SAAJ (Soap Attachment API for Java)

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"Learning is fun!"

Agenda

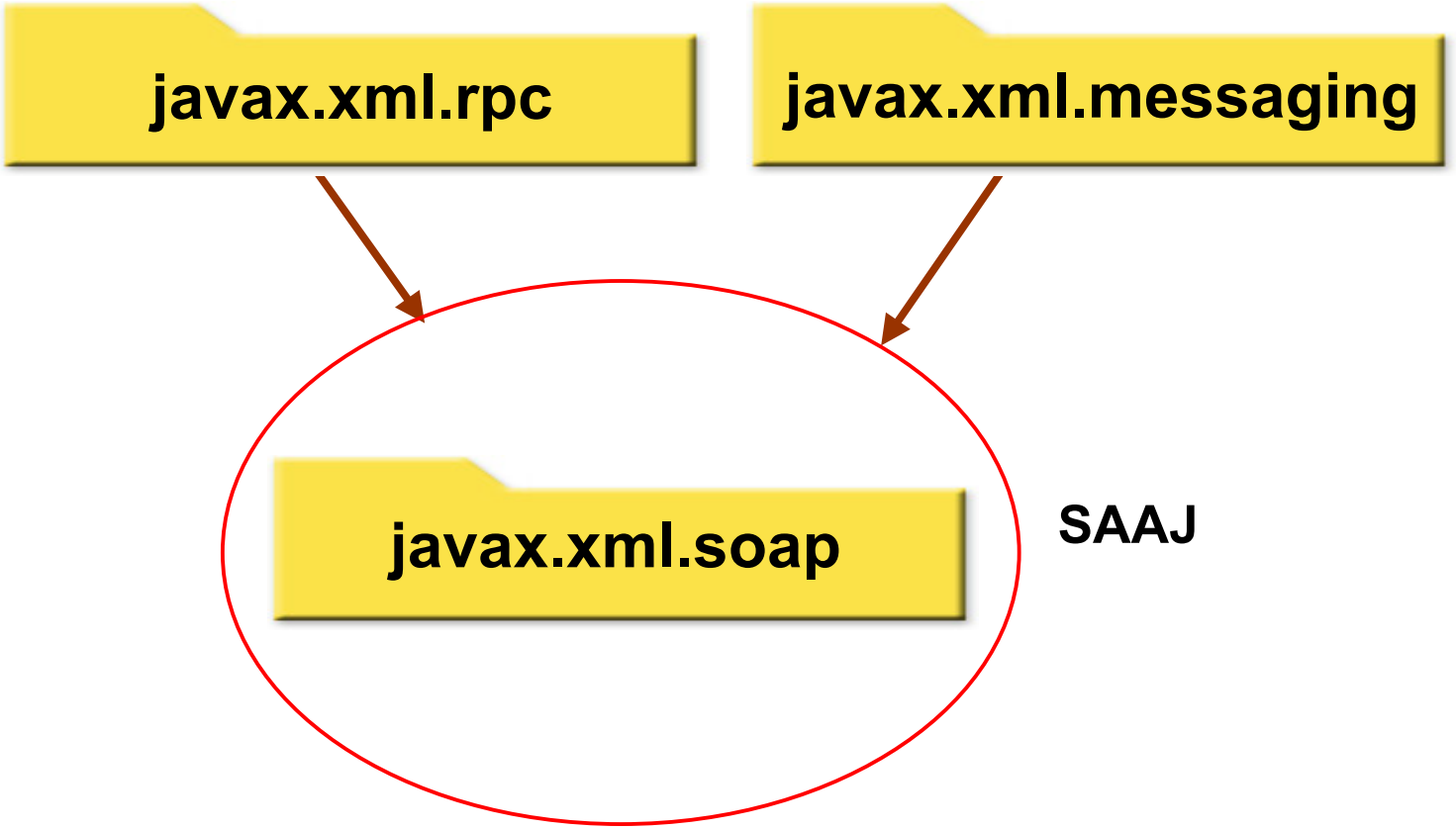
- What is SAAJ?
- SOAP message structure
- SAAJ programming APIs
- SAAJ and DOM
- SAAJ service
- SAAJ error handling

What is SAAJ?

SAAJ

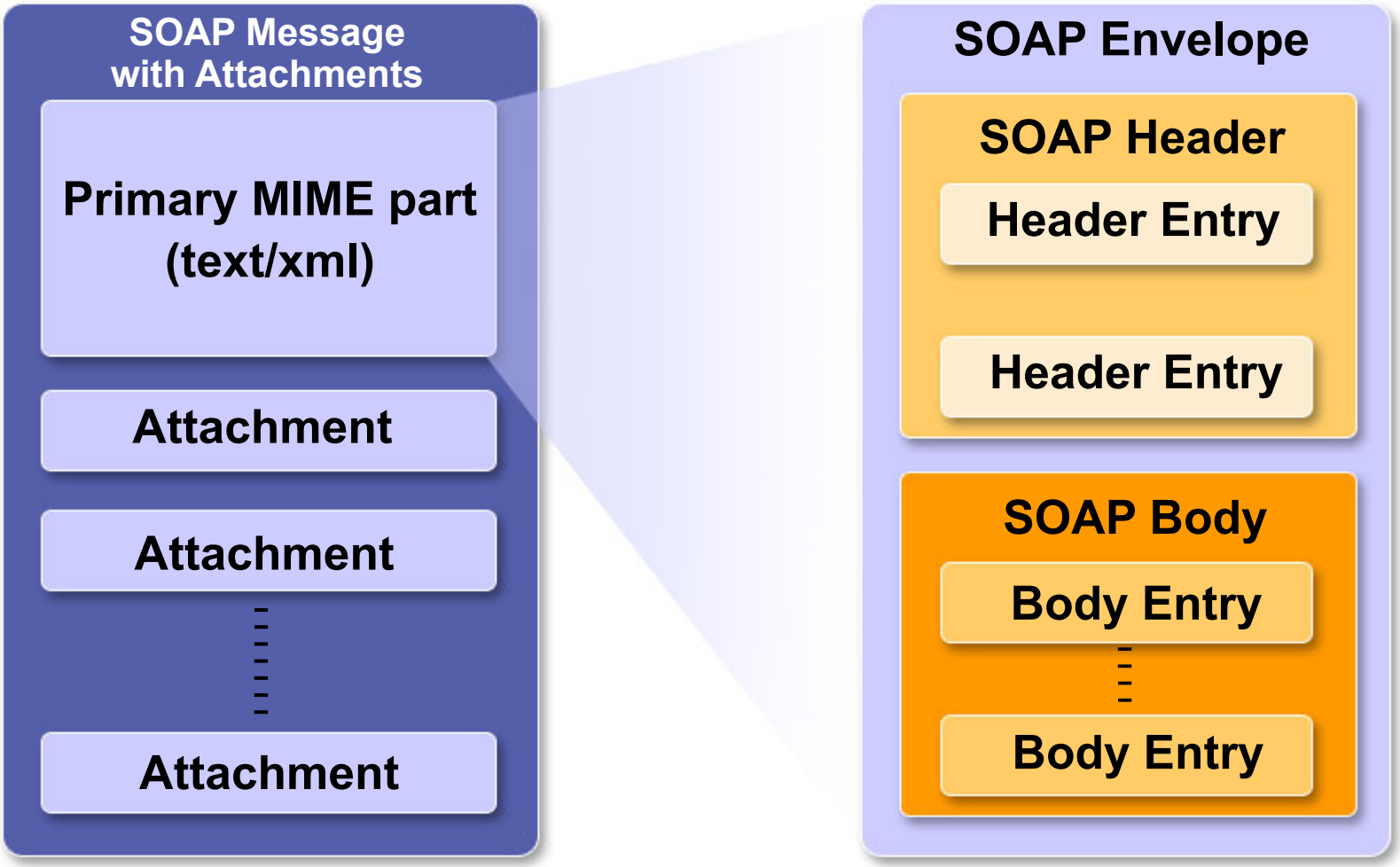
- Contains the API for creating, populating, and accessing SOAP messages conforming to SOAP 1.1 and SOAP with Attachment specifications
  - Used within SOAP message handlers for reading/modifying SOAP headers
- Contains API necessary for sending request-response (non-provider-model) messages

