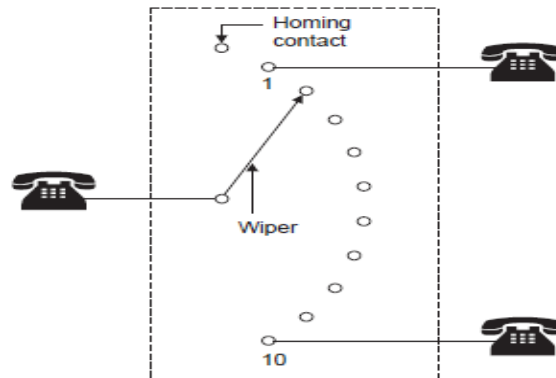


**Q2 (a) Write short notes on (a) uniselector and (b) two motion selector.**

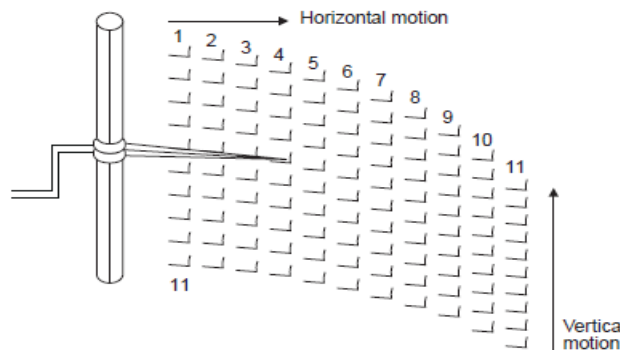
**Answer**

Uniselectors. A uniselector is a one which has a single rotary switch with a bank of contacts. Depending upon the number of switching contacts, uniselectors are identified as 10 outlet or 24 outlet uniselectors. A single 10 outlet or 24 outlet uniselector can be used as a switching element for 10 or 24 subscribers. Several uniselectors can be graded together so that multiple incoming circuits can be connected to multiple outgoing circuits.



The contact arm (wiper) moves across a fixed set of switch contacts. In the case single uniselector, each contact is connected to an outgoing channel, so a caller can choose to connect to any of 10 different subscribers by dialling any digit from 1 to 10. As this selector moves in just one plane, thus sort of automated selector is known as uniselector. An uniselector is operated by (wiper movement) is performed by a drive mechanism of a rotary switch. This mechanism contains an armature, electromagnet, Pawl, and Ratched wheel. The wiper is attached to the ratchet wheel. When the line relay detects a calling signal, the magnet is energised and operates the ratchet wheel, pawl and its associated wiper. When the electromagnet is deenergised the armature is released and returns to its rest position. Thus, if the electromagnet is energised and deenergised, (for example 3 times by applying 3 pulses), the wiper moves by three contacts.

Two motion selectors. A two motion selector is a selector in which a set of wipers is moved in two different planes by means of separate mechanisms. By mounting several arcs of outlets on top of each other, the number of outlets can be increased significantly, but the wipers are then required to move both horizontally to select a bank and then vertically to move around that bank to the required outlet. Such a selector is known as a two motion selector



Typically, the outlets are arranged in banks of ten rows or ten contacts each. A given outlet may be reached by between one and ten vertical steps followed and by one to ten horizontal steps. Thus the wiper in a two motion selector has access to 100 switching contacts. It has two rotary switches. One for the vertical movement of the wiper and another for horizontal movement of the wiper. Actually there are 11 vertical positions and 11 horizontal contacts. The lowest vertical position and first horizontal position in each vertical level are home position.

**Q2 (b) List the basic functions of a switching system.**

**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.

**Q3 (a) What do you mean by modelling of the traffic? Explain in detail?**

**Answer**

To analyse 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 phenomenon may be regarded as a queuing system. The mathematical description of the queuing system characteristics is called a queuing model. Once a mathematical model is obtained, various analytical and computational tools can be used for analysis and synthesis purposes.

**Q3 (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.**

**Answer**

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

$$(a) \text{ Traffic offered } A = (1400 \times 3)/60 = 70 \text{ E}$$

$$(b) \text{ Traffic carried } A_0 = (1386 \times 3)/60 = 69.3 \text{ E}$$

$$(c) \text{ GOS} = (A - A_0) / A_0$$

$$\text{Where } A - A_0 = 70 - 69.3 = 0.7 \text{ E (lost traffic)}$$

$$\text{GOS} = 0.7/69.3 = 0.01$$

**Q3 (c) Define calling rate and holding time.**

**Answer**

**Calling rate:** This is the average number of requests for connection that are made per unit time. If the instant in time that a call request arises is a random variable, the calling rate may be stated as the probability that a call request will occur in a certain short interval of time.

