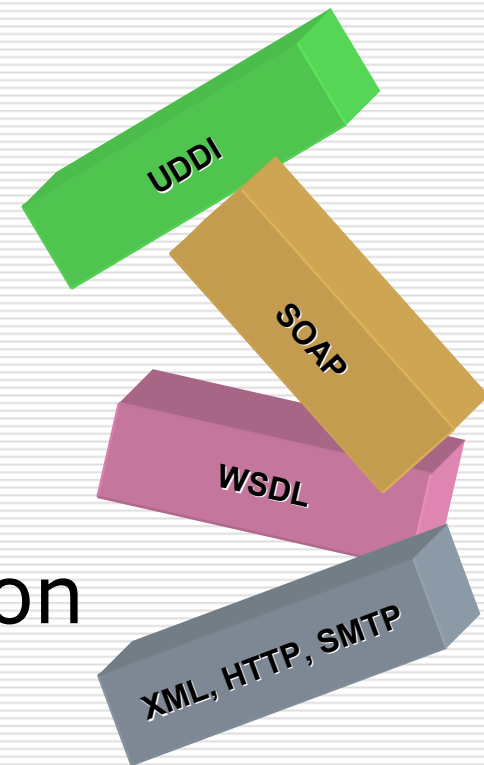


Introduction to SOA and Web Services

Federated Distributed Systems Class
Nov. 8, 2006

Content

- Motivation
- What are Web Services?
- WS Characteristics
- WS Architecture
- Web Service Implementation
- Research issues



Motivation

Before:

- ❑ Applications were very specialized. Each company had to build them
 - ❑ Applications were very complex and heavy to maintain
 - ❑ Data was maintained by the company
 - ❑ Servers to support applications were needed locally
 - ❑ Writing software became a difficult activity
-

Motivation

Today

- ❑ Modular design is promoted
 - ❑ Legacy systems are stable; nobody wants to “change” code
 - ❑ Small pieces of code are required for many people.
 - ❑ Programmers need a way to reuse functionality, not just “code”
 - ❑ Services decomposed on finer-grained components
 - ❑ Applications are seen as commodities (homogeneous products) : services
-

Motivation

Typical problems

- ❑ Heterogeneous platforms, program languages, various devices (sensors), etc.
 - ❑ Different vendors use different data schemas & formats
 - ❑ Subsystem-providers are typically autonomous and coordination is not easy to undertake or even impossible
-

Motivation

Desired Properties

- ❑ Interface: platform independent
- ❑ Service dynamically located and invoked
- ❑ Self contained

Requirement

- Need for a common program-to-program communication model, build upon existing and emerging standards
-

Motivation

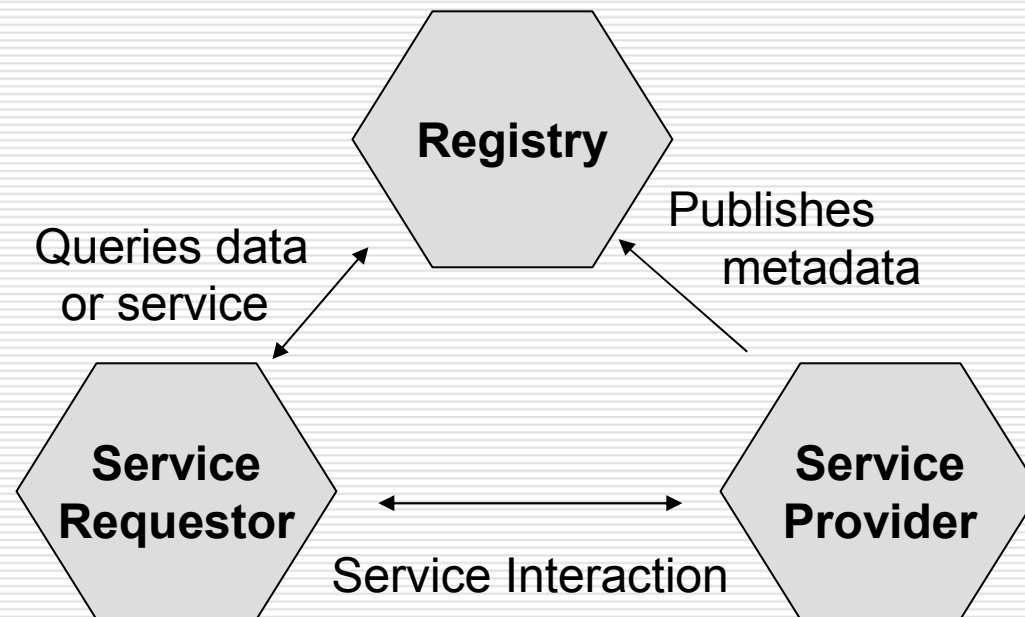
To ensure interoperability to the greatest possible extent, we need three **fundamental standards**:

- ✓ Common encoding schema for requests and responses
- ✓ Standardized description language to make metadata widely interpretable
- ✓ Well defined catalog / discovery service to find available and suitable Web-Services all over the Web

Service Oriented Architecture

Fundamental concept: Service - Trading

(Publish-Find-Bind Paradigm)



Composing at runtime, not on design time!

