Service Computing: Basics

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Generalities: Defining a Service

- Services are
  - **self-describing, open components that support rapid, low-cost composition of distributed applications.**
- Since services may be offered by different enterprises and communicate over the Internet, they provide a
  - **distributed computing infrastructure for both intra and cross-enterprise application integration and collaboration.**

Guest editorial. In [CACM03]

Generalities: Defining a Service

- Service descriptions are used to advertise the service capabilities, interface, behavior, and quality.
  - **Publication of such information about available services provides the necessary means for discovery, selection, binding, and composition of services.**
  - **In particular, the service capability description states the conceptual purpose and expected results of the service (by using terms or concepts defined in an application-specific taxonomy).**
  - **The service interface description publishes the service signature (its input / output / error parameters and message types).**

Guest editorial. In [CACM03]

Generalities: Defining a Service

- Service descriptions are used to advertise the service capabilities, interface, behavior, and quality.
  - **The (expected) behavior of a service during its execution is described by its service behavior description.**
  - **the Quality of Service (QoS) description publishes important functional and nonfunctional service quality attributes**
- Service clients (end-user organizations that use some service) and service aggregators (organizations that consolidate multiple services into a new, single service offering) utilize service descriptions to achieve their objectives.

Guest editorial. In [CACM03]

Generalities: Defining a Web Service

- The application on the Web of a service is manifested by Web services
- Web service
  - **Software component available on the Web, to be invoked by some other client application / component**
  - **A way of building Web-scale component-based distributed systems**

Generalities: Principles of Service Computing

- Self-describing: description of their functionality and the location (the application server to which the service is deployed) from which they can be accessed so that applications can use them
- Service-oriented: Web services are developed to offer a particular service over the Internet. For example, a currency converter can be a Web service.

Generalities: Principles of Service Computing

- Component-based:
  - **Web services are the evolution of some distributed computing models such as**
    - Common Object Request Broker Architecture (CORBA)
    - Component Object Model (COM)
    - Distributed Component Object Model (DCOM)
  - **Web services are platform and language independent. But unlike these technologies, Web services are not accessed via specific protocols but rely on standard protocols**

SOA (Service Oriented Architecture)

- Service Oriented Architecture (SOA) is an architectural approach to viewing and creating a business solution as a network of services.
- In a SOA, services can be
  - **distributed across geography, enterprises, and disparate IT systems**
  - **reconfigured into new business processes**

SOA (Service Oriented Architecture)

- These services are built on open standards and loosely coupled
  - **easily combined both within and across enterprises to create new business processes**

SOC (Service Oriented Computing)

- Service Oriented Computing (SOC) is a new generation computing paradigm to building distributed applications

Putting pieces together…

1. **Service-orientation** is a way of thinking in terms of services and service-based development and the outcomes of services.
2. **Service-Oriented Architecture(SOA)** is an architectural style that supports service orientation.
3. **Service Oriented Computing (SOC)** revolves around the realisation of Service-Oriented business solutions and its associated strategic goals, by applying a Service-Oriented architectural model that complies with Service-Orientation design principles.

Principles of Service Design

Contracts - 1

- A service contract is comprised of one or more documents that provide information about the service
- The fundamental document is the **service interface**, a standards based technical specification which defines the capabilities of the service to the service consumer

Contracts - 2

- A service provider can also publish non-technical documents as part of the service contract
  - **SLA (Service Level Agreement) which provides additional service metadata such as the non-functional, QoS (Quality of Service) features, service availability, behaviours and limitations**
- For example, a service implemented as a web service uses a WSDL (Web Service Description Language) to describe the functionality of the service.

