



Introduction to Networks

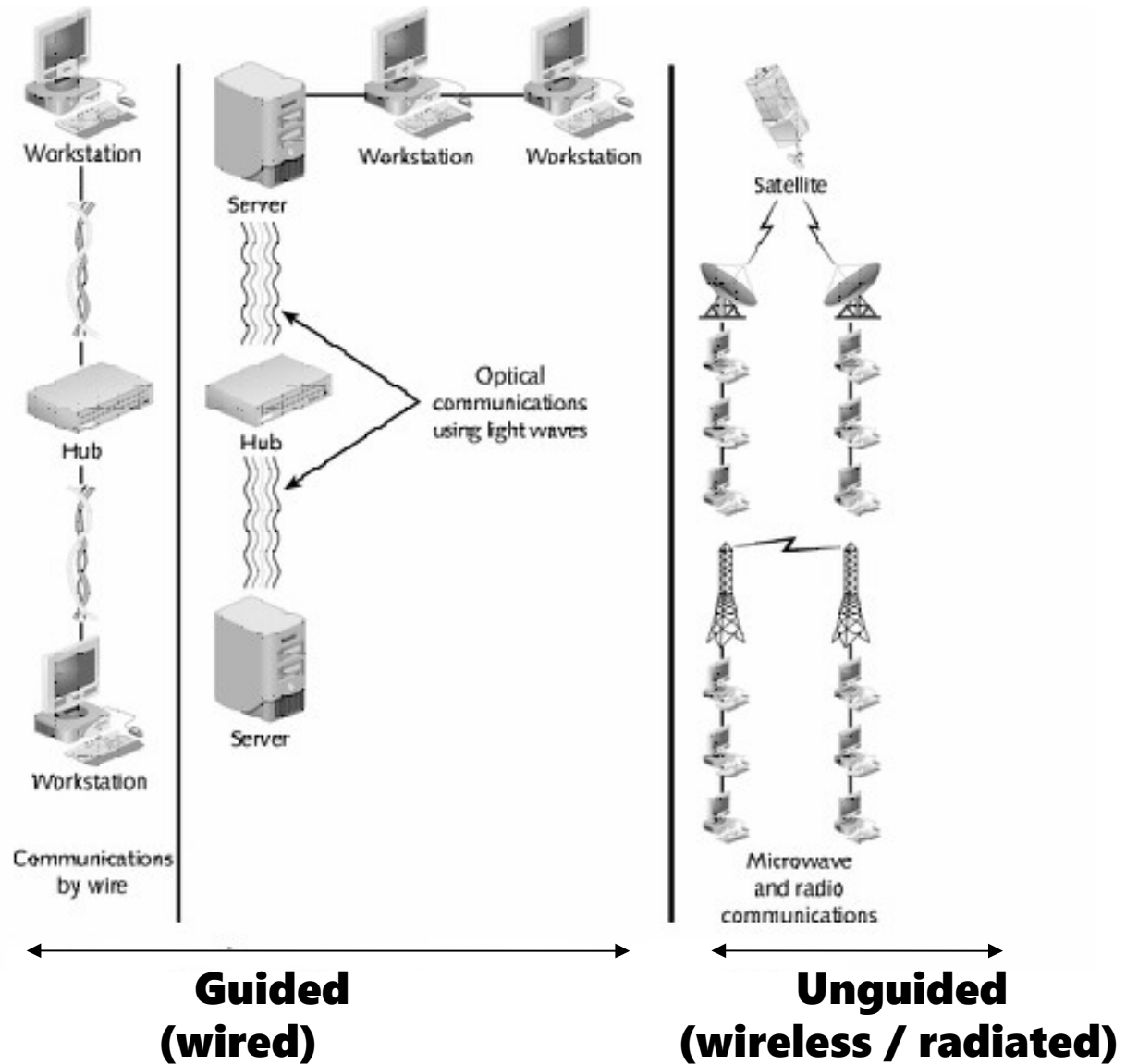
CAN2120C

Communication & Networking

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



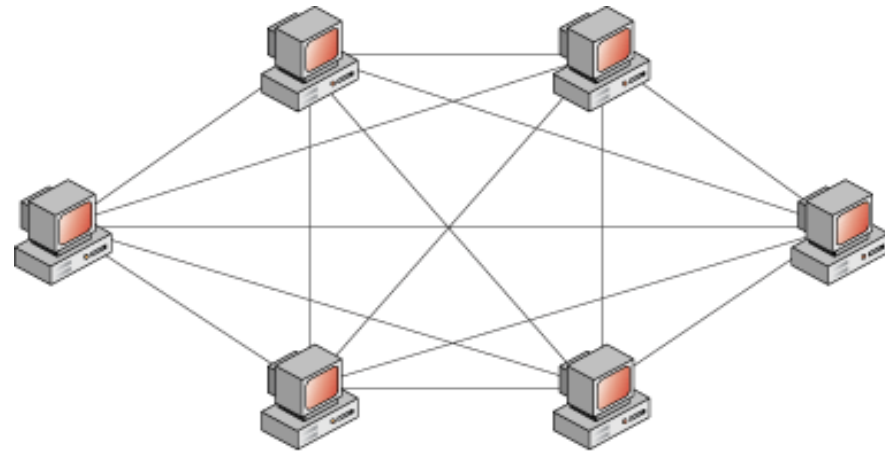
Physical Topology

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

