



FACOLTÀ DI INGEGNERIA
UNIVERSITÀ DEGLI
STUDI DI PALERMO

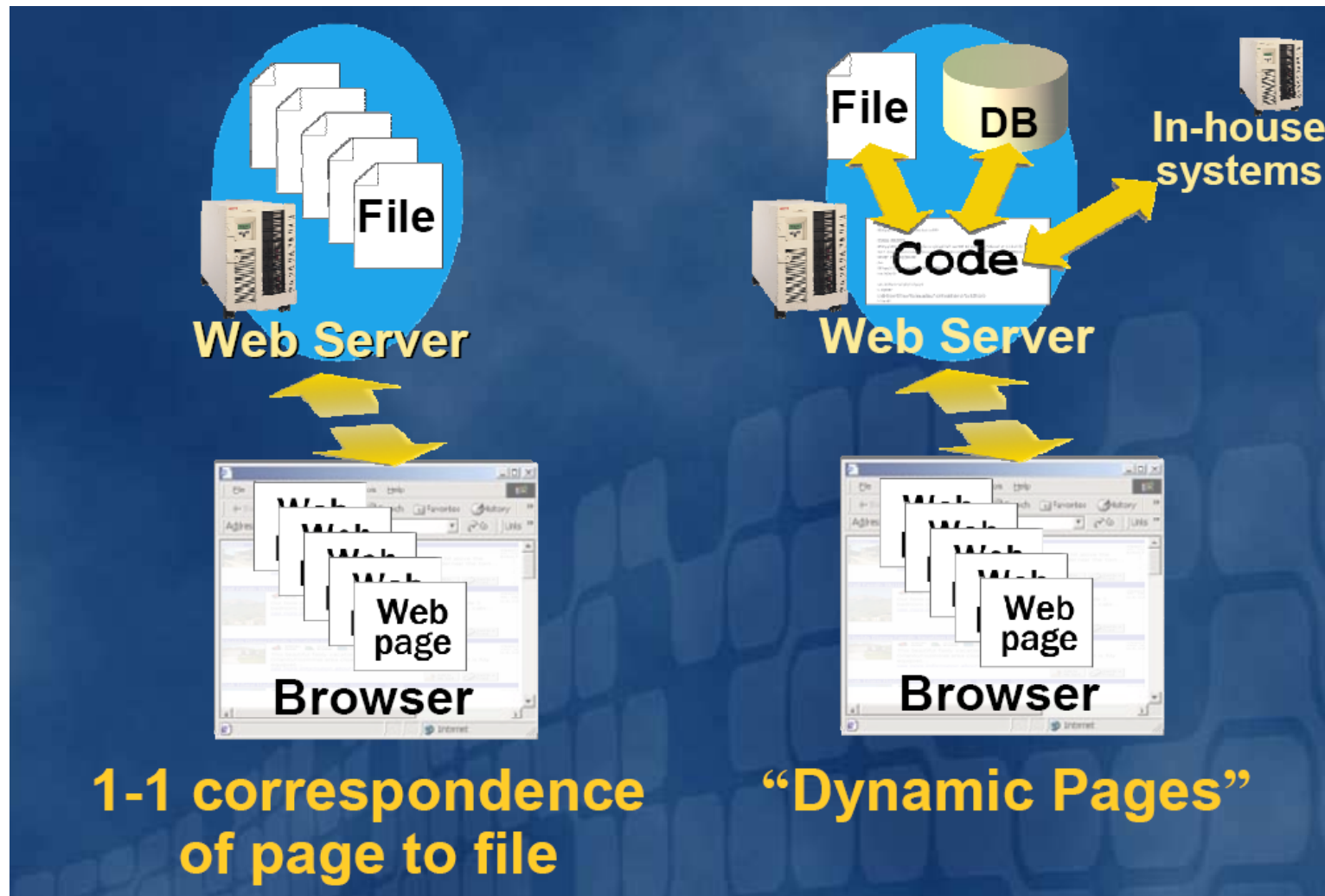
Corso di Laurea Specialistica
Ingegneria Gestionale

Sistemi ICT per il Business Networking

SOA and Web Services

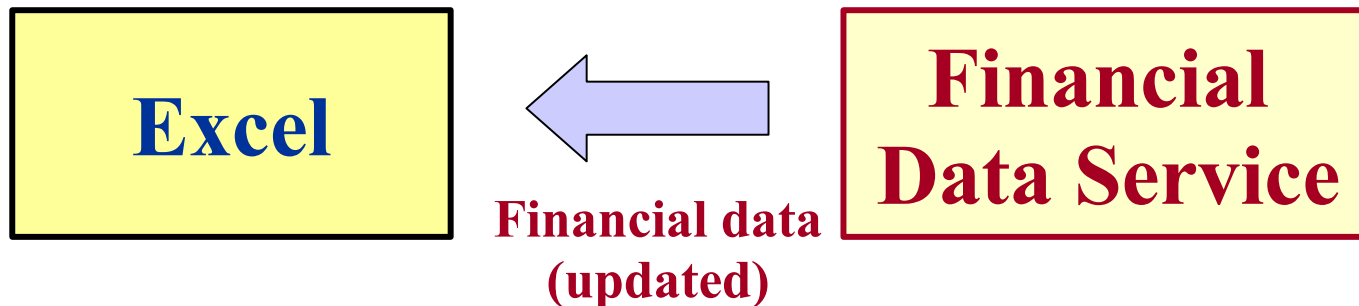
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1st & 2nd Generation Web Apps



