SOAP and REST Web Services

Software Testing

Lector: Aleksandar Karamfilov
Skype: sanders_kar
Email: alex@pragmatic.bg
Facebook: facebook.com/a.karamfilov

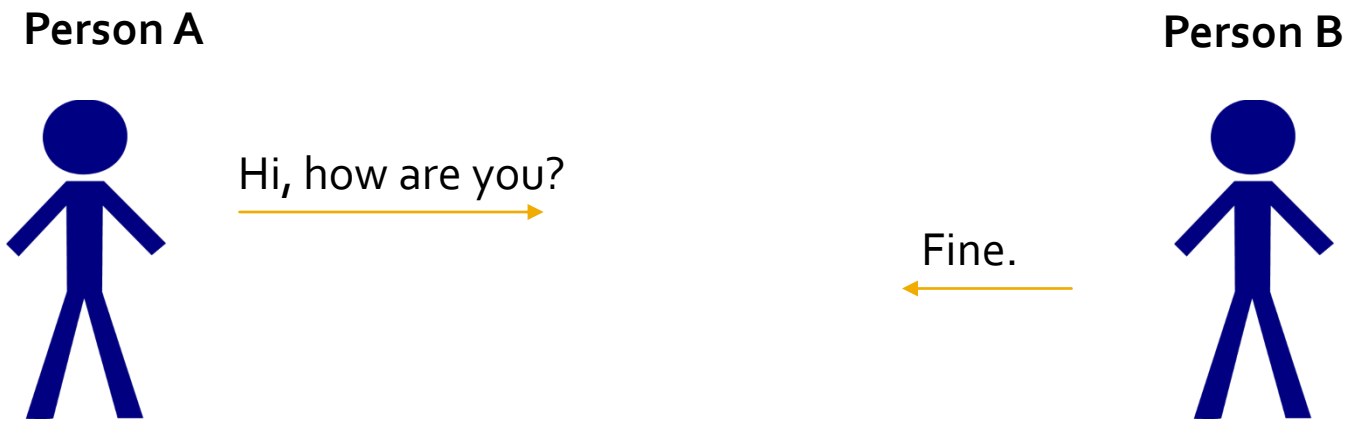
PRAGMATIC

www.pragmatic.bg

Content

- Different Types of Web Services
- SOAP Services – Theory
  - SOAP (Simple Object Access Protocol)
  - WSDL (Web Service Description Language)
  - UDDI (Universal Description Discovery and Integration)
- RESTful Services – Theory
  - Resource
  - Representation
  - Actions
- SOAP vs. REST

Web Service Types



- Two important things
  - Media / Transport (Phone)
  - Message Format (English grammar)

Web Service Types

- Based on messaging format and transport we can distinguish two types of Web Services
  - SOAP
  - REST

SOAP Services

- Message Format
  - XML
  - SOAP strictly defines message format in SOAP protocol
- Transport
  - HTTP, FTP, UDP

REST Services

- Message Format
  - XML, JSON, YAML, HTML, plain text
  - Message can be anything we can transfer over the network
  - Data is send as it is (not enveloped)
- Transport
  - HTTP

What is SOAP?

- SOAP Services are based on SOAP protocol
- SOAP stands for Simple Object Access Protocol
- SOAP is
  - A communication protocol
  - A format for sending messages
  - Based on XML
  - Platform independent
  - Language independent
  - Simple and extensible
  - Will be developed as a W3C standard

SOAP Services

- In order to access the server client should know two things
  - Location of the service (where the service is)
  - Description of the service (what this service provides and how it works)
    - Description is XML file know as WSDL
    - WSDL stands for “Web Services Description Language”

