

Computer Networks: Introduction to Computer Networks



By,

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Computer Networks: What it is ?

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- Merging of Computers and Communications has had a profound influence on the way computer systems are organized.
- The Concept of the “Computer Center” as a room is obsolete.
- The old model of a single computer serving all of the organizational computational needs has been replaced.
- Large number of separate but interconnected computers do the job.
- Collection of autonomous computers interconnected by a technology is referred as Computer Networks.

MOVIE !!

“WARRIORS OF THE NET”

Computer Networks: Merits ??

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- Business Applications
 - Resource Sharing (File/Print Sharing)
 - Business Collaboration
- Home Applications
 - Access to Remote Information (E.g BBC Online)
 - Person to Person Communication (E.g Skype)
 - Instant Messaging (E.g Gtalk, Yahoo)
 - Interactive Entertainment (E.g YouTube)
- Social Applications
 - Social Networking (E.g Facebook)
- Banking Applications
 - Core Banking System (E.g Temenos T24)

Computer Networks: Demerits ??

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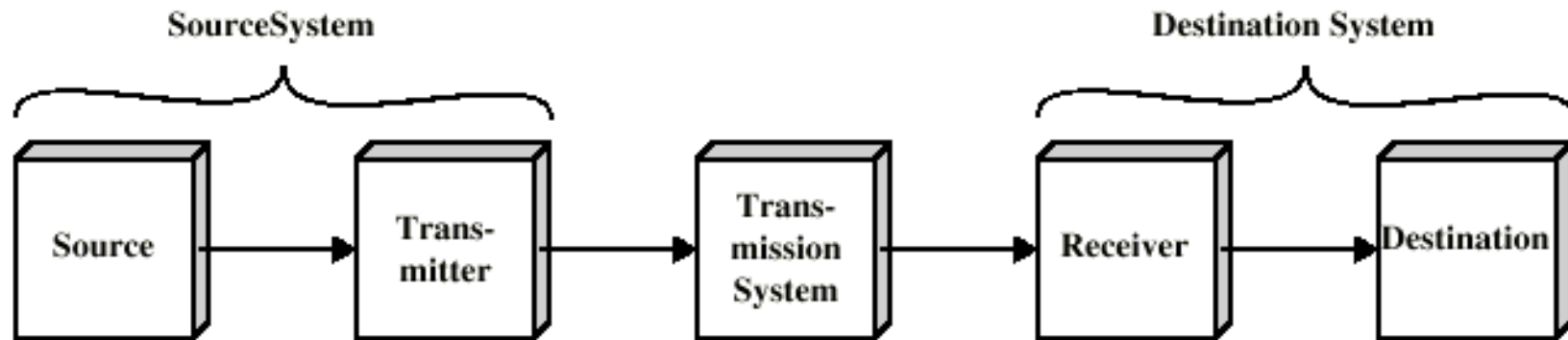
- ❑ Increased Cost
- ❑ Security
- ❑ Unavailability of Information in case of Network Failure

Assignment

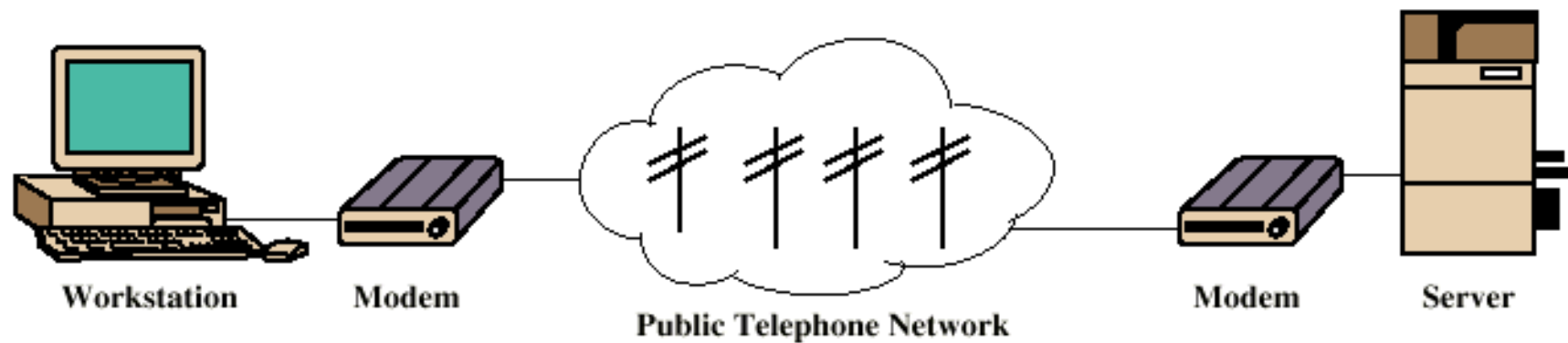
Discuss the merits and demerits of Computer Networks with a suitable example.

A Communication Model

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(a) General block diagram



(b) Example

A Communication Model

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Source

- ☐ Generates data to be transmitted

Transmitter

- ☐ Converts data into transmittable signals

Transmission System

- ☐ Carries data

Receiver

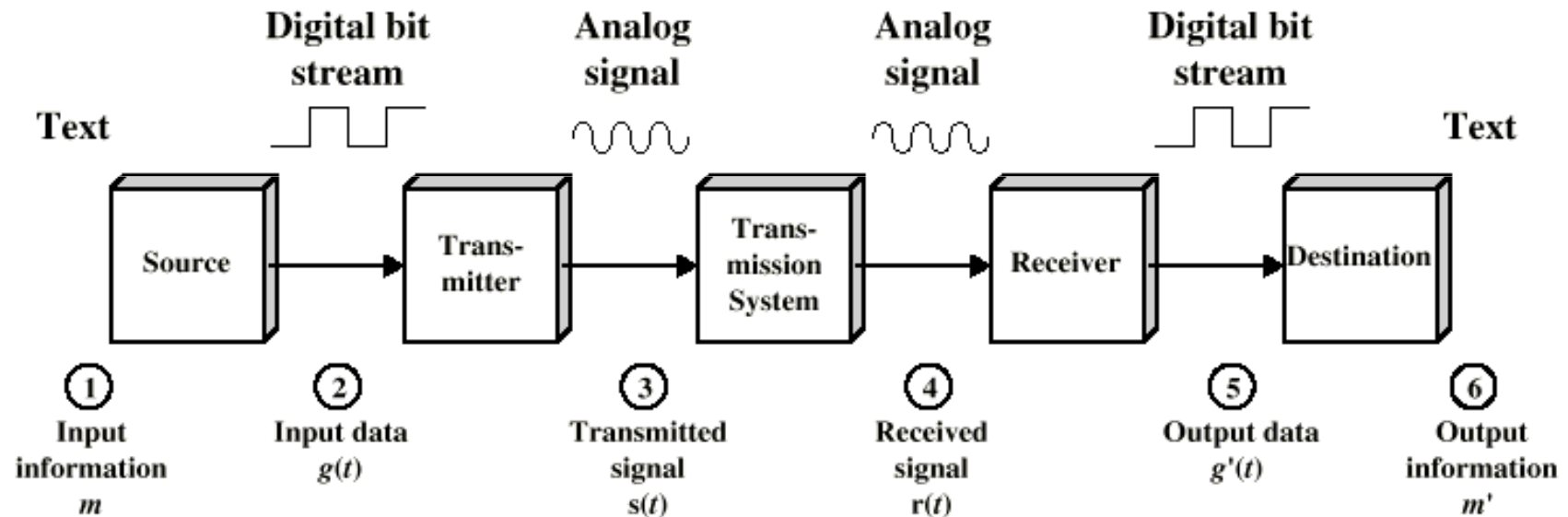
- ☐ Converts received signal into data

Destination

- ☐ Takes incoming data

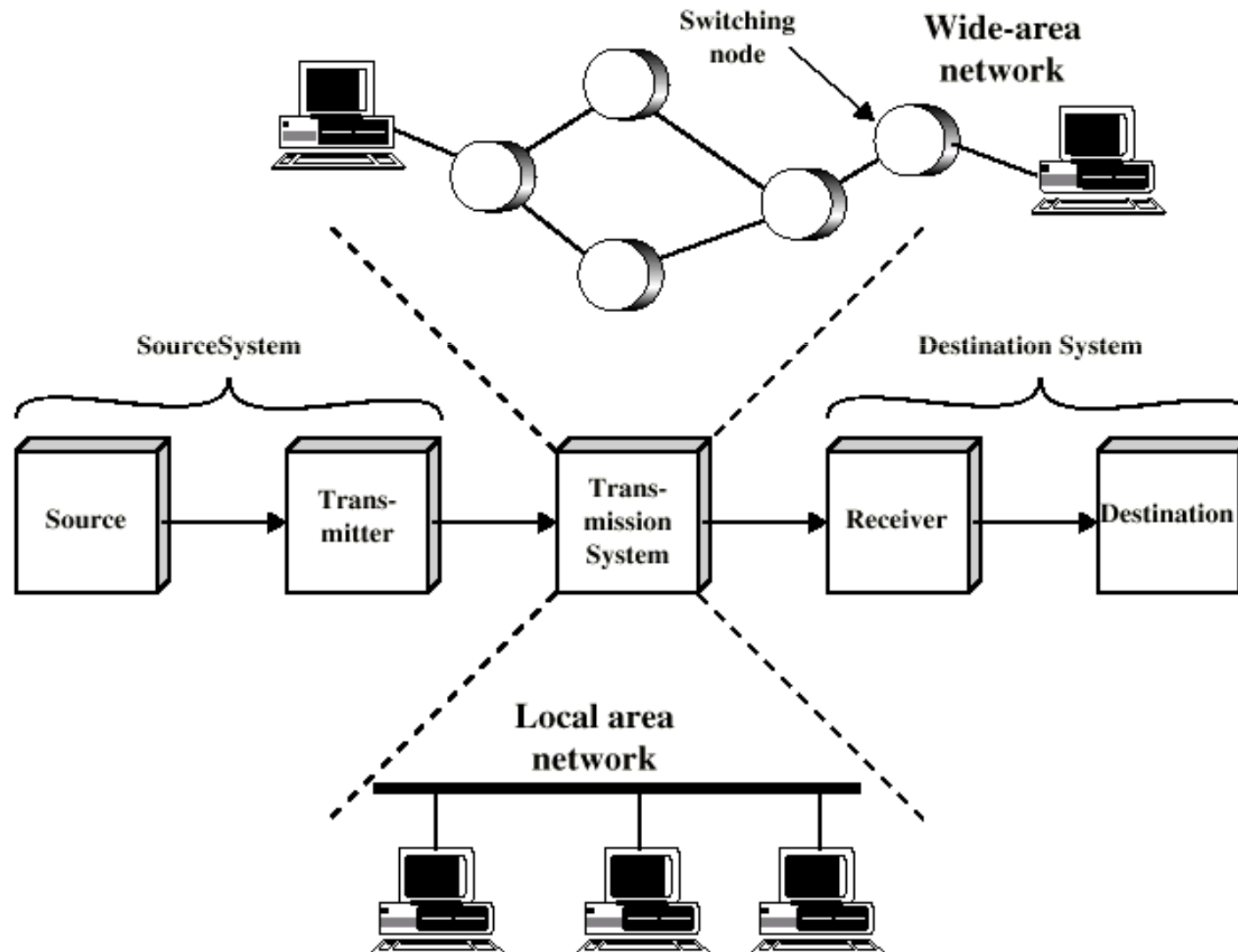
A Communication Model: In Terms of Signal

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A Communication Model: Transmission System in Detail

