IIT KHARAGPUR

NPTEL ONLINE
CERTIFICATION COURSES

E-BUSINESS

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Week 7: Lecture 1

DIGITAL PAYMENT SYSTEMS

We are going to learn

- Features of a payment system
- Assessment Criteria for Electronic Payment Systems
- Digital counter part of the real world payment system
- Description of each type of payment methods

What is a payment system

- A Payment System is a mechanism that facilitates transfer of value between a payer and a beneficiary by which the payer discharges the payment obligations to the beneficiary. Payment system enables two-way flow of payments in exchange of goods and services in the economy.

(http://www.rbi.org.in/scripts/FAQView.aspx?Id=59)

Components of any payment system

- **Instruments:** through which payments can be made,
- **Rules, regulations and procedures:** that guide these payments,
- **Institutions:** which facilitate payment mechanisms
- **legal systems:** that are established to facilitate transfer of funds between different participants.

Assessment Criteria for Electronic Payment Systems

- Technological aspect
  - Authenticity, non-repudiation, Integrity, Confidentiality
- Economic aspect
  - Cost of Transactions, User Reach, Value Mobility, Financial Risk
- Social aspect
  - Anonymity, User friendliness, Mobility
- Regulatory aspects
  - Abide by government regulations

http://ieeexplore.ieee.org/iel5/7553/20586/00952002.pdf

Real world payment systems Vis-à-Vis Internet based payment Systems

- Cash Equivalents
  - DigiCash, Millicent etc.
- Cheques
  - CyberCash
- Credit card Payments
  - TTP, SET
- Electronic funds transfer
  - Swift network

Various E-Payment Methods

- Payment cards
- Peer-to-Peer Methods
- E-Wallets
- Digital cash
- Smart card
- B2B

Payment Cards

- The term payment card describes all types of plastic cards used to make purchases
- Credit card
  - Has a spending limit based on a user's credit history
- Debit card
  - Removes an amount from a cardholder's bank account
  - Transfers it to the seller's bank account
- Charge card
  - Carries no spending limit
  - Amount charged is due at the end of the billing period

Payment Cards

- Advantages:
  - Worldwide acceptance
  - Built-in security for merchants
- Disadvantage:
  - Payment card service companies charge merchants per-transaction fees and monthly processing fees

Payment Acceptance and Processing

- Steps followed once a merchant receives a consumer's payment card information:
  - Merchant authenticates payment card
  - Merchant checks with payment card issuer
    - To ensure that credit or funds are available
    - Puts a hold on the credit line or the funds needed to cover the charge
  - Settlement occurs

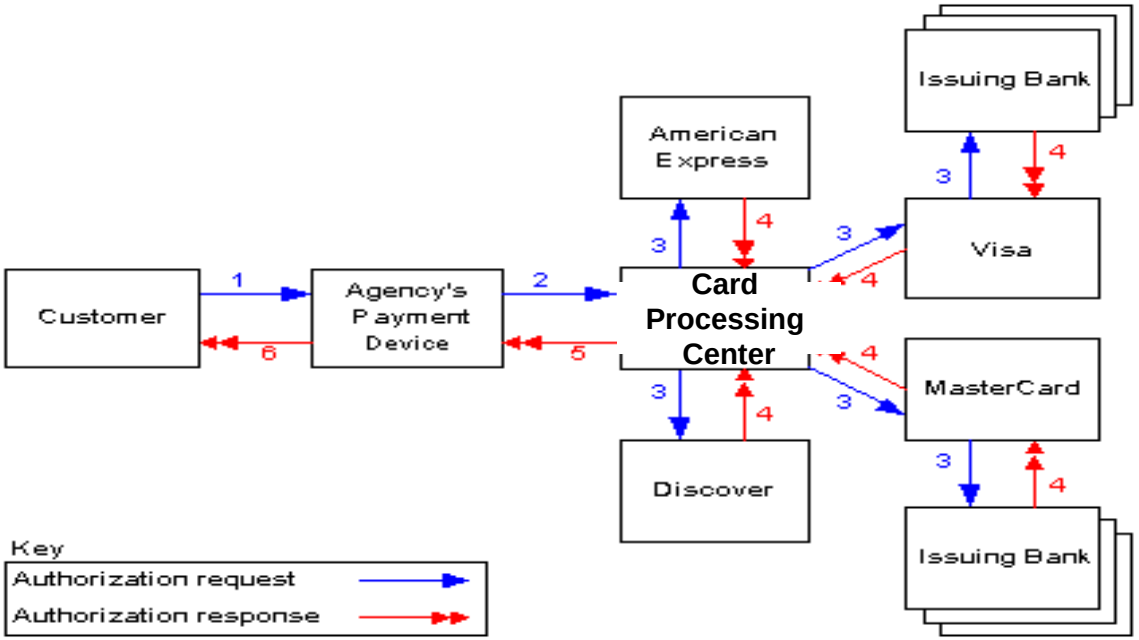
Payment Acceptance and Processing

- Closed loop systems
  - Card issuer pays the merchants that accept the card directly and does not use an intermediary
- Open loop systems
  - Involve three or more parties
  - Systems using Visa or MasterCard are examples

Merchant Accounts

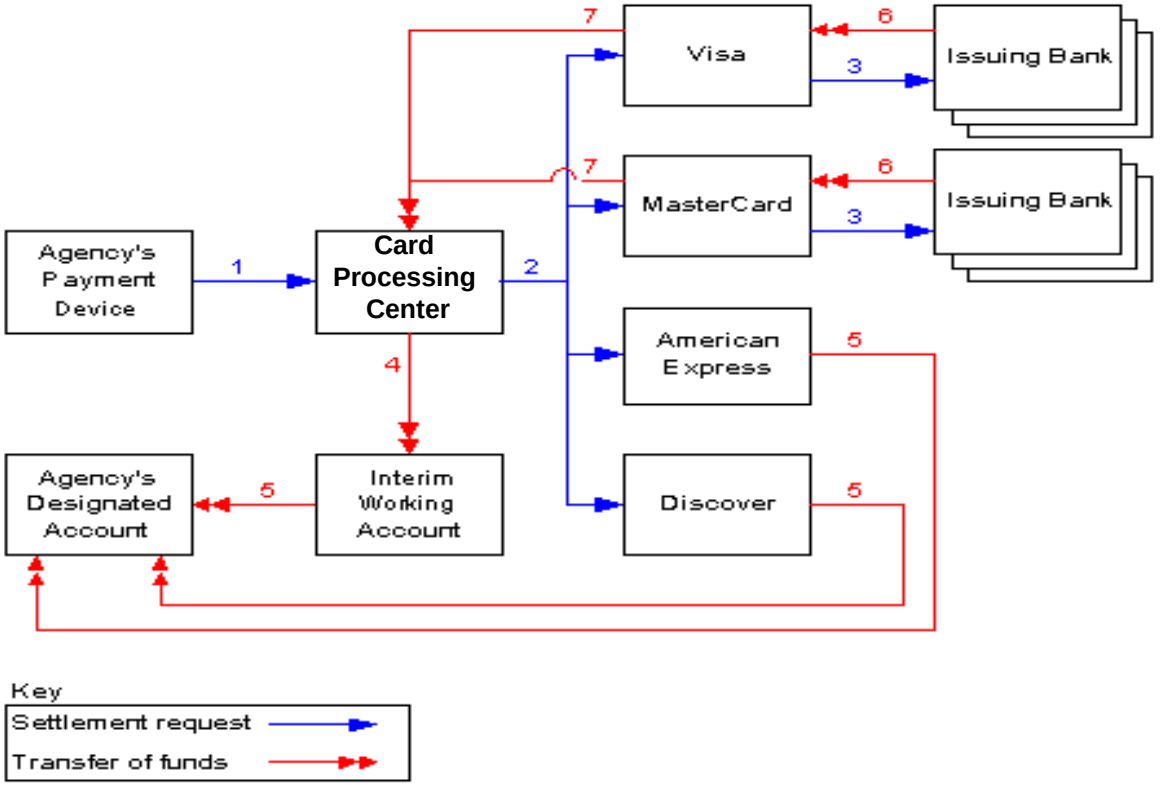
- To process payment cards for Internet transactions an online merchant must set up a merchant account
- New merchants must supply:
  - Business plans
  - Details about existing bank accounts
  - Business and personal credit histories

Diagram 1., Credit Card Authorization Process



http://www.tax.state.ny.us/evta/guidelines_credit_background.htm

Credit Card Settlement Process



Using TLS for Credit Card Transaction

- TLS supports mutual authentication between client and server
- No guarantee that the payment information is secured and not misused at the merchant's server.
- No guarantee that the merchant is authorized to get the payment through the specified credit card.
- Solution
  - SET protocol: not widely accepted
  - Use of trusted third party services: Payment gateways

Peer-to-Peer Methods

- Online technology that allows customers to transfer funds from their bank account or credit card to another individual's account via the Internet or a mobile phone.

Peer-to-Peer Methods

- Two types:
  - Through Trusted Third Party, Ex. Paypal
  - Through Web/Mobile interface provided by the bank
- PayPal.com – digital payment system
  - Sender sets up an account and requests to send payment
  - Sender places payment into the receivers account by credit-card
  - Receiver is notified of payment via email
  - Receiver can transfer funds to bank account or request a cheque

Electronic Cheques

- Similar to paper cheques
- Customer need a wallet software to store information on the browser about the checking account.
- ((Encrypted Customer's payment information with banks public key) + other information for the merchant) encrypted with the customer's private key
- Merchant sends the payment information to the appropriate bank and gets the fund transferred to its account.
- Ex. CyberCash

Digital Cash

- Computer Files containing huge random numbers digitally stamped by the bank
  - Encrypted with banks private key followed by customer's pubic key
- Maintained by the customer's wallet software
- Can be classified as
  - identifiable or anonymous
  - Online or Offline
- Problem of double spending
  - When the money is anonymous and Offline
- Smart Cards
  - Mondex, Visa Cash

Identifiable Vs. Anonymous Electronic Money

- Identifiable Electronic Money
  - A serial number is provided by the bank for each of the computer file.
  - CyberCash
- Anonymous Electronic Money
  - Serial number created by the customer
  - Blinded
  - Signed by the bank
  - Ex. DigiCash

Online or Offline Electronic Money

- Online
  - Money is validated online
  - Active participation of the bank
  - CyberCash
- Offline
  - Money is not validated online
  - Peer to peer transaction
  - DigiCash

Electronic Wallets

- Hold credit card numbers, electronic cash, owner identification, and contact information
- Give consumers the benefit of entering their information just once
- Make shopping more efficient

Electronic Wallets

- Server-side electronic wallet
  - Stores a customer's information on a remote server belonging to a particular merchant or wallet publisher
- Client-side electronic wallet
  - Stores a consumer's information on his or her own computer

Smart Cards

- Cards with computer chips embedded on their faces – very common in Europe
- Used for health care, transportation, ID, retail, pay phones, loyalty programs, banking machines
- Smart card readers interface with card and request user PIN for access
- Bank machines can load cards with cash and then merchants can download cash from card
- Returns anonymity of purchase to customer
- GemPlus, MasterCard are leading supplier of SCs

Online B2B Payments

- Society for Worldwide Inter-bank Financial Telecommunication (SWIFT) network
- Electronic Funds Transfer
- Online bill payment
- B2B payment gateways

http://www.ffiec.gov/ffiecinfobase/html_pages/ebanking_book_frame.htm

Week 7: Lecture 2

INTEROPERABILITY OF INFORMATION SYSTEM

We are going to learn

- Dimensions of Interoperability
- B2B interoperability layers

Issues in SC integration

- SC Integration
  - Collaboration
  - Interoperability
- Collaboration
  - Strategic issues
- Interoperability
  - Technical issues

Dimensions of supply chain interoperability

- Interoperability of data
- Interoperability of service
- Interoperability of process
- Interoperability of business

Interoperability of data

- Two concerns
  - Finding and sharing information from heterogeneous databases
    - reside on different machines with various operating systems and database management systems;
  - Resolving the semantics differences that exist with the structure and contents of the databases.
    - Data exchange standards such as EDI, and XML are primarily used to solve this level of interoperability issues.