Package Relationship

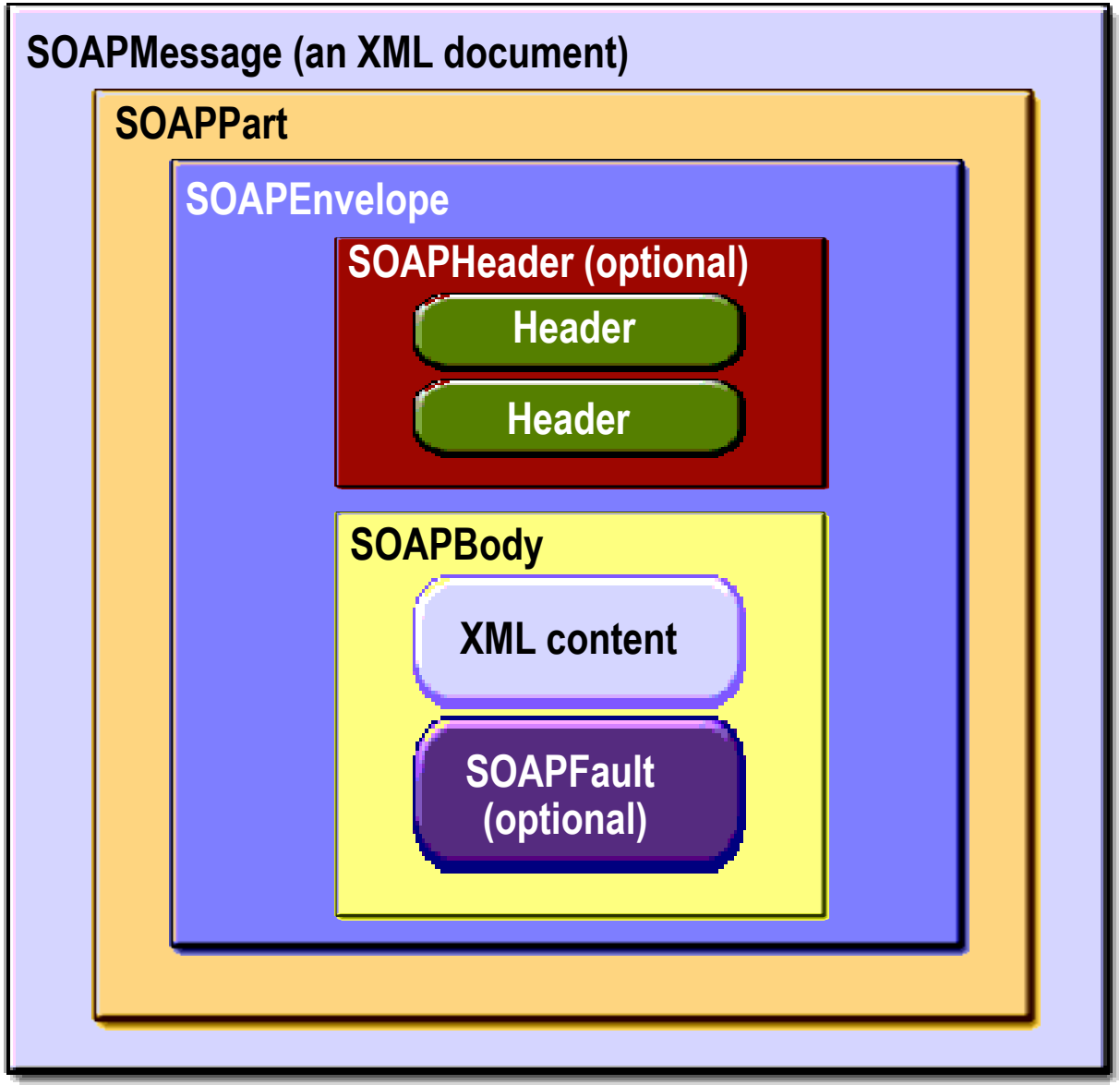


SOAP Message Structure

SOAP Message Structure

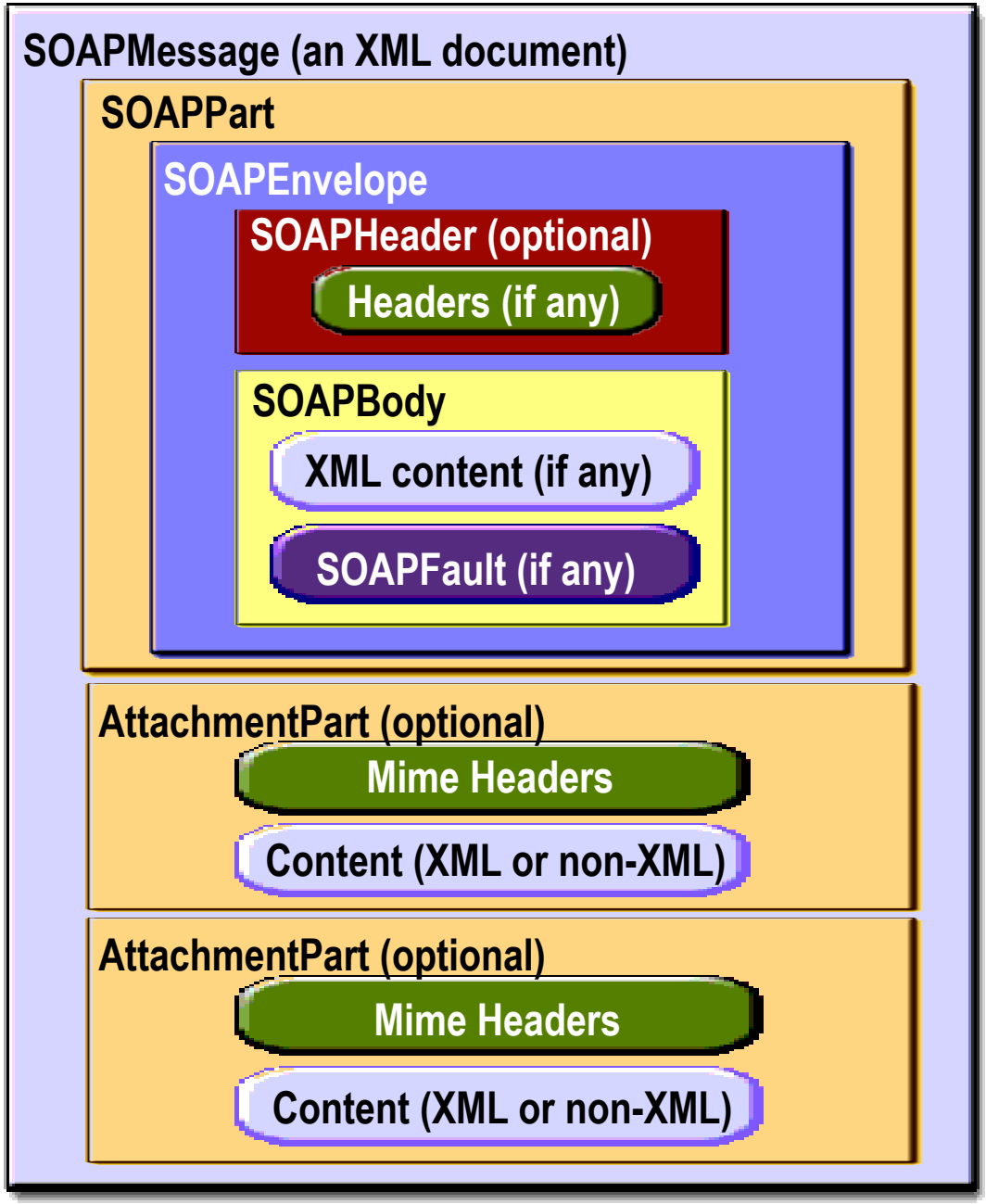


SOAP Message Object without Attachments



Source: Java WSDP

SOAP Message Object with Attachments



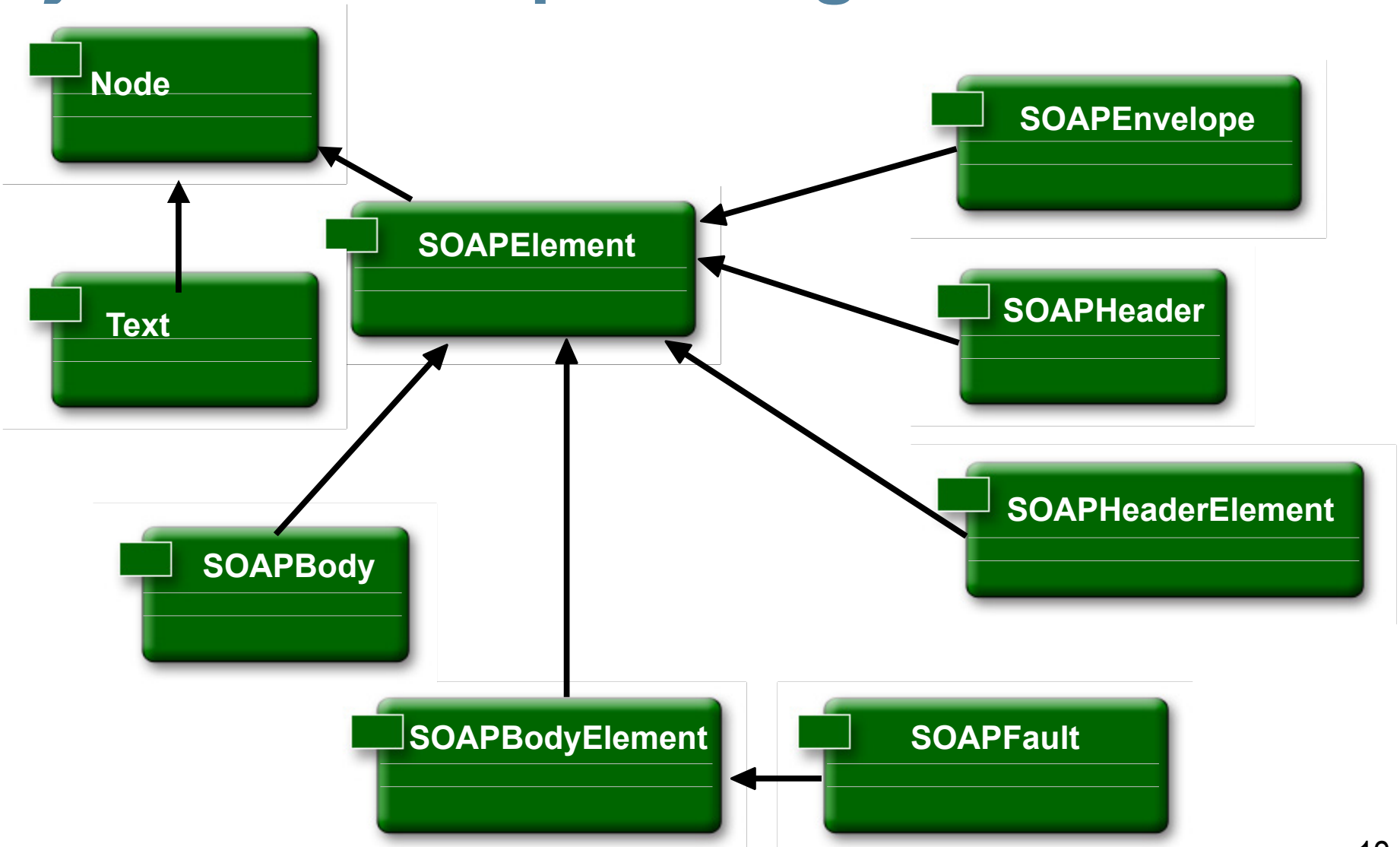
