To maintain consistency.
Lectures throughout TIM158 adapted or borrowed from Kevin Ross.
Additional material added as needed.
• News Presentation
  
  Elaine Chen, Ellis Izumoto, & James Choulos on "BlackBerry Just Had Its First Good Idea in Years";

  Brian Nguyen, Marvin Wong, & Vincent Wong on "Microsoft's Azure Intelligent System". Analyze metrics

• Case Discussion
  
  – CareGroup
Key dates

• May 1, 2014
  – Turn in Business Case Assignments in hardcopy in class
  – Make sure you final project team and topic is published and included in the spreadsheet maintained by Jing Du

• May 1, 2014 (a 80 minute fun session)
  – IT thinking and analysis - a test where you will have opportunity to write about key concepts and show your understanding.

• June 3 or 6 – Turn in final project document in hardcopy in class.

• Finals day – Hello world, goodbye TIM 158 class. Quiz/test ...
CareGroup

- IT can hurt you ...
- What caused the failure
- What could CareGroup done to avoid the failure?
- Do you think the budget pressures had a role to play in the failure?
- How come Cisco gave the system a clean bill of health 60 days before the failure?
- CIO has an MD/PhD ... how good an administrator?

- What was the cause of the
John Halamka – CIO CareGroup

He has been busy.

http://healthsystemcio.com/2013/04/17/no-mission-is-more-critical-than-maintaining-a-solid-infrastructure/
McFarlan’s Strategic Grid

- Support
- Turnaround
- Factory
- Strategic
Strategic Grid

<table>
<thead>
<tr>
<th>Reactive</th>
<th>Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Keeping the Business Running</strong></td>
<td><strong>Differentiating the Business</strong></td>
</tr>
<tr>
<td>- Systems are relied upon but not invested in</td>
<td></td>
</tr>
<tr>
<td>- When an outage occurs, impact to revenue</td>
<td></td>
</tr>
<tr>
<td>- Systems are frail, and basically not adaptable</td>
<td></td>
</tr>
<tr>
<td>- IT Projects are primarily support and maintain</td>
<td></td>
</tr>
<tr>
<td>- IT is not a strategic differentiator</td>
<td></td>
</tr>
<tr>
<td><strong>Keeping the Lights Running</strong></td>
<td><strong>Transforming the Business</strong></td>
</tr>
<tr>
<td>- Operate IT at the lowest cost possible</td>
<td></td>
</tr>
<tr>
<td>- Organization invest in clerks for automation</td>
<td></td>
</tr>
<tr>
<td>- Systems are frail, and basically not adaptable</td>
<td></td>
</tr>
<tr>
<td>- IT Projects are primarily support and maintain</td>
<td></td>
</tr>
<tr>
<td>- Business can revert back to paper manual processes</td>
<td></td>
</tr>
<tr>
<td><strong>Differentiating the Business</strong></td>
<td><strong>Transforming the Business</strong></td>
</tr>
<tr>
<td>- Systems are robust and agile.</td>
<td></td>
</tr>
<tr>
<td>- Organization uses IT has a market enabler for physician and patient satisfaction.</td>
<td></td>
</tr>
<tr>
<td>- IT Projects are primarily transformation through a process change (paper to electronic) or a new service (physician portals)</td>
<td></td>
</tr>
<tr>
<td><strong>Transforming the Business</strong></td>
<td><strong>Low to high need for IT</strong></td>
</tr>
<tr>
<td>- Operate IT to reduce organizational expense</td>
<td></td>
</tr>
<tr>
<td>- Organization invest in IT for business growth.</td>
<td></td>
</tr>
<tr>
<td>- Half of the Capital Dollars are IT components.</td>
<td></td>
</tr>
<tr>
<td>- IT Budget justification is on what IT can do for the business.</td>
<td></td>
</tr>
</tbody>
</table>

http://www.anticlue.net/archives/000969.htm
CareGroup

![Graph showing operating expenses and capital expenditures from FY98 to FY01. The graph indicates a decrease in expenses over time.](image-url)
Lessons

1. Do not hesitate to bring in experts
2. Do not depend on one individual
3. Keep working knowledge current
4. Beware of users armed with little knowledge
5. Institute rigorous change control
6. Adapt to externalities
7. There are limits to being “customer friendly”
8. Have a backup procedure
9. Redundancy is not enough – alternative access!!
10. Life-cycle manage your network
Next week

• IT Infrastructure
Understanding IT Infrastructure

Lecture 9
Announcements

• Business Case due Thursday

• Business Analysis teams?
• Project teams?
Module 2: The Business of IT

- IT increasingly embedded in business model
  - Advancing technologies drive new products, processes, & industries
- IT capability critical to business model execution
  - Operational results affect business value creation
  - Requires sound IT management
- We need to explore how:
  - Changing infrastructure affects business
  - Management priorities must shift
  - To exploit opportunities and reduce operational risks
Overview of Module 2 Chapters

• Chapter 5
  – Introduces elements of modern IT infrastructure and core IT management issues

