**CLASS: FORM FOUR**

**DURATION: 4Hrs**

**SUBJECT: COMPUTER SCIENCE**

1. **Network Topologies**

Network topology is the physical layout or arrangement of the components of a network. Network topologies can be of many different types depending on the need of the network to be constituted.

* 1. **Bus Topology**

In bus topology, all computers are connected to a single cable (trunk or backbone) known as bus, by a transceiver either directly or by using a short drop cable. Bus transmits in both directions such that any transmission can be received by all stations. All ends of the cable must be terminated, that is plugged into a device such as a computer or terminator, to avoid signals from bouncing back.



1. **Advantages**

* Easy and inexpensive to set up as little cabling is required
* Easy to include additional stations without disrupting the network
* Failure of one node does not affect network

1. **Disadvantages**

* High rate of data collision
* Fails if there is any damage to the bus
* Any break in the bus is difficult to identify
  1. **Star Topology**

In a star topology, all the computers are connected to a central device which could be a computer, a hub or a switch. Any communications between computers in this topology must pass through the central node. As such, the central node controls all the activities of the network.



1. **Advantages**

* Breakdown of anode does not affect the network
* No disruption of the network when connecting or removing devices
* It is easy to detect faults

1. **Disadvantage**

* Failure of the central node affects the entire network
* It is costly due to the amount of cables required to connect the devices
  1. **Ring Topology**

In ring topology, all the nodes are connected in the form of a closed loop such that each node is connected to two others. It uses an empty data packet called a token and a special protocol called token ring. Packets travel around the ring in a clockwise direction. To transmit, a node requires an empty token.



1. **Advantage**

* No collision as data travels in one direction

1. **Disadvantage**

* If a node in the network fails, the entire network fails
* Network is disrupted when additional stations are added
  1. Mesh Topology
  2. Tree Topology

1. **Network Standards**
   1. **Token Ring Network**

Token ring (IEEE 802.5 standard) is a network technology developed by IBM in which computers are connected together in a ring. Token ring’s media-access method is called token passing. A special message, called token, circulates along the ring from one computer to another and each computer can transmit only while it is holding the token. Information flows in one direction along the ring from source to destination and back to source. When a station wishes to transmit, it waits for the empty token to pass by. It seizes it and inserts data into it and then releases it to the medium. The token circulates until it gets to the destination computer that picks it and retrieves the data. After retrieving the data, it regenerates the token and sends it back to the medium.

* 1. **Ethernet Network**

Ethernet (IEEE 802.3 standard) is the most common and widely used technology to establish any computer network. An Ethernet network is formed by physically connecting the individual computer units to each other in a bus topology or a star topology. Ethernet’s media access policy is CSMA/CD (Carrier Sense Multiple Access with Collision Detection).

* CS: means that a station listens to the medium and transmits only if medium is idle
* MA: means that any station can use (access) the medium
* CD: means that each station stops transmitting immediately it senses a collision

When a collision is detected, the two stations involved will retransmit after a random time wait created by a backoff algorithm.

Assignment: What are the different versions of Ethernet?

* 1. **Fiber Distributed Data Interface**

FDDI is a network technology that uses fiber-optic cables in a ring topology with dual rings on which information can travel in opposite directions. The media access method for FDDI is token passing. The primary ring is used for data transmission, and the secondary ring remains idle. Because of this double ring topology, if a station fails or a cable becomes damaged, the dual ring is automatically wrapped around itself, forming a single ring. This prevents downtime as a result of a failed machine or faulty wiring.

* 1. **Wireless Network Standards**

Wireless networks are established without physical wiring techniques involved. They use radio and infrared signals and are based around one of these technologies: Bluetooth, Wi-Fi, WiMax, terrestrial microwaves and satellite.

1. **Bluetooth**: is a low power, short-range wireless technology largely used to interconnect computing devices into a personal area network. It is based on IEEE standard 802.15 which gives specifications for Wireless Personal Area Network (WPAN).
2. **Wi-Fi**: stands for Wireless Fidelity. It is based on a set of wireless networking technologies known as 802.11. These include 802.11b, 802.11a, 802.11g and 802.11n. The range of Wi-Fi network transmission is about 30-40m indoors and up to about 100moutdoors.

