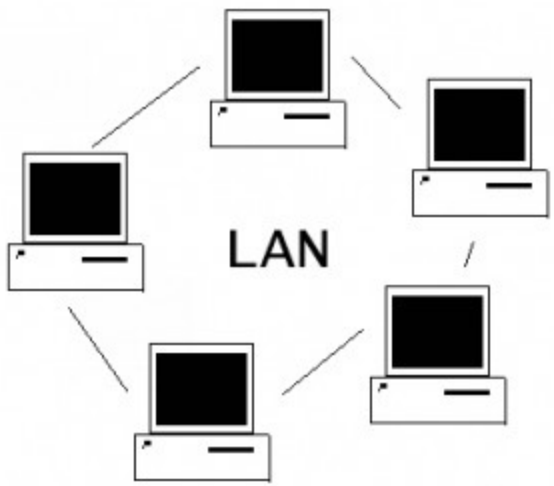
TYPES OF NETWORK

- There are three main types of network :
  - **LAN**
  - **MAN**
  - **WAN**

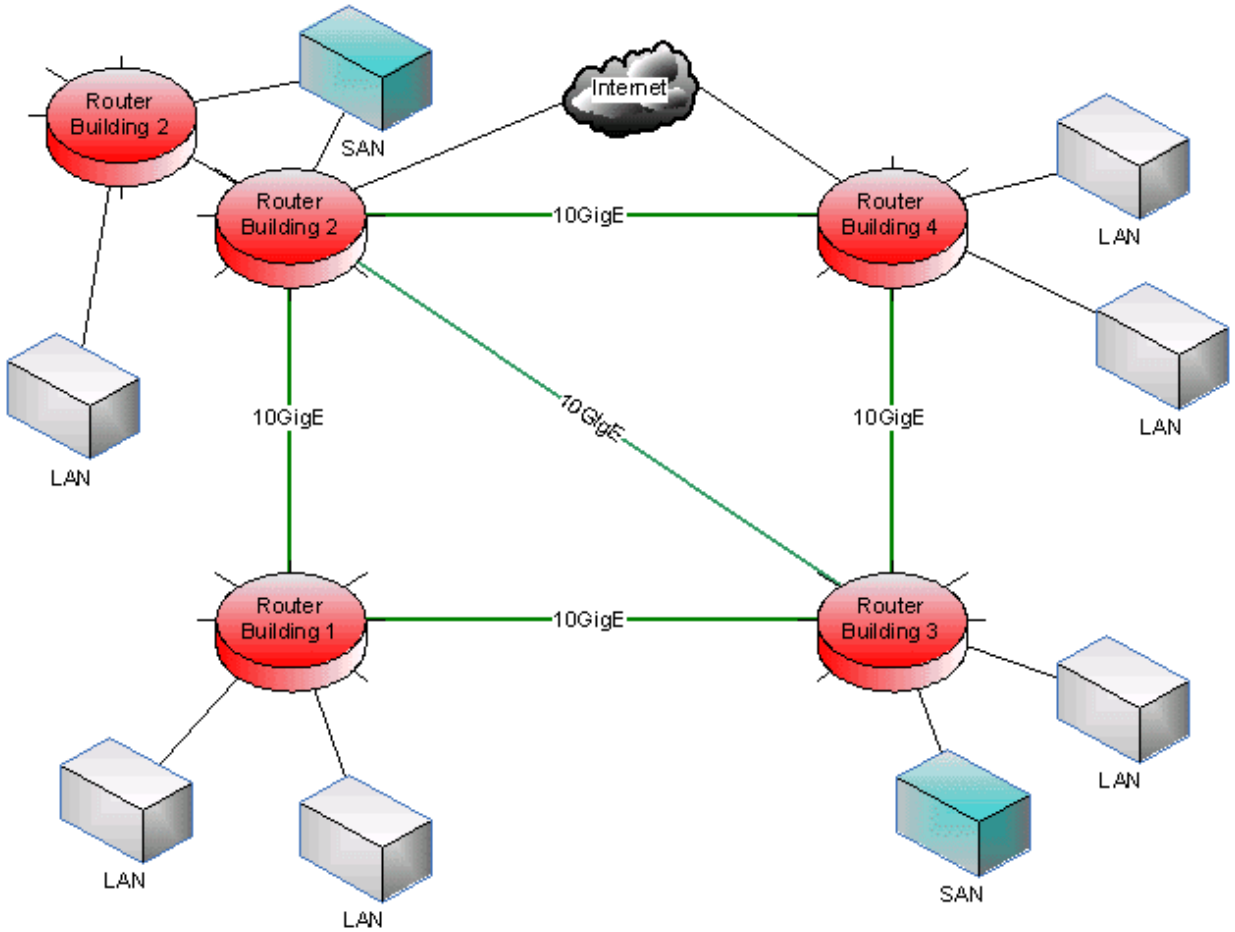
- **LOCAL AREA NETWORK (LAN) :**
  - **Definition: "**A network which is located entirely on one site such as an office, school or within a group of buildings that are in close area, that are connected together."



Metropolitan Area Network

- A **metropolitan area network** (**MAN**) is a computer network that usually spans a city or a large campus. A MAN usually interconnects a number of local area networks (LANs) using a high-capacity backbone technology, such as fiber-optical links, and provides up-link services to wide area networks (or WAN) and the Internet.

Diagram of MAN



WIDE AREA NETWORK (WAN) :

"A network which connects together computers on a number of sites in different areas".

A WAN or Wide Area Network is a group of widely dispersed computers that are connected together. These could be across the same town, or across a country or even across the world".

Apart from distance, the other feature that distinguishes as WAN from a LAN is that the WAN would make use of a range of communication technologies such as telephone, microwave and satellite links.

Using a WAN, schools in Florida can communicate with places like Tokyo in a matter of minutes, without paying enormous phone bills. A WAN is complicated

History of Computer Network

- In the 1960's Computers from different manufactures were unable to communicate with one another.
- The advanced Research Project Agency (ARPA) in the Department of Defense (DOD) has taken interest in connecting computers so that the computers can communicate with one another.
- In 1967 ARPA came up with its ideas for ARPANET a small network of connected computers.

- In 1969 the ARPANET has become a reality. Software called Network Control protocol (NCP) provided communication between host.
- In 1972 two core members of the ARPANET group collaborated on a project called Internetting project, and in 1973 they outlined the protocols for the end-to-end delivery of packets (Transmission control protocol: TCP).
- Later the authorities decided to split TCP into two protocols: Transmission control protocol (TCP) and Internet Protocol(IP).

Advantages of Networking

1. Peripherals such as printers can be shared amongst many different users.
2. Terminals are cheaper than standalone PCs.
3. Software can be shared amongst different users.
4. Communication across the network is cheap and fast.

