Computer Network

Chapter 1: Introduction to Computer Network

Computer Networks

Books:

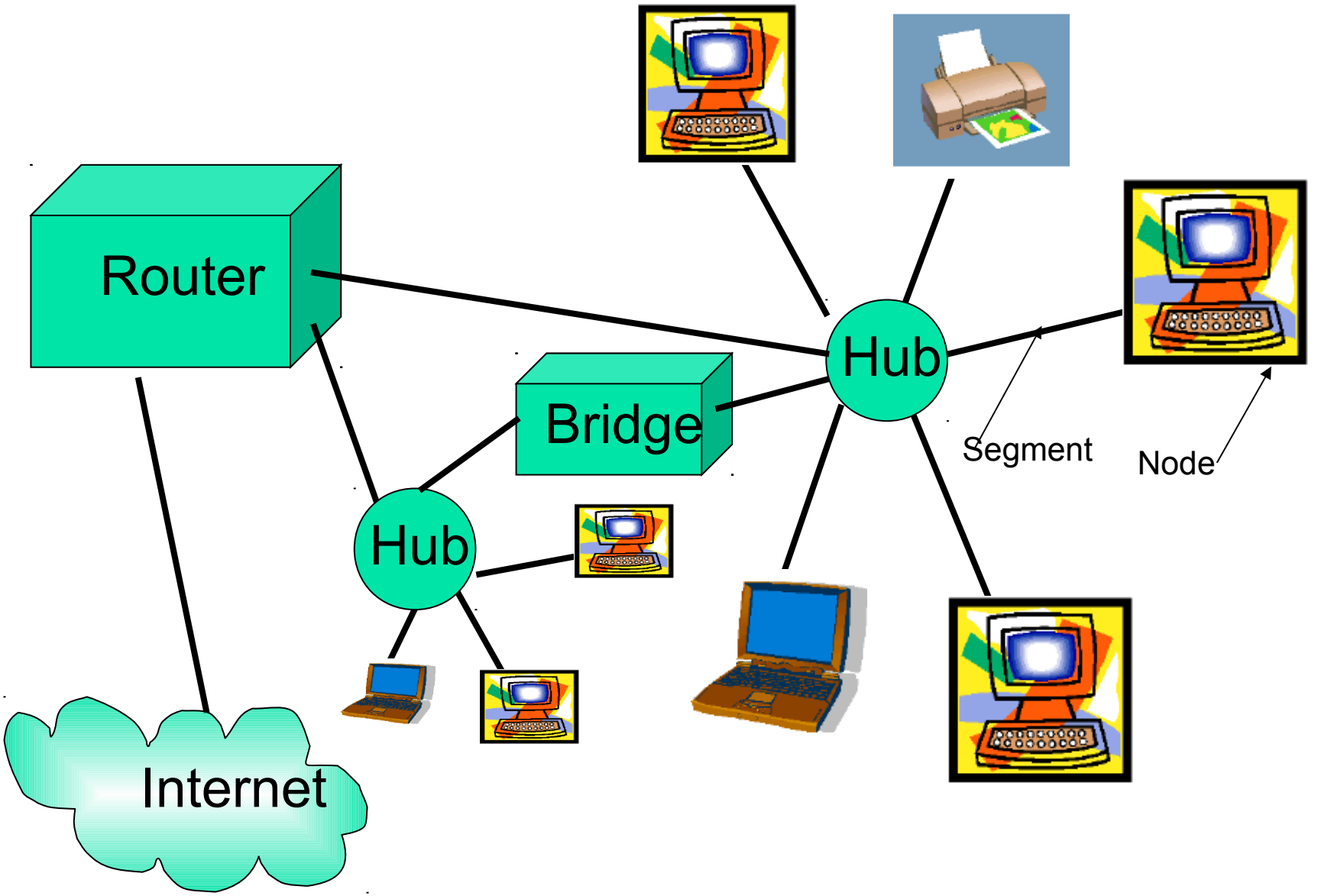
- AS. TANENBAUM, “Computer Networks”
- W. Stallings, “Data and Computer Communication”

What is Computer Network ?

Computer network:

- A collection of computing devices
- Devices are connected in various ways in order to communicate and share resources
- Usually, the connections between computers in a network are made using physical wires or cables
- Sometime connections are **wireless**, using radio waves or infrared signals

An example of a network



Example of a network Contd..

- The generic term **node** or **host** refers to any device on a network
- **Data transfer rate** The speed with which data is moved from one place on a network to another
- Data transfer rate is a key issue in computer networks

Merits of Computer Networking

- File Sharing
- Resource Sharing
  - Device sharing(Printers)
- In-expensive setup
  - Sharing Resource reduce Cost
- Flexible Handling
  - Easy For Network ADMIN to Manage Resource
  - User can login from any Host and access his/her files
- Increased Resource Capacity
  - By Sharing Resource

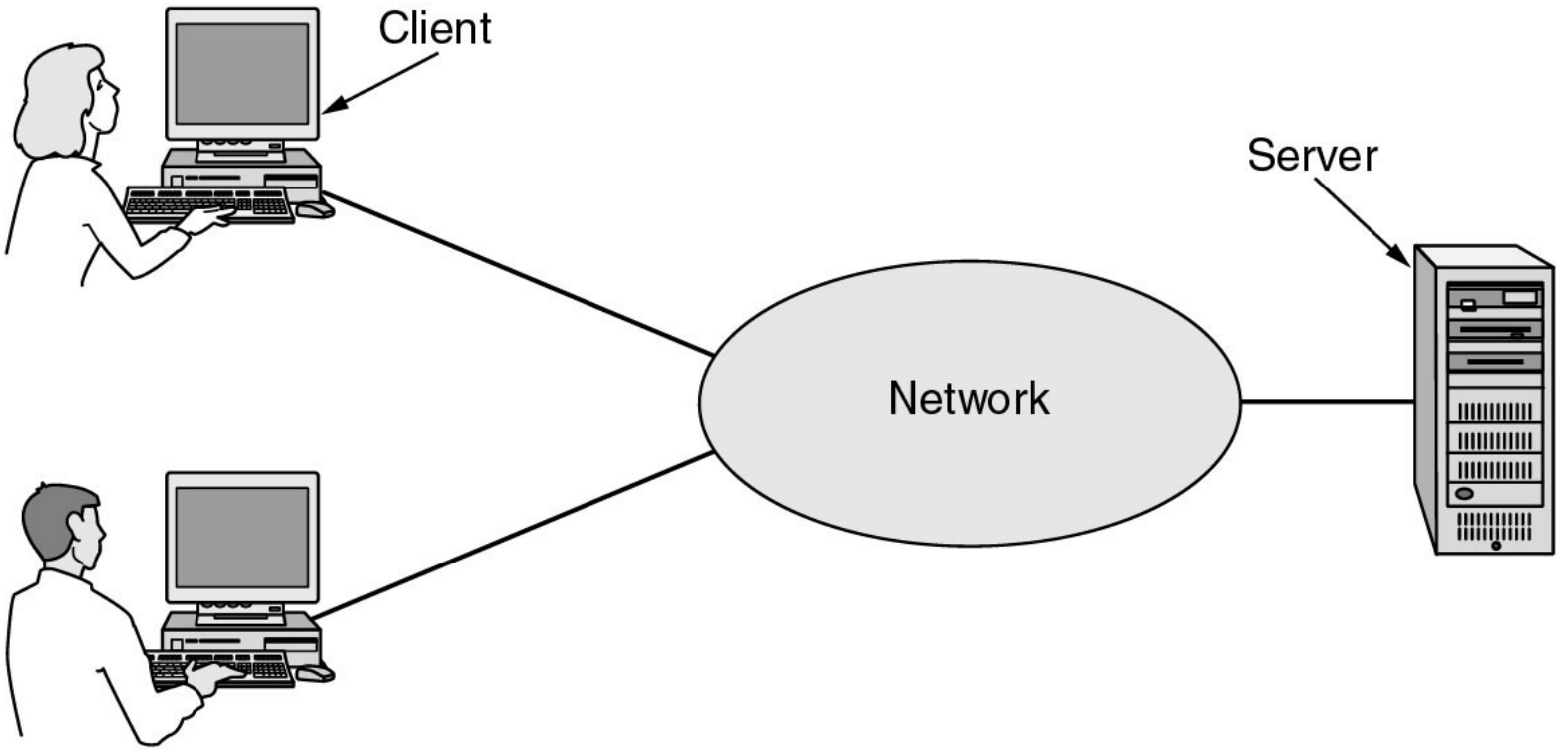
D-merits of Computer Network

- Security Concerns
  - Computer within a Network can be Vulnerable
- Mal ware (Malicious software)
  - Malicious software (worms, viruses, Trojan Horse, adware, spyware, scareware)
- Lack of Robustness
  - Break down of Central System disrupt the Entire System
- Needs An Efficient Handler
  - Required Technically qualified Candidate to maintain the system
- Lack of Independence

Uses of Computer Networks (Application)

- Business Applications
- Home Applications
- Mobile Users
- Social Issues

Business Applications of Networks



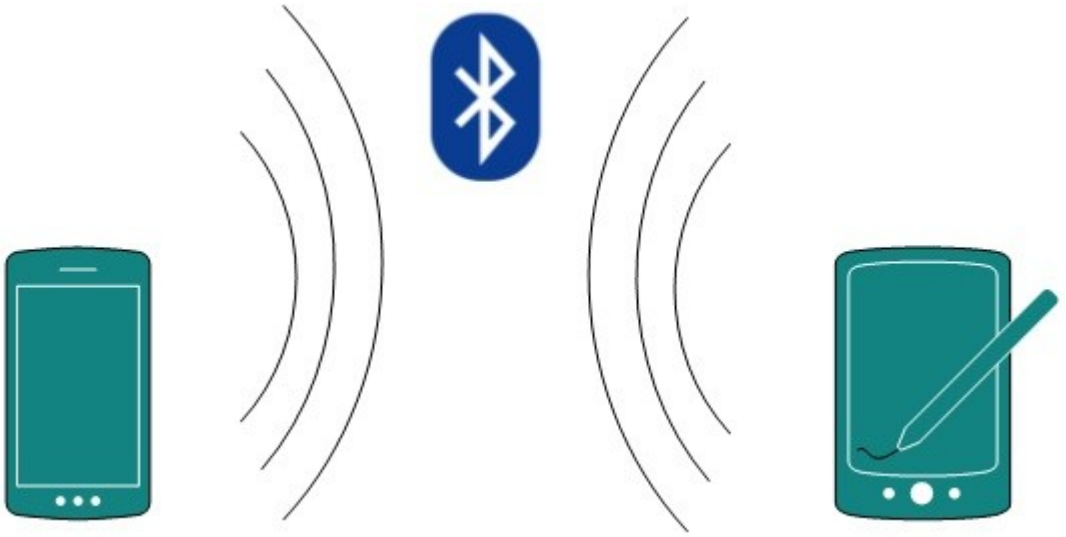
A network with two clients and one server.

