TIM158
Business Information Strategy

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Teaching Assistant: Paul Vroomen

To maintain consistency.
Lectures throughout TIM158 adapted or borrowed from Kevin Ross.
Additional material added as needed.
Lecture 8

• News Presentation

• Case Discussion
  – CareGroup
Key dates

• May 5, 2015
  – 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 5, 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 first week – 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?
John Halamka – CIO CareGroup

He has been busy.

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

“The reason why I’ve been successful is because I know all the technologies, I program in 12 languages, and I’ve written books on Unix system administration. I’m a doctor, so I understand the clinical domain and the technical requirements. But as I tell people, my own blind spot—I’ve wired a telephone closet, I’ve built 100 servers, hundreds of desktops, but never built anything beyond a home network. It’s just the reality. But, I have now.”
By 2002, all of these hospitals had been brought together on a common system with the Meditech software at the center. All had state-of-the-art e-mail, networking, PCs, and clinical/financial information systems at costs similar or reduced from those at the time Halamka took over. For example, NEBH’s IT budget dropped $135,000 in fiscal year 2002, and it was expected to drop another $400,000 in fiscal year 2003.

By 2003, CareGroup believed it had the most advanced network in health care, the most advanced e-mail system in health care, the most advanced voice/wireless system in health care, the most advanced data center in health care, and the most advanced Web infrastructure in health care. It served 3,000 physicians, processed 40 terabytes of data per day, and handled 900,000 patient records dating back to 1977, all supported by a staff of 200.
Care Group formation

Exhibit 1  CareGroup Organizational Chart, January 1, 2003

By December 31, 2002, Deaconess-Waltham Hospital and Deaconess-Nashoba Hospital were no longer part of CareGroup, and Nashoba-Glover Hospital reported to the Beth Israel Deaconess Medical Center.

Source: CareGroup internal documents.
In the days leading up to November 13, 2002, a researcher on the CareGroup network had begun experimenting with a knowledge management application based on file sharing, a sort of “Napster for health care.” The software was designed to locate and copy information across the network automatically. No sooner had this researcher set up the software in its original configuration than he received a call from his wife telling him she was in labor. He departed hurriedly for a three-week paternity leave. The new software was left running in a basic mode not yet tested or tuned for the environment in which it was operating. The new application began to explore the surrounding network, seeking out and copying data in larger and larger volumes from other computers. By the afternoon of Wednesday, November 13, the rogue software program was moving terabytes of data across the network.
Cisco to the rescue

Within hours, Cisco had dispatched from Santa Clara, California, a Boeing 747 loaded with network equipment and support engineers. At the same time, an expert team from North Carolina, consisting of staff from Cisco and Callisma (a Cisco consulting partner), boarded commercial airline flights headed for Boston. The team and equipment were adequate to build an entire redundant core network to get CareGroup systems up and running again, should that prove necessary. In the late hours of Thursday night, as Halamka drove to the airport to meet the Cisco engineers, he realized just how tired he was; by then he had been awake for 36 consecutive hours. He knew that other members of his team were also tired and badly needed the strong support he hoped he would get from Cisco.
McFarlan’s Strategic Grid
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>- Systems are robust and agile.</td>
</tr>
<tr>
<td>- When an outage occurs, impact to revenue</td>
<td>- Organization uses IT has a market enabler for physician and patient satisfaction.</td>
</tr>
<tr>
<td>- Systems are frail, and basically not adaptable</td>
<td>- IT Projects are primarily transformation through a process change (paper to electronic) or a new service (physician portals)</td>
</tr>
<tr>
<td>- IT Projects are primarily support and maintain</td>
<td>- IT is not a strategic differentiator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reactive</th>
<th>Proactive</th>
</tr>
</thead>
<tbody>
<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>- Operate IT to reduce organizational expense</td>
</tr>
<tr>
<td>- Organization invest in clerks for automation</td>
<td>- Organization invest in IT for business growth.</td>
</tr>
<tr>
<td>- Systems are frail, and basically not adaptable</td>
<td>- Half of the Capital Dollars are IT components.</td>
</tr>
<tr>
<td>- IT Projects are primarily support and maintain</td>
<td>- IT Budget justification is on what IT can do for the business.</td>
</tr>
<tr>
<td>- Business can revert back to paper manual processes</td>
<td></td>
</tr>
</tbody>
</table>

http://www.anticlue.net/archives/000969.htm
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 nex week
• Quiz - Thursday
• 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