• Chapter 6
  – Addresses the robustness of IT capabilities; system availability and security

• Chapter 7
  – Explores contemporary IT service models and their management requirements

• Chapter 8
  – Examines IT project management
Understanding IT Infrastructure

Key Learning Objectives

1. Recognize the core components of modern IT infrastructure and understand the management issues associated with these components
2. Understand the business opportunities and challenges associated with pervasive internetworked computing power

“75% of all IT dollars to go Infrastructure. Isn’t it time you learned what it is?”
IBM ad campaign
Key trends

• More reliance on IT infrastructure
• New services
• Distributed Processing
• New business models
• Cloud computing
• Software defined. Adaptive, reconfigurable, …
  – Network
  – Storage
  – Infrastructure
Challenges

• Poor IT decisions lead to
  – Products with insufficient support
  – Relying on outdated protocols/systems

• The cloud promises better ...

• Technology / management divide
  – Who makes decisions?
Moore's Law or how overall processing power for computers will double every two years.
Fig. 5.1 Moore’s Law
Microprocessor Transistor Counts 1971-2011 & Moore’s Law

curve shows transistor count doubling every two years
"Moore's second law", aka Rock's law, which is that the capital cost of a semiconductor fab also increases exponentially over time.

Materials required for advancing technology (e.g., photoresists and other polymers and industrial chemicals) are derived from natural resources such as petroleum and so are affected by the cost and supply of these resources. Nevertheless, photoresist costs are coming down through more efficient delivery, though shortage risks remain.
1980’s

• PC released
  – Pre 1980 - Sinclair, Commodore, Apple II ... People moved jobs to computers

• No longer needed staff for computing/data processing

• LANs allowed people to share files, printers etc.

• IT services provided over distributed servers
1990’s

• Internet boom
• TCP/IP provided robust standard for messages between all computers on web
• Network resources available to individuals
Fig 5.2 Evolution of Corporate IT Infrastructure
Total value of a network to its users grows as the square of the total number of its users. Thus, the ratio of value to cost of adding one more network user grows disproportionately as the network grows larger. Also called law of telecom, it was proposed by Robert C. Metcalfe, co-inventor of the Ethernet.
Fig 5.3 Metcalfe’s Law

“The usefulness of a network increases with the square of the number of users connected to the network”
What Metcalfe actually said ...

The Systemic Value of Compatibly Communicating Devices Grows as the Square of Their Number:

- Value $\propto N^2$
- Cost $\propto N$

Critical Mass Crossover
Keeping up with Bandwidth Demand?

Annual global IP traffic will surpass the zettabyte threshold (1.3 zettabytes) by the end of 2016.
Global IP traffic has increased eightfold over the past 5 years, and will increase threefold over the next 5 years.

In 2016, the gigabyte equivalent of all movies ever made will cross global IP networks every 3 minutes.

Global IP networks will deliver 12.5 petabytes every 5 minutes in 2016.
No. of Devices connected to IP networks = 3x Global Population (2016)

A growing amount of IP and Internet traffic is originating with non-PC devices.

% of IP Traffic from non-PC Devices
- 2011: 22%
- 2016: 31%

Consumer Internet Traffic from non-PC Devices
- 2011: 6%
- 2016: 20%
It would take over 6 million years to watch the amount of video that will cross global IP networks each month in 2016.

Every second, 1.2 million minutes of video content will cross the network in 2016.
Fig 5.4 Bandwidth Explosion

Growth faster than computer chips

Network Bandwidth Growth

2001+
- True voice-over-IP telephony, high-resolution Internet television, music and movies on demand, virtual workplaces, broadband wireless

1999–2000
- Live audio and video streaming events, digital commerce, Internet radio and television, voice chat applications

1997–1998
- Streaming audio and video, advanced e-commerce, live stock quotes, 1,000MBps

1996–1997
- Mass WWW adoption, graphic-intensive, instant messaging

1994–1996
- Mass e-mail adoption, basic WWW sites

1990–1994
- Large file transfer, e-mail

1960–1990
- File transfer

Increasing Network Bandwidth
Components of Internetworking Infrastructure

• Network
  – Hardware/software that permit exchange of information between processing units and organizations

• Processing Systems
  – Hardware/software providing ability to handle business transactions

• Facilities
  – Physical systems that house and protect devices

• Trend: Increasing freedom to manage resources

• See table 5.1
### Table 5.1: Fundamental Components of Internetworking Infrastructure

