

MG6553 Intro to Management of Data & Communications Networks

Monday 6 – 8:15 PM RH-503

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- 9/10 9/17 9/24 • 10/01 10/09* 10/15 10/22 10/29 • **11/05 11/12 11/19 11/26** • **12/03 12/10 12/17** •
* Tuesday Class – For Columbus Day – 10/08

<u>CLASS</u>	<u>TOPIC</u>	<u>CHAPTERS</u>
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Textbook: Business Data Communications, 6th Edition, David A Stamper & Thomas L Case, Prentice-Hall, ISBN: 0-13-009428-5, 2003.

This course is designed to introduce the fundamentals of modern telecommunications and networking to current and future managers. The course covers basic concepts such as components of data communication, data transmission, Open System Interconnection (OSI), TCP/IP and other models, data link and network layers, and local area networks (LANs). The emphasis of the course is to expand technical knowledge and discuss related managerial issues.

Class attendance is mandatory. A paper will be due on each class' lecture; each paper building on the preceding one. Failure to attend class will disadvantage the student and may result in lower grades due to the lack of merits on these weekly papers.

Each paper (15) should be 3 pages in length and will count for 3% of the final grade. Each paper will be due the following class . . . total **45%** of the final grade.

Class participation and involvement will count for **15%** of the final grade based on depth and scope of discussion.

Each student will keep and maintain a personal journal concerning data communications management issues throughout the semester. This journal will be submitted on the last day of class during which each student will give a 3 minute discussion of it and its issues. This journal and discussion will count for **15%** of the total course grade.

The final paper/presentation will serve to bring the technical and management issues discussed in alignment with the business strategy of an actual or hypothetical company. The depth, scope, and maturity of the analysis as well as the overall technical/management plan outlined will determine the grade which will count for **25%** of the total course grade.

MG6553 CLASS NOTES

Data Communications for Managers

Class 1: (Chapter 1)

Business Data Communications

➤ **Evolution of Modern Data Communications**

- The 1970's: mainframe-based data processing
- The 1980's: PC augmented client / server information systems
- The 1990's: networked enterprise-wide information systems
- Today: inter-networked e-business communities

➤ **The Nature of Business Systems**

- Distributed Data Processing, Information Systems
- Intranets, Extranets, Knowledge Systems
- Issues: bandwidth, cost, convergence, standards, security, business alignment, careers

➤ **Understanding the Transmission of Information**

- Transmission Protocols (LAN, WAN, TCP/IP)
- Messaging, Media, Encoding Techniques, Efficiency / Communication Theory

➤ **Networking / Internetworking**

- Local Area Networks (LAN)
- Wireless (WLAN, WiFi, WiMax)
- Wide Area Networks (WAN)
- Internet Protocols (TCP/IP)
- Network / Internet Management
- International Standards & Security
- eCommerce / eBusiness – building the new “e-infrastructure” platform !

➤ **OSI Reference Model** (pgs. 15-16)

- Application - Layer 7 - user interface
- Presentation - Layer 6 - (re)formats data
- Session - Layer 5 - dialog between applications
- Transport - Layer 4 - end-to-end delivery
- Network - Layer 3 - message routing
- Data Link - Layer 2 - error detection/correction, path control
- Physical - Layer 1 - transmission media, electrical connectivity

Summary

The communications technologies when taken together and properly managed form the infrastructure of the new ebusiness initiative! Communications allows us to expand the scope of the business and manage it more efficiently. Through collaboration we can better understand and harness it's emergent behaviors and so better lead the business in the future.

Homework: Discuss the OSI transmission protocol model and its business ramifications.

Class 2: (Chapter 2)

The Internet: TCP/IP Protocols

- **Internet Beginnings, Personalities, and Organizations** (see text page 44)
 - *Jon Postel, IANA* (Internet Assigned Numbers Authority)
 - The RFC Process (Request for Comments)
 - ARPANET: Advanced Research Projects Agency Network (US DOD)
 - The World Wide Web (WWW) & Tim Berners-Lee (see: www.w3.org)
 - The Browser & Marc Andreessen / The Browser Wars (Microsoft vs Netscape)
 - ICANN (Internet Corporation for Assigned Names and Numbers) www.icann.org

- **IP: Internet Protocol** (Internet Addressing)
 - IPv4 (32 bit address; Tbl. 2-4, pg. 59)
 - IPv6 (128 bit address; Tbl. 2-5, pg. 62)
 - Dotted Decimal Notation
 - Subnets / Subnet Masks (Fig. 2-3, pg. 45)
 - Adding Complexity to the Communications Infrastructure
 - The Domain Name System
 - .com, .org, .net, .mil, .gov, .edu (and others)