Disadvantages of Networking

1. Cabling can be expensive to install and replace.
2. A fault with the server will prevent the whole network from working.
3. Security measures are needed to restrict access to the network.
4. WANs are vulnerable to hackers and viruses.

Network Components

- The following list explains some of these parts:
- ***Server: powerful computer that provides services to the other computers on the network.***
- ***Client: computer that uses the services that a server provides. The client is usually less powerful than the server.***
- ***Peer: A computer that acts as both a client and server.***
- ***Media: physical connection between the devices on a network.***
- ***Resources: anything available to a client on a network is considered resource printers; data, fax devices and other networked and information are resources.***
- ***User: any person that uses a client to access resources on the network.***
- ***Protocol: protocols are written rules used for communications, they are the languages that computer uses to talk to each other over a network.***

End of 1st Lecture

COMPUTER NETWORKS

LECTURE-2

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Basic Network Terminologies.

- Data
- Data rate
- Baud rate
- Peak data rate.
- Bursty data.

Data

- The Collection of raw facts and figure is called data.
- Data can be either
  - Alphabetic (A-Z, a-z)
  - Numeric (0,1,2,3,4,5,6,7,8,9)
  - Alphanumeric data (A1, alpha23)

DATA RATE/BIT RATE

- Definition of: data rate

  (1) The speed at which data is transferred within the computer or between a peripheral device and the computer, measured in bytes per second.

  (2) The speed at which audio and video files are encoded (compressed), measured in bits per second

  (3) The transmission speed of a network. For example, 100Base-T Ethernet is rated at 100 Mbps (megabits per second). Also called "bit rate”

Data rate (continue)

- In telecommunications and computing, **bit** is the number of bits that are conveyed or processed per unit of time.
- The bit rate is quantified using the bits per second (**bit/s**) unit, often in conjunction with an System International prefix such as
  - kilo- (kbit/s), mega- (Mbit/s), giga- (Gbit/s) or tera- (Tbit/s).

Baud rate

- Baud rate refers to the number of signal or symbol changes that occur per second. A symbol is one of several voltage, frequency, or phase changes.
- Baud is used to measure the rate of electrical signals, or "signaling elements," for modems, networks, serial cables, and other data transfer mediums. .

Peak data rate

- The maximum data rate of the traffic.
- The maximum data rate that a user can attain from a network is called peak data rate.

Bursty data.

- It Refers to data that is transferred or transmitted in short, uneven spurts.
- LAN traffic is typically bursty.
- Any relatively high-bandwidth transmission over a short period.
- For example, a download might use 2 Mbit/s on average, while having "peaks" bursting up to, say, 2.4 Mbit/s.
- Transmission that combines a very high data signaling rate with very short transmission times - i.e., the message is compressed.

End of 2nd Lecture

COMPUTER NETWORKS

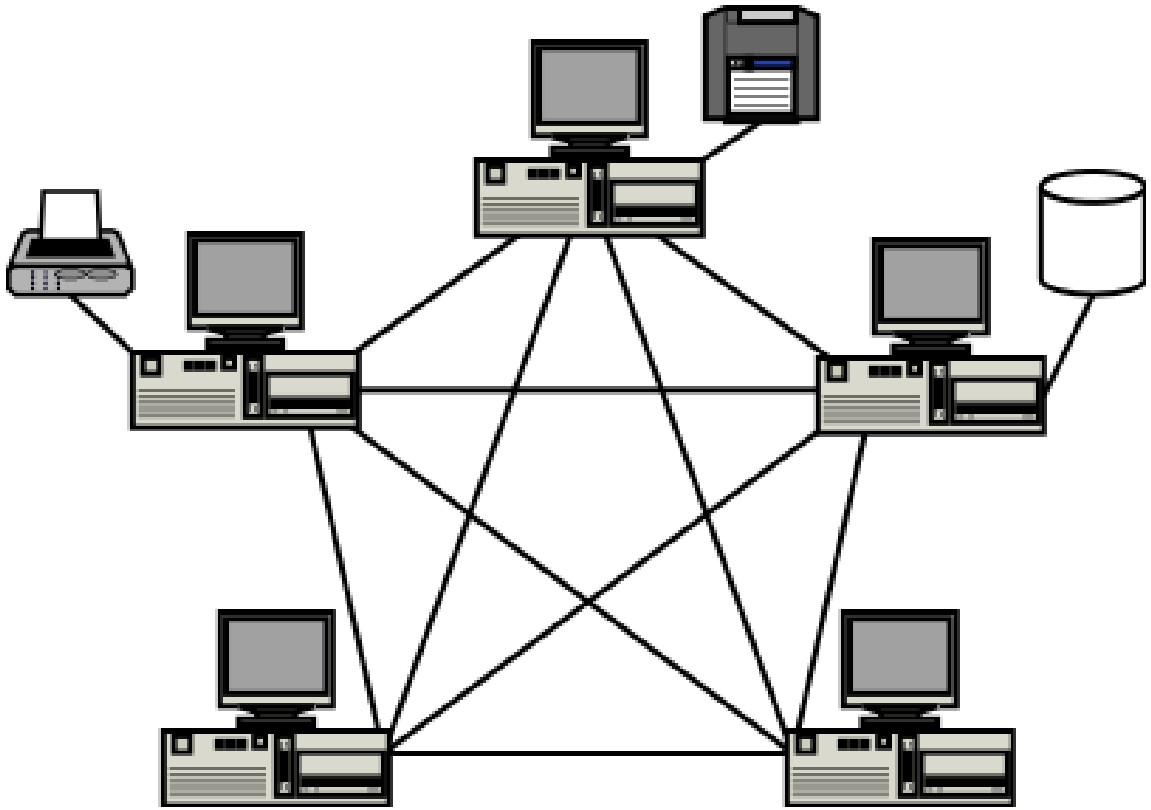
LECTURE-3

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Peer-to-peer Network

- A **peer-to-peer** (abbreviated to **P2P**) computer network is one in which each computer in the network can act as a client or server for the other computers in the network, allowing shared access to various resources such as files, peripherals, and sensors without the need for a central server.
- P2P networks can be set up within the home, a business, or over the Internet.
- Each network type requires all computers in the network to use the same or a compatible program to connect to each other and access files and other resources found on the other computer.
- P2P networks can be used for sharing content such as audio, video, data, or anything in digital format

