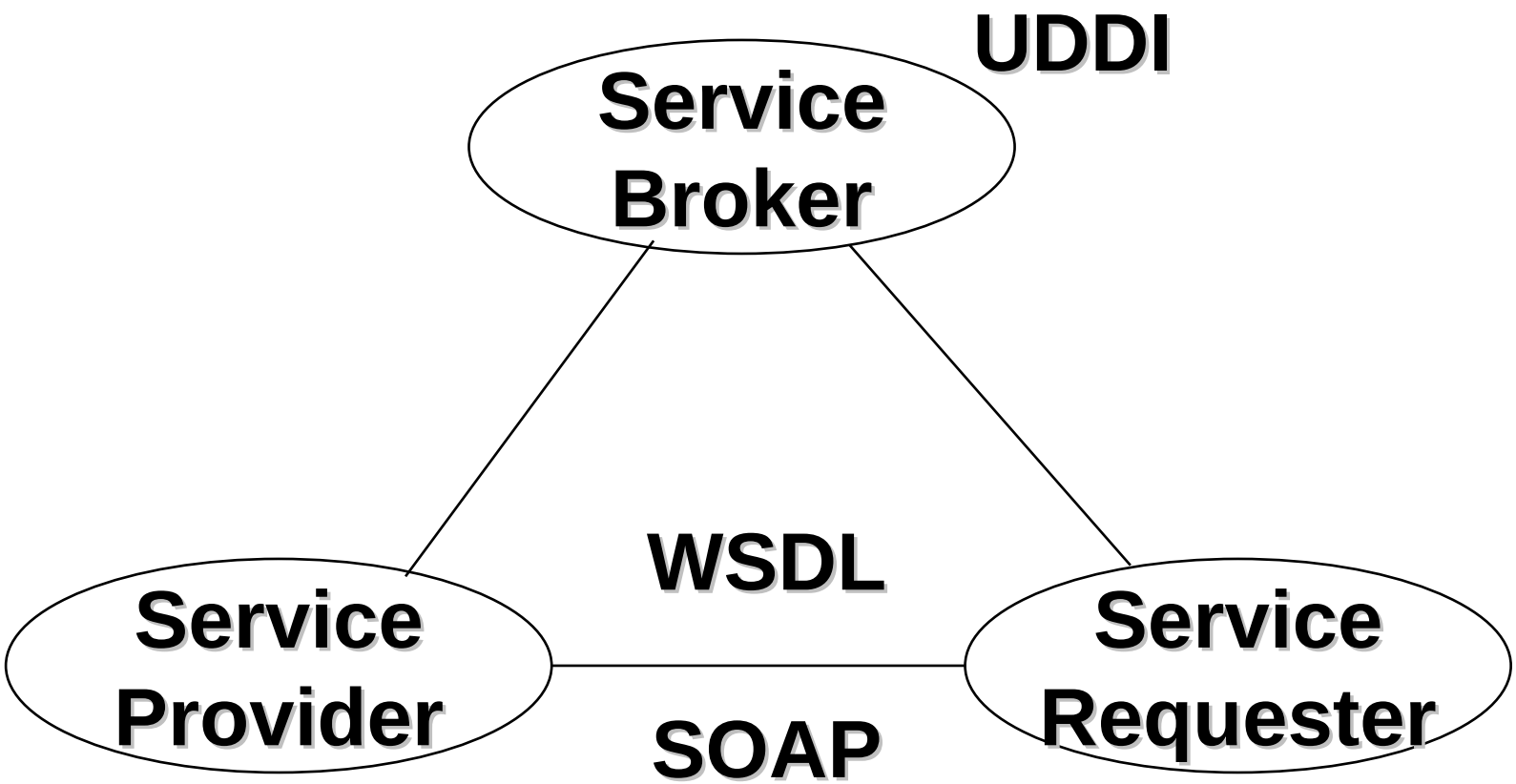