Service coupling

- Coupling refers to a connection or relationship between two things.
- Loosely coupling prescribes minimum dependency between the service contract, its implementation and its service consumers.
- Loosely coupled architectures provide several benefits
  - **Loosely coupled components are less dependent on their environment and capable of autonomous functionality, thereby increasing their potential for reuse.**

Service abstraction

- This principle advocates that services be regarded as **black boxes** whose functionality is published to service consumers through well-define service contracts and the underlying implementation be hidden from the consumers
- Abstraction enables developers to leverage technological advances to provide new improved service implementations, with **minimal impact** to service contract and service consumers

Service statelessness

- In order to design **scalable** services by freeing up services from storing their **state information** whenever possible
- “Functional” style for service behaviour

Service reusability

- This principle is strongly emphasised in the design of services
- Designing services as generic, reusable enterprise resources with agnostic functional context maximises their potential for reuse as they will be less dependent on any one particular business process

Service autonomy

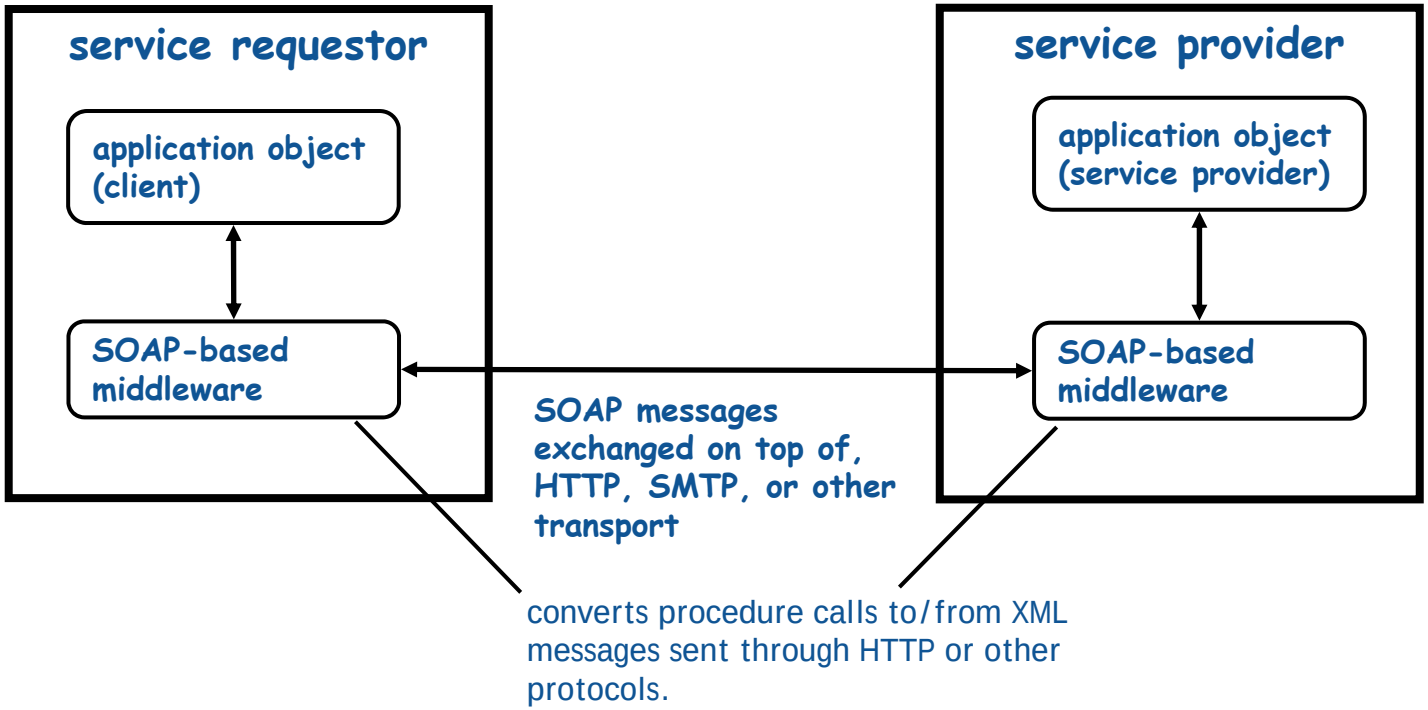
- Different levels:
  - **Shared logic**
  - **Shared infrastructure**
  - **Autonomous**

Service Composability

- Services are expected to be effective composition members, as part of a richer, complex composite service
- Services must be very composable regardless whether or not immediate composition requirements are already in existence

