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Web Services - Characteristics

A Web Service is a standardized way of integrating Web-based applications.

Informal Definition

Integration

- allows integration of application functionality
  - within organizations
  - between business partners across organizational boundaries

Features of Web Services

Potential of Web Services

Web Services - Distributed Objects

- Web Services have the potential to change IT infrastructure of organizations
  - setting up a service oriented architecture based on web services
  - process oriented integration of existing systems
    - intra- and inter-organizational scenarios
    - approach for enterprise application integration (EAI)
    - development of complex cooperative processes
  - paradigm for the development of new software architectures
    - reuse of software components
    - redesign of monolithic enterprise resource planning (ERP)
  - increase the process oriented interoperability and the flexibility of the technical infrastructure.

- Web services and distributed objects
  - have some sort of description language
    - what to call: operations, signatures, return types, exceptions.
    - how to make an invocation.
  - compilers generate client stub and server skeleton
  - both have well-defined network interactions
  - both have a similar mechanism for registering and discovering available components.

Differences

- Web services are usually designed for stateless computing.
  - Distributed objects enable stateful computing.
- Web services are a technology supporting the integration on the Web.
  - Distributed objects are mainly for intranet.

Definition: A **Web service** (W3C) is a software system identified by a URI, whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML based messages conveyed by internet protocols.

A Web Service is a standardized way of integrating Web-based applications using XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone.

XML: tag the data

SOAP: transfer the data

WSDL: describe the available services

UDDI: list the available services.

simplified view : a web service is a remote procedure call over the internet using XML messages.

Web Services interoperability Stack

Compositional	BPEL4WS, WS-Notification
Quality of Experience	WS-Security, WS-Transactions, ..
Description	WSDL, UDDI, WS-Policy, ..
Messaging	XML, SOAP, WS-Adressing
transport	HTTP, SMTP, ...

defines an interaction between software components as an exchange of messages between service requesters and service providers.

Functions of the architecture

exchanging messages.

describing Web services.

publishing and discovering Web service descriptions.

The service: a Web service is an interface; implementation of it is the service.

The service description: details of the interface and the implementation of the service.

The basic Web service architecture models the interactions between three roles

Service Provider

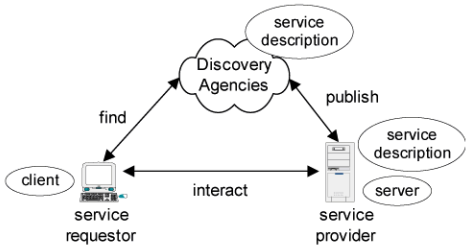
processes a Web service request.

Service Discovery Agency

agency through which a Web service description is published and made discoverable.

Service Requestor

requests the execution of a Web service.



Publish : a service needs to publish its description such that a requestor can subsequently find it.

Find : the requestor queries a registry for the required service and retrieves a service description.

Interact : a service needs to be invoked and the results are returned.

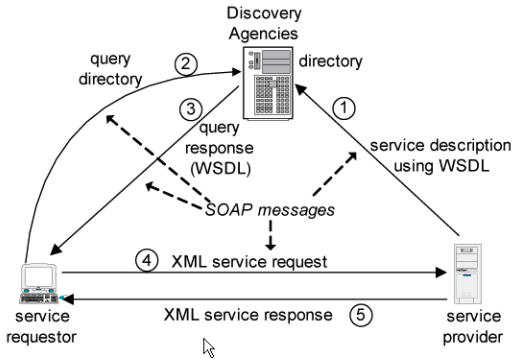
Basic Standard Technologies

Web services are based on 3 basic standards

WSDL: Web Services Description Language.

UDDI: Universal Description, Discovery and Integration

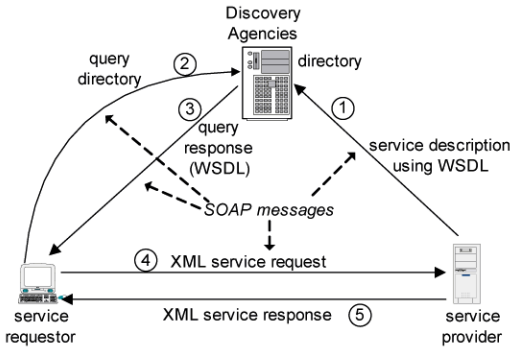
SOAP: Simple Object Access Protocol



Steps involved in providing and consuming a service

1. a service provider describes its service using WSDL.
2. a service requestor queries the directory to locate a service and determine how to communicate with that service.
3. directory sends service description to service requestor.