If 'n' is the average number of calls to and from a terminal during a period T seconds, the calling rate is defined as

$$\lambda = \frac{n}{T}$$

**Holding time:** The average holding time or service time 'h' is the average duration of occupancy of a traffic path by a call. For voice traffic, it is the average holding time per

call in hours or 100 seconds and for data traffic, average transmission per message in seconds. The reciprocal of the average holding time referred to as service rate ( $\mu$ ) in calls per hour is given as

$$\mu = \frac{1}{h}$$

**Q4 (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 crosspoints 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  $p = 15\%$ .**

**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

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

$$N_x = 7680 \text{ cross points.}$$

$$\text{Number of cross points} = 7680$$

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

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

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

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

**Q4 (b) Define grading in telecommunication switching networks.**

**Answer:**

Grading: for a route switch it is not necessary for each incoming trunk to have access to every outgoing trunk. It is adequate if each incoming trunk has access to a sufficient number of trunks on each route to give the required grade of service. The technique of interconnecting the multiples of switches is called Grading.

**Q4 (c) Design a strictly non blocking network for 1000 incoming and 1000 outgoing trunks. Also calculate the total cross points.**

**Answer**

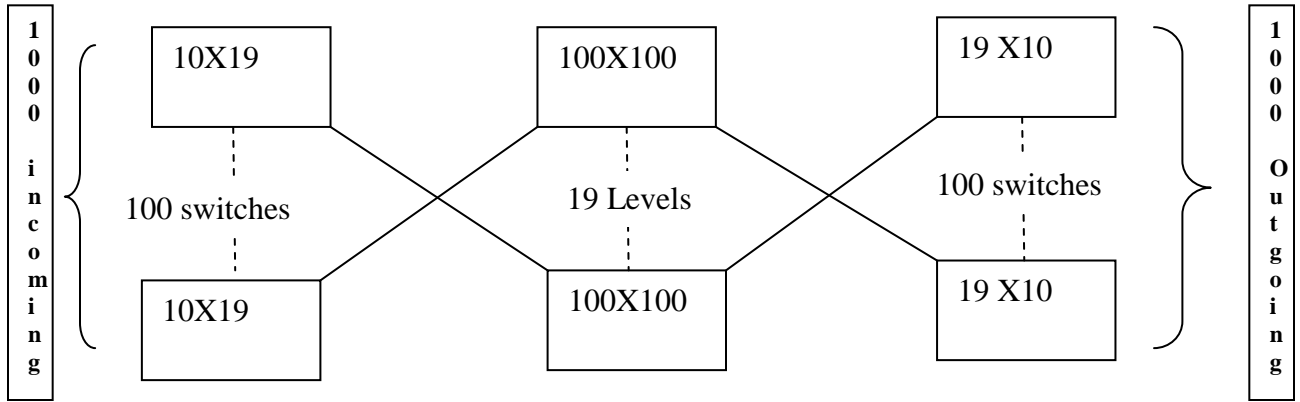
Choose a five stage network. The minimum number of cross point is obtained when

$$n = (2N)^{1/3} = 2000^{1/3} = 12.599$$

Use  $n=10$

The number of levels needed is  $2n-1=19$

No of switches in 1<sup>st</sup> stage = No of switches in 5<sup>th</sup> stage =  $1000/10=100$



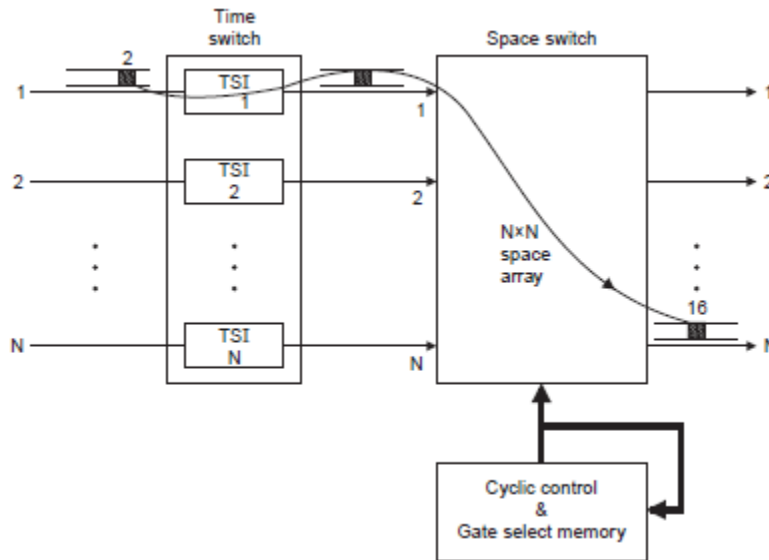
The number of cross points is

$$= 100 \times 10 \times 19 + 19 \times 5400 + 100 \times 19 \times 10 = 140600$$