The table below shows the different 802.11 standards for wireless networking.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Specification** | **Popular name** | **Frequency** | **Speed** | **Compatible with** |
| 802.11a | Wireless-A | 5 GHz | 54 Mbps |  |
| 802.11b | Wireless-B | 2.4 GHz | 11 Mbps | Wireless-B |
| 802.11g | Wireless-G | 2.4 GHz | 54 Mbps | Wireless-B, -G |
|  |  |  |  |  |
| 802.11n | Wireless-N | 2.4 GHz | 100 Mbps | Wireless-B, -G, -N |

1. **WiMax**: stands for Worldwide Interoperability for Microwave Access. It is based on IEEE standard 802.16 and facilitates high speed wireless network links to both fixed and mobile devices. The range of a WiMax wireless connection is around 3-10km.WiMax service providers are now just entering the market, offering customers an alternative to a [DSL](file:///H:\CSC%20&%20ICT\Glossary.htm#dsl) Internet connection.
2. **Network Architectures**
   1. **Client-Server Architecture**

Client/server is a network architecture in which a more powerful computer called server is dedicated to serving less powerful computers called clients. Servers hold shared resources like files, programs and the network operating system. They provide access to network resources to all the users of the network. There are many different kinds of servers, and one server can provide several functions. For example, there are file servers, print servers, mail servers, database servers and Web servers, to name a few.Users run applications on client workstations which rely on servers for resources such as files, devices and even processing power.

Internet services are organized according to a client/server architecture. Client programs, such as Web browsers and file transfer programs, create connections to servers, such as Web and FTP servers. The clients make requests of the server, and the server responds to the requests by providing the service requested by the client.

* 1. **Peer-to-peer Architecture**

Peer-to-peer (P2P) is a network configuration in which all the workstations (computer) have equalcapabilities and responsibilities. Each workstation acts both as a server and a client. This means thatany computer on the network can provide services to any other computer. Peer-2-peer is usually implemented where strict security is not necessary. P2Pnetworks are generally simpler and less expensive, but they usually do not offer the same performance under heavy loads.

Remark A hybrid network combines client/server and peer-to-peer architectures. It is the most commonly used network architecture.

1. **Benefits and Limitations Of Computer Networks**
   1. **Benefits**
2. **File sharing**

Networks allow files located on one system to be accessed remotely. In an organization, this saves employees from the hassle of carrying a storage device each time data has to be transported from one system to another. Furthermore, if files are stored on a server and all of its clients share that storage capacity, then it becomes easier to make a file available to multiple users.

1. **Resource Sharing**

Networks allow resources like modems, printers and scanners to be shared amongst multiple users.

1. **Communication**

Computer networks have improved the way people communicate. People all over the world can communicate and collaborate in a matter of minutes thanks to networks. In organizations, computer networks serve as the backbone of daily communication

1. **Save costs**

Shared resources mean reduction in hardware costs. Shared files mean reduction in memory requirements which indirectly means reduction in file storage expenses.

1. **Increased Storage Capacity**

A stand alone computer might fall short of storage memory, but when many computers are on a network, the memory of different computers can be used in such a case. One can also design a storage server on the network in order to have a huge storage capacity.

1. **Teleworking**

Teleworking is the act of working from home and communicating with the office through the use of telecommunication equipment. This is possible because of networks. Working from home enables organizations to save cost of renting large offices, save money on furniture and IT equipment and pay their employees only when they are jobs or projects to do. On the other hand, employees have flexible working hours, they can attend to household chores and they save money on transport.

1. **Teleconferencing**

Conferences can be held with participants found at different locations. This enables organizations to save travelling cost for employees. This is as a result of computer networks.

* 1. **Limitations**

1. **Security concerns**

If a computer is a standalone computer, physical access becomes necessary for any kind of data theft. However, if a computer is on a network, a hacker can get unauthorized access by using different tools.

1. **Malware attacks**

Computers connected to a network are susceptible to malware attacks. If one system gets infected by a virus, there is a possible for the other systems getting infected too.

1. **Backup Issues**

On a network with distributed resources, it becomes difficult to backup data for security purposes.