CAN 1011: Data Communication

- Introduction
- Communication Models
- Overview of Networking

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  - Network topologies and classifications
  - Brief chronology of data and computer communication & networking

Data communication v/s Networking

- **Data communication** is concerned with the transmission of data over a communication medium or channel between two entities. Here we are more concerned about issues such as physical properties of communication medium, physical characteristics of signals and interfaces, format, and timing of signals, etc.
- **Networking** is concerned with the physical topology of two or more communicating entities and the logical topology of data transmission. Issues of importance are, for example, addressing, routing, reliability, etc.

Major Communication Tasks

Interfacing	Addressing
Security	Routing
Synchronization	Recovery
Exchange management	Message formatting
Error control	Signal Generation
Congestion control	Network management
Flow control	Transmission system utilization

= Data Communication = Networking = Data Communication & Networking

Communication modes

Simplex: One-way e.g. traditional Radio

Half-Duplex: Two-way but only one direction at a time e.g. Walkie-Talkie, CB radio, Ethernet (later)

Full-Duplex: Two-way with both directions at the same time e.g. Telephone, Ethernet (later)

Transmission types

Unicast

One-to-one. Dedicated channel between two communication parties.

Broadcast

One-to-all. All network nodes receive the same information via a shared communication channel

Multicast

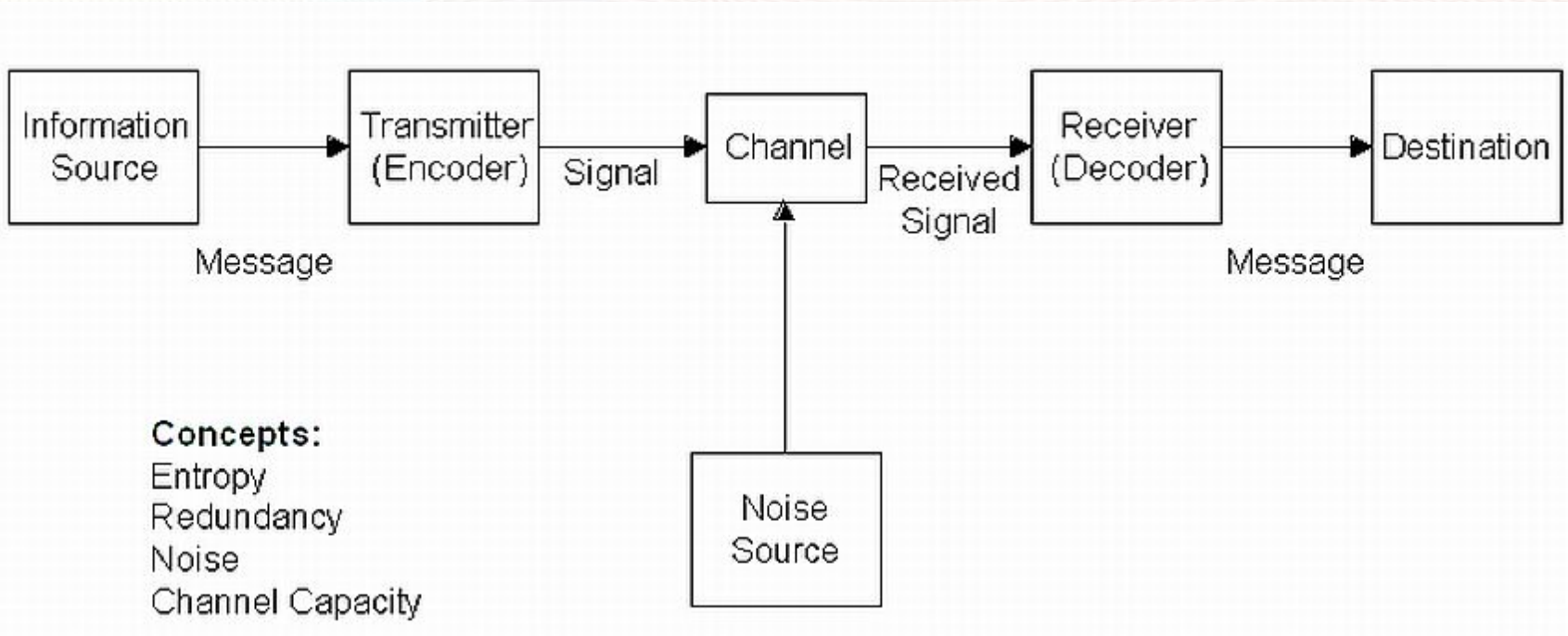
One-to-many. Communication channel is shared by a group of users

Data is transmitted to a group of users which have subscribed to the information.

