Basic Computing and Programming

Lecture # 7

Computer Networks

Today's Aim

- What is a 'Computer Network'
- Advantages & Disadvantages of Networks
- Types of Networks
- Components of a Network
- Communication Media

Computer Network

- System of independent but linked computers
- sharing
  - data and Resources
    - Hard disks
    - Printers and scanners
- Electronic Communication

Advantages of a Network

- Speed
- Cost
- Centralized Software Management
- Resource Sharing
- Electronic Mail
- Flexible Access
- Workgroup Computing

Disadvantages

- Initial Costs
- Administrative Support needs to be provided
- A single point of Failure (e.g., File Server Failure)
- Cables Breakage

Types of Networks
(According to N/W Access Policy)

- Private
  - Privately owned by Organizations
  - Only Authorized Computer gain Access
  - Information is Protected
- Public
  - Shared by Organizations and Individuals
- Virtual Private Networks (VPN)
  - Uses Public Network
  - Seems like a Secure Private Network

Types of Networks
(According to N/W Access Policy)

- VPN is Used for:
  - LAN-to-LAN Internetworking
  - Remote Access Client Connections
  - Shared resource (Internet) is used for connecting remote parts of the private network

Types of Networks
(According to N/W Access Policy)

- Advantages of VPN:
  - Lower Cost
  - Network Scalability
  - Ease of Use

- Disadvantages of VPN:
  - Complex Security Procedure
  - Reliability and Performance
  - Equipment Compatibility

Types of Networks
(According to Scale)

- PAN (Personal Area Network)
  - Limited to a very few users
  - No centralized control
  - Examples:
    - Bluetooth, Infra Red Communication

- LAN (Local Area Network)
  - Limited to a Small Area
    - few offices, a building or two.
  - Owned and Managed by an Individual or Organization
  - Protocols Used:
    - Ethernet, Token Ring, FDDI (Fast Distributed Data Interface)
  - Building block for larger networks.

Types of Networks
(According to Scale)

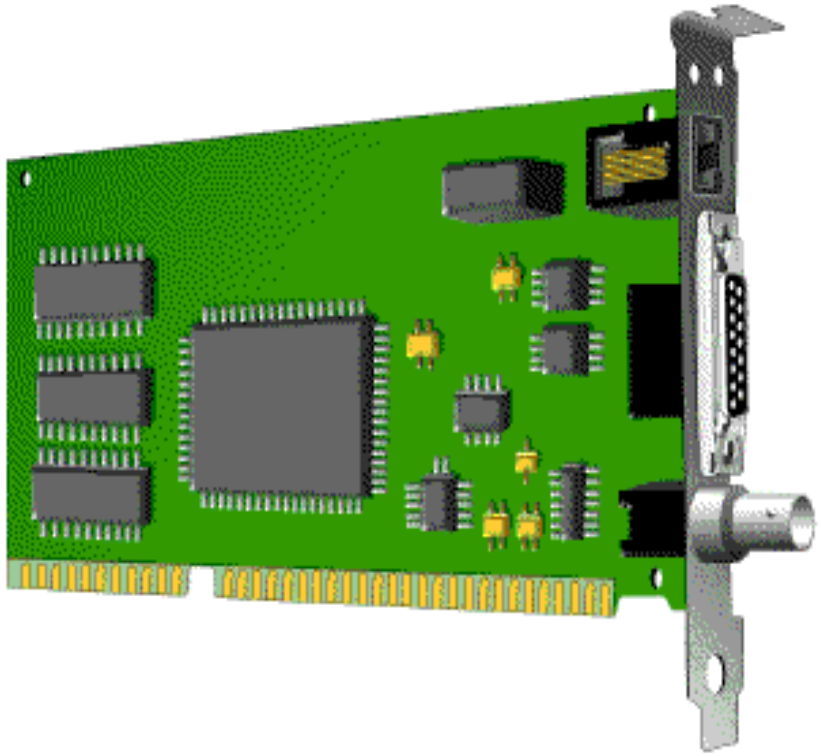
- MAN (Metropolitan Area Network)
  - Spread over cities
  - Owned by a single organization
  - Consisting of several LANs
- WAN
  - Covers Larger Geographical Area
  - Uses Transoceanic Cabling (were coaxial cables that transmitted frequency-multiplexed voiceband signals) or Satellite Links
  - Collective/Distributive Management and Ownership
  - Protocols Used: ATM, Frame Relays, X.25 etc.
  - Internet is the ultimate WAN