<table>
<thead>
<tr>
<th>Core Technologies</th>
<th>Key Management Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network</strong></td>
<td></td>
</tr>
<tr>
<td>Fiber optics, cable systems, DSL, satellite, wireless, internetworking hardware (routers, switches, firewalls), content delivery software, identity and policy management, Net monitoring</td>
<td>How to select technologies and standards</td>
</tr>
<tr>
<td></td>
<td>How to select partners</td>
</tr>
<tr>
<td></td>
<td>How to manage partner relationships</td>
</tr>
<tr>
<td></td>
<td>How to assure reliability</td>
</tr>
<tr>
<td></td>
<td>How to maintain security</td>
</tr>
<tr>
<td><strong>Processing Systems</strong></td>
<td></td>
</tr>
<tr>
<td>Transaction software (enterprise systems offered by companies such as SAP and Oracle or more targeted solutions, sometimes homegrown), servers, server appliances, client devices (PCs, handhelds)</td>
<td>What to keep internal and what to outsource</td>
</tr>
<tr>
<td></td>
<td>How to deploy, grow, and modify</td>
</tr>
<tr>
<td></td>
<td>Enterprise system or best-of-breed hybrid</td>
</tr>
<tr>
<td></td>
<td>Relationships with legacies</td>
</tr>
<tr>
<td></td>
<td>How to manage incidents</td>
</tr>
<tr>
<td></td>
<td>How to recover after a “disaster”</td>
</tr>
<tr>
<td><strong>Facilities</strong></td>
<td></td>
</tr>
<tr>
<td>Corporate data centers, collocation data centers, managed services data centers, data closets</td>
<td>Internal or external management</td>
</tr>
<tr>
<td></td>
<td>Choosing a facilities model suited to one’s company</td>
</tr>
<tr>
<td></td>
<td>How to assure reliability</td>
</tr>
<tr>
<td></td>
<td>How to maintain security</td>
</tr>
</tbody>
</table>
Networks

• Local Area Networks (LANs)
• Hubs, switches, wireless access points, network adapters
• Wide Area networks (WANs)
• Routers
• Firewalls, Security Systems
• Caching, Content Acceleration
Fig 5.5 LAN
An Example of a WAN
Processing Systems

• Client Devices and Systems
• Server Devices and Systems
• Mainframe Devices and Systems
• Middleware
• Infrastructure Management Systems
• Business Applications
Fig 5.7 Servers in possible E-commerce configuration
Facilities

- Buildings, physical space
- Network Conduits, connections
- Power
- Environmental Controls
- Security
Fig 5.8 Modern Data Center

- Two Generators
- Switches (high-voltage)
- Electrical Vault
- Private Suites
- Transport Room
- Network Operations Center
- Card Key Access
- Storage and Receiving
- Air Conditioning
- Collocation Area

© Robert Austin, 2005
Discussion

• How much does a typical manager understand of computing networks?

• What educational opportunities are there?
Operational Characteristics of Internetworking

- Internetworking Technologies are Based on Open Standards
- Internetworking Technologies operate asynchronously
- Internetworking communications have inherent latency
- Internetworking technologies are naturally decentralized
- Internetworking technologies are scalable
- See tables 5.2, 5.3
Business Implications

• Quicker communications leads to efficiency
• More data leads to better-informed decisions
• Progress of processes become transparent
• Processes more efficient
• *Make and sell becomes sense and respond*
Threats

- Automation can lead to chain reaction, cascading failures
- Outside attacks
- See table 5.4
# Table 5.4: Denial of Service Attacks

<table>
<thead>
<tr>
<th>Date</th>
<th>Target Company</th>
<th>Results of Attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 7</td>
<td>Yahoo!</td>
<td>• Overwhelming spike in traffic that lasted 3 hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Network availability dropped from 98% to 0%.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Attack originated from 50 different locations and was timed to occur during middle of business day.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stock was down 3.2% for a week in which NASDAQ rose almost 3%.</td>
</tr>
<tr>
<td>February 8</td>
<td>Buy.com</td>
<td>• Attack occurred within an hour of the company’s initial public offering (IPO).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stock was down at week’s end more than 20% from IPO price.</td>
</tr>
<tr>
<td></td>
<td>eBay</td>
<td>• Stock was down 7.3% for a week in which NASDAQ rose almost 3%.</td>
</tr>
<tr>
<td></td>
<td>CNN.com</td>
<td>• Service disrupted.</td>
</tr>
<tr>
<td>February 9</td>
<td>E*TRADE</td>
<td>• Attacked during peak trading hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stock was down 7.6% for a week in which NASDAQ rose almost 3%.</td>
</tr>
<tr>
<td></td>
<td>ZDNet</td>
<td>• Service disrupted.</td>
</tr>
<tr>
<td>February 18</td>
<td>Federal Bureau of Investigation (FBI)</td>
<td>• Service disrupted.</td>
</tr>
<tr>
<td>February 24</td>
<td>National Discount Brokers Group (NDB)</td>
<td>• Attacked during peak trading hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operators accidentally crashed site as they attempted to defend against the attack</td>
</tr>
</tbody>
</table>

*Overall performance of the Internet degraded by as much as 25% during the peak of the attacks as computers resent messages repeatedly and automatically, trying to recover interrupted transactions.

New service models

- Physical location of computers less important
- Economies of scale for particular services
- New capabilities must be integrated into existing systems
  - Deal with legacy technology
- Reliability must improve
  - See next case!
Discussion: Outsourcing

• What about outsourcing of IT infrastructure?