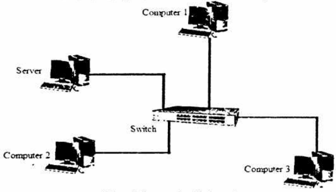
CHAPTER 5
COMPUTER NETWORKS

SHORT AND LONG QUESTIONS

Q.1 What is meant by computer network?

Ans: Computer Network:

A computer network can be defined as an interconnection of two or more computers to share data and other resources such as documents, printers and Internet connection. A small computer network is shown in Fig.



A Small Computer Network

For Your Information

Internet is a world-wide network that interconnects millions of computers and provides information and communication facilities.

Q.2 Define data transmission.

Ans: Data Transmission:

Data transmission is the process of sending data from one device to another. It consists of sender, receiver and the medium which carries the information.

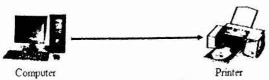
Q.3 List three modes of data transmission.

Ans: There are three modes of data transmission which are simplex, Half-duplex and Full-duplex.

Q.4 Write a note on simplex transmission mode.

Ans: Simplex Transmission Mode:

A simplex mode provides data transmission in only one direction. One end is the sender and the other is receiver as shown in Fig.



Transmission through simplex mode

Transmission of data/information from keyboard to CPU or from CPU to printer is always in one direction. Therefore, these are simplex transmissions. Radio and television broadcastings are also simplex transmissions.

Q.5 What is meant by network architecture?

Ans: Network Architecture:

Network architecture refers to layout of network that consists of computers, communication devices, software, wired or wireless transmission of data and connectivity between components.

A computer network can be as small as two computers linked together by a single cable whereas large networks connect thousands of computers and other devices.

Q.6 List three types of network architecture.

Ans: Types of Network Architectures:

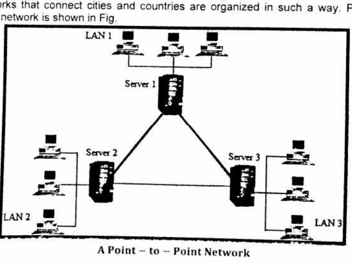
Three types of network architectures are commonly used which are:

i. Client/server network **ii.** Peer-to-peer network
iii. Point-to-point network

Q.7 Write a note on Point-to-Point networks.

Ans: Point-to-Point Networks:

It is a type of network in which a message is sent from one computer to another via other computers in the network. Large networks such as wide area networks that connect cities and countries are organized in such a way. Point-to-Point network is shown in Fig.



A Point – to – Point Network

Characteristics of Point-to-Point Networks:

i) Point-to-Point networks are generally used for long distance communication.
ii) There may be different paths for transmission of information.

Q.8 What is meant by communication over network?

Ans: Communication over Networks:

Communication over network refers to transmission of data/information from one computer to another through a communication medium.

Q.9 Write a note on communication via telephone networks.

Ans: Communication via Telephone Networks:

Telephone network is now commonly used for data communications. The main reason for using telephone network is that it exists all over the world.

Types of communication lines are provided via telephone networks:

Following four types of communication lines are provided via telephone networks.

- Dial-up line
- Digital Subscriber Line (DSL)
- Integrated Services Digital Network (ISDN) lines
- Code Division Multiple Access (CDMA)

Q.10 Explain different types of modem which are commonly used.

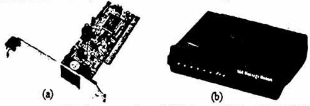
Ans: Types of Modems:

There are three types of modem which are commonly used. These are Dial-up modem, DSL modem and ISDN modem.

Dial-up Modem:

A Dial-up modem is required for Dial-up Internet connection. It is the short form of **MODulator/DEModulator**.

Modem accepts digital data from the computer in the form of two-level signals and converts them into analog signals for transmission over the telephone line. This process is called modulation. A second modem at the receiving end is used to convert the analog signals back to digital form which is called demodulation. Dial-up modems are shown in Fig.