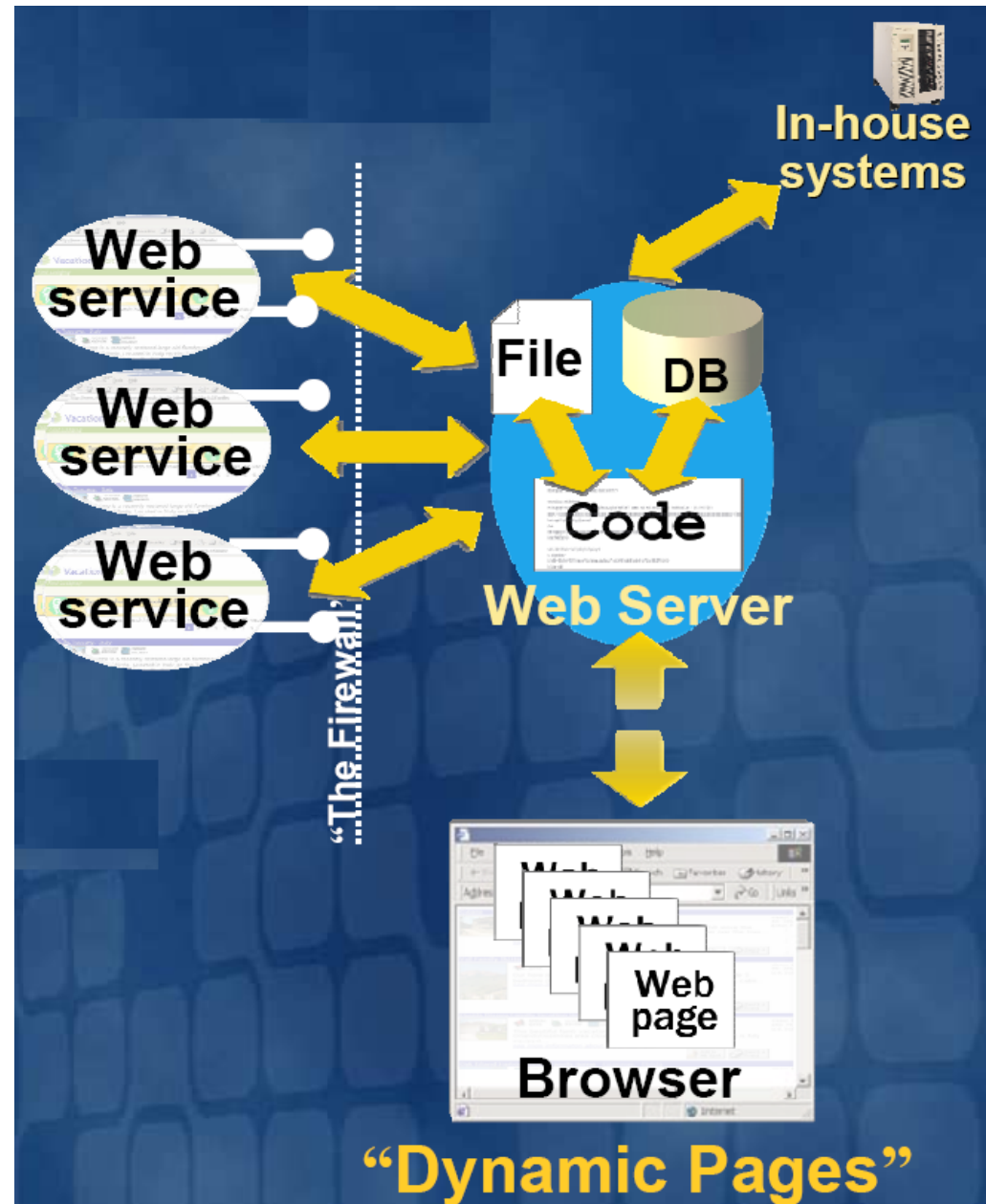
Motivation

- The ability to **program the Web**
- **Example:**
 - Consider an Excel spreadsheet that summarizes your whole financial picture: stocks, bank accounts, loans, etc.
 - If some of this **information** is **available through XML Web services**, Excel can update it and present the update information to the user



3rd Generation Web

The **transactional web** will be dominated by **program-to-program** business-to-business (B2B) **interactions**



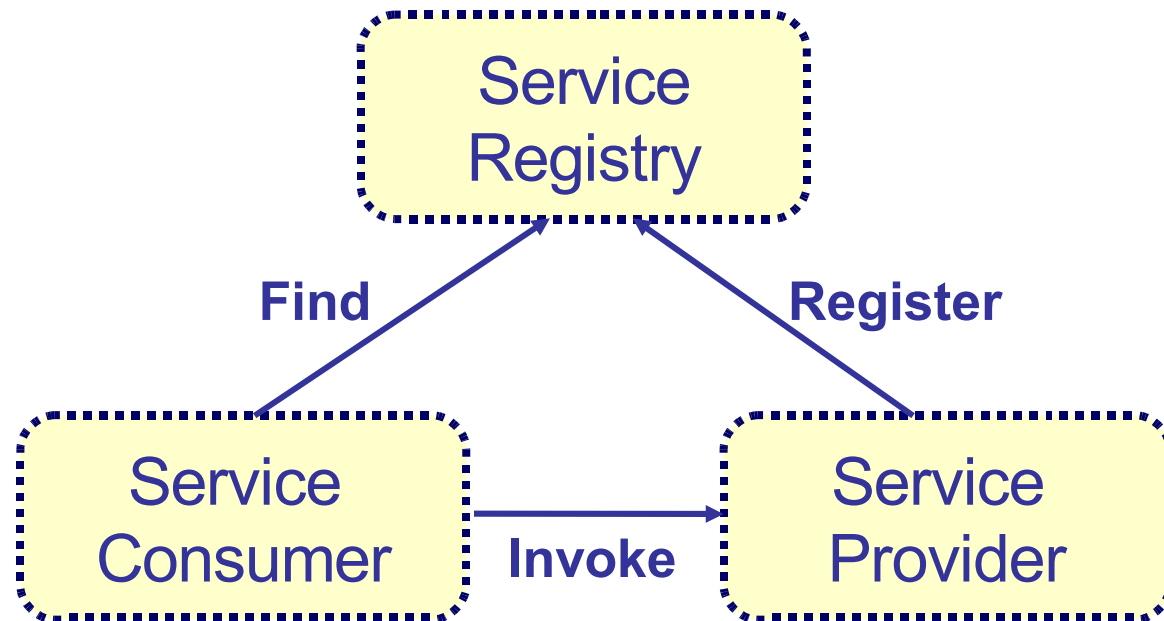
Changes in business environment

- The **business environment** is undergoing a dramatic change:
 - non-traditional **players**
 - emergence of a multitude of delivery **channels**
 - a plethora of regulatory and governmental compliance **requirements**
 - demands for more **flexibility** and **agility** to name a few, influence business design and execution
 - shorter **time to market** for new products
 - the desire to create **new revenue sources**