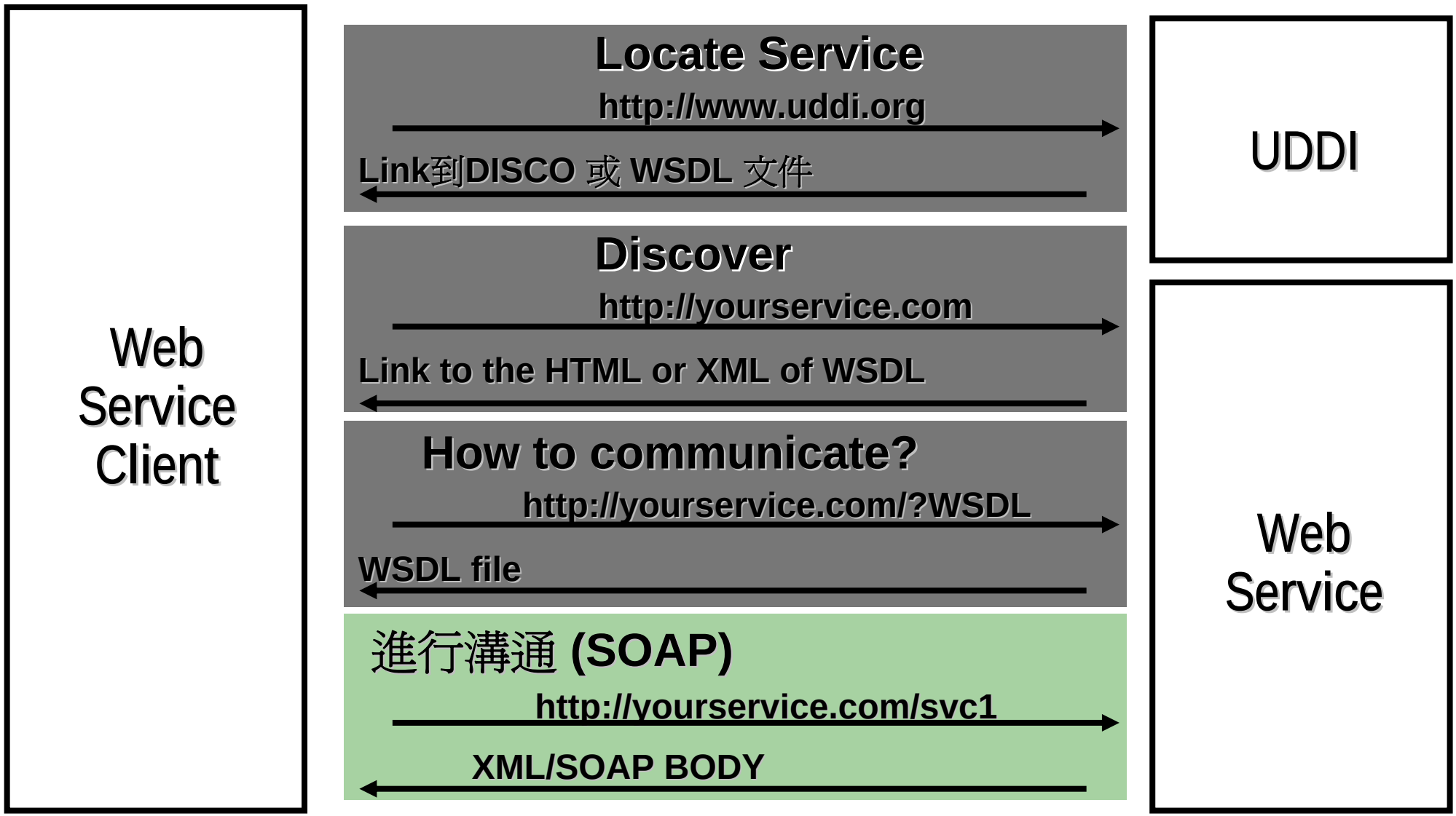
State of the Art

