

# The Analysis & Mining of Globally Distributed Data

## Chapter 4. Web Services

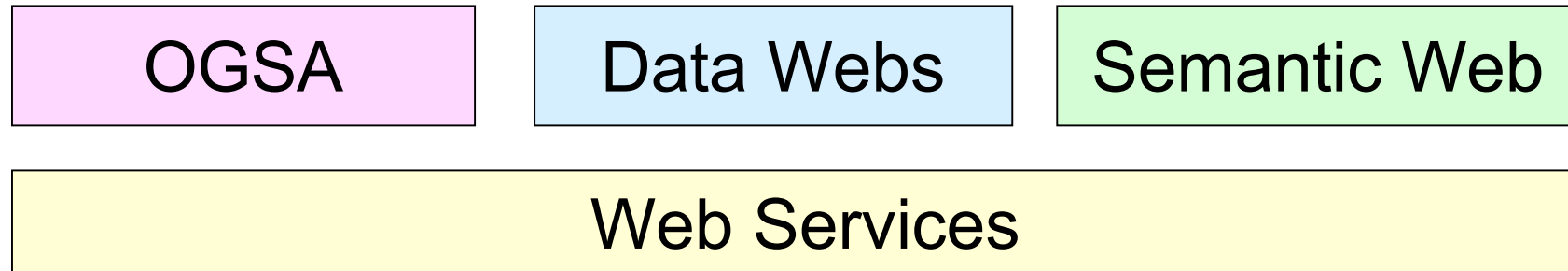
(based in part on notes by Isabel Cruz)

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# 4.1 Web Services – Basic Idea

Wide Support, Multiple  
Vendor Implementations

# Central Role of Web Services



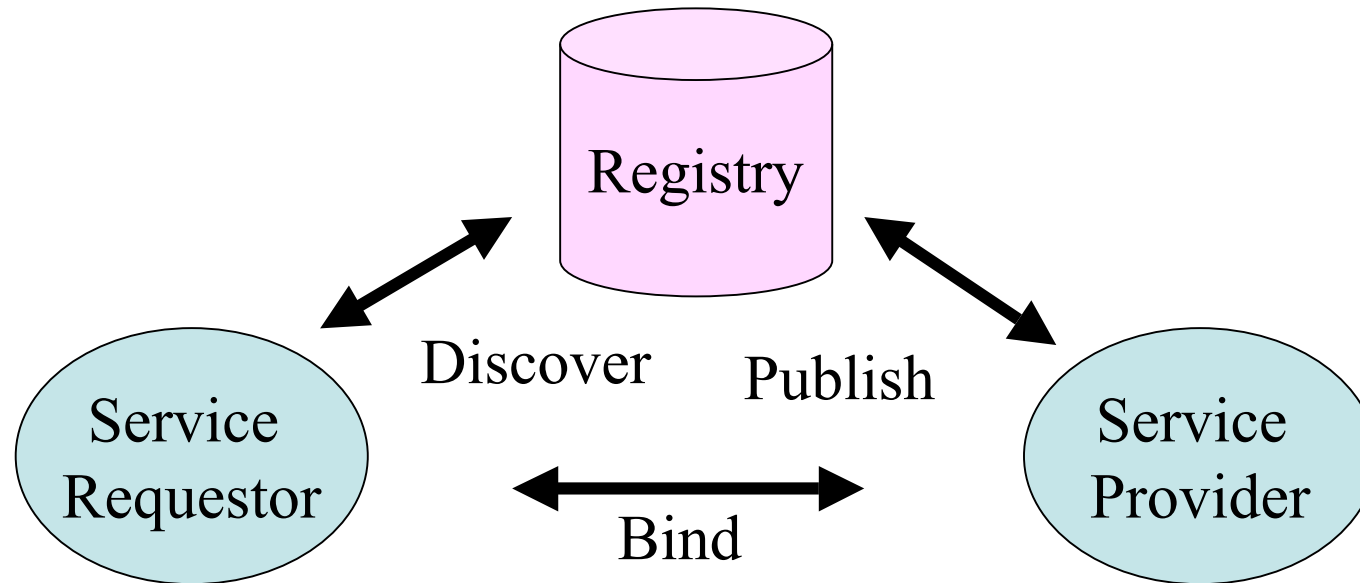
- Web services have emerged as the underlying infrastructure for a number of different distributed middleware platforms.
- Open Grid Service Architecture (OGSA) is a re-engineering of grid services to be compatible with web services

# Web Services Definition

“A Web service is a software application identified by a URI, whose interfaces and bindings are capable of being defined, described, and discovered as XML artifacts. A Web service supports direct interactions with other software agents using XML based messages exchanged via internet-based protocols.”

