Introduction to Computer Networks

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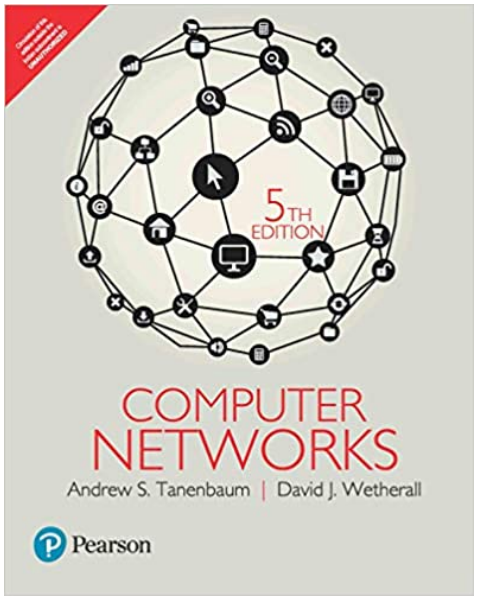
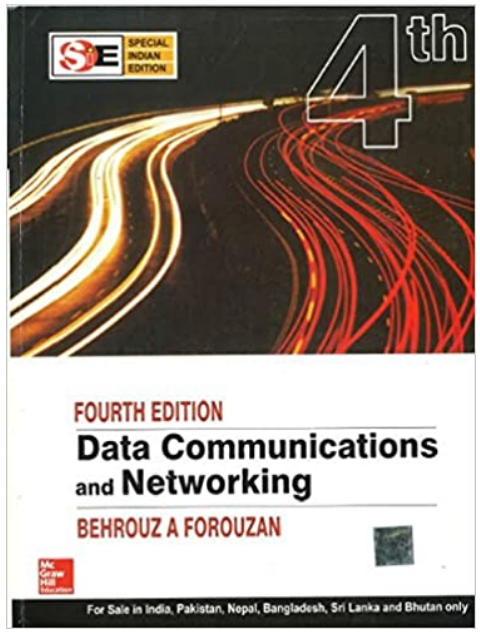
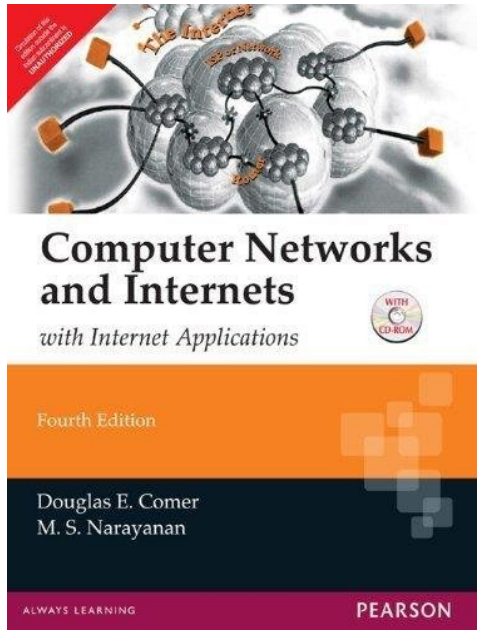
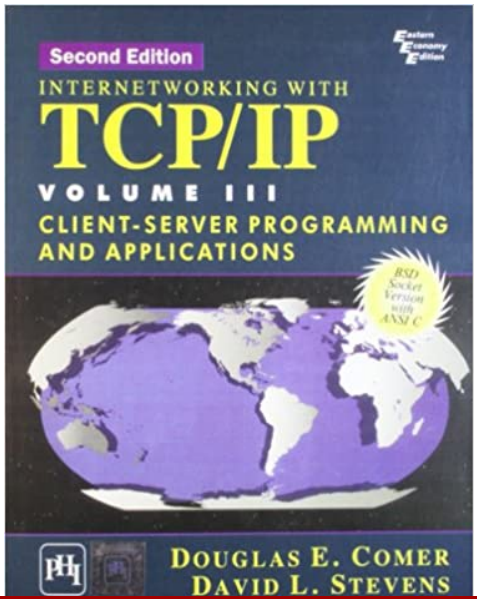
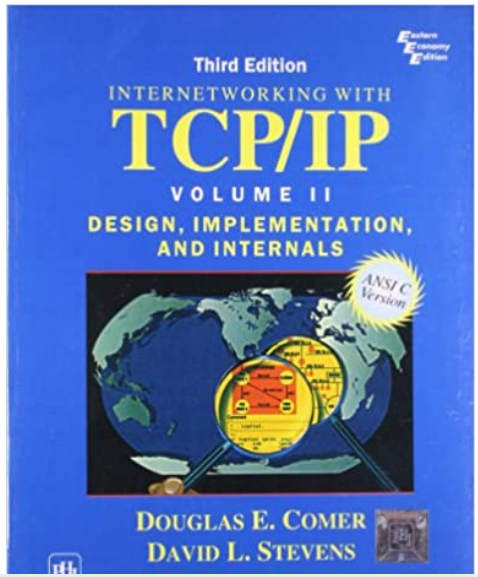
Course Text Books for Theory and Practice