Basic Standard Technologies

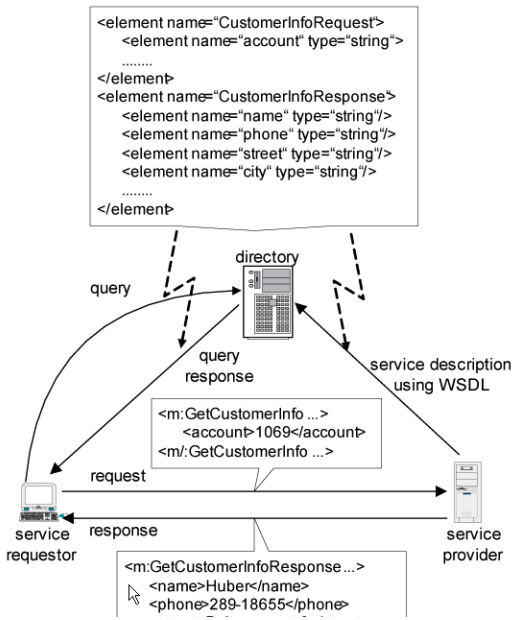


Steps involved in providing and consuming a service

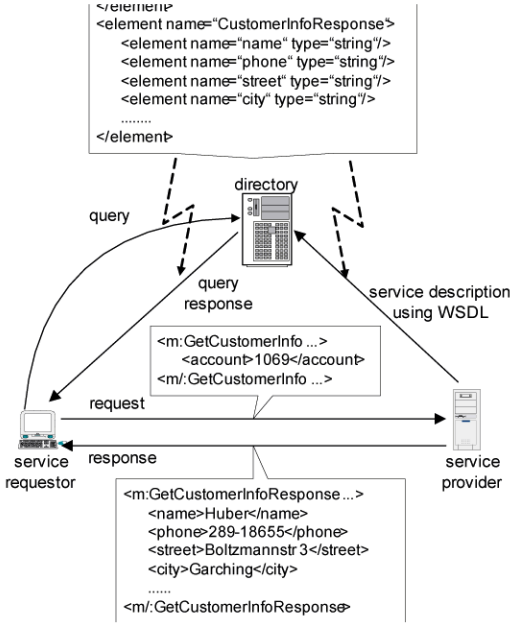
1. a service provider describes its service using WSDL.
2. a service requestor queries the directory to locate a service and determine how to communicate with that service.
3. directory sends service description to service requestor.
4. service requestor send service request based on WSDL
5. service provider send response based on WSDL

[Web Service Messages]

WSDL uses XML to define messages.



Web Service Messages



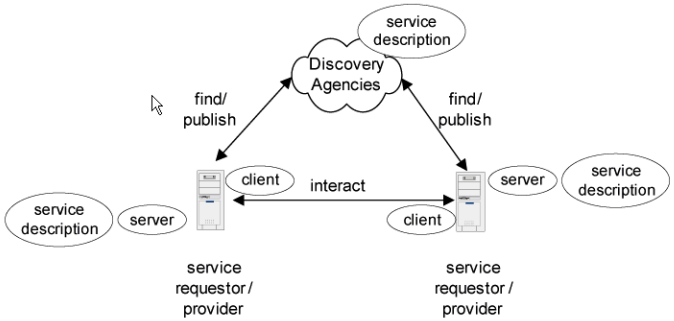
Message Exchange Patterns

define the sequence of one or more messages exchanged between service requestor and service provider.

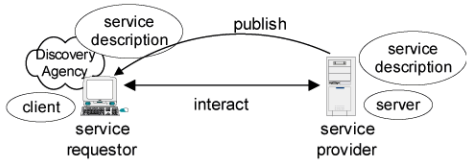
Examples are: one-way, request/response, broadcast.

The Web service architecture may support different interaction scenarios.

- Peer-to-Peer
- Direct Interaction
- Intermediary

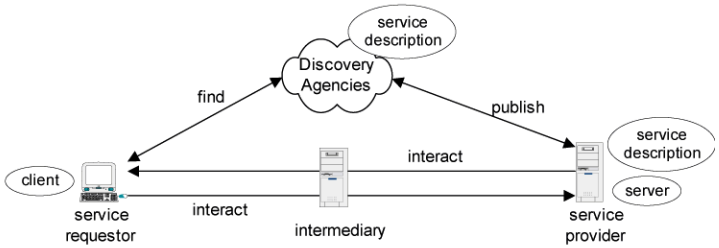


In the peer-to-peer scenario, each Web service instance serves in both the service requestor and service provider roles.