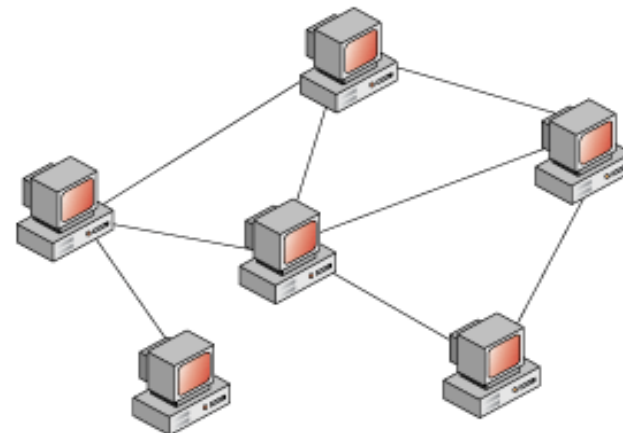
Mesh Topology

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

Full-Mesh:



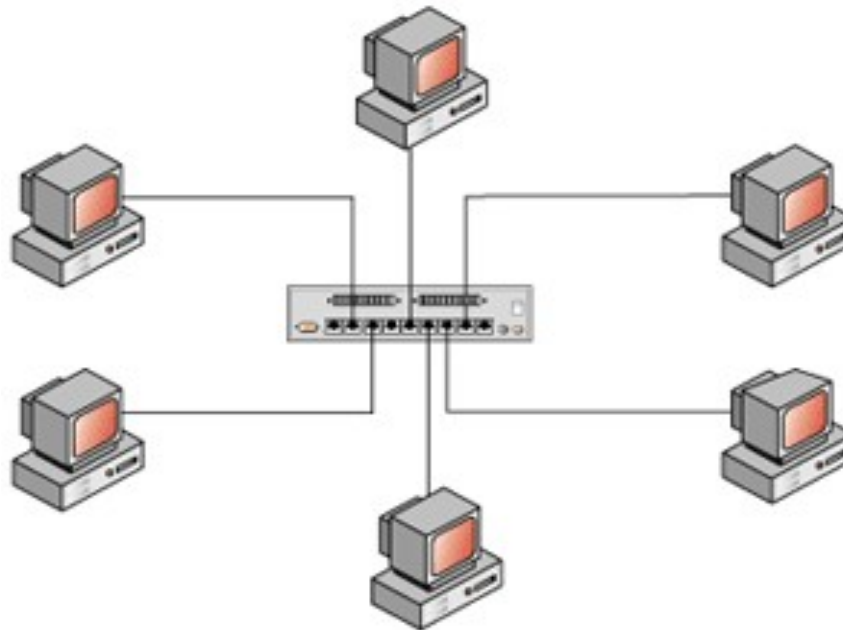
Partial-Mesh:



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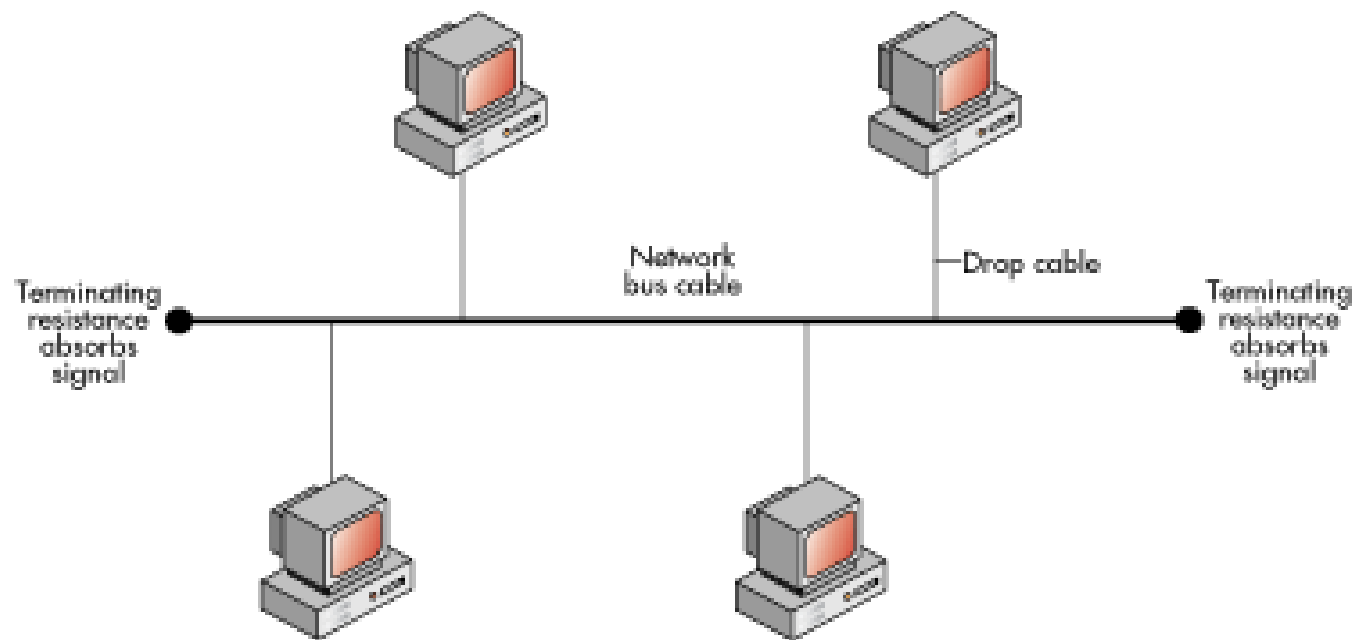
Star Topology

