ISM 50 - Business Information Systems
Lecture 10

Instructor: Prof. Ram Akella
UC Santa Cruz
Feb 4, 2010

Class announcements

- Midterm Thursday Feb 11, 2010
- Syllabus: Everything covered till Feb 09, 2010 Tue.

Class announcements

- Business Paper Assessment:
  - In addition to the details mentioned on the website, we will consider the following.
  - At the end of the business paper you have to mention which team member has taken care of which section.
  - You can also mention that the whole team has worked together to prepare each of the sections if that is the case.
  - If there is a huge difference between the quality of overall paper and the individual sections then the grading will be done accordingly.
  - Remember this project is to inculcate team-work!

Student Presentation

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Architecture

by
David G. Messerschmitt
What is Architecture?

How do you architect a solution?

Architecture

A system is decomposed into interacting subsystems

Each subsystem may have a similar internal decomposition

System examples

Let’s quickly look at some system decomposition examples

- Quick tour of information technology systems

Three elements of architecture

Decomposition
Organization
Functionality
Responsibility
Interaction
Adaptation

Time sharing

Point-to-point wire (no network)

Mainframe (database and application server)

Two-tier client/server

Local-area network

Server

Mainframe
Three-tier client/server

Inter-organizational computing

Consumer access

System integration

Architecture
  → subsystem implementation
  → system integration

Bring together subsystems and make them cooperate properly to achieve desired system functionality
  - Always requires testing
  - May require modifications to architecture and/or subsystem implementation

Emergence

Subsystems are more specialized and simpler functionality
Higher-level system functionality arises from the interaction of subsystems
Emergence includes capabilities that arise purely from that interaction (desired or not)
  - e.g. airplane flies, but subsystems can’t

Why system decomposition?

- Divide and conquer approach to containing complexity
- Reuse
- Consonant with industry structure (unless system is to be supplied by one company)
- Others?
Networked computing infrastructure

by
David G. Messerschmitt

Layering

Example of Layering: networking

Operational system functions

- Graphical user interface (client only)
- Hide details of equipment from the application
- Multitasking
- Resource management
  - Processing, memory, storage, etc
  - etc

Middleware Functions

- Capabilities that can be shared by many applications, but that is not part of OS
  - Example: Database Management System (DBMS)
- Hide details of OS from application
  - Java Virtual Machine
- More purposes we’ll talk about later.
What's a database?

Database
- File with specified structure
- Example: relational table

A Database

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>John</td>
<td>CEO</td>
</tr>
<tr>
<td>2001</td>
<td>Jane</td>
<td>CFO</td>
</tr>
<tr>
<td>2002</td>
<td>Mike</td>
<td>COO</td>
</tr>
<tr>
<td>2003</td>
<td>Sarah</td>
<td>CTO</td>
</tr>
</tbody>
</table>

Storage Middleware example: DBMS

- Database Management System (DBMS)
  - Manage multiple databases
  - Allow multiple applications to access common databases
  - Implement standard data "lookup" (query) functions

The Internet

by
David G. Messerschmitt

Extranet

An Extranet is composed of
- Intranets connected through an unprotected domain (typically the Internet)
  - Encryption and other security technologies used to
    - protect proprietary information
    - prevent impacters, vandals, etc
**What is the Internet?**

- An internet is a "network of networks"
- Interconnect standard for LANs, MANs, and WANs
- **Internet** = the major global internet
- A private internet is called an **intranet**

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**Client - Server Computing**

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**Client Server Example**

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**Client Server Example - Layers Revealed**

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**3-Tier Client Server Architecture example**

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3-Tier Client Server Architecture example

Client  Application Server

Web Server  
Common Gateway Interchange

Application Logic

What is Bob's Balance?

Database Management System (DBMS)

DBMS Responsibilities

- Hide Changes in the Database hardware from the Application
- Standard operations on the data, including searches, such a search is called a query.
- Separate Database Management from Applications, so that many applications can access the same data.
- Security, Integrity, Backup, fault tolerance, etc.