- **TCP: Transmission Control Protocol** (see Figure 2-9. Pg. 58)
 - Transmission Control Analogies
 - Phone System, Postal Service
 - Root Servers, Firewalls, Routers & 'Next Hop' Processing (Fig. 2-8, pg. 57)

- **TCP/IP Layers**
 - Physical, Network Access, Internet, Transport, Application
- **OSI (Open Systems Interconnection) Model**
 - Physical, Data Link, Network, Transport, Session, Presentation, Application

- **Other Important Protocols**
 - Email: SMTP – Simple Mail Transfer Protocol
 - File Transfer: FTP – File Transfer Protocol
 - Machine-to-Machine: UDP – User Datagram Protocol
 - WWW: HTTP – HyperText Transfer Protocol

- **Internet Utilization** (see www.isoc.org)
 - Internet Service Providers (ISP, Fig 2.4 pg,47)
 - Public, Commercial, & Business Internet Usage

Summary:

The Internet's architecture determines its utility & it's management determines its usability; both are in a state of flux as we continue to re-invent this global network. The protocols by which the Internet functions are designed for global access and compatibility. In achieving their goals, the inventors of the Internet have given us a unique communications environment.

Homework: Research (from the internet sites pg. 44 of the text) and discuss an important Internet issue and its business / management / social ramifications.

Class 3: (Chapter 3)

eCommerce / eBusiness

➤ **Internet Business**

- eCommerce / eBusiness - the differences, similarities, and technologies

➤ **Types of eCommerce**

- B2C – Business to Consumer Amazon.com
- C2C – Consumer to Consumer eBay.com
- B2B – Business to Business [emarketplaces / exchanges](#)

➤ **eCommerce Issues**

- Secure Transaction Processing
- eCommerce Business Architectures

➤ **eCommerce Architectures**

- e-Storefront Design / Processing Issues (see Table 3-3, page 96)
- SET – Secure Electronic Transaction Standard (see 'payment technologies')
- Complete eCommerce Architecture Diagram (see Figure 3-3, page 95)

➤ **eBusiness Issues & Applications**

- Business Process Reengineering
- Intra-company ebusiness (Intranet)
- Extra-company ebusiness (Extranet with [XML](#), Extensible Markup Language)

- [EDI](#) – Electronic Data Interchange (especially EDI over the Internet)
- [SCM](#) – Supply Chain Management
- [CRM](#) – Customer Relationship Management

➤ **eBusiness Communications Infrastructure** (Figure 3-7, Page 119)

- Local networks, regional networks, wide area networks, internetworking
- Internet-based EDI Systems (Case Study, pages 125 – 126, Course text)
- [A Framework for Global Electronic Commerce](#), July 1997 (see Tbl. 1-3 & 1-4, pgs. 22 & 23)

➤ **Case Study: Yummy Jams of South Carolina (a fictitious company)**

- ◆ Founded in 1870 just after the US Civil War. For over a hundred years, its famous jams and jellies were almost unknown outside the Palmetto state. In the 1980's, Yummy Jams began selling to select gourmet shoppes nationwide.
- ◆ With the 'coming-of-age' of the Internet in the early 1990's, the new CEO (a recent MBA from Harvard and the current generation in this still family-owned business) started yummy_jams.com – a new Internet venture. This matured with the Internet so that today it's joined by yummy_jams.biz and [.info](http://yummy_jams.info).
- ◆ yummy_jams.com – the corporate site – is mainly an online brochure introducing every Internet guest to Yummy Jams' history, operations, and financial status; it also serves as the company's B2B portal. yummy_jams.biz is the company's online e-store. yummy_jams.info is its 'community' site bringing together customers, aficionados, chefs, and simply the curious into a community-of-interest (COIN) for all lovers of jams, jellies, and the 'goodies' that human creativity can devise from them.

Summary

Through eCommerce and eBusiness, industry worldwide is changing for the better as we watch it.

Homework: Discuss the difference between eCommerce & eBusiness and their attendant management ramifications for a typical company such as Yummy Jams.

Class 4: (Chapter 4)

Internet Addressing & Operations

➤ **Internet (IP) Addressing**

- IPv4 (32 bit) (see Tables 4-1 and 4-2, pages 130-131)
 - Dotted Quad (dotted decimal) Notation
 - N1.N2.N3.N4 - separated into network & host segments
 - Class A – denotes the small number of large networks
 - N1 – network, N2.N3.N4 – host / N1 = 1 to 127
 - Class B – denotes the medium number of medium size networks
 - N1.N2 – network, N3.N4 – host / N1 = 128 to 191
 - Class C – denotes the large number of small networks
 - N1.N2.N3 – network, N4 – host / N1 = 192 to 223
- IPv6 (128 bit) – the future of Internet addressing; in use today and growing.