Components of a Network

- End devices (Hosts)
  - PCs, Workstations, Printers, IP phones & IP cameras etc.
  - To communicate over a network, an end device must have a special Network-Hardware, called NIC
- Network Access Devices
  - Where the end devices get connected to the network
  - Hubs & Switches
- Inter-Network Devices
  - They serve to inter-connect the LANs for inter-LAN communication
  - Bridges & Routers

Ethernet Card

- Fast Data Transfer (10 to 100Mbps)
- Expensive-Bought Separately
- Requires a Computer Slot
- Major Types:
  - Ethernet Cards
  - Token Ring Cards

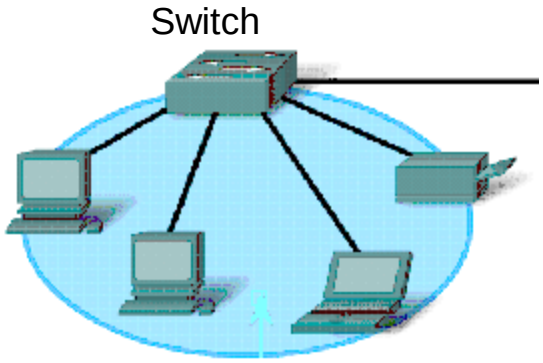


Network Access Devices

- Hub
  - Connection Point b/w several Networked Devices
  - Have 8, 12, 16, 24, 32, or 48 Ports for Connecting Devices
  - These ports may be active or blocked as per requirement
  - Work normally with star or star-wired ring topology
  - Broadcasts the received Message
  - That’s why collision rate is very high
  - Switches subside the collision issue

Network Access Devices

- Switch
  - Works on the principal of selective forwarding rather than broadcast
    - Reduced collision to an extent
  - More Intelligent than Hubs
  - RJ-45 interface with 8, 4 or 12 ports
  - Specialized softwares for Port Management
  - Used with Star or Star-Wired Ring Topology

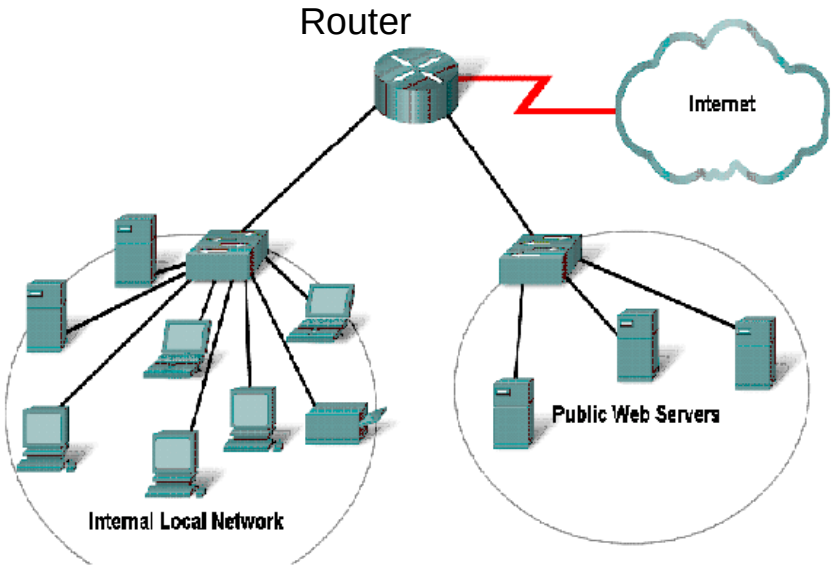


Inter-Network Devices

- Bridge
  - Used to Connect Smaller Networks together
  - Manages Traffic for Optimum Performance on Two sides of the N/W
  - “Listens” to N/W on both sides
  - If necessary, transmits data from one side of the N/W to the other
  - Used to Route Messages Across:
    - Different Cables
    - Different Topologies