SOAP Services

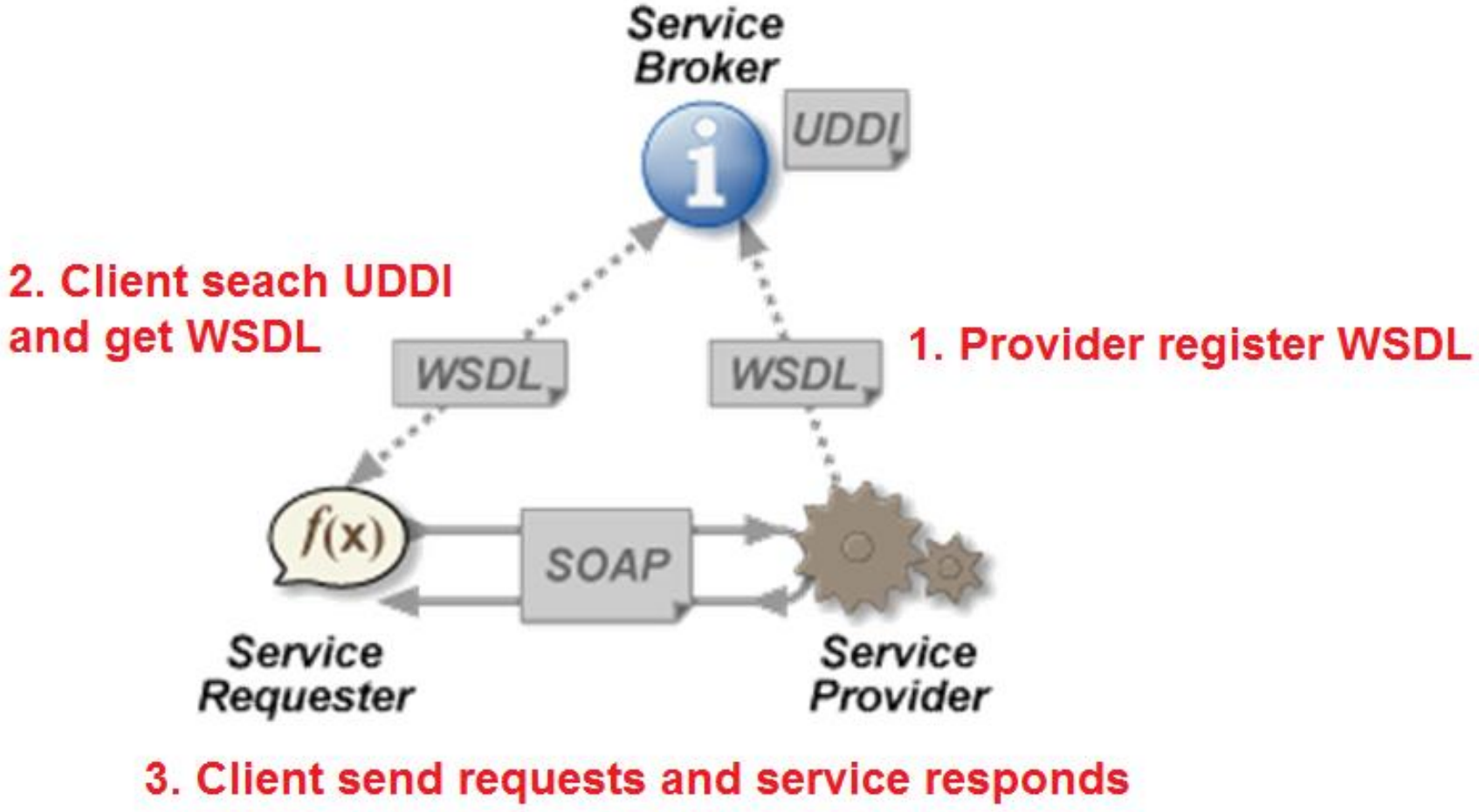
- How client locate the server
  - Server knows the client and send him WSDL
  - UDDI
    - Place where service providers register their services
    - UDDI stands for “Universal Description, Discovery and Integration”

SOAP Services

- UDDI communication workflow
  - Client search UDDI
  - UDDI returns all services providing searched service
  - Client choses a service and get its WSDL

