Service Oriented Architecture & Web Services

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Outline

Where are Web Services used?

Google

- offers handful of Web Services
- e.g. ad sense, analytics, blogger, books, calendar, custom search, latitude, maps, plus
- translate API was discontinued last year
- some of these APIs provide full control of the user account (calendar, plus,...)
- other APIs provide Google functions available through its web site

e-bay

- trading & shopping API
- with Trading API one can create an offer for sale through the APIs
  - AddItem, AddOrder, CompleteSale,...
- shopping API enables to search for products, etc.
  - FindProducts, GetItemStatus, GetShippingCost, etc.

Amazon

- Product Advertising API
- enables to search products on Amazon, and more...
- intended for resellers with provisions up to 15%

PayPal

- Express Checkout, Website Payments Pro, Mass Payment
- payment can be fully integrated into the seller's web site

Datove Schranky

- a tool for communication with the Government
- can be completely controlled by a 3rd party software thanks to the provided WS API

Facebook

- REST support is now deprecated
- GraphAPI is the preferred way to communicate with Facebook

Business-to-Business

- major area where SOA and WS are used
- reduce costs of B2B cooperation

Links

- https://code.google.com/apis/explorer
- http://developer.ebay.com/devzone/xml/docs/reference/ebay/index.htm
- https://affiliate-program.amazon.com/gp/advertising/api/detail/main.html

Evolution of Web Services

Client/Server architecture

- a central server handles requests from one or more clients
- Web is a perfect example
- transition to 3-tier system, followed by N-tier system
- N-tier systems are predecessors of the distributed computing environment (DCE)

RPC/DCE

- a framework for software development
- introduced in 1990s
- Microsoft created its own implementation MSRPC (interprocess communication)
- first generation for distributed-object systems are based on RPC/DCE procedural framework
  - CORBA, MIcrosoft DCOM, RMI
- Samba is based on RPC/DCE

RPC/DCE (2)

- has the familiar client/server architecture
- client invokes a procedure that executes on the server
- arguments and return values can be passed
- service contract defined by Interface Definition Language (IDL) file
- used in ActiveX, etc.

XML-RPC

- emerged in late 1990s
- support for elementary data types
- messages are encapsulated in XML

XML-RPC Request Example

```
<?xml version="1.0"\>
<methodCall><methodName>someMethod</methodName>
<params><param><value><i4>42</i4></value></param></params>
</methodCall>
```

Service Oriented Architecture

SOA: The Definition

- **What it IS NOT:** Web Service(s)
- **What it IS:** a flexible set of design principles used during the phases of system development and integration
- **or:** A set of components which can be invoked, and whose interface descriptions can be published and discovered *(W3C)*
- **or:** The policies, practices, frameworks that enable application functionality to be provided and consumed as sets of services published at a granularity relevant to the service consumer. Services can be invoked, published and discovered, and are abstracted away from the implementation using a single, standards-based form of interface. *(CBDI)*
- SOA provides a way for consumers to find available SOA-based services **MOVE TO OTHER SLIDE**

Parallels between SO and OO

- services represent natural building blocks that allow us to organize capabilities in ways that are familiar to us (just like classes)
- services, just like classes
  - combine information and behavior,
  - hide the internal workings,
  - presents a relatively simple interface to the rest of the "application".
- services can create hierarchies

Why use SOA?

- component reuse
- simplify usage of legacy applications (enable their use in the distributed environment)
- platform independence — allows for arbitrary SW/HW
- avoid vendor lock-in
- one can use the existing software and build atop
- high scalability, evolvable systems

When not to use SOA?