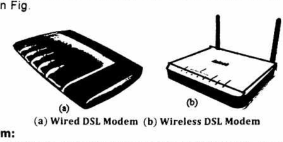
(a) Internal Dial – up modem (b) External Dial – up modem

DSL Modem:

A DSL modem is used to connect microcomputers to high-speed DSL connections. It is designed to provide high-speed Internet access.

ADSL modem is an external device that connects to a computer via USB or Ethernet port. These ports are usually available at the back of system unit. Wireless DSL modems are also available for connecting laptop and other wireless devices such as mobile phones to Internet.

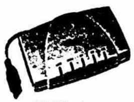
DSL modem converts the digital signals into analog high frequency signals that are carried by the telephone lines and vice versa. DSL modems are shown in Fig.



(a) Wired DSL Modem (b) Wireless DSL Modem

ISDN Modem:

ISDN modem is a device that converts digital signals used in computers to the signals that can be transmitted over the ISDN lines. It provides both voice and data transmission on a single line at the same time. ISDN modem is shown in Fig.



ISDN Modem

Q.11 Compare data communication lines on the basis of transfer rate, cost per month, advantages and disadvantages.

Ans: Comparison between Data Communication Lines:

Dial-up Line:

- Maximum speed is 56 Kbps.
- Easily available anywhere, no extra lines required.
- Cheaper than other Internet services.
- Internet connection is not permanently available.
- Voice communication is not possible while using Internet.

DSL (Digital Subscriber Line):

- Typical speed is 256Kbps or above.
- DSL connection is always available.
- Telephonic conversation and Internet access are available simultaneously.
- Costly than other types of Internet services.
- Various monthly rates are charged depending on the speed.
- Connection is available as soon as computer and DSL modem are turned on.

ISDN (Integrated Services Digital Network):

- Maximum communication speed is 128 Kbps.
- Costs more than Dial-up service.
- Can simultaneously transmit both voice and data.

- Allows multiple devices to share a single line.

CDMA (Code Division Multiple Access):

- It is a wireless cellular communication technology.
- Transmission speed can be up to a several Mbps.
- Can provide service to many people at the same time.
- Provides improved voice quality.

KEY POINTS

- A computer network is an interconnection between computers and devices to provide facilities among users to exchange information and resources such as printer, hard disk, Internet, etc.
- Simplex transmission mode provides data transmission in only one direction.
- Half-duplex transmission mode can send and receive data in both directions but not simultaneously.
- Full-duplex transmission mode provides data transmission in both directions at the same time.
- A computer that shares resources for others to use on a network is known as a server.
- A computer that accesses the resources shared by other computers on a network is known as a client.
- In a client/server network, each computer in the network acts as either a server or a client. Server cannot be used as client computer and client computer cannot act as server.
- In peer-to-peer network, all the computers have the same status. Every computer is capable of playing the role of client, server or both as the same time.
- Point-to-Point network is a type of network in which when a message is sent from one computer to another, it usually has to be sent via other computers in the network.
- Local Area Network (LAN) covers a limited area, usually ranging from a small office to a campus of nearby buildings.
- Wide Area Network (WAN) spans a large area, connecting several locations of an organization across cities, countries and continents.
- Metropolitan Area Network (MAN) falls between LAN and WAN. It spans area larger than a LAN but smaller than a WAN, such as a city.
- The physical arrangement of network nodes is known as network topology.
- Bus topology consists of a single central cable known as bus. All the devices are connected to the bus along its length to communicate with each other.
- Ring topology is shaped just like a ring. It is like a bus with both ends connected together.
- In star topology, all the nodes are connected to a central device called switch or hub.
- In mesh topology, all the network nodes are connected to all the other nodes.