What are Web services?

Web services are **loosely coupled, contracted components** that communicate via **XML-based interfaces**

[Schmelzer 2002]

loosely coupled:

- they can be changed independently
- platform independent

contracted: in and output are publicly available

components: interface encapsulates the code

XML-based interfaces:

- human readable
- firewall friendly
- self-describing (allows for discovery of their functionality)

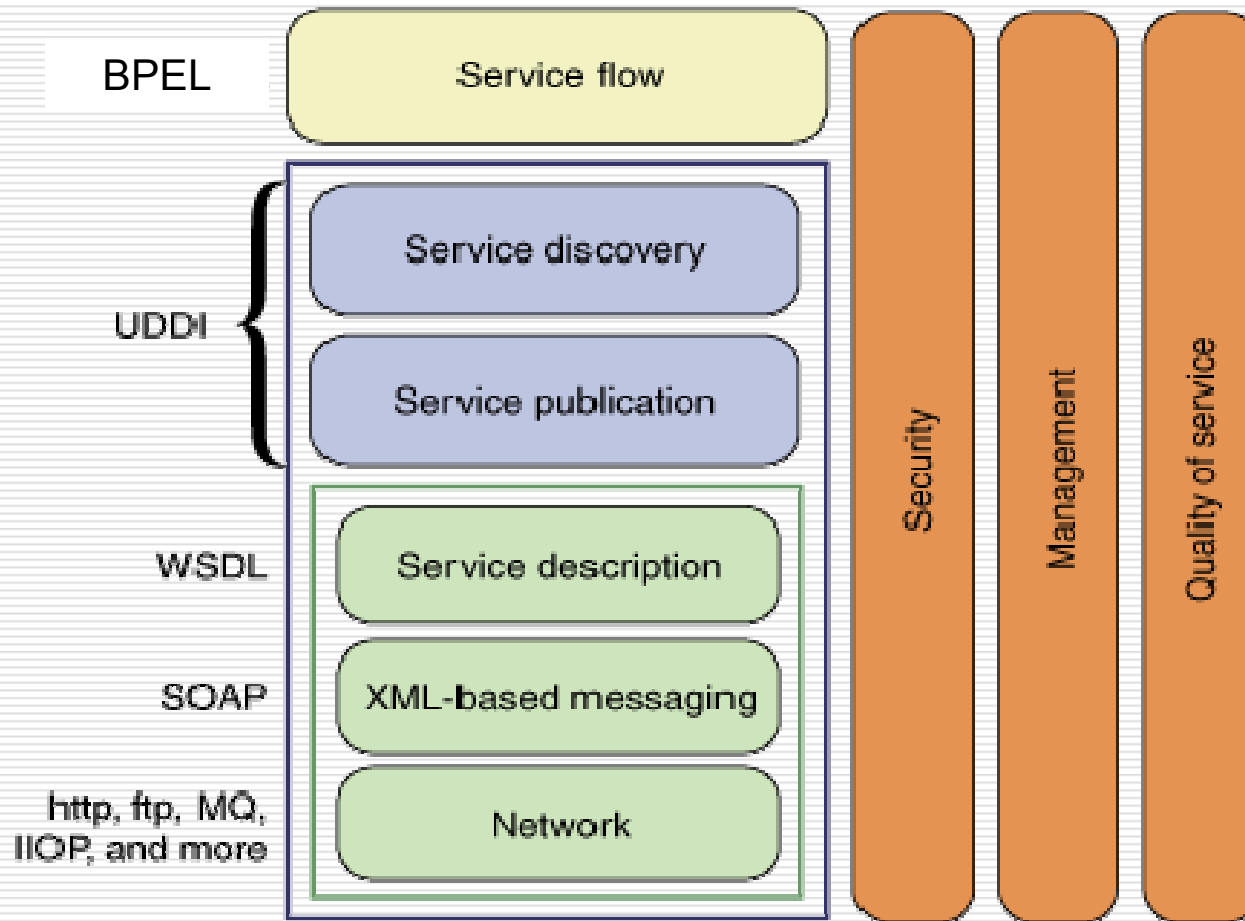
Web Service Characteristics

- ✓ Network accessible via standardized XML messaging, typically based on HTTP
 - ✓ Described using a standard, formal XML notion (service description)
 - Covers all the details, necessary to invoke the service (message formats, location, etc.)
 - ✓ Interface hides the implementation details
 - Allows it to be used independently of the hardware or software platform on which it is implemented
-