Source: Java WSDP

SAAJ Programming APIs

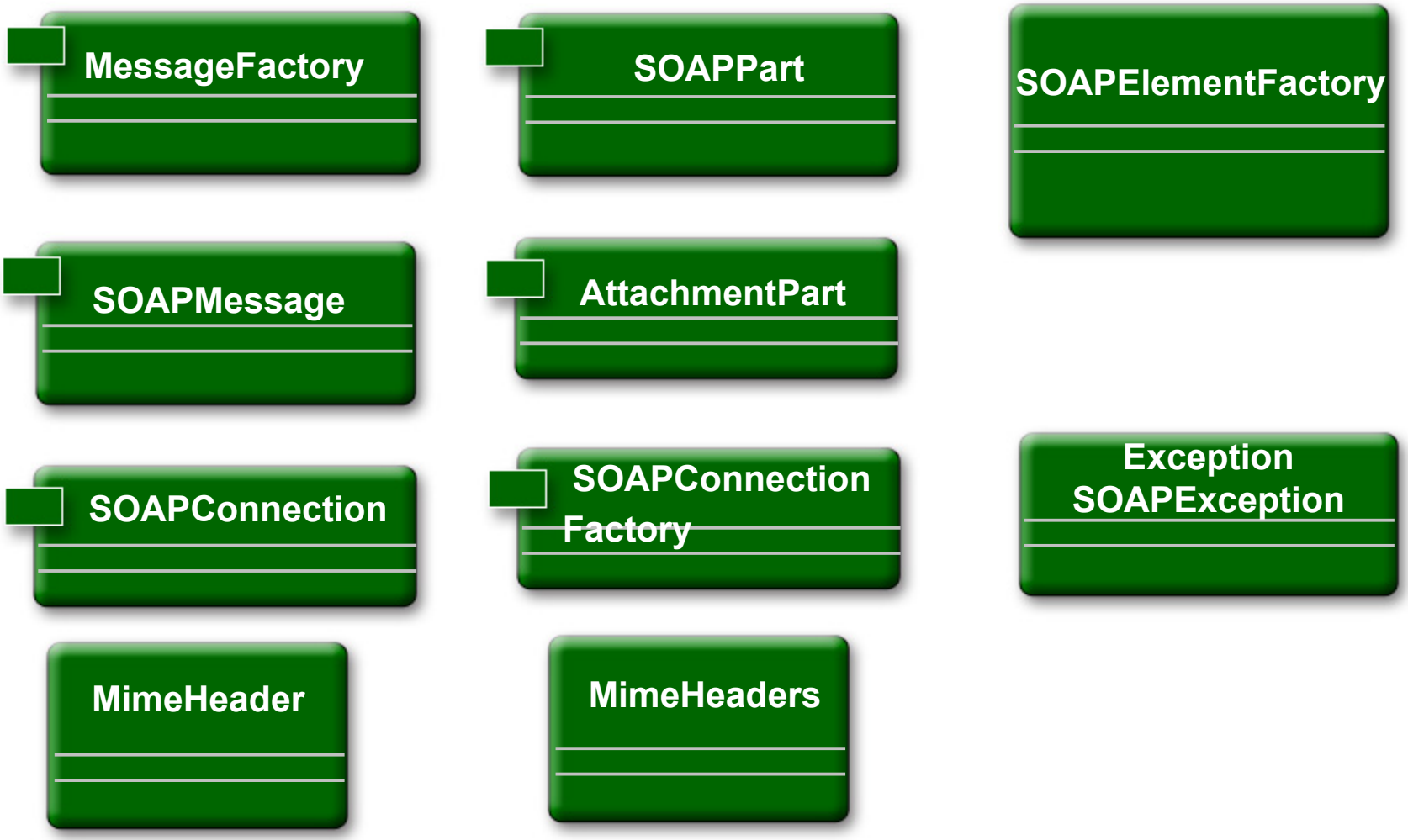
SAAJ

- javax.xml.soap.* package
- SOAPConnection
  - For request/response SOAP message exchange
- SOAPMessage
  - Creating and populating
- Constituent parts of a SOAP message
  - SOAPPart
  - AttachmentPart