Quick overview of Web Services (main) standards

A Minimalist Infrastructure for Web Service

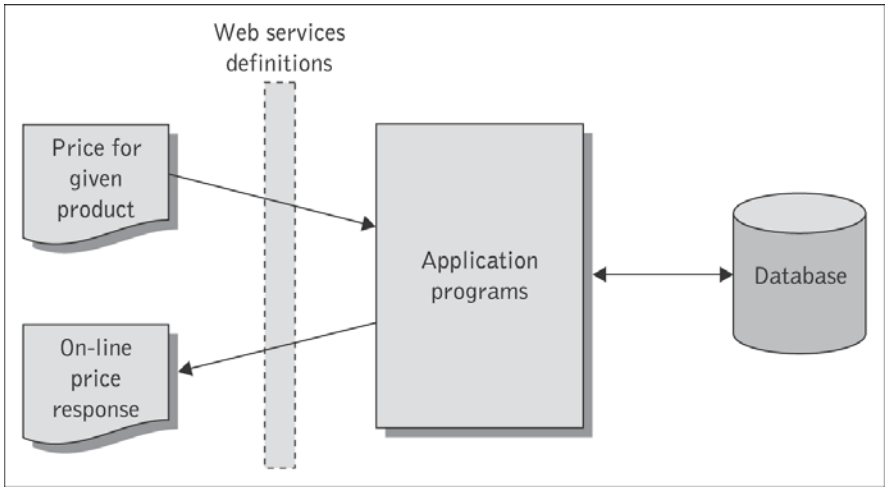


SOAP

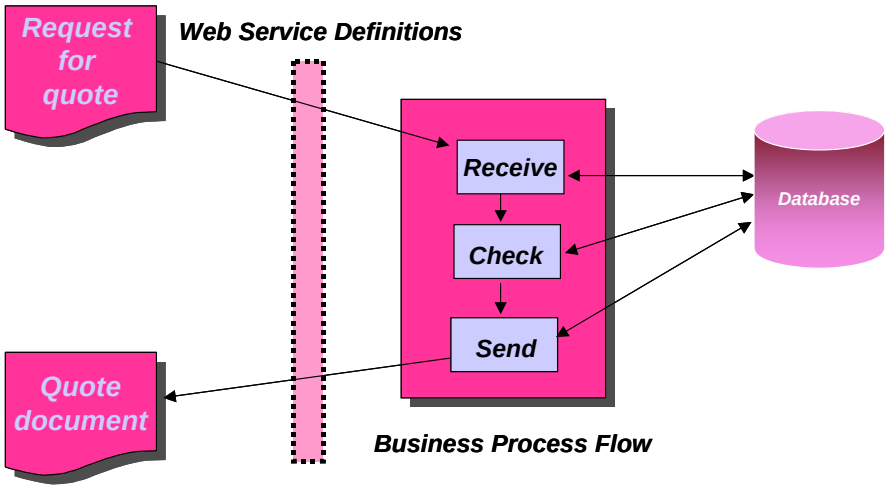
- SOAP is based on **message exchanges.**
- Messages are seen as **envelopes** where the application encloses the data to be sent.
- A SOAP message consists of a SOAP of an <Envelope> element containing an optional <Header> and a mandatory <Body> element.
- The contents of these elements are application defined and not a part of the SOAP specifications.
- A SOAP <Header> contains blocks of information relevant to how the message is to be processed. This helps pass information in SOAP messages that is not application payload.
- The SOAP <Body> is where the main end-to-end information conveyed in a SOAP message must be carried.

SOAP Communication Model

- SOAP supports two possible communication styles:
  - **remote procedure call (RPC) and**
  - **document (or message).**