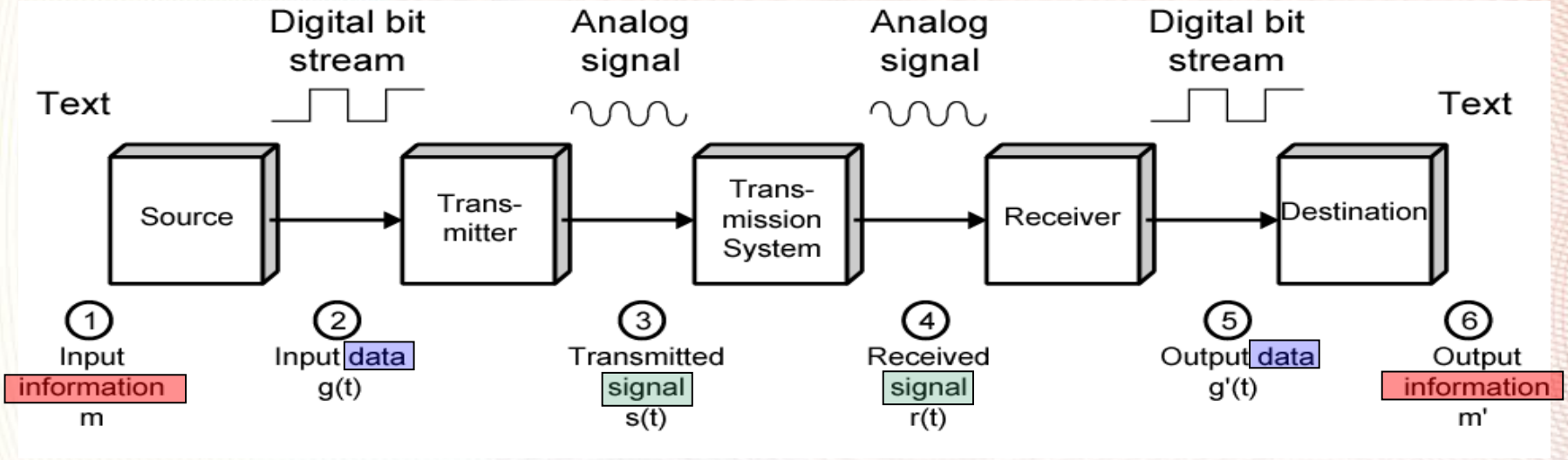
Anycast

One-to-one-of-many. Communication between a single sender and the nearest of several receivers in a group.

Shannon-Weaver Communication Model (1949)



Simplified Communication Model



- **Input information** *m* => ASCII => **Input data** *g(t)* as a digital bit stream.
- Encoding and modulation of **input data** *g(t)* as **transmitted signal** *s(t).*
- **Transmitted signal** *s(t)* must suit the transmission medium.
- Transmission Impairments such as attenuation, noise, distortion are present.
- Is **Output data** *g'(t)* identical to **Input data** *g(t)*? Error detection must be used. If not, Error correction at receiver may help restore the original data.
- Otherwise, request retransmission of message. Flow control involved**.**
- Better utilization of transmission system's capacity by using multiplexing.