javax.xml.soap Package: Interfaces



javax.xml.soap Package: Classes

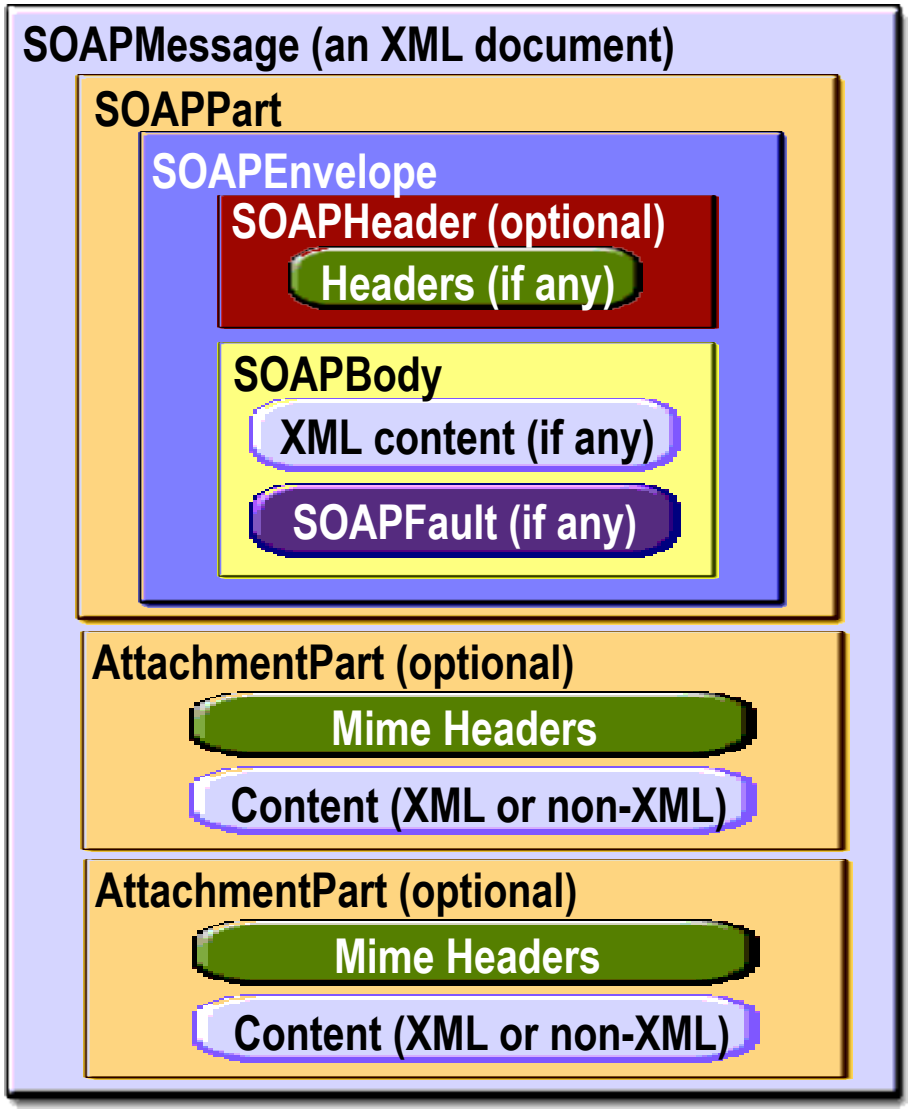


javax.xml.soap.MessageFactory

- Factory for creating SOAP 1.1 and 1.2 -based messages

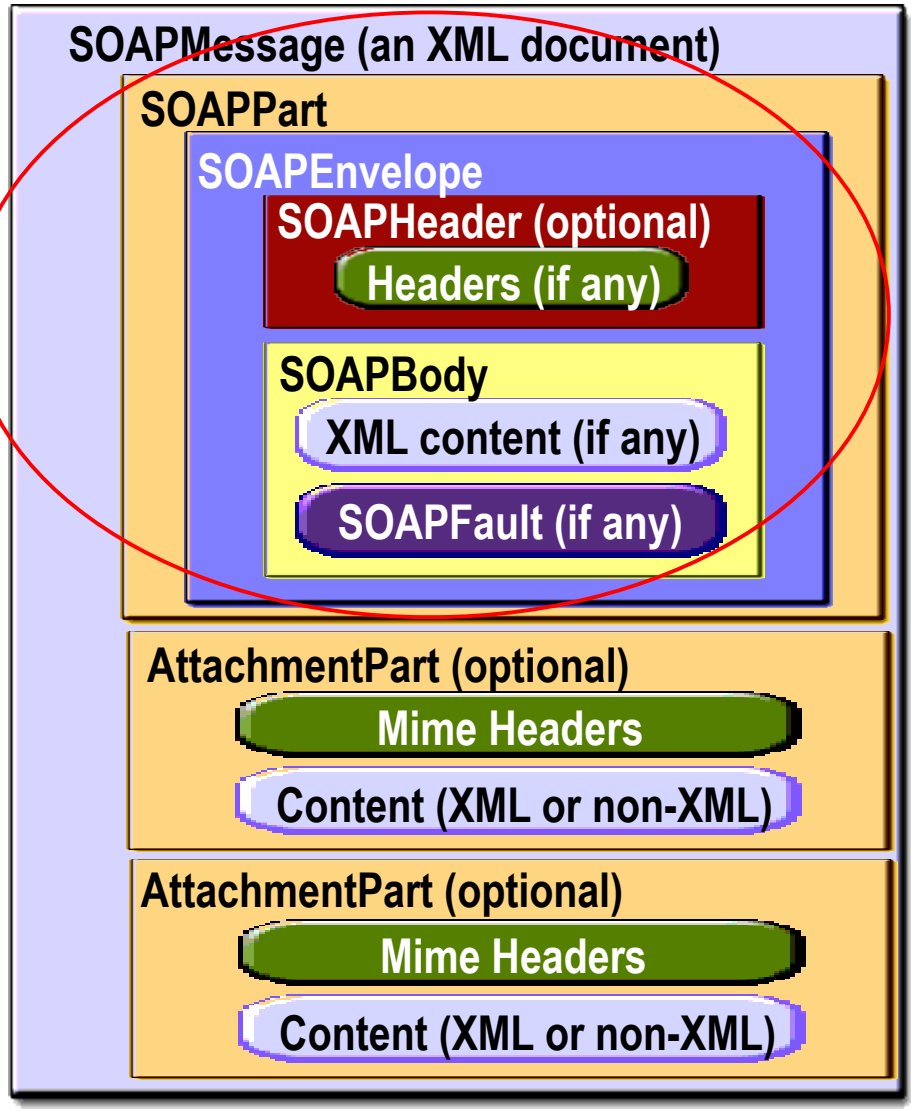
javax.xml.soap.SOAPMessage

- Java technology abstraction for a SOAP 1.1 message