- [www.w3.org](http://www.w3.org)

# Service Based Architecture



- Platform independent software component published via a directory or registry by a service provider
- Distributed computing paradigm that differs from DCE, CORBA, & Java RMI by exploiting internet protocols & XML

# Web Services – Example App

The diagram illustrates the integration of various biological databases into a web application. On the left, logos for SwissProt, ExPASy, PDB, NCBI, and SGD are displayed. A large light blue arrow points from these logos to a screenshot of a web browser window on the right. The browser window shows a 'RasMol Version 2.5' interface with a 3D protein structure model and a sidebar with a table of links for 'Molecular Data Space'.

View/Download CML	Display	Info
<a href="#">View/Download CML</a>	<a href="#">Display</a>	<a href="#">Info</a>
<a href="#">View/Download CML</a>	<a href="#">Display</a>	<a href="#">Info</a>
<a href="#">View/Download CML</a>	<a href="#">Display</a>	<a href="#">Info</a>
<a href="#">View/Download CML</a>	<a href="#">Display</a>	<a href="#">Info</a>

□ What are the properties of this protein?

# Web Services

- A Web service is registered and can be located through a Web service registry.
  - existing UDDI registry service are available at [www.UDDI.org](http://www.UDDI.org) and several companies.
- Web services are available as XML interfaces
  - UDDI, WSDL, SOAP all are protocol standards defined in XML syntax
  - More standards are under development

# Web Services

- Communicate using XML messages over standard Internet protocol
  - Using HTTP, FTP or SMTP as message transport layer
  - Accessible through fire walls on the web
  
- Support loosely-coupled connections between systems
  - An attractive RPC architecture
  - Change to the implementation of a web service will not imply change the application that uses that service
  - Allowing just in time application integration



