Computer Networks

By Hardeep Singh

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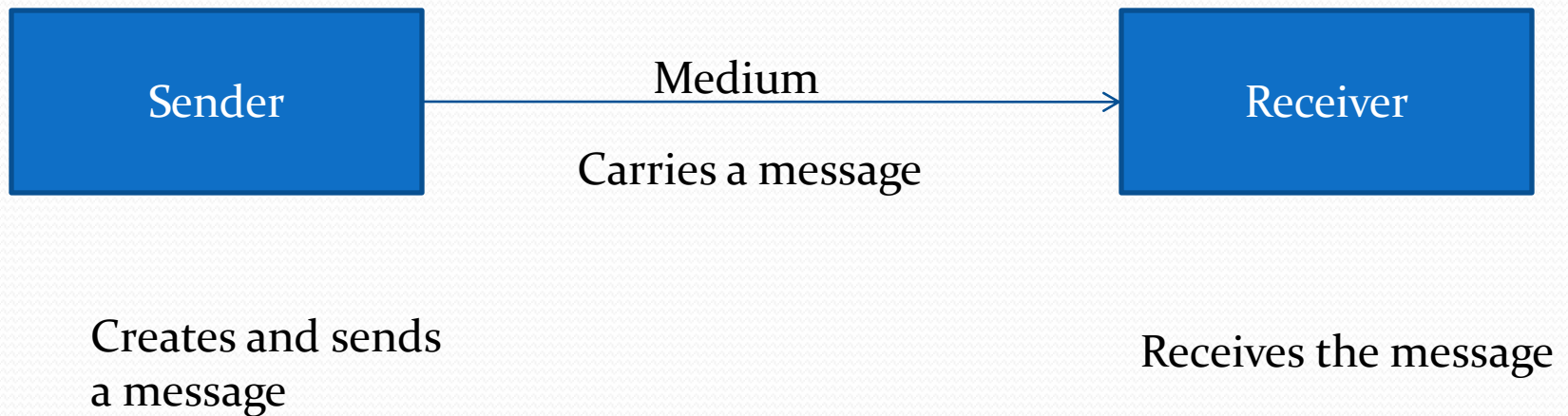- Basic Elements of communication systemNetwork Topologies
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Introduction

- A Computer network is a network of computers that are geographically distributed, but connected in a manner to enable meaningful transmission and exchange of data among them.

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Basic Elements of a Communication System

- Sender: Creates and sends a message
- Medium: Carriers a message
- Receiver: Receives a message

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Example

Sender — Medium (Carries a message) → Receiver

Creates and sends a message

Receives the message

Data Transmission Modes

SIMPLEX MODE

A Simplex communication system can transmit data in one direction only. Devices connected to such a circuit wither send(keyboard) only or receive(printer) only.

Data Transmission modes

HALF DUPLEX

A Half Duplex communication system can transmit data in both direction., but in only one direction at a time. Hence, it can alternately send and receives data. It requires two wires. it is most suitable for voice communication using telephones in which open person can speak at a time.

Data Transmission Modes

FULL DUPLEX

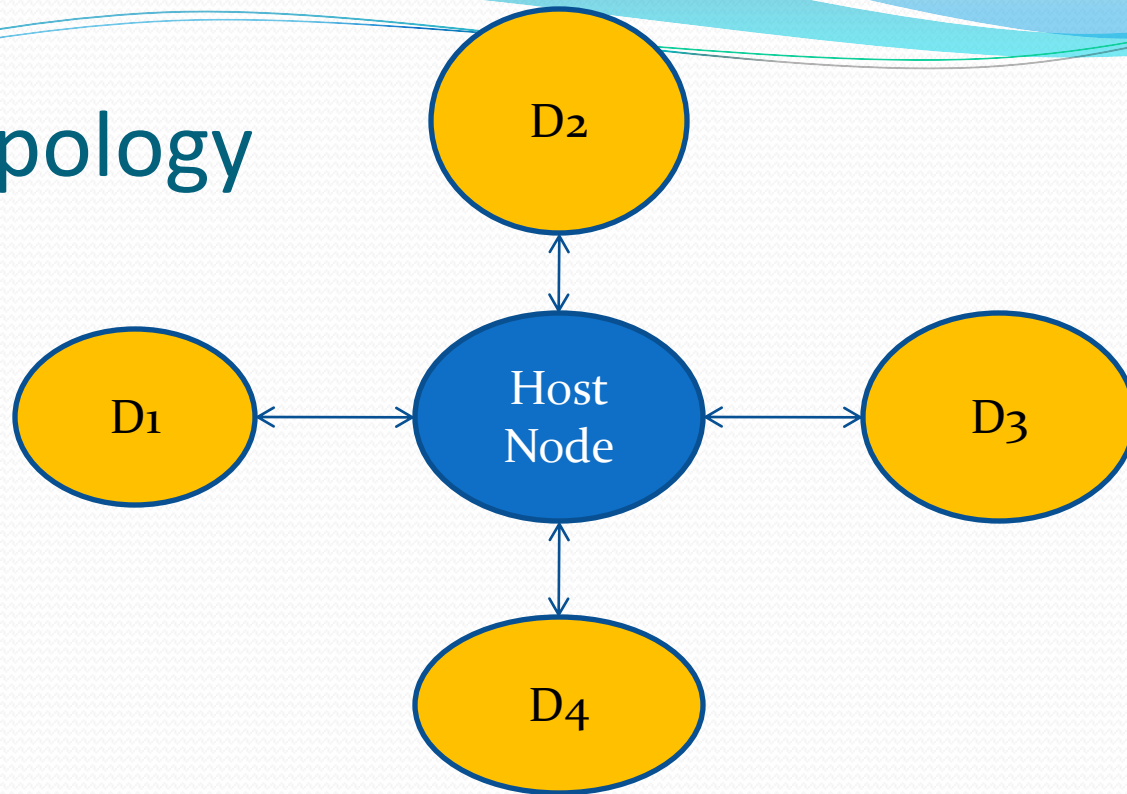| Sender (Or Receiver) | → AND ← | Receiver (Or Sender) |

This mode requires four wires that allows data to flow in both directions simultaneously. Modern computer and internet are most popular examples of this mode. It improves efficiency because it eliminates the direction switching delay of a half duplex system

Network Topologies

- Topology of a network refers to the way in which the network's nodes(computer or other devices that need to communicate) are linked together.

- It determines the various data paths available between any pair of nodes in the network.

- Choice of a topology for a computer network depends on a combination of factors, such as:
  - Desired Performance of the system
  - Reliability of the system
  - Size(Numbers of nodes and their geographical distribution) of the system)
  - Cost of components and services required to implement network
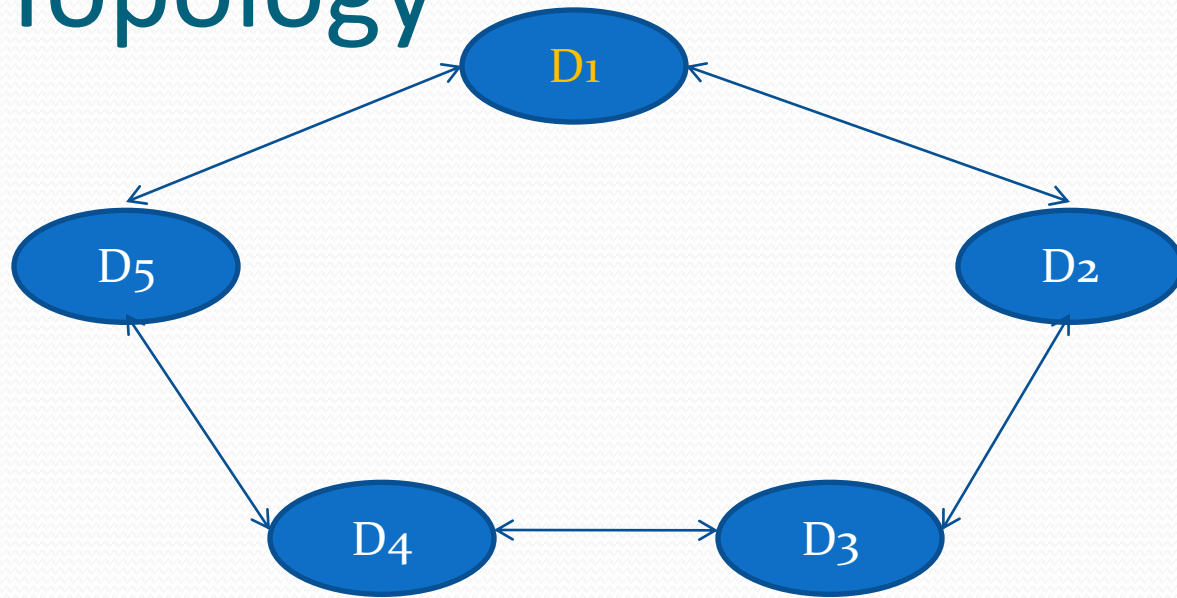 - Availability of communication lines

Star Topology

- Multiple Nodes connected to a host node
- Nodes in the network are linked to each other through the host node and can communicate only via the host node
- Routing function is performed by the host node that centrally controls communication between any two other nodes by establishing a logical path between them.

- Advantages of Star Topology
  - Star topology has minimal line cost because only "n-1" lines are required for connecting "n" nodes.
  - Transmission delays between two nodes do not increase by adding new nodes to network, because any two nodes are connected via two links only.
  - If any node other than the host node fails, remaining nodes are unaffected

- Disadvantage of Star Topology
  - The system crucially depends on the host node. If it fails, entire network fails.
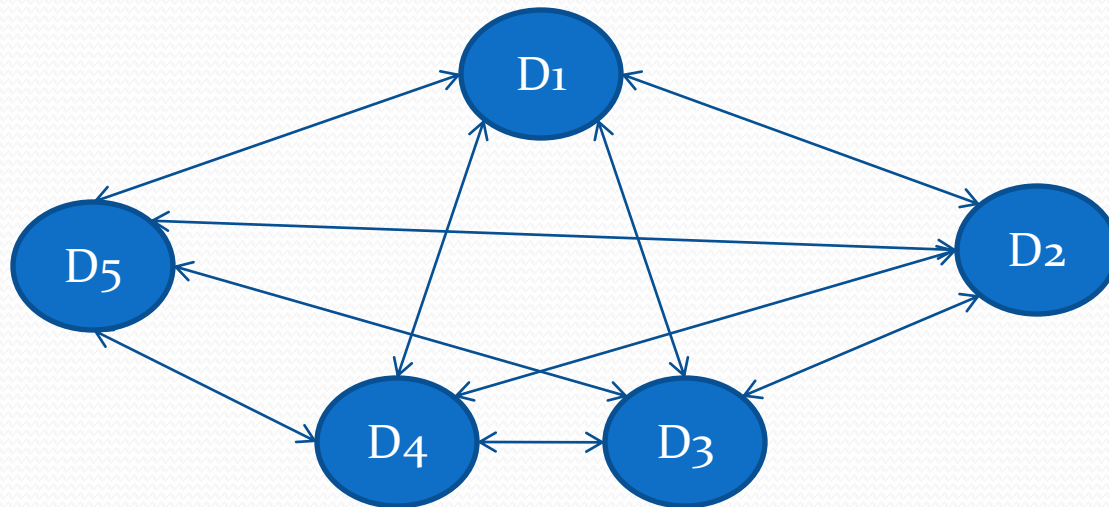
Ring Topology

- Each node has two communicating subordinates(adjacent nodes with which it can communicates directly), but there is no master node for controlling other nodes
- Node receives data from one of its two adjacent nodes.
- The only decision a node has to take is whether the data is for its own use.
- If it is addressed to it, utilizes it otherwise it merely passes it to the next node

- Advantages of Ring Topology
  - There is no central node for making routing decision
  - It is more reliable than a star network because communication is not dependent on a single central node. If a link between any two nodes fails, or if one of the nodes fails, alternate routing is possible.

- Disadvantages of Ring Topology
  - Communication delay is directly proportional to number of nodes in the network.
  - Addition of new node in a network increase communication delays
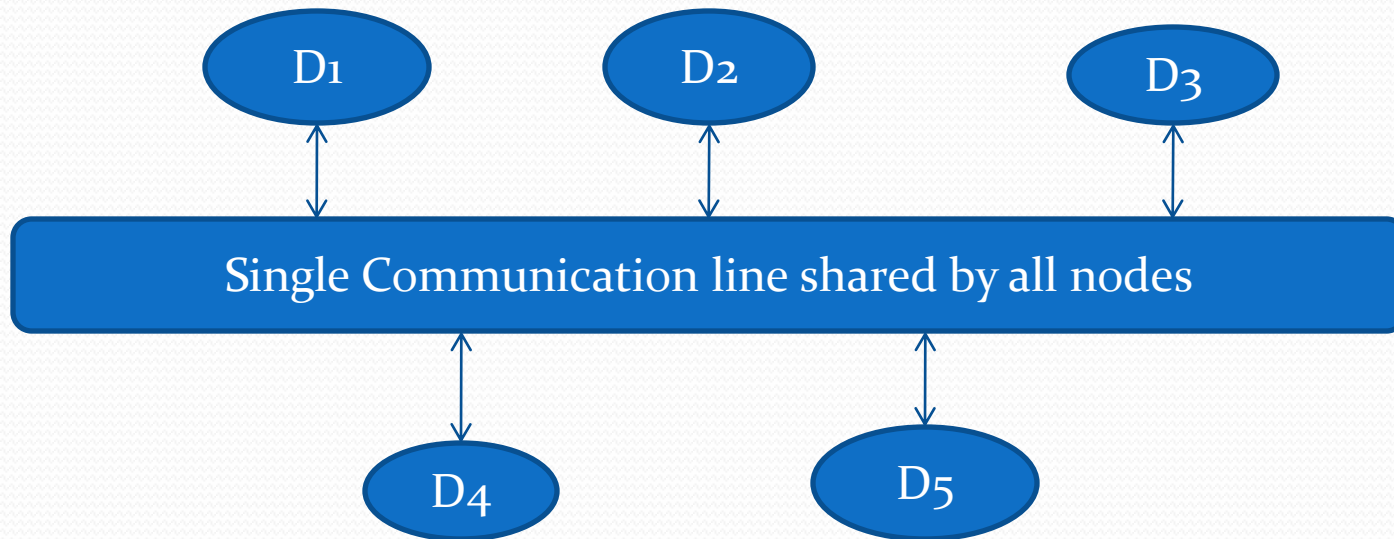 - It requires more complicated controls software than star topology.

Completely Connected Network

- Separate physical link for connecting each node to any other node
- Each node has a direct link, called point-to-point link, with all other nodes in the network
- The control is distributed with each node deciding its communicating priorities.

- Advantages of Completely Connected
  - It is very reliable because any link failure will affect only direct communication between nodes connected by that link
  - Each node of the network need not have individual routing capability
  - Communication is very fast between any two nodes.

- Disadvantages of completely connected
  - It is the most expensive network from the point of view of link cost.
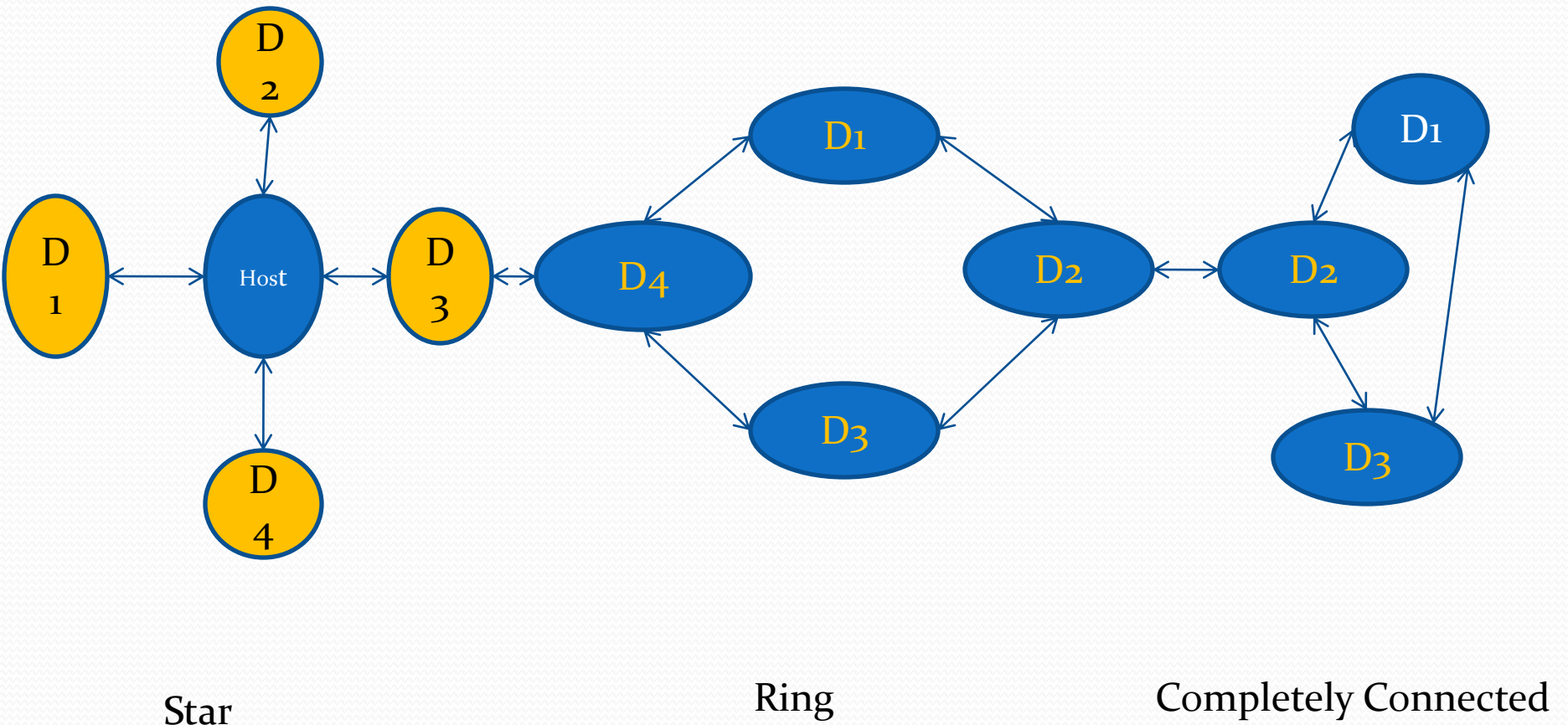 - If there are "n" nodes in a network, "n(n-1)/2" links are required.

Bus Topology

- All nodes share a single transmission medium
- When a node wants to send a message to another node, it appends destination address to the message and checks whether communication line is free.
- As soon as line become free, it broadcast the messages on the line. As the message travels on the line, each node check whether the message addressed to it.
- The message is picked up by addressee node that sends an acknowledgement to source node and frees the line.