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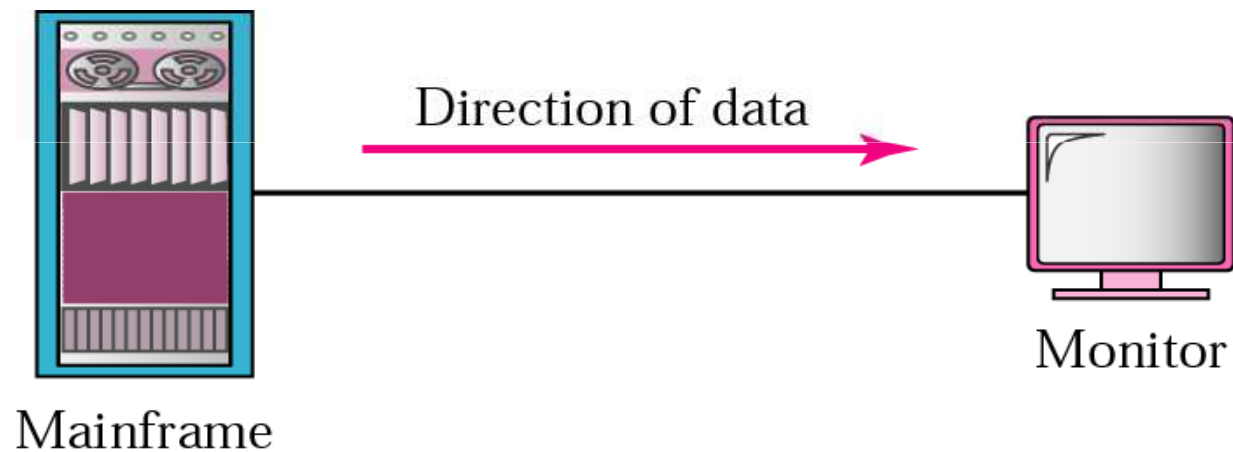
Direction of Data Flow

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- ☐ Simplex
- ☐ Half Duplex
- ☐ Full Duplex

Direction of Data Flow: Simplex

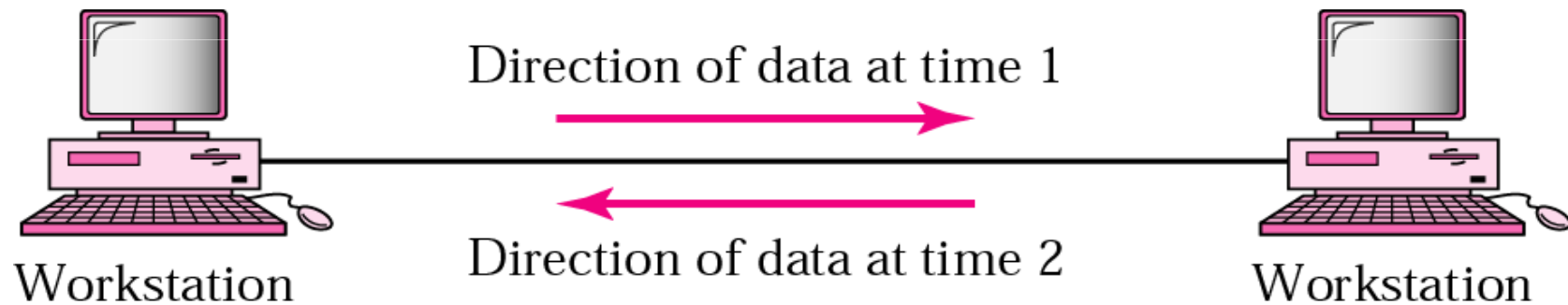
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Example : Television, Radio Broadcasting

Direction of Data Flow: Half Duplex

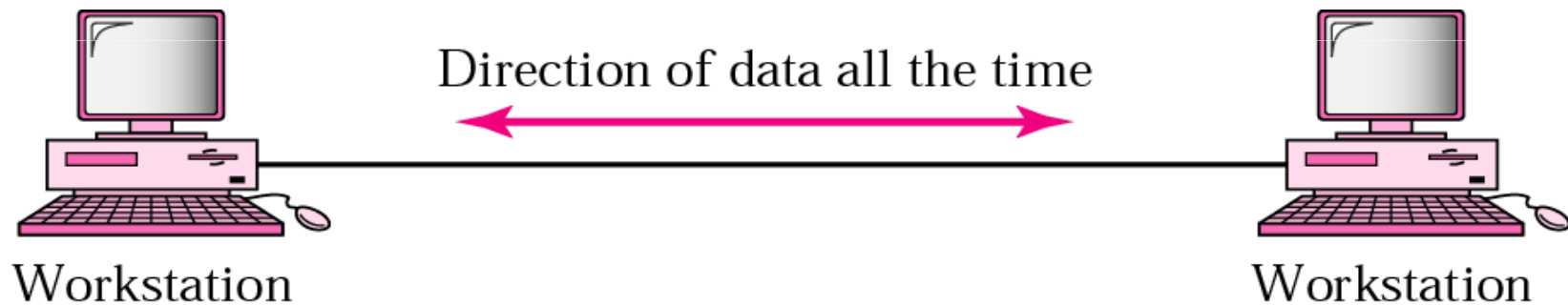
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Example : Police Radio

Direction of Data Flow: Full Duplex

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Example : Telephone Communication

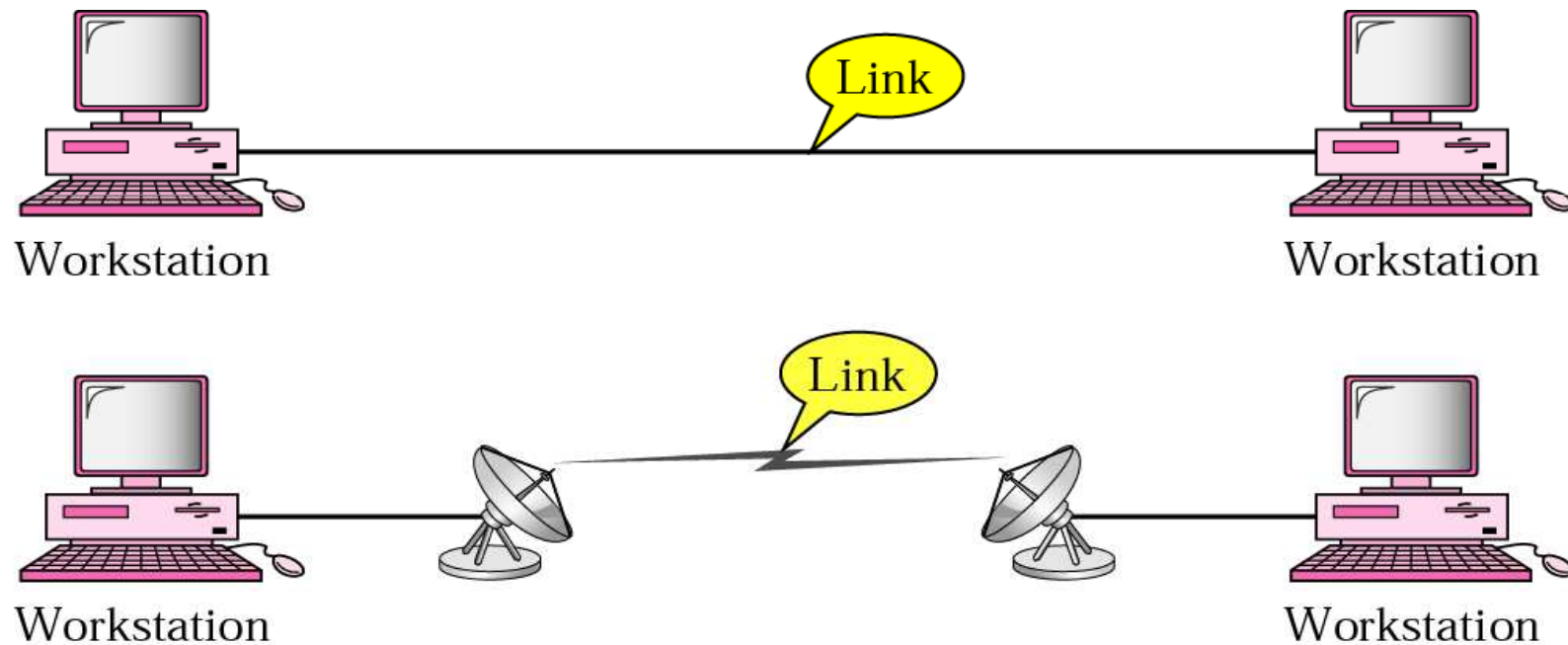
Types of Communication Service

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- ❑ Point to Point Communication
- ❑ Multi Point Communication

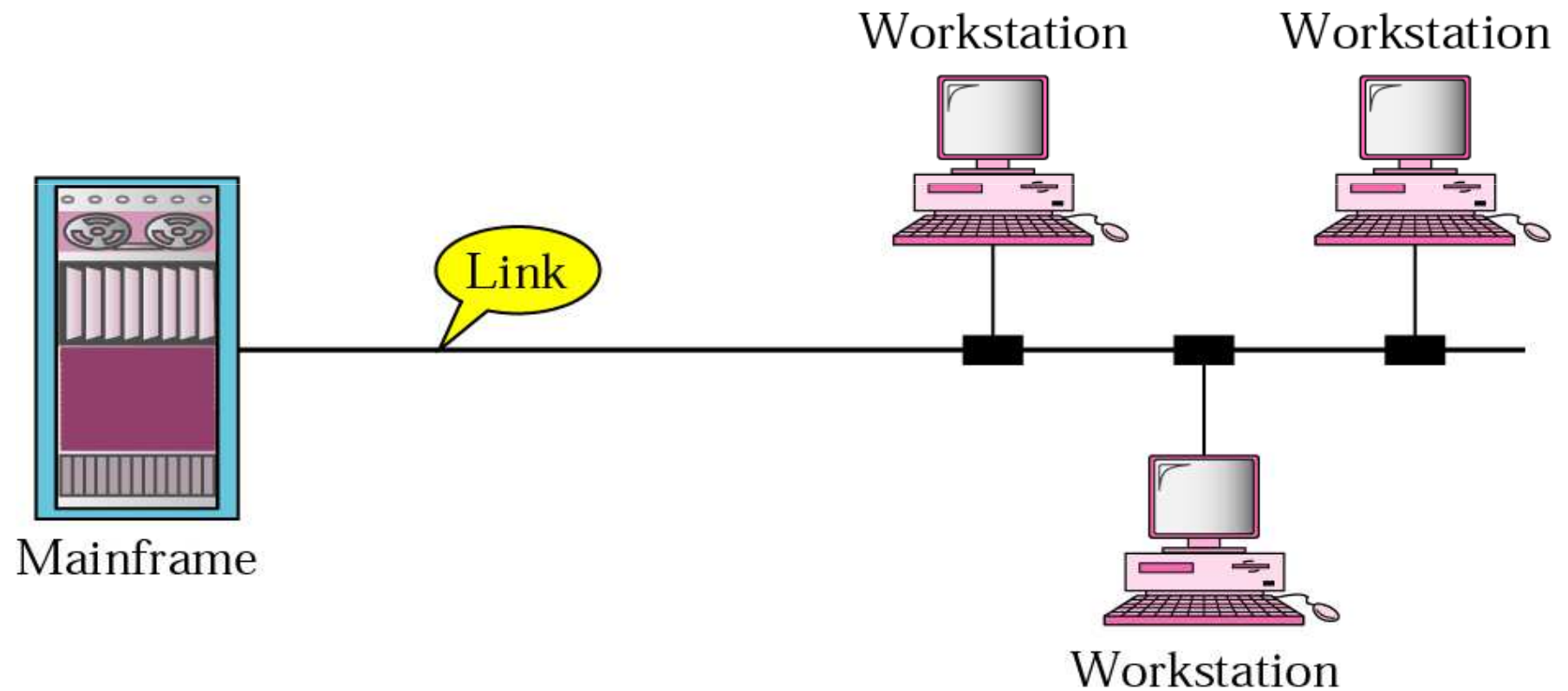
Communication Services: Point to Point Connection

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Communication Services: Multi Point Connection

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Data Transmission

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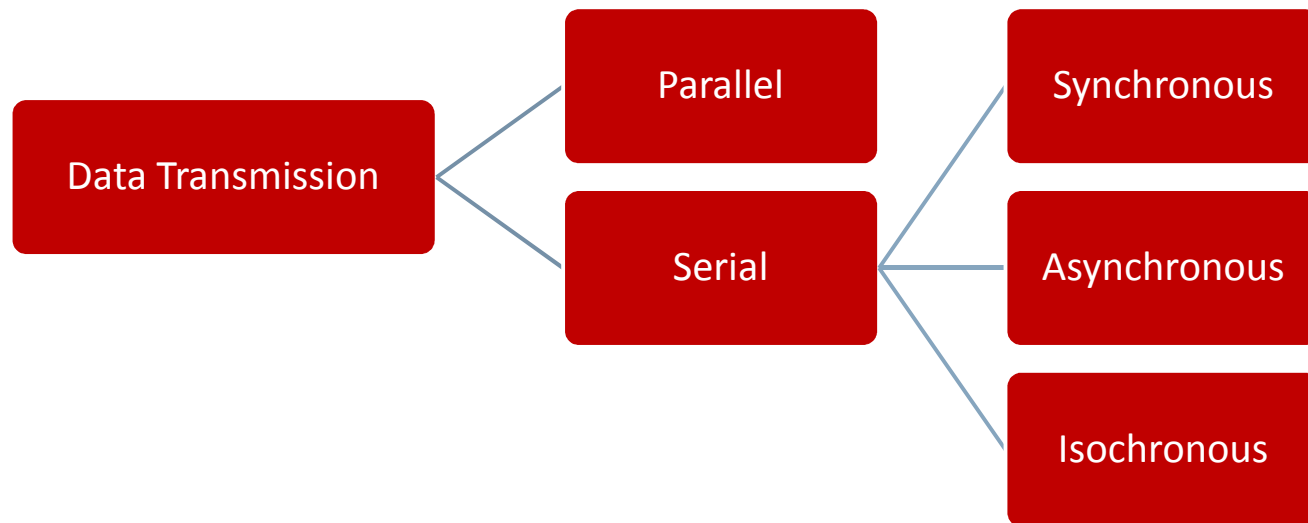
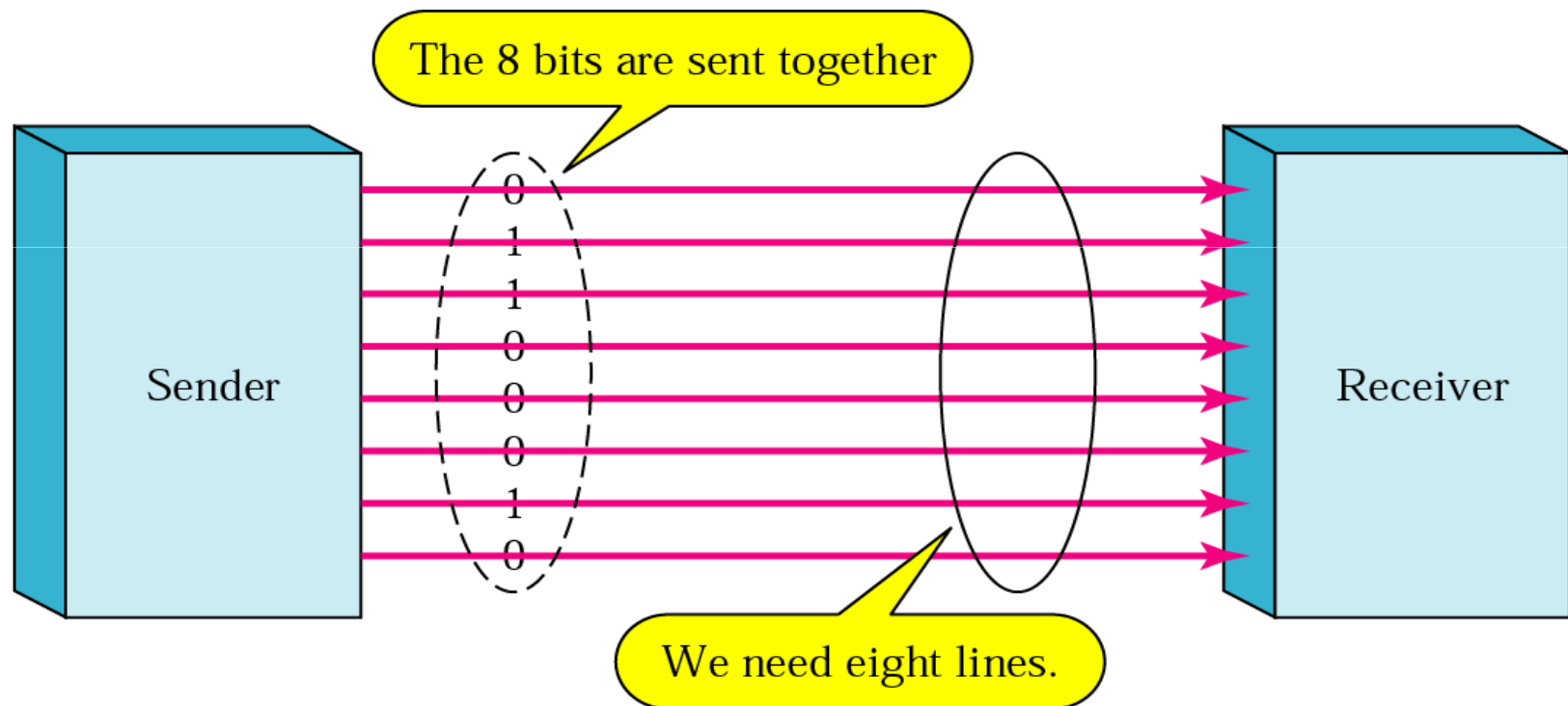


Figure : Data Communication

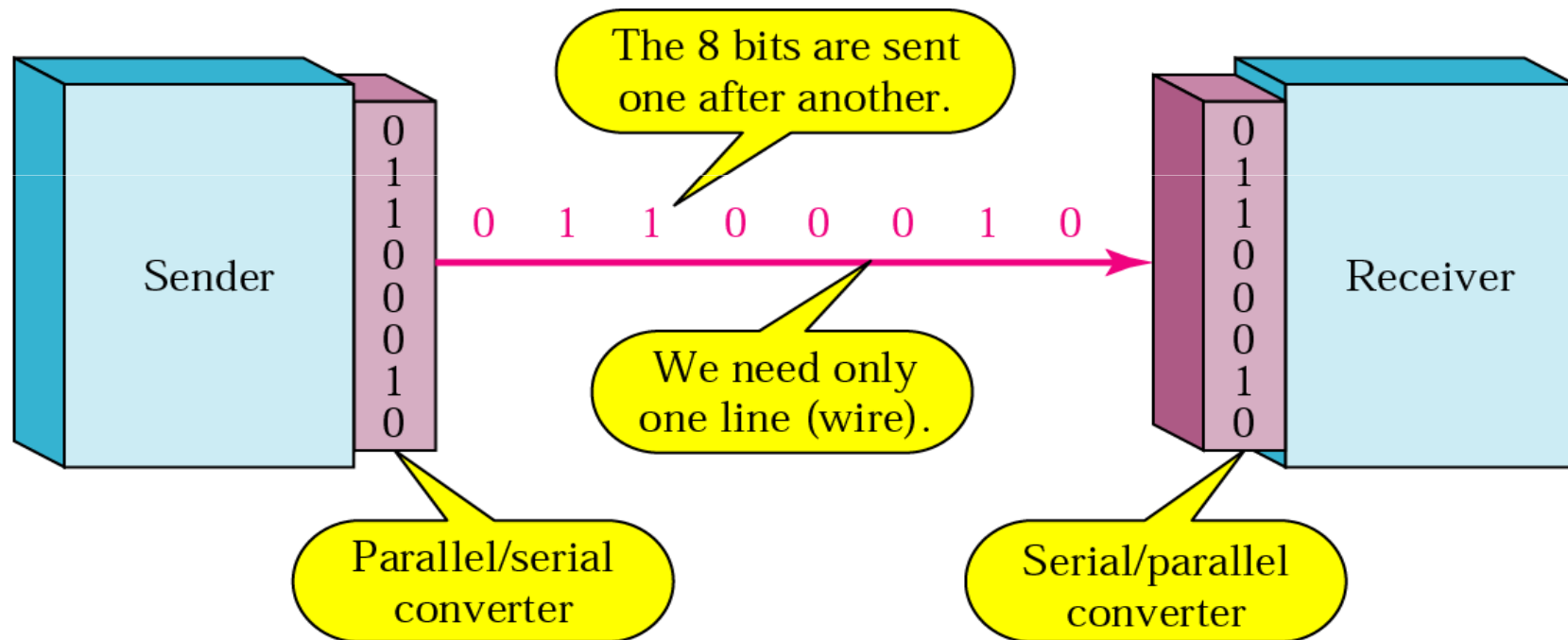
Data Transmission: Parallel Transmission

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Data Transmission: Serial Transmission

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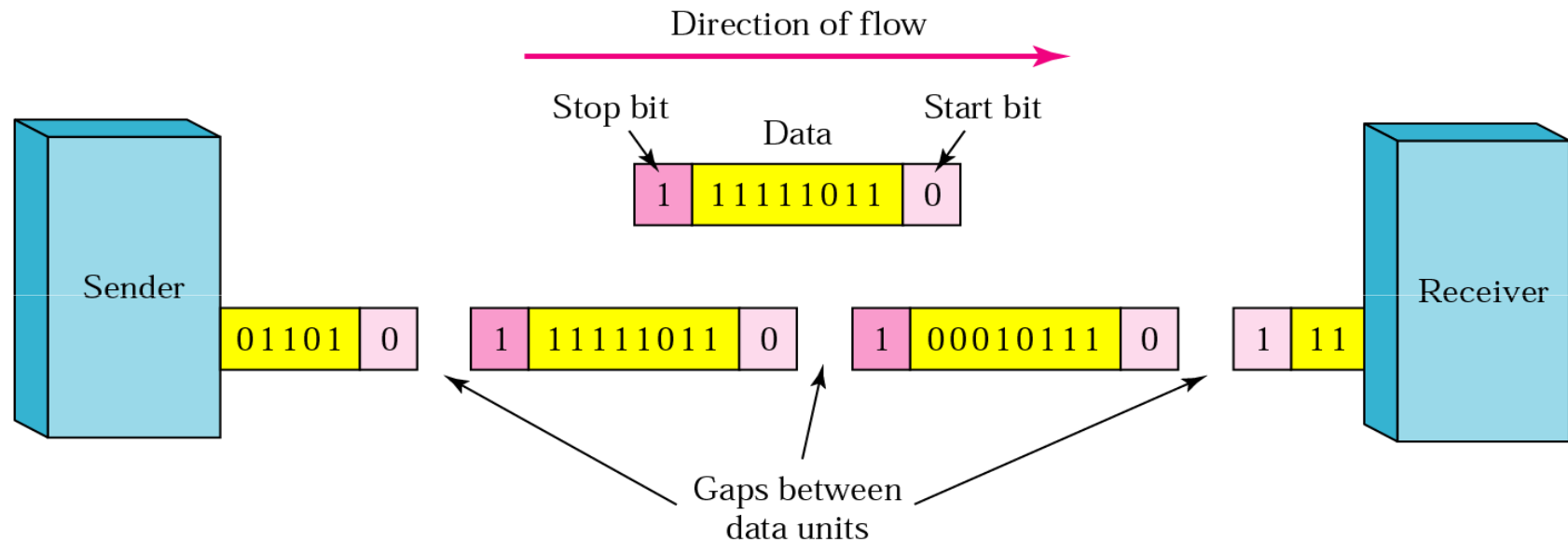
Serial Transmission

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- Serial transmission mechanisms can be divided into three broad categories => Depending on how transmissions are spaced in time.
- Asynchronous Transmission
It can occur at any time with an arbitrary delay between the transmission of two data items.
- Synchronous Transmission
It occurs continuously with no gap between the transmission of two data items.
- Isochronous Transmission
It occurs at regular intervals with a fixed gap between the transmission of two data items.

