Sistemi ICT per il Business Networking

SOA and Web Services

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1st & 2nd Generation Web Apps

1-1 correspondence of page to file

“Dynamic Pages”
Motivation

- The ability to **program the Web**

**Example:**

- Consider an Excel spreadsheet that summarizes your whole financial picture: stocks, bank accounts, loans, etc.
- If some of this information is available through XML Web services, Excel can update it and present the update information to the user.

![Diagram showing Excel updating Financial Data Service](image-url)
3rd Generation Web

The **transactional web** will be dominated by **program-to-program** business-to-business (B2B) **interactions**.
Changes in business environment

- The **business environment** is undergoing a dramatic change:
  - non-traditional **players**
  - emergence of a multitude of delivery **channels**
  - a plethora of regulatory and governmental compliance **requirements**
  - demands for more **flexibility** and **agility** to name a few, influence business design and execution
  - shorter **time to market** for new products
  - the desire to create **new revenue sources**
Problems with application interfaces

- **If** all applications were to use a common programming interface and interoperability protocol, the job of IT would be much simpler, complexity would be reduced, and existing functionality could be more easily reused.

- This is the promise that service-oriented development brings to the IT world, and when deployed using a service-oriented architecture (SOA), services also become the foundation for more easily creating a variety of new strategic solutions:
  - **Rapid application integration**
  - **Automated business processes**
  - **Multi-channel access to applications**, including fixed and mobile devices
Service-Oriented Architecture (SOA)
Transactional Web

- This transformation is being fueled by the **program-to-program communication model** of Web services built on **existing and emerging standards** such as
  - HyperText Transfer Protocol (HTTP)
  - Extensible Markup Language (XML)
  - Simple Object Access Protocol (SOAP)
  - Web Services Description Language (WSDL)
  - Universal Description, Discovery, and Integration (UDDI)
Web Services

- **Web services technologies** provide a **language-neutral, environment-neutral programming model** that **accelerates application integration** inside and outside the enterprise
  - Application integration through Web services yields **flexible loosely coupled business systems**

- Because Web services are easily applied as a **wrapping** technology around existing applications and information technology assets, new solutions can be deployed quickly and recomposed to address new opportunities

- As adoption of Web services accelerates, the pool of services will grow, fostering development of more **dynamic models of just-in-time application and business integration** over the Internet
Web Service

- A **Web service** is an **interface** that describes a **collection of operations** that are **network-accessible** through standardized XML messaging
  - A **web application without a user interface**
- A Web service **performs** a specific task or a set of tasks
- A Web service is **described** using a **standard, formal XML notation**, called its **service description**, that provides all of the details necessary to interact with the service, including
  - message formats (that detail the operations)
  - transport protocols
  - location
History

Web services evolved from previous technologies that served the same purpose such as RPC, ORPC (DCOM, CORBA and JAVA RMI)

Web Services were intended to solve these main problems:

1. Interoperability
2. Firewall traversal
Interoperability

- Earlier distributed systems suffered from interoperability issues because each vendor implemented its own on-wire format for distributed object messaging.
  - Development of DCOM apps strictly bound to Windows Operating system.
  - Development of RMI bound to Java programming language.
**Firewall traversal**

- Collaboration across corporations was an issue because distributed systems such as CORBA and DCOM used **non-standard ports**.
- **Web Services use HTTP** as a transport protocol and most of the firewalls allow access though **port 80** (HTTP), leading to easier and dynamic collaboration.
Web Services Components

- **XML** – eXtensible Markup Language – A uniform data representation and exchange mechanism

- **SOAP** – Simple Object Access Protocol – A standard way for communication

- **UDDI** – Universal Description, Discovery and Integration specification – A mechanism to register and locate WS based application.

- **WSDL** – Web Services Description Language – A standard meta language to described the services offered
Web Services in practices

Find a Service
http://www.uddi.org
Link to WSDL document

How do we talk? (WSDL)
http://yourservice.com/?WSDL
XML with service descriptions

Let me talk to you (SOAP)
http://yourservice.com/svc1
XML/SOAP BODY

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Web Service Architecture

1. A service provider **creates** a **Web service** and its **service definition** and then **publishes** the service with a service registry
   - based on a standard called the **Universal Description, Discovery, and Integration (UDDI)** specification

2. A service requester may **find** the service via the UDDI interface

3. The UDDI registry **provides** the service requester with a **WSDL service description** and a **URL** (uniform resource locator) pointing to the service itself

4. The service requester may then use this information to directly **bind** to the service and **invoke** it
Web Service Architecture

- Service Consumer
  - Find UDDI - WSDL
- Service Provider
  - Register UDDI - WSDL
  - Invoke SOAP
Web Services in practices

1. Where can I find a Web Service that does X?

2. Server A is capable of doing X!
   UDDI

3. How exactly should I invoke you?

4. Take a look at this:
   WSDL

5. Request operation X
   SOAP

6. Result of operation X
   SOAP
Example – A simple Web Service

- A buyer (which might be a simple client) is ordering goods from a seller service
- The buyer finds the seller service by searching the UDDI directory
- The seller service is a Web Service whose interface is defined using Web Services Description Language (WSDL)
- The buyer is invoking the order operation on the seller service using Simple Object Access Protocol (SOAP) and the WSDL definition for the seller service
- The buyer knows what to expect in the SOAP reply message because this is defined in the WSDL definition for the seller service
Another Example