- Sun RPC: XDR Streams + XDR + Portmapper
- RMI: RPC + Interfaces + Registry
- Corba: IIOP + IDL + ORB
- Web services: SOAP + WSDL +UDDI

- References:
  - http://www.w3.org/TR/soap12-part0/
  - http://www.w3.org/TR/wsdl
  - http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=uddi-spec
  - http://www.w3schools.com/default.asp

Service Oriented Application Architecture (SOA)




Web Service Client
Locate Service
http://www.uddi.org
Link到DISCO 或 WSDL 文件
UDDI
Discover
http://yourservice.com
Link to the HTML or XML of WSDL
How to communicate?
http://yourservice.com/?WSDL
WSDL file
進行溝通 (SOAP)
http://yourservice.com/svc1
XML/SOAP BODY
Web Service

Web Service Technology Stack

Service Publication/Discovery	**➔ UDDI**
Service Description WSDL	**➔ WSDL**
Service Interaction	**➔ SOAP**
Transport Network	**➔ HTTP, SMTP, FTP**

What is SOAP?

- SOAP stands for Simple Object Access Protocol
- SOAP is a communication protocol
- SOAP is for communication between applications
- SOAP is a format for sending messages
- SOAP is designed to communicate via Internet
- SOAP is platform independent
- SOAP is language independent
- SOAP is based on XML
- SOAP is simple and extensible

Why SOAP?

- It is important for application development to allow Internet communication between programs.
- Today's applications communicate using Remote Procedure Calls (RPC) between objects like DCOM and CORBA, but HTTP was not designed for this. RPC represents a compatibility and security problem; firewalls and proxy servers will normally block this kind of traffic.
- A better way to communicate between applications is over HTTP, because HTTP is supported by all Internet browsers and servers. SOAP was created to accomplish this.
- SOAP provides a way to communicate between applications running on different operating systems, with different technologies and programming languages.

Background

- Microsoft and SOAP
  - SOAP is a key element of Microsoft's .NET architecture for future Internet application development.
- SOAP 1.1 was Proposed to W3C
  - UserLand, Ariba, Commerce One, Compaq, Developmentor, HP, IBM, IONA, Lotus, Microsoft, and SAP proposed to W3C, in May 2000, the SOAP Internet protocol that they hope will revolutionize application development by connecting graphic user interface desktop applications to powerful Internet servers using the standards of the Internet; HTTP and XML.
- W3C is Working on SOAP 1.2
  - The first public Working Draft on SOAP was published from W3C in December 2001. To read more about the SOAP activities at W3C please visit our W3C School.

SOAP Building Blocks

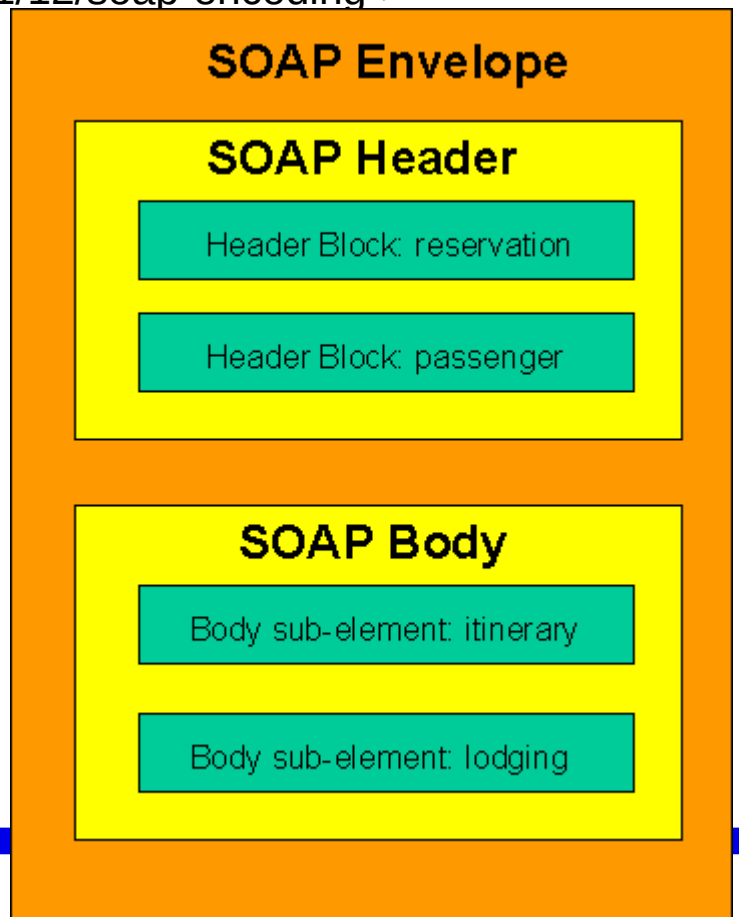
- A SOAP message is an ordinary XML document containing the following elements:
  - A required Envelope element that identifies the XML document as a SOAP message
  - An optional Header element that contains header information
  - A required Body element that contains call and response information
  - An optional Fault element that provides information about errors that occurred while processing the message
  - All the elements above are declared in the default namespace for the SOAP envelope:

Syntax Rules

- Here are some important syntax rules:
  - A SOAP message MUST be encoded using XML
  - A SOAP message MUST use the SOAP Envelope namespace
  - A SOAP message MUST use the SOAP Encoding namespace
  - A SOAP message must NOT contain a DTD reference
  - A SOAP message must NOT contain XML Processing Instructions

Skeleton of SOAP Messages

```
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
 soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
<soap:Header>
  ...
  ...
</soap:Header>
<soap:Body>
  ...
  ...
  <soap:Fault>
    ...
    ...
  </soap:Fault>
</soap:Body>
</soap:Envelope>
```



Example of a SOAP Envelop: Request

```
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
 soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
<soap:Body>
   <m:GetPrice xmlns:m="http://www.w3schools.com/prices">
      <m:Item>Apples</m:Item>
   </m:GetPrice>
</soap:Body>
</soap:Envelope>
```

Example of a SOAP Envelop: Response

```
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2001/12/soap-envelope“
    soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
<soap:Body>
  <m:GetPriceResponse xmlns:m="http://www.w3schools.com/prices">
    <m:Price>1.90</m:Price>
  </m:GetPriceResponse>
</soap:Body>
</soap:Envelope>
```

What is WSDL?

- WSDL stands for Web Services Description Language
- WSDL is written in XML
- WSDL is an XML document
- WSDL is used to describe Web services
- WSDL is also used to locate Web services
- WSDL is not yet a W3C standard

WSDL Describes Web Services

- WSDL stands for
  - Web Services Description Language.
- WSDL is a document written in XML.
  - It contains a set of definitions to define a web service.
  - It specifies the location of the service and the operations (or methods) the service exposes.

WSDL Development History at W3C

- WSDL 1.1 was submitted as a W3C Note by Ariba, IBM and Microsoft for describing services for the W3C XML Activity on XML Protocols in March 2001.
  - (a W3C Note is made available by the W3C for discussion only. Publication of a Note by W3C indicates no endorsement by W3C or the W3C Team, or any W3C Members)
- The first Working Draft of WSDL 1.2 was released by W3C in July 2002.

The WSDL Document Structure

- A WSDL document defines a web service using these major elements:
  - **types**, which provides data type definitions used to describe the messages exchanged.
  - **message**, which represents an abstract definition of the data being transmitted.
    - A message consists of logical parts, each of which is associated with a definition within some type system.
    - The parts are just like the parameters of a function call in a programming language.
  - **portType**, which is a set of abstract operations.
    - Each operation refers to an input message and output messages.
    - It defines a web service, the operations that can be performed, and the messages that are involved.
    - It is just like a function library (or a module, or a class) in a programming language.
  - **binding**, which specifies concrete protocol and data format specifications for the operations and messages defined by a particular portType.
  - **port**, which specifies an address for a binding, thus defining a single communication endpoint.
  - **service**, which is used to aggregate a set of related ports.