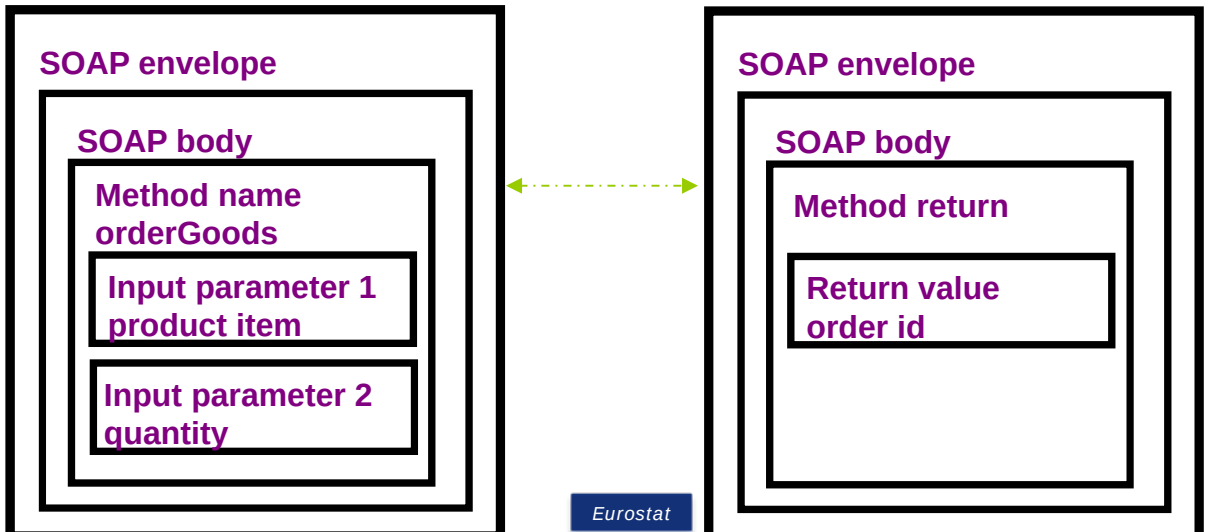
RPC-style interaction



Document-style interaction

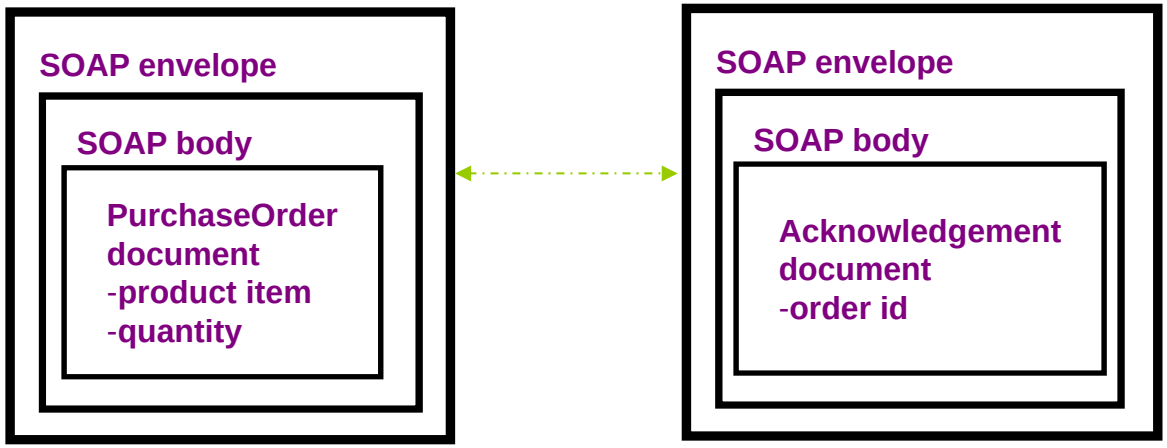
RPC-style SOAP Services

- A remote procedure call (RPC)-style Web service appears as a remote object to a client application. The interaction between a client and an RPC-style Web service centers around a service-specific interface. Clients express their request as a method call with a set of arguments, which returns a response containing a return value.