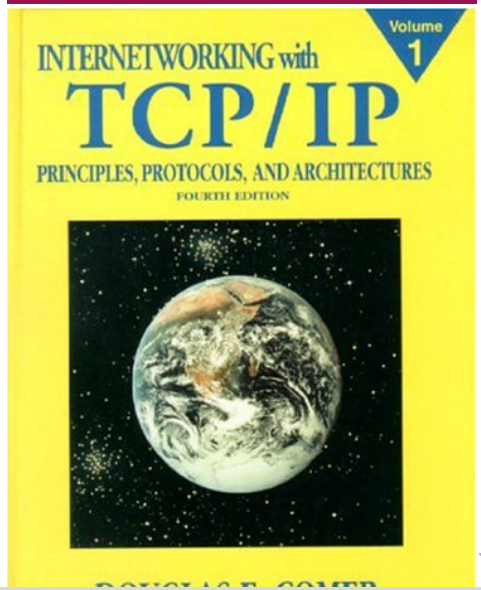












Computer Networks History

George Stibitz
use a teletype machine
Dartmouth college-New York

1940

SemiĀutomatic Ground
Environment (SAGE)
for military radar

1950

Commercial airline reservation
system SemiAutomated Business Research
Environment went online with
two mainframe computer

1960

Researcher at dartmouth develop a dartmouth
time sharing system for distributed
users of large computer networks

1962

Liniking output system
like teletypewrite with computer was
an intersect of
advance research project agency(ARPA)
project code name was
"Intergalactic computer network

1964

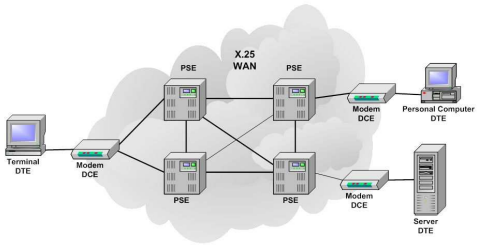
Thomas marill and
Lawerence G robert
created the first WAN

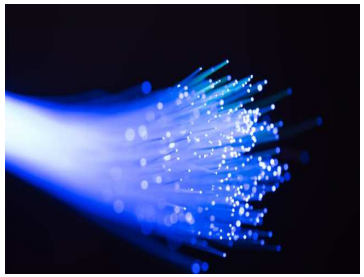
1965

A research group at MIT supported by
Bell labs & General electric
used to route and manage telephone connections

Computer Networks History (Cont...)

