ISM 50 - Business Information Systems

Lecture 10

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UC Santa Cruz
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Class announcements

Homework 3 due today
- Late penalty for homeworks and folios:
  - full credit if handed in on the due date
  - 10% penalty if handed in up to one lecture late
  - 20% penalty if handed in up to two lectures late
  - no credit if turned in more than two lectures late
- turn in on paper during the lecture; otherwise, your grade for that assignment may be delayed

Midterm next Wednesday!
- Study guide posted on class web site.

Today’s Class

- Midterm review part 2
- Review of data and information, architecture, and infrastructure
- The Internet
- Client server technology
- Student presentation of Sun N-tier
- Sun N-tier case discussion

Midterm Review Part 2

- Porter Models
- Cisco Case
- Alibris Case
- E-Commerce
- More terminology

Porter Models

- Five forces
  - Buyers
  - Suppliers
  - New entrants
  - Substitutes
  - Rivals
- Value chain
- Competitive strategies
  - Primary
  - Supporting

Cisco Case

- Drivers of change
- Corporate strategy
- Vendor selection process
- Conference room prototyping
- Success factors
- Mistakes
- Lessons learned
**Alibris Case**

- Changes to Interloc’s revenue model?
- Benefits of changing the revenue model?
- Why the decision to switch to Oracle?
- Benefits of the fulfillment facility?

**O’Brien Framework and Cisco**

- Management Challenges
- Business Applications
- Developmental Process
- Information Systems
- Foundational Concepts
- Specific Types of IT

**E-Commerce**

- Categories:
  - B2B
  - B2C
  - C2C

- Steps
  - Matching buyers and sellers
  - Negotiating terms
  - Consummation
  - Customer service

- Procurement
  - Direct, indirect, EDI, SCM

**Review: concepts to know (1)**

**Review: concepts to know (2)**
Review: concepts to know (3)

Data and information

by

David G. Messerschmitt

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Replication of information requires knowledge of representation

What is Architecture?

Structure and organizing principles of any system

What does that mean?

How do you architect a solution?

Understand the higher purpose of the system
Identify the basic elements of the system
Decompose into subsystems
Understand the functions and interactions of the subsystems
Orchestrate the emergence of the higher purpose

Slide adapted from slides for Understanding Networked Applications By David G Messerschmitt. Copyright 2000. See copyright notice
A system is decomposed into interacting subsystems. Each subsystem may have a similar internal decomposition.

**Three Elements of Architecture**
- **Decomposition**: identification of interacting subsystems that make up the higher purpose of the system
- **Functionality**: capabilities assigned to each subsystem supporting the overall system purpose
- **Interaction**: how the subsystems communicate to support the system purpose

**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?

**Architecture example**: functional decomposition of an organization, through its org. chart.

<table>
<thead>
<tr>
<th>Vice Chancellor</th>
<th>Dr. Mary Doyle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Functions: Budgeting, Communications, Research</td>
<td></td>
</tr>
</tbody>
</table>

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**Org. chart (2)**

![Org chart](image)
Networked computing infrastructure

by
David G. Messerschmitt

Layering

Existing layers
Elaboration or specialization
Services

Example of Layering: networking

Application
Transport
Network
Link
Physical

Messages
Packets
Frames
Bits
Signals

Software Layering

Application
Middleware
Operating System

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.

Operating system functions

- Graphical user interface (client only)
- Hide details of equipment from the application
- Multitasking
- Resource management
  - Processing, memory, storage, etc
- etc
The Internet
by
David G. Messerschmitt

Intranet

Private internet

Often connected to Internet

- Firewall creates a protected enclave

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 imposters, 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
- An extranet is an interconnection of intranets through the Internet

Network layering and the Internet

Protocol
TCP, UDP
IP
Ethernet, WiFi
Physical
Application
Transport
Network
Link
Ethernet, WiFi
Physical
Messages
Network
Transport
Application
Where used
Server or client computer at network edge
Internet routers, servers, clients
Internet routers, servers, clients, LAN hubs, LAN switches
Signals
Bits
Frames
Packets
_protocol_
Network layering and the Internet

Physical

Link

Network

Transport

Application

Messages

Companies

Sun, Microsoft, IBM,...
Servers, client computers

Cisco, Huawei, Juniper,...
Internet routers

Ethernet, WiFi

Electronic hardware subsystems

Bits

Frames

Packets

TCP, UDP

IP

Protocol

Companies

Client - Server Computing

Client Server Example

Client: "I want to see www.google.com"

Server:

Packet

Packet

Infrastructure

Internet

Infrastructure

3-Tier Client Server Architecture example

Client: Clicks, keystrokes

Application Server: What is Bob's balance?