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

The 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

- Mainframe-Based Centralized Computing (Pre-1980)
- PC-Based Distributed Computing (1980s)
- Client-Server Computing (late 1980s to early 1990s)
- Internetwork-Based Computing (Mid-1990s to Present)
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:

- Cost \( \approx N \)
- Value \( \approx N^2 \)
- Critical Mass Crossover
The U.S. Ranks 8th in High Speed Internet Penetration

Top 10 countries with the highest penetration of 10+ Mbps internet connections

South Korea: 45%
Japan: 43%
Switzerland: 37%
Latvia: 33%
Netherlands: 31%
Czech Republic: 27%
Belgium: 25%
United States: 24%
Finland: 23%
United Kingdom: 23%

Source: Akamai
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%
The Internet of Things (IoT)* units installed base by category from 2013 to 2020 (in millions)

The statistic shows the installed base of the Internet of Things (IoT) by category between 2013 and 2020. An estimated 3.5 billion units will be in use in the automotive industry by 2020.
The chart shows the Compound Annual Growth Rate (CAGR) for different categories of devices:

- PCs: 28%
- TVs: 42%
- Tablets: 116%
- Smartphones: 119%
- Business Internet M2M modules: 86%
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

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Network Bandwidth Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001+</td>
<td>True voice-over-IP telephony, high-resolution Internet television, music and movies on demand, virtual workplaces, broadband wireless</td>
</tr>
<tr>
<td>1999–2000</td>
<td>Live audio and video streaming events, digital commerce, Internet radio and television, voice chat applications</td>
</tr>
<tr>
<td>1997–1998</td>
<td>Streaming audio and video, advanced e-commerce, live stock quotes, 1,000MBps</td>
</tr>
<tr>
<td>1996–1997</td>
<td>Mass WWW adoption, graphic-intensive, instant messaging</td>
</tr>
<tr>
<td>1994–1996</td>
<td>Mass e-mail adoption, basic WWW sites</td>
</tr>
<tr>
<td>1990–1994</td>
<td>Large file transfer, e-mail</td>
</tr>
<tr>
<td>1960–1990</td>
<td>File transfer</td>
</tr>
</tbody>
</table>

© Robert Austin, 2005
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
Drivers for SDN

SDN addresses the fact that the static architecture of conventional networks is ill-suited to the dynamic computing and storage needs of today’s data centers, campuses, and carrier environments. The key computing trends driving the need for a new network paradigm include:

• Changing traffic patterns: Applications that commonly access geographically distributed databases and servers through public and private clouds require extremely flexible traffic management and access to bandwidth on demand.
• The “consumerization of IT”: The Bring Your Own Device (BYOD) trend requires networks that are both flexible and secure.
• The rise of cloud services: Users expect on-demand access to applications, infrastructure, and other IT resources.
• “Big data” means more bandwidth: Handling today’s mega datasets requires massive parallel processing that is fueling a constant demand for additional capacity and any-to-any connectivity.
• In trying to meet the networking requirements posed by evolving computing trends, network designers find themselves constrained by the limitations of current networks:
  • Complexity that leads to stasis: Adding or moving devices and implementing network-wide policies are complex, time-consuming, and primarily manual endeavors that risk service disruption, discouraging network changes.
  • Inability to scale: The time-honored approach of link oversubscription to provision scalability is not effective with the dynamic traffic patterns in virtualized networks—a problem that is even more pronounced in service provider networks with large-scale parallel processing algorithms and associated datasets across an entire computing pool.
  • Vendor dependence: Lengthy vendor equipment product cycles and a lack of standard, open interfaces limit the ability of network operators to tailor the network to their individual environments.
Software Defined Network