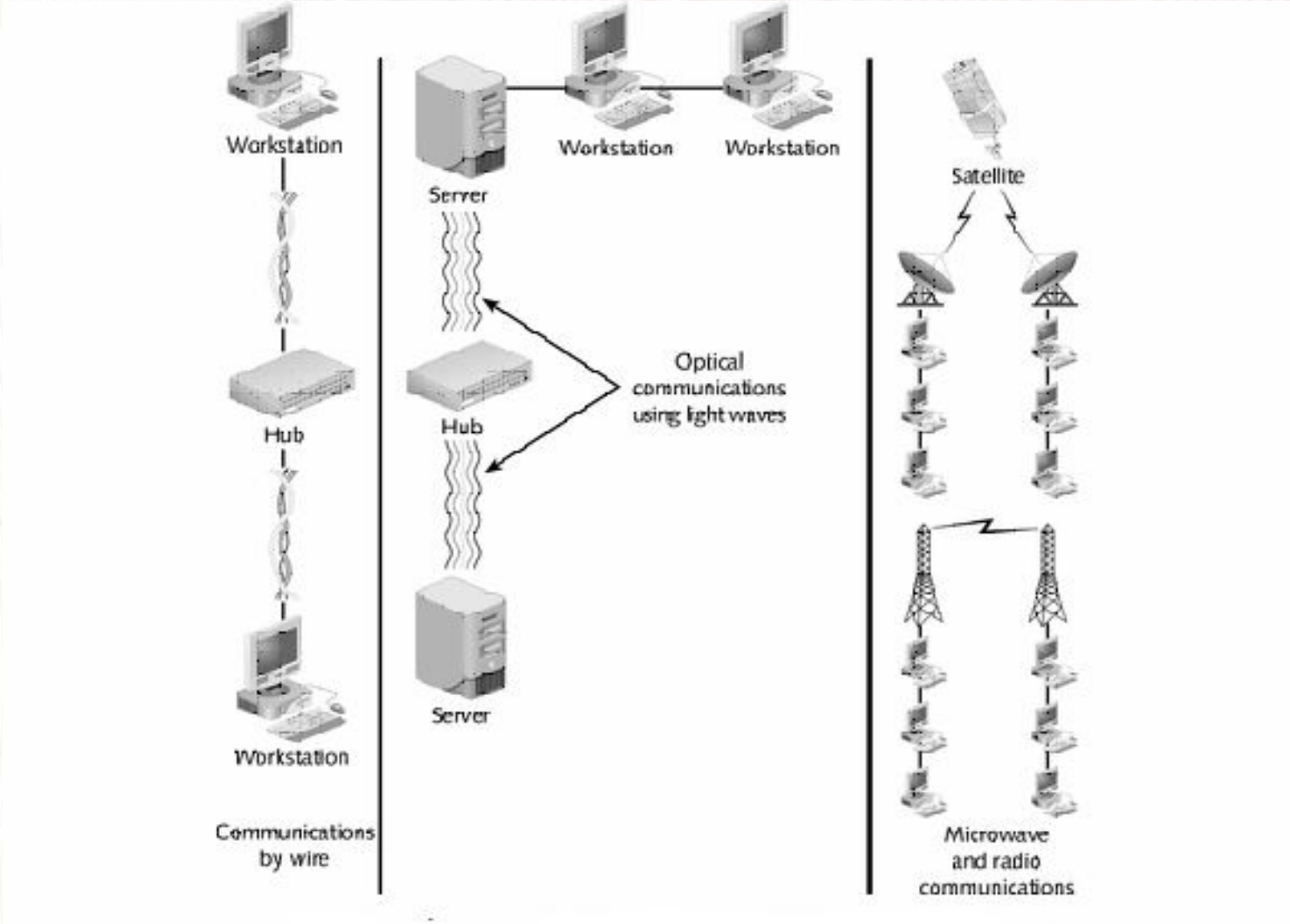
Network: Definition

- A set of devices (**nodes**) connected by a **communication channel** (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**.

Describing a Network

- **Communication medium**
  - Guided or Radiated i.e. coaxial cable, fibre-optic cable, radio waves, microwaves, etc...
- **Protocol**
  - How networked data is formatted into discrete units.
  - How each unit is transmitted and interpreted