Interoperability of service

- Identifying, composing and operating together various applications that are designed and implemented independently.
- Requires a common architectural framework that enables integration
  - CORBA (Common Object Broker Architecture) , Service Oriented Architectures (SOA).

Interoperability of process

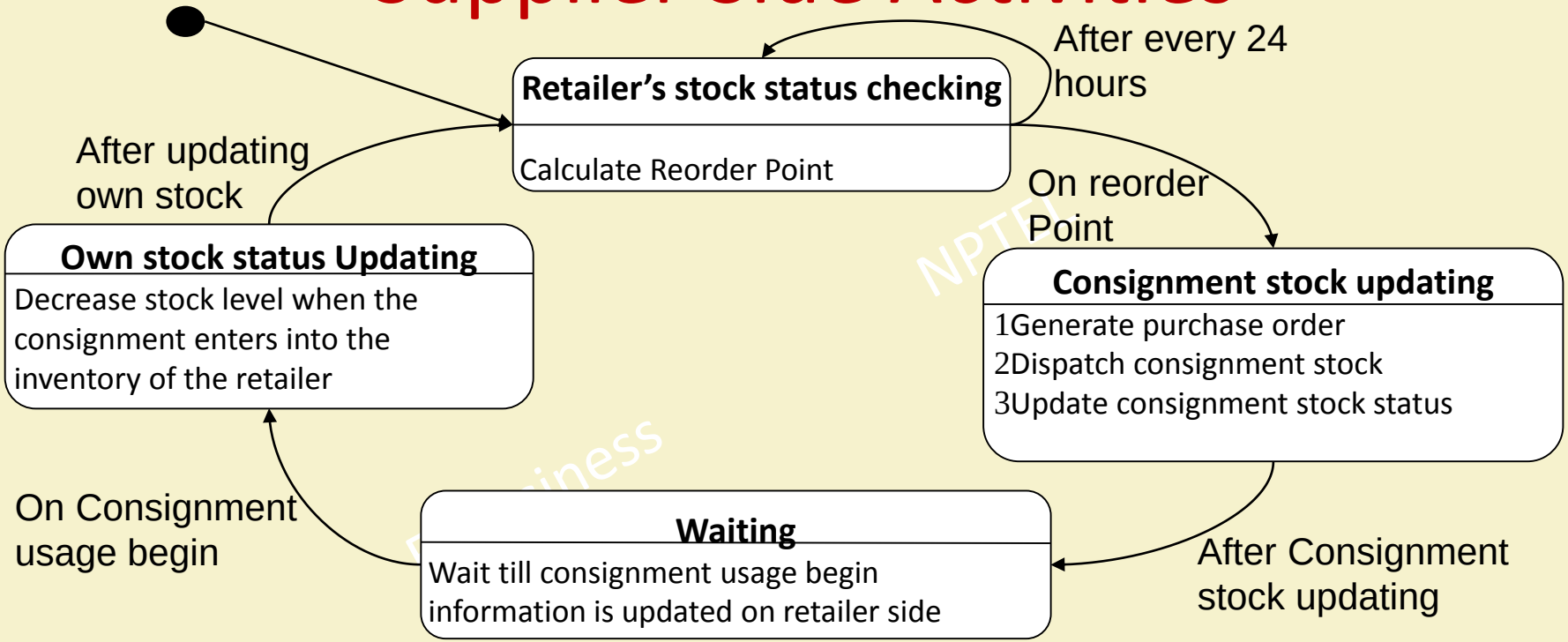
- The process interoperability means linking different process descriptions to form collaborative processes.
- In Web services framework such processes can be composed by putting individual services together using orchestration or choreography technologies.

Interoperability of business

- Business interoperability explores interoperability from a business perspective and identifies the fundamental artifacts related to business issues.
- These issues range from the business vision and culture to the ICT infrastructure support as well as the compatibility between different organization structures, methods of work, accounting systems and rules, labor legislations etc.

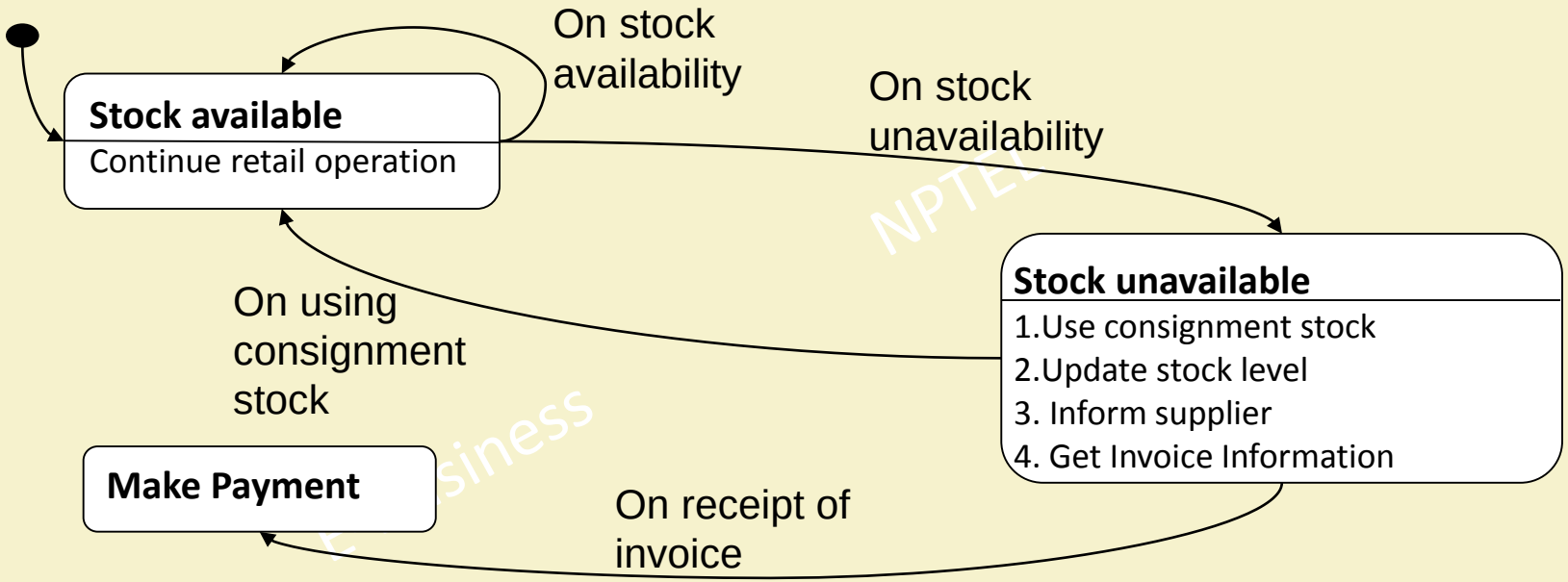
A Motivating Example: Vendor Managed Inventory Systems

Supplier Side Activities



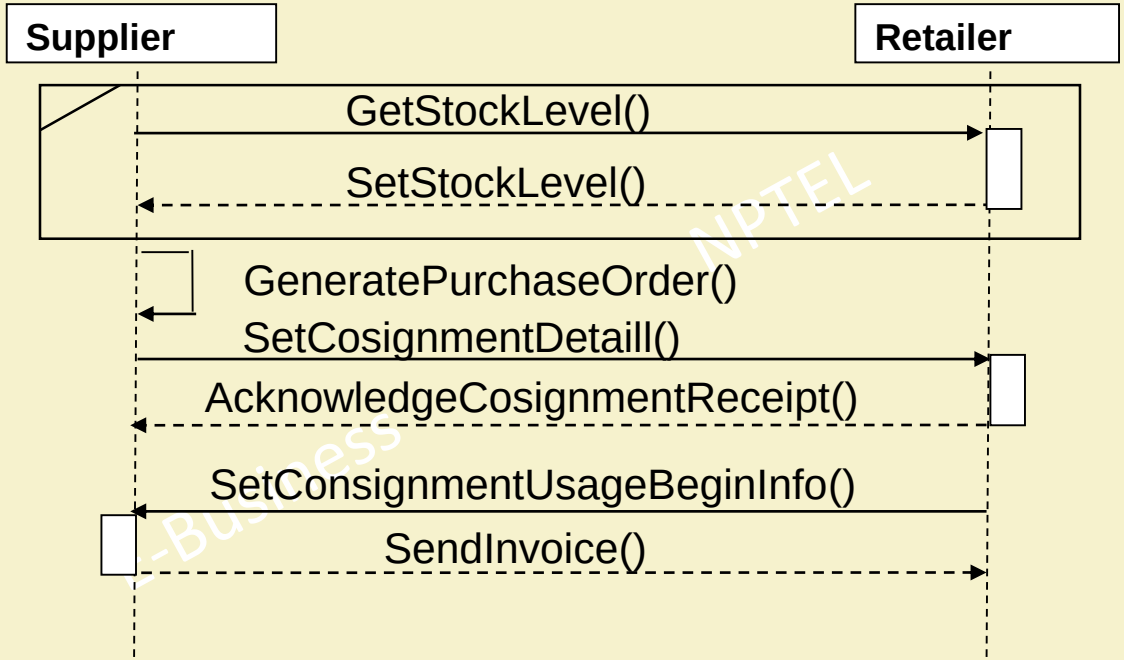
A model using state chart diagram

Retailer Side Activities



A Model using statechart diagram

Information Flow
Between a Supplier and a Retailer



Modeling information flow using an UML sequence diagram

Interoperability Issues in VMI implementation

- Interoperability of data
- Interoperability of service
- Interoperability of process
- Interoperability of business

Interoperability Issues in VMI implementation

- Interoperability of data
  - Are the retailer and supplier using the same database? If not, what is that common format both can understand?
  - The data corresponding to the stock level at the retailer side is represented using a variable (field) callled “stock_level”. The same data the supplier end is culled “currentStockLevel”.

Interoperability Issues in VMI implementation

- Interoperability of service
  - Both the partners are using different ERP packages. Say SAP R/3 and Oracle e-business suit.
  - If the stock data is to be send how to resolve the technical incompatibility at this level?

Interoperability Issues in VMI implementation

- Interoperability of process
  - The are a number of data exchange steps between both the partners which together make the VMI process realized.
  - How to coordinate these data exchange steps ?