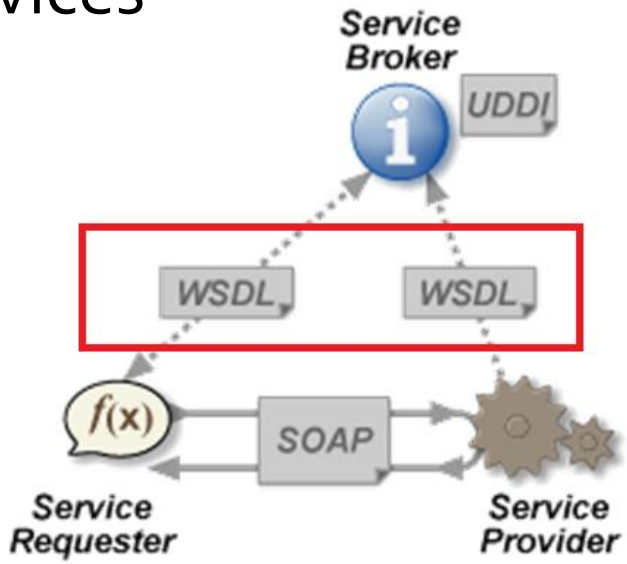
SOAP Services

- SOAP Services communication in picture

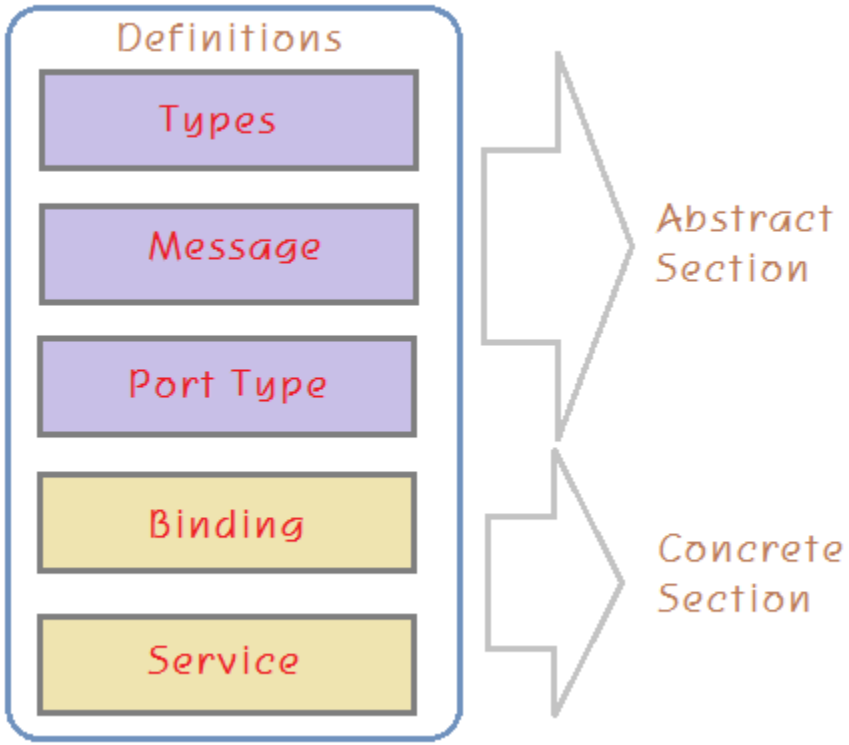


What is WSDL?

- WSDL is an XML-based language
- WSDL document is actually XML document
- WSDL is used to describe Web services
- WSDL is also used to locate Web services
- WSDL is W3C recommendation



WSDL Structure



- Abstract Section
  - What messages service use
  - What operations service can perform
- Concrete Section
  - Where service is located
  - How we can access the service

WSDL Abstract Section

- Types
  - Defines the data type definitions for messages that will be exchanged by the web service.
- Message
  - Defines the set of actual messages that will be exchanged.
- PortType
  - Defines the operations provided/available and involved messages.
  - Operation refers to the messages involved in the transaction.

WSDL Abstract Section

- Types

```
<!-- Type definitions -->
<types>
    <xsd:schema targetNamespace="http://www.skatestown.com/ns/availability"
        xmlns:xsd="http://www.w3.org/2001/XMLSchema">
        <xsd:complexType name="availabilityType">
            <xsd:sequence>
                <xsd:element name="sku" type="xsd:string"/>
                <xsd:element name="price" type="xsd:double"/>
                <xsd:element name="quantityAvailable" type="xsd:integer"/>
            </xsd:sequence>
        </xsd:complexType>
    </xsd:schema>
</types>
```

WSDL Abstract Section

- Message

```
<!-- Message definitions -->
<!-- A PriceCheckRequest is simply an item code (sku)   -->
<message name="PriceCheckRequest">
    <part name="sku" type="xsd:string"/>
</message>

<!-- A PriceCheckResponse consists of an availability structure,
<!-- defined above.
<message name="PriceCheckResponse">
    <part name="result" type="avail:availabilityType"/>
</message>
```

