Web Services 2

Contents

- WSDL
- REST architecture

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Role of WSDL

- SOAP Web Service Definition by W3C: “a software application identified by a URI, whose interfaces and bindings are capable of being defined, described, and discovered as XML artifacts.”
- Given that the client and service are different entities – we need to know:
  - where is the service?
  - what does it offer me?
  - what XML should I send/receive to interact with it?
  - how can I expose it to others?

WSDL

- WSDL stands for **Web Services Description Language**
- WSDL is written in XML
- WSDL is used to describe web services
- WSDL is used to locate Web services

WSDL Document Structure

```
<definitions>
        <types>
                definition of types........
        </types>
        <message>
                definition of a message....
        </message>
        <portType>
                definition of a port.......
        </portType>
        <binding>
                definition of a binding....
        </binding>
        <service>
                definition of the service....
        </service>
</definitions>
```

WSDL Document Structure (cont.)

- Abstract part
  - **Types**– a container for data type definitions using some type system (such as XSD).
  - **Message**– an abstract, typed definition of the data being communicated.
  - **Port Type**–an abstract set of operations supported by one or more endpoints.
    - **Operation**– an abstract description of an action supported by the service.
- Concrete part
  - **Binding**– a concrete protocol and data format specification for a particular port type.
  - **Service**– a collection of related endpoints.
    - **Port**– a single endpoint defined as a combination of a binding and a network address.

WSDL Types

- The **<types>** element defines the data type that are used by the web service
- WSDL uses XML Schema syntax to define data types

WSDL Messages

- The **<message>** element defines the data elements of an operation
- The messages let clients know about the input and output. Each message is a series of name/type pairs
- Example:

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

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

WSDL PortType

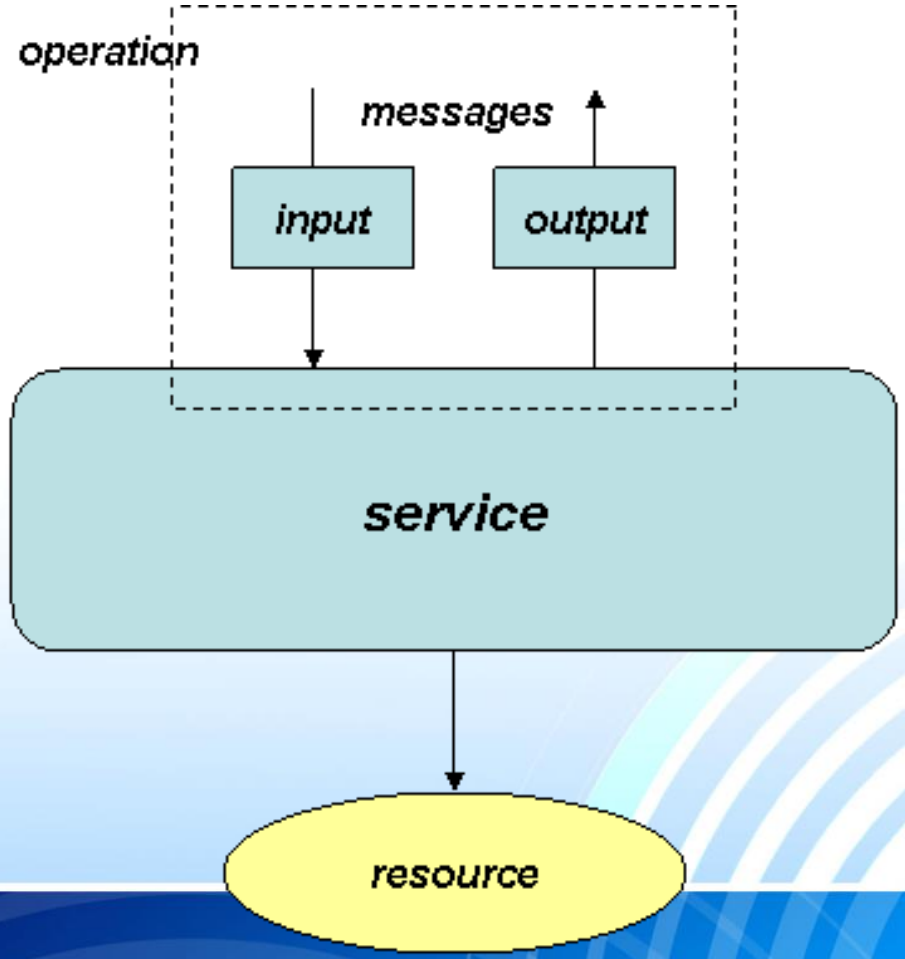
- The **<portType>** element describes the operations that can be performed, and the messages that are involved
- Each port type is a group of operations
- Example:

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

WSDL PortType (cont.)

Type	Definition
One-way	The operation can receive a message but will not return a response
Request-response	The operation can receive a request and will return a response
Solicit-response	The operation can send a request and will wait for a response
Notification	The operation can send a message but will not wait for a response

Messages and operations



Source: https://msdn.microsoft.com/en-us/library/ms996486.aspx

WSDL Bindings

- The <binding> element defines the message format and protocol details for a web service
- The binding element has the *name* and the *type* attributes
  - The name attribute defines the name of the binding
  - The type attribute points to the port for the binding.

WSDL Bindings (cont.)

- The soap:binding element has the *style* and the *transport* attributes
  - The *style* attribute can be "rpc" or "document“
- The *operation* element defines each operation that the port exposes

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

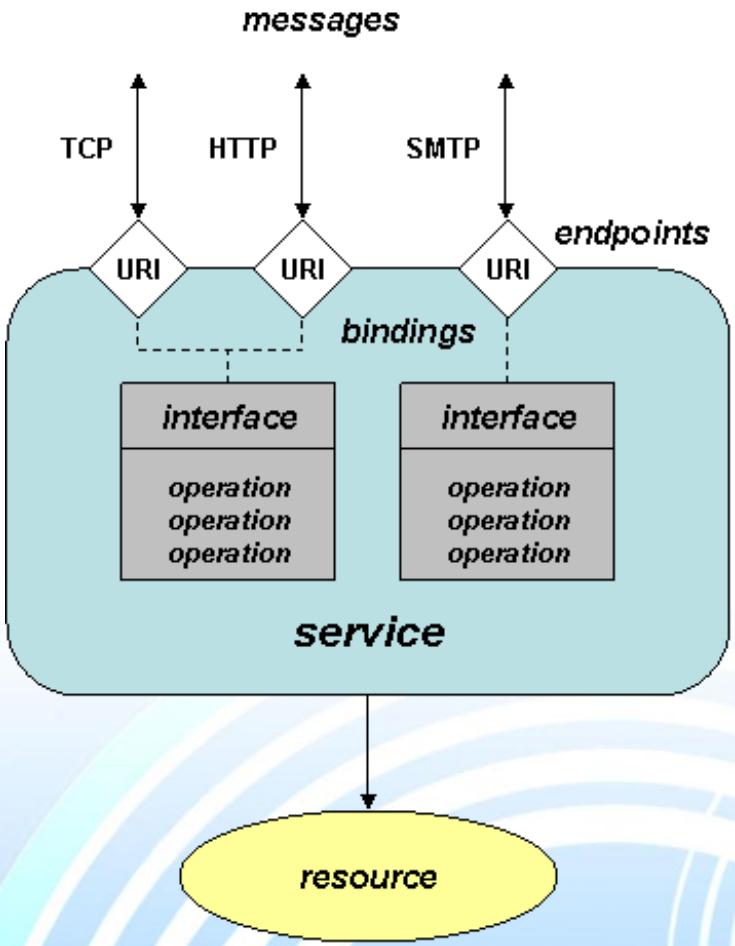
WSDL Service and Ports

- The <service> element defines a collection of ports, or endpoints, and which binding to use
- The <port> element defines the connection point to a web service
  - Each port has a name and is assigned to a binding
  - Within the port element, the address details is defined for that specific binding

```
<service name="MathService">
       <port name="MathEndpoint" binding="y:MathSoapHttpBinding">
         <soap:address  location="http://localhost/math/math.asmx"/>
       </port>
   </service>
```

