Announcements

- Assignment 4 due 11/8
- Business Paper Draft Due 11/10
- Database Assignment 2 due 11/22

Example 1

Bob sends a letter to Alice

US Postal Service
Shipping Container
ABC Airlines

Example 2

Web server
Web page
Screen
Web browser
HTML

Application
File system
File
Message

Operating system
Network
Fragmentation
Collection of packets
Assembly

Example 3: Network Infrastructure Expanded

Seatback Application
Passenger Information
Linux OS
TCP transport layer
WiFi Link Layer
WiFi Physical Layer
Networking Infrastructure

Airplane Server
Linux OS
TCP transport layer
WiFi Link Layer
WiFi Physical Layer
Networking Infrastructure

Computer & Comm. Industry Structure
Two ways to design a system:
- Decomposition from system requirements
- Assembly from available components

Available components

Requirements

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Available components

Requirements

Components
- Component: A subsystem purchased "as is" from an outside vendor
- (Alternative – building your own subsystem)
- A component implementation is encapsulated (although often configurable)

Component:

Component IMPLEMENTATION IS ENCAPSULATED (ALTHOUGH OFTEN CONFIGURABLE)

Other Examples of components
- Computer
- Disk drive
- Network
- Network router
- Operating system
- Integrated circuit
- Database management system

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Why is a component implementation encapsulated?

Interoperability
- Components are interoperable when they interact properly to achieve some desired functionality
- Increasingly component interoperability cannot be dependent on end-user integration
  - PC and peripherals
  - Enterprise, inter-enterprise, consumer applications
  - Role for standardization

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Suppose we choose to pay another firm to develop the user interface. This is called **Outsourcing**. Why would we do this?

**Suppliers Types**

- Three types of suppliers:
  - Component Suppliers
  - Custom Subsystem Developers
  - System Integrators
- (Some suppliers are 2 or even 3 of above.)

**System Integration**

- Bring together subsystems; make them work together; to achieve a goal.
- Requires
  - Testing
  - Making modifications to architecture and/or subsystem implementation

**Can System Integration be Outsourced?**

- Of course!
Recall: Infrastructure and Applications

Infrastructure
- Equipment and/or software used by many applications

Applications
- Provide specific capabilities and features serving individual users.

Four possibilities

<table>
<thead>
<tr>
<th>Product</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Office</td>
<td>Hotmail</td>
</tr>
<tr>
<td>Application</td>
<td>Infrastructure</td>
</tr>
<tr>
<td>Personal computer</td>
<td>Internet DNS</td>
</tr>
</tbody>
</table>

Application Service Provider

- Two types
  - Bundled
    - An infrastructure provider bundles applications with their infrastructure
      - Example: Comcast, telephony service providers
  - Unbundled
    - A provider of an application service without providing an infrastructure service
      - Examples?

Examples of unbundled ASP model

- Yahoo: Web-based calendar
- gmail: Web-based email
- Schwab: Web-based stock trading

Unbundled ASP model

Advantageous to user
- Proven way to reduce installation, integration, and maintenance costs
- Contractual obligation for availability and quality
- Location independence

Unbundled ASP model (cont.)

Advantages to supplier
- Ongoing revenue stream supporting upgrade and maintenance
- Usage-based revenue better aligned with user’s value proposition
- Opportunity for price discrimination, advertising revenue, etc.
Some pricing alternatives

- Price discrimination?
- Usage dependent?
- Terms and conditions:
  - fixed, leasing, per-use, subscription
  - warrantee, service level agreements
- Bundles:
  - maintenance, support, releases, provisioning and operations
- Who pays?
  - sometimes not the end user

Infrastructure acquisition

- Infrastructure
  - Build and operate
  - Do not build but operate
  - Build but do not operate
  - Neither

Application acquisition

- Application
  - Develop internally
  - Buy as product
  - Contract development
  - Product w/ customization

Stovepipe vs. Integrated Infrastructure

- Stovepipe architecture
  - Single supplier provides all encompassing solution
  - (complete with infrastructure)
- Integrated Infrastructure
  - Separate infrastructure that can support many applications

From stovepipe to layering

- Data
- Voice
- Video
- Many applications
- Integrated Infrastructure (Maybe broken into Additional layers.)
- Application-dependent infrastructure
- Application-independent infrastructure