Peer to Peer Network

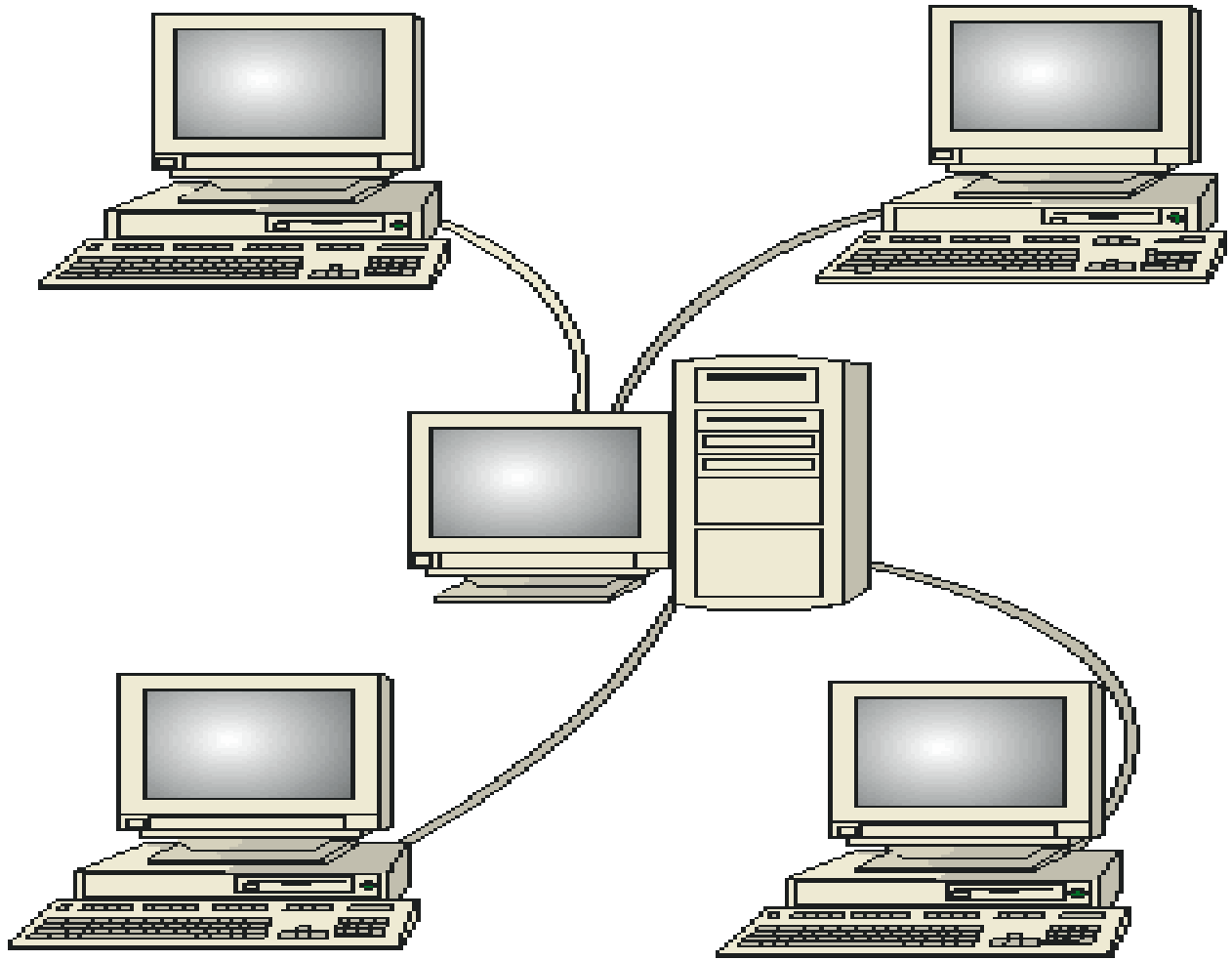


Server Based Network

- In a server-based network, the server is the central location where users share and access network resources.
- This dedicated computer controls the level of access that users have to shared resources.
- Shared data is in one location, making it easy to back up critical business information.

- Each computer that connects to the network is called a client computer.
- In a server-based network, users have one user account and password to log on to the server and to access shared resources.
- Server operating systems are designed to handle the load when multiple client computers access server-based resources.

Server based Network



Peer-to-peer Network Vs Server basic Network

- **Peer to Peer Network**
- A network is either a peer-to-peer network (also called a workgroup) or a server-based network (also called a client/server network).
- In a peer-to-peer network a group of computers is connected together so that users can share resources and information.
- There is no central location for authenticating users, storing files, or accessing resources.
- This means that users must remember which computers in the workgroup have the shared resource or information that they want to access.
- It also means that users must log on to each computer to access the shared resources on that computer.

Continue

- In most peer-to-peer networks, it is difficult for users to track where information is located because data is generally stored on multiple computers.
- This makes it difficult to back up critical business information, and it often results in small businesses not completing backups.
- Often, there are multiple versions of the same file on different computers in the workgroup.

Continue

- In some peer-to-peer networks, the small business uses one computer that is running a client operating system, such as Microsoft Windows 98 or Windows XP Professional, as the designated "server" for the network.
- Although this helps with saving data in a central location, it does not provide a robust solution for many of the needs of a small business, such as collaborating on documents.

- **Server-based network**
- In a server-based network, the server is the central location where users share and access network resources .
- This dedicated computer controls the level of access that users have to shared resources.
- Shared data is in one location, making it easy to back up critical business information.
- Each computer that connects to the network is called a client computer.
- In a server-based network, users have one user account and password to log on to the server and to access shared resources.

Continue

- Server operating systems are designed to handle the load when multiple client computers access server-based resources.
- Windows SBS 2003 is installed and configured as the central server on a server-based network.
- Windows SBS 2003 provides the central point for authenticating users, accessing resources, and storing information.

End of 3RD Lecture

COMPUTER NETWORKS

LECTURE-4

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Networking Topologies

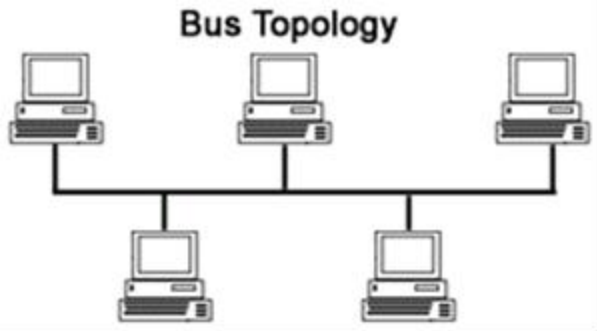
- Mesh,
- Bus,
- Star,
- Ring,
- Hybrid

NETWORK TOPOLOGY

- Network topology refers to the **layout** used to wire the computers together.
- **TYPES OF TOPOLOGY**
- There are five main topologies that are used.
  - Mesh,
  - Bus,
  - Star,
  - Ring,
  - Hybrid

BUS TOPOLOGY

- Each computer is connected to a single cable which connects all of the computers. All nodes (file server, workstations, and peripherals) are connected to the linear cable.