$0.50

Shared data

Web Server

Common Gateway Interchange

Application Logic

Client

Application Server

Web Server

Common Gateway Interchange

Application Logic

3-Tier Client Server Architecture example

Client Server Example - Layers Revealed

Client

Server

Application:

Google

Internet

Infrastructure

Packet

Packet

Packet

Packet

3-Tier Client Server Architecture example

Client

Application Server

Web Server

Common Gateway Interchange

Application Logic

Client

Application Server

Web Server

Common Gateway Interchange

Application Logic

3-Tier Client Server Architecture example
3-Tier Client Server Architecture example

Application Server

Web Server

Common Gateway Interchange

Application Logic

Database Management System (DBMS)

Database

Client

Shared data

In some implementations, Application Logic and Web Server can be put on different machines.

What is Bob’s Balance?

Database Management System

In some implementations, Application Logic and Web Server can be put on different machines.

What is Bob’s Balance?

Database Management System

3-Tier Client Server Architecture in General

Client

Application Server

- Takes inputs from client
- Makes requests of server
- Processes shared data

- Supports multiple applications with common data
- Protects critical data
- Decouples data administration and application administration

Customer | Balance | Customer Class
---------|---------|-----------------
Alice    | $527    | Silver
Bob      | $0.50   | Bronze
Charles  | $1000000| Gold

Relational Database

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.

3-Tier Client Server Architecture in General

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Book distribution centers

Financial institution

Customers

book4u.com

Inter-enterprise

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Sun Case

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.

Peer to peer

What is peer to peer good for?

- "...dominant player in powerful servers for the Internet and the exploding market for corporate intranets." (p.1)
- "last standing, fully integrated computing company" (p.2)

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"

IT Architecture I

- Sun Microsystems
  - SPARC (processor)
  - Solaris (Multiuser, Unix-like OS)
  - Foothold in large server market
  - $1.3B Cash
  - "the better idea would ultimately prevail"

- Microsoft
  - Intel (processor)
  - Windows (95, 98) single-user OS
  - NT Server (2000) finally a multiuser OS
  - $13B Cash
  - Bill Gates is confident that NT can be improved to "industrial strength"

IT Architecture II

- Sun Microsystems
  - Open Standards Strategy (TCP/IP, Java)
  - Java (programming language)
  - Java Virtual Machine (JVM) abstract away hardware and OS concerns
  - Java Applets, Servlets, Webtop Computing
  - N-tier Architecture (an idea or a product?)
  - "Thin Client"

- Microsoft
  - "Embrace and Extend" Strategy
  - Kills Applets in IE (lawsuit)
  - Total Cost of Ownership (TCO) $9900/PC
  - "Fat Client"
  - PCs are difficult to support

Who won? Who had the better idea?

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.
Sun had the better ideas!

“Sun’s goal was to create a fully developed network environment that could serve as a universal open standard for corporations that did not want to be tied to proprietary technology.” (p.13)

James A. Gosling, O.C., Ph.D. (born May 19, 1955 near Calgary, Alberta, Canada) is a famous software developer, best known as the father of the Java programming language.

Compiling C Code

- Library files are difficult to keep synchronized for all of the software on a system.
- This makes maintaining systems difficult.
- Each system becomes unique.
- N-tier architecture attempted to avoid this problem.

Java: “compile once, run anywhere”

- 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.
  - TCO of $6,500 per year ($3,400 cheaper than a PC)

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
Microsoft is more successful…

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.

Java Applets

- Killed by Microsoft in IE by “embracing and extending” (lawsuit)
- Javascript (Unrelated to Java, Brendan Eich of Netscape 1995) becomes de facto standard for client-side programming

IT Architecture III – Bill Joy

- [http://www.wired.com/wired/archive/6.08/joy_pr.html](http://www.wired.com/wired/archive/6.08/joy_pr.html)
- Q: You’ve been writing computer languages like Java. Do you envision a computer-language dislocation?
- A: The common programming languages of C and C++ basically beached us. These languages are like whales. Sun and Microsoft maintain these monstrous C programs - Solaris and Windows NT - that are built out of materials that are very difficult to work with.

IT Architecture III – Bill Joy

- [http://www.wired.com/wired/archive/6.08/joy_pr.html](http://www.wired.com/wired/archive/6.08/joy_pr.html)
- Q: Yet NT is a hit. Everyone is moving on to it.
- A: Many people were happy with the cars they bought from Detroit before Honda came along. I’d like to think that Java is more like when the Japanese came along with quality cars. With Java-based programming, instead of having one big system with infinitely complex buggy software, we can get a federation of machines working together to solve problems. The individual components are simpler. --interview with James Gosling
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
Today

- **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...

Sun case – questions (1)

1. How much time did Sun estimate developers could save when writing new applications by reusing Java objects?

2. Name one or two key differences between the 3-tier architecture and Sun’s 4-tier architecture.

3. What benefits are provided to Sun’s customers by the 4-tier architecture?

4. What is meant by a “high-latency servlet?”

Sun case – questions (2)

5. Bill Joy and James Gosling think Java is a superior programming language, but does Java have any weaknesses?

6. Which is more expensive: Sun’s application server, or the ongoing maintenance of heterogeneous software applications on diverse platforms?

7. What advantage did Microsoft have over Sun in dealing with line of business managers in customer firms? (See p. 158)