Q.2 a. With neat diagrams explain the configuration of a step-by-step switching system. (8)

Answer:

The schematic diagram for such an exchange is given in Fig. Each subscriber is connected to a single rotary pre-selector switch at the exchange, the outputs from this switch being connected to a bank of two-motion switches known as 'group selectors'. The out-puts from the pre-selector switches of a whole group of subscribers are connected together in parallel as that group of subscribers share a single bank of group selectors. When a subscriber lifts his telephone, the cradle switch causes a circuit to be completed back to the telephone exchange, signaling that the subscriber wishes to make a call. This causes the pre-selector switch to step around until it finds a free group selector. The pre-selector switch then stop in this position and the group selector is 'seized' by the subscriber wishing to make a call.

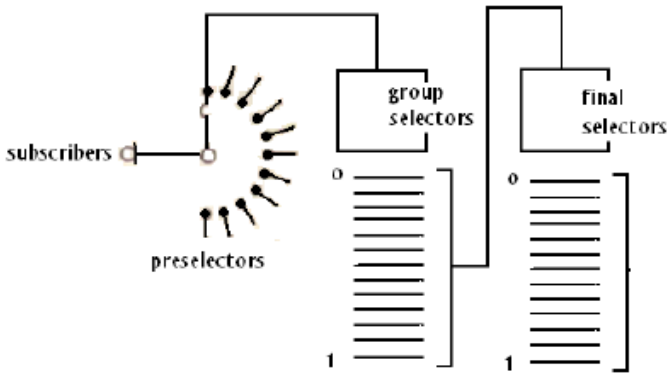


FIG – 1000 Line Exchange

On seizing the group selector, the subscriber dials his first digit and the selector switch moves up to the appropriate row on the switch contact array. Each final selector has the possibility of connection to 100 lines. The 1000 lines are therefore divided into 10 groups of 100 each, the group being identified by the first digit in the subscriber's number. The vertical motion of the group selector therefore selects a final selector in the group associated with the first digit dialed. Each individual row of contacts, or levels, of the group selector is connected to a bank of final selectors associated with a particular group of 100 line numbers. Having dialed the first digit to select the appropriate group, the group selector arm then automatically rotates in the vertical direction until it finds a free final selector. In the final selector, both directions of motion are under the control of the subscriber's dial and, after dialing two further digits, connection is established, providing the called subscriber's to answer his telephone.

b. List the basic functions of a switching system. (8)

Answer:

The switching office performs the following basic functions irrespective of the system whether it is a manual or electromechanical or electronic switching system.

1. **Identity.** The local switching center must react to a calling signal from calling subscriber and must be able to receive information to identify the required destination terminal seize.
2. **Addressing.** The switching system must be able to identify the called subscriber from the input information

3. **Finding and path setup.** Once the calling subscriber destination is identified and the called subscriber is available, an accept signal is passed to the switching system and calling subscriber. Based on the availability, suitable path will be selected.
4. **Busy testing.** If number dialled by the calling subscriber is wrong or the called subscriber is busy (not attending the phone) or the terminal may be free (lifting the phone) but no response (not willing to talk or children handling), a switching system has to pass a corresponding voice message or busy tone after waiting for some time (status).
5. **Supervision.** Once the path is setup between calling and called subscriber, it should be supervised in order to detect answer and clear down conditions and recording billing information.
6. **Clear down.** When the established call is completed, the path setup should be disconnected. If the calling subscriber keeps the phone down first, the signal called clear forward is passed to the switching system. If the called subscriber keeps the phone down first, a signal called clear backward signal is passed to the switching system. By clear signal, the switching system must disconnect the path setup between calling and called subscriber.
7. **Billing.** A switching system should have a mechanism to meter to count the number of units made during the conversation. The cumulative number of units made for a particular duration by the calling subscriber is calculated. This information and if any should be sent to the called subscriber.

