Introduction to Web Services

Technologies involved

- **Xml**
  - schemas
- **XML Messaging**:
  - SOAP
- **Description**
  - WSDL
- **Registry:**
  - WSIL
  - UDDI

What is a web service?

- **W3C Definition**:
  - A Web service is a software application identified by a URI, whose interfaces and binding are capable of being defined, described and discovered by XML artifacts and supports direct interactions with other software applications using XML based messages via internet-based protocols
- **Other definitions**
  - "Web services" is an effort to build a distributed computing platform for the Web.
  - enabling systematic application-to-application interaction on the Web.

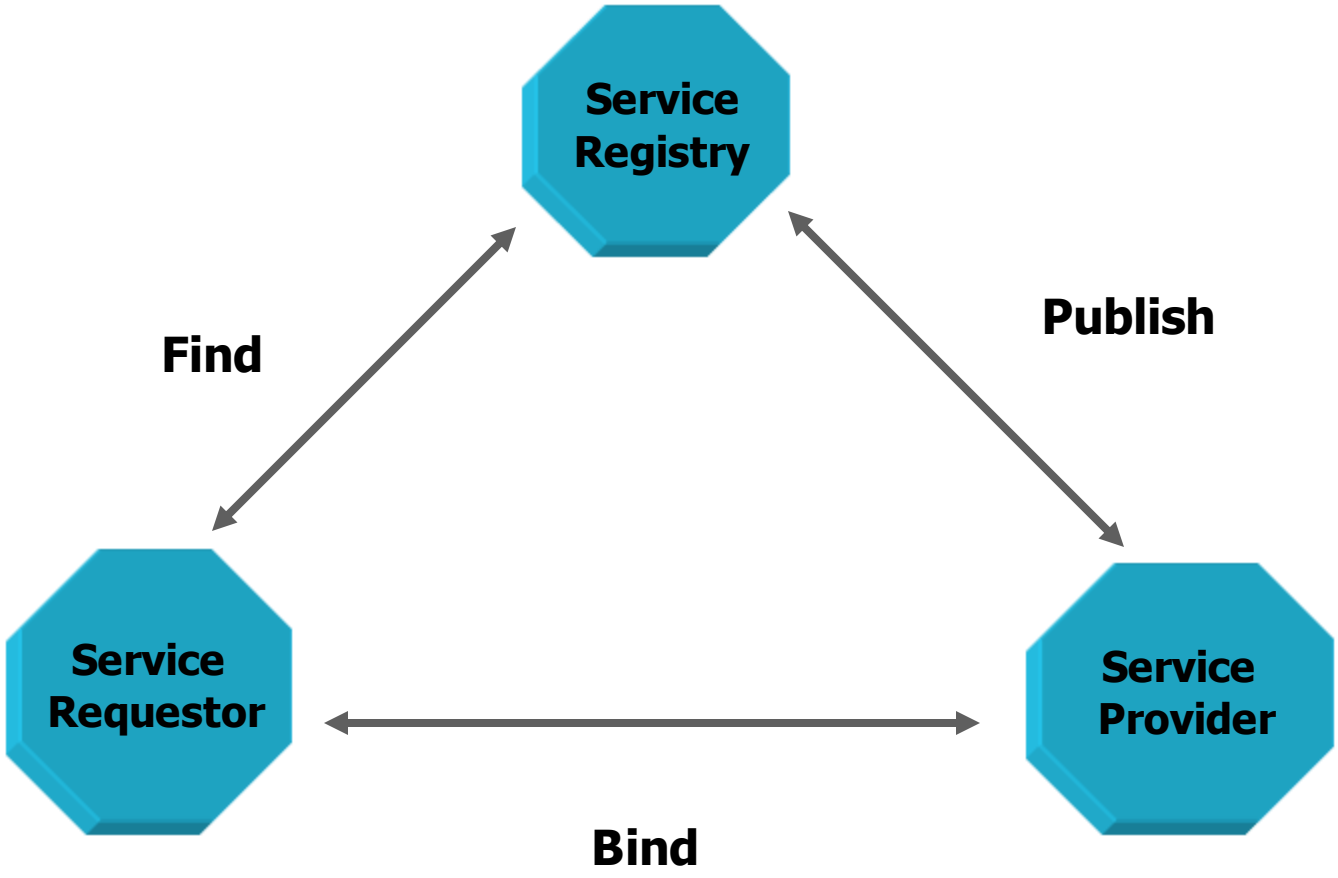
Current distributed infrastructure

- **Microsoft:**
  - **DCOM/COM+**
- **SUN:**
  - **Java RMI**
- **CORBA:**
  - **Try to be a standard specification (but complex to use)**