Serial Transmission: Asynchronous Transmission

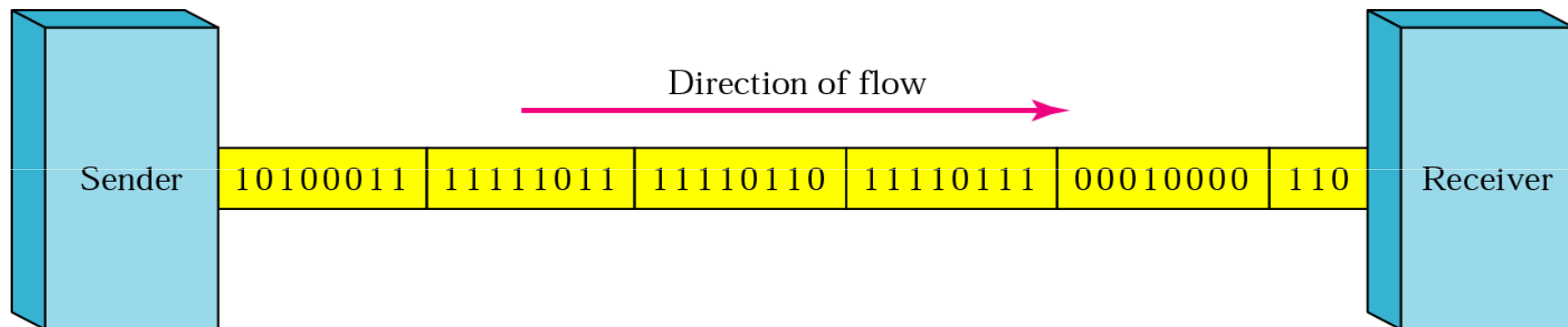
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In asynchronous transmission, we send 1 start bit (0) at the beginning and 1 or more stop bits (1s) at the end of each byte. There may be a gap between each byte. Example : Email, Blogs.

Serial Transmission: Synchronous Transmission

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In synchronous transmission, we send bits one after another without start/stop bits or gaps. It is the responsibility of the receiver to group the bits. Example : Telephone Conversation, Chat Room.

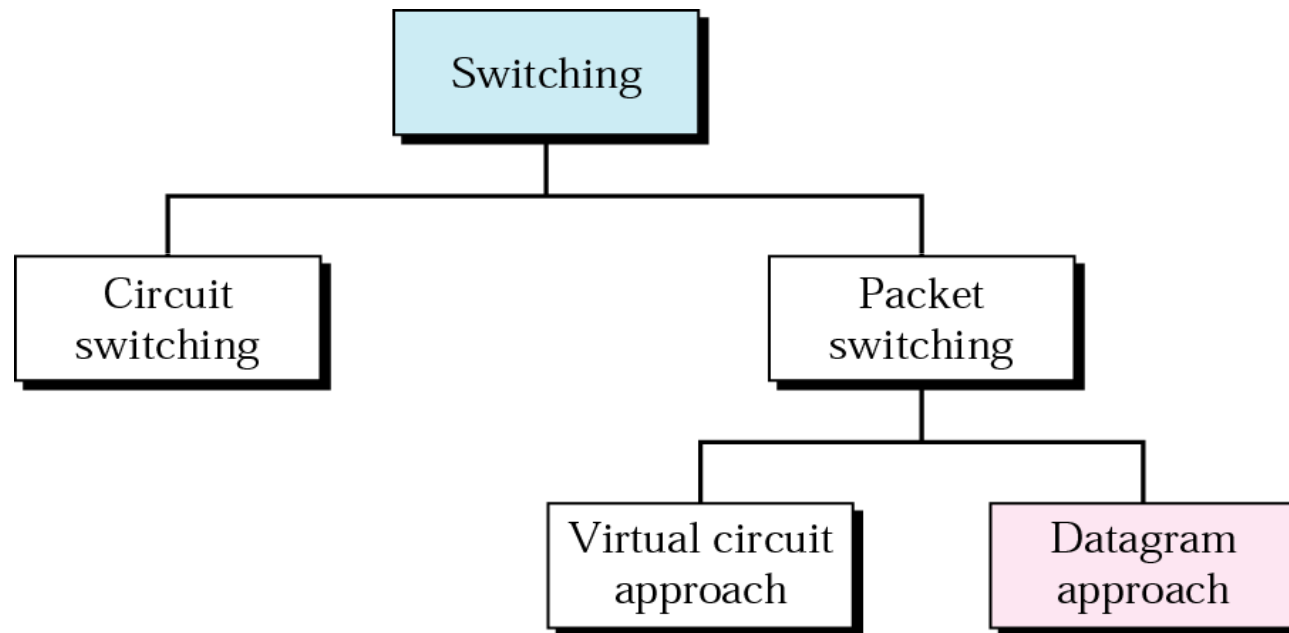
Serial Transmission: Isochronous Transmission

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- The driving force => Fast, steady and uninterrupted data stream.
- Best suited for applications where a steady data stream.
- Necessary for Multimedia applications.
- Delivering such data at a steady rate is essential. (Variation in delay known as *Jitter* can disrupt reception).
- Just in time delivery.
- Isochronous network is designed to accept and send data rate at a fixed rate R .
- Provides each stream a guaranteed time slot of $125 \mu\text{s}$
- Example : Video Conferencing.

Switching Techniques

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Circuit Switching

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- A complete circuit between source and destination nodes is established before the data can be transmitted.
- Dedicated communication between two stations.
- Communication Link => Telephone line, Coaxial cable, Satellite link, Microwave link etc.
- The following three steps are required to establish the connection
 - Connection Setup
 - Data Interchange
 - Connection Termination

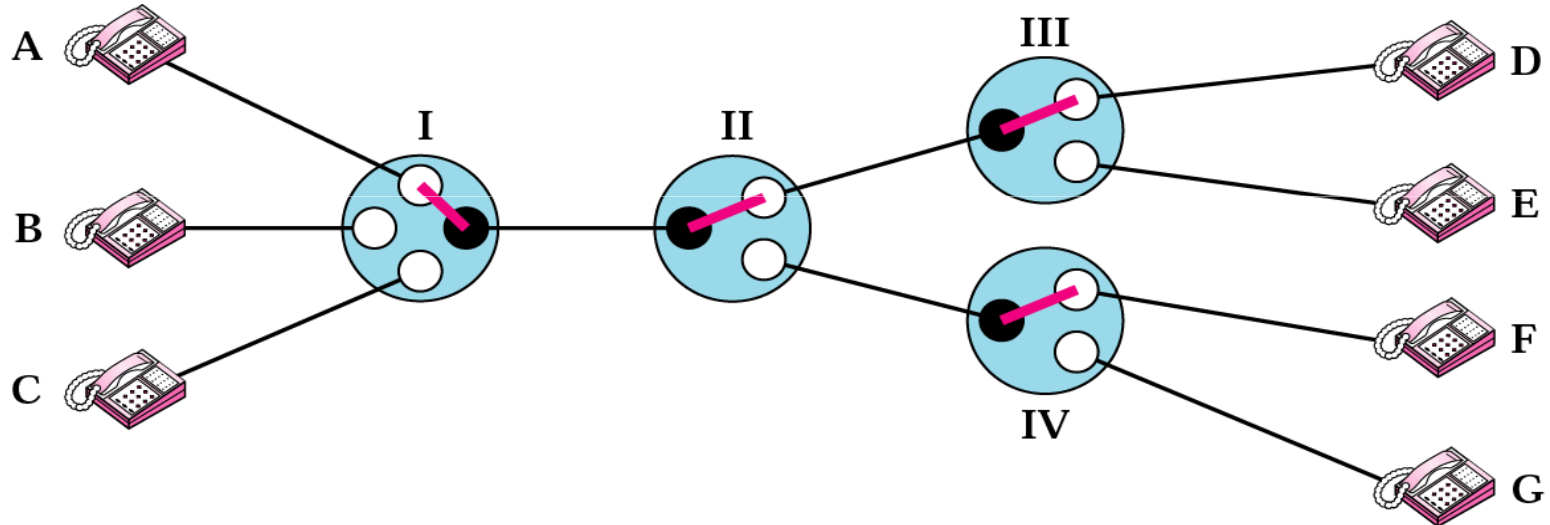
Circuit Switching: Problems ??

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- Inefficient
 - Channel dedicated for the duration of connection.
 - If no data => Capacity is wasted
- Setup Connection Takes Time
- Once Connected, Transfer is Transparent
- Developed for Voice Traffic
- Circuit switching usually uses a fixed data rate (E.g. 64 Kbps) and is difficult to support variable data rate.

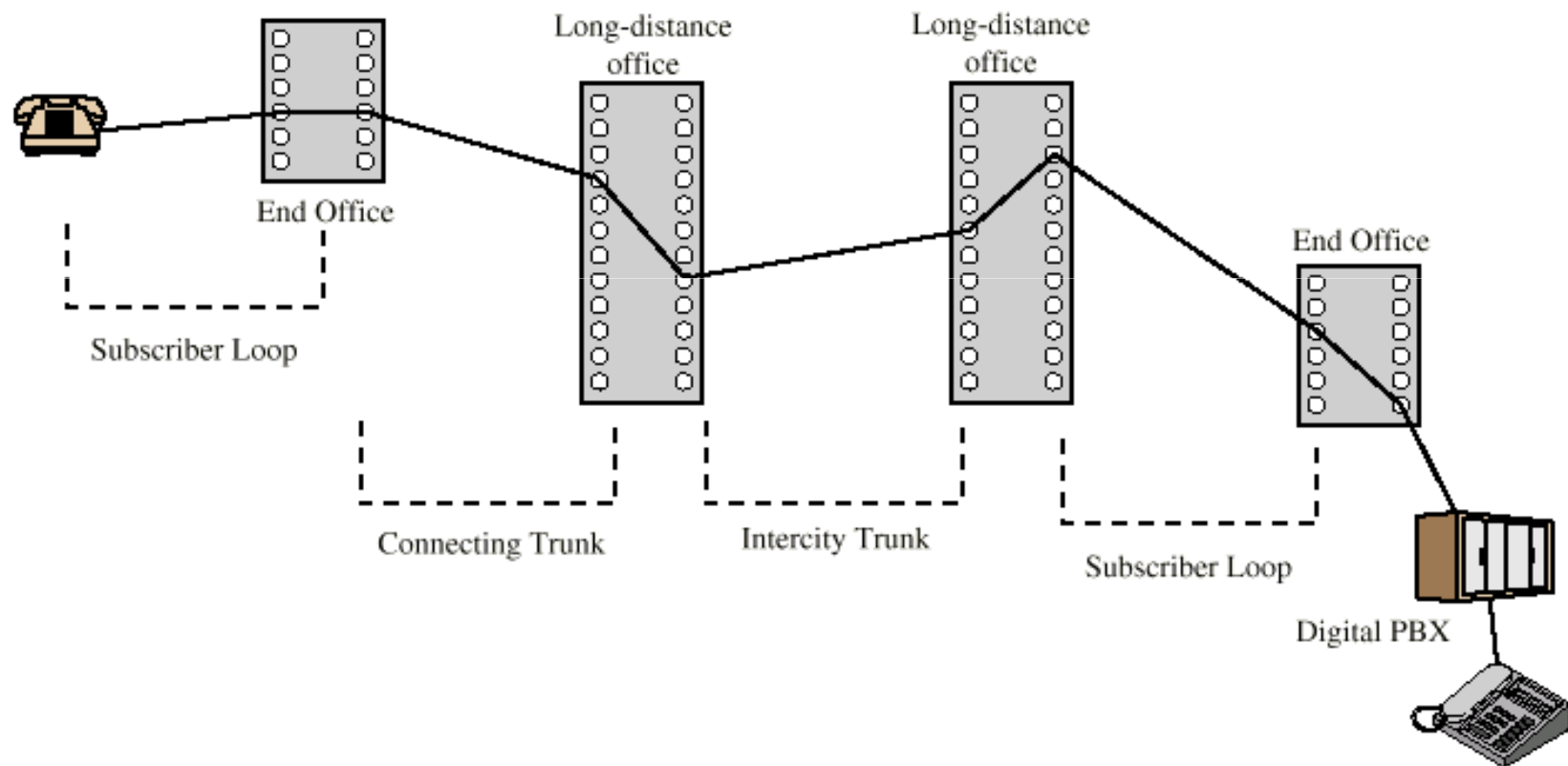
Circuit Switching: Public Circuit Switched Network

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Circuit Switching: Public Circuit Switched Network

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Packet Switching

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- Data Transmitted in Small Packets.
- Each Packet Contains User data plus Control Information.
- Control Information => Routing Information.
- Two Types of Packet Switching
 - ✓ Datagram Packet Switching
 - ✓ Virtual Circuit Packet Switching.