**Q5 (a) Draw and explain time division space switching in detail.**

**Answer:**

This switch consists of only two stages. This structure contains a time stage T followed by a space stage S as shown in Figure. Thus this structure is referred to as time-space (TS) switch. The space arrays have N inlets and N outlets. For each inlet line, a time slot interchanger with T slots is introduced. Each TSI is provided with a time slot memories. Similarly a gate select memory needs to be provided for the space array.



The transmission of signals carried out from sender to receiver through multiplexer input and de multiplexer output. The reverse communication also similar. Thus a hybrid arrangement is needed to isolate the transmitted signal from the received signal. The basic function of the time switch is to delay information in arriving time slots until the desired output time slot occurs.

**Q5 (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.**

**Answer:**

Sol. Given  $N = 16$

$T = 128$

$L = 25$

$$IC = 16^3 + \frac{16 \times 25 \times \log_2 16 + 2 \times 16 \times 128 \times 8 + 2 \times 16 \times 25 \times \log_2 128}{100}$$

$IC = 656$  cross points.

**Q5 (c) Enlist any four important features of T-S-T (time space time) switching.**

**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 independency.** 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  $T$ .

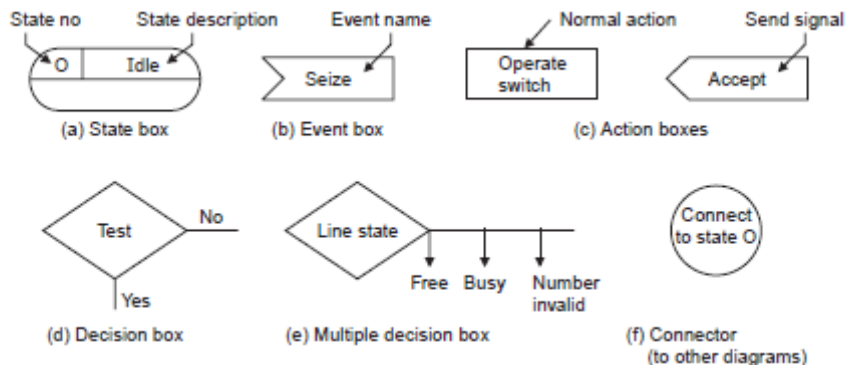
(iii) **Implementation advantage.** The factors to be considered for switching design and implementation are traffic loads, modularity, testability, expandability and simple control requirements. For large switches with heavy traffic loads, the TST have good implementation advantage.

(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.

**Q6 (a) Define State Transition Diagram and explain the various SDL symbols used in state transition diagram.**

**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 occurrence 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 these results in next state. Sometimes more than one state occurs, the choice depending on external information.

**Event boxes.** The intended arrow of the symbol indicates whether the event corresponds to the receipt 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.

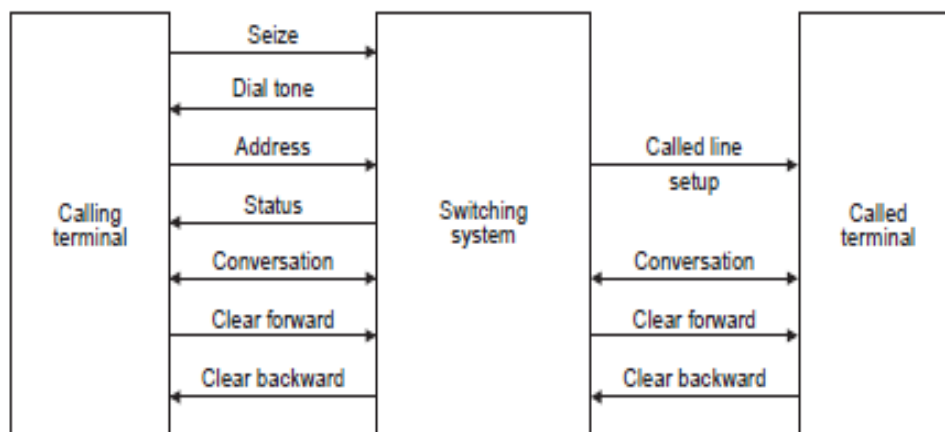
**Action boxes.** The rectangular box represents the action taken on the event. The protruding arrow indicates whether the signal is sent forward or backward.