Web Service Characteristics

- ✓ Provide interface accessed by another program
 - ✓ Fulfill a specific task or set of tasks
 - Accessible through the web
 - Can be used alone
 - Can be used along with other Web Services to fulfill complex tasks
 - Can communicate to other web services
-

Web Services Stack

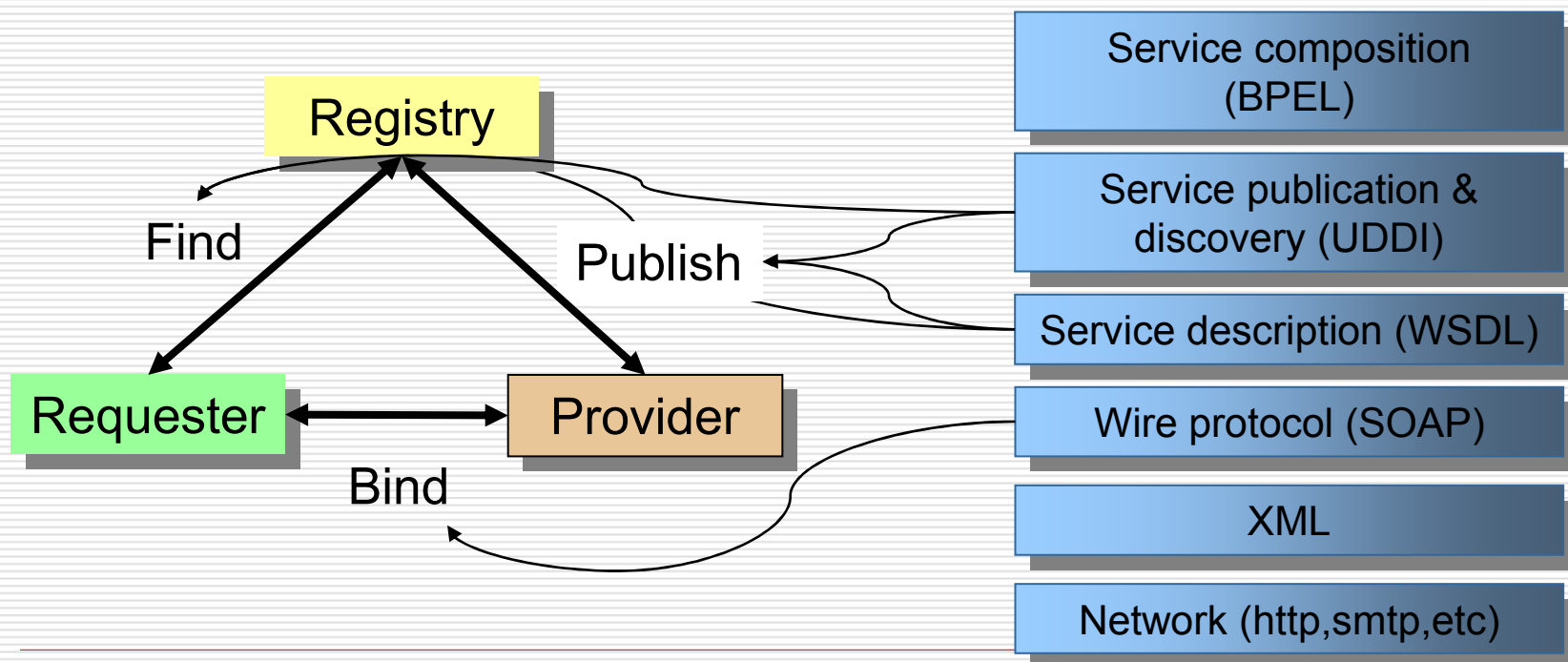


Source: www.ibm.com

Web Services Architecture

Service-oriented architecture (SOA)

Web Services technology stack



Web Services Specification

There are three basic specifications, forming the basis for state-of-the-art Web-Service technology