Home Network Applications

- Access to remote information
- Person-to-person communication
- Interactive entertainment
- Electronic commerce

PAN (Personal Area Network)

- computer network used for data transmission among devices such as computers, telephones and personal digital assistants
- communication among the personal devices themselves (**intra personal communication**)



Local Area Network LAN

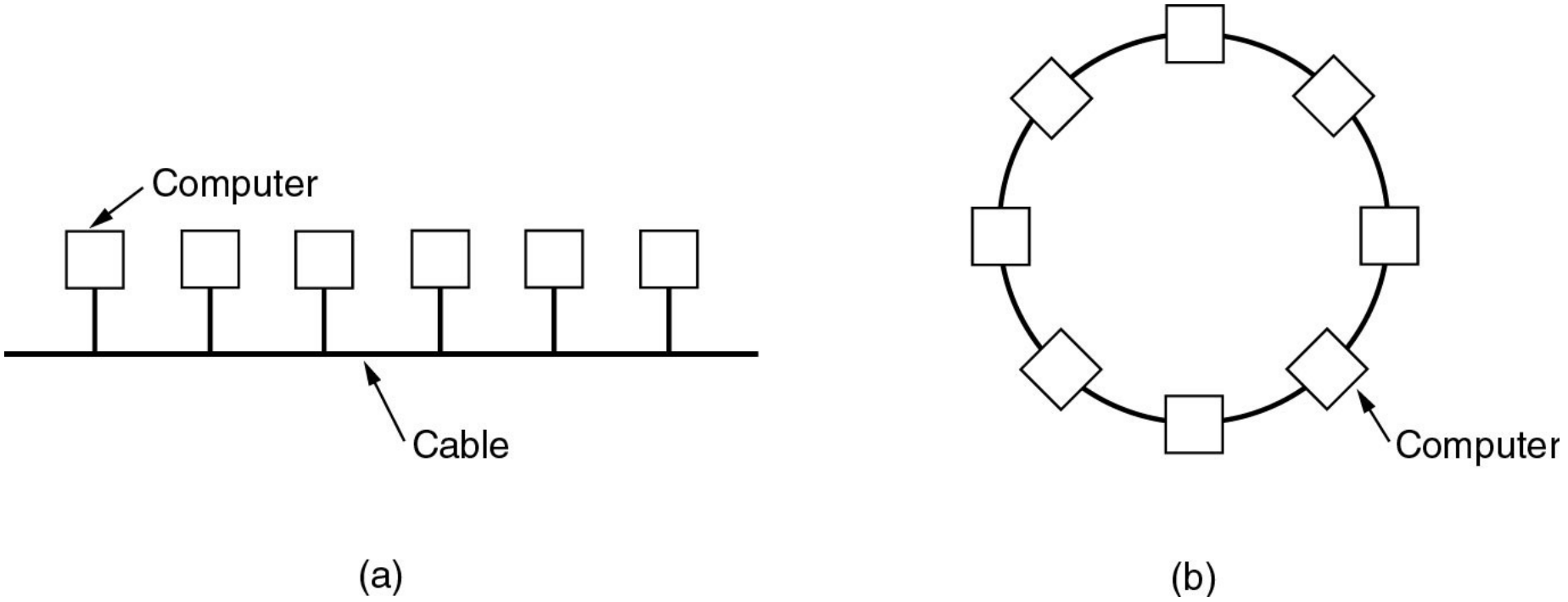
- LAN (Local Area Network). A LAN is a privately owned network that operates within and nearby a single building like a home, office- or factory

- When LANs are used by companies, they are called **enterprise networks.**

- **WLAN** is the wireless LAN in which the devices use the radio spectrum to communicate with the other devices.

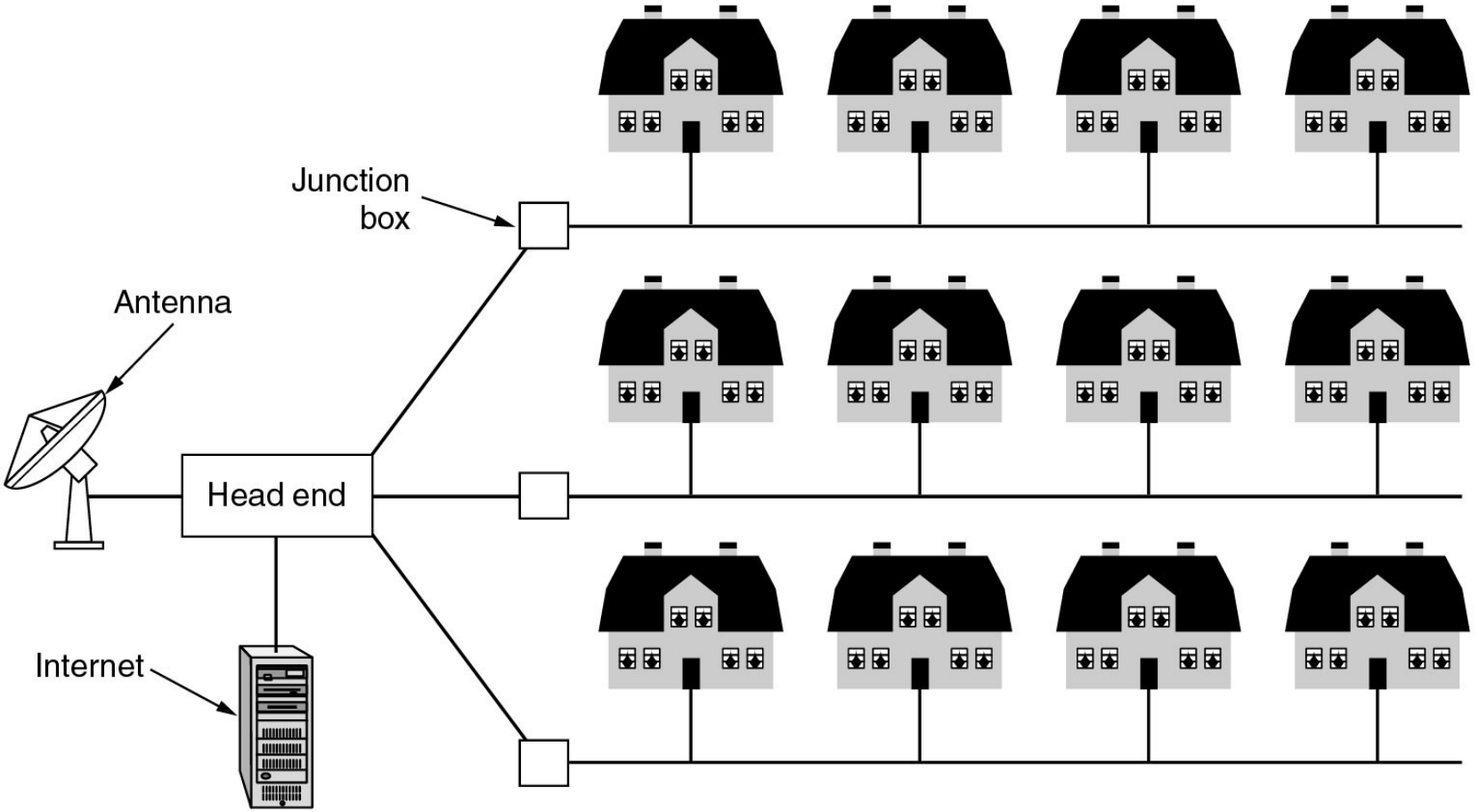
- There is a standard for wireless LANs called IEEE 802.11, popularly known as **WiFi**

Local Area Networks



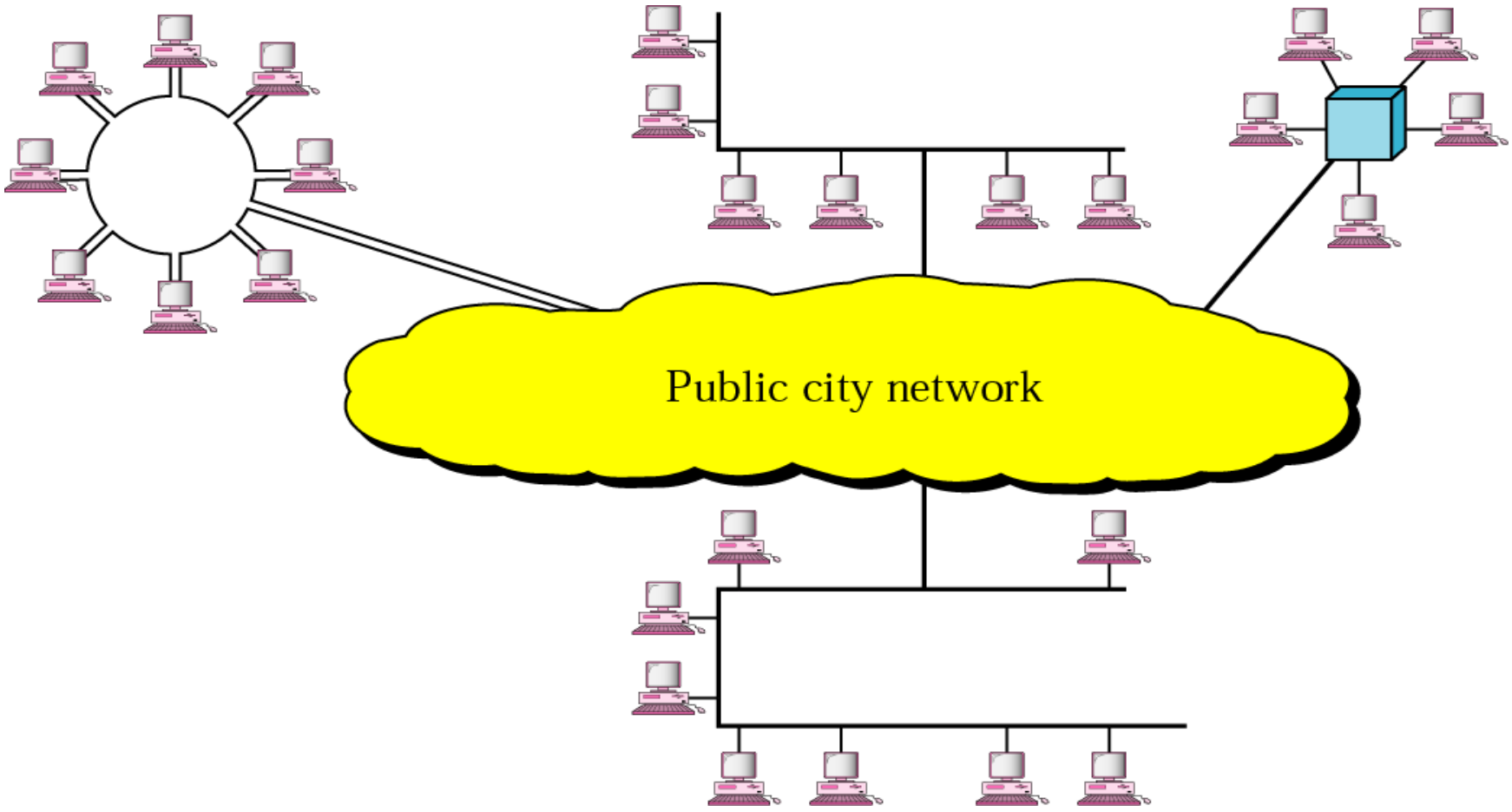
Two broadcast networks
(a) Bus
(b) Ring

Metropolitan Area Networks



A metropolitan area network based on cable TV.