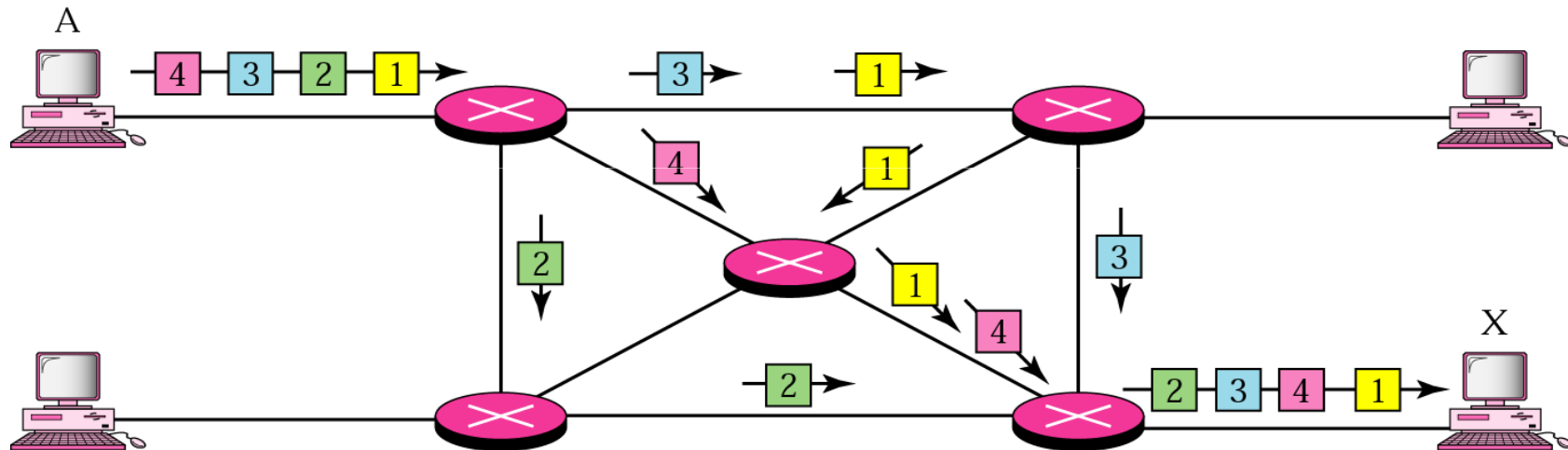
Packet Switching: Datagram Packet Switching

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- No need to establish the connection between the source and destination.
- Route chosen on packet by packet basis.
- Packets may be stored until delivered => (Store and Forward)
- Different packets may follow different routes.
- Packets may arrive out of order at the destination.

Packet Switching: Datagram Packet Switching

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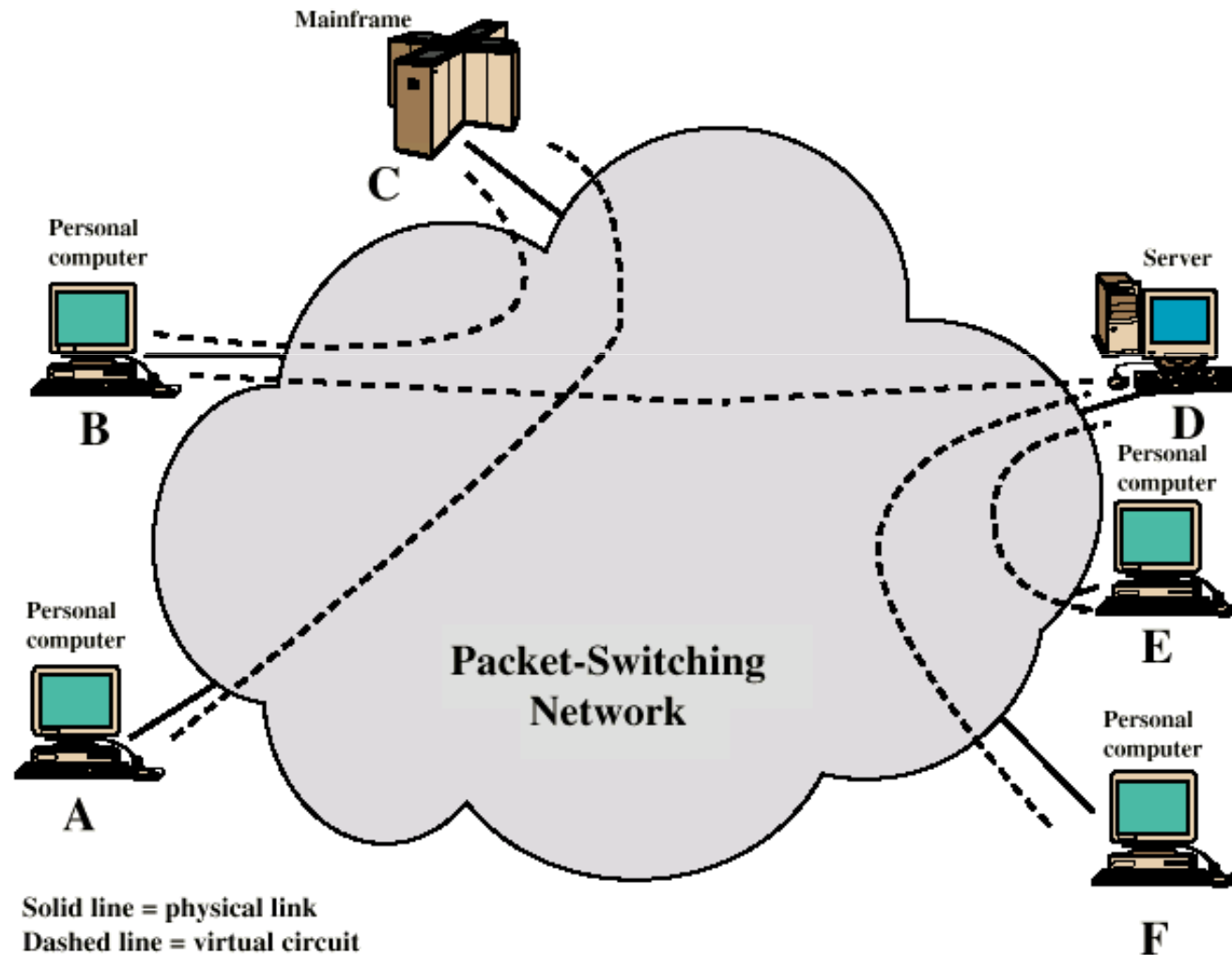
Packet Switching: Virtual Circuit Switching

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- Route is chosen at the start of session and it is only a logical connection.
- All Packets associated with a session follow the same path.
- Packets are labeled with a VC# designated the route.
- The VC number must be unique on a given link.
- Packets are forwarded more quickly. (No Routing Decisions)
- Example : Asynchronous Transfer Mode

Packet Switching: Virtual Circuit Switching

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History of Computer Networking and Internet

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The Development of Packet Switching (1961-1972)

- During 1960's telephone network was world's dominant communication network. [Uses Circuit Switching Technique]
- ARPAnet => First Packet Switched Computer Network
- Early Packet Switches => IMP (Interface Message Processors)

Proprietary Networks and Internetworking (1972-1980)

- ALOHAnet => Microwave link to connect universities on Hawaiian islands.
- Telnet => BBN Commercial Packet Switching Network based on ARPAnet.
- Cyclades => French Packet Switching Networks

History of Computer Networking and Internet

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A Proliferation of Networks (1980-1990)

- End of 1970s => 200 hosts were connected to ARPAnet.
- January 1, 1983 => Official deployment of TCP/IP for ARPAnet.
- Replaced traditional NCP Protocol.
- Concept of DNS and 32 bit IP Address was also developed.
- Early 1980s => French launched Minitel Project.
- It Was Sponsored by French Government to bring data networking into everyone's home.
- Minitel became a huge success in 1984.
- It was used over by 20% of France's Population => 1 Million \$ revenue each year.
- It was in large proportion of French homes 10 years before most Americans had ever heard of the internet.

History of Computer Networking and Internet

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The Internet Explosion (The 1990s)

- ❑ Commercialization of Internet.
- ❑ Emergence of WWW (World Wide Web).
- ❑ Brought the Internet into the homes and business of millions of people.
- ❑ 1994 => Netscape browser.
- ❑ In 1996 Microsoft started to make browsers.
- ❑ Browser war started between Netscape and Microsoft.
- ❑ End of Millennium => Internet Supported Hundreds of Applications.
- ❑ Four Killer Applications => Email, Web Browsing, Instant Messaging and Peer to Peer File Sharing (Napster).

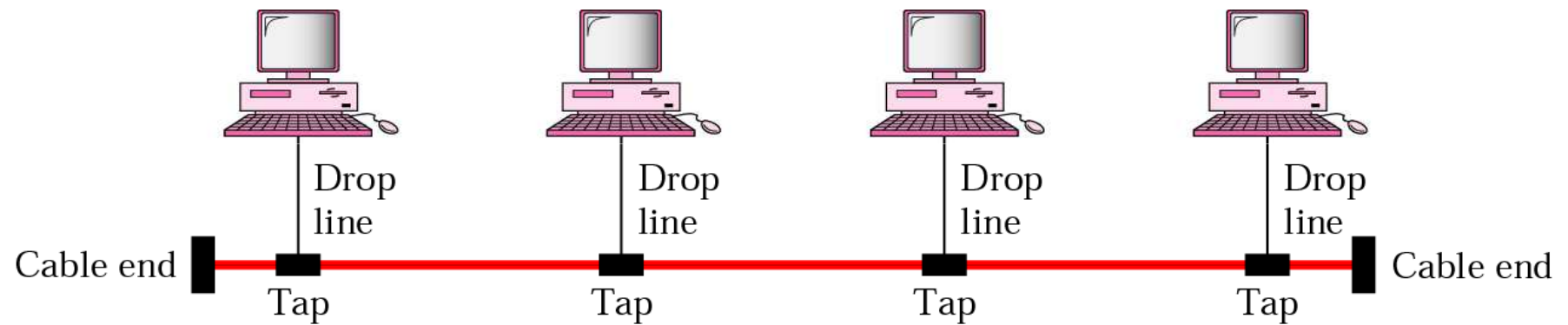
Physical Topologies : What It is ?