- SOAPPart + Zero or more AttachmentPart's



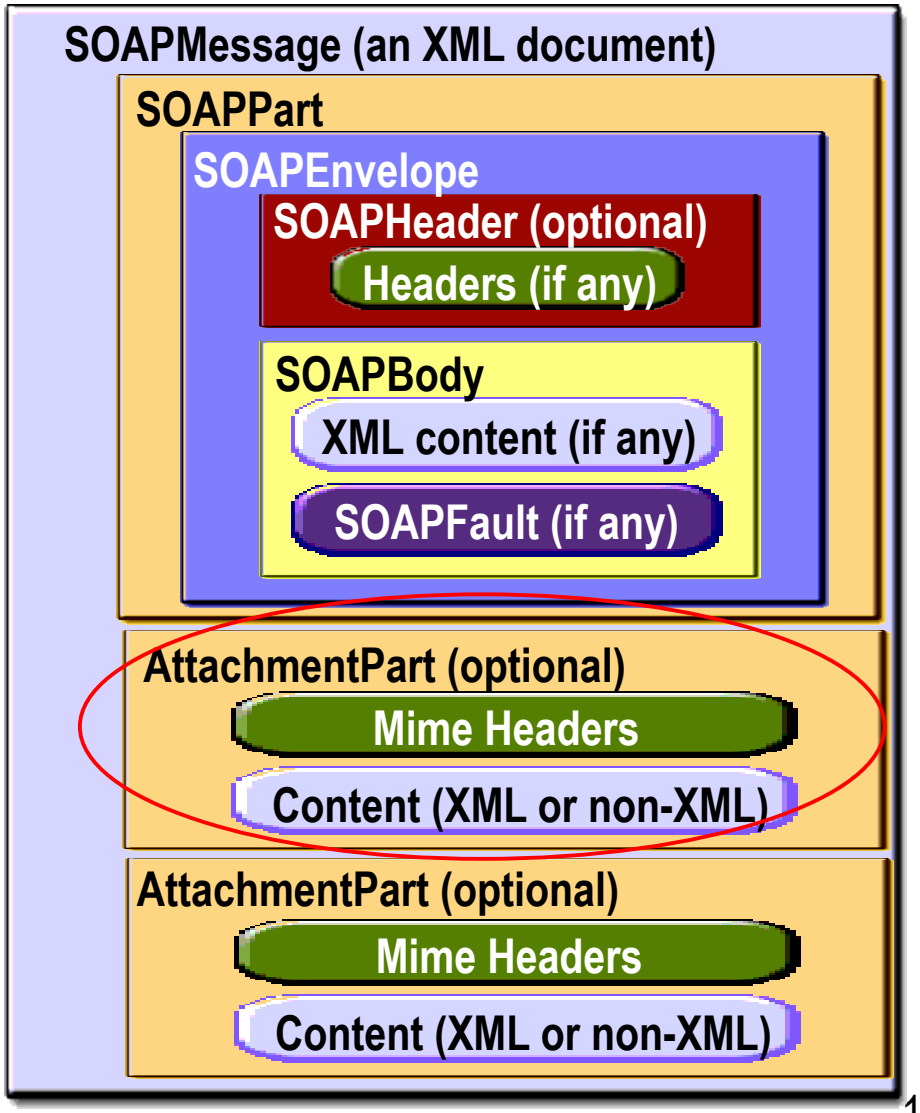
javax.xml.soap.SOAPPart

- The first part of a multi-part message when there are attachments
- Contains a SOAP 1.1 header and body
- Support to create or examine the SOAP 1.1 header elements