MAN



MAN contd..

- Metropolitan area network (MAN) is a computer network larger than a local area network, covering an area of a few city(By Cable Networks) blocks to the area of an entire city, possibly also including the surrounding areas
- A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations.
- Backbone of MAN is high-capacity and high-speed fiber optics. MAN is works in between Local Area Network and Wide Area Network. MAN provides uplink for LANs to WANs or Internet.

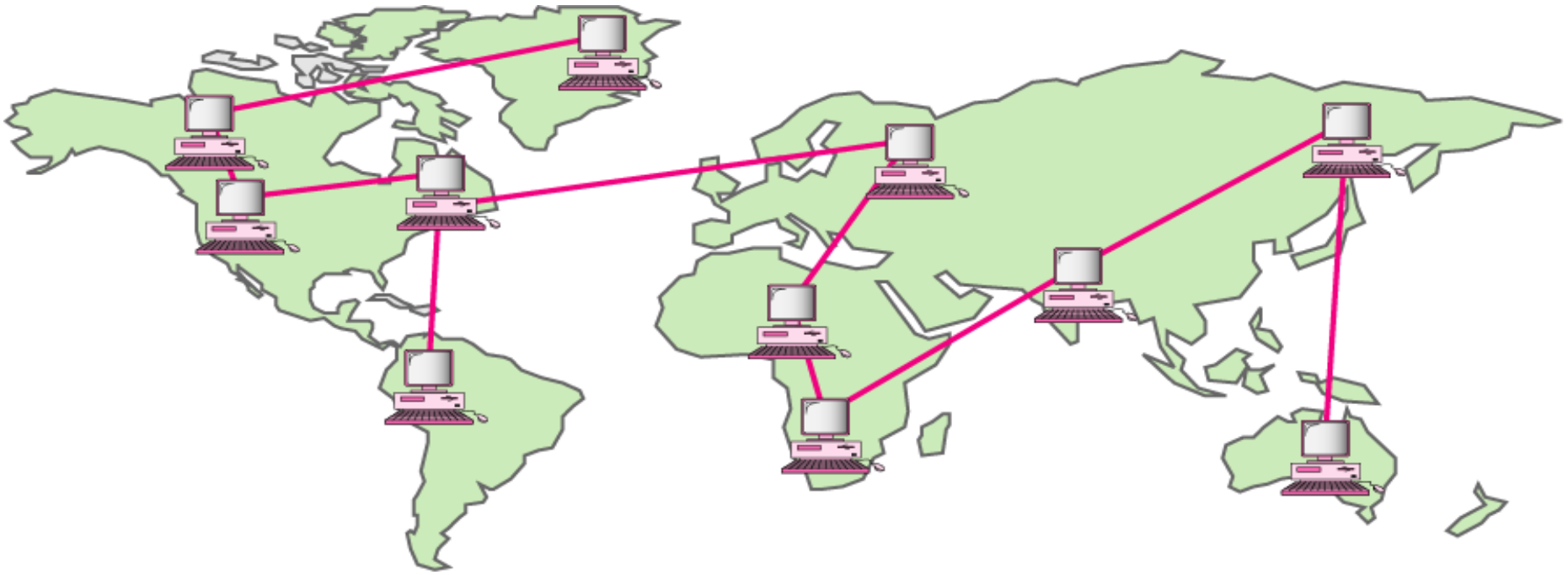
Campus Area Network (CAN)

- Network of multiple interconnected local area networks (LAN) in a limited geographical area
- smaller than a wide area network (WAN) or metropolitan area network (MAN).
- CAN benefits are as follows:
  - Cost-effective
  - Wireless, versus cable
  - Multi departmental network access
  - Single shared data transfer rate (DTR)

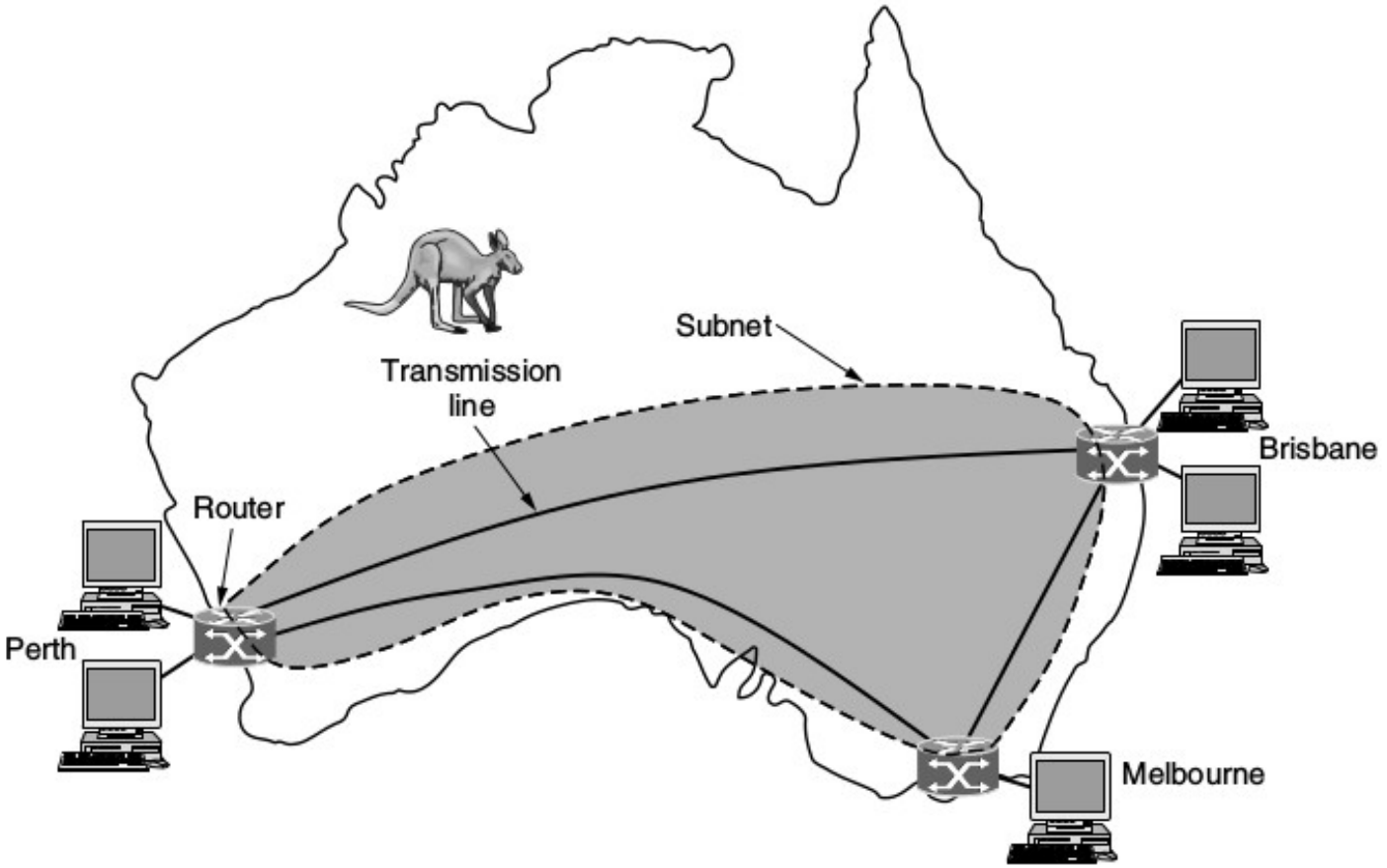
Wide Area Network(WAN)

- spans a large geographical area, often a country or continent
- Telecommunication networks are Wide Area Network.
- These networks provides connectivity to MANs and LANs.
- Equipped with very high speed backbone, WAN uses very expensive network equipment

WIDE AREA NETWORK



WAN


Subnet
Transmission line
Router
Perth
Brisbane
Melbourne

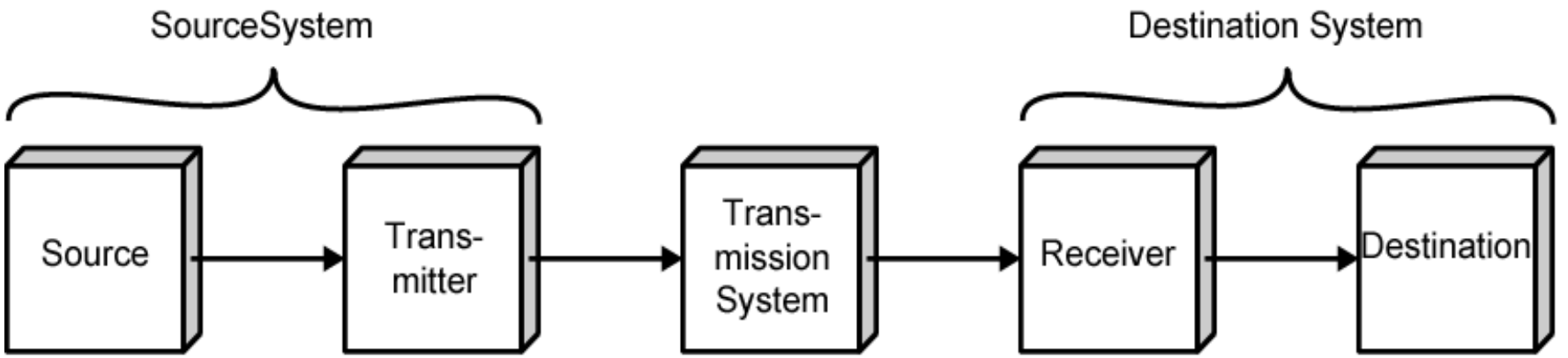
GAN
Global Area Network

- A global area network (GAN) refers to a network composed of different interconnected networks that cover an unlimited geographical area.
- The term is loosely synonymous with Internet, which is considered a global area network
- GAN is used to support mobile communication across a number of wireless LAN s,

CAN
Country Area Network

- CAN connects the no of MAN within the Country
- The network is Government owned
- Backbone of Country Network

Communication Model



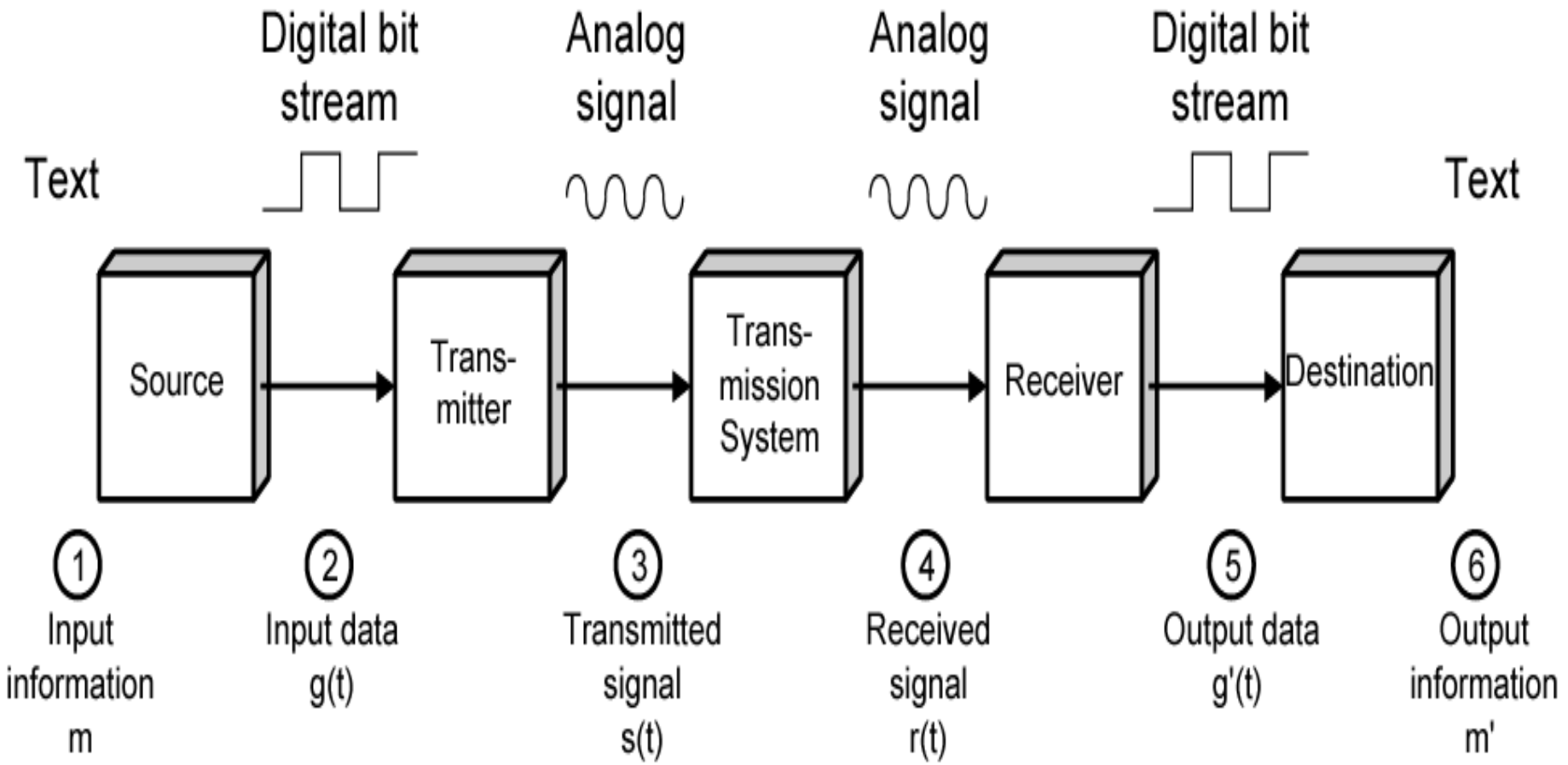
(a) General block diagram

(b) Example

Communication Model

- 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

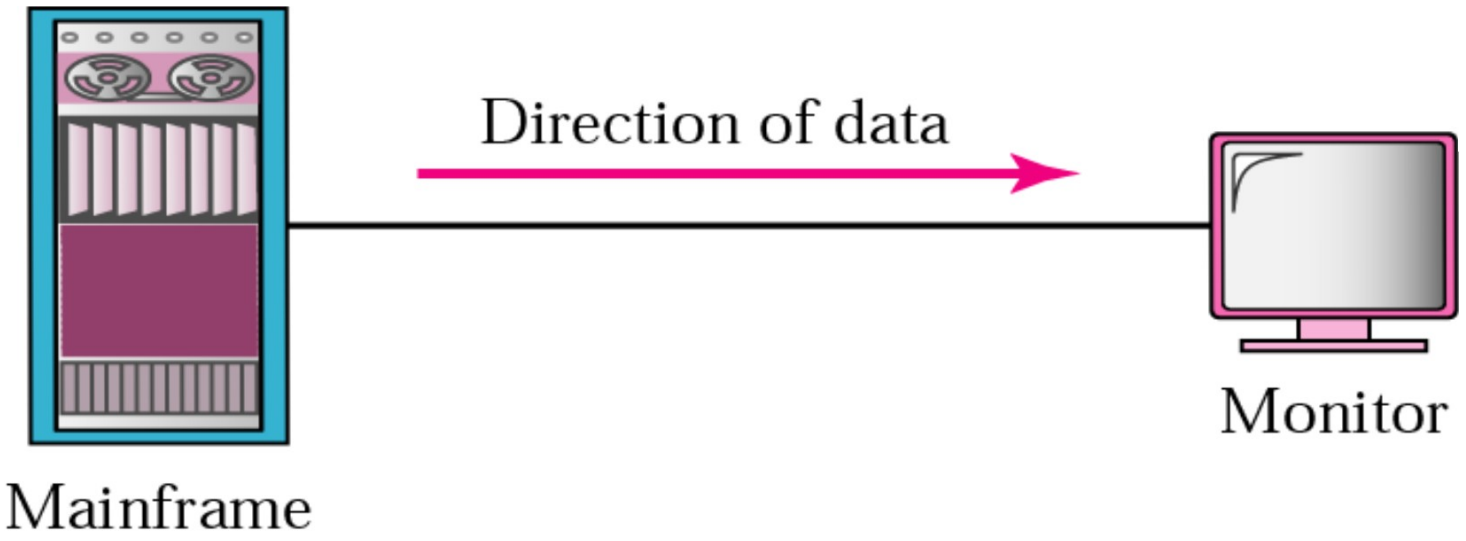
Communication Model



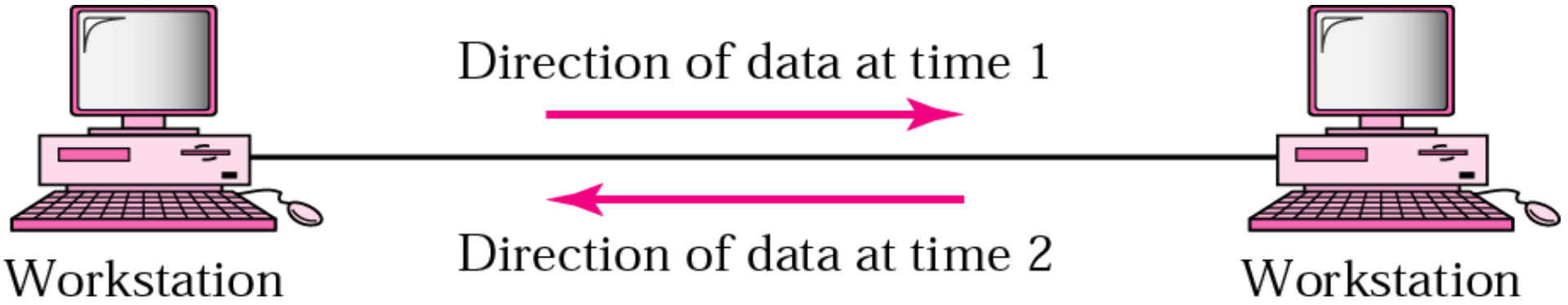
Transmission Modes

- Simplex
- Half Duplex
- Full Duplex

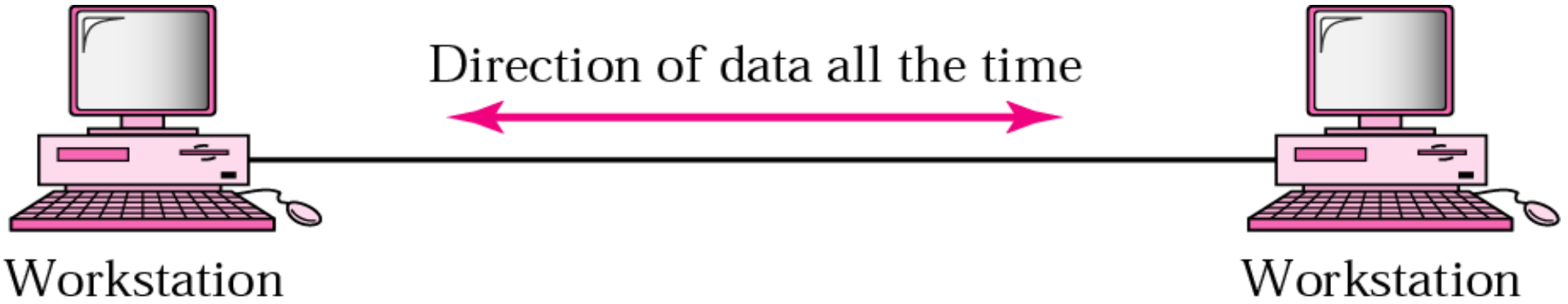
Simplex Mode



Half Duplex Communication



Full Duplex Communication



Communication Types

- Unicasting (one-to-one)
- Multicasting (many-to-many)
- Broadcasting (one-to-all)

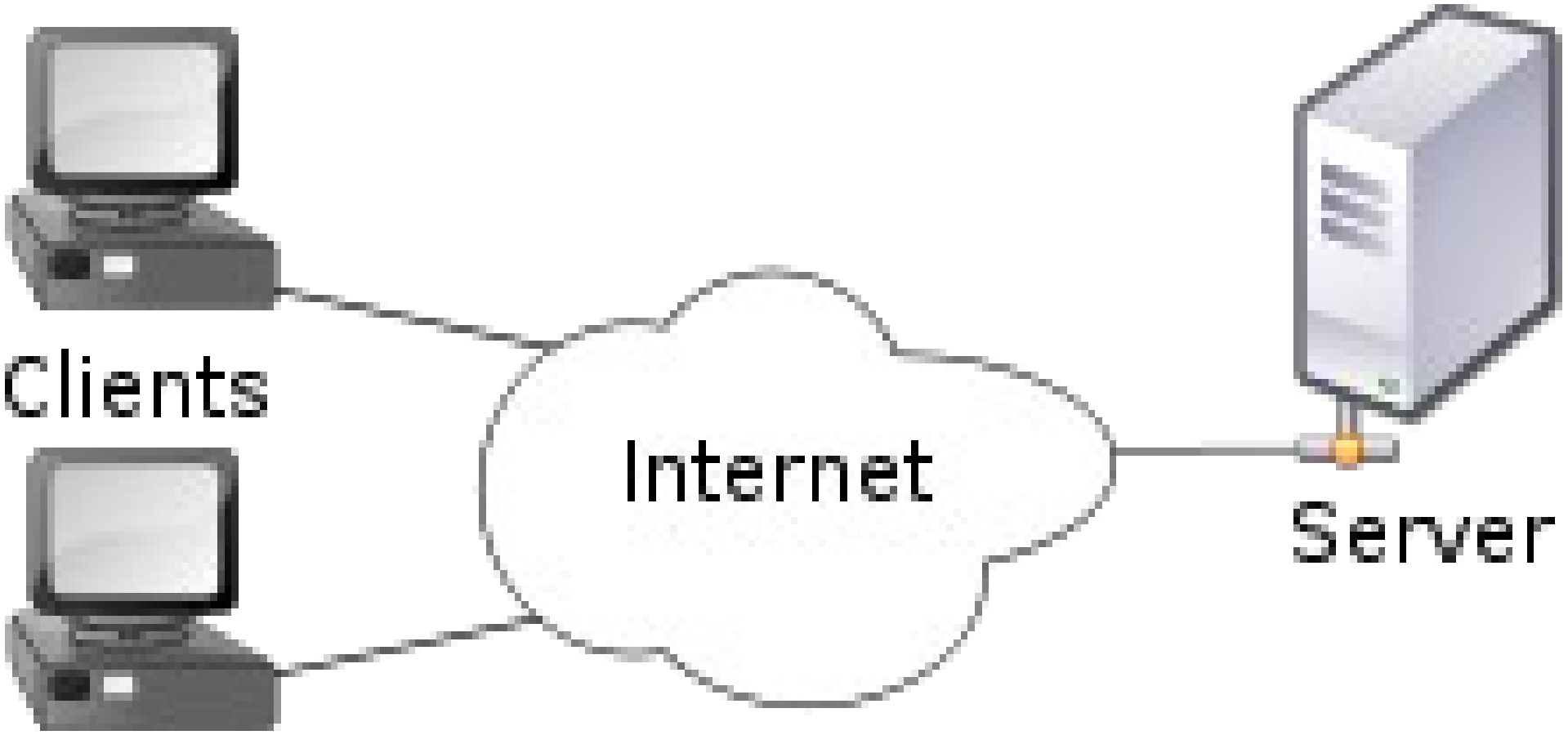
Network Classification

- By Structure / Functional Relationship
  - Client / Server
  - Peer to Peer (P2PN)
  - Active Network Model

Client/Server network

- Nodes and servers share data roles
- Nodes are called clients
- Servers are used to control access
- Database software
  - Access to data controlled by server
- Server is the most important computer
- Examples:
  - Email, Network Printing, WWW

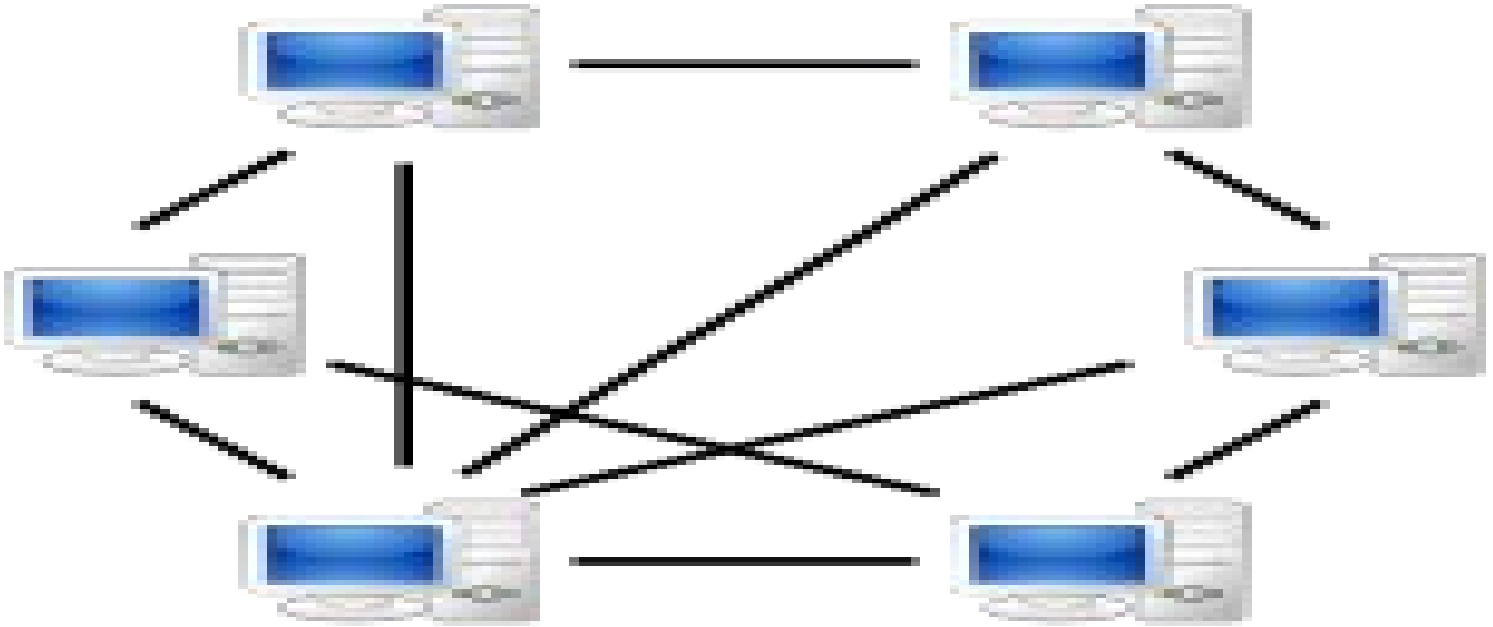
Client Server Model



Peer to peer networks (P2PN)

- All nodes are equal
- Nodes access resources on other nodes
- Each node controls its own resources
- Most modern OS allow P2PN
- Distributed computing is a form
- Kazaa(P2pN based Music sharing software)
- Example
  - Torrent software

Peer2Peer



Active Network Model

- Type of Network Architecture
- Allow packets traveling through the network to dynamically modify the operation of network
- Active network architecture is composed of execution environments (similar to a UNIX shell that can execute active packets)

Network Classification

- By Topology / Physical Connectivity
  1. BUS
  2. STAR
  3. RING
  4. MESH
  5. TREE
  6. Hybrid
  7. Distributed Bus

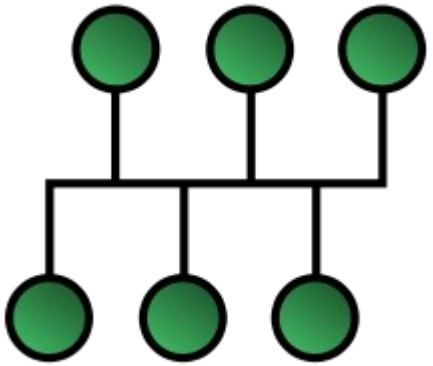
Network Topology

- Network topology is the arrangement of the various elements (links, nodes, etc.) of a computer network
- Physical Topology
  - Placement of Devices (Physical Location)
- Logical Topology
  - Defines How Data Flow, regardless of Physical Design

Bus Topology

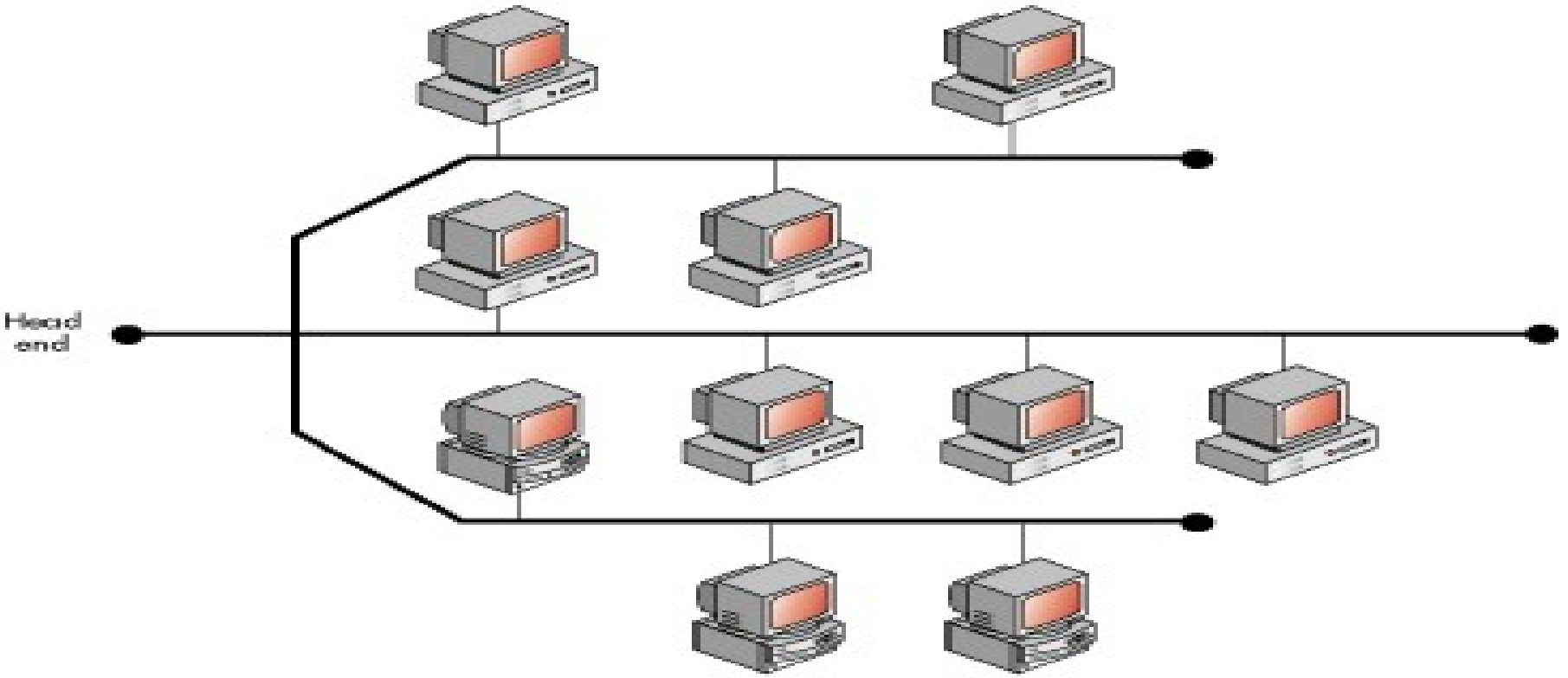
- Each node(Devices) is Connected to Single Cable
- Signal from the source travel in Both Directions to all Machine until it get the intended recipient
- Can be the single point of failure
- Cable is terminated in both ends with terminator
- Terminator reduces echo's

- Bus Topology
  - Linear Bus
    - All nodes are Connected to Common Transmission Medium
    - Has exactly Two end points

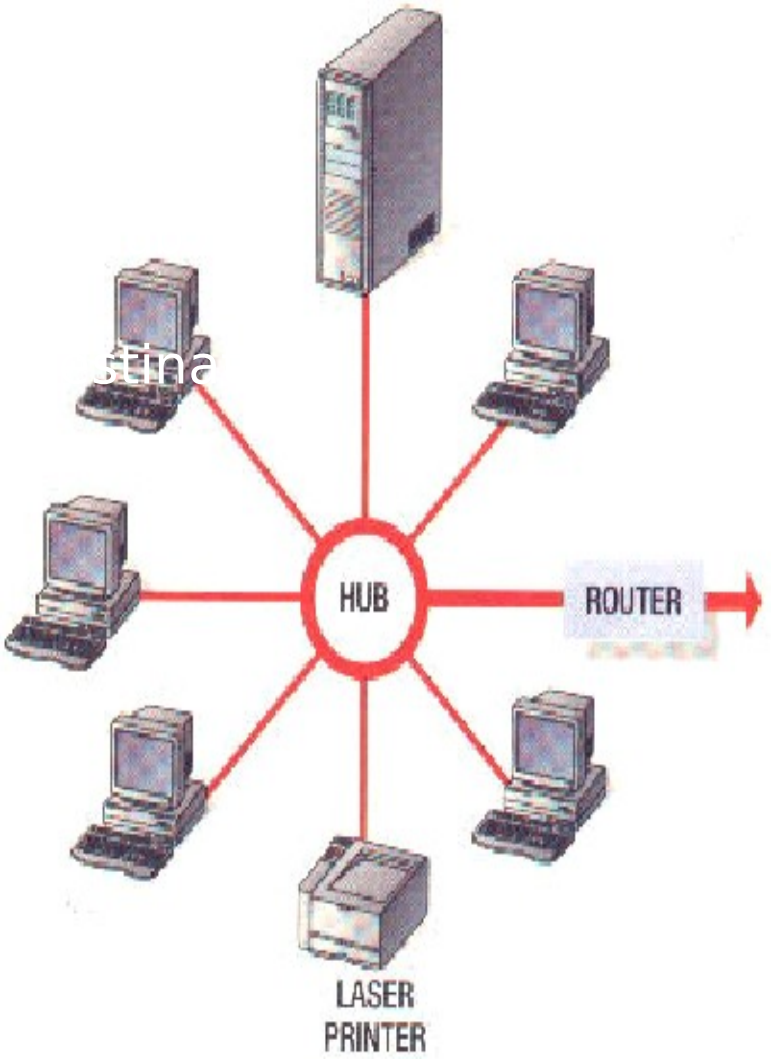


Distributed Bus

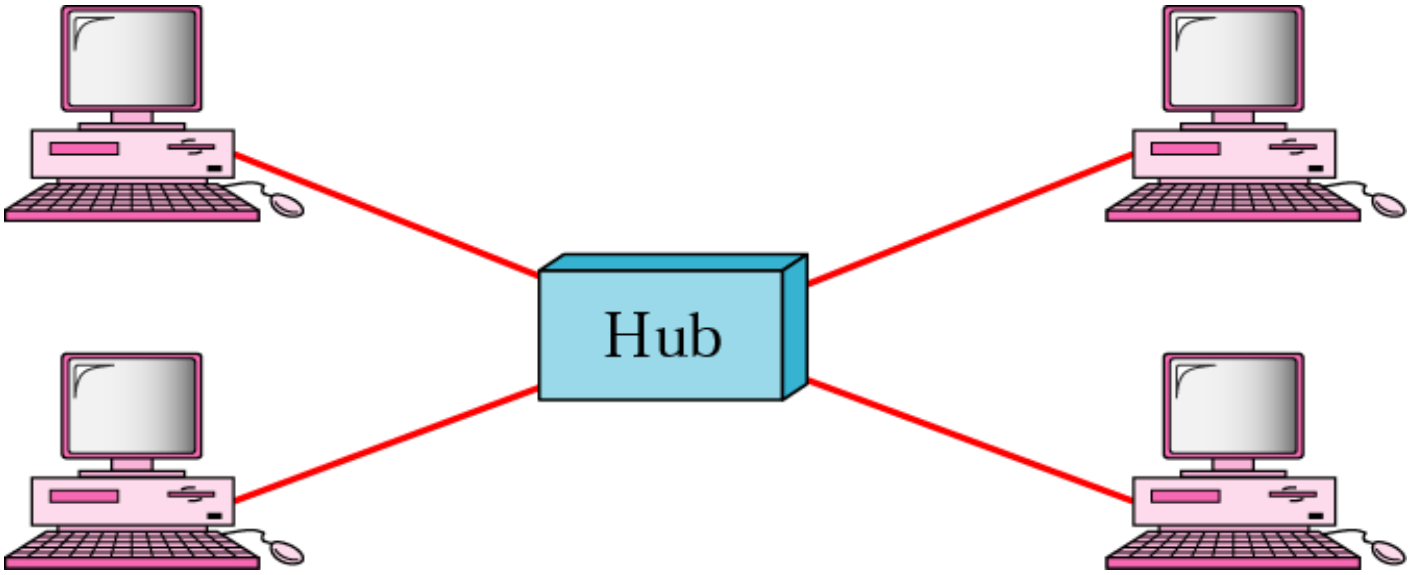
- More than two end points
- Starting end point also called ROOT



STAR



Star Topology Using HUB



Star topology

- All nodes connect to a hub
- Packets sent to hub
- Hub sends packet to destination

- Advantages
- Easy to setup
- One cable can not crash network

- Disadvantages
- One hub crashing downs entire network
- Uses lots of cable

- Most common topology

Star contd..

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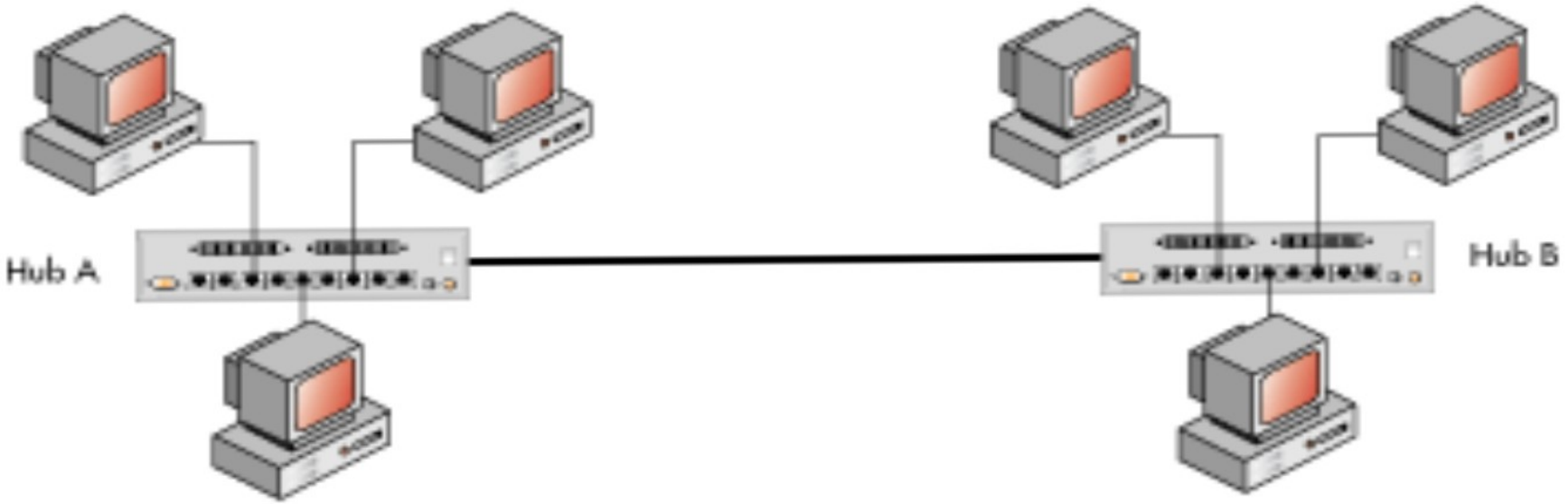
- Most common topology

Distributed-Star

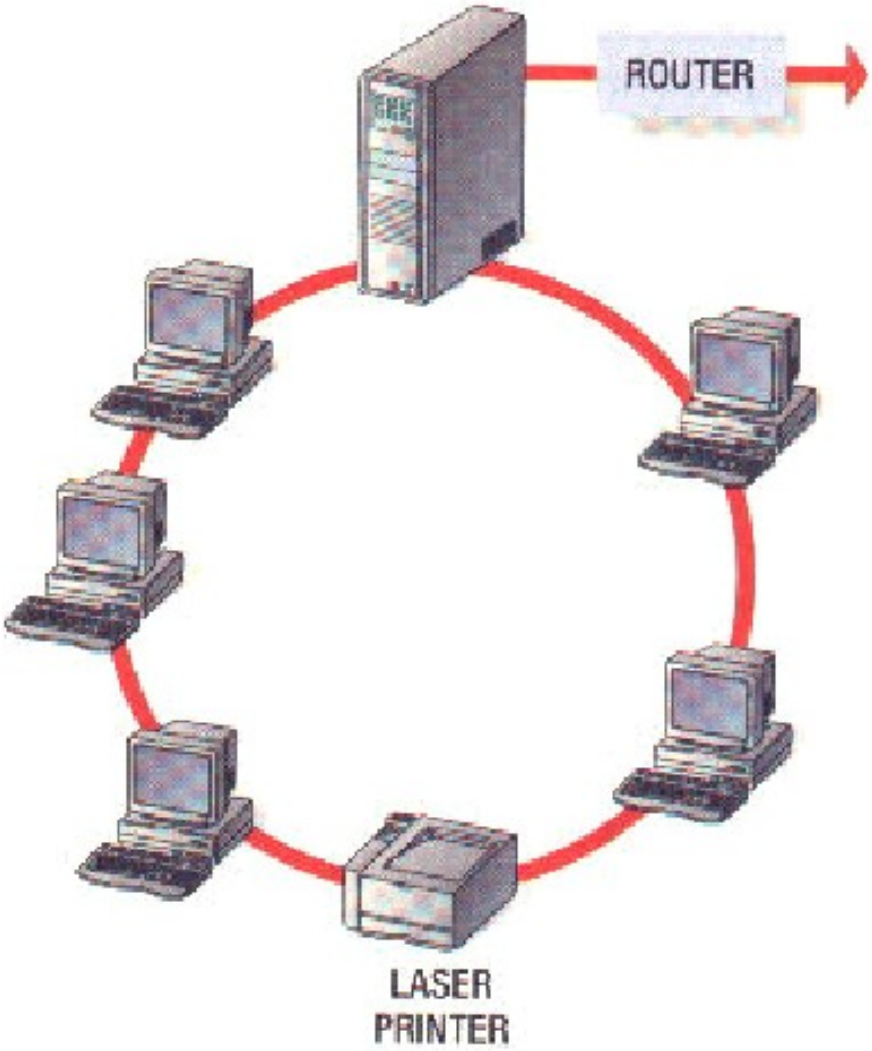


RING

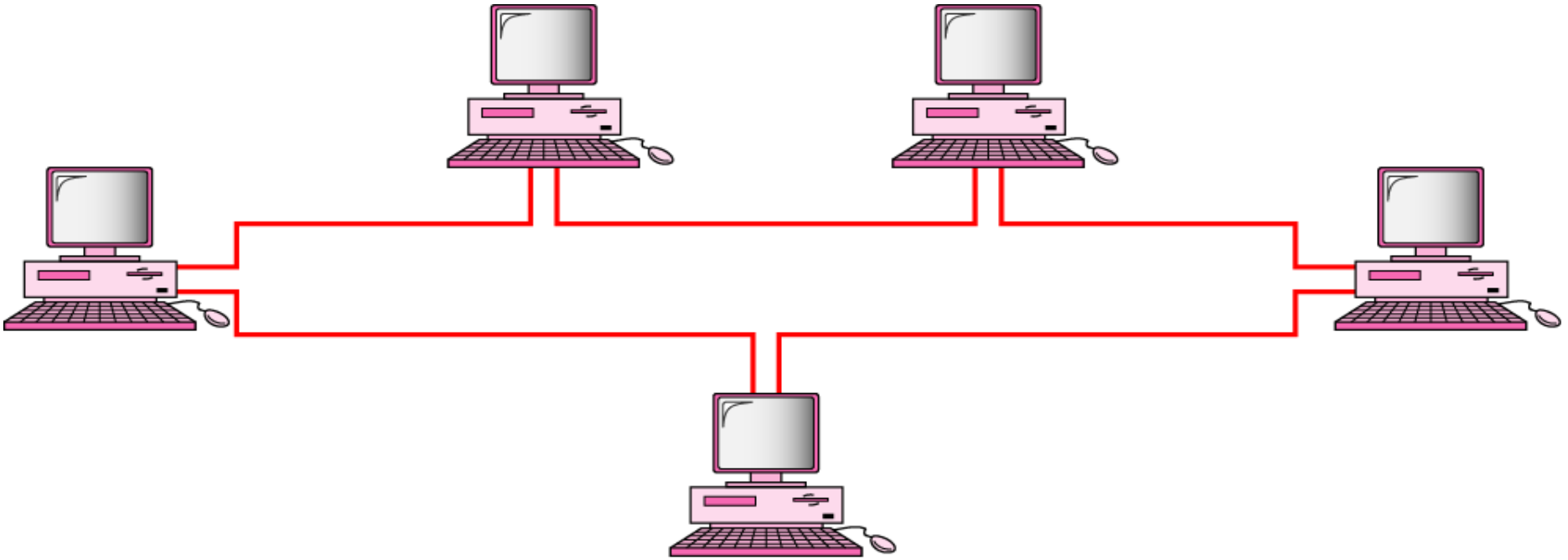
- Nodes connected in a circle

- Tokens used to transmit data
- Nodes must wait for token to send

- Advantages
- Time to send data is known
- No data collisions
-
- Disadvantages
- Slow
- Lots of cable
-

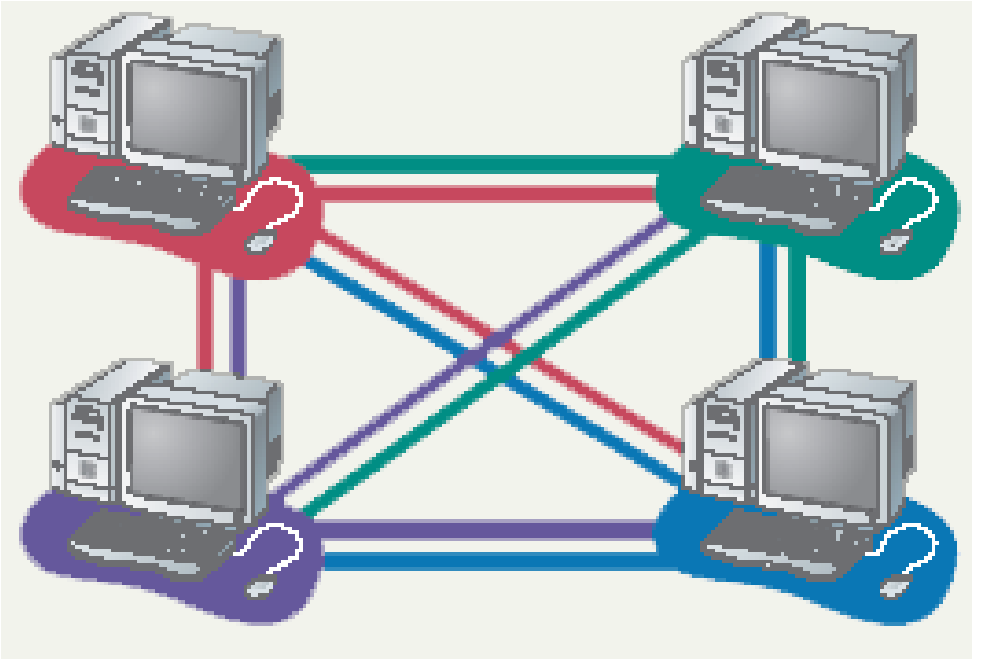


Ring Topology



MESH

- All computers connected together
- Internet is a mesh network
- Advantage
  - Data will always be delivered
- Disadvantages
  - Lots of cable
  - Hard to setup

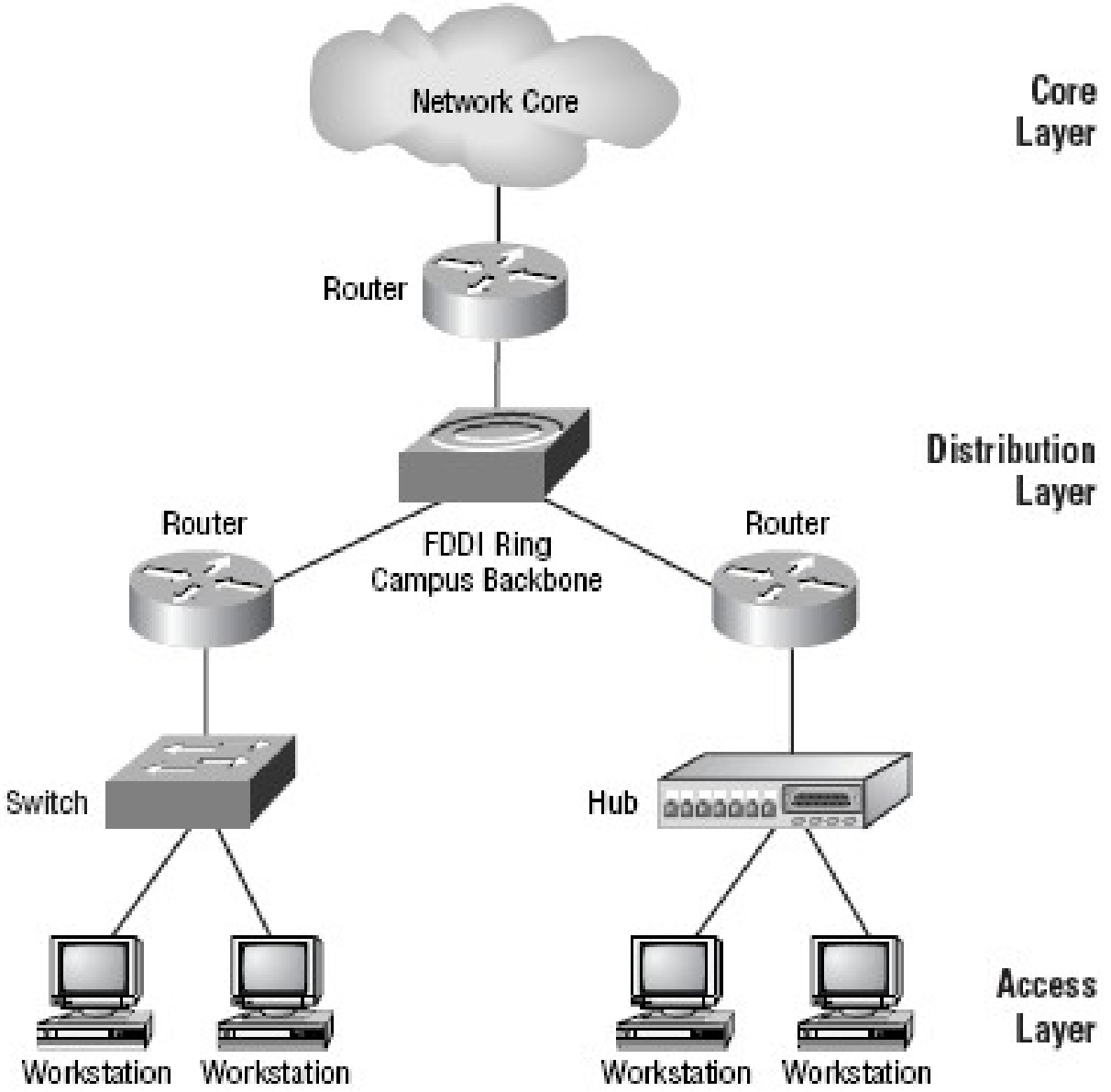


Mesh

For N Node Mesh , the no of wire required to connect each node is given by Formula

$x=n(n-1)/2$

TREE


Network Core
Core Layer
Router
Distribution Layer
Router
FDDI Ring
Campus Backbone
Router
Switch
Hub
Workstation
Workstation
Workstation
Workstation
Access Layer

Tree Contd..

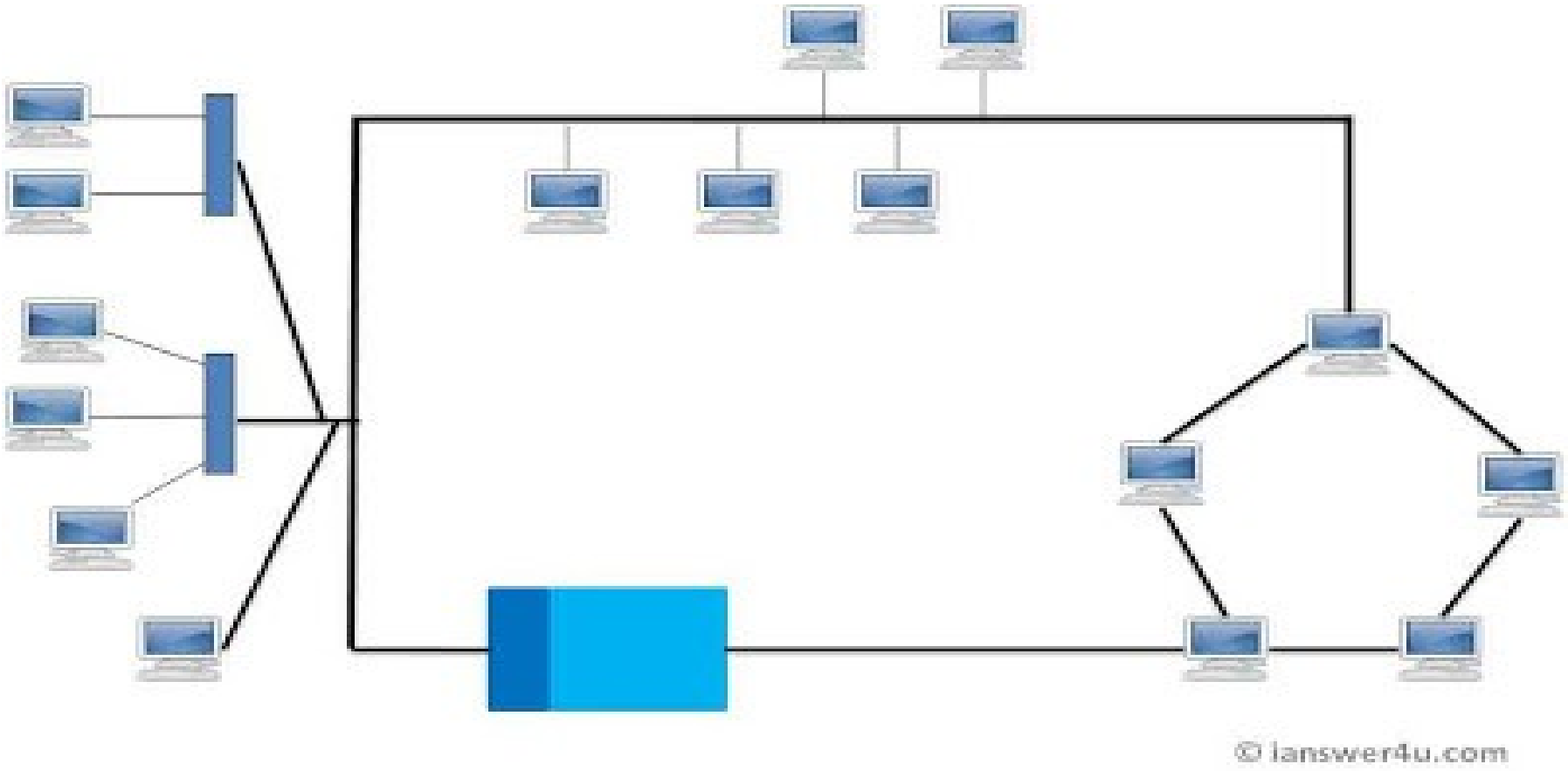
- Hierarchal Model

  Advantages
- Scaleable
- Easy Implementation
- Easy Troubleshooting

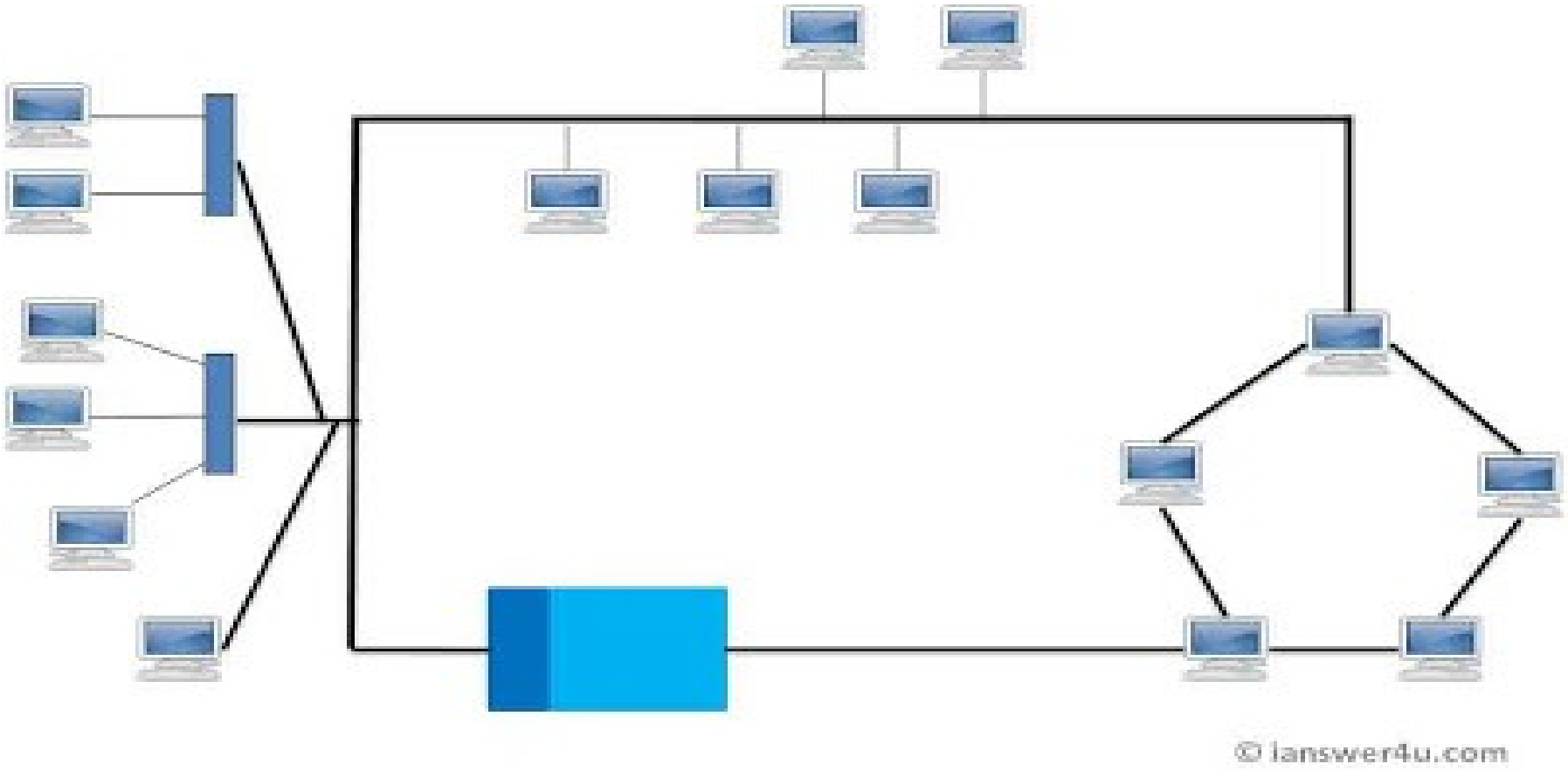
Hybrid Model

- Mixture of one or more topology
- Done according to the requirements of the organization.
- For example, if there exists a ring topology in one office department while a bus topology in another department, connecting these two will result in Hybrid topology.
- connecting two similar topologies cannot be termed as Hybrid topology.

Hybrid Topology



Hybrid Topology



Internetwork

- An Internetwork is the connection of two or more distinct computer networks or network segments via a common routing technology.

- Any interconnection among or between public, private, commercial, industrial, or governmental networks may also be defined as an internetwork.

Internetwork

- **Intranet**
  - An intranet is a set of networks, using the Internet Protocol and IP-based tools such as web browsers and file transfer applications, that is under the control of a single administrative entity.
  - Most commonly, an intranet is the internal network of an organization
- **Extranet**
  - An extranet is a network or internetwork that is limited in scope to a single organization or entity but which also has limited connections to the networks of one or more other usually, but not necessarily, trusted organizations or entities
  - by definition, an extranet cannot consist of a single LAN; it must have at least one connection with an external network.
- **Internet**
  - The Internet consists of a worldwide interconnection of governmental, academic, public, and private networks based upon the networking technologies of the Internet Protocol Suite.
  - It is the successor of the Advanced Research Projects Agency Network (ARPANET) developed by DARPA of the U.S. Department of Defense.
  - The Internet is also the communications backbone underlying the World Wide Web (WWW).