WSDL Abstract Section

- PortType

```
<!-- Port type definitions -->
<portType name="PriceCheckPortType">
    <operation name="checkPrice">
        <input message="pc:PriceCheckRequest"/>
        <output message="pc:PriceCheckResponse"/>
    </operation>
</portType>
```

WSDL Concrete Section

- Bindings
  - Defines transport protocol
  - Defines the message format for operations defined by the portType.
- Service
  - Defines the endpoint where the web service will be exposed

WSDL Concrete Section

- Bindings

```
<!-- Binding definitions -->
<binding name="PriceCheckSOAPBinding" type="pc:PriceCheckPortType">
   <soap:binding style="rpc"
      transport="http://schemas.xmlsoap.org/soap/http"/>
   <operation name="checkPrice">
      <soap:operation soapAction=""/>
      <input>
         <soap:body use="encoded"
                    namespace=
                       "http://www.skatestown.com/services/PriceCheck"
                    encodingStyle=
                       "http://schemas.xmlsoap.org/soap/encoding/"/>
      </input>
      <output>
         <soap:body use="encoded"
                    namespace=
                       "http://www.skatestown.com/services/PriceCheck"
                    encodingStyle=
                      "http://schemas.xmlsoap.org/soap/encoding/"/>
      </output>
   </operation>
</binding>
```

WSDL Concrete Section

- Service

```
<!-- Service definition -->
<service name="PriceCheckService">
    <port name="PriceCheck" binding="pc:PriceCheckSOAPBinding">
        <soap:address
            location=
                "http://localhost:8080/axis/services/PriceCheck"/>
    </port>
</service>
```

WSDL Example

- Examples
  - Example 1
  - Example 2

SOAP Messages

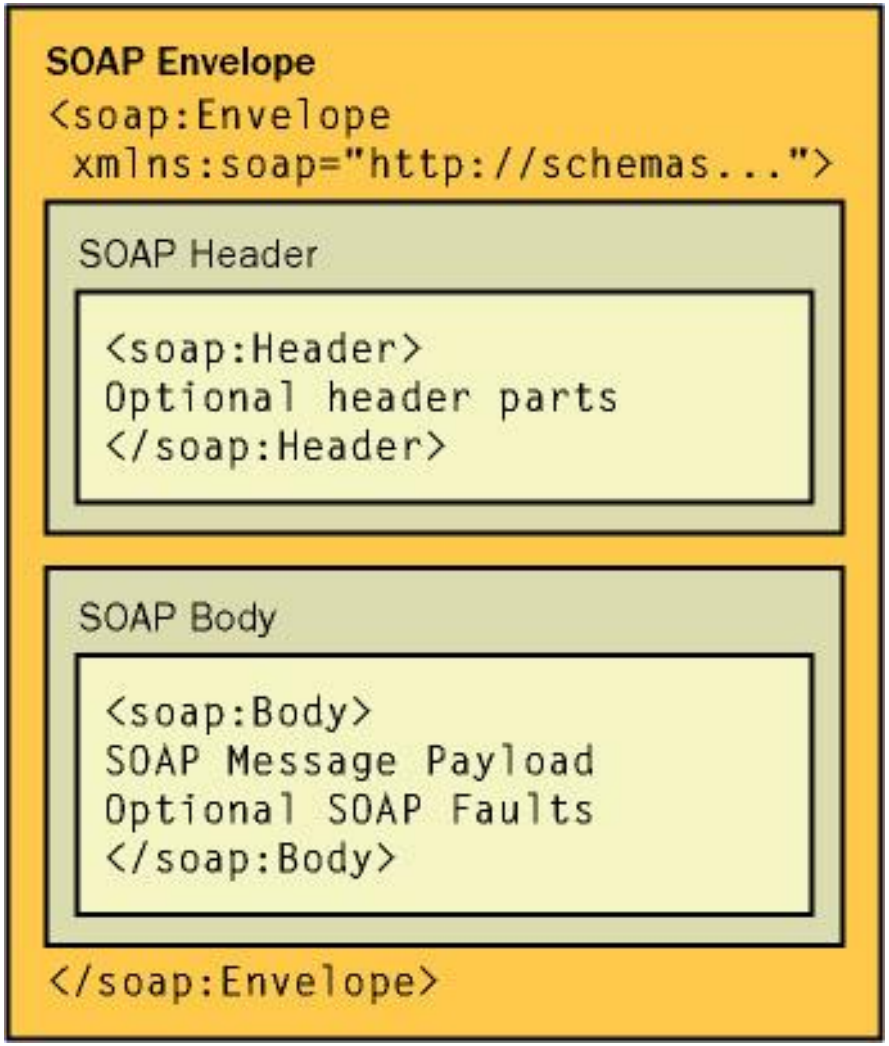
- Client and server communicate with SOAP messages