javax.xml.soap.AttachmentPart

- Can contain any data (for example: JPEG images, XML business documents, etc.)
  - Each AttachmentPart has a MIME header to indicate the type of data it contains
  - An AttachmentPart may also have additional MIME headers to identify it or to give its location, which are optional but can be useful when there are multiple attachments



Steps of SAAJ Programming

Steps Sending and Receiving

- Create a message (SOAPMessage)
- Access elements of a message
- Add contents to the body
- Get a SOAPConnection object
- Send and receive a message

1. Creating a Message

- Use MessageFactory as a factory of messages
- SOAPMessage object has the following
  - 1 SOAPPart object
    - 1 SOAPEnvelope object
      - 1 empty SOAPHeader object
      - 1 empty SOAPBody object
- Example

```
MessageFactory factory = MessageFactory.newInstance();
SOAPMessage message = factory.createMessage();
```

XML Fragment that gets created

```
<SOAP-ENV:Envelope
 xmlns:SOAP-
ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header/>
  <SOAP-ENV:Body>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2. Accessing SOAPHeader & SOAPBody

- Approach 1: from SOAPEnvelope object

```
SOAPPart soapPart = message.getSOAPPart();
SOAPEnvelope envelope = soapPart.getEnvelope();
SOAPHeader header = envelope.getHeader();
SOAPBody body = envelope.getBody();
```

- Approach 2: from SOAPMessage object

```
SOAPHeader header = message.getSOAPHeader();
SOAPBody body = message.getSOAPBody();
```

3. Add contents to the body

```
SOAPFactory soapFactory = SOAPFactory.newInstance();
Name bodyName = soapFactory.createName("GetLastTradePrice",
  "m", "http://wombat.ztrade.com");

SOAPBody body = message.getSOAPBody();
SOAPBodyElement bodyElement = body.addBodyElement(bodyName);
```

Generates XML fragment like following:

```
<SOAP-ENV:Body>
   <m:GetLastTradePrice
    xmlns:m="http://wombat.ztrade.com">
    . . . .
   </m:GetLastTradePrice>
</SOAP-ENV:Body>
```

Add contents to the body

```
Name name = soapFactory.createName("symbol");
SOAPElement symbol = bodyElement.addChildElement(name);
symbol.addTextNode("SUNW");
```

Generates XML fragment like following:

```
...
<symbol>SUNW</symbol>
...
```

4. Get a SOAPConnection Object

```
SOAPConnectionFactory soapConnectionFactory =
  SOAPConnectionFactory.newInstance();
SOAPConnection connection =
  soapConnectionFactory.createConnection();
```

5. Send a Message & Receive a response

```
// Create an endpoint point which is either URL or String type
java.net.URL endpoint =
                new URL("http://wombat.ztrade.com/quotes");

// Send a SOAPMessage (request) and then wait for
// SOAPMessage (response)
SOAPMessage response = connection.call(message, endpoint);
```

Reading a response

```
SOAPBody soapBody = response.getSOAPBody();
java.util.Iterator iterator =
  soapBody.getChildElements(bodyName);
SOAPBodyElement bodyElement =
  (SOAPBodyElement)iterator.next();
String lastPrice = bodyElement.getValue();
System.out.print("The last price for SUNW is ");
System.out.println(lastPrice);
```

Constructing SOAP Message

Constructing SOAP Message

- Adding elements to SOAPHeader
- Adding elements to SOAPBody
- Adding contents of a file to SOAPBody
- Adding contents of a file to SOAPPart
- Adding attachments
- Adding attributes

Adding Content to SOAPHEader

Constructing SOAP Message

Adding Contents to SOAPHeader

- Create SOAPHeaderElement
  - Must have an associated Name object
- Java Code

```
SOAPHeader header = message.getSOAPHeader();
Name headerName =
soapFactory.createName("Claim",
  "wsi", "http://ws-i.org/schemas/conformanceClaim/");
SOAPHeaderElement headerElement =
  header.addHeaderElement(headerName);

headerElement.addAttribute(soapFactory.createName(
  "conformsTo"), "http://ws-i.org/profiles/basic1.0/");
```

Adding Contents to SOAPHeader

- XML fragment generated

```
<SOAP-ENV:Header>
 <wsi:Claim conformsTo="http://ws-i.org/profiles/basic1.0/"
  xmlns:wsi="http://ws-i.org/schemas/conformanceClaim/">
 </wsi:Claim>
</SOAP-ENV:Header>
```

Adding Contents to SOAPHeader

- Adding a TextNode to SOAPHeaderElement

```
headerElement.addTextNode("order");
```

Adding Content to SOAPBody

Constructing SOAP Message

Adding Contents to Empty SOAPBody

```
SOAPBody body = soapFactory.getSOAPBody();
Name bodyName = soapFactory.createName("PurchaseLineItems",
  "PO", "http://sonata.fruitsgalore.com");
SOAPBodyElement purchaseLineItems =
  body.addBodyElement(bodyName);

Name childName = soapFactory.createName("Order");
SOAPElement order =
  purchaseLineItems.addChildElement(childName);

childName = soapFactory.createName("Product");
SOAPElement product = order.addChildElement(childName);
product.addTextNode("Apple");

childName = soapFactory.createName("Price");
SOAPElement price = order.addChildElement(childName);
price.addTextNode("1.56");
```

XML fragment

```
<PO:PurchaseLineItems
 xmlns:PO="http://www.sonata.fruitsgalore/order">
  <Order>
    <Product>Apple</Product>
    <Price>1.56</Price>
  </Order>

  ...
</PO:PurchaseLineItems>
```

Adding a File to SOAPBody

Constructing SOAP Message

Adding an XML File to SOAPBody as DOM object