**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 symbols are used to connect one flow chart to another diagram.

**Q6 (b) Draw the signal exchange diagram for a local call used to represent the sequence of events between the subscriber and exchanges?**

**Answer**



**Q7 (a) Enlist the advantages and disadvantages of in band and out band voice signalling?**

**Answer**

In band signaling:

Advantages of In band signalling:

1. In band 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. Its operations are simpler.

Disadvantages of In band signalling:

1. More possibility of speech signals imitating control signals. This problem can be reduced using suitable guard circuit.
2. The in band signals may 'spill-over' from one link to the another and causes error in that signalling system. This limitation occurs when several transmissions 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 signal 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.

**Q7 (b) Explain Channel Associated mode, Channel Non-Associated mode and Quasi-Associated mode of common channel signalling networks.****Answer**

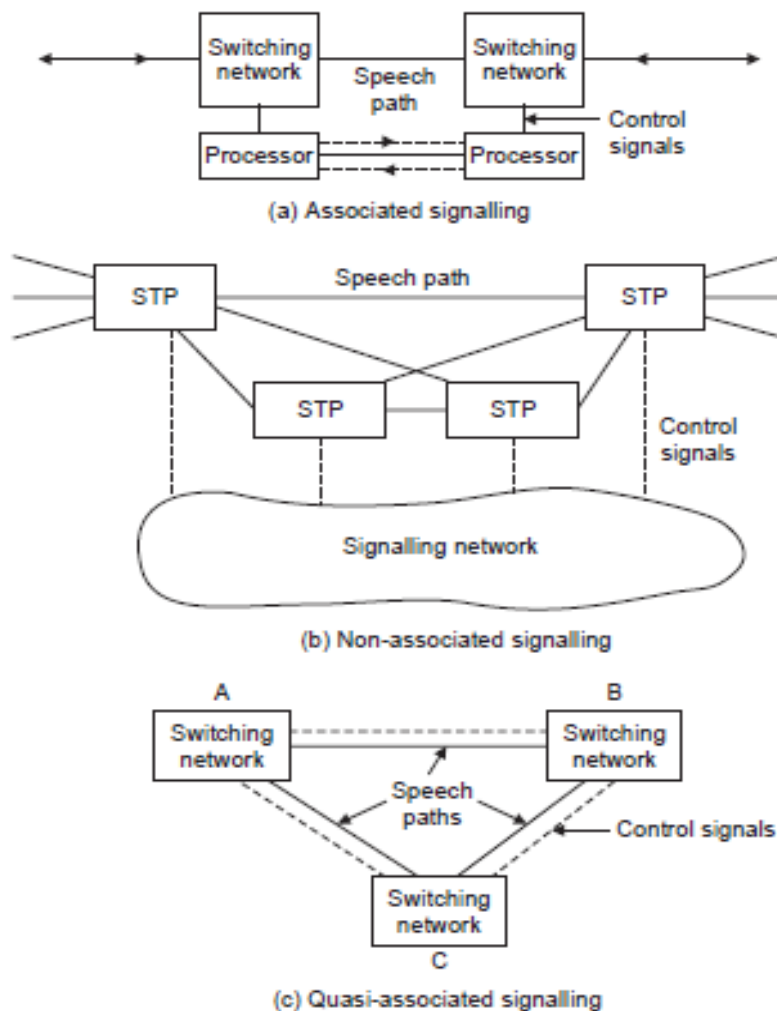
In associated CCS signalling mode, there is a direct link between two exchanges. In this mode, the signalling path passes through the same set of switches as does the speech path. Network topologies of the signalling network and the speech network are the same. This mode of operation is simple, economic and easy to control. This involves in delayed operation for long distance communication.

In non-associated CCS signalling, there are separate controls of the networks from the switching machines themselves. In multi exchange network, signal message passing through several intermediate nodes is referred as non-associated signalling. The network topologies for the signalling and the speech networks are different. Between exchanges, many STP's are placed. This approach is flexible as far as the routing is concerned. It demands more comprehensive scheme for message addressing than is needed for channel associated signalling.