- **Directly programmable:** Network control is directly programmable because it is decoupled from forwarding functions.
- **Agile:** Abstracting control from forwarding lets administrators dynamically adjust network-wide traffic flow to meet changing needs.
- **Centrally managed:** Network intelligence is (logically) centralized in software-based SDN controllers that maintain a global view of the network, which appears to applications and policy engines as a single, logical switch.
- **Programmatically configured:** SDN lets network managers configure, manage, secure, and optimize network resources very quickly via dynamic, automated SDN programs, which they can write themselves because the programs do not depend on proprietary software.
- **Open standards-based and vendor-neutral:** When implemented through open standards, SDN simplifies network design and operation because instructions are provided by SDN controllers instead of multiple, vendor-specific devices and protocols.
SDN Application
- SDN App Logic
- NBI Driver

SDN Northbound Interfaces (NBIs)

SDN Controller
- NBI Agent
- SDN Control Logic
- CDPI Driver

SDN Datapath
- CDPI Agent
- Forwarding Engine / Processing Function

Network Element

Contracts
- SLAs

Management & Admin
- Configure Policy
- Monitor Performance

App's explicit requirements
- Network State, Stats, Events

Expose Instrumentation, statistics and events up
- Translate req's down

Enforce Behavior
- Low-level Ctrl
- Capability Discovery
- Stats and Faults

Element setup

* indicates one or more instances
| * indicates zero or more instances

Multiple NBIs at varying latitudes and longitudes.
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>• How to select technologies and standards</td>
</tr>
<tr>
<td>Fiber optics, cable systems, DSL, satellite, wireless, internetworking</td>
<td>• How to select partners</td>
</tr>
<tr>
<td>hardware (routers, switches, firewalls), content delivery software, identity and</td>
<td>• How to manage partner relationships</td>
</tr>
<tr>
<td>policy management, Net monitoring</td>
<td>• How to assure reliability</td>
</tr>
<tr>
<td><strong>Processing Systems</strong></td>
<td>• How to maintain security</td>
</tr>
<tr>
<td>Transaction software (enterprise systems offered by companies such as SAP and</td>
<td>• What to keep internal and what to outsource</td>
</tr>
<tr>
<td>Oracle or more targeted solutions, sometimes homegrown), servers, server appliances,</td>
<td>• How to deploy, grow, and modify</td>
</tr>
<tr>
<td>client devices (PCs, handhelds)</td>
<td>• Enterprise system or best-of-breed hybrid</td>
</tr>
<tr>
<td><strong>Facilities</strong></td>
<td>• Relationships with legacies</td>
</tr>
<tr>
<td>Corporate data centers, collocation data centers, managed services data centers,</td>
<td>• How to manage incidents</td>
</tr>
<tr>
<td>data centers, data closets, data closets</td>
<td>• How to recover after a “disaster”</td>
</tr>
<tr>
<td><strong>Key Management Issues</strong></td>
<td>• Internal or external management</td>
</tr>
<tr>
<td>• How to select technologies and standards</td>
<td>• Choosing a facilities model suited to one’s company</td>
</tr>
<tr>
<td>• How to select partners</td>
<td>• How to assure reliability</td>
</tr>
<tr>
<td>• How to manage partner relationships</td>
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<td></td>
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<tr>
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<td></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
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>eBay</td>
<td>• Stock was down at week’s end more than 20% from IPO price.</td>
</tr>
<tr>
<td></td>
<td>CNN.com</td>
<td>• Stock was down 7.3% for a week in which NASDAQ rose almost 3%.</td>
</tr>
<tr>
<td></td>
<td></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>ZDNet</td>
<td>• Stock was down 7.6% for a week in which NASDAQ rose almost 3%.</td>
</tr>
<tr>
<td></td>
<td></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?