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



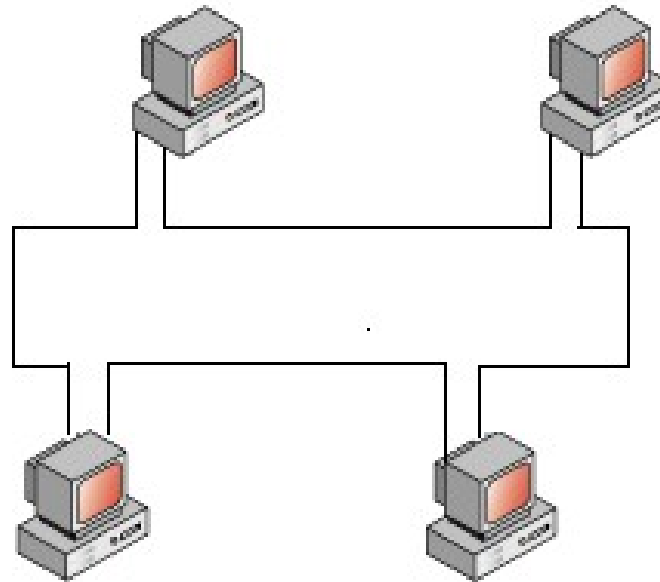
Bus Topology

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



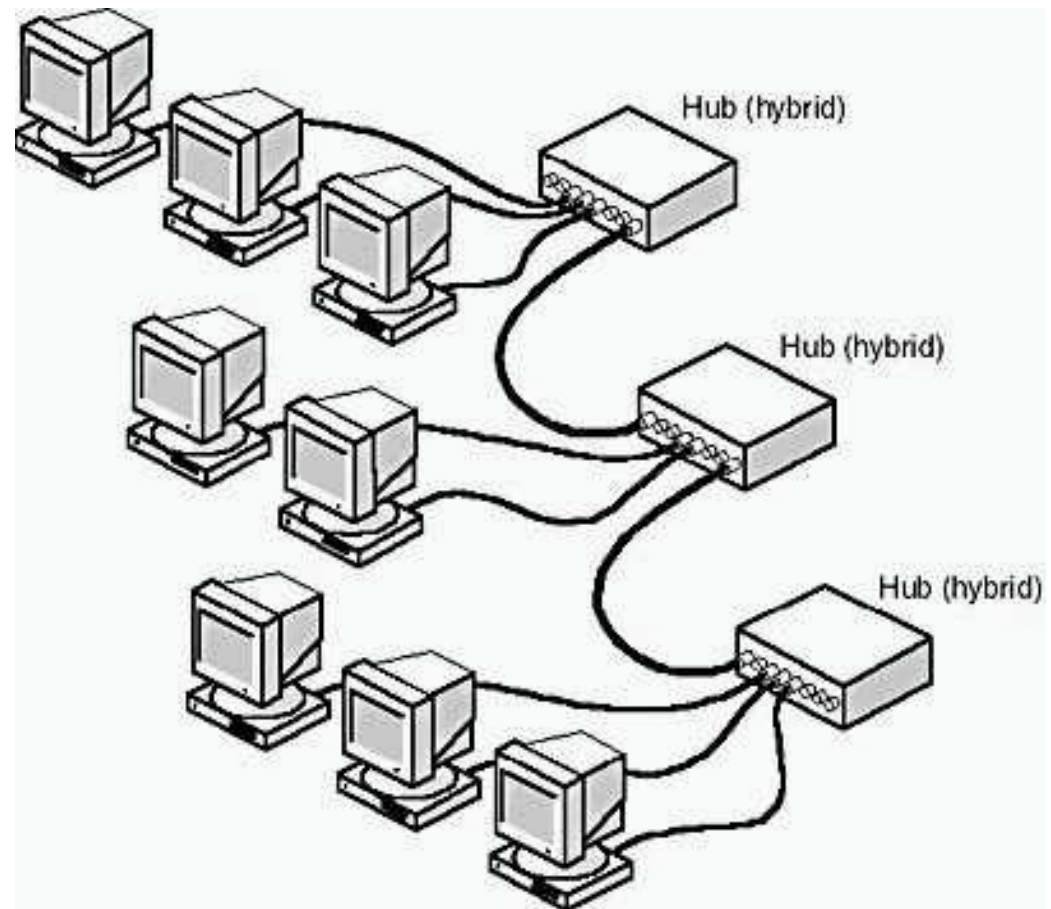
Ring Topology

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



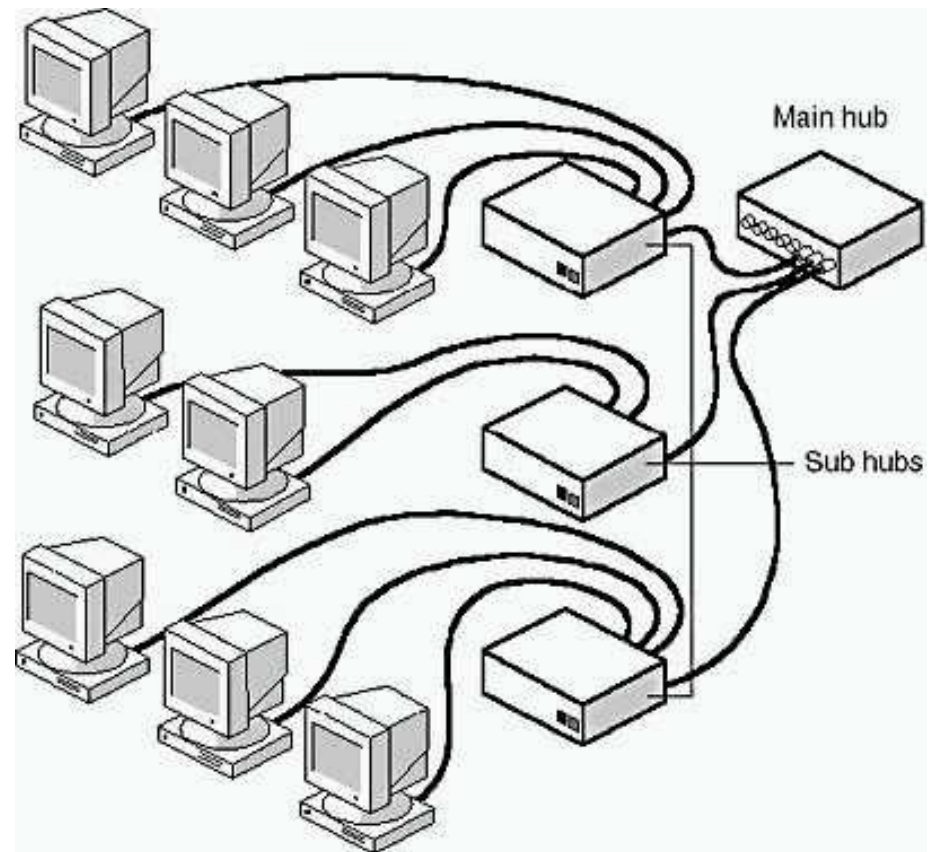
Hybrid: Star Bus Topology