- Advantages of Bus Topology
  - It helps in reducing the number of physical lines
  - Failure of a node does not affect communication among other nodes in the network
  - Addition of a new node to the network is easy

- Disadvantages of Bus Topology
  - If the shared communication line fails, entire network fails

Hybrid Network

Star

Ring

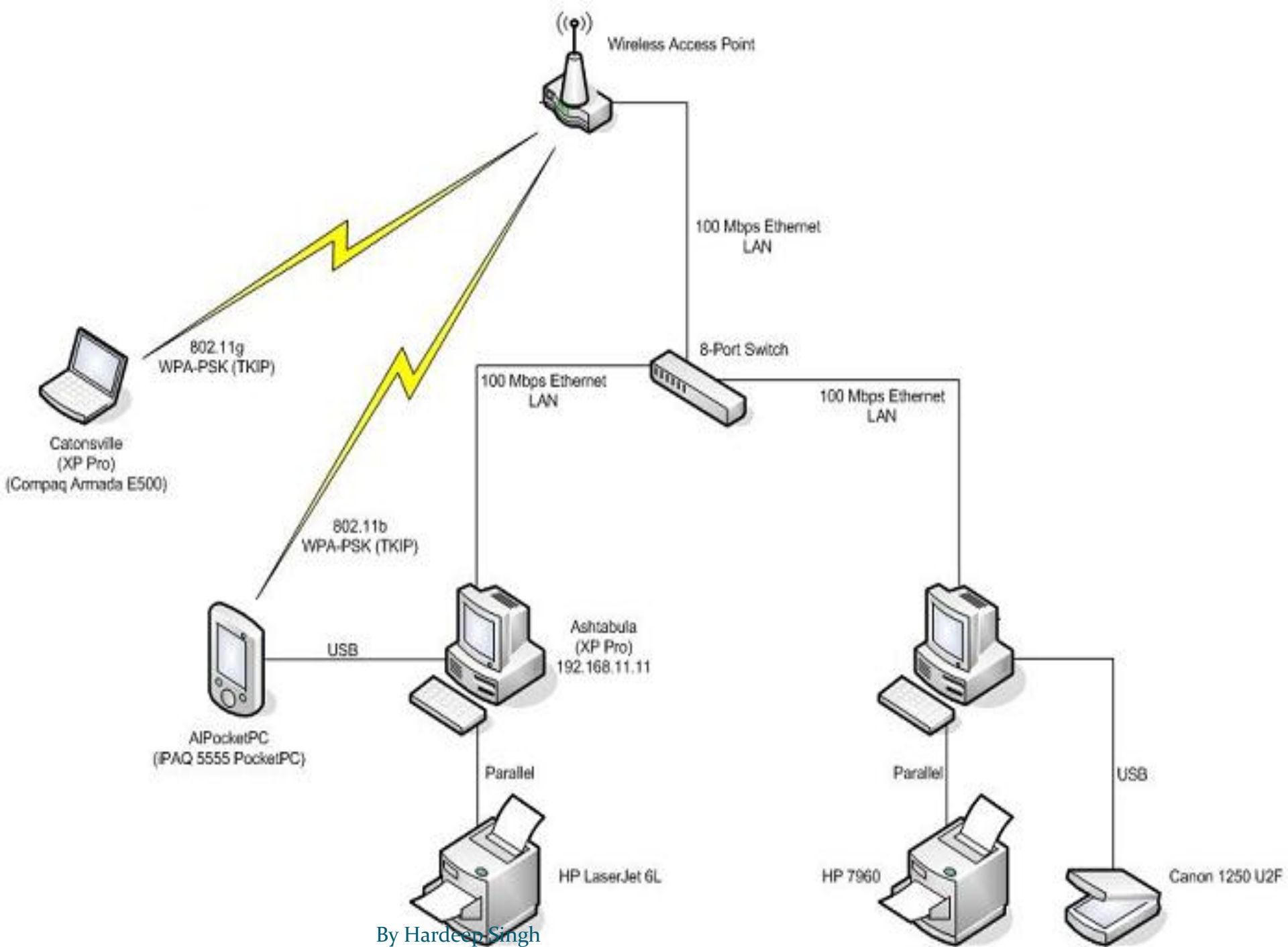Completely Connected

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NETWORK TYPE

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Local Area Network (LAN)

✓ A **Local Area Network (LAN)** is a computer network covering a small geographic area, like a home, office, or group of buildings.