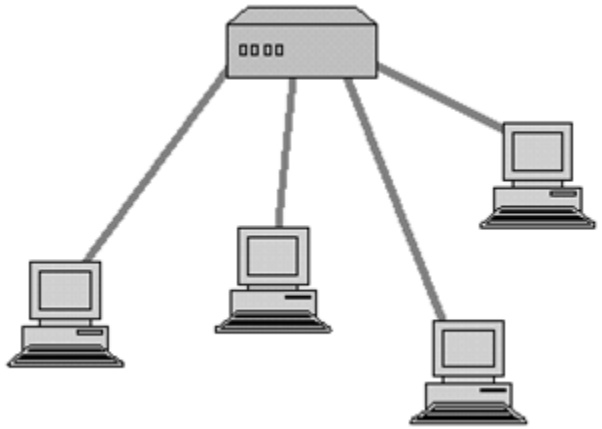


- **Advantages of Bus Topology**
  - Easy to connect a computer or peripheral to a linear bus.
  - Requires less cable length than a star topology.
- **Disadvantages of a Bus Topology**
  - Entire network shuts down if there is a break in the main cable.
  - Terminators are required at both ends of the backbone cable.
  - Difficult to identify the problem if the entire network shuts down.

STAR TOPOLOGY

- “All communication takes place via a central computer or **HUB** device.”
- A star topology is designed with each node connected directly to a central network hub, switch, or concentrator.
- Data on a star network passes through the hub, switch before continuing to its destination. The hub, switch, or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow.

Diagram of Star Topology



- **Advantages of a Star Topology**

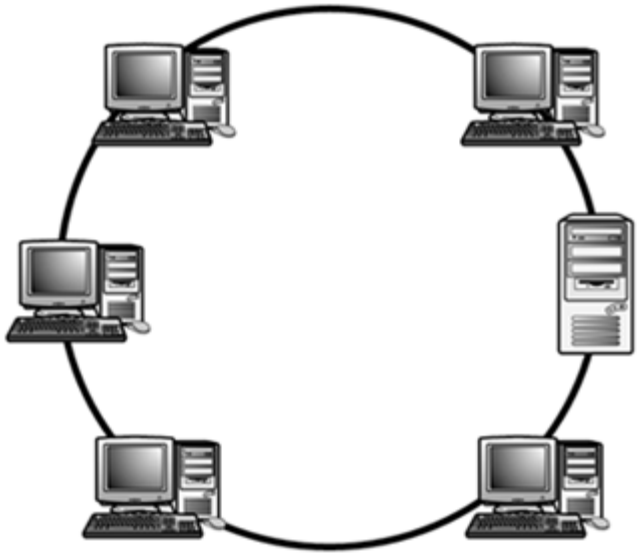
  - Easy to install and wire.
  - No disruptions to the network then connecting or removing devices.
  - Easy to detect faults and to remove parts.

  Disadvantages of a Star Topology

  - Requires more cable length than a linear topology.
  - If the hub or concentrator fails, nodes attached are disabled.
  - More expensive than bus topologies because of the cost of the HUB device.

RING TOPOLOGY

- Each computer is connected to the two computers on either side of it. The last computer is linked to the first to form a ring.



- **Advantages of a Ring Topology**
  - Easy to install and wire.
  - Equal Access to devices no one computer will use all the bandwidth
  - Easy to detect faults and to remove parts.

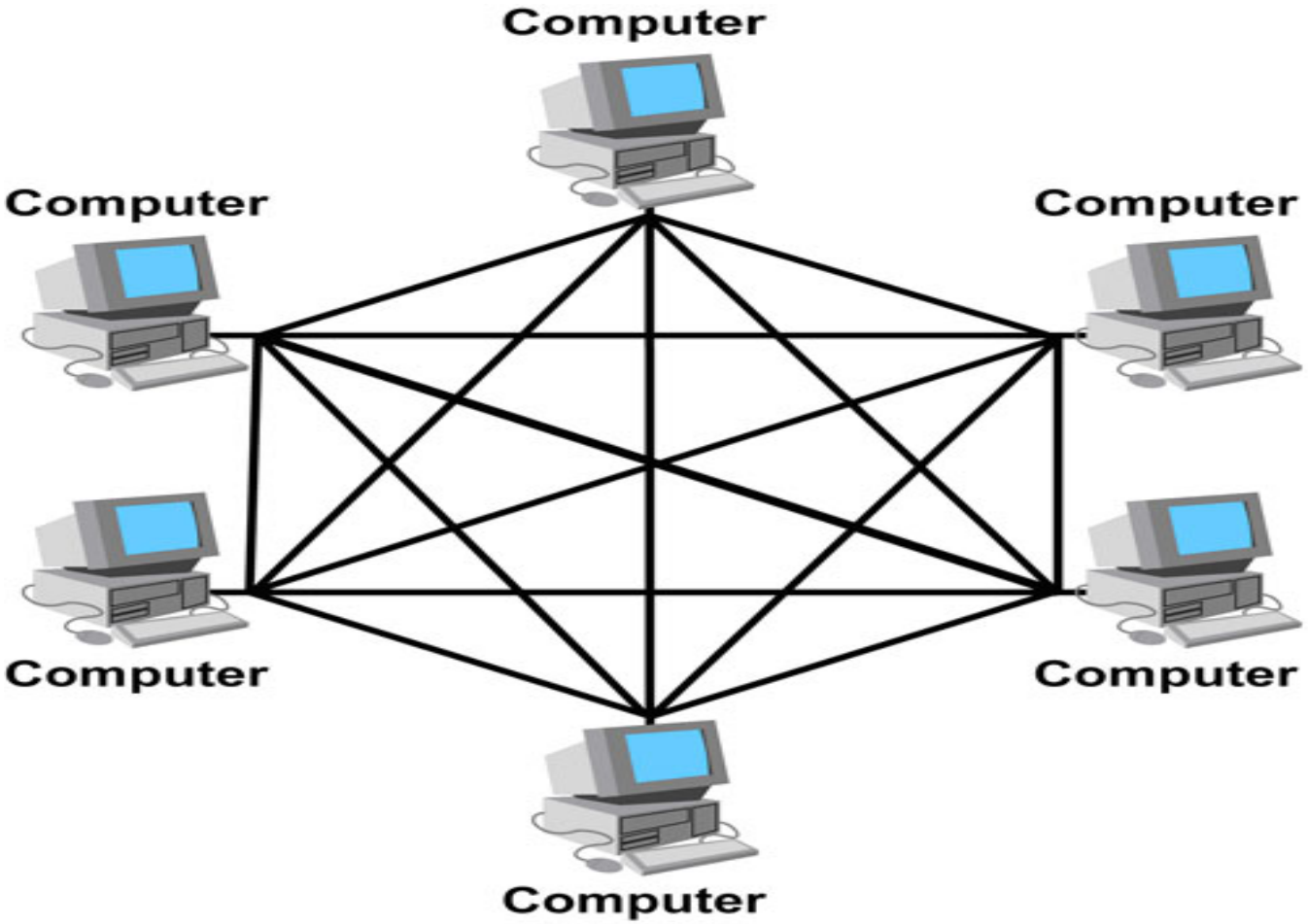
Disadvantages of a Ring Topology

- Slow since signals goes in sequential order
- If the concentrator fails, nodes attached are disabled.
- Single break in cable can disrupt the flow of network.

