Web Services Overview

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SWE 642
Software Engineering for the World Wide Web

Motivating Example—Travel Info
Travel Information Needed

Information Needed
- Conference schedule
- Hotel address & phone number
- Flight numbers and times
- Gate numbers
- Seat numbers
- Hotel confirmation number
- Hotel room number
- Meeting rooms and times
- Local contact information for colleagues

And after returning home ... all this information is immediately discarded!

Current Method

- Most of us accumulate this information from
  - Email
  - Websites
  - Phone conversations
  - Personal conversations
  - Pieces of paper

- And then try to organize and track it
  - In our heads
  - Random scraps of paper
  - Laboriously hand-entering data into hand-held devices

This is very 20th century analog ...
21st Century Method

- Data are sent to a hand-held device wirelessly
  - Hand-held device automatically organizes data into meaningful information
- Information is presented to traveler when needed

Data can be generated and sent through software in a service oriented architecture

Distributed Technologies

- Pre-web distributed technologies
  - Remote procedure calls (RPC)
  - Common object request broker architecture (CORBA)
  - Distributed component object model (DCOM)
- Disadvantages of pre-web distributed technologies
  - The architecture gets very complicated
  - Shared data are mostly binary, so it’s hard to make components compatible
  - Software must be homogeneous
**Web Services**

- A **Web Service** is a program that offers services over the Internet to other software programs
  - Internet-based
  - Uses SOAP and XML
  - Peer-to-peer communication via message passing
- Web service components can integrate dynamically, by finding other services during execution
- Web services transmit data formatted in XML
- One way to create systems of systems

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**Web Service Architecture**

**Client-server**

- Server
- Clients

**Web Apps**

- Servers
- Internet
- Clients

**Web Services**

- PDA
- Cell phone
- Server
- Workstation
- Laptop

3 December 2013
Web Services Technologies

- Extensible Markup Language (XML)
- Simple Object Access Protocol (SOAP)
  - Standard packaging structure to transport XML documents over networks (HTTP, FTP, SMTP)
- Web Services Description Language (WSDL)
  - An XML-based language for describing interfaces of web services (IO parameters, binding protocol, …)
- Universal Description, Discovery and Integration (UDDI)
  - Internet-based registry service where service providers publish services, and service subscribers search and locate services
SOAP Message Structure

SOAP Message Structure:

- **SOAP Envelope**
  - **SOAP Header**
  - **SOAP Element**
    - ... (multiple elements)
  - **SOAP Element**
- **SOAP Body**
  - **SOAP Element**
    - ... (multiple elements)
  - **SOAP Element**

Sample SOAP Message (RPC)

- **Method Signature**

  ```
  int doubleAnInteger (int numberToDouble);
  ```

- **Request**

  ```xml
  <?xml version="1.0" encoding="UTF-8" standalone="no" ?>
  <SOAP-ENV:Envelope
    SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
    xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/1999/XMLSchema">
    <SOAP-ENV:Body>
      <ns1:doubleAnInteger xmlns:ns1="urn:MySoapServices">
        <param1 xsi:type="xsd:int">123</param1>
      </ns1:doubleAnInteger>
    </SOAP-ENV:Body>
  </SOAP-ENV:Envelope>
  ```
Sample SOAP Message (RPC)

• Response

```xml
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/1999/XMLSchema">
    <SOAP-ENV:Body>
        <ns1:doubleAnIntegerResponse xmlns:ns1="urn:MySoapServices"
            SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/envelope/">
            <return xsi:type="xsd:int">246</return>
        </ns1:doubleAnIntegerResponse>
    </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Sample SOAP Message (Web Service)

```xml
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/1999/XMLSchema">
    <SOAP-ENV:Header>
        <jaws:msgheader xmlns:jaws="http://jaws.sample.com">
            <from>George P Burdell</from>
            <msgID>30332</msgID>
        </jaws:msgheader>
    </SOAP-ENV:Header>
    ...
</SOAP-ENV:Envelope>
```
Sample Web Service SOAP

<Message (cont.)>
<items>
  <item>
    <name>Buzz light pen</name>
    <price>$19.85</price>
    <quantity>25</quantity>
  </item>
</items>
<shipto>
  <name>George P Burdell</name>
  <address>1988 Tech Drive</address>
  <city>Atlanta</city>
  <state>GA</state>
</shipto>
</jaws:purchaseorder>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>

Web Services Definition Language (WSDL)

- Defines abstract functionality of services
- Defines how to invoke services
- Five parts
  - Operations : Message exchange between a provider and requester
  - Interface : A collection of operations
  - Bindings : Concrete protocol and message format for interfaces
  - Endpoints : URI for invoking a service
  - Service : A collection of endpoints bound to the same interface
WSDL Structure

```xml
<definitions>
  <message> … </message>
  <interface>
    <operation>
      <input> … </input>
      <output> … </output>
    </operation>
  </interface>
  <binding> … </binding>
  <service>
    <endpoint> … </endpoint>
  </service>
</interface>
</definitions>
```

Travel Info Flow – Web Services

Use web services instead of email to plan trip

Connect wirelessly to web services during journey
Summary—Trustworthiness

For widespread adoption, users must be confident web services are

- Reliable
- Secure
- Dependable
- Usable

Testing addresses some, but not all these issues