Chapter 2

Local Area Networks: An Introduction

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CMP 110: Data Communications & the Internet
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Business Purposes of Local Area Networks

- Allow Employees to:
  - Save files to a common centralized location & share them with other employees
  - Exchange e-mail and other information
  - Access centralized printers, applications and databases
  - Maintain secure access to network resources

Servers, LAN Services, and Clients

- Server
  - Hardware device that runs a specialized **network operating system**
  - Provides shared **LAN Services** to users and devices on the LAN, including data storage and retrieval, printing services, and directory/authentication services

Servers, LAN Services, and Clients

- Client
  - LAN device which connects a user to LAN services
  - Runs a local operating system *and* the client version of a network operating system (either bundled with the local OS or added later)

LAN Configurations

- Mainframes and Terminals
  - Old technology (1960s and 1970s) that is still in use today
  - The **mainframe** acts as the server, performing **all** computing functions
  - The **terminals** act as clients, but perform **no** processing

LAN Configurations

- Mainframes and Terminals
  - Mainframes were designed for **centralized** processing, data access, data storage, and information management
  - They deliver fixed computing power for fixed cost
    - Higher demand leads to longer waits
    - Upgrades can cost tens of thousands, or even hundreds of thousands, of dollars

LAN Configurations

- Peer-to-Peer Local Area Networks
  - Mid-1980s technology
  - Each node on the LAN is a **peer** to every other node
  - Each node can request services of the others
  - NOS client software is built in to each node's local OS, and they all provide limited server capabilities

LAN Configurations

- Client-Dominant Local Area Networks
  - Popular from the mid-1980s to the mid-1990s
  - Most application processing takes place on the clients; the server's primary purpose is data storage
  - Why did these networks become popular?
    - PC prices dropped; storage prices did not
    - One shared expensive hard drive did away with need for *sneaker-net* networks

LAN Configurations

- Client/Server Local Area Networks
  - Some processing is performed on the clients, and some on the server
  - Network applications are usually written in such a way that only necessary parts are delivered to the clients
    - Reduces overall amount of network traffic
    - Both server and clients run more efficiently

LAN Configurations

- Distributed Processing LANs
  - Data access and data storage components of applications are separate from data processing components
  - Data processing responsibility can be shared by many servers
  - As different parts of the operation require more processing power, extra hardware can be added to serve only those parts of the operation

LAN Configurations

- Distributed Processing LANs
  - This is also called *n-tier architecture* since different tiers of each application can be handled by different servers or groups of servers
  - Each computer benefits from lighter processing load
  - The network will experience greater traffic

Media Types and Connectors

- Coaxial Cable
  - Consists of two conductors separated by special insulating material
  - One conductor carries the signal; the other conductor acts as the ground
  - Coax was the only cabling choice for early Ethernet networks

Media Types and Connectors

- Coaxial Cable
  - **Thicknet**
    - Developed jointly by DEC, Intel, and Xerox in 1980
    - Allowed for 10 Mbps over a distance of 500m
    - Allowed for 100 hosts per segment

Media Types and Connectors

- Coaxial Cable
  - **Thicknet**
    - Connector:

      Vampire Tap

Media Types and Connectors

- Coaxial Cable
  - **Thinnet**
    - Thinner diameter cable; cheaper cost than Thicknet
    - Allowed for 10 Mbps, but only over a distance of 185m
    - Only allowed for 30 hosts per segment

Media Types and Connectors

- Coaxial Cable
  - **Thinnet**
    - Connector: BNC

Media Types and Connectors

- Unshielded Twisted Pair (UTP) Cable
  - Several pairs of 22-gauge or 24-gauge copper wires twisted together to reduce **EMI**
  - Popular due to inexpensive price, ease of installation, and ease of maintenance
  - Two, three, or four pairs of wires, each coated in vinyl or other plastic

Media Types and Connectors

- Unshielded Twisted Pair (UTP) Cable
  - Bundle of pairs of wires then wrapped in plastic
  - Categorized according to maximum data rate

Media Types and Connectors

Category	Data Rate	Usage
1	Up to 4 Mbps	Home telephone lines
2	4 Mbps	Token Ring networks and older telephone lines
3	10 Mbps	4 Mbps Token Ring; 10 Mbps Ethernet
4	100 Mbps	4 & 16 Mbps Token Ring; 10 & 100 Mbps Ethernet

Media Types and Connectors

Category	Data Rate	Usage
5	1000 Mbps	Supports 10 Mbps and 100 Mbps Ethernet
5e	Up to 1 Gbps	Supports Gigabit Ethernet
6	Up to 10 Gbps	Supports high-speed multimedia applications

Media Types and Connectors

- UTP Connector: RJ-45

Media Types and Connectors

- Shielded Twisted Pair (STP) also exists
  - Adds two layers of shielding to UTP
  - Useful near fluorescent lighting, powerful electric motors, or high-voltage electrical cabling
  - Used with specially-shielded RJ-45 connectors

Media Types and Connectors

- Fiber Optic Media
  - Transmits data across a glass or plastic fiber using pulses of light
  - More expensive than UTP, but useful where high data rates and large volumes of data transfer are required
  - Most often used to connect two LANs that exchange large amounts of data

Media Types and Connectors

- Fiber Optic Media
  - Simplex
  - Not susceptible to EMI
  - Single-mode fiber only transmits one frequency of light
  - Multimode fiber uses many frequencies; is susceptible to **optical dispersion**

Media Types and Connectors

- Wireless Media
  - Radio Frequency
    - Each node requires a radio *transceiver* and antenna
    - Frequencies are allocated by the FCC
    - Requires implementation of **access points**

Media Types and Connectors

- Wireless Media
  - Infrared
    - Uses light frequencies just below the red band of the visible spectrum
    - Limited to short distances
    - Susceptible to many types of interference

Media Types and Connectors

- Wireless Media
  - Microwave
    - Uses very high frequency directional radio waves

Network Interface Cards

- Physical interface between a host and a LAN
- Various forms: built-in, PCI, USB, PCMCIA, etc.
- Connects to a particular kind of network media (coax, WiFi, etc.)

Network Interface Cards

- Breaks data into **frames** that the network media can manage, and places the frames on the media as a series of electrical pulses, radio waves, etc.

Network Interface Cards

- Performance and Manageability
  - Some NICs are half-duplex; others are full-duplex
  - Some NICs are *autosensing*, meaning that they can adjust certain configuration details to the network they are attached to

Network Interface Cards

- Performance and Manageability
  - **High-performance NICs** perform some processing locally (e.g., encryption), resulting in higher performance on the NIC and on the host
  - **SNMP** provides remote management and remote status checks

Network Interface Cards

- Performance and Manageability
  - A NIC that provides **Wake-on-LAN** can power on the host when asked to by the LAN administrator