What is Mesh Topology?

- In a mesh network topology, each of the network node, computer and other devices, are interconnected with one another.
- Every node not only sends its own signals but also relays data from other nodes.
- In fact a true mesh topology is the one where every node is connected to every other node in the network.
- This type of topology is very expensive as there are many redundant connections, thus it is not mostly used in computer networks.
- It is commonly used in wireless networks. Flooding or routing technique is used in mesh topology.

Mesh Topology Diagram



Advantages of Mesh topology

- **1)** Data can be transmitted from different devices simultaneously.
  2) Even if one of the components fails there is always an alternative present. So data transfer doesn't get affected.
  3) Expansion and modification in topology can be done without disrupting other nodes.

Disadvantages of Mesh topology

- **1)** There are high chances of redundancy in many of the network connections.
  2) Overall cost of this network is way too high as compared to other network topologies.
  3) Set-up and maintenance of this topology is very difficult. Even administration of the network is tough.

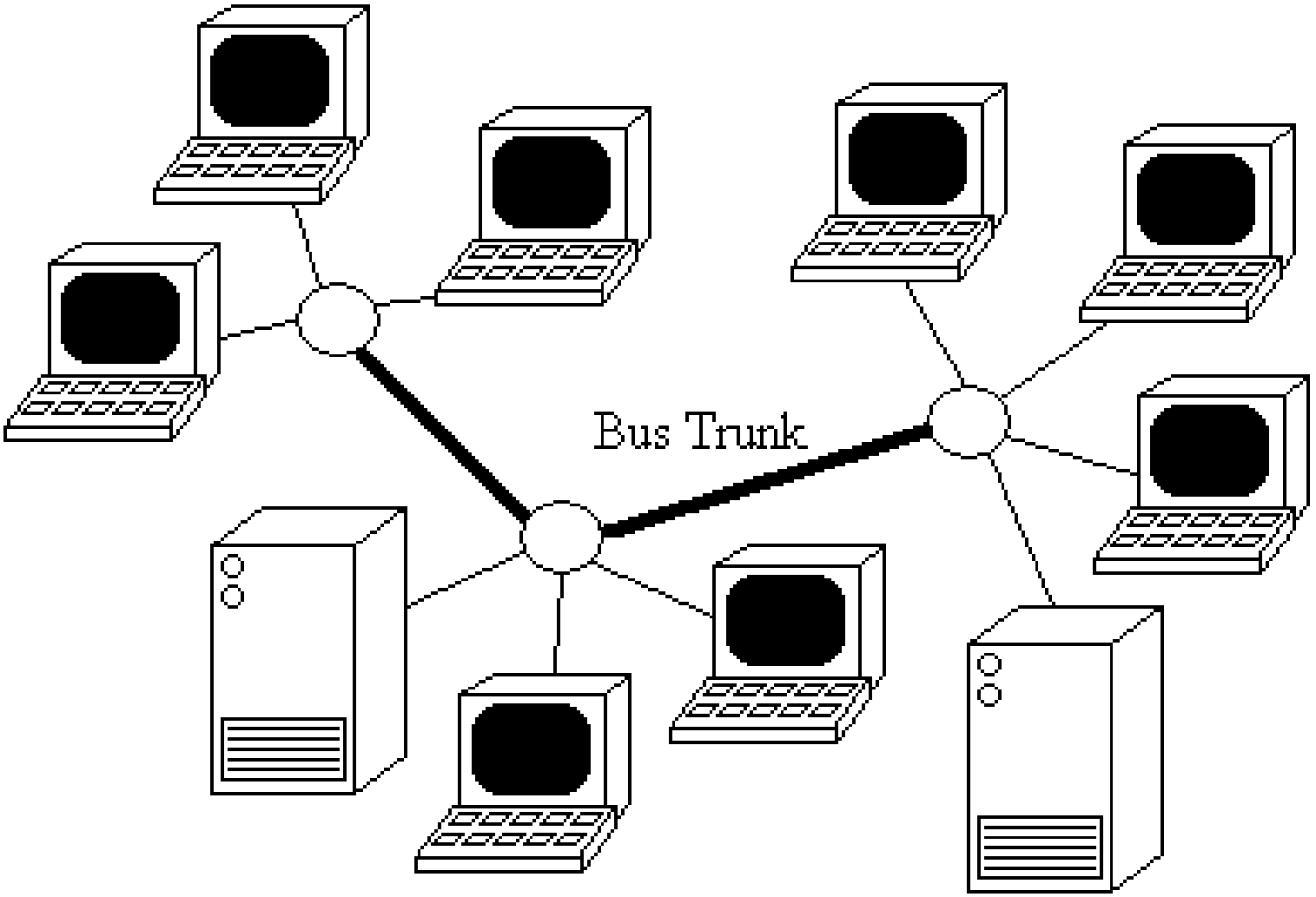
What is Hybrid Topology ?

- In this type of topology we integrate two or more different topologies to form a resultant topology which has good points(as well as weaknesses) of all the constituent basic topologies rather than having characteristics of one specific topology.
- This combination of topologies is done according to the requirements of the organization.

Continue

- 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. Remember connecting two similar topologies cannot be termed as Hybrid topology. Star-Ring and Star-Bus networks are most common examples of hybrid network

Hybrid Topology



Advantages of Hybrid Network Topology

- 1) **Reliable :** Unlike other networks, fault detection and troubleshooting is easy in this type of topology. The part in which fault is detected can be isolated from the rest of network and required corrective measures can be taken, WITHOUT affecting the functioning of rest of the network.
  2) **Scalable:** Its easy to increase the size of network by adding new components, without disturbing existing architecture.
  3) **Flexible:** Hybrid Network can be designed according to the requirements of the organization and by optimizing the available resources. Special care can be given to nodes where traffic is high as well as where chances of fault are high.
  4) **Effective:** Hybrid topology is the combination of two or more topologies, so we can design it in such a way that strengths of constituent topologies are maximized while there weaknesses are neutralized. For example we saw Ring Topology has good data reliability (achieved by use of tokens) and Star topology has high tolerance capability (as each node is not directly connected to other but through central device), so these two can be used effectively in hybrid star-ring topology.

Disadvantages of Hybrid Topology

- 1) **Complexity of Design:** One of the biggest drawback of hybrid topology is its design. Its not easy to design this type of architecture and its a tough job for designers. Configuration and installation process needs to be very efficient.
  2) **Costly Hub:** The hubs used to connect two distinct networks, are very expensive. These hubs are different from usual hubs as they need to be intelligent enough to work with different architectures and should be function even if a part of network is down.
  3) **Costly Infrastructure:** As hybrid architectures are usually larger in scale, they require a lot of cables, cooling systems, sophisticate network devices, etc.