```
static Document document;
...
  DocumentBuilderFactory factory =
    DocumentBuilderFactory.newInstance();
  factory.setNamespaceAware(true);
  try {
    DocumentBuilder builder =
      factory.newDocumentBuilder();
    document = builder.parse( new File(args[0]) );
    ...
    // document can be any XML document
    SOAPBody body = message.getSOAPBody();
    SOAPBodyElement docElement =
body.addDocument(document);
```

Adding a File to SOAPPart

Constructing SOAP Message

Adding a File to SOAPPart Object

- Create a javax.xml.transform.Source object
  - using APIs from JAXP
- The XML document must be a SOAP message format since it is setting SOAPPart
- Three types of Source objects
  - SAXSource or DOMSource
    - hold content along with the instructions for transforming the content into an XML document
  - StreamSource
    - holds content as an XML document

Adding a file using DOMSource Object

```
DocumentBuilderFactory dbFactory =
    DocumentBuilderFactory.newInstance();
dbFactory.setNamespaceAware(true);
DocumentBuilder builder =
dbFactory.newDocumentBuilder();
Document document =
    builder.parse("file:///music/order/soap.xml");
DOMSource domSource = new DOMSource(document);

// Document must be a SOAP message
SOAPPart soapPart = message.getSOAPPart();
soapPart.setContent(domSource);
```

Adding & Accessing Attachments

Constructing SOAP Message

Creating an AttachmentPart

- Create from SOAPMessage object
- Example

```
AttachmentPart attachment =
message.createAttachmentPart();
```

- AttachmentPart is made of two parts
  - associated MIME header
    - Content-Type and ID
    - attachment.setMimeHeader("Content-Type", "application/xml"); //Setting Content-type
  - application-specific content

Adding Contents to Attachment (Option 1: Setting Content & ContentId)

```
String stringContent = "Update address for Sunny Skies " +
    "Inc., to 10 Upbeat Street, Pleasant Grove, CA 95439";

// Set content and content type
attachment.setContent(stringContent, "text/plain");
// Set content id
attachment.setContentId("update_address");

// Add an attachment to a SOAP message
message.addAttachmentPart(attachment);
```

Possible ContentType

- String
- Stream
- javax.xml.transform.Source
- javax.activation.DataHandler

Adding Contents to Attachment (Option 2: Using DataHandler)

```
// Create DataHandler object
URL url =
    new URL ("http://greatproducts.com/gizmos/img.jpg");
DataHandler dataHandler = new DataHandler(url);
AttachmentPart attachment =
     message.createAttachmentPart(dataHandler);

// Note that there is no need to set Content Type
// because DataHandler object already has that info
attachment.setContentId("attached_image");

message.addAttachmentPart(attachment);
```

Accessing Attachments

```
    java.util.Iterator iterator = message.getAttachments();
     while (iterator.hasNext()) {
       AttachmentPart attachment =
         (AttachmentPart)iterator.next();

       // Get content id
       String id = attachment.getContentId();
       // Get content type
       String type = attachment.getContentType();

       System.out.print("Attachment " + id + " has content type " + type);
       if (type == "text/plain") {
         Object content = attachment.getContent();
         System.out.println("Attachment " + "contains:\n" + content);
       }
}
```

Adding Attributes

Constructing SOAP Message

Adding an Attribute to any SOAPElement

- Java code

```
Name attributeName = envelope.createName("id");
person.addAttribute(attributeName, "Person7");
```

- XML fragment

```
<person id="Person7">
  ...
</person>
```

Retrieving a value of an Attribute from any SOAPElement

- Return a value of single attribute

```
String attributeValue =
  person.getAttributeValue(attributeName);
```

- Return values for all of the attributes

```
Iterator iterator = person.getAllAttributes();
while (iterator.hasNext()){
  Name attributeName = (Name) iterator.next();
  System.out.println("Attribute name is " +
    attributeName.getQualifiedName());
  System.out.println("Attribute value is " +
    element.getAttributeValue(attributeName));
}
```

Removal of an Attribute from any SOAPElement

- Java code

```
boolean successful =
person.removeAttribute(attributeName);
```

Adding Attributes to SOAPHeaderElement

- Header attributes
  - actor
  - mustUnderstand

Retrieving All SOAPHeaderElement's

```
Iterator allHeaders =
    header.examineAllHeaderElements();
while (allHeaders.hasNext()) {
    SOAPHeaderElement headerElement =
        (SOAPHeaderElement)allHeaders.next();
    Name headerName =
        headerElement.getElementName();
    System.out.println("\nHeader name is " +
                       headerName.getQualifiedName());
    System.out.println("Actor is " +
                       headerElement.getActor());
}
```

Adding Actor Attribute

```
SOAPHeader header = message.getSOAPHeader();
SOAPFactory soapFactory = SOAPFactory.newInstance();

String nameSpace = "ns";
String nameSpaceURI = "http://gizmos.com/NSURI";

Name order = soapFactory.createName("orderDesk",
  nameSpace, nameSpaceURI);
SOAPHeaderElement orderHeader =
  header.addHeaderElement(order);
orderHeader.setActor("http://gizmos.com/orders");

Name shipping =
  soapFactory.createName("shippingDesk",
    nameSpace, nameSpaceURI);
SOAPHeaderElement shippingHeader =
  header.addHeaderElement(shipping);
shippingHeader.setActor("http://gizmos.com/shipping");
```

Retrieving All SOAPHeaderElements with a particular Actor (Option 1)

```
java.util.Iterator headerElements =

Header.examineHeaderElements("http://gizmos.com/orders");
```

Extracting All SOAPHeaderElements with a particular Actor (Option 2)

```
java.util.Iterator headerElements =

header.extractHeaderElements("http://gizmos.com/orders");
```

Creating SOAPHeaderElement with mustUnderstand attribute (page 1)

- Java code

```
SOAPHeader header = message.getSOAPHeader();

Name name = soapFactory.createName("Transaction", "t",
  "http://gizmos.com/orders");
SOAPHeaderElement transaction =
header.addHeaderElement(name);
transaction.setMustUnderstand(true);
transaction.addTextNode("5");
```

Creating SOAPHeaderElement with mustUnderstand attribute (page 2)

- XML fragment

