# Introduction to Networks

Slide Set 1

Network: Definition

- A set of devices (**nodes**) connected by **communication links** (wired or wireless).

- A **node** can be a computer, or any device capable of sending and/or receiving data generated by other nodes on the network.

- A network must be able to meet a certain number of criteria. The most important of those are: **Performance**, **Reliability** and **Security**.

Types of Communication Links

Guided (wired) — Unguided (wireless / radiated)
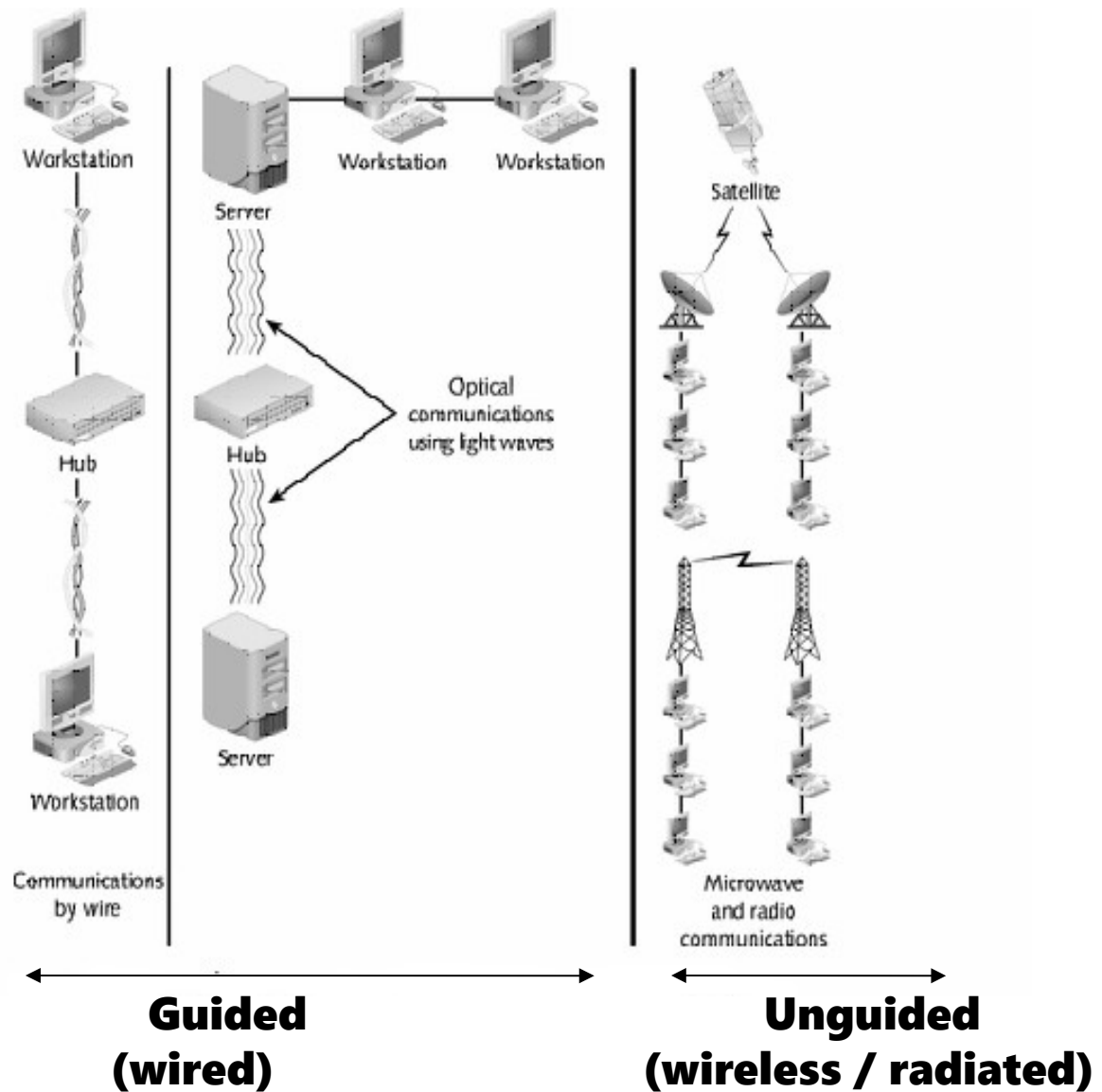
Physical Topology

- The **physical topology** refers to the way a network is laid out physically.

- **2** or more **nodes** connect to a **link. 2** or more **links** form a **topology**. The **topology** is the geometric representation of the relationship of all the links and nodes to one another.