- Service Registry
  - Find UDDI - WSDL
  - Register UDDI - WSDL
- Italian-Chinese Translator
  - Register UDDI - WSDL
- Other service
- MS Word
  - Invoke SOAP
- Grammar corrector
  - Invoke SOAP
Example – A process

Calculate rates

Authorize payment

Book Room

Reservation System

Accounting System

Calculate rates

Authorize payment

Book room

Clearing House System
Web services stack

- A collection of standardized protocols that lets individuals and applications locate and utilize Web services
Web services stack

- All Web services must be available over some network
  - The network is often based on an HTTP protocol, but other kinds of network protocols, such as the Internet Inter-ORB Protocol (IIOP), can be also used

- On top of the networking layer is an XML-based messaging layer that facilitates communications between Web services and their clients
  - The messaging layer is based on SOAP (Simple Object Access Protocol), which is an XML protocol that facilitates the invoke operation

- Web Service descriptions take the form of XML documents for the programming interface and location of Web services
  - WSDL is a specification that describes available Web services to clients
Web services stack

- **Publication of a service** is an action performed by the service provider that makes the **WSDL document available** to a potential service requester.
  - **Sending the WSDL (or a URL pointer to the WSDL) as an e-mail** to a developer is considered to be publishing.
  - Publishing is also **advertising the WSDL in a UDDI registry** for many developers or executing services to find.

- **Discovery of a service** is any action that gives the service requester access to the WSDL for a service.
  - The action may be as simple as **accessing a file or URL containing the WSDL** or as complex as **querying a UDDI registry** and using the WSDL file(s) to select one of many potential services.
Web services stack

- The **service flow layer** of the stack facilitates the **composition of Web services** into workflows and the **representation of this aggregation** of Web services as a **higher-level Web service**.

  - Standardization activity at this level is ongoing, but there are several proposals, such as
    - Web Service Flow Language (WSFL)
    - BPEL4WS
    - BPML
    - ...

Services vs. composition

Accounting System
- Calculate rates

Clearing House System
- Authorize payment

Reservation System
- Book Room

Room Reservation Process
- Calculate rates
- Authorize payment
- Book Room
SOAP

- SOAP stands for "Simple Object Access Protocol"
- SOAP is an XML vocabulary standard to enable programs on separate computers to interact across any network
- SOAP is a simple markup language for describing messages between applications
- SOAP uses mainly HTTP as a transport protocol
  - HTTP message contains a SOAP message as its payload section
WSDL

- WSDL stands for **Web Services Description Language**
- WSDL is an XML vocabulary for **describing Web services** and their capabilities, in a standard manner
  - WSDL specifies **what a request message must contain** and **what the response message will look like** in unambiguous notation
  - In other words, it is a **contract between the XML Web service and the client** who wishes to use this service
  - In addition to describing message contents, WSDL defines **where the service is available** and **what communications protocol is used** to talk to the service
The WSDL Document Structure

- A WSDL document is just a simple XML document
- It defines a web service using these major elements:
  - **port type** - The operations performed by the web service
  - **message** - The messages used by the web service
  - **types** - The data types used by the web service
  - **binding** - The communication protocols used by the web service
<message name="GetStockPriceRequest">
    <part name="stock" type="xs:string"/>
</message>

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

<portType name="StocksRates">
    <operation name="GetStockPrice">
        <input message="GetStockPriceRequest"/>
        <output message="GetStockPriceResponse"/>
    </operation>
</portType>
A SOAP message is an ordinary XML document containing the following elements:

- A required **Envelope** element that identifies the XML document as a SOAP message
- An optional **Header** element that contains header information
- A required **Body** element that contains call and response information
- An optional **Fault** element that provides information about errors that occurred while processing the message
POST /InStock HTTP/1.1
Host: www.stock.org
Content-Type: application/soap+xml; charset=utf-8
Content-Length: 150

<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body
xmlns:m="http://www.stock.org/stock">
    <m:GetStockPrice>
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
HTTP/1.1 200 OK
Content-Type: application/soap; charset=utf-8
Content-Length: 126

<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2001/12/soap-envelope" soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body xmlns:m="http://www.stock.org/stock">
    <m:GetStockPriceResponse>
      <m:Price>34.5</m:Price>
    </m:GetStockPriceResponse>
  </soap:Body>
</soap:Envelope>
SOAP Security

- SOAP uses HTTP as a transport protocol and hence can use **HTTP security** mainly **HTTP over SSL**
- But, since SOAP can run over a number of application protocols (such as SMTP) security had to be considered
- The **WS-Security specification** defines a complete encryption system
UDDI

- UDDI stands for **Universal Description, Discovery and Integration**
- UDDI is a **directory for storing information about web services**, like yellow pages.
- UDDI is a **directory of web service interfaces** described by WSDL.
Materiale didattico

- A short introduction to Web Services
- Introduction to Web Service Architecture
Resources

- http://msdn.microsoft.com/webservices/understanding/webserv
- http://www.w3schools.com/
- Many more on the web...