Sample X.25 Network





1977

Commercial services using X.25 were deployed,and later used underlying infrastructure for expanding TCP/IP networks

1991

Home broadband created

1996

56K modem

Home broadband enter into the mainstream usage

2000

Cisco enter into the networking martket and capitalized 550 million dollar

2001

2009

10GigaBits ethernet was the only market segment

The terabit optical ethernet 1000 trillion bits per second

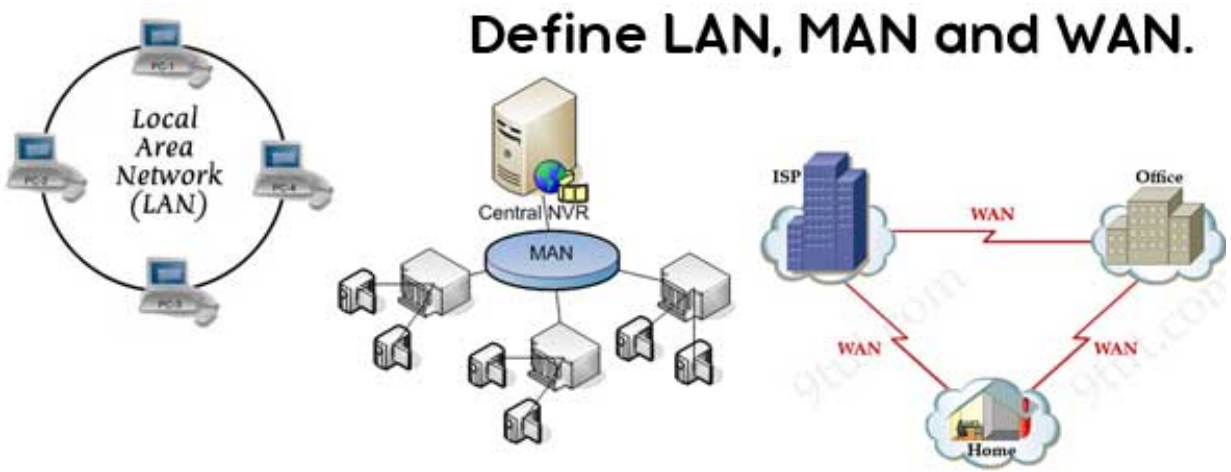
2010

100 GigaBits ethernet standard

2020

Computer Networks

- A computer network is a collection of computers and other hardware components interconnected by communication channels that allows the sharing of resources and information.
- **Internet** being the most well-known example of a network of networks
- Networks come in many sizes, shapes and forms
  - **LAN:** Network in small geographical Area (Room, Building or a Campus) is called LAN (Local Area Network)
  - **MAN:** Network in a City is call MAN (Metropolitan Area Network)
  - **WAN:** Network spread geographically (Country or across Globe) is called WAN (Wide Area Network)



Applications of Networks

- **Resource Sharing:**
  - Hardware (computing resources, disks, printers)
  - Software (application software)
- **Information Sharing**
  - Easy accessibility from anywhere (files, databases)
  - Search Capability (WWW).
- **Communication**
  - Email
  - Message broadcast
- **Remote computing**
- **Distributed processing (GRID Computing)**

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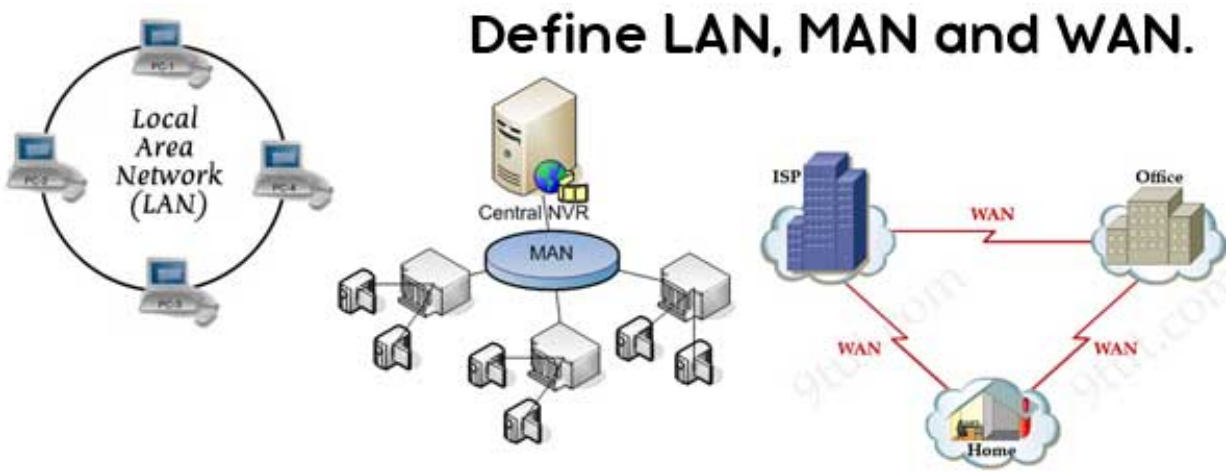

