Class announcements

- **Assignment 4 out!**
  - Due next Tuesday (November 8th)

- **Reading for Wednesday:**
  - Chapter 11.1 - 11.2, 15.1-15.2

- **Student Presentations Thursday**
  - Keith Lucitt
  - Ryan Fargo
Student Presentations

- Melinda Hsieh
- Salvador Barrios
Suggested Research sources

- ABI/Inform
  - http://library.ucsc.edu/Zope/eresources/bytool/ArticleDatabases

- 10K reports
  - http://www.morningstar.com/
  - Lookup company, click SEC filings
Architecture

HEADQUARTERS
Airline Dataserver

HHC Server

Airline Intranet

Wireless Link

HHC

Airline Dataserver
Two ways to design a system

- **Decomposition from system requirements**
- **Assembly from available components**

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A component implementation is encapsulated (although often configurable)

Component: A subsystem purchased “as is” from an outside vendor

(Alternative – building your own subsystem)

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The Palm OS we are buying “off the shelf” and integrating into our architecture. The Palm OS is a component.
Other Examples of components

Computer
Disk drive
Network
Network router
Operating system
Integrated circuit
Database management system

Why is a component implementation encapsulated?

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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
Outsourcing: A subsystem design is contracted to an outside vendor.

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

- Suppose we
  - Bring together all these subsystems
  - and test them...

- This is called **System Integration**
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!
Supplier Types

- Three types of suppliers:
  - Component Suppliers
  - Custom Subsystem Developers
  - System Integrators

- (Some suppliers are 2 or even 3 of above.)
Two ways to sell Software

Product

- Customer installed and operated
- Often (but not necessarily) sold or licensed at a fixed price

Service

- Functionality provided over a wide-area network
- Often (but not necessarily) sold by subscription

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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></td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
</tr>
<tr>
<td>Personal computer</td>
<td>Internet DNS</td>
</tr>
</tbody>
</table>

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Application Service Provider

- **Two types**
  - **Bundled**
    - An infrastructure provider bundles applications with their infrastructure
      - **Example**: AOL, 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
- Hotmail: 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 (con't)

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

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Infrastructure acquisition

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

Trend

Outsourced operations
System integrator
Service provider

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Application acquisition

Application

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

Trend

- Software supplier
- Outsource developer
- Supplier, consultants
Stovepipe vs. Integrated Infrastructure

**stovepipe architecture**
---or---

**Turnkey Solution**
- Single supplier provides all encompassing solution
- (complete with infrastructure)

**Integrated Infrastructure**
- Separate infrastructure that can support many applications
From stovepipe to layering

Many applications
Integrated Infrastructure
(Maybe broken into Additional layers.)

Application-dependent infrastructure

Data
Voice
Video

Application-independent
Stovepipe vs. Integrated Infrastructure

- What are some examples of each?

- What are the advantages of each approach?
Vertical Integration vs. Diversification

- A company is \textit{vertically integrated} when it makes rather than buys the subsystems in its products.

- A \textit{diversified} company produces products across different industry segments.

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Vertical Integration vs. Diversification

Why do customers favor less vertical integration?

- Prefer competition amongst component suppliers
- Mix and match components
- Reduced lock in

Disadvantages??

- Customer needs to integrate components from different suppliers.
Why do customers favor diversification?
- Reduce coordination costs by having to deal with fewer suppliers.
General Trend

- Less Vertical Integration
- More Diversification

- Of course there are exceptions...
Today’s supplier structure

Applications
Frameworks and components
Middleware
Infrastructure (network, OS) software
Equipment (network, computers)
Semiconductors, components

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Role of Venture Capital in Computing.

- Open interfaces allow small firms to contribute components without having to develop entire solution

- Fast decision making and no supplier lock-in.

- Other Advantages?
Purpose of a standard?

- Allow products or services from different suppliers or providers to be interoperable
Scope of a standard

Included:
- interfaces (physical, electrical, information)
- architecture (reference model)
- formats and protocols (FAP)
- compliance tests (or process)

Excluded:
- implementation
- (possibly) extensions
Reference model

Decide decomposition of system
- where interfaces fall
Defines the boundaries of competition and ultimately industrial organization
- competition on the same side of an interface
- complementary suppliers on different sides
- hierarchical decomposition at the option of suppliers
- (possibly) optional extensions at option of suppliers
Some issues

Once a standard is set
- becomes possible source of industry lock-in; overcoming that standard requires a major (~10x?) advance
- may lock out some innovation

In recognition, some standards evolve
- IETF, CCITT (modems), MPEG
- backward compatibility
Types of standards

**de jure**
- Sanctioned and actively promoted by some organization with jurisdiction, or by government

**de facto**
- Dominant solution arising out of the market
- Voluntary industry standards body

**Industry consortium**

**Common or best practice**

**Examples?**

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Examples

**de jure**
- GSM, ISDN Telephone interface

**de facto**
- Hayes command set, Windows API, Pentium instruction set, Ethernet

Voluntary industry standards body
- OMG/CORBA, IAB/IETF, IEEE

Industry consortium
- W3C/XML, SET

Best practice
- Windowed GUI

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The changing process

- As technology and industry move more quickly, the global consensus standards activity has proven too unwieldy
  - e.g. ISO
- “New age” standards activities are more informal, less consensus driven, a little less political, more strategic, smaller groups
  - e.g. OMG, IETF, ATM Forum, WAP

Programmable/extensible approaches for flexibility
- e.g. XML, Java

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Old giving way to the new

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Reasons for change

- From government sanction/ownership to market forces
  - Increasing fragmentation
  - Importance of time to market

Greater complexity

- Less physical/performance constraint for either hardware or software
Lock-in

(Particularly open) standards reduce consumer lock-in

- Consumers can mix and match complementary products

Increase supplier lock-in

- Innovation limited by backward compatibility
- e.g. IP/TCP, x86, Hayes command set

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Network effects

Standards can harness network effects to the industry advantage

- Revenue = (market size) x (market share)

Increases value to customer

Increases competition

- Only within confines of the standard
- But forces customer integration or services of a system integrator
Why standards?

*de jure* are customer driven to reduce confusion and cost

*de facto* standards are sometimes the result of positive feedback in network effects

Customers and suppliers like them because they

- increase value
- reduce lockin

Governments like them because they

- promote competition in some circumstances
- May believe they can be used to national advantage

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Approaches

Consensus
- ISO

Collaborative design
- MPEG

Competitive “bake off”
- IETF

Coordination of vendors
- OMG

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Open Standards

- Open standard – a standard that is well documented, unencumbered by intellectual property rights and restrictions, and available to any vendor.

- What are the advantages?

- What are the disadvantages?
Why companies participate

Pool expertise in collaborative design
- e.g. MPEG

Have influence on the standard

Get technology into the standard
- Proprietary, with expectation of royalties
- Non-proprietary

Reduced time to market
Standards applied to Business Processes?

- Can you standardize business processes?

- Yes!:
  - ISO 9000
    - A set of standardized business processes for Quality Management.
    - Supports TQM (Total Quality Management)
  - RosettaNet
    - A set of standardized business processes, and accompanying standardized data interfaces/formats for conducting e-business.
Midterm Results

- High: 97
- Low: 36