- The are usually **four** basic topologies: **Mesh**, **Star, Bus** and **Ring**.
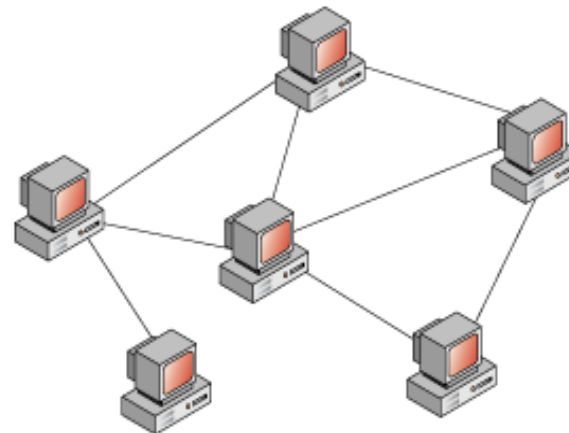
Mesh Topology

- In a **mesh topology**, every node has a **dedicated point-to-point** link to every other node.
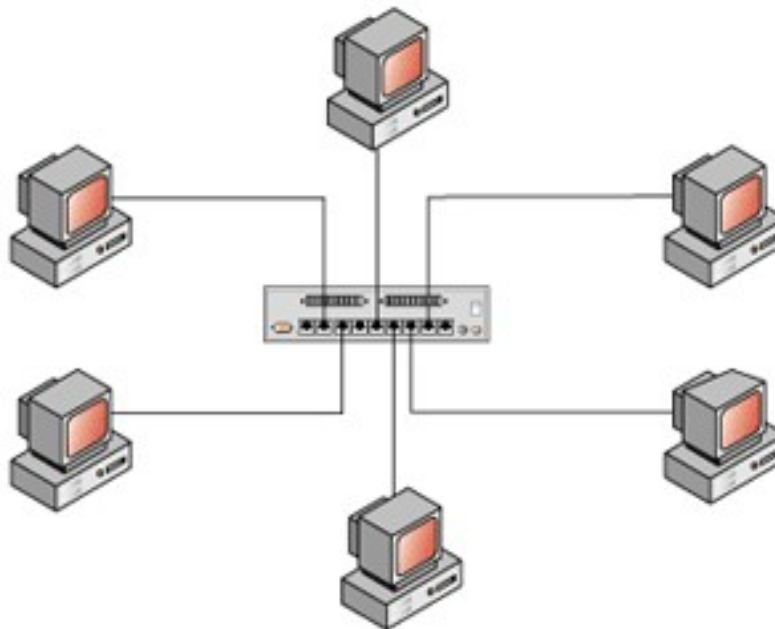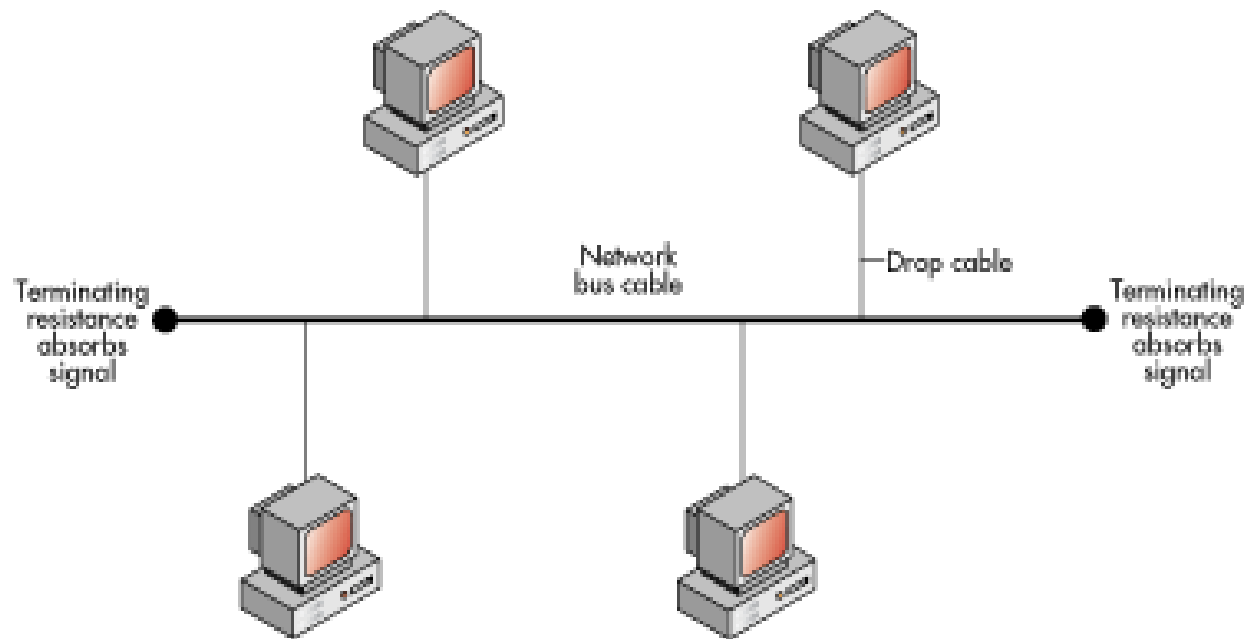
Full-Mesh:
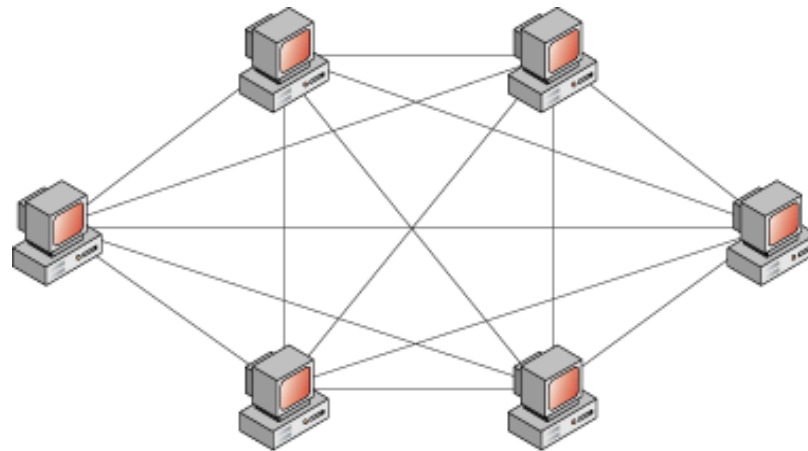
Partial-Mesh:

Star Topology

- In a **star topology**, each node has a **dedicated point-to-point** link only to a central controller, usually a **hub** or **switch**.
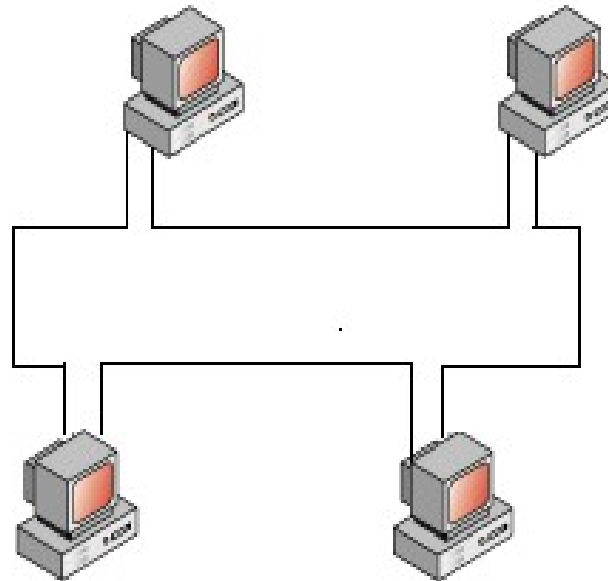
Bus Topology

- In a **bus topology**, a **multipoint** link is used. One long cable acts as a **backbone** to link all the devices in a network.
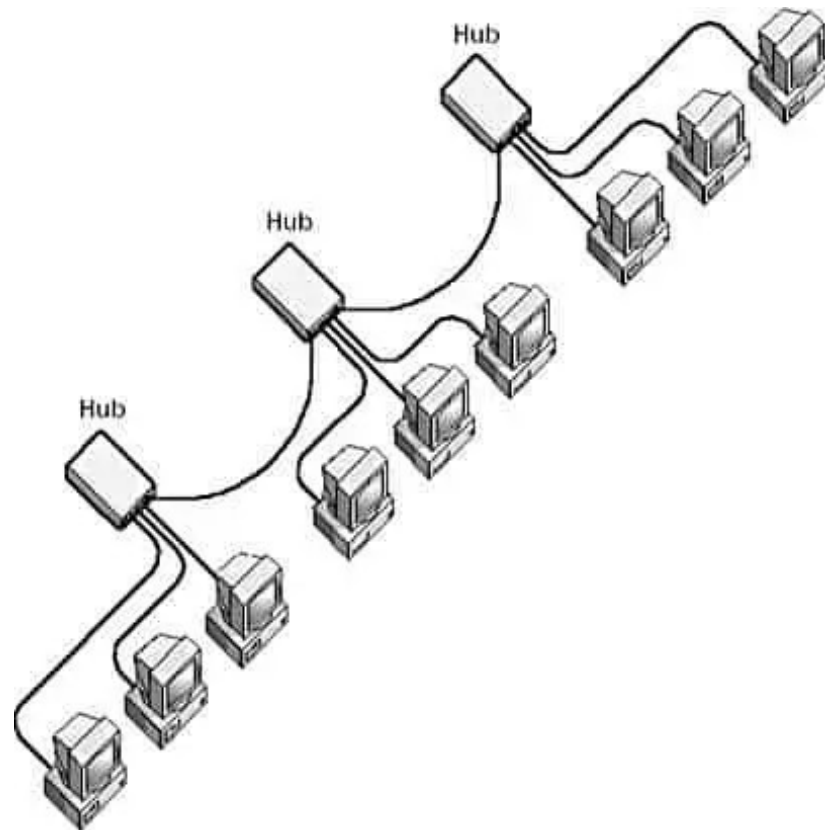
Ring Topology