Disadvantages

- **Vendor Specific**
- **Platform Specific**
- **No interoperability**
- **Configuring Firewalls**

Service Oriented Arquitecture

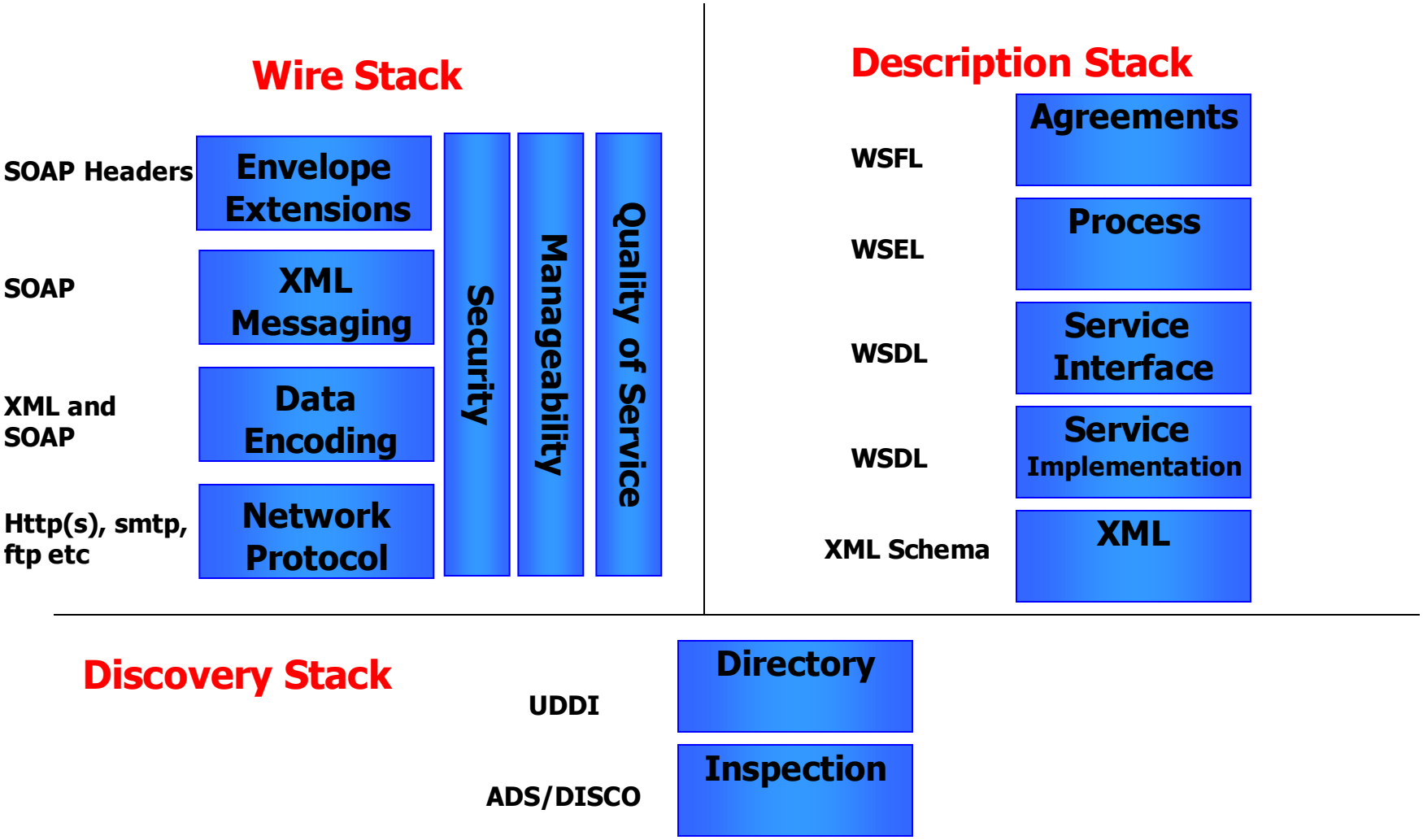


According to the SOA

A Web service is:

- An interface that describes a collection of network accessible operations
- Described using a service description language
- Published by making this service description available to users
- Found by sending queries to a registry matching service descriptions
- Bound-Invoked by using the information contained in the service description
- Composed with other services to create new services (service orchestration)

Web services interoperability stack



WSDL – Web Services description Language
UDDI – Universal Description, Discovery and Interaction

eXtensible Markup Language

- All the technologies in Web Services are XML based
  - Messaging
  - Description
  - Registry