Q.3 a. What do you mean by modelling of the traffic? Explain in detail. (8)

Answer:

To analyze the statistical characteristics of a switching system, traffic flow and service time, it is necessary to have a mathematical model of the traffic offered to telecommunication systems. The model is a mathematical expression of physical quantity to represents the behaviour of the quantity under consideration. Also the model provides an analytical solutions to a teletraffic problems. As the switching system may be represented in different ways, different models are
possible. Depending on the particular system and particular circumstance, a suitable model can be selected. In practice, the facilities of the switching systems are shared by many users. This arrangement may introduce the possibility of call setup inability due to lack of available facilities. Also in data transfer, a system has to buffer message while waiting for transmission. Here size of the buffer depends on traffic flow. As serving the number of subscribers subject to fluctuation (due to random generation of subscriber calls, variations in holding time, location of the exchange, limitation in servers etc), modelling of traffic is studied using the concepts and methods of the theory of probability.
If a subscriber finds no available server for his call attempt, he will wait in a line (queue) or leave immediately. This phenomenen may be regarded as a queuing system. The mathematical description of the queuing system characteristics is called a queueing model. Once a mathematical model is obtained, various analytical and computational tools can be used for analysis and synthesis purposes.

b. During a busy hour, 1400 calls were offered to a group of trunks and 14 calls were lost. The average call duration has 3 minutes. Find (a) Traffic offered (b) Traffic carried (c) GOS. (8)

Answer:

Given data : *n = 1400 h = 3 T = 60, lost calls = 14*

(a) **Traffic offered A = (1400 X 3)/60 = 70 E**

(b) **Traffic carried A_0 = (1386 X 3)/60 = 69.3 E**

(c) GOS =(A- A_0) /A_0

where A – A_0 = 70 – 69.3 = 0.7 E (lost traffic)

GOS =07/69. 3= 0.01

Q.4 a. A three stage switching structure is to accommodate N = 128 input and 128 output terminals. For 16 first stage and 16 last stage, determine the number of cross points for nonblocking. If the number of cross points in the example is to be reduced by the factor of 3 with non blocking what is the probability that a call will be blocked? Assume the utilization probability p = 15%. . (8)

Answer:

Sol. The number of matrices at first and last stage is given by $\alpha = \frac{N}{n}$.

Hence $n = \frac{N}{\alpha} = \frac{128}{16} = 8$

To avoid blocking $k = 2n - 1 = 2 \times 8 - 1 = 15.$

Number of crosspoints is calculated by

$$N_x = k\left[2N + \left(\frac{N}{n}\right)^2\right] = 15\left[2 \times 128 + \left(\frac{128}{8}\right)^2\right]$$

$N_x = 7680$ cross points.

Number of cross points = 7680

Number of cross points reduced by factor 3 = $\frac{7680}{3} = 2560.$

For the cross point 2560, the number of k matrices is calculated from

$$N_x = k\,(2N + (N/n)^2]$$

$$k = \frac{N}{[2N + (N/n)^2]} = \frac{2560}{256 + (128/8)^2}$$

$$k = 5$$

$$P = np/k = 8 \times 0.15/5 = 0.24$$

The probability that k links are busy is

$$B = [1 - (1 - P)^2]^k$$

$$B = [1 - (1 - 0.24)^2]^5 = 1.34\%$$

b. Discuss grade of service. During busy hour, 1500 calls were offered to a group of trunks and 8 calls were lost. The average call duration was 120 seconds. Calculate total duration of congestion. (8)

Answer:

Ans:

(i) Grade of service: In loss systems, the traffic carried by the network is generally lower than the actual traffic offered to the network by the subscribers. The overload traffic is rejected and hence it is not carried by the network. The amount of traffic rejected by the network is an index of the quality of the service offered by the network. This is termed **Grade of Service (GOS)** and is defined as the ratio of lost traffic to offered traffic. Offered traffic is the product of the average number of calls generated by the users and the average holding time per call.. Accordingly , GOS is given by

$$GOS = \frac{A - A_0}{A}$$

Where

A= offered traffic

A_0 = carried traffic

$A - A_0$= lost traffic

(ii) we know that

$$\text{Traffic offered} = A = \frac{Ch}{T} = \frac{1500 \times 2}{360} = 50\ E$$

$$\text{Traffic lost} = \frac{8 \times 2}{6/30} = \frac{4}{15}E = 0.26\ E$$

$$\text{Grade of service} = \frac{\text{Number of call lost}}{\text{Number of calls offered}} = \frac{8}{1500}$$

$$\text{Duration of congestion} = \text{Grade of service} \times 1\ h = \frac{8}{1500} \times 3600 = \frac{96}{5} = 19.2\ \text{sec.}$$