The role service requestor and discovery agency are fulfilled by the client.

Intermediary



Intermediaries may perform additional functions (besides the operations defined by the message exchange patterns) with a message such as routing, security, management.

Web Services

Web services provide a standard means of communication among distributed software applications based on the Web technology. Standardization by the W3C community.

Motivation - Example

Service Oriented Architecture - SOA

Web Services - Characteristics

Web Services Architecture

Simple Object Access Protocol (SOAP)

Web Services Description Language (WSDL)

Universal Description, Discovery, and Integration (UDDI)

REST

Web Service Composition

Adopting Web Services

Mashups

simple and lightweight XML-based mechanism for exchanging data between network applications. SOAP is a de-facto standard for XML messaging:

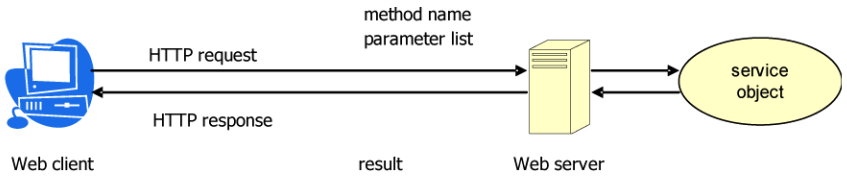
relatively simple.

flexible and extensible.

based on XML.

not bound to a specific protocol; use of Internet protocols such as HTTP, SMTP

may be used for RPC or document transfer.



use of SOAP for sending Web Services messages

Parts of SOAP

Exchange Model

Using SOAP in HTTP

SOAP RPC Conventions

Minimalist Infrastructure for Web Services

SOAP consists of three parts:

an envelope.

a set of encoding rules.

a convention for representing remote procedure calls and responses.

SOAP Message

Exchange Model

one-way transmissions from a sender to a receiver.

combination of SOAP messages to implement interaction patterns such as request/response.

A SOAP application receiving a SOAP message must process the message by performing the following actions

1. Identify all parts of the SOAP message intended for that application; interpret the "SOAP actor" attribute of the SOAP header.
2. Verify that all mandatory parts are supported by the application for this message and process them accordingly.
3. If the SOAP application is not the ultimate destination of the message then remove all parts identified in step 1 before forwarding the message.

SOAP naturally follows the HTTP request/response message model providing SOAP request parameters in a HTTP request and SOAP response parameters in a HTTP response.

use of media type "text/xml".

SOAP Message Embedded in HTTP Request

SOAP Message Embedded in HTTP Response

SOAP Message Embedded in HTTP Request

```
POST /StockQuote HTTP/1.1
Host: www.stockquoteserver.com
Content-Type: text/xml; charset="utf-8"
Content-Length: nnnn
SOAPAction: "Some-URI"

<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
    <SOAP-ENV:Body>
        <m:GetLastTradePrice xmlns:m="Some-URI">
        <symbol>DIS</symbol>
        </m:GetLastTradePrice>
    </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

SOAP request: processed by a servlet, CGI or standalone daemon running on a remote web server.

Using SOAP in HTTP

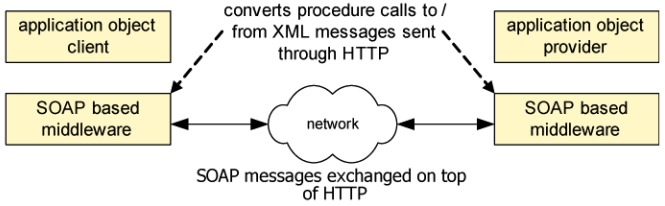
SOAP naturally follows the HTTP request/response message model providing SOAP request parameters in a HTTP request and SOAP response parameters in a HTTP response.

use of media type "text/xml".

SOAP Message Embedded in HTTP Request

SOAP Message Embedded in HTTP Response

RPC interactions may be mapped to SOAP.



Example

Example

Java Method

```
public int addFive(int arg);
```

Request Message in SOAP

```
<env:Envelope>
    <env:Body>
        <myNS:addFive xmlns:myNS="http://my-domain.de/"
        enc:encodingStyle="http://">
            <arg xsi:type="xsd:int">33</arg>
        </myNS:addFive>
    </env:Body>
</env:Envelope>
```

Response Message in SOAP