  } Are all in XML

- Why?
  - XML is pure text with no binary data
  - Applications read the XML
  - Applications share data using XML . Any application can talk to any other application using XML (unlike binary) irrespective of the platform
  - XML is a method for putting structured data in a text file

XML Document

```
<?XML version="1.0" encoding="UTF-8" standalone="no"?>
<!-- this is an XML comment -->
<books xmlns="somename"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="somename M:\XML\Schemas\docbook.xsd">
   <book year="2000" book-title="XML in Depth">
        <author>
        <title>Mr.</title> John Doe
        </author>
        <publisher> &pub </publisher>
   </book>
</books>
```

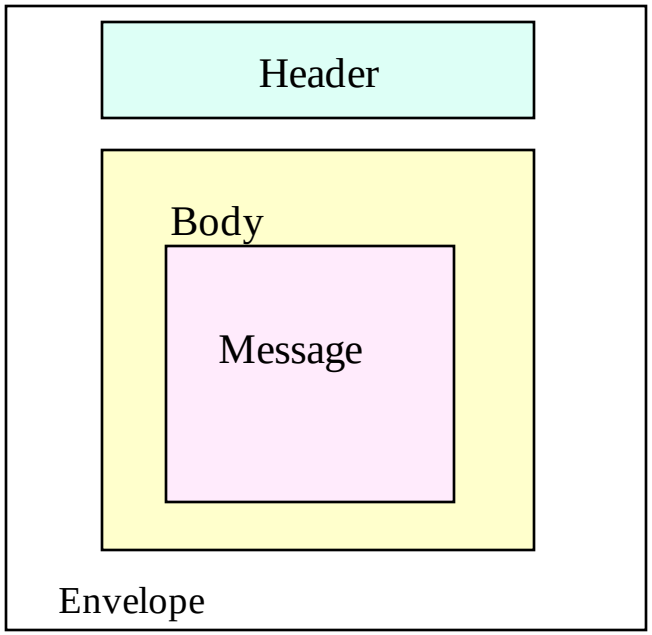
XML instance schema *comment* root attributes element

XML Rules

- Well formed
  - Syntax is correct (all tags opened and closed)
- Valid
  - All the elements matches the definitions written in the schema
- XML Documents (.xml) == XML Instances of the Schema (.xsd)
- DTD
  - Document Type Definitions – Validates XML data against it
- XML Schema
  - Alternative to DTD with added functionality. It supports other data types not supported by DTD
    - > Predefined Simple Types (integers,booleans,dateTime…)
    - > User-defined datatypes (Complex Types)
    - > Validations Restrictions to types
  - XML schema itself is an XML document !
- XML Processing
  - Read the XML documents XML processors (Parsers)
    - > SAX (based on events)
    - > DOM (reads the xml document and loads it in memory)
    - > Python implements this interfaces in a package PyXML

SOAP: Simple Object Access Protocol

- **An Internet standard specification, the goal of which is to define a platform and vendor-neutral WIRE PROTOCOL based on Internet standard protocols [HTTP & XML] to access Web Services**
- **How do we access a service???**
  - **With a SOAP message: Is a XML stream which is used to transmit messages via HTTP**
- **SOAP Structure**
  - **Envelope:contains the entire SOAP message**
  - **Header**
  - **Boby**
    - **Message**



SOAP Example

Soap Request

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
        <SOAP-ENV:Body>
                <m:calculateCarPayment  xmlns:m="http://www.exadel.com/services/CarPayment.xsd">
                        <loanAmount xsi:type="xsd:string">5000</loanAmount>
                        <loanTerm xsi:type="xsd:string">12</loanTerm>
                        <loanRate xsi:type="xsd:string">8</loanRate>
                </m:calculateCarPayment>
        </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

This example sends a request for a web service method called calculateCarPayment with three different arguments

You can try that with XML SPY (v 4.4)