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- Physical Layout of the Network.
- It is the geometric representation of the relationships of all the links and linking devices.
- Linking devices are called Nodes.
- Four Basic Possible Topologies are
 - Bus Topology
 - Star Topology
 - Mesh Topology
 - Ring Topology

Physical Topologies : Bus Topology

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Physical Topologies : Bus Topology

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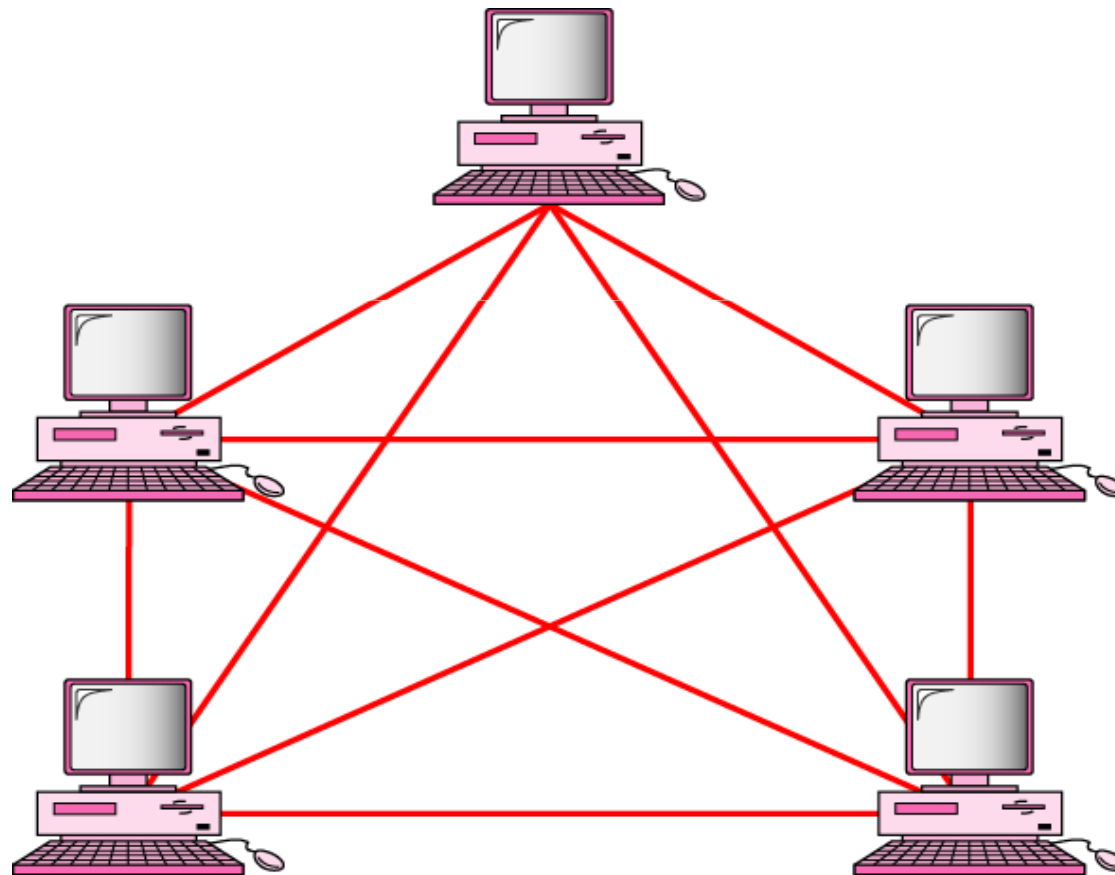
- ❑ Bus Topology is Multipoint.
- ❑ One long cable acts as a backbone to link all the devices.
- ❑ Nodes are connected to the bus cable by drop line and taps.
- ❑ Taps = > T-Connector
- ❑ Terminators required for both ends of backbone cable.

- ❑ **Advantages**
 - ❑ Ease of Installation.
 - ❑ Requires less cabling.

- ❑ **Disadvantages**
 - ❑ Difficult reconnection and fault isolation.
 - ❑ Fault or break in bus cable stops all transmission.

Physical Topologies : Mesh Topology

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Physical Topologies : Mesh Topology

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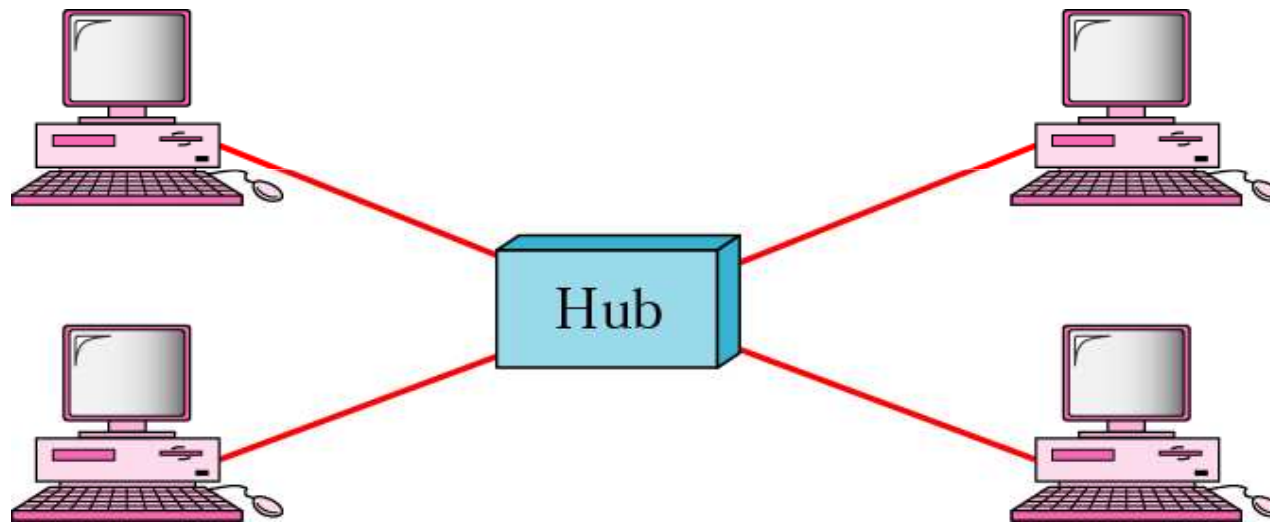
- Every device has a dedicated point to point link to other device.
- Fully connected Mesh Network has $n(n-1)/2$ links.
- Every device on the network must have $n-1$ I/O Ports.

- **Advantages**
 - Robust
 - Privacy and Security.
 - Fully Point to Point link makes Fault Isolation Easy.

- **Disadvantages**
 - More No of I/O Ports Required.
 - Amount of Cabling Required is more.
 - Cost High.

Physical Topologies : Star Topology

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Physical Topologies : Star Topology

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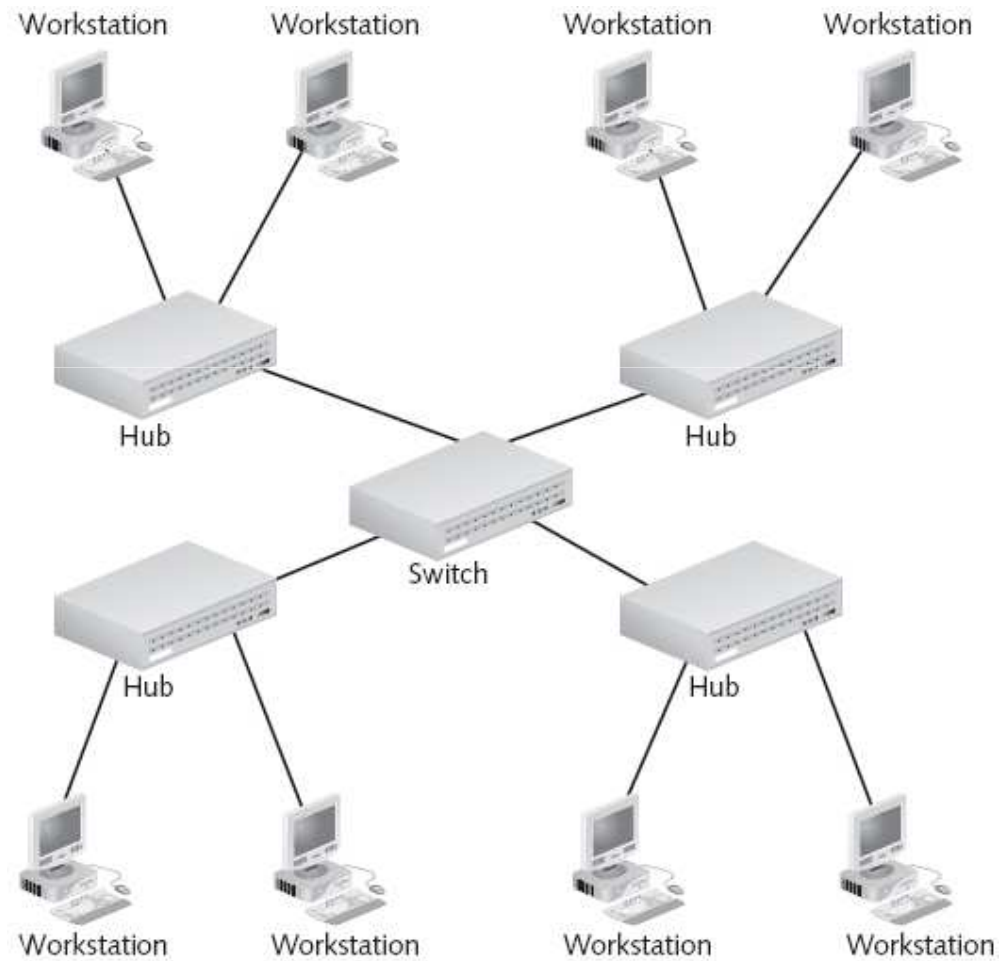
- Each device has a dedicated point to point link only to central controller.
- Central Controller => Hub or Switch
- Device are not directly linked to one another.
- Controller acts as an Exchange.
- Each device needs only one I/O Port.

- **Advantages**
 - Easy to Install and Reconfigure.
 - Less Expensive than Mesh Topology.
 - Robustness
 - Easy for Fault Identification.

- **Disadvantages**
 - More Cabling required than Ring or Bus.