Problems with application interfaces

- **If all applications were to use a common programming interface and interoperability protocol, the job of IT would be much simpler, complexity would be reduced, and existing functionality could be more easily reused**
- This is the promise that **service-oriented** development brings to the IT world, and when deployed using a **service-oriented architecture (SOA)**, services also become the foundation for more easily creating a variety of new strategic solutions
 - Rapid **application integration**
 - **Automated business processes**
 - **Multi-channel access to applications**, including fixed and mobile devices

Service-Oriented Architecture (SOA)



Transactional Web

- This transformation is being fueled by the **program-to-program communication model** of Web services built on **existing and emerging standards** such as
 - **HyperText Transfer Protocol (HTTP)**
 - **Extensible Markup Language (XML)**
 - **Simple Object Access Protocol (SOAP)**
 - **Web Services Description Language (WSDL)**
 - **Universal Description, Discovery, and Integration (UDDI)**

Web Services

- **Web services technologies** provide a **language-neutral, environment-neutral programming model** that **accelerates application integration** inside and outside the enterprise
 - Application integration through Web services yields **flexible loosely coupled business systems**
- Because Web services are easily applied as a **wrapping** technology around existing applications and information technology assets, new solutions can be deployed quickly and recomposed to address new opportunities
- As adoption of Web services accelerates, the pool of services will grow, fostering development of more **dynamic models of just-in-time application and business integration** over the Internet

Web Service

- A **Web service** is an **interface** that describes a **collection of operations** that are **network-accessible** through **standardized XML messaging**
 - A **web application without a user interface**
- A Web service **performs** a specific task or a set of tasks
- A Web service is **described** using a **standard, formal XML notation**, called its **service description**, that provides all of the details necessary to interact with the service, including
 - message formats (that detail the operations)
 - transport protocols
 - location

History

- Web services **evolved** from **previous technologies** that served the same purpose such as RPC, ORPC (DCOM, CORBA and JAVA RMI)
- Web Services were intended to solve these main **problems**:
 - 1. Interoperability**
 - 2. Firewall traversal**

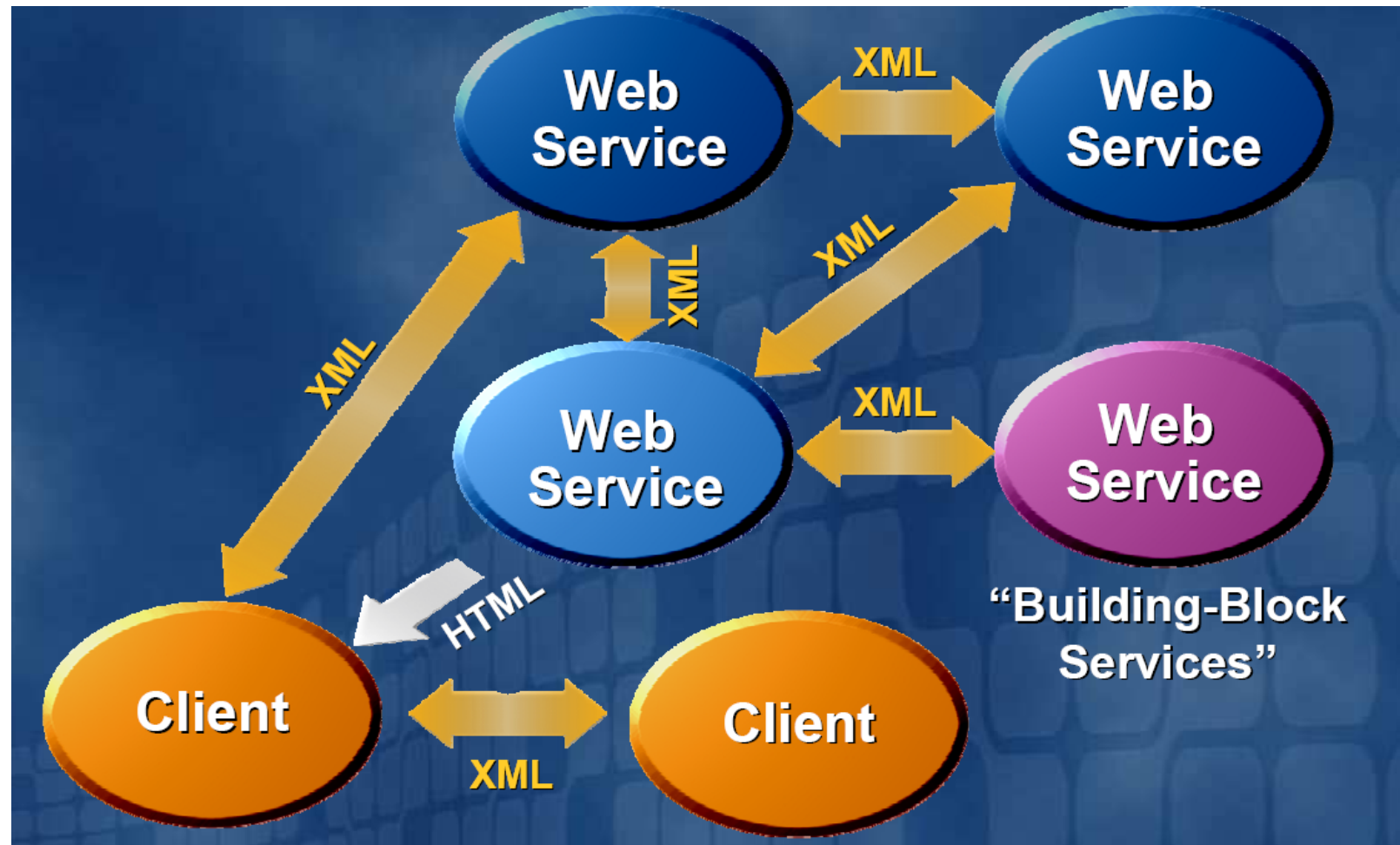
Interoperability

- Earlier **distributed systems** suffered from interoperability issues because each vendor implemented its own on-wire format for distributed object messaging
 - Development of DCOM apps strictly bound to Windows Operating system
 - Development of RMI bound to Java programming language

Firewall traversal

- Collaboration across corporations was an issue because distributed systems such as CORBA and DCOM used **non-standard ports**
- **Web Services use HTTP** as a transport protocol and most of the firewalls allow access though **port 80** (HTTP), leading to easier and dynamic collaboration