Relational Database

<table>
<thead>
<tr>
<th>Customer</th>
<th>Balance</th>
<th>Customer Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>$527</td>
<td>Silver</td>
</tr>
<tr>
<td>Bob</td>
<td>$0.50</td>
<td>Bronze</td>
</tr>
<tr>
<td>Charles</td>
<td>$10,000</td>
<td>Gold</td>
</tr>
</tbody>
</table>

3-Tier Client Server Architecture in General

Client  Application Server

- Accept instructions from user
- Make requests of server
- Display responses of server

- Takes inputs from client
- Decides what to be done next
- Decides what shared data to access and manipulates it
- Processes shared data

Shared data
Peer to peer

- Client
- Server

Peer to Peer

- What is peer to peer good for?

Sun Case

- What does Sun make?
  - Workstations
  - Servers
  - Software

Sun N-tier case
How Successful had Sun been up to 1998?
- Founded in 1982
- Open Standards Workstation
  - Unix Operating System (Solaris)
  - TCP/IP networking
- 1988 - Revenues $1 billion
- 1993 - Market value $3.0 billion
- 1997 - Jumped from 3rd to 1st in Unix Server Market.

How Successful had Sun been up to 1998?
- 1993 - "The network is the computer."
- 1994 - Internet explodes in popularity

Microsoft mid to late 90s
- Dominated Desktop software
  - Users familiar with Windows, Office, etc.
- NT servers
  - Fine for small intranets, "not industrial strength"

Sun N-Tier Case
- What is Java?
  - Programming Language
  - Portable between computers with different operating systems
- Easy to write programs in
- Easier re-use
- But, programs are slow

What problems did the micro era produce?
- Desktops are expensive to maintain
  - TCO for windows PC $9900!
- Every PC had a lot of software that had to be maintained
  - Office, Windows, etc...
- Small differences, like the order in which software is installed, could make different PCs behave differently!

In the Networking Era
- These "bloated" PCs are networked and termed fat clients.
- But networking of PCs offered the possibility of
  - putting most of the functionality into servers
  - Getting rid of much of the software on the client
  - These clients would be called thin clients.
- Sun, Oracle, and others saw it as the future.
Hardware for thin clients

- A **Network Computer** (NC) - a computer with minimal hardware that depends on a network connection to a server to function
  - Be careful not to confuse it with the phrase "networked computer!"
  - Example: Sun's JavaStation (1996-2000)
  - It is the hardware one would use to implement a **thin-client** computing model.

Another term from that era...

- A **NetPC** was a PC introduced by Microsoft and Intel in 1996
  - Same software as a normal PC
  - Did not allow users to install their own software
  - NetPC died out
  - Features of it, and Microsoft's Zero Administration Kit, live on in today's version of windows.

Microsoft Vision

- Keep "fat-client" model
- Add some features to Windows to reduce administration costs

Sun's Vision

- Thin Client model.
- Application Servers with Applications written in Java.
- NCs could retrieve applications from application server as needed.
- Applications compatible with any NC hardware and OS.
- Applications could be fixed, added, updated at the server level, rather than maintaining each PC.

SUN 3 - Tier

**Exhibit 1**

United States

Europe

Tier One

Tier Two

Tier Three

Asia

Sun N-tier

**Exhibit 2**

Asian

United States

Europe

Tier One

Tier Two

Tier Three

Tier Four

Asia

United States

Europe
Today

- 3-tier model common.
- Sun's version of 4-tier model not common.
- N-tier model where Webserver and Application Server on separate equipment also common.
- Sun's hardware business not strong.
  - Linux on cheap PCs most common servers
  - Microsoft desktops replacing Sun workstations

Java
- Common in Server implementations
  - Example: Java Servlet implementing application logic in a banking application.
  - Often used to push simple applets onto client
- Not common
  - For "big" desktop applications
  - Office Suite in Java not popular
  - Microsoft is still in business...