Interoperability Issues in VMI implementation

- Interoperability of business
  - Due to this new information sharing framework, will process be reengineered?

B2B Interoperability technical layers

- Communication level
- Content/Data level
- Process level

B2B Interoperability - Communication level

- It is concerned with the exchange of messages among partners.
- Multiple protocols and frameworks have been developed that varies from network level of communication to the distributed objects frameworks.
- This layer's interoperability objective is to provide independence from such protocols and frameworks by translating and converting messages between heterogeneous protocols

B2B Interoperability - Communication level

- Network-protocol level
  - TCP/IP
  - Transfer of data in the basic format
  - Low level programming

B2B Interoperability - Communication level

- **Object and component-based middleware level**
  - A component is an independent delivery piece of functionality presented as a black-box
  - Objects and components have been in use in the distributed computing in such a way that an object or a component can invoke another remote object or component functionality through their interfaces.

B2B Interoperability - Communication level

- **Object and component-based middleware level**
  - Remote Procedure Calls (RPC)
    - Java-based RMI and EJB
      - RMI: Remote method invocation
      - EJB: Enterprise java Beans
    - OMG CORBA
      - OMG: Object Management Group
      - CORBA: Common Object Request Broker Architecture

Week 7: Lecture 3

ELECTRONIC DATA INTERCHANGE (EDI)

We are going to learn

- Interoperability at content/data layer
- Fundamentals of EDI
- Fundamentals of XML based data interchange

B2B Interoperability - Content level

- Resolves semantic and structural heterogeneity issues.
  - For example, it determines if a document represents a purchase order or a request for a quote or a product description etc.
- Structural differences arise from the use of diverse information formats.

B2B Interoperability - Content level

- Semantic differences come from different interpretations of the same concept.
  - For example, a data item called “price” can mean a price that includes or excludes tax.
- Therefore, this layer’s interoperability objective is to provide independence from data models, formats and languages.

B2B Interoperability - Content level

- EDI
  - Traditional EDI
  - Internet based EDI
- XML based frameworks
  - **The Electronic Commerce(eCO)** framework
  - **Commerce XML (cXML)**
  - **BizTalk**
  - **RosettaNet**
  - **The Electronic-Business-XML (ebXML)**

EDI: Electronic Data Interchange

- What is EDI?
  - Exchange of electronic data between companies using precisely defined transactions
  - Set of hardware, software, and standards that accommodate the EDI process

Benefits of EDI

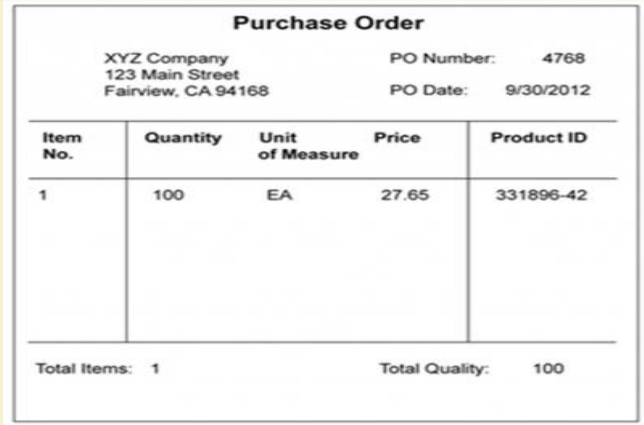
- Cost saving
- Speed
- Accuracy
- Security
- System Integration
- Just-in-time support

The basic steps of EDI

- Preparation of Electronic Documents:
- Outbound Translation:
- Communication:
- Inbound Translation:
- Processing Electronic Documents

http://hilltop.bradley.edu/~simonp/atg383/edipindx.html

Paper Purchase Order



Purchase Order

XYZ Company
123 Main Street
Fairview, CA 94168

PO Number: 4768
PO Date: 9/30/2012

Item No.	Quantity	Unit of Measure	Price	Product ID
1	100	EA	27.65	331896-42

Total Items: 1 Total Quality: 100

```
ST*850*540001
BEG*00*SA*4768*65*20120930
N1*SO*XYZ Company
N3*123 Main Street
N4*Fairview*CA*94168
PO1*1*100*EA*27.65**VN*331896-42
CTT*1*100
SE*8*54001
```

ANSI EDI Purchase Order

```
UNH+SSDD1+ORDERS:D:03B:UN:EAN008'
BGM+220+4768+9'
DTM+137:20120930:102'
NAD+BY+5412345000176::9++XYZ
Company+123 Main
Street+Fairview+CA+94168+US'
LIN+1+1+331896-42:VN'
QTY+1:100:EA'
PRI+AAA:27.65'
UNS+S'
CNT+2:1'
UNT+10+SSDD1'
```

EDIFACT EDI Purchase Order

EDI Standards

- EDI requires companies to agree on standards
  - Compatible hardware and software
  - Agreed upon electronic form format
- Few Established EDI standards
  - Automotive Industry Action Group (AIAG)
  - X.12 EDI standard in U.S. and Canada
  - EDI for Administration, Commerce, and Trade (EDIFACT) umbrella of standards in Europe
- India is a member of the Asia EDIFACT board (AEB) in addition to Japan, Korea, Hong Kong, China, Singapore, Taiwan and Malaysia.

http://commerce.nic.in/ecedimain.htm

Communication for EDI

- **Peer-to-Peer**
  - Suitable for large companies
  - Trading partners can connect directly to each other.
    - For example, an automotive manufacturer might maintain a modem-pool that all of its hundreds of suppliers are required to dial into to perform EDI.
    - If a supplier does business with several manufacturers, it may need to acquire a different modem (or VPN device, etc.) and different software for each one.

Communication for EDI

- **Value-added networks**
  - **Third party service providers**
  - Receives transactions, examines the 'from' and the 'to' information, and routes the transaction to the final recipient.
  - Provide a number of additional services, e.g. retransmitting documents, providing third party audit information, acting as a gateway for different transmission methods, and handling telecommunications support.

Communication for EDI

- VANs may be operated by various entities:
  - telecommunication companies;
  - industry group consortia;
  - a large company interacting with its suppliers/vendors.

Communication for EDI

- EDI over the Internet (EDIINT)
  - A set of protocols developed for secure and reliable EDI data transmission over the internet.
  - Standards:
    - AS1
      - XML & SMTP
      - S/MIME encryption and security over SMTP
    - AS2
      - XML and HTTP or HTTP/S
      - AS2 is an adjustment of AS1, providing S/MIME over HTTP or HTTP/S
    - AS3
      - FTP based
    - AS4
      - Web services based

EDI Implementation cost components

- **Translation Software:** Cost is usually on a per-CPU basis, and most vendors will negotiate site license costs.
- **Software Maintenance:** Purchasing a software maintenance contract is always advisable, since this will usually provide technical assistance, and will frequently guarantee automatic updates. With translation software, the updates should include additional transaction sets as they are implemented.

EDI Implementation cost components

- **Internal Software development costs:** Modifications to internal systems should be costed as any other software project would be.
- **Hardware costs:** Cost will depend not only upon platform, but upon the specific configuration of the platform. Additional costs may be encountered in operating system software licensing, hardware interfaces for networking, and additional peripheral devices such as backup systems.

EDI Implementation cost components

- **Training costs:** these costs can include in-house training for new procedures, vendor training for software products and for hardware.
- **Additional resource costs:** If a business is venturing for the first time into the UNIX open-systems environment, it may be necessary to hire a technical specialist that s familiar with system administration and support for the platform.

EDI Implementation cost components

- **Specialty hardware:** the EDI project may require special data collection devices such as bar code equipment or special printers.
- **Networking costs:** If a private network will be used, there are leasing costs for phone lines, and additional networking hardware costs. If the business opts for the use of a VAN, explicit pricing policies for all services should be available, allowing for exact determination of start-up and on-going communications costs.

EDI Implementation cost components

- **Legal costs:** Since EDI requires entering partnerships with other companies, it will require that contractual relationships are defined. For EDI, a standard contract form has been developed called and EDI Trading Partner Agreement. This form helps define relationships and responsibilities. It is a fairly straight-forward form, and should serve as the basis for any contractual arrangements. Also, it is always advisable to insure that such contracts properly protect parties, so legal costs may have to be factored into project estimates.

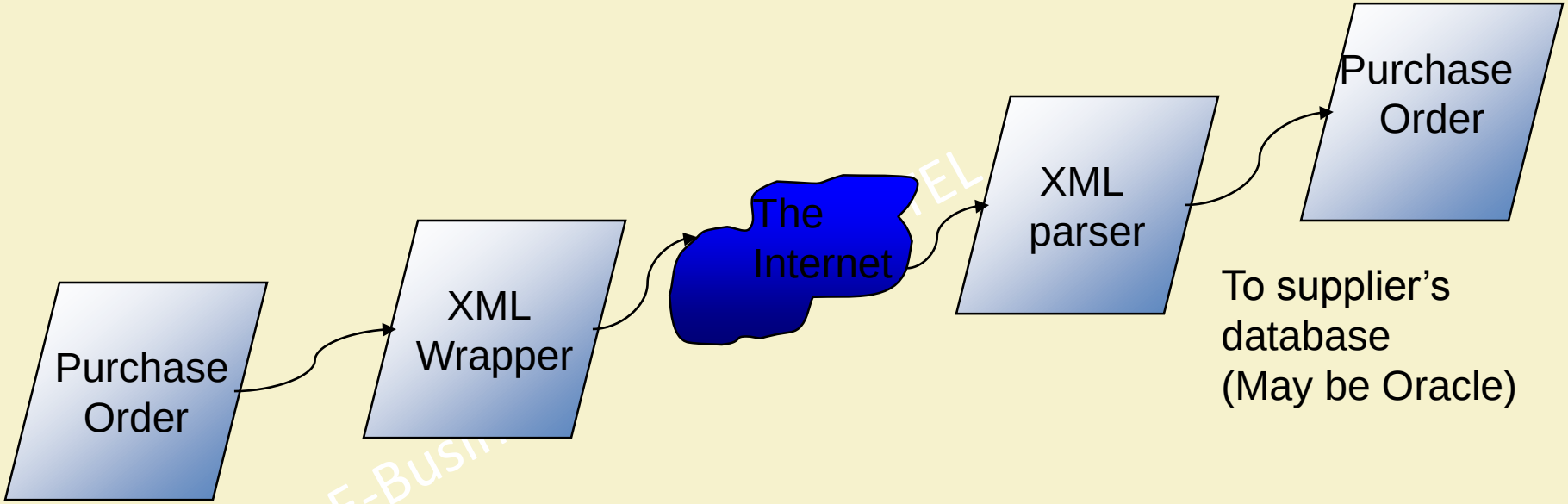
EDI Implementation cost components

- **Consulting costs:** It may be a worthwhile investment for a company new to EDI to hire the consulting services of knowledgeable experts. Professional expertise can be invaluable in initial planning, particularly in determining strategic objectives.