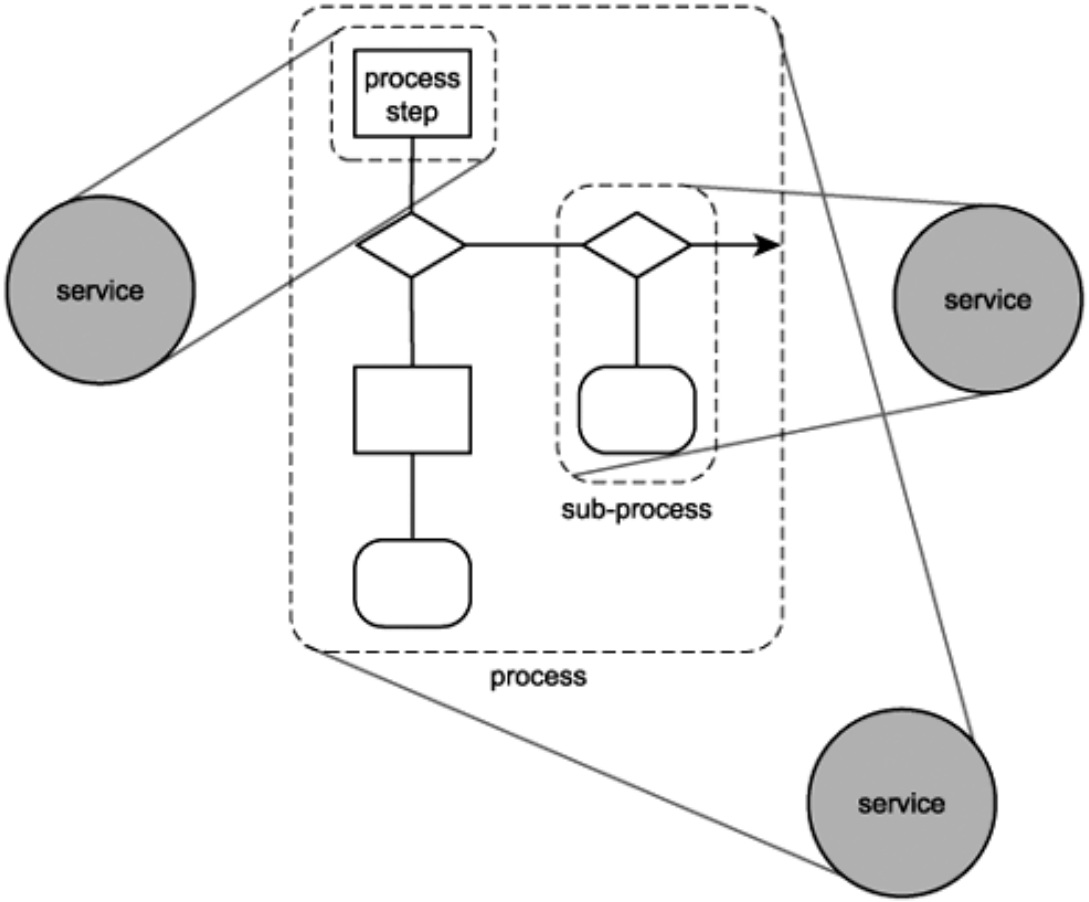
- when you have homogeneous environment
- when real-time processing is critical
- “if it works, don’t mess with it”
- when tight coupling is a pro or is necessary

Essence of SOA

- reflects the reality of ownership boundaries (in contrast to RMI and CORBA - those create transparent distributed systems)
- is task oriented, services are organized by function
- implementations rely on a mesh of software services

More on SOA

- provides a loosely-integrated suite of services that can be used within multiple business domains
- defines how to integrate widely disparate applications for a world that is distributed and uses multiple implementation platforms
- defines the interface in terms of protocols and functionality
- requires loose coupling of services with operating system and other technologies that underlie applications
- separates functions into distinct units, or services, which developers make accessible over a network


process step
service
service
sub-process
process
service

Services

- allow users to combine and reuse them in the production of applications
- services and their corresponding consumers communicate with each other by passing data in a well-defined, shared format, or by coordinating an activity between two or more services

Services

- services comprise unassociated, loosely coupled units of functionality that have no calls to each other embedded in them
- each service implements one action
- instead of services embedding calls to each other in their source code they use defined protocols that describe how services pass and parse messages, using description metadata

Services Principles (I)

- reuse
  - a service once created can be reused for various application
- granularity
  - a question of the optimal choice of granularity
  - fine-grained means large overhead, coarse-grained means small reusability
- modularity
  - services can be deployed independently
- composability
  - services are recombinant and can be selected and assembled in various combinations
- componentization
  - services are simple units that can be easily combined
  - inspired by hardware manufacture
- interoperability
  - services are capable of working together

Services Principles (II)

- standards compliance
  - common & industry-specific
- services identification and categorization, provisioning
- service encapsulation
  - many services are consolidated for use under the SOA; often such services were not planned to be under SOA
- service loose coupling
  - services maintain a relationship that minimizes dependencies and only requires that they maintain an awareness of each other

Services Principles (III)

- service contract
  - services adhere to a communications agreement, as defined collectively by one or more service-description documents
  - header (name, version, responsible organization, type), functional (functionality, invocation) and non-functional (security, QoS) description
- service abstraction
  - beyond descriptions in the service contract, services hide logic from the outside world
- service autonomy
  - services have control over the logic they encapsulate

Service types

- stateless service
  - each message that a consumer sends to a provider must contain all necessary information for the provider to process it. Each request can be treated as generic. There are no intermediate states to worry about, so recovery from partial failure is also relatively easy. This makes a service more reliable.
- stateful service
  - holds a session between a consumer and a provider. Stateful services require both the consumer and the provider to share the same context. It may reduce the overall scalability of the service as it needs to remember shared context for each consumer.
- idempotent requests
  - repeated execution has the same effect as a single execution

SOA implementation

SOA can be implemented using various technologies:

- SOAP
- RPC
- REST
- DCOM
- CORBA
- WCF
- ...