Inter-Network Devices

- Router
  - A Super-Intelligent Bridge
  - Selects best Route
  - Helps Prevents Head-on Collisions
  - Knows Addresses of all Devices on the Network
  - Listens to Entire N/W
  - Can Route Messages Across:
    - Different Cables
    - Different Topologies
    - Different Protocols



Gateways

- serves as entry or exit point of the network
  - data sent outside the LAN, must pass through the gateway
- Routers are gateways usually
- Enforces the security policies

Repeater

- Electrical Amplification of the traveling Signal
- Extended data transmission range (virtually infinite)
- May be Separate or Built into the Concentrator e.g. Active Switch

Modem

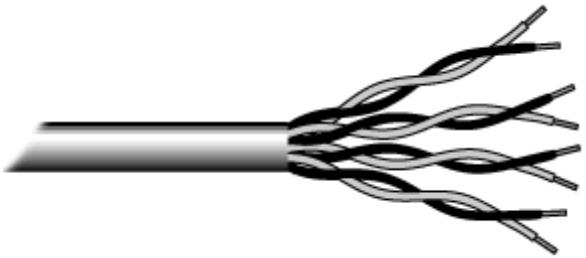
- Used for Connection over Telephone Lines
- **modem** (***mo****dulator-****dem****odulator*) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data.

Communication Media

- Electrical Conductors
  - Copper e.g., Twisted Pair (UTP, STP)
  - Coaxial Cable
- Optical Media
  - Glass Fiber tubes with repeaters
  - Photonic Devices
- Wireless
  - Infrared
  - Light
  - Microwave
  - Radio Carriers

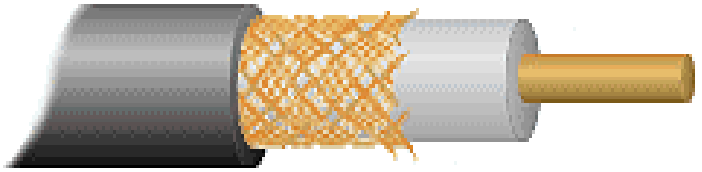
UTP (unshielded twisted pair) Cable and Connector

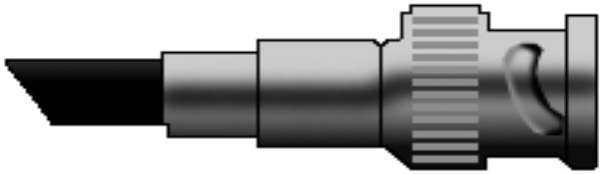
- The most popular cables used for LAN and consisting of four twisted pairs of metal wires
- Five Categories Depending on Data Rates
- Maximum Segment Length- 100 to 220 meter
- Susceptible (Capable of change) to Radio and Electric Frequency Interference
- Connector Type - RJ-45



Coaxial Cable and Connector

- Difficult to Install
- Highly resistant to Interference
- Thinnet-200 Meters
- Thicket-500 Meters
- Good for Linear Bus N/W
- BNC (Bayonet Neill–Concelman) is a quick connect/disconnect RF connector used for coaxial cable) Connector





Fiber Optic Cable

- Transmits Light
- Eliminates Electrical Interference
- Immune to Moisture
- Costs Comparable to Copper Cabling
- Higher Speeds
- Maximum Segment Length- 2000 Meters
- Difficult installation