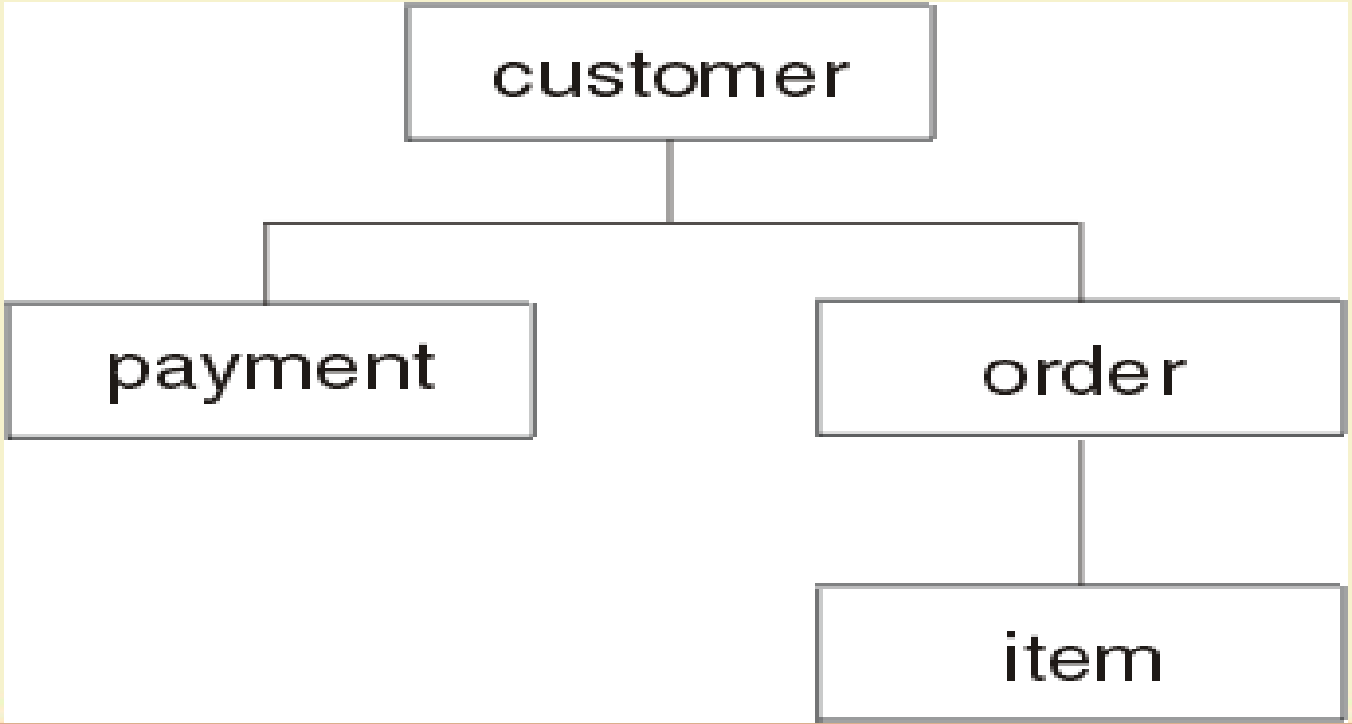
Extensible Markup Language

- XML or Extensible Markup Language is a meta-markup language that provides a format for describing structured data
- XML is the universal format for structured documents and data
- XML provides a standard for more precise declarations of content and more meaningful search results across loosely coupled applications

XML – A solution to blend diversified data formats

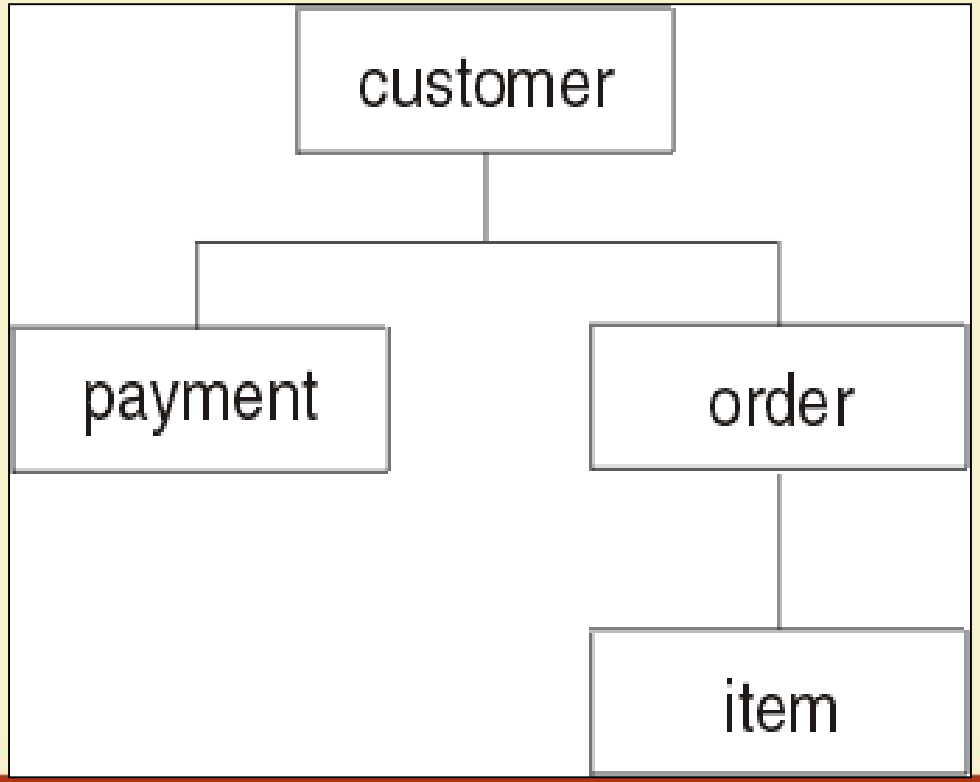


Tree structure of a sample XML document



A sample XML File

```
<?xml version="1.0" encoding=UTF-8"?>
 <doc>
   <customer id='123'>
     <name>...</name>
     <address>...</address>
      ...
     <order>
       <amount>...</amount>
          <date>...</date>
       <item quant='12'>
          <name>...</name>
       </item>
       <item quant='4'>...</item>
        ...
     </order>
     <order>...</order>
      ...
     <payment>
       <number>...</number>
       <date>...</date>
     </payment>
     <payment>>...</payment>
      ...
   </customer>
   <customer id='124'>...</customer>
 </doc>
```



Why XML

- It is a simultaneously human and machine-readable format;
- It is platform independent
- It supports Unicode, allowing almost any information in any written human language to be communicated;
- It can represent the most general data structures: records, lists and trees

Why XML

- It can represent the most general data structures: records, lists and trees;
- It's self-documenting format describes structure and field names as well as specific values;
- The strict syntax and parsing requirements make the necessary parsing algorithms extremely simple, efficient, and consistent.

Why XML

- XML is heavily used as a format for document storage and processing, both online and offline,
- It is based on international standards;
- The hierarchical structure is suitable for most (but not all) types of documents;
- It manifests as plain text files, which are less restrictive than other proprietary document formats;

XML and EDI Comparison

Issues	XML Advantages	XML Problems	Traditional EDI Problems	EDI Advantages
E-commerce Standard	•New technology •Internet based, easy to implement	• Many standards of multiple complex frameworks • Not as simple to implement	•Old electronic standard	•Time tested and successfully works •Straight forward to implement
Cost	•Cost effective to implement and cheaper to deploy via the Internet	•Tools and developers still cost money •Consumer still pay for Internet connection •Bandwidth usage can be costly	•Traditionally expensive	• Cost of tools are getting cheaper implemented over the Internet • Less bandwidth

XML and EDI Comparison

Issues	XML Advantages	XML Problems	Traditional EDI Problems	EDI Advantages
Data Representation	•Intuitive, easy to read	•Verbose •Time consuming to implement •Storage requirements increases	•Cryptic	• Once understood, quick to implement • Storage requirements are minimal
Companies pushing the technology	•New economy companies	•High business risk	•Established companies (Fortune 500) and governments	• Status quo • Established global user base • Low business risk

XML based data interchange frameworks

- **The Electronic Commerce(eCO)**
- **Commerce XML (cXML)**
- **BizTalk**
- **RosettaNet**
- **The Electronic-Business-XML (ebXML)**
- **XML/EDIFACT**
  - allows EDIFACT message types to be used by XML systems

Week 7: Lecture 4

FUNDAMENTALS OF WEB SERVICES

We are going to learn

- What is web service
- Existing standards
- Connecting multiple web services for business process automation

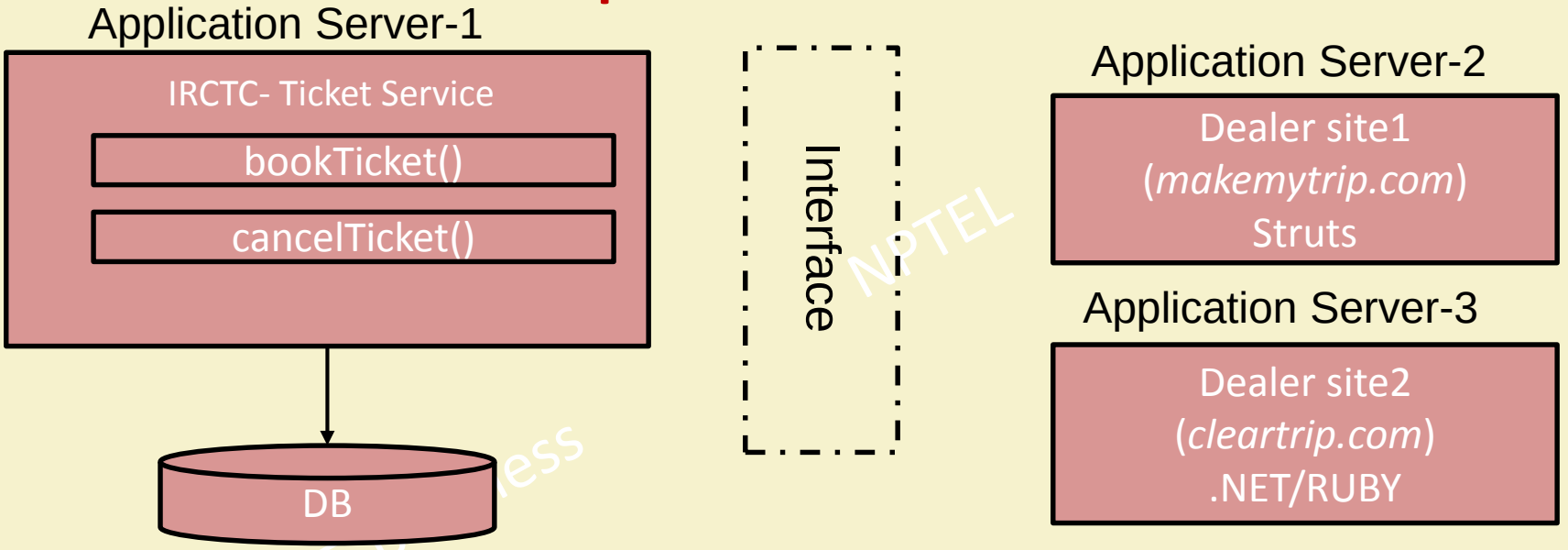
B2B Interoperability
- Business process level