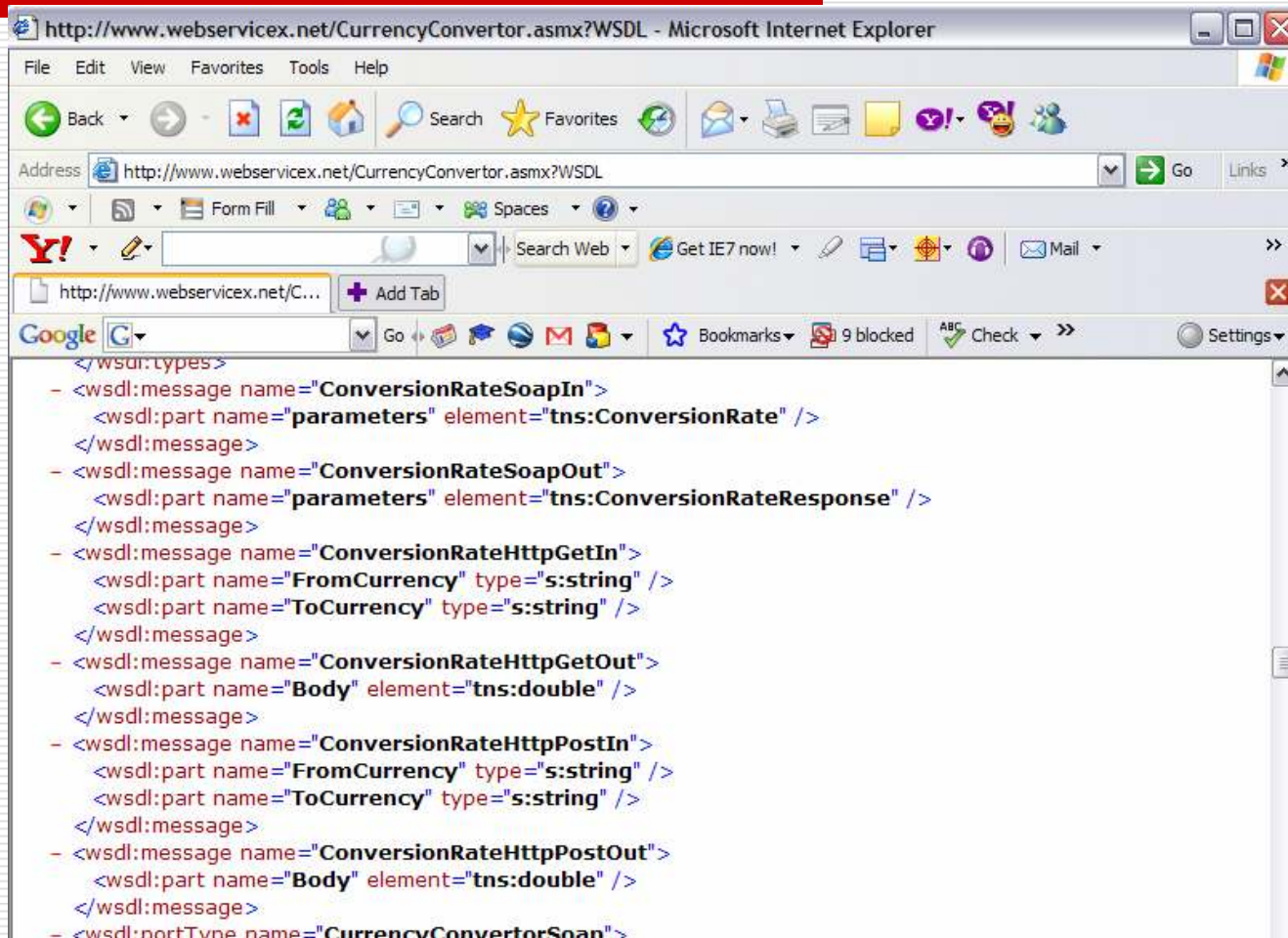
- Simple Object Access Protocol (**SOAP**)
for a common message processing & coding
 - Web Service Description Language (**WSDL**)
as a metadata standard for Web-Services
 - Universal Description, Discovery and Integration (**UDDI**)
specifying a catalog / discovery service
-

Web Service Description Language

WSDL

- Issues to think about:
 - What services do you offer?
 - How can they be invoked?
 - What information do they need to be executed?
 - How is the user providing that information?
 - What format is used to send information back?
 - The components of a WSDL document:
 - SOAP messages supported (request/response)
 - Rules for finding the port at which WS is listening the requests
 - The definition of the service itself
-

WSDL example (Currency converter)