Q.5 a. Enlist the important features of T-S-T (time space time) switching. (6)

Answer:

Some important features of TST switches are :

(*i*) **Low blocking probability.** An incoming channel time slot may be connected to an outgoing channel time slot using any possible space array time slot. Thus there are many alternative paths between two subscribers. This concept reduces the blocking probability of a three stage combination switch.

(*ii*) **Stage independancy.** The space stage operates in a time-divided fashion, independently of the external TDM links. The number of space stage time slots L does not coincide with the number of external TDM time slots T.

(*iii*) **Implementation advantage.** The factors to be considered for switching design and implementation are traffic loads, modularity, testability, expandability and simple control requirements. For large switches with heavy traffic loads, the TST have good implementation advantage.

(*iv*) **More cost effective.** If the input channel loading is high, the time expansion of TST and space expansion of STS are required. Time expansion of TST can be achieved at less cost than space expansion of STS.

b. Determine the implementation complexity of 2048 channel TST switch with 16 TDM links and 128 channels. Let the time slot of space switch is 25. (4)

Answer:

Sol. Given $N = 16$

$T = 128$

$L = 25$

$$IC = 16^2 + \frac{16 \times 25 \times \log_2 16 + 2 \times 16 \times 128 \times 8 + 2 \times 16 \times 25 \times \log_2 128}{100}$$

$IC = 656$ cross points.

c. Explain with diagram the Space switching system in detail. (6)

Answer:

Space Switches: Connections can be made between incoming and outgoing PCM highways by means of a cross point matrix of the form shown in Fig. However, different channels of an incoming PCM frame may need to be switched by different cross points in order to reach different destinations. The cross point is therefore a two-input AND gate. One input is connected to the incoming PCM highway and the other to a connection store that produce a pulse at the required instant. A group of cross points gates can be implemented as an integrated circuit, for example by using a multiplexer chip.

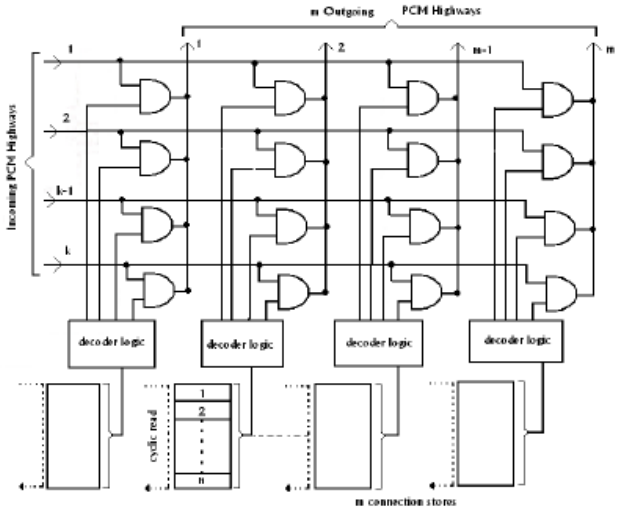


FIG – Space Switch.

Fig. shows a space switch with k incoming and m outgoing PCM highways, Each carrying n channels. The connections store for each column of cross points is a memory with an address location for each time-slot, which stores the number of the cross points to be operated in that time slot. This number is written into the address by the controlling processor in order to setup the connection. The numbers are read out cyclically, in synchronism with the incoming PCM frame. In each time slot, the number stored at the corresponding store address is read out and decoding logic converts this into a pulse or a single lead to operate the relevant cross point.
Since a cross point can make a different connection in each of the n time-slots, it is equivalent to n cross points in a space division network. The complete space switch is thus equivalent to n separate k x m switches in a space division switching network.

Q.6 a. Explain the principles of operation of centralized SPC and distributed SPC. Discuss the various operating modes of centralized SPC. (8)

Answer:

Ans:

In centralized control, all the control equipment is replaced by a single processor which must be quite powerful. It must be capable of processing 10 to 100 calls per second, depending on the load on the system, and simultaneously performing many other ancillary tasks. A typical control configuration of an ESS using centralized SPC is shown in Fig. A centralized SPC configuration may use more than one processor for redundancy purposes there are two approaches to organizing stored program control:

Centralized: In this control, all the control equipment is replaced by a single processor which must be quite powerful.

Distributed: In this control, the control functions are shared by many processors within the exchange itself.

In centralized SPC, dual processor architecture may be configured to operate in one of three modes:

Standby mode: In this mode, one processor is active and the other is on standby, both hardware and software wise. The standby processor brought online when active processor fails. An important requirement of this configuration is the ability of the standby processor to reconstitute the state of the exchange system when it takes over the control.

Synchronous duplex mode: In synchronous duplex mode, hardware coupling is provided between the two processors which execute the same set of instructions and compare the results continuously. If a mismatch occurs, the faculty processor is identified and taken out of service immediately. When the system is operating normally, the two processors have the same data in their memories at all the times and receive all information from the exchange environment.

Load Sharing mode; In load sharing operation, an incoming call is assigned randomly or in a predetermined order to one of the processors which then handles the call right through completion. Thus both the processors are active simultaneously and share the load and the resources dynamically.

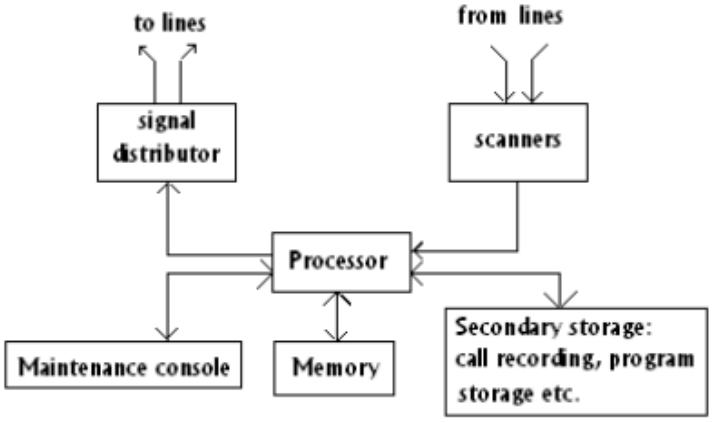
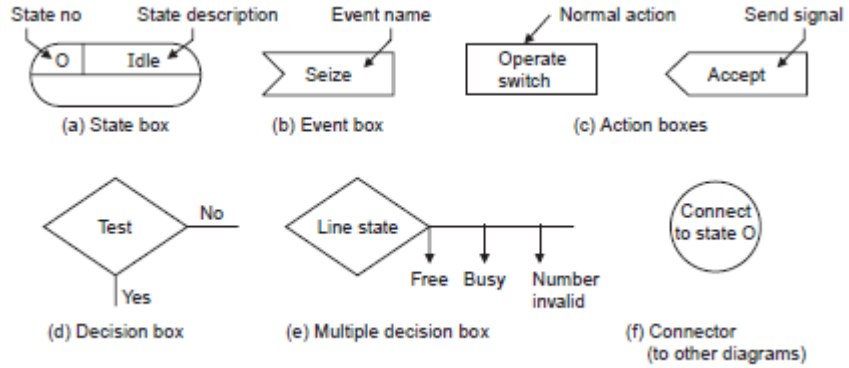


FIG - Typically Centralized SPC Organization .

b. Define State Transition Diagram and explain the various SDL symbols used in state transition diagram. (8)

Answer:

The state transition diagram (s.t.d.) specifies the response of a control unit to any sequence of events. s.t.d. is a powerful design tool. It helps the designer to consider all possibilities of occurence of events. Fig. shows the basic symbols used in a state transition diagram.