- *Intra-enterprise work-flow*
  - Traditional workflow systems
  - ERP systems such as SAP/R3, Baan, People-Soft
- *Inter-enterprise work-flow*
  - Web Services

What is a Web Service

- "a method of communication between two electronic devices over the Web"
  - From Wikipedia entry on "Web service"
- "a software system designed to support interoperable machine-to-machine interaction over a network"
  - From W3C definition

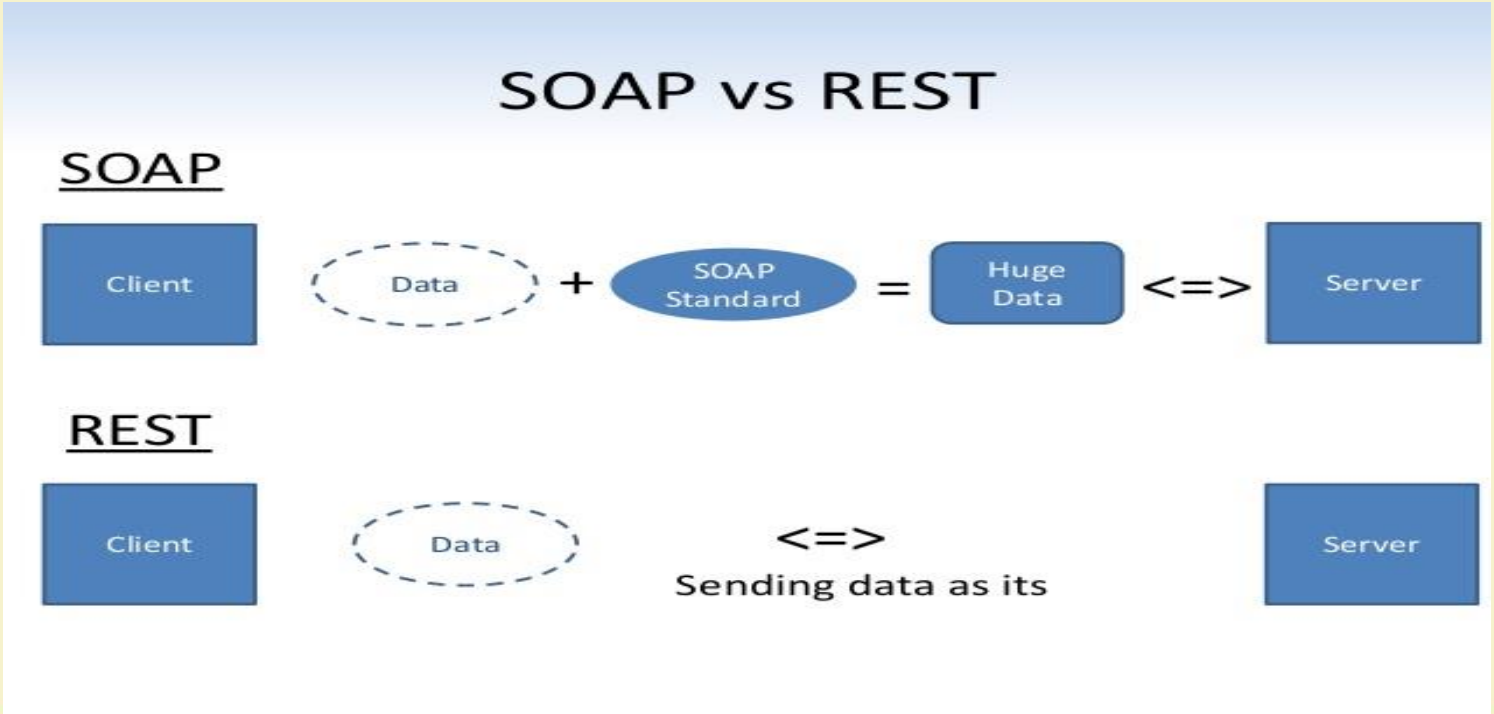
Simple Use case



- Interface should be platform independent.
- Request and response should be language natural.

https://www.slideshare.net/madhaiyanm/web-services-a-practical-approach

Two Approaches



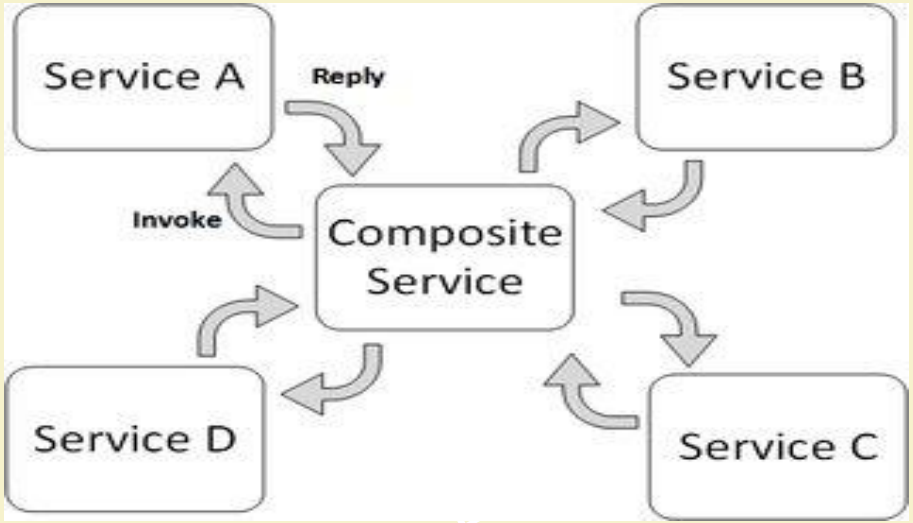
Web Services terminologies

- SOAP – *Simple Object Access Protocol*.
  - Envelope for soap request/response.
- WSDL – *Web Service Description Language*.
  - Interface for SOAP web service
- UDDI – *Universal Description, Discovery and Integration*.
  - Repository/yellow pages of web services
- REST – *REpresentational State Transfer*.
  - Architecture style of communication to the services

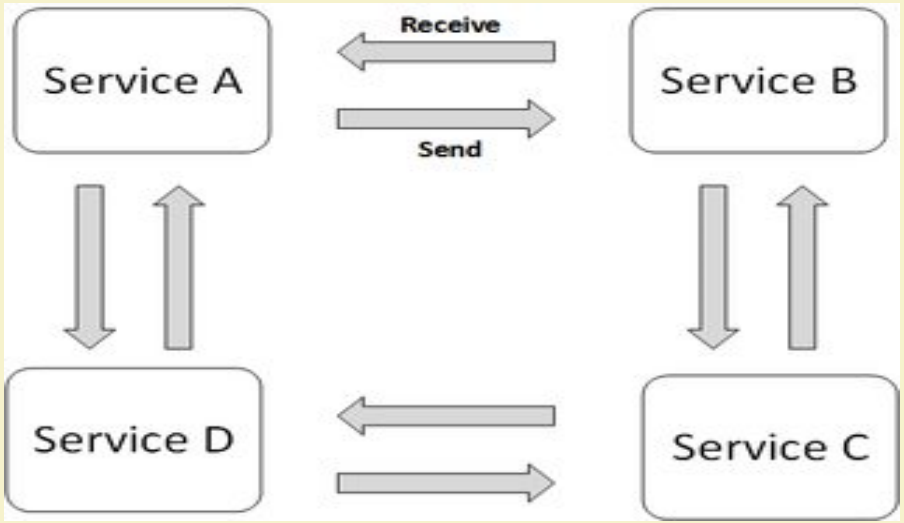
SOAP	REST
XML based message protocol	An architectural style protocol
Uses WSDL for communication	Uses XML and JSON
Invokes services using RPC	Simply calls the service via URL path
Does not return human readable form	Readable results
Runs over HTTP	Uses HTTP
Call through Java Script difficult to implement	Easy to call from Java Script
Slow	Much faster

Automating business processes

- Service Vs.