Soap Example II

Soap Response

```
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/1999/XMLSchema">
        <SOAP-ENV:Body>
                <ns1:calculateCarPaymentResponse
xmlns:ns1="http://www.exadel.com/services/CarPayment.xsd" SOAP-
ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
                        <Result xsi:type="xsd:double">434.94</Result>
                </ns1:calculateCarPaymentResponse>
        </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The response could include Fault elements to describe any error that occurred invoking the service

Invoking a web service

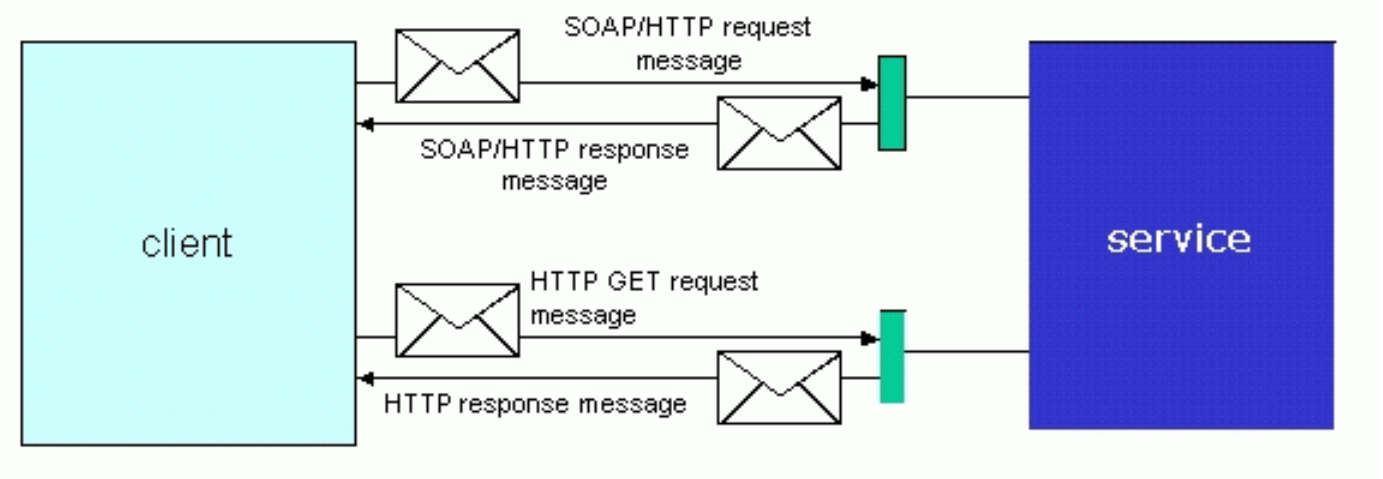


Figure 1. A client invoking a Web service

Soap libraries-engines

- To run SOAP :
  - XML Spy (first try)
- Soap Engine
  - Apache AXIS: Is an application you include inside Tom Cat Has Java API's that talk to SOAP
- Python SOAP Libraries
  - Python SOAP Libraries
    - 4Suite SOAP, administered by Fourthought
    - SOAPy, administered by Adam Elman
    - SOAP.py, a project of the Web services for Python project
      - **SOAP.py 0.9.5 download from http://sourceforge.net/projects/pywebsvcs**
    - soaplib, by Secret Labs
    - Orchard, by Ken MacLeod
    - PySOAP, administered by Dave Warner

- The good part of this is that SOAP is completely transparent to developers when trying to access web services
- You need PyXML to install python soap libraries

WSDL Web Service Definition Language

- WSDL is an XML-based language used to define Web Services and describe how to access them.