In practice, CCS messages are routed through one intermediate node for short distance communication. This is known as quasi-associated signalling. It establishes simplified



predetermined paths between exchanges. The signalling paths are not associated but are fixed for given speech connections.



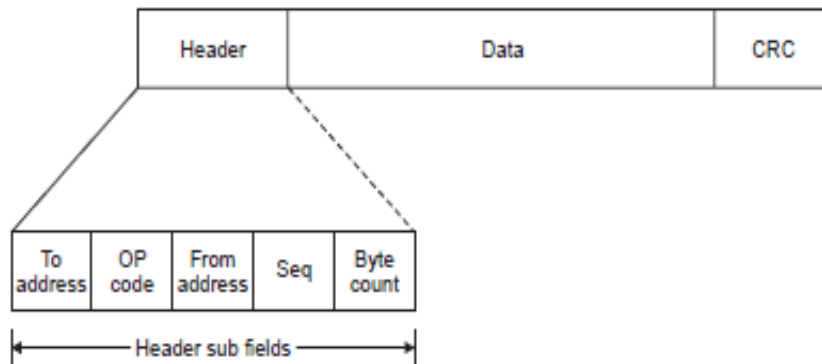
**Q7 (c) What are the various features of CCITT SIGNALLING SYSTEM 7(SS7).**

**Answer**

1. Internationally standardised by the ITU.
2. SS7 is suitable for any transmission medium *i.e.*, can be operated over both terrestrial and satellite links.
3. Even though SS7 is optimised to work with digital SPC exchanges utilising 64 kbps digital channels, it is suitable for operation over analog channels.
4. SS7 is suitable for various communication services such as telephony, text, data, images and video.
5. Transport mechanism is application independent.

**Q8 (a) Draw the Frame format of typical packet switching and explain various fields?**

**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 check code.

**Q8 (b) A pure ALOHA system uses a 56 kbit/s channel. On an average, each terminal originates a 1024-bit packet every 30 seconds. How many terminals can the system accommodate? How many terminals could the system accommodate using the slotted ALOHA protocol?**

**Answer**

$$\text{Duration of Packet} = 1024/56 = 18.3 \text{ ms.}$$

$$\text{Traffic per terminal} = (18.3 \times 10^{-3})/30 = 6.1 \times 10^{-4} \text{ E}$$

$$N = 104 / (6.1 \times 2e) = 301$$

So pure aloha can accommodate 301 terminals.

$$\text{For slotted ALOHA the number of terminals} = 10^4/6.1e = 603$$

**Q8 (c) Draw Asynchronous Transfer Mode (ATM) header structure.**

**Answer**

	1	2	3	4	5	6	7	8
1	GFC				VPI			
2	VPI				VCI			
3	VCI				VCI			
4	VCI				PT		CLP	
5	Header error check							
	Cell payload (48 bytes)							

**Q9 (a) Explain three types of ISDN channels. Tabulate the specifications of all the channels**

**Answer**

ISDN consists of three types of communications channels. They are:

1. Bearer channel (B channel)
2. Delta channel (D channel), and
3. Hybrid channels (H channel).

These three ISDN channels are described below.

**B channel** B channels are logical digital “pipes” which exist on a single ISDN line. B channels carry data and services at 64 kbps. It carries data in full duplex mode. Each B channels provide a 64 kbps clear channel, clear meaning that the entire bandwidth is available for data, B channels typically form circuit switched connections. B channel connection is an end-to-end physical circuit that is temporarily dedicated to transferring data between two devices. The circuit switched nature of B channel connections; combined with their reliability and relatively high bandwidth makes ISDN suitable for a range of applications including voice, video, fax and data. B channels are normally used for on-demand connection. As B channel operation based on circuit switching, it can be configured as semi permanent or “nailed up” connections.

**D channel** D channel can be either 16 or 64 kbps, depending on the needs of the user. The primary function of the D channel is to carry control signalling and administrative information for B channels to set up and tear down the calls. The D channel uses packet switched connection. The packet switched connection are best adapted to the intermittent but latency sensitive nature of signalling traffic, accounting for the highly reduced call setup time of 1 to 2 seconds on ISDN calls. Unlike the B-channel, which can function as a simple ‘pipe’, the D channel is associated with higher level protocols at layers 2 and 3 of OSI model which form the packet switched connections. The D channel provides the signalling information that is required for caller identification. It also includes low-rate data transfer and applications such as telemetry and alarm transmission.

**H channels** