XVI. System Design

What is System Design?
The Outputs of System Design
The (Global) System Architecture
Classification of Applications
State of the Market

The Information System Lifecycle, Again

Survey project scope & feasibility
Study current system
Define end user reqs.
Select feasible solution
Select & Acquire new S&H/W
Design new system
Construct new system
Deliver new system
S+W

Maintain & improve system
Delivered system
Major Concerns of System Design

- Identify major subsystems and components.
- Identify (usage, control or data) dependencies among subsystems.
- Decide on a hardware and software platform for the new system, i.e., the hardware and network(s) on which it will run, the operating system and other off-the-shelf software (e.g., DBMSs) it will use.
- Allocate subsystems to hardware nodes (for a possibly distributed system.)
- Decide on a data management strategy.
- Choose a strategy and standards for human-computer interfaces.

Other Elements of System Design

(...Not discussed in this course....)

- Plan control aspects of the application.
- Produce test plans.
- Specify code development standards.
- Set priorities for design trade-offs.
- Identify implementation requirements (e.g., data conversion)
Outputs of the Design Phase

- Hardware, networking and software platform for the new system.
- A (global) system architecture, which describes the hardware nodes and communication connections among them.
- A software architecture for the new system, showing the hierarchy of subsystems and their inter-dependencies.
- An allocation of subsystems and data to hardware nodes.
- A detailed description of interactions between different elements of the design (through sequence, collaboration, state and activity diagrams.)
- A database design, consisting of a database schema for the data managed by the new system.
- User interfaces for different groups of users.

(Global) System Architecture

- Describes the collection of inter-connected hardware nodes on which the system will eventually run.
- A (global) system architecture consists of:
  - Hardware nodes, where components of the new system will run; for each node select a hardware configuration and operating system platform that will run; for example, hardware platform: 486, 2MB RAM, 100MB disk OS: DOS Windows.
  - The connectivity among hardware nodes, defined by length of connection, type of connection, product used for the connection; for example, length: <100ft, 100miles, type: twisted pair, fiber optic, ethernet, product: Novell 386 LAN, PC3270.
  - The location of users, inputs and outputs for the new system;

Key concern: Minimize data communication
Example

- To each hardware node, associate users (external entities) and network interconnections

Distribution Issues

- **Batch mode** -- process a batch of inputs/outputs together; sometimes most appropriate solution
  - e.g., incoming mail (purchase orders), outgoing mail (invoices, cheques)
- **On-line mode** -- process inputs/outputs as they become available; can save data entry time, particularly if end user can do the input, clearly the way of the future, because on-line data entry can be done on PCs
- **Remote batch** -- data are input on-line on several machines, then fed in a batch mode to a centralized database
New Technologies for I/O and
New Standards for Data Interchange

- **Keyless data entry** -- bar coding, optical character recognition, special keyboards -- very appropriate for large volumes of I/O
- **Pen input** -- several products in the market, with mixed success rate for different types of data
- **Electronic data interchange (EDI)** -- data are transferred through telephone lines from one location to another
e.g., credit card charging
- **Image and Document Interchange** -- like electronic data interchange, but now whole documents, including images, are passed around
e.g., law enforcement, bank applications
- **HTML/XML/SGML** -- markup languages for documents; SGML is a general markup languages for documents; HTML is a special version used for WWW documents; XML is something in between.

Choosing a System Architecture

Here is a series of issues that need to be addressed:
- **Establish** batch and on-line computer processes; key consideration: data communication and response time
e.g., on-site conference registration
- **Determine** process cycles, i.e., when does each process need to run
e.g., end-of-month, end-of-project
- **Establish** processing locations -- identify user locations (and numbers), processor locations, types and numbers, storage devices and storage capacities, connection protocols and traffic volumes
- **Distribute** data to locations -- simple solution: all in one location; more and more we are moving towards distributed DB solutions
- **Distribute** software subsystems to locations
- **Assign** technology -- what hardware, software is going to run where?
## Classification of Applications

<table>
<thead>
<tr>
<th>Span Type</th>
<th>Operational Support</th>
<th>Decision Support (browsing+analysis)</th>
<th>Real Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group/Dept</td>
<td>E.g., regional inventory control</td>
<td>E.g., regional marketing info system</td>
<td>E.g., video conferencing within group</td>
</tr>
<tr>
<td>Enterprise</td>
<td>E.g., enterprise-wide cash mgt</td>
<td>E.g., corporate data warehouse</td>
<td>E.g., enterpr-wide video-conference</td>
</tr>
<tr>
<td>Inter-Enterprise</td>
<td>E.g., B2B Ecommerce</td>
<td>E.g., DBs for communities of interest</td>
<td>E.g., distributed multimedia over the internet</td>
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## State of the Market

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<tbody>
<tr>
<td>Group/Dept</td>
<td>PC, Windows, OLTP, OO products</td>
<td>COTS (mainly SQL-based)</td>
<td>Multimedia technology maturing</td>
</tr>
<tr>
<td>Enterprise</td>
<td>ERPs, OLTP over private intranets</td>
<td>ERPs, Web-based products</td>
<td>ERPs, Web-based technologies</td>
</tr>
<tr>
<td>Inter-Enterprise</td>
<td>Ecommerce technologies</td>
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- OLTP – On-Line Transaction Processing
- ERPs – Enterprise Resource Planning systems
- COTS – Components Off-The Shelf
Data Management Issues

- Need to identify the amount and type of data persistence needed for the new system:
  - Is simple file I/O sufficient?
  - Is a Data Base Management System (DBMS) required?
- A DBMS is typically needed when:
  - Data is accessed at a fine level of detail,
  - Sophisticated indexing is required,
  - There is a need to port data across multiple platforms,
  - Data needs to be accessible from multiple platforms.

Isolate persistence mechanisms from the application!