- **Topology**
  - Physical layout of circuits and devices.
- **Network type**
  - LAN/MAN/WAN; Private versus Public

Types of communication media



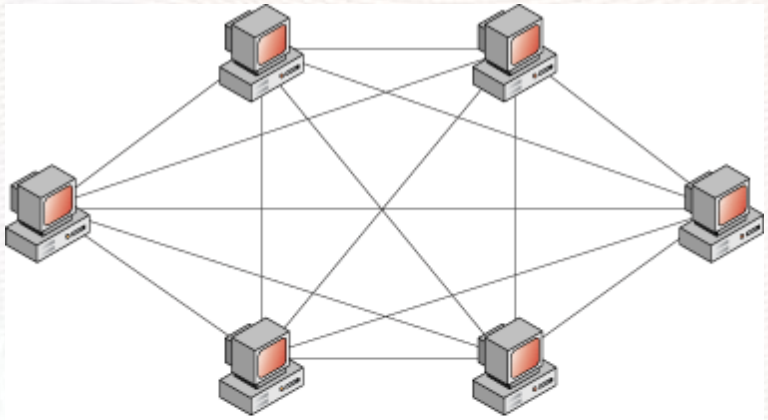
Physical Topology

- 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**.

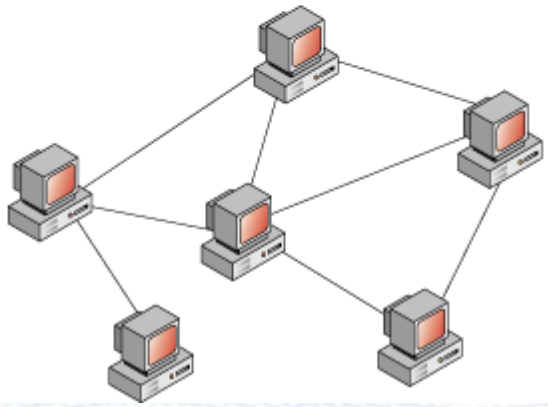
Mesh Topology

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

Full-Mesh:

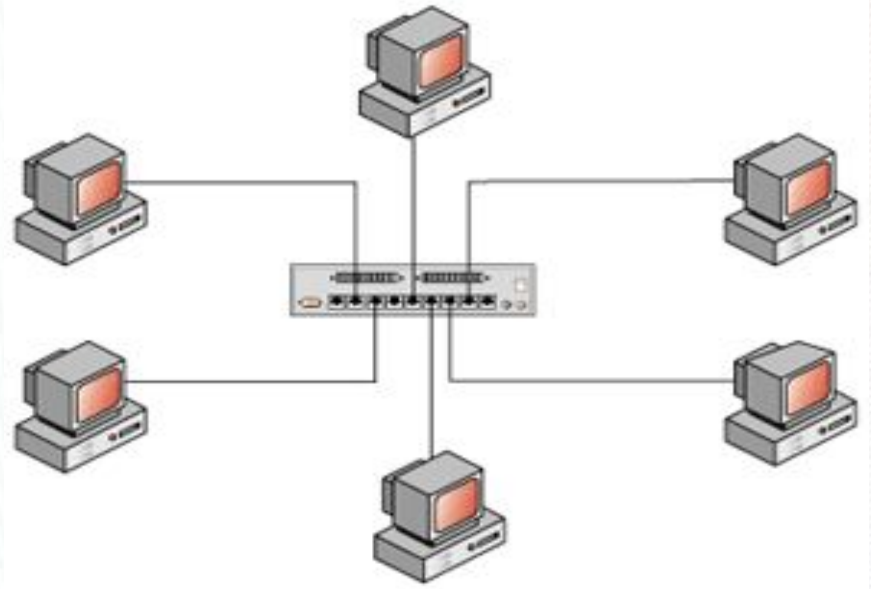


Partial-Mesh:



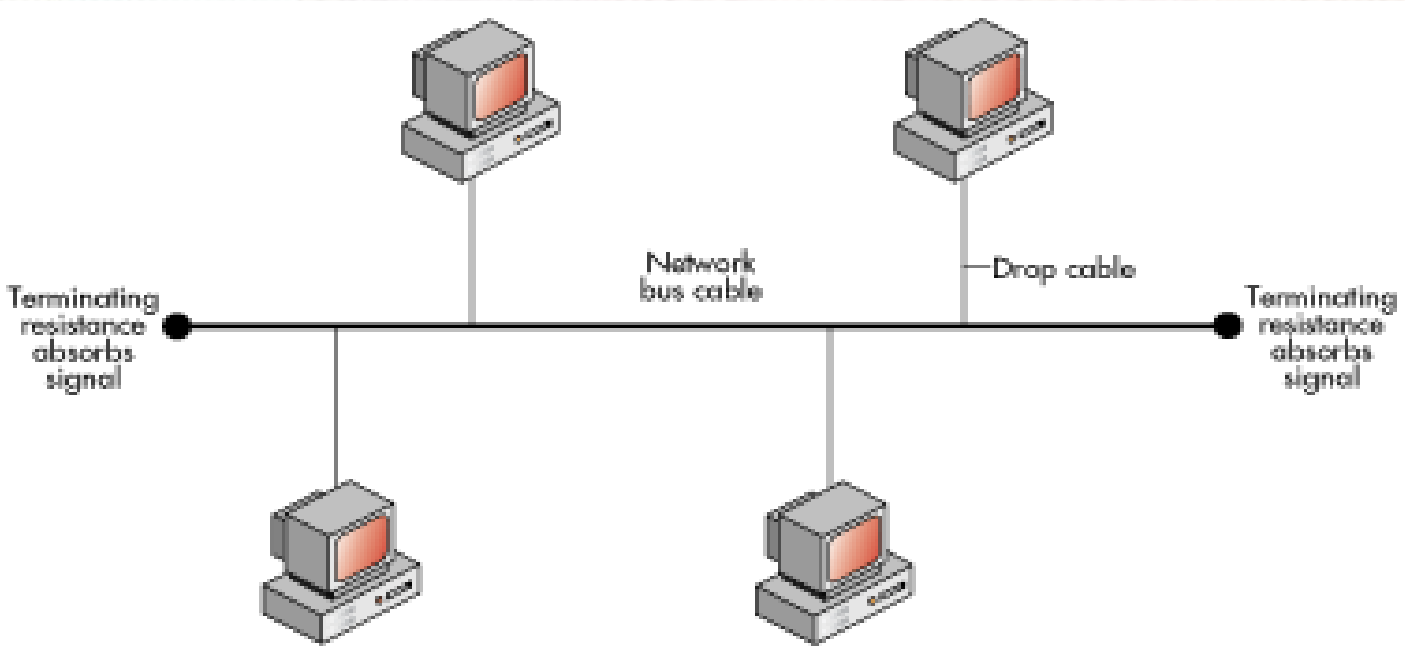
Star Topology

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



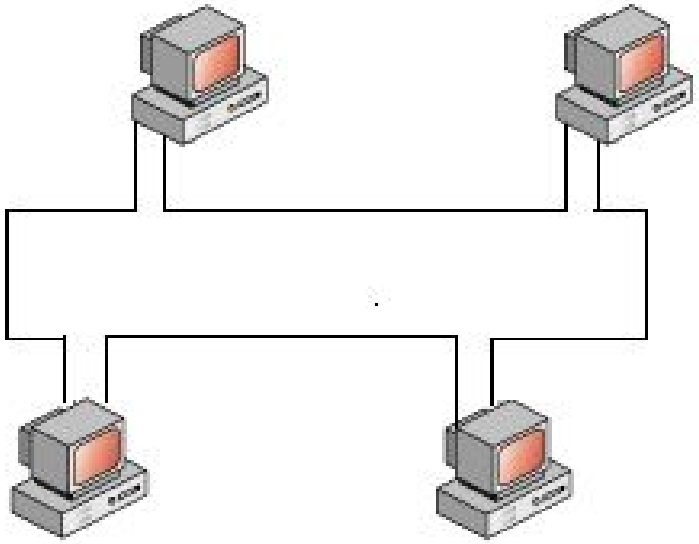
Bus Topology

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



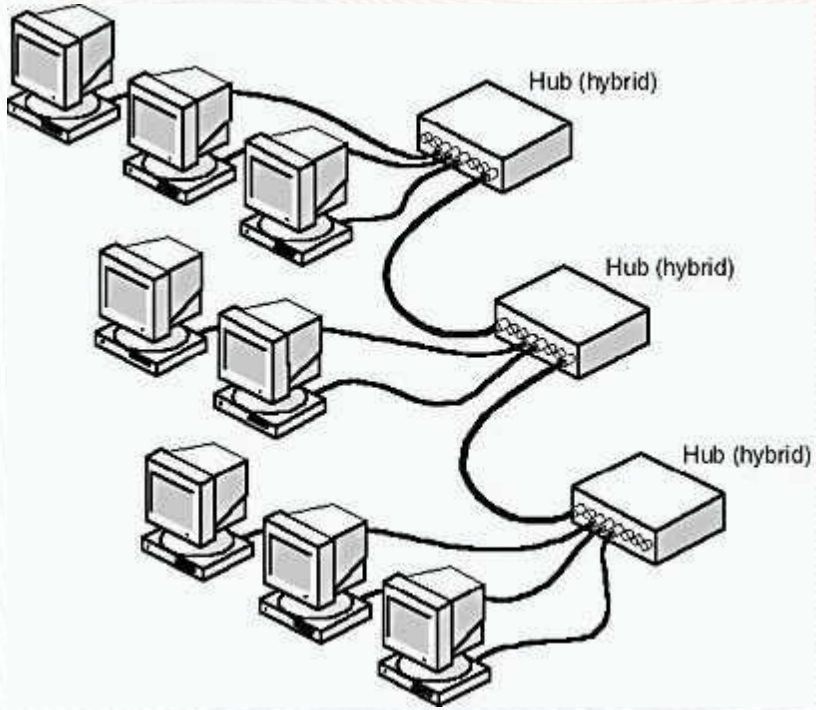
Ring Topology