- In a **ring topology**, each node has a **dedicated point-to-point** link only with the **two** nodes on either side of it.
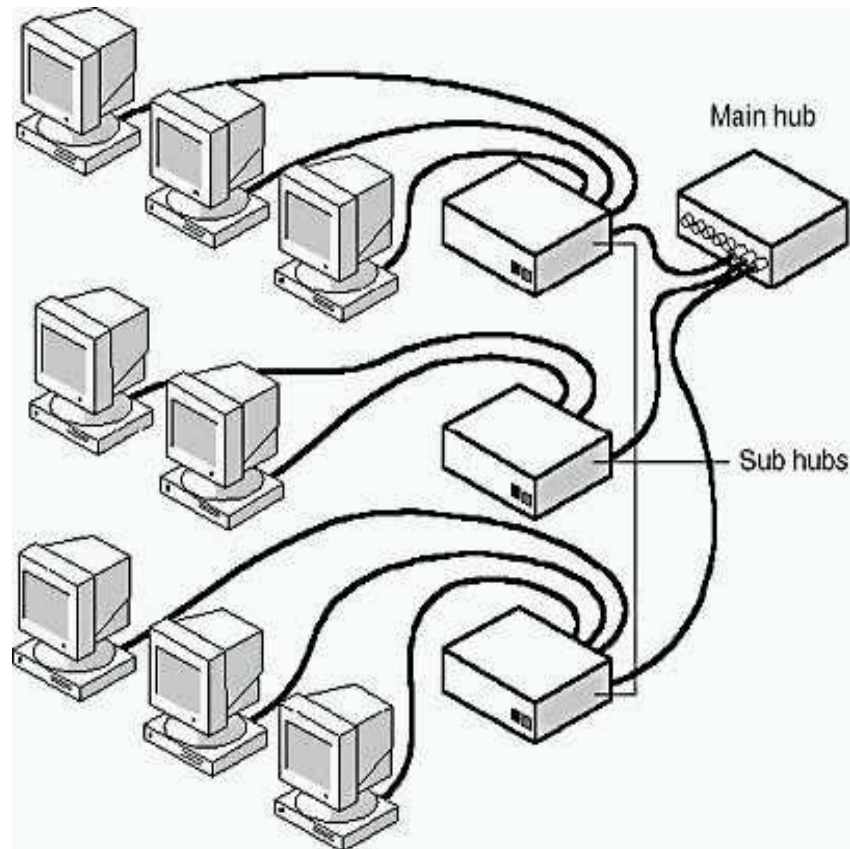
Hybrid: Star Bus Topology

- In a **star bus topology**, **several star topology networks** are linked together with **linear bus trunks**.
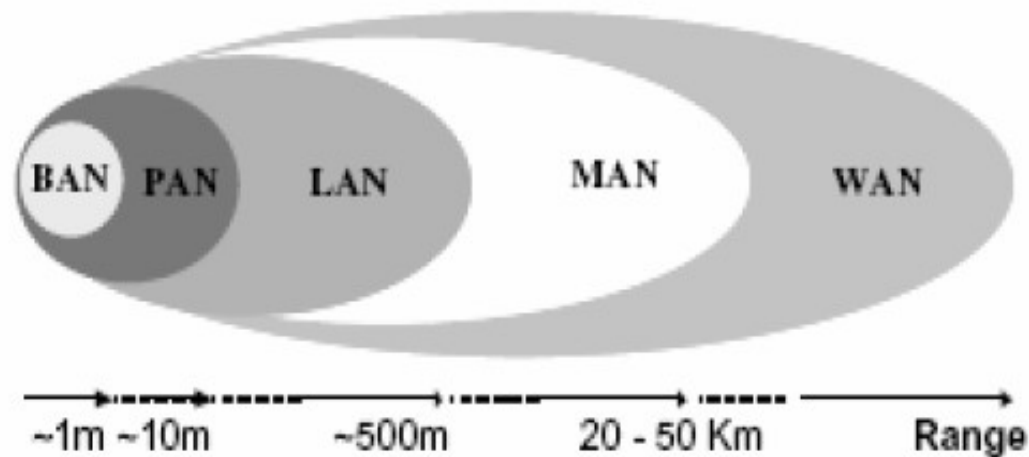
Hybrid: Star Ring Topology

- In a **star ring topology**, **sub hubs** are linked together in a **star pattern** to a **main hub**, rather than to themselves with **linear bus trunks**.

Network Types Defined

- Body Area Network
- Personal Area Network
- Local Area Network
- Metropolitan Area Networks
- Wide Area Networks

Body Area Network (BAN)

- Short range wireless network which consists of wearable or implanted electronic devices that transmit ID or sensor data to gateway device.

- It is also referred to as Wireless Body Area Network (WBAN) or Body Sensor Network (BSN)