WSDL Ports

- The <portType> element is the most important WSDL element.
- Operation Types
  - The request-response type is the most common operation type, but WSDL defines four types:
- Type Definition
  - One-way
    - The operation can receive a message but will not return a response
  - Request-response
    - The operation can receive a request and will return a response
  - Solicit-response
    - The operation can send a request and will wait for a response
  - Notification
    - The operation can send a message but will not wait for a response

Example of Java Web Services

- Java Interface

```
package helloservice;

import java.rmi.Remote;
import java.rmi.RemoteException;

public interface HelloIF extends Remote {
    public String sayHello(String s) throws RemoteException;
}
```

Config of WSDL in J2EE

```
<?xml version="1.0" encoding="UTF-8"?>
<webservices xmlns="http://java.sun.com/xml/ns/j2ee" version="1.1"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee
      http://www.ibm.com/webservices/xsd/j2ee_web_services_1_1.xsd">
<webservice-description>
<display-name>MyHelloService</display-name>
<webservice-description-name>MyHelloService</webservice-description-name>
<wsdl-file>WEB-INF/wsdl/MyHelloService.wsdl</wsdl-file>
<jaxrpc-mapping-file>build/mapping.xml</jaxrpc-mapping-file>
<port-component>
<display-name>HelloIF</display-name>
<port-component-name>HelloIF</port-component-name>
<wsdl-port xmlns:wsdl-port_ns__="urn:Foo">wsdl-port_ns__:HelloIFPort</wsdl-port>
<service-endpoint-interface>helloservice.HelloIF</service-endpoint-interface>
<service-impl-bean>
<servlet-link>HelloImpl</servlet-link>
</service-impl-bean>
</port-component>
</webservice-description>
</webservices>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
      <output message="tns:HelloIF_sayHelloResponse"/></operation></portType>
  <binding name="HelloIFBinding" type="tns:HelloIF">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
      <output message="tns:HelloIF_sayHelloResponse"/></operation></portType>
  <binding name="HelloIFBinding" type="tns:HelloIF">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```

Description name:
MyHelloService

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
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  <binding name="HelloIFBinding" type="tns:HelloIF">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```

Port & Binding:
HelloIF

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
      <output message="tns:HelloIF_sayHelloResponse"/></operation></portType>
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    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```
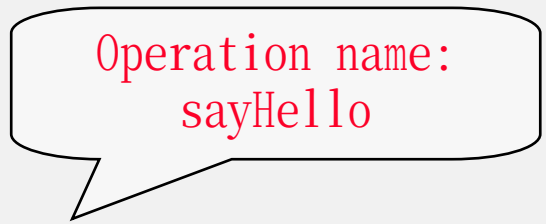
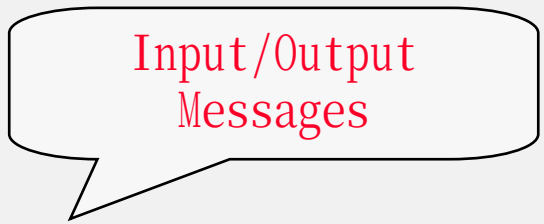



