BA 4323
Business Data Communications

Administrative Details
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All assignments will be submitted using WebCT.
All communication will take place through WebCT.
Assignment 0, due September 3rd, will help you familiarize yourself with using WebCT and make sure that you can access your course material without any trouble.
Check for changes at least twice a week.
Objectives

- Brief History of Telecommunications
- Data Communications Networks
  - Components of a Network
  - Types of Networks
- Network Models
  - OSI Model
  - Internet Model
- Network Standards
- Benefits and Impact of Telecommunications

Why Study Data Communications

- An organization needs cooperation
  - Inter-personal
  - Inter-departmental
  - Inter-organizational

Why Study Data Communications

- Cooperation needs exchange of information
- Move from the Industrial Age to the Information Age
  - Information is an important organizational resource
  - Information sharing
  - Information must be timely and accurate

Data Communications has global implications
A Brief History of Telecommunications in the U.S.

- First working telegraph system – 1837
- Patent of printing telegraph – 1843
- First telephone – 1876

- 1879 – First private manual telephone switchboard
- 1880 – First pay phone
- 1915 – First transcontinental telephone service & first transatlantic voice connections

- 1947 – First commercial microwave link for telephone transmission established
- 1951 – First direct long distance dialing
- 1962 – First international satellite telephone call
A Brief History of Telecommunications in the U.S.

- 1970 - MCI permitted to provide limited long distance service in competition to AT&T.
- 1984 - deregulation of AT&T
- 1980s - radio telephone calls supplanted by cellular telephone networks
- 1990s - cellular telephones commonplace
- 1996 - U.S. Congress enacted the Telecommunications Act of 1996
- 1997 - International agreement signed by 68 countries to reduce regulation in TC markets

The Internet has been a different story. Virtually all RBOCs, LECs, and IXCs, have aggressively entered the Internet market.

Today, there are more than 5000 Internet Service Providers (ISPs) who provide dial-in access to the Internet to millions of small business and home users.
Data Communications Networks

- Data Communications
  - Movement of encoded information from one device to another
- Data Communications networks
  - Collection of devices connected together to enable the movement of information using electrical or optical impulses
- Telecommunications
  - Includes the transmission of voice and video as well as data

Components of a Computer Network

- Computers
  - Server (host computer), client
  - These are the devices between which the information is exchanged
- Communication circuits
  - Fiber-optic cable, coaxial cable
  - The pathway through which the information travels
- Communication devices
  - Routers, bridges, modems
    - Devices that perform special functions to facilitate the operations of a computer network
- Protocols
  - A set of rules that describe how to transmit data across a network
    - e.g. TCP/IP
Networking Issues

- Connectivity
  - Reliability
  - Availability
  - Alternate Routes
- Response Time
  - Speed
  - Distance
  - Congestion
- Security

Types of Communications Networks

Commonly classified based on geographical scope

- Local Area Networks
  - Span a single building or a cluster of buildings
  - Supports data rates of 10 to 100 million bits per second (mbps)
  - Connected by a common circuit

- Wide Area Networks
  - Covers a large geographical area – 100’s to 1000’s of miles
  - Crosses the boundaries of an organization’s private property into public regions
  - May partly rely on circuits provided by a common carrier
  - Supports data rates of 28.8 Kbps to 2 Gbps

- Metropolitan Area Networks
  - Connect LAN’s and BN’s located in different areas to each other and WAN’s
  - Span 3 – 30 miles
  - Support data rates of 100 to 1000 Mbps
Types of Communications Networks

- **Backbone Networks**
  - Span several miles
  - Connect several LAN’s, other BN’s, MAN’s and WAN’s together
  - Provide data transmission speeds of 100 to 1000 Mbps

**Nested Network Structure**

**Example**

**Network Models**
Network Model

- A logical description of the functionality of a networked system
  - Enables understanding and analysis of data communication networks
  - Functionalities are modularized into layers
  - Hardware and software can be independently developed for each layer
  - Plug-n-play

Two prominent network models

- Open Systems Interconnection Model
  - Developed in 1984
  - Seven layer Model

- TCP/IP Model
  - Most widely used networking architecture
  - Five layer Model

Encapsulation: Concept behind Layered Models
**The OSI 7-layer Model**

**Application**: provides a set of utilities used by application programs.

**Presentation**: formats data for presentation to the user, provides data interfaces, data compression and translation between different data formats.

**Session**: responsible for initiating, maintaining and terminating each logical session between sender and receiver.

**Transport**: deals with end-to-end issues such as segmenting the message for network transport, and maintaining the logical connections between sender and receiver.

**Network**: responsible for making routing decisions.

**Data Link**: deals with message delineation, error control and network medium access control.

**Physical**: defines how individual bits are formatted to be transmitted through the network.

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**TCP/IP Model**

**Sender**

- Application (HTTP)
- Transport (TCP)
- Internet (IP)
- Data Link (Ethernet)
- Physical (Connection)

**Receiver**

- Application (HTTP)
- Transport (TCP)
- Internet (IP)
- Data Link (Ethernet)
- Physical (Connection)

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**Application layer (Layer 5)**

The application software used by the network user, allows the user to define what messages are sent over the network.