- In a star bus topology, several star topology networks are linked together with linear bus trunks.



Hybrid: Star Ring Topology

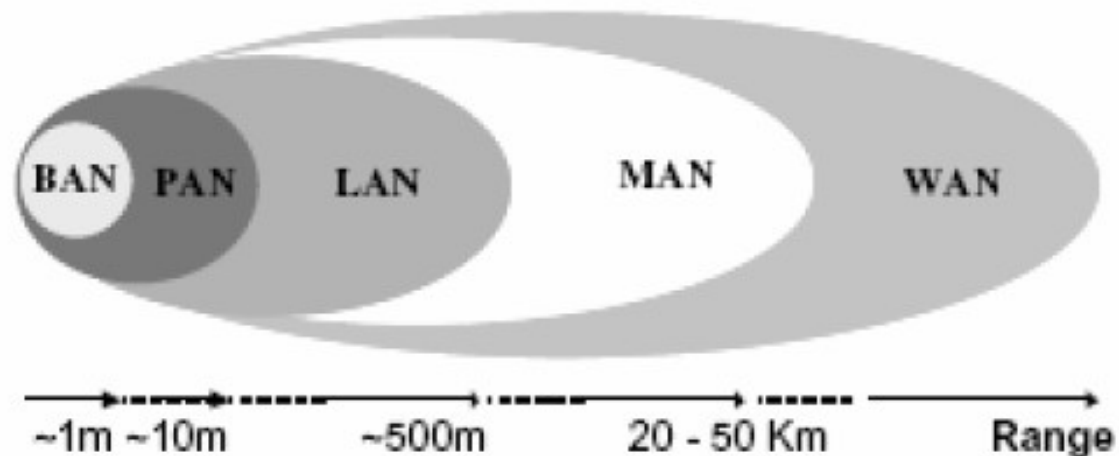
- In a **star ring topology**, sub hubs are linked together in a **star pattern** to a **main hub**, rather than to themselves with **linear bus trunks**.