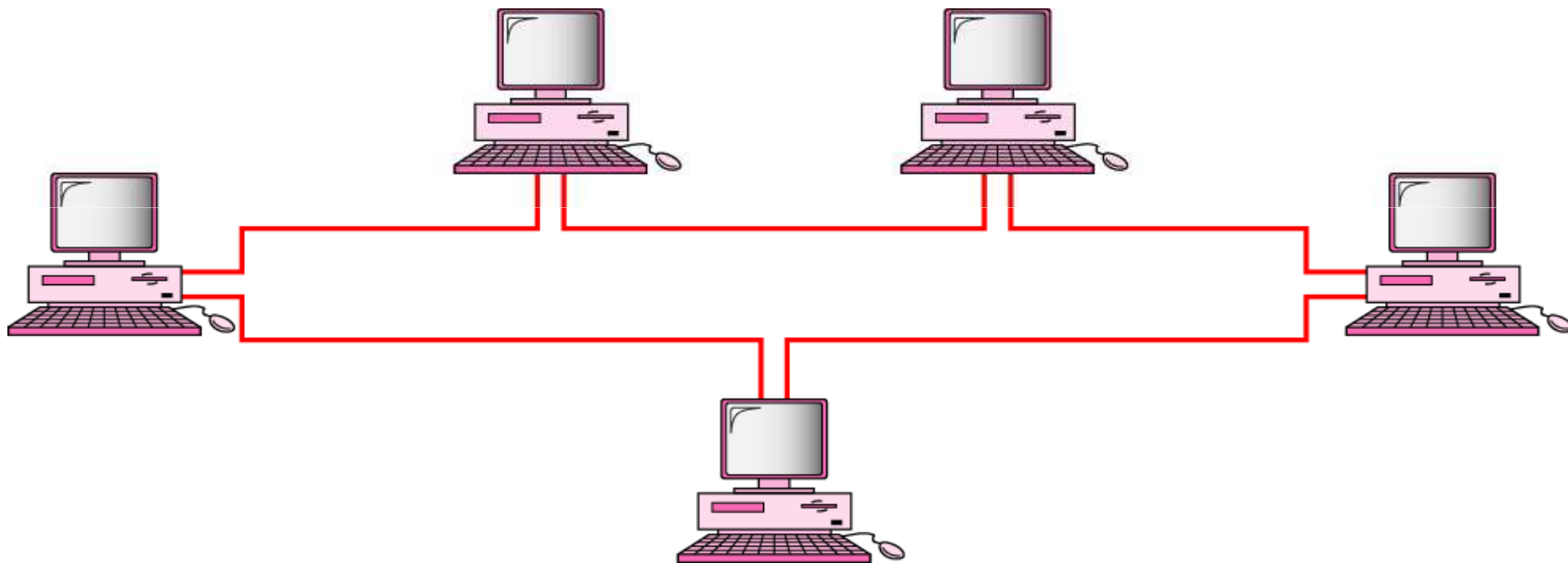
Physical Topologies : Extended Star Topology

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Physical Topologies : Ring Topology

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Physical Topologies : Ring Topology

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- Each device has a dedicated point to point connection only with two devices.
- A signal is passed along with the ring in one direction from device to device.
- Each device in the ring incorporates a repeater.
- **Advantages**
 - Easy to Install and Reconfigure.
- **Disadvantages**
 - Unidirectional Traffic.
 - A Break in Ring can disable the entire Network.

Network Categories

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- Determined by its size, Ownership and the Distance.
- Three Primary Network Categories are :
 - Local Area Networks (LAN)
 - Metropolitan Area Networks (MAN)
 - Wide Area Networks (WAN)
 - Campus Area Networks (CAN)
 - Country Area Networks (CAN)
 - Personal Area Networks (PAN)
 - Global Area Networks (GAN)

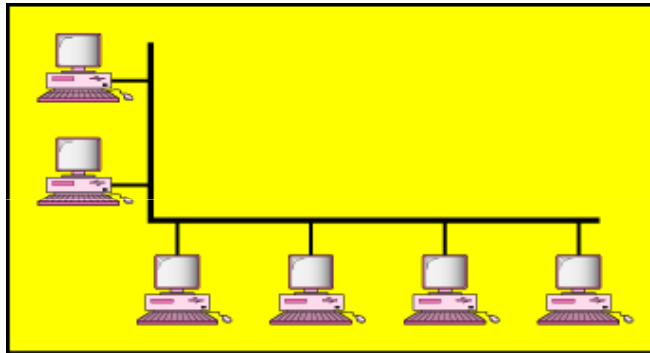
Network Categories: Local Area Networks

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- It is usually privately owned.
- Links the devices in a single office, building or campus.
- LAN size is limited to a few kilometers.
- It is designed to allow resources to be shared between devices.
- Most common LAN topologies are Bus, Ring and Star.
- Transmission Media => Twisted Pair
- In Backbone Cabling Optical Fiber can be Used.
- Data Rate Up to 1000 Mbps can be achieved.
- Wireless LANS are More Popular these days (Wi-Fi).
- Single Building LAN.
- Multiple Building LAN. (Especially Campus Networks)

Network Categories : Local Area Networks

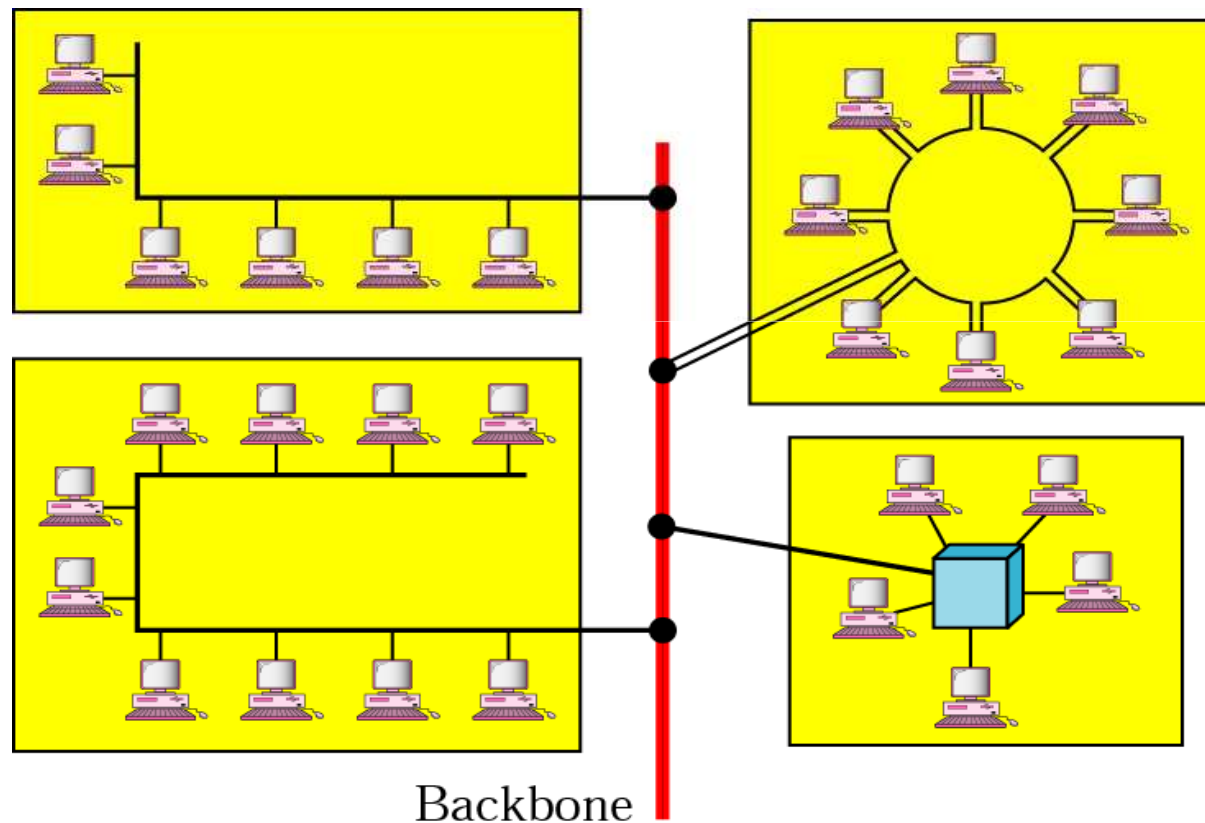
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a. Single-building LAN

Network Categories : Local Area Networks

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b. Multiple-building LAN

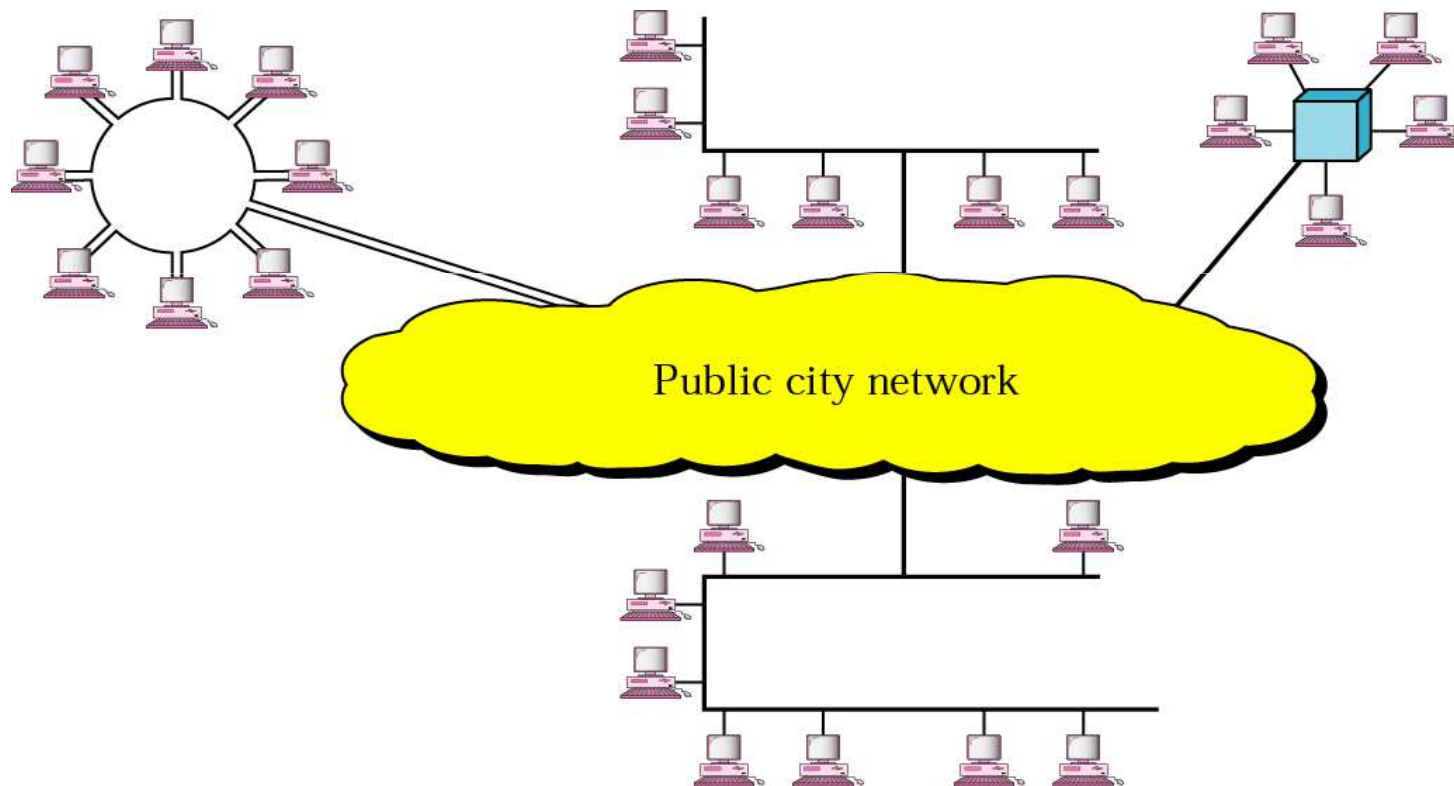
Network Categories: Metropolitan Area Networks

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- ❑ MAN is designed to extend over an entire city.
- ❑ It may be a Single Network such as Cable Television.
- ❑ It may be a means of connecting a number of LANS.
- ❑ A Company can use MAN to connect its numbers of LANs throughout a city.
- ❑ MAN may be wholly owned by a Company.
- ❑ Often Uses Public, Third Party Infrastructure.
- ❑ MAN Service may be provided by Telecom Company.
- ❑ Transmission Media => Optical Fiber
- ❑ It can Extend Up to 20 Kms.

