Introduction to Networking & Telecommunications

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Meaning of star symbols

- Something to which you should pay special attention.
- Multiple stars are for especially important or difficult material

Learning Objectives

You should be able to describe basic Networking Concepts in wide use today:

- Basic terminology of computer networks
- Voice and Video Communications Versus Data Communication
- Circuit Switching Versus Packet Switching
- Components of a computer network
Computer Network

- An interconnection of computers and computing equipment using either wires or radio waves over small or large geographic distances
- Local area network - networks that are small in geographic size spanning a room, building, or campus
- Metropolitan area network - networks that serve an area of up to 40 miles - approximately the area of a typical city
- Wide area network - a large network that encompasses parts of states, multiple states, countries, and the world

Why Networking?

- Resource sharing
  - Sharing hardware (printers, processors, etc.)
  - Sharing software (programs, data files)
- High reliability
  - Could set automatic backup of programs and data at different locations
  - Fault tolerance (if one server is down, another provides service. If a disk fails, a mirror disk may be available)
- Cost saving
- Communication tool
  - Internal email service
  - Remote Access service
The Language of Computer Networks

- Voice network - a network that transmits telephone signals
- Voice communication - Transmission of analog data (specifically spoken words) usually between people
- Telecommunication - the study of telephones and the systems that transmit telephone signals
- Data network - a network that transmits computer data
- Data communication - the transfer of digital or analog data using digital or analog signals

Voice & Data Communication

- Originally, there was a sharp distinction:
  - Voice Communication
  - Data Communication, in which one or both parties is a computer
  - Database
  - Electronic mail
  - World Wide Web
- Distinction is fading because voice communication is increasingly computer-based

Circuit Switching and Reserved Capacity

- Circuit capacity is reserved during duration of each call
- At each switch
- On each trunk line

**Reserved Capacity**

**Circuit**
Pros and cons of Reserved Capacity

- Nothing like the congestion on the Internet
- Reserved Circuit Capacity is Expensive
  - Have to pay for it whether you use it or not
  - Good for voice, because conversations are fairly constant
  - Bad for data, because most data transmission is bursty;
  - e.g., in World Wide Web, download, then stare at screen for a long time until next download

Packet-Switching Data Networks

- Packet Switching
  - Large messages are broken into small pieces called packets (or frames)
  - Packets are short (averaging a few hundred bytes) because networking devices handle short messages more efficiently

Packet-Switching Data Networks

- Multiplexing
  - Packets from many conversations are mixed (multiplexed) over each trunk line

Packet Switching

Multiplexing on Transmission Line
The Big Picture of Networks

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Figure 1.1: An overall view of the interconnected network between workstations and servers. Workstations are PCs or terminals used to receive services from the network.

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The Big Picture of Networks

Workstations
- PCs or terminals used to receive services form the network.

Servers
- Computers that host the network software and shared or private user files.

Bridges
- Connecting devices between separate LANs.

Routers
- Connecting devices between LANs and WANs.

Nodes
- Any computer (or computing device) connected to the network.

Hubs (or switches)
- Collection points for voice/data networking/Workstations.

Elements of a Simple LAN

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Hub or Switch
- Media connection points.
**Elements of a Simple LAN**

**Hub or Switch**: Device that connects all stations

**Media**: Wired or Wireless transmission media used to transfer data.

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** Elements of a Simple LAN**

**Client PCs** are used by ordinary managers and professionals. Receive services from servers.

**Servers** provide services to client PCs.

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**Elements of a Simple LAN**

**NIC** (Network Interface Card): Device that provides a dedicated connection to the network. Includes a physical address called MAC address.
1. Station A transmits to the Hub

2. Hub broadcasts to all stations

Station C must wait, or its signal will collide with Station A’s signal.

Hubs split available bandwidth among computers, i.e. with a 100 Mbps hub, the network speed will be 100 Mbps / n (where n is the number of computers).

Active hubs include repeater capabilities for regenerating signals.

Passive hubs don’t regenerate signals. Limited to a 30 meter distance apart from computers.

Switch operation

Switches send out a single port: destination port.

Most switches can efficiently handle simultaneous transmissions.

Switches provide a full bandwidth to all connected computers.

Summary Questions

- Define the following:
  - Computer Network
  - Data communications
  - Voice Network
  - 4,7

- Distinguish between voice and data communications.
  - 8

- Distinguish between circuit switching and packet switching.
  - 9-12

- List and explain the elements of a Simple Network.
  - 15-
What category of network is illustrated here?