Wearable   Implant

Access point is several meters away, at most

Gateway   Wearable
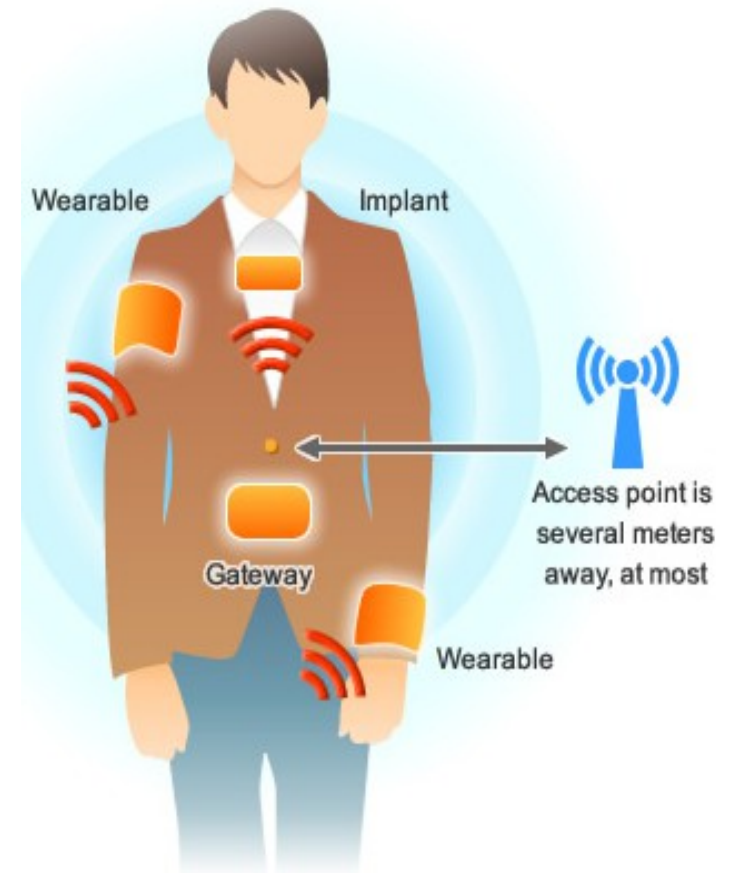
Personal Area Network (PAN)

- A Personal Area Network (PAN) is a computer network used for communication amongst computing devices (Smartphones, PDAs, Tablets) close to one person. The reach of a PAN is typically a few meters.

- Personal area networks may be wired by computer buses such as USB and FireWire. However, a Wireless Personal Area Network (WPAN) is made possible with network technologies such as Infrared (IrDA) and Bluetooth.

Local Area Network (LAN)

- Series of interconnected computers, printing devices, and other computer equipment that share hardware and software resources

- Service area usually limited to a given office area, floor, or building and is usually privately-owned.
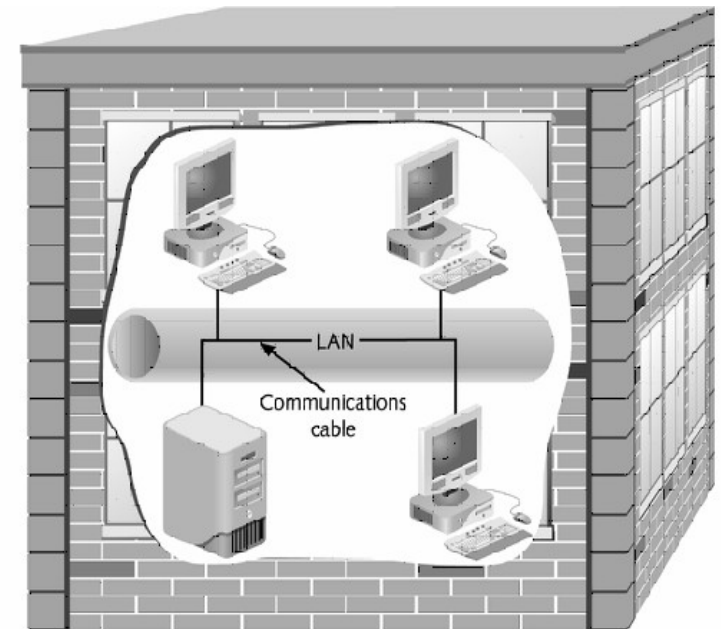
Metropolitan Area Network

- Links **multiple LANs** in a large city or metropolitan region.
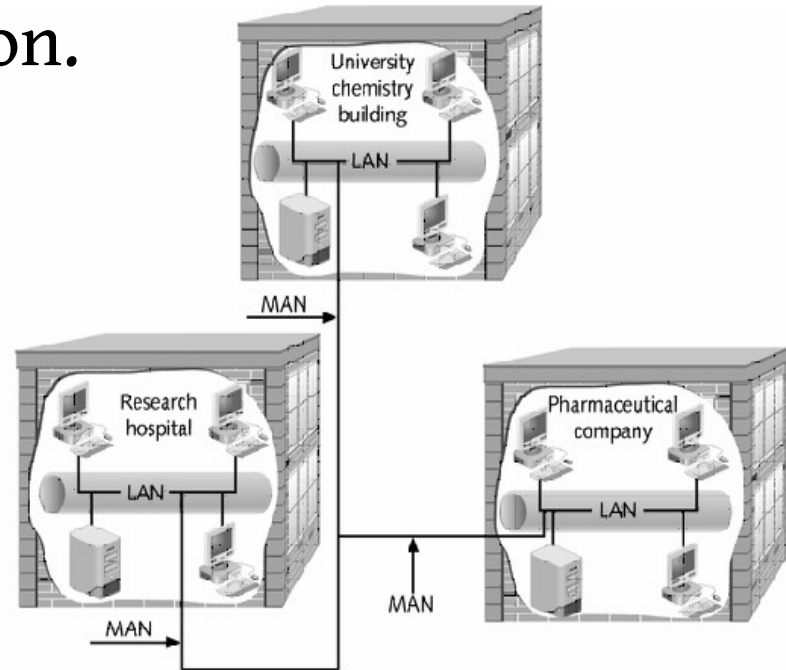
- May be wholly owned & operated by a private or public company such as a local telephone company.