Web Services

Web Service Definition

- a software system designed to support interoperable machine-to-machine interaction over a network
- uses WSDL (Web Service Definition Language) to define an interface
  - a machine-processable format
- communicate with other services in a manner prescribed by its description using SOAP messages
- typically uses HTTP with XML serialization as a communication protocol
- uses UDDI for service discovery

Web Service Types *(W3C)*

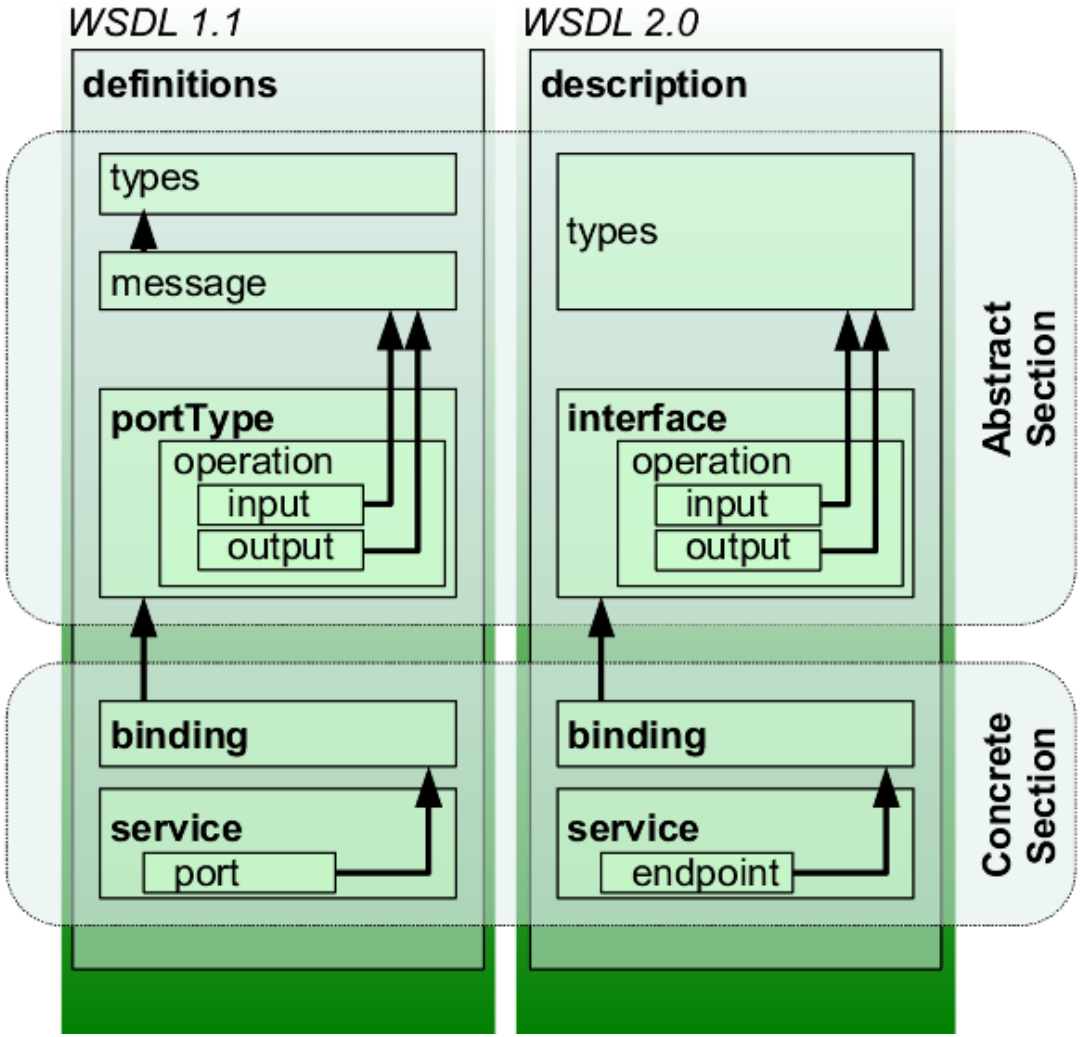
- RESTfull Web Services
  - Primary purpose is to manipulate XML representations of Web resources
  - Uniform set of stateless operations
- "Big" Web Services
  - expose arbitrary set of operations
  - (can be) stateful