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



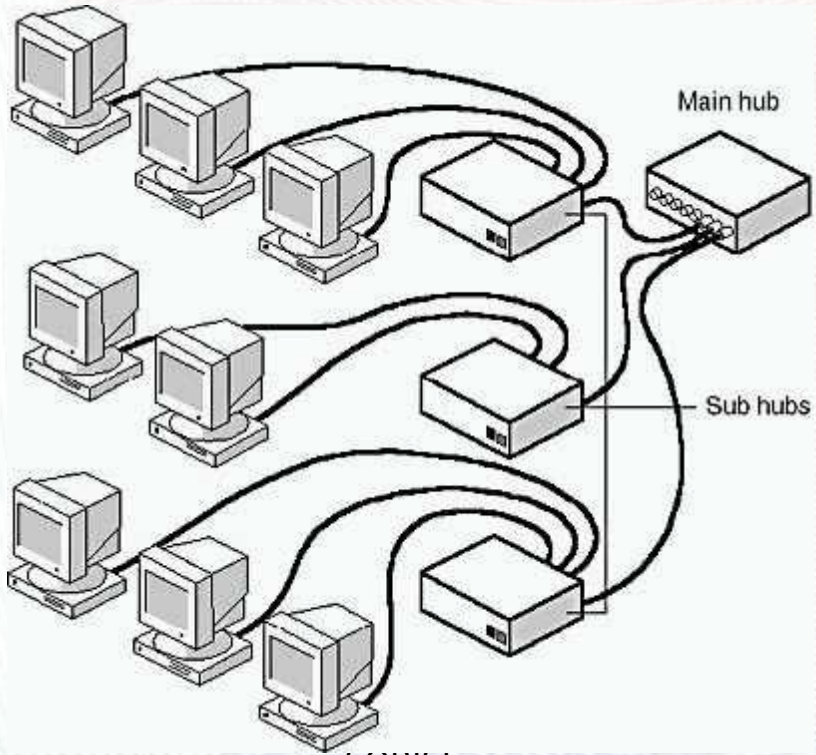
Hybrid: Star Bus Topology

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

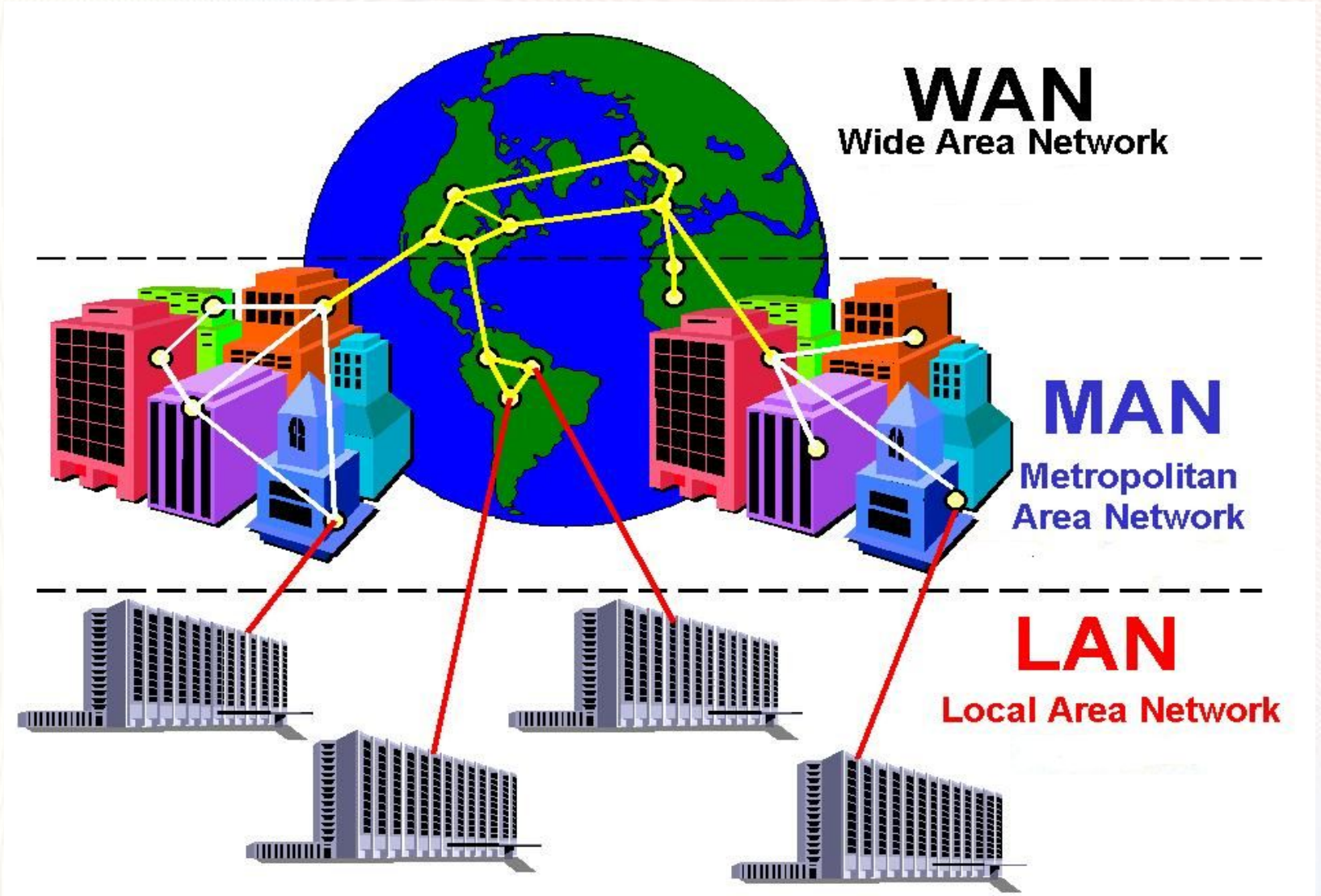


Hybrid: Star Ring Topology

- 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**.