- Many **telcos** provide services like **Switched Multi-Megabit Data Services** (SMDS).

Wide Area Network (WAN)

- Provides long-distance transmission of data, voice, image and video information over large geographic areas that may comprise a country, a continent, even the whole world.

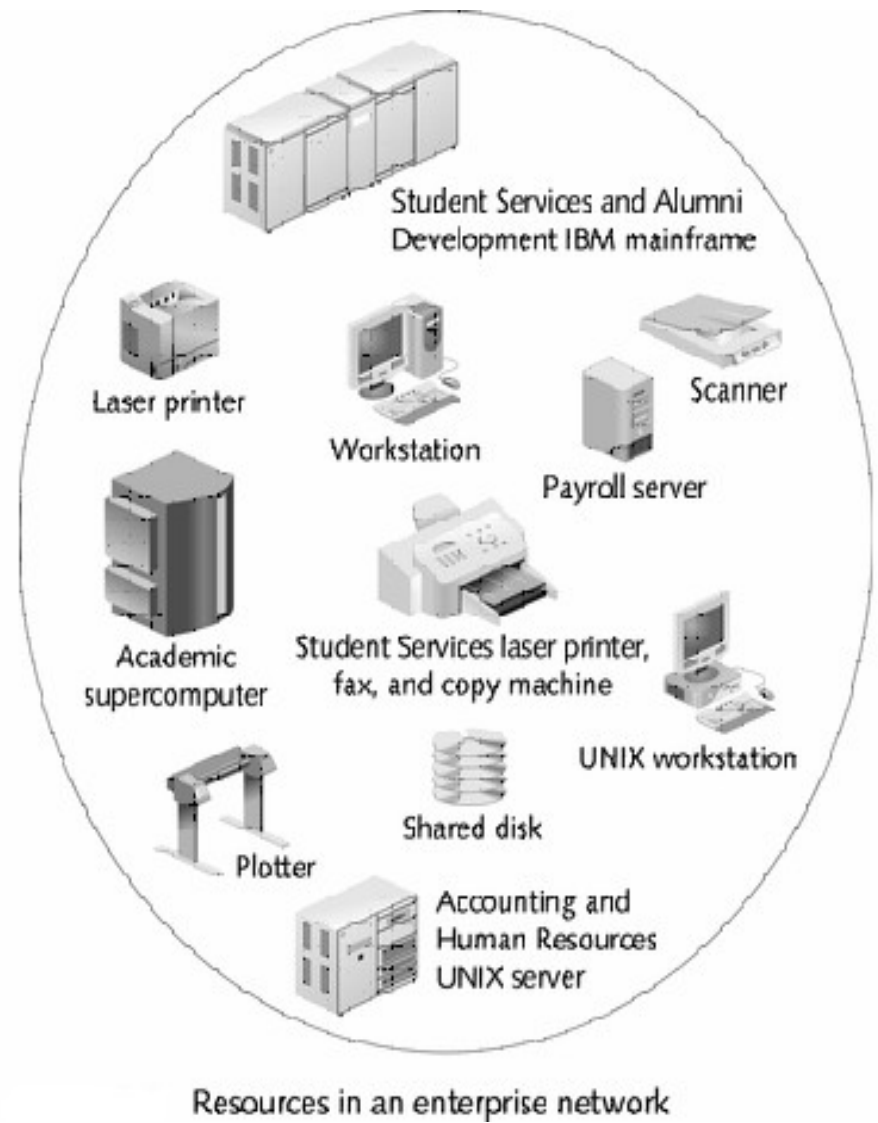- The best example of a WAN is the **Internet**.

Identifying a Network Type

- Communications medium
  - Wire cable, fiber-optic cable, radio waves, microwaves, infrared radiation.

- Protocol
  - How networked data is formatted into discrete units
  - How each unit is transmitted and interpreted

- Topology
  - Physical layout of cable and logical path

- Network type
  - Private versus public

Network Classification

- **Enterprise** network
  - Combination of **LANs**, **MANs**, or **WANs** that provides users with an array of computer and network resources to complete different tasks.

