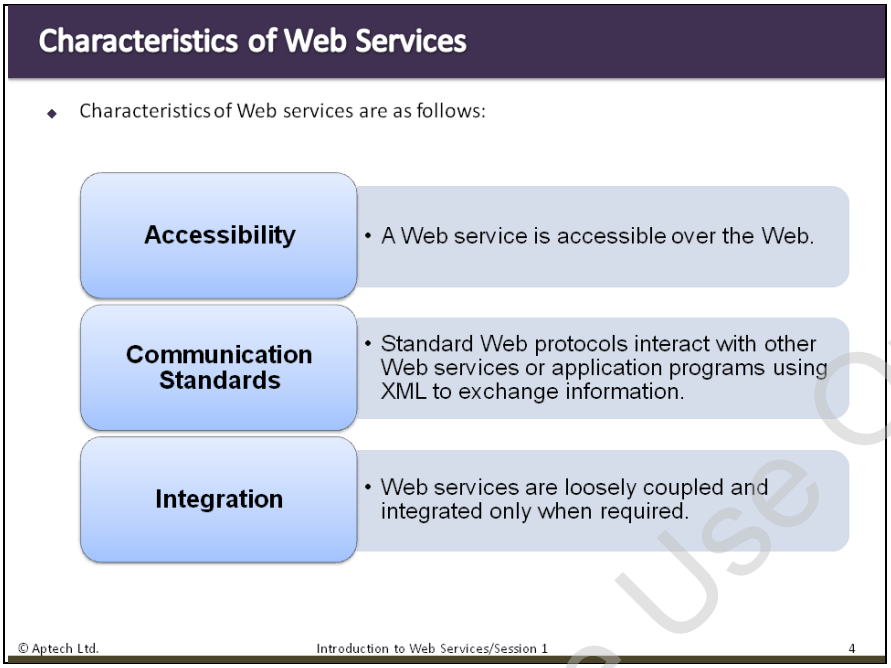
Slide 3



Using slide 3, explain the meaning of Web service. Provide or ask a few examples where Web services are used. Tell them what made Web services highly successful. Explain with the help of the figure that Web services generally follow the client-server architecture.

Characteristics of Web Services

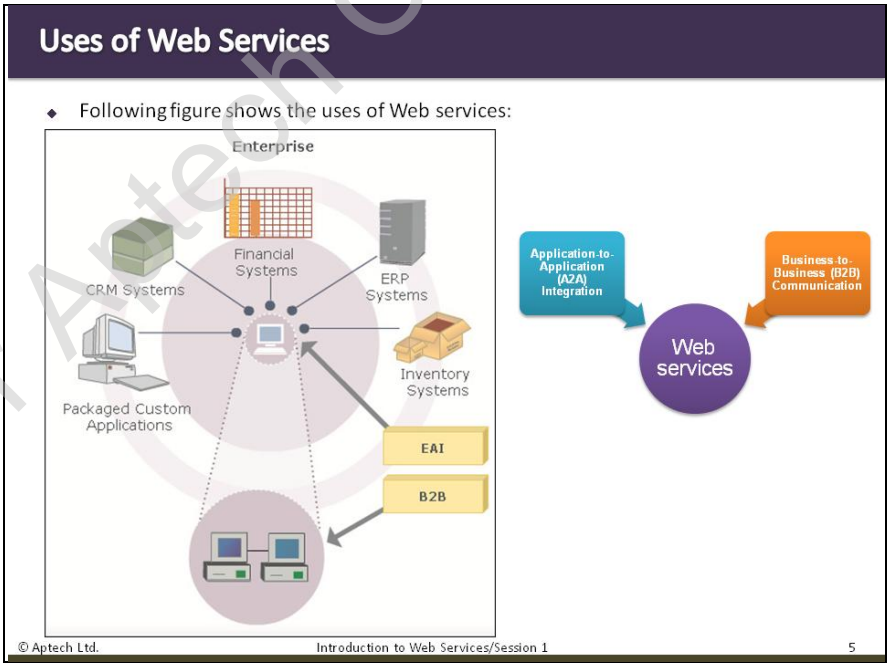
Slide 4



Using slide 4, explain the main characteristics of a Web service, which are accessibility, communication standards, and integration.

Uses of Web Services

Slide 5



Using slide 5, explain in detail about the uses of a Web service. Tell them that the Web services are generally used in Application-to-Application (A2A) integration or Business-to-Business (B2B) Communication. Explain how Web services are used in these applications.

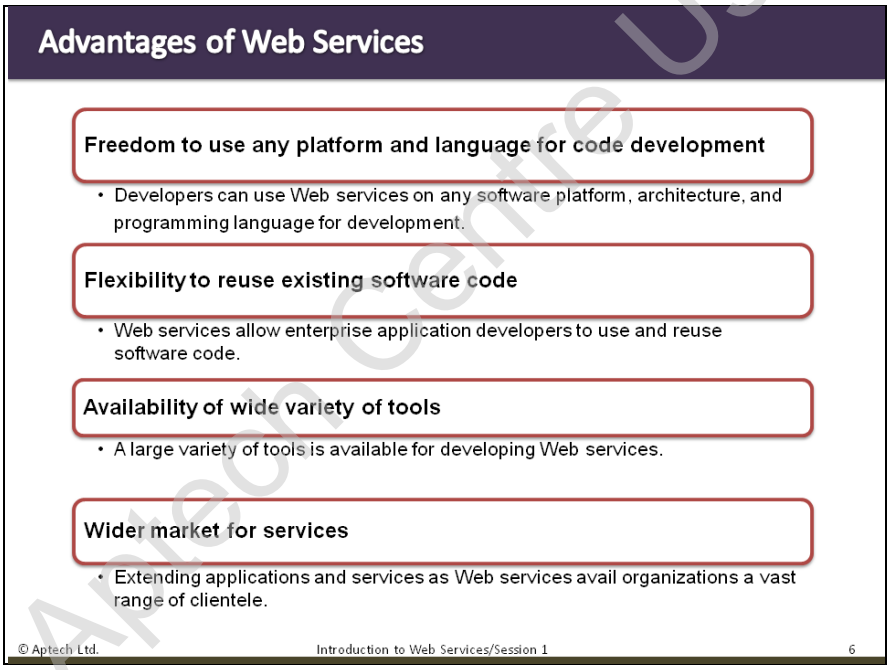
Explain with an example for A2A integration that can be seen in a social media site such as Facebook or Twitter in which the application needs to share data with every other application. Explain that B2B communication happens between a company, its customers, and suppliers for business purposes such as request, purchase order, price, invoice, and payment.

In-Class Question:

What is a Web service?

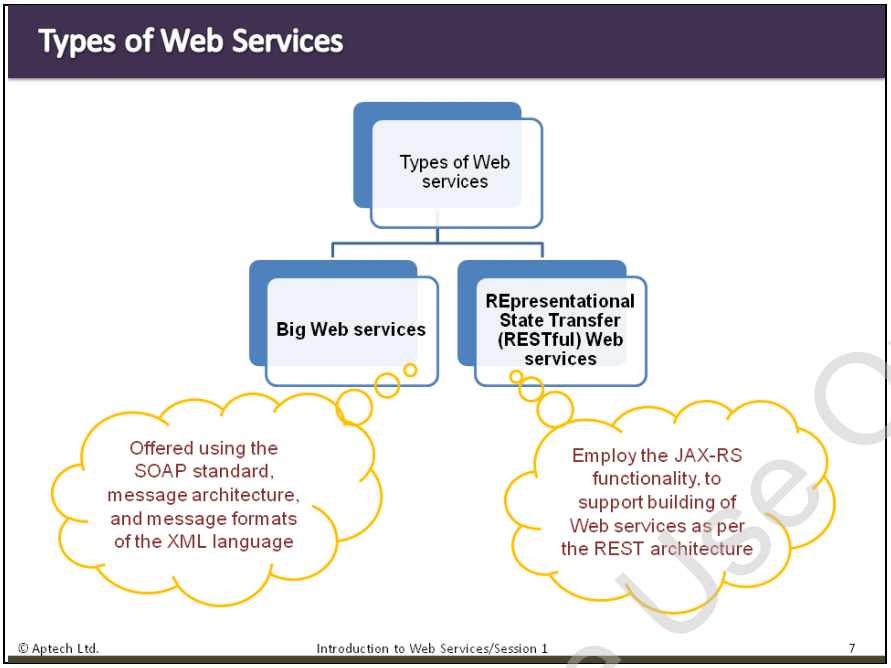
Answer:
A Web service is a service available on the Web. In programming terms, Web service is a method made available on the Web.

Advantages of Web Services
Slide 6



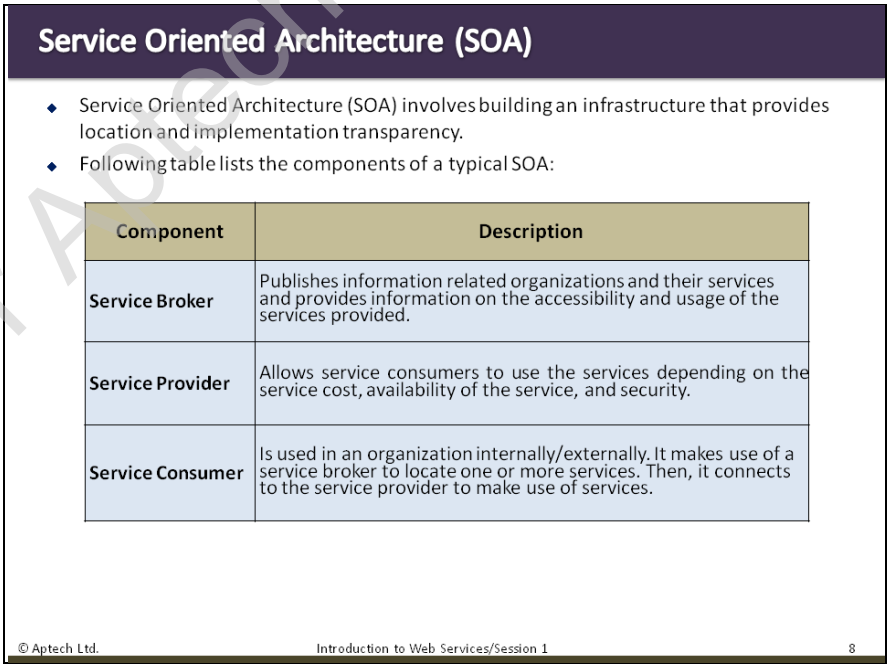
Using slide 6, discuss the advantages of Web services that have made them popular. Explain how Web services are beneficial to the users.

Types of Web Services
Slide 7



Using slide 7, explain the types of Web services, which are Big Web services and RESTful Web services. Describe the tools, such as NetBeans IDE that simplify the development of Web service applications. Explain WSDL and JAX-RS, which support Web services. Explain how the performance of RESTful Web services can be enhanced by leveraging the caching infrastructure.

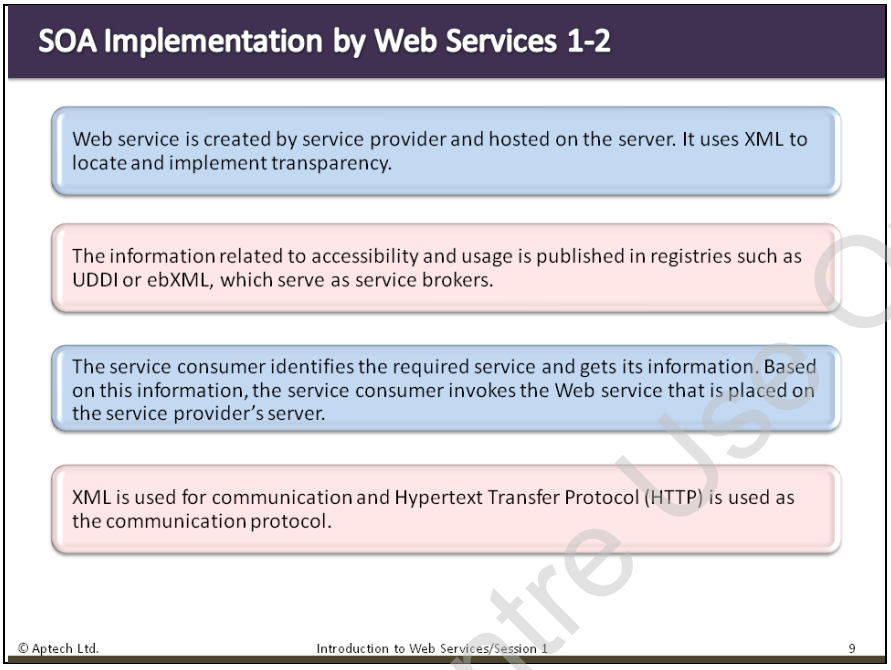
Service Oriented Architecture
Slide 8

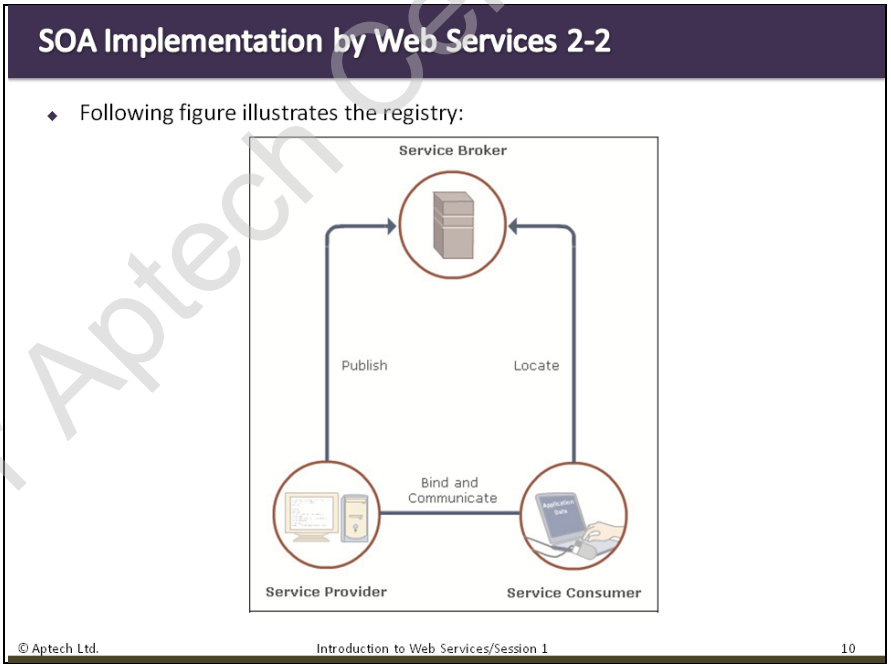


Using slide 8, explain Service Oriented Architecture (SOA). Describe location and implementation transparency. Also, explain the components of a typical SOA with the help of the table and what it is useful for.

SOA Implementation by Web Services

Slides 9 and 10



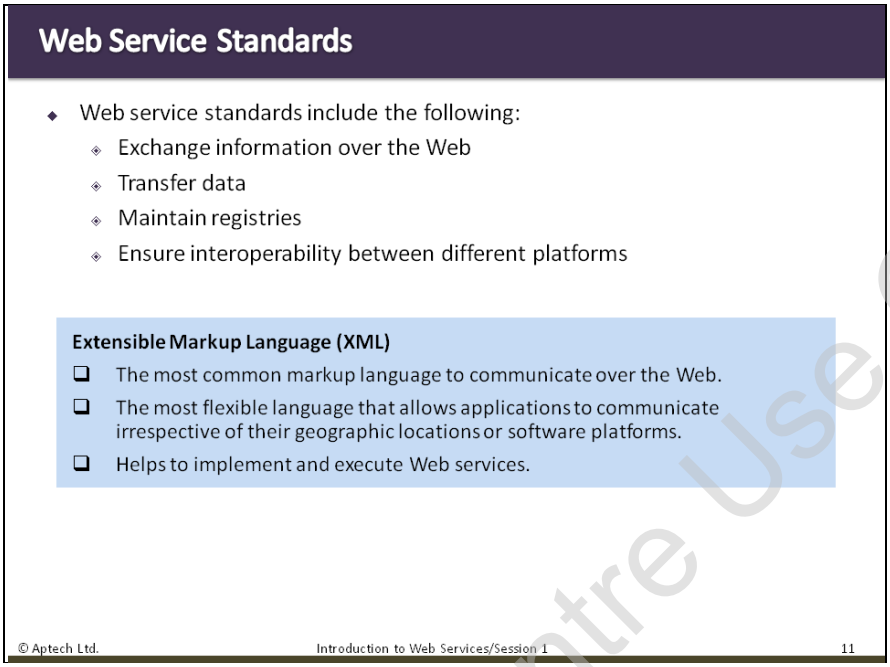


Using slides 9 and 10, explain how the Web services locate and implement SOA. Using slide 9 explain that the Service Provider registers the Web service in registries such as UDDI or ebXML and these registries serve as the Service Broker. The Service Consumer locates the Web service as per the requirements and invokes it. Using the figure on slide 10, explain the registry in SOA.

Mention that when an employee wants to know the number of leaves he/she can avail in a year. A service consumer can use the service published on the service broker to provide the number of leaves an employee can avail in a year.

Web Service Standards

Slide 11



Using slide 11, explain the need for Web service standards. Explain in brief about XML, which is the most common markup language used to communicate over the Web. Inform that XML is very flexible. It is used to develop standards such as SOAP, WSDL, and UDDI, which enables communication between applications at different geographical locations or software platforms.

In-Class Question:

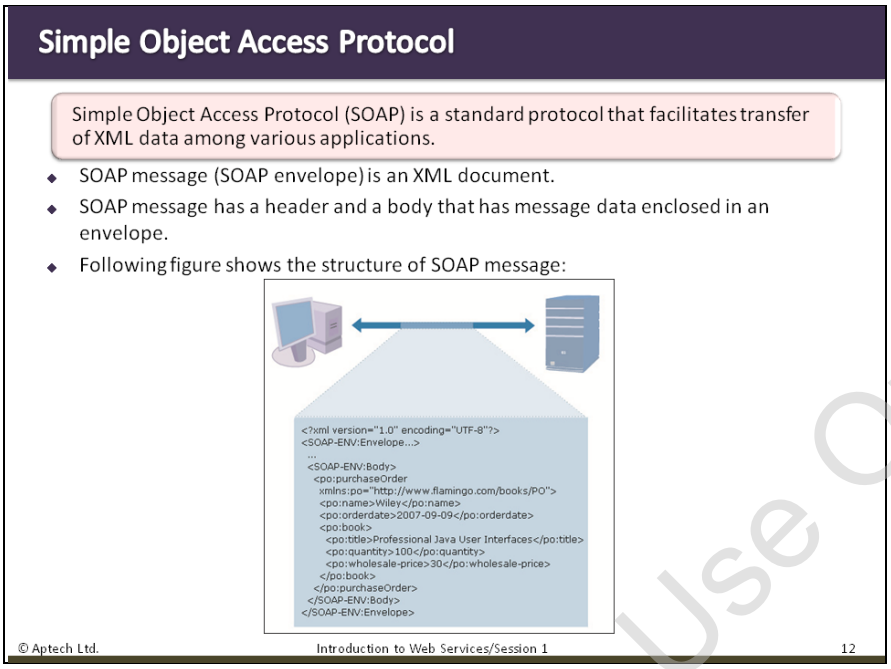
What is XML?

Answer:

XML is Extensible Markup Language which is used to communicate over the Web. It is the most flexible language that allows applications to communicate irrespective of their geographic locations or software platforms. It also helps to implement and execute Web services.

Simple Object Access Protocol

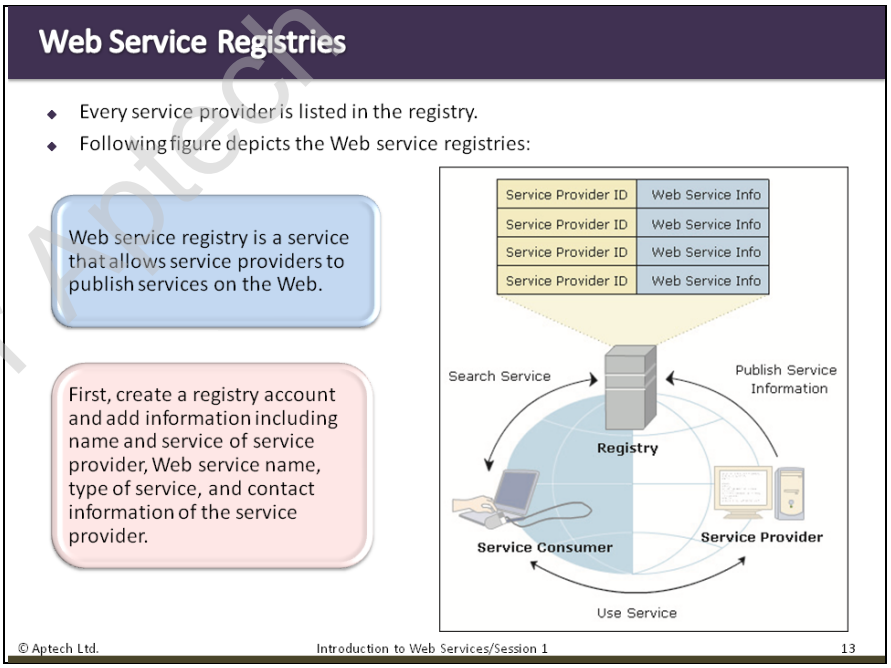
Slide 12



Using slide 12, explain SOAP. Describe the advantages of SOAP. Also, explain SOAP Message structure showing header and an envelope with the help of the illustration given in the figure. Mention that a SOAP message mandatorily consists of the Envelope and the Body element. The Envelope element defines the start and end of the message and the Body element contains the data being sent.

Web Service Registries

Slide 13



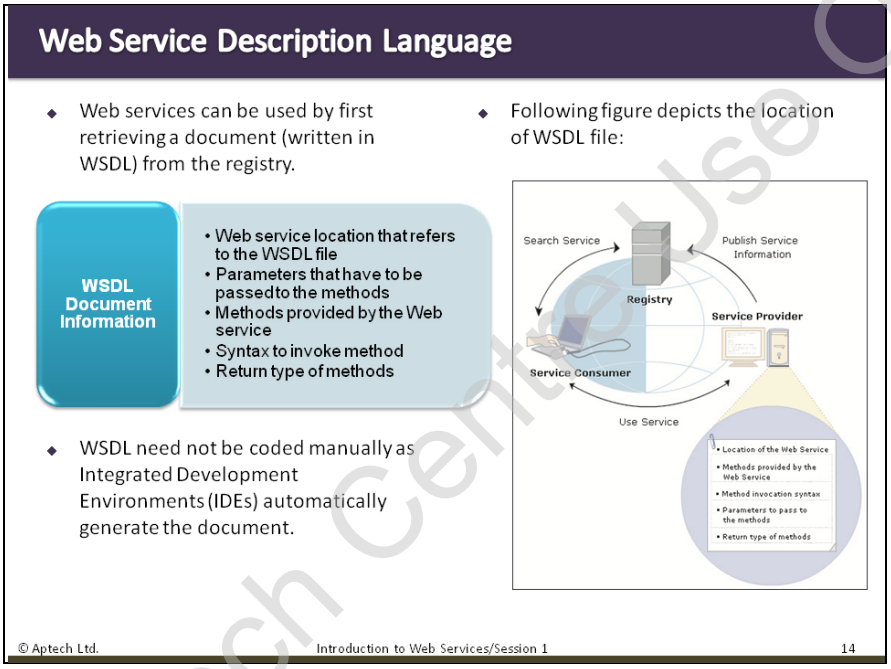
Using slide 13, explain that Web Service Registry is a service that allows service providers to publish their services on the Web. Explain what the user has to do to use the information given in the Web service registry. Show the figure on slide 13 and mention that every

service provider is listed in the registry. If a consumer needs a service, the entire registry is explored to locate the required service.

What is a Web service registry?

Answer:
Web service registry is a service that allows service providers to publish services on the Web.

Web Service Description Language
Slide 14



Using slide 14, explain WSDL. Explain that it is a document written in WSDL that can be retrieved from the registry. Explain the information contained in the document, which are listed as follows:

- Web service location that refers to the WSDL file
- Parameters that have to be passed to the methods
- Methods provided by the Web service
- Syntax to invoke method
- Return type of methods

Additionally, explain the location of the WSDL document using the illustration given in the figure on slide 14.

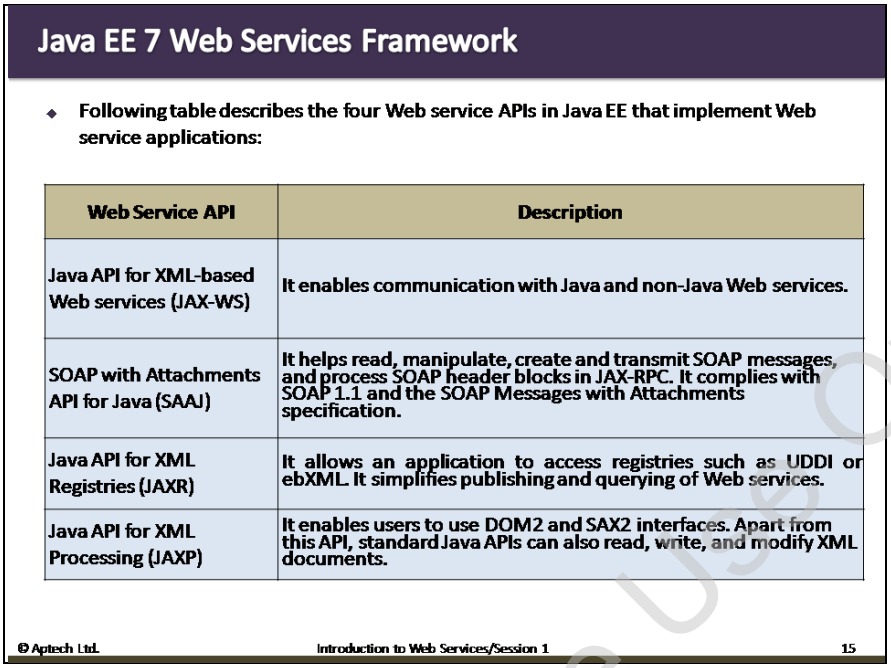
In-Class Question:

What is WSDL?

Answer:
WSDL is a language that is used to describe Web services and how to access the Web service. Generally, the WSDL is written in XML.

Java EE 7 Web Services Framework

Slide 15



Java EE 7 Web Services Framework

- Following table describes the four Web service APIs in Java EE that implement Web service applications:

Web Service API	Description
Java API for XML-based Web services (JAX-WS)	It enables communication with Java and non-Java Web services.
SOAP with Attachments API for Java (SAAJ)	It helps read, manipulate, create and transmit SOAP messages, and process SOAP header blocks in JAX-RPC. It complies with SOAP 1.1 and the SOAP Messages with Attachments specification.
Java API for XML Registries (JAXR)	It allows an application to access registries such as UDDI or ebXML. It simplifies publishing and querying of Web services.
Java API for XML Processing (JAXP)	It enables users to use DOM2 and SAX2 interfaces. Apart from this API, standard Java APIs can also read, write, and modify XML documents.

© Aptech Ltd. Introduction to Web Services/Session 1 15

Using slide 15, explain Web service APIs in the J2EE platform which are JAX-WS, SAAJ, JAXR, and JAXP and the use of each.

In-Class Question:

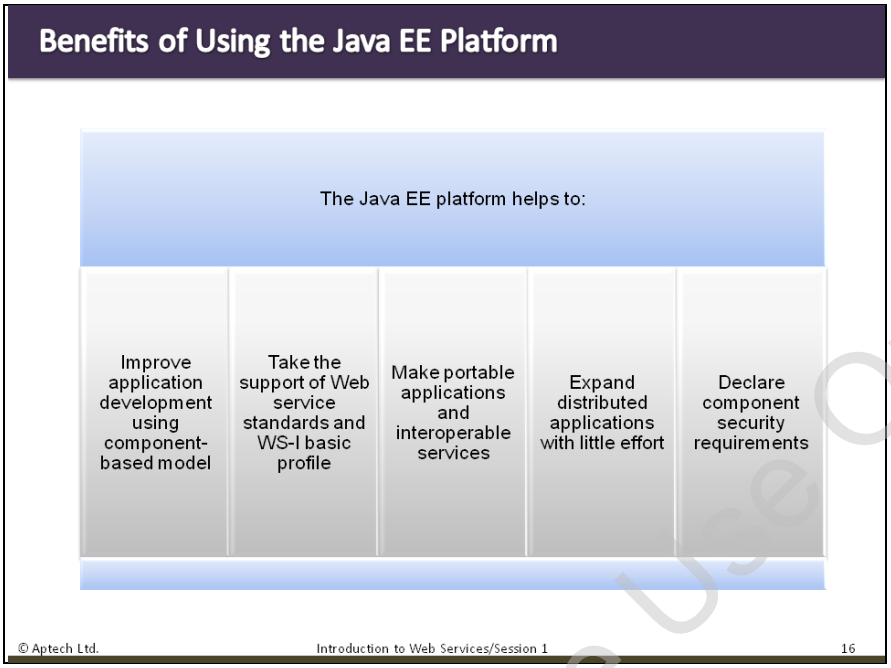
List the different Java Web services APIs.

Answer:

- Java API for XML-based Web services (JAX-WS)
- SOAP with Attachments API for Java (SAAJ)
- Java API for XML Registries (JAXR)
- Java API for XML Processing (JAXP)

Benefits of Using the Java EE Platform

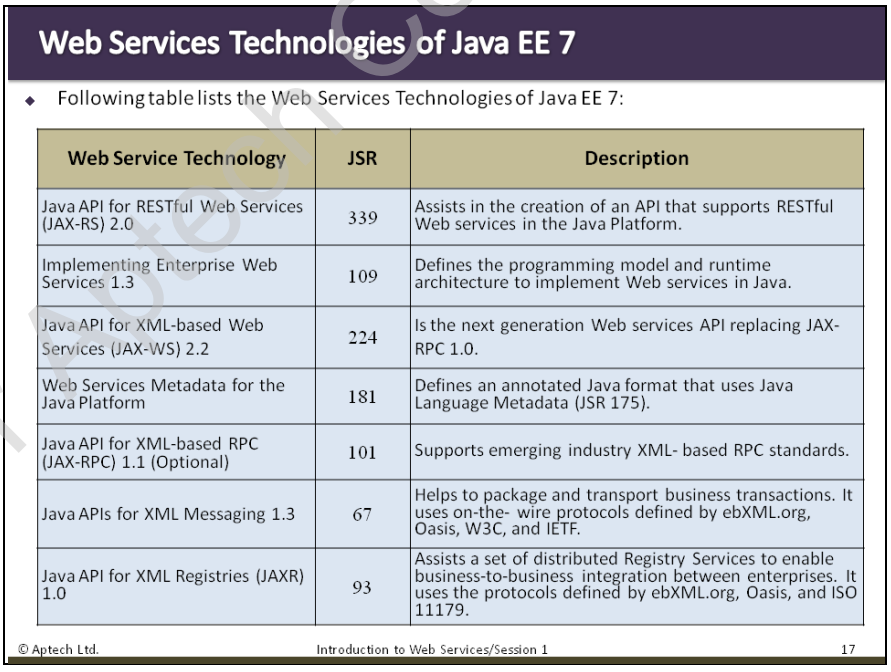
Slide 16



Using slide 16, explain the benefits of using the Java EE Platform.

Web Services Technologies of Java EE 7

Slide 17



Using slide 17, explain the Web Service Technologies of Java EE 7 and the uses of each.

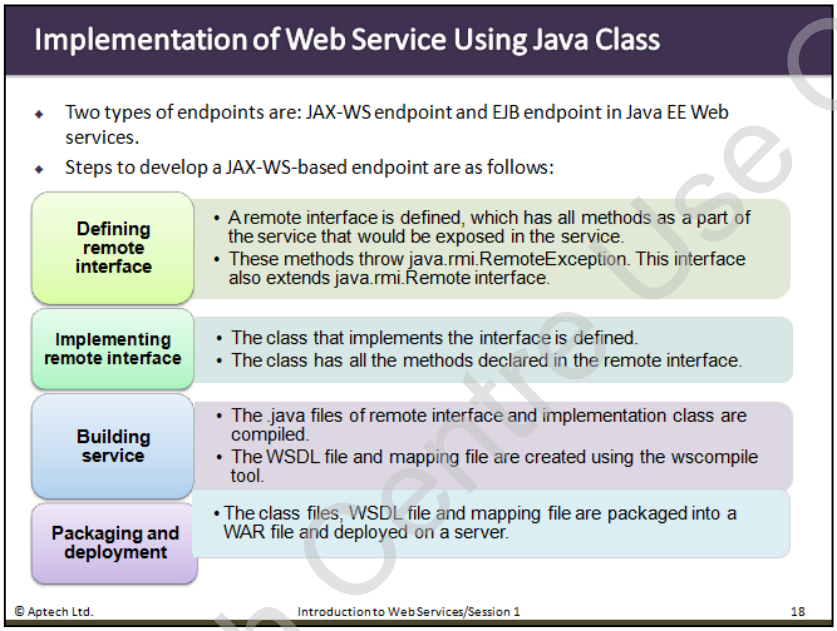
In-Class Question:

What is use of JAXR 1.0?

Answer:
It assists a set of distributed Registry Services to enable business-to-business integration between enterprises. It uses the protocols defined by ebXML.org, Oasis, and ISO 11179.

Implementation of Web Service Using Java Class

Slide 18



Using slide 18, explain that there can be two types of endpoints namely, JAX-WS endpoint and EJB endpoint in Java EE Web services. Then, explain the four steps to develop JAX-WS based endpoint, which are:

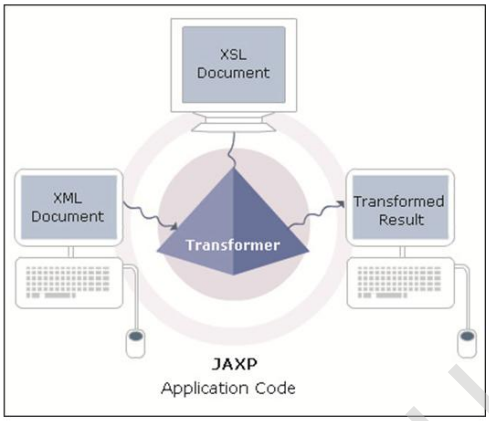
- Defining remote interface
- Implementing remote interface
- Building service
- Packaging and deployment

JAXP

Slides 19 and 20

JAXP 1-2

- JAXP uses Extensible Stylesheet Language Transformation (XSLT) engines to transform XML documents from one format to another.
- Following figure shows processing of XML documents using JAXP:



JAXP 2-2

- Following table lists the packages that define the JAX API:

Package	Description
javax.xml.parsers	Defines SAXParserFactory and DocumentBuilderFactory classes, which provide a common interface for SAX and DOM parsers.
javax.xml.transform	Defines the generic APIs to transform source to result.
javax.xml.transform.dom	Implements DOM-specific transformation APIs.
javax.xml.transform.sax	Implements SAX2-specific transformation APIs.

Using slides 19 and 20, explain JAXP in brief. Explain the two Java standards that are used to parse XML documents, which are Simple API for XML (SAX) or Document Object Model (DOM) Java standards.

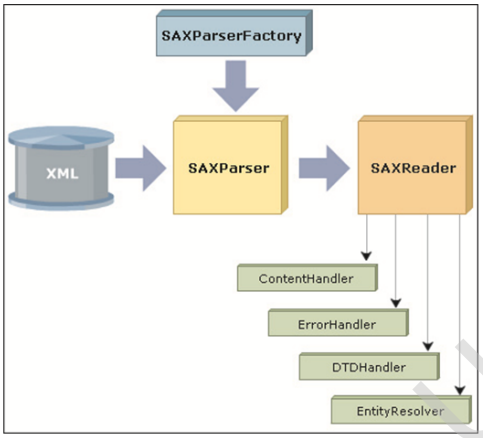
Inform that these APIs can read, write, and modify XML documents by using XML parser. Then, explain processing of XML documents using JAXP using the figure on slide 19. Mention that XSLT engine is used to output the transformation result as a XML document. Explain that a package is a namespace that is attributed to the classes based on category or functionality. Using slide 20, explain the packages that define the JAX API and the use of each.

SAX Parser

Slides 21 and 22

SAX Parser 1-2

- SAX processes the XML documents sequentially into a series of events.
- SAX is very fast as it does not load the document into memory.
- The SAX parser is depicted in the following figure:



SAX Parser 2-2

- Following table lists the key classes/interfaces to parse XML documents:

Package	Description
DefaultHandler	Is present in the org.xml.sax.helpers package. It acts as a default base class for SAX2 event handlers.
SAXParserFactory	Is present in the javax.xml.parsers package. It returns the SAXParser and the exception classes to report errors.
SAXParser	Is present in the javax.xml.parsers. It defines the API that wraps an XMLReader implementation class.
XMLReader	Is present in the java.io package. It is an interface to read an XML document by using callbacks.

Using slides 21 and 22, explain SAX Parser. Explain that SAX processes the XML documents sequentially. Show the figure of SAX Parser on slide 21 and mention about the relationship between the various components used while parsing an XML document with a SAX parser. SAXParserFactory class is used to generate an instance of the SAX parser. The parser contains a SAXReader object. When the parser's parse() method is invoked, the reader invokes one of the many callback methods implemented in the application. Those methods are defined by the interfaces ContentHandler, ErrorHandler, DTDHandler, and EntityResolver.

Using slide 22, explain the key classes/interfaces that are used to parse XML documents that are listed as follows:

- DefaultHandler
- SAXParserFactory
- SAXParser
- XMLReader

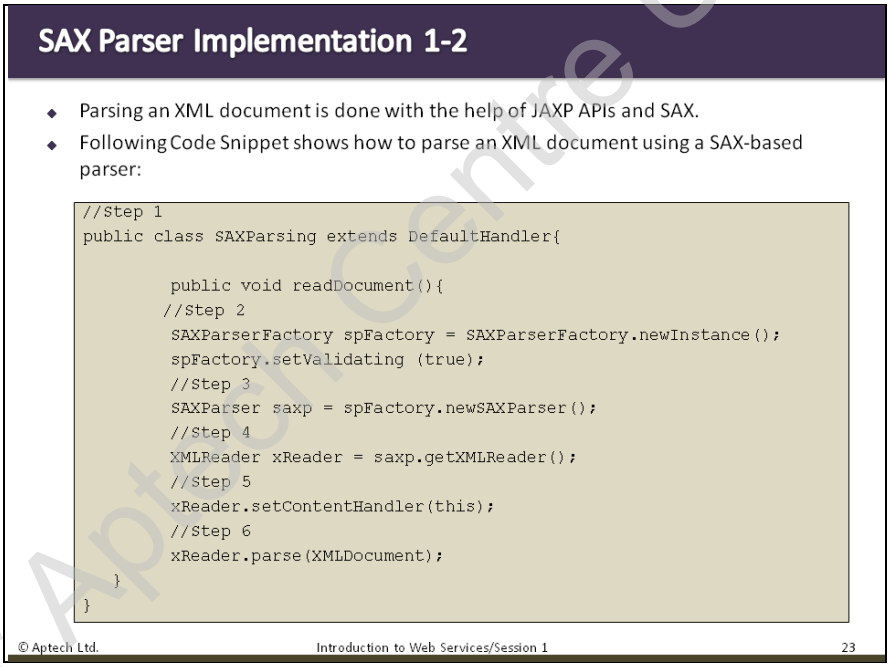
While explaining the key classes, point out the package in which each class is present and what it is useful for.

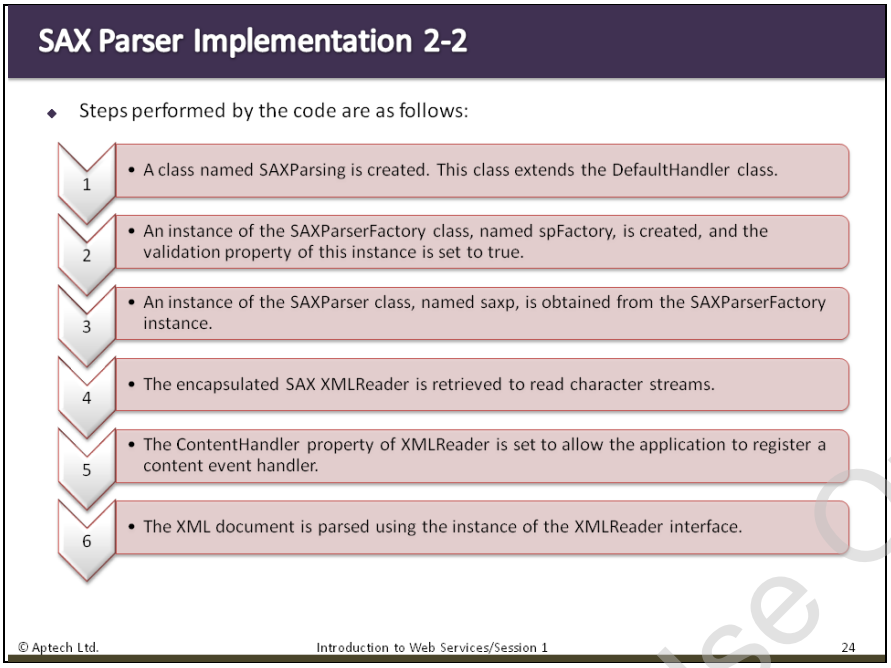
In-Class Question:


List any one advantage of SAX Parser.

Answer:
SAX is very fast as it does not load the document into memory.

SAX Parser Implementation
Slides 23 and 24

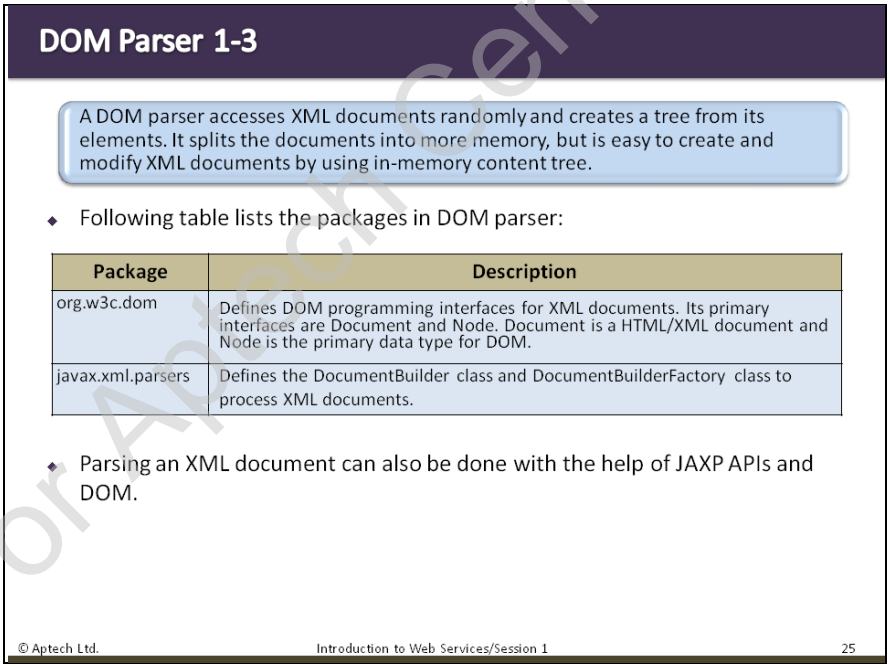


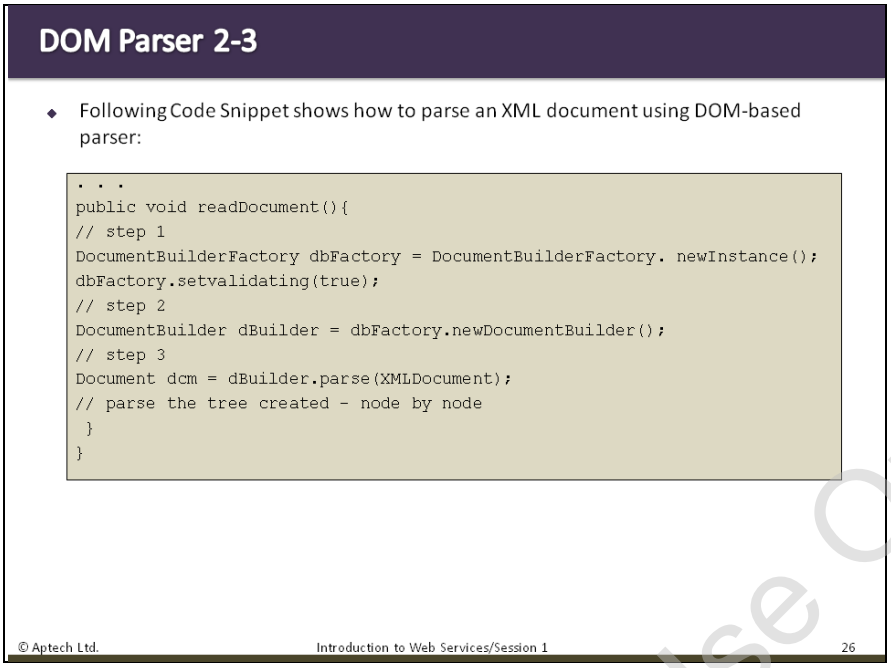


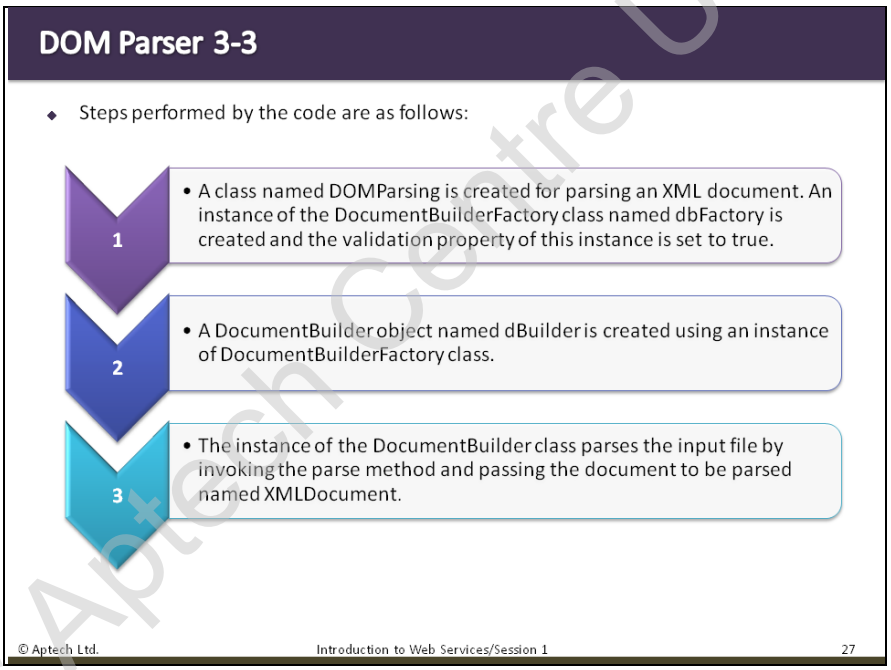
Using slides 23 and 24, explain the SAX Parser implementation by using first the Code Snippet on slide 23. Using slide 24, explain each of the given steps with reference to the Code Snippet.

DOM Parser

Slides 25 to 27







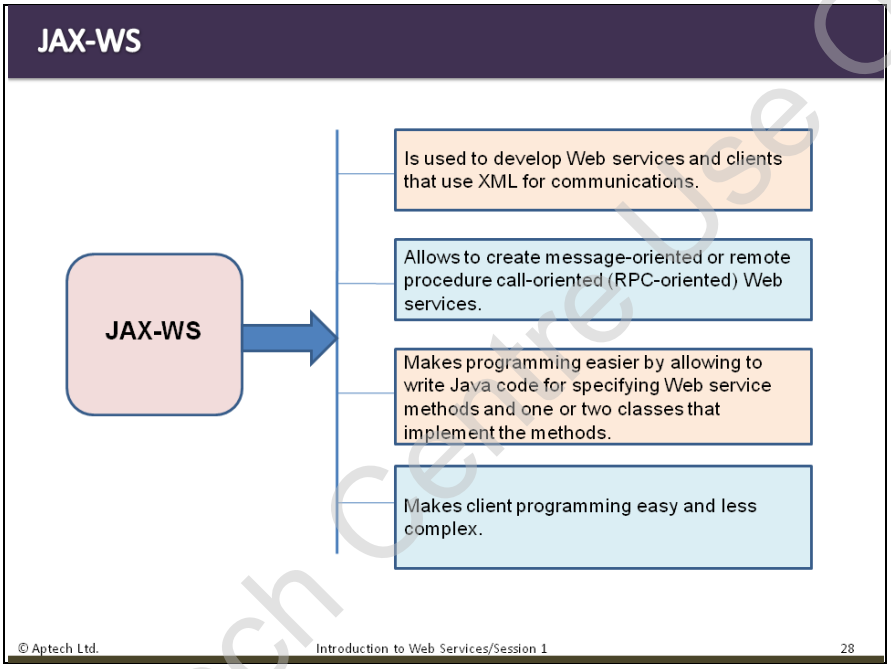
Using slides 25 to 27, explain the DOM Parser and its advantages. Explain the two packages in the DOM Parser, which are org.w3c.dom and javax.xml.parsers. Explain that org.w3c.dom defines DOM programming interfaces for XML documents and javax.xml.parsers defines the DocumentBuilder class and DocumentBuilderFactory class to process XML documents. Also, explain how parsing an XML document can be done. Explain the steps to parse an XML document using a DOM-based parser given on slide 27 with reference to the Code Snippet on slide 26.

In-Class Question:

What is DOM Parser?

Answer:
A DOM parser accesses XML documents randomly and creates a tree from its elements. It splits the documents into more memory, but is easy to create and modify XML documents by using in-memory content tree.

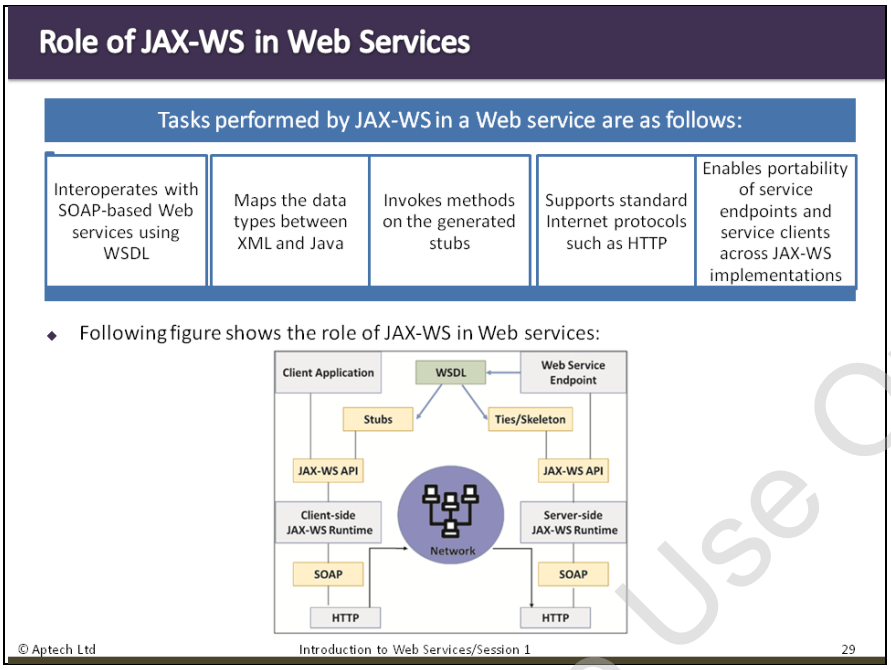
JAX-WS
Slide 28



Using slide 28, explain JAX-WS. Describe the characteristics of JAX-WS and the advantages provided by them. Explain how JAX-WS makes programming easier by:

- Enabling Java code to specify Web service methods and one / two classes that implement these methods
- Enabling JAX-WS client programs to create a proxy / local object for the Web service to utilize and invoke the Web service methods on the proxy
- Making client programming very easy and less complex
- Generating SOAP messages for the API calls and parsing them from responses, by which, code need not be written to generate or parse SOAP messages

Role of JAX-WS in Web Services
Slide 29



Using slide 29, explain the different tasks performed by JAX-WS in a Web service.

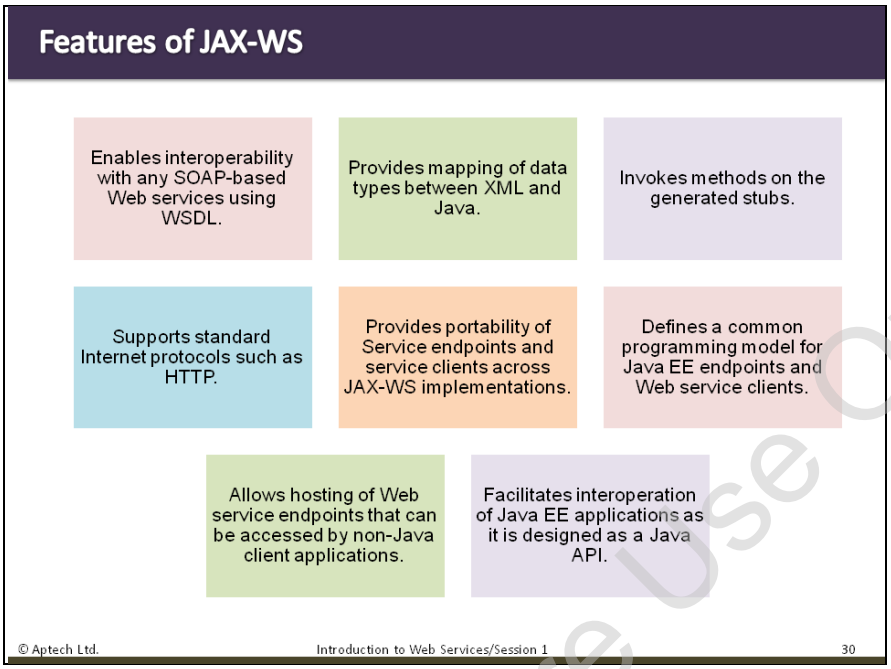
In-Class Question:

List any one task performed by JAX-WS in a Web Service.

Answer: JAX-WS Maps the data types between XML and Java.

Features of JAX-WS

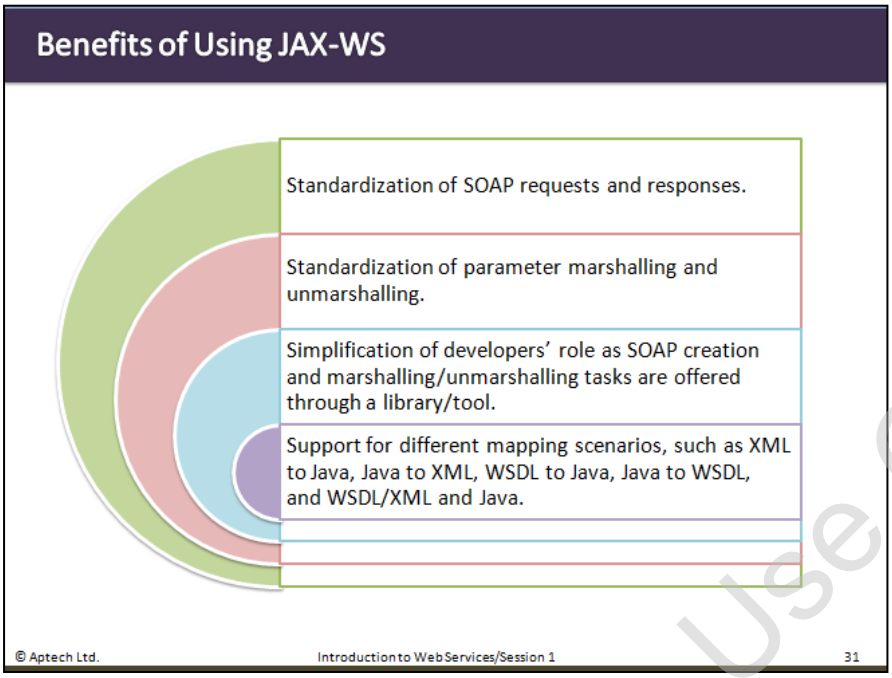
Slide 30



Using slide 30, explain how JAX-WS functions to communicate even with non-Java platforms. Explain the key features of JAX-WS frame work.

Benefits of Using JAX-WS

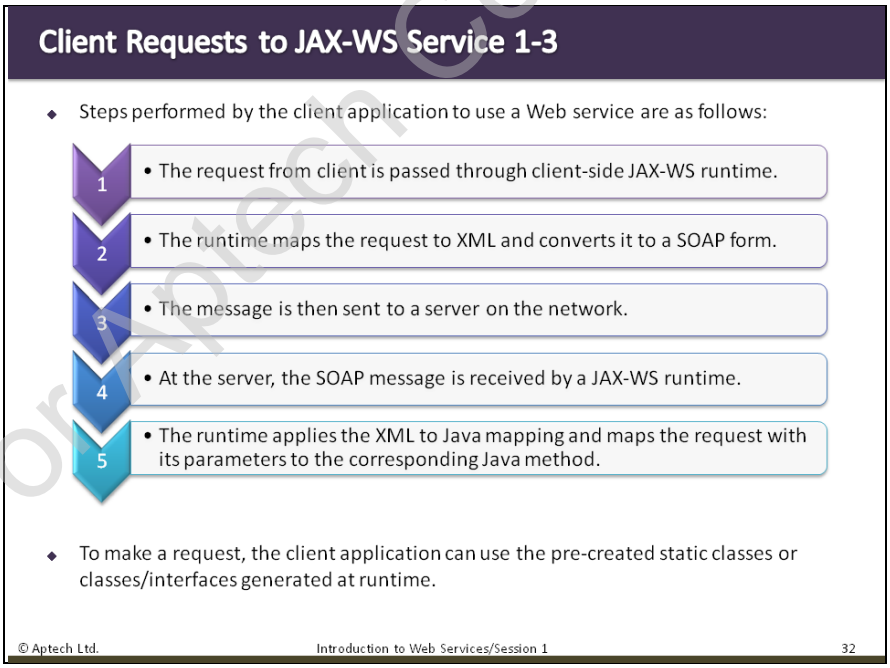
Slide 31



Using slide 31, explain that JAX-WS reduces the complexity for developers. Explain the key benefits of using JAX-WS.

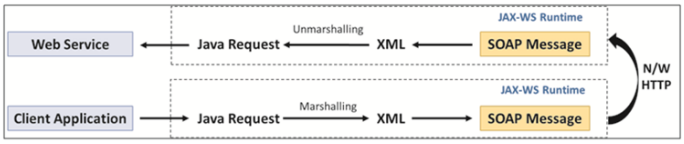
Client Requests to JAX-WS

Slides 32 to 34



Client Requests to JAX-WS Service 2-3

- Following figure depicts the client requests to JAX-WS service:



- Following Code Snippet shows how to implement JAX-WS:

```
import javax.jws.WebService;
import javax.jws.WebMethod;
@WebService
public class Welcome{
private final String message1 = "Welcome, ";
private final String message2 = "to WebService Course.";
public void Welcome(){
}
@WebMethod
public String sayWelcome(String name){
return message1 + name + message2;
}}
```

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Client Requests to JAX-WS Service 3-3

- The code displays a welcome message to the users who call the Web service.
- Following two annotations have been used in the Code Snippet:

@WebService
- The attributes are: name, targetNamespace, serviceName, wsdlLocation, and endpointInterface.
- All these attributes are optional.

@WebMethod
- The attributes are: operationName and action.
- These attributes are optional.

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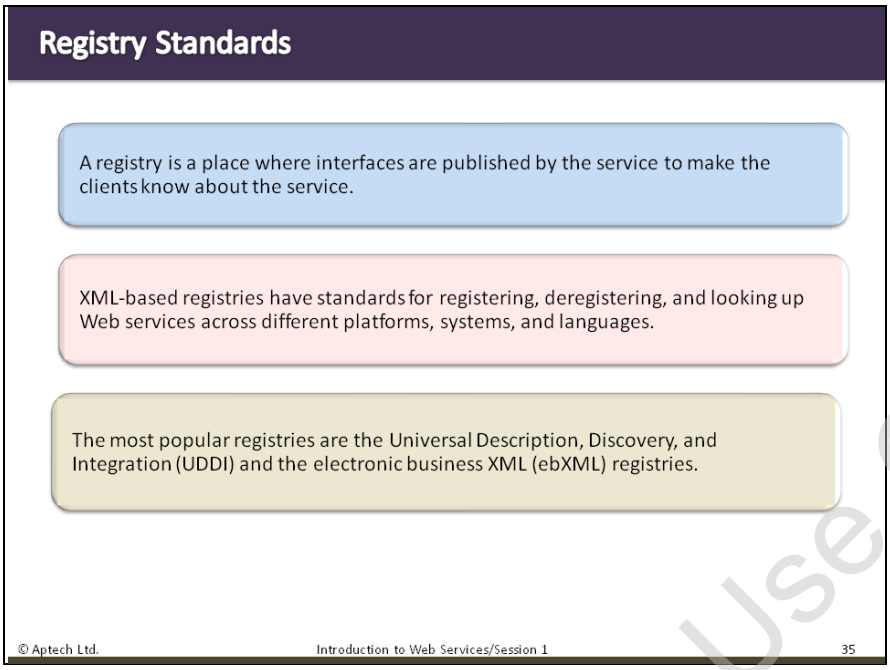
Using slides 32 to 34, explain the steps performed by the client application to use a Web service. Also, explain the client requests to JAX-WS with the help of the figure on slide 33. Use the Code Snippet on slide 33, to implement JAX-WS for displaying a welcome message to the users who call the Web service. Explain the steps that show implementation of JAX-WS. Also, using slide 34, explain the two annotations used in the Code Snippet namely, @WebService and @WebMethod and their attributes.

Registry Standards

Slide 35



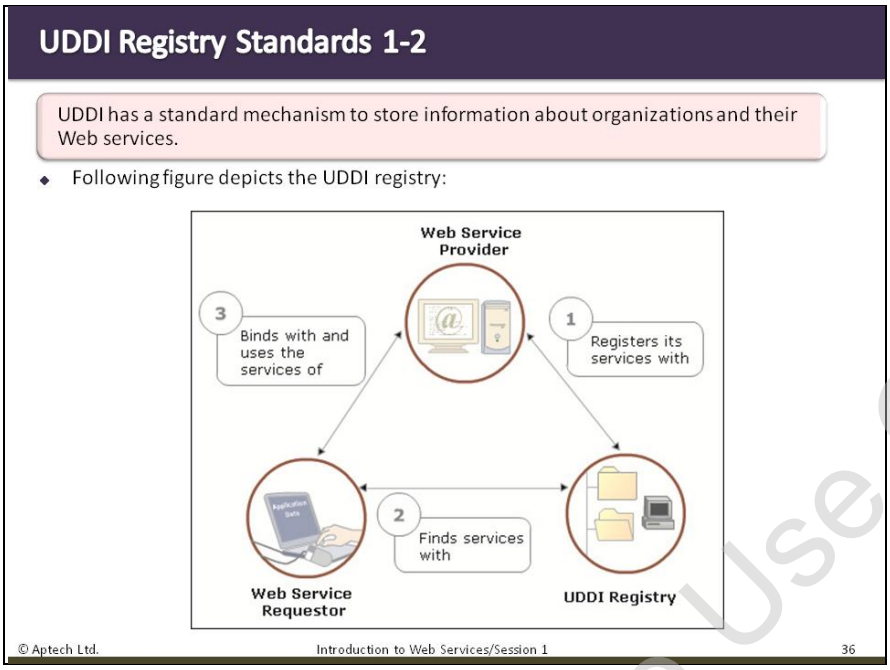
Using slide 35, explain registry and the requirements of an XML-based registry. Then explain the uses of XML-based registries. Next, inform that these registries have certain standards for registering, deregistering, and looking up Web services across different platforms, systems, and languages. List the most popular registries such as UDDI and ebXML.