➤ **Static / Dynamic IP Addressing**

- “always-on” vs “dial-up”
- DHCP – Dynamic Host Configuration Protocol

➤ **IP Addressing in LANs**

- LAN Media Access Control (MAC) Addresses
- Address Resolution Protocol (ARP)
- Translating IP addresses into MAC addresses
- Subnets & their Advantages (page 135-139)
- Overlaying a LAN with an Intranet’s Subnet

➤ **IP Operations** (see Figure 4-12, page 148)

- IP Routing Algorithm (page 147)

➤ **IPSec – Internet Protocol Security Architecture** (see Figure 4-19, page 160)

- Transport Mode, Tunnel Mode
- Virtual Private Networks (VPN)
- Ports and Sockets (page 147-149; connecting to a VPN)

➤ **The Domain Name System** (enhanced; see Fig. 4-3, page 134)

- Top-Level Domains (TLDs) – see Table 4-4, page 132
- Country Codes (ccTLDs) - see Table 4-5, page 133
- Newly Approved TLDs – see Table 4-6, page 133

➤ **Internet Business & Management Issues**

- eCommerce Transaction Processing
- eBusiness Process Reengineering
- Intranets, Extranets, Portals, eMarketplaces

➤ **Technology Architectures** (pages 151-155)

- HTML, HTTP, S-HTTP, SSL
- Java, XML, XHTML / Web Services

➤ **Server Configurations**

- Server Farms, Load Balancing (see Figure 4-17, page 156)
- HTML Servers, XML Servers, Merchant Servers, Server Clusters
- **Data Communications Security** (see Figure 4-18, page 158)
 - Firewalls, Proxy Servers, Network Address Translation
- **Case Study:** Discussion of how these technologies might affect a typical company such as Yummy Jams and its business operations.

Summary:

While eCommerce & eBusiness operational architectures are complex, the family of Internet technologies is fitted together by design so well that smooth operations are achieved. This is seen especially with IP subnet addressing which allows easy, consistent communications between any two computers while permitting local networks the degree of complexity needed.

Homework: Discuss the various business and management aspects of IP addressing technology..

Class 5: (Chapter 5)

Telecomm / Datacomm Technologies

- **Voice Communications** (Circuit Switching Networks)
 - Physics of Sound
 - Voice Transmission
 - The Telephone / The Telephone Circuit
 - Private Branch Exchange (PBX)
 - Public Switched Telephone Network (PSTN)
- **The Telecommunications Industry** (USA)
 - American Telephone & Telegraph (AT&T)
 - The Breakup of AT&T (1984) / RBOCs / CLECs
 - Regional Bell Operating Companies
 - Competitive Local Exchange Carriers
- Regulated Natural Monopoly Vs Specialized Competitive Industry
- **Data Communications** (Packet Switching Networks)
 - Characteristics of Discrete Data
 - Transmission Line Usage
 - Internet Service Provider (ISP)
 - Packet Distribution Network (PDN)
- **Communication Line Speeds**
 - Standard Telephone Service
 - Plain Old Telephone Service (POTS) Line
 - Digital Subscriber Lines (DSL)
 - xDSL – symmetric / asymmetric
 - Digital Service Lines (DS-n)
 - DS-0, DS-1, ... T-n, Fractional T-n
 - Optical Transmission Lines (OC)

- Synchronous Optical Network (SONET)
 - OC1 / OC3 / ... / OC192
- **Technology Convergence**
 - VoIP – Voice over IP
 - Is it 'voice' or is it 'data' transmission?
 - Should it be 'regulated' or 'unregulated'?
 - Multimedia Internet Capabilities
- **Legal / Social Issues**
 - The Telecommunications Act of 1934
 - The Telecommunications Reform Act Of 1996
 -
 - Universal (Telephone) Service Mandate
 - Tele-commuting / Mobile-Wireless Connectivity
 - The Digital Divide – An Internet Futures Dilemma

Summary:

Through the eyes of technology, we can see the necessary evolution of the telecommunications / data communications industry. The different types of communications equipment provide functionality across a wide range of business needs. This flexibility yields the universal service upon which ebusiness is built. We have to assure there's a future where communications technology is used for the freedom and betterment of all.

Homework: Discuss the 'convergence' of tele-comm and data-comm technologies and the emergence of the VoIP environment.