Service and Bindings

- A service can have multiple bindings for a given interface/portType
- Each binding can be only accessible at a unique URL (endpoint/port)



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REST (REpresentational State Transfer)

- **REST is an architecture**
  - NOT a technology or standards specification or a protocol
- While REST is not a standard, it uses standards:
  - HTTP
  - URL
  - XML/HTML/JSON/etc
  - MIME Types or Media types such as text/xml, image/gif, application/json, audio/mpeg

REST Constraints

- REST constraints are design rules that are applied to establish the distinct characteristics of the REST architectural style.
- The formal REST constraints are:
  - Client/Server
  - Stateless
  - Cacheable
  - Uniform Interface
  - Layered Systems
  - Code-On-Demand

Client/Server

- This essentially means that client application and server application MUST be able to evolve separately without any dependency
  - separating the user interface concerns (e.g. of clients) from the data storage concerns (e.g. of servers)
  - allows the components to evolve independently
  - improve the **portability** of the user interface across multiple platforms
  - improves **scalability** by simplifying the server components

Stateless

- Make all client-server interaction stateless. Server will not store anything about latest HTTP request client made. It will treat each and every request as new. No session, no history.
  - each request from client to server must contain all of the information necessary to understand the request
  - it cannot take advantage of any stored context on the server
  - Improves scalability and reliability

Cacheable

- In REST, caching shall be applied on resources when applicable and then these resources MUST declare themselves cacheable.
- Caching brings performance improvement for client side, and better scope for scalability for server because load has reduced.
- If a response is cacheable, then a client cache is given the right to reuse that response data for later, equivalent requests
- Reliability might be reduced if stale data within the cache differs significantly from the data that would have been obtained had the request been sent directly to the server

Uniform interface

- APIs interface MUST be decided for resources inside system which are exposed to API consumers and follow religiously. A resource in system should have only one logical URI, and then should provide way to fetch related or additional data.
  - all resources are accessed with a generic interface (e.g., HTTP **GET, POST, PUT, DELETE**)
  - the overall system architecture is simplified
  - But “degrades efficiency, since information is transferred in a standardized form rather than one which is specific to an application's needs”

Guiding principles of the uniform interface

- Identifying the resource
- Resource representation
- Self-descriptive Messages
- Hypermedia as the Engine of Application State (HATEOAS)

Identifying the resource

- Each resource must have a specific and cohesive URI to be made available
- **REST is based on these notions:**
  - A **resource**
    - Any information that can be named can be a resource
    - A document or image, a temporal service, a collection of other resources, a non-virtual object (e.g. a person)
    - Nouns instead of verbs
  - A **resource identifier**
    - Each resource accessible by a URI/URL
    - A resource identifier (URI) identifies a particular resource
    - ‘Nice’ URIs

Identifying the resource: Example

```
HTTP/1.1 GET
https://www.googleapis.com/customsearch/v1?parameters
```

REST methods

Method	Meaning
GET	Retrieve a copy of a Resource
DELETE	Remove a Resource
POST	Create or sometimes update
PUT	Update a Resource or sometimes create
PATCH	Update only part of a resource

- The difference between PUT and POST
  - POST is not idempotent but PUT is
  - The client uses PUT when it's in charge of deciding which URI the new resource should have.
  - The client uses POST when the server is in charge of deciding which URI the new resource should have