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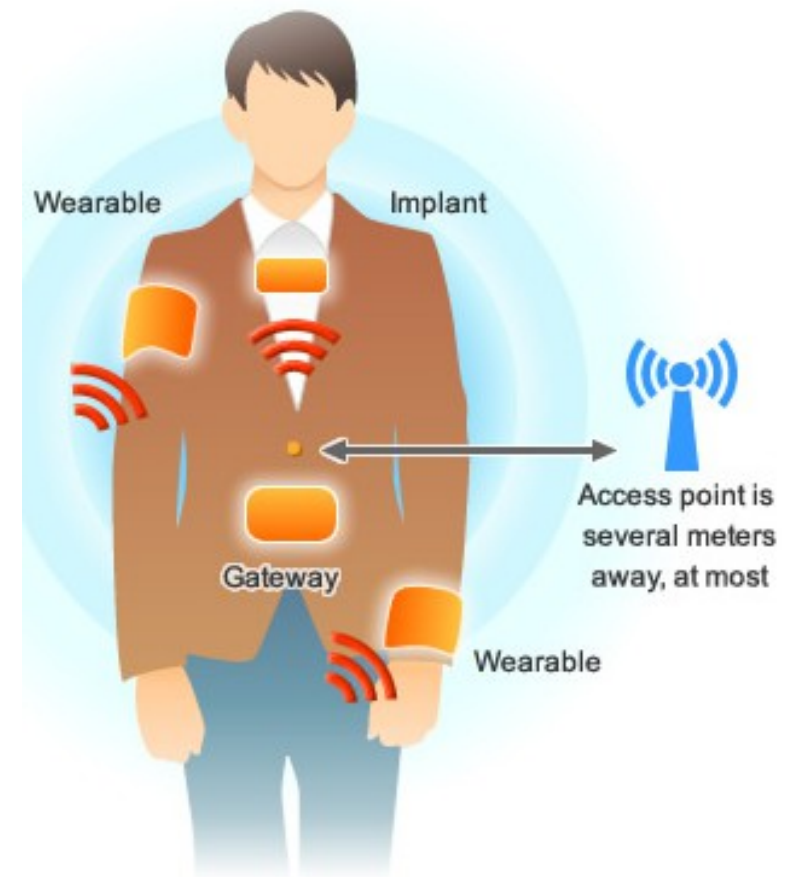
Network Types Defined

- 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)

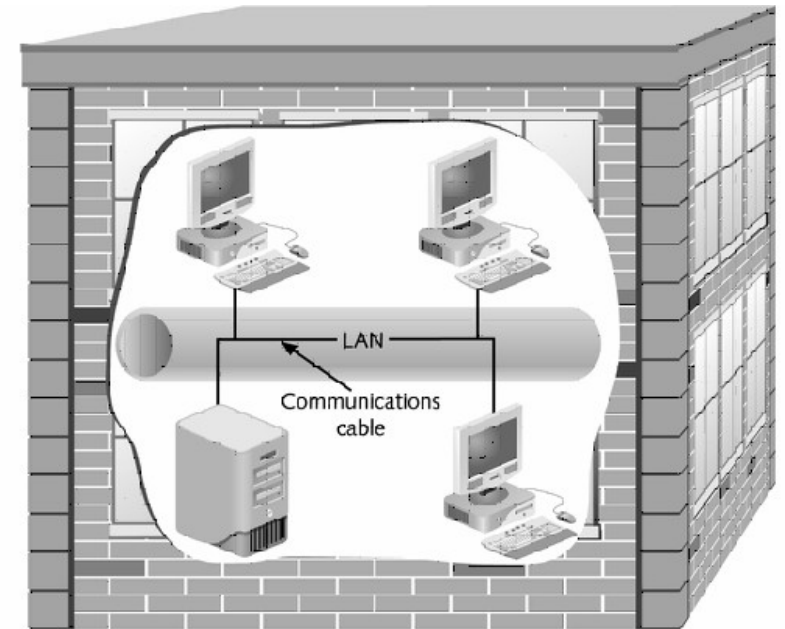


Personal Area Network (PAN)

- 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.