- Email message, a file, a block of user input

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**Transport Layer (Layer 4)**

- Establishes end-to-end connection between sender and receiver.
- Translates the destination of the message into an address understood by the network.
- Breaks the data block into a number of segments if necessary.
- **Network layer (Layer 3):**
  - Handles routing, prioritizing and addressing issues.

- **Data link layer (Layer 2):**
  - Determines when to transmit messages over the media
  - Formats the message by indicating where messages start and end
  - Detects and corrects any errors that have occurred in the transmission

- **Physical layer (Layer 1):**
  - The physical connection between the sender and receiver.
  - It transfers a series of electrical, radio, or light signals through the circuit from sender to receiver.
  - It specifies the type of connection, and the signals that pass through it.

- **Network Layers:**
  - Network layers can also be placed in three groups:
    - **application layer**
      - Includes the application layer,
    - **internet network layer**
      - Includes the transport and network layers
    - **hardware layer**
      - Includes the data link and physical layers
Network Models

<table>
<thead>
<tr>
<th>OSI Model</th>
<th>Internet Model</th>
<th>Groups of Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Application Layer</td>
<td>5. Application Layer</td>
<td>Application Layer</td>
</tr>
<tr>
<td>6. Presentation Layer</td>
<td>4. Transport Layer</td>
<td>Inter-network Layer</td>
</tr>
<tr>
<td>5. Session Layer</td>
<td>3. Network Layer</td>
<td>Hardware Layer</td>
</tr>
<tr>
<td>4. Transport Layer</td>
<td>2. Data Link Layer</td>
<td></td>
</tr>
<tr>
<td>3. Network Layer</td>
<td>1. Physical Layer</td>
<td></td>
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</tbody>
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Network Models

For communications to be successful, each layer in one computer must be able to communicate with its matching layer in the other computer.

This is accomplished by standards.

Advantages of having Standards

- Allows products from multiple vendors to communicate, providing consumers with wider selection
- Assures a large market, which encourages mass production and often lowers costs
- Makes it easier to develop software and hardware that link different networks because software and hardware can be developed one layer at a time.
Networking Standards

Two Types
- Market Driven and Voluntary
  - Called de-facto standards
  - Supported by vendors, but have no official standing
- Formal Standards
  - Developed by official bodies or government regulated

The Standards Making Process

Three stages
1. Specification stage: developing a nomenclature and identifying the problems to be addressed.
2. Identification of choices stage: those working on the standard identify the various solutions and choose the optimum solution from among the alternatives.
3. Acceptance, the most difficult stage: defining the solution and getting recognized industry leaders to agree on a single, uniform solution

Telecommunications Standards Organizations

- International Organization for Standards (ISO)
  Member of the ITU, makes technical recommendations about data communications interfaces.

International Telecommunications Union - Telecommunication Standardization Sector (ITU-TSS)
- Technical standard setting organization of the ITU. Formerly called the Consultative Committee on International Telegraph and Telephone (CCITT)
- Comprised of representatives of over 150 Postal Telephone and Telegraphs (PTTs), like AT&T, RBOCs, or common carriers.
TC Standards Organizations
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Electronic Industries Association (EIA)
- National Institute of Standards and Technology (NIST)
- Electronic Data Interchange - (EDI) of Electronic Data Interchange for Administration Commerce and Transport (EDIFACT).

Some Common Standards

<table>
<thead>
<tr>
<th>Layer</th>
<th>Common Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Application Layer</td>
<td>HTTP, HTML (Web), MPEG, H.123 (audio/video), IMAP, POP (email)</td>
</tr>
<tr>
<td>4. Transport Layer</td>
<td>TCP (internet)</td>
</tr>
<tr>
<td>3. Network Layer</td>
<td>IP (Internet), IPX (Novell LANs)</td>
</tr>
<tr>
<td>2. Data Link Layer</td>
<td>Ethernet (LAN), PPP (dial-up via modems)</td>
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<tr>
<td>1. Physical Layer</td>
<td>Category 5 cable (LAN), 50/100 Mbps (modem)</td>
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Benefits and Impact of Telecommunications
- Anytime, Anywhere nature of business
- Geographical independence
- Reductions in response times
- Improvements in productivity
- Flattening of organizational structures
- Widespread and easy information dissemination
- Product differentiation (initially)
Applications

- New methods
  - Collaborative work: whiteboards, newsgroups etc.
  - Distribution of labor: telecommuting, corporations sharing space etc.
- Cost savings
  - Utilization of highly skilled employees:
    - Telemedicine
  - Savings in real estate costs
  - Telecommuting

Applications

- Crossing organizational barriers
  - Vertical integration
- Crossing organizational boundaries
  - Airlines - customers (bypassing travel agents)
  - Parcel companies (e.g.: UPS/FedEx - customers)
- Manpower reductions:
  - VR systems: Telephone companies, Appliance companies etc.

Applications

- "Flat" communication channels
  - Impact of email (non-obtrusive communications)
- Re-distribution of production due to globalization
  - Offshore software development
  - Labor intensive functions moved to lower cost countries/sites (e.g.: Medical diagnosis transcription services in India)

Impact on Industry

- Impact on Processes/Cost:
  - Shorter cycle times
  - Lower real estate costs
  - Faster information dissemination
  - Lower labor costs
- Impact on Structure of Industry:
  - New minimum capabilities e.g.: Banks - ATMs etc. i.e. Barriers to entry
  - Changes in corporate structure