Student Services and Alumni Development IBM mainframe

Laser printer

Workstation

Scanner

Payroll server

Academic supercomputer

Student Services laser printer, fax, and copy machine

UNIX workstation

Plotter

Shared disk

Accounting and Human Resources UNIX server

Resources in an enterprise network

Events that Led up to LANs and WANs

- **1800s**
  - Oersted
  - Morse
  - Undersea cable
  - Pony Express
  - Bell

- **1900s**
  - Transcontinental and transatlantic calls
  - Voice digitization
  - Electronic digital computers
  - Transistors
  - Sputnik
  - Communications satellites
  - ASCII
  - Mass-produced minicomputers

LAN/WAN History: 1960s

- First WAN
- Hypertext
- Use of fiber optics for phone signals
- Beginning of ARPANET
- Packets and packet switching
- UNIX
- Telecommunications equipment
- First IMP prototype

LAN/WAN History: 1970s

- Ethernet
- ARPANET - 15 sites
- E-mail
- Terminal emulation
- International connections to ARPANET

- Telecommunications conversion from analogue to digital
- X.25
- First wireless gateway
- Internet Protocol
- LSI and VLSI chips
- ICCB later IAB

LAN/WAN History: 1980s

- BITNET
- IBM's PC
- Dial-up modem technology
- TCP and IP adopted as protocol suite for ARPANET
- First PC LAN
- Arrival of Internet

- Internetwork hosts
  - 5,000 in 1986
  - 100,000 in 1989
- "Cyberspace"
- T-carrier services
- NFSNET
- Desktop authoring and multimedia
- SNMP

LAN/WAN History: 1990s

- ARPANET retired
- SS7 technology
- NSFNET opened to commercial use
- First cyberbank
- Internet service providers
- Over 16 million Internet hosts

LAN/WAN History: 2000s

- IPv6 used for Internet2 backbone communications

- Video and radio capability

- Prices of 1-Gbps devices fall as competition increases
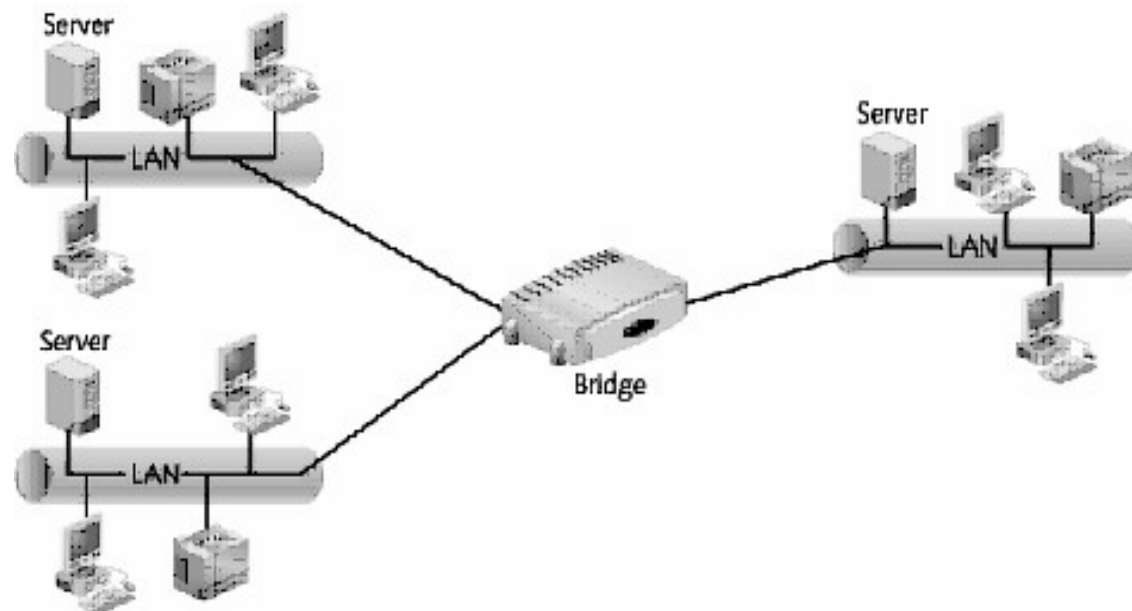
LAN/WAN History: 2010s

- Cloud Services commonplace
- Internet of Things (IoT)
- 10G, 25G, 40G and 100G Ethernet has been developed

LAN/WAN Integration

- Becoming more advanced through networking devices
  - Bridges
  - Routers
  - Gateways
  - Switches
  - Firewalls
  - Access Points