The basic symbols are defined as follows :

State boxes. The state boxes are labelled with state number and state description. If necessary, additional information can also be included. The combination of the present state and a new event defines a task and performing this results in next state. Sometimes more than one state occurs, the choise depending on external information.

Event boxes. The intended arrow of the symbol indicate whether the event corresponds to the recipt of forward or backward signal. The forward signal and backward signal refers to the flow of signal from calling to called and called to calling subscriber through exchange respectively.

Action boxes. The rectangular box represents the action taken on the event. The portruding arrow indicates whether the signal is sent forward or backward.

Decision boxes. The diamond shaped box is used for the cases where two divisions are possible. For multiple decisions, another symbol shown in Fig. (*e*) is used.

Connectors. This sysmbols are used to connect one flow chart to another diagram.

Q.7 a. Describe the architecture of SS7 common channel signalling network with the help of a neat diagram. (8)

Answer:

A block schematic diagram of the CCITT no. 7 signalling system is shown in fig. Signal messages are passed from the central processor of the sending exchange to the CCS system. This consists of the microprocessor based subsystem.

The signaling control subsystems, the signaling termination subsystem and the error control subsystem. The signaling control subsystem structures the messages in the appropriate format and queues them for transmission. When there are no messages to send, it generates filler messages to keep the link active. Messages then passed to the signaling termination sub system, where complete signal units (SU) are assembled using sequence numbers and check bits generated by the error control subsystem. At the receiving terminal, the reverse sequence is carried out. The levels are as follows:

Level 1: The Physical Layer
Level 2: The Data Link Level
Level 3: The signaling network level
Level 4: The User Part

The relationship between these levels and the layers of the OSI model is shown in Fig. The user part encompasses layers 4 to 7 of the OSI model.

Level 1 is the means of sending bit streams over a physical path. It uses times lot 16 of a 2 Mbit/s PCM system or times slot 24 of a 1.5 M bit/s system.

Level 2 performs the functions of error control, link initialization, error rate monitoring, flow control and delineation of messages.

Level 3 provides the functions required for a signaling network. Each node in the network has a single point odd, which is a 14 bit address. Every message contains a point code of the originating and terminating nodes for that messages.

Levels 1 to 3 form the message transfer part (MTP) of CCITT no. 7 .

Level 4 is the user part. This consists of the processes for handling the service being supported by the signaling system. The message transfer part is capable of supporting many different user parts. So far, three have been defined: the telephone user part(TUE), the data user part (DUP) and the (ISDN) user part (ISDN-UP).

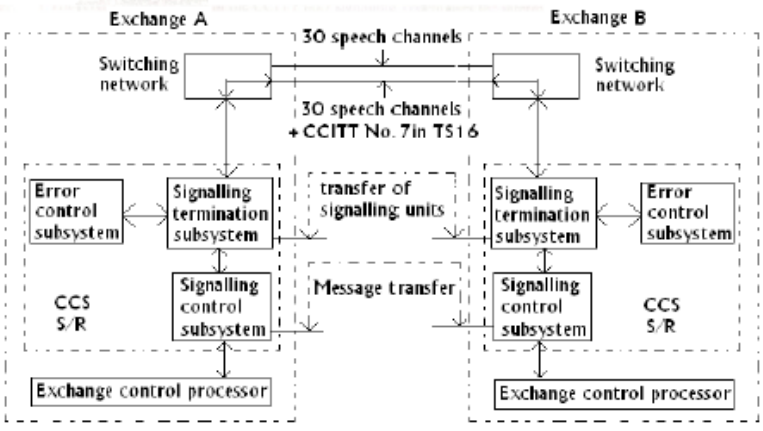


FIG – Block Schematic Diagram of CCITT No.7 Signally System

b. Enlist the advantages and disadvantages of in band and out band voice signalling. (8)

Answer:

In band signalling:

Advantages of Inband signalling:

1. Inband signalling can be used on any transmission medium.
2. The control signals can be sent to every part where a speech signal can reach.
3. Owing to the flexibility of operation, it is the most widely used signalling system for long distance telephone networks.
4. It is operations are simpler.