End of 4TH Lecture

COMPUTER NETWORKS

LECTURE-5

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Networking Devices

- Node
- NIC
- Modem
- Access point
- Hub (active Hub, Passive Hub)
- Bridge
- Switch
- Router

Computer Networks
Lecture 5

Diploma in Information Technology

By
Fazal Mabood
Mobile No: 0301-5540084

Node

- In communication networks, a **node** is a connection point, either a redistribution point or a communication endpoint
- In data communication, a physical network node may either be a data circuit-terminating equipment (DCE) such as a modem, hub, bridge or switch; or a data terminal equipment (DTE) such as a digital telephone handset, a printer or a host computer, for example a router, a workstation or a server.

NIC

- NIC Stands for Network Interface Card.
- **Definition:** In computer networking, a **NIC** provides the hardware interface between a computer and a network. A NIC technically is network adapter hardware in the form of a PCI card.

- Some NIC cards work with wired connections while others are wireless. Most NICs support either wired Ethernet or Wi-Fi wireless standards.
- Ethernet NICs plug into the system bus of the PC and include jacks for network cables, while WiFi NICs contain built-in transmitters / receivers (transceivers).

NIC CARD

WHAT IS MODEM?

- Modem Stands for Modulation and Demodulation.
- A device which convert Analog signals to digital signals and digital signals to Analog for transmitting data over internet.
- ***There are three types of modem.***

- ***External :***
  - It is that type of Modem which is placed outside the CPU. It can be attached to the PC externally through a serial or USB port. As shown in the figure.

- ***Internal:***
  - It is that type of Modem which is installed and present inside a CPU. An internal modem is installed like any other expansion card — into a compatible expansion slot. As shown in the figure.

Access point

- An Access Point is a Wi-Fi wireless networking radio transceiver that allows an appropriately equipped computer or other wireless client device (phone, camera, barcode scanner etc.), to connect to a data network.
- The resulting connection functions exactly like a wired Ethernet connection.
- The WAP (Wireless Access Points) acts as a bridge between your existing wired network and your wireless equipped computers.

Wireless Access points

- Wireless **access points** (APs or WAPs) are specially configured nodes on wireless local area networks (WLANs).
- Access points act as a central transmitter and receiver of WLAN radio signals.
- Access points used in home or small business networks are generally small, dedicated hardware devices featuring a built-in network adapter, antenna, and radio transmitter.
- Access points support Wi-Fi wireless communication standards.

Wireless AP's

HUB

- An **Ethernet hub**, **active hub**, **network hub**, **repeater hub**, **multiport repeater** or **hub** is a device for connecting multiple Ethernet devices together and making them act as a single network segment.
- It has multiple input/output (I/O) ports, in which a signal introduced at the input of any port appears at the output of every port except the original incoming.
- A hub works at the physical layer (layer 1) of the OSI model.

Active HUBS

- Active hubs are a little smarter than the passive hubs.
- Active hubs regenerate the signals and also perform network management
- These hubs usually come in configurations of 4, 8, 16 and 24 ports, providing link & activity leds (lights) to show which devices are currently connected, powered on and transmitting or receiving data.
- All Ethernet hubs are active hubs.

Passive Hubs

- These hubs are nothing more than point contacts for the wires that make up the physical network.
- A passive HUB simply combines the signal of network. There is no regeneration of signals with a passive hub; each computer receives the signal sent from the other entire computer connected to the HUB.

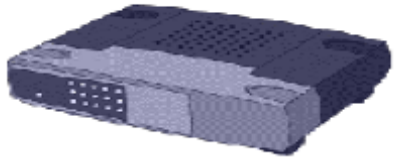
Smart or Intelligent Hubs

- Smart hubs are similar to the previous Active ones we saw, but in addition contain some type of management software to help determine possible network problems and isolate them.
- The management software loaded uses protocols such as SNMP (Simple Network Management Protocol) to communicate with various network devices and obtain real time statistics such as throughput, bandwidth, uptime, routing tables and more.
- An intelligent HUB only chooses the part of the device where the signal needs to go. Rather than sending the signal along all paths

Bridge

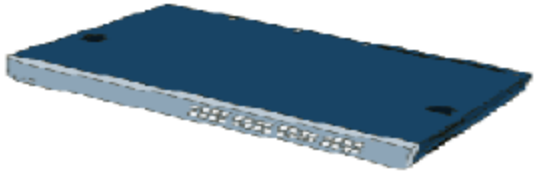
- A network bridge is software or hardware that connects two or more networks so that they can communicate. we can create only one network bridge on a computer, but one bridge can handle any number of network connections.
- we should not create a bridge between an Internet connection and a network connection because it creates an unprotected link between your network and the Internet, which makes your network accessible to anyone on the Internet.

Switch



- **Definition:** A **network switch** is a small hardware device that joins multiple computers together within one local area network (LAN).
- Network switches operate at layer two (Data Link Layer) of the OSI model.
- Network switches appear nearly identical to network hubs, but a switch generally contains more intelligence than a hub.
- Unlike hubs, network switches are capable of inspecting data packets as they are received, determining the source and destination device of each packet, and forwarding them appropriately.
- By delivering messages only to the connected device intended, a network switch conserves network bandwidth and offers generally better performance than a hub.

Router



- **Definition: Routers** are small physical devices that join multiple networks together.
- Routers are devices that connect two or more networks. They consist of hard ware and software. There is a root table which consists of the logical and physical addresses of the computer. Routers may discards the packet if it cannot find the destination address in it routing table.
- Some routers allow a network administrator to update the routing table from a Web browser interface.
- Broadband routers combine the functions of a router with those of a network switch and a firewall in a single unit.

Repeaters:

- A repeater is a network device that operates only on the physical layers.
- A repeater receives a signal and, before it becomes too weak or corrupted, regenerated the original signal.
- The repeater translates it then sends the refreshed signal. We can use a repeater when difference in area is 500M,in a LAN when we use a repeater then it is called as a segment

Gateways:

- A gateway is a computer or electronic device that is connected to two different networks. And can move TCP/ IP data from one to the other.
- It is usually a dedicated computer.
- A gate way is a device that can interpret the different protocols that are used on two different networks.
- Gate way can be comprised of software and hardware or combination of both.

Brouters:

- A network interconnectivity device that can provide both bridge and router services.
- A brouter is a router that can also a bridge.
- A brouter first try to deliver the packet based on network protocol information. It bridges the packet using the physical address
- true routers simply discard a packet if it does not have a correct logical address.
- A brouter can have more different option by having both a router and bridge.

