

Course Code : BCS-041

Course Title : : Fundamentals of Computer

Networks Assignment

Assignment Number : : BCA(4)/041/Assignment/16-17

Maximum Marks : 100 Weightage :

**1. (a) Explain the switching techniques used in ATM. Draw and explain structure of ATM cell format.**

**Ans (a)**

**cell switching is associated with Asynchronous Transmission Mode (ATM) which is considered to be a high speed switching technology that attempted to overcome the speed problems faced by the shared media like Ethernet and FDDI. Cell switching uses a connection-oriented packet-switched network.**

**When a connection is established it is known as signaling. It is called cell switching because this methodology uses a fixed length of packets of 53 bytes out of which 5 bytes are reserved for header. Unlike cell technology, packet switching technology uses variable length packets. Even though cell switching closely resembles packet switching because cell switching also breaks the information into smaller packets of fixed length and thereby ensuring guaranteed delays.**

**(b) What is a sub-netting and super-netting? How do you implement sub-netting? Explain this with an example.**

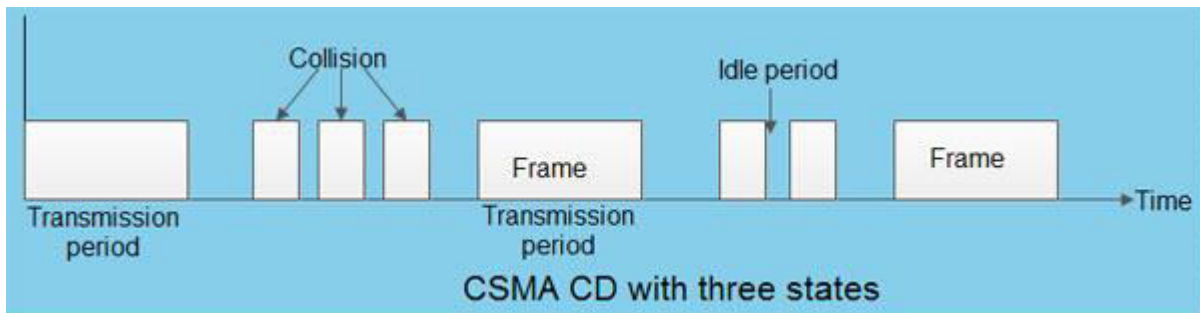
Ans(b) Subnetting is the process of dividing an IP network into sub divisions called subnets whereas\*\*\*\*; Super netting is the process of combining several IP networks with a common network prefix. Supernetting will reduce the number of entries in a routing table and also will simplify the routing process

(c) Explain the CSMA/CD Protocol with collision detection with the help of a diagram

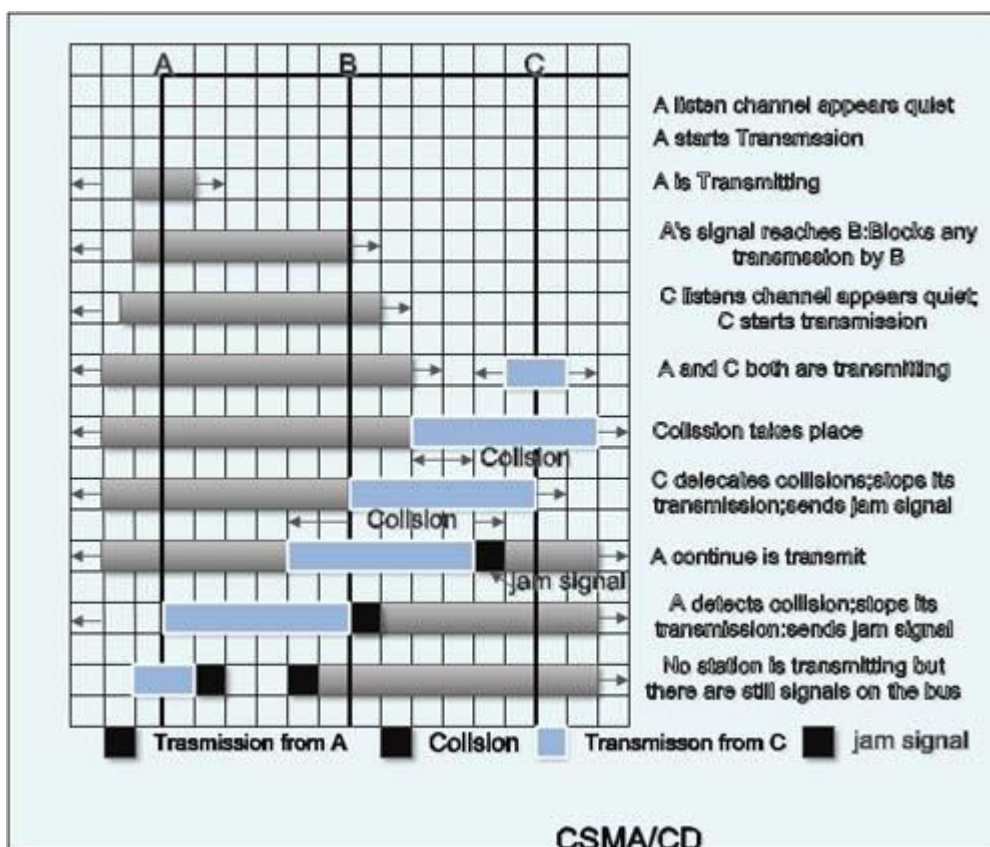
Ans (c)

To reduce the impact of collisions on the network performance, Ethernet uses an algorithm called CSMA with Collision Detection (CSMA / CD): CSMA/CD is a **protocol** in which the station senses the carrier or channel before transmitting frame just as in persistent and non-persistent CSMA. If the channel is busy, the station waits. it listens at the same time on communication media to ensure that there is no collision with a packet sent by another station. In a collision, the issuer immediately cancel the sending of the package. This allows to limit the duration of collisions: we do not waste time to send a packet complete if it detects a collision. After a collision, the transmitter waits again silence and again, he continued his hold for a random number; but this time the random number is nearly double the previous one: it is this called back-off (that is to say, the "decline") exponential. In fact, the window collision is simply doubled (unless it has already reached a maximum). From a packet is transmitted successfully, the window will return to its original size.

Again, this is what we do naturally in a meeting room if many people speak exactly the same time, they are realizing account immediately (as they listen at the same time they speak), and they **interrupt** without completing their sentence. After a while, one of them speaks again. If a new collision occurs, the two are interrupted again and tend to wait a little longer before speaking again.

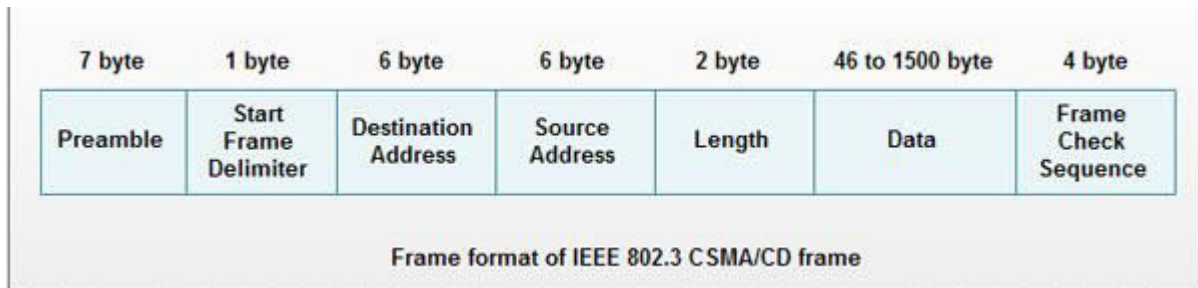


The entire scheme of CSMA/CD is depicted in the fig.



Frame format of CSMA/CD

**The frame format specified by IEEE 802.3 standard contains following fields.**



**(d) What is the remainder obtained by dividing  $x^7 + x^5 + 1$  by the generator polynomial  $x^3 + 1$ ?**

**Ans(d)**

**The remainder is  $x^2 + x + 1$ .**

**2. (a) Explain with the help of an example/illustration the problem with Distance vector routing algorithm. Explain in detail how does link state routing algorithm resolve the shortcoming of the above algorithm.**

**Ans(a)** In computer communication theory relating to packet-switched networks, a distance-vector routing protocol is one of the two major classes of intra domain routing protocols, the other major class being the link-state protocol. Distance-vector routing protocols use the Bellman–Ford algorithm, Ford–Fulkerson algorithm, or DUAL FSM (in the case of Cisco Systems's protocols) to calculate paths.

A distance-vector routing protocol requires that a router inform its neighbors of topology changes periodically. Compared to link-state protocols, which require a router to inform all the nodes in a network of topology changes, distance-vector routing protocols have less computational complexity and message overhead.<sup>[citation needed]</sup>

The term *distance vector* refers to the fact that the protocol manipulates vectors (arrays) of distances to other nodes in the network. The vector distance algorithm was the original ARPANET routing algorithm and was also used in the internet under the name of RIP (Routing Information Protocol).

**(b) Television channels are 8 MHz wide. How many bits/sec can be sent if 8 level digital signals are used? Assume that this channel is noiseless.**

**Ans (b) Assuming you are allowed leak some energy out beyond the 6MHz channel limit and that you can design transmit filters a with close brickwall shape, you can get close to 6MHz symbol rate, lets say 5M symbols/second. You can send two orthogonal channels simultaneously by modulating one onto the centre frequency with four levels for each symbol give 2 bits/symbol giving 10Mbits/sec. You can simultaneous send another channel 90 degrees out of phase and get another 10 Mbits/second. i.e. one is modulated onto a sine wave, the other onto a cosine wave giving 20Mbits/sec in total. This is called Quadrature Amplitude Modulation (QAM) and because each symbol has 16 possible states, it is called 16QAM. This has so far assumed no coding. In practice it would be better to increase to 32QAM and**

**add trellis coding. This paradoxically has the effect of moving the signals farther apart than 16QAM giving you a higher data rate with better separation and hence a lower error rate for a given signal to noise ratio.**

**(c) Describe and explain the throughput expression of Aloha and Pure Aloha. Consider the delay of Pure Aloha vs Slotted Aloha.**

**Where will be less delay ? Justify.**

### **Pure Aloha**

**The pure Aloha protocol is the basic protocol in the family of the Aloha protocols. It considers a single-hop system with an infinite population generating packets of equal length  $T$  according to a Poisson process with rate  $\lambda$  packets/sec. The channel is error-free without capture: whenever a transmission of a packet does not interfere with any other packet transmission, the transmitted packet is received correctly while if two or more packet transmissions overlap in time, a collision is caused and none of the colliding packets is received correctly and they have to be retransmitted. The users whose packets collide with one another are called the colliding users. At the end of every transmission each user knows whether its transmission was successful or a collision took place. A simple example of the operation of the protocol is shown below:**

**Pure Aloha is a single-hop system. Hence, the throughput is the fraction of time the channel carries useful information, namely noncolliding packets. The channel capacity is the highest value of**

arrival rate  $\lambda$  for which the rate of departure (throughput) equals the total arrival rate.

Consider a packet (new or old) scheduled for transmission at some time  $t$ . This packet will be successful if no other packet is scheduled for transmission in the interval  $(t-T, t+T)$  (this period of  $2T$  is called the vulnerable period). The probability of this happening, that is, the probability of success, is that no packet is scheduled in an interval of length  $2T$  and since scheduling is Poisson we have

$$P_{\text{suc}} = e^{-2gT}$$

Now, packets are scheduled at a rate of  $g$  per second of which only a fraction  $P_{\text{suc}}$  are successful. Thus, the rate of successfully transmitted packets is  $gP_{\text{suc}}$ . When a packet is successful the channel carries useful information for a period of  $T$  seconds; in any other case it carries no useful information at all. Using the definition that the throughput is the fraction of time that useful information is carried on the channel we get

$$S = gTe^{-2gT}$$

which gives the channel throughput as a function of the offered load. Defining to  $G \triangleq gT$  be the *normalized offered load* to the channel, i.e., the rate (per packet transmission time) packets are transmitted on the channel, we have

$$S = Ge^{-2G}$$

The relation between  $S$  and  $G$  is depicted in Figure 3.2, which is typical to many Aloha

type protocols. At  $G=1/2$ ,  $S$  takes on its maximal value of  $1/(2e) \approx 0.18$

### Slotted Aloha

The slotted Aloha variation of the Aloha protocol is simply that of pure Aloha with a slotted channel. The slot size equals  $T$ --the

duration of packet transmission. Users are restricted to start transmission of packets only at slot boundaries. Thus, the vulnerable period is reduced to a single slot. In other words, a slot will be successful if and only if exactly one packet was scheduled for transmission sometime during the previous slot. The throughput is therefore the fraction of slots (or probability) in which a single packet is scheduled for transmission. Because the process composed of newly generated and retransmitted packets is Poisson we conclude that

$$S = gTe^{-gT}$$

or using the definition of the normalized offered load  $G = gT$

$$S = Ge^{-G}$$

This relation is very similar to that of pure Aloha, except of increased throughput (see Figure). Channel capacity is  $1/e \approx 0.36$  and is achieved at  $G=1$

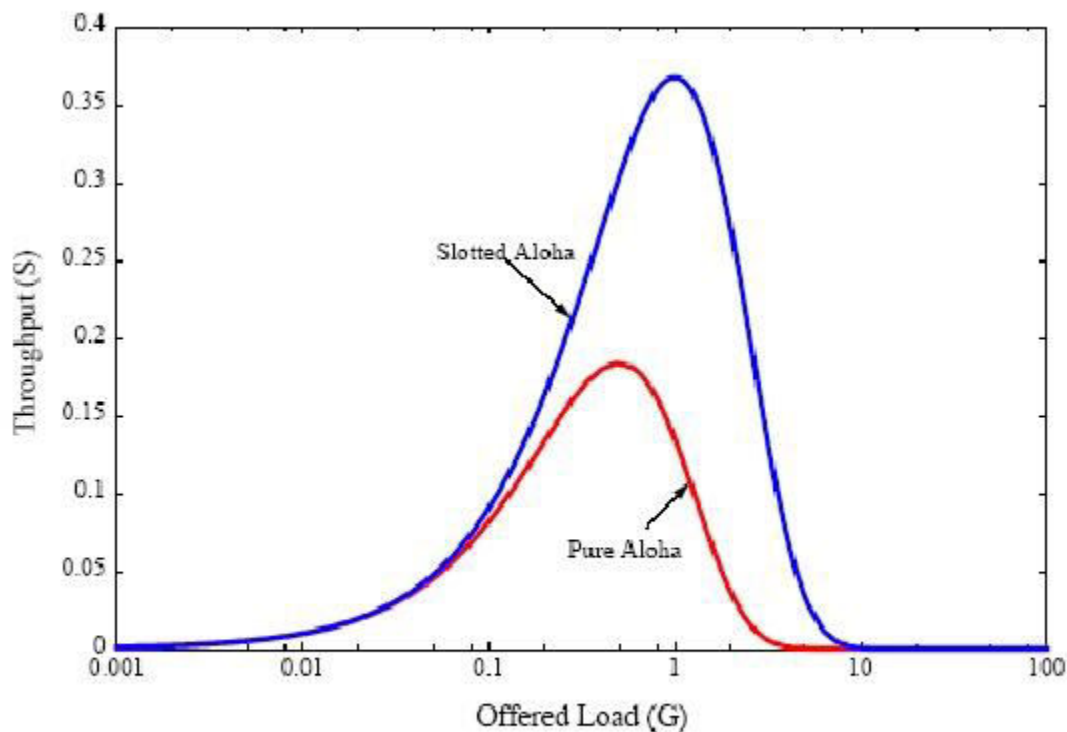


FIGURE 3.2: Throughput-Load of Pure and Slotted Aloha

**(d) A bit string 01111101111010111110 needs to be transmitted at the Data-Link layer. What is the string actually transmitted after bit stuffing**

**ANS (D)**

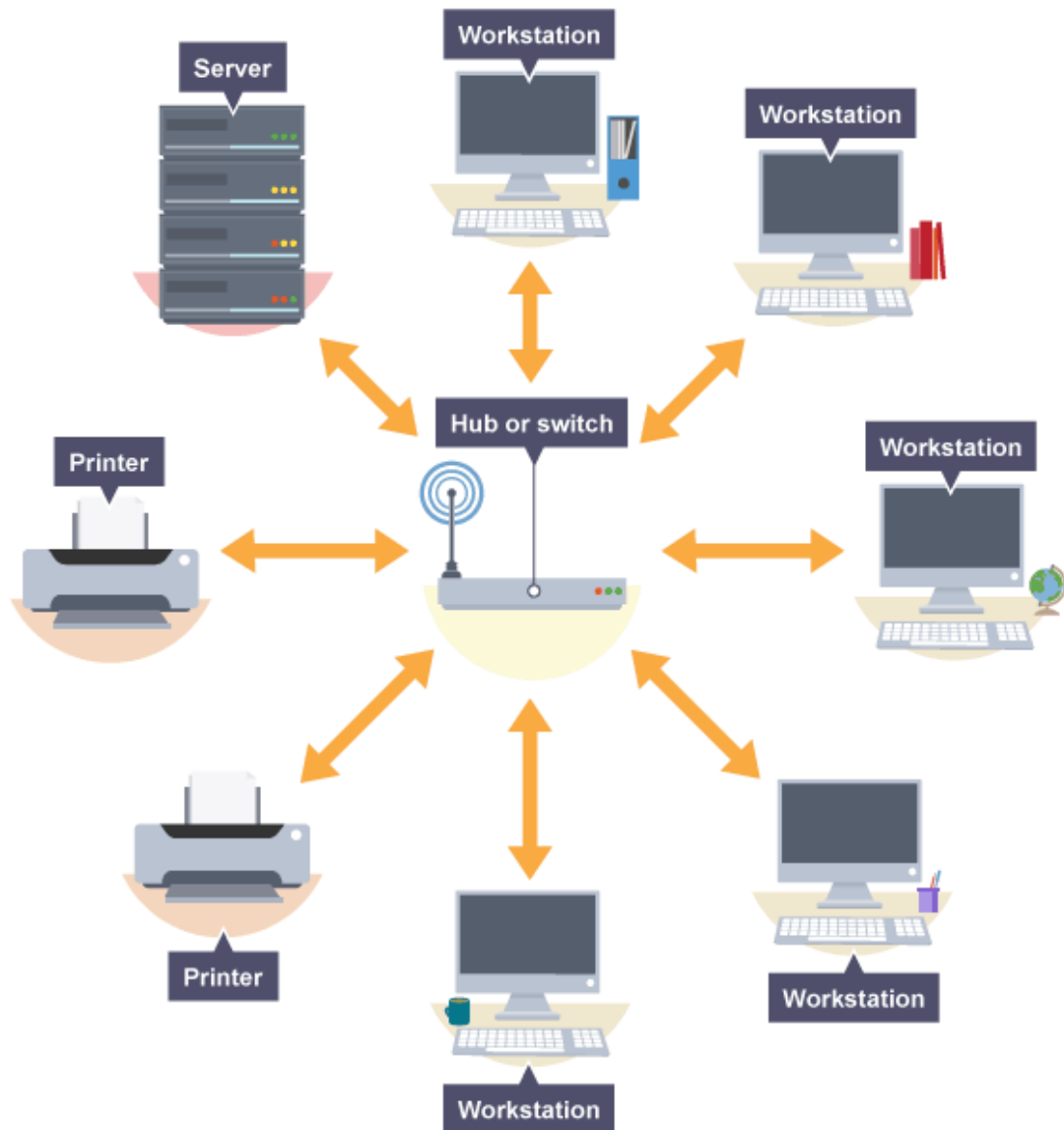
**01111011111      0              011111      0              10**  
**(data)              (Inserted 0)    (data)    (Inserted 0)    (data)**

**When five consecutive 1s have been transmitted from the body of the message, the sender inserts a 0 (as shown above) before transmitting the next bit.**

**3. (a) Analyze your computer lab in your study centre or college (in guidance of your teacher/ coordinator )and perform the following tasks:**

**(i) Draw diagram of your lab consisting of nodes (computers), hubs, switches bridges, type of cabling, servers and other various network devices.**

**ANS (i)**



**(ii) Describe the network topology and its implementation in the lab.**

**ANS (II) A network's topology affects its capabilities. The choice of one topology over another will have an impact on the:**

- **Type of equipment the network needs.**
- **Capabilities of the equipment.**
- **Growth of the network.**
- **Way the network is managed.**

**Developing a sense of how to use the different topologies is a key to understanding the capabilities of the different types of networks.**

**Before computers can share resources or perform other communication tasks they must be connected. Most networks use cable to connect one computer to another.**

**(iii) Number of ports of the hub(s) with specifications.**

**Ans (III) A USB hub is a device that expands a single Universal Serial Bus (USB) port into several so that there are more ports available to connect devices to a host system, similar to a power strip.**

**USB hubs are often built into equipment such as computers, keyboards, monitors, or printers. When such a device has many USB ports, they all usually stem from one or two internal USB hubs rather than each port having independent USB circuitry.**

**Physically separate USB hubs come in a wide variety of form factors: from external boxes (looking similar to an Ethernet or network hub) connectible**

with a long cable, to small designs that can be directly plugged into a USB port (see the "compact design" picture). In the middle case, there are "short cable" hubs which typically use an integral 6-inch cable to slightly distance a small hub away from physical port congestion and of course increase the number of available ports.

Laptop computers may be equipped with many USB ports, but an external USB hub can consolidate several everyday devices (like a mouse and a printer) into a single hub to enable one-step attachment and removal of all the devices

**(iv) Describe configuration / features of the server machine.**

**ANS (IV)** In computing, a server is a computer program or a device that provides functionality for other programs or devices, called "clients". This architecture is called the client–server model, and a single overall computation is distributed across multiple processes or devices. Servers can provide various functionalities, often called "services", such as sharing data or resources among multiple clients, or performing computation for a client. A single server can serve multiple clients, and a single client can use multiple servers. A client process may run on the same device or may connect over a network to a server on a different device.<sup>[1]</sup> Typical servers are database servers, file servers, mail servers, print servers, web servers, game servers, and application servers.<sup>[2]</sup>

Client–server systems are today most frequently implemented by (and often identified with) the request–

**response model: a client sends a request to the server, which performs some action and sends a response back to the client, typically with a result or acknowledgement. Designating a computer as "server-class hardware" implies that it is specialized for running servers on it. This often implies that it is more powerful and reliable than standard personal computers, but alternatively, large computing clusters may be composed of many relatively simple, replaceable server components.**

**(v) List of applications running on the network with their brief description.**

**ANS(V) An application program (app or application for short) is a computer program designed to perform a group of coordinated functions, tasks, or activities for the benefit of the user. Examples of an application include a word processor, a spreadsheet, an accounting application, a web browser, a media player, an aeronautical flight simulator, a console game or a photo editor. The collective noun application software refers to all applications collectively.<sup>[1]</sup> This contrasts with system software, which is mainly involved with running the computer.**

**Applications may be bundled with the computer and its system software or published separately, and may be coded as proprietary, open-source or university projects.<sup>[2]</sup> Apps built for mobile platforms are called mobile apps.**

**(vi) Describe briefly about the speed of the LAN and the protocol.**

**To allow for an increased speed of transmission, the Ethernet protocol has developed a new standard that supports 100 Mbps. This is**

**commonly called Fast Ethernet. Fast Ethernet requires the application of different, more expensive network concentrators/hubs and network interface cards. In addition, category 5 twisted pair or fiber optic cable is necessary. Fast Ethernet is becoming common in schools that have been recently wired.**

**(vii) Describe the specification of cable used and its length.**

**ANS(VII) Coaxial Cable.** Coaxial cable comes in two versions: Thinnet and Thicknet. **Thinnet** looks like regular TV cable.\* It is about 1/4 inch in diameter and is very flexible and easy to work with. In contrast, **Thicknet** is about 1/2 inch in diameter and not very flexible. Thicknet is older and not very common anymore except as a backbone within and between buildings. Coax transmits at 10 Mbps..

**Twisted Pair.** Twisted pair looks like telephone wire and consists of insulated strands of copper wire twisted together. There are two versions of twisted pair cable: Shielded Twisted Pair (STP) and Unshielded Twisted Pair (UTP). **STP** is commonly used in Token Ring networks and **UTP** in Ethernet networks where it is referred to as "10baseT." Transmission rates vary between 10-100 Mbps..

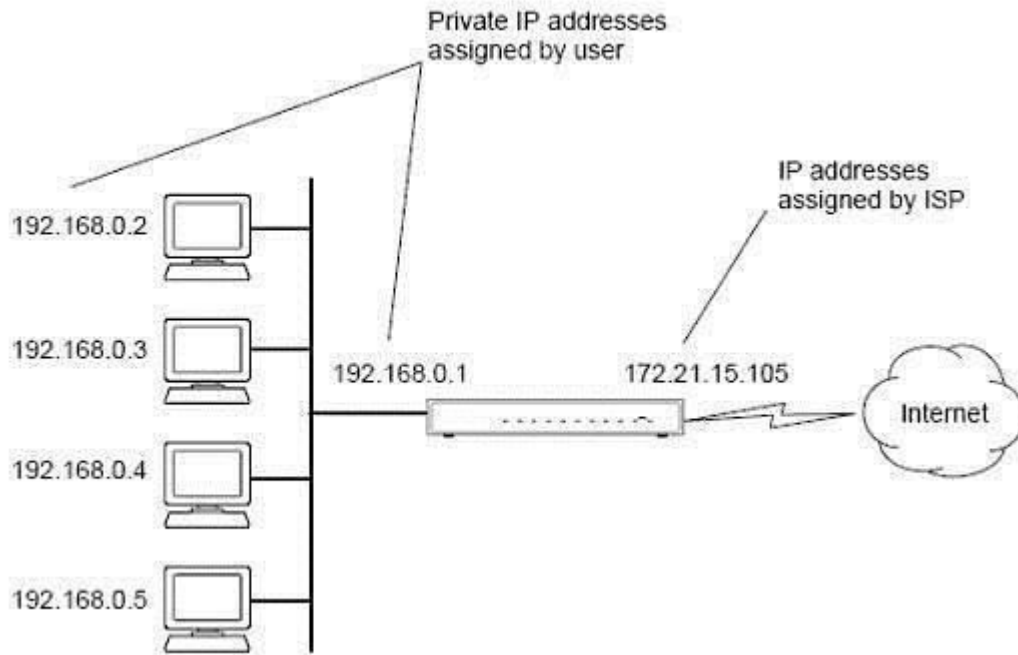
**Fiber-Optic Cable.** Fiber-optic cable consists of a thin cylinder of glass surrounded by glass cladding, encased in protective outer sheath. Fiber-optic cable is very fast (100 Mbps). It can transmit over long distances (2 km +) but is expensive.

**(viii) Describe the networking features of the server operating system.**

**ANS (VII) A network operating system (NOS) is a computer operating system system that is designed primarily to support workstation, personal computer, and, in some instances, older terminal that are connected on a local area network (LAN). Artisoft's LANtastic, Banyan VINES, Novell's NetWare, and Microsoft's LAN Manager are examples of network operating systems. In addition, some multi-purpose operating systems, such as Windows NT and Digital's OpenVMS come with capabilities that enable them to be described as a network operating system.**

**4. (a) Draw the wireless LAN architecture and explain its components? Explain the functioning of the various wireless LAN Protocols?**

**ANS (A) The process of assembling the parts of computer hardware in computer networking is called as computer architecture. Similarly if we use this architectural technique in Wireless LAN or WiFi is called as Wireless LAN Architecture. It is a technique of designing and arrangement of different components in Wireless local area networking device in a specific way. Special type of device which is the combination of transmitter and receiver called as transceiver which is an essential part for standard Wireless LAN architecture that is known as Access points.**



## **Components of Wireless Architecture:**

**Wireless LAN architecture is composed of different components which help in establishing the local area network between different operating systems. These components are very essential for WiFi architecture.**

- 1. Access point**
- 2. Clients**
- 3. Bridge**

### **Access Points**

**A special type of routing device that is used to transmit the data between wired and wireless networking device is called as AP. It is often connected with the help of wired devices such as Ethernet. It only transmits or transfers the data between wireless LAN and wired network by using infra structure mode of network. One access point can only support a small group of networks and works more efficiently. It is operated less than hundred feet. It is denoted by AP.**

## **Clients**

**Any kind of device such as personal computers, Note books, or any kind of mobile devices which are inter linked with wireless network area referred as a client of wireless LAN architecture.**

## **Bridge**

**A special type of connectors which is used to establish connections between wired network devices such as Ethernet and different wireless networks such as wireless LAN. It is called as bridge. It acts as a point of control in wireless LAN architecture.**

**Two components are also some time play an important role in Wireless LAN architecture i.e.**

- 1. Basic Service Set (BSS)**
- 2. Extended Service Set (ESS)**

## **(b) Explain the following in the context of Transport Layer: Addressing scheme Flow control and Buffering schemes**

- Addressing scheme**
- Flow control and Buffering schemes**

**ANS (B) (I)** An **addressing scheme** is clearly a requirement for communications in a computer network. With an **addressing scheme**, packets are forwarded from one location to another. Each of the three layers, 2, 3, and 4, of the TCP/IP protocol stack model produces a header

**(II)** **Flow control** is a function for the control of the data flow within an OSI layer or between adjacent layers. In other

**words it limits the amount of data transmitted by the sending transport entity to a level, or rate, that the receiver can manage.**

**Flow control is a good example of a protocol function that must be implemented in *several layers* of the OSI architecture model. At the transport level flow control will allow the transport protocol entity in a host to restrict the flow of data over a logical connection from the transport protocol entity in another host. However, one of the services of the network level is to prevent congestion. Thus the network level also uses flow control to restrict the flow of network protocol data units (NPDUs)**

**(c) List different types of transmission media used in data communications. Write one advantage and one disadvantage of each**

**ANS (C)** The means through which data is transferred from one place to another is called transmission or communication media. There are two categories of transmission media used in computer communications.

- **BOUNDED/GUIDED MEDIA**
- **UNBOUNDED/UNGUIDED MEDIA**

**1. BOUNDED MEDIA:**

Bounded media are the physical links through which signals are confined to narrow path. These are also called guide media. Bounded media are made up of an external conductor (Usually Copper) bounded by jacket material. Bounded media are great for LANs because they offer high speed, good security and low cost. However, some time they cannot be used due to distance communication. Three common types of bounded media are used for data transmission. These are

- Coaxial Cable
- Twisted Pairs Cable
- Fiber Optics Cable

**(d) Explain the terms Bandwidth, Channel, Frequency, Amplitude used in Data Communication**

**ANS (D)** Bandwidth is the difference between the upper and lower frequencies in a continuous set of frequencies. It is typically measured in hertz, and may sometimes refer to *passband bandwidth*, sometimes to *baseband bandwidth*, depending on context. Passband bandwidth is the difference between the upper and lower cutoff frequencies of, for example, a band-pass filter, a communication channel, or a signal spectrum. In the case of a low-pass filter or baseband signal, the bandwidth is equal to its upper cutoff frequency.

Bandwidth in hertz is a central concept in many fields, including electronics, information theory, digital communications, radio communications, signal processing, and spectroscopy and is one of the determinants of the capacity of a given communication channel.

A key characteristic of bandwidth is that any band of a given width can carry the same amount of information, regardless of where that band is located in the frequency spectrum.<sup>[note 1]</sup> For example, a 3 kHz band can carry a telephone conversation whether that band is at baseband (as in a POTS telephone line) or modulated to some higher frequency.