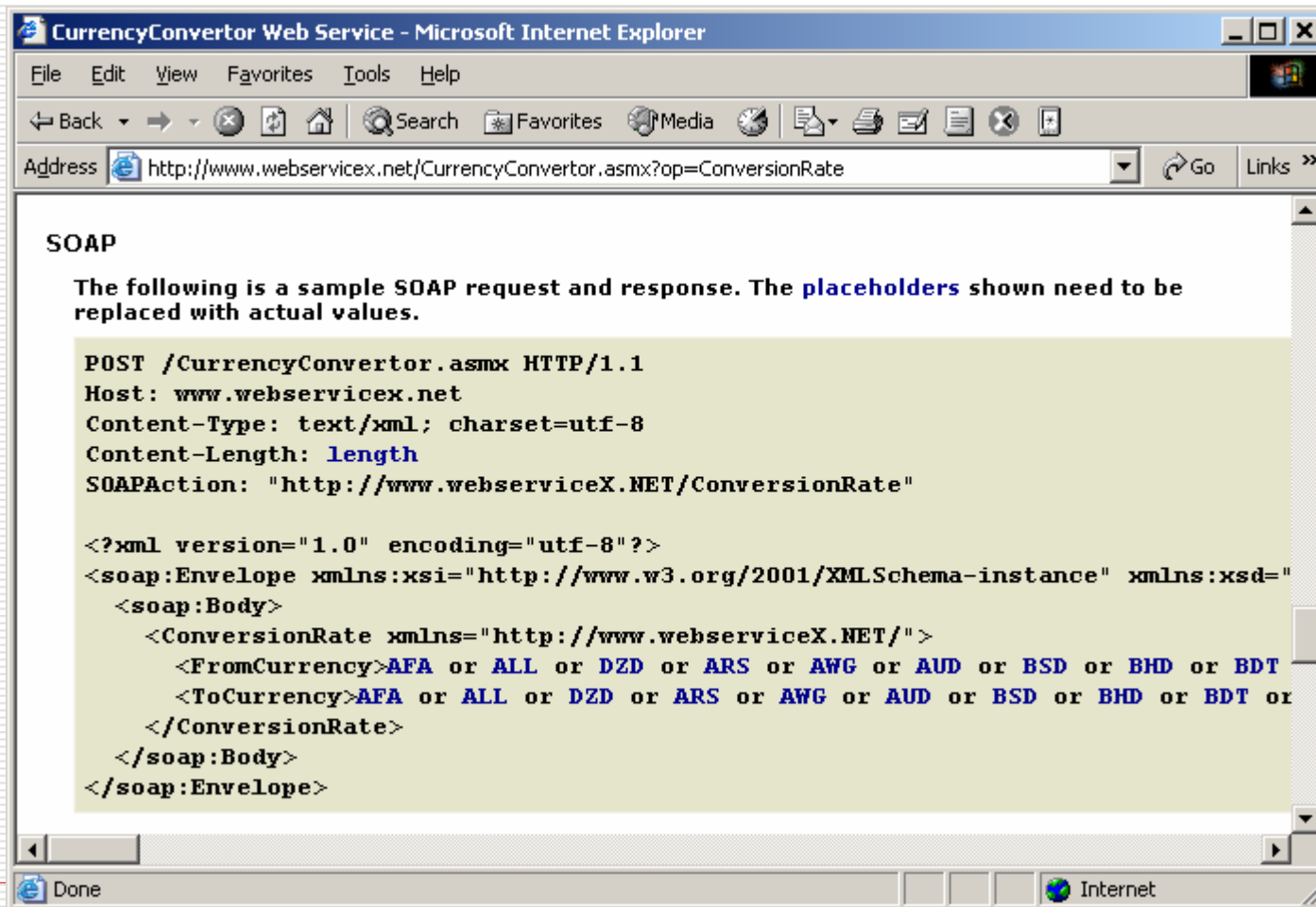


The screenshot shows a Microsoft Internet Explorer browser window with the address bar containing the URL `http://www.websvcicex.net/CurrencyConvertor.asmx?WSDL`. The browser's address bar also shows a search bar with the text "Search Web" and a "Go" button. The main content area of the browser displays the WSDL XML document for the Currency Converter web service. The XML is color-coded and shows the following structure:

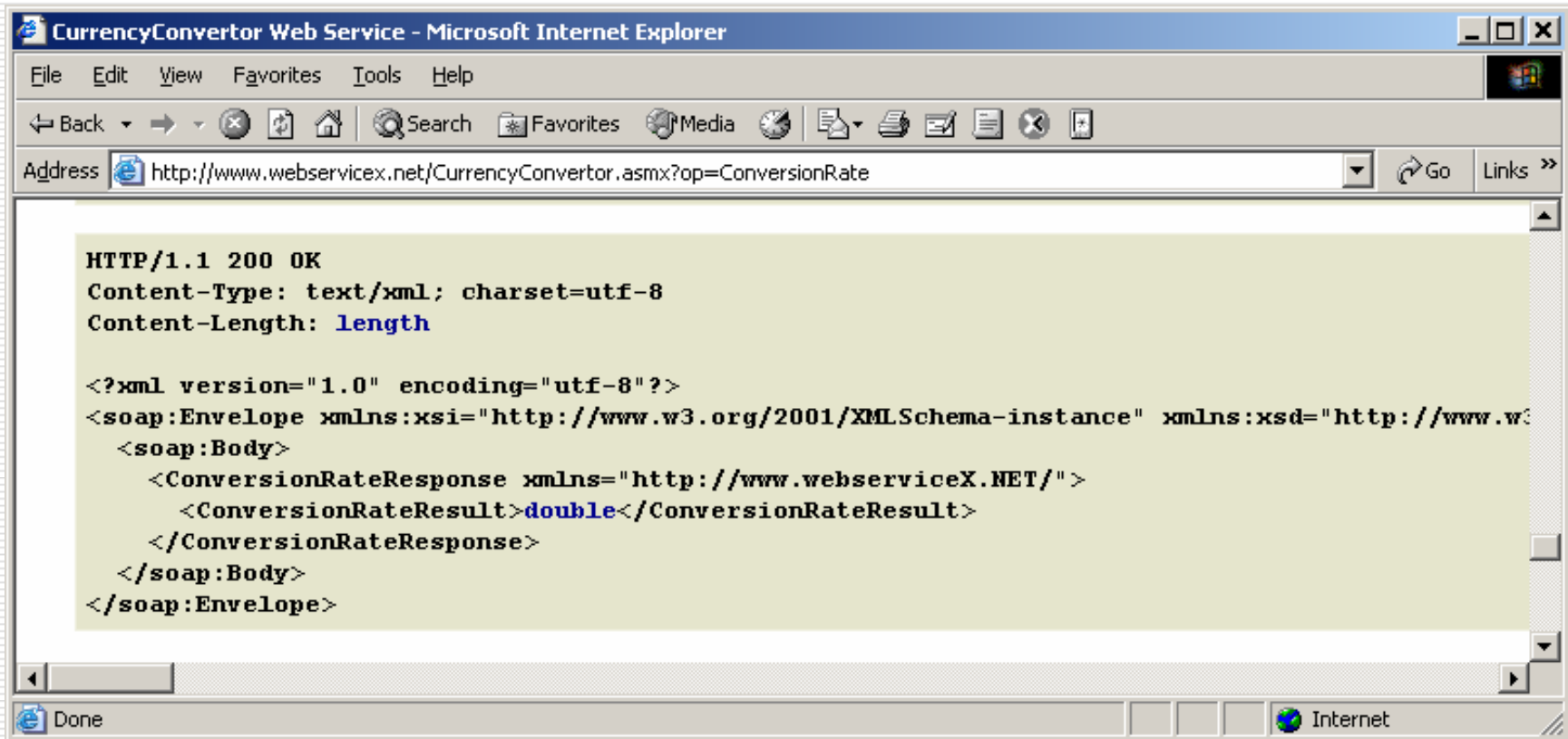
```
<?xml version="1.0" encoding="utf-8" ?>
<wsdl:types>
  - <wsdl:message name="ConversionRateSoapIn">
    <wsdl:part name="parameters" element="tns:ConversionRate" />
  </wsdl:message>
  - <wsdl:message name="ConversionRateSoapOut">
    <wsdl:part name="parameters" element="tns:ConversionRateResponse" />
  </wsdl:message>
  - <wsdl:message name="ConversionRateHttpGetIn">
    <wsdl:part name="FromCurrency" type="s:string" />
    <wsdl:part name="ToCurrency" type="s:string" />
  </wsdl:message>
  - <wsdl:message name="ConversionRateHttpGetOut">
    <wsdl:part name="Body" element="tns:double" />
  </wsdl:message>
  - <wsdl:message name="ConversionRateHttpPostIn">
    <wsdl:part name="FromCurrency" type="s:string" />
    <wsdl:part name="ToCurrency" type="s:string" />
  </wsdl:message>
  - <wsdl:message name="ConversionRateHttpPostOut">
    <wsdl:part name="Body" element="tns:double" />
  </wsdl:message>
  - <wsdl:portType name="CurrencyConvertorSoap">
```

<http://www.websvcicex.net/CurrencyConvertor.asmx?WSDL>

SOAP example request (Currency converter)



SOAP example response (Currency converter)



The screenshot shows a Microsoft Internet Explorer browser window titled "CurrencyConverter Web Service - Microsoft Internet Explorer". The address bar contains the URL "http://www.webserviceX.net/CurrencyConverter.asmx?op=ConversionRate". The main content area displays the raw SOAP response, which is highlighted in a light green background. The response starts with "HTTP/1.1 200 OK" and includes headers for "Content-Type: text/xml; charset=utf-8" and "Content-Length: length". The XML body is as follows:

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" >
  <soap:Body>
    <ConversionRateResponse xmlns="http://www.webserviceX.NET/" >
      <ConversionRateResult>double</ConversionRateResult>
    </ConversionRateResponse>
  </soap:Body>
</soap:Envelope>
```

The status bar at the bottom of the browser shows "Done" and "Internet".

Previewing a Web Service

http://www.webserviceX.net - CurrencyConvertor Web Service - Microsoft Internet Explorer

CurrencyConvertor

Click [here](#) for a complete list of operations.

ConversionRate

Get conversion rate from one currency to another currency

[Differnent currency Code and Names around the world](#)

- AFA-Afghanistan Afghani
- ALL-Albanian Lek
- DZD-Algerian Dinar
- ARS-Argentine Peso
- AWG-Aruba Florin
- AUD-Australian Dollar
- BSD-Bahamian Dollar
- BHD-Bahraini Dinar
- BDT-Bangladesh Taka
- BBD-Barbados Dollar
- BZD-Belize Dollar
- BMD-Bermuda Dollar
- BTN-Bhutan Ngultrum
- BOB-Bolivian Boliviano
- BWP-Botswana Pula
- BRL-Brazilian Real
- GBP-British Pound
- BND-Brunei Dollar
- BIF-Burundi Franc

Test

To test the operation using the HTTP POST protocol, click the 'Invoke' button.

Parameter	Value
FromCurrency:	<input type="text" value="USD"/>
ToCurrency:	<input type="text" value="COP"/>



http://www.webserviceX.net/CurrencyConvertor.asmx/ConversionRate - Microsoft Internet Explorer

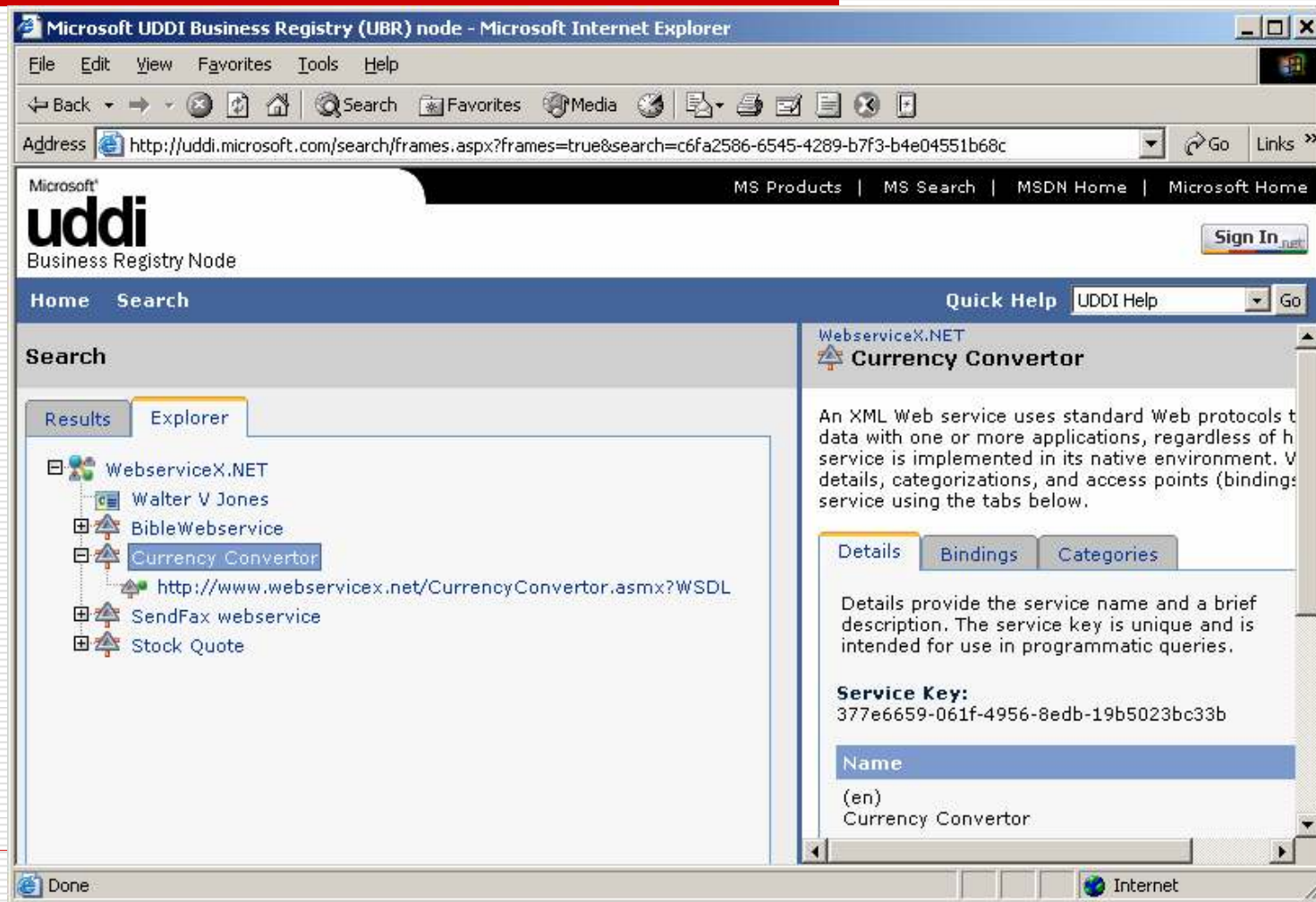
File Edit View Favorites Tools Help