- Dial-up modem is a communication device that converts digital signals to analog signals for transmission over telephone line. The analog signals are converted back to digital signals by the modem attached to computer at the receiving end.
- DSL modem is a communication device that provides high-speed connection to Internet.
- ISDN modem is a device that converts digital signals used in computers to the signals that can be transmitted over the ISDN lines.

EXERCISE

Q1. Select the best answer for the following MCQs.

i. In which of the following transmission mode, information is transmitted in both directions but not simultaneously?

A. Simplex mode　B. Half-duplex mode
C. Full-duplex mode　D. High speed mode

ii. In which of the following network, every computer can act as client, server or both at the same time?

A. Client/server network　B. Peer-to-peer network
B Point-to-Point network　D. Local area network

iii. Which of the following network provides centralized security?

A. Client/server network　B. Peer-to-peer
C. Point-to-Point network　D. Local area network

iv. Which of the following computer shares resources on a network for others to use?

A. Desktop computer　B Client
C. Server　D. Microcomputer

v. Which of the following topology is most expensive to implement?

A. Star　B. Bus
C. Ring　D. Mesh

vi. In which of the following network topology, switch is required?

A. Star　B. Bus
C. Ring　D. Mesh

vii. Which of the following network is used to provide Cable TV and Internet services?

A. Local area network　B. Wide area network
C. Metropolitan area network　D. Point-to-Point network

viii. Which of the following provides high speed Internet connection?

A. Dial-up connection　B. DSL connection
C. ISDN connection　D. CDMA connection

ix. Which of the following network connects computers across cities, countries and continents?

A. Local area network　B. Wide area network
C Metropolitan area network　D. Client/Server network

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A. Local area network B. Wide area network
C. Metropolitan area network D. Client/Server network

x. Which of the following network topology uses a device called terminator?

A. Ring topology B. Mesh topology
C. Bus topology D. Star topology

Answers

i. B	ii. B	iii. A	iv. C	v. D
vi. A	vii. C	viii. B	ix. B	x. C

Q2. Write short answers of the following questions.

i. Describe any three difficulties a company may face in running a business without having computer network.

Ans: Here are some of the ways a computer network can help your business:

File sharing:

A network makes it easy for everyone to access the same file and prevents people from accidentally creating different versions.

Printer sharing:

If you use a computer, chances are you also use a printer. With a network, several computers can share the same printer.

Share office equipment:

Instead of having one printer, one fax and one scanner per person, you can have just one of each for the whole office if you have them set up to be shared in the network. It is much more cost efficient than individual computers having their own printer.

Communication and collaboration:

It's hard for people to work together if no one knows what anyone else is doing. A network allows employees to share files, view other people's work, and exchange ideas more efficiently.

Data protection:

You should know by now that it's vital to back up your computer data regularly.

As you can see, the advantages of a computer network in your business are numerous and that is the reason it is so popular nowadays. It enhances productivity by using connectivity and sharing of files.

Due to above discussion it is clear that a company may face difficulties in running a business without having computer network.

ii. What is meant by data transmission?

Ans: Data Transmission:

Data transmission is the process of sending data from one device to another. It consists of sender, receiver and the medium which carries the information.

There are three modes of data transmission which are simplex, Half-duplex and Full-duplex.

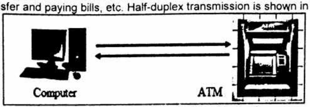
iii. Differentiate between Half-duplex and Full-duplex transmission modes.

Ans: Half-duplex Transmission Mode:

A Half-duplex mode can send and receive data/information in both directions but not simultaneously. During data transmission, one end is the sender and the other is receiver.

Examples:

Half-duplex transmission is used in ATM machines for withdrawal of cash, money transfer and paying bills, etc. Half-duplex transmission is shown in Fig.

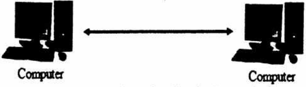


Transmission through Half – duplex mode

Full-duplex Transmission Mode:

A Full-duplex mode is used to transmit data/information in both directions simultaneously as shown in Fig.