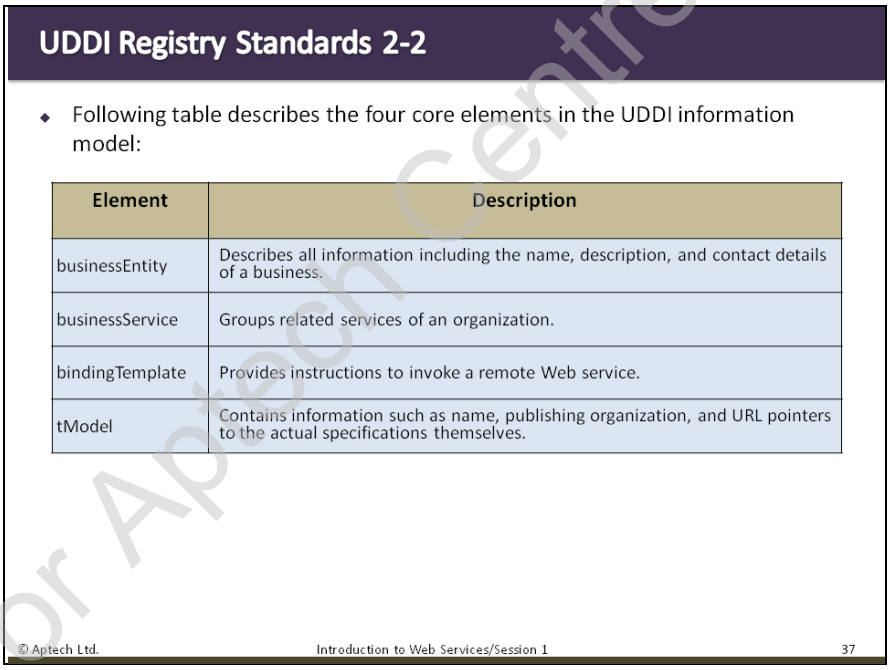
In-Class Question:

What are the most commonly used registries?

Answer: UDDI and ebXML are the most commonly used registries.

UDDI Registry Standards
Slides 36 and 37





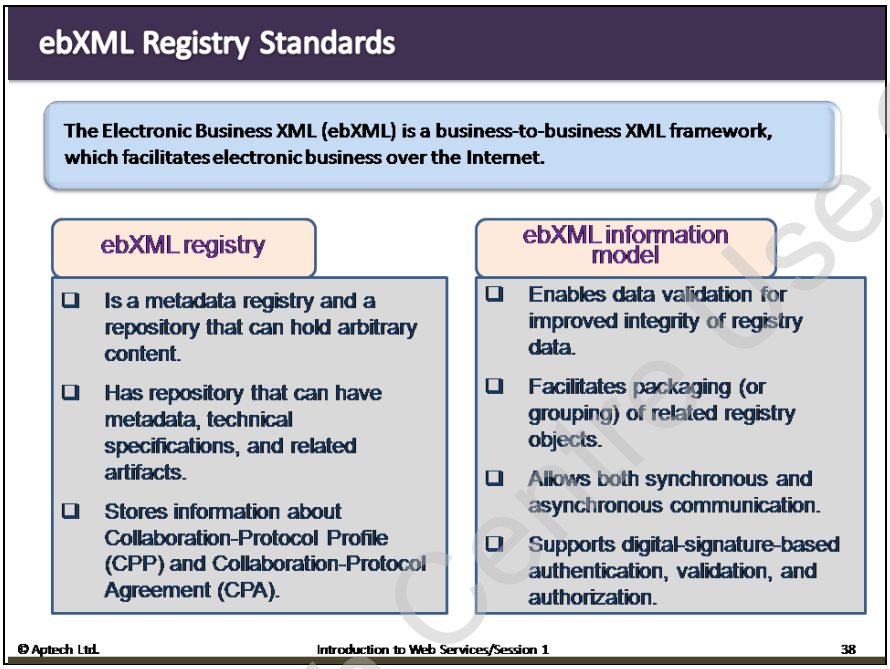
Using slides 36 and 37, explain UDDI registry and for what it is used. Using the figure on slide 36 explain about UDDI registry. Mention that a service provider publishes its services to the UDDI registry. A service requestor in need of a service looks up for the service in the registry and receives the service binding information. The service provider then uses the binding information to invoke the service.
Using slide 37, explain the four key elements of UDDI information model and what each one is useful for.

In-Class Question:


What does a businessEntity element of the UDDI information model do?

Answer:
It describes all information including the name, description, and contact details of a business.

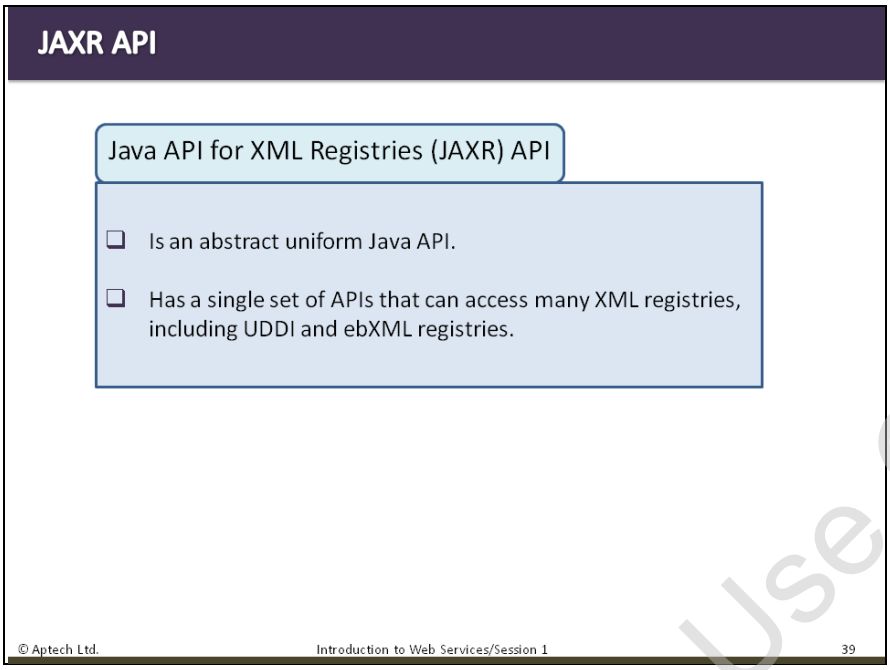
ebXML Registry Standards
Slide 38



Using slide 38, explain ebXML and its features. Mention that ebXML facilitates electronic business over the Internet. It can be used to advertise and find out information about businesses. ebXML can also be used to publish Web service descriptions in this registry. Explain ebXML registry and what data it can hold. Additionally, explain the ebXML information model and its advantages.

JAXR API

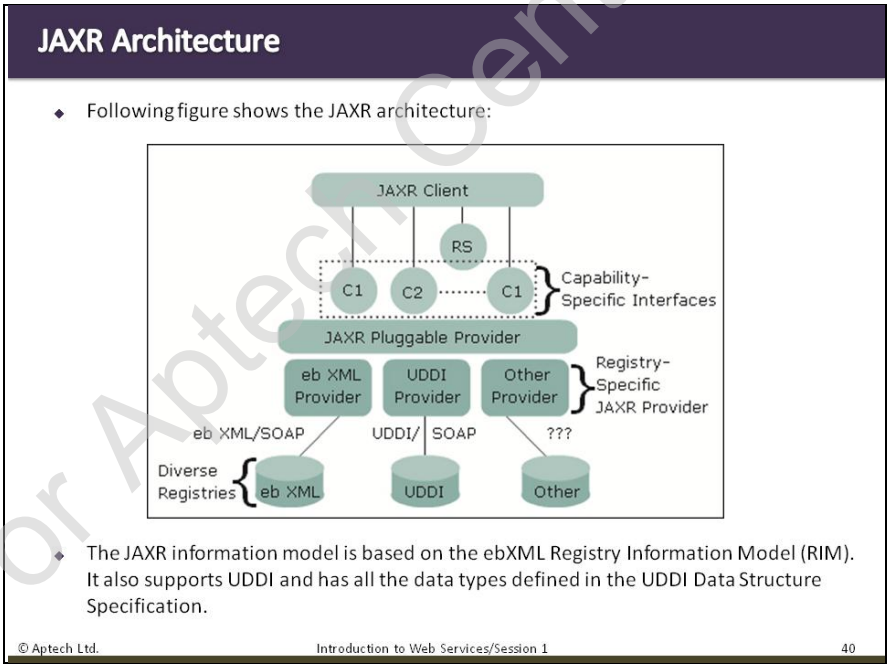
Slide 39



Using slide 39, introduce the JAXR API.

JAXR Architecture

Slide 40



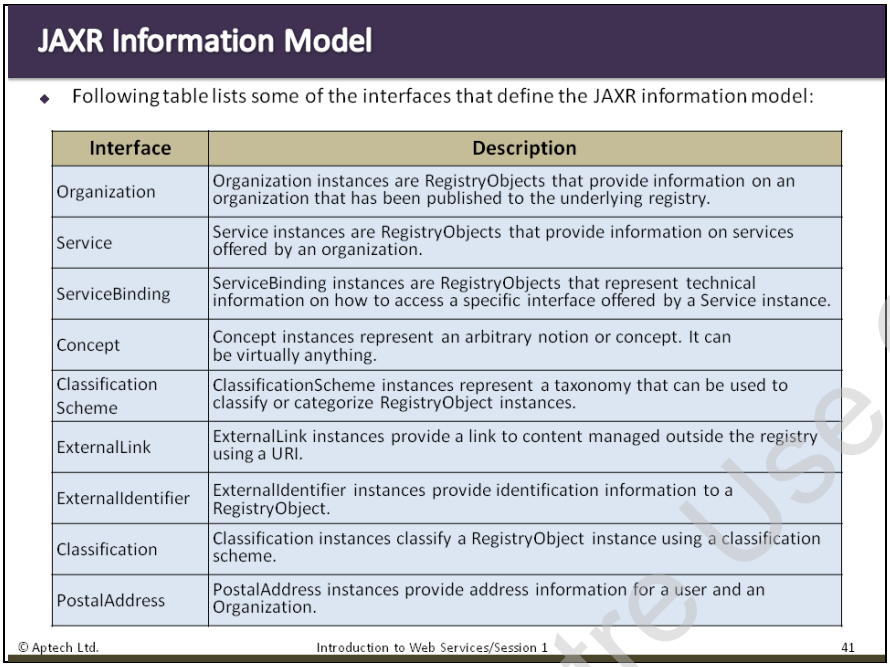
Using slide 40, explain the JAXR architecture and its two parts namely, JAXR client and JAXR provider and for what they are used. Mention that the JAXR provider is a JAXR pluggable provider with underlying implementations of a UDDI-specific JAXR provider and an ebXML-specific provider.

The JAXR pluggable provider exposes capability-specific methods to the JAXR client via the registry interface. The registry returns the response to JAXR provider where the response is transformed to JAXR response. The provider sends this response back to the JAXR client.

Explain the different functionalities from different registry providers and the two capability profiles, namely level 0 and level 1.

JAXR Information Model

Slide 41



JAXR Information Model

- Following table lists some of the interfaces that define the JAXR information model:

Interface	Description
Organization	Organization instances are RegistryObjects that provide information on an organization that has been published to the underlying registry.
Service	Service instances are RegistryObjects that provide information on services offered by an organization.
ServiceBinding	ServiceBinding instances are RegistryObjects that represent technical information on how to access a specific interface offered by a Service instance.
Concept	Concept instances represent an arbitrary notion or concept. It can be virtually anything.
Classification Scheme	ClassificationScheme instances represent a taxonomy that can be used to classify or categorize RegistryObject instances.
ExternalLink	ExternalLink instances provide a link to content managed outside the registry using a URI.
ExternalIdentifier	ExternalIdentifier instances provide identification information to a RegistryObject.
Classification	Classification instances classify a RegistryObject instance using a classification scheme.
PostalAddress	PostalAddress instances provide address information for a user and an Organization.

Using slide 41, explain the ebXML Information Model. Explain its features and benefits. Explain the various interfaces that define the JAXR information model. Provide an insight on how the registry is used.

In-Class Question:

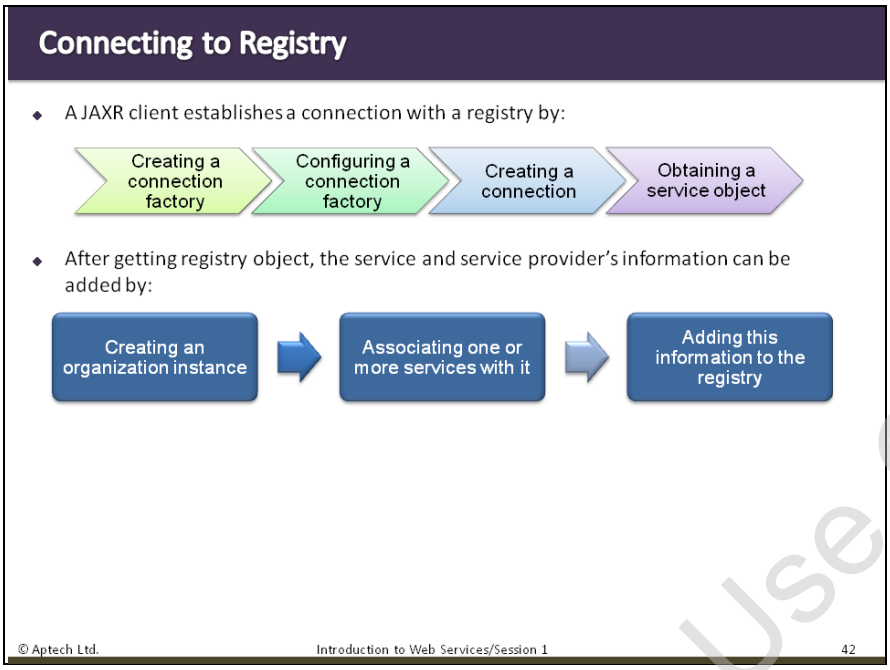
What is JAXR?

Answer:

Java API for XML Registries (JAXR) API is an abstract uniform Java API. It has a single set of APIs that can access many XML registries, including UDDI and ebXML registries.

Connecting to Registry

Slide 42



Using slide 42, explain how the JAXR client establishes a connection with the registry by the following steps:

- Creating a connection factory
- Configuring connection factory
- Creating a connection
- Obtaining a service object

Explain how service and service provider's information can be added to registry object by the following steps:

- Creating an organization instance
- Associating one or more services with it
- Adding this information to the registry

Use different examples (such as properties of objects, methods, instances of objects, and so on) to explain the above steps for establishing connection as well as adding information to registry.

Publishing Data on Registry

Slides 43 to 47

Publishing Data on Registry 1-5

- Following Code Snippet demonstrates the steps to publish a Web service to UDDI:

```
public static void main(String[] args) throws JAXRException{
try {
//Setting the properties for the ConnectionFactory Properties enviro = new
Properties(); enviro.setProperty("javax.xml.registry.queryManagerURL",
QUERY_URL); enviro.setProperty("javax.xml.registry.lifeCycleManagerURL"
, PUBLISH_URL);
enviro.setProperty("javax.xml.registry.factoryClass",
"com.sun.xml.registry.uddi.ConnectionFactoryImpl");
//creating a connection
ConnectionFactory confac = ConnectionFactory.newInstance();
confac.setProperties(enviro);
Connection conn = confac.createConnection();
//Authenticating the UDDI userName and Password
PasswordAuthentication passwdAuth = new
PasswordAuthentication(uddiUserName,
uddiPassword.toCharArray());
Set credentials = new HashSet();
credentials.add(passwdAuth);
conn.setCredentials(credentials);
```

Publish data to the UDDI by configuring the properties.
Then, create a connection.

Authenticate the UDDI credentials.

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Publishing Data on Registry 2-5

```
//Obtaining a reference to the RegistryService,
//BusinessLifeCycleManager and the BusinessQueryManger
RegistryService registryservice = conn.getRegistryService();
BusinessLifeCycleManager lifecyclemgr =
registryservice.getBusinessLifeCycleManager();
BusinessQueryManager querymgr =
registryservice.getBusinessQueryManager();
//Creating an organization object
Organization company = lifecyclemgr.createOrganization("Aptech");
InternationalString description =
lifecyclemgr.createInternationalString("Leading IT
Trainers");
//Creating a user object
User contact = lifecyclemgr.createUser();
PersonName name = lifecyclemgr.createPersonName("John Miller");
contact.setPersonName(name);
//creating and assigning the users telephone number
TelephoneNumber telnum = lifecyclemgr.createTelephoneNumber();
telnum.setNumber("1800-420-8000");
Collection phonenumbers = new ArrayList();
phonenumbers.add(telnum);
contact.setTelephoneNumbers(phonenumbers);
```

Obtain a reference to the RegistryService, BusinessLifeCycleManager and the BusinessQueryManager classes.

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Publishing Data on Registry 3-5

```
//creating and assigning the users email address
EmailAddress email = lifecyclemgr.createEmailAddress("enquiry@abcinc.com");
Collection emaillist = new ArrayList();
emaillist.add(email);
contact.setEmailAddresses(emaillist);
//Setting the user as the primary contact for the organization
company.setPrimaryContact(contact);
//Creating the Web service object
Collection servicelist = new ArrayList();
Service service = lifecyclemgr.createService("Courses");
InternationalString serviceDescription =
lifecyclemgr.createInternationalString("Available
courses..");
service.setDescription(serviceDescription);
//Creating the Web service bindings
Collection serviceBindigs = new ArrayList();
ServiceBinding binding =
lifecyclemgr.createServiceBinding();
InternationalString bindingDescription =
lifecyclemgr.createInternationalString("Course Name");
```

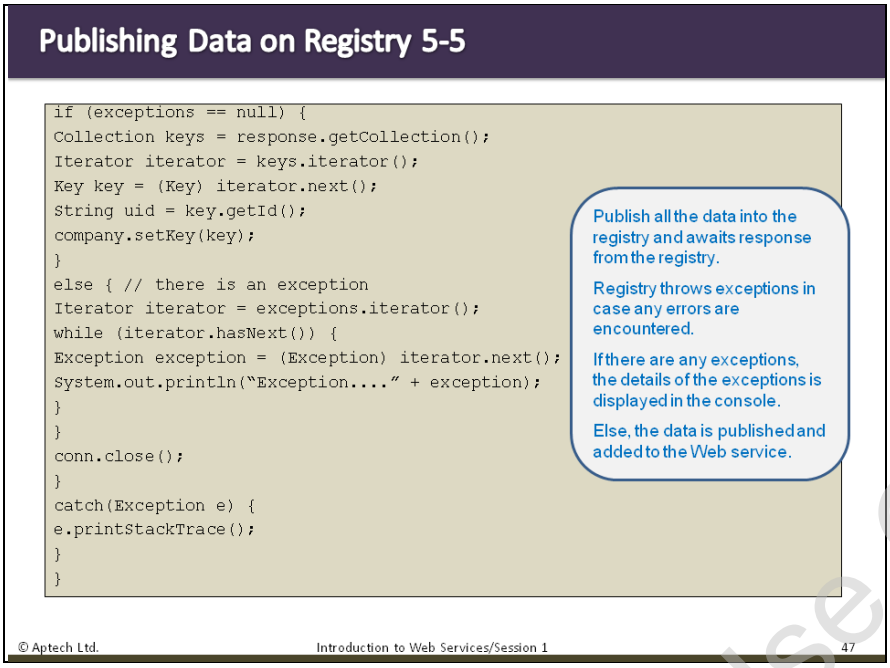
Define the data that needs to be published to the UDDI.

Define the Web services to be offered and the Web service bindings for the same.

Publishing Data on Registry 4-5

```
binding.setDescription(bindingDescription);
binding.setAccessURI("http://www.aptech.org");
boolean b = serviceBindigs.add(binding);
service.addServiceBindings(serviceBindings);
servicelist.add(service);
company.addServices(servicelist);
//Classifying the organization
ClassificationScheme scheme = querymgr.
findClassificationSchemeByName(servicelist,"Courses");
Classification classification = lifecyclemgr.
createClassification(scheme, "Course name", "Course number");
Collection classificationlist = new ArrayList();
boolean c = classificationlist.add(classification);
company.addClassifications(classificationlist);
Collection organizationlist = new ArrayList();
organizationlist.add(company);
//making the final call to the registry to get a response
BulkResponse response = lifecyclemgr.saveOrganizations(organizationlist);
Collection exceptions = response.getExceptions();
```

Classify the Web services offered into the appropriate category.



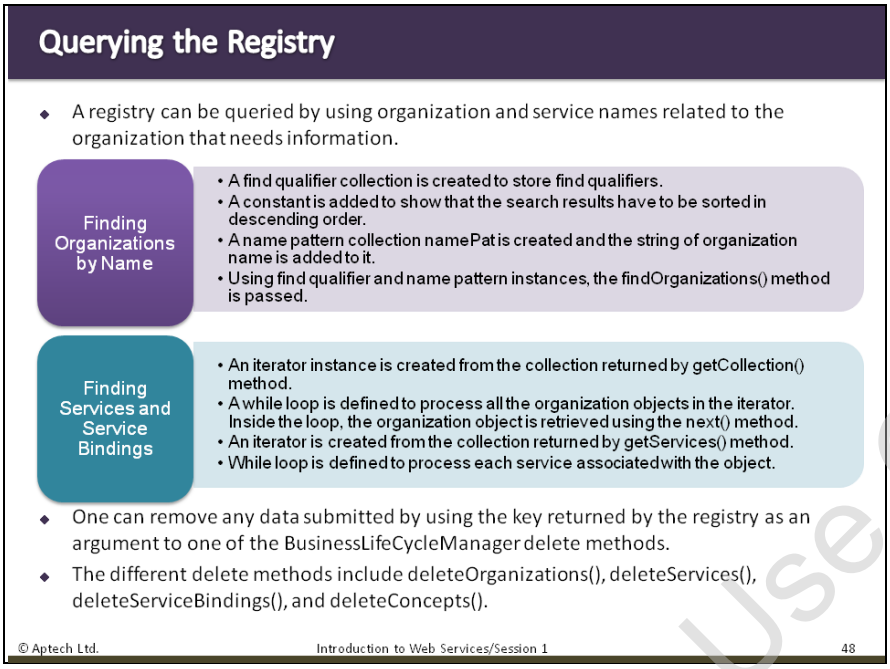
Using slides 43 to 47, explain the Code Snippet that demonstrates the steps to publish a Web service to UDDI. Explain that the code publishes data to the UDDI. It first configures the properties, such as queryManagerURL, lifeCycleManagerURL, and factoryClass for the ConnectionFactory. Then, the code creates a connection and authenticates the UDDI credentials.

Next, the code obtains a reference to the RegistryService, BusinessLifeCycleManager and the BusinessQueryManger classes. The code then defines the data that needs to be published to the UDDI. It also defines the Web services to be offered and the Web service bindings for the same. The code also classifies the Web services offered into the appropriate category.

Finally, the code publishes all the data into the registry and awaits response from the registry. The registry will throw exceptions in case any errors are encountered. If there are any exceptions, the details of the exceptions will be displayed in the console. Else, the data will be published and added to the Web service.

Querying the Registry

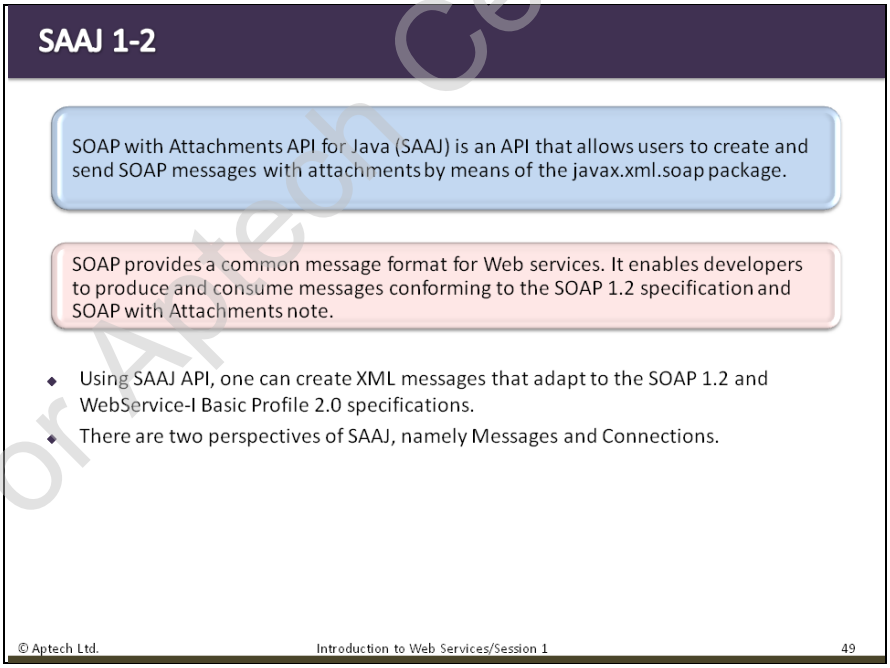
Slide 48

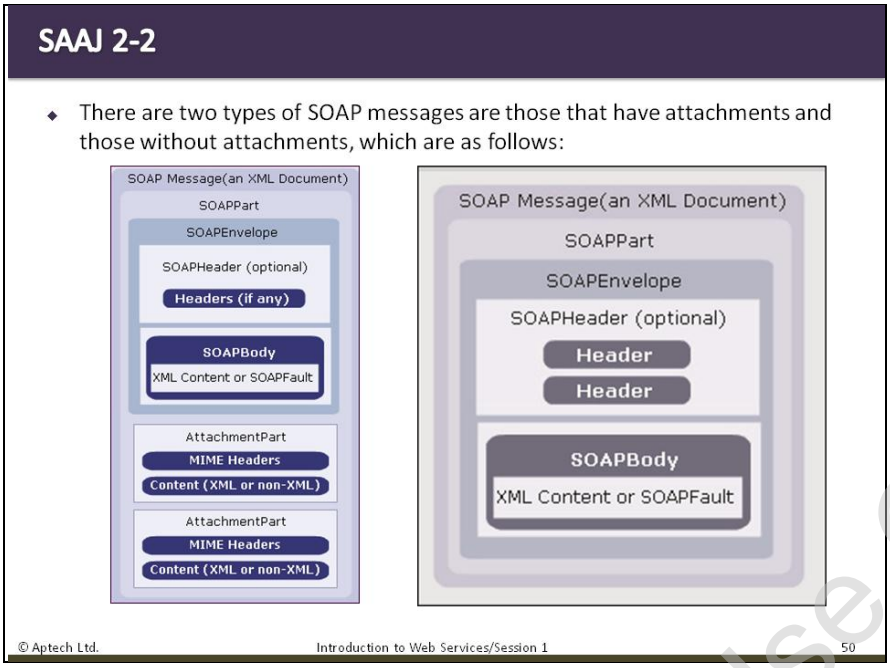


Using slide 48, explain how a registry can be queried by using the name of the organization and the name of the service.

SAAJ

Slides 49 and 50





Using slides 49 and 50, explain what SAAJ is and what it does. Explain the two perspectives of SAAJ, namely Messages and Connections. Using slide 50, explain the two types of SOAP messages: those that have attachments and those without attachments.

Mention that a SOAP message that does not have attachments has a structure made up of a SOAPPart, a SOAPEnvelope, an optional SOAPHeader, and a SOAPBody. The SOAPPart represents the SOAP document and includes the SOAPEnvelope objects.

The SOAPEnvelope represents the Envelope element in the SOAP document and contains SOAPHeader object and SOAPBody object which represents the Header and Body elements in the SOAP document.

Besides the SOAPPart, a SOAP message can have one or more attachment parts. However, the SOAP part must contain only XML content. If any content in a message is not in XML format, it is placed in the attachment part.

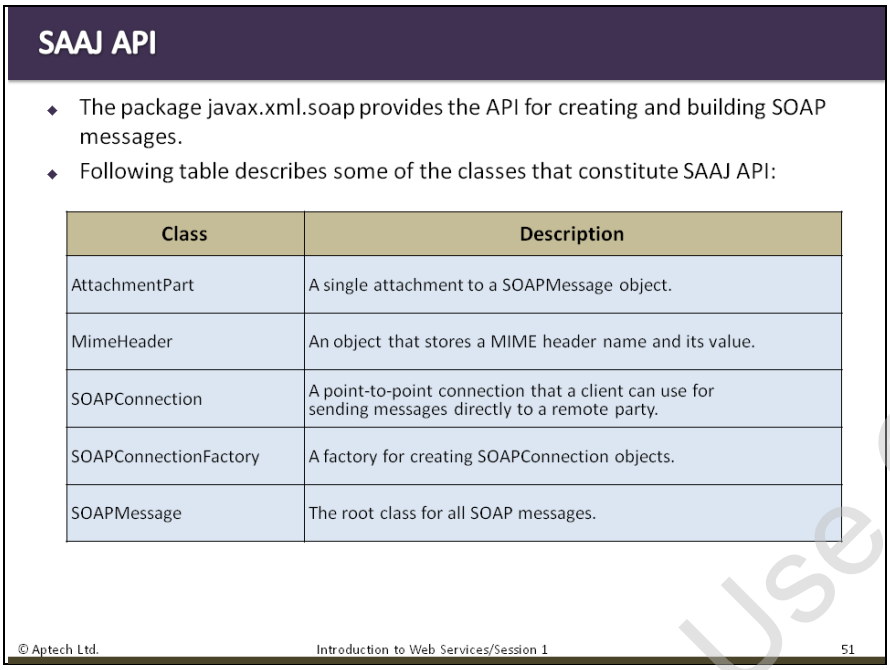
In-Class Question:

What is SAAJ?

Answer:
SOAP with Attachments API for Java (SAAJ) is an API that allows users to create and send SOAP messages with attachments by means of the javax.xml.soap package.

SAAJ API

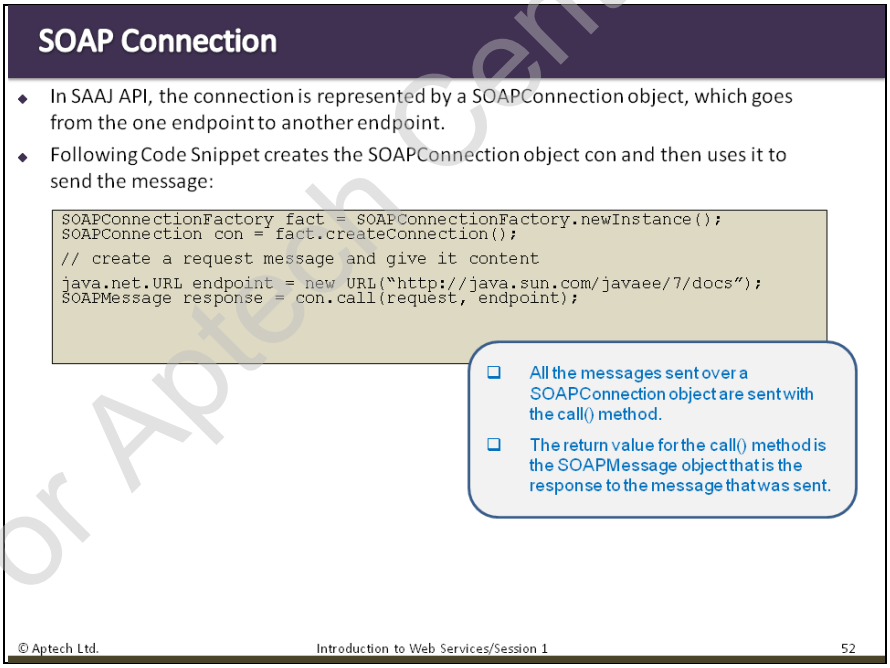
Slide 51



Using slide 51, explain SAAJ API and the classes that constitute SAAJ API.

SOAP Connection

Slide 52

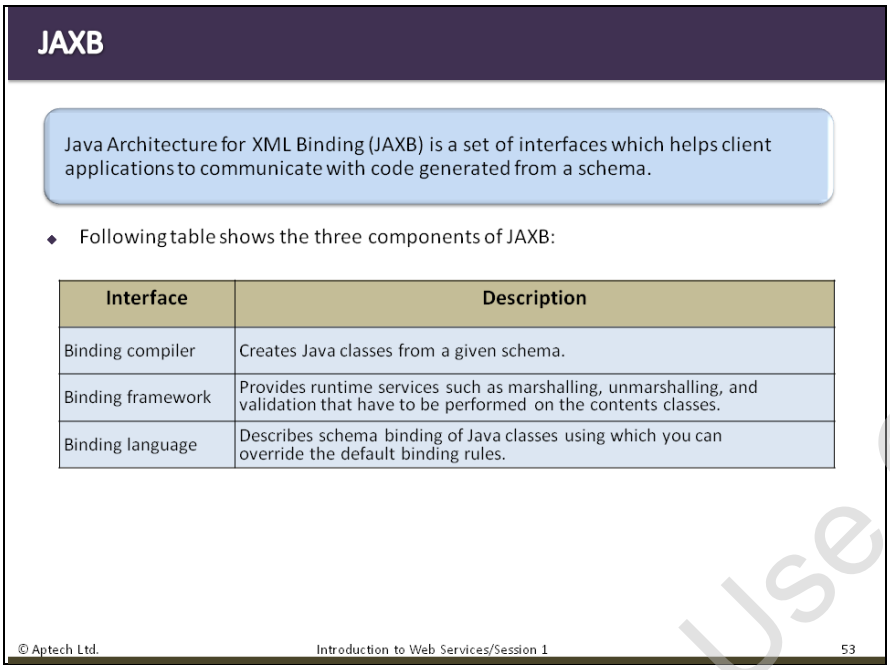


Using slide 52, explain the connection that is represented by SOAPConnection Object. Explain why it is called a point-to-point connection. Using the Code Snippet, explain how a connection is established. Explain some of the new features of SAAJ 1.3. They are listed as follows:

- Support for the WS-I Basic Profile 1.1
- Document Object Model integration
- SOAPMessage properties being used to set character set encoding and turn the writing of an XML declaration at the start of the SOAP part of the message

JAXB

Slide 53



Using slide 53, explain JAXB and the three components or interfaces of JAXB, which are Binding compiler, Binding framework, and Binding language. Describe the usage of each component.

In-Class Question:

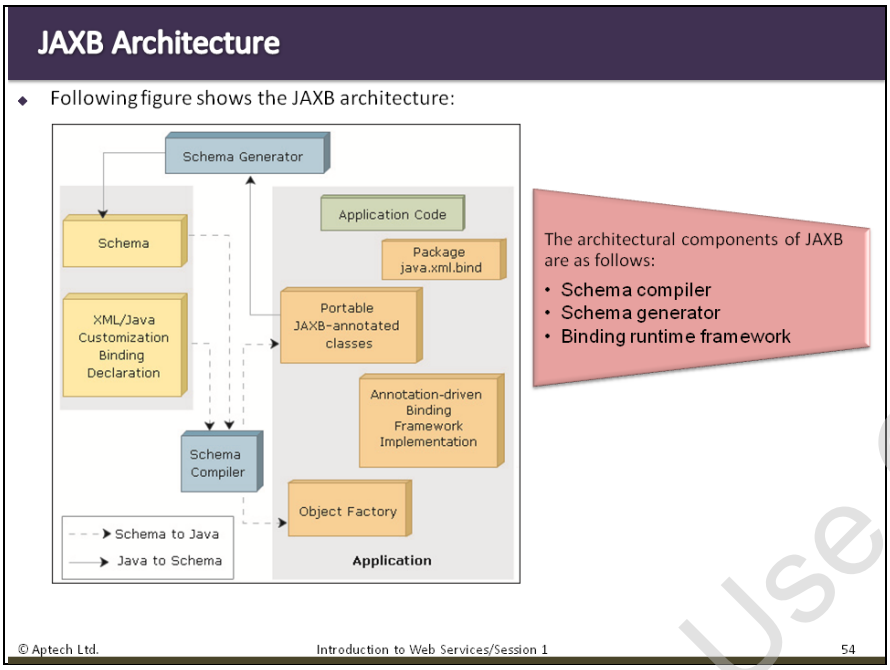
 What is JAXB?

Answer:

Java Architecture for XML Binding (JAXB) is a set of interfaces which helps client applications to communicate with code generated from a schema.

JAXB Architecture

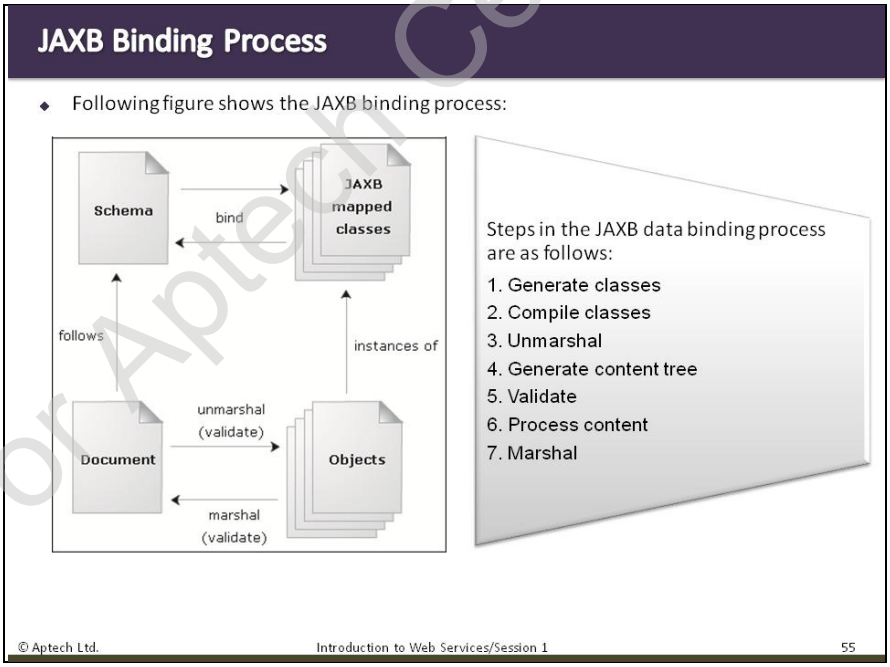
Slide 54



Using slide 54, explain JAXB architecture and the benefit of standard structure. Also, explain the architectural components of JAXB: Schema compiler, Schema generator, and Binding runtime framework and for what they are used.

JAXB Binding Process

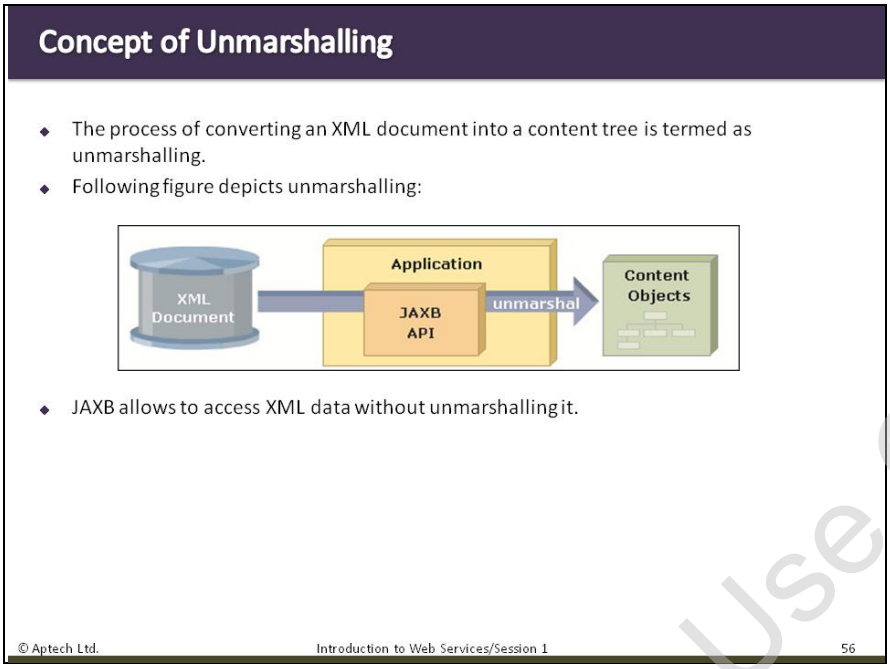
Slide 55



Using slide 55, explain that JAXB presents an XML document in a Java format to the application, which enables easy access to the contents. Explain that the schema is bound into a set of Java classes. Finally, explain the six steps in the JAXB binding process.

Concept of Unmarshalling

Slide 56



Using slide 56, explain the concept of Unmarshalling. Explain that the process of converting an XML document into a content tree is termed as unmarshalling. Explain further with the help of the figure.

In-Class Question:

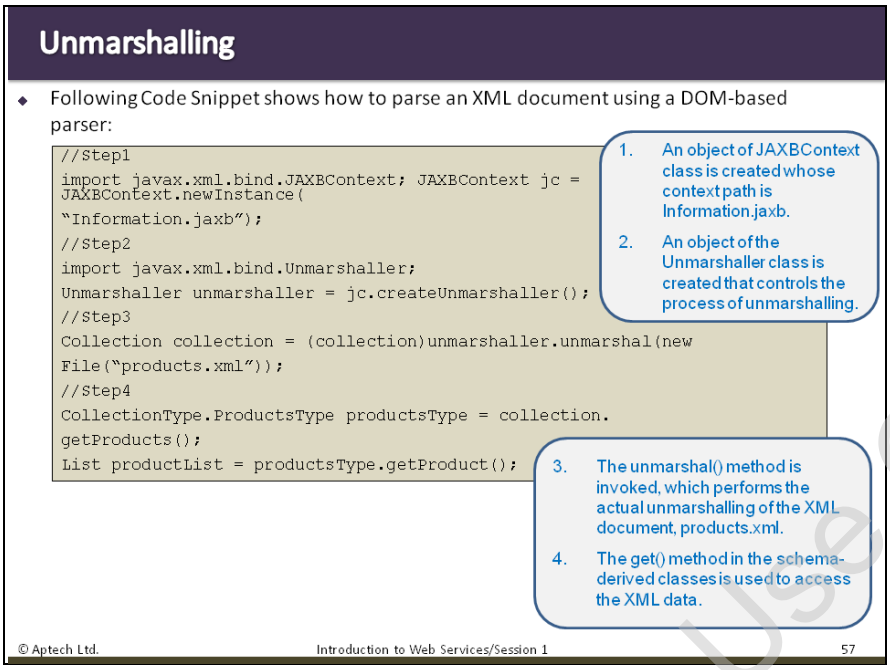
What is Unmarshalling?

Answer:

The process of converting an XML document into a content tree is termed as unmarshalling.

Unmarshalling

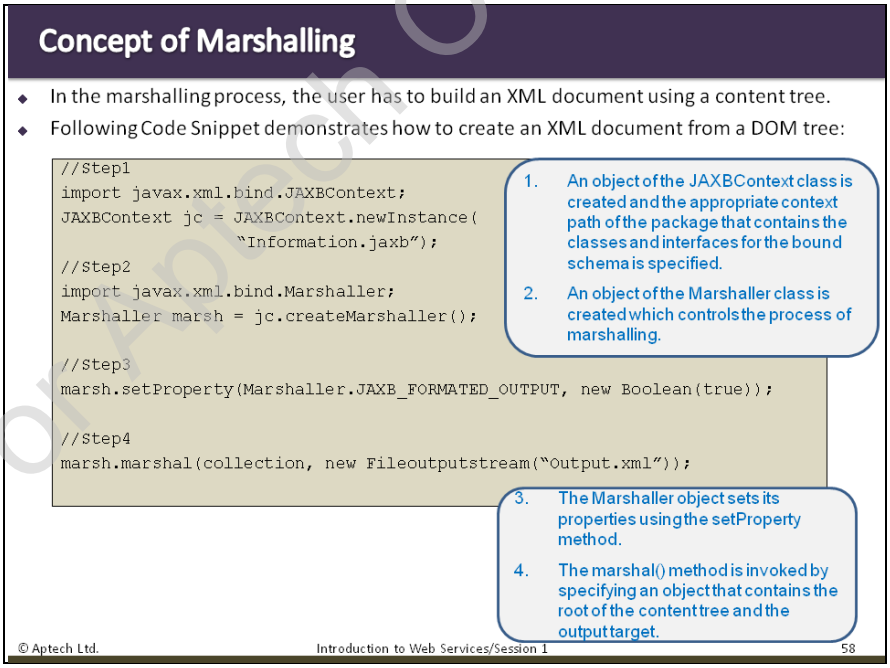
Slide 57



Using slide 57, explain using the Code Snippet that during unmarshalling, a DOM tree that represents the content of XML document is created. The content in the tree is in the form of nodes. Explain the steps in the Code Snippet.

Concept of Marshalling

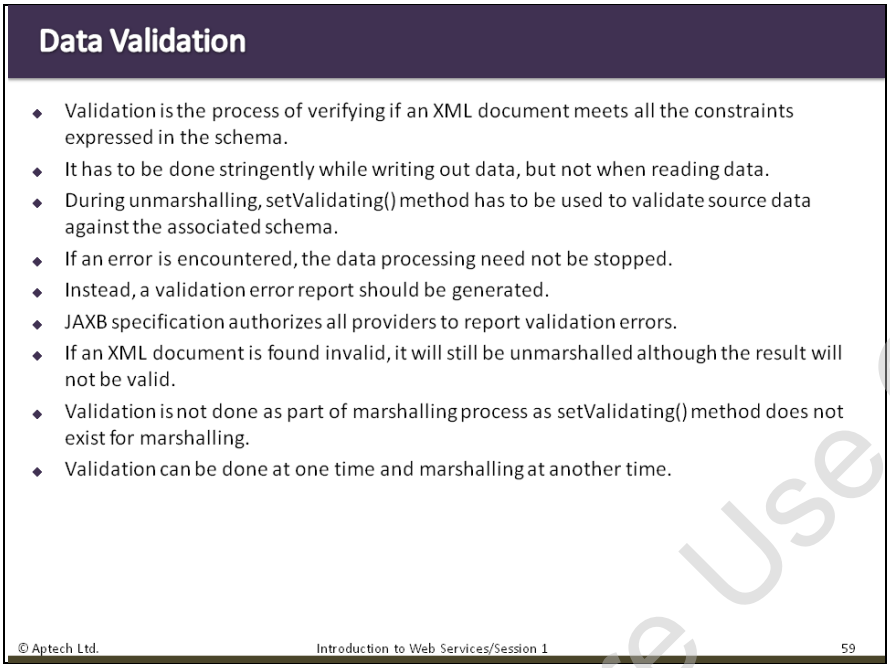
Slide 58



Using slide 58, explain the concept of Marshalling. Explain that unlike the unmarshalling process, the user has to build an XML document using a content tree in the marshalling process. Explain the various steps to create an XML document from a DOM tree.

Data Validation

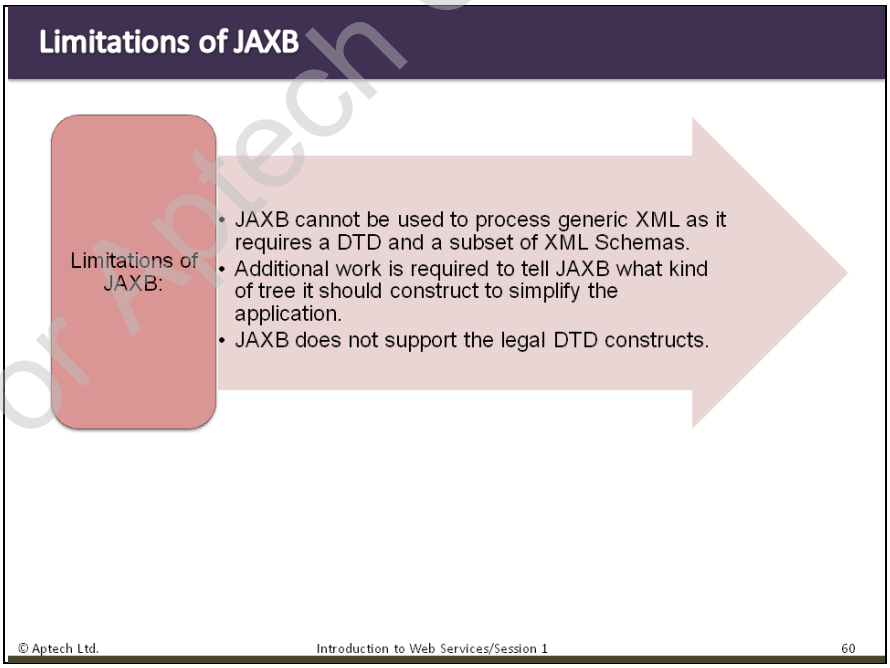
Slide 59



Using slide 59, explain data validation and how it has to be done during unmarshalling. Explain why validation is not done as part of marshalling process.

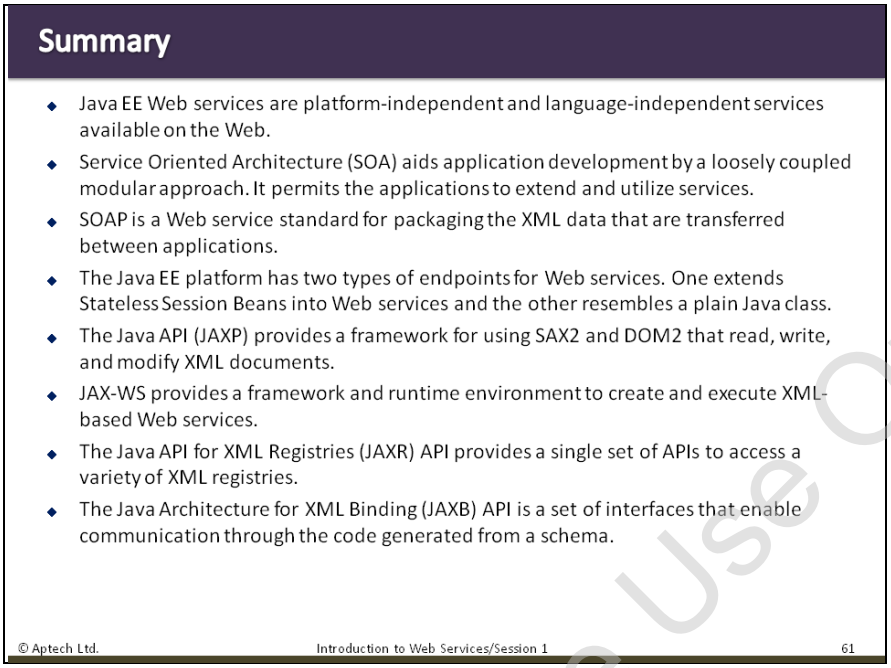
Limitations of JAXB

Slide 60



Using slide 60, explain the limitations of JAXB.

Summarize Session
Slide 61



Using slide 61, summarize the session. Make them revise the following points:

- Java EE Web services are platform-independent and language-independent services available on the Web.
- Service Oriented Architecture (SOA) aids application development by a loosely-coupled modular approach. It permits the applications to extend and utilize services.
- SOAP is a Web service standard for packaging the XML data that are transferred between applications.
- The Java EE platform has two types of endpoints for Web services. One extends Stateless Session Beans into Web services and the other resembles a plain Java class.
- The Java API (JAXP) provides a framework for using SAX2 and DOM2 that read, write, and modify XML documents.
- JAX-WS provides a framework and runtime environment to create and execute XML-based Web services.
- The Java API for XML Registries (JAXR) API provides a single set of APIs to access a variety of XML registries.
- The Java Architecture for XML Binding (JAXB) API is a set of interfaces that enable communication through the code generated from a schema.

1.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the next session which describes SOAP, WSDL, and UDDI.

Tips: You can also check the **Articles/Blogs/Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

Session 2: SOAP, WSDL, and UDDI

2.1 Pre-Class Activities

You should familiarize yourself with the concepts of SOAP, WSDL, and UDDI. You should be able to explain the advantages of using SOAP in a Web service. You should be able to explain different parts of a SOAP Message. You should also be able to explain purpose of WSDL file and describe its elements. In addition, you should also be able to explain UDDI model and ebXML Registry Standards.

Familiarize yourself with the topics of the current session in-depth.

2.1.1 Objectives

After the session, learners will be able to:

- Explain the purpose and advantages of using SOAP in Web service
- Describe the different parts of a SOAP message
- Explain SOAP messaging with attachment
- Define Document/Literal SOAP and RPC/Literal SOAP messaging modes
- Explain transportation of SOAP over HTTP protocol
- List sub-elements of SOAP fault element and describe SOAP fault codes
- Explain the purpose of a WSDL file and describe its elements
- Describe UDDI model
- Explain the ebXML Registry standards

2.1.2 Teaching Skills

To teach this session, you should be well versed with the concept of Simple Object Access Protocol (SOAP) and its advantages. You should know about SOAP messaging thoroughly. You should have sound knowledge on the concepts of Web Service Description Language (WSDL) and Universal Description, Discovery, and Integration (UDDI) model, and ebXML Registry Standards. You should teach the concepts in the theory class using the images provided. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

2.1.3 In-Class Activities

Follow the order given here during In-Class activities.

Review of Previous Session

You should begin with a brief recap or review of previous session which discussed about Web services and their purpose. You should summarize the various Web service standards and APIs discussed in the previous session.

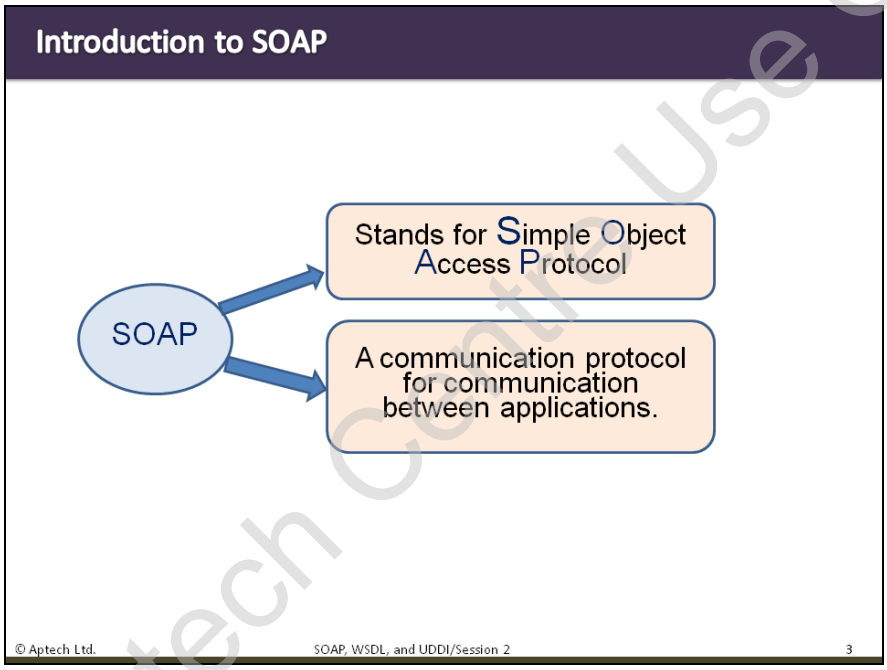
Overview of the Session

Then, give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session explains the concept of SOAP, WSDL, and UDDI. Tell them that this session also explains in detail the purpose and advantages of SOAP. The session introduces them to the purpose of WSDL and also explains about UDDI model and ebXML Registry Standards.

2.2 In-Class Explanations

Introduction to SOAP

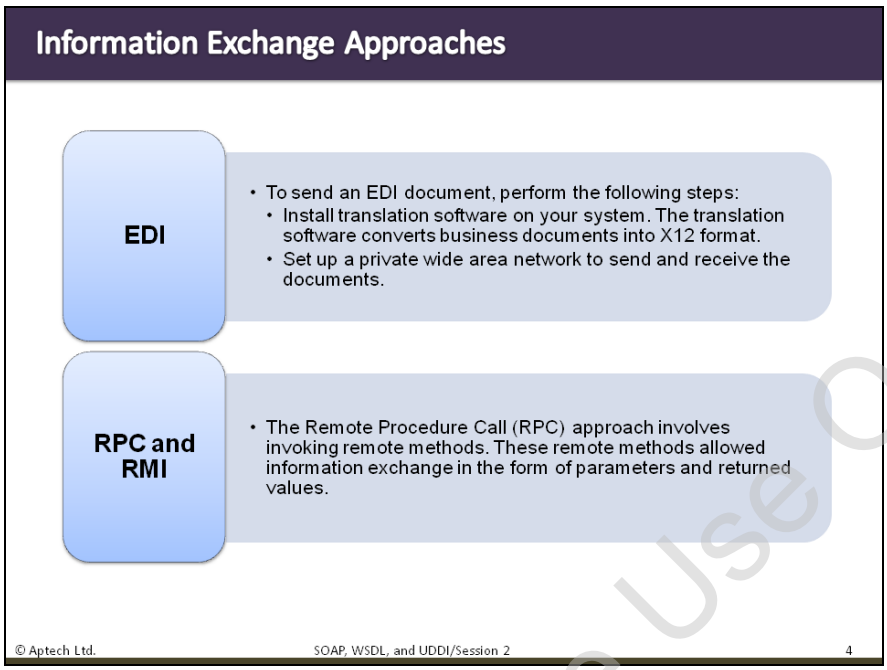
Slide 3



Using slide 3, provide the full form of SOAP. Then, explain the definition of SOAP. Inform the students that SOAP is based on XML and W3C recommendations.

Information Exchange Approaches

Slide 4

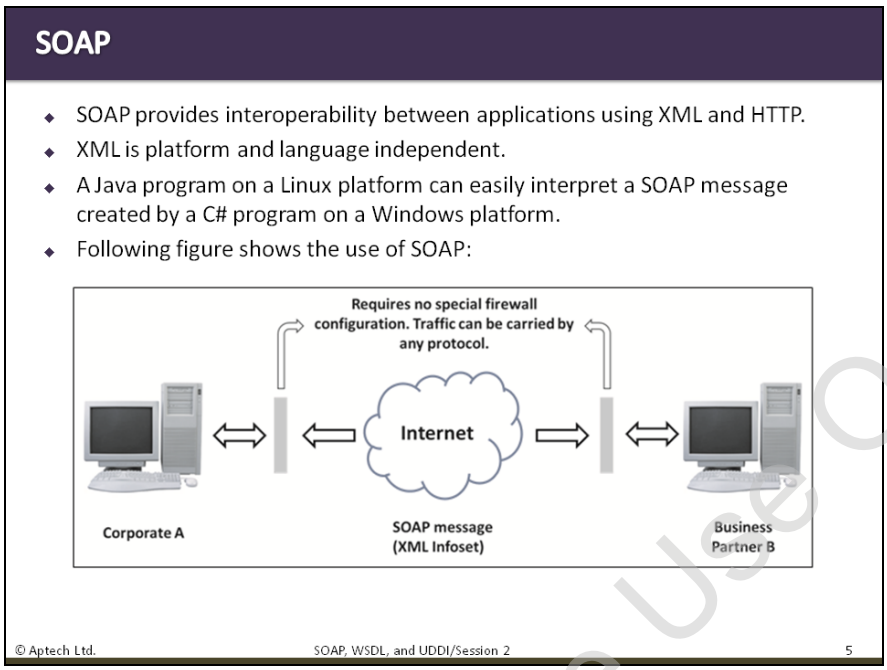


Using slide 4, explain the two common approaches for information exchange between distributed systems, that is, Electronic Data Interchange (EDI) and Remote Procedure Call (RPC). Explain that EDI is used to exchange business documents between business partners. Explain the steps to send or receive EDI documents. Also, explain the drawbacks of using this approach.

Then, discuss RPC and Remote Method Invocation (RMI). Tell the students that these approaches are used to invoke remote methods, which allow information exchange. Explain the drawbacks of RPC and RMI approach.

SOAP

Slide 5



Using slide 5, describe SOAP. Explain to the uses of SOAP with the help of the figure. Tell them that SOAP provides interoperability between Extensible Markup Language (XML) and Hypertext Transfer Protocol (HTTP) applications. Hence, Business Corporate can easily exchange business information using SOAP Messages through different platforms.

In-Class Question:

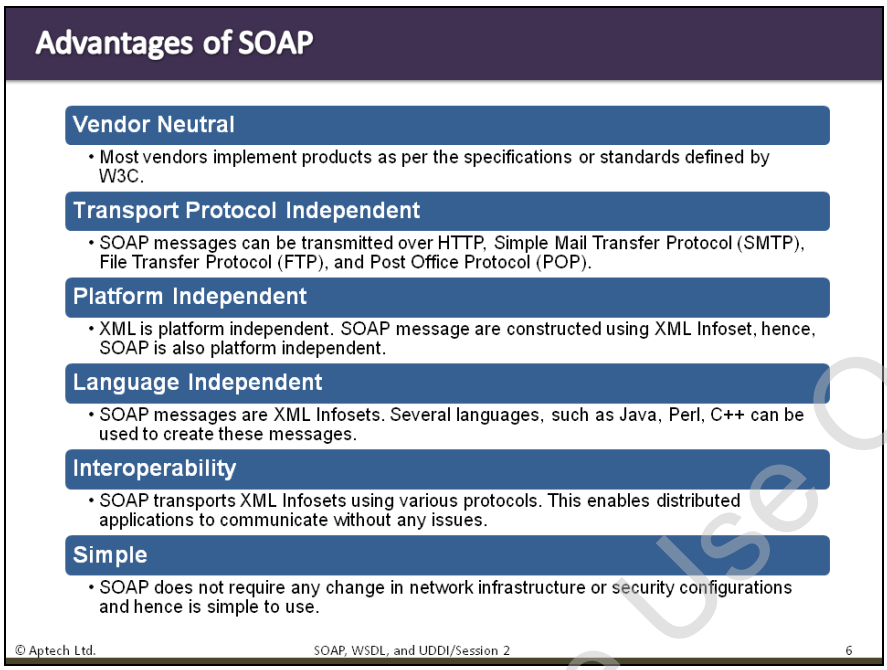
What is SOAP?

Answer:

SOAP stands for Simple Object Access Protocol. It is a communication protocol used between different applications.

Advantages of SOAP

Slide 6



Using slide 6, discuss the advantages of SOAP. Explain the various advantages of SOAP such as Vendor Neutrality, Transport Protocol Independence, Platform Independence, Language Independence, Interoperability, and Simplicity. Explain why these are the advantages of SOAP. Tell the students that from version 1.2, the acronym for SOAP, 'Simple Object Access Protocol', has been dropped. Also, tell that SOAP uses other application layer protocols such as HTTP for transmission of messages.

SOAP 1.1 vs. SOAP 1.2
Slides 7 to 9

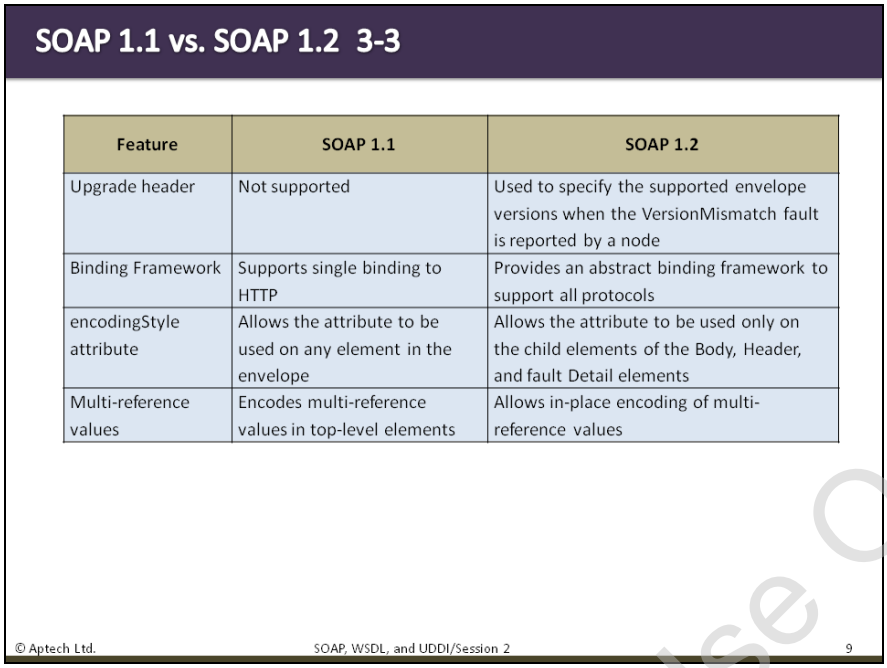
SOAP 1.1 vs. SOAP 1.2 1-3

- Following table provides a comparison between the features provided by SOAP 1.1 and SOAP 1.2:

Feature	SOAP 1.1	SOAP 1.2
SOAP messages	Is based on XML 1.0	Is based on XML Infosets
SOAP elements	Allows additional elements to be used after the <body> element	Does not allow additional elements to be used after the <body> element
actor attribute	Indicates the receiver of a header element	Renamed to role and indicates the receiver of a header element
next role	Can be applied to the intermediary SOAP nodes	Can be applied to the intermediary SOAP nodes and the ultimate receiver
none role	Not supported	Used to indicate that the header block should not be processed by any of the SOAP nodes
ultimateReceiver role	Not supported	Used to indicate a header block must be processed only by the ultimate receiver of the SOAP message

SOAP 1.1 vs. SOAP 1.2 2-3

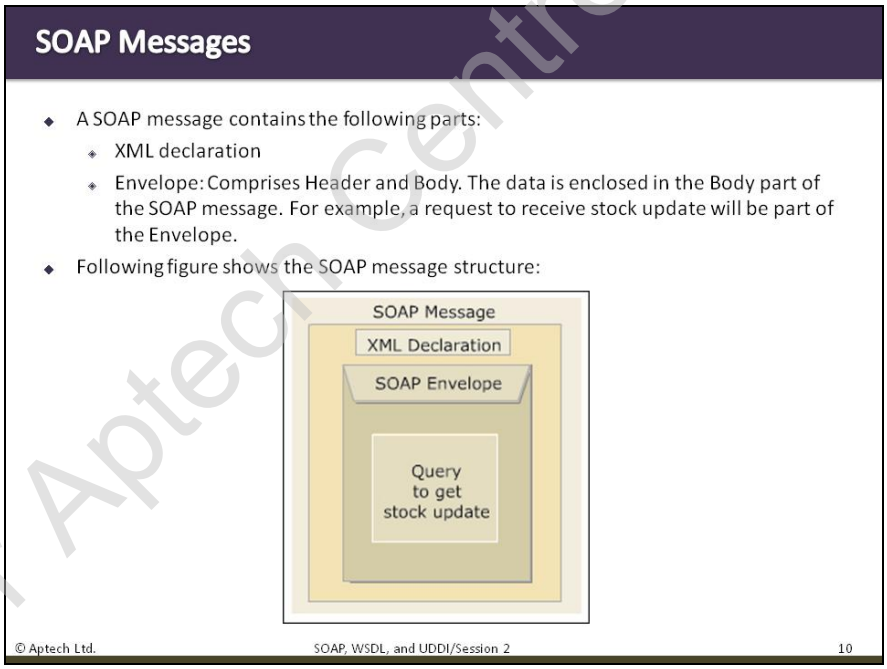
Feature	SOAP 1.1	SOAP 1.2
Fault codes	Supports the VersionMismatch, MustUnderstand, Client, and Server fault codes	Supports the DataEncodingUnknown, VersionMismatch, MustUnderstand, Sender (previously, Client), and Receiver (previously, Server) fault codes
Fault code extensions	Allows a dot notation to be used to indicate fault code extensions	Provides an XML-like structure for the fault code extensions
Fault structure	Only the root element was namespace qualified (e:fault); the other elements are faultcode, faultstring, faultfactor, and detail	All the elements are namespace qualified with e:fault as the root element and e:Code, e:Subcode, e:Value, e:Reason, e:Node, e:Role, and e:detail as the child elements
Fault semantics	Allows the body of the fault message to include multiple child elements	Allows the body of the fault message to include only one child element
Misunderstood header	Not supported	Used for providing additional information in the MustUnderstand faults



Using slides 7 to 9, explain the difference between the features of SOAP 1.1 and SOAP 1.2.

SOAP Messages

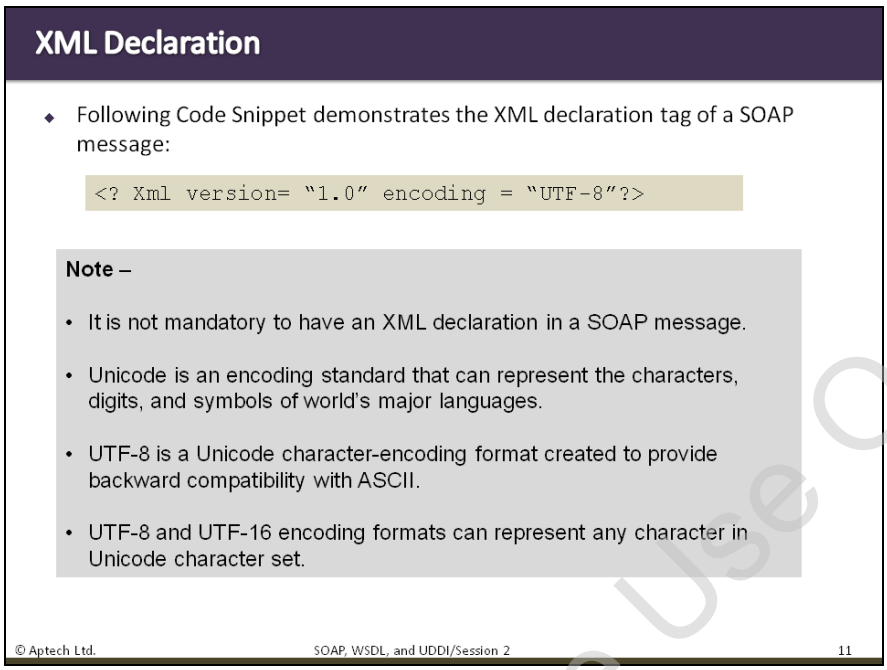
Slide 10



Using slide 10, explain SOAP message structure. Begin the explanation by providing few examples of SOAP messages such as request to receive stock update, list of available flights, request to get a price quote, query to a search engine. Then, explain the different parts of SOAP message. Give an example for Envelope such as a request to receive stock update will be part of the Envelope and then explain the parts of SOAP Envelope.

XML Declaration

Slide 11



Using slide 11, explain XML Declaration part of a SOAP Message. Emphasize that a SOAP message always begins with an XML Declaration. Explain the Code Snippet that shows the XML Declaration tag of a SOAP Message. The declaration states the version of XML and the encoding used in the message. The XML version has to be 1.0 and the encoding value can be (UTF) -8 or (UTF)-16. If no encoding attribute is present, then by default the document uses UTF-8 encoding and the document version is considered as 1.0.

SOAP Message Envelope

Slides 12 to 17

SOAP Message Envelope 1-6

- The SOAP envelope contains a message from one application to be sent to another application.
- The envelope part of the SOAP message acts as a container for the message.
- The Envelope element:
  - is the root element of the message and is mandatory
  - acts as a processing node to the receiving application. For example, the <Envelope> tag indicates the start of a SOAP message and the </Envelope> tag indicates the end. Once the receiving application encounters the </Envelope> tag, it starts processing the message
  - contains two child elements, an optional <Header> element and a mandatory <Body> element

SOAP 1.1 allows additional elements to be added after the SOAP Body element, SOAP 1.2 does not allow these.

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SOAP Message Envelope 2-6

- Following Code Snippet demonstrates the Envelope tag in a SOAP message:

```
<Envelope ...>
  <Header>
    0 or more headers
  </Header>
  <Body>
    message body
  </Body>
</Envelope>
```

SOAP Namespaces

- Following Code Snippet demonstrates a SOAP message with its elements qualified with respective namespaces:

```
<SOAP-ENV:Envelope
xmlns:SOAP-ENV= "http://www.w3.org/2003/05/soap-envelope"
xmlns:po= "http://www.flamingo.com/books/PO">
   ...
<!--SOAP Message goes here -->
       <po:orderDate> 2014/07/06 </po:orderDate>
   ...
</SOAP-ENV:Envelope>
```

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SOAP Message Envelope 3-6

SOAP Message Header

- Header is the child element of Envelope element.
- Headers can also include information such as digital signatures for password-protected service, authentication, authorization, transaction management, and routing path.

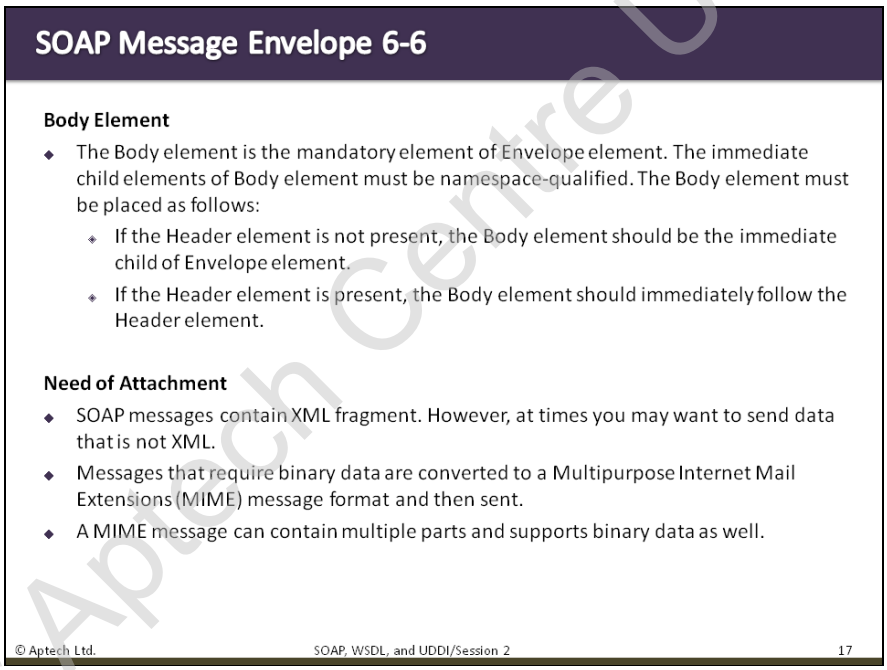
role Attribute

- Following Code Snippet demonstrates a SOAP message with various header entries:

```
<SOAP-ENV: Envelope
xmlns:SOAP-ENV= "http://www.w3.org/2003/05/soap-envelope"
xmlns:mid= "http://www.flamingo.com/books/message-id"
xmlns:m= "http://www.flamingo.com/books/monitored-by"
xmlns:md = "http://www.flamingo.com/books/monitoring-date"
xmlns:mu = "http://www.flamingo.com/books/mark"
        <SOAP-ENV: Header>
        <mid:message-id
SOAP-ENV:role="http://www.flamingo.com/logger">
    11546544ea:b134534:f3sdas5342:4354
   </mid:message-id>
   <m:monitored-by SOAP-ENV:role = "
```


SOAP Message Envelope 4-6

```
http://www.w3.org/2003/05/soap-envelope/role/next">
      <node>
         <time> 1078753670000   </time>
         <identity>austria</identity>
     </node>
  </m:monitored-by>
<md:monitoring-date SOAP-ENV:role = " http://www.w3.org/2003/05/soap-
envelope/role/none">
...
  </md:monitoring-date>
  <mu:mark SOAP-ENV:role = "http://www.w3.org/2003/05/soap-
envelope/role/ultimateReceiver">
   ...
   </mu:mark>
  </SOAP-ENV: Header>
</SOAP-ENV: Envelope>
```



Using slides 12 to 17, explain SOAP Message Envelope, its usage, and contents. Give examples to explain these concepts. Then, use the Code Snippet on slide 13 to explain the Envelope tag in a SOAP message. Using Code Snippets from 13 to 16, explain the students about SOAP Namespaces, SOAP Message Header, role Attribute, and mustUnderstand Attributes.

While discussing about SOAP Message Header, describe the information included in Header. The students may be asked to provide a few examples. While explaining about role attribute, explain the roles that are important in a SOAP message namely, next, none, and ultimateReceiver.

Next, proceed to explain about the Body Element. Describe its contents and how it should be placed. Then, provide a few examples of data in the Body element such as billing address or parameters to a method call.

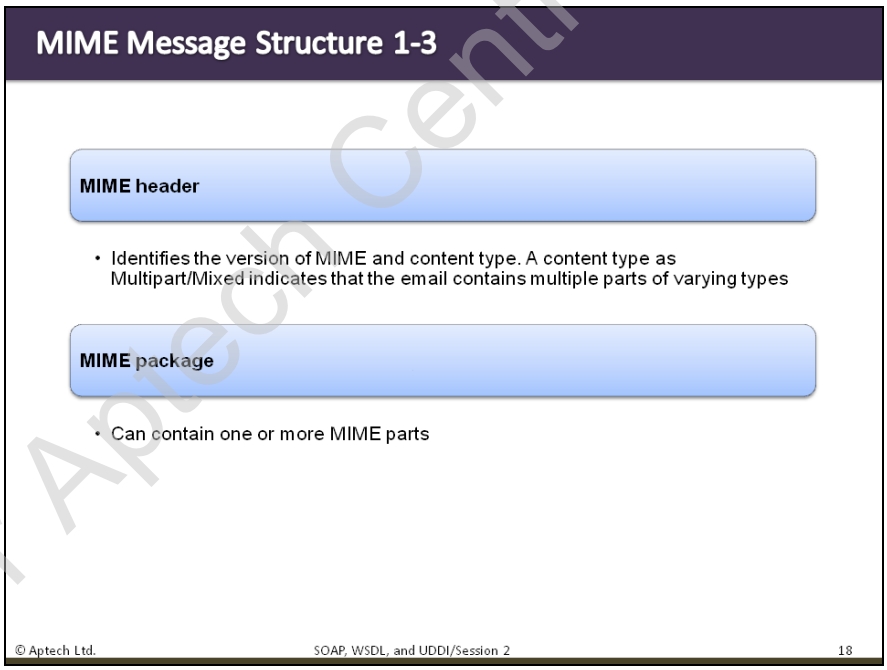
Finally, explain the Need of Attachment. Tell that SOAP messages need not always be in XML hence, messages that require binary data are converted to Multipurpose Internet Mail Extensions (MIME). Explain by providing scenario-based examples. A scenario can be one where you want to allow customers to book a room in a hotel and how this can be achieved through SOAP-based Web Service.

In-Class Question:

 What is MIME?

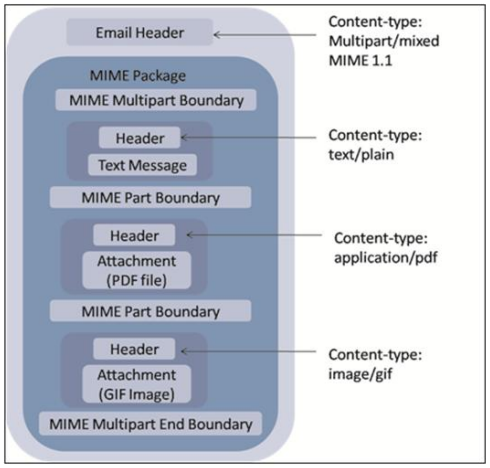
Answer:
MIME stands for Multipurpose Internet Mail Extensions that is used to convert binary data to a MIME message and then sent across different platforms.

MIME Message Structure
Slides 18 to 20



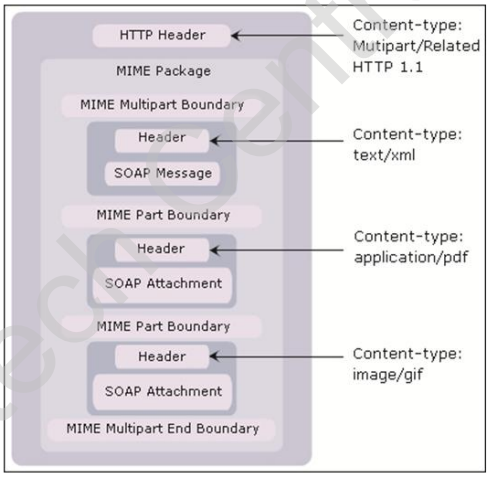
MIME Message Structure 2-3

- Following figure shows different types of message attachments:



MIME Message Structure 3-3

- Following figure shows a SOAP message with two attachments:



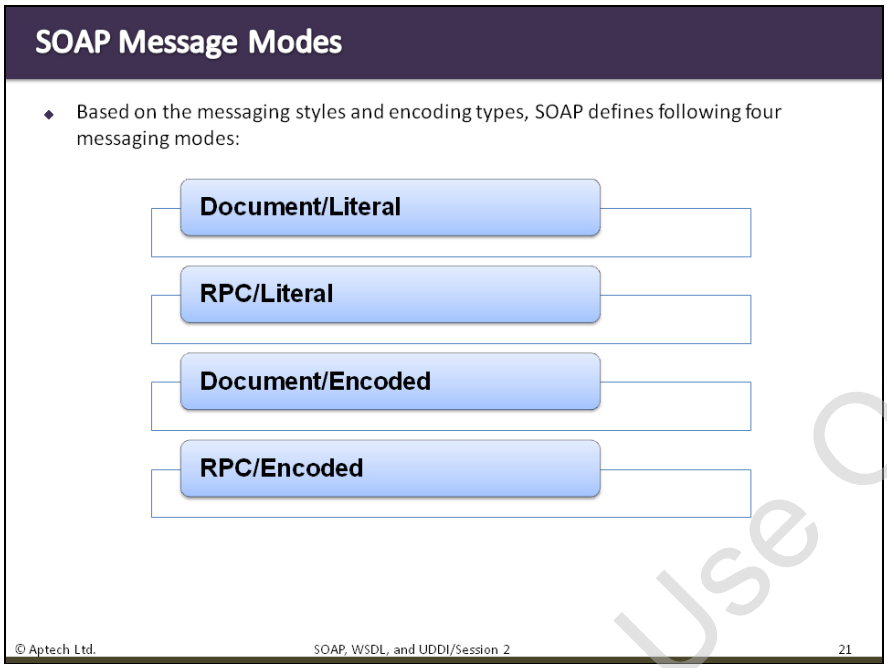
Using slides 18 to 20, explain MIME message structure. Explain the difference between the MIME header and the MIME package.

Explain about an email with attachment containing two or more MIME parts. Emphasize that each MIME message contains a header, which identifies the content type. Show the different types of message attachments using the figure on slide 19.

Then, explain about MIME message with a SOAP attachment. Tell that SOAP cannot have binary data in the message. However, SOAP messages can be sent along with binary data using SOAP with Attachments (SwA) standard. Using the figure on slide 20, explain a SOAP message with two attachments.

SOAP Message Modes

Slide 21



Using slide 21, list the messaging modes based on messaging styles and encoding types. Mention that Document/Encoded and RPC/Encoded messaging modes are not WS-I compliant.

In-Class Question:

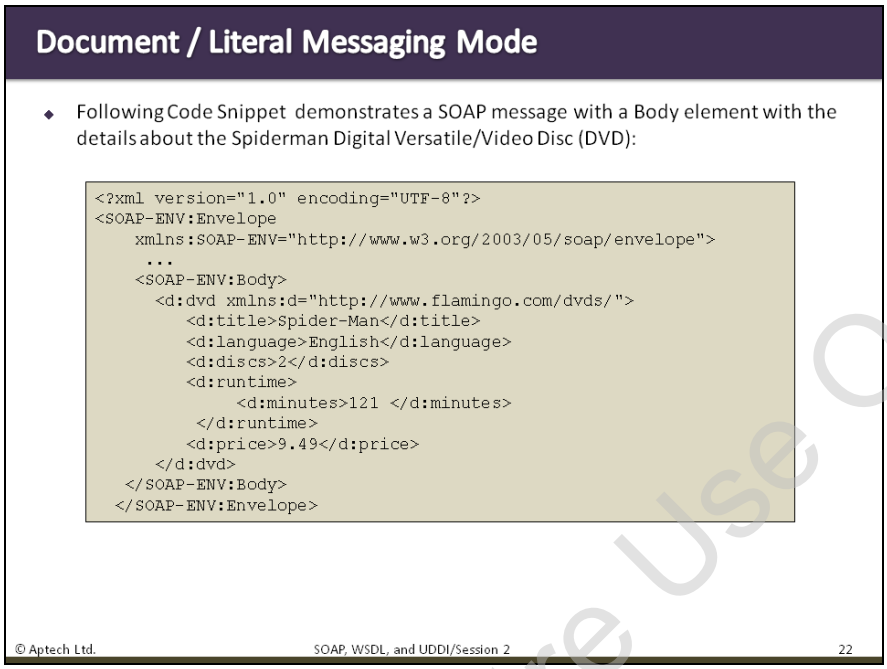
What are the various SOAP Messaging Modes?

Answer:

- Document/Literal
- RPC/Literal
- Document/Encoded
- RPC/Encoded

Document / Literal Messaging Mode

Slides 22



Using slide 22, explain the Document / Literal Messaging Mode. Explain that Document / Literal messaging mode is used when XML fragments have to be sent in a SOAP message. Give examples of XML fragment such as movie details, purchase order, billing address, book details. Tell that the schema and namespace of XML fragment is different from that of SOAP elements. Use the Code Snippet to explain a SOAP message on Spiderman Digital Versatile/Video Disc (DVD).

In-Class Question:

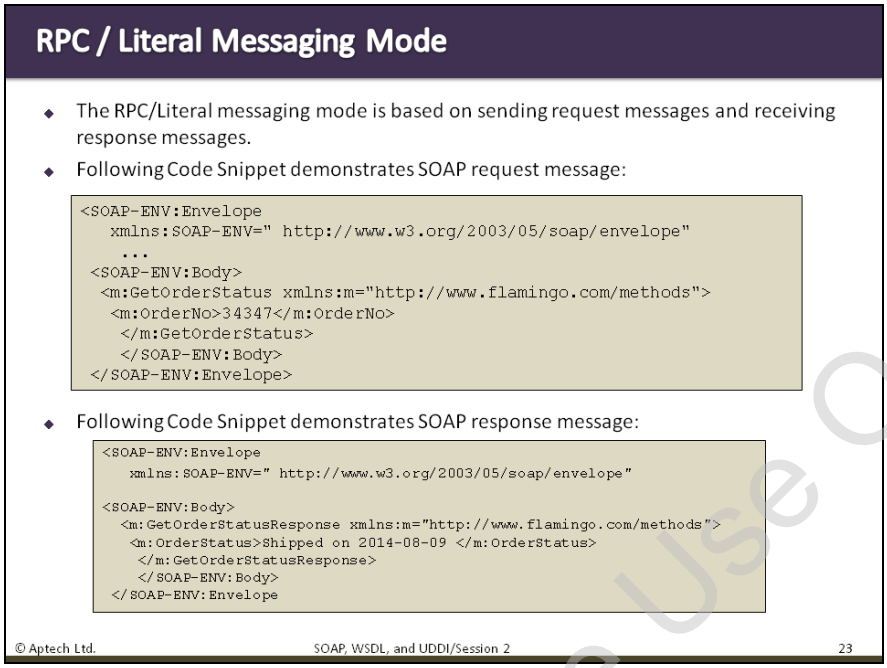
What are the messaging modes that WS-I Basic Profile (WS-I BP) 2.0 does not support?

Answer:

Document/Encoded and RPC/ Encoded messaging modes.

RPC / Literal Messaging Mode

Slide 23

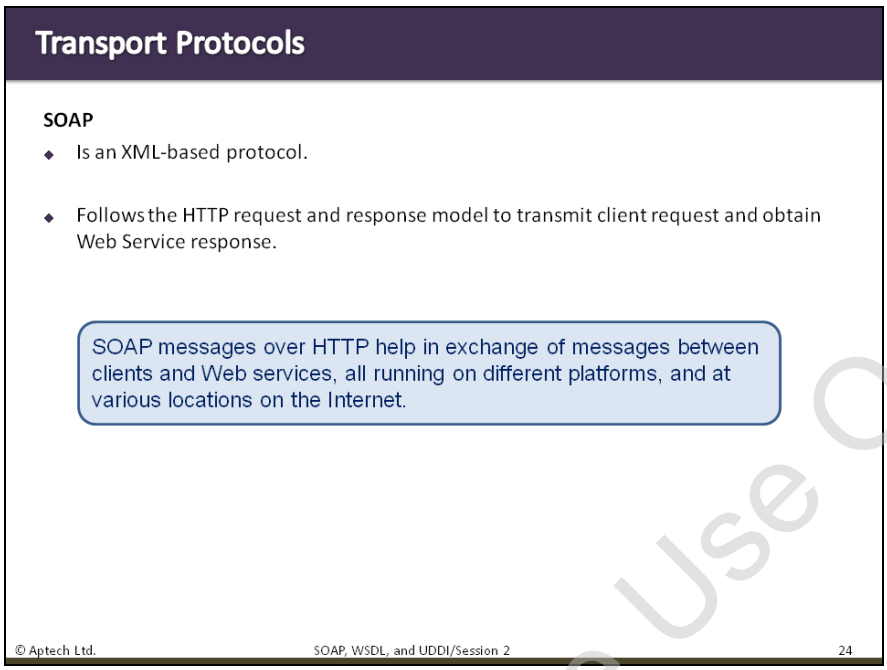


Using slide 23, explain the RPC / Literal Messaging mode. Explain that it is based on sending request messages and receiving response messages. The request message represents a method with one or more parameters and the response message represents a value returned by the method. Tell that the requested and resultant information are sent as part of Body element.

Using the Code Snippets, explain the SOAP request message and the SOAP response message.

Transport Protocols

Slide 24



Using slide24, explain what SOAP is based on. Explain what model it follows to transmit client request and obtain Web Service response and the benefit of SOAP messages over HTTP.

SOAP HTTP Binding

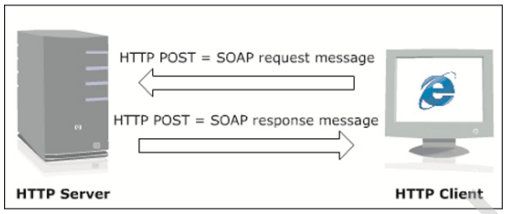
Slides 25 and 26

SOAP HTTP Binding 1-2

- SOAP messages are transmitted as a payload of an HTTP message.
- A payload of an HTTP message contains form data such as username, password, credit card number, and so on.

HTTP

- Is a request-response protocol. A SOAP message is carried as a payload in an HTTP POST message.
- Following figure shows the HTTP POST message:



SOAP HTTP Binding 2-2

- Features of HTTP 1.1 are as follows:
  - Requires a Host header. This header allows a message to be routed through proxy servers and helps the Web server to distinguish between various sites on the same server.
  - Supports persistent connections, which allows multiple request/response on the same HTTP connections.
  - Provides the OPTIONS method that helps determine the capabilities of the HTTP server.
  - Provides the entity tag, which expands on the caching support.
  - Provides additional conditional headers such as If-Unmodified-Since, If-Match, and If-None-Match.

Using slides 25 and 26, explain about SOAP HTTP binding. Explain HTTP tunneling and how it helps a message pass through any firewall without any obstruction. Explain about payload of an HTTP message and what type of data it contains.

Describe the HTTP POST message using the figure on slide 25. Explain that SOAP messages sent over HTTP are placed in the payload of an HTTP request or response. By saying that HTTP is a Request/Response protocol, we mean that the sender expects a response from the receiver. The response can be data or even an error code. HTTP requests are typified by

the messages that your browser sends to a Web server to request a Web page or submit a form.
Mention that a request for a Web page is usually made in an HTTP GET message, while submission of a form is done with an HTTP POST message.

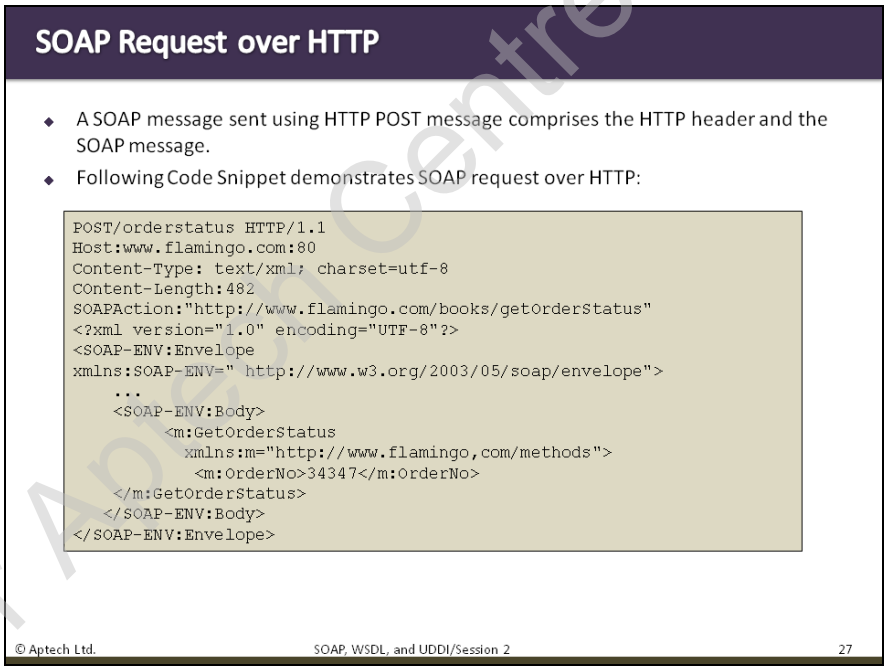
Explain that being an application-level protocol, HTTP is used in distributed, collaborative, and hypermedia information systems. Explain the limitations of HTTP 1.0. Tell that the limitations of HTTP 1.0 are overcome by HTTP 1.1 version. Then proceed to explain the features of HTTP 1.1.

In-Class Question:

Which version of Hypertext Transfer Protocol (HTTP) is most commonly used?

Answer:
HTTP 1.1

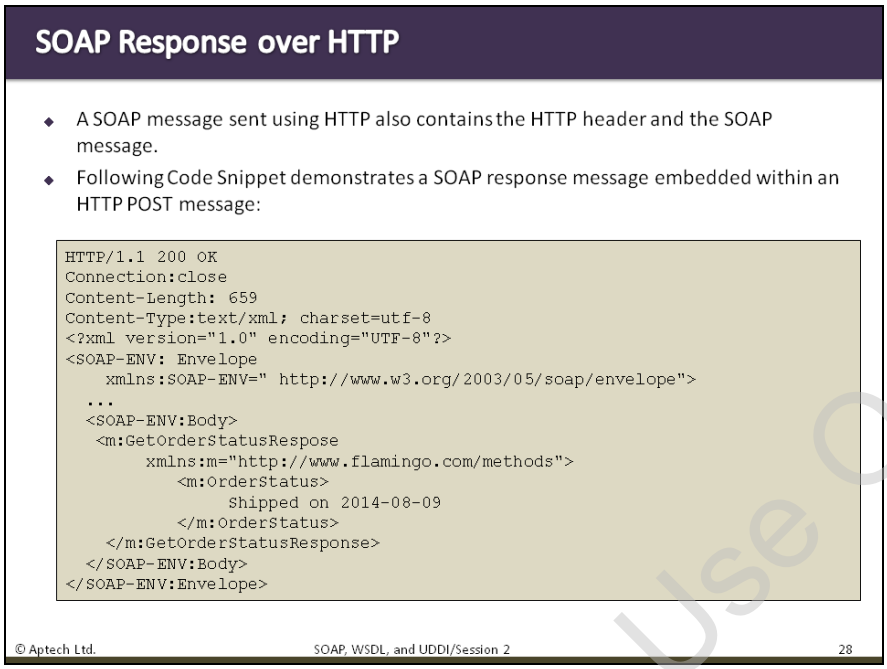
SOAP Request over HTTP
Slide 27



Using slide 27, explain SOAP Request Message over HTTP. Also, explain the Code Snippet in detail.

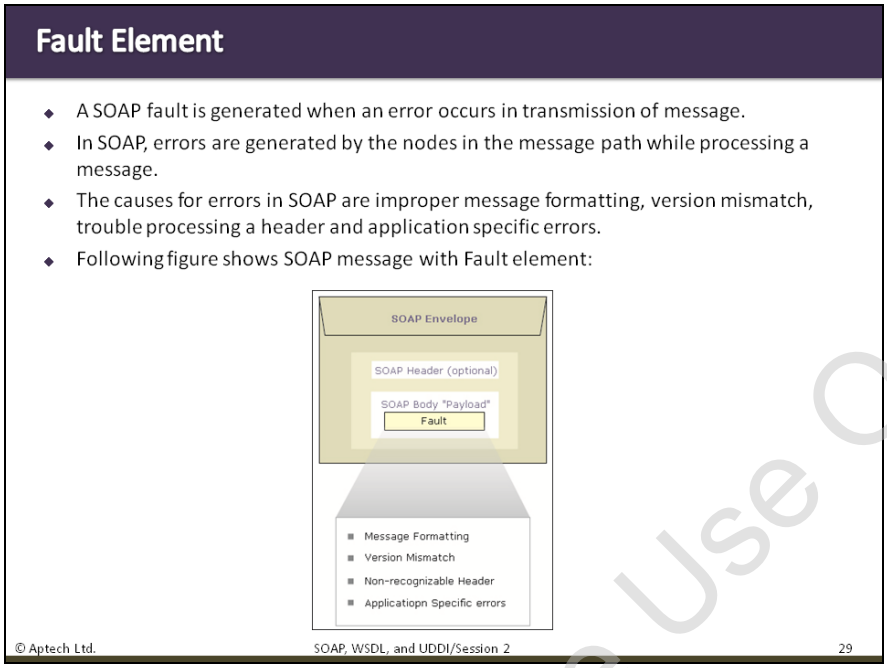
SOAP Response over HTTP

Slide 28



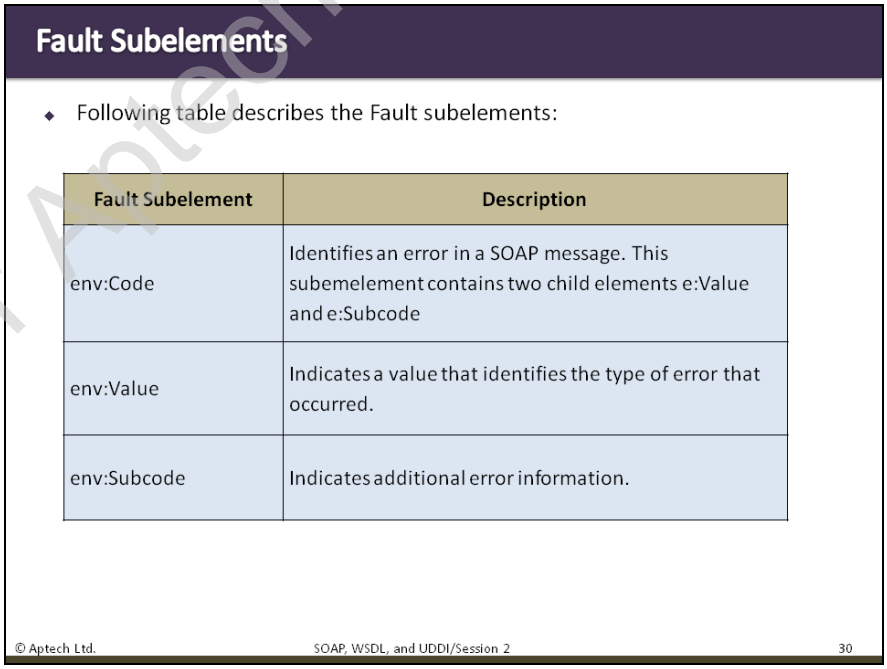
Using slide 28, explain how SOAP Response message is sent over HTTP. Explain the Code Snippet and tell that the value 200 OK in the first line is an HTTP response success code which indicates that the message was received and processed successfully.

Fault Element
Slide 29



Using slide 29, explain Fault Element. Explain how SOAP Fault is generated. Explain the causes for errors in SOAP. Explain that an error is enclosed in a Fault element. Point out that a Fault element is always a child of Body element and it appears only once in the Body element. The Body element has only the Fault element. Using the figure, explain the structure of SOAP message with Fault element.

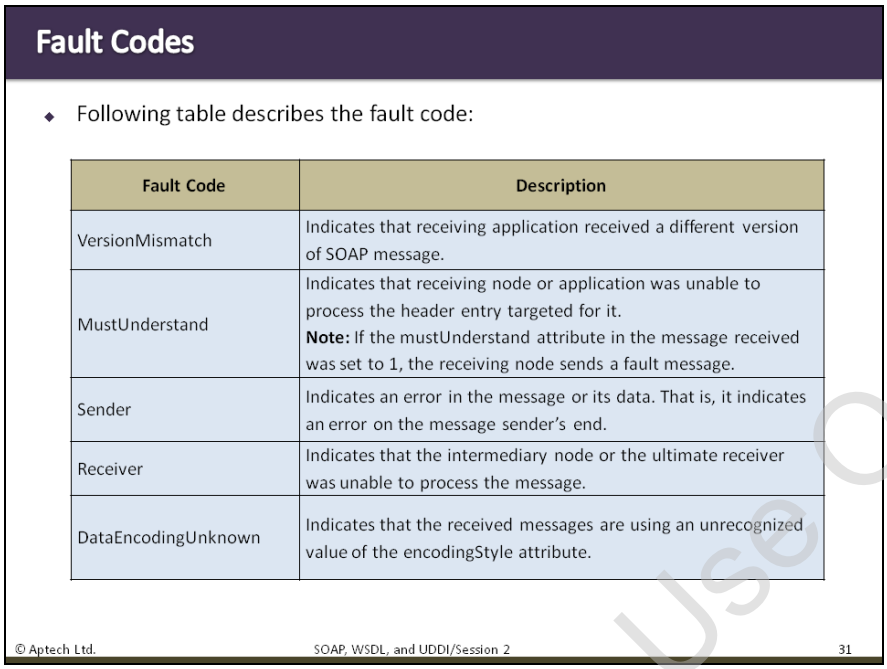
Fault Subelements
Slides 30



Using slide 30, explain the subelements of Fault element. Explain each of the Subelement and its functions.

Fault Codes

Slide 31



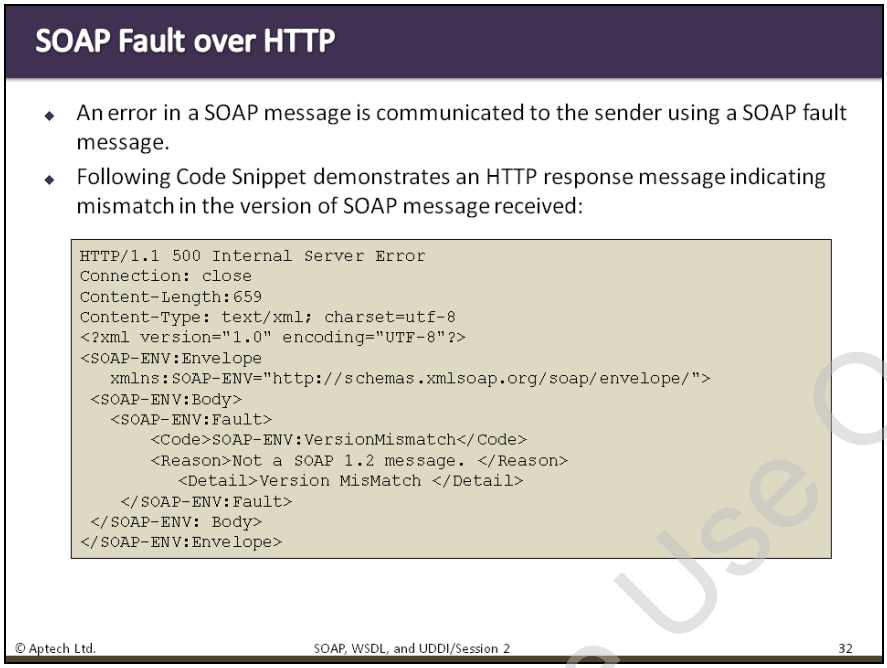
Using slide 31, explain that a faultcode subelement provides error information in the form of fault codes. Tell about different Fault Codes and what each indicates.

In-Class Question:

What is the function of the Fault subelement env:Code?

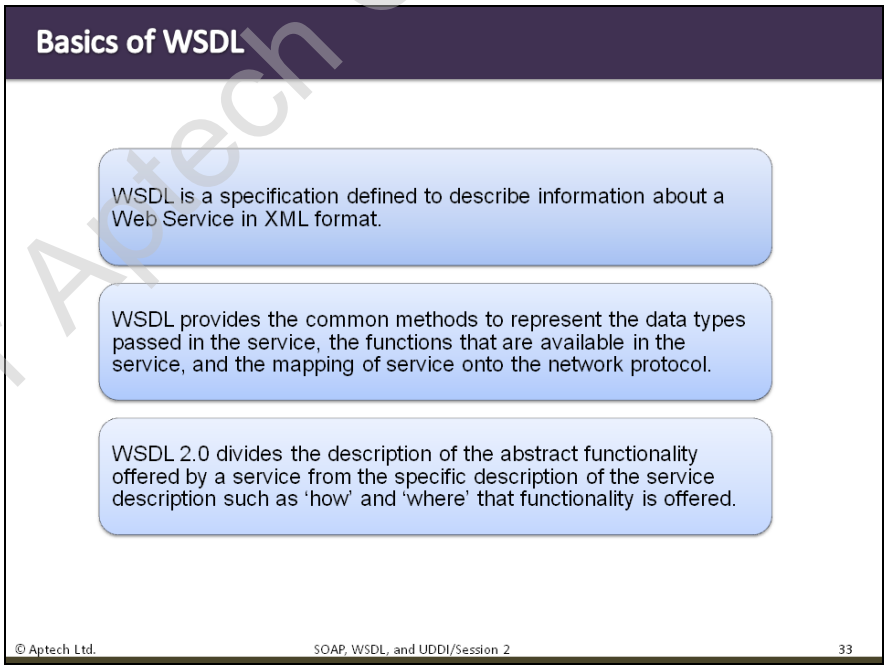
Answer: Fault Subelement env:Code identifies an error in a SOAP message. This subelement contains two child elements e:Value and e:Subcode.

SOAP Fault over HTTP
Slide 32



Using slide 32, explain how an error in a SOAP message is sent to the sender.
Explain using the Code Snippet how an HTTP response message indicates a mismatch in the version of SOAP message received.

Basics of WSDL
Slide 33



Using slide 33, explain WSDL. Describe the common methods of WSDL and how abstract functionality differs from the specific description of the service description.

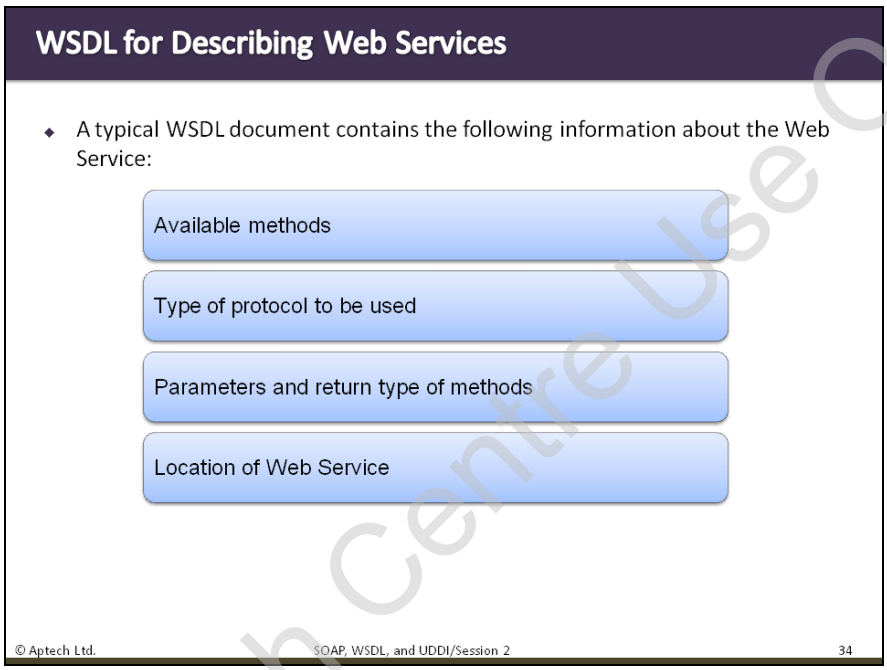
In-Class Question:

 What is WSDL?

Answer: WSDL stands for Web Services Description Language. It is a language that describes Web services and how to access them.

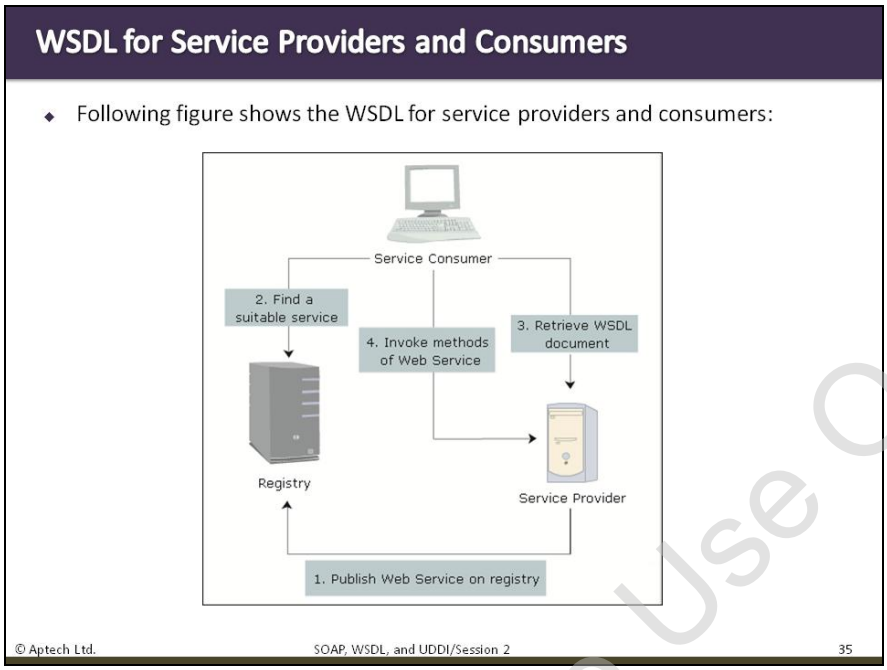
WSDL for Describing Web services

Slide 34



Using slide 34, explain what a typical WSDL document contains.

WSDL for Service Providers and Consumers
Slide 35



Using slide 35, explain how WSDL helps the Service Providers and Consumers using the figure. Explain that a Service Provider creates the WSDL document and publishes it along with other information to a registry. Next, a service consumer searches the registry to locate service of interest. The service consumer downloads the WSDL document after finding relevant service. Explain how the service consumer's application de-serializes the WSDL document and creates Java classes from them. Explain how Java classes can now invoke the methods of the Web service and start using the Web service.

WSDL Document Structure
Slides 36 to 39

WSDL Document Structure 1-4

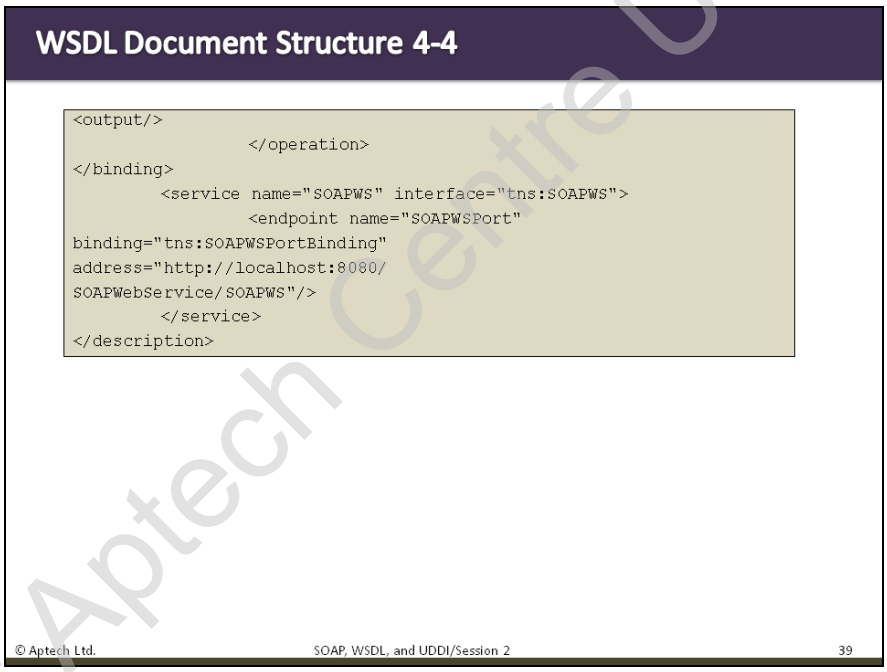
- Following table describes the WSDL document elements:

Elements	Description
description	• Acts as a container for the elements types, interface, binding, and service. • Defines the name of the Web Service and also one or more namespaces used by its child elements.
types	• Defines the data type of the information exchanged between applications. • Is mandatory only if the data type is other than the built-in data types of XML Schema. Example of XML schema's built-in types are string, integer, and so on.
interface	• Describes the operations that the Web service includes and the input/output messages that are exchanged for each operation. • Describes the fault messages.
binding	• Describes how the input and output messages of each operation will be transmitted over the Internet from one application to another.
service	• Defines the address for invoking the Web Service. In other words, it provides the URL of the service provider's server on which the Web Service is hosted. The service consumer's application uses this URL to invoke the methods of the Web Service.
import	• Used to import XML Schemas or WSDL document. This is an optional element.

WSDL Document Structure 2-4

- Following Code Snippet shows a sample WSDL document:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>

<description targetNamespace="http://ws.soap.syskan.com/"
xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-
200401-wss-wssecurity-utility-1.0.xsd"
xmlns:wsp="http://www.w3.org/ns/ws-policy"
xmlns:wsp1_2="http://schemas.xmlsoap.org/ws/2004/09/policy"
xmlns:wsam="http://www.w3.org/2007/05/addressing/metadata"
xmlns:tns="http://ws.soap.syskan.com/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://www.w3.org/ns/wsdl"
xmlns:wsoap="http://www.w3.org/ns/wsdl/soap">
<types>
<xsd:schema>
<xsd:import
namespace="http://ws.soap.syskan.com/"
 schemaLocation="http://localhost:8080/SOAPWebService/SOAPWS?xsd=1"/>
```

Using slides 36 to 39, explain the structure of WSDL document. Explain the important elements of the WSDL document and what each are used for. Also, explain a sample WSDL Document using the given Code Snippet on slides 37 to 39.

What is UDDI?

Slides 40 to 42

What is UDDI 1-3

Web Service Registry

- A dictionary consists of searchable collection of words in one or more specific languages.
- Similarly, a service registry consists of searchable collection of descriptions of Web services.

Universal Description, Discovery, and Integration (UDDI)

- Is a platform-independent, XML based registry for businesses worldwide to list the business on the Internet.
- Provides standard mechanisms for businesses to describe and publish their Web Services, discover published Web Services, and use them.

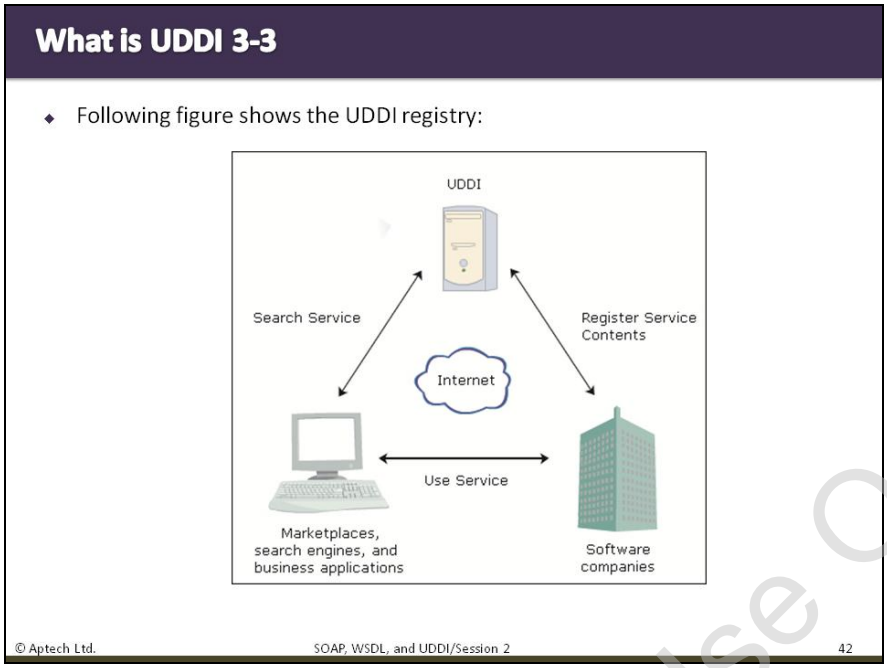
 SOAP, WSDL, and UDDI/Session 2 40

What is UDDI 2-3

To use the registry following steps are required:

- UDDI contains references to specifications called as Technical Models, or tModels.
- The tModels describe the working of Web Services. They are built upon a programming model and schema that are platform and language independent.
- The software companies populate the registry by describing various tModels and specifications common to a business.
- UDDI programmatically assigns a Unique Universal Identifier (UUID) to each tModel and business registration.
- Market places, search engines, and business applications query the registry to discover services of other companies and integrate this data with each other over the Web.

 SOAP, WSDL, and UDDI/Session 2 41



Using slides 40 to 42, explain Web service registry and UDDI. Also, using the figure on slide 42 explain how UDDI can be used.
Give an example of the airline industry. Assume that the industry published an UDDI standard for flight rate checking and reservation. Now, all airlines can register their services into an UDDI directory. Travel agencies can then search the UDDI directory to find the airline's reservation interface. When the interface is found, the travel agency can communicate with the service immediately because it uses a well-defined reservation interface.

Consider a travel company XYZ wants to register its contact information, service description, and online service access information with UDDI. The following steps are necessary:

1. Select an appropriate operator (such as Microsoft) and obtain a UDDI client, such as those provided by the operator.
2. Obtain an authentication token from the operator.
3. Register all the important information about the business so that it helps when searching for matches.
4. Release the authentication token.
5. Fill in the tModel information. This is important because when someone wants to search for a given service can find your business as one of the service providers.
6. Update the information to reflect changing business contact information and new service details.

In-Class Question:

What is UDDI?

Answer: UDDI or Universal Description, Discovery, and Integration is a registry where businesses can list themselves on the Internet.

UDDI Data Structure
Slides 43 to 45

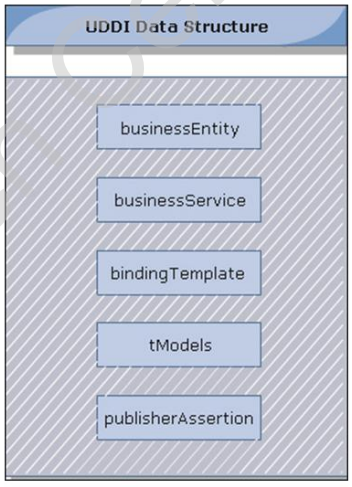
UDDI Data Structure 1-3

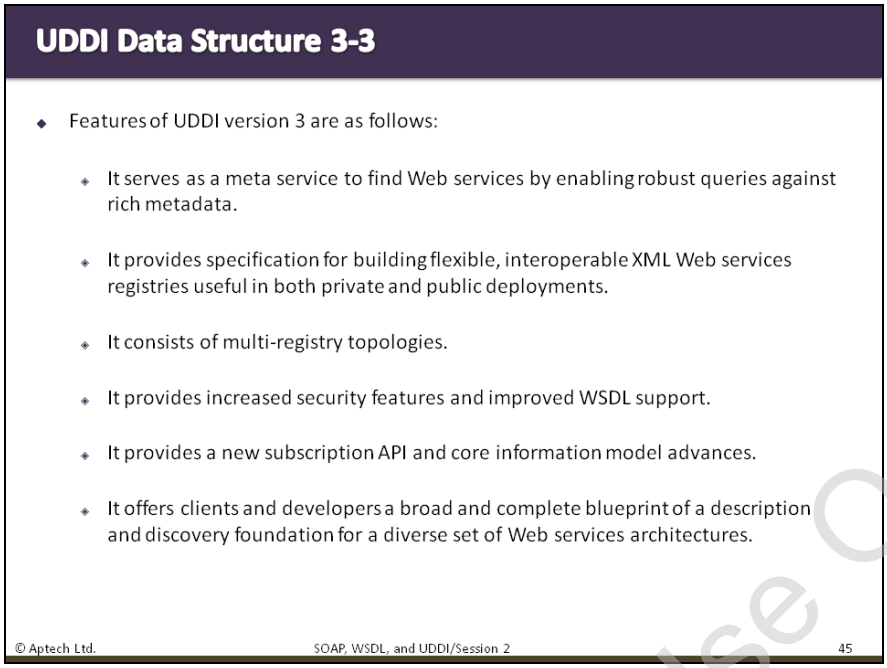
- UDDI provides five core data structures as follows:

businessEntity	• Represents all the information about the business or the organization that provides the Web Service.
businessService	• Represents a Web Service.
bindingTemplate	• Represents the binding of a Web Service with its URL and its tModels.
tModel	• Provides information about a Web Service. It specifies the name of the service, brief description of the service, and a unique code that is used to identify a service in the registry.
publisherAssertion	• Represents a relationship between two business entities or service providers.

UDDI Data Structure 2-3

- Following figure show the UDDI data structure:





Using slides 43 to 45, explain the core data structures of UDDI. Explain the benefit of each data structure. Also, explain the key features of UDDI version 3.

In-Class Question:

 List the core Data Structures of UDDI.

Answer:

- businessEntity
- businessService
- bindingTemplate
- tModel
- publisherAssertion

UDDI Publisher API

Slides 46 and 47

UDDI Publisher API 1-2

Following table describes some of the methods available under UDDI Publisher API:

Methods	Description
Add_publisherAssertions	Adds relationship assertions to the existing set of assertions
save_business	Adds or updates one or more businessEntity entries
save_service	Adds or updates one or more businessService entries
save_binding	Adds or updates one or more bindingTemplate entries
save_tModel	Adds or updates one or more tModel entries
delete_business	Deletes one or more businessEntity entries
delete_service	Deletes one or more businessService entries
delete_binding	Deletes one or more bindingTemplate entries
delete_tModel	Deletes (or hides) one or more tModel entries
delete_publisherAssertions	Deletes specific publisher assertions from the assertion collection managed by a specific publisher

 SOAP, WSDL, and UDDI/Session 2 46

UDDI Publisher API 2-2

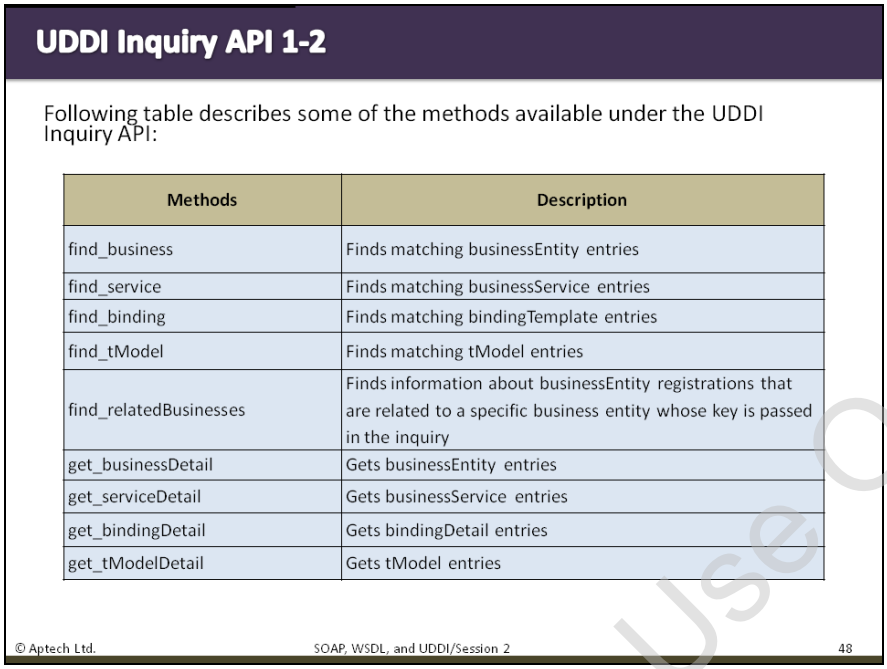
Methods	Description
get_authToken (deprecated)	Logs you into the registry
discard_authToken (deprecated)	Logs you out of the registry
find_relatedBusinesses(deprecated)	Finds matching publisherAssertion entries
get_publisherAssertions	Gets a list of publisherAssertion entries
get_registeredInfo	Gets an abbreviated list of businesses and tModels currently being managed by a given publisher
get_assertionStatusReport	Gets a summary of publisherAssertion entries
set_publisherAssertions	Saves the entire set of publisher assertions for an individual publisher

 SOAP, WSDL, and UDDI/Session 2 47

Using slides 46 and 47, explain about Publisher API and Inquiry API in UDDI. Then, explain the different methods available under UDDI Publisher API.

UDDI Inquiry API

Slides 48 and 49

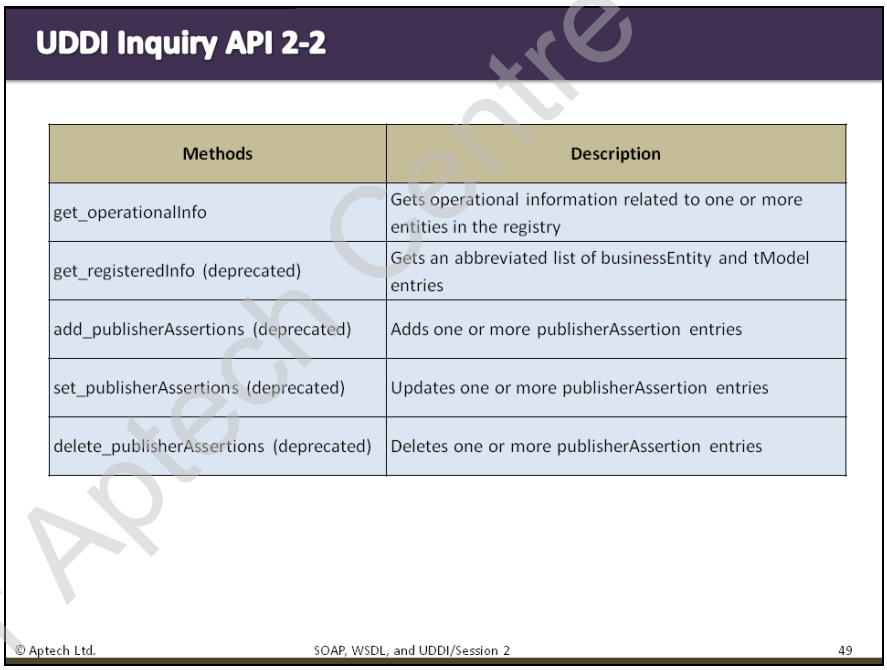


UDDI Inquiry API 1-2

Following table describes some of the methods available under the UDDI Inquiry API:

Methods	Description
find_business	Finds matching businessEntity entries
find_service	Finds matching businessService entries
find_binding	Finds matching bindingTemplate entries
find_tModel	Finds matching tModel entries
find_relatedBusinesses	Finds information about businessEntity registrations that are related to a specific business entity whose key is passed in the inquiry
get_businessDetail	Gets businessEntity entries
get_serviceDetail	Gets businessService entries
get_bindingDetail	Gets bindingDetail entries
get_tModelDetail	Gets tModel entries

 SOAP, WSDL, and UDDI/Session 2 48



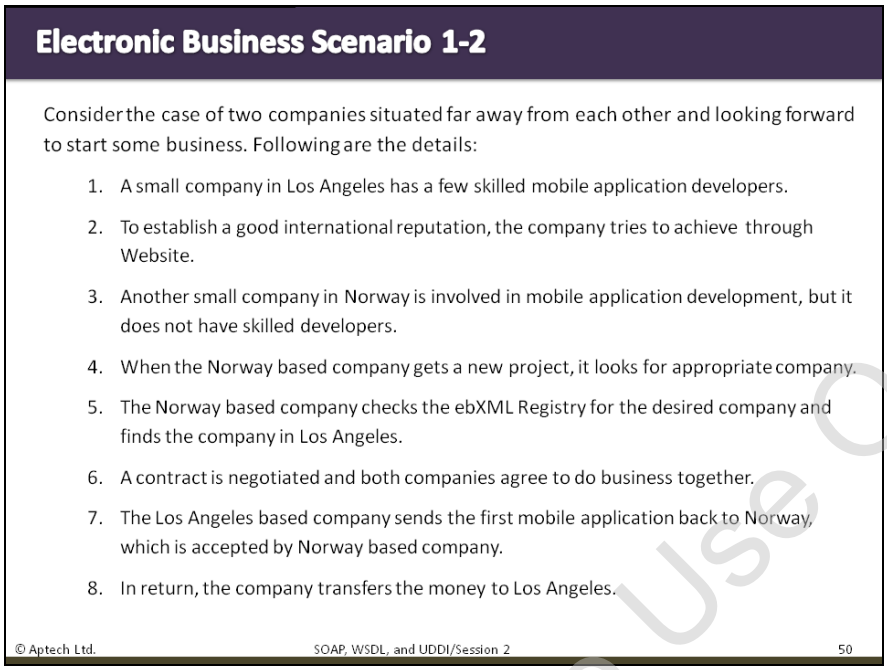
UDDI Inquiry API 2-2

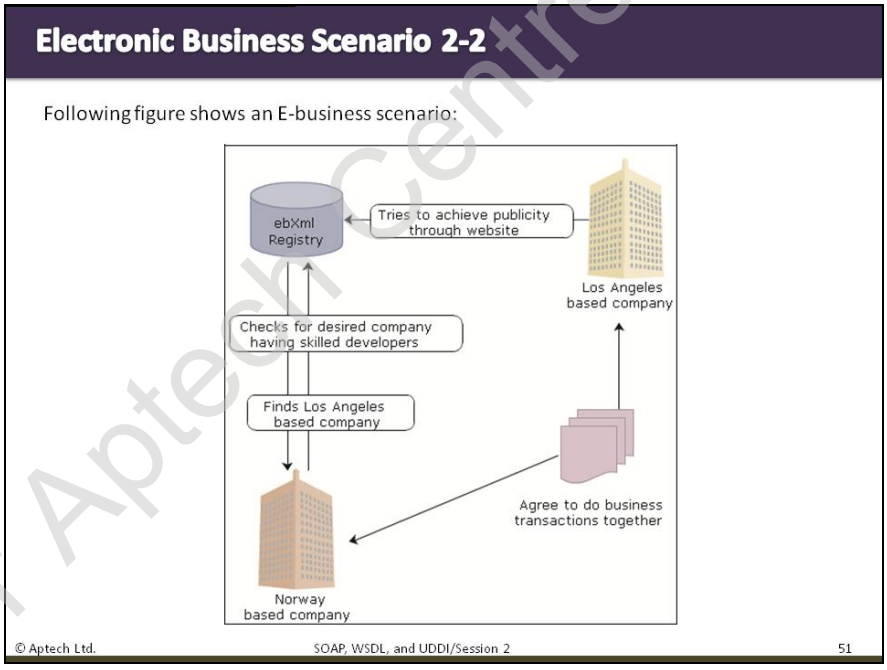
Methods	Description
get_operationalInfo	Gets operational information related to one or more entities in the registry
get_registeredInfo (deprecated)	Gets an abbreviated list of businessEntity and tModel entries
add_publisherAssertions (deprecated)	Adds one or more publisherAssertion entries
set_publisherAssertions (deprecated)	Updates one or more publisherAssertion entries
delete_publisherAssertions (deprecated)	Deletes one or more publisherAssertion entries

 SOAP, WSDL, and UDDI/Session 2 49

Using slides 48 and 49, explain the benefit of using the Inquiry API. Then, explain the various methods available under UDDI Inquiry API.

Electronic Business Scenario
Slides 50 and 51





Using slides 50 and 51, explain the concept of electronic business. Then, explain an E-business scenario in which two companies situated in remote locations want to start some business. Explain how the companies provide business details to each other and how ebXML enables the companies to work together in future.

Electronic Business Process
Slides 52 and 53

Electronic Business Process 1-2

Consider a scenario of how two companies, Exxon Corporation, a Los Angeles-based company and Nikido Electrics, a Norwegian company could implement a business that adheres to ebXML processes.

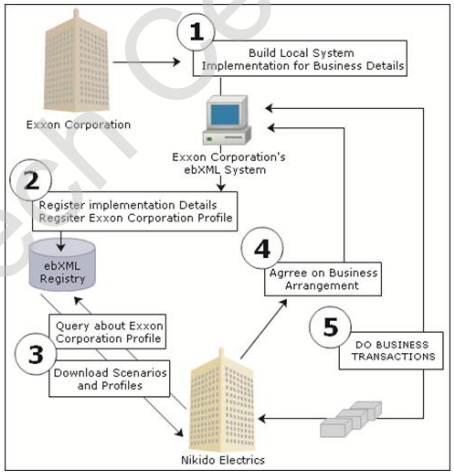
Following are the steps both the companies must do to do electronic business in ebXML format:

1. Exxon Corporation creates a Collaboration Protocol Profile (CPP) by defining itself in an ebXML compliant application.
2. Exxon Corporation submits its CPP to the registry and tries to achieve publicity through its Website.
3. Nikido Electrics, already registered at the ebXML registry/repository, is looking for new trading partners. It starts a new query and receives the CPP of Exxon Corporation. Using the CPP of Exxon Corporation and that of Nikido Electrics, ebXML derives a document called Collaboration Protocol Agreement (CPA).
4. Nikido Electrics contacts Exxon Corporation directly and sends the newly created CPA for acceptance.
5. After signing the contract, both the companies do electronic business directly following the business processes defined in the CPA.

 SOAP, WSDL, and UDDI/Session 2 52

Electronic Business Process 2-2

Following figure shows the use of ebXML:



 SOAP, WSDL, and UDDI/Session 2 53

Using slides 52 and 53, explain using a scenario how companies can implement a business that adheres to ebXML processes. Explain the steps the companies need to take up for doing electronic business in ebXML format using the figure on slide 53.

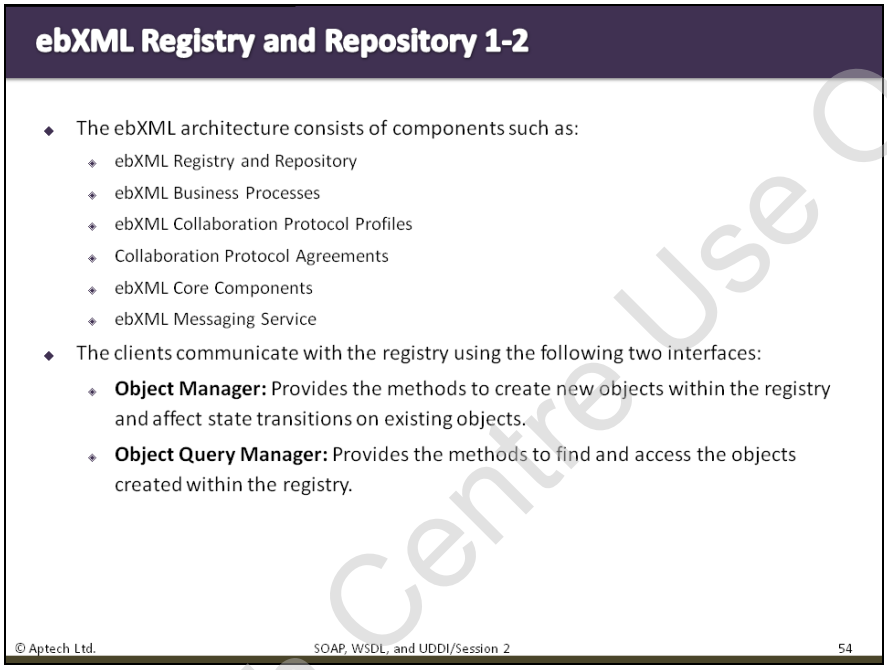
Begin the explanation of the figure starting from step 1 stating Exxon Corporation builds Local System Implementation for Business Details and submits the CPP to the registry. Then, Register implementation details of Exxon Corporation profile and query about EXXON Corporation Profile and ensure that both the companies (Exxon Corporation and Nikido Electrics) agree on Business arrangement and finally do business transactions.

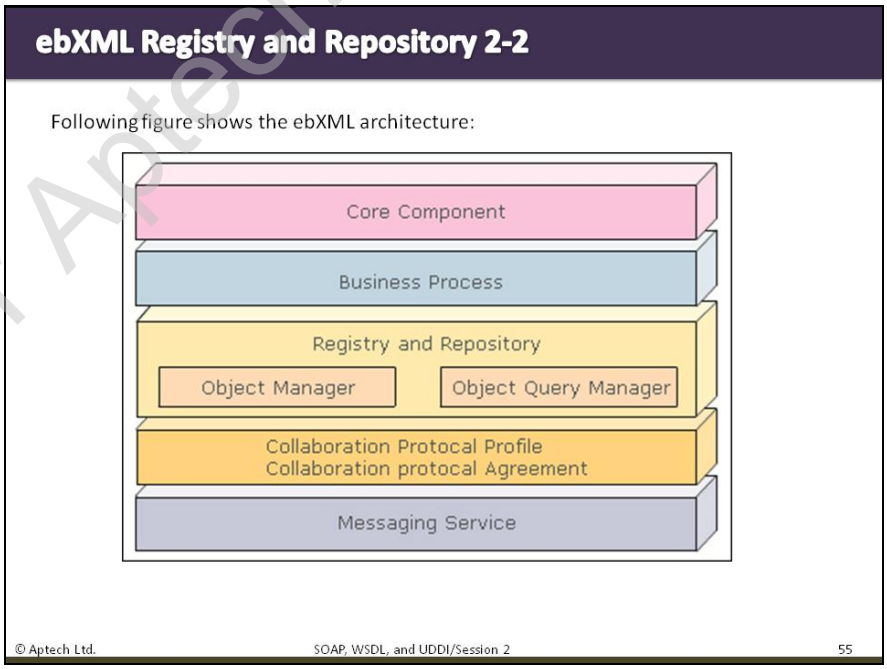
In Class Question:

What is ebXML?

Answer: ebXML is an XML based standard, which enables business organizations to use business information available on the Internet in a secure way for their benefits.

ebXML Registry and Repository
Slides 54 and 55

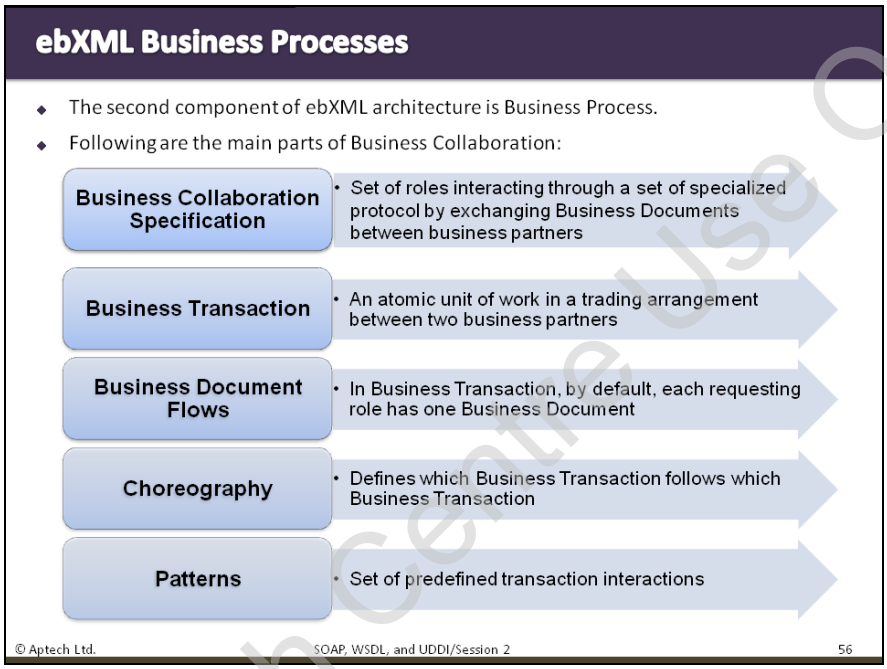




Using slides 54 and 55, explain the components of ebXML architecture. Inform that ebXML registry and repository is a superset of UDDI. Then, explain what information is stored in

ebXML registry. Point out that the registry is connected internally to the repository. Explain the interfaces through which clients can communicate with the registry. Explain for what each interface is used. Show the figure on slide 55 and explain each block. For example, mention that a core component is the basic building block that contains information representing a business concept. A Business Process involves the exchange of information between two or more Trading Partners, and so on.

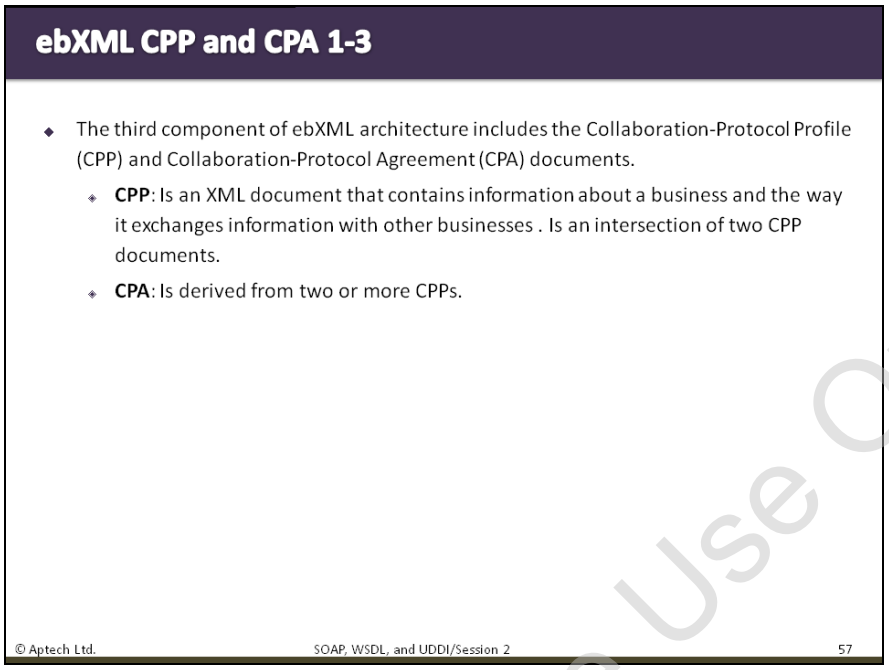
ebXML Business Processes
Slide 56

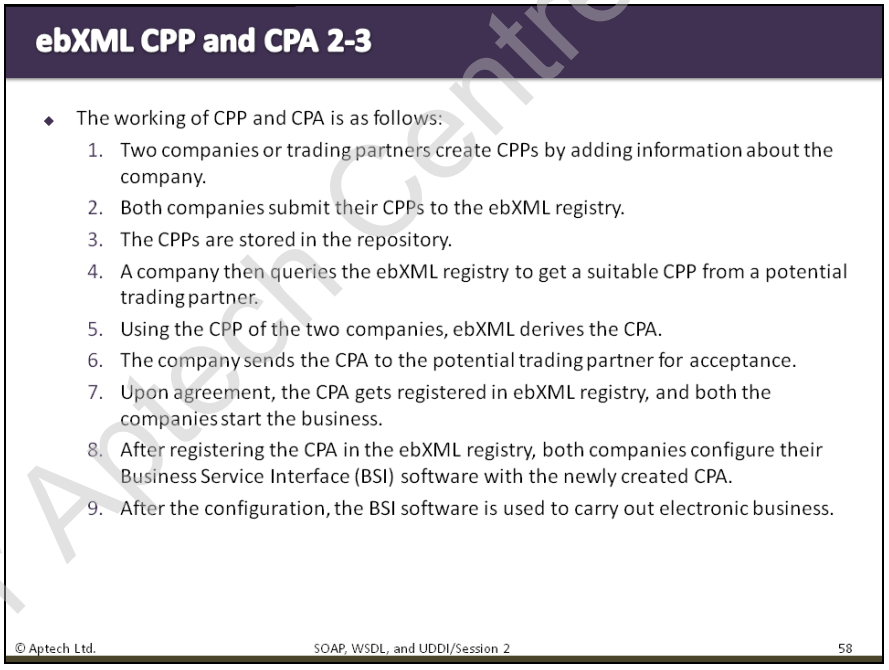


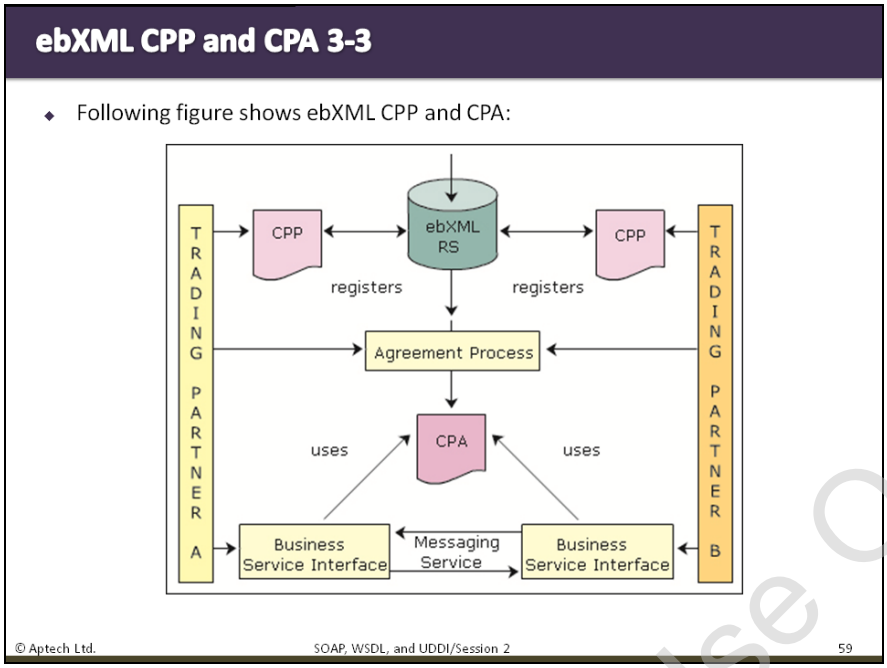
Using slide56, explain the second component of ebXML architecture that is Business Process. Explain how it defines the Business Collaboration. Additionally, describe the main parts of Business Collaboration, which are:

- Business Collaboration Specification
- Business Transaction
- Business Document Flows
- Choreography
- Patterns

ebXML CPP and CPA
Slides 57 to 59







Using slides 57 to 59, explain the next component of ebXML architecture, which includes the Collaboration-Protocol Profile (CPP) and Collaboration – Protocol Agreement (CPA) documents. Explain their working with the help of the given figure on slide 59.

Mention that the Messaging Service helps to exchange messages between organizations and the registries is a database of items such as XML schemas of business documents, definitions of library components for business process modelling, and trading partner agreements which support doing business electronically. The CPA is derived from the CPP's of the trading partners.

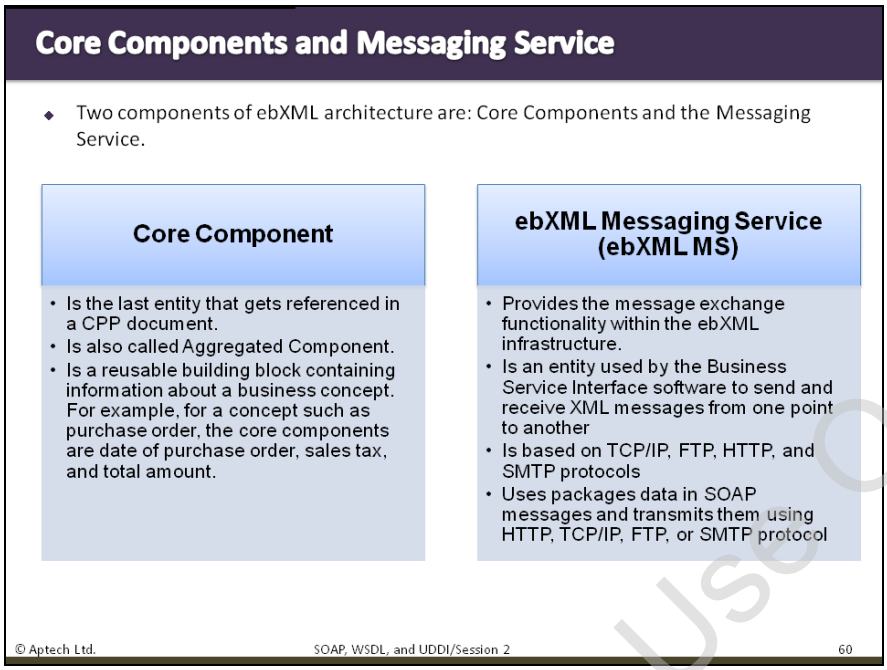
In-Class Question:


What is CPP?

Answer: CPP is an XML document that contains information about a business and the way it exchanges information with other businesses. It is an intersection of two CPP documents.

Core Components and Messaging Service

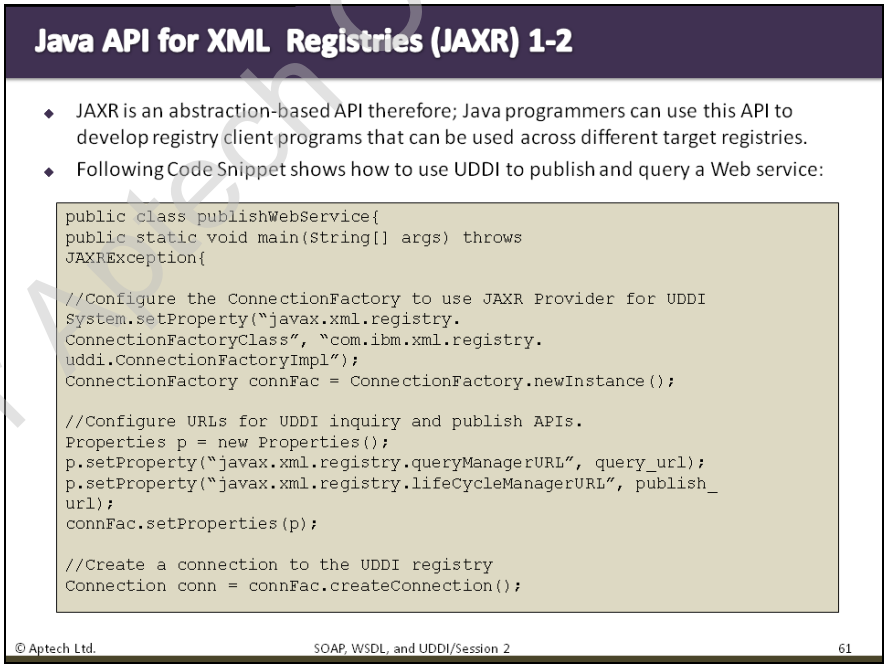
Slide 60

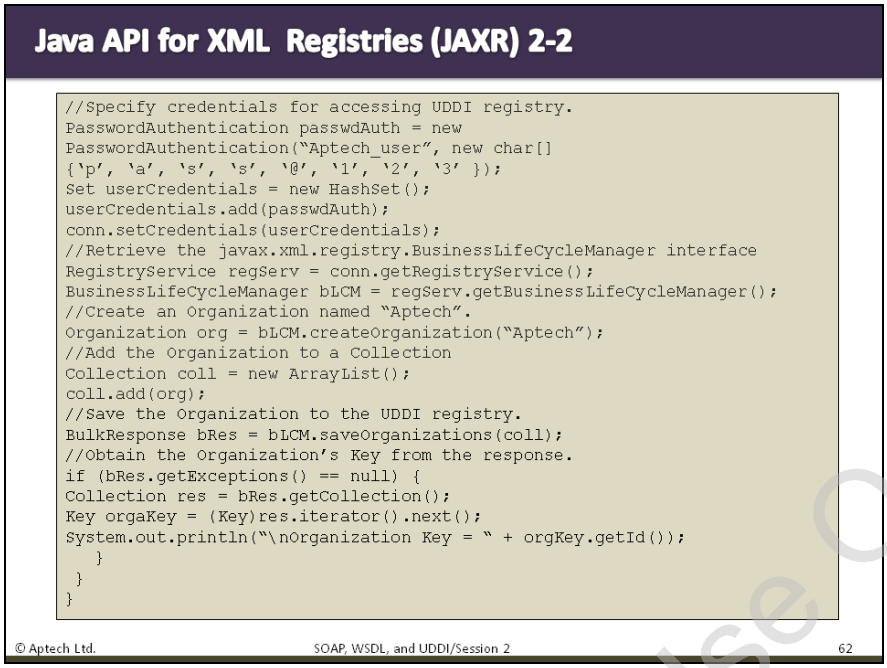


Using slide 60, explain the components of ebXML architecture, which are, Core Components and the Messaging Service. Explain how ebXML supports re-usability. Also, explain about ebXML Messaging Service.

Java API for XML Registries (JAXR)

Slides 61 and 62

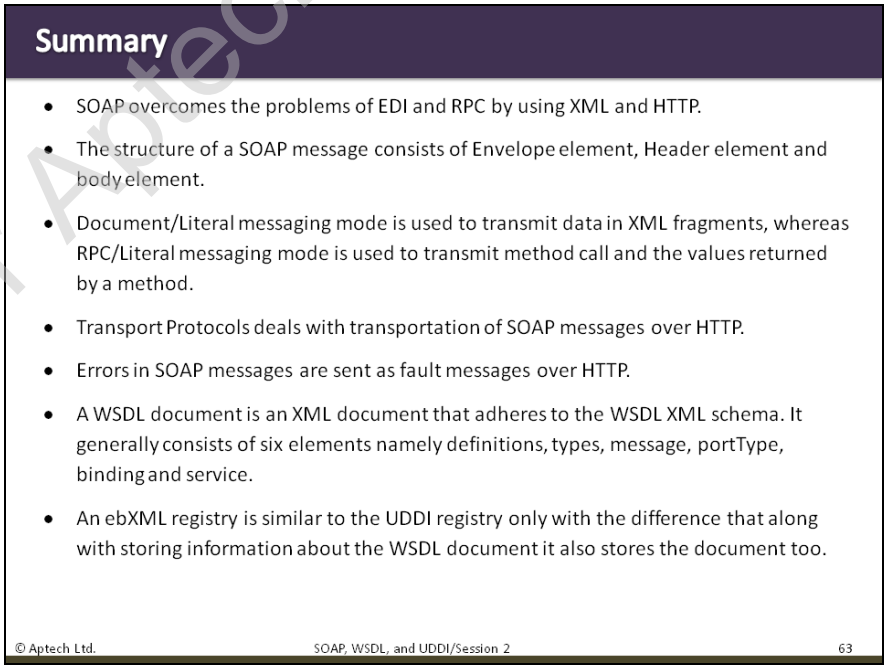




Use slides 61 and 62, explain about Java API for accessing XML registries.
Point out that JAXR has a unified JAXR information model that describes data and metadata in the registries. Explain how JAXR helps Java programmers. Also, explain about JAXR metadata. Point out that JAXR works well with JAXP, JAX-WS, and JAXM to enable Web services in Java EE7.

Then, explain the Code Snippet which shows how to use UDDI to publish and query a Web service.

Summarize Session
Slide 63



Using slide 63, summarize the session. Make them revise the following points:

- SOAP overcomes the problems of EDI and RPC by using XML and HTTP.
- The structure of a SOAP message consists of Envelope element, Header element, and body element.
- Document/Literal messaging mode is used to transmit data in XML fragments, whereas RPC/Literal messaging mode is used to transmit method call and the values returned by a method.
- Transport Protocols deals with transportation of SOAP messages over HTTP.
- Errors in SOAP messages are sent as fault messages over HTTP.
- A WSDL document is an XML document that adheres to the WSDL XML schema. It generally consists of six elements namely, definitions, types, message, portType, binding, and service.
- An ebXML registry is similar to the UDDI registry only with the difference that along with storing information about the WSDL document it also stores the document too.

2.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the next session which describes Web service Endpoints and guidelines to design a Web service endpoint.

Tips: You can also check the **Articles/Blogs/Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

Session 3: Web Service Endpoints

3.1 Pre-Class Activities

You should familiarize yourself with the guidelines to design Web service endpoints. You should know the guidelines to design a Web service. You should be well-versed with Web service annotations. You should also be able to explain the method to package and deploy a Web service. You should also know thoroughly the process of invoking a Web service.

Familiarize yourself with the topics of the current session in-depth.

3.1.1 Objectives

After the session, learners will be able to:

- Explain the guidelines to design Web service endpoints
- Describe the method to package and deploy a Web service
- Explain the process of invoking Web service

3.1.2 Teaching Skills

To teach this session, you should be well versed with Web Service Endpoints, deploying a Web service, and the process of invoking a Web service. You should teach the concepts in the theory class using the images provided. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

3.1.3 In-Class Activities:

Follow the order given here during In-Class activities.

Review of Previous Session

You should begin with a brief recap or review of previous session. You should summarize the concepts of SOAP, WSDL, and UDDI along with their purpose and advantages that were discussed in the previous session.

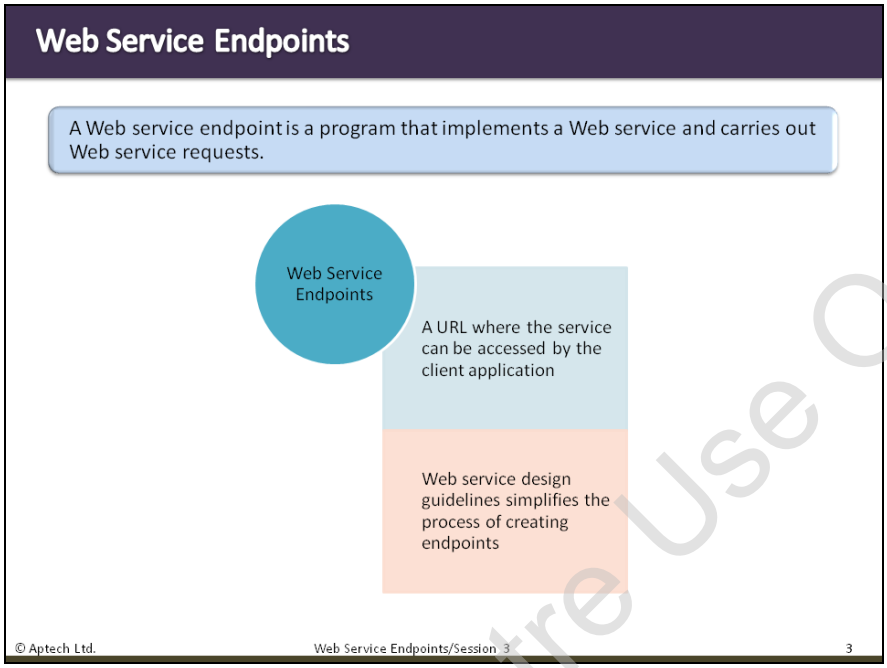
Overview of the Session

Then, give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session explains Web Service Endpoints in detail. Tell them that this session also explains the methods to deploy the Web service and the process of invoking Web service.

3.2 In-Class Explanations

Web Service Endpoints

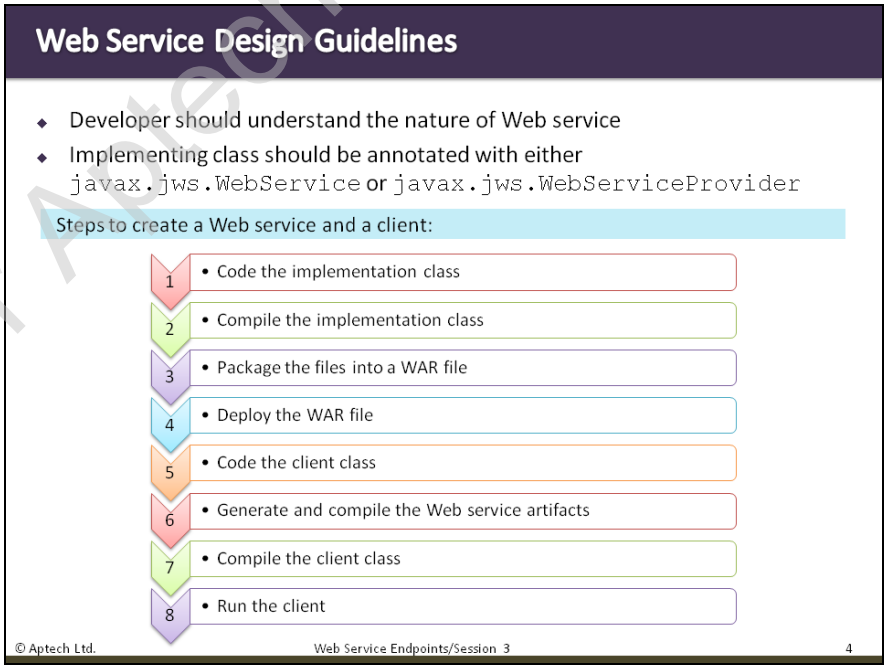
Slide 3



Using slide 3, explain a Web service endpoint. List the guidelines a developer has to consider while designing the Web service. Tell that Web service design guidelines simplify the creation of Web service endpoints.

Web Service Design Guidelines

Slide 4

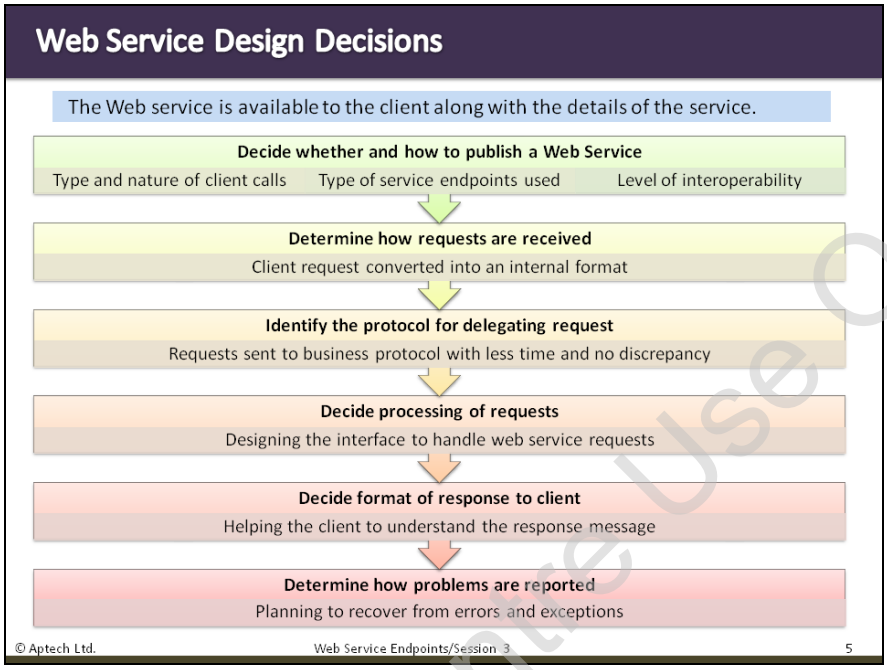


Using slide 4, explain the steps to create a Web service and a client. Explain that first the developer has to understand the nature of the service and the implementation class has to

be annotated with `javax.jws.WebService` or the `javax.jws.WebServiceProvider` annotation. Then, proceed to explain the various steps to create a Web service and a client.

Web Service Design Decisions

Slide 5



Using slide 5, explain briefly how the Web service is made available to the client. Then, explain the different steps to decide the design of the Web service. Discuss the various factors on which the interface of the Web service depends. Explain about the importance of handling exceptions and errors and the need for a recovery plan.

In-Class Question:

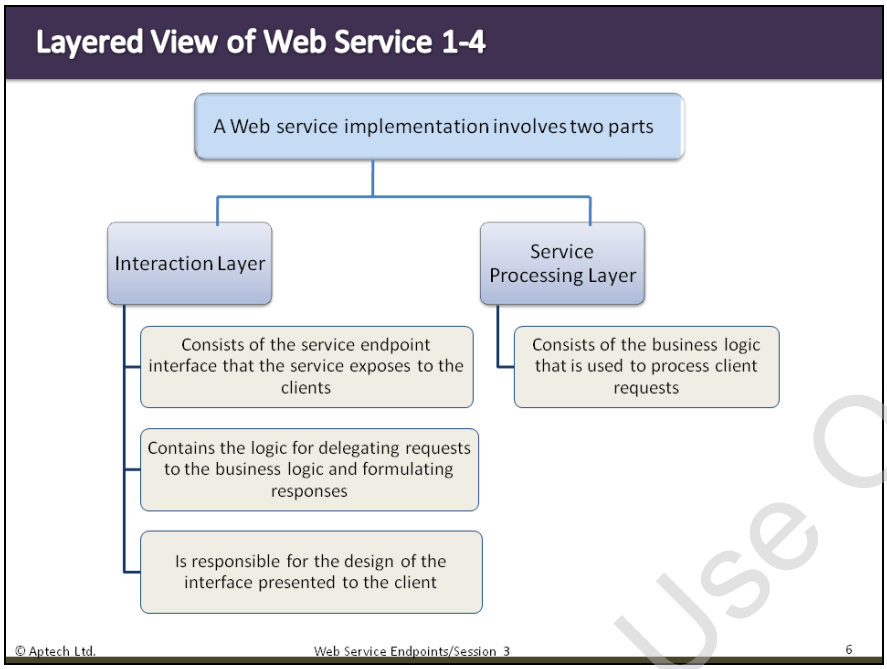
What is a Web service endpoint?

Answer:

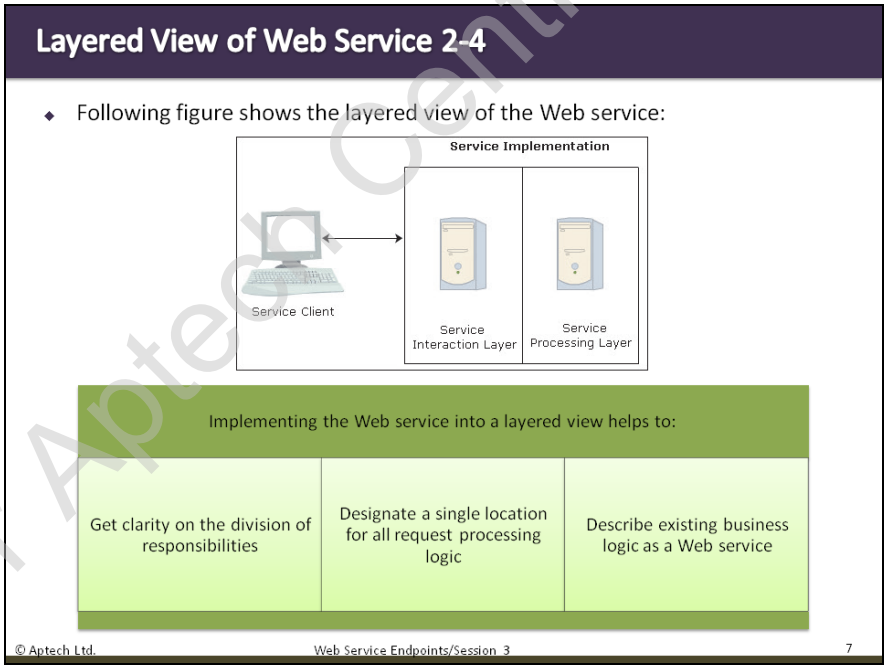
A Web service endpoint is a program that implements a Web service and carries out Web service requests.

Layered View of Web Service

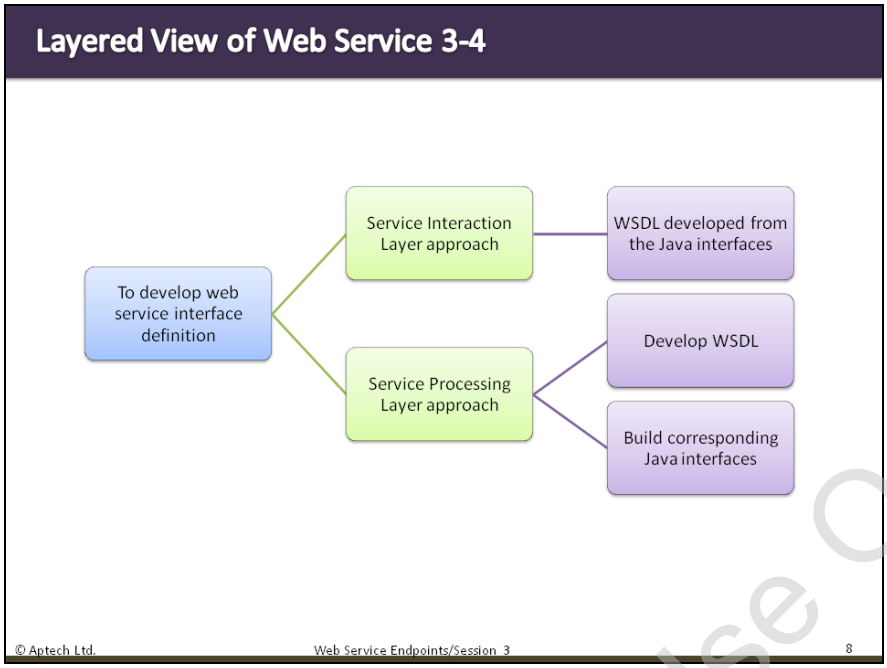
Slides 6 to 9



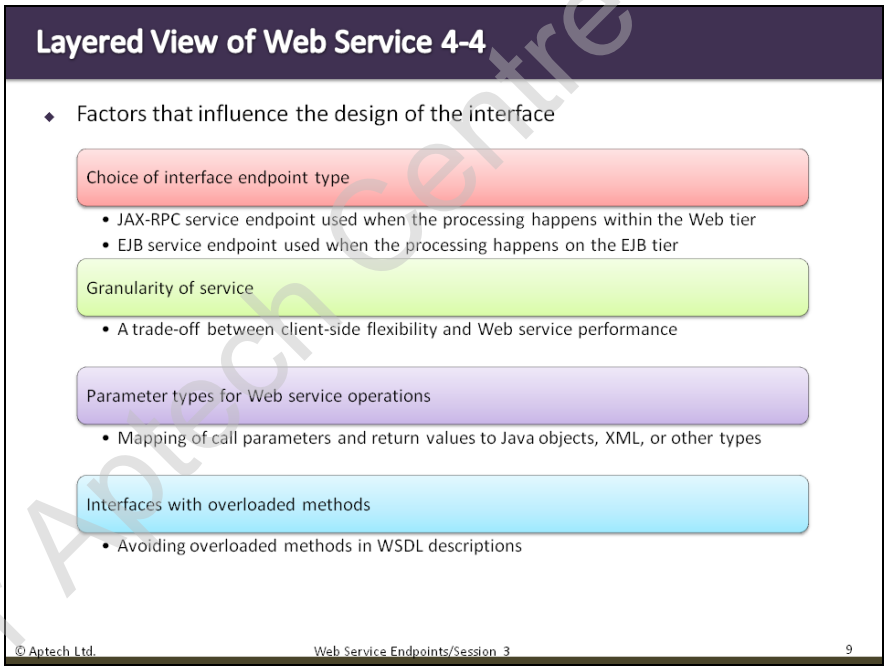
Using slide 6, discuss about the two parts that are involved in the Web service implementation. Explain the benefits of implementing the Web service into a layered view.



Using slide 7, explain the figure that shows the layered view of the Web service. Using the figure, explain how the Service clients interact with Service Interaction Layer and Service Processing Layer.



Using slide 8, discuss how Web service interface definition can be developed using Service Interaction Layer approach or Service Processing Layer approach.



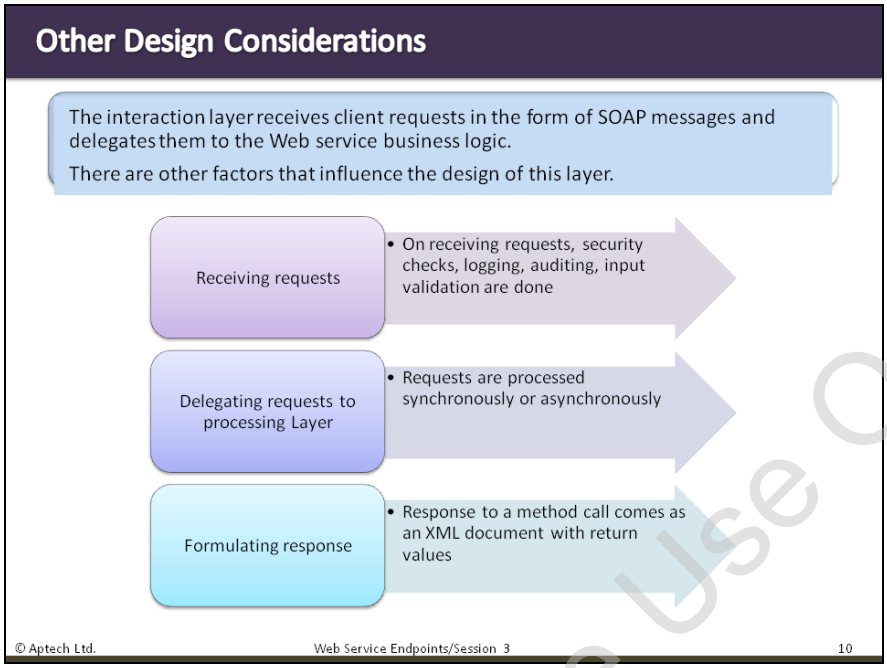
Using slide 9, explain the factors that influence the design of the interface.

In-Class Question:

What are the two layers involved in the implementation of Web service?

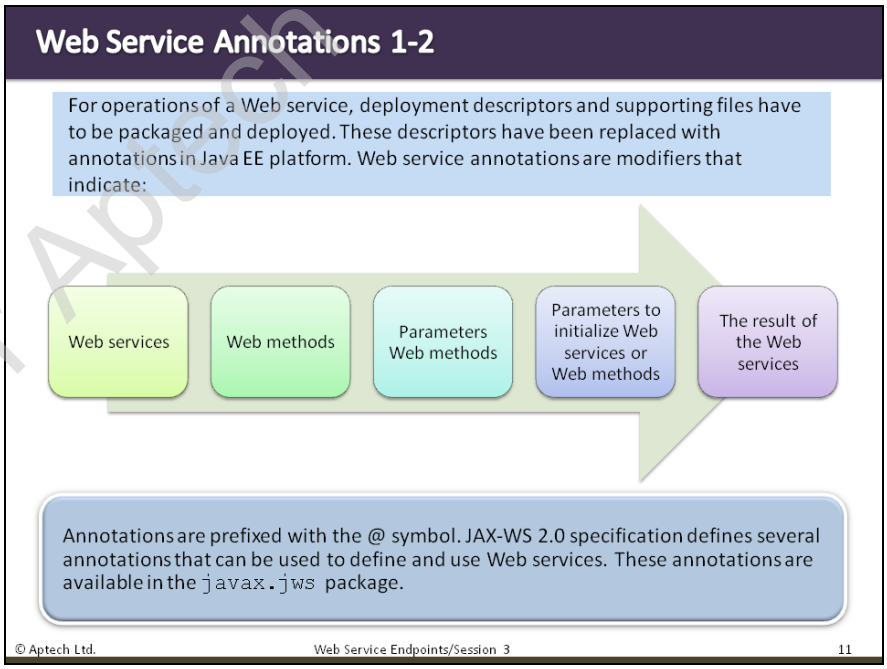
Answer:
Service Interaction Layer and Service Processing Layer.

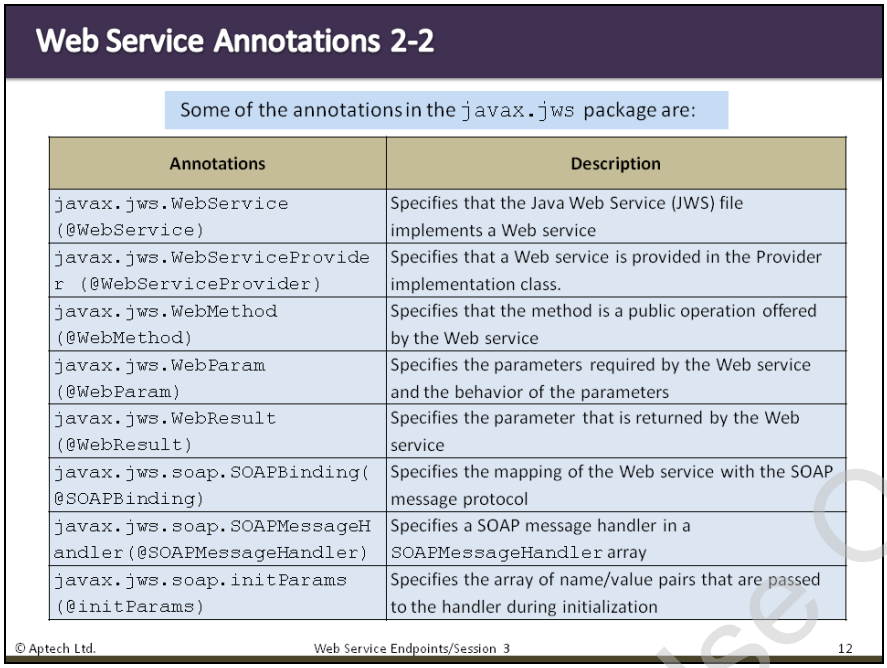
Other Design Considerations
Slide 10



Using slide 10, explain that the interaction layer receives client requests in the form of SOAP messages. Describe how the interaction layer delegates the messages to the Web service business logic. Finally, explain the other factors that influence the design of the service interaction layer.

Web Service Annotations
Slides 11 and 12





Using slides 11 and 12, explain how the Web service becomes available to clients. Explain that the different files needed for operating a Web service including deployment descriptors are packaged into archive files before deployment. Explain that the deployment descriptors used in J2EE 1.4 are replaced by annotations in Java EE platform. Describe the Web service annotations. Then, proceed to explain about the annotations in the javax.jws package.

In-Class Question:

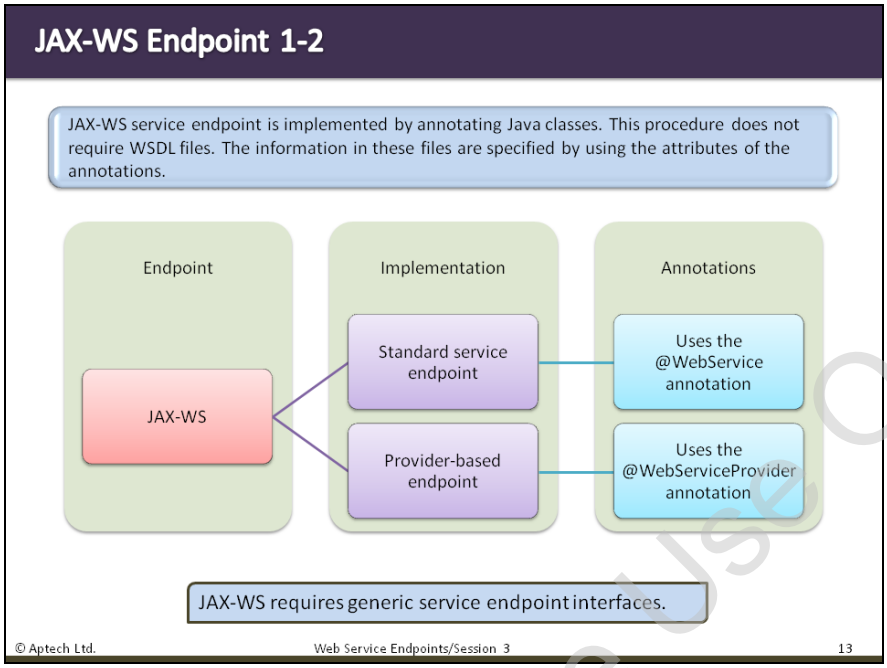

Name the Web service annotation that specifies that the Java Web Service (JWS) file implements a Web service.

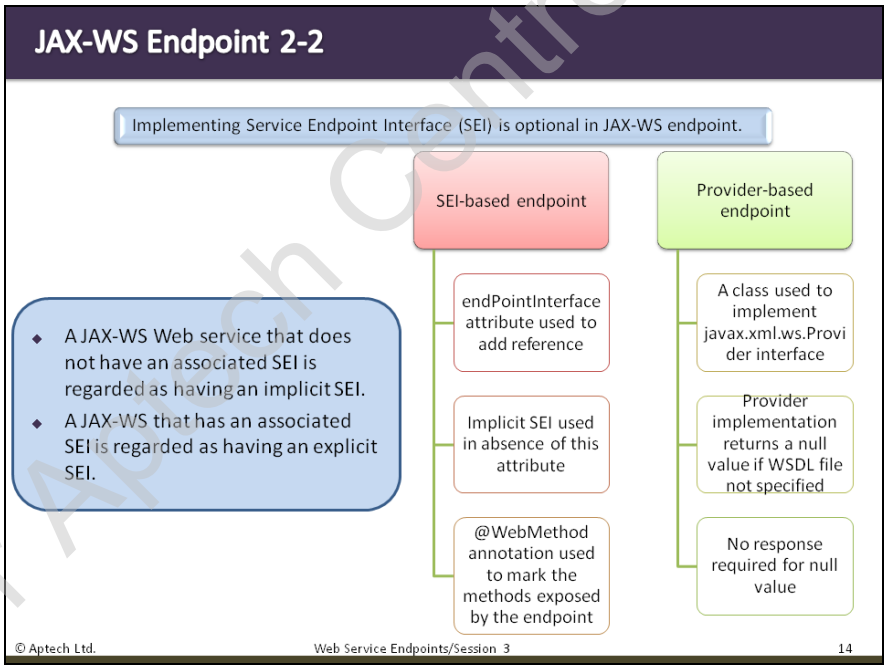
Answer:

The javax.jws.WebService (@WebService) annotation is used to specify that the Java Web Service (JWS) file implements a Web service. This annotation has five optional attributes namely, name, targetNamespace, serviceName, wsdlLocation, and endpointInterface.

JAX-WS Endpoint

Slides 13 and 14



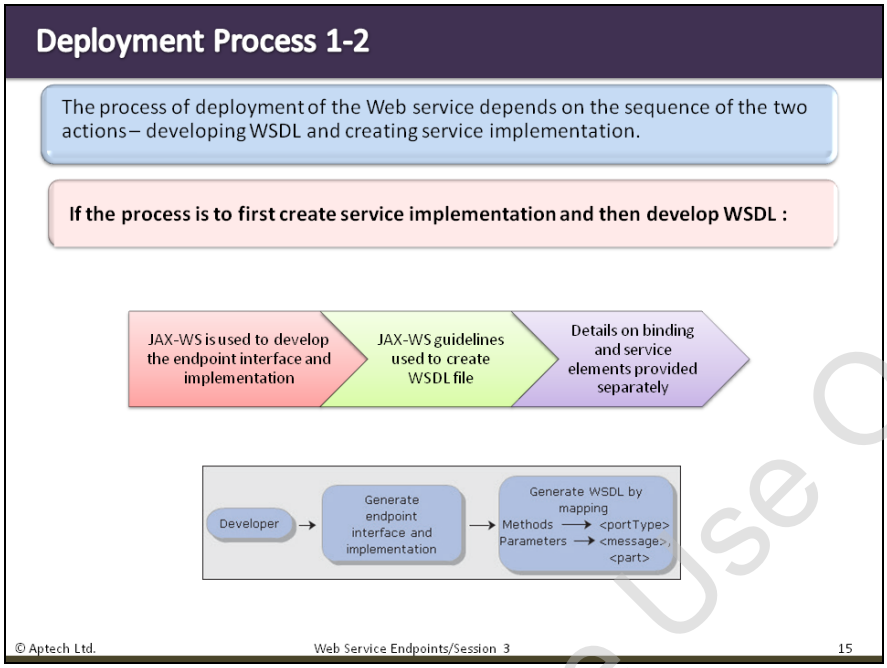


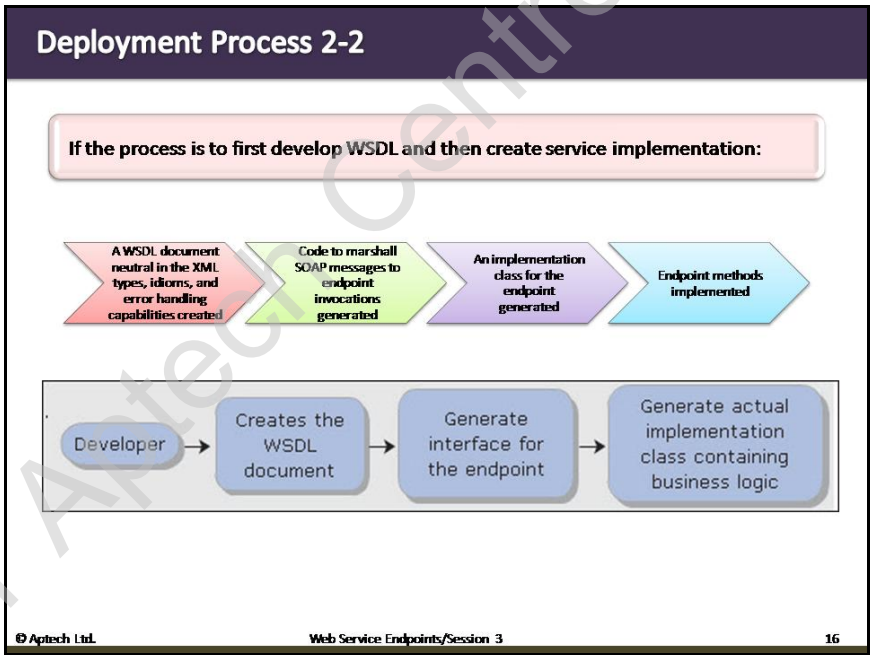
Using slides 13 and 14, explain that in JAX-WS, the basis for implementing an endpoint is the standard service endpoint or a provider-based endpoint that uses the @WebServiceProvider annotation. Describe the association of a Service Endpoint Interface (SEI) with JAX-WS. Explain the reason for considering a JAX-WS as an implicit or an explicit Service Endpoint Interface (SEI). Explain the method to annotate a Java class when developing a JAX-WS Web service.

Also, explain the process to use endPointInterface attribute while creating a SEI-based endpoint. Finally, explain the points to consider while creating a Provider-based endpoint.

Deployment Process

Slides 15 and 16

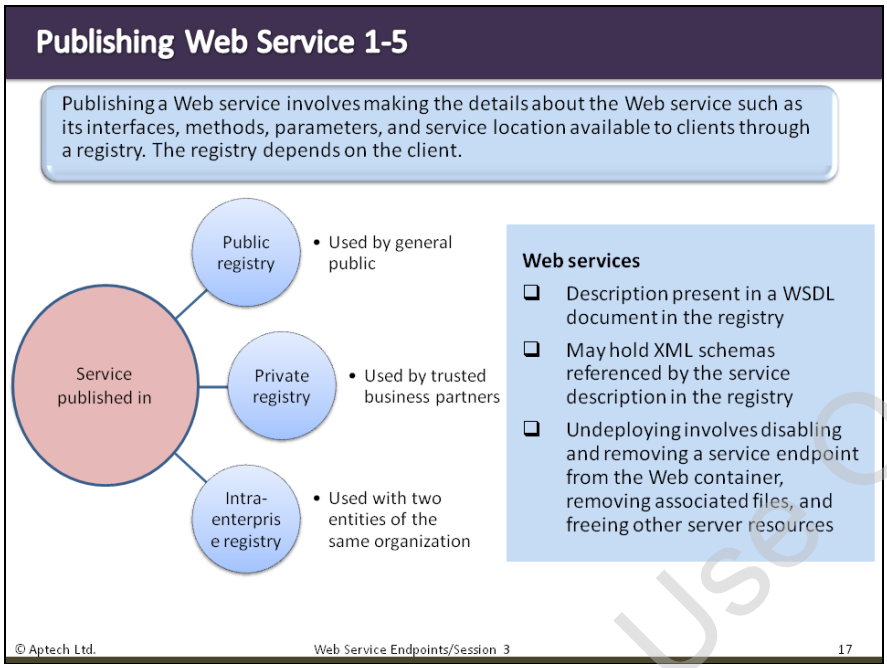




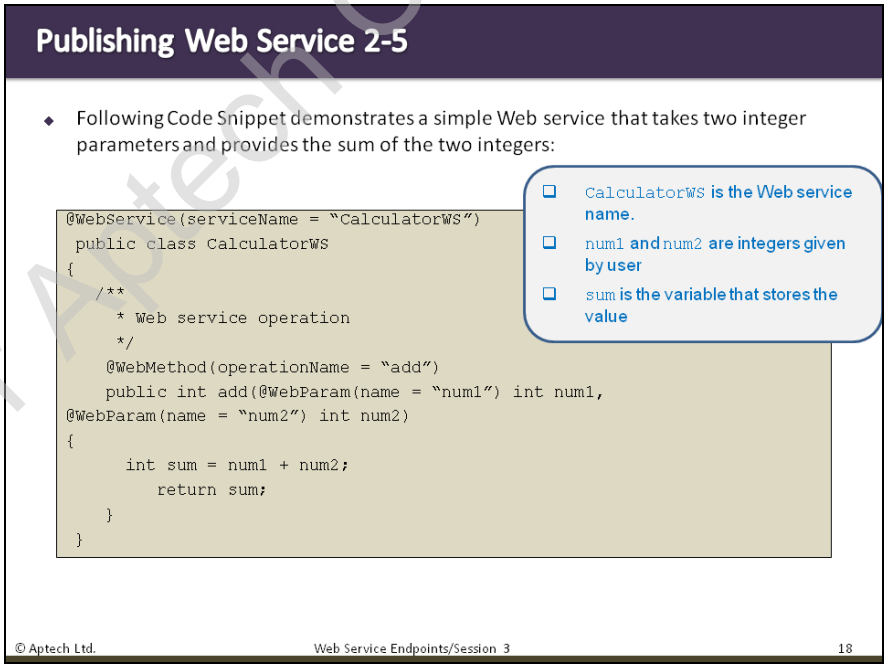
Using slides 15 and 16, explain the factors on which the process of deployment of the Web service depends. Describe the different approaches in which a Web service can be created. Then, explain how the process of deployment is different for each of the approaches. Explain the steps to create the service implementation and then develop WSDL. Further, explain the steps to develop the WSDL and then create service implementation.

Publishing Web Service

Slides 17 to 21



Using slide 17, describe the registries in which a Web service is published. Mention that Web services published on registries can be used by the general public, trusted business partners, or just two entities within the same organization. Explain the factors that are involved in publishing a Web service. Mention that description about the Web service is made available in the WSDL document which is published in the registry. Then, explain about undeploying a Web service.



Publishing Web Service 3-5

- Following Code Snippet demonstrates the WSDL file of the CalculatorWS Web service:

```
This XML file does not appear to have any style information associated
with it. The document tree is shown here.
<!–
 Published by JAX-WS RI at http://jax-ws.dev.java.net. RI's version is
Metro/2.3 (tags/2.3-7528; 2013-04-29T19:34:10+0000) JAXWS- RI/2.2.8
JAXWS/2.2 svn-revision#unknown.
 –->
 <!–
 Generated by JAX-WS RI at http://jax-ws.dev.java.net. RI's version is
Metro/2.3 (tags/2.3-7528; 2013-04-29T19:34:10+0000) JAXWS- RI/2.2.8
JAXWS/2.2 svn-revision#unknown.
 –->
<definitions xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/ oasis-
200401-wss-wssecurity-utility-1.0.xsd"xmlns:wsp="http:// www.w3.org/ns/ws-
policy" xmlns:wsp1_2="http://schemas.xmlsoap.
org/ws/2004/09/policy"xmlns:wsam="http://www.w3.org/2007/05/
addressing/metadata" xmlns:soap="http://schemas.xmlsoap.org/
wsdl/soap/"xmlns:tns="http://DJWS.com/" xmlns:xsd="http://
www.w3.org/2001/XMLSchema" xmlns="http://schemas.xmlsoap.org/
wsdl/"targetNamespace="http://DJWS.com/" name="CalculatorWS">
<types>
<xsd:schema>
 <xsd:import namespace="http://DJWS.com/" schemaLocation="
 http://localhost:8080/CalculatorWS/CalculatorWS?xsd=1"/>
 </xsd:schema>
 </types>
```


Publishing Web Service 4-5

```
<message name="add">
 <part name="parameters" element="tns:add"/>
 </message>
 <message name="addResponse">
 <part name="parameters" element="tns:addResponse"/>
 </message>
<portType name="CalculatorWS">
 <operation name="add">
 <input wsam:Action="http://DJWS.com/CalculatorWS/
 addRequest" message="tns:add"/>
 <output wsam:Action="http://DJWS.com/CalculatorWS/
 addResponse" message="tns:addResponse"/>
 </operation>
</portType>
<binding name="CalculatorWSPortBinding" type="tns:CalculatorWS">
<soap:binding transport="http://schemas.xmlsoap.org/soap/http"
style="document"/>
```

- message element defines the messages mapped to the method invocation
- portType element maps the add operation of the Web service to the input and output endpoints
- binding element defines the protocols and data formats for the messages and the operations

Using slides 18 to 21, explain the Code Snippet that demonstrates a simple Web service called 'CalculatorWS' with a Web method named `add()`. Explain the code line by line to show that the method returns the sum of two integers when two integer parameters are passed. Explain the Code Snippet that shows how the WSDL document defines the name of the Web service as CalculatorWS. Explain further to show how the service element is used to map the binding to the port.

In-Class Question:

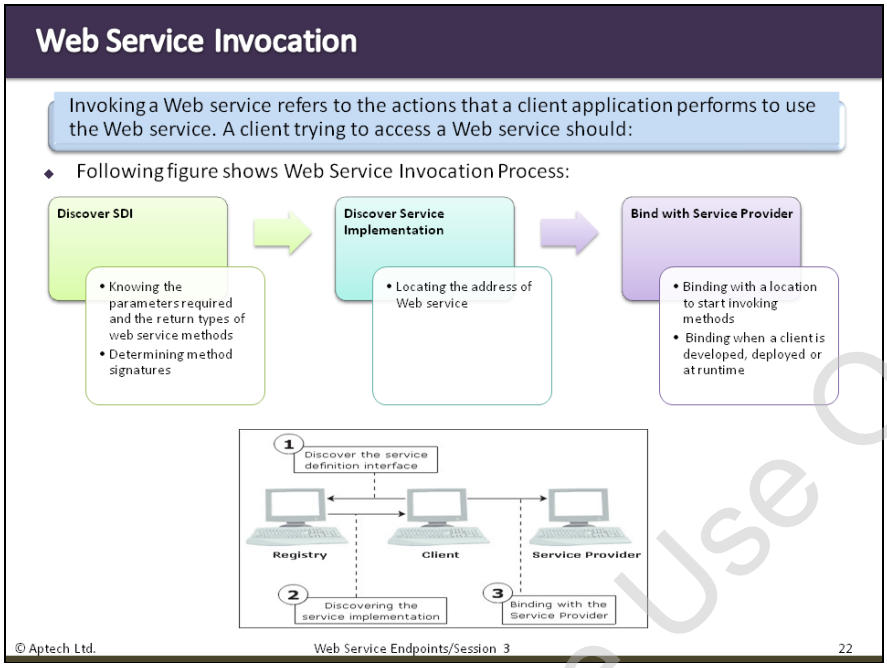

Name the three registries in which a Web service can be published.

Answer:

Depending on the intended clientele for the Web service, the service is published on either a public registry, private registry (inter-enterprise registry), or an intra-enterprise registry.

Web Service Invocation

Slide 22



Using slide 22, explain Metadata Annotations of JAX-WS. Describe the annotations that are present in the `javax.jws` package. Discuss the process for invoking a Web service. Explain the steps a client must perform while trying to access a Web service. Explain the figure that shows the Web service invocation process. Explain how the client discovers the service definition interface and then process of discovering the service implementation, and finally the binding of the client with the service provider.

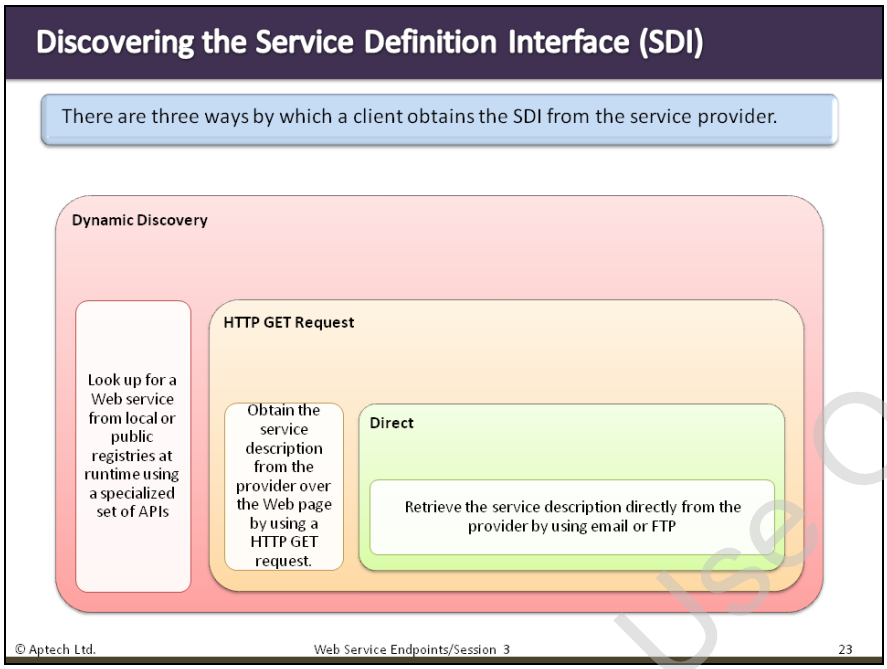
What is Web Service Invocation?

Answer:

Invoking a Web service refers to the actions that a client application performs to use the Web service.

Discovering the Service Definition Interface

Slides 23

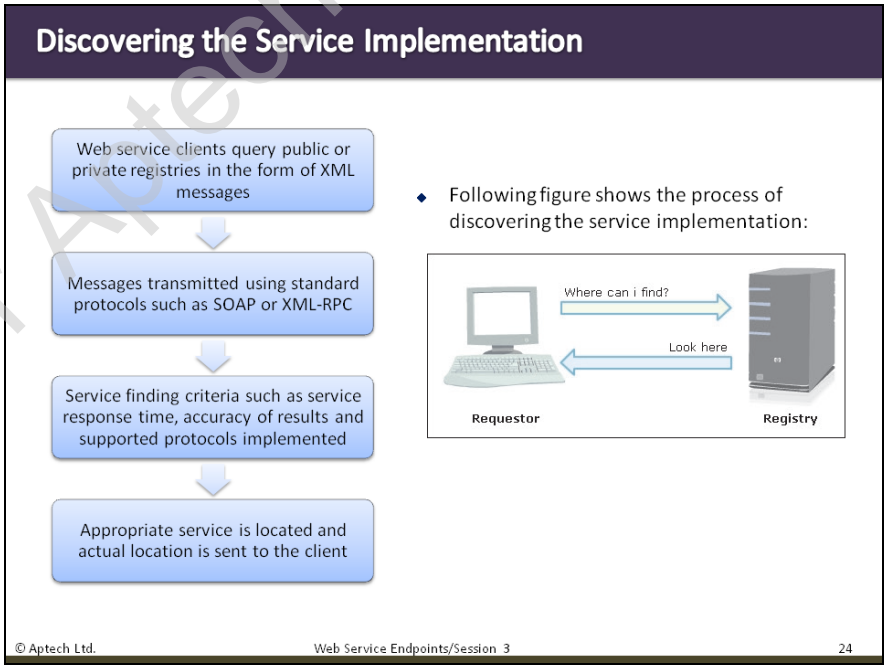


Using slide 23, explain the three ways by which a client obtains the SDI from the service provider, which are as follows:

- Direct
- HTTP GET Request
- Dynamic Discovery

Discovering the Service Implementation

Slide 24

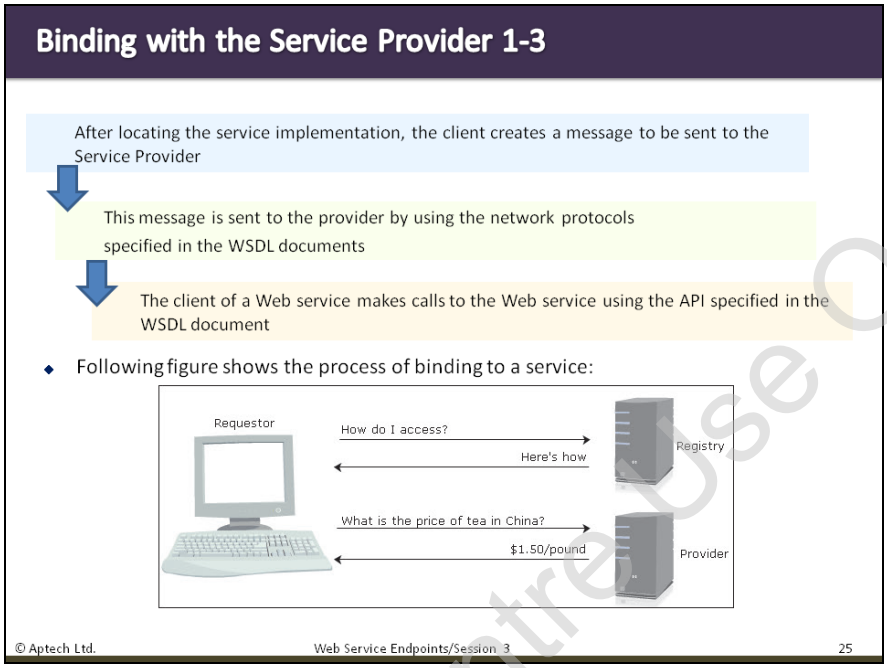


Using slide 24, explain how the Web service clients query public or private registries. Explain the common criteria used to find a service. Describe how the actual service implementation

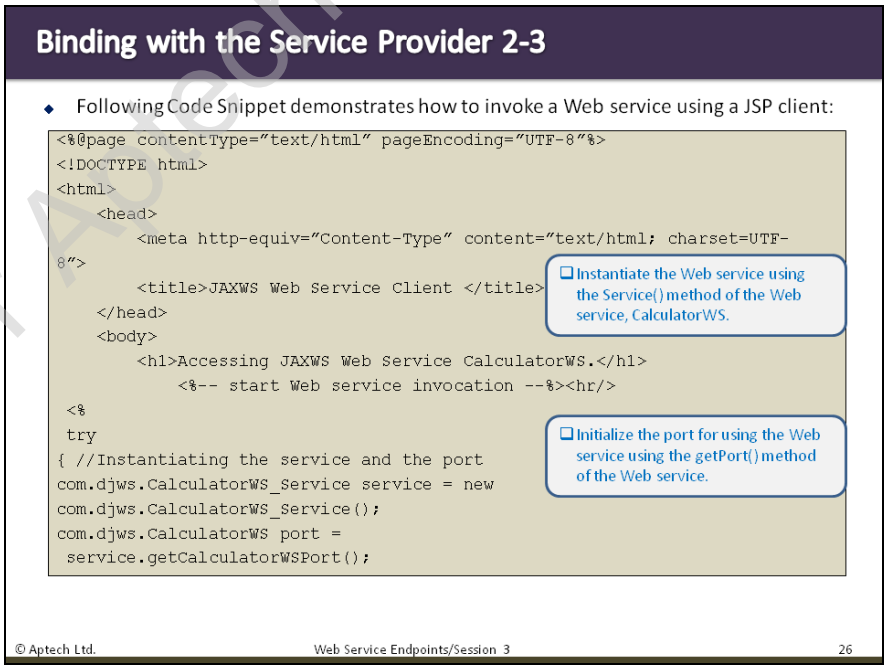
is obtained by the service requestor. Using the figure, describe the process of discovering the service implementation between the requestor and the registry.

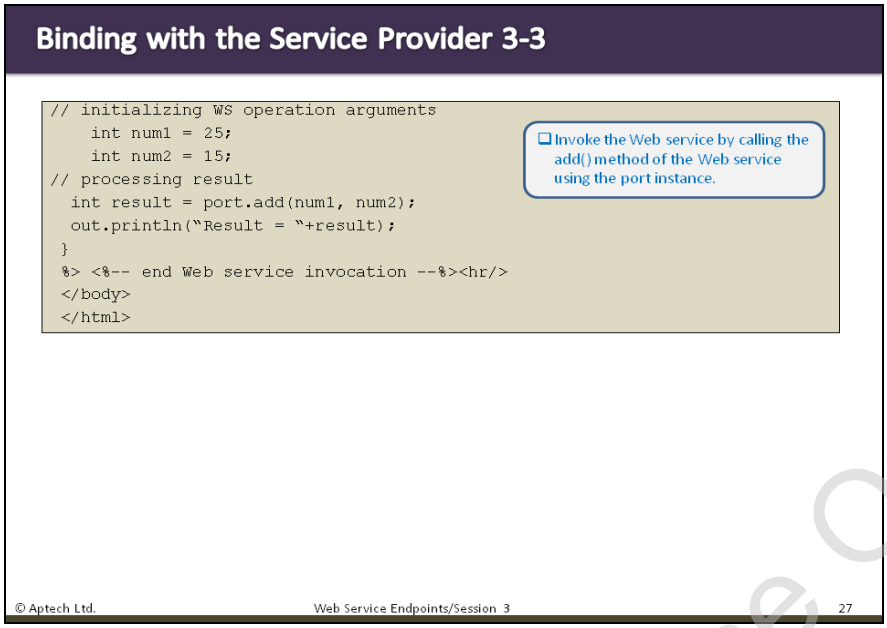
Binding with the Service Provider

Slides 25 to 27



Using slide 25, explain how the client creates a message, which is sent to the provider by using the network protocols as given in WSDL documents and how the client makes calls to the Web service. Then, proceed to explain the process of binding to a service using the figure.

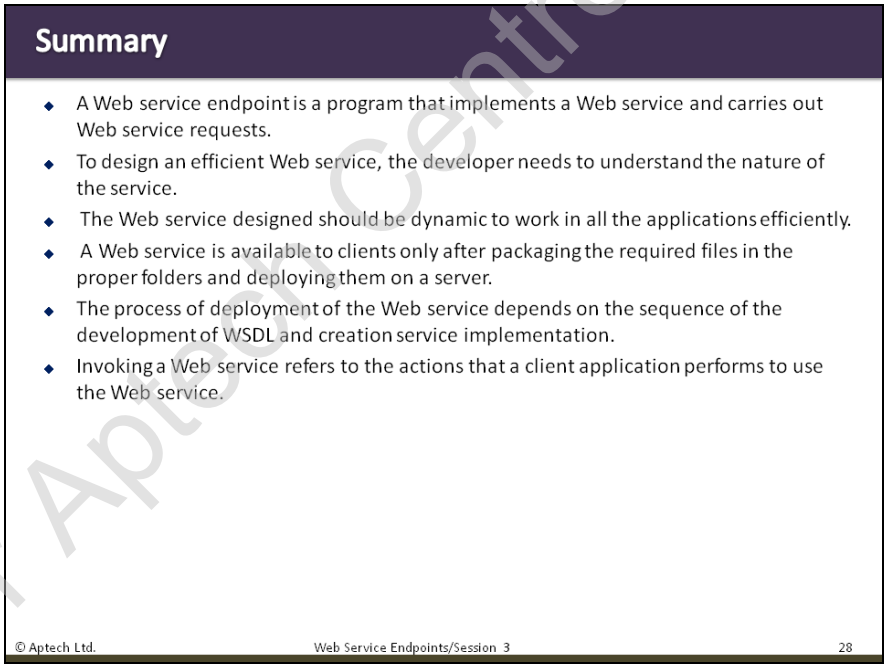




Using slides 26 and 27, explain the Code Snippet that demonstrate how to invoke a Web service using a JSP client.

Summarize Session

Slide 28



Using slide 28, summarize the session. Make them revise the following points:

- A Web service endpoint is a program that implements a Web service and carries out Web service requests.
- To design an efficient Web service, the developer needs to understand the nature of the service.
- The Web service designed should be dynamic to work in all the applications efficiently.
- A Web service is available to clients only after packaging the required files in the

proper folders and deploying them on a server.

- The process of deployment of the Web service depends on the sequence of the development of WSDL and creation service implementation.
- Invoking a Web service refers to the actions that a client application performs to use the Web service.

3.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the next session which describes Designing Web Service Clients.

Tips: You can also check the **Articles**/**Blogs**/**Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

Session 4: Designing Web Services Clients

4.1 Pre-Class Activities

You should familiarize yourself with the concepts of designing Web service clients. You should know the different Modes of Communication. You should also know how to locate and access the Web services. Further, you should know how to handle Web service exceptions. Familiarize yourself with the topics of the current session in-depth.

4.1.1 Objectives

After the session, learners will be able to:

- Explain Web Service Clients
- Describe the Modes of Communication
- Explain how to Locate and Access the Web Services
- Explain how to handle Web Service Exceptions

4.1.2 Teaching Skills

To teach this session, you should be well versed with Web service clients. You should have knowledge about Dynamic client and Standalone client through which users access a Web service. You must be familiar with the features and modes of communication of Dynamic Proxy Clients, DII, Standalone Clients, and Web Tier Clients. You should be able to demonstrate how to locate and access a Web service. Further, you should be able to teach them how to handle the different Web service exceptions. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

4.1.3 In-Class Activities:

Follow the order given here during In-Class activities.

Review of Previous Session

You should begin with a brief recap or review of previous session. You should summarize the creation of Web service endpoints and the process of packaging, deploying, and invoking a Web service.

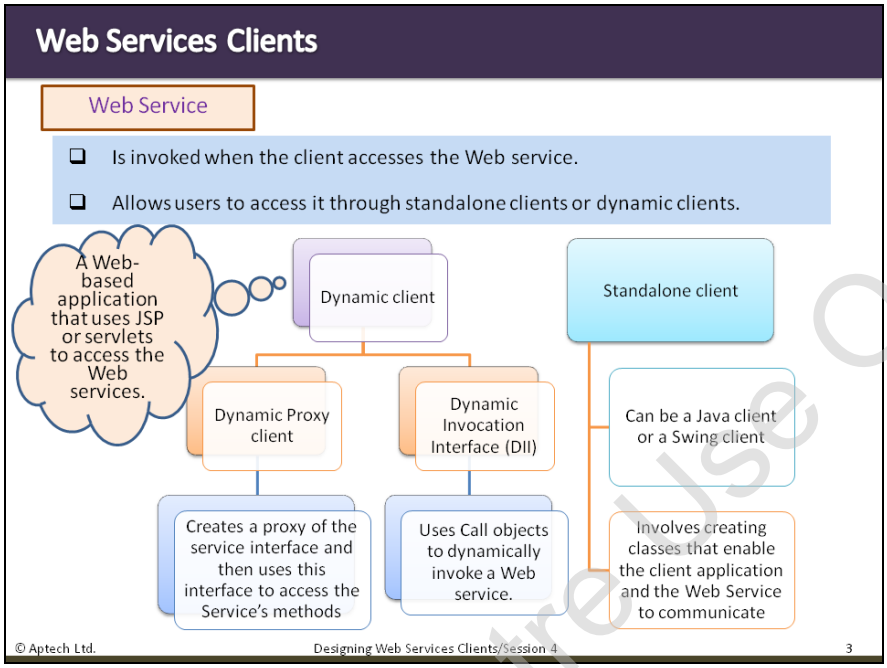
Overview of the Session

Then, give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session explains about the Web service clients. The session describes the various modes of communication that enables the client application and the Web service to communicate. Tell them that the session explains the process of locating and accessing the Web service. Further, the session explains the method to handle Web service endpoints.

4.2 In-Class Explanations

Web Service Clients

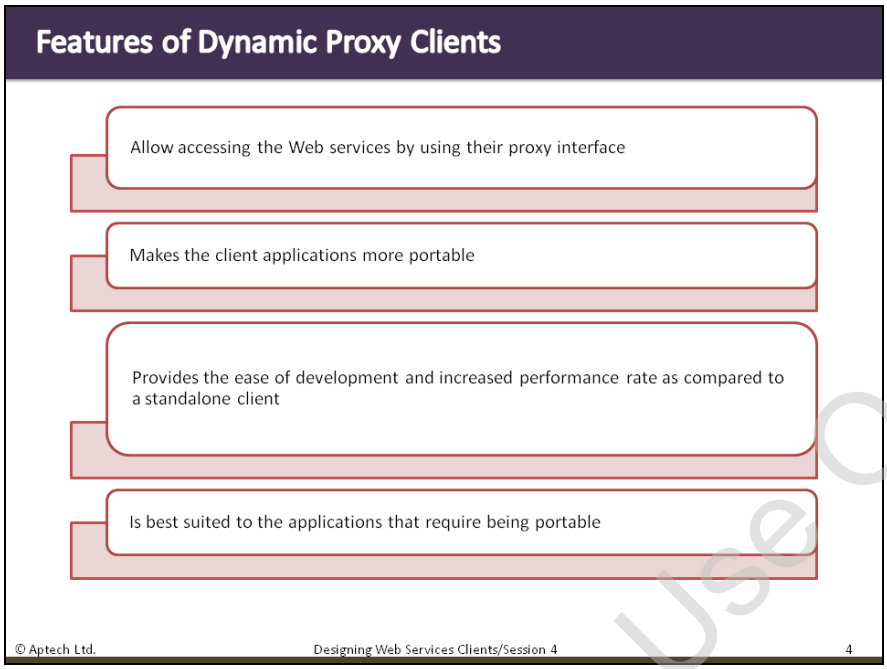
Slide 3



Using slide 3, explain how to invoke and access a Web service. Explain about Dynamic client and its types, namely, Dynamic Proxy client, and Dynamic Invocation Interface (DII). Also, list the types of Standalone clients and its features.

Features of Dynamic Proxy Clients

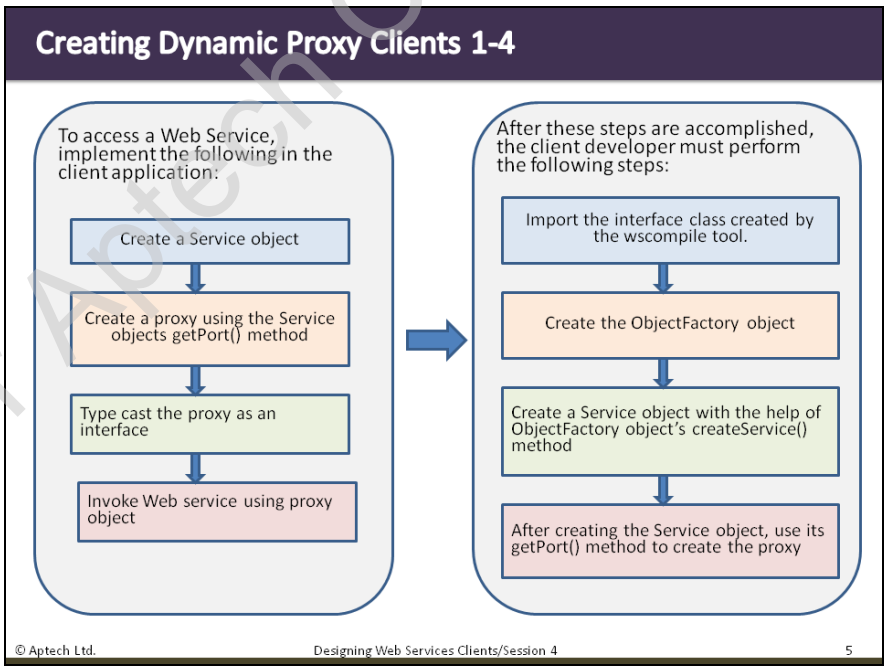
Slide 4



Using slide 4, explain the features of Dynamic Proxy Clients. Explain how proxy interface is better than standalone clients to access Web services. Finally, explain the reason for suitability of Dynamic Proxy for applications.

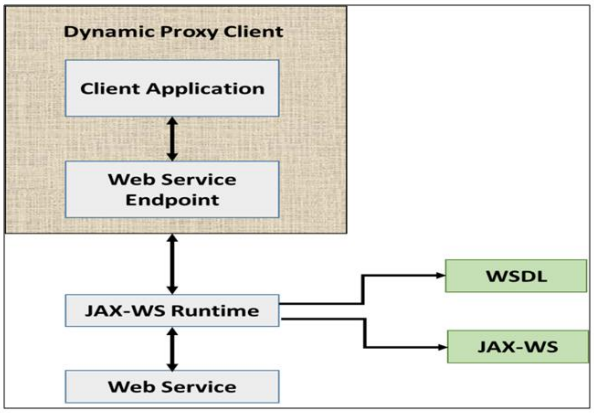
Creating Dynamic Proxy Clients

Slides 5 to 8



Creating Dynamic Proxy Clients 2-4

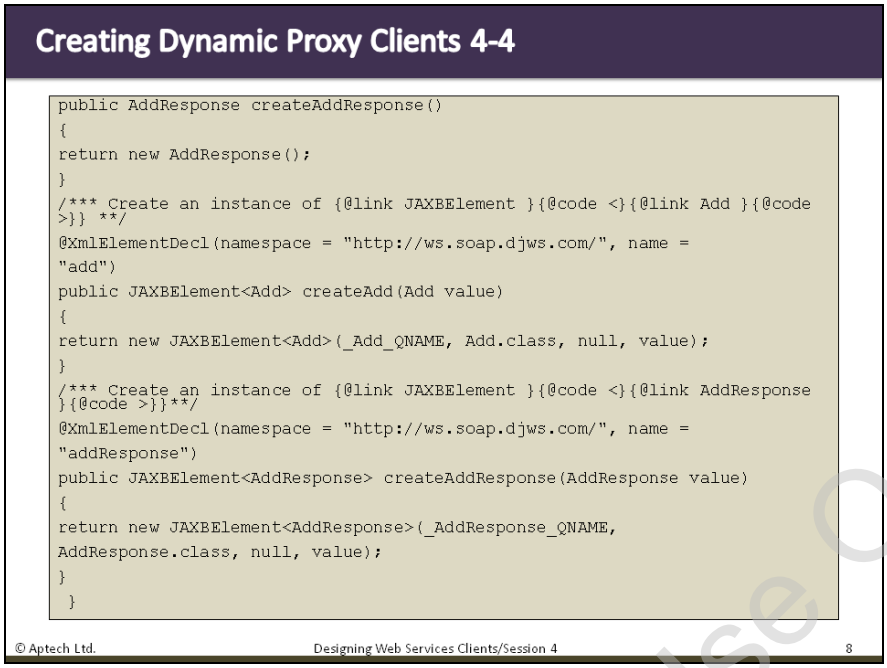
- Following figure shows the use of Dynamic Proxy Client:



Creating Dynamic Proxy Clients 3-4

- Following Code Snippet demonstrates the use of ObjectFactory object:

```
@XmlRegistry
public class ObjectFactory
{
private final static QName _Add_QNAME = new
QName("http://ws.soap.djws.com/", "add");
private final static QName _AddResponse_QNAME = new
QName("http://ws.soap.djws.com/", "addResponse");

/*** Create a new ObjectFactory that can be used to create new instances
of schema derived classes for package: com.djws.soap.ws **/
public ObjectFactory()
{
}
/*** Create an instance of {@link Add } **/
public Add createAdd()
{
return new Add();
}
 /*** Create an instance of {@link AddResponse } **/
```



Using slides 5 to 8, explain the steps to access a Web service using the Dynamic Proxy approach in the client application. Then, explain the steps to be performed by the client developer.

Using the figure on slide 6, explain how the client uses Dynamic Proxy approach to access a Web service. Using slide 7 and 8, explain the use of `ObjectFactory` class.

In-Class Question:

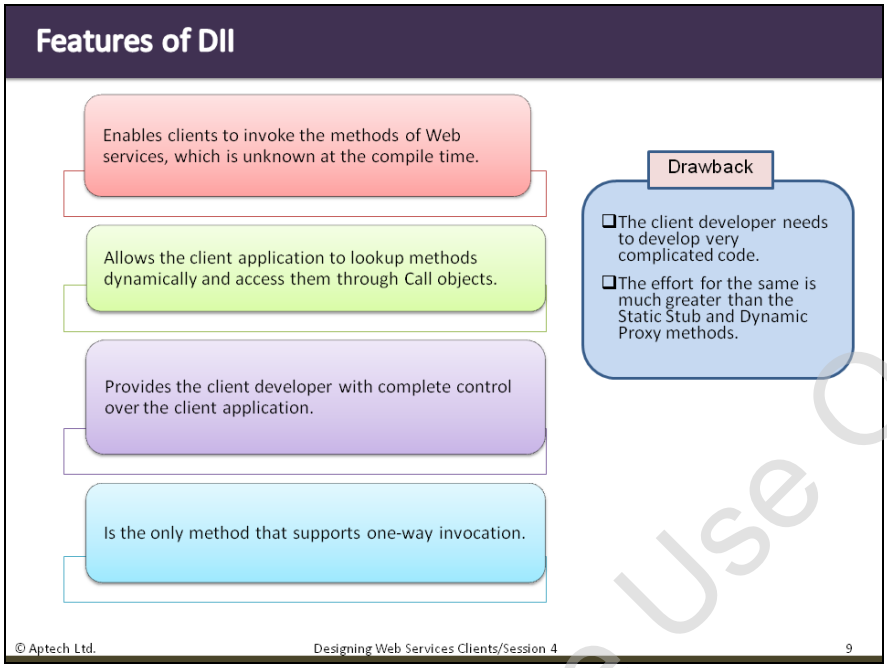

List the steps to access the Web service using Dynamic Proxy approach.

Answer: The steps to access the Web service using Dynamic Proxy approach are as follows:

1. Create a Service object
2. Create a proxy using the Service objects `getPort()` method
3. Type cast the proxy as an interface
4. Invoke Web service using proxy object

Features of DII

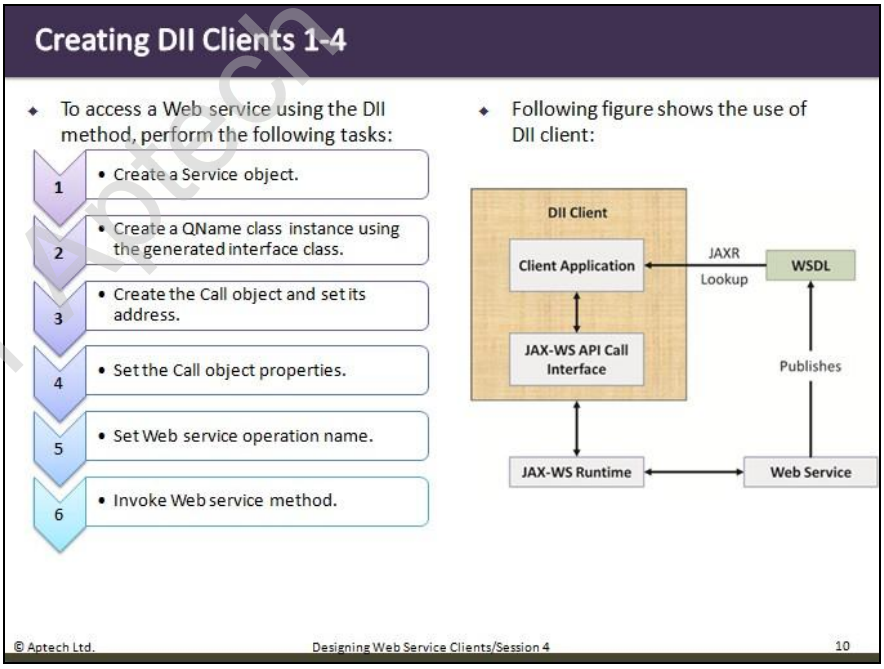
Slide 9



Using slide 9, explain the features of DII Client. Explain about DII methods by highlighting that DII method is the only method that supports one-way invocation. Describe the need for developing highly complicated code by the client developer for DII.

Creating DII Clients

Slides 10 to 13



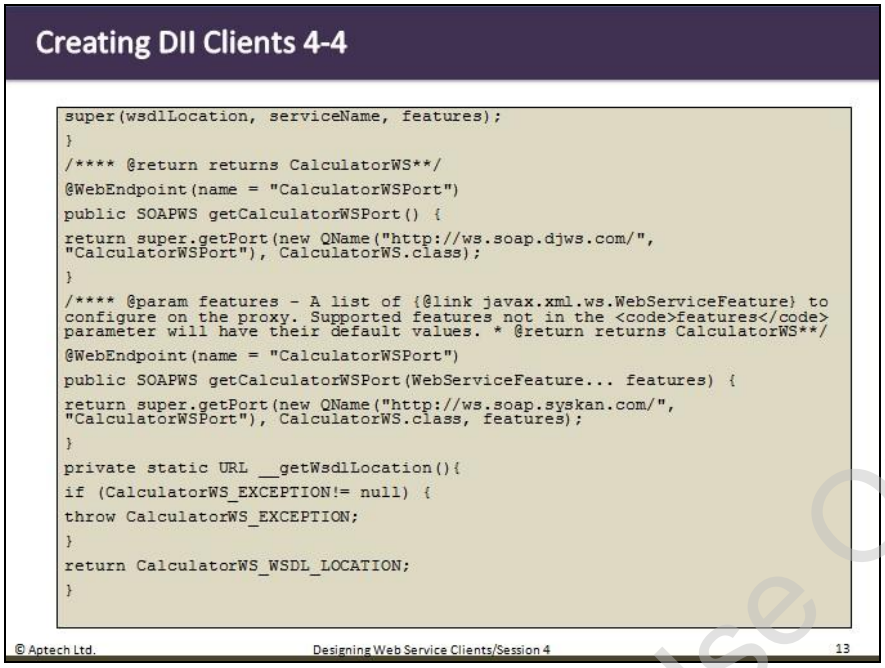
Creating DII Clients 2-4

- Following code snippet shows creation of a DII client:

```
WebServiceClient(name = "CalculatorWS", targetNamespace =
"http://ws.soap.syskan.com/", wsdlLocation =
"http://localhost:8080/SOAPWebService/CalculatorWS?wsdl")

public class CalculatorWS_Service extends Service{

private final static URL CalculatorWS_WSDL_LOCATION;
private final static WebServiceException CalculatorWS_EXCEPTION;
private final static QName CalculatorWS_QNAME = new
QName("http://ws.soap.djws.com/", "CalculatorWS");

static {
URL url = null;
WebServiceException e = null;
try {
  url = new URL("http://localhost:8080/SOAPWebService/CalculatorWS?wsdl");
}
catch (MalformedURLException ex) {
   e = new WebServiceException(ex);
}
```


Creating DII Clients 3-4

```
CalculatorWS_WSDL_LOCATION = url;
CalculatorWS_EXCEPTION = e;
}
public CalculatorWS_Service(){
super(__getWsdlLocation(),CalculatorWS_QNAME);
}
public CalculatorWS_Service(WebServiceFeature... features) {
super(__getWsdlLocation(),CalculatorWS_QNAME, features);
}
public CalculatorWS_Service(URL wsdlLocation) {
super(wsdlLocation, CalculatorWS_QNAME);
}
public CalculatorWS_Service(URL wsdlLocation, WebServiceFeature...
features) {
super(wsdlLocation, CalculatorWS_QNAME, features);
}
public CalculatorWS_Service(URL wsdlLocation, QName serviceName) {
super(wsdlLocation, serviceName);
}
public CalculatorWS_Service(URL wsdlLocation, QName serviceName,
WebServiceFeature... features) {
```

Using slide 10, explain the different tasks to access a Web service using the DII method. The different tasks are listed here:

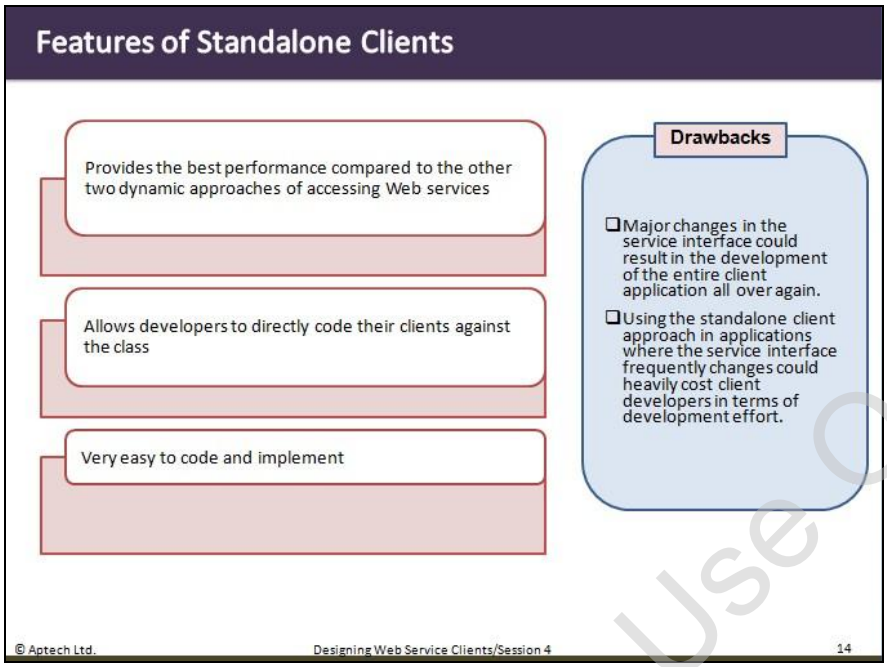
- Create a Service object
- Create a `QName` class instance using the generated interface class
- Create the Call object and set its address
- Set the Call object properties
- Set Web Service operation name
- Invoke Web Service method

Explain the methods to be used, what input parameters are to be given, and what properties are to be set. Explain the use of DII Client using the figure. Explain how WSDL uses JAXR to locate the services.

Using slides 11 to 13, explain the Code Snippet that shows the creation of a DII client.

Features of Standalone Clients

Slide 14



Using slide 14, explain the features of Standalone Client. Also, explain the drawbacks of standalone client.

In-Class Question:

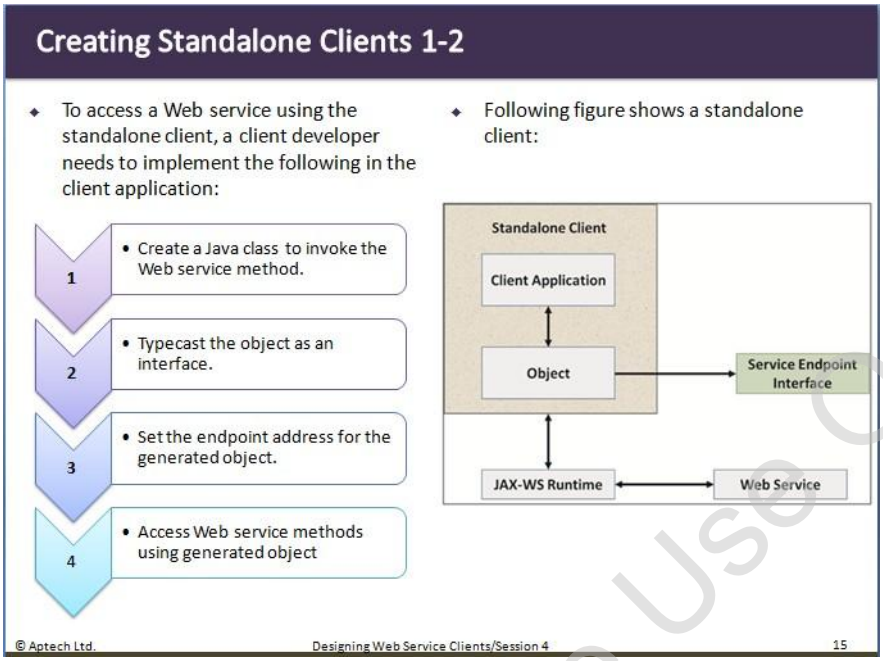
Among Dynamic Proxy Clients, DII Clients, and Standalone Clients, which clients provide the best performance?

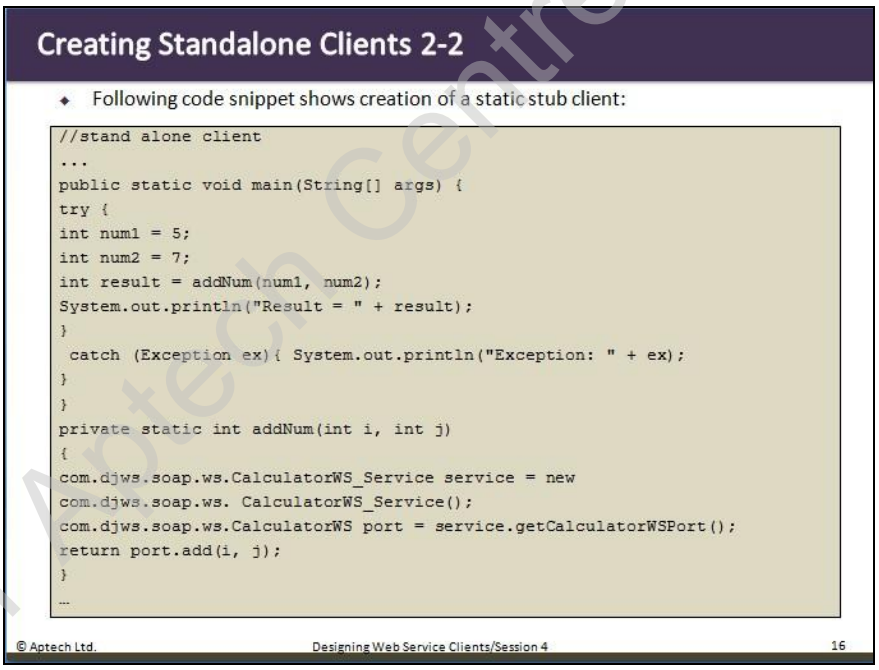
Answer:

Standalone Clients provide the best performance when compared to the other two dynamic approaches of accessing Web Services.

Creating Standalone Clients

Slides 15 and 16

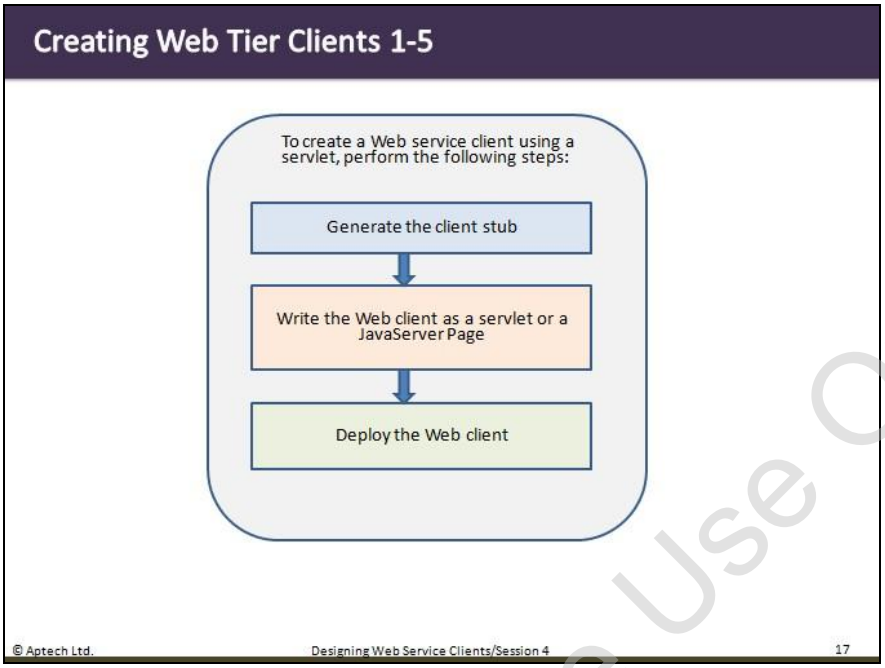




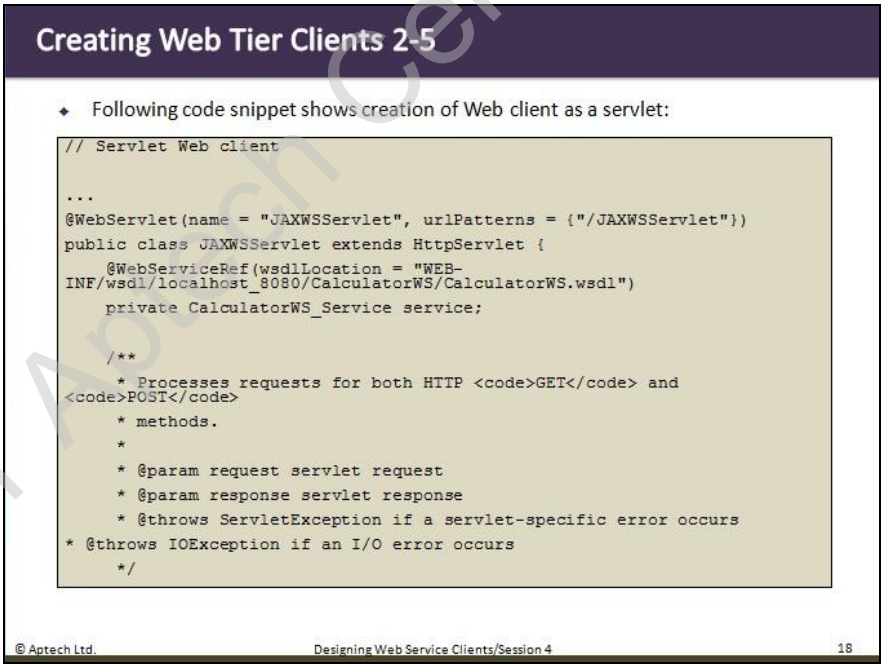
Using slide 15, explain the steps to access a Web Service using the standalone client. Describe the standalone client using the figure. Using slide 16, explain the Code Snippet that shows the creation of a static stub client.

Creating Web Tier Clients

Slides 17 to 21



Using slide 17, explain a scenario of Web client accessing the CalculatorWS Web service. Inform that two numbers have to be entered by the client on the browser page of the Web service. Tell that the Web Service returns the sum and the Web component plays the role of the Web service client.

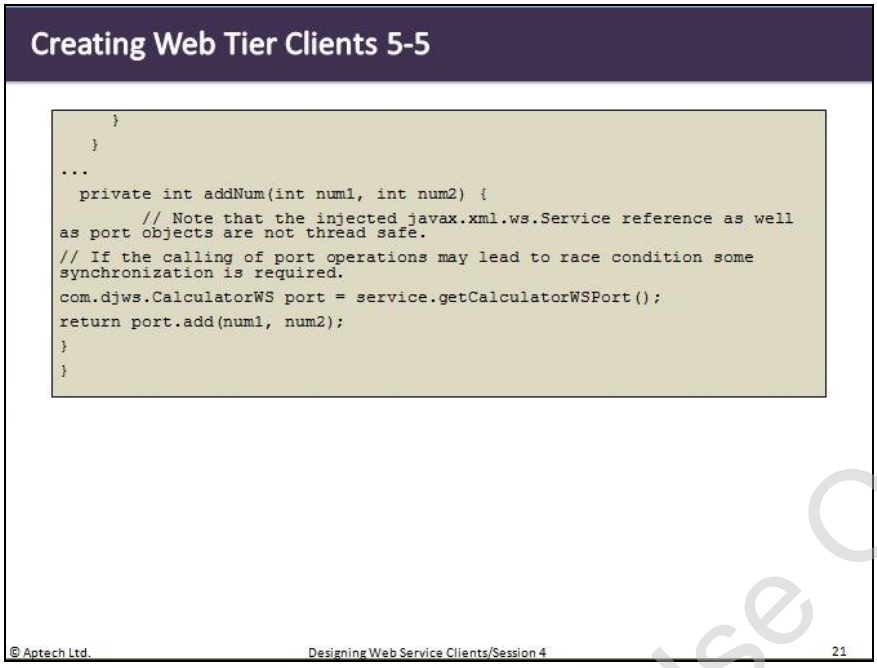


Creating Web Tier Clients 3-5

```
protected void processRequest(HttpServletRequest request,
HttpServletResponse response) throws ServletException, IOException {
        response.setContentType("text/html;charset=UTF-8");
    try (PrintWriter out = response.getWriter()) {
  /* TODO output your page here. You may use following sample code. */
    out.println("<!DOCTYPE html>");
    out.println("<html>");
    out.println("<head>");
    out.println("<title>Servlet JAXWSServlet</title>");
    out.println("</head>");
    out.println("<body>");
    out.println("<form method=\"post\" action=\"\">");
    out.println("<h2>Consuming CalculatorWS Web Service Using a
Servlet Client</h2>");
out.println("First number: <input type=\"text\" id=\"txtbox1\"
name=\"num1\" size=\"6\" maxlength=\"6\" value=\"\">");
     out.println("<br></br>");
out.println("Second number: <input type=\"text\" id=\"txtbox2\"
name=\"num2\" size=\"6\" maxlength=\"6\"value=\"\" >");
out.println("<br></br>");
  out.println("<input type=\"submit\" name=\"btn\" value=\"Add\">");
```


Creating Web Tier Clients 4-5

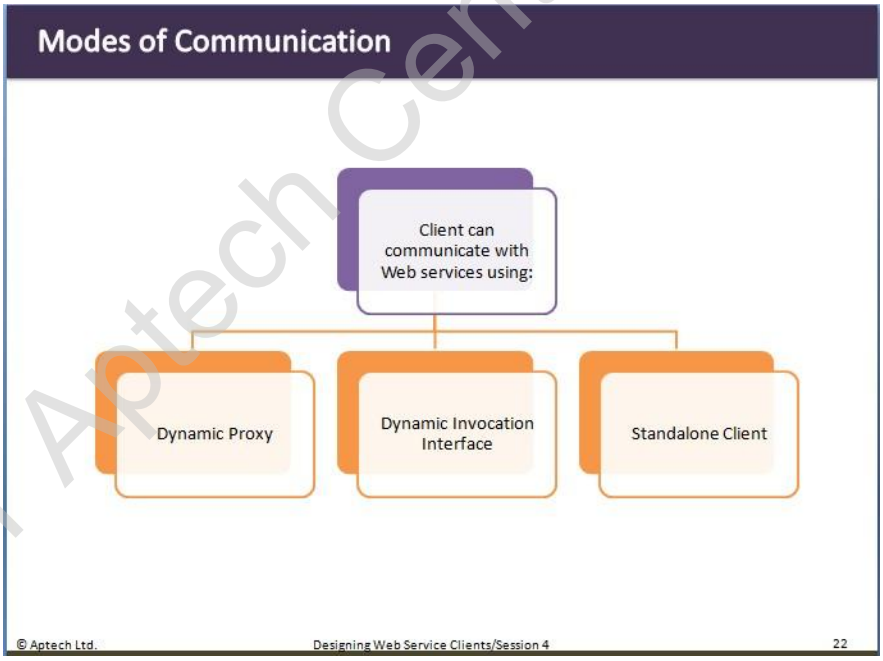
```
out.println("<br></br>");
   int i=0;
  int j=0;
  if (request.getParameter("btn").equalsIgnoreCase("Add")){

    if(request.getParameter("num1").isEmpty() ||
request.getParameter("num2").isEmpty()){
    out.println("Specify the two numbers to be added");
   }else {
          i = Integer.parseInt(request.getParameter("num1"));
         j = Integer.parseInt(request.getParameter("num2"));

         int result = addNum(i,j);
         out.println("<h3><u>Result</u></h3>" );
         out.println("Sum of the two numbers is " + result);
         out.println("</form>");
         out.println("</body>");
         out.println("</html>");
          }
     }
```



Using slides 18 to 21, explain the Code Snippet that shows the creation of Web client as a servlet. Explain about exception handling using try-catch block in the code.

Modes of Communication

Slide 22



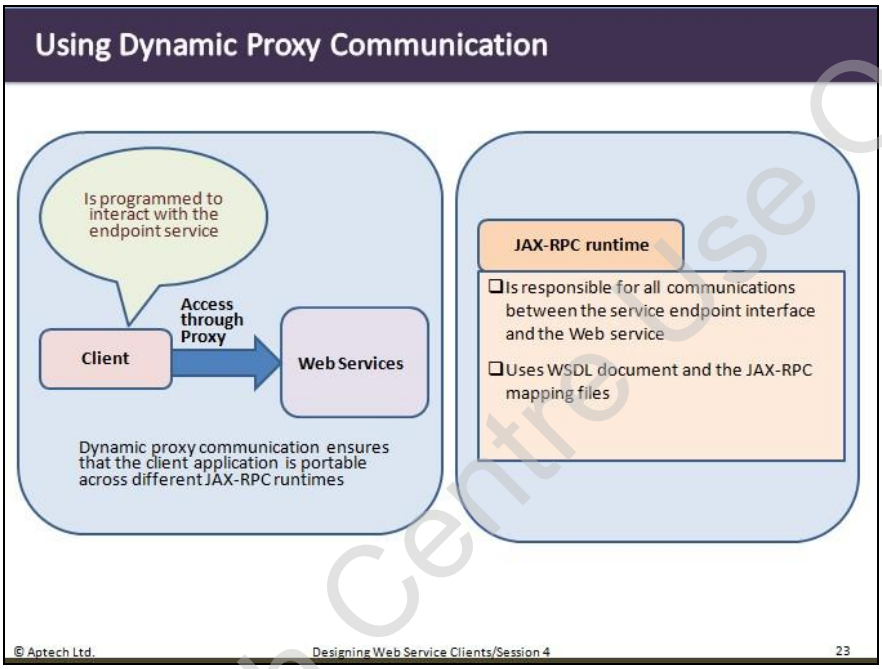
Using slide 22, explain the key methods by which the client can communicate with the Web services.

In-Class Question:

Name the three modes of communication.

Answer:
The client can communicate with the Web services using three methods. They are Dynamic Proxy, Dynamic Invocation Interface, and Standalone Client.

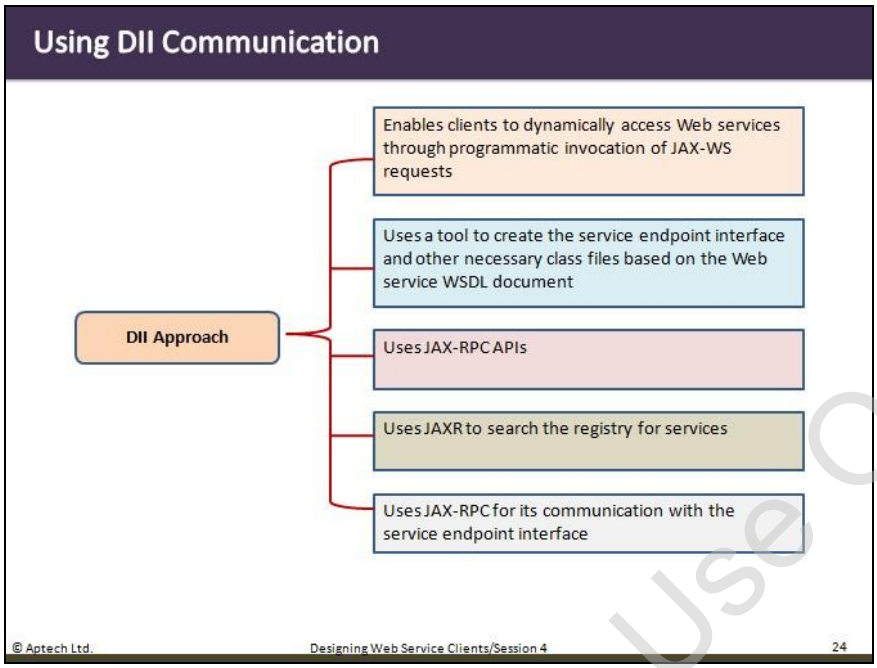
Using Dynamic Proxy Communication
Slide 23



Using slide 23, explain Dynamic Proxy Communication. Explain how the client accesses the Web Service through its proxy. Describe how JAX-RPC runtime uses WSDL document and the JAX-RPC mapping files for all communications between the service endpoint interface and the Web Service. Explain the method to use the invocation mode. Explain the classes that developers must create when using dynamic proxies.

Using DII Communication

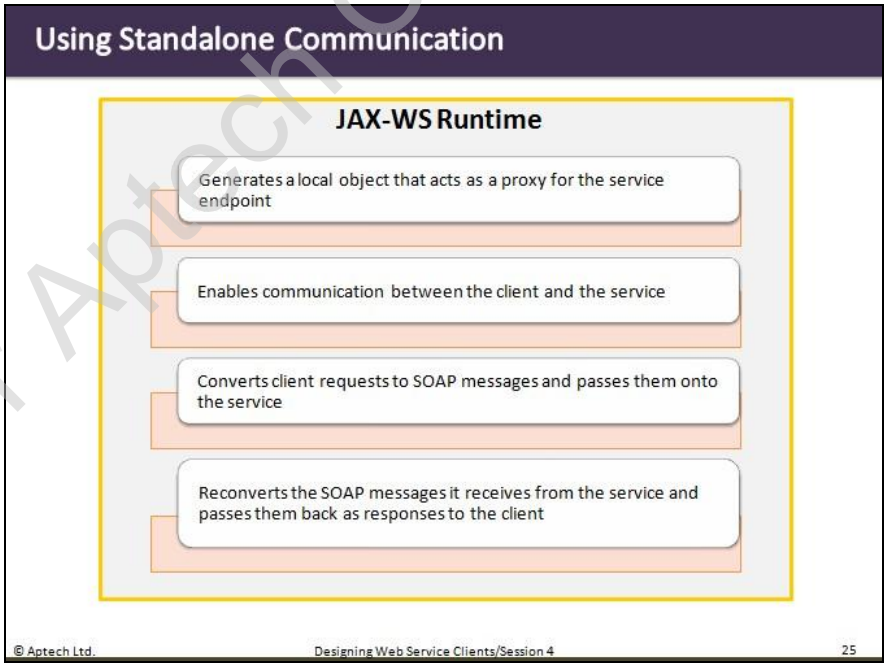
Slide 24



Using slide 24, explain DII communication. Describe about the DII approach. Explain the files that are created by a built-in tool based on the Web Service WSDL document. Explain about using JAX-RPC APIs in DII. Explain how the DII client searches the registry for services.

Using Standalone Communication

Slide 25



Using slide 25, explain how JAX-WS runtime helps in Standalone communication.

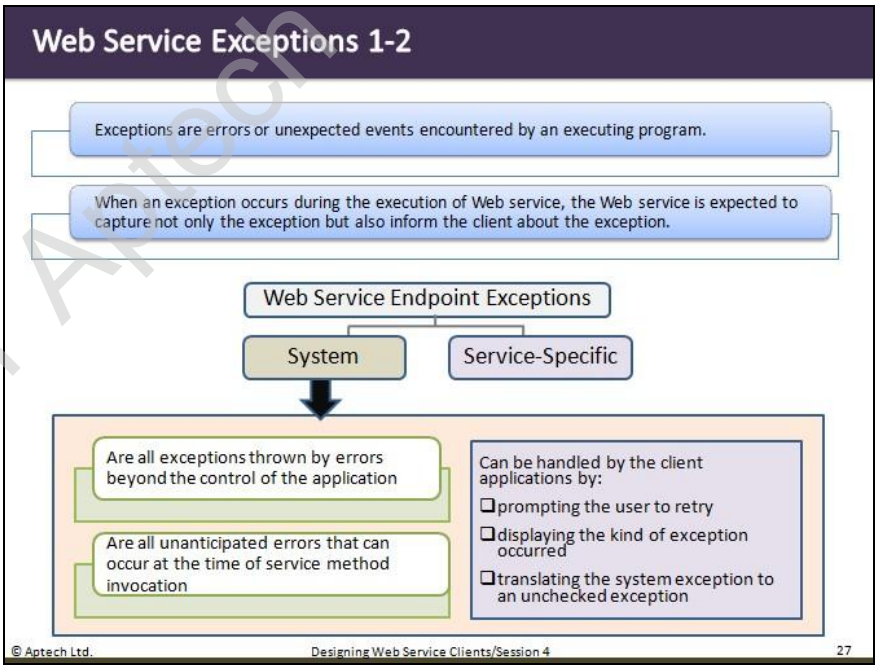
Locating and Accessing Web Services

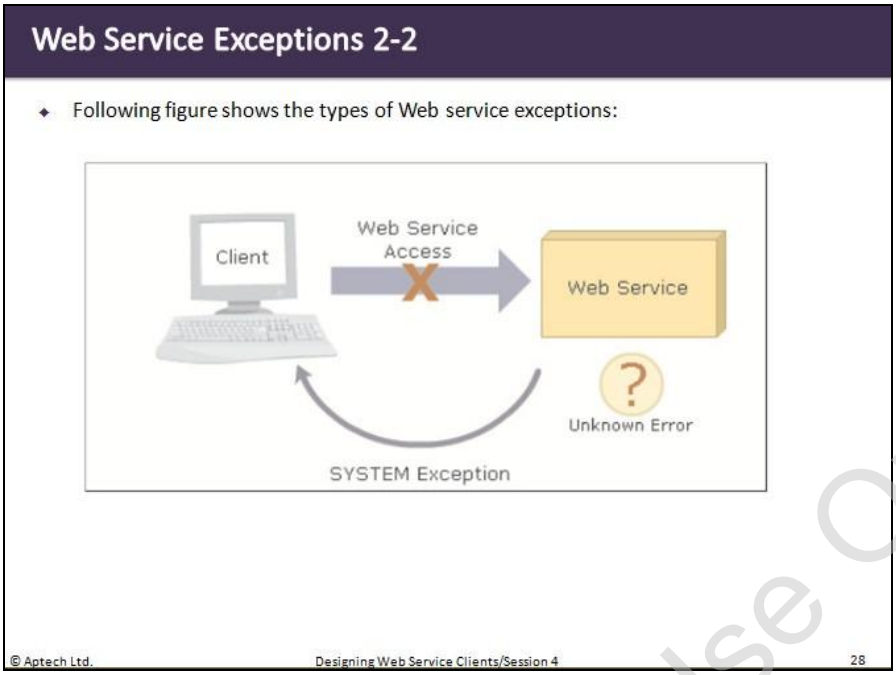
Slide 26

Using slide 26, explain the procedure to locate and access a Web service using the Code Snippet. Describe the details on Web methods and its parameters. Discuss the annotations that have been used in the Code Snippet.

Web Service Exceptions

Slides 27 and 28





Using slides 27 to 28, describe exceptions. Explain about the types of exceptions thrown by the Web Service endpoint. Explain the exceptions that are categorized as System exceptions. Provide a few examples of unanticipated errors that give rise to these exceptions. Explain how these errors can be handled by client applications.
Use the figure in slide 28 to explain the types of Web Service exceptions. Explain how the Web service throws System exception.

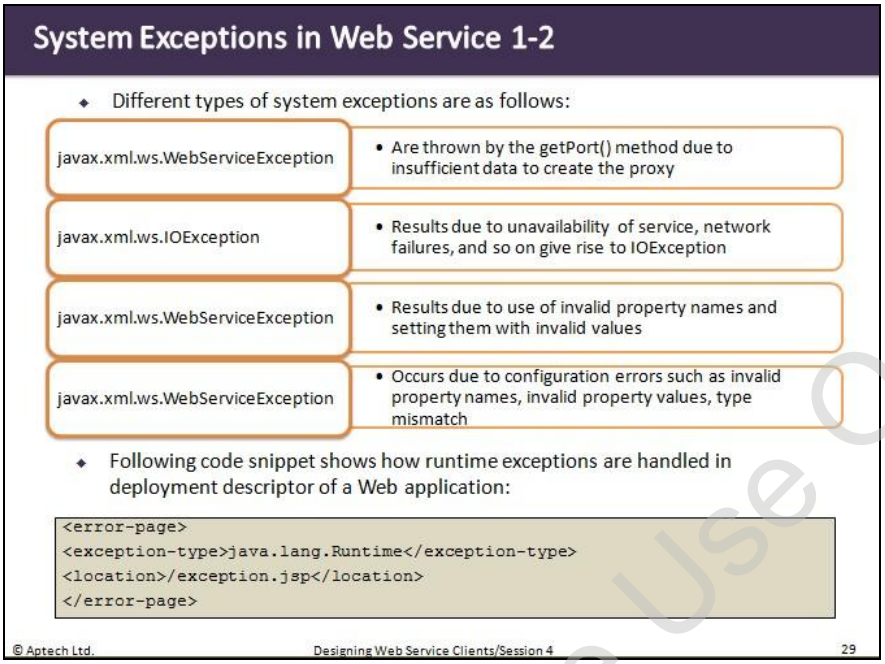
In-Class Question:

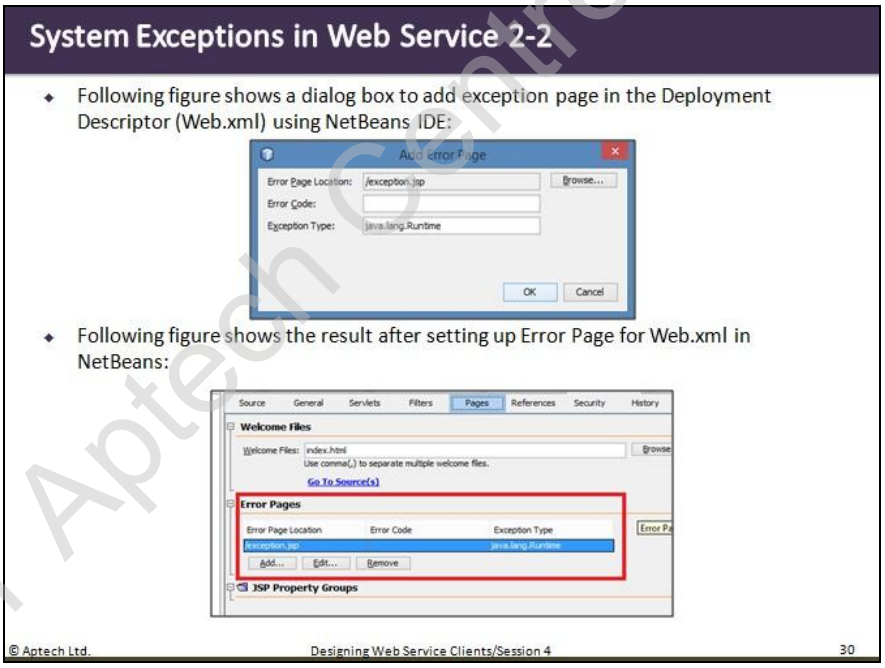
What are the two types of Web service exceptions?

Answer:
The two types of exceptions that can be thrown by a Web Service endpoint are System and Service-specific.

System Exceptions in Web Service

Slides 29 and 30



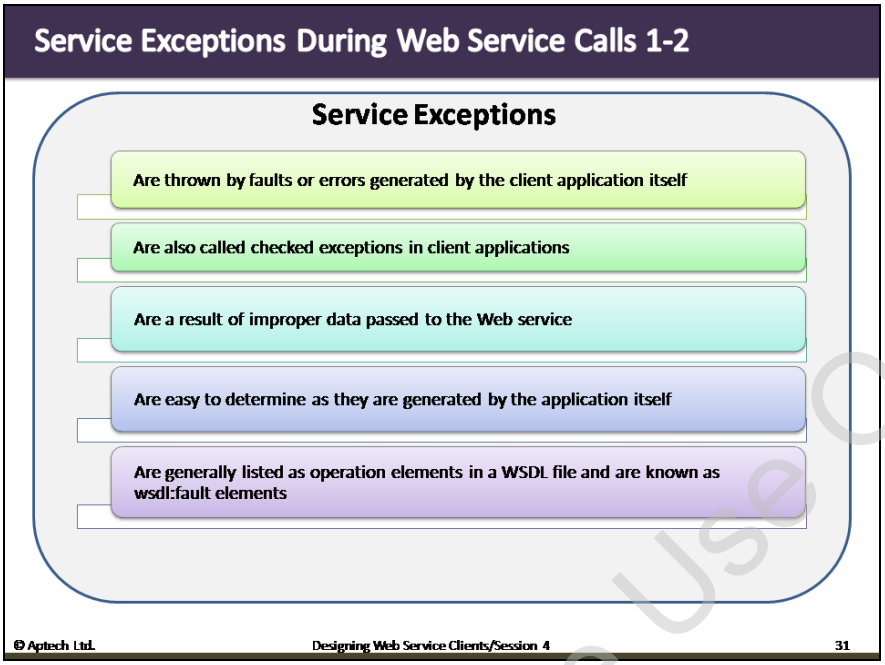


Using slides 29 and 30, explain about system exceptions in Web service. Using slide 29, list the different issues faced by the Web service clients during execution. Mention that these issues lead to different types of System exceptions. A javax.xml.ws.WebServiceException is thrown by dynamic proxy clients. IOException and javax.xml.ws.WebServiceException are thrown by DII Call interfaces and Standalone clients mostly face problems during the configuration of the stub. Explain the Code Snippet on slide 29 that shows how runtime exceptions are handled in deployment descriptor of a Web application.

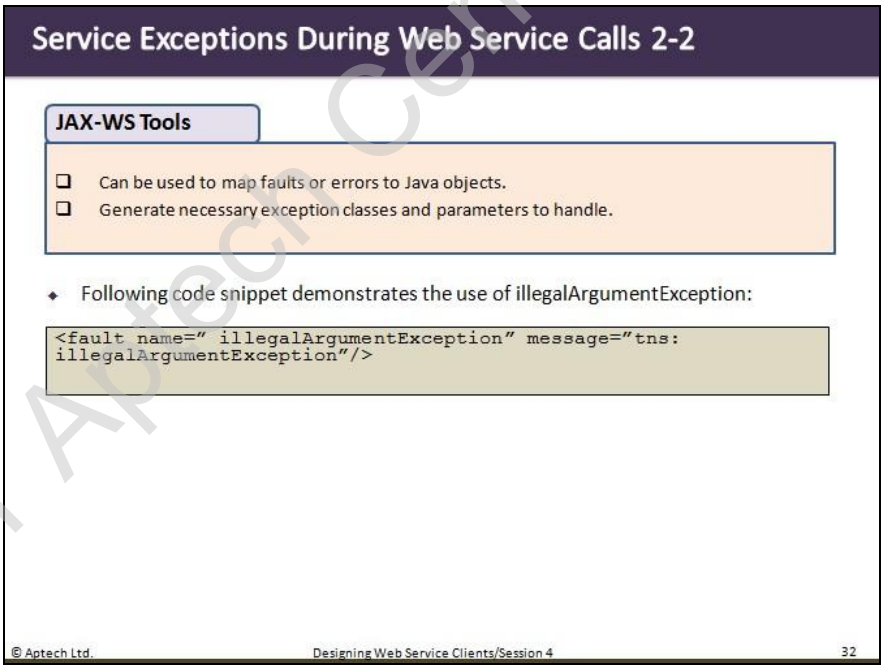
Using slide 30, explain the figures to show how to add exception page in the Deployment Descriptor using NetBeans IDE. Show the figure that displays the result after setting up Error Page for Web.xml in NetBeans.

Service Exceptions During Web Service Calls

Slides 31 and 32



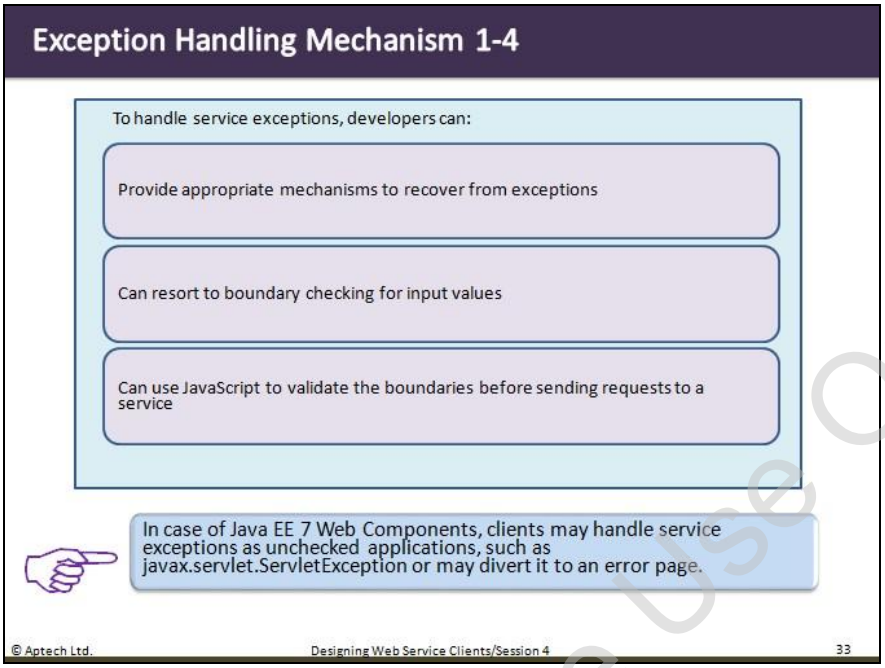
Using slides 31, explain about Service exceptions. Explain the reason for the occurrence of these errors. Explain the reason why these errors are easy to determine and handle.



Using slide 32, explain about JAX-WS tools and their usage. Explain how the client application handles these checked exceptions and recovers from such exceptions. Mention that a client accessing the CalculatorWS Web service pass two non-numeric values to the method. Explain about `illegalArgumentException` that is received by the client because the error message is defined in the WSDL document. Finally, explain the Code Snippet that shows the use of `illegalArgumentException`.

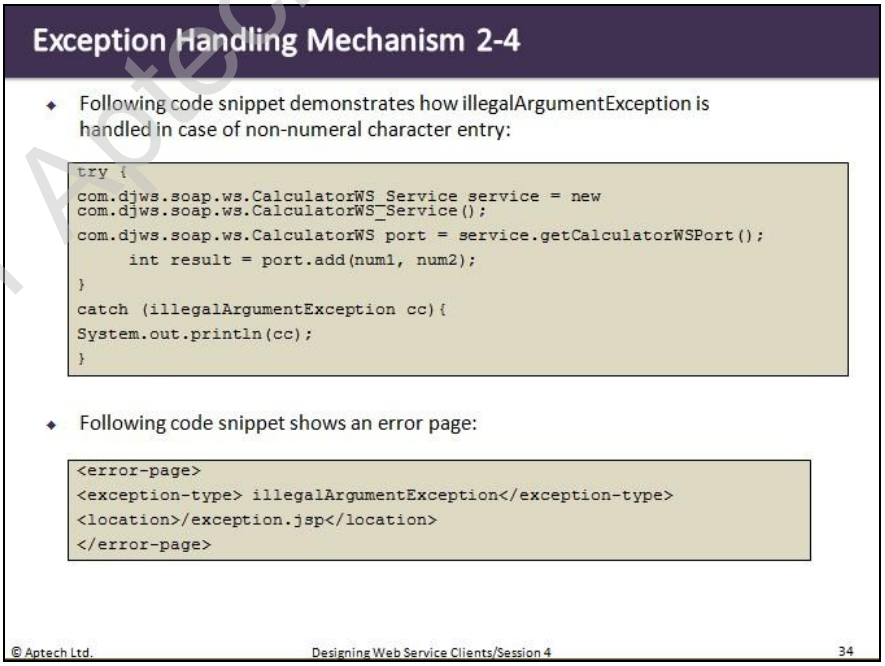
Exception Handling Mechanism

Slides 33 to 36



Using slides 33, explain the role of client application developer in handling Service exceptions. Explain how clients handle service exceptions in Java EE 7 Web Components. Explain how the clients must perform boundary checking using an example such as credit card numbers consisting 16-digit integers of particular range. Point out the uses of validation, which are:

- Minimized multiple trips to the service
- Reduction of network traffic
- Increase in service access speed



Exception Handling Mechanism 3-4

- Following figure shows the output which the Servlet Web service client code will produce when the page is first loaded:

- Following figure shows an error message if the **Add** button is clicked without entering any numbers in the text boxes:

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Exception Handling Mechanism 4-4

- Following figure shows the Web page after the numbers to be added are entered in the text boxes:

- Following figure shows the sum of two numbers after the **Add** button is clicked:

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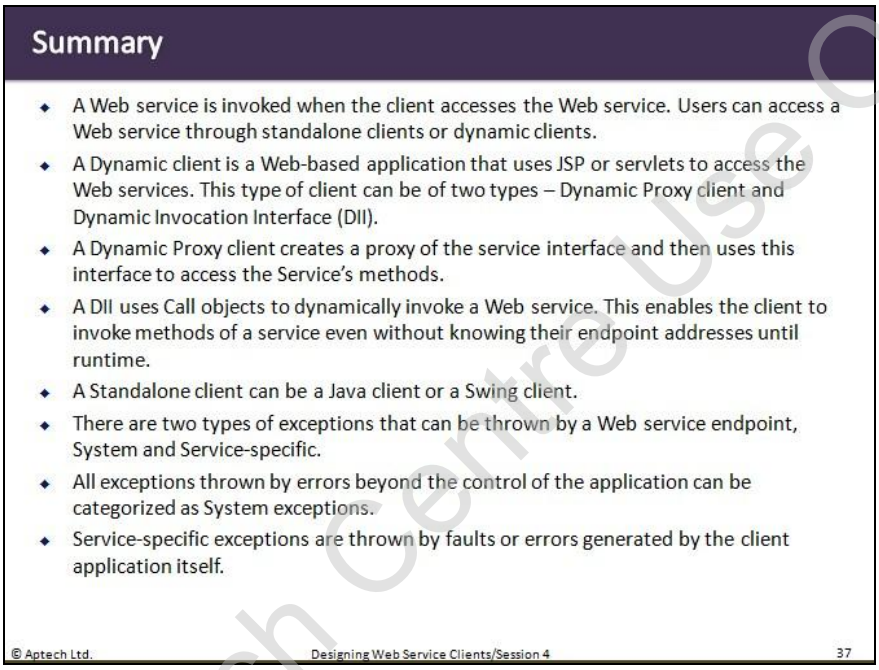
Using slides 34 to 36, explain the Code Snippet which demonstrates how an `illegalArgumentException` in the case of non-numeral character entry is handled. Then, explain the Code Snippet that shows the error page to which the Web-tier clients are redirected in case of an exception. Finally, show the figures on slides 35 and 36 to explain the output after executing the code.

In-Class Question:

 How do clients handle service exceptions for Java EE 7 Web Components?

Answer:
In case of Java EE 7 Web Components, clients may handle service exceptions as unchecked applications, such as `javax.servlet.ServletException` or may divert it to an error page.

Summarize Session
Slide 37



Using slide 37, summarize the session. Make them revise the following points:

- A Web service is invoked when the client accesses the Web service. Users can access a Web service through standalone clients or dynamic clients.
- A Dynamic client is a Web-based application that uses JSP or servlets to access the Web services. This type of client can be of two types – Dynamic Proxy client and Dynamic Invocation Interface (DII).
- A Dynamic Proxy client creates a proxy of the service interface and then uses this interface to access the Service's methods.
- A DII uses Call objects to dynamically invoke a Web service. This enables the client to invoke methods of a service even without knowing their endpoint addresses until runtime.
- A Standalone client can be a Java client or a Swing client.
- There are two types of exceptions that can be thrown by a Web service endpoint, System and Service-specific.

- All exceptions thrown by errors beyond the control of the application can be categorized as System exceptions.
- Service-specific exceptions are thrown by faults or errors generated by the client application itself.

4.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the next session which describes JAX-WS.

Tips: You can also check the **Articles**/**Blogs**/**Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

Session 5: JAX-WS

5.1 Pre-Class Activities

You should familiarize yourself with the concept of the Java API for XML based Web services (JAX-WS). You should be able to explain the need for JAX-WS. You should also be able to explain the features of JAX-WS. In addition, you should also be able to explain JAX-WS architecture, annotations, and programming model.

Familiarize yourself with the topics of the current session in-depth.

5.1.1 Objectives

After the session, learners will be able to:

- Explain Web services on Java Enterprise Edition platform
- Explain Java API for XML based Web services (JAX-WS)
- Explain the need of JAX-WS
- Explain the features and standards of JAX-WS
- Explain the JAX-WS architecture
- Explain JAX-WS annotations
- Explain JAX-WS programming model

5.1.2 Teaching Skills

To teach this session, you should be well versed with the concept of Java API for XML based Web services (JAX-WS), its need and features along with JAX-WS architecture, standards, annotations, and programming model.

You should teach the concepts in the theory class using the images provided. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:

It is recommended that you test the understanding of the students by asking questions in between the class.

5.1.3 In-Class Activities

Follow the order given here during In-Class activities. Give a summary of Web service clients, communication modes, and handling Web service exceptions discussed in the previous session.

Review of Previous Session

You should begin with a brief recap or review of previous session.

Overview of the Session

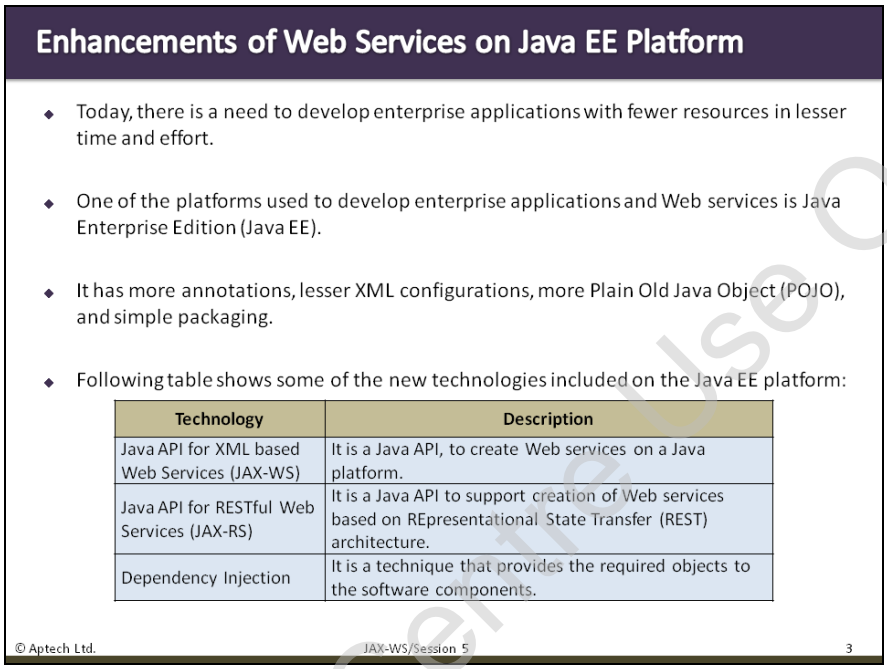
Then, give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session explains JAX-WS in detail. Tell them that this session also explains the need, features, and

standards of JAX-WS. Finally, the session introduces them to the JAX-WS architecture and describes JAX-WS annotations and JAX-WS programming model.

5.2 In-Class Explanations

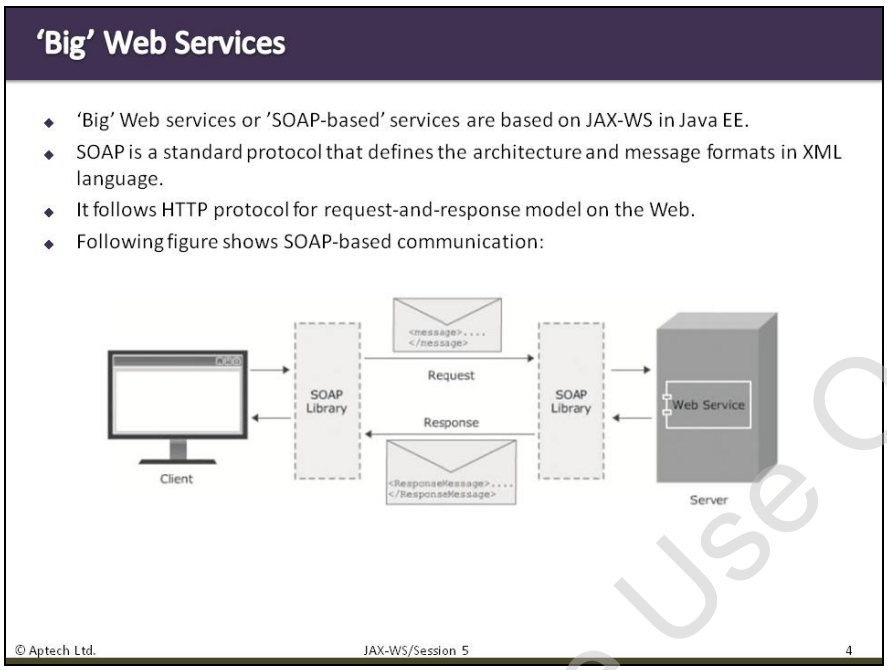
Enhancements of Web Services on Java EE Platform

Slide 3



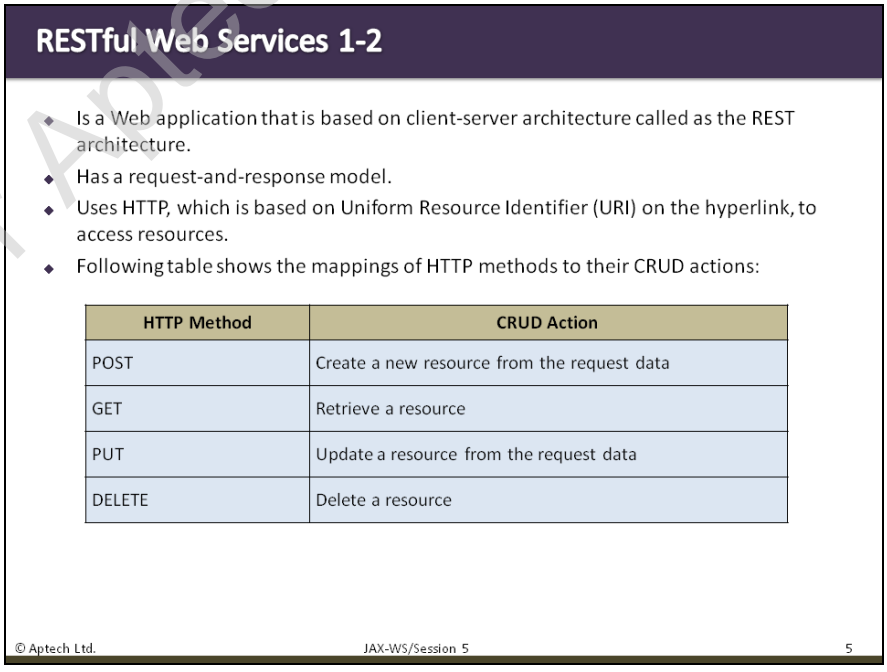
Using slide 3, introduce Java Platform, Enterprise Edition (Java EE) by emphasizing the need to develop enterprise applications with fewer resources in lesser time and effort. Tell that Java EE is one such platform that satisfies today's requirements. Then provide the gist of the features and advantages of Java EE Platform. Tell how Java EE platform helps the developer. Also, explain some of the new technologies included on the Java EE platform.

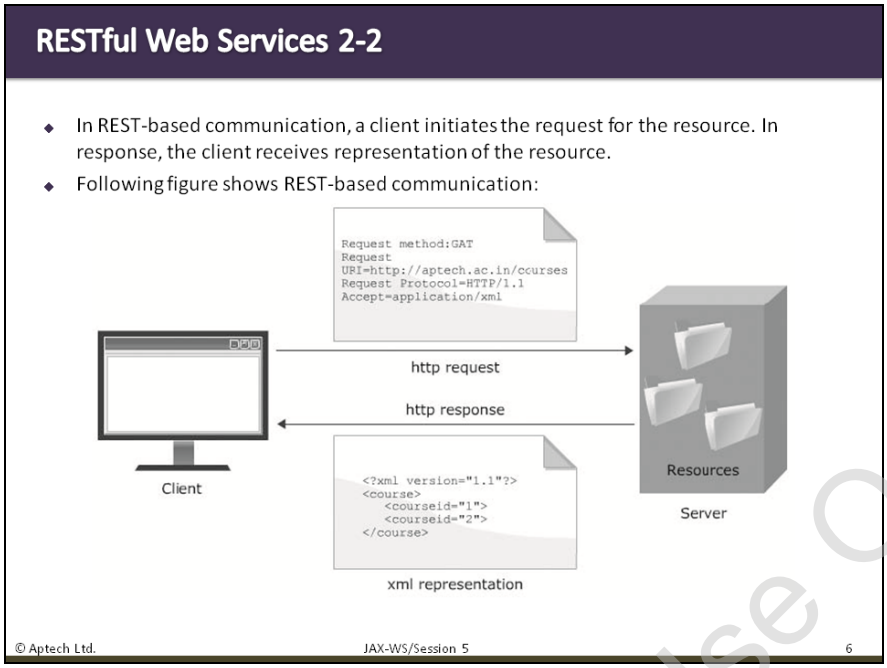
'Big' Web Services
Slide 4



Using slide 4, first explain that Web services are classified as 'Big' Web services and REpresentational State Transfer or RESTful Web services. Tell that this classification is based on their implementation method. Then, explain why JAX-WS in Java EE forms the basis for 'Big' Web services' or 'Simple Object Access Protocol (SOAP) based' services. Explain WSDL and that it is used to describe Web services. Using the figure, explain SOAP-based communication.

RESTful Web Service
Slides 5 and 6





Using slides 5 and 6, explain what RESTful Web service is. Tell about the architecture on which it is based on. Point out what it uses to access resources. Tell about the various types of resources that can be accessed. Tell about the four main Hyper Text Transfer Protocol (HTTP) methods that are used to Create, Retrieve, Update, and Delete (CRUD) resources. Then detail the mappings of HTTP methods to their CRUD actions. Explain that REST uses Web standards such as HTTP, URL, and XML and JAX-RS provides the functionality for RESTful Web services. Using the figure on slide 6, explain REST-based communication.

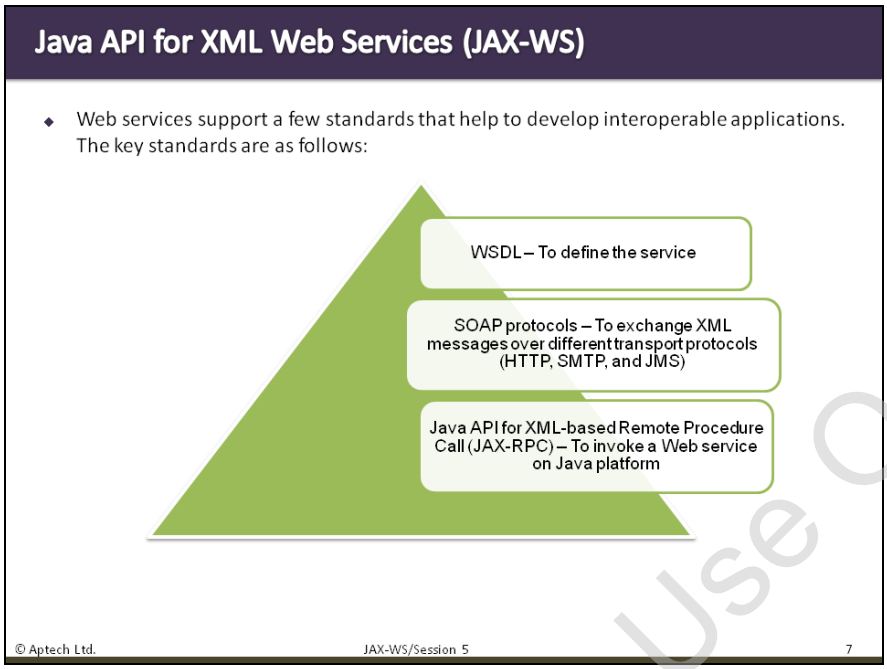
In-Class Question:

What are the two types of Web services?

Answer:
'Big' Web services and RESTful Web services are the two types of Web services.

Java API for XML Web Services (JAX-WS)

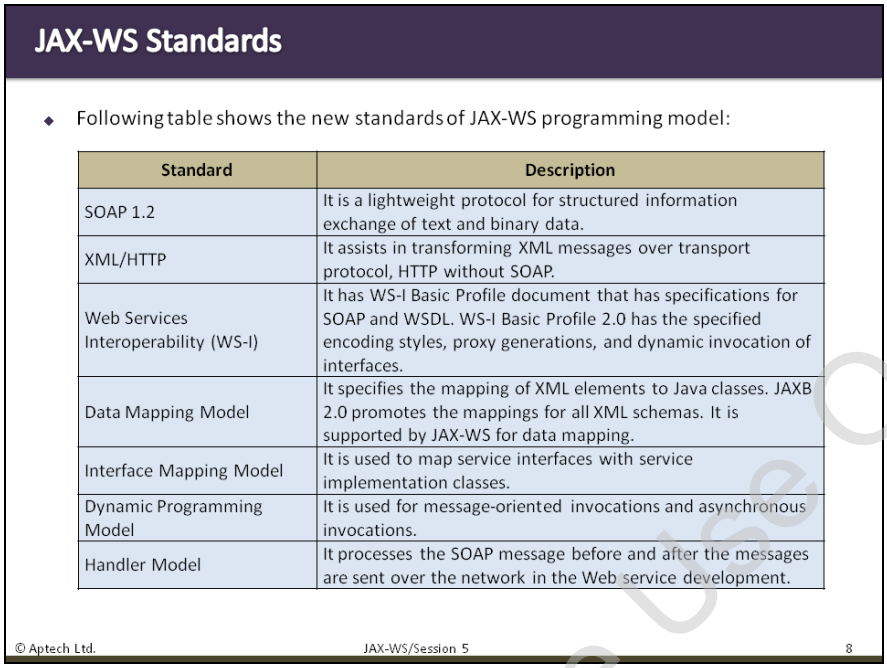
Slide 7



Using slide 7, discuss the key standards that help to develop interoperable applications. Web Services Description Language (WSDL), Simple Object Access Protocol (SOAP) protocols, and Java API for XML-based Remote Procedure Call (JAX-RPC). Explain the usage of these standards.

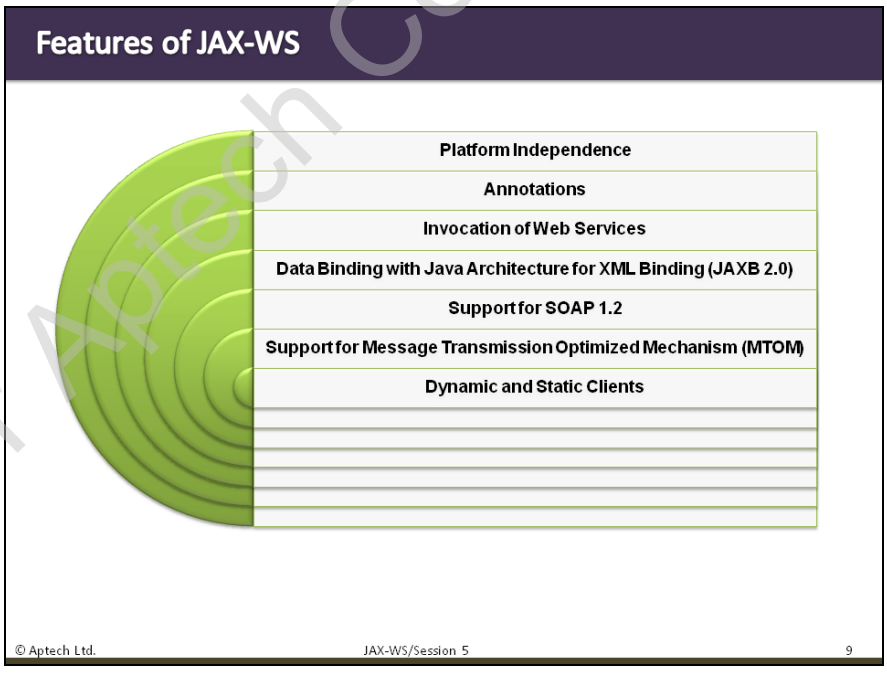
Point out that JAX-RPC has a few APIs based on its own data bindings, which support SOAP protocol over HTTP to exchange XML messages. Tell that to support new industry standards, JAX-RPC was modified and renamed with JAX-WS, which makes the development of Web service applications simple and easy. Finally, explain the advantages of JAX-WS.

JAX-WS Standards
Slide 8



Using slide 8, explain the new standards of JAX-WS programming model. Explain each standard and its usage.

Features of JAX-WS
Slide 9



Using slide 9, explain the key features of JAX-WS, which are as follows:

- Platform Independence
- Annotations
- Invocation of Web services

- Synchronous invocation
- Asynchronous invocation Data Binding with Java Architecture for XML Binding (JAXB 2.0)
- Support for SOAP 1.2
- Support for Message Transmission Optimized Mechanism (MTOM)
- Dynamic and Static Clients
- Development Tools

While explaining Platform Independence, describe the delegate class that is generated internally by JAX-WS that helps to achieve better platform independence. While explaining Annotations, tell that they help to expose Java artifacts as Web service. While explaining about Invocation of Web services, point out the two types of client-side invocations supported by JAX-WS, namely, synchronous and asynchronous invocation.

Discuss the two types of asynchronous invocation approaches: Polling approach and Callback approach. Tell for what JAXB 2.0, SOAP 1.2, Message Transmission Optimized Mechanism (MTOM), and dynamic client API called javax.ws.Dispatch are used. Discuss the constants in the dispatch client. Tell about PAYLOAD mode and MESSAGE mode. Point out the two command tools for Web service development, namely, wsimport tool and wsgen tool.

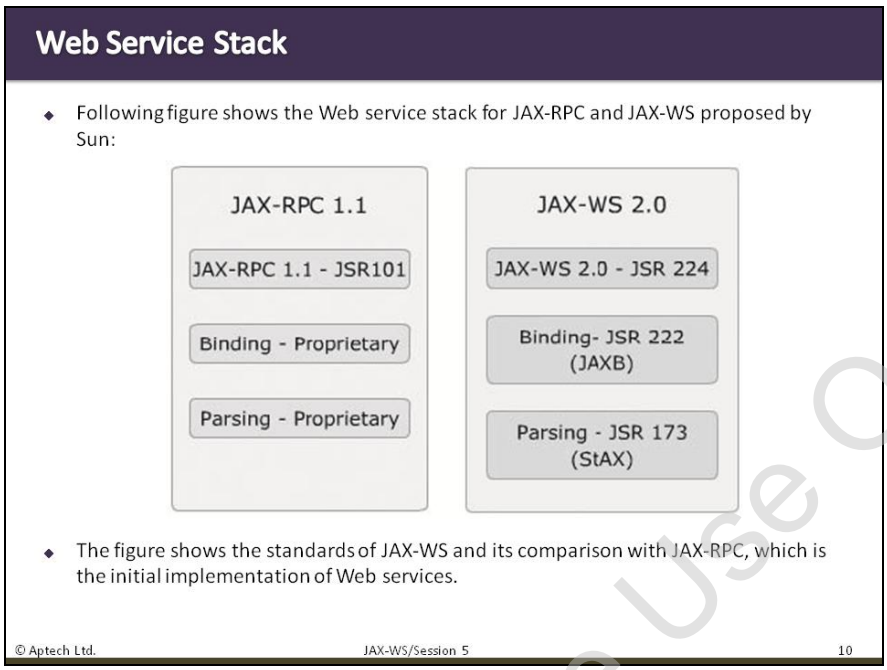
In-Class Question:

 Name the mechanism supported by JAX-WS for optimized transmission of binary data in Web service.

Answer:
Support for Message Transmission Optimized Mechanism (MTOM). MTOM is a mechanism supported by JAX-WS for optimized transmission of binary data in Web service.

Web Service Stack

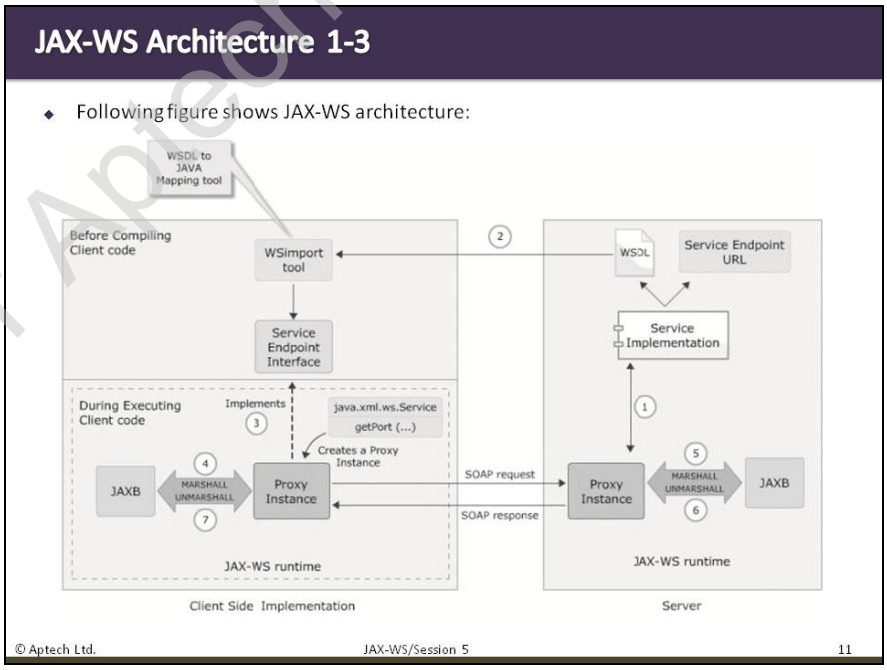
Slide 10

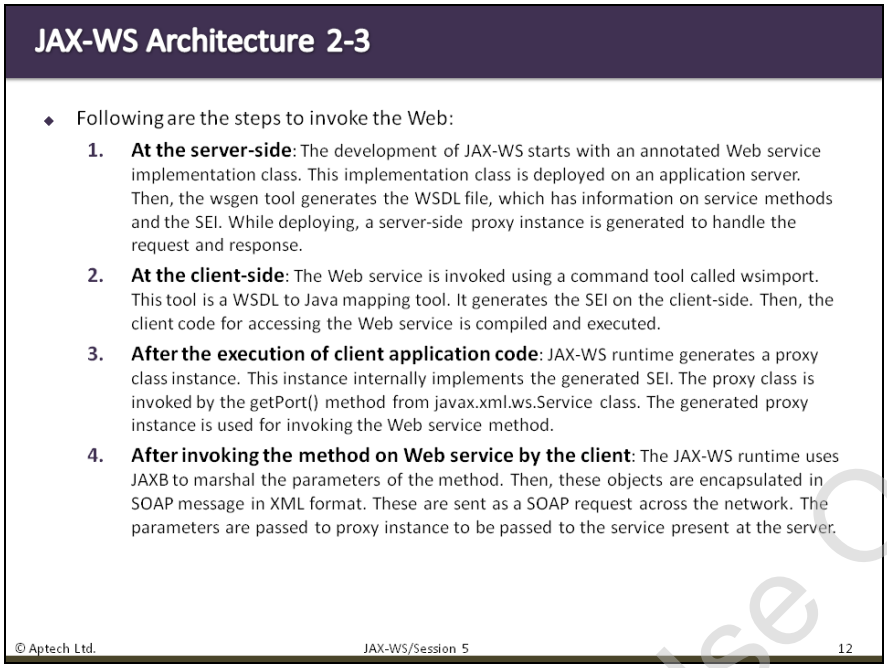


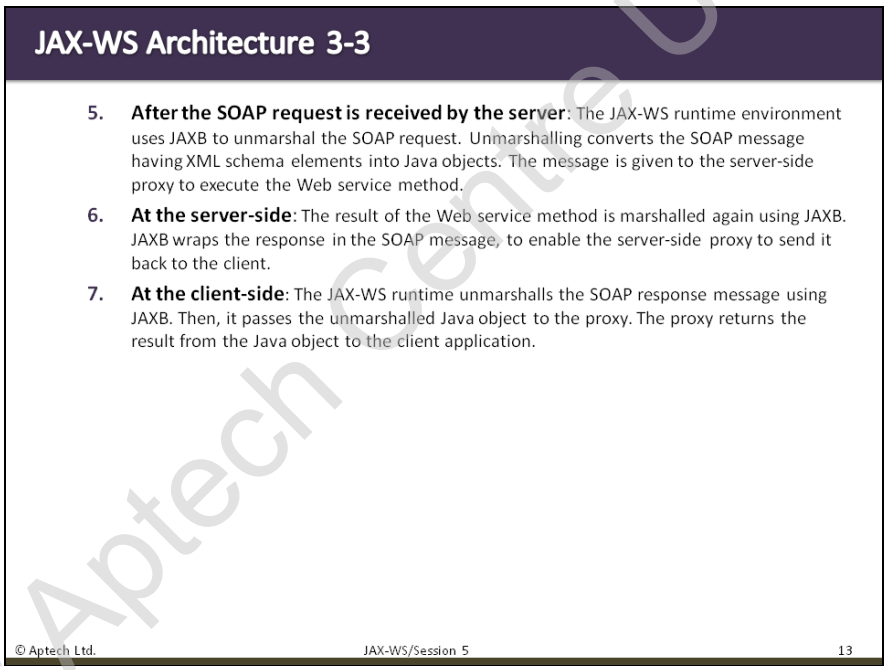
Using slide 10, explain that JAX-RPC has its own data binding and parsing mechanism, which are based on Java Architecture for XML Binding (JAXB) and Streaming API for XML (StAX). Using the figure, compare JAX-WS with JAX-RPC, which is the initial implementation of Web services.

JAX-WS Architecture

Slides 11 to 13



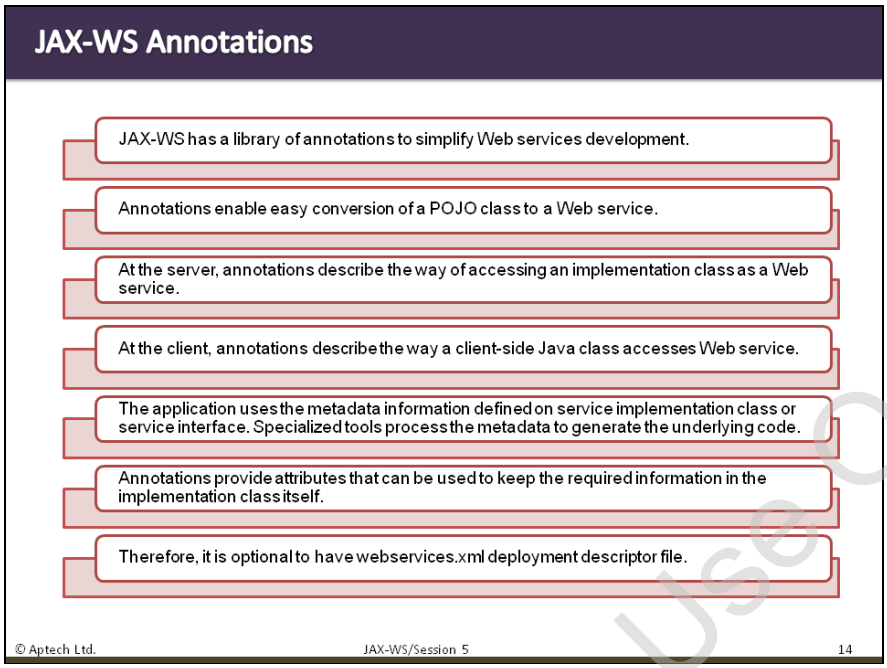




Using slides 11 to 13, explain that the generation of dynamic proxy class instance is the basis for JAX-WS architecture. Tell that this instance sends and receives the SOAP request and SOAP response to the client and server. Then, explain the steps to invoke the Web service.

JAX-WS Annotations

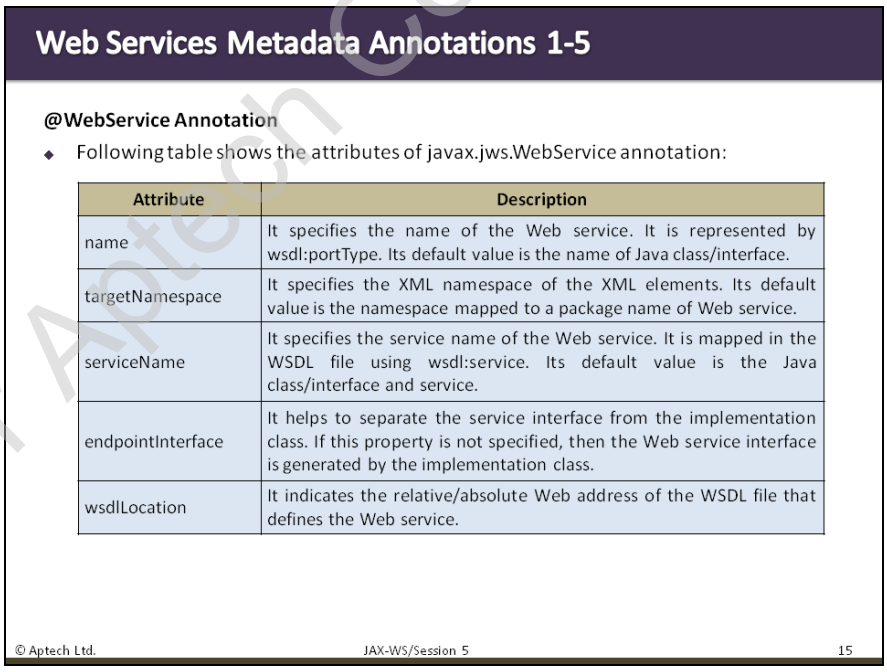
Slide 14



Using slide 14, explain the JAX-WS Annotations. Explain the benefits of using JAX-WS annotations. Discuss the usage of annotations at the server-side and at the client-side.

Web Services Metadata Annotations

Slides 15 to 19



Web Services Metadata Annotations 2-5

@WebMethod Annotation

- Following table shows the attributes of javax.jws.WebMethod annotation:

Attribute	Description
operationName	It maps the method to wsdl:operation element in the WSDL file. It defines the operation type performed by the Web service method. The default value is the name of the Java method as a string.
action	It defines the action for this operation. It finds out SOAP action header value for SOAP bindings. Its default value is a string.

@WebResult Annotation

- Following table lists the attributes of javax.jws.WebResult annotation:

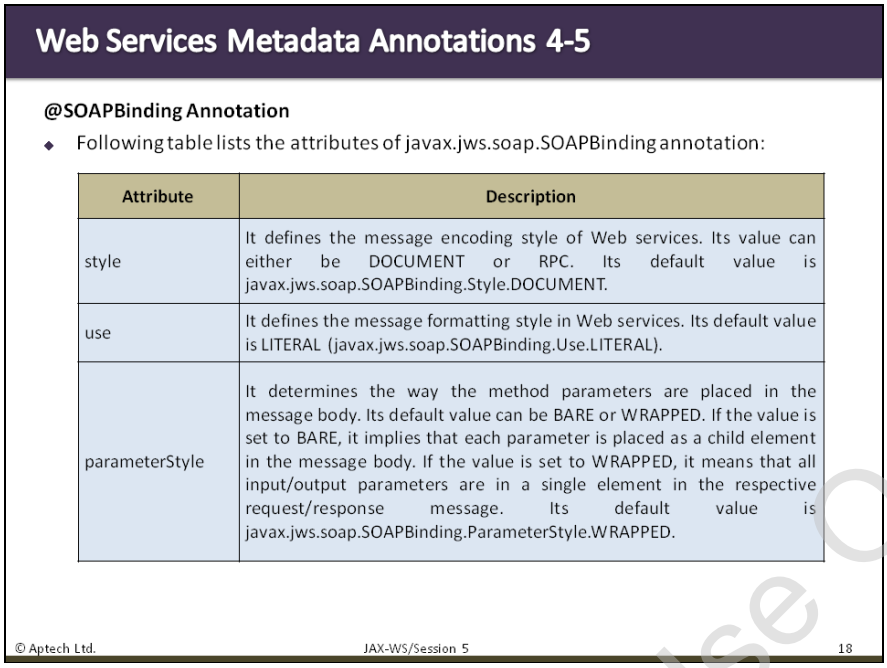
Attribute	Description
name	It specifies the variable name that is returned after invoking the Web service method. In document style operations, the name parameter is the local name of XML element, which is the return value.
targetNamespace	It specifies the XML namespace for the value returned. When the return value maps to an XML element, this is used to bind documents. The default value of targetNamespace is empty namespace, represented as "".

Web Services Metadata Annotations 3-5

@WebParam Annotation

- Following table shows the attributes of javax.jws.WebParam annotation:

Attribute	Description
name	It specifies the name of the parameter.
targetNamespace	It specifies the XML namespace for the parameter. This attribute has to be applied only when the operation is document-style or the parameter maps to a header. Its default value is the Web service's namespace.
mode	It shows the direction in which the parameters are passed and returned in the method. Its values can be IN, OUT, and INOUT. Its default value is IN.

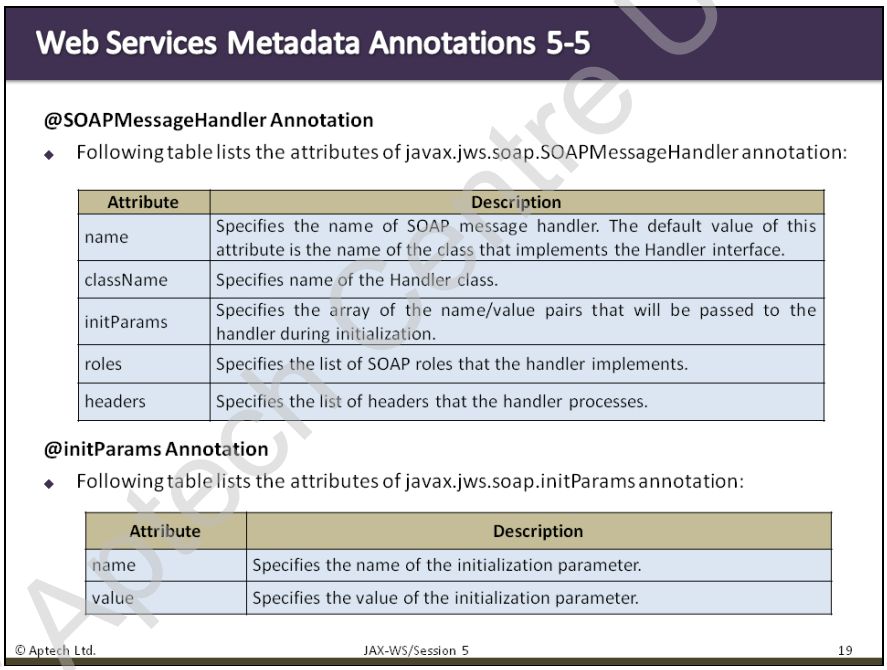


Web Services Metadata Annotations 4-5

@SOAPBinding Annotation

- Following table lists the attributes of javax.jws.soap.SOAPBinding annotation:

Attribute	Description
style	It defines the message encoding style of Web services. Its value can either be DOCUMENT or RPC. Its default value is javax.jws.soap.SOAPBinding.Style.DOCUMENT.
use	It defines the message formatting style in Web services. Its default value is LITERAL (javax.jws.soap.SOAPBinding.Use.LITERAL).
parameterStyle	It determines the way the method parameters are placed in the message body. Its default value can be BARE or WRAPPED. If the value is set to BARE, it implies that each parameter is placed as a child element in the message body. If the value is set to WRAPPED, it means that all input/output parameters are in a single element in the respective request/response message. Its default value is javax.jws.soap.SOAPBinding.ParameterStyle.WRAPPED.



Web Services Metadata Annotations 5-5

@SOAPMessageHandler Annotation

- Following table lists the attributes of javax.jws.soap.SOAPMessageHandler annotation:

Attribute	Description
name	Specifies the name of SOAP message handler. The default value of this attribute is the name of the class that implements the Handler interface.
className	Specifies name of the Handler class.
initParams	Specifies the array of the name/value pairs that will be passed to the handler during initialization.
roles	Specifies the list of SOAP roles that the handler implements.
headers	Specifies the list of headers that the handler processes.

@initParams Annotation

- Following table lists the attributes of javax.jws.soap.initParams annotation:

Attribute	Description
name	Specifies the name of the initialization parameter.
value	Specifies the value of the initialization parameter.

Using slides 15 to 19, explain Web service metadata. Point out that these annotations are supported for Web both JAX-WS and JAX-RPC application. Explain the different annotations present in the javax.jws package, which are as follows:

- @WebService Annotation
- @WebMethod Annotation
- @WebParam Annotation
- @WebResult Annotation
- @SOAPBinding Annotation
- @SOAPMessageHandler Annotation
- @initParams Annotation

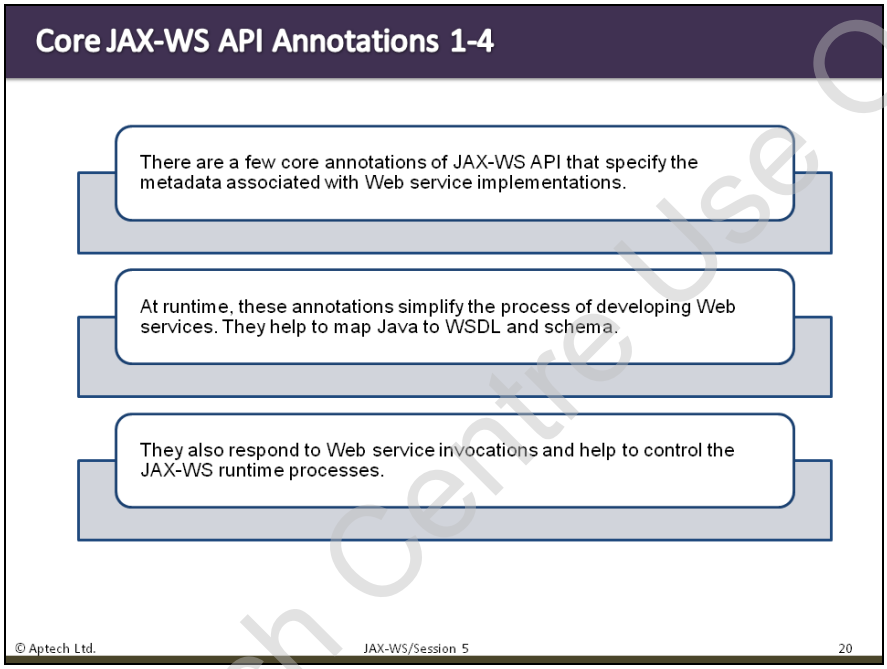
For each of the mentioned annotations, explain the different attributes and what each attribute specifies or defines.

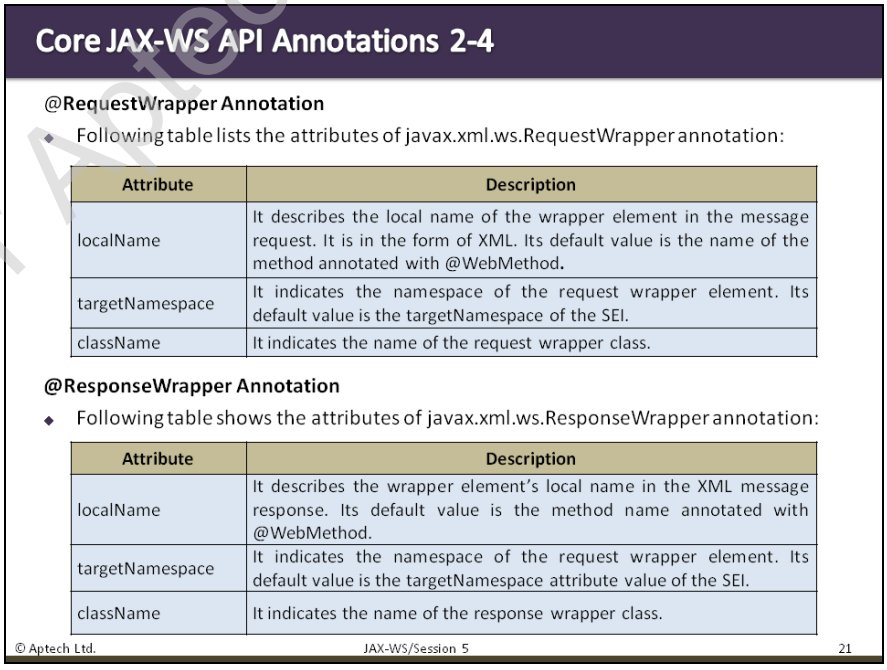
In-Class Question:

What is @WebService Annotation?

Answer:
@WebService annotation marks a Java class as a Web service or a Java interface as a Web service interface. This is present in all endpoint Java implementation classes.

Core JAX-WS API Annotations
Slides 20 to 23





Core JAX-WS API Annotations 3-4

@WebServiceProvider Annotation

- Following table lists the attributes of javax.xml.ws.WebServiceProvider annotation:

Attribute	Description
wsdlLocation	It is a mandatory attribute. It defines the Web location of the WSDL file that describes the Web service.
portName	It defines the service end point and maps to the wsdl:port element of WSDL file.
serviceName	It defines the service endpoint and maps to the wsdl:service element of WSDL file. Its default value is the unqualified name of the Java class, which is appended with the service keyword.
targetNamespace	It specifies the WSDL generated from Web service and the XML namespace of the XML elements. Its default value is the namespace, which is mapped to a package name of the Web service.

Core JAX-WS API Annotations 4-4

@ServiceMode Annotation

- This annotation is used to develop JAX-WS Web services implementation class with the help of the Web service provider.

@WebServiceRef Annotation

- Following table lists the attributes of javax.xml.ws.WebServiceRef annotation:

Attribute	Description
name	It specifies the JNDI name of the resource. It maps the annotated method to its related Java bean property name. It maps to the default field name in case of field annotation.
type	It specifies the resource of Java type. It maps the annotated method type to its related Java bean property type. It maps to the default field name in case of annotated field.
mappedName	It specifies that a resource is mapped to a product specific name.
value	It specifies that javax.xml.ws.Service is extended by the service class. Its reference is of SEI.

Using slides 20 to 23, list and explain the Core JAX-WS API Annotations. Point out the uses of these annotations. They are:

- Simplify Web services development
- Map Java to WSDL and schema
- Respond to Web service invocations
- Help to control the JAX-WS runtime processes

Explain the different annotations, which are listed here:

- @RequestWrapper Annotation
- @ResponseWrapper Annotation
- @WebServiceProvider Annotation
- @ServiceMode Annotation

- @WebServiceRef Annotation

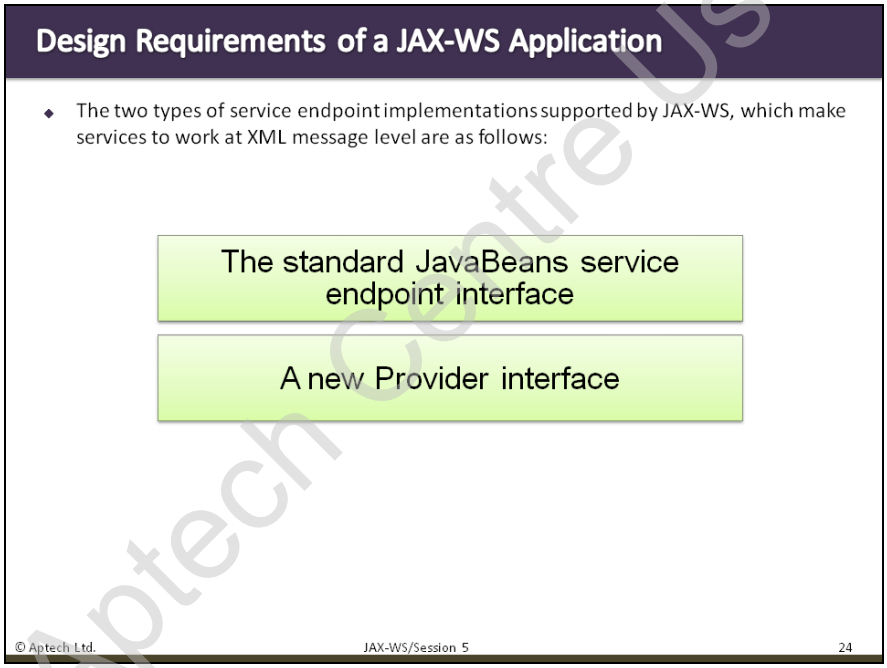
For each of these annotations, explain the different attributes and what each attribute specifies or defines.

In-Class Question:

For what is @serviceMode Annotation used?

Answer:
This annotation is used to develop JAX-WS Web services implementation class with the help of the Web service provider.

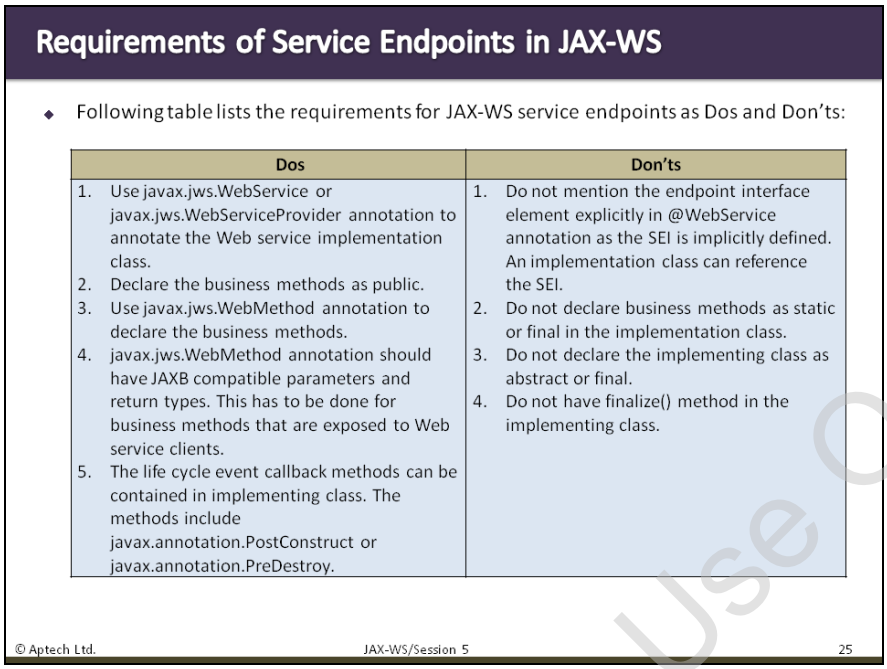
Design Requirements of a JAX-WS Application
Slide 24



Using slide 24, explain the two types of service endpoints implementation supported by JAX-WS. Further, point out that javax.jws.WebService or JAXWS javax.jws.WebServiceProvider annotation can be used to develop JAX-WS Web service. Add that @WebService can be used for JavaBeans endpoints and @WebServiceProvider can be used for provider endpoints.

Requirements of Service Endpoints in JAX-WS

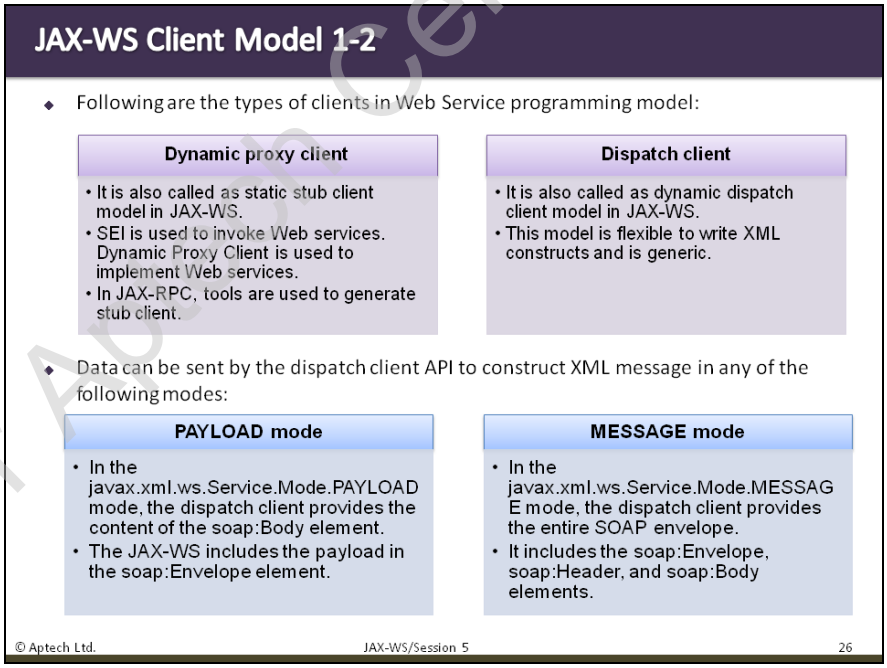
Slide 25

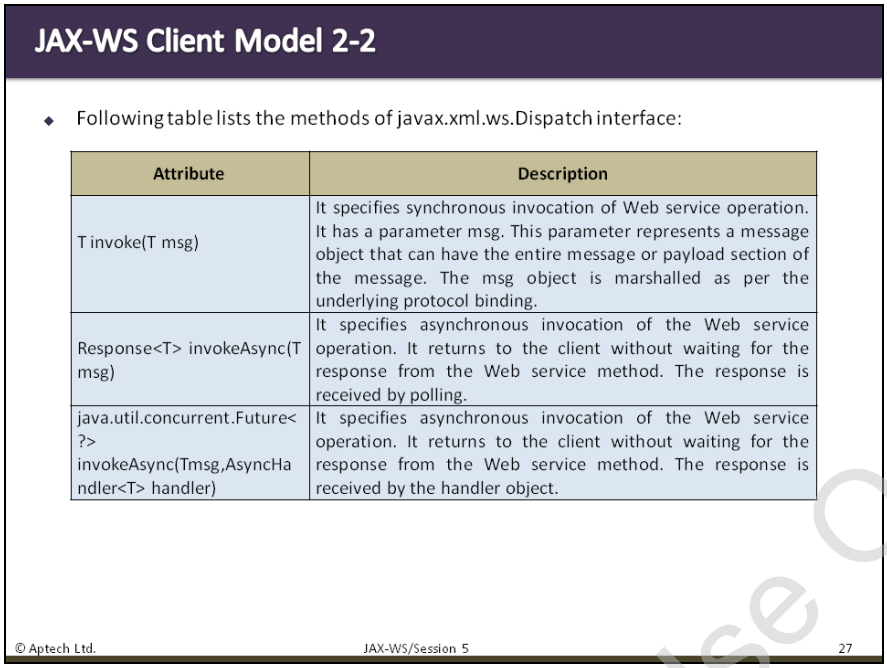


Using slide 25, explain the dos and don'ts of the requirements of JAX-WS service endpoints.

JAX-WS Client Model

Slides 26 and 27





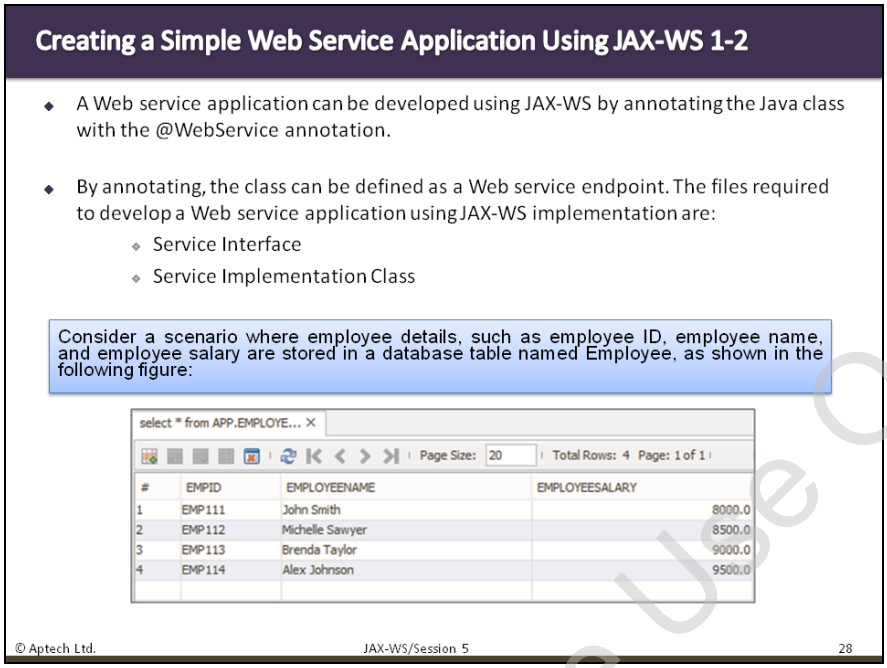
Using slides 26 and 27, explain the types of clients in Web service programming model which are Dynamic Proxy Client and Dispatch Client. Explain why they are used. Tell that the data can be sent by Dispatch client using PAYLOAD mode or MESSAGE mode. Also, explain the methods of javax.xml.ws Dispatch interface. Tell what each method specifies, the parameters in the method, and how the response is received.

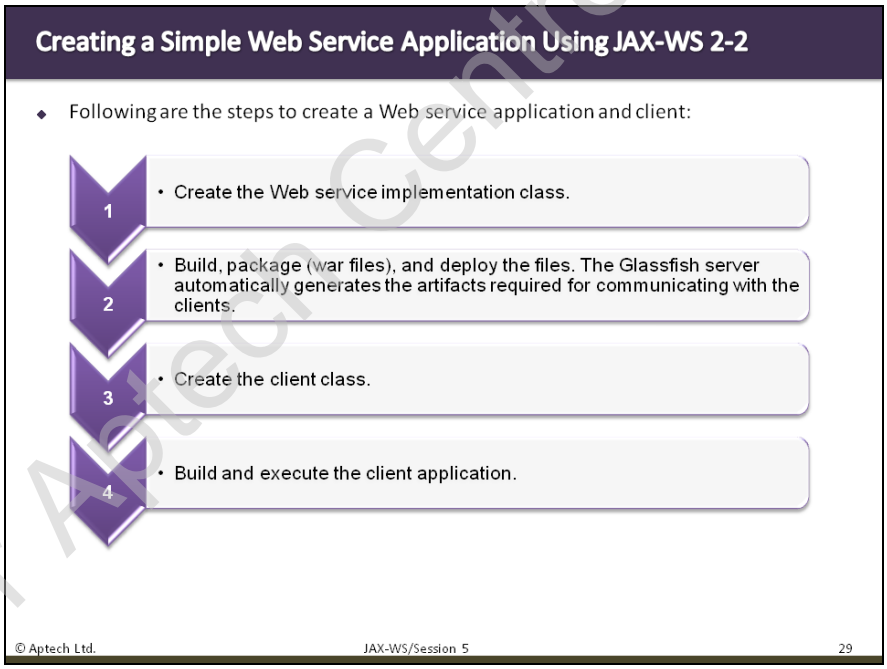
In-Class Question:

What are the two types of clients in Web service programming model?

Answer:
Dynamic Proxy client and Dispatch Client

Creating a Simple Web Service Application Using JAX-WS
Slides 28 and 29





Using slides 28 and 29, explain that @WebService annotation can be used to develop a Web service application. Tell about the two files that are required to develop a Web service application using JAX-WS implementation.

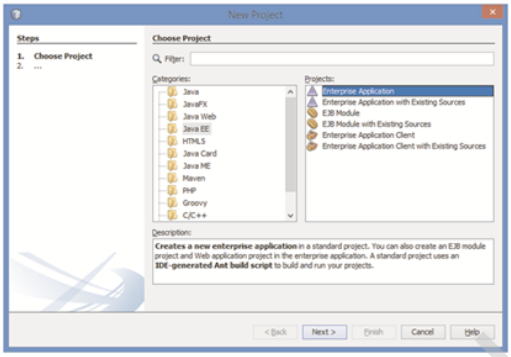
Clarify when it is necessary and when it is not necessary to have service implementation class to implement service interface. Explain the four important steps to create a Web service application and client by using a scenario, where employee details, such as employee ID, employee name, and employee salary are stored in 'Employee' database.

Create a Web Application Implementation Class

Slides 30 to 39

Create a Web Service Implementation Class 1-10

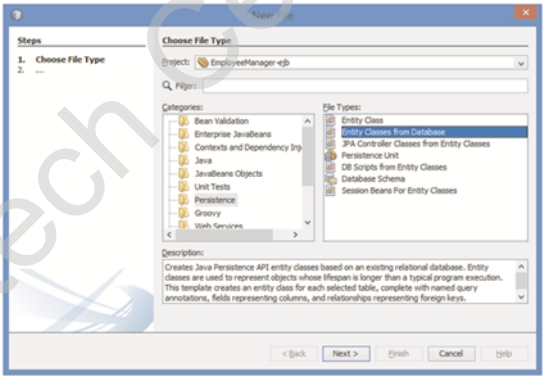
- To create the Web service implementation class, perform the following steps:
- In the NetBeans IDE, click File → New Project → Others and then, in the New Project wizard, select Java EE from the Categories list and Enterprise Application from the Projects list, as shown in the following figure:



 JAX-WS/Session 5 30

Create a Web Service Implementation Class 2-10

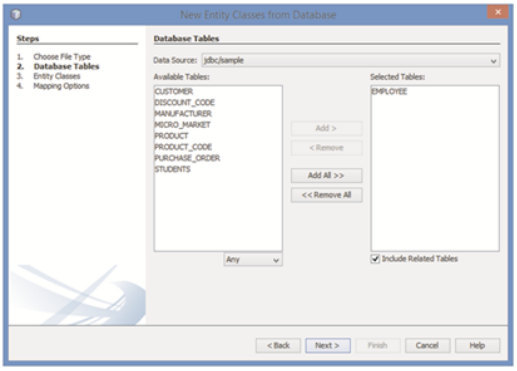
To use entity beans to create the Web service, entity classes need to be created from the Employee database. To do this, right-click EmployeeManager-ejb and then, click New → Other. Then, in the New File wizard, select Persistence in the Categories list and Entity Classes from Database in the File Types list, as shown in the following figure:



 JAX-WS/Session 5 31

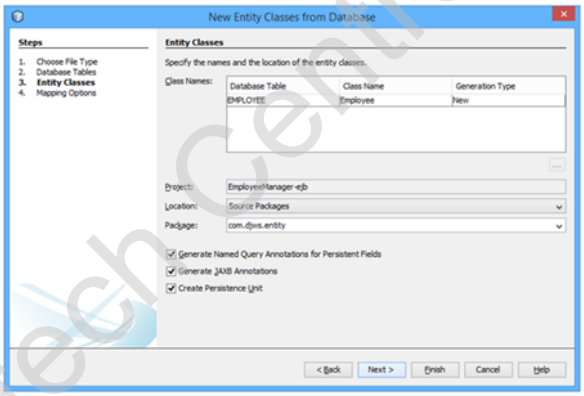
Create a Web Service Implementation Class 3-10

Next, to select the database to use, in the Database Source drop-down list, select jdbc/sample. All the tables associated with the selected source will be displayed in the Available Tables list. Select EMPLOYEE and then, click the Add button to add the table to the Selected Tables list, as shown in the following figure:



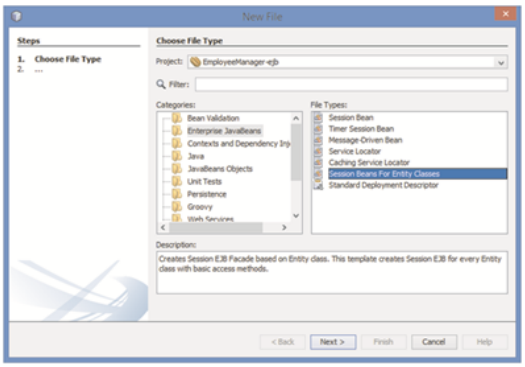
Create a Web Service Implementation Class 4-10

On the next page of the wizard, specify a package for the entity classes and then, click Finish, as shown in the following figure:



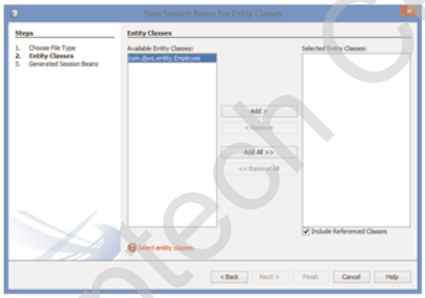
Create a Web Service Implementation Class 5-10

To create session beans from the entity classes, right-click EmployeeManager-ejb and then, click New → Others. Then, in the New File wizard, select Enterprise JavaBeans from the Categories list and Session Beans for Entity Classes from the File Types list, as shown in the following figure:

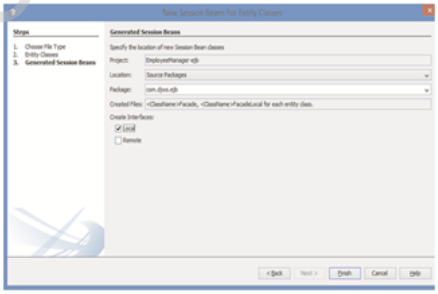


Create a Web Service Implementation Class 6-10

On the next page of the wizard, select the required entity classes from the Available Entity Classes list and then, click the Add button, as shown in the following figure:

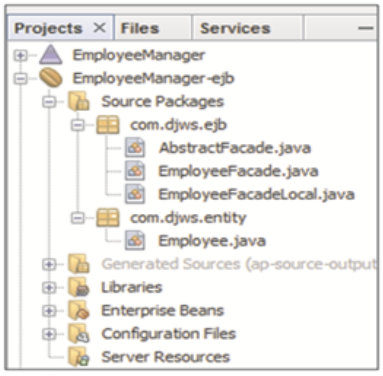


Next, specify a package name for the session beans and select Local to create local interfaces, as shown in the following figure:

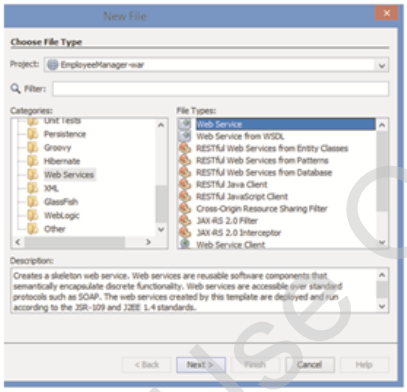


Create a Web Service Implementation Class 7-10

Three Java classes will be created. In this example, the three Java classes are AbstractFacade, EmployeeFacade, and EmployeeFacadeLocal, as shown in the following figure:

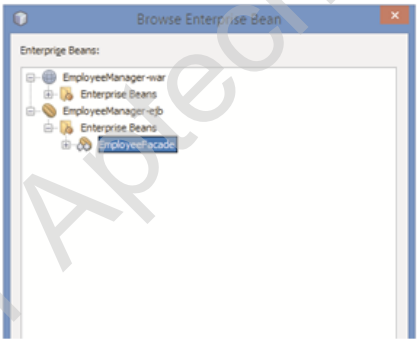


To create a Web Service from the sessions beans, right-click EmployeeManager-war, and then, click New → Other. Then, in the New File wizard, select Web Services in the Categories list and Web Service in the File Types list, as shown in the following figure:



Create a Web Service Implementation Class 8-10

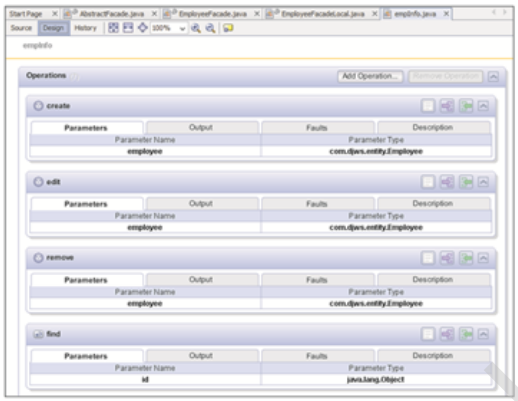
Specify a name for the Web service, a package name for the Web service, select the Create Web Service from Existing Session Bean option, and then, click Browse. In the Browse Enterprise Bean dialog box, select the bean to be used, as shown in the following figure:



Select the Implement Web Service as Stateless Session Bean check box, as shown in the following figure:

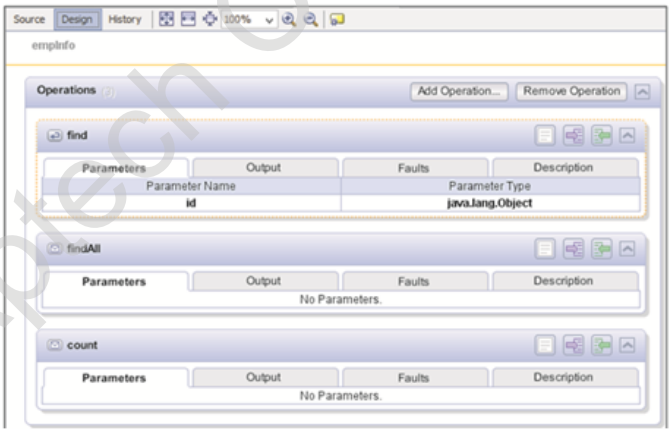
Create a Web Service Implementation Class 9-10

- Alternatively, you can create a session bean from scratch. By default, the Web service is implemented as a stateful session bean. To create a stateless session bean, you need specify explicitly by selecting the check box provided. The .java file for the Web service is created.
- By default, this Web service contains code for several operations, such as create, edit, remove, find, findAll, findRange, and count, which can be viewed by clicking the Design tab as shown in the following figure:



Create a Web Service Implementation Class 10-10

To remove some of these default operations, in the Design tab, click the operation name bar to select the operation and click Remove Operation button. Retain the count, find, and findAll operations, as shown in the following figure:



Using slides 30 to 39, explain what the Web service implementation class contains, namely, the method definition or implementation code for the method, which is accessed by the client. Demonstrate the various steps to create the Web service implementation class using the figures given on slides 30 to 39.

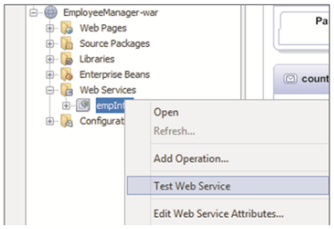
Build, Package, and Deploy the Web Service
Slides 40 to 42

Build, Package, and Deploy the Web Service 1-3

- The generation and deployment of the Web service is done in NetBeans IDE. The steps to do are as follows:

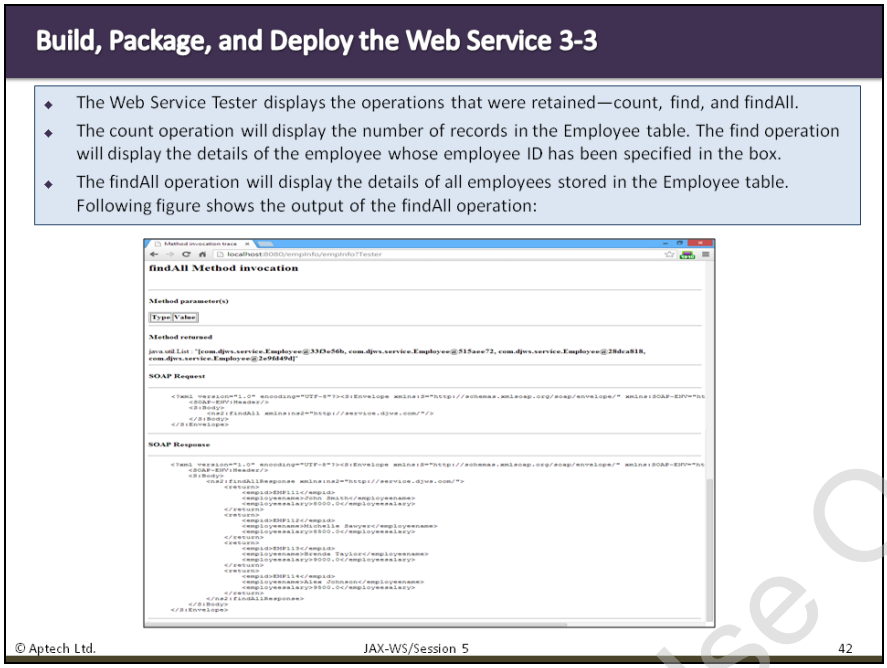
1. Select the project in NetBeans IDE.
2. Right-click to view the context menu.
3. Select Deploy from the context menu.

The command Deploy builds and packages the Web application into the WAR file. Then, it deploys the file on the application server, that is, GlassFish Server. To test the Web Service, right-click the Web Service and then, in the context menu, click Test Web Service, as shown in the following figure:



Build, Package, and Deploy the Web Service 2-3

The tester Web page appears as shown in the following figure:



Using slides 40 to 42, explain how to build, package, and deploy the Web service. Demonstrate the steps to deploy the Web service, which are:

- Select the project in NetBeans IDE.
- Right-click to view the context menu.
- Select Deploy from the context menu.

Also, explain about tester Web page using the figures on slides 41 and 42.

In-Class Question:

List the steps to deploy the Web service.

Answer:

1. Select the project in NetBeans IDE.
2. Right-click to view the context menu.
3. Select Deploy from the context menu.

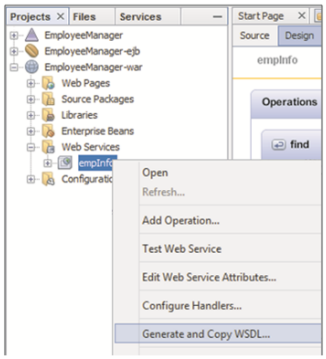
Create Web Client

Slides 43 to 48

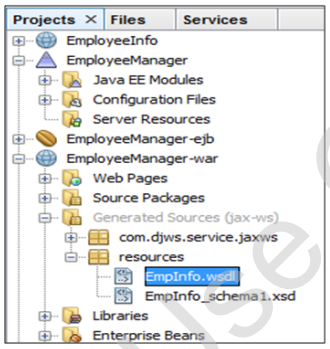
Create Web Client 1-6

- A Web client can be created using JSP, Servlet, and so on. The WSDL file is generated based on the Web service.

The WSDL can also be copied to the project. To do this, right-click the Web service and then, click Generate and Copy WSDL as shown in the following figure:



A new folder is created in the project named Generated Sources (jax-ws). To view the WSDL file, expand Generated Sources (jax-ws) and then expand resources, as shown in the following figure:



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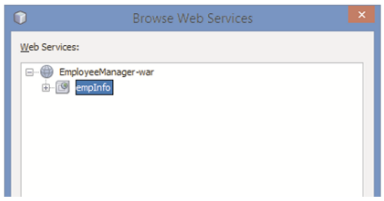
Create Web Client 2-6

The WSDL file is used to generate the Web service client.
Perform the following steps to generate the Web service client:

1. Create a new Web Application project in NetBeans IDE.
2. Ensure that the Glassfish Server is selected and the Context Path is set.
3. Right-click the project and then click New → Others and then in the New File Wizard, select Web Services in the Categories list and Web Service Client in the File Types list.
4. To specify the project where the WSDL file is located, click Browse next to the Project box.
5. Browse to the Web service for which the Web service client is being created, as shown in the following figure:



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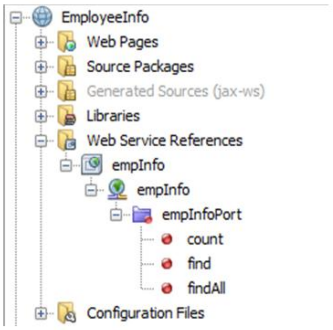
Create Web Client 3-6

A Web Service References folder is created in the project. This folder contains the method exposed by the Web service, as shown in the following figure:



Create Web Client 4-6

6. • Add a new JSP file by right-clicking the project and then clicking New → JSP.
7. • Name the JSP file as index.

Drag the find() method from the Web Service Reference folder to the index.jsp file and place it after the h1 heading. The updated index.jsp file appears, as shown in the following figure:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html>
    <head>
        <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
        <title>JSP Page</title>
    </head>
    <body>
        <h1>Hello World</h1>    <%-- start web service invocation --%><hr/>
    <%
    try {
        com.djws.service.EmpInfo_Service service = new com.djws.service.EmpInfo_Service();
        com.djws.service.EmpInfo port = service.getEmpInfoPort();
        // TODO initialize WS operation arguments here
            java.lang.Object id = null;
        // TODO process result here
        com.djws.service.Employee result = port.find(id);
    } catch (Exception ex) {
        // TODO handle custom exceptions here
    }
    %>
    <%-- end web service invocation --%><hr/>
    </body>
</html>
```