End of 5TH Lecture

COMPUTER NETWORKS

LECTURE-6

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Transmission media

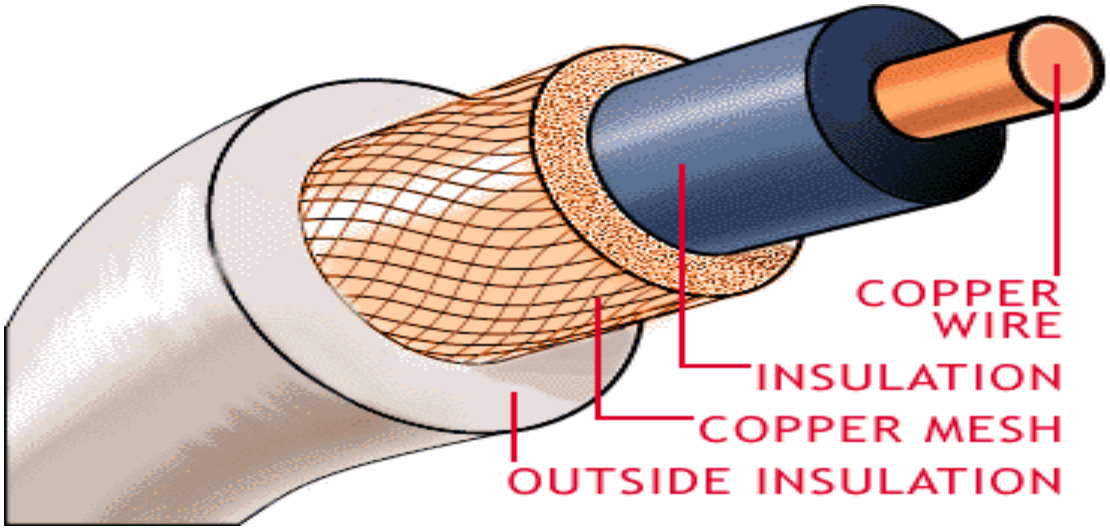
- Wired media
  - Coaxial cable (10 Base2 10 Base 5 10Base T, 100Base X)
  - Twisted pair cable
- Unshielded twisted- pair (Cat1,Cat 2, Cat 3, Cat 4, Cat 5, Cat 6,)
- Shielded twisted- pair
  - Fiber optic cable
- Wireless media
  - Reasons for wireless network
  - Wireless communication with LANs

Wired media

- Wired transmission media is media used to transfer information over a network, such as Twisted Pair cable. This is opposed to wireless transmission media which uses radio waves to transmit information.
- There are many types of wired transmission media such as coaxial cable, telephone lines, etc. Basically any form of wire used to transmit information over a network is considered a wired transmission media.

Coaxial Cable

- Coaxial cables are a type of cable that is used by cable TV and that is common for data communications.
- Taking a round cross-section of the cable, one would find a single center solid wire symmetrically surrounded by a braided or foil conductor.
- Between the center wire and foil is a insulating dialectric. This dialectric has a large affect on the fundamental characteristics of the cable.



- Data is transmitted through the center wire, while the outer braided layer serves as a line to ground. Both of these conductors are parallel and share the same axis. This is why the wire is called coaxial!

- 10Base2:
  - An Ethernet term meaning a maximum transfer rate of 10 Megabits per second that uses baseband signaling, with a coaxial cable segment length of 185 meters.
- 10Base5:
  - An Ethernet term meaning a maximum transfer rate of 10 Megabits per second that uses baseband signaling, with not exceeding 500 meters per segment, use coaxial cable.
- 10BaseT:
  - An Ethernet term meaning a maximum transfer rate of 10 Megabits per second that uses baseband signaling and twisted pair cabling and distance does not exceed 100 meters

Twisted pair

- **Twisted pair** cabling is a type of wiring in which two conductors of a single circuit are twisted together for the purposes of canceling out electromagnetic interference (EMI) from external sources; for instance, electromagnetic radiation from unshielded twisted pair (UTP) cables, and crosstalk between neighboring pairs.
- Twisted-pair cable uses one or more pairs of two copper wires to transmit signals. It is commonly used as telecommunications cable

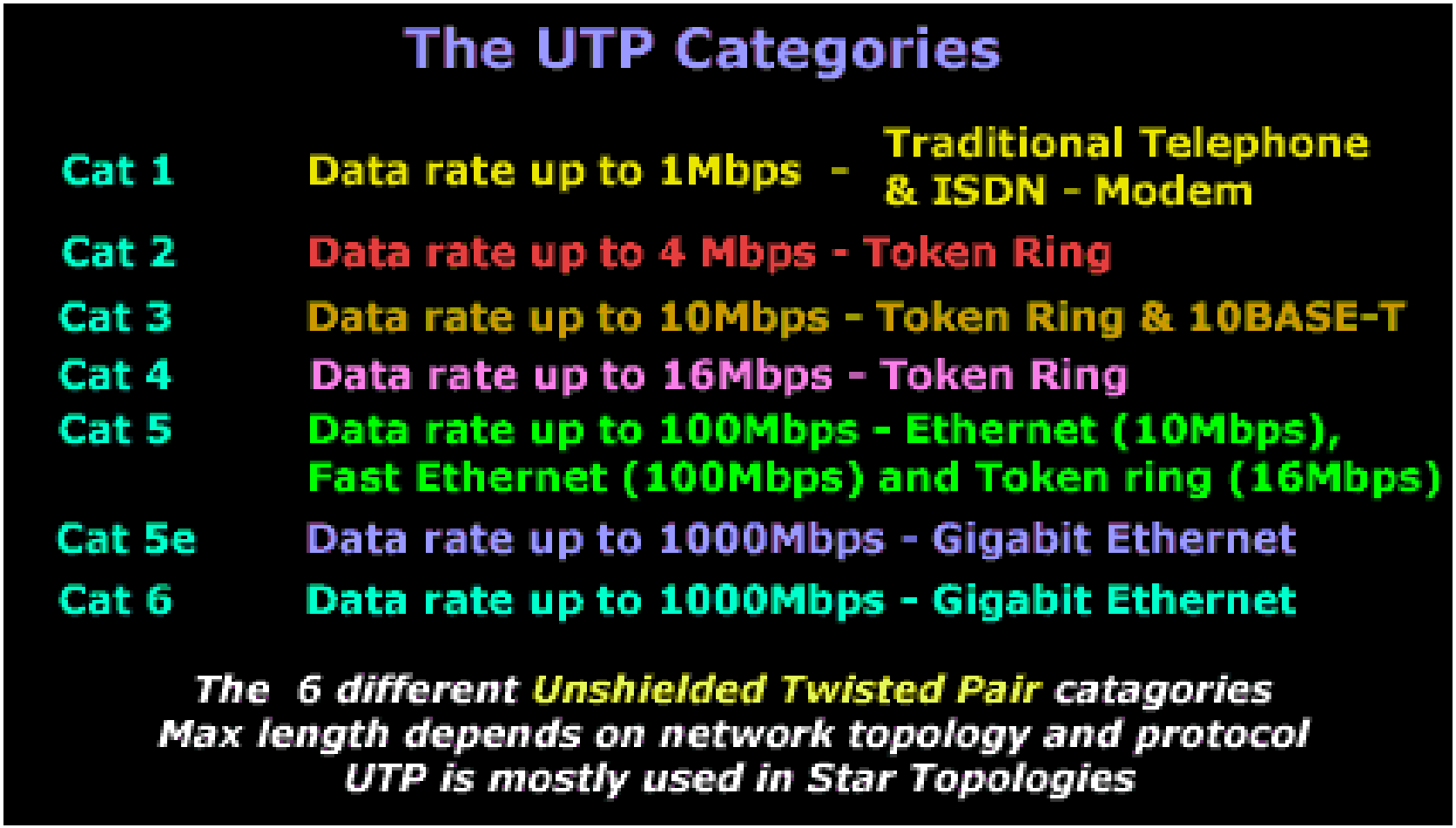
Unshielded twisted pair (UTP)