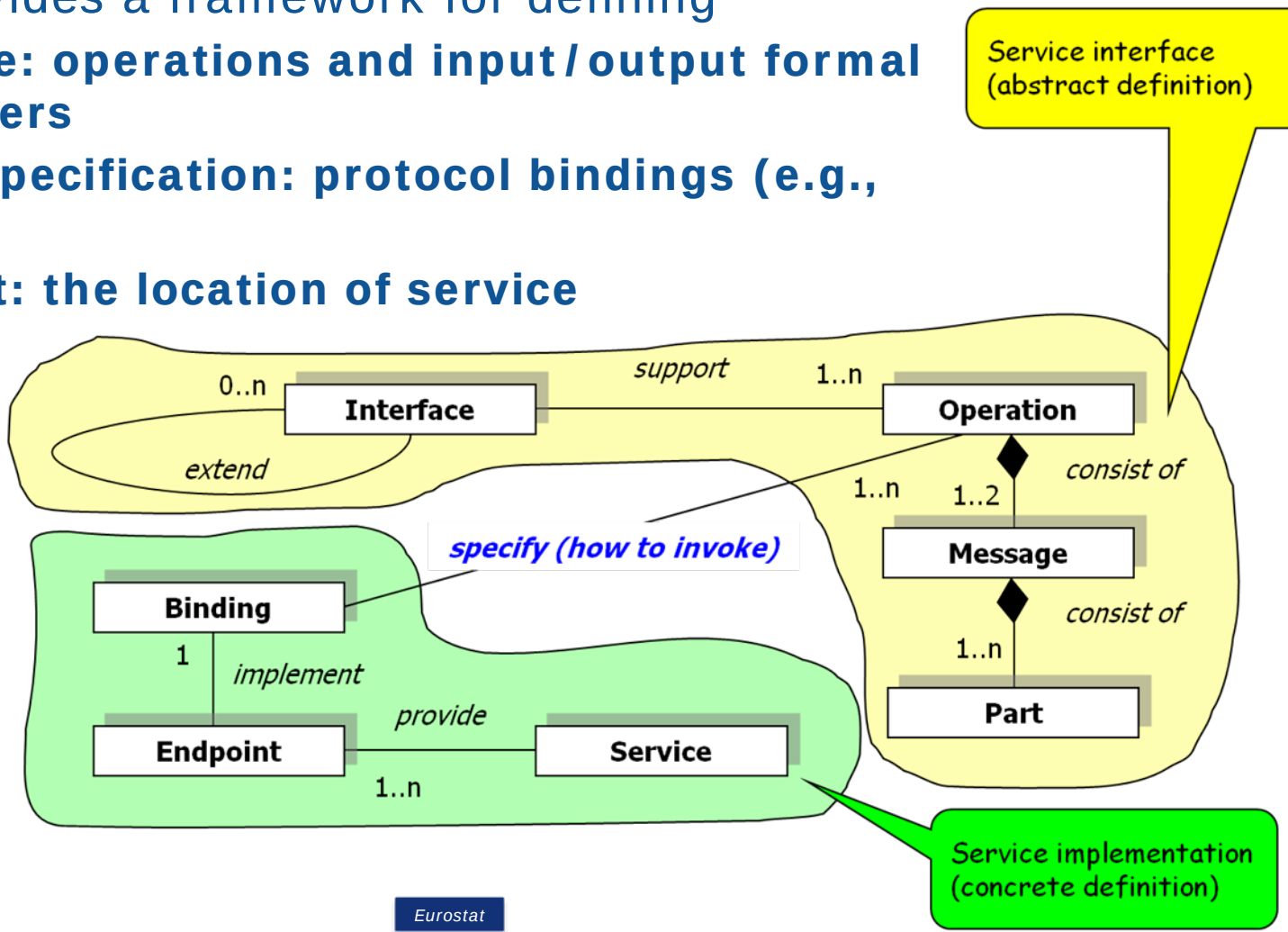
Document (Message)-style SOAP Services

- In the document-style of messaging, the SOAP <Body> contains an XML document fragment. The <Body> element reflects no explicit XML structure.
- The SOAP run-time environment accepts the SOAP <Body> element as it stands and hands it over to the application it is destined for unchanged. There may or may not be a response associated with this message