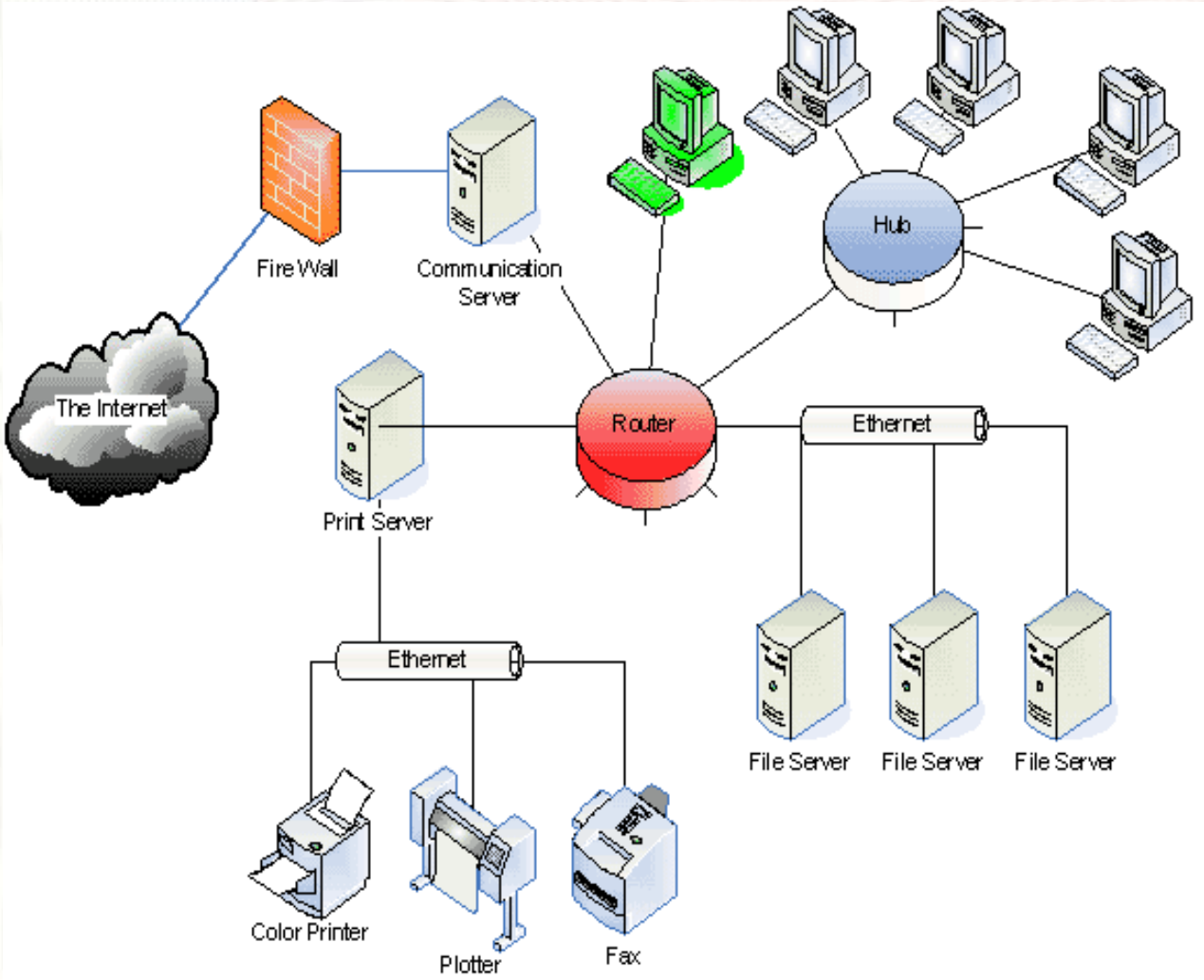
Network Types Defined



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 e.g. SITE LAN
- LAN usually have high bandwidth and low latency.

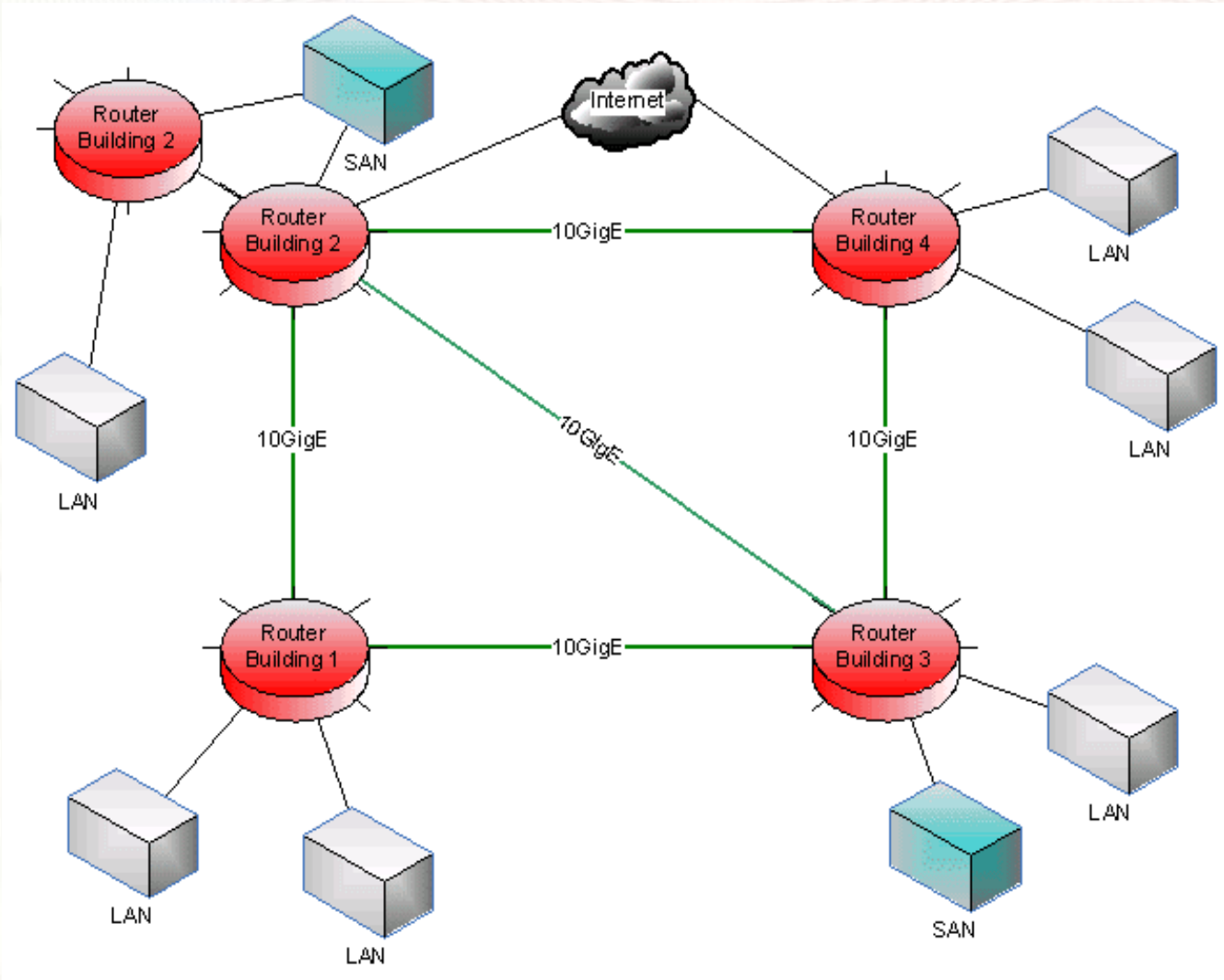
Example of a typical LAN



Metropolitan Area Network: MAN

- Links **multiple LANs** in a large city or metropolitan region.
- May be wholly owned & operated by a private company or it may be a service provided by a public company, such as a local telephone company.
- Many **telcos** usually provide popular services like **Switched Multi-Megabit Data Services** (SMDS).