```
<?xml version="1.0" encoding="utf-8" ?>
<double xmlns="http://www.webserviceX.NET/">2284.5</double>
```

<http://www.webserviceX.net/WS/default.aspx>

Universal Description, Discovery and Integration (UDDI)

Example UDDI registry



<http://www.microsoft.com/windowsserver2003/technologies/idm/uddi/default.mspx>

Web Service brokers

STRIKEIRON Extending Your SOA

Search strikeiron.com: | Contact | Register | Login

Marketplace | Products | Developers | Partners | Customers | News | Company | Support | Your Account

Purchase
Buy or Try a Web service →

Publish
Sell your Web service in the Marketplace →

Search Web Services

currency Search

All Categories Browse

Welcome to the World's Largest Marketplace of Commercial Web Services

SPOTLIGHT

SDP StrikeIron Launches Super Data Pack New Web services provide 10,000 free hits per month and a single access point to multiple external data sources

bea BEA Enters OEM Agreement with StrikeIron to Enable Front Office to Back Office Integration, Bring Live Data to Business Users via Microsoft Excel®

PRODUCTS AND SERVICES

- Super Data Pack
- Web Services
- OnDemand Web Services for Excel Add-in
- StrikeIron's Marketplace API

HOT WEB SERVICES

- US Address Verification
- Global SMS Pro
- Sales and Use Tax

NEW WEB SERVICES

- Currency Rates
- D&B WorldBase Marketing Plus

<http://www.strikeiron.com/>

When are WS a good option?

- Client/server applications
 - Dynamic environment
 - Modest performance needs
 - Interoperability is the main concern
 - Rapid response is not a requirement
-

Work in progress

- WS discovery
 - Business Process Integration (BPEL)
 - WS-Security
 - Quality of Service (QoS)
 - Performance and reliability
 - Resource Framework (WSRF)
-

WS Research topics

- Semantic WS
 - Ontologies for WS
 - Location-based WS
 - Automatic WS composition
 - WS matchmaking
 - WS modeling
 - Grid services
-

To think about ...

- ❑ Web services infrastructures promise to revolutionize the way people develop software systems
 - ❑ Usually every organization has a team of skilled programmers, with an existing business system, realistically, the best choice is to continue using the same platform
 - ❑ You need more than good tools and standards
-

Discussion: SOA and business

What Analysts Are Saying About Service-Oriented Architecture...

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"By 2008, SOA will provide the basis for 80% of new development projects. By 2008, SOAs will enable organizations to increase code reuse by more than 100%."

"By 2010, 80% of application software revenue growth, including licenses and subscription fees, will come from products based on SOA."

— *Gartner: "Positions 2005: SOA Adds Flexibility to Business Processes," Simon Hayward, 16-Feb-05*

Service-Oriented Architecture

[Why is SOA Important? And Why Now?](#)

[What Analysts Are Saying About SOA...](#)

[Frequently Asked Questions About SOA](#)

Additional Information about SOA

Discussion: SOA and business

— Gartner: "Positions 2005: SOA Adds Flexibility to Business Processes," Simon Hayward, 16-Feb-05

"By the end of 2006, Forrester expects to see 62% of Global 2000 firms implementing SOA; 41% of these firms have already deployed a service-oriented architecture."

— Forrester's Business Technographics November 2005
North
American and European Enterprise Software and
Services Survey

"...the difficulty and cost of modifying today's rigid IT architectures, dominated by big enterprise applications such as ERP, can be so high that some companies would rather abandon new strategic initiatives than make a single change to the applications they already have in place. Good news is on the horizon in the form of service-oriented architectures, which promise to reduce, if not remove, the current obstacles."

— McKinsey Quarterly: "Flexible IT, Better Strategy,"
J. Seely Brown and J. Hagel III

Additional Information about SOA

[Dr. Khalid Mansour's Presentation — Driving Toward SOA: An Architectural Roadmap](#) (PPT)

["SOA: Why You Need To Care About This Business Method"](#) (PDF)
Smart Business Magazine

["Piecing Together SOA"](#) (PDF)
PC Connection Magazine

[Maximize Your Investment in Service-Oriented Architecture: Leveraging the IBM Software Foundation](#) (PDF)
CIBER Viewpoint

SOA

- Is SOA really needed?
 - Why is SOA adopted?
 - If not SOA, what?
-

Check this out

- ❑ Translate text between two languages:
<http://babelfish.altavista.com/>
 - ❑ Track the current location of a package
www.fedex.com/us/tracking
 - ❑ Validate an email address
<http://ws.cdyne.com/emailverify/emailvernotestemail.asmx>
 - ❑ Find info about sky resorts
<http://www.skiwhere.com/>
 - ❑ Address validation
<http://www.serviceobjects.com/Default.asp?bhcp=1>
 - ❑ Currency converter
<http://www.websvcex.net/WS/default.aspx>
-