Orchestration

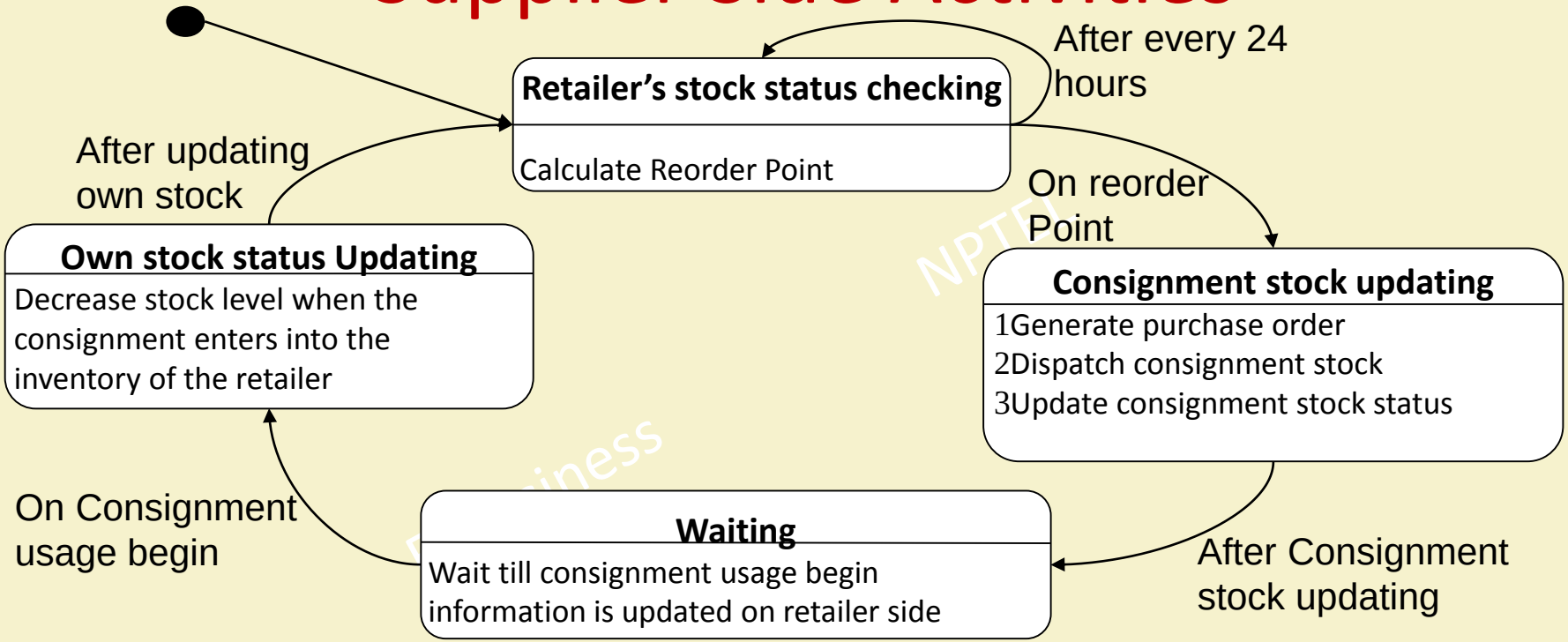


Choreography

https://stackoverflow.com/questions/4127241/orchestration-vs-choreography

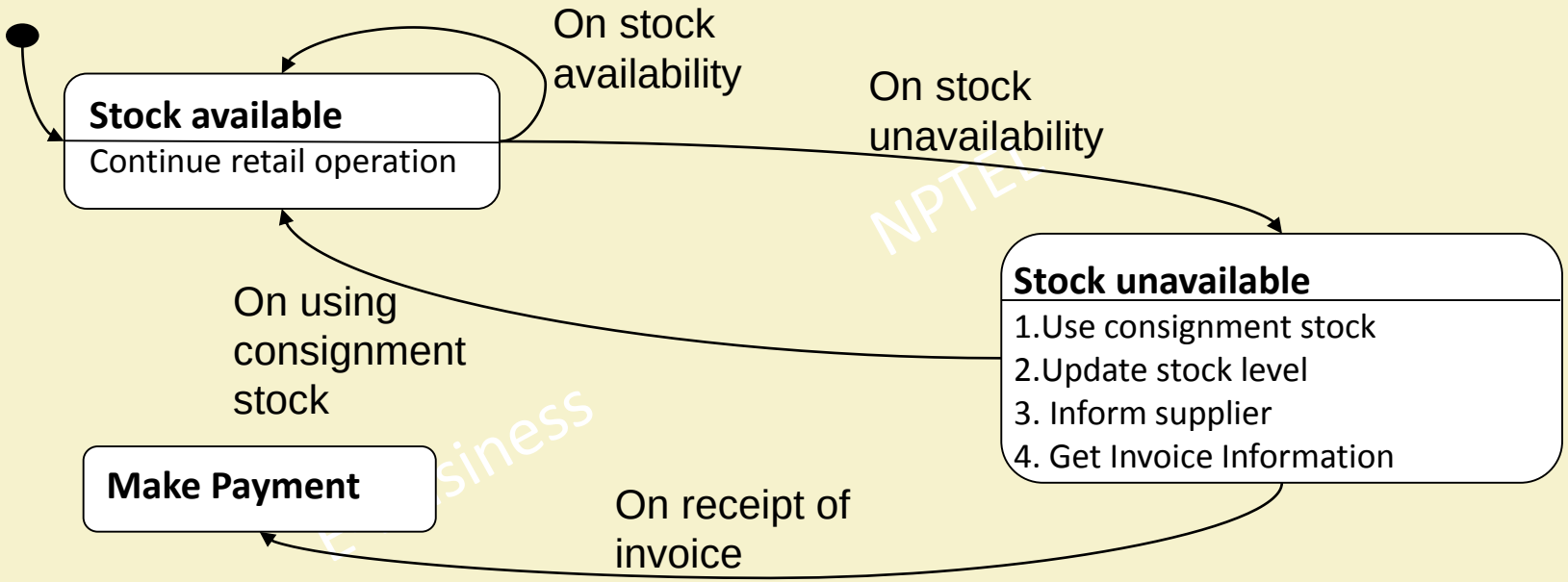
An Implementation of VMI using web Services