Create Web Client 5-6

Update the title of the JSP page and h1 heading, add an input text box for entering the employee ID and a button, add the code to use the Web service to retrieve and display the relevant employee details and add the exception handling code in the catch block as shown in the following code snippet:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html>
    <head>
        <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
        <title>JSP Page</title>
     <link href="style.css" rel="stylesheet" type="text/css"/>
    </head>
    <body>
        <h1>Employee Information</h1>
<%-- start Web service invocation --%><hr/>
        <form action="index.jsp">
        Enter Employee ID:
        <input type="text" id="txtbox" name="empid" size="6"
maxlength="6">
        <br></br>
        <input type="submit" value="Get Details">
        <br></br>
<%
```

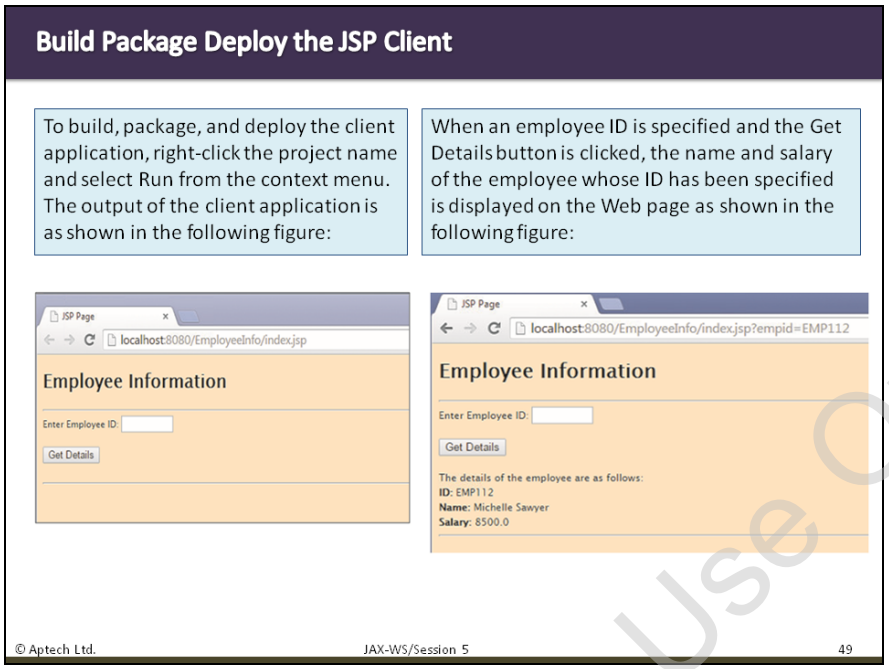

Create Web Client 6-6

```
try {
com.djws.service.EmpInfo_Service service = new
com.djws.service.EmpInfo_Service();
          com.djws.service.EmpInfo port = service.getEmpInfoPort();

// TODO initialize WS operation arguments here
          if(request.getParameter("empid")!=null){
java.lang.String id =request.getParameter("empid");

          // TODO process result here
          com.djws.service.Employee emp = port.find(id);
          out.println("The details of the employee are as follows:");
      out.println("<br>");
      out.println("<b>ID: </b>" + emp.getEmpid());
      out.println("<br>");
      out.println("<b>Name: </b>" + emp.getEmployeename());
      out.println("<br>");
      out.println("<b>Salary: </b>" + emp.getEmployeesalary());
          }
       }
catch (Exception ex) {
          out.println("Exception :" + ex);
       }
    %>
    <%-- end Web service invocation --%><hr/>
 </form>     </body>   </html>
```


Using slides 44 to 48, explain that WSDL file is generated based on the Web service. Explain the code to generate WSDL by the Web eservice. Demonstrate the steps to generate the WSDL Web Client. Using the figures on slides 43 to 46, explain the creation of index.jsp file. Explain the addition of the exception handling code and the style.css file specified in the Code Snippet on slides 47 and 48.

Build Package and Deploy the JSP Client

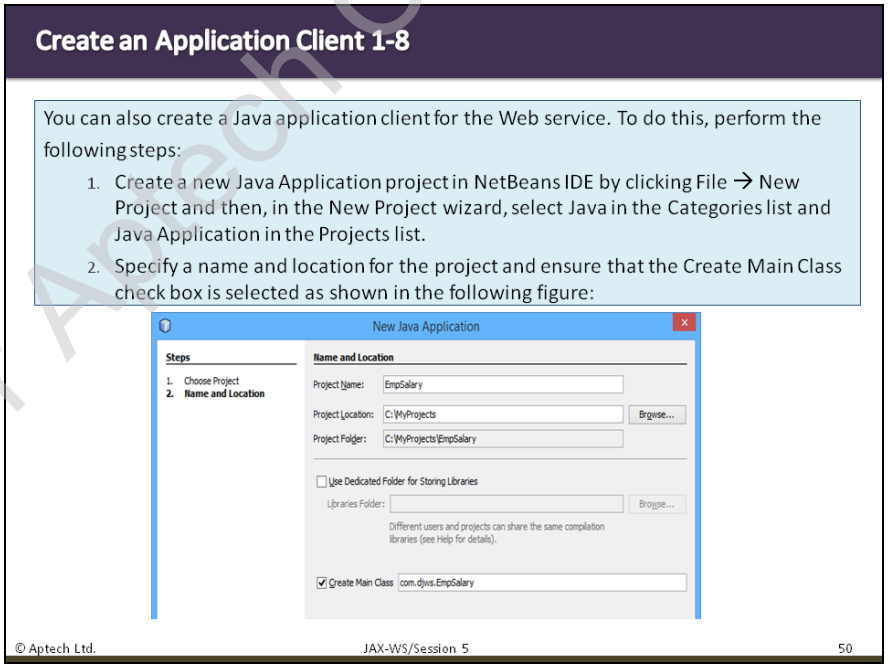
Slide 49



Using slide 49, demonstrate the steps to build, package, and deploy the JSP client. Use the figures to show the output of the client application and the retrieved employee details that are displayed on the Web page.

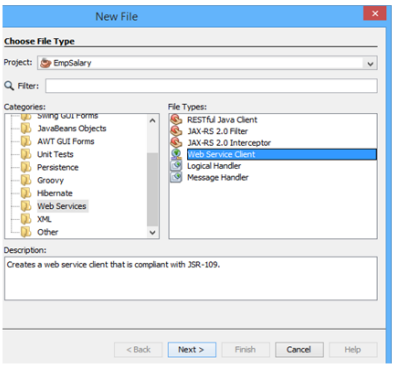
Create an Application Client

Slides 50 to 57

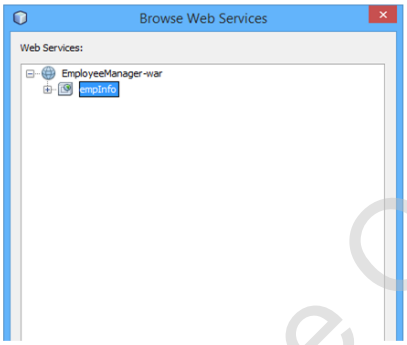


Create an Application Client 2-8

3. To create a Web service client, right-click the Java Application project and then click New → Others. Then, in the New File wizard, select Web Services in the Categories list and Web Service Client in the File Types list, as shown in the following figure:

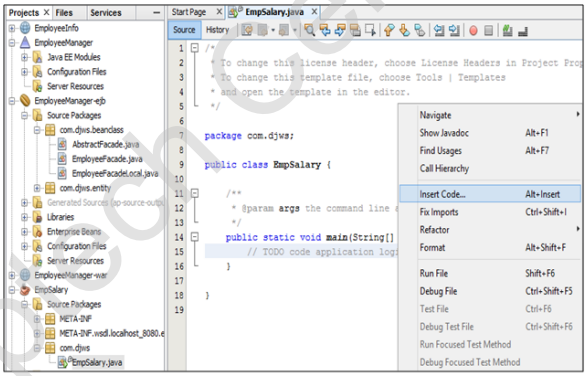


4. To specify the project that contains the Web service, in the New Web Service Client wizard, click Browse, next to the Project box, and then in the Browse Web Service dialog box, select the Web service for which the client is being created, as shown in the following figure:



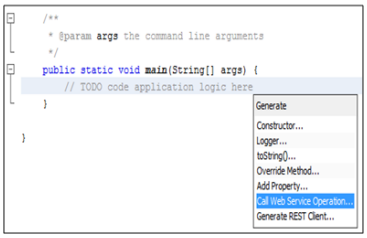
Create an Application Client 3-8

5. The Web Service code will be generated. Build the Web service client project to compile all the generated resources.
6. Open the EmpSalary.java file, right-click inside the main() method, and then click Insert Code as shown in the following figure:

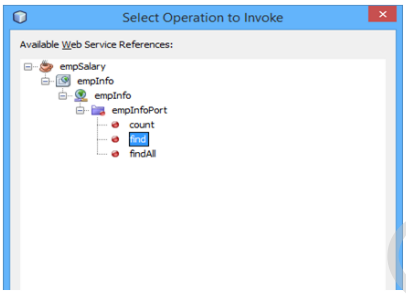


Create an Application Client 4-8

7. In the context menu that appears, click Call Web Service Operation, as shown in the following figure:



8. In the Select Operation to Invoke dialog box, select the find() method, as shown in the following figure:



Create an Application Client 5-8

The IDE adds the code required to invoke the find() method, as shown in the following figure:

```
11
12  public class EmpSalary {
13
14      /**
15       * @param args the command line arguments
16       */
17      public static void main(String[] args) {
18          // TODO code application logic here
19      }
20
21      private static Employee find(java.lang.Object id) {
22          com.djws.service.EmpInfo_Service service = new com.djws.service.EmpInfo_Ser
23          com.djws.service.EmpInfo port = service.getEmpInfoPort();
24          return port.find(id);
25      }
26
27  }
```

Create an Application Client 6-8

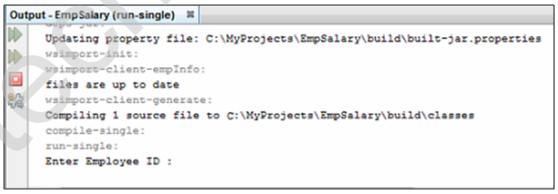
9. To accept user input and display the output, add the code given as shown in code snippet, in the main() method of the EmpSalary class.

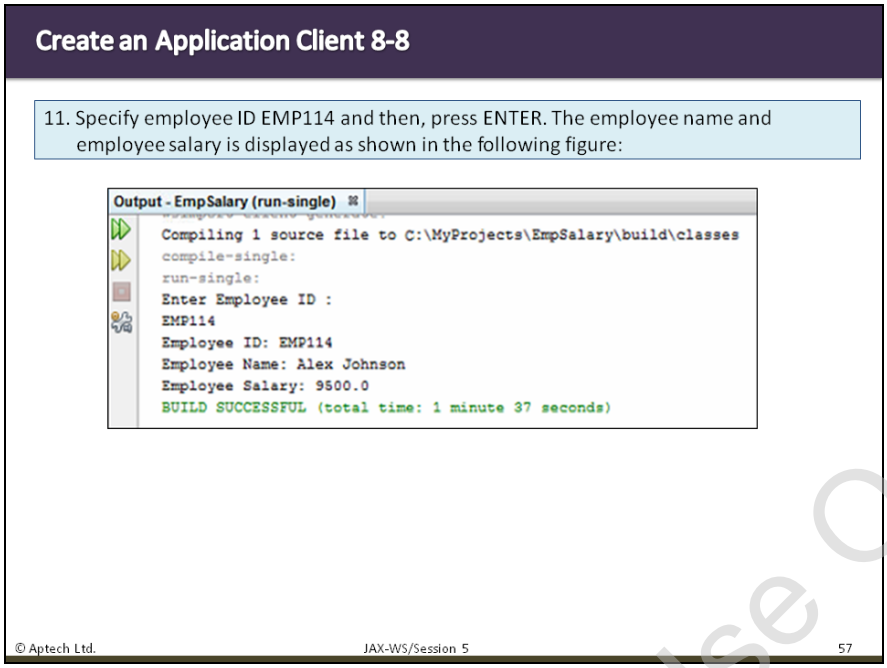
```
...
import java.util.scanner;
...
{
public static void main(String[] args)
{
    String empId = null;
    Scanner in = new Scanner(System.in);
    System.out.println("Enter Employee Id :");
    empId = in.nextLine();
    Employee emp = new Employee();
    emp = find (empId);
    System.out.println("Employee ID: " + emp.getEmpid());
    System.out.println("Employee Name: " +
emp.getEmployeename());
    System.out.println("Employee Salary: " +
                       emp.getEmployeesalary());
}
```


Create an Application Client 7-8