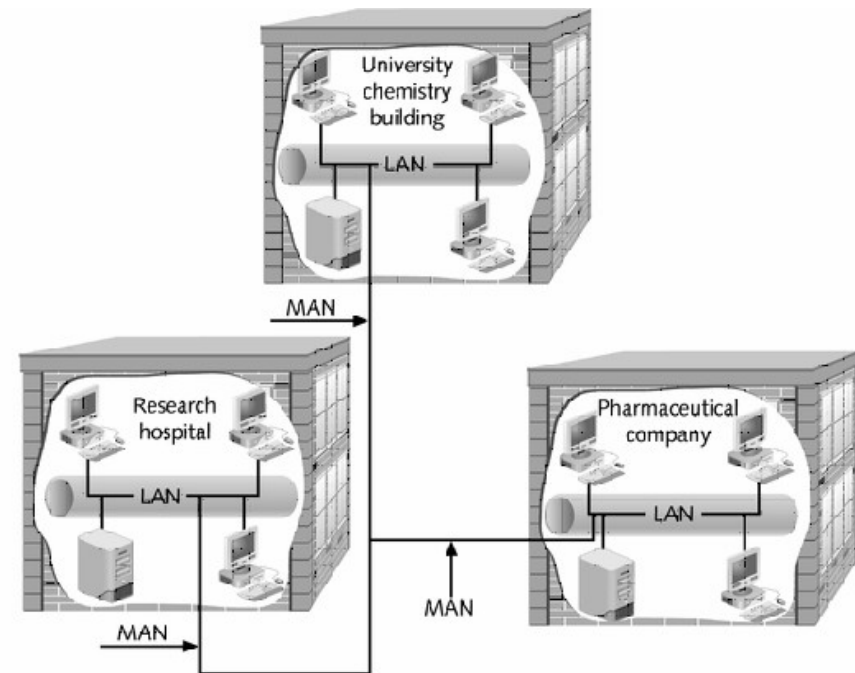
Local Area Network (LAN)

- 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)

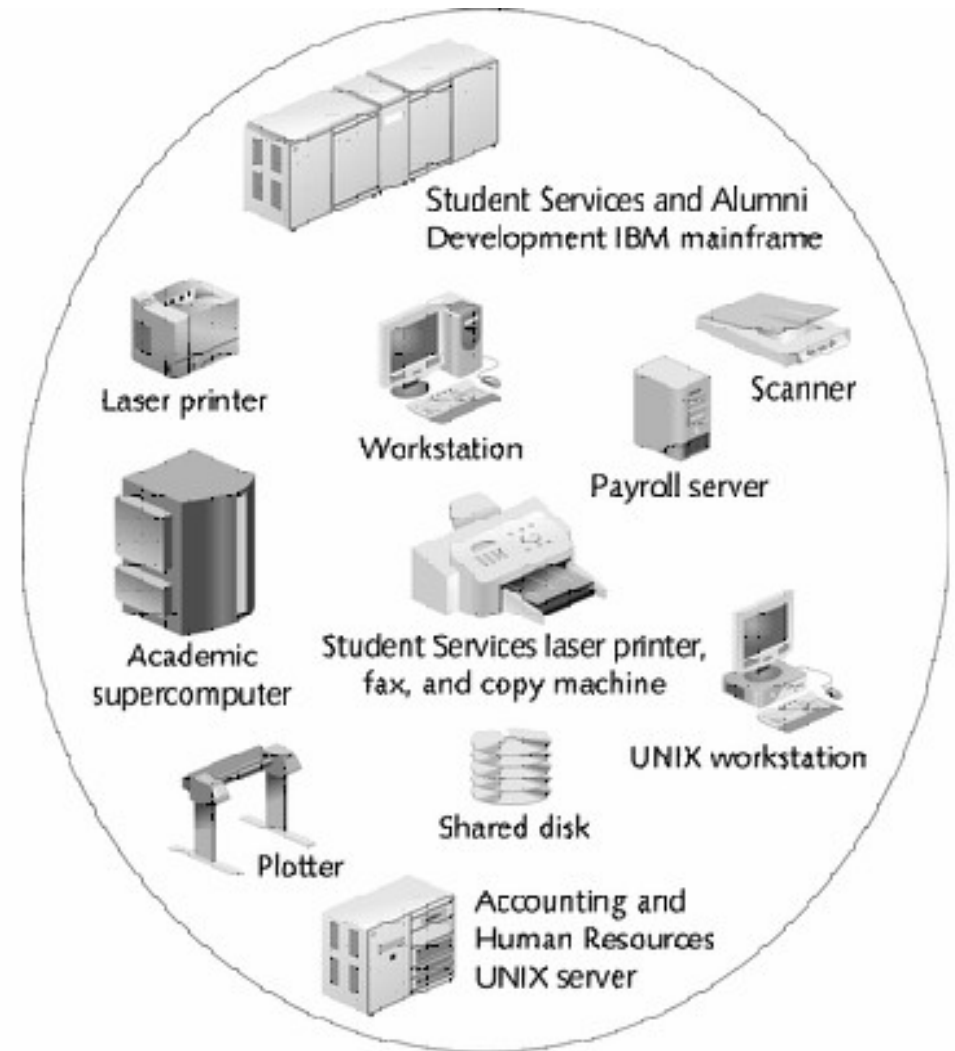
- Provides long-distance transmission of data, voice, image and video information over large geographic areas that may comprise a country, a continent, even the whole world.
- The best example of a WAN is the **Internet**.