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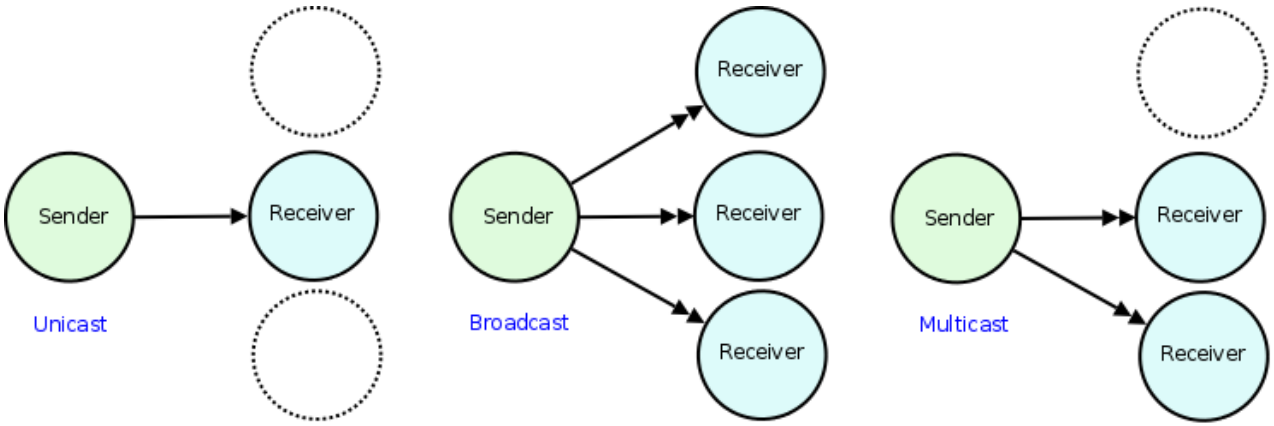
Network Design

- Two dimensions stand out as important:
  - **Transmission technology**
    - Multi-point links: (Shared links)
    - Point-to-Point links: (Unicast link)
  - **Scale**
    - Distance
  - **Network Performance**
    - Performance (Transmit & Response Time)
    - Reliability (Throughput)
    - Security