Resource representation

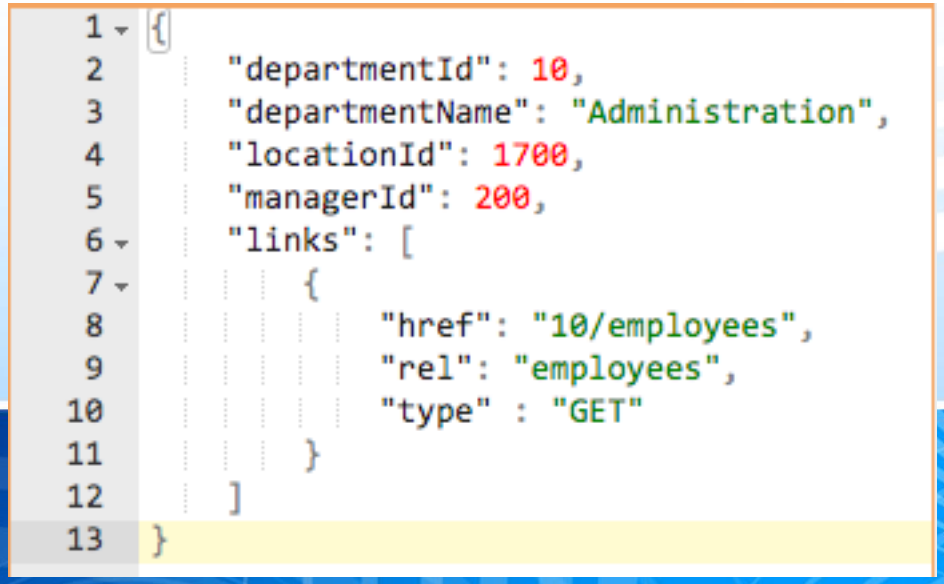
- A representation of a resource
  - A document capturing current state of a resource
  - A resource can have different representations
  - Client can specify which representation can accept (e.g. in http accept header)
  - A resource representation provides links for navigation and accessing further resources
- This representation can be in HTML, XML, JSON, TXT, and more.

Self-descriptive Messages

- Each message includes enough information to describe how to process the message.
- Beyond what we have seen so far, the passage of meta information is needed (metadata) in the request and response. Some of this information are: HTTP response code, Host, Content-Type etc.

Hypermedia as the Engine of Application State (HATEOAS)

- It means that hypertext should be used to find your way through the API
- For example, below given JSON response may be from an API like HTTP `GET http://api.domain.com/management/departments`



```
{
    "departmentId": 10,
    "departmentName": "Administration",
    "locationId": 1700,
    "managerId": 200,
    "links": [
        {
            "href": "10/employees",
            "rel": "employees",
            "type" : "GET"
        }
    ]
}
```

Layered system

- REST allow you to use a layered system architecture where you deploy the APIs
  - The architecture is transparent. A client cannot ordinarily tell whether it is connected directly to the end server, or to an intermediary along the way.
  - This can be used to improve system scalability by enabling load balancing of services across multiple networks and processors

Code on demand

- This *optional* constraint is primarily intended to allow logic within clients (such as Web browsers) to be updated independently from server-side logic.
- Allows client functionality to be extended by downloading and executing code in the form of applets or scripts