Bridges

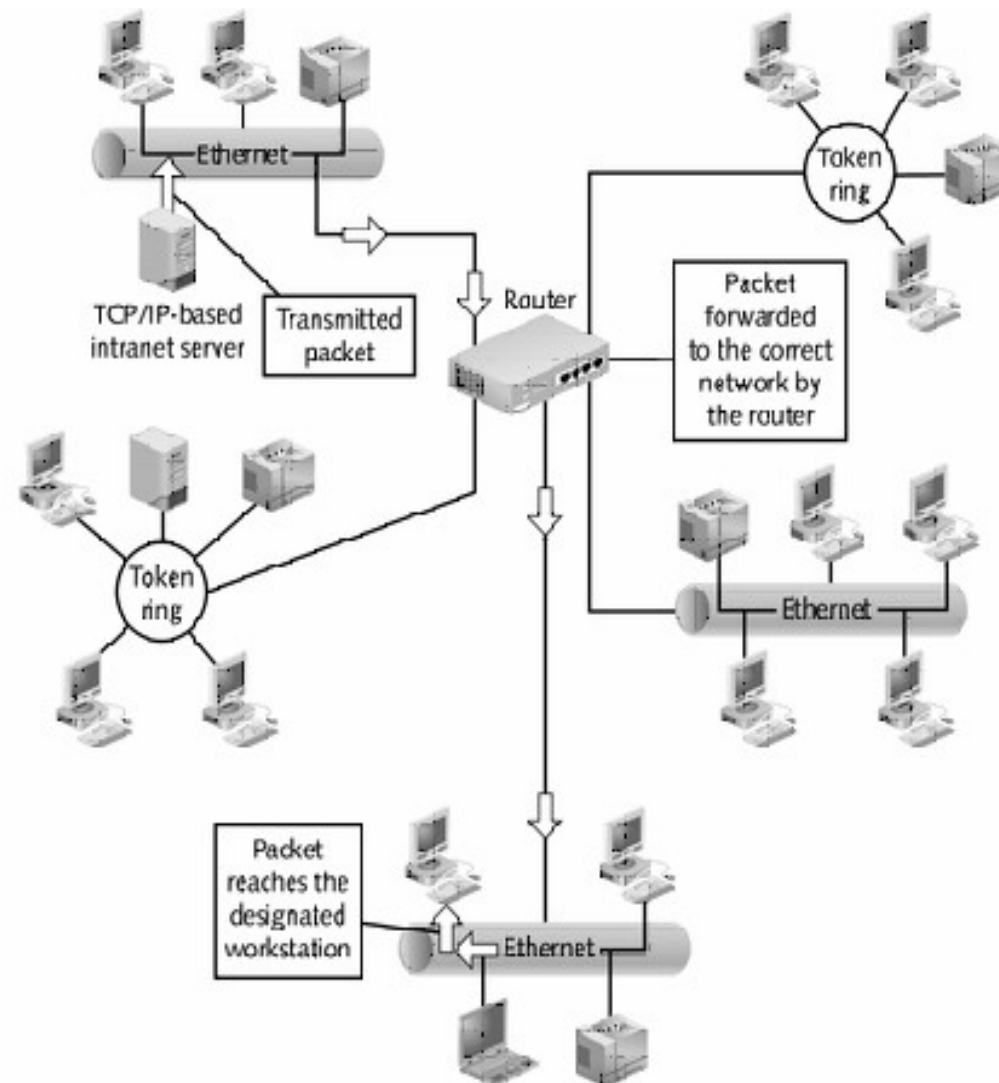- Connect different LANs or LAN segments using the **same access** method

Routers

- Connect networks having the same or different access methods and media
- Route packets and datagrams to networks by using a decision-making process based on:
  - Routing table data
  - Discovery of most efficient routes
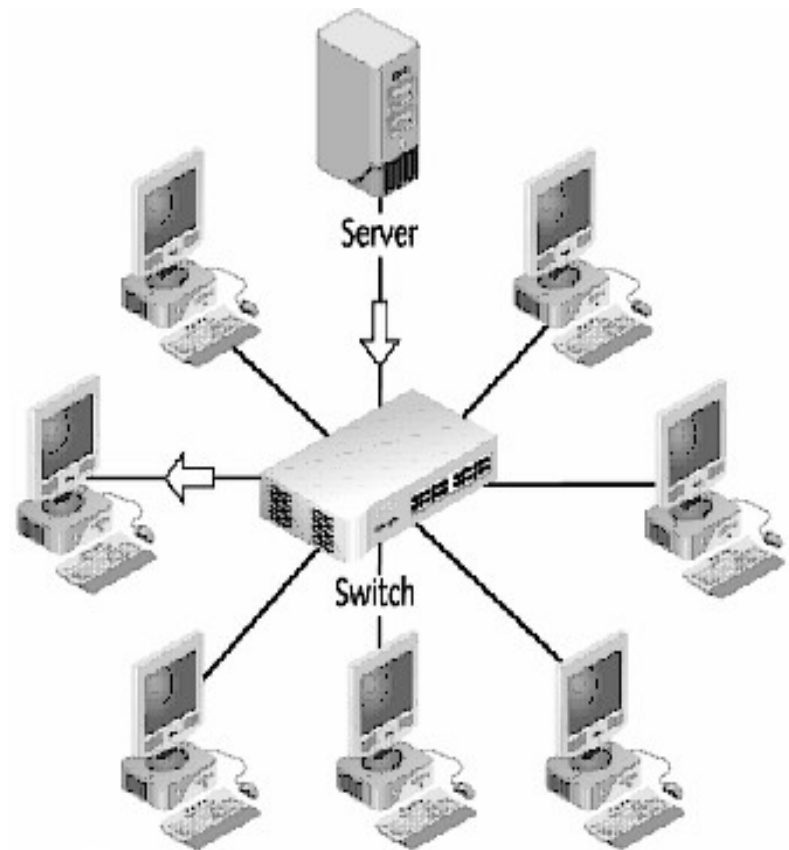 - Pre-programmed information from network administrator

Routers

A router directing packets

Switches

- Link network segments
- Forward and filter frames between segments

A switch in operation