Web Services



Web Services Components

- **XML – eXtensible Markup Language** – A uniform data representation and exchange mechanism
- **SOAP – Simple Object Access Protocol** – A standard way for communication
- **UDDI – Universal Description, Discovery and Integration specification** – A mechanism to register and locate WS based application.
- **WSDL – Web Services Description Language** – A standard meta language to described the services offered

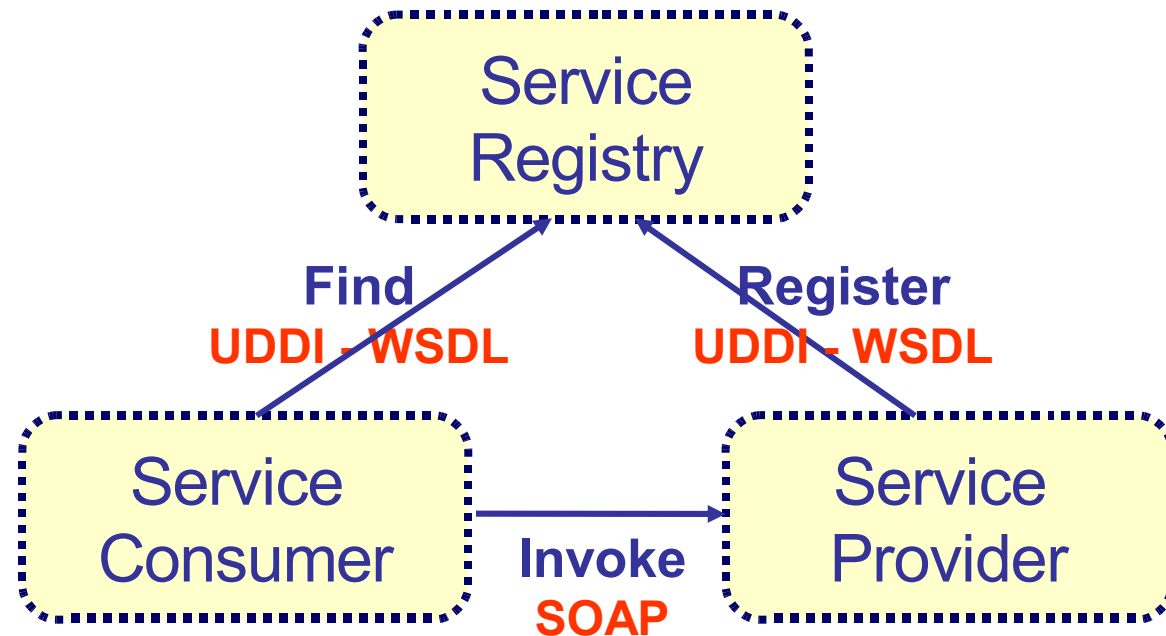
Web Services in practices



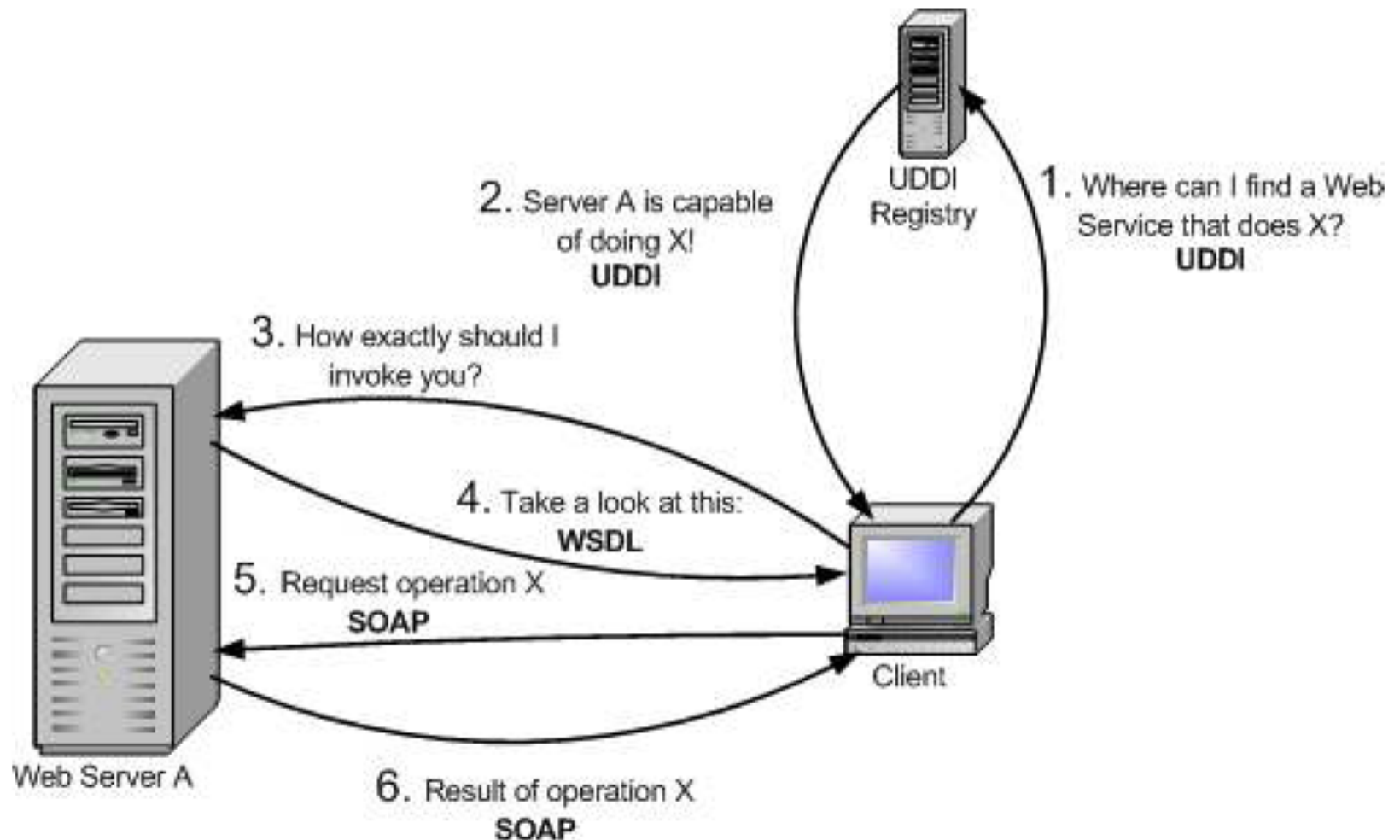
Web Service Architecture

1. A service provider **creates** a Web service and its service definition and then **publishes** the service with a service registry
 - based on a standard called the **Universal Description, Discovery, and Integration (UDDI)** specification
2. A service requester may **find** the service via the UDDI interface
3. The UDDI registry **provides** the service requester with a **WSDL service description** and a **URL** (uniform resource locator) pointing to the service itself
4. The service requester may then use this information to directly bind to the service and **invoke** it

Web Service Architecture



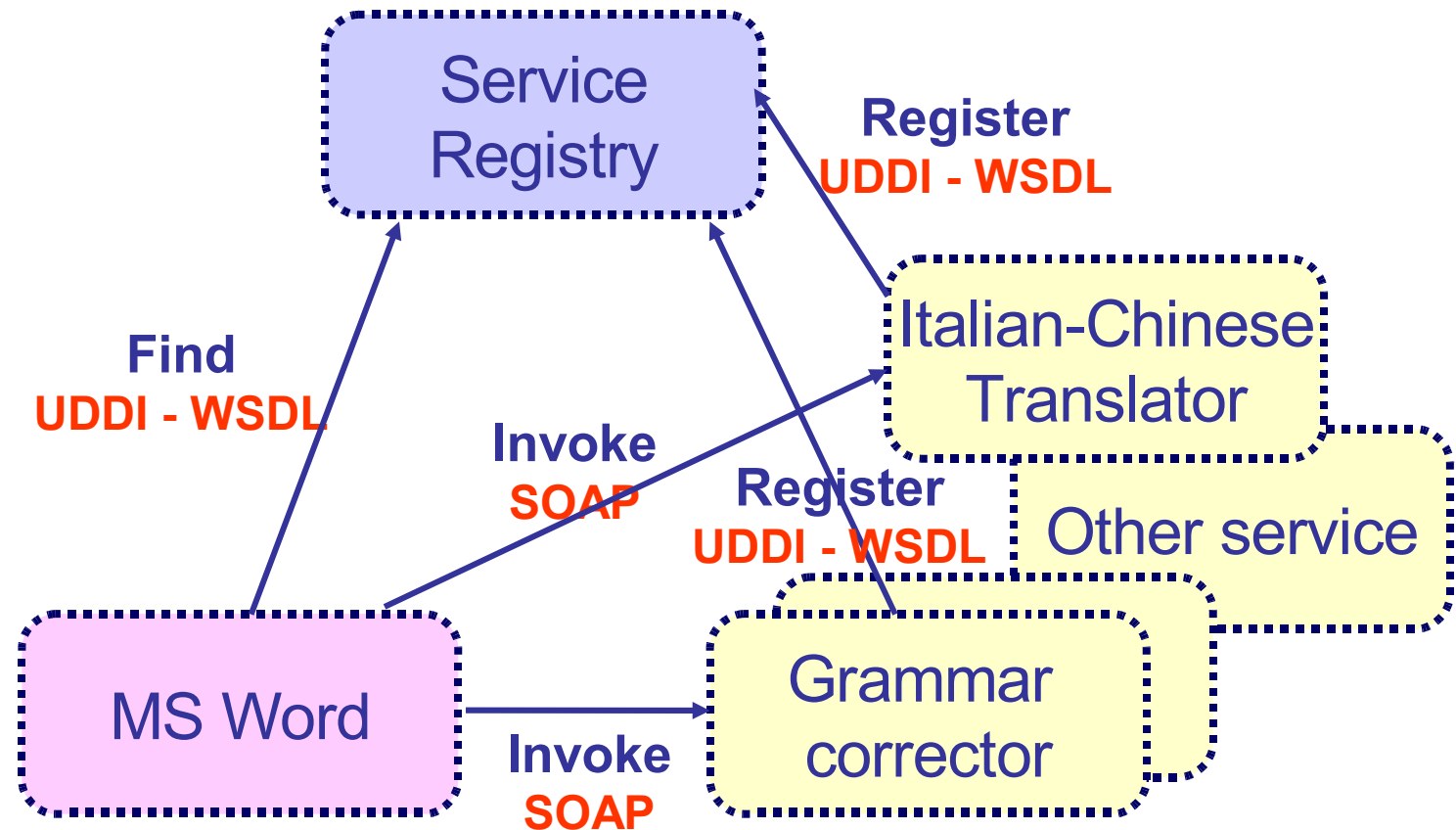
Web Services in practices



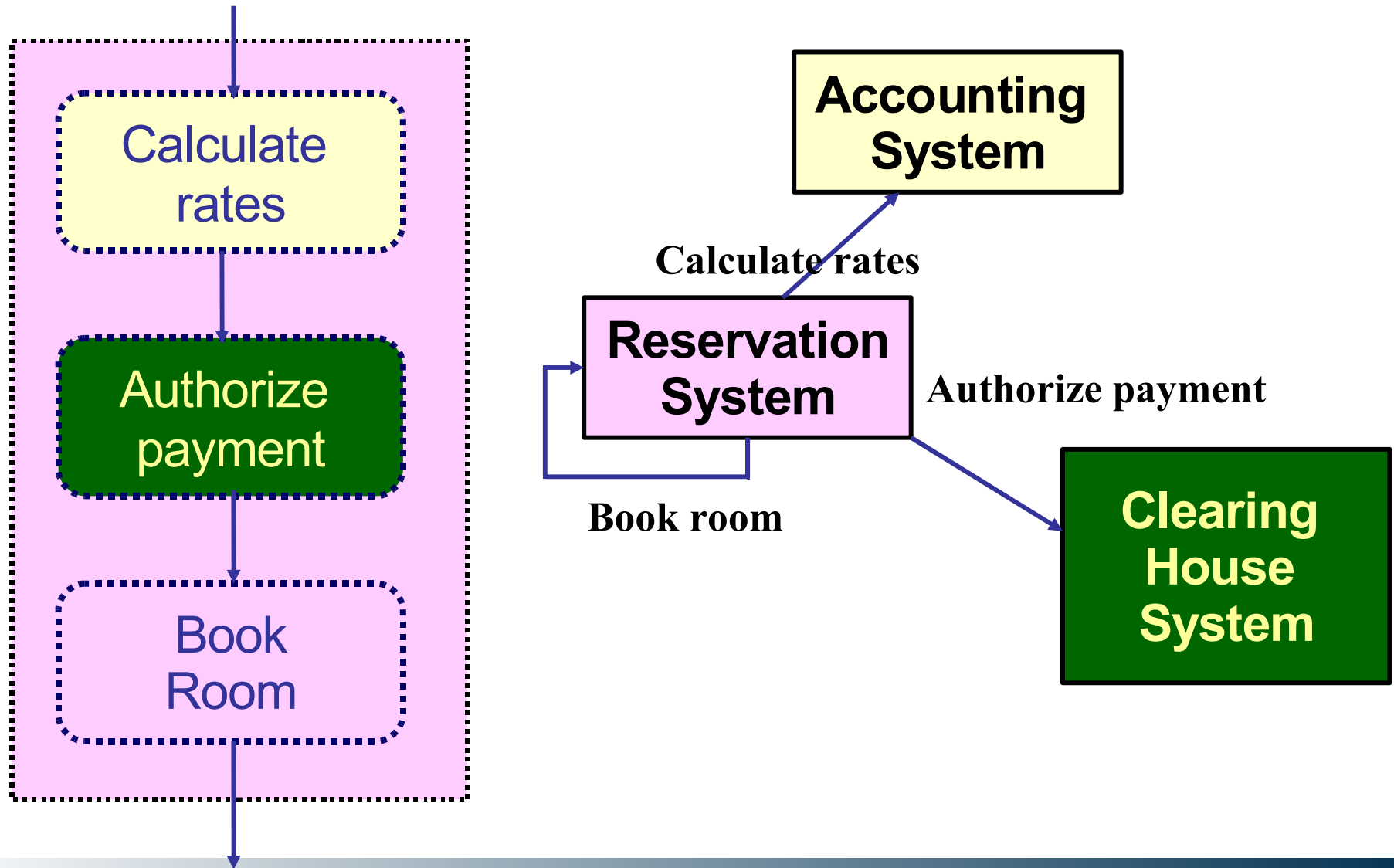
Example – A simple Web Service

- A buyer (which might be a simple client) is ordering goods from a seller service
- The buyer finds the seller service by searching the UDDI directory
- The seller service is a Web Service whose interface is defined using Web Services Description Language (WSDL)
- The buyer is invoking the order operation on the seller service using Simple Object Access Protocol (SOAP) and the WSDL definition for the seller service
- The buyer knows what to expect in the SOAP reply message because this is defined in the WSDL definition for the seller service

Another Example

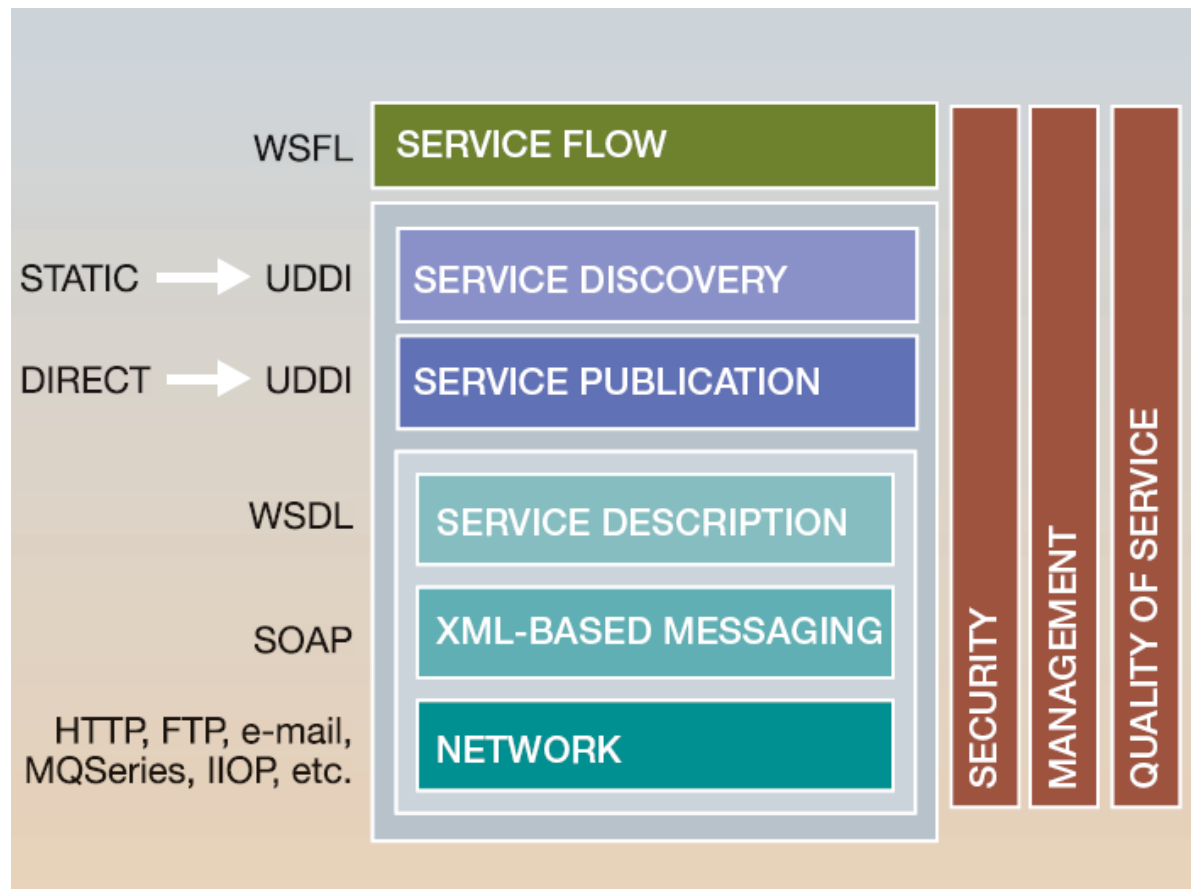


Example – A process



Web services stack

- A **collection of standardized protocols** that lets individuals and applications locate and utilize Web services



Web services stack

- All Web services must be **available over some network**
 - The network is **often based on an HTTP protocol**, but other kinds of network protocols, such as the Internet Inter-ORB Protocol (IIOP), can be also used
- On top of the networking layer is an **XML-based messaging layer** that facilitates communications between Web services and their clients
 - The messaging layer is **based on SOAP (Simple Object Access Protocol)**, which is an XML protocol that facilitates the invoke operation
- **Web Service descriptions** take the form of XML documents for the programming interface and location of Web services
 - **WSDL** is a specification that describes available Web services to clients

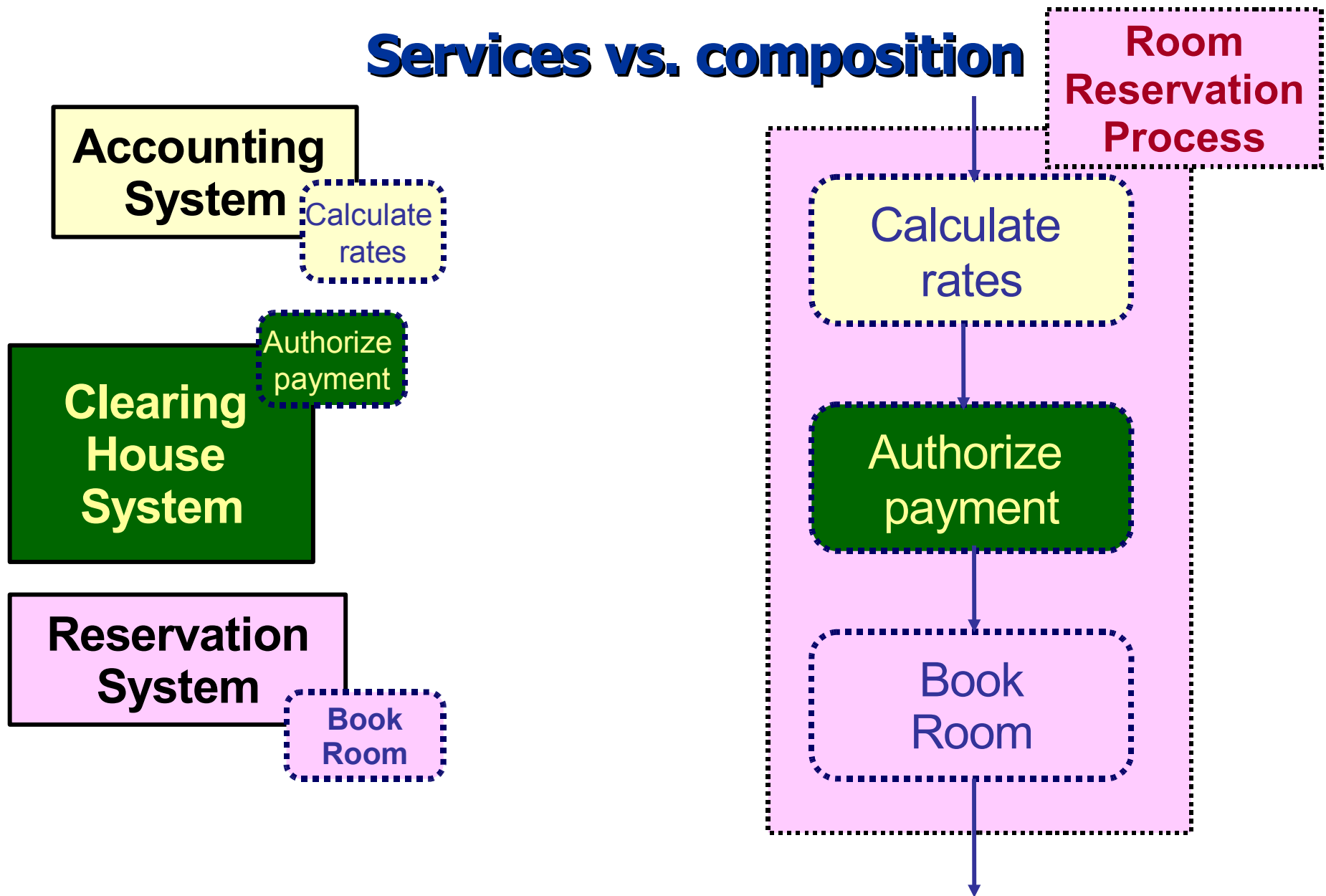
Web services stack

- **Publication of a service** is an action performed by the service provider that makes the **WSDL document available** to a potential service requester
 - **Sending the WSDL (or a URL pointer to the WSDL) as an e-mail** to a developer is considered to be publishing
 - Publishing is also **advertising the WSDL in a UDDI registry** for many developers or executing services to find
- **Discovery of a service** is any action that gives the service requester access to the WSDL for a service
 - The action may be as simple as **accessing a file or URL containing the WSDL** or as complex as **querying a UDDI registry** and using the WSDL file(s) to select one of many potential services