SOAP Messages

- Plain SOAP Message Diagram

SOAP Messages

- SOAP Message contains following main elements:
  - Envelope (mandatory)
  - Header (optional)
  - Body (mandatory)
- Both SOAP Requests and Responses use Envelope



SOAP Message

```
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
    <soap:Header>
        [Here's where extraneous information, like password data, resides]
    </soap:Header>
    <soap:Body>
        [Here's where the actual message content resides]
        <soap:Fault>
            [Here are instructions to the server about how to handle errors]
        </soap:Fault>
    </soap:Body>
</soap:Envelope>
```

SOAP Message

- Example
  - Simple request message with out headers

```
<?xml version="1.0"?>

<soap:Envelope
xmlns:soap="http://www.w3.org/2003/05/soap-envelope/"
soap:encodingStyle="http://www.w3.org/2003/05/soap-encoding">

<soap:Body>
  <m:GetPrice xmlns:m="https://www.w3schools.com/prices">
    <m:Item>Apples</m:Item>
  </m:GetPrice>
</soap:Body>

</soap:Envelope>
```

SOAP Message

- Example
  - Simple response message

```
<?xml version="1.0"?>

<soap:Envelope
xmlns:soap="http://www.w3.org/2003/05/soap-envelope/"
soap:encodingStyle="http://www.w3.org/2003/05/soap-encoding">

<soap:Body>
  <m:GetPriceResponse xmlns:m="https://www.w3schools.com/prices">
    <m:Price>1.90</m:Price>
  </m:GetPriceResponse>
</soap:Body>

</soap:Envelope>
```

SOAP Envelope

- SOAP Envelope encapsulates the entire message
- SOAP Envelope is the root element of a SOAP message
- This element defines the XML document as a SOAP message.
- SOAP Envelope contains two child elements, an optional <Header> and a mandatory <Body>

SOAP Header

- SOAP Header is optional
- Must be the first child element of the Envelope
- Header elements can occur multiple times
- Header includes information that might be needed by the receiver but isn't strictly part of the message content, like
  - login and password information
  - digital signatures
  - maximum time the SOAP request may take to process
  - state

SOAP Header Attributes

- Attributes appear in Header elements
- Determine how a recipient processes a message
- The SOAP 1.1 specification defines two attributes that can appear in SOAP Header Element:
  - actor
  - mustUnderstand
- The SOAP 1.2 specification defines three attributes:
  - role (a new name for actor)
  - mustUnderstand
  - relay

Role/Actor Attribute

- Header blocks (elements) can be targeted at nodes acting in specific roles
- Example:
  - If a header block is targeted for nodes acting in the "ultimateReceiver" role, then only nodes acting as ultimate receivers must process that header block. All other nodes should leave it unprocessed.

mustUnderstand Attribute

- Indicate whether a header entry is mandatory or optional
- Has two valid values
  - True
    - Means that any node (computer) processing the SOAP message must understand the given header block
    - If intermediate node does not understand the header block (element) containing the mustUnderstand attribute, it should not process the header and must return a SOAP fault.
  - False
    - Means that node might not understand given header block

Relay Attribute

- Determines if a header block is allowed to be relayed if not processed
- Has two valid values
  - True
    - Header element can be forwarded even if not processed
  - False (Default)
    - Header element should be removed if the message is forwarded

SOAP Body

- The SOAP Body element is mandatory
- The SOAP Body element contains the actual SOAP message
- Sample request:

```
<soap:Body>
  <m:GetPrice xmlns:m="http://www.w3schools.com/prices">
    <m:Item>Apples</m:Item>
  </m:GetPrice>
</soap:Body>
```