A Full-duplex mode can transmit more data/information at higher rate.



Transmission through Full – duplex mode

Examples:

Examples of Full-duplex mode are communication between computers in a network and communication over telephone line.

Iv. Define network architecture?

Ans: Network Architecture:

Network architecture refers to layout of network that consists of computers, communication devices, software, wired or wireless transmission of data and connectivity between components.

A computer network can be as small as two computers linked together by a single cable whereas large networks connect thousands of computers and other devices.

Types of Network Architectures:

Three types of network architectures are commonly used which are:

- Client/server network
- Peer-to-peer network
- Point-to-point network

v. Differentiate between a server and a client computer.

Ans: Server Computer:

A Server is a main computer in a network which is used to manage network resources and facilitates other computers.

Client Computer:

Clients are computers in a network that access services made available by a server.

In a client/server network, each computer on the network acts as either a server or a client. Servers are not used as client computers and client computers are not used as servers.

In a client/server network, server shares its resources such as hard disk, printers and Internet connection with client computers.

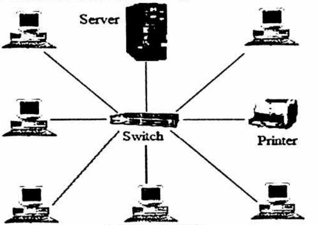
vi. Compare LAN and WAN.

Ans: Local Area Network (LAN):

Local area network is commonly used network. It is a network that covers a limited area, usually ranging from a small office to a campus of nearby buildings.

Examples:

Examples of LAN include networks within a school, college, business and organization. A local area network is shown in Fig.



Local Area Network

Characteristics of LAN:

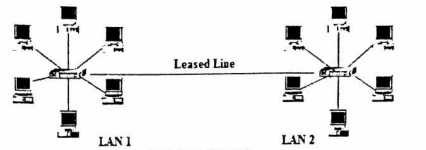
i) LAN is restricted to a limited geographical area.
ii) Data transmission speed is fast.
iii) Data communication problems rarely occur.
iv) Transmission medium is owned by the user organization.

Wide Area Network (WAN):

Wide Area Network spans a large area, connecting several locations of an organization across cities, countries and continents. A WAN is often made up of two or more LANs and/or MANs at each location of an organization and these LANs might be connected together to form a WAN.

Examples:

Examples of WAN are the networks used in banks, airlines and national database authorities like NADRA in Pakistan. Internet is another good example of WAN. A wide area network is shown in Fig.



Wide Area Network

Characteristics of WAN:

- **i)** WAN spans large geographical area. It can connect computers between cities and countries.
- **ii)** Data transmission speed is slow.
- **iii)** Data communication problems often occur.
- **iv)** Transmission medium is leased lines or public systems such as telephone lines or satellite links.

vii. Why star topology is more reliable than bus or ring topologies?

Ans: Due to following reasons star topology is more reliable than bus or ring topologies.

- Provides fast communication between computers.
- Easy to connect new devices to the network.
- Easy to detect and fix faults.
- Failure of one computer does not stop functioning of the entire network.

viii. Mention any three problems which may occur if peer-to-peer network is used for a large number of users in an organization.

Ans: Problems of Peer-to-Peer Networks:

- **i)** In a peer-to-peer network, each computer can play the role of server, client or both at the same time.
- **ii)** Peer-to-peer networks are suitable for a small number of users, ranging between two to ten computers. Large peer-to-peer networks become difficult to manage.
- **iii)** It does not provide centralized security. No single person is assigned to administer the resources of network. Individual users have complete control over resources of their computers.

ix. What is ISDN?

Ans: ISDN:

ISDN stands for Integrated Services Digital Network. It provides a maximum speed of 128Kbps which is more than Dial-up connection but less than DSL. It can transmit both voice and data at the same time over a single cable. It requires that the user has ISDN digital telephone service from telephone company and uses a faster modem than Dial-up modem. ISDN service is being replaced by faster DSL service.

x. What is CDMA technology?