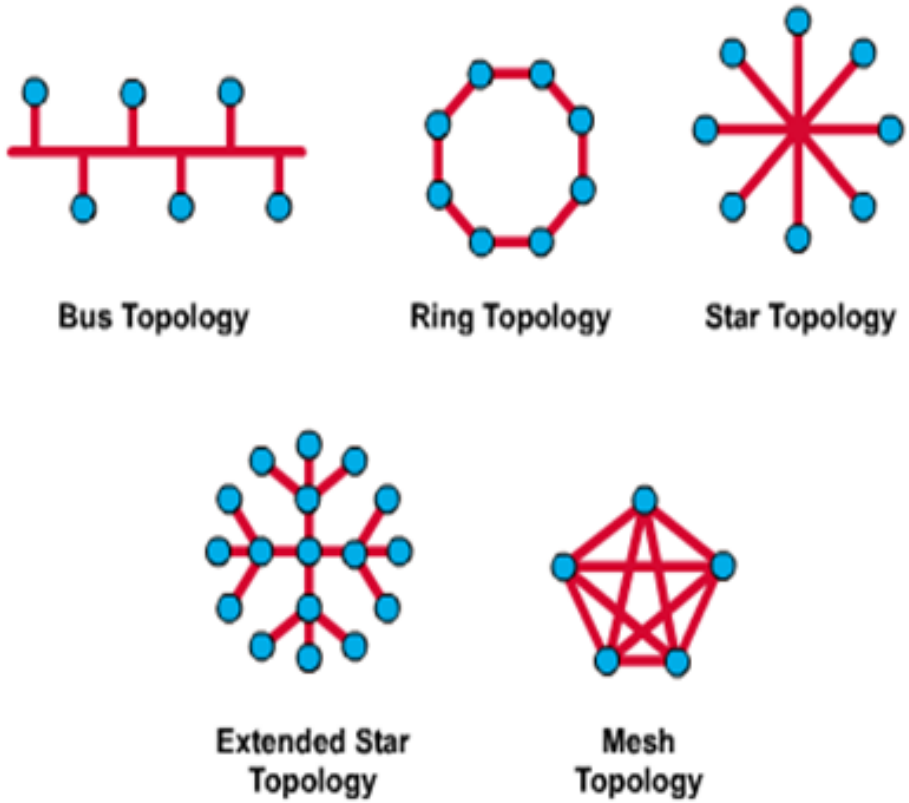


Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	
100 m	Building	Local area network
1 km	Campus	
10 km	City	Metropolitan area networ
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

Scale (distance)

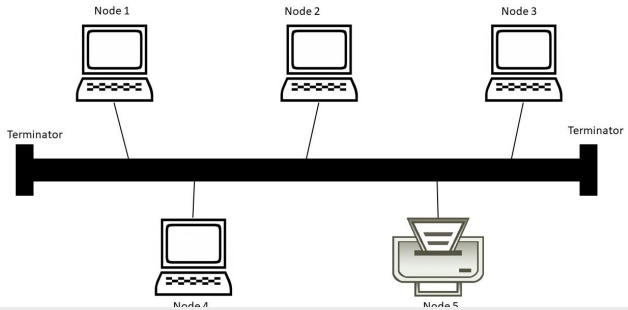
Network Topology

- The network topology defines the way in which computers, printers, and other devices are connected.
- A network topology describes the layout of the wire and devices as well as the paths used by data transmissions



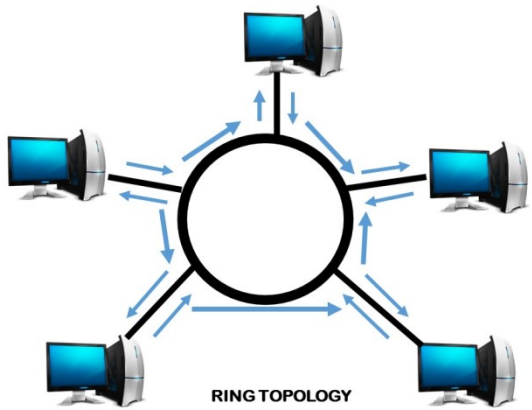
Bus Topology

- Commonly referred to as a linear bus, all the devices on a bus topology are connected by one single cable.
- **Bus Topology (MultiPoint)**
  - Easy to install
  - Use for small Network
  - Easy to Expand
  - Slow speed as only one system can transmit at a time
  - Faulty cable bring down whole N/W
  - If the main cable fails or gets damaged the whole network will fail.
  - As more workstations are connected the performance of the network will become slower because of data collisions.
  - Every workstation on the network "sees" all of the data on the network this is a security risk



