Introduction to SOA and Web Services

Federated Distributed Systems Class
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Motivation

Before:

- Applications were very specialized. Each company had to build them
- Applications were very complex and heavy to maintain
- Data was maintained by the company
- Servers to support applications were needed locally
- Writing software became a difficult activity
Motivation

Today

- Modular design is promoted
- Legacy systems are stable; nobody wants to “change” code
- Small pieces of code are required for many people.
- Programmers need a way to reuse functionality, not just “code”
- Services decomposed on finer-grained components
- Applications are seen as commodities (homogeneous products) : services
Motivation

Typical problems

- Heterogeneous platforms, program languages, various devices (sensors), etc.
- Different vendors use different data schemas & formats
- Subsystem-providers are typically autonomous and coordination is not easy to undertake or even impossible
Motivation

Desired Properties
- Interface: platform independent
- Service dynamically located and invoked
- Self contained

Requirement

→ Need for a common program-to-program communication model, build upon existing and emerging standards
Motivation

To ensure interoperability to the greatest possible extent, we need three fundamental standards:

✓ Common encoding schema for requests and responses

✓ Standardized description language to make metadata widely interpretable

✓ Well defined catalog / discovery service to find available and suitable Web-Services all over the Web
Service Oriented Architecture

**Fundamental concept: Service - Trading**
(Publish-Find-Bind Paradigm)

Composing at runtime, not on design time!
What are Web services?

Web services are **loosely coupled, contracted components** that communicate via **XML-based interfaces**

[Schmelzer 2002]

- **loosely coupled:**
  - they can be changed independently
  - platform independent

- **contracted:** in and output are publicly available

- **components:** interface encapsulates the code

- **XML-based interfaces:**
  - human readable
  - firewall friendly
  - self-describing (allows for discovery of their functionality)
Web Service Characteristics

- Network accessible via standardized XML messaging, typically based on HTTP

- Described using a standard, formal XML notion (service description)
  - Covers all the details, necessary to invoke the service (message formats, location, etc.)

- Interface hides the implementation details
  - Allows it to be used independently of the hardware or software platform on which it is implemented
Web Service Characteristics

- Provide interface accessed by another program
- Fulfill a specific task or set of tasks
  - Accessible through the web
  - Can be used alone
  - Can be used along with other Web Services to fulfill complex tasks
  - Can communicate to other web services
Web Services Stack

- BPEL
  - Service flow
- UDDI
  - Service discovery
  - Service publication
- WSDL
  - Service description
- SOAP
  - XML-based messaging
  - Network

Source: www.ibm.com
Web Services Architecture

Service-oriented architecture (SOA)

Web Services technology stack

- Service composition (BPEL)
- Service publication & discovery (UDDI)
- Service description (WSDL)
- Wire protocol (SOAP)
- XML
- Network (http, smtp, etc)

Registry

Requester

Provider

Find

Publish

Bind
Web Services Specification

There are three basic specifications, forming the basis for state-of-the-art Web-Service technology

- Simple Object Access Protocol (SOAP) for a common message processing & coding
- Web Service Description Language (WSDL) as a metadata standard for Web-Services
- Universal Description, Discovery and Integration (UDDI) specifying a catalog / discovery service
Web Service Description Language (WSDL)

Issues to think about:
- What services do you offer?
- How can they be invoked?
- What information do they need to be executed?
- How is the user providing that information?
- What format is used to send information back?

The components of a WSDL document:
- SOAP messages supported (request/response)
- Rules for finding the port at which WS is listening the requests
- The definition of the service itself
WSDL example
(Currency converter)

http://www.webservicex.net/CurrencyConvertor.asmx?WSDL
SOAP example request
(Currency converter)

The following is a sample SOAP request and response. The placeholders shown need to be replaced with actual values.

POST /CurrencyConvertor.asmx HTTP/1.1
Host: www.webservicex.net
Content-Type: text/xml; charset=utf-8
Content-Length: length
SOAPAction: "http://www.webservicex.NET/ConversionRate"

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance' xmlns:xs='http://www.w3.org/2000/09/xm...
SOAP example response (Currency converter)

HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
  <soap:Body>
    <ConversionRateResponse xmlns="http://www.webserviceX.NET/">
      <ConversionRateResult>double</ConversionRateResult>
    </ConversionRateResponse>
  </soap:Body>
</soap:Envelope>
Previewing a Web Service

http://www.webservicex.net/WS/default.aspx
Universal Description, Discovery and Integration (UDDI)

Example UDDI registry

Web Service brokers

http://www.strikeiron.com/
When are WS a good option?

- Client/server applications
- Dynamic environment
- Modest performance needs
- Interoperability is the main concern
- Rapid response is not a requirement
Work in progress

- WS discovery
- Business Process Integration (BPEL)
- WS-Security
- Quality of Service (QoS)
- Performance and reliability
- Resource Framework (WSRF)
WS Research topics

☐ Semantic WS
☐ Ontologies for WS
☐ Location-based WS
☐ Automatic WS composition
☐ WS matchmaking
☐ WS modeling
☐ Grid services
To think about ...

- Web services infrastructures promise to revolutionize the way people develop software systems.
- Usually every organization has a team of skilled programmers, with an existing business system, realistically, the best choice is to continue using the same platform.
- You need more than good tools and standards.
Discussion: SOA and business

What Analysts Are Saying About Service-Oriented Architecture...

“By 2008, SOA will provide the basis for 80% of new development projects. By 2008, SOAs will enable organizations to increase code reuse by more than 100%.”

“By 2010, 80% of application software revenue growth, including licenses and subscription fees, will come from products based on SOA.”

— Gartner: “Positions 2005: SOA Adds Flexibility to Business Processes,” Simon Hayward, 16-Feb-05

http://www.ciber.com/services/integration/index.cfm?id=cs-ei-soa-analysts
Discussion: SOA and business

— Gartner: “Positions 2005: SOA Adds Flexibility to Business Processes,” Simon Hayward, 16-Feb-05

“By the end of 2006, Forrester expects to see 62% of Global 2000 firms implementing SOA; 41% of these firms have already deployed a service-oriented architecture.”

— Forrester’s Business Technographics November 2005

North American and European Enterprise Software and Services Survey

“...the difficulty and cost of modifying today’s rigid IT architectures, dominated by big enterprise applications such as ERP, can be so high that some companies would rather abandon new strategic initiatives than make a single change to the applications they already have in place. Good news is on the horizon in the form of service-oriented architectures, which promise to reduce, if not remove, the current obstacles.”

J. Seely Brown and J. Hagel III

http://www.ciber.com/services/integration/index.cfm?id=cs-ei-soa-analysts
SOA

- Is SOA really needed?
- Why is SOA adopted?
- If not SOA, what?
Check this out

- Translate text between two languages: http://babelfish.altavista.com/
- Track the current location of a package www.fedex.com/us/tracking
- Validate an email address http://ws.cdyne.com/emailverify/emailvernotestemail.asmx
- Find info about sky resorts http://www.skiwhere.com/
- Address validation http://www.serviceobjects.com/Default.asp?bhcp=1