Ans: CDMA Technology:

CDMA stands for Code Division Multiple Access. It is a wireless cellular communication technology. CDMA services include short messaging, voice, data and video transmission. It can provide speed of several Mbps for video transmission.

Q3. Write long answers of the following questions.

i. What are the advantages of using networks?

Ans: Advantages of using networks:

The following are some common uses of networks.

Hardware Sharing:

Network allows sharing of computer hardware such as hard disk and printer. A hard disk can be attached to a server to share it with other network users. A single hard disk can provide storage space to many users.

A printer can also be connected to a computer to share it with all the other computer users across the network. Every user on network can use it for printing documents and there is no need to buy a printer for every user.

Software Sharing:

Application software can be installed on a server and shared over the network. There is no need to install it on all the computers in network.

File Sharing:

A user of a network can easily share files with other users over the network. A user can place a file in a shared location on one computer and make it available to other users.

Users can access, view and modify information stored on another computer in the network.

Internet Sharing:

A single high speed Internet connection can be shared with all the users over a network. There is no need to provide a separate Internet connection to every user on the network.

ii. Describe Client/Server and Peer-to-Peer networks.

Ans: Client/Server Network:

A Server is a main computer in a network which is used to manage network resources and facilitates other computers.

Clients are computers in a network that access services made available by a server.

In a client/server network, each computer on the network acts as either a server or a client. Servers are not used as client computers and client computers are not used as servers.

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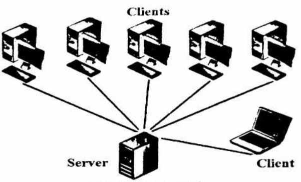


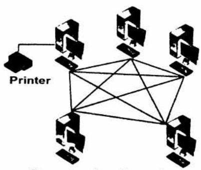
Client/Server Network

Characteristics of Client/Server Networks:

- **i)** Client/server network can be as small as two computers and it can have hundreds and even thousands of computers as well.
- **ii)** It provides centralized security to ensure that resources are not accessed by unauthorized users.
- **iii)** In a client/server network, a person known as Network Administrator is responsible for sharing resources, creating user accounts and assigning privileges to all the users of the network.

Peer-to-Peer Network:

In Peer-to-Peer network all computers have the same status. Every computer is capable of playing the role of client, server or both at the same time. Each computer on the network is known as peer. A peer on the network can share as well as access available resources on the network. Peer-to-peer network is illustrated in Fig.



Peer – to – Peer Network

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- **iii)** It does not provide centralized security. No single person is assigned to administer the resources of network. Individual users have complete control over resources of their computers.

iii. Describe the types of networks based on area covered.

Ans: Types of Networks Based on Geographical Area:

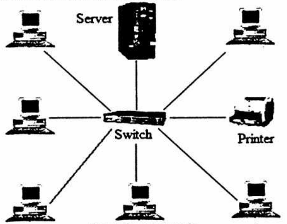
Based on the geographical distance covered, computer networks are classified into Local Area Network, Wide Area Network and Metropolitan Area Network.

Local Area Network (LAN):

Local area network is commonly used network. It is a network that covers a limited area, usually ranging from a small office to a campus of nearby buildings.

Examples:

Examples of LAN include networks within a school, college, business and organization. A local area network is shown in Fig.



Local Area Network

Characteristics of LAN:

- **i)** LAN is restricted to a limited geographical area.
- **ii)** Data transmission speed is fast.
- **iii)** Data communication problems rarely occur.
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Wide Area Network (WAN):

Wide Area Network spans a large area, connecting several locations of an organization across cities, countries and continents. A WAN is often made up of two or more LANs and/or MANs at each location of an organization and these LANs might be connected together to form a WAN.