- Sample response:

```
<soap:Body>
  <m:GetPriceResponse xmlns:m="http://www.w3schools.com/prices">
    <m:Price>1.90</m:Price>
  </m:GetPriceResponse>
</soap:Body>
```

SOAP Fault

- SOAP Fault element is optional
- Must appear as a child element of the Body element
- Fault element can only appear once in a SOAP
- Holds errors and status information for a SOAP message

SOAP Fault

- SOAP Fault element has the following sub elements

<faultcode>

A code for identifying the fault

<faultstring>

A human readable explanation of the fault

<faultactor>

Information about who caused the fault to happen

<detail>

Holds application specific error information related to the Body element

SOAP Faultcode Values

- SOAP Fault code values

<VersionMismatch>

Found an invalid namespace for the SOAP Envelope element

<MustUnderstand>

Child element of the Header element, with the mustUnderstand attribute set to "1", was not understood

<Client>

The message was incorrectly formed or contained incorrect information

<Server>

There was a problem with the server so the message could not proceed

SOAP Example

- Examples
  - Example Request
  - Example Response

What is REST?

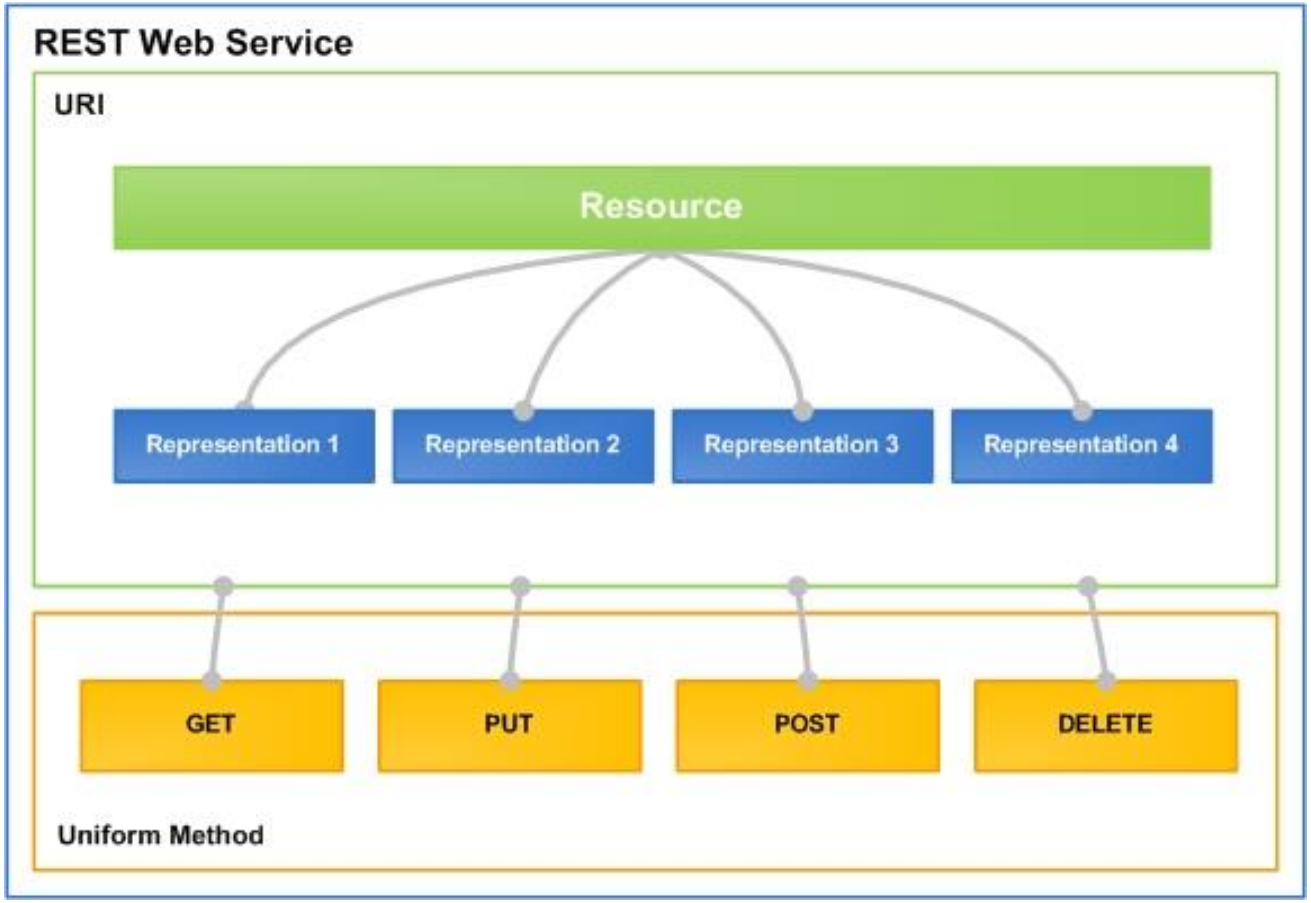
- REST stands for “Representational State Transfer”
- Definition
  - Representational State Transfer (REST) is a software architecture style consisting of guidelines and best practices for creating scalable web services.
- REST is not a standard!