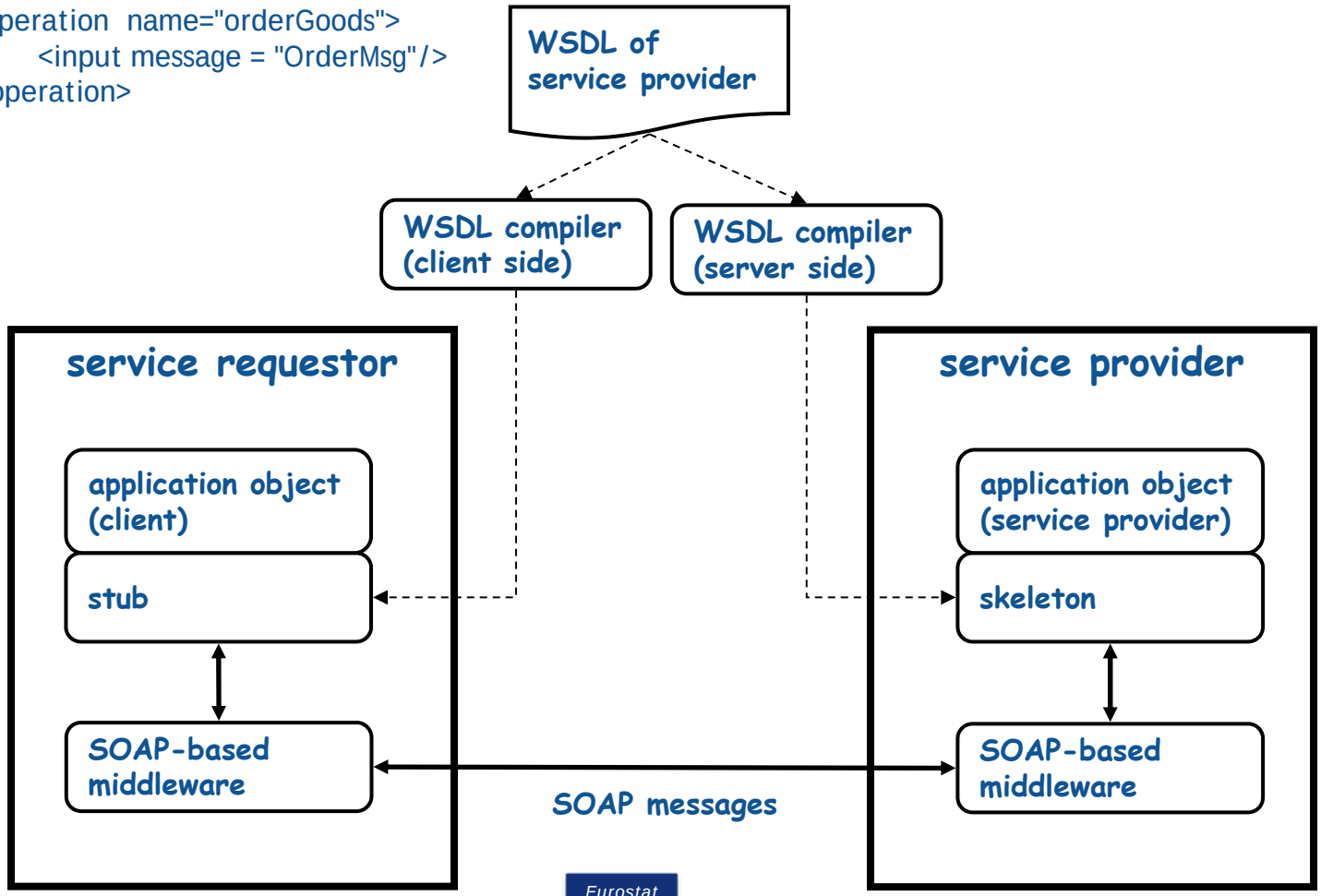
Web Service Definition Language (WS-DL)

- WS-DL provides a framework for defining
  - **Interface: operations and input/output formal parameters**
  - **Access specification: protocol bindings (e.g., SOAP)**
  - **Endpoint: the location of service**