# Web Services Stack

Discovery - UDDI

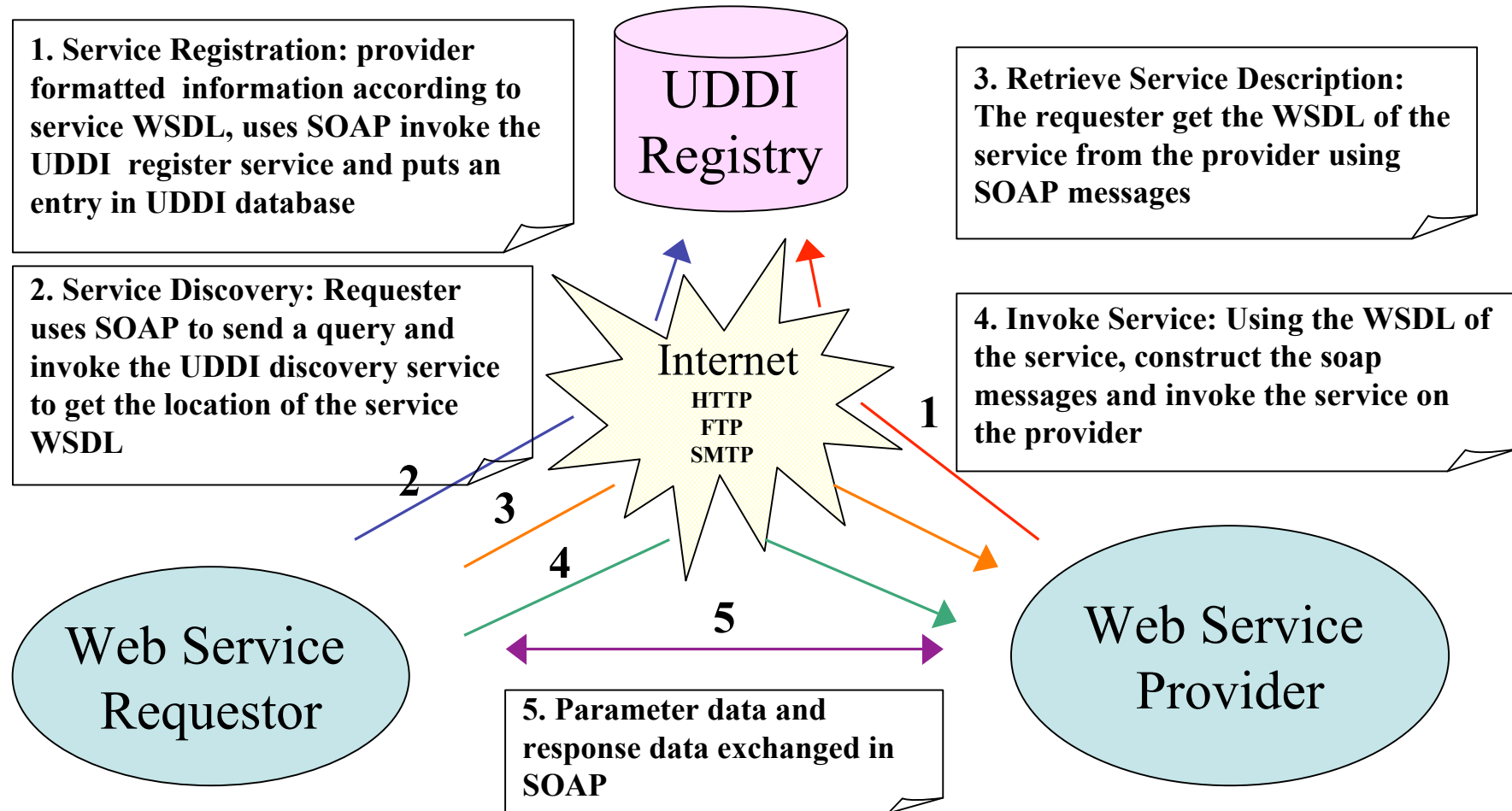
Description - WSDL

Packaging – XML

Transport – HTTP & SOAP

Network Protocol – TCP

# Web Service Conversation



# Web Services: A Better RPC Architecture

- Compared with other distributed computing platforms (CORBA, DCOM, and Java RMI) web services are:
  - Loosely coupled, allowing service invocation at runtime.
  - Use URL identify the communication endpoints
  - Use text based SOAP as wire protocol, XML as the payload parameter value format, firewall friendly
  - Service interface described in WSDL, they are available through public registry UDDI
- Substantial improvements in interoperability, flexibility and easy deployment.

# RPC Architectures Compared

-by Jason Bloomberg, Director of E-Services , Ashton Services

<b>RPC Architecture</b>	<b>Payload Parameter Value Format</b>	<b>Endpoint Naming</b>	<b>Wire Protocol</b>	<b>Interfaces</b>
<b>CORBA</b>	Common Data Representation (CDR)	Interoperable Object Reference (IOR)	IIOP (Binary)	Interface Definition Language (IDL)
<b>DCOM</b>	Network Data Representation (NDR)	OBJREF	DCOM (Binary)	Inherited from COM
<b>RMI</b>	Serializable Java Objects	URL	Java Remote Method Protocol (JRMP)	Java Interfaces
<b>Web Services</b>	XML	URL	SOAP (Text-based)	WSDL

-[http://www.therationaledge.com/content/sep\\_01/f\\_webServices\\_jb.html](http://www.therationaledge.com/content/sep_01/f_webServices_jb.html)

## 4.2 SOAP

Simple way to execute  
RPCs when using XML  
payload of parameters

# SOAP

- XML messaging provides an application and platform independent means of sharing data
- SOAP is a good mechanism for sending XML messages
- Focus to date is on using SOAP for sending XML-RPCs over HTTP
- SOAP messages consists of
  - SOAP envelope
  - SOAP header
  - SOAP body