```
<env:Envelope>
    <env:Body>
        <myNS:addFiveResponse xmlns:myNS="http://my-domain.de/"
        xmlns:rpc="http://www.w3.org/2003/05/soap-rpc"
        enc:encodingStyle="http://">
            <rpc:result>ret</rpc:result>
            <ret xsi:type="xsd:int">38</ret>
```

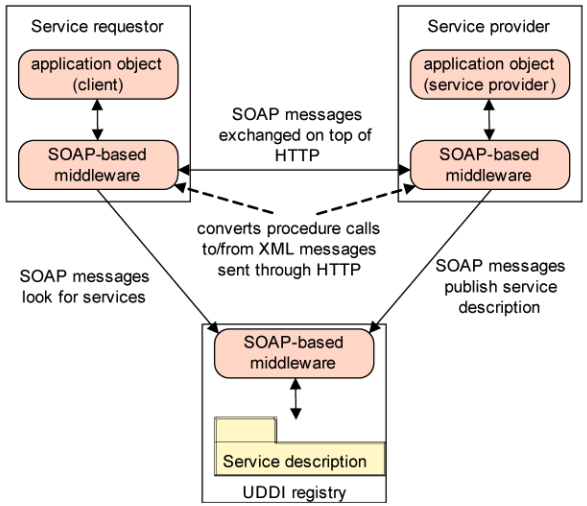
Example

```
<env:Envelope>
    <env:Body>
        <myNS:addFive xmlns:myNS="http://my-domain.de/"
        enc:encodingStyle="http://">
            <arg xsi:type="xsd:int">33</arg>
        </myNS:addFive>
    </env:Body>
</env:Envelope>
```

Response Message in SOAP

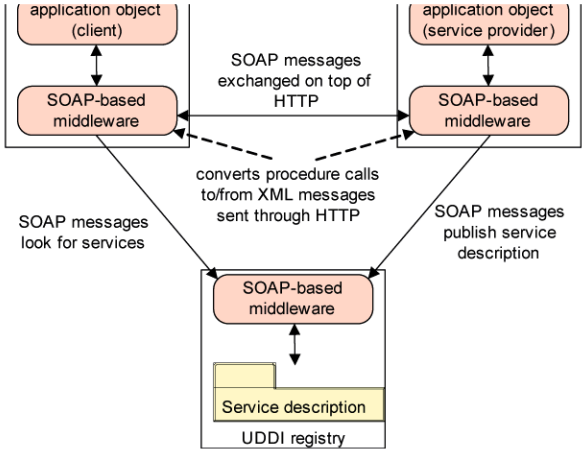
```
<env:Envelope>
    <env:Body>
        <myNS:addFiveResponse xmlns:myNS="http://my-domain.de/"
        xmlns:rpc="http://www.w3.org/2003/05/soap-rpc"
        enc:encodingStyle="http://">
            <rpc:result>ret</rpc:result>
            <ret xsi:type="xsd:int">38</ret>
        </myNS:addFiveResponse>
    </env:Body>
</env:Envelope>
```

Minimalist Infrastructure for Web Services



1. providers advertise their services in a UDDI registry
2. clients look for services in a UDDI registry
   - statically: at development time
   - dynamically: at run-time

Minimalist Infrastructure for Web Services

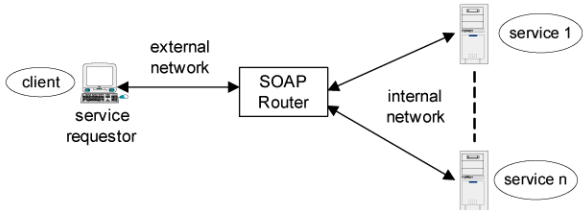


1. providers advertise their services in a UDDI registry
2. clients look for services in a UDDI registry
   - statically: at development time
   - dynamically: at run-time
3. client invokes the service

SOAP-Router

Routing is a process of delivering messages through a series of nodes or intermediaries, called ***SOAP-Routers*** in the context of SOAP.

The SOAP Router is the entity that moves SOAP messages between internal and external networks.



Besides routing capabilities the SOAP-Router may provide value-added services such as logging, auditing and enforcement of security policies.

WS_Routing is a protocol that defines how SOAP messages can be delivered using various transports.

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