Disadvantages of Inband signalling :

1. More possibility of speech signals imitating control signals. This problem can be reduced using suitable guard circuit.
2. The inband signal may 'spill-over' from one link to the another and causes error in that signalling system. This limitation occurs when several transmission links one connected end-to-end. The spill over problem can be eliminated by operating a line split to disconnect link whenever a signal is detected. The line split is designed generally to operate with in 35 ms.

Out band signalling:

Advantages:

1. The requirement of line splits are not necessary to avoid sigal limitation.
2. Signals and speech can be transmitted simultaneously without disturbing the conversation.
3. Simple and consequently cheap.

Disadvantages:

1. Very narrow bandwidth is available for signalling.
2. Filtering circuits are needed to handle the signalling bands.
3. More dependent on the transmission system.

Q.8 a. Explain in detail ring and bus topology used in LAN technology. (8)

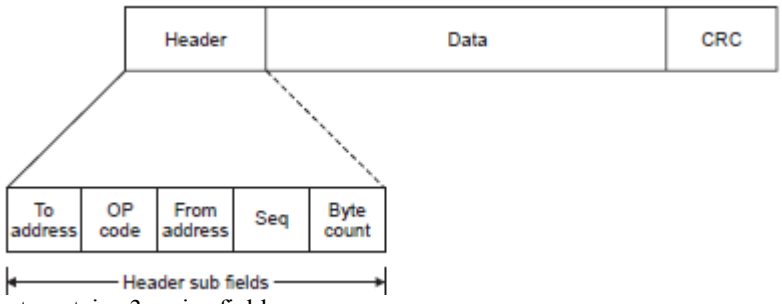
Answer:

Bus Topology: This topology shares a single link or path way among all users. This common single path way is known as bus. In this topology, the link serves as a high way for all data signals, and users connect on to the bus at their node location. In bus configurations, network control is not centralized to a particular node. Here control is distributed among all nodes connected to the LAN. Data transmission on a bus network is usually in the form of small packets containing user addresses and data. When one node/user desires to transmit data to another station, it monitors the bus to determine if it is currently being used. If no other nodes/users are communicating over the network, the monitoring node/user can start to transmit its data. Each node must monitor all transmission on the network and determine which are intended for them.

Ring Topology: In ring topology, all user nodes are connected with the physical path acting as links of a chain and the last user node is connected back to the first node. A signal going on to the next node must be processed by the first node, which then passes it through to the next node. Adding a new user requires breaking the ring temporarily, inserting the new node and then reestablishing the complete ring path.

b. Draw the Frame format of typical packet switching and explain various fields. (8)

Answer:



A packet contains 3 major fields.

1. **Header.** It contains sub fields in addition to the necessary address fields. Other than the to and from address field, the following are the useful control information.

(*a*) **Op code.** It designates whether the packet is a message (text) packet or control packet.

(*b*) A **sequence number (Seq)** to reassemble messages at the destination node, detect faults and facilitates recovery procedures.

(*c*) **Byte count.** Used to indicate the length of a packet.

2. **Data.** A portion of a data stream to be transferred in the data field. Some packets may not contain a message field if they are being used strictly for control purposes.

3. **CRC.** The cyclic redundancy checks (CRC) field contains a set of parity bits that cover overlapping fields of message bits. The fields overlap in such a way that small numbers of errors are always detected. The probability of not detecting the occurrence of 2 large number of errors is 1 in 2^M, where M is the number of bits in the cheek code

Q.9 a. Explain the working of broad band ISDN. (8)

Answer:

BISDN Configuration: Fig. shows how access to the BISDN network is accomplished. Each peripheral device is interfaced to the access node of a BISDN network through a broadband distant terminal (BDT). The BDT is responsible for electrical to optical conversion, multiplexing of peripherals, and maintenance of the subscriber's local system. Excess nodes concentrate several BDT's into high speed optical fiber line directed through a feeder point into a service node. Most of the control function for system excess is managed by the service node, such as call processing, administrative function and switching and maintenance functions. The functional modules are interconnected in a star configuration and include switching, administrative, gateway, and maintenance modules. The interconnection of the function module is shown in Fig. The central control hub acts as the end user interface for control signaling and data traffic maintenance. In essence, it oversees the operation of the modules.