Class 6: (Chapter 6)

Data Encoding / Transmission

- **Data Codes** (pgs. 221-222)
 - ASCII / EBCDIC
 - UNICODE
- **Data Compression** (pg.248)
 - V.42bis – Lempel Ziv
 - MNP Class 5
 - Huffman Encoding
 - Run-Length Encoding
 - MNP Class 7 / V.44
- **Data Transmission**
 - Carrier Signals / Amplitude, Frequency & Phase Modulation
 - Bit Rates, Baud Rates, Bandwidth, and Handshaking
- **Data Flow Control**
 - Connector Design / Pinouts

➤ **Error Detection / Correction**

- Error Sources
 - Impulse Noise, Crosstalk, Echo
 - White Noise, Electromagnetic Interference (EMI)
 -
- Parity Checks (odd, even), Checksums
- Cyclical Redundancy Checks (CRC)
- Acknowledgement (ACK) / Negative Acknowledgement (NAK)
-
- Automatic Repeat Request (ARQ)
 - Discrete (stop-and-wait) ARQ
 - Continuous (go-back-n) ARQ
 - Selective ARQ

Summary:

The different types of data encoding and transmission techniques provide communications across a wide range of environments. This flexibility permits the types of service upon which ebusiness is built.

Homework: Research and discuss the various data transmission technologies and their business scenarios/issues.

Class 7: (Chapter 7 & 8)

Local Area Networks (LAN)

- **Business Advantages**
 - Enhanced Management Control
 - Cost Effective / Modular Expansion
 - Links Computer Resources by Business Use
- **LAN Components** (see Fig. 7-4, Pg. 285)
 - T-Connectors, RJ-45 Plugs, Wall Jacks
 - Network Interface Cards (NICs), PCMCIA Cards
 - Hubs, Patch Panels, Patch Cables, Baluns
 - Wires, Bundles, Coaxial & Fiber Optic Cables
 - PCs, Notebooks, Workstations, Terminals
 - Printers, Servers, UPS, RAID Storage, Wireless
- **Communication Media**
 - Twisted Pair, Coaxial, Fiber Optic
 - Unshielded Twisted Pair (UTP)
 - Shielded Twisted Pair (STP)
 - Category (CAT) 1, 2, 3, 4, 5, 5e, 6 (see Tbl. 7-2, Pg. 297)
 - Communication Rates: 10mbps, 100mbps, 1000mbps (see pages 347-348)
- **LAN Alternatives**
 - CEBus, HomeRF
 - Sub-LANs / Zero-Slot LANs

➤ **Management Issues**

- LAN Topology
 - Bus / Ring / Star
- LAN Upgrade / Maintenance
- LAN Interoperability Issues
- LAN-to-Host Interoperability
- LAN Security: Wireless, Enterprise-wide

Summary:

Local Area Networks (LANs) permit a business to bring together all necessary resources needed by groups of employees to best perform their related business functions.

Homework: For the small department noted in Problem #11, page 323, course text: design /construct a LAN including designation of communication line speed and media type (for online hardware references).

Class 8: (Chapters 8 & 9)

LAN Protocols & Architectures

➤ **Local Area Networks (LANs)**

- Ethernet (logical bus topology)
 - Manchester Encoding
- Token Ring (logical ring topology)
 - Differential Manchester Encoding

➤ **Data Link Protocols** (Fig. 8-10,pg. 340)

- Media Access Control (MAC)
- Logical Link Control (LLC)

- Delineation of Data / Error Control / Addressing
- Transparency / Code Independence / Media Access

➤ **MAC Protocols**

- CSMA/CD
 - Carrier Sense Multiple Access & Collision Detection
- CSMA/CA
 - Carrier Sense Multiple Access & Collision Avoidance

➤ Token Passing (with MAU – Multistation Access Unit)

➤ **LAN Architectures**

- Ring / Bus / Star (Fig. 8-1, pg. 329)

➤ **Tiered Architectures** (see Fig. 8-22, Pg. 359)

- Three Tiered Client Server
 - PC Client / Application Server / Enterprise Database Server

- Wireless LANs & Their Security Issues

- **LAN Standards**
 - IEEE 802.3 (Ethernet)
 - IEEE 802.5 (Token Ring)
 - IEEE 802.11 (Wireless)

- **LAN Software**
 - **Network Operating Systems (NOS)** (pg. 414)
 - Windows 2000 / Netware / Linux / Unix / Solaris
 - **Workgroup Software**
 - EMail / Conferencing / Workflow Automation
 - Document Management / Decision Support / Collaboration

- **Management Considerations**
 - LAN Interoperability Issues
 - LAN Upgrade / Maintenance
 - LAN-to-Host Interoperability
 - LAN Security: Wireless, Enterprise-wide

 - LAN Selection Factors (pg. 365 - pg. 369)
 - LAN Support Staffing / LAN Software License Agreements

Summary:

Local Area Networks (LANs) are chosen more for their strategic business 'fit' than for their protocols. Of Ethernet and Token Ring, Ethernet is the more popular and scalable. LAN architecture/software deployment should parallel & support business needs at every level.

Homework: Research and discuss an Ethernet-based LAN network product..