Class Announcements

- Assignment 4
  - Due Thursday 2/19
- Business paper draft
  - Due Tuesday 2/24
- Database Assignment 2 posted
  - Due Thursday 2/26

System integration

- Bring together subsystems;
- make them work together;
- to achieve a goal.

- Requires
  - Testing
  - Making modifications to
    - architecture and/or
    - subsystem implementation

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

<table>
<thead>
<tr>
<th>Product</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer installed and operated</td>
<td>Functionality provided over a wide-area network</td>
</tr>
<tr>
<td>Often (but not necessarily) sold or licensed at a fixed price</td>
<td>Often (but not necessarily) sold by subscription</td>
</tr>
</tbody>
</table>

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>Application</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal computer</td>
<td>Internet DNS</td>
</tr>
<tr>
<td>Microsoft Office</td>
<td>Hotmail</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 (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
**Infrastructure acquisition**

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

**Application acquisition**

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

**Stovepipe vs. Integrated Infrastructure**

- *Stovepipe architecture*
  - 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
  - Data
  - Voice
  - Video

  - Integrated Infrastructure (Maybe broken into Additional layers.)

  - Application-dependent infrastructure

  - 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 *vertically integrated* when it makes rather than buys the subsystems in its products.

- A *diversified* company produces products across different industry segments.
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

<table>
<thead>
<tr>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frameworks and components</td>
</tr>
<tr>
<td>Middleware</td>
</tr>
<tr>
<td>Infrastructure (network, OS) software</td>
</tr>
<tr>
<td>Equipment (network, computers)</td>
</tr>
<tr>
<td>Semiconductors, components</td>
</tr>
</tbody>
</table>

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?

Examples

de jure
- GSM, ISDN Telephone interface

de facto
- Microsoft Windows API (Application Programming Interface)
- Intel Pentium instruction set
- Voluntary industry standards body
- IEEE (Institute of Electrical and Electronic Engineers)
- IETF (Internet Engineering Task Force)
- Industry consortium
- blurry

Best practice
- Windowed GUI

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. IETF

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

## Aside: Network Effects

- The value of owning some products goes up if lots of other people have it too.
  - Examples?
- This phenomenon is called “network effects”
- How do standards influence network effects?

## 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

## Approaches

- Consensus
  - ISO
- Collaborative design
  - MPEG
- Competitive “bake off”
  - IETF
Open vs. Proprietary 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.