Supplier Side Activities



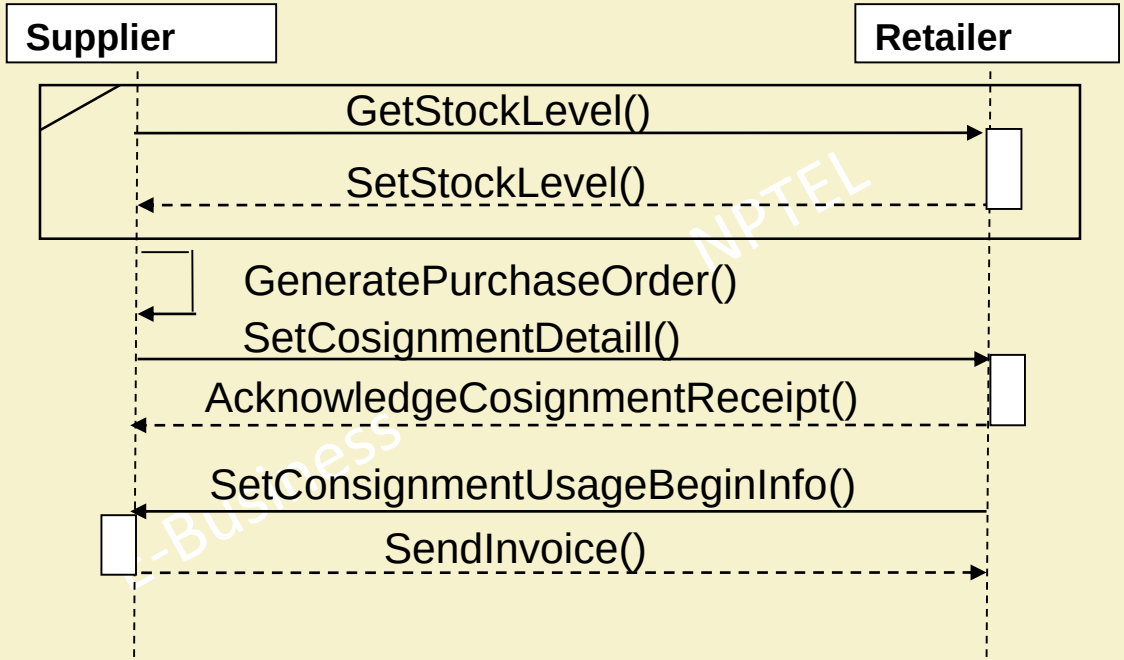
A model using state chart diagram

Retailer Side Activities



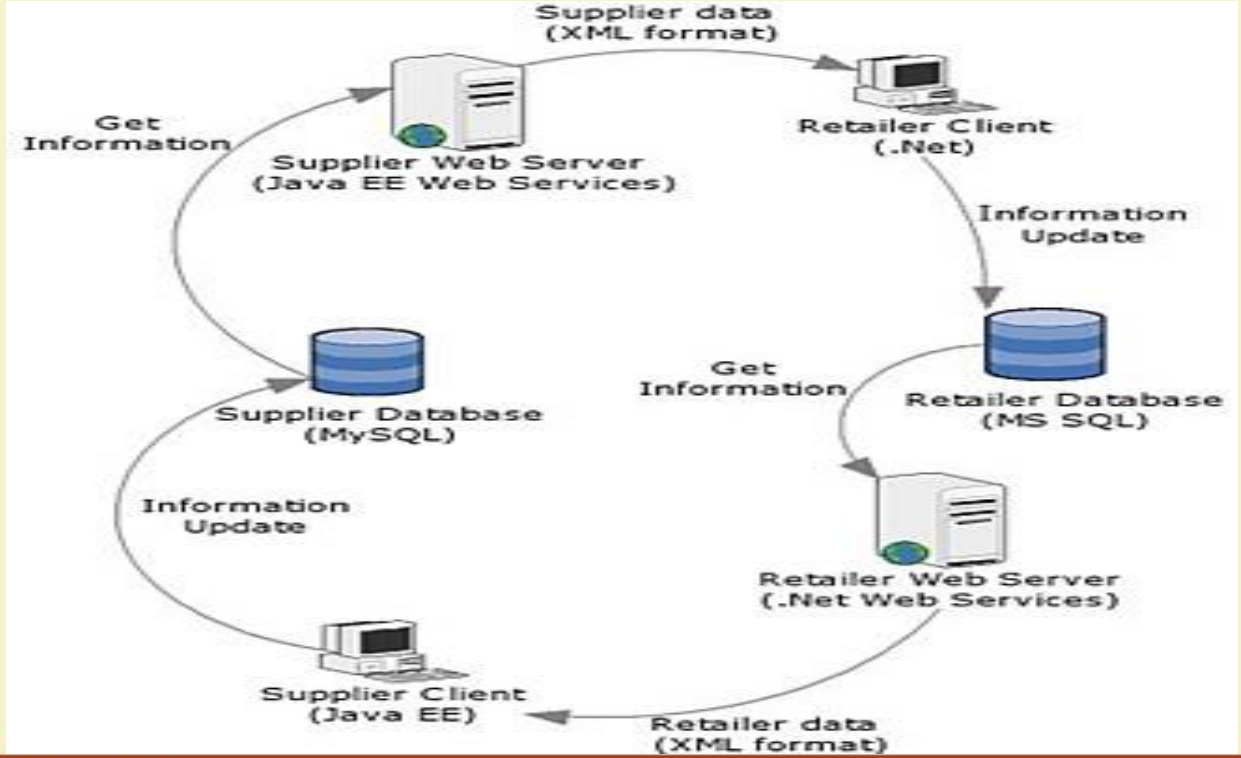
A Model using statechart diagram

Information Flow
Between a Supplier and a Retailer

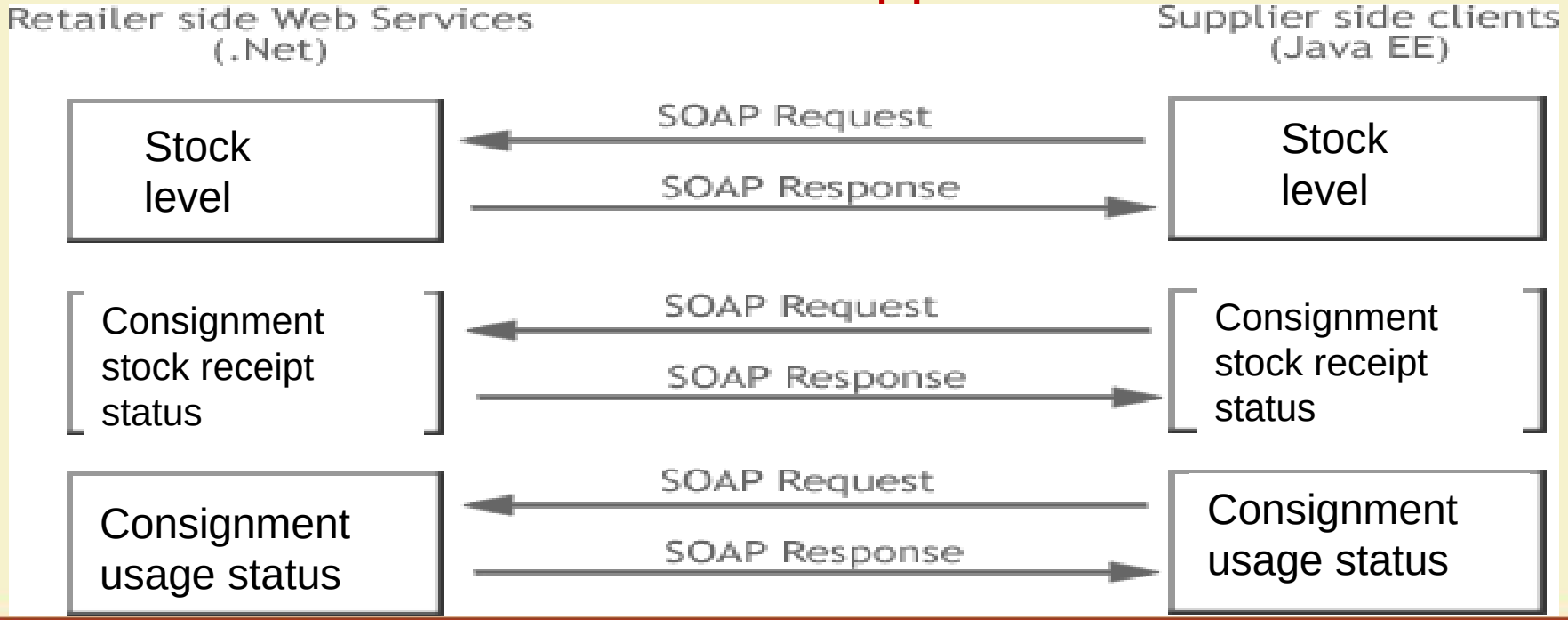


Modeling information flow using an UML sequence diagram

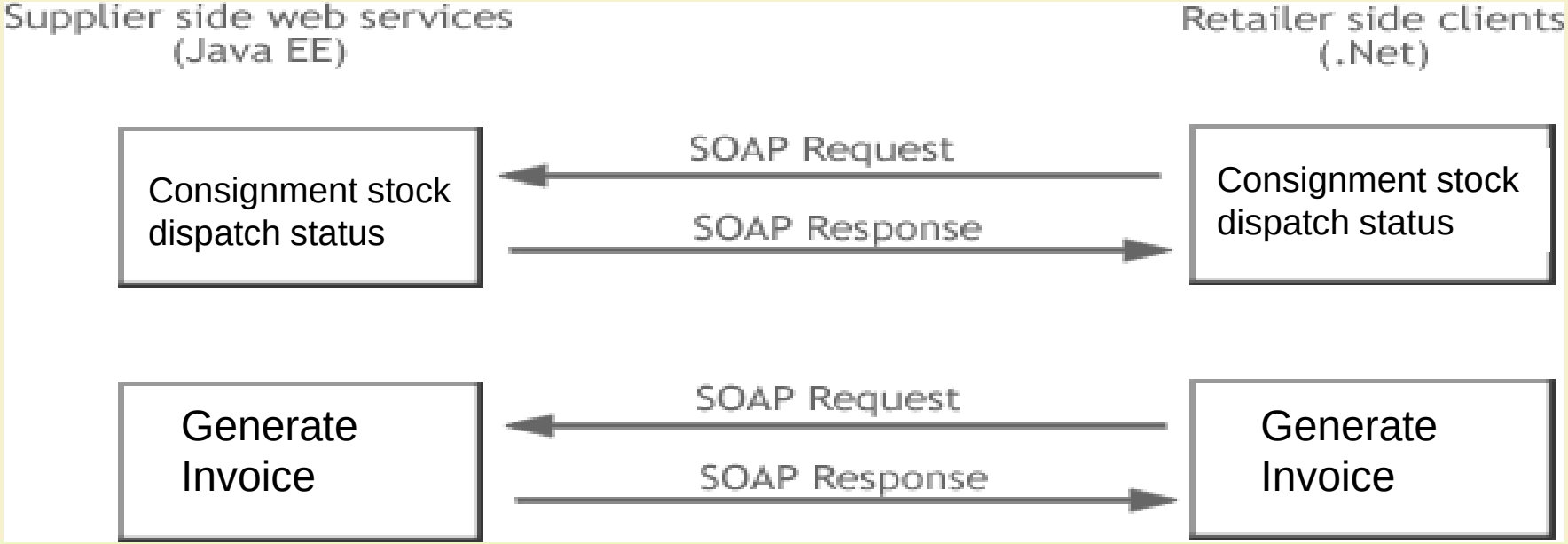
Understanding the Information flow



Retailer Side Web Services and their Interactions with the Clients on Supplier Side



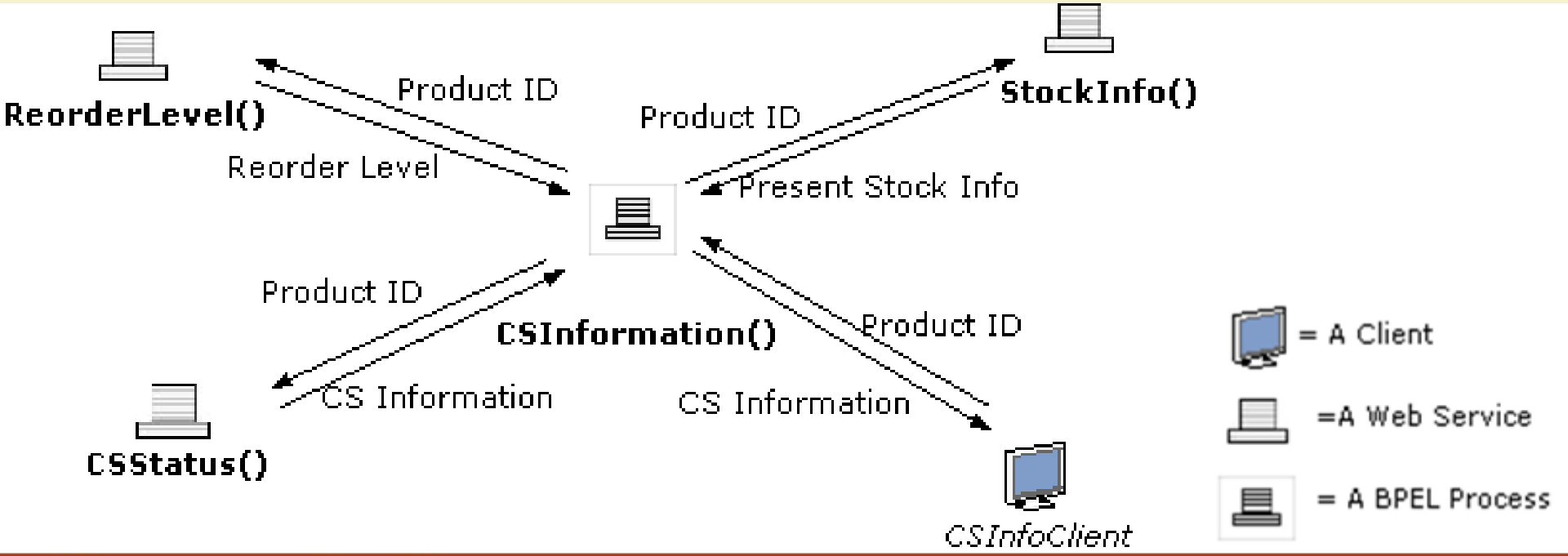
Supplier Side Web Services and their Interactions with the Clients on Retailer Side



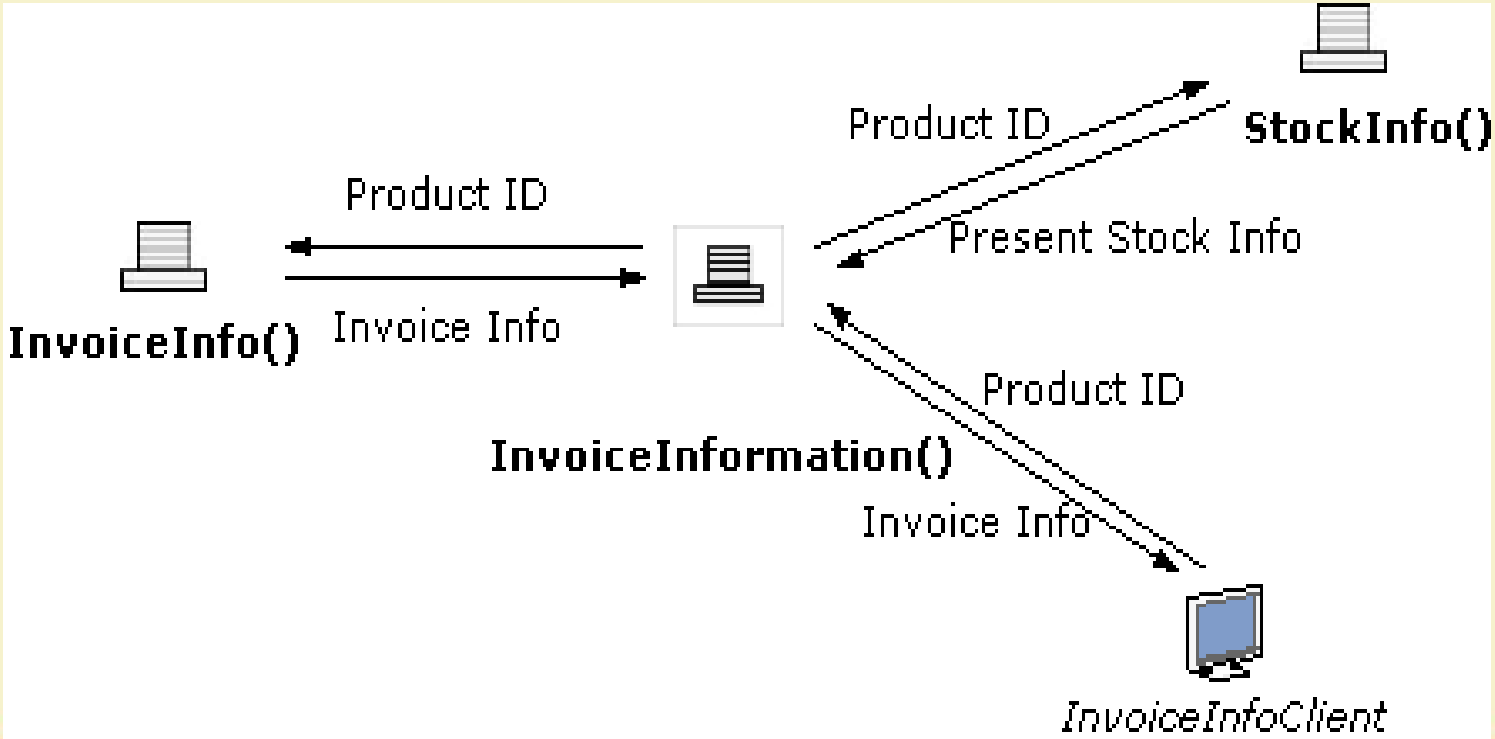
Composite Web Services for VMI

- What's wrong without CWS
  - Five cycles
    - A service for each cycle
    - Each cycle involves manual activation of the clients to access a service
- It is observed that five cycles can now be clubbed into two cycles
  - *Pre- consignment stock delivery* business process (CSInformation)
  - *Post-consignment stock delivery* business process (InvoiceInformation)

CSInformation: *pre- consignment stock delivery*



InvoiceInformation: *post-consignment stock delivery*



Week 7: Lecture 5

FUNDAMENTALS OF CLOUD BASED SYSTEMS

We are going to learn

- What is cloud computing
- Characteristics of Cloud Computing
- Cloud Service Models
- Cloud Deployment Models
- Advantages and disadvantages

What is cloud computing

- **Cloud computing** is the delivery of computing as a service rather than a product, whereby shared computing resources, software, and information are provided to computers and other devices over a network.
  - Shared pool of configurable computing resources
  - On-demand network access
  - Provisioned by the Service Provider

Characteristics of Cloud Computing

- **Remotely hosted**: Services or data are hosted on remote infrastructure.
- **Ubiquitous**: Services or data are available from anywhere.
- **Commodified**: The result is a utility computing model similar to that of traditional utilities, like gas and electricity - you pay for what you would want!