REST Concepts

- A RESTful system should be
  - Client-server
  - Stateless
    - Each request should be independent of others
  - Cacheable
    - Clients are able to cache responses
    - Responses must therefore, implicitly or explicitly, define themselves as cacheable, or not
  - Uniformly accessible
    - Each resource must have a unique address and a valid point of access

A RESTful System Main Actors

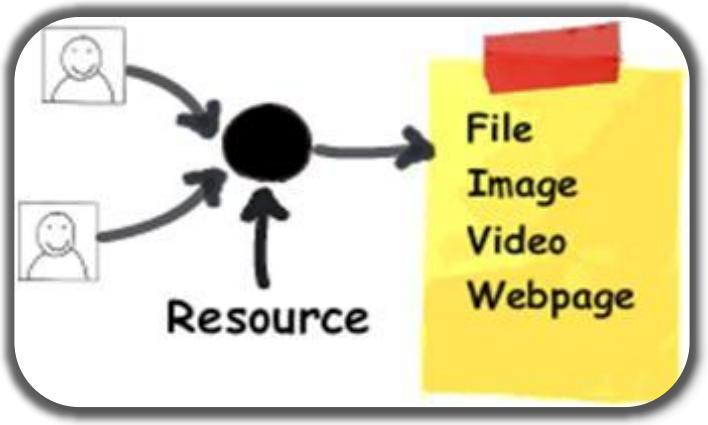
- Resources, Representations and Actions



Resources

- A resources is "everything" the service can provide
- State and functions of a remote application are also considered as resources
- A resource must have a unique address over the Web

- Example of resources:
  - Title of a movie from IMDb
  - YouTube video
  - Images from Flicker
  - Order info from eBay



Representations

- The representations of resources is what is sent back and forth clients and servers
- We never send or receive resources, only their representations

Representation Formats

- Different clients are able to consume different representations of the same resource
- A representation can take various forms, but its resource has to be available through the same URI
- The format of the representations is determined by the content-type
  - Content type is a reusable collection of settings that you want to apply to a certain category of content

```
Accept: application/json, text/javascript, */*
Content-Type: application/json; charset=utf-8
Accept-Encoding: gzip, deflate
```

XML Format

- XML is markup-language for encoding documents in machine-readable form
  - Text-based format
  - Consists of tags, attributes and content
  - Provide data and meta-data in the same time

```
<?xml version="1.0"?>
<library>
  <book><title>HTML 5</title><author>Bay Ivan</author></book>
  <book><title>WPF 4</title><author>Microsoft</author></book>
  <book><title>WCF 4</title><author>Kaka Mara</author></book>
  <book><title>UML 2.0</title><author>Bay Ali</author></book>
</library>
```

JSON Format

- JSON (JavaScript Object Notation)
  - Standard for representing simple data structures and associative arrays
  - Lightweight text-based open standard
  - Derived from the JavaScript language

```
{
  "firstName": "John", "lastName": "Smith", "age": 25,
  "phoneNumber": [{ "type": "home", "number": "212 555-1234"},
    { "type": "fax", "number": "646 555-4567" }]
},
{
"firstName": "Bay", "lastName": "Ivan", "age": 79
}
```