```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
      <output message="tns:HelloIF_sayHelloResponse"/></operation></portType>
  <binding name="HelloIFBinding" type="tns:HelloIF">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```



```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="MyHelloService" targetNamespace="urn:Foo" xmlns:tns="urn:Foo"
xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/">
  <types/>
  <message name="HelloIF_sayHello">
    <part name="String_1" type="xsd:string"/></message>
  <message name="HelloIF_sayHelloResponse">
    <part name="result" type="xsd:string"/></message>
  <portType name="HelloIF">
    <operation name="sayHello" parameterOrder="String_1">
      <input message="tns:HelloIF_sayHello"/>
      <output message="tns:HelloIF_sayHelloResponse"/></operation></portType>
  <binding name="HelloIFBinding" type="tns:HelloIF">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>
    <operation name="sayHello">
      <soap:operation soapAction=""/>
      <input>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></input>
      <output>
        <soap:body encodingStyle="http://schemas.xmlsoap.org/soap/encoding/" use="encoded"
              namespace="urn:Foo"/></output></operation></binding>
  <service name="MyHelloService">
    <port name="HelloIFPort" binding="tns:HelloIFBinding">
      <soap:address location="REPLACE_WITH_ACTUAL_URL"/></port></service></definitions>
```

Parameters of sayHello

Examples of C# Web Service

- Example 1:
  - C# source code.
  - The corresponding WSDL (generated)
  - The corresponding SOAP.
- Example 2:
  - C# source code.
  - The corresponding WSDL (generated)
  - The corresponding SOAP.

What is UDDI

- UDDI is a platform-independent framework for describing services, discovering businesses, and integrating business services by using the Internet.
- UDDI stands for Universal Description, Discovery and Integration
- UDDI is a directory for storing information about web services
- UDDI is a directory of web service interfaces described by WSDL
- UDDI communicates via SOAP
- UDDI is built into the Microsoft .NET platform

What is UDDI Based On?

- UDDI uses World Wide Web Consortium (W3C) and Internet Engineering Task Force (IETF) Internet standards such as XML, HTTP, and DNS protocols.
- UDDI uses WSDL to describe interfaces to web services
- Additionally, cross platform programming features are addressed by adopting SOAP, known as XML Protocol messaging specifications found at the W3C Web site.

UDDI Benefits

- Any industry or businesses of all sizes can benefit from UDDI
- Before UDDI, there was no Internet standard for businesses to reach their customers and partners with information about their products and services. Nor was there a method of how to integrate into each other's systems and processes.
- Problems the UDDI specification can help to solve:
  - Making it possible to discover the right business from the millions currently online
  - Defining how to enable commerce once the preferred business is discovered
  - Reaching new customers and increasing access to current customers
  - Expanding offerings and extending market reach
  - Solving customer-driven need to remove barriers to allow for rapid participation in the global Internet economy
  - Describing services and business processes programmatically in a single, open, and secure environment

How can UDDI be Used

- If the industry published an UDDI standard for flight rate checking and reservation, airlines could register their services into an UDDI directory.
- Travel agencies could then search the UDDI directory to find the airline's reservation interface.
- When the interface is found, the travel agency can communicate with the service immediately because it uses a well-defined reservation interface.

Who is Supporting UDDI?

- UDDI is a cross-industry effort driven by all major platform and software providers like
  - Dell, Fujitsu, HP, Hitachi, IBM, Intel, Microsoft, Oracle, SAP, and Sun,
  - as well as a large community of marketplace operators, and e-business leaders.
- Over 220 companies are members of the UDDI community.


PIVOTAL
autodesk
COMPAQ
TOSHIBA
IBM
SAP
accenture
McAFEE.COM
UNITED
ORACLE
intel
Peregrine
Microsoft
FUJITSU
KPMG Consulting
DAIMLERCHRYSLER
flamenco networks
Ford Motor Company
GRAND CENTRAL COMMUNICATIONS
jamcracker
LOUDCLOUD
WSI
hp invent
IONA
POSC
CommerceQuest
KANA
epicentric
bea
CAPE CLEAR
epicor
REUTERS
BUSINESS OBJECTS
Rational the software development company
corechange
plumtree
REED ELSEVIER
FrontRange SOLUTIONS
Borland
SYBASE
sas
Sabre
FileNET
macromedia
COMMERCE ONE
ride the light
Qwest
Akamai
webMethods
JDEDWARDS
groove NETWORKS
DASSAULT SYSTEMES
RealNames
VeriSign
versata
Automating e-Business