Network Categories : Metropolitan Area Networks

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Network Categories: Wide Area Networks

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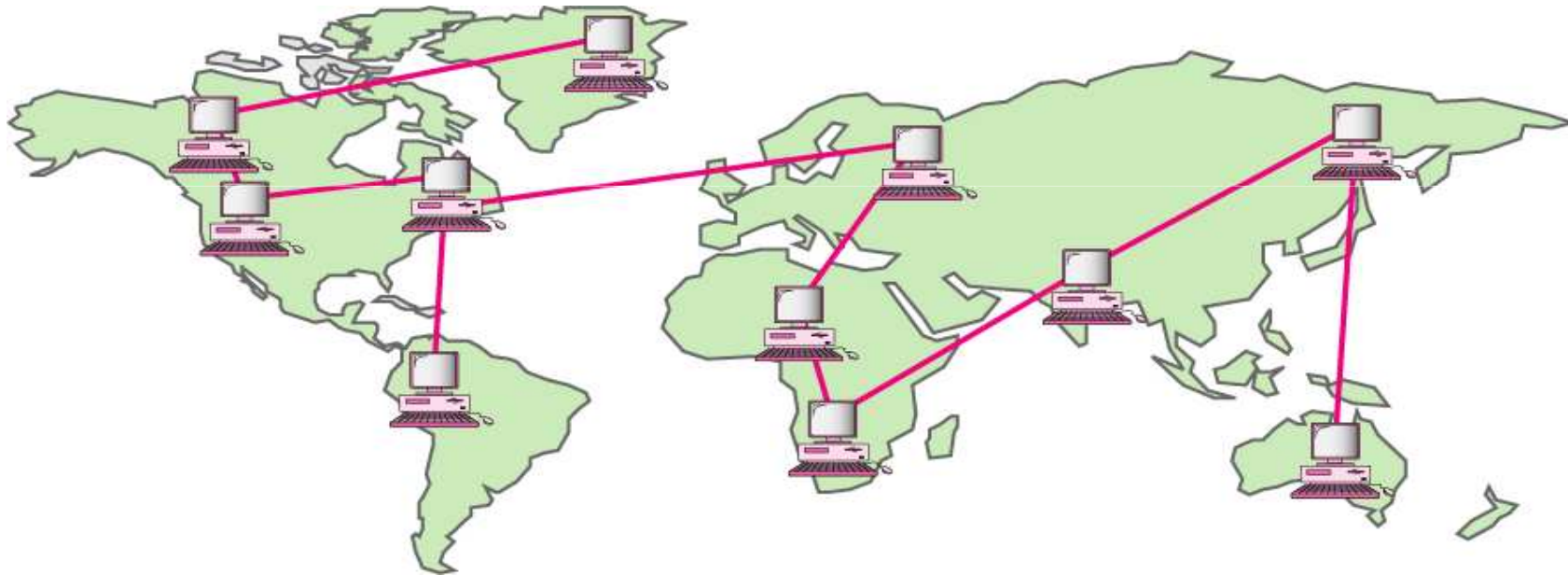
- It Covers large geographic area.
- Provides long distance transmission of data, voice, image and video.
- WAN may utilize public, leased or private communication equipment.
- WAN owned by a single company => Enterprise Network.
- Global Village.

“The World is Flat !”

Book Written By Thomas L. Friedman

Network Categories : Wide Area Networks

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Inter Networking: Types ??

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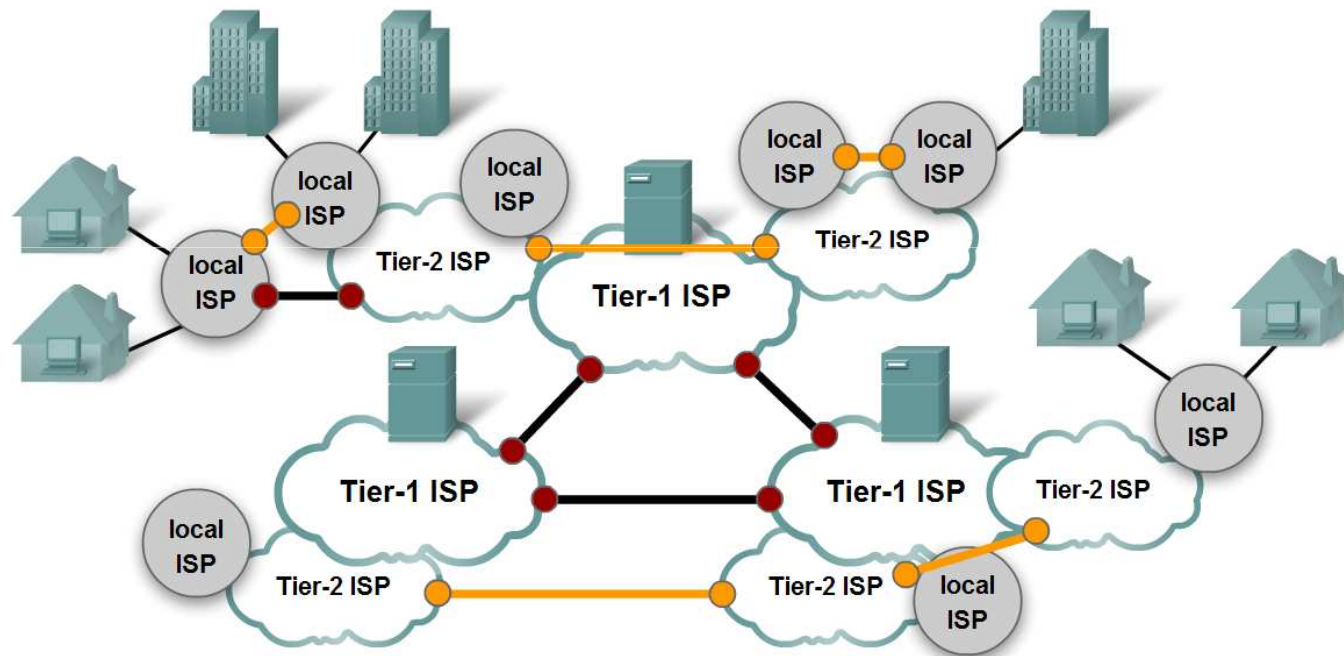
- Intra Net
 - Network Within an Organization.

- Internet
 - Network Between Different Other Organizations.

- The Internet
 - Global Network Within an Universe.

The Internet Today

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Network Models: Types

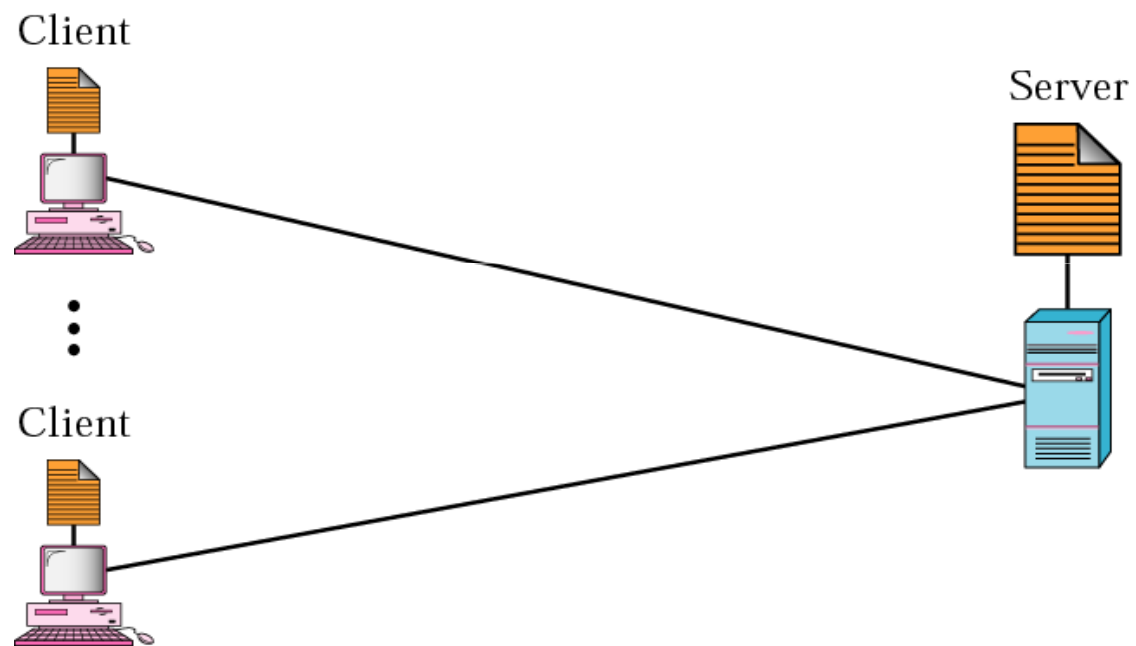
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- Client Server Model
 - Client Host Requests for the Service.
 - Example : Browser
 - Server Provides Response.
 - Example : Web Server
 - High End Servers can Process Multiple Requests at a Time.

- Peer to Peer Model
 - No Use of Dedicated Servers.
 - Example : Skype, Bit Torrent

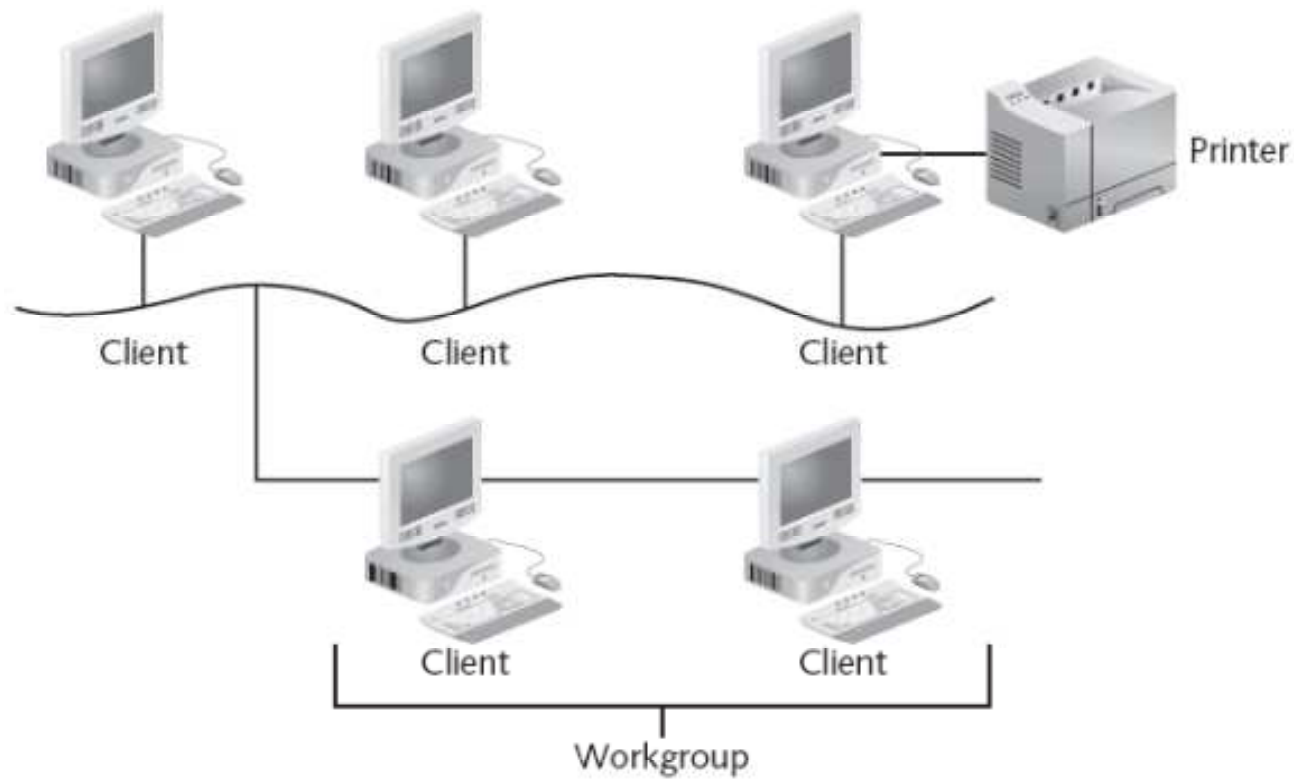
Network Models: Client Server Model

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Network Models: Peer to Peer Model

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Thank You