JSON vs. XML

XML

```
<employees>
  <employee>
    <firstName>John</firstName> <lastName>Doe</lastName>
  </employee>
  <employee>
    <firstName>Anna</firstName> <lastName>Smith</lastName>
  </employee>
  <employee>
    <firstName>Peter</firstName> <lastName>Jones</lastName>
  </employee>
</employees>
```

JSON

```
{"employees":[
  {"firstName":"John", "lastName":"Doe"},
  {"firstName":"Anna", "lastName":"Smith"},
  {"firstName":"Peter", "lastName":"Jones"}
]}
```

Actions

- Actions are used to operate on resources
- For example they can be used for
  - Getting info about a movie
  - Adding photo to Flicker
  - Deleting a post from Facebook
  - Updating Facebook status

HTTP Based Actions

- Under HTTP, actions are standard HTTP request

Method	Description
GET	Retrieve / load a resource
POST	Create / store a resource
PUT	Update a resource
DELETE	Delete (remove) a resource
PATCH	Update resource partially
HEAD	Retrieve the resource's headers

HTTP Status Codes

Status Code	Action	Description
200	OK	Successfully retrieved resource
201	Created	A new resource was created
204	No Content	Request has nothing to return
301 / 302	Moved	Moved to another location (redirect)
400	Bad Request	Invalid request / syntax error
401 / 403	Unauthorized	Authentication failed / Access denied
404	Not Found	Invalid resource
409	Conflict	Conflict was detected, e.g. duplicated email
500 / 503	Server Error	Internal server error / Service unavailable

SOAP vs REST

- REST
  - Exposes RESOURCES which represent DATA
  - Use HTTP Verbs (GET/POST/PUT/DELETE)
  - Supports multiple data formats
- SOAP
  - Exposes OPERATIONS which represent LOGIC
  - Use HTTP POST
  - Supports only XML (and attachments)

SOAP vs REST

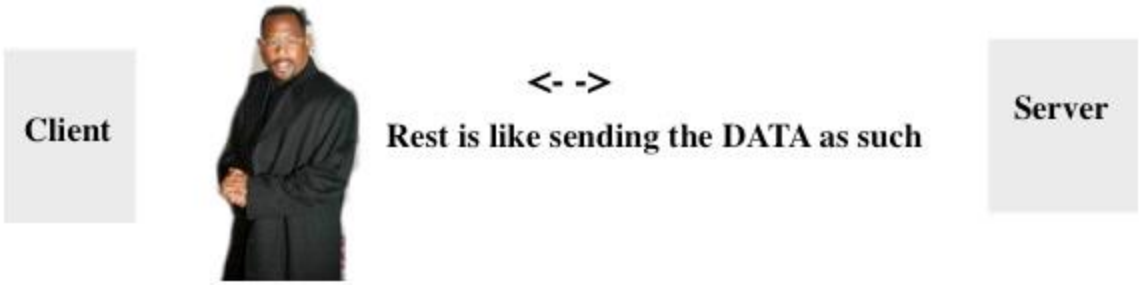
Consider "Martin Lawrence" as your data

SOAP

Data + SOAP Standards

Your data sent to SERVER would become huge as Big mama

REST



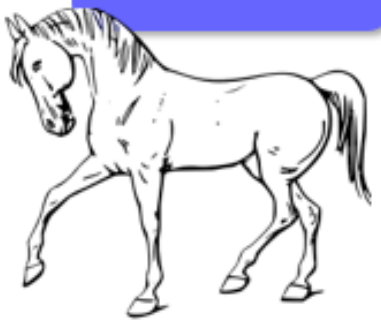
Rest is like sending the DATA as such

SOAP vs REST

REST

Rides directly on HTTP. Plain and simple. In reality, this is all you need to send data from point A to point B and get the required response. Catch: Until something that represents a service contract is put in to place, it's kinda "anything goes".

HTTP



SOAP

The coach is your SOAP envelope: it wraps your data. Main strength is the presence of a contract: the WSDL. Gives you the "comfort" of easily generating artifacts. Catch: look at the complexity and added weight.

Who Use REST?




Who Prefer SOAP?

- Big old companies
- Mission critical software systems

Additional Resources

- SOAP Specification
  - http://www.w3.org/TR/2000/NOTE-SOAP-20000508/
- REST Articles
  - http://en.wikipedia.org/wiki/Representational_state_transfer
  - http://www.ibm.com/developerworks/library/ws-restful/

Questions