Service-oriented Architectures
Agenda

- What is SOA?
- Main Concepts
- OASIS SOA Reference Model
- Open Service Oriented Architecture
- Web Services
- WS-BPEL
- Choreography
- Service Oriented Analysis & Design
- A few words about SODSL
What is SOA?

“A paradigm for organizing and utilizing distributed capabilities that may be under control of different ownership domains.” OASIS

“A form of distributed systems architecture characterized by service abstraction, message orientation, description orientation, and platform neutrality” W3C Web Services Architect.

“an evolution of the Component Based Architecture, Interface Based Design (Object Oriented) and Distributed Systems such as DCOM, CORBA, J2EE and the Internet in general” Adobe Systems
What is SOA?

● Application Architectures:
  – Monolithic Application
  – Object-Oriented Application
  – Client-Server
  – 3-tier, n-tier
  – Distributed Objects
  – Component Orientation
  – Service Orientation
What is SOA?

Applications

Choreography  Business Rules

Composition  Mediation

Security  Trans. & Reliabil.

Discovery  Description

Services
Main Concepts

- **Service**
  - A service is a contractually defined behavior that can be implemented and provided by a component for use by another component.
  - The mechanism by which needs and capabilities are brought together
  - Well-defined, self-contained modules that provide standard business functionality and independent of the state or context of other services
Main Concepts

- Service Description
  - consists of the technical parameters, constraints and policies that define the terms to invoke the service.
  - Contains information necessary to interact with the service
  - The concept of visibility
  - W³C’s Web Service Description Language
  - ebXML Collaboration Protocol Profile
  - OWL-S Semantic Markup for Web Services
  - Web Service Modeling Ontology (WSMO)
  - WS-Policy
Web Services

- The most common (but not only) form of services used extensively in SOA
- Service interfaces are described using Web Services Description Language (WSDL)
- Payload is transmitted using Simple Object Access Protocol (SOAP) over Hypertext Transfer Protocol (HTTP)
- Optionally Universal Description, Discovery and Integration (UDDI) is used as the directory service.
Main Concepts

- Advertising
  - Pull methodology: potential service consumers request the service provider to send them the service description.
  - Push methodology: the service provider, or its agent, sends the service description to potential service consumers.

- Discovery
  - A potential consumer obtains information about the existence of a service, its applicable parameters and terms.
Service-Oriented Architecture

- an architectural style for IT systems that are exploiting reusable and encapsulated software components available on network (or namely services) in a *loosely coupled and highly interoperable* manner
SOA Model

SOA is usually comprised of three primary parties:

1. Provider (of services); basic service producers and aggregators
2. Requester (of services); service consumers and end users
3. Broker (of services); middleware, directories and registries
Services in SOA

1. Defined by explicit, implementation-independent interfaces
2. Loosely bound and invoked through communication protocols that stress location transparency and interoperability
3. Integrated via service composition mechanisms (orchestration/choreography) in order to collaborate in heterogenous environments and to create complex, dynamic and context-aware applications
4. SOA offers coarse-grained business services, as opposed to fine-grained software-oriented function calls
Coarse-grained services are intelligently structured to meet specific business needs and constructed from fine-grained services which provide a small amount of business-process usefulness, such as basic data access.
Fundamental Issue: Interoperability

- A common framework for service interactions based on open standards must occur at least for proper;
  - Communication (SOAP, REST)
  - Description (WSDL, OWL-S)
  - Registration (UDDI, ebXML)
  - Composition as Choreography and Orchestration (WS-CDL, BPEL)

- An agreed set of vocabularies and interactions (common processes) for specific industries or common functions must be adopted (HL7, CEN/TC251, ISO, OpenEHR for eHealth)
Main Concepts

- **Registry/Repository**
  - A component where users can store and manage artifacts required for their enterprise to function.
  - Includes artifacts that require sharing among more than one user (such as XML schemas and web-service descriptions)
  - OASIS ebXML Registry/Repository
  - OASIS Universal Description and Discovery Interface (UDDI)
Define the essence of service oriented architecture
To create a vocabulary and a common understanding of SOA
Based on concepts present in all SOA’s
A Reference Model defines SOA in an abstract sense. Example:

- Abstract = Service Description
- Concrete = WSDL
Open Service Oriented Architecture (OSOA)

- alliance of industry leaders that share a common interest (www.osoa.org):
  - defining a language-neutral programming model that exploits SOA characteristics and benefits.
Service Component Architecture (SCA)