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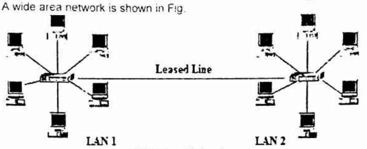

Wide Area Network

Characteristics of WAN:

- **i)** WAN spans large geographical area. It can connect computers between cities and countries.
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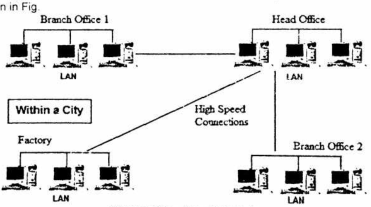
Metropolitan Area Network (MAN):

A Metropolitan Area Network (MAN) falls between LAN and WAN. It spans area larger than a LAN but smaller than a WAN. A metropolitan area network is shown in Fig.



Metropolitan Area Network

Examples:

Examples of MAN are networks used by telecommunication companies for providing Cable TV and Internet services.

Characteristics of MAN:

- **i)** MAN can connect computers within several blocks of buildings to entire city.

- **ii)** Data transmission speed is slower than LAN but faster than WAN.
- **iii)** Fibre optic cable or wireless microwave transmission is used as communication medium.

Personal Area Network (PAN):

A personal area network (PAN) is a computer network organized around an individual person. Personal area networks typically involve a mobile computer, a cell phone and/or a handheld computing device such as a PDA. Users can use these networks to transfer files including emails, calendar appointments, photos and audio/video files.

Personal area networks can be wired or wireless. USB and FireWire technologies often link together a wired PAN, while wireless PANs typically use Bluetooth or sometimes infrared connections.

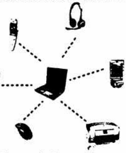
Example of wireless PAN using Bluetooth technology:

The following is the example of wireless PAN using Bluetooth technology.

Bluetooth Network:

The process of setting up a Bluetooth network is referred to as "**Pairing**" Pairing is done through interaction between two users. The user interaction is required to confirm the identity of the devices.

When pairing process completes, a network forms between the two devices and now the devices can communicate with each other. It is possible to pair one device to multiple other devices. Bluetooth creates a secure network. A Bluetooth network connecting various Bluetooth devices is shown in Fig.



Bluetooth Network

Characteristics of Bluetooth Communication

- **i)** Bluetooth transmission eliminates the need of cable to form a network.
- **ii)** Transmission is secure, reliable and fast.
- **iii)** It creates Personal Area Network in which Bluetooth devices are close to each other.
- **iv)** It can transmit text, images, audio files and video files.

Internet (International Network):

Internet is the largest computer network that connects millions of computers all over the world. Computers on the Internet are connected together using telephone lines, fiber optics or wireless signals. Each computer on the Internet has an IP address. IP stands for Internet Protocol. It identifies each computer on the Internet with its location.

Internet has brought a huge revolution in our daily life. It allows people to send e-mail, chat with friends around the world and obtain information on any topic.

Computer users pay bills, do shopping, find jobs, work at home and do reservation for trains, flights, and hotels through Internet. Social networking websites such as Facebook and Twitter allow millions of people all over the world to communicate with each other and share their views and ideas.

World Wide Web (www) or Web in short, is the most popular and widely used system to access the Internet. It is a collection of websites available on the Internet. A website contains related webpages that can be accessed using a browser such as Google Chrome or Internet Explorer.

To access a website, computer users enter a string of characters called Uniform Resource Locator (URL) into a browser. For example to access the website of Federal board, the user will enter the URL ***www.fbise.gov.pk*** into a browser.

iv. Explain the types of network topologies.

Ans: Network Topology:

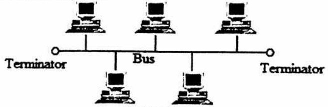
The physical arrangement of network nodes is called network topology. A node represents a computer or a network device.

Types of Network Topologies:

Four types of network topologies are commonly used which are bus, ring, star and mesh.