# Example: SOAP Google Interface

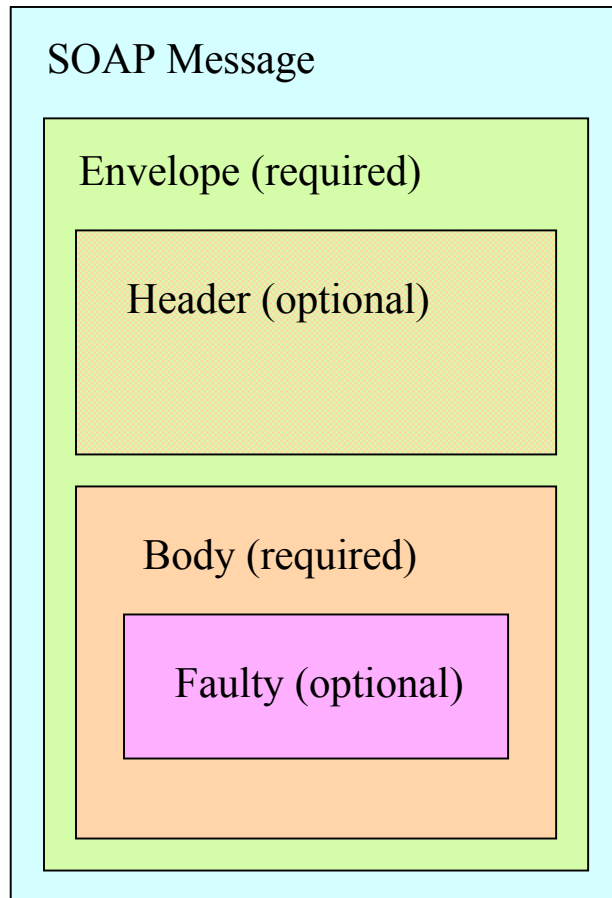
```
<SOAP-ENV:Envelope
  xmlns:SOAPENV="http://schemas.xmlsoap.org/... >
  <SOAP-ENV:Body>
    <ns1:doGoogleSearch xmlns:ns1="urn:GoogleSearch" ... ">
      <key xsi:type="xsd:string">XXXXXXXXXXXXXX</key>
      <q xsi:type="xsd:string">data </q>
      <start xsi:type="xsd:int">0</start>
      <maxResults xsi:type="xsd:int">10</maxResults>
      <filter xsi:type="xsd:boolean">true</filter>
      ...
    </ns1:doGoogleSearch>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

# SOAP: Simple Object Access Protocol

- Used for exchanging structured data in a decentralized, distributed environment
- Collaboratively developed by several companies (Microsoft, IBM, etc.) before the advent of Web services
- An XML messaging protocol that provides a non-platform specific way to invoke remote operations
- Can be used in many ways, best suitable for Web services as the transport protocol.



# SOAP Message



Soap message elements

- *Envelope* marks the beginning and end of a SOAP message
- *Header* (can have zero or more): might contain *addresses*, *payment code*, *etc.*
- *Message body* carries the data formatted as either a self-describing structure (document) or an RPC-style interface (method name and agreements)
- *Faulty* indicates an error upon a request. Contains: *faultCode*, *faultString*, *faultActor*, *detail*

# SOAP Request

<SOAP Element>

<Method Name>

<Parameter>

```
<?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/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <SOAP-ENV:Body>
    <ns1:getTemp xmlns:ns1="urn:xmethods-Temperature"
      SOAP-ENV:encodingStyle =
        "http://schemas.xmlsoap.org/soap/encoding/">
      <zipcode xsi:type="xsd:string">60008</zipcode>
    </ns1:getTemp>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