- Provides an assembly model for services
- To simplify and standardize development
- Control Files or pragmas
- Six values that define a service:
  - Interfaces
  - Implementation
  - Policy Assertion
  - Required Interfaces
  - Resources
  - Valid Operation Sequences
Service Component Architecture (SCA)

- Components and Services work together
Service Component Architecture (SCA)

- Apache Tuscany
  - http://incubator.apache.org/tuscany/
- Eclipse SOA Tools Platform Project
  - http://www.eclipse.org/stp/
- IBM DeveloperWorks SCA
Web Services Technology Stack

- Choreography (WS-BPL, ebBP)
- Mediation (WSMO, ESB, Biztalk)
- Enterprise (WS-BPEL, WS-Management)
- Description & Discovery (WSDL, WS-Policy, UDDI, ebXML)
- Messaging (XML, XSD, SOAP, SOAPAttachment)
- Transport (HTTP, HTTPS, SMTP, FTP)
WS-BPEL

- Web Services Business Process Execution Language
- A notation for specifying business process behavior based on web services
- Owned by OASIS, originally created by IBM and Microsoft
WS-BPEL

BPEL Constructs:
- sequence: executes one or more activities sequentially.
- flow: executes one or more activities in parallel.
- switch: executes one of several paths based on the value of a condition.
- while: executes a specified activity as long as a condition is true.
- invoke: calls a web service.
- receive: receives an incoming web services call.
- reply: sends a response to a received web services call.
- variables: defines any global variables the process uses.
- assign: allows copying and manipulating data using XPath
- partnerLink: specifying the roles and message exchanges between communication partners
BPEL Example
Choreography

- Describe collaborations of parties by defining from a global viewpoint their common and complementary observable behavior
  - Information exchanges, the jointly agreed ordering rules...
- Unlike processes, more than one party is included
- More like a global contract which can be realized by more than one parties
- W3C’s Web Services Choreography Description Language (WS-CDL)
- ebXML Business Processes (ebBP)
Example: Healthcare Domain

Cardiology
Hospital X

Place Lab Order

Order Result

Confirmed

Check Insurance

Laboratory
Hospital Y

Insurance
Company
Business Service Choreography

- Business Domains
  - Business Processes
  - Applications
  - Coarse-Grained Services
  - Fine-Grained Services
  - Existing Computing Assets
- IT Domains
- Business Process Experts
- System Experts
- Business Analysts
- Choreography GUI
- WS-CDL
- Choreography between Co. A & Co. B
- WS-BPEL
- Java
- Generated Work flow
- Traditional Integration
- Company A
- Company B
Choreography Example

Choreography GUI / WS-CDL

Choreography Between Companies A & B

WS-BPEL

Generated workflow

Company A

Traditional integration

Company B

Java

Company A Company B

Co. A                  Co. B
Enterprise Service Bus

- A point-to-point Web service may offer significant value:
Enterprise Service Bus

- What if we have more than one client:
  - We need something to simplify this
Enterprise Service Bus

- Enterprise Service Bus routes messages between WSs:
Enterprise Service Bus

- ERP
- .NET
- Web Services

Transformation (XSLT)
- JCA
- SOAP/HTTP

Reliable Asynchronous Secure Messaging
- SOAP/HTTP
- JMS
- C/C++ Legacy Application
- J2EE

Connection Layer
- Communication Layer
Enterprise Service Bus

- A BPEL Server can be a basic ESB
- But introducing following limitations:
  - A process defined using BPEL will commonly need to access local objects
  - A process often needs to communicate with other software outside its own environment.
  - Processes commonly need to access data
  - Business processes commonly involve people
WSMO

- Stands for the Web Service Modeling Ontology
- Providing a standard for describing semantic web services.
- http://www.wsmo.org
- WSMO Working Group
  - 79 Members
Service Oriented Analysis & Design

- IT Lifecycle proposed by IBM
- Grady Booch on an interview about SOA
  - “Services should not be driven bottom up from technology, as DHS folks are proposing, but rather top down—with the use cases.”
A few words about SODSL

Service Oriented Domain specific Languages
A few words about SODSL
A few words about SODSL

- Traditional $\rightarrow$ Function Oriented
- Object Orientation $\rightarrow$ Data Oriented
- Component Orientation $\rightarrow$ Structure Oriented
- Service Orientation $\rightarrow$ Process Oriented
- Build for change
- Message Oriented, Loosely Coupled
- Rule based