WSDL - Web Service Definition Language

- XML-based language that provides a model for describing Web services
- Defines services as collections of network endpoints, or ports associating a network address with a reusable bindings
- Describes the public interface of the web service
- machine-readable
- can be used to generate client code
- roughly equivalent to method signature in programming languages

WSDL Versions

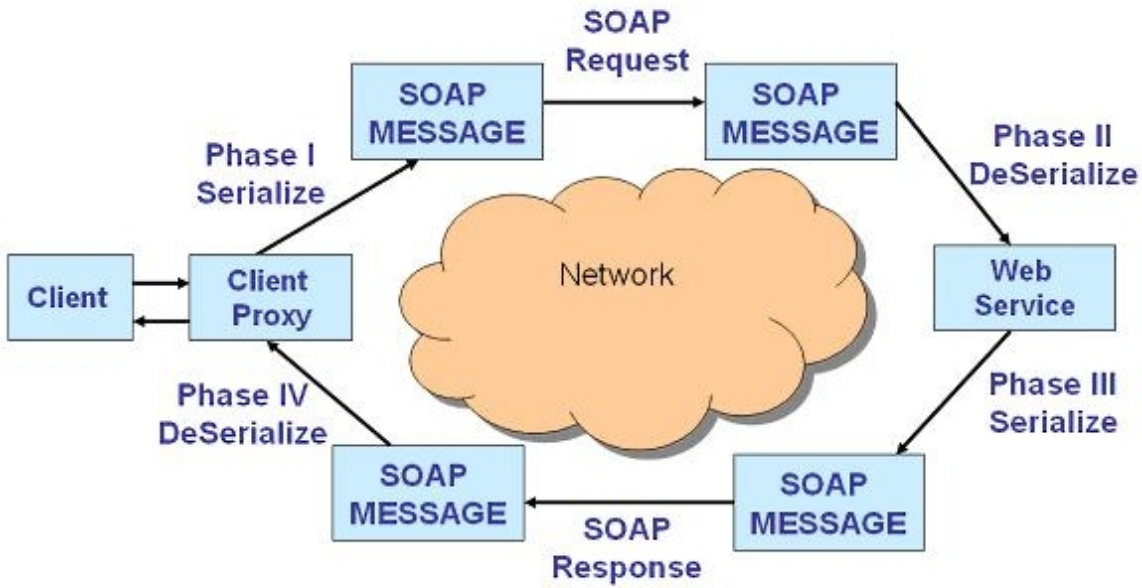
- WSDL 1.0 (2000), 1.1 (2001) – developed by IBM, Microsoft, and Ariba
- WSDL 1.2 (2003) – W3C draft; easier and more flexible for developers; attempts to remove noninteroperable features
- WSDL 2.0 (2007) – W3C recommendation


WSDL 1.1
definitions
types
message
portType
operation
input
output
binding
service
port
WSDL 2.0
description
types
interface
operation
input
output
binding
service
endpoint
Abstract Section
Concrete Section

SOAP - Simple Object Access Protocol

- Protocol specification for exchanging structured information for WS
- Relies on XML for its message format
- Uses other application layer protocols (RPC, HTTP)
- Originally designed as an object-access protocol
- Underlying layer for Web Services, based on WSDL and UDDI

SOAP Call


SOAP
Request
SOAP
MESSAGE
SOAP
MESSAGE
Phase I
Serialize
Phase II
DeSerialize
Client
Client
Proxy
Network
Web
Service
Phase IV
DeSerialize
Phase III
Serialize
SOAP
MESSAGE
SOAP
MESSAGE
SOAP
Response

SOAP Nodes

- SOAP sender
- SOAP receiver
- SOAP message path
- Initial SOAP sender (Originator)
- SOAP intermediary
- Ultimate SOAP receiver

SOAP Example

```
POST /InStock HTTP/1.1
Host: www.example.org
Content-Type: application/soap+xml; charset=utf-8
Content-Length: 299

<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/...">
  <soap:Header>
  </soap:Header>
  <soap:Body>
    <m:GetStockPrice xmlns:m="http://www.example.org/stock">
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
```