Bus Topology:

It is the simplest network topology. It consists of a single central cable known as bus. All the devices are connected to the bus along its length to communicate with each other as shown in Fig. A computer sends a message on the bus. The computer to whom the message is sent receives it while others ignore it. At each end of bus a device called terminator is attached so that the signals do not bounce back on the bus causing errors.



Bus topology

Advantages of Bus Topology:

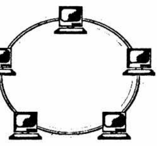
- Lowest cost topology to implement due to short cable length.
- Easy to add new computers.
- Easy to setup as compared to Star or Mesh topology.
- Suitable for small networks.

Limitations of Bus Topology:

- If bus is damaged at any point, the entire network stops working.
- Difficult to detect and fix faults.

Ring Topology:

The ring network topology is shaped just like a ring as shown in Fig. It is like a bus with both ends connected together. All the messages travel in the same direction. Message from one node is sent to the next node. It is received by it if it is addressed to it otherwise it is ignored and passed on to the next until the destination is reached.



Ring topology

Advantages of Ring Topology:

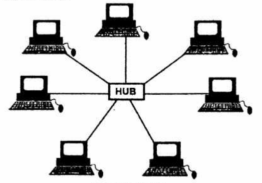
- High network performance.
- Server or switch is not required to manage the network.
- All the computers have equal opportunity to transmit data.

Limitations of Ring Topology:

- If ring is broken at any point, the entire network stops functioning.
- Detection of fault is difficult.
- If any computer in the ring is not working the whole network is affected.
- Expansive than Star and Bus topologies.

Star Topology:

In star topology all the nodes are connected to a central device called switch or hub as shown in Fig. It is a one of the commonly used network topologies. A switch can connect 4, 8, 16, 24 or 32 nodes. A switch can be connected to another switch to expand the network.



Star topology

Advantages of Star Topology:

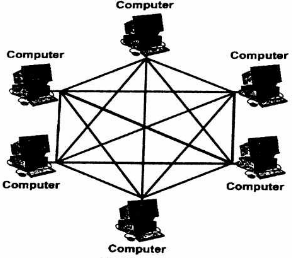
- Provides fast communication between computers.
- Easy to connect new devices to the network
- Easy to detect and fix faults.
- Failure of one computer does not stop functioning of the entire network.

Limitations of Star Topology:

- At least one switch/hub is required for connecting two computers.
- Lengthy cable is required to connect all the computers to the switch.
- Costly to implement.

Mesh Topology:

In mesh network topology, all the network nodes are connected to all the other nodes as shown in Fig. Message sent on a mesh network, can take any possible path from source to destination. It is not commonly used since it is costly and difficult to implement.



Mesh topology

Advantages of Mesh Topology:

- It is the most reliable network topology.
- Alternative paths are available in case a path is broken from source to destination.

Limitations of Mesh Topology:

- Most expensive topology to implement since it requires more cable then Bus, Ring or Star topologies.
- Difficult to implement as compared to other topologies.
- Difficult to add new computer.

v. **Write a note on Dial-up and DSL Internet connections.**

Ans: Dial-up Line:

Dial-up line uses standard telephone lines for Internet connection. It requires a Dial-up modem that provides a maximum Internet connection speed of 56Kbps.

The main advantage of using Dial-up line is that it uses complex network of telephone lines that allows data to be transmitted to almost any location in the world. It is becoming outdated due to very slow Internet connection.

DSL:

DSL (Digital Subscriber Line) provides a very high speed broadband Internet connection. It is called broadband because it has broad range of frequencies for transmitting digital data.

Broadband:

Any type of Internet speed that is 256Kbps or above is known as broadband.

A DSL modem is required for setting up the DSL Internet connection. Internet Service Providers (ISPs) have several DSL speeds available with different monthly rates.

Lab Activities

Activity:

The students should be shown/explained a switch and network card and its use to create a local area network in school computer lab. The cables and connectors used for creating a local area network (LAN) should also be physically shown to students.