```
private static Employee find(java.lang.String id)
{
    com.djws.EmpInfo_Service service = new
         com.djws.EmpInfo_Service();
    com.djws.EmpInfo port = service.getEmpInfoPort();
    return port.find(id);
}
}
```

10. Build and run the EmpSalary project. The user will be prompted to enter the employee ID as shown in the following figure:

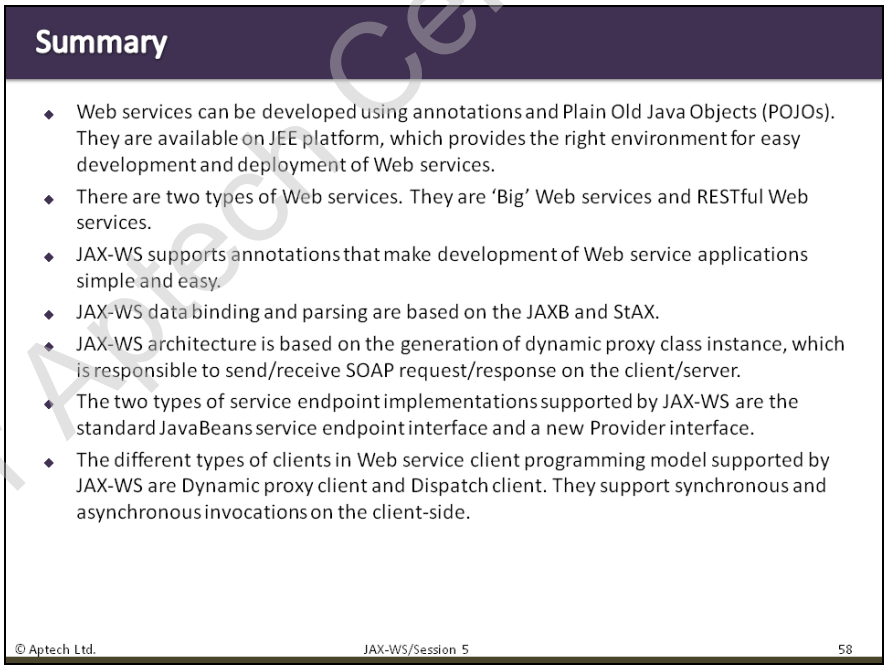




Using slides 50 to 57, demonstrate the steps to create a Java application client for the Web service. Use the figures to point out what option(s) need to be selected in the menu or dialog boxes to get the final output of the Web services.

Summarize Session

Slide 58



Using slide 58, summarize the session. Make them revise the following points:

- Web services can be developed using annotations and Plain Old Java Objects (POJOs). They are available on JEE platform, which provides the right environment for easy development and deployment of Web services.

- There are two types of Web services. They are 'Big' Web services and RESTful Web services.
- JAX-WS supports annotations that make development of Web service applications simple and easy.
- JAX-WS data binding and parsing are based on the JAXB and StAX.
- JAX-WS architecture is based on the generation of dynamic proxy class instance, which is responsible to send/receive SOAP request/response on the client/server.
- The two types of service endpoint implementations supported by JAX-WS are the standard JavaBeans service endpoint interface and a new Provider interface.
- The different types of clients in Web service client programming model supported by JAX-WS are Dynamic proxy client and Dispatch client. They support synchronous and asynchronous invocations on the client-side.

5.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. You should also explore the next session which describes the RESTful Web services.

Tips: You can also check the **Articles**/**Blogs**/**Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in the next session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.

Session 6: RESTful Web Services

6.1 Pre-Class Activities

You should familiarize yourself with RESTful Web services. You should be able to explain Java API for RESTful Web Services Application Program Interface (JAX-RS API). You should also know how to build a RESTful Web service with JAX-RS API.
Familiarize yourself with the topics of the current session in-depth.

6.1.1 Objectives

After the session, learners will be able to:

- Explain RESTful Web Services
- Describe JAX–RS API
- Explain how to build a RESTful Web Service with JAX-RS API

6.1.2 Teaching Skills

To teach this session, you should be well versed with RESTful Web Services. You should know about REpresentational State Transfer (REST) architecture guidelines and the constraints applied to these architectures. You should know the requirements for developing RESTful Web services. You should be able to describe the JAX-RS API, its annotations, and how to build a RESTful Web Service with JAX-RS API. You should know well how to use RESTful implementation class. You should have sound knowledge on how to build, package and deploy the RESTful Web service. You should also know all the steps to create a Web client for the RESTful Web service. For teaching in the class, you are expected to use slides and LCD projectors.

Tips:
It is recommended that you test the understanding of the students by asking questions in between the class.

6.1.3 In-Class Activities:

Follow the order given here during In-Class activities.

Review of Previous Session

You should begin with a brief recap or review of previous session which defined JAX-WS and explained the need, features, and standards of JAX-WS. You should summarize about JAX-WS architecture and JAX-WS annotations and JAX-WS programming model discussed in the previous session.

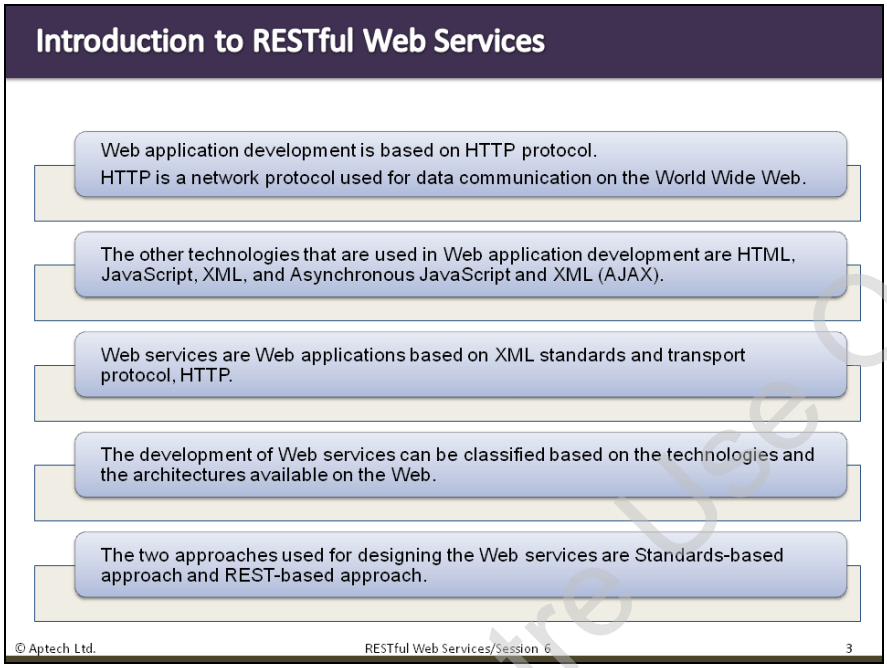
Overview of the Session

Give the students the overview of the current session in the form of session objectives. Show the students slide 2 of the presentation. Tell the students that this session explains RESTful Web services. Tell that the session also describes JAX-RS API and explains how to build a RESTful Web Service with JAX-RS API.

6.2 In-Class Explanations

Introduction to RESTful Web Services

Slide 3



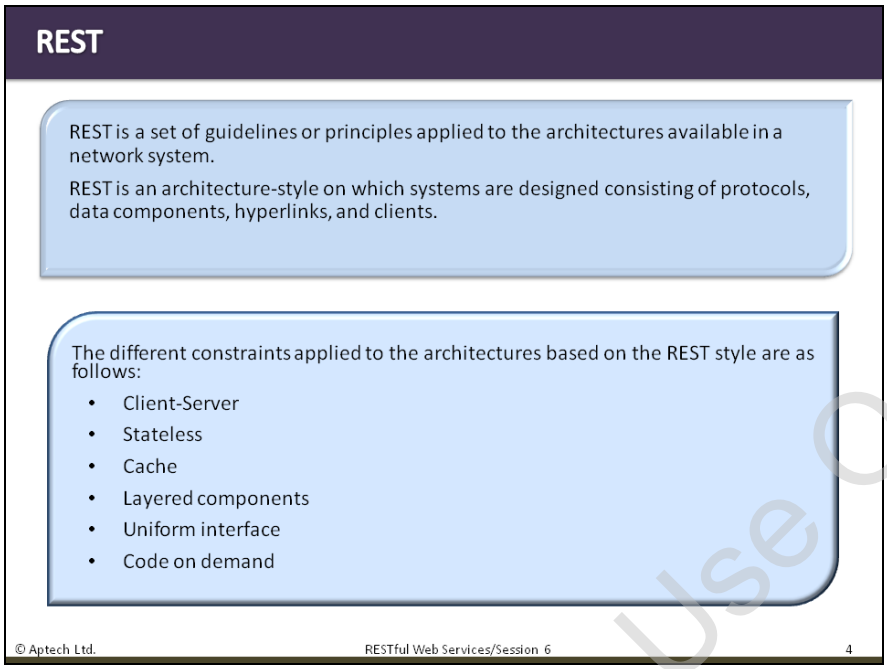
Using slide 3, introduce the learners to RESTful Web Services. Mention that RESTful Web Services are based on Hyper Text Transfer Protocol (HTTP) protocol, which implements a request-response pattern in the client-server architecture. List the other technologies such as HTML, JavaScript, XML, and Asynchronous JavaScript and XML (AJAX) that are used in Web application development.

Explain that Web services are classified on the basis of technologies. Cite few examples such as Simple Object Access Protocol (SOAP), Web Service Definition Language (WSDL), Extensible Markup Language (XML), security, Uniform Resource Locator (URL), and JAX-RPC. Point out that Web services are also based on the Web architectures such as client-server architecture.

Mention that in these architectures, a server transfers the information requested by the client, which is presented to the client. Discuss about the Standards-based approach and REST-based approach, the two approaches used for designing the Web services. Mention that the Uniform Resource Identifiers (URIs) that are accessible over HTTP protocol identify these resources.

REST

Slide 4



Using slide 4, explain the concept of REST. Mention that the World Wide Web, a system of interlinked hypertext documents, is an example of the REST architecture-style. Explain the different constraints applied to the architectures based on the REST style.

In-Class Question:

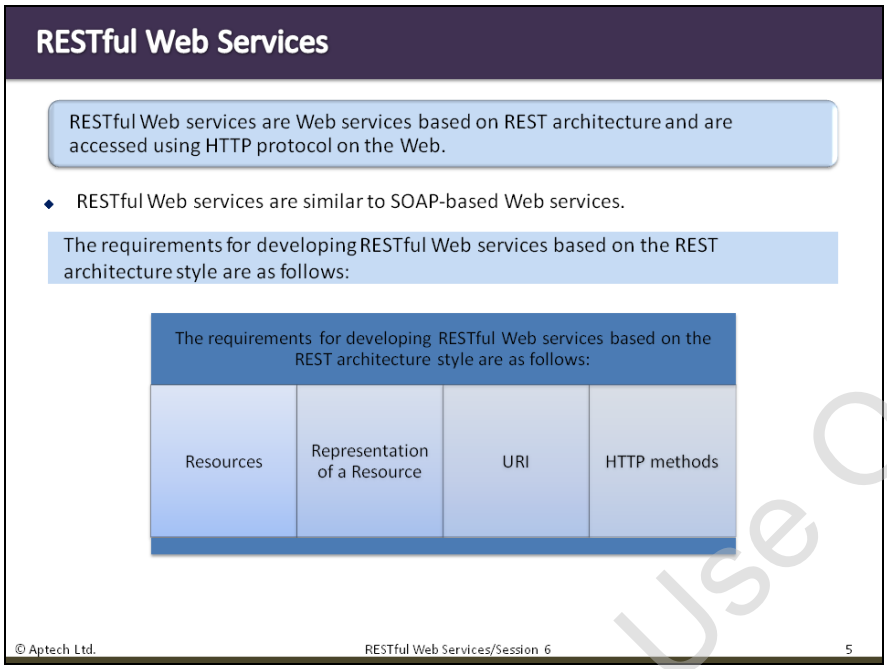
What is REST?

Answer:

REST is a set of guidelines or principles applied to the architectures available in a network system.

RESTful Web Services

Slide 5



Using slide 5, explain about RESTful Web services. Tell that RESTful Web services are platform and language independent. Explain the similarity in characteristics of RESTful Web services and SOAP-based Web services. Then, explain the difference between RESTful Web services and SOAP-based Web services. Mention that RESTful Web services use Uniform Resource Identifier (URI) to send data directly to the service over the underlying protocol, HTTP whereas SOAP-based Web services use SOAP protocol over HTTP. Explain the requirements for developing RESTful Web services.

In-Class Question:

List the requirements for developing RESTful Web services based on the REST architecture style.

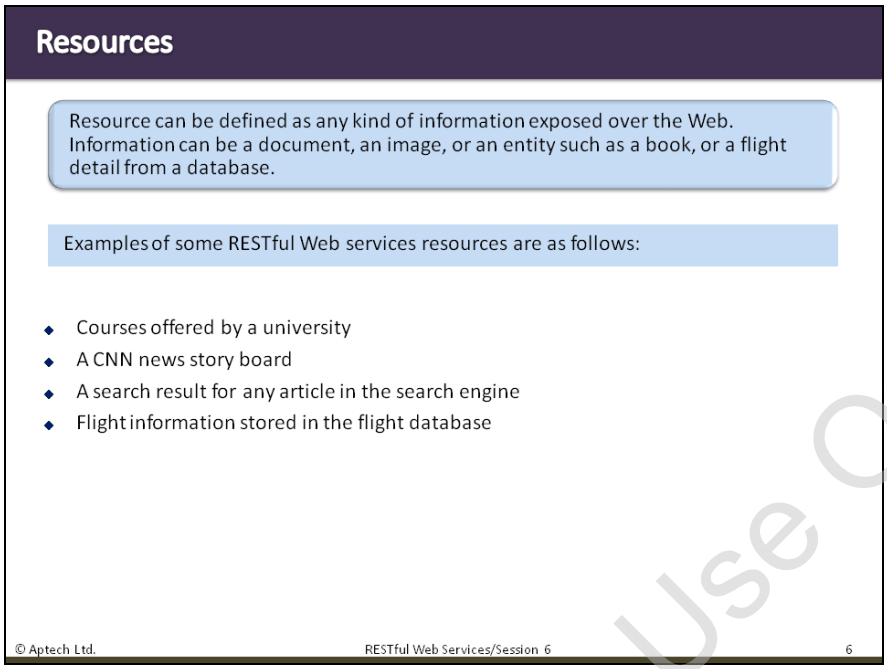
Answer:

The requirements for developing RESTful Web services based on the REST architecture style are as follows:

- Resources
- Representation of a Resource
- URI
- HTTP methods

Resources

Slide 6



Using slide 6, define Resource and provide a few examples of RESTful Web services.

In-Class Question:

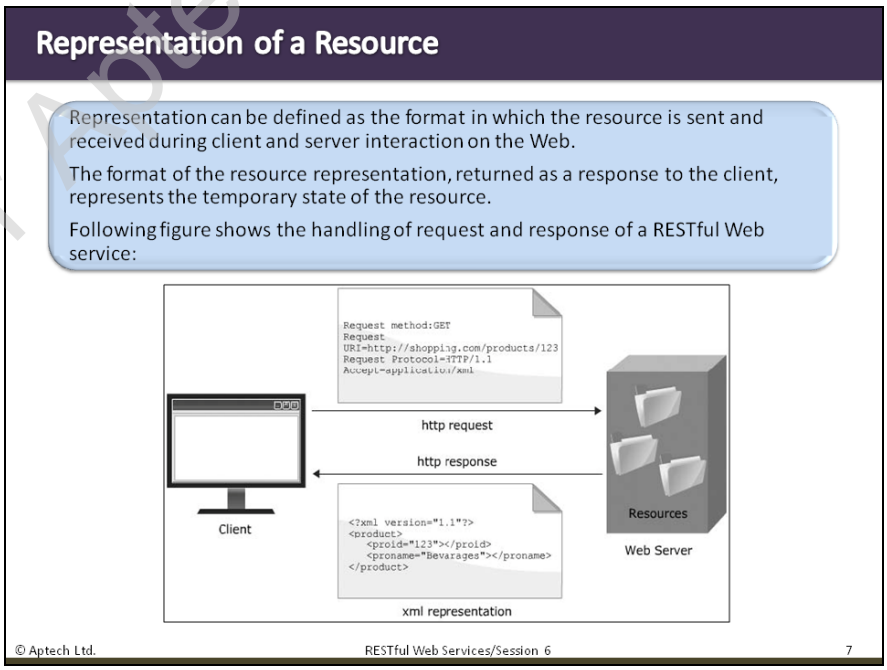
What is a Resource?

Answer:

Resource can be defined as any kind of information exposed over the Web.

Representation of a Resource

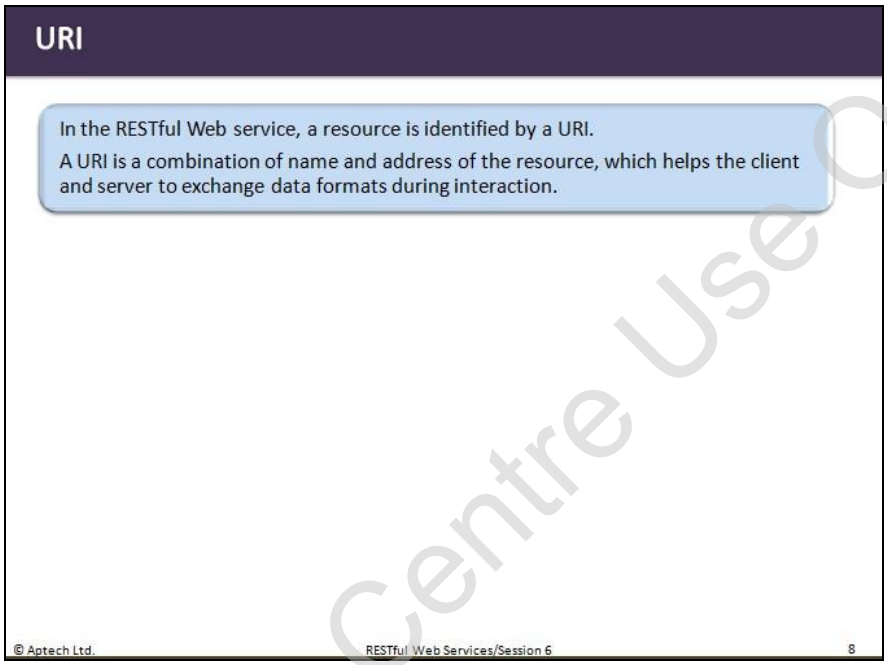
Slide 7



Using slide 7, define Representation. Tell about the different data formats in which a resource can be represented and they can be accessed by different clients. Explain the figure, which shows a client application requesting for a resource on a URI. Explain that client application receives an XML document containing the details of the product in an XML format. Point out that based on the client requirement, the format in which the response is returned varies.

URI

Slide 8



Using slide 8, explain URI and mention that URI helps the client and server to exchange data formats during interaction.

In-Class Question:

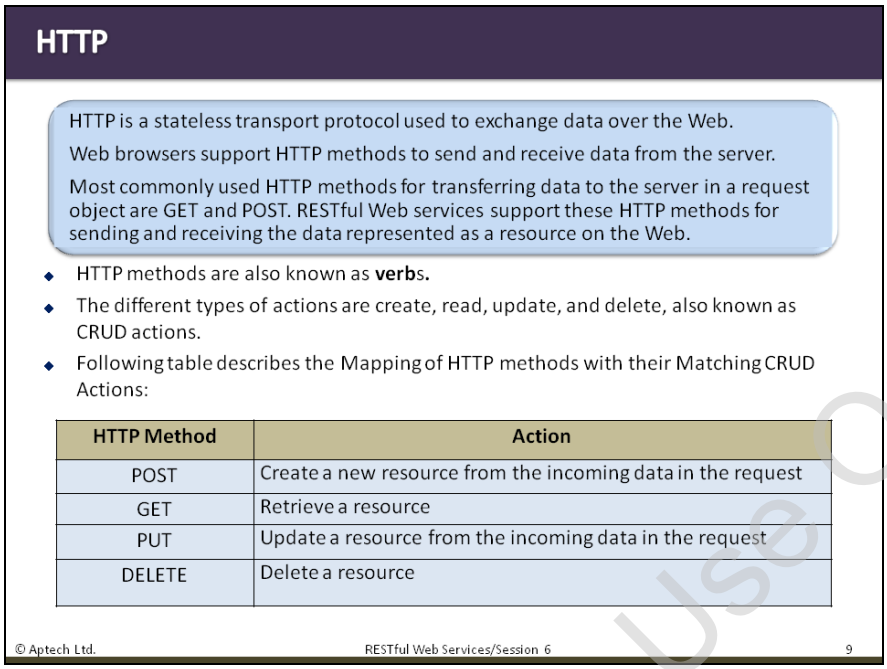
What is URI?

Answer:

A URI is a combination of name and address of the resource, which helps the client and server to exchange data formats during interaction.

HTTP

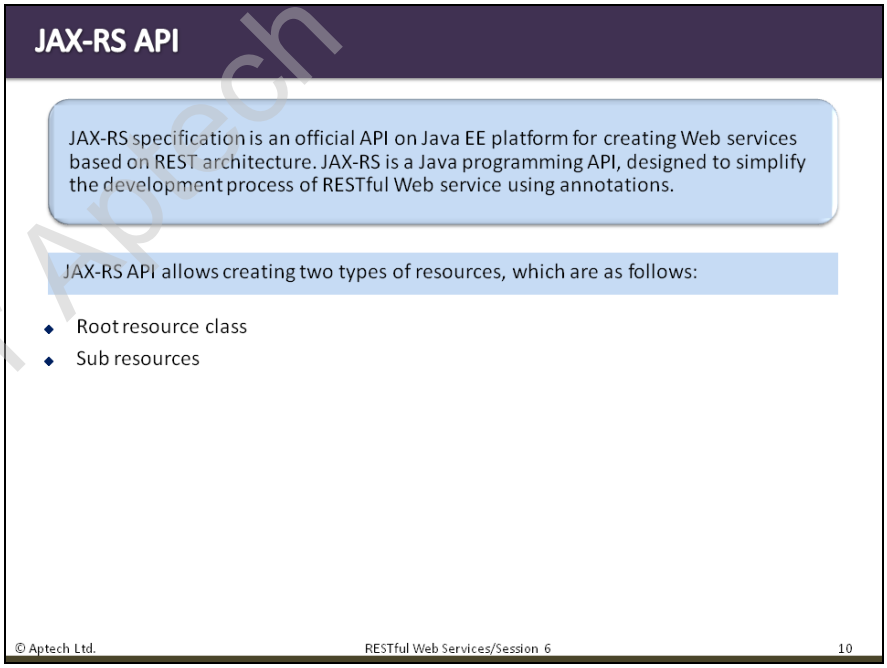
Slide 9



Using slide 9, explain HTTP and its uses. Tell that `GET` and `POST` are the most commonly used HTTP methods for transferring data to the server. Explain that the other HTTP methods are PUT, HEAD, and DELETE. Explain why HTTP methods are also known as 'verbs'. Explain the mapping of HTTP methods with their corresponding CRUD (Create, Read, Update, Delete) Actions.

JAX-RS API

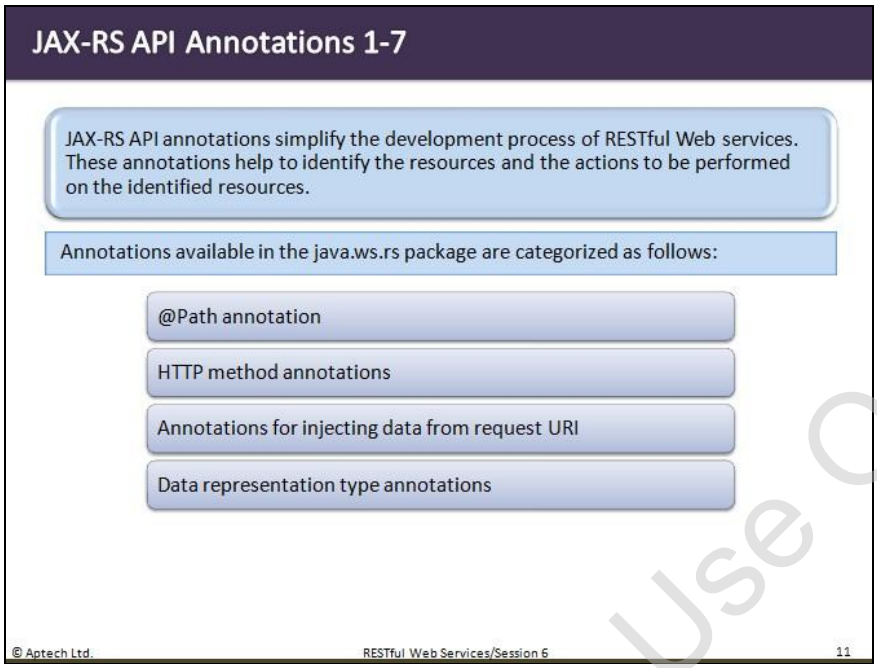
Slide 10



Using slide 10, explain JAX-RS API. Tell that it simplifies the development process of RESTful Web service by using annotations. Discuss the two types of resources that are created by JAX-RS API. Explain the role of `@Path` annotation in the resources of JAX-RS API.

JAX-RS API Annotations

Slides 11 to 17



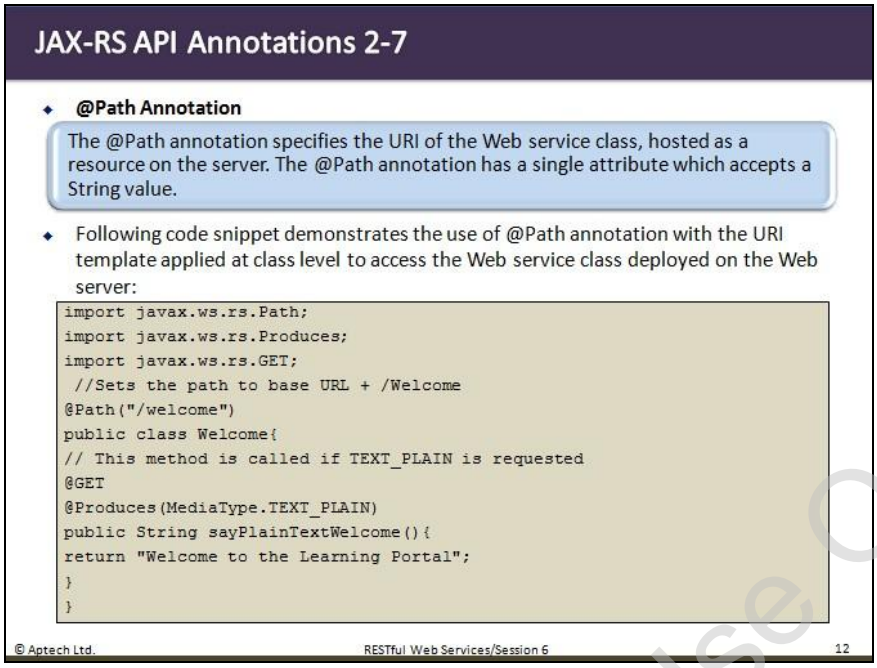
Using slide 11, explain JAX-RS API annotations and the uses of JAX-RS API annotations, which can be listed as follows:

- Simplifying the development process of RESTful Web services
- Identifying the resources and the actions to be performed on the identified resources

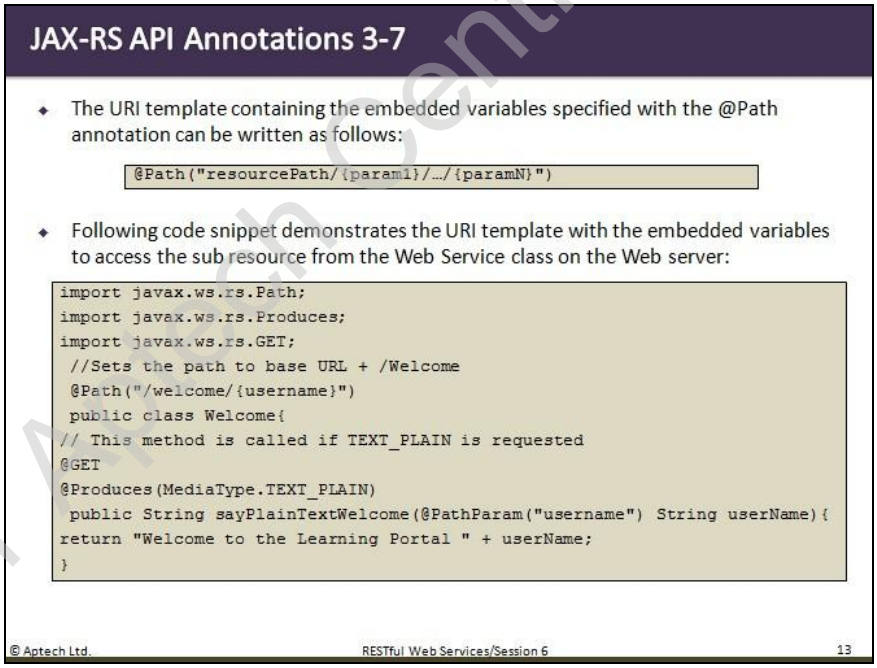
Discuss the action of Annotation Processing Tool (APT) at runtime.

List the annotations available in the javax.ws.rs package, which are as follows:

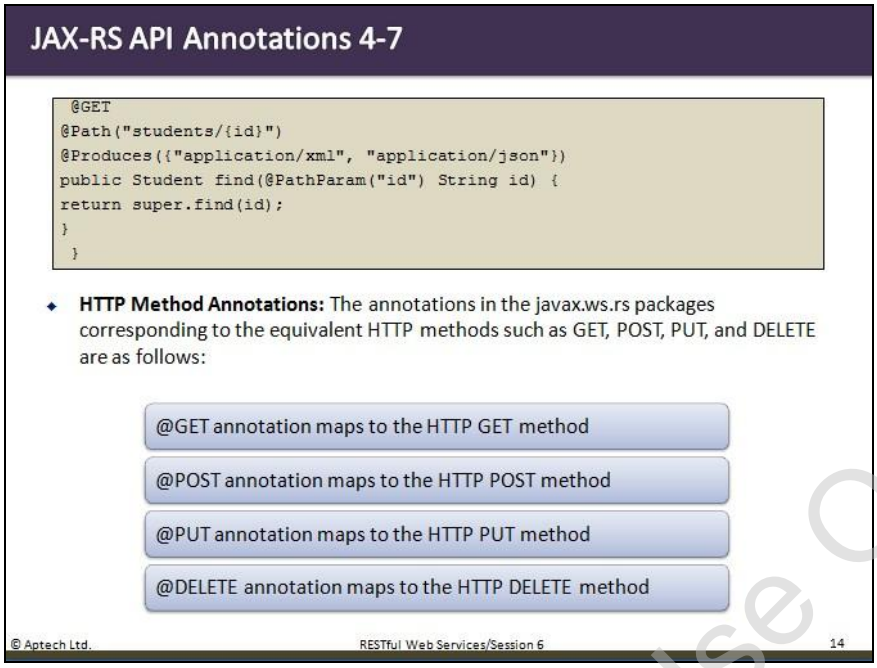
- `@Path` annotation
- HTTP Method Annotations
- Injecting Data from Request URI Annotations
- Data Representation Type Annotations



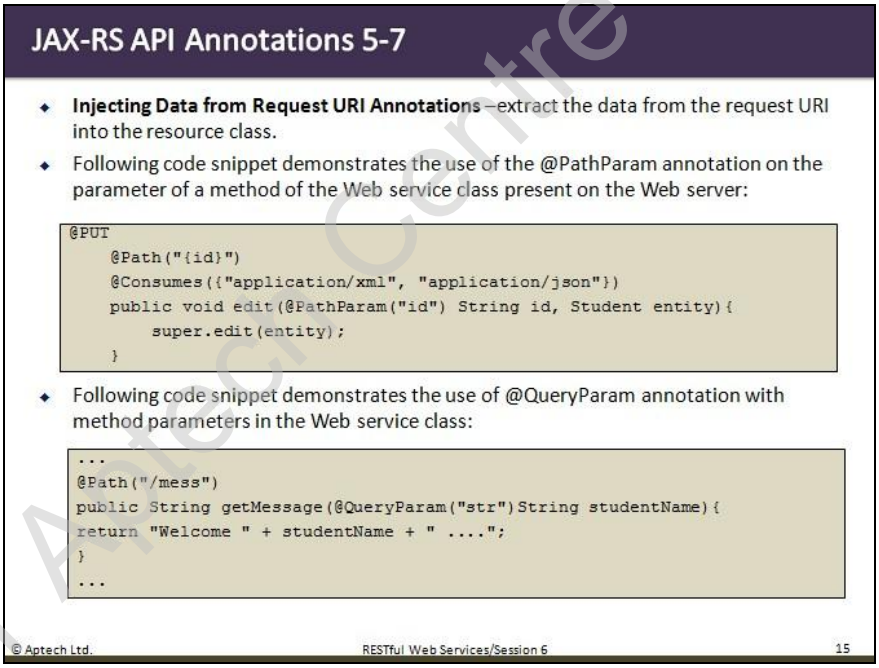
Using slide 12, explain `@Path` annotation. Discuss about the levels at which `@Path` annotation can be used in the Web service class.
Use the Code Snippet to explain the use of `@Path` annotation with the URI template applied at class level, which accesses the Web service class deployed on the Web server.



Using slide 13, mention that URI template can be embedded with the variables for accessing the resources. Using the Code Snippet explain the usage of the URI template with the embedded variables to access the sub resource from the Web Service class on the Web server.

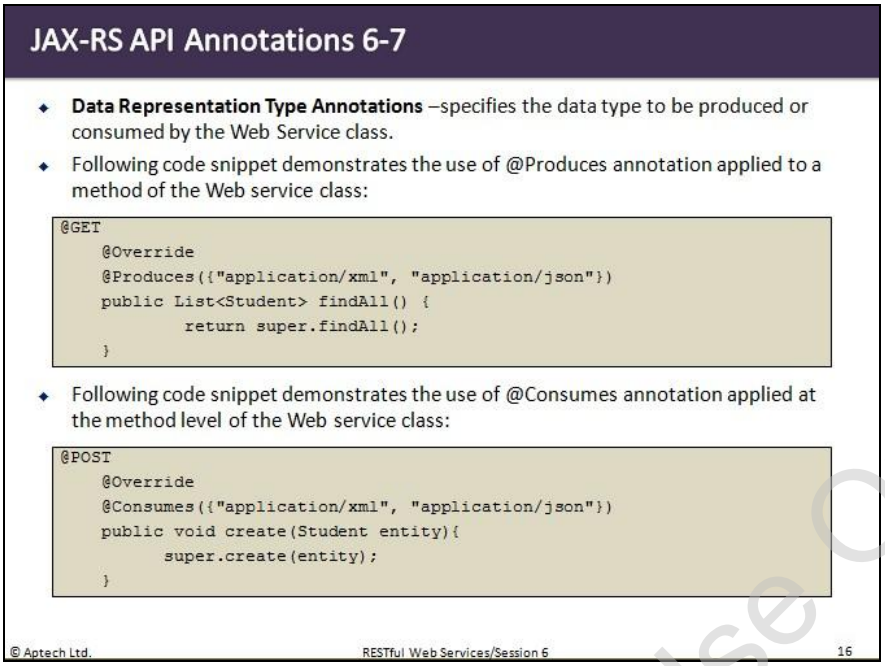


Using slide 14, explain HTTP method annotations. List the annotations in the javax.ws.rs packages corresponding to the equivalent HTTP methods such as GET, POST, PUT, and DELETE.

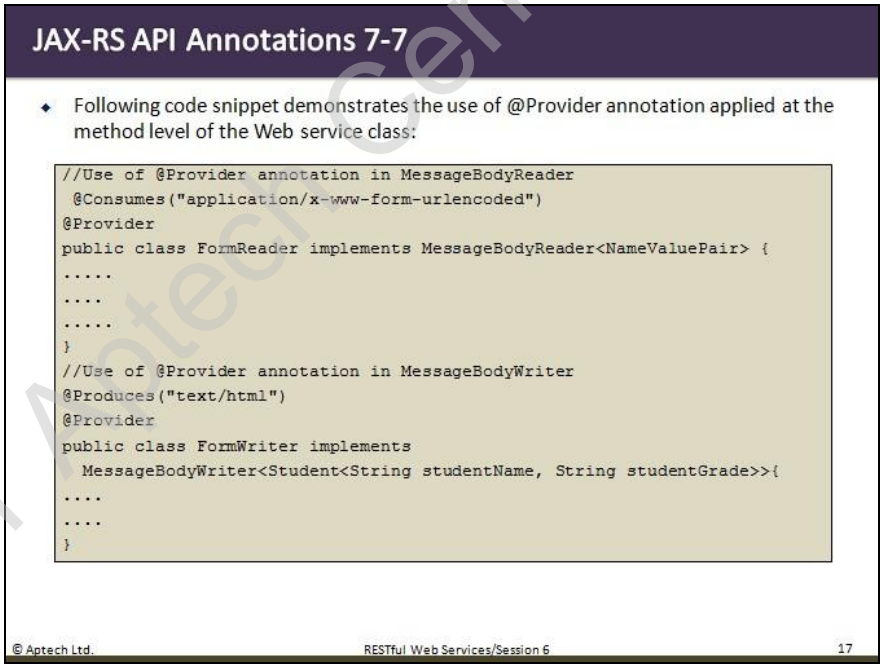


Using slide 15, explain Injecting Data from Request URI Annotations and its use. Describe @PathParam annotation. Using the Code Snippet, explain the use of the @PathParam annotation on the parameter of a method of the Web service class present on the Web server.

Then, explain about @QueryParam annotation and the Code Snippet that demonstrates the use of @QueryParam annotation with method parameters in the Web service class Use the Code Snippets to explain how they are used.



Using slide 16, explain Data Representation Type annotations. Describe @Produces annotation, and explain the Code Snippet that shows the use of @Produces annotation applied to a method of the Web service class. Describe @Consumes annotation, and explain the Code Snippet that shows the use of @Consumes annotation applied at the method level of the Web service class.



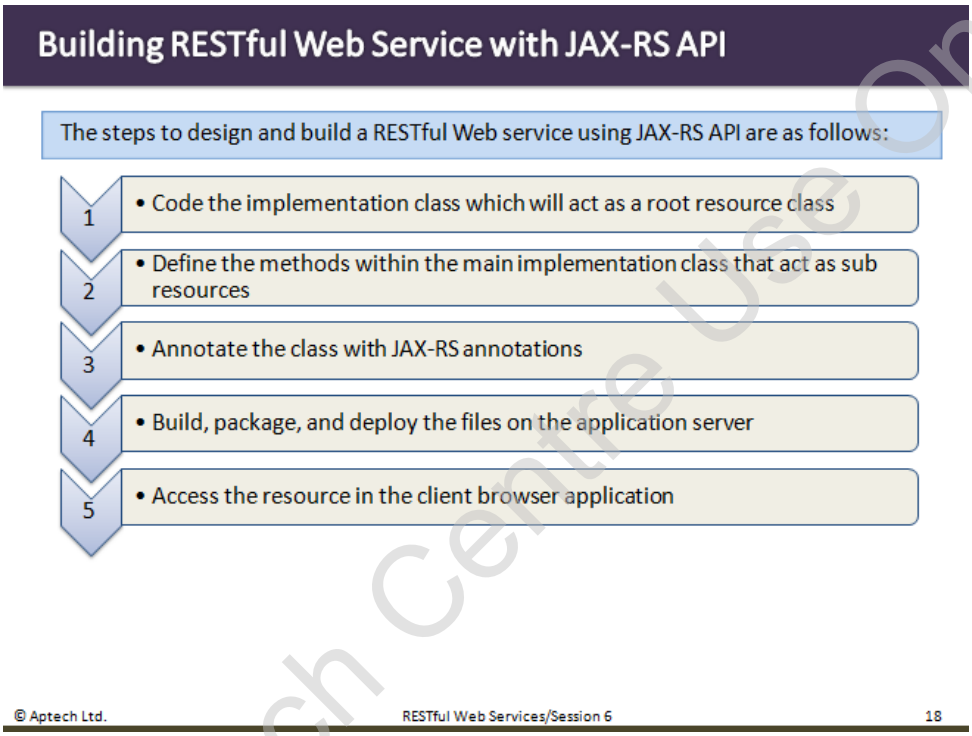
Using slide 17, explain @Provider annotation and state the different types of data representations consumed and produced by the Web service methods. Using Code Snippet, describe the use of @Provider annotation applied at the method level of the Web service class. Mention that the @Provider annotation helps to map MessageBodyReader and MessageBodyWriter to the HTTP request and HTTP response, respectively, using JAX-RS runtime.

In-Class Question:

What is @QueryParam annotation used for?

Answer:
This annotation is used to extract the query parameter from the request URI sent by the client as a name-value pair.

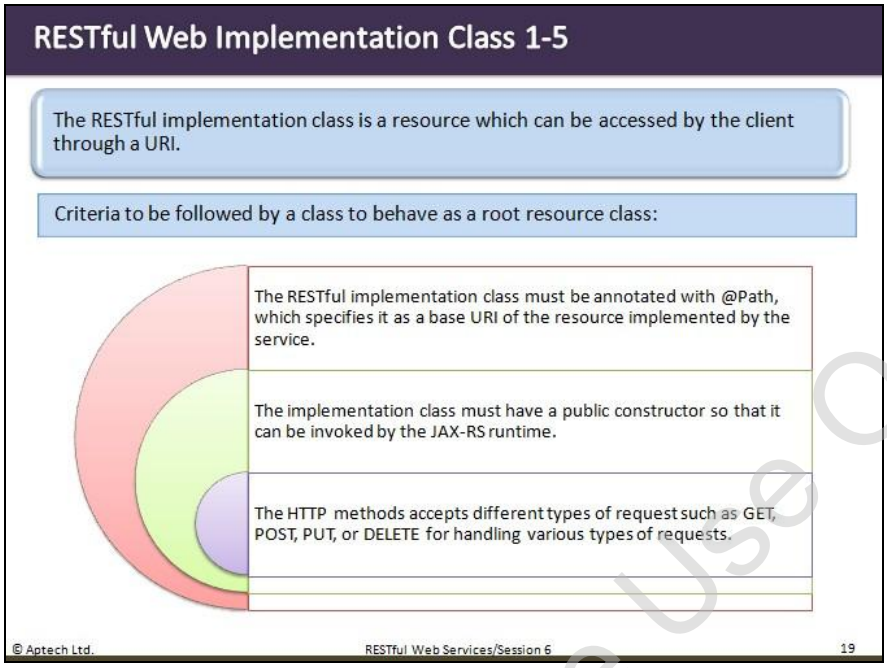
Building RESTful Web Service with JAX-RS API
Slide 18

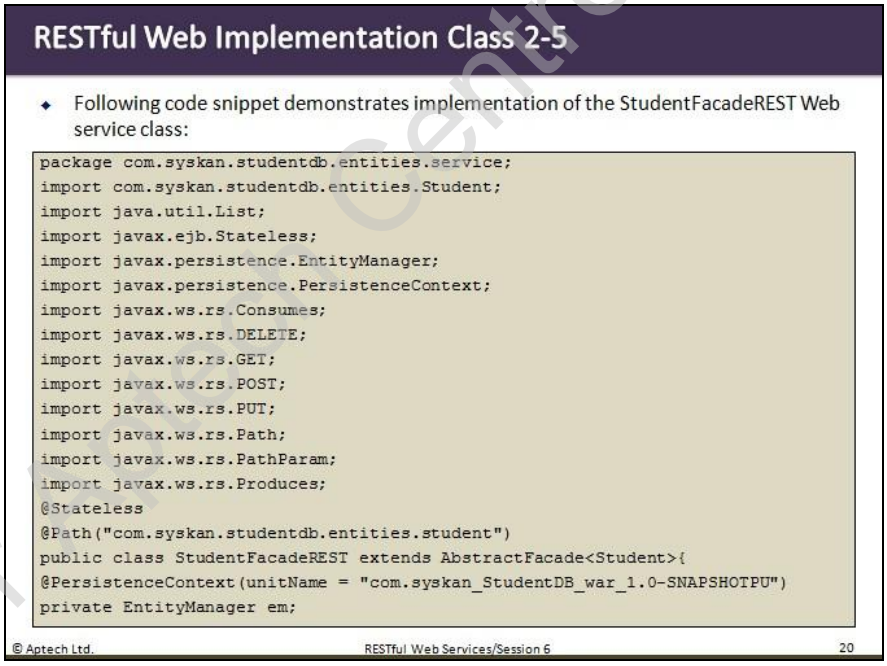


Using slide 18, explain the steps to build a RESTful Web Service with JAX-RS API.

RESTful Web Implementation Class

Slides 19 to 23



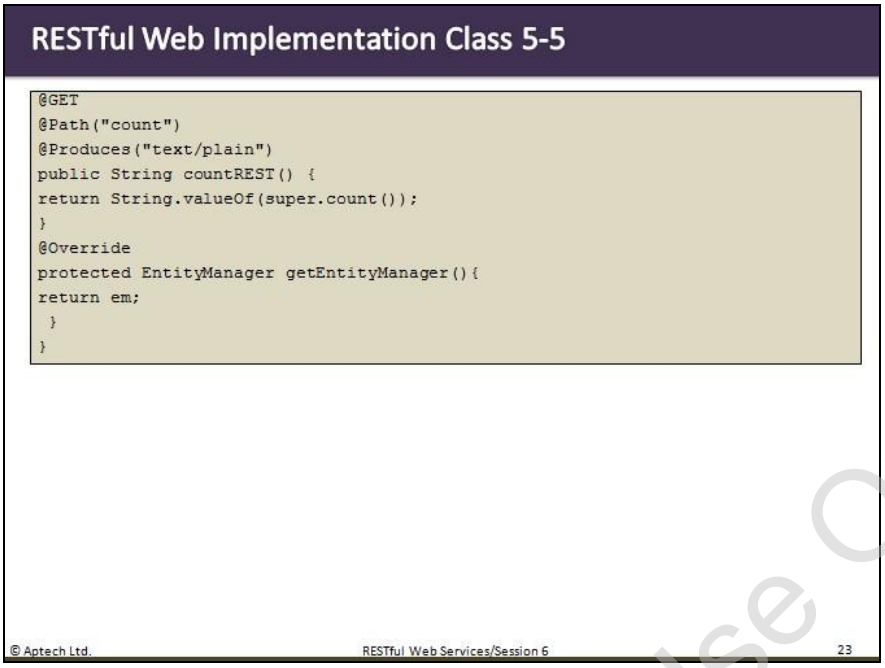


RESTful Web Implementation Class 3-5

```
public StudentFacadeREST() {
super(Student.class);
}
@POST
@Override
@Consumes({"application/xml", "application/json"})
public void create(Student entity) {
super.create(entity);
}
@PUT
@Path("{id}")
@Consumes({"application/xml", "application/json"})
public void edit(@PathParam("id") Integer id, Student entity) {
super.edit(entity);
}
@DELETE
@Path("{id}")
public void remove(@PathParam("id") Integer id) {
super.remove(super.find(id));
}
```


RESTful Web Implementation Class 4-5

```
@GET
@Path("{id}")
@Produces({"application/xml", "application/json"})
public Student find(@PathParam("id") Integer id){
return super.find(id);
}

@GET
@Override
@Produces({"application/xml", "application/json"})
public List<Student> findAll() {
return super.findAll();
}
@GET
@Path("{from}/{to}")
@Produces({"application/xml", "application/json"})
public List<Student> findRange(@PathParam("from") Integer from,
@PathParam("to") Integer to) {
return super.findRange(new int[]{from, to});
}
```

Using slides 19 to 23, explain RESTful Web Implementation Class. Using slide 19, define RESTful implementation class and explain the criteria to be followed by a class to behave as a root resource class. Using slides 20 to 23, explain the Code Snippet that demonstrates the implementation StudentsFacadeREST Web service. Mention that that this code uses the Web service to retrieve a list of the student names based on count, by id, or by using the functions findAll(), find(), and findRange() with proper parameters.

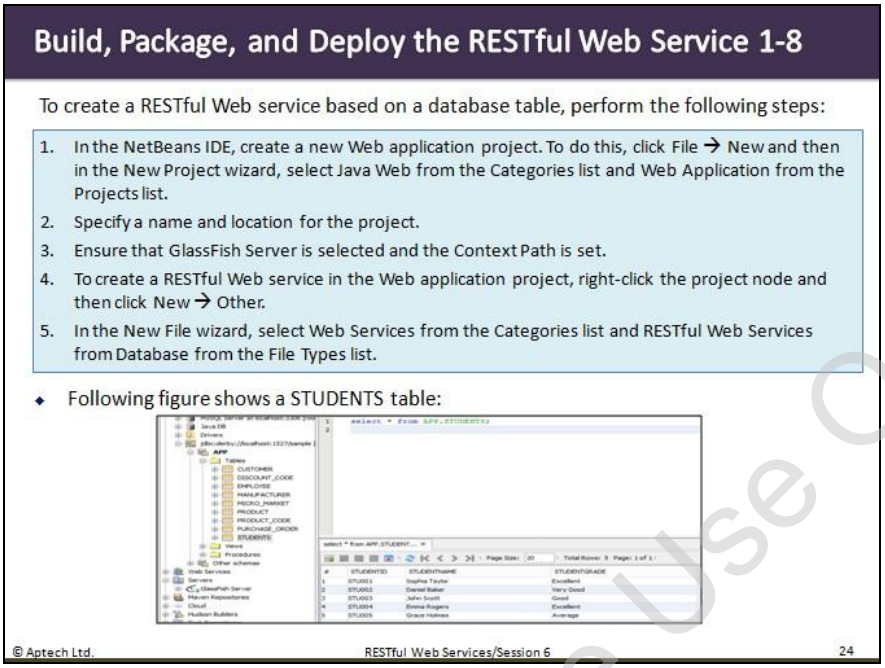
In-Class Question:

 What is RESTful Web implementation class?

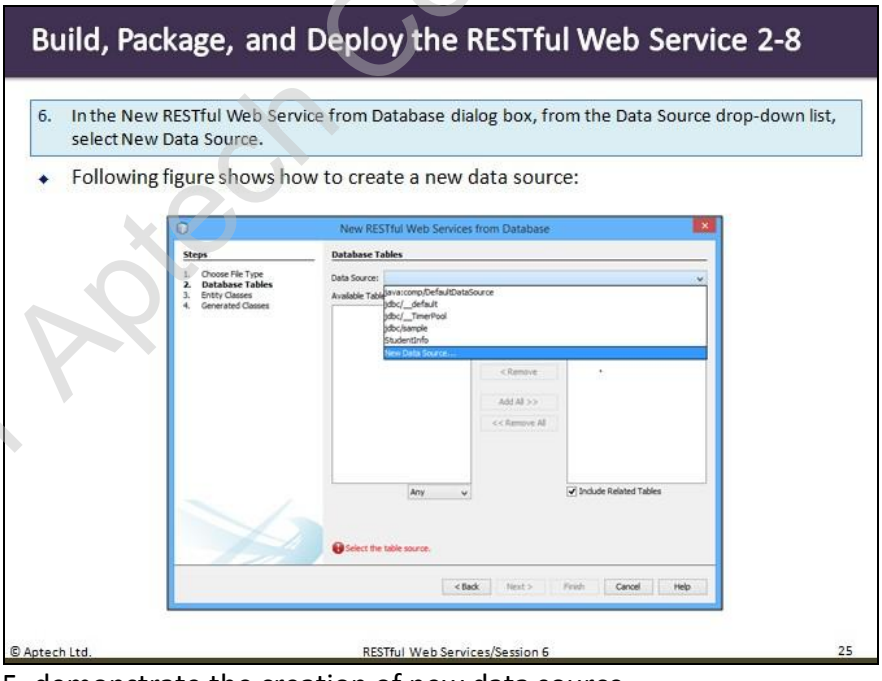
Answer:
The RESTful implementation class is a resource which can be accessed by the client through a URI.

Build, Package, and Deploy the RESTful Web Service

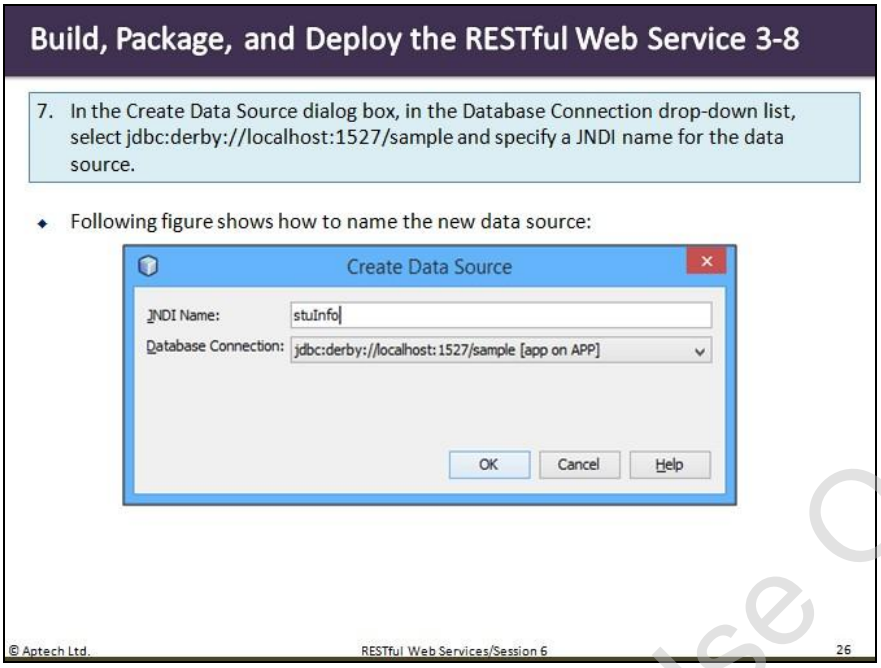
Slides 24 to 31



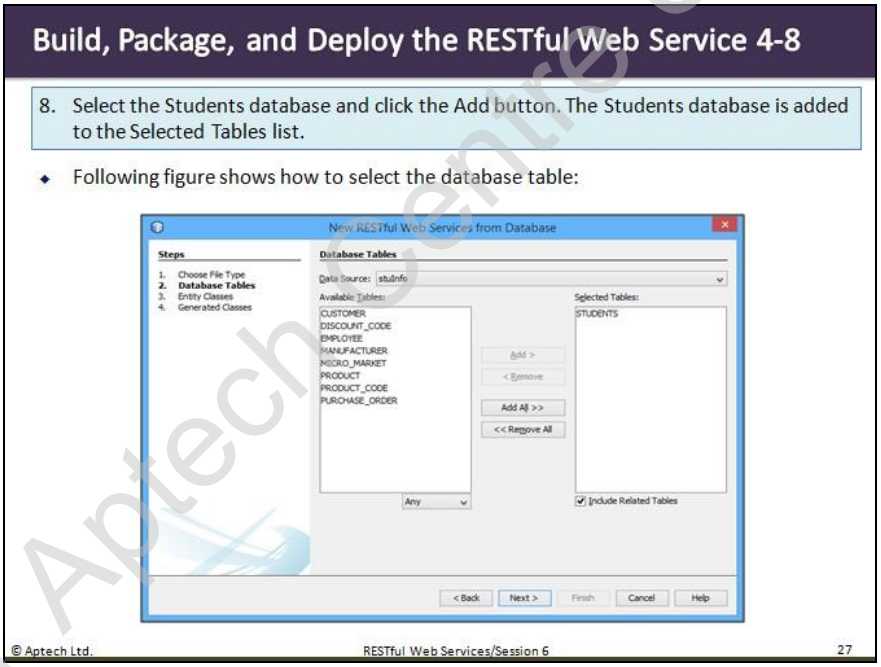
Using slides 24 to 31, demonstrate the steps to build, package, and deploy RESTful Web Service. Using slide 24, demonstrate the steps to create a RESTful Web service based on STUDENTS database table. Show the screenshot of STUDENTS database and mention that the STUDENTS table will be used to explain the steps.



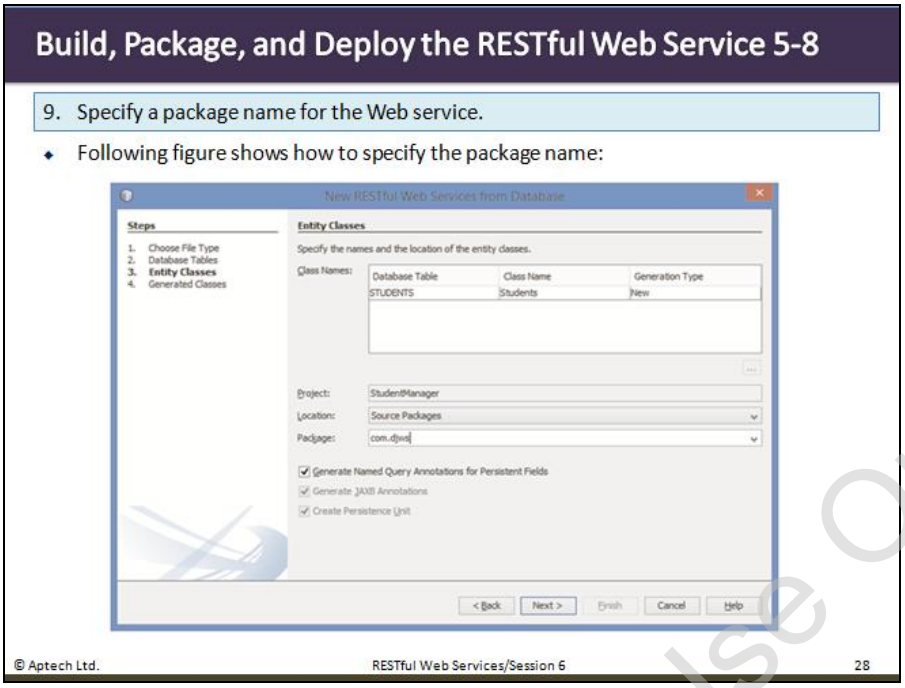
Using slide 25, demonstrate the creation of new data source.



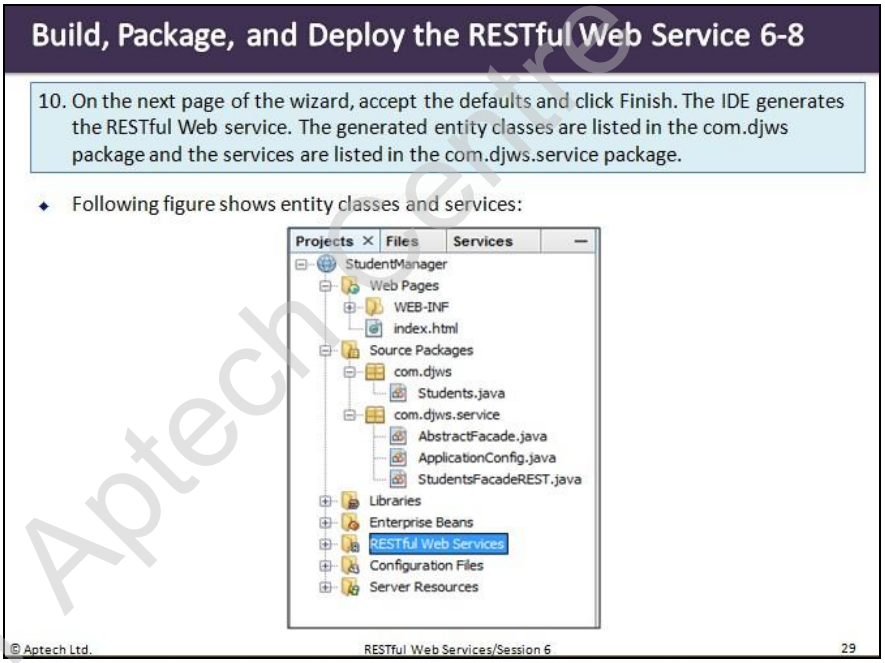
Using slide 26, demonstrate the naming the new data source.



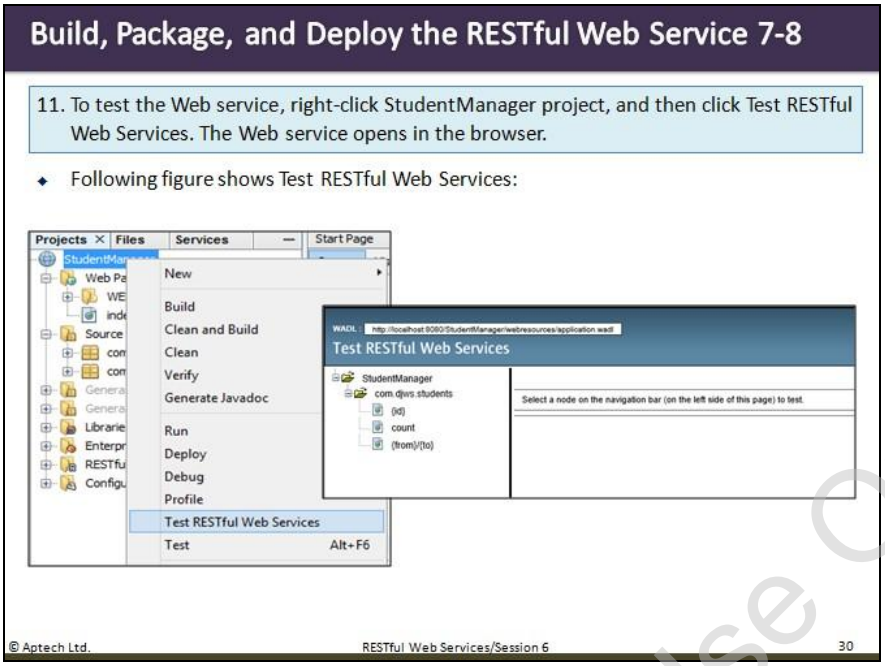
Using slide 27, demonstrate adding the STUDENTS table to the selection of the database table.



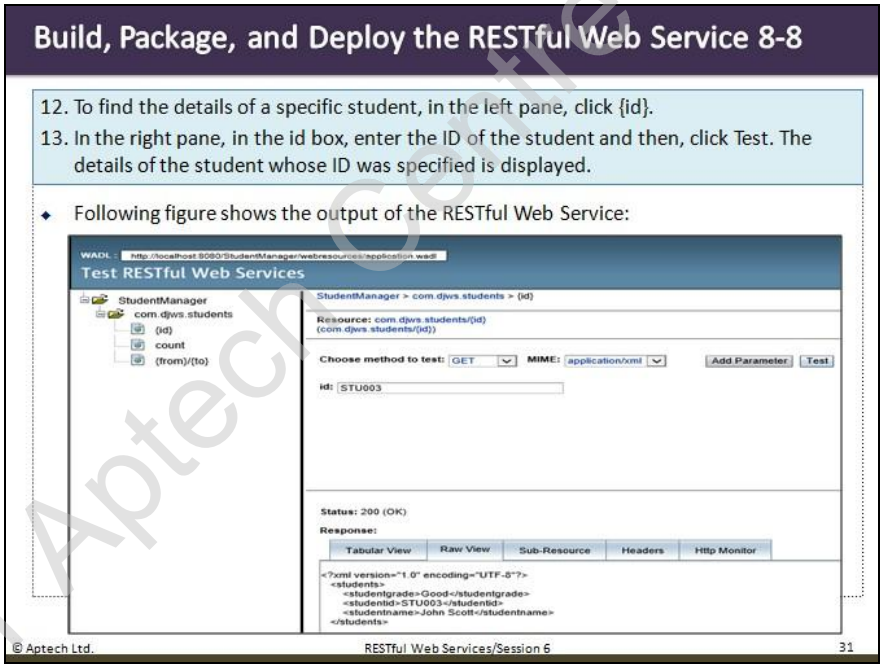
Using slide 28, demonstrate how to specify the package name.



Using slide 29, explain the generated entity classes are listed in the com.djws package and the services are listed in the com.djws.service package.



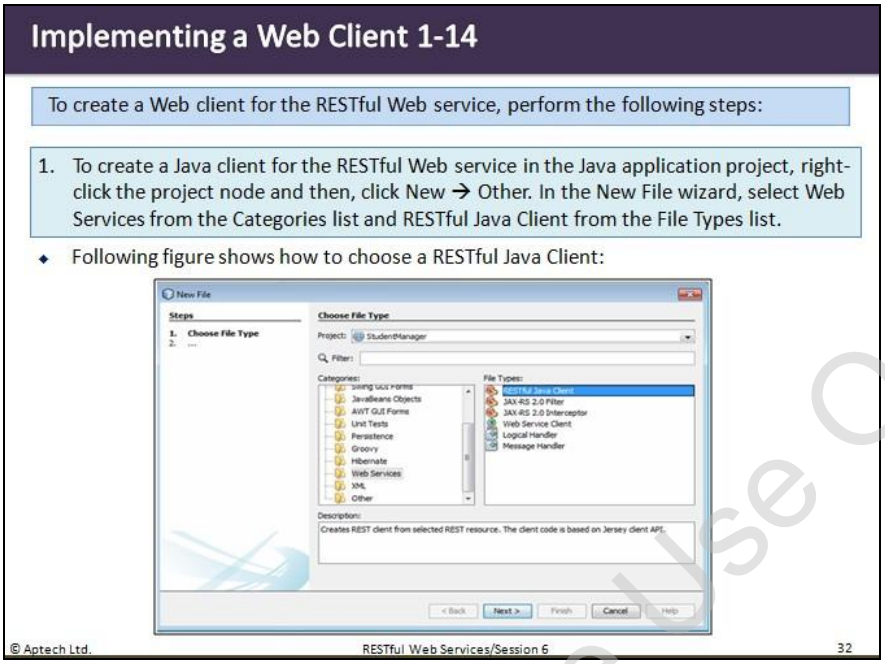
Using slide 30, demonstrate how to test the Web service and the figure that shows how the Web service opens in the browser.



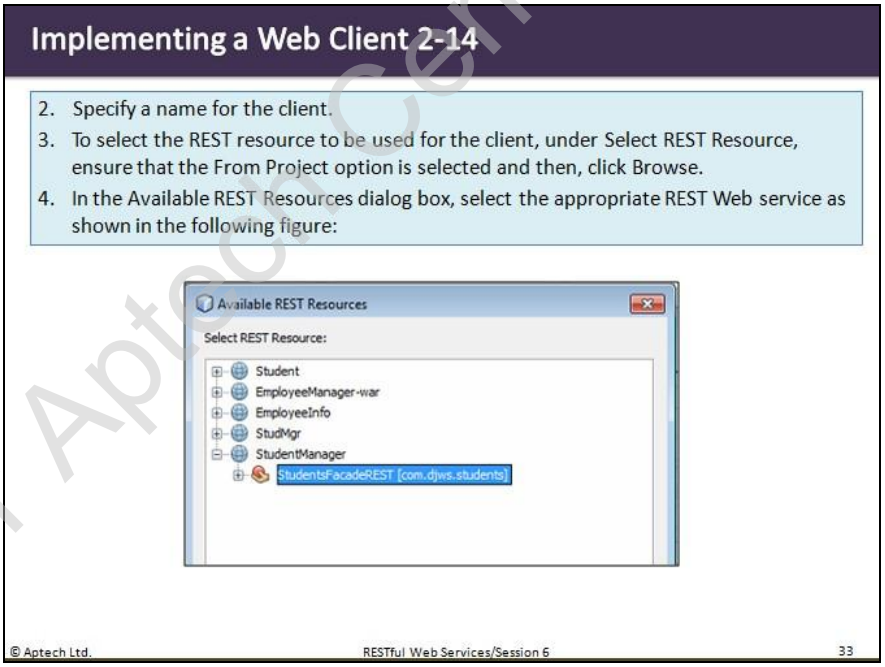
Using slide 31, demonstrate how to input student ID and view the output of the RESTful Web Service.

Implementing a Web Client

Slides 32 to 45



Using slides 32 to 45, demonstrate the steps to implement a Web Client. Using slide 32, demonstrate how to create a RESTfule Java client for the RESTful Web service.

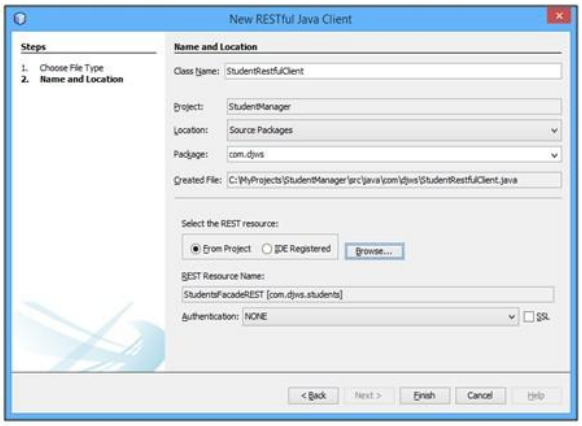


Using slide 33, demonstrate how to select the appropriate REST Web service.

Implementing a Web Client 3-14

5. Select the package for the client.

- Following figure shows how to specify package for Java client:

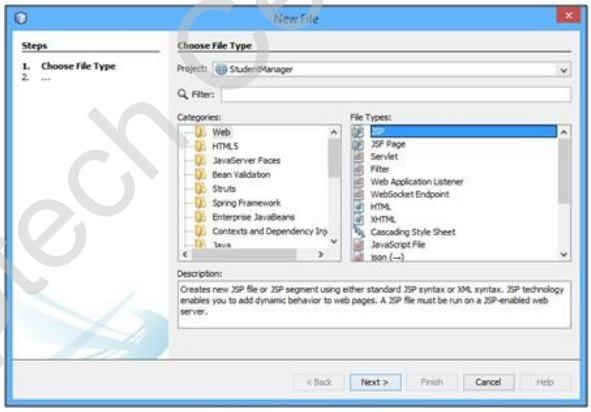


Using slide 34, demonstrate how to specify the package for the Java client.

Implementing a Web Client 4-14

6. To create a JSP file for the client, right-click the StudentManager project and then, click New → Other. Then, in the New File wizard, select Web from the Categories list and JSP from the File Types list.

- Following figure shows how to create a JSP file:

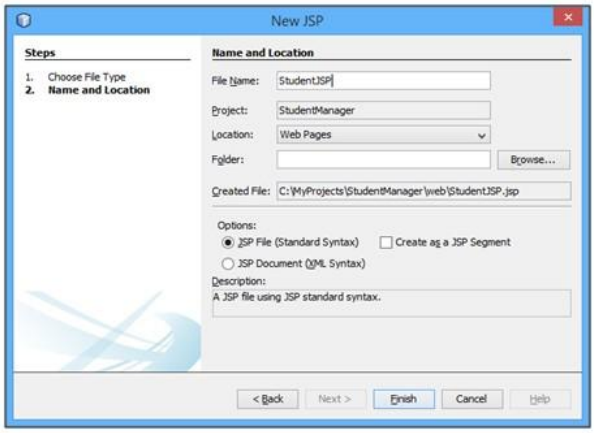


Using slide 35, demonstrate how to create a JSP file.

Implementing a Web Client 5-14

7. Specify a name for the JSP file.

- Following figure shows how to specify a name for the JSP file:

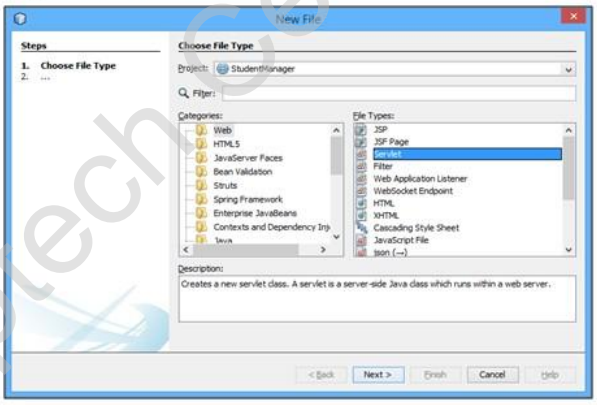


Using slide 36, demonstrate how to specify a name for the JSP file.

Implementing a Web Client 6-14

8. To create a Servlet for the client, right-click the StudentManager project and then, click New → Other. Then, in the New File wizard, select Web from the Categories list and Servlet from the File Types list.

- Following figure shows how to create a servlet:

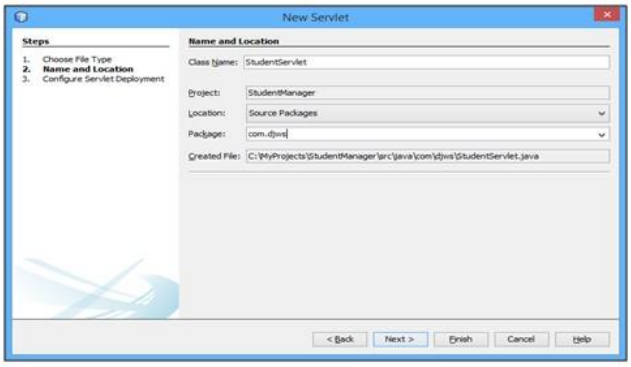


Using slide 37, demonstrate how to create a servlet for the client.

Implementing a Web Client 7-14

9. Specify a name and package for the servlet.

- Following figure shows how to specify a name for servlet:

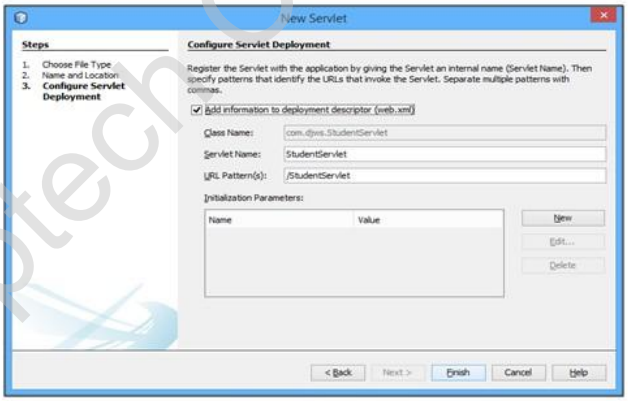


Using slide 38, demonstrate how to specify a name and package for the servlet in the wizard.

Implementing a Web Client 8-14

10. To add the servlet information to the web.xml page, select the Add information to deployment descriptor (web.xml) check box.

- Following figure shows how to add servlet information to web.xml:



Using slide 39, demonstrate how to add the servlet information to the web.xml page.

Implementing a Web Client 9-14

11. To add a text box and a Submit button to the JSP file, update the code as shown in the following code snippet:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html>
    <head>
        <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
        <title>JSP Page</title>
    </head>
    <body>
        <form action ="StudentServlet">

            <h1>Student Details</h1>
            Enter Student ID: <input type="text" name="txtID" value="" />
            <input type="submit" value="Submit" name="Submit" />
        </form>
    </body>
</html>
```


Using slide 40, explain the Code Snippet to add a text box and a submit button to the StudentJSP file.

Implementing a Web Client 10-14

12. To use the Web service to retrieve the student information from the database and display it on the Web page, update the code in the StudentServlet file as shown in the following code snippet:

```
...
protected void processRequest(HttpServletRequest request, HttpServletResponse
response)throws ServletException, IOException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
        /* TODO output your page here. You may use following sample code. */
            out.println("<!DOCTYPE html>");
            out.println("<html>");
            out.println("<head>");
            out.println("<title>Servlet StudentServlet</title>");
            out.println("</head>");
            out.println("<body>");
            String id = request.getParameter("txtID");
            StudentRestfulClient stuInfo = new StudentRestfulClient();
Students stu = stuInfo.find_XML(Students.class, id);
out.println("Student ID: " + stu.getStudentid()+ "<br/>");
out.println("Student Name: " + stu.getStudentname()+ "<br/>");
out.println("Student Grade: " + stu.getStudentgrade());
```

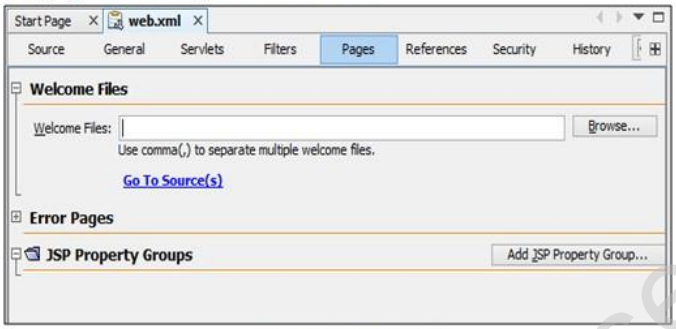

Using slide 41, explain how to update the code in the StudentServlet file in order to use the Web service to retrieve the student information from the database and display it on the Web page.

Implementing a Web Client 11-14

```
stuInfo.close();
out.println("</body>");
out.println("</html>");
}
}
```

13. To specify the startup file for the project, open web.xml and then, click the Pages tab.

- Following figure shows Pages tab of web.xml:



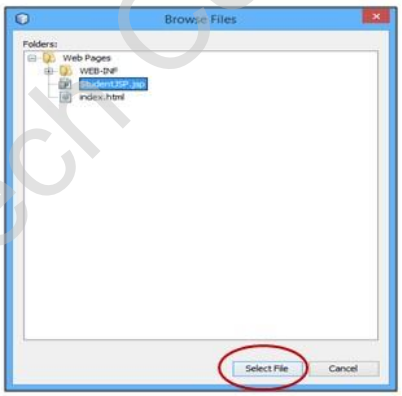
Using slide 42, demonstrate how to specify the startup file for the project.

Implementing a Web Client 12-14

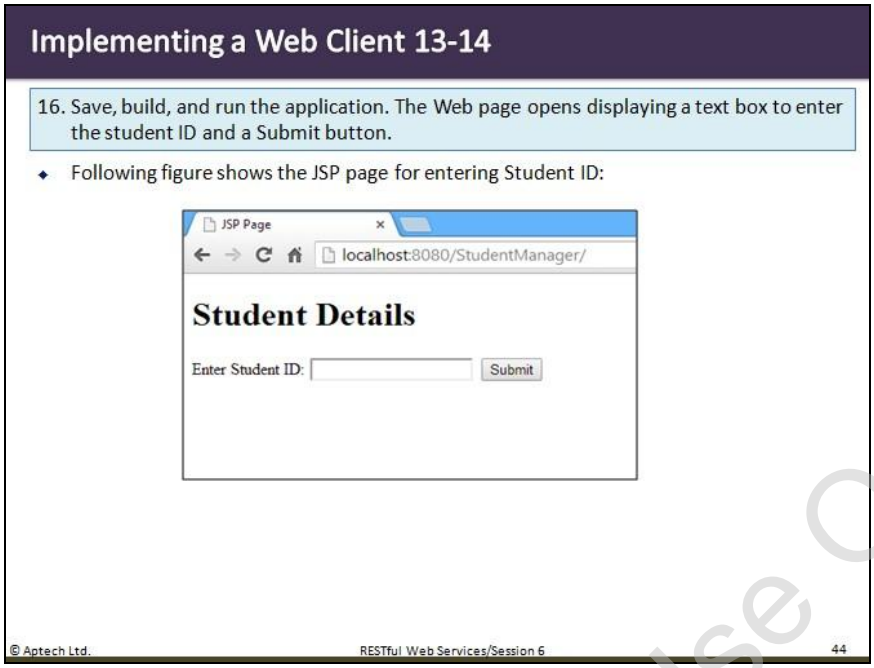
14. Click the Browse button. In the Browse Files dialog box, select the StudentJSP file.

15. Click Select File button.

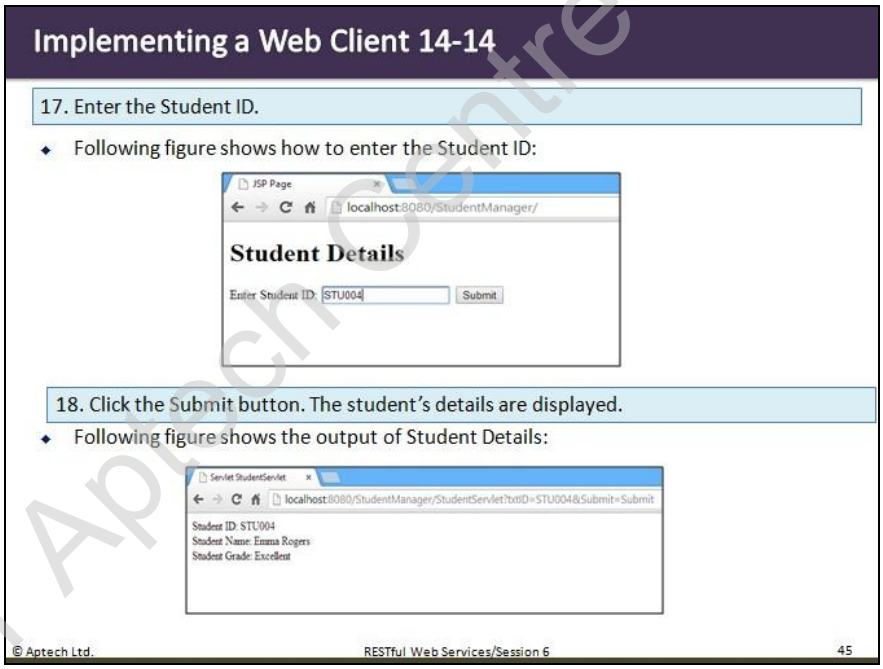
- Following figure shows how to select the JSP file:



Using slide 43, demonstrate the steps to select the JSP file.



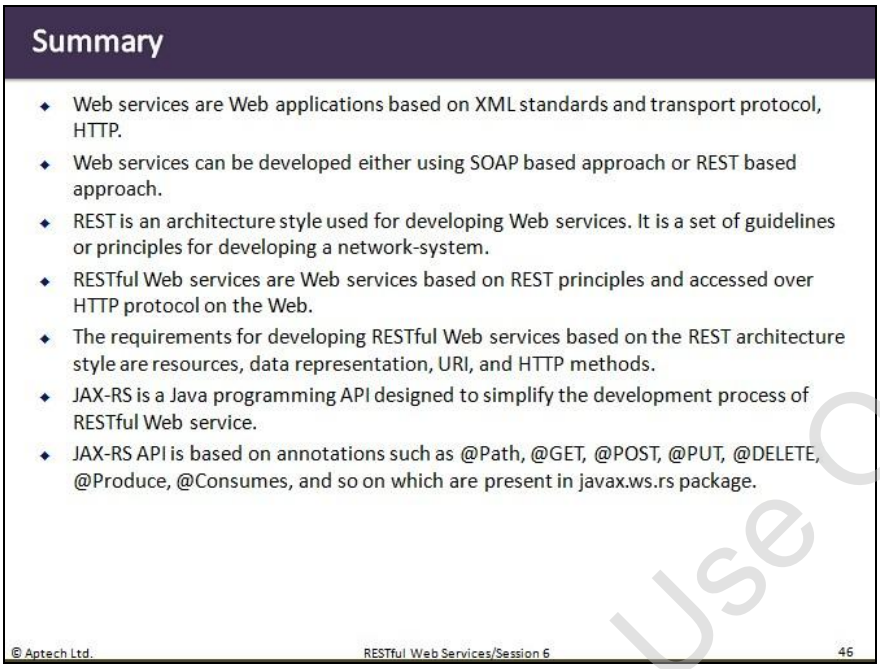
Using slide 44, describe the JSP page that opens up after saving, building, and running the application.



Using slide 45, demonstrate how to enter the student ID in the JSP page and how student details are displayed when Submit button is clicked.

Summarize Session

Slide 46



Using slide 46, summarize the session. Make them revise the following points:

- Web services are Web applications based on XML standards and transport protocol, HTTP.
- Web services can be developed either using SOAP based approach or REST based approach.
- REST is an architecture style used for developing Web services. It is a set of guidelines or principles for developing a network-system.
- RESTful Web services are Web services based on REST principles and accessed over HTTP protocol on the Web.
- The requirements for developing RESTful Web services based on the REST architecture style are resources, data representation, URI, and HTTP methods.
- JAX-RS is a Java programming API designed to simplify the development process of RESTful Web service.
- JAX-RS API is based on annotations such as @Path, @GET, @POST, @PUT, @DELETE, @Produce, @Consumes, and so on which are present in javax.ws.rs package.

6.3 Post Class Activities for Faculty

You should familiarize yourself with the topics of the next session. Since this is the last session, you can skip doing this.

Tips: You can check the **Articles**/**Blogs**/**Expert Videos** uploaded on the OnlineVarsity site to gain additional information related to the topics covered in this session. You can also connect to online tutors on the OnlineVarsity site to ask queries related to the sessions.