Subscriber terminal near the control office may by pass the excess nodes entirely and the directly connected to the BISDN network through a service node. BISDN nodes that used optical fiber cables can utilize much wider band width and consequently, have higher transmission rates and offer more channel handling capacity than ISDN systems.

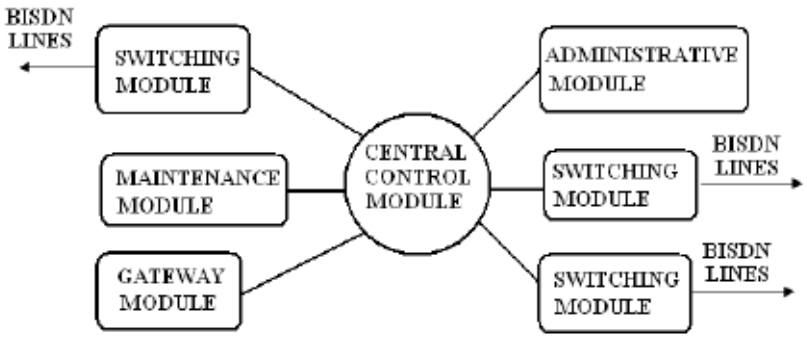


FIG - BISDN Functional Module Interconnection

b. Explain the concept of Network management and the various services associated with network management. (8)

Answer:

The basic goal of the network management is to maintain efficient operations during equipment failures and traffic overloads. Also controlling the flow of call requests during network overloadis a vital function of network management. For the effective network management the study of various services provided by the network, offered load of the network, classification of the network based on services offered, interconnection of different types of networks and network planning is important. Based on the data available for the above factors, the network management is become updated.

Network services : The capabilities often collectively referred to "as intelligence" within the network are listed below. Depending upon the applications the network is to handle the interconnectivity with other networks. The following functions and its essential parts are included in the network. Various services are :

1. **Switching.** The process of interconnecting incoming calls or data to the appropriate outgoing channel called destination is referred switching. Various switching methods right from manual exchange to the automated digital switching system were discussed in previous chapters.
2. **Routing.** The ability of the network to select a path to connect calling and called subscriber for telephone conversations or providing path for data transfer between source and destination is referred as routing. The network generally choses a path and sometimes user may specify it.
3. **Flow control.** It is the ability of a network to reject traffic. Managing the rate at which traffic enters a network is referred to as flow control. A network without effective flow control procedures becomes very inefficient.
4. **Security.** There are two ways of providing security of the network. First, to increase the security of operation in presence of faults. To provide adequate security, the complete network may be duplicated or triplicated. Second, preventing unauthorized access to the network and the data it carries. This may be achieved by pass words, data encryption and providing limiting factors in accessing the network.
5. **Signalling.** A signalling system link the variety of switching system, transmission system and subscriber equipments in a telecommunication network to enable the network to function as a whole.
6. **Traffic management.** The ability of the network to keep track of traffic levels is referred as traffic management. Traffic management is useful both in short term and long term bases. On a short term basis, it can be used to support dynamic routing and flow control. Over a long term it can be used in network design to identify parts of the network where capacity may be productively increased or decreased.
7. **Accountability.** This includes charging, billing, accounting and inventory control. This is the ability of the network to track the users of the network.
8. **Administration.** It is related to the ability of the network to identify the load of a network and providing corresponding upgradition of parts, extention of networks facility. It also identities the sales strategy, investment planning etc.

TEXT BOOK

I. Telecommunications Switching, Traffic and Networks, J.E.Flood, Pearson Education, 2006
II. Telecommunication Switching Systems and Networks, Thiagarajan Viswanathan, Prentice Hall of India Pvt. Ltd, 2006