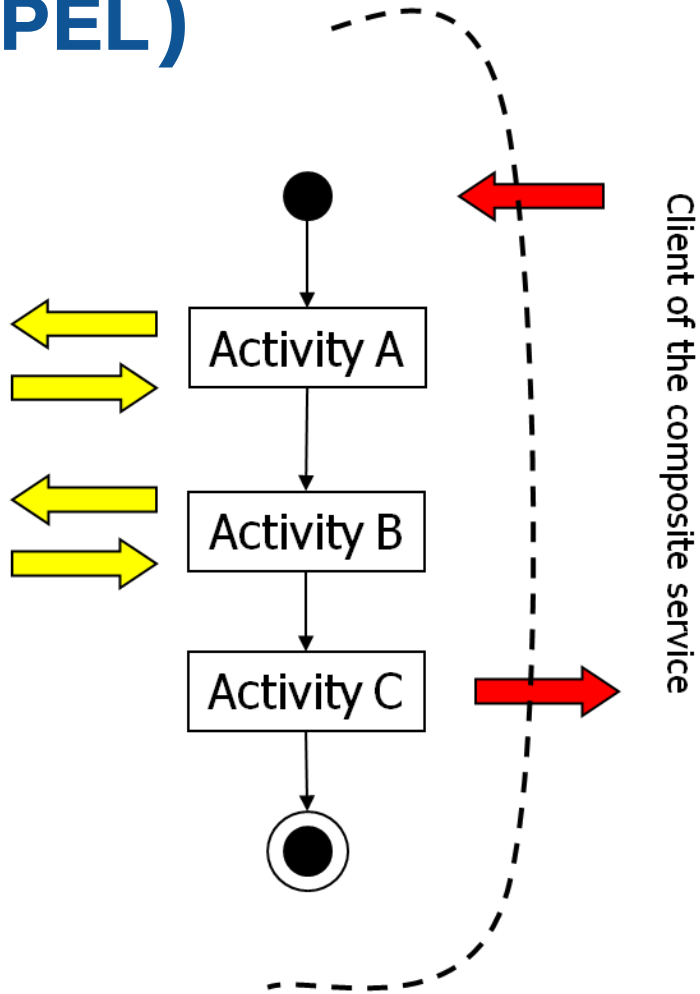
From Interfaces to Stub/Skeleton

```
<operation  name="orderGoods">
      <input message = "OrderMsg"/>
</operation>
```



Business Process Execution Language for Web Services (WS-BPEL)

- Allows specification of composition schemas of Web Services
  - **Business processes as coordinated interactions of Web Services**
  - **Business processes as Web Services**
- Allows abstract and executable processes
- Influenced from
  - **Traditional flow models**
  - **Structured programming**
  - **Successor of WSFL and XLANG**



RESTful Services (1)

- REST refers to simple application interfaces transmitting data over HTTP without additional layers as SOAP
  - **Web page meant to be consumed by program as opposed to a Web browser or similar UI tool**
  - **require an architectural style to make sense of them (the REST one), because there's no smart human being on the client end to keep track**

RESTful Services (2)

- Metaphor based on nouns and verbs
  - **URIs ~ nouns**
  - **Verbs describe actions that are applicable to nouns**

    GET -- retrieve information / READ, SELECT

    POST (PUT) – add/update new information / CREATE, INSERT, UPDATE

    DELETE -- discard information / DELETE
- State means the application/session state, maintained as part of the content transferred (in XML) from client to server back to client

RESTful Services (3)

- REST is, in a sense, a kind of RPC, except the methods have been defined in advance
  - **Consider the stock example of a remote procedure called “getStockPrice”**
  - **It's not clear what what it means to GET, PUT, and POST to something called "getStockPrice“**
  - **But if we change the name from "getStockPrice" to "CurrentStockPrice“ all is well !!**

Statistical Services: Design issues

Statistical Services Design Issues: data awareness?

- Statistical services do have to take exchanged data into account
  - **A step beyond generic services**
- Statistical data standards
  - **Conceptual level: GSIM**
  - **Logical/implementation level: SDMX and DDI**

Statistical Services Design Issues: strong or weak data awareness?

- A «strong» data aware service integration must take fully data exchanged by services into account
  - **Format**
  - **Schema (i.e., domain specific concepts)**
  - **Model (i.e., dataset structure)**
- A «weak» data aware service integration can focus on some aspects of data (mainly format)
  - **Tradeoff with automation**

Statistical Services Design Issues: Service granularity

- Fine-grained services (e.g., a function sorting a dataset with respect to a set of variables)
- Course-grained services (e.g., a full-fledged GUI-based record linkage system)
- Is it really an issue?
  - **Conformance to a «contract»**

Statistical Services Design Issues: Contracts

- Example of contract rules for statistical services
  - **Design- time service output definition**
  - **Number and nature of service inputs**
  - **…**

References

- [CACM03] – M.P. Papazoglou, D. Georgakopoulos (eds.): Special Issue on Service Oriented Computing. Communications of the ACM 46(10), 2003
- http://www.whatissoa.com/
- Thomas Erl: SOA: Principles of Service Design