- It is the external interface for a client (IDL)

- WSDL includes information about
  - Data types it uses
  - Parameters it requires and returns
  - Groupings of functionality
  - The protocol to be used to access the service
  - The location or address of the service

WSDL Structure

- <definition> - Root element
- <types> - Provides data type definitions
- <message> - Represents the abstract definition of the data being transmitted
- <portType> - Defines a set of abstract operations
- <binding> - Specifies concrete protocol and data format specifications for the operations and messages defined by a particular portType
- <port> - Specifies an address for a binding
- **<**service> - Used to aggregate a set of related ports
- <serviceType> - Mechanism to aggregate portTypes

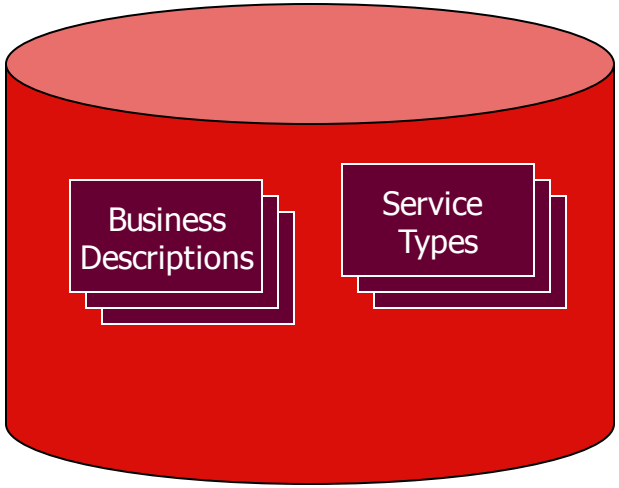
UDDI Universal Description Discovery and Integration

1. 

SW companies, standards bodies, and programmers populate the registry with descriptions of different types of services

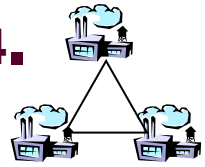
2. 

• Businesses populate the registry with descriptions of the services they support



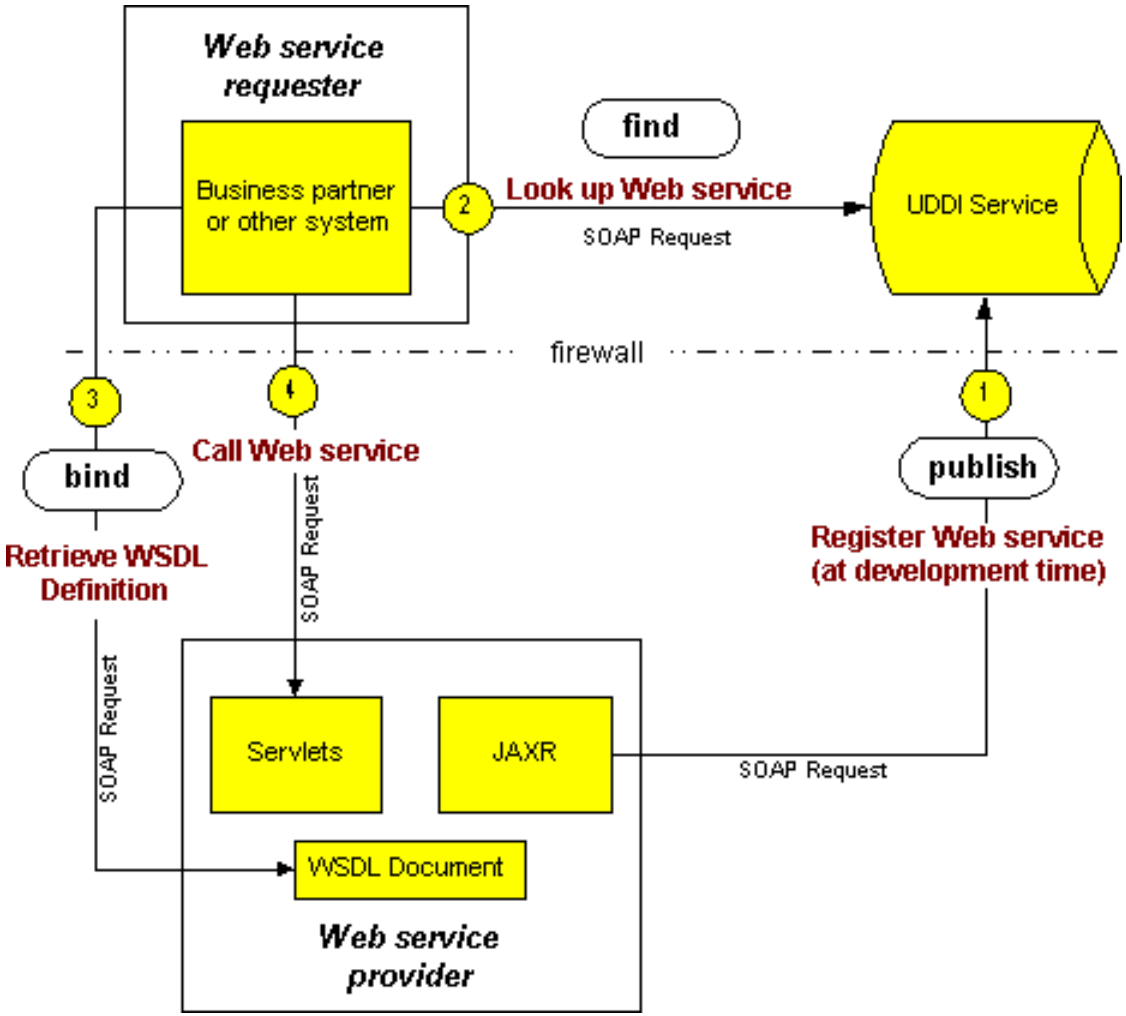
3. 

Marketplaces, search engines, and business apps query the registry to discover services at other companies

4. 

Business uses this data to facilitate easier integration with each other over the Web

How it works all together



UDDI Registries

- https://uddi.ibm.com/testregistry/registry.html
- http://demo.alphaworks.ibm.com/browser/
- http://uddi.microsoft.com
- http://uddi.hp.com