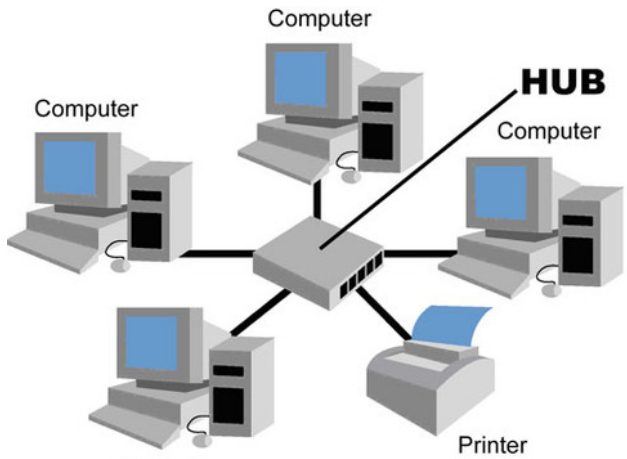
Ring Topology

- In a ring network each deviceis connected to two other devices - this forms a ring for the signals to travel around.
- **Ring Topology (MultiPoint)**
  - Token Passing mechanism
  - Faulty cable bring down whole N/W
  - Reduced chances of data collision as each node release a data packet after receiving the token
  - Token passing makes ring topology perform better than bus topology under heavy traffic
  - No need of server to control connectivity among the nodes
  - In Unidirectional Ring, a data packet must pass through all the nodes.



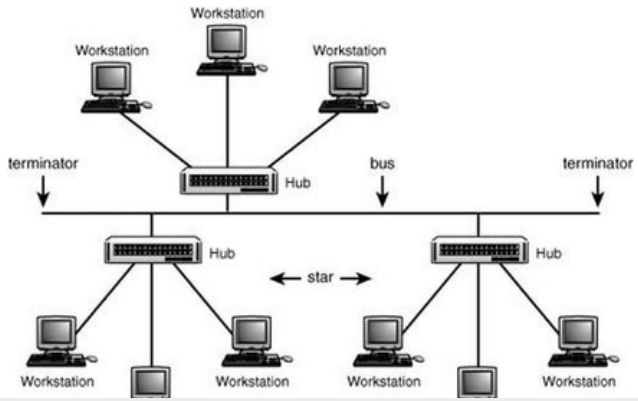
Star Topology

- In a star network each device on the network has its own cable that connects to a switch or hub.
- **Star Topology (Point-to-Point)**
  - it is very reliable if one cable or device fails then all the others will continue to work
  - it is high-performing as no data collisions can occur
  - it is expensive to install as this type of network uses the most cable (network cable is expensive)
  - extra hardware is required (hubs or switches) which adds to cost
  - if a hub or switch fails, all the devices connected to it will have no network connection



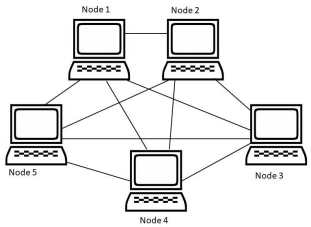
Tree Topology

- A tree topology is a combination of a star network topology and a bus topology.
- **Tree Topology (Point-to-Point) or (MultiPoint)**
  - Scalable as leaf nodes can accommodate more nodes in the hierarchical chain
  - A point to point wiring to the central hub at each intermediate node of a tree topology represents a node in the bus topology
  - Other hierarchical networks are not affected if one of them gets damaged
  - Easier maintenance and fault finding
  - Huge cabling is needed
  - A lot of maintenance is needed



Mesh Topology

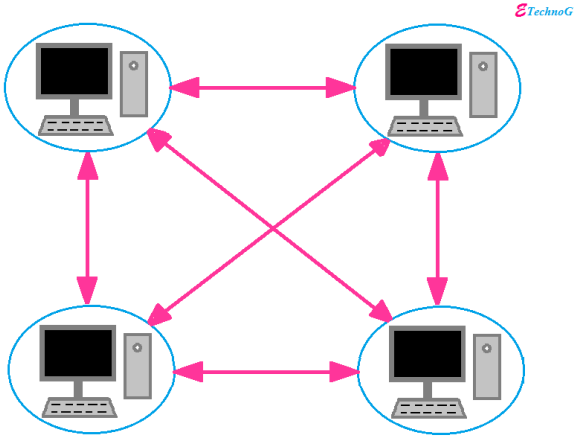
- A network setup where each computer and network device is interconnected with one another,.
- **Mesh Topology (Point-to-Point)**
  - Manages high amounts of traffic, because multiple devices can transmit data simultaneously.
  - A failure of one device does not cause a break in the network or transmission of data.
  - Adding additional devices does not disrupt data transmission between other devices.
  - The cost to implement is higher than other network topologies, making it a less desirable option
  - Building and maintaining the topology is difficult and time consuming.
  - The chance of redundant connections is high, which adds to the high costs and potential for reduced efficiency.