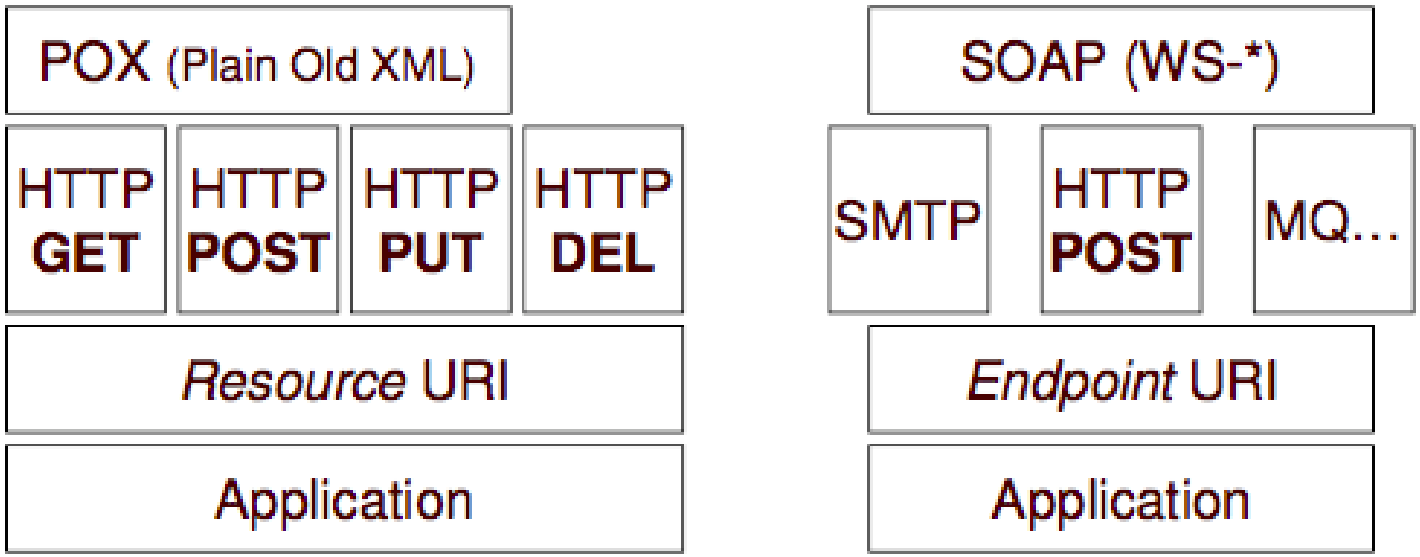
REST vs SOAP

- Main differences
- Conceptual Comparison
- Technology Comparison
- Protocol Comparison

REST vs SOAP: Main differences

- "The Web is the universe of globally accessible information"
  (Tim Berners Lee)
  - Applications should publish their data on the Web (through URI)

- "The Web is the universal transport for messages"
  - Applications get a chance to interact but they remain "outside of the Web"



REST vs SOAP: Main differences

REST	SOAP
REST operates through a solitary, consistent interface to access named resources.	SOAP operates through different interfaces
Mainly accesses data	Mainly performs operations through a more standardized set of messaging patterns
Direct point-to-point communication	Works well in distributed enterprise environments

REST vs SOAP: Conceptual Comparison

REST	SOAP
The Web as an open publishing medium	The Web as a cross enterprise communication medium
Resource Documents originally meant for human consumption	Business Documents for business process driven consumption
Resource oriented access informational resources	Activity/Service oriented – actions that may be performed orthogonally to the resources upon which they act

REST vs SOAP: Technology Comparison

REST	SOAP
User-driven interactions via forms	Orchestrated reliable event flows
Few operations (generic interface) on many resources	Many operations (service interface) on few resources
URI: Consistent naming mechanism for resources	Lack of standard naming mechanism
Focus on scalability and performance of large scale distributed hypermedia systems	Focus on design of integrated (distributed) applications

REST vs SOAP: Protocol Comparison

REST	SOAP
XML in – XML out (with POST)	SOAP in – SOAP out (with POST)
URI in – XML out (with GET)	Strong Typing (XML Schema)
“Self-Describing” XML	“Transport independent”
HTTP only	Heterogeneity in QoS needs. Different protocols may be used
HTTP/SSL is enough – no need for more standards	HTTP as a transport protocol
HTTP is an application protocol	Synchronous and Asynchronous
Synchronous	Foundation for the whole WS* advanced protocol stack
Do-it-yourself when it comes to “reliable message delivery”, “distributed transactions”	

Reference

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- https://www.tutorialspoint.com/uddi/uddi_overview.htm
- http://whatisrest.com/