# SOAP Response

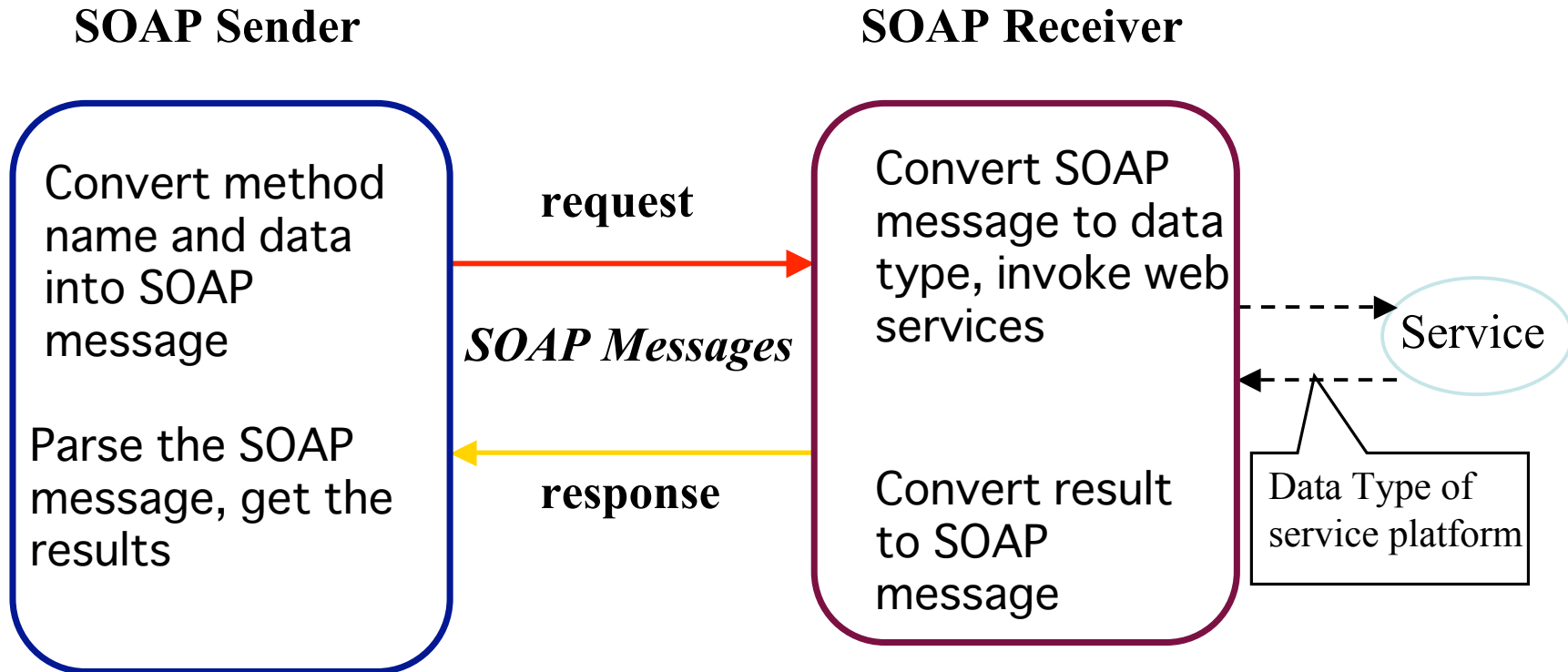
<SOAP Element>

<Method Name>

<Parameter>

```
<?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/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <SOAP-ENV:Body>
    <ns1:getTempResponse xmlns:ns1="urn:xmethods-Temperature"
      SOAP-ENV:encodingStyle =
        "http://schemas.xmlsoap.org/soap/encoding/">
      <return xsi:type="xsd:float">71.0</return>
    </ns1:getTempResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

# SOAP Message Exchange



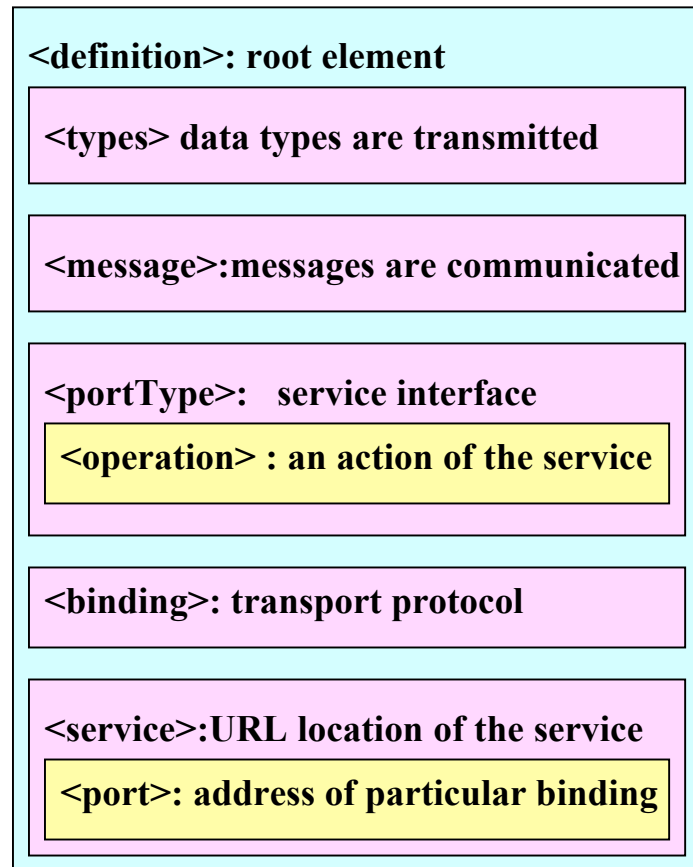
## 4.3 WSDL

### Simple XML-Based Mechanism to Register Services

# WSDL: Web Service Description Language

- Is an XML schema format that defines an extensible framework for describing web services interfaces (in the past this role was performed by IDL)
- Describe a set of SOAP messages and how messages can be exchanged
- WSDL definition can be mapped to any language object model or messaging system (multi-platform)
- WSDL components are generated automatically using web services aware tools

# WSDL Components



- Data Type Definitions: determine the structure and the content of message
  - *Data type, Message*
- Abstract Operations: determine the operations performed on the message content
  - *Operation, Port type, Binding*
- Service Binding: determines the network transport that will carry the message to its destination
  - *Port, Service*

# WSDL Example – Google (1 of 3)

```
<message name="doGoogleSearch">
  <part name="key"      type="xsd:string"/>
  <part name="q"       type="xsd:string"/>
  <part name="start"   type="xsd:int"/>