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.



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 analog 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

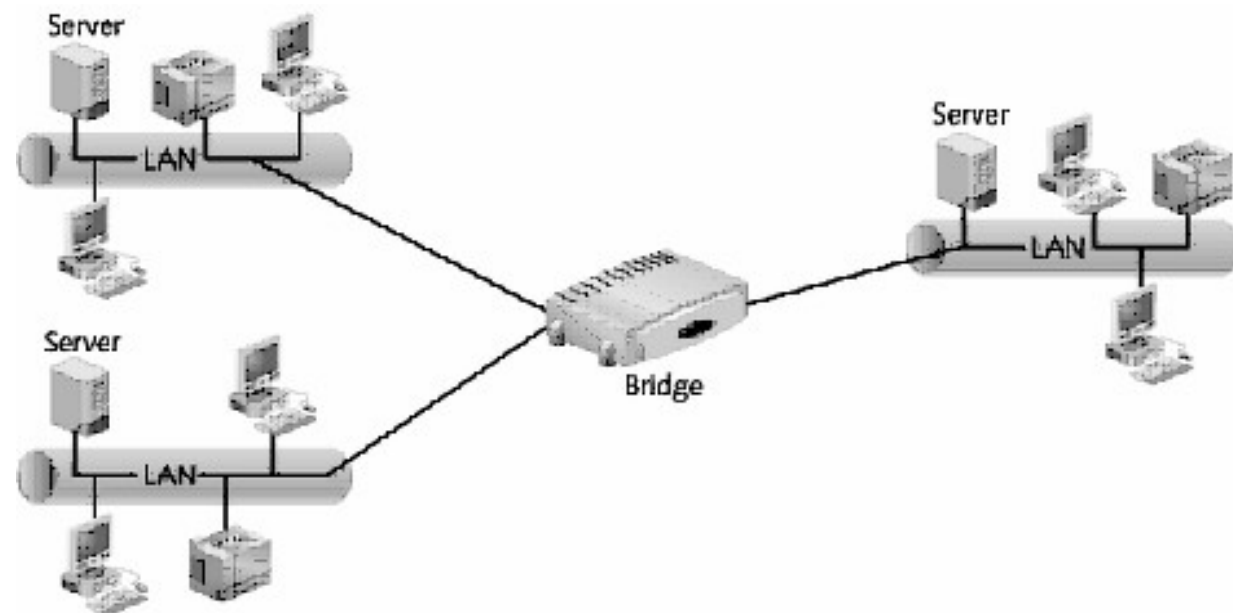
- Cloud Services commonplace
- Internet Of Things (IOT)
- 10G, 25G, 40G and 100G Ethernet has been developed