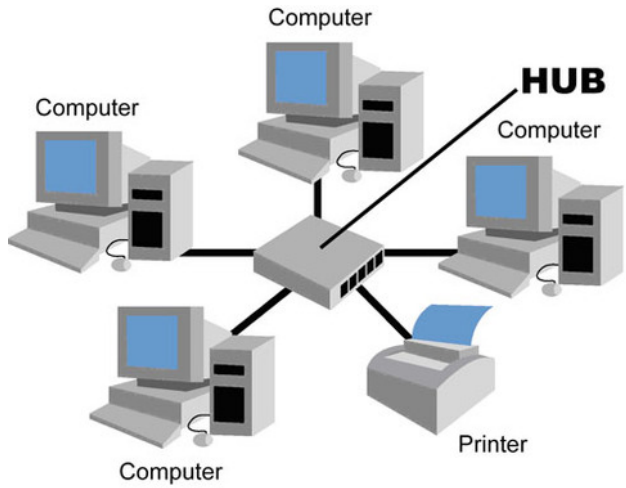
Network Topologies Configurational Requirements

- **Mesh Topology**
- Number of cables: $\frac{n*(n-1)}{2}$
- Number of ports: $n*(n-1)$
- Performance: $\uparrow$
- Reliability: $\uparrow$
- Cost: High
- Security: $\uparrow$

- **Star Topology**
- Number of cables: n
- Number of ports: $1*n$
- Performance: $\downarrow$(hub), $\uparrow$(switch)
- Reliability: $\downarrow$(hub), $\uparrow$(switch)
- Cost: High
- Security: $\uparrow$(switch),$\downarrow$(hub)

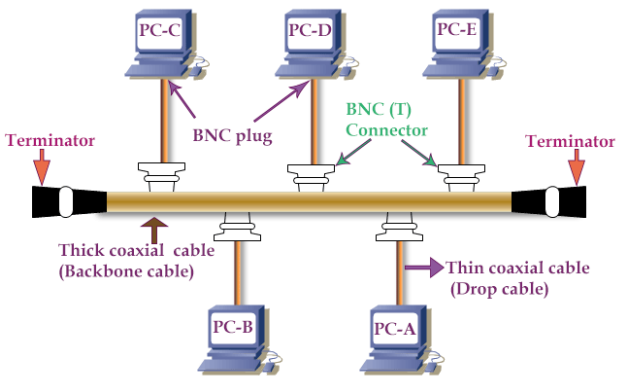


Mesh Topology

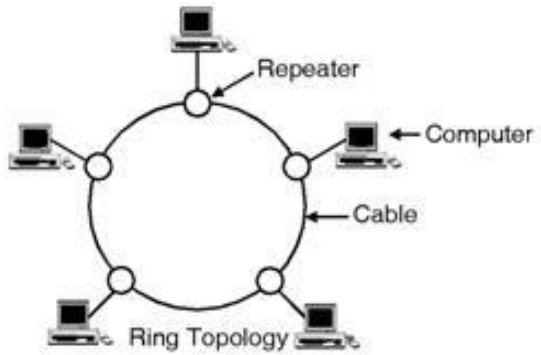


Network Topologies Configurational Requirements

- Bus Topology
- Number of cables: $n + 1$
- Number of ports: n
- Performance: $\uparrow$
- Reliability: $\downarrow$
- Cost: $\downarrow$
- Security: $\downarrow$



- Ring Topology
- Number of cables: $n + 1$
- Number of ports: n
- Performance: $\downarrow$
- Reliability:$\uparrow$
- Cost: High
- Security: $\downarrow$



Thank You