```
<SOAP-ENV:Header>
 <t:Transaction
   xmlns:t="http://gizmos.com/orders"
   SOAP-ENV:mustUnderstand="1">
  5
 </t:Transaction>
</SOAP-ENV:Header>
```

SAAJ & DOM

SAAJ nodes are DOM nodes

- At SAAJ 1.2, the SAAJ APIs extend their counterparts in the org.w3c.dom package
  - The Node interface extends the org.w3c.dom.Node interface.
  - The SOAPElement interface extends both the Node interface and the org.w3c.dom.Element interface.
  - The SOAPPart class implements the org.w3c.dom.Document interface.
  - The Text interface extends the org.w3c.dom.Text interface.

SAAJ nodes are DOM nodes

- SAAJ nodes and elements implement the DOM Node and Element interfaces, you have several options for adding or changing message content:
  - Use only DOM APIs
  - Use only SAAJ APIs
  - Use SAAJ APIs and then switch to using DOM APIs
  - Use DOM APIs and then switch to using SAAJ APIs (with a caveat)

SAAJ Service

SAAJ Service

- Provides the response part of the request-response paradigm
- Server code is in the form of a servlet
- javax.servlet.HttpServlet
  - Init(), doPost(): set up the response message
  - OnMessage(): gives the message its content

SAAJ Distributor Service

```
public class PriceListServlet extends HttpServlet {
  static MessageFactory fac = null;

  static {
    try {
      fac = MessageFactory.newInstance();
    } catch (Exception ex) {
      ex.printStackTrace();
    }
  };
```

SAAJ Distributor Service

```
public void doPost(HttpServletRequest req,
                   HttpServletResponse resp)
                   throws ServletException, IOException {
 try {
   // Get all the headers from the HTTP request
   MimeHeaders headers = getHeaders(req);

   // Get the body of the HTTP request
   InputStream is = req.getInputStream();

   // Now internalize the contents of the HTTP request
   // and create a SOAPMessage
   SOAPMessage msg = fac.createMessage(headers, is);
```

SAAJ Distributor Service

```
SOAPMessage reply = null;
reply = onMessage(msg);
if (reply != null) {


 /*
  * Need to call saveChanges because we're
  * going to use the MimeHeaders to set HTTP
  * response information. These MimeHeaders
  * are generated as part of the save.
  */
 if (reply.saveRequired()) {
   reply.saveChanges();
 }
```

SAAJ Distributor Service

```
      resp.setStatus(HttpServletResponse.SC_OK);
      putHeaders(reply.getMimeHeaders(), resp);

      // Write out the message on the response stream
      OutputStream os = resp.getOutputStream();
      reply.writeTo(os);
      os.flush();
    } else {
      resp.setStatus(
        HttpServletResponse.SC_NO_CONTENT);
    }
  } catch (Exception ex) {
    throw new ServletException( "SAAJ POST failed: " +
      ex.getMessage());
  }
}
```

SAAJ Distributor Service

```
public SOAPMessage onMessage(SOAPMessage msg) {
  SOAPMessage message = null;

  try {
    message = fac.createMessage();

    SOAPPart part = message.getSOAPPart();
    SOAPEnvelope envelope = part.getEnvelope();
    SOAPBody body = envelope.getBody();

    Name bodyName = envelope.createName("price-list",
      "PriceList", "http://sonata.coffeebreak.com");
    SOAPBodyElement list = body.addBodyElement(bodyName);

    Name coffeeN = envelope.createName("coffee");
    SOAPElement coffee = list.addChildElement(coffeeN);

    Name coffeeNm1 = envelope.createName("coffee-name");
    SOAPElement coffeeName =
      coffee.addChildElement(coffeeNm1);
    coffeeName.addTextNode("Arabica");
```

SAAJ Distributor Service

```
    Name priceName3 = envelope.createName("price");
    SOAPElement price3 = coffee.addChildElement(priceName3);
    price3.addTextNode("6.00");

    Name coffeeNm4 = envelope.createName("coffee-name");
    SOAPElement coffeeName4 =
      coffee.addChildElement(coffeeNm4);
    coffeeName4.addTextNode("House Blend");

    Name priceName4 = envelope.createName("price");
    SOAPElement price4 = coffee.addChildElement(priceName4);
    price4.addTextNode("5.00");

    message.saveChanges();

  } catch(Exception e) {
    e.printStackTrace();
  }
  return message;
}
```

SAAJ Error Handling

SOAPFault Object

- Represents SOAP Fault element in SOAP body
- Parties that can generate SOAPFault
  - Recipient of a message in point-to-point messaging
    - Indicates missing address information in purchase order SOAP message
  - Messaging provider in messaging provider-based messaging
    - Messaging provider cannot deliver the message due to server failure

SOAPFault Object Contains

- fault code (mandatory)
  - Required in SOAPFault Object
  - VersionMismatch, MustUnderstand, Client, Server
- fault string (mandatory)
  - Human readable explanation of the fault
- fault actor (conditional)
  - Required if SOAPHeader object has one or more actor attributes
- Detail object (conditional)
  - Required if the fault is error related to the SOAPBody object
  - If not present in Client fault, SOAPBody is assumed to be OK

Example 1: SOAPFault with No Detail Object

```
// Create SOAPBody object
SOAPEnvelope envelope = msg.getSOAPPart().getEnvelope();
SOAPBody body = envelope.getBody();

// Create and fill up SOAPFault object.
// Note that Detail object is not being set here since the fault has
// nothing to do with SOAPBody
SOAPFault fault = body.addFault();
fault.setFaultCode("Server");
fault.setFaultActor("http://gizmos.com/orders");
fault.setFaultString("Server not responding");
```

Example 2: SOAPFault with Detail Object

```
// Create SOAPFault object
SOAPFault fault = body.addFault();
// Set fault code and fault string
fault.setFaultCode("Client");
fault.setFaultString("Message does not have necessary info");

// Detail object contains two DetailEntry's
Detail detail = fault.addDetail();
Name entryName =
        envelope.createName("order", "PO", "http://gizmos.com/orders/");
DetailEntry entry = detail.addDetailEntry(entryName);
entry.addTextNode("quantity element does not have a value");

Name entryName2 =
        envelope.createName("confirmation", "PO",
"http://gizmos.com/confirm");
DetailEntry entry2 = detail.addDetailEntry(entryName2);
entry2.addTextNode("Incomplete address: no zip code");
```

Example 3: Retrieving SOAPFault

```
// Get SOAPBody object
SOAPBody body = newmsg.getSOAPPart().getEnvelope().getBody();

// Check if SOAPFault is present in the message
if ( body.hasFault() ) {
    SOAPFault newFault = body.getFault();
    String code = newFault.getFaultCode();
    String string = newFault.getFaultString();
    String actor = newFault.getFaultActor();
    if ( actor != null ) { System.out.println(" fault actor = " + actor); }
}
```

Example 4: Retrieving Detail Object

```
// Get Detail object
Detail newDetail = newFault.getDetail();

// Get the list of DetailEntry's
if ( newDetail != null) {
    Iterator it = newDetail.getDetailEntries();
    while ( it.hasNext() ) {
        DetailEntry entry = (DetailEntry)it.next();
        String value = entry.getValue();
        System.out.println(" Detail entry = " + value);
     }
}
```

Thank you!

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"Learning is fun!"