LAN/WAN Integration

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

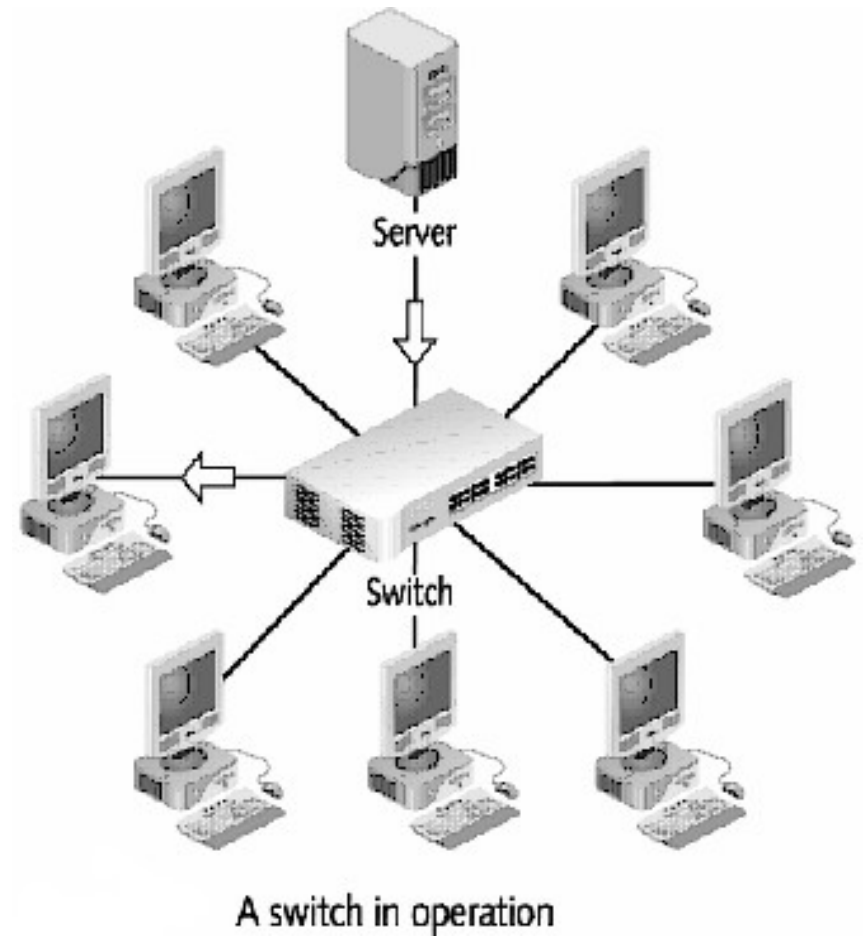
Bridges

- Connect different LANs or LAN segments using the **same access method**. (*Analogy: Road Junction*)



Switches

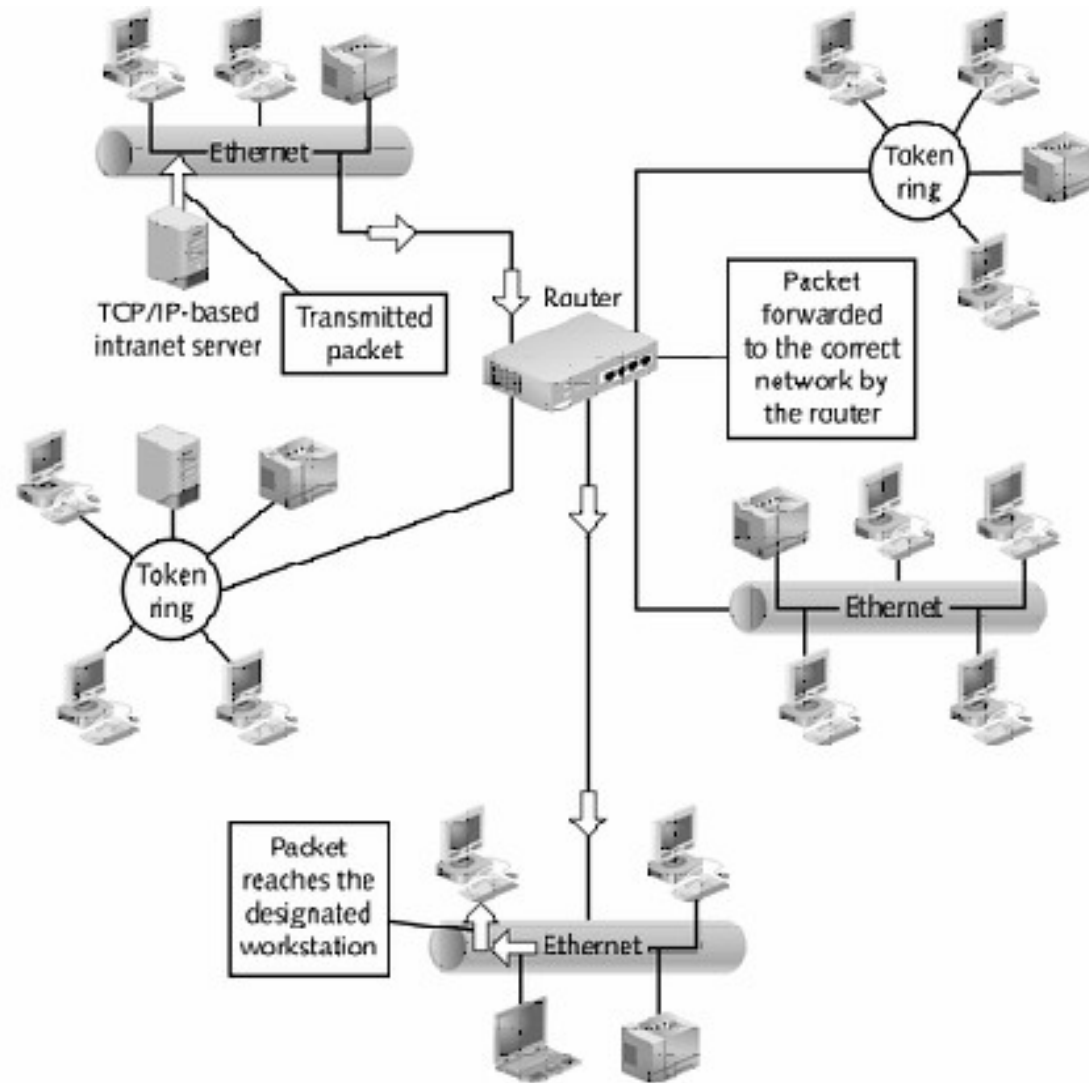
- Same functions as Bridges but has more ports.
- Link network segments
- Forward and filter frames between segments



Routers

- Connect networks having the same or different access methods and media
(Analogy: Roundabouts)
- 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