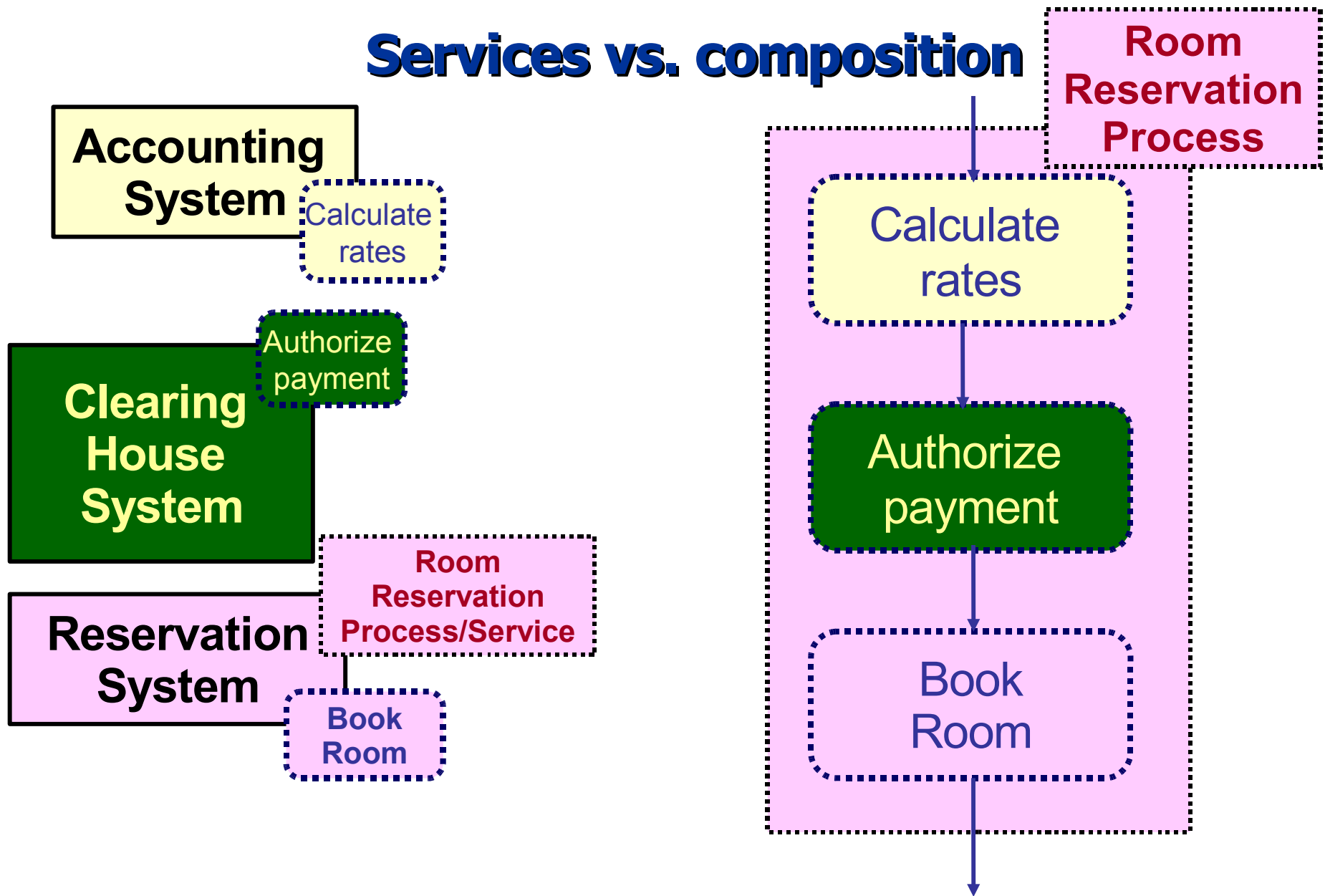
Web services stack

- The **service flow layer** of the stack facilitates the **composition of Web services** into workflows and the **representation of this aggregation** of Web services as a **higher-level Web service**
 - Standardization activity at this level is ongoing, but there are several proposals, such as
 - Web Service Flow Language (WSFL)
 - BPEL4WS
 - BPML
 - ...

Services vs. composition

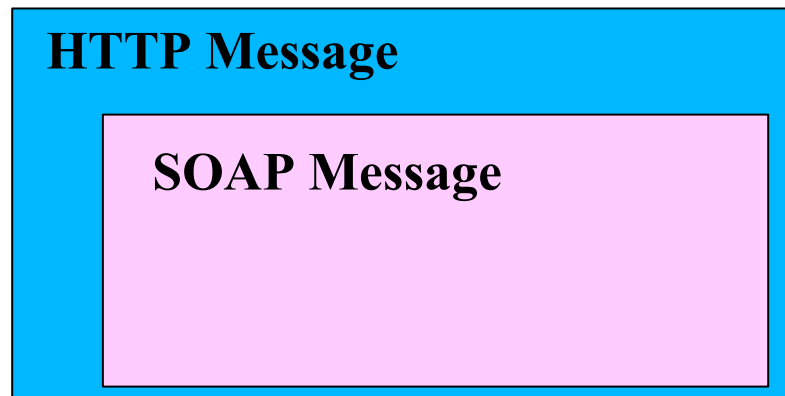


Services vs. composition



SOAP

- SOAP stands for "**Simple Object Access Protocol**"
- SOAP is an **XML vocabulary** standard **to enable programs on separate computers to interact across any network**
- SOAP is a simple **markup language for describing messages between applications**
- SOAP uses mainly **HTTP as a transport protocol**
 - HTTP message contains a SOAP message as its payload section



WSDL

- WSDL stands for **Web Services Description Language**
- WSDL is an XML vocabulary for **describing Web services** and their capabilities, in a standard manner
 - WSDL specifies **what a request message must contain** and **what the response message will look like** in unambiguous notation
 - In other words, it is **a contract between the XML Web service and the client** who wishes to use this service
 - In addition to describing message contents, WSDL defines **where the service is available** and **what communications protocol is used** to talk to the service

The WSDL Document Structure

- A WSDL document is just a simple **XML document**
- It defines a web service using these major elements:
 - **port type** - The operations performed by the web service
 - **message** - The messages used by the web service
 - **types** - The data types used by the web service
 - **binding** - The communication protocols used by the web service

WSDL Document

```
<message name="GetStockPriceRequest">
  <part name="stock" type="xs:string"/>
</message>
<message name="GetStockPriceResponse">
  <part name="value" type="xs:string"/>
</message>
<portType name="StocksRates">
  <operation name="GetStockPrice">
    <input message="GetStockPriceRequest"/>
    <output message="GetStockPriceResponse"/>
  </operation>
</portType>
```


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

SOAP Request

```
POST /InStock HTTP/1.1
Host: www.stock.org
Content-Type: application/soap+xml; charset=utf-8 Content-
Length: 150
<?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 xmlns:m="http://www.stock.org/stock">
    <m:GetStockPrice>
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
```

SOAP Response

HTTP/1.1 200 OK

Content-Type: application/soap; charset=utf-8

Content-Length: 126

<?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 xmlns:m="http://www.stock.org/stock">

 <m:GetStockPriceResponse>

 <m:Price>34.5</m:Price>

 </m:GetStockPriceResponse>

 </soap:Body>

</soap:Envelope>

SOAP Security

- SOAP uses HTTP as a transport protocol and hence **can use HTTP security** mainly **HTTP over SSL**
- But, since SOAP can run over a number of application protocols (such as SMTP) security had to be considered
- The **WS-Security specification** defines a complete encryption system

UDDI

- UDDI stands for **Universal Description, Discovery and Integration**
- UDDI is a **directory for storing information about web services**, like yellow pages.
- UDDI is a **directory of web service interfaces** described by WSDL

Materiale didattico

- A short introduction to Web Services
- Introduction to Web Service Architecture

Resources

- <http://msdn.microsoft.com/webservices/understanding/webserv>
- <http://www.w3schools.com/>
- <http://uddi.microsoft.com/Default.aspx>
- <http://www.developer.com/services/article.php/2195981>
- Many more on the web...