✓ It connects workstations, personal computers, printers, servers and many other devices.

✓ LAN uses low speed communication lines for connections like Twisted Pair Cable, Coaxial Cable and Fiber Optics.

✓ The cost of sending/receiving data is negligible.

✓ LAN is owned by a single organization because of its limited area.

Wireless Access Point

100 Mbps Ethernet
LAN

802.11g
WPA-PSK (TKIP)

Catonsville
(XP Pro)
(Compaq Armada E500)

8-Port Switch

100 Mbps Ethernet
LAN

100 Mbps Ethernet
LAN

802.11b
WPA-PSK (TKIP)

USB

Ashtabula
(XP Pro)
192.168.11.11

AlPocketPC
(iPAQ 5555 PocketPC)

Parallel
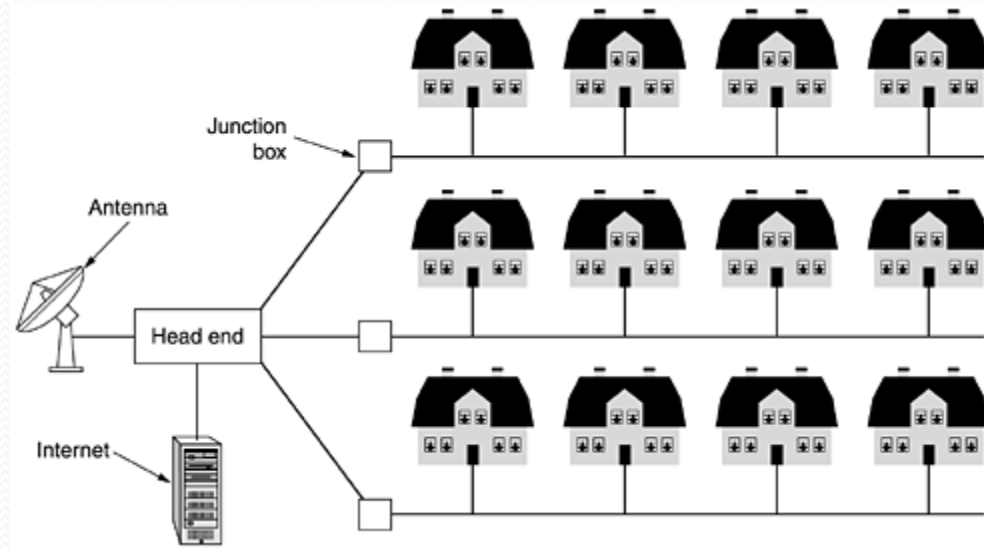
HP LaserJet 6L

Parallel

HP 7960

USB

Canon 1250 U2F

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Metropolitan Area Network (MAN)

✓ A **Metropolitan Area Network** (MAN) is a computer network covering a town or city.

✓ MANs are larger LANs in terms of geographic area covered.

✓ MANs use high speed connections using coaxial cable and microwave links.

✓ Best example of MAN is Cable Television network in many cities.

✓ MAN is formed by connections several LANs which may belong to various organizations.

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Metropolitan Area Network (MAN)

Wide Area Network (WAN)

- ✓ A **Wide Area Network (WAN)** is a computer network covering a very large geographic area, like a country or continent.

- ✓ WAN uses very high speed communication links like satellite communication, telephone lines and microwave links.

- ✓ The cost of sending data in a WAN may be very high because public communication systems such as telephone lines, microwave links or satellite communication are used.

- ✓ The largest WAN in existence is the Internet.

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LAN, MAN & WAN

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

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