Example of a MAN



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 using telephone lines or communication satellites.
- The best example of a WAN is the **Internet**.
- WAN usually have low bandwidth and high latency.

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 fibre 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

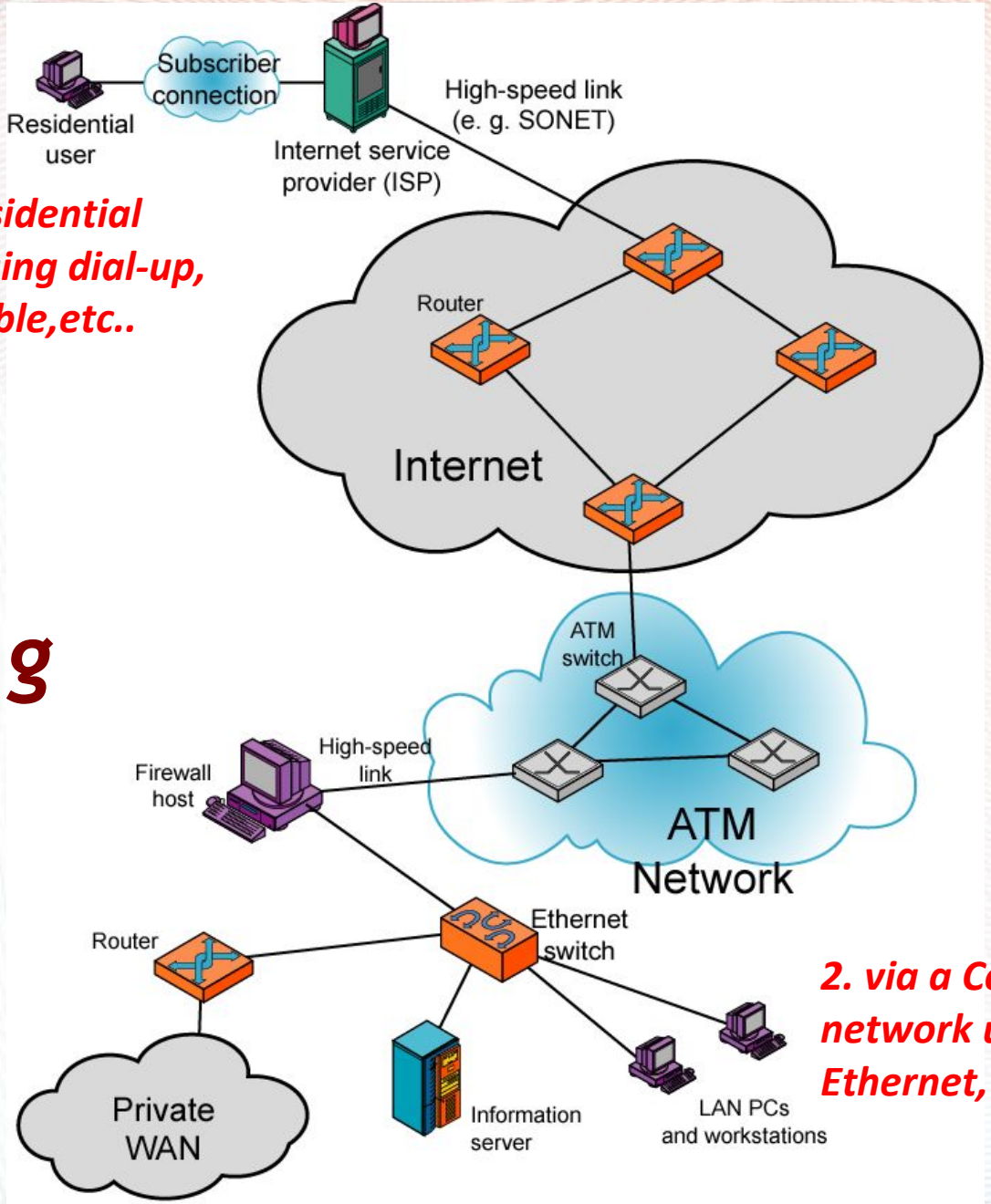
LAN/WAN History: 1980s

- 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 - Now

- ARPANET retired
- NSFNET opened to commercial use
- First cyberbank
- ISProviders starts to mushroom.
- IPv6 or Ipng used for Internet2 backbone
- Streaming video and radio capability
- Prices of Gigabit devices fall as competition increases

2 popular ways of connecting to the Internet



1. via Residential Access using dial-up, ADSL, Cable,etc..

2. via a Corporate network using Ethernet, ATM, etc...