  <part name="maxResults" type="xsd:int"/>
  <part name="filter"  type="xsd:boolean"/>
  <part name="restrict" type="xsd:string"/>
  <part name="safeSearch" type="xsd:boolean"/>
  <part name="lr"      type="xsd:string"/>
  <part name="ie"      type="xsd:string"/>
  <part name="oe"      type="xsd:string"/>
</message>
```



# WSDL Example – Google (2 of 3)

```
<portType name="GoogleSearchPort">  
  <operation name="doGetCachedPage">  
    <input message="typens:doGetCachedPage"/>  
    <output message="typens:doGetCachedPageResponse"/>  
  </operation>
```

...

```
  <operation name="doGoogleSearch">  
    <input message="typens:doGoogleSearch"/>  
    <output message="typens:doGoogleSearchResponse"/>  
  </operation>
```

```
</portType>
```

# WSDL Example – Google (3 of 3)

```
<operation name="doGoogleSearch">  
  <soap:operation soapAction="urn:GoogleSearchAction"/>  
  <input>  
    <soap:body use="encoded"  
      namespace="urn:GoogleSearch"  
      encodingStyle="http://schemas.xmlsoap.org/soap/encoding"/>  
  </input>  
  <output>  
    <soap:body use="encoded"  
      namespace="urn:GoogleSearch"  
      encodingStyle="http://schemas.xmlsoap.org/soap/encoding"/>  
  </output>  
</operation>
```

## 4.4 UDDI

# Simple XML-Based Mechanism to Discover Services

# UDDI Publishing and Discovery

- UDDI (*Universal Description, Discovery and Integration*) registers and publishes Web service definitions
- UDDI Support supports web service interface discovery
- UDDI uses SOAP for registry and discovery
- An alternative is ebXML, designed for business collaboration (intends to replace EDI)