- UTP cable is also the most common cable used in computer networking.
- Modern Ethernet utilizes UTP cables. Twisted pair cabling is often used in data networks for short and medium length connections because of its relatively lower costs compared to optical fiber and coaxial cable.

Shielded twisted pair

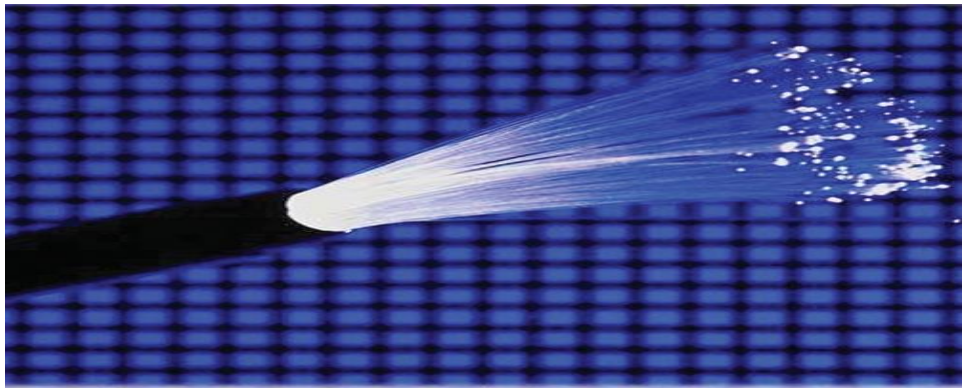
- Twisted pair cables are often shielded in an attempt to prevent electromagnetic interference. Because the shielding is made of metal, it may also serve as a ground.
- However, usually a shielded or a screened twisted pair cable has a special grounding wire added called a drain wire.
- This type of shielding protects cable from external EMI from entering or exiting the cable and also protects neighboring pairs from crosstalk.

Cat1,Cat 2, Cat 3, Cat 4, Cat 5, Cat 6,



Fiber Optics

- A technology that uses glass (or plastic) threads (fibers) to transmit data.
- A fiber optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages modulated into light waves.
- Fiber optics has several advantages over traditional metal communications lines.
- Fiber optic cables have a much greater bandwidth than metal cables. This means that they can carry more data.
- Fiber optic cables are less vulnerable than metal cables to interference.



The main disadvantage of fiber optics is that the cables are expensive to install.

Fiber optics is a particularly popular technology for local-area networks.

In addition, telephone companies are steadily replacing traditional telephone lines with fiber optic cables.

In the future, almost all communications will employ fiber optics.

End of 6TH Lecture

COMPUTER NETWORKS

LECTURE-7

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

Types of Connectors

- RJ45
- An RJ45 connector, also known as registered jack-45, is a modular connector using 8 conductors that is especially used for twisted pair Ethernet connections but also for ISDN-connections.
- Basically, it is one of the most common cables used for the communication between computers and peripherals.
- It is also used to connect your computer or laptop to a router or modem to form a local-area network or LAN.

- When we connect our registered jack to a modern switch, it will automatically detect what kind of cable is connected.
- If we want to use a RJ45 to connect to our network, it is recommended that we look up a picture of the registered jack to see the pin positions and colors in order to comprehend what is being said.
- For a network connection of 100 megabyte or less, only the 1st, 2nd, 3rd and 6th are of importance.
- For gigabit Ethernet connection, which is usually the case, all eight pins are being used.

- **RJ-11**
- It is more commonly known as a phone connector, phone jack or phone line, the RJ-11 is Short for Registered Jack-11, a four- or six-wire connector used primarily to connect telephone.
- RJ-11 connectors are also used to connect some types of local-area networks (LANs), although RJ-45 connectors are more common.
- This cable can also be used to connect your modem to the Internet it should not be confused with the RJ-45 connector, which is used with your network card.

- **BNC**
- BNC Short for Bayonet Neill Concelman connector, a type of connector used with coaxial cables such as the RG-58 A/U cable used with the 10Base-2 Ethernet system.
- The basic BNC connector is a male type mounted at each end of a cable. This connector has a center pin connected to the center cable conductor and a metal tube connected to the outer cable shield. A rotating ring outside the tube locks the cable to any female connector.
- A BNC barrel connector allows connecting two cables together.
- BNC connectors can also be used to connect some monitors, which increases the accuracy of the signals sent from the video adapter

End of 7TH Lecture

COMPUTER NETWORKS

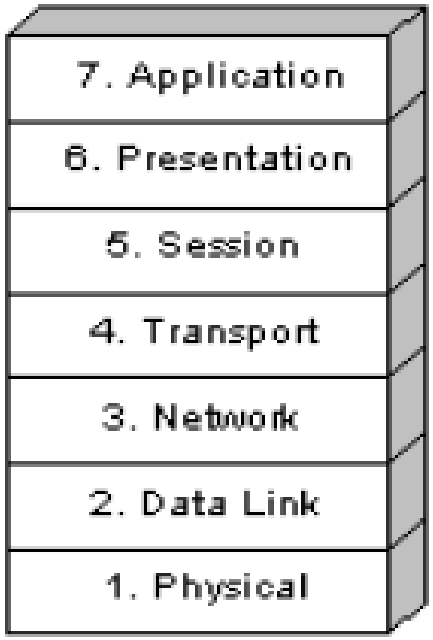
LECTURE-8

By
Mr. Fazal Mabood
Lecturer Computer Science/IT Expert
Mobile No: 0301-5540084
www.facebook.com/fazalmaboodsw

OSI Model (Open System Interconnection)

- The International Standardization Organization (ISO) begins developing the Open System Interconnection (OSI) model in 1977. The OSI model was released in 1984 by ISO. OSI attempts to define rules for the following issues.
  1. How network devices connect each other and if they help Different languages. How they communicate with each other.
  2. Methods to ensure that network transmissions transmit correctly and by the right receive.
  3. How the physical transmission Medias are arranged and connected etc.

- OSI model simply defines which tasks need to be done and which protocols will handle those tasks at each of the following seven Layers of the model.



Summary of Layers