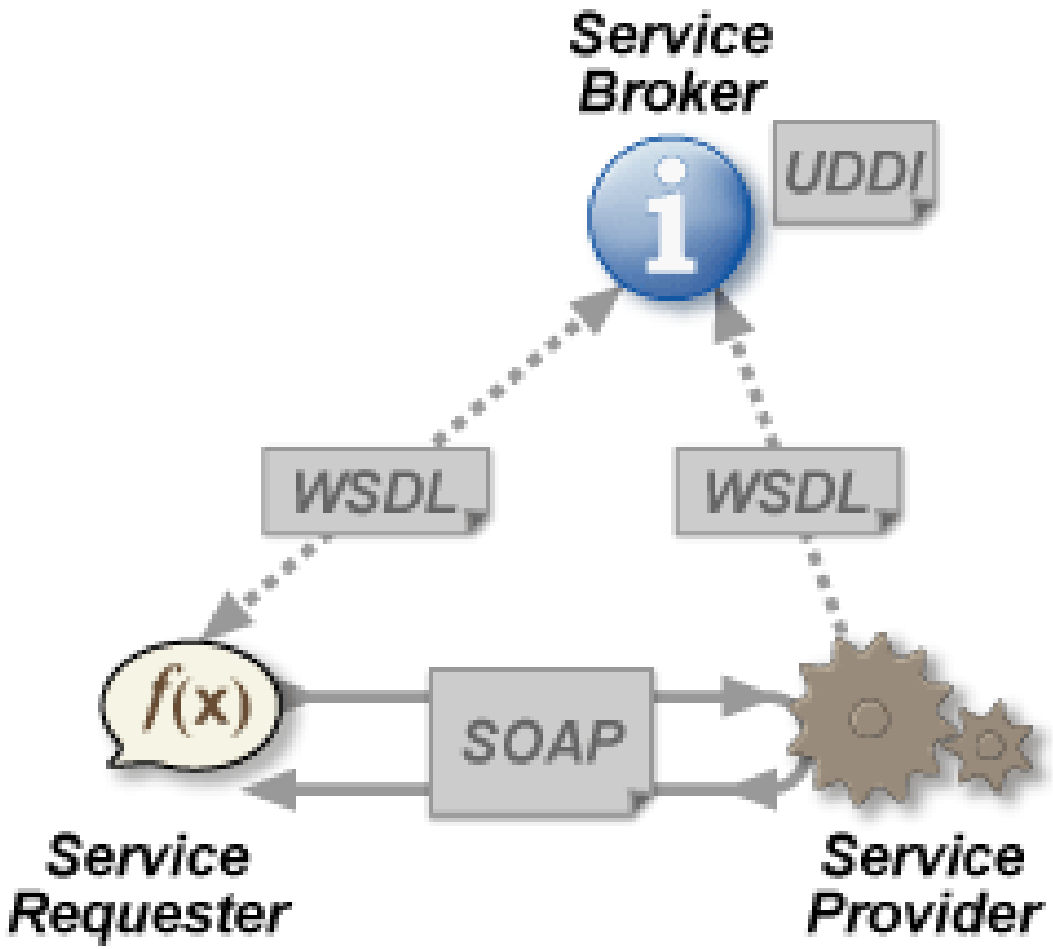
UDDI

- Universal Description, Discovery and Integration
- Platform-independent XML-based registry for businesses worldwide to list themselves on the Internet
- Enables businesses to publish service listings and discover each other and define how the services or software applications interact over the Internet
- brokerage system

UDDI components

- White pages - address, contact, and known identifiers
- Yellow pages - industrial categorizations
- Green pages - technical information about services exposed by the business

Web Service Architecture



Web Service Design

- Bottom up
  - First write the implementing class, then generate WSDL
  - Considered simpler
  - Language/platform dependence/influence risk
- Top down - industrial categorizations
  - first write the WSDL document, then generate class skeleton
  - Considered more difficult
  - Produce cleaner designs

Example - Corporate IT

Corporate IT: Former State

- several independent software products - each department had its own set of applications
- client-server, mainframe based
- limited amount of data to process
- a lot of user effort
- associated costs (time, employee, business)

Corporate IT: Transition

- business-processes optimization
  - time costs
  - employee costs
  - new business models
- a growing need for intra- and inter- company communication
  - mergers
  - outsourcing
- stronger business intelligence
- more extensive reporting

Corporate IT: A Bank Example

- more than a dozen separate applications
- point in case: mortgages
  - verify line of credit
  - create a credit account
  - create a savings account
  - create a mortgage
  - interest rate change
- we can automate the process
- redesigning the mortgage process
- use of SOA

References

- A4M33AOS materials by Jiri Vokrinek (http://cw.felk.cvut.cz/doku.php/courses/a4m33aos/start)
- Service-Oriented Architecture: Concepts, Technology, and Design by Thomas Erl