Characteristics of Cloud Computing

- **Resource pooling**
  - Location independence
  - Provider resources pooled to server multiple clients
- **Rapid elasticity**
  - Ability to quickly scale in/out service
- **Measured service**
  - control, optimize services based on metering

Cloud Service Models

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)

Infrastructure as a service (IaaS)

- Infrastructure as a service (IaaS) is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage, and networking. Organizations use their own platforms and applications within a service provider's infrastructure.

Infrastructure as a service (IaaS)

- A vendor provides clients pay-as-you-go access to the infrastructure
- Virtualization: An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols

Infrastructure as a service (IaaS)

- Key features
  - Instead of purchasing hardware outright, users pay for IaaS on demand.
  - Infrastructure is scalable depending on processing and storage needs.
  - Saves enterprises the costs of buying and maintaining their own hardware.
  - Because data is on the cloud, there is no single point of failure.

Platform as a service (PaaS)

- Platform as a service (PaaS) is a cloud computing offering that provides users a cloud environment in which they can develop, manage, and deliver applications. In addition to storage and other computing resources, users are able to use a suite of prebuilt tools to develop, customize and test their own applications.
- A service provider offers access to a cloud-based environment in which users can build and deliver applications. The provider supplies underlying infrastructure.

Platform as a service (PaaS)

- Key features
  - PaaS provides a platform with tools to test, develop, and host applications in the same environment.
  - Enables organizations to focus on development without having to worry about underlying infrastructure.
  - Providers manage security, operating systems, server software, and backups.
  - Facilitates collaborative work even if teams work remotely.

Software as a service (SaaS)

- Software as a service (SaaS) is a cloud computing offering that provides users with access to a vendor's cloud-based software. Users do not install applications on their local devices. Instead, the applications reside on a remote cloud network accessed through the web or an API. Through the application, users can store and analyze data and collaborate on projects.
- A service provider delivers software and applications through the Internet. Users subscribe to the software and access it via the web or vendor APIs.

Software as a service (SaaS)

- Key features
  - SaaS vendors provide users with software and applications on a subscription model.
  - Users do not have to manage, install, or upgrade software; SaaS providers manage this.
  - Data is secure in the cloud; equipment failure does not result in loss of data.
  - Use of resources can be scaled depending on service needs.
  - Applications are accessible from almost any Internet-connected device, from virtually anywhere in the world.

Software as a Service (SaaS)

Platform as a Service (PaaS)

Infrastructure as a Service (IaaS)

SalesForce CRM

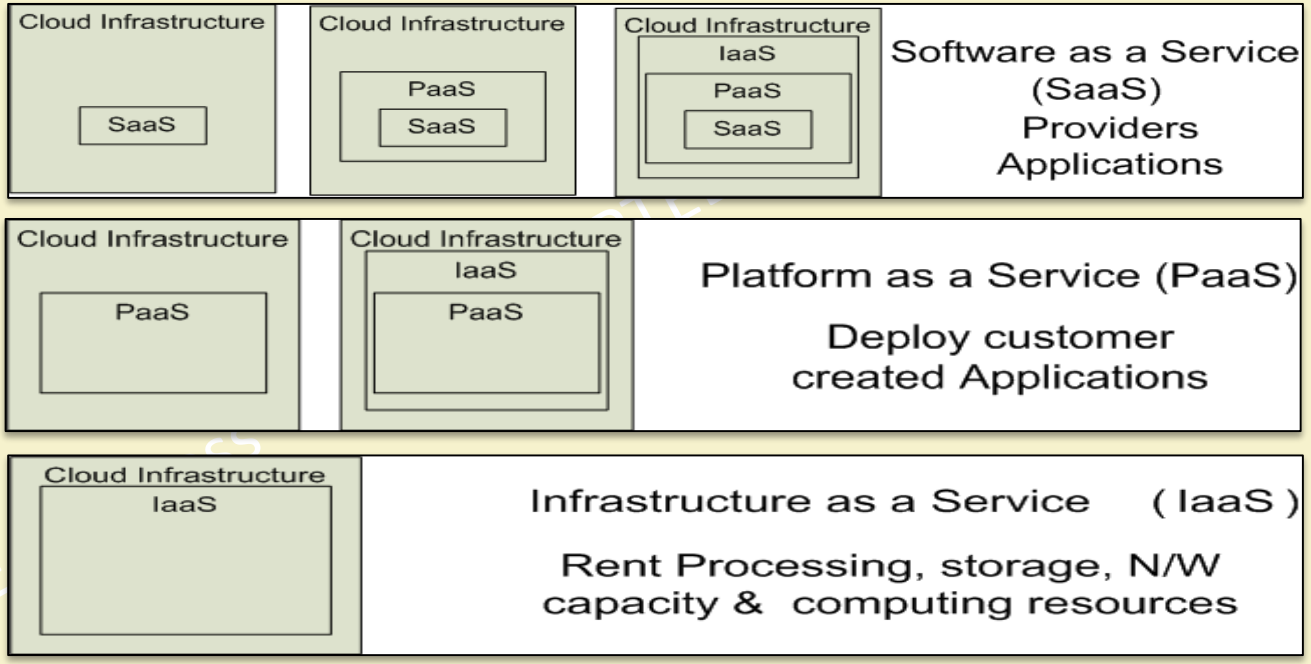
LotusLive

Google App Engine

Windows Azure
The Future Made Familiar

amazon web services

rackspace HOSTING



Adopted from: Effectively and Securely Using the Cloud Computing Paradigm by peter Mell, Tim Grance

Cloud Deployment Models

- Private cloud
  - single org only,
  - managed by the org or a 3rd party,
  - on or off premise
- Community cloud
  - shared infrastructure for specific community
  - several orgs that have shared concerns,
  - managed by org or a 3rd party

Cloud Deployment Models (Cont.)

- Public cloud
  - Sold to the public, mega-scale infrastructure
  - available to the general public
- Hybrid cloud
  - composition of two or more clouds
  - bound by standard or proprietary technology

Concerns with Cloud Computing

- Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation:
  - The others are likely become the bigger Internet companies like Google and IBM, who may monopolise the market.
  - Some argue that this use of supercomputers is a return to the time of mainframe computing that the PC was a reaction against.

https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

Concerns with Cloud Computing

- Security
  - It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.
- There are also issues relating to policy and access:
  - If your data is stored abroad whose policy do you adhere to?
  - What happens if the remote server goes down?
  - How will you then access files?
  - There have been cases of users being locked out of accounts and losing access to data.

https://www.cse.unr.edu/~mgunes/cpe401/cpe401sp12/lect15_cloud.ppt

Advantages of Cloud Computing

- Lower computer costs:
  - You do not need a high-powered and high-priced computer to run cloud computing's web-based applications.
  - Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software.
  - When you are using web-based applications, your PC can be less expensive, with a smaller hard disk, less memory, more efficient processor...
  - In fact, your PC in this scenario does not even need a CD or DVD drive, as no software programs have to be loaded and no document files need to be saved.

Advantages of Cloud Computing

- Improved performance:
  - With few large programs hogging your computer's memory, you will see better performance from your PC.
  - Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory…
- Reduced software costs:
  - Instead of purchasing expensive software applications, you can get most of what you need for free-ish!
    - most cloud computing applications today, such as the Google Docs suite.
  - better than paying for similar commercial software
    - which alone may be justification for switching to cloud applications.

Advantages of Cloud Computing

- Instant software updates:
  - Another advantage to cloud computing is that you are no longer faced with choosing between obsolete software and high upgrade costs.
  - When the application is web-based, updates happen automatically
    - available the next time you log into the cloud.
  - When you access a web-based application, you get the latest version
    - without needing to pay for or download an upgrade.

- Improved document format compatibility.
  - You do not have to worry about the documents you create on your machine being compatible with other users' applications or OSes
  - There are potentially no format incompatibilities when everyone is sharing documents and applications in the cloud.

Advantages of Cloud Computing

- Unlimited storage capacity:
  - Cloud computing offers virtually limitless storage.
  - Your computer's current 1 Tbyte hard drive is small compared to the hundreds of Pbytes available in the cloud.
- Increased data reliability:
  - Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data.
    - if your personal computer crashes, all your data is still out there in the cloud, still accessible
  - In a world where few individual desktop PC users back up their data on a regular basis, cloud computing is a data-safe computing platform!

Advantages of Cloud Computing

- Universal document access:
  - That is not a problem with cloud computing, because you do not take your documents with you.
  - Instead, they stay in the cloud, and you can access them whenever you have a computer and an Internet connection
  - Documents are instantly available from wherever you are
- Latest version availability:
  - When you edit a document at home, that edited version is what you see when you access the document at work.
  - The cloud always hosts the latest version of your documents
    - as long as you are connected, you are not in danger of having an outdated version

Advantages of Cloud Computing

- Easier group collaboration:
  - Sharing documents leads directly to better collaboration.
  - Many users do this as it is an important advantages of cloud computing
    - multiple users can collaborate easily on documents and projects
- Device independence.
  - You are no longer tethered to a single computer or network.
  - Changes to computers, applications and documents follow you through the cloud.
  - Move to a portable device, and your applications and documents are still available.

Disadvantages of Cloud Computing

- Requires a constant Internet connection:
  - Cloud computing is impossible if you cannot connect to the Internet.
  - Since you use the Internet to connect to both your applications and documents, if you do not have an Internet connection you cannot access anything, even your own documents.
  - A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.

Disadvantages of Cloud Computing

- Does not work well with low-speed connections:
  - Similarly, a low-speed Internet connection, such as that found with dial-up services, makes cloud computing painful at best and often impossible.
  - Web-based applications require a lot of bandwidth to download, as do large documents.
- Features might be limited:
  - This situation is bound to change, but today many web-based applications simply are not as full-featured as their desktop-based applications.
    - For example, you can do a lot more with Microsoft PowerPoint than with Google Presentation's web-based offering

Disadvantages of Cloud Computing

- Can be slow:
  - Even with a fast connection, web-based applications can sometimes be slower than accessing a similar software program on your desktop PC.
  - Everything about the program, from the interface to the current document, has to be sent back and forth from your computer to the computers in the cloud.
  - If the cloud servers happen to be backed up at that moment, or if the Internet is having a slow day, you would not get the instantaneous access you might expect from desktop applications.

Disadvantages of Cloud Computing

- Stored data might not be secure:
  - With cloud computing, all your data is stored on the cloud.
    - The questions is How secure is the cloud?
  - Can unauthorised users gain access to your confidential data?
- Stored data can be lost:
  - Theoretically, data stored in the cloud is safe, replicated across multiple machines.
  - But on the off chance that your data goes missing, you have no physical or local backup.
    - Put simply, relying on the cloud puts you at risk if the cloud lets you down.

Disadvantages of Cloud Computing

- HPC Systems:
  - Not clear that you can run compute-intensive HPC applications that use MPI/OpenMP!
  - Scheduling is important with this type of application
    - as you want all the VM to be co-located to minimize communication latency!
- General Concerns:
  - Each cloud systems uses different protocols and different APIs
    - may not be possible to run applications between cloud based systems
  - Amazon has created its own DB system (not SQL 92), and workflow system (many popular workflow systems out there)
    - so your normal applications will have to be adapted to execute on these platforms.