XVI. System Design

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

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
- 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

- +200MB, Ethernet, Novell/UNIX

- +400MB, Token Ring, Novell/UNIX

- +400MB, Token Ring, Novell/UNIX

- +1000MB, Internal, IBM 3090

- 100MB disk

- 2GB disk

- 486, DOS Win

- 386 notepads

- /square6/square6

- 100MB disk

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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/Ink 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 language for documents; HTML is a special version used for WWWW documents; XML is something in between.

Classification of Applications

<table>
<thead>
<tr>
<th>Span Type</th>
<th>Operational Support</th>
<th>Decision Support</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 mgmt</td>
<td>E.g., corporate data warehouse</td>
<td>E.g., enterprise-wide video-conference</td>
</tr>
<tr>
<td>Inter-Employee</td>
<td>E.g., B2B E-commerce</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, Web-based products</td>
<td>ERPs, COTS-based products</td>
<td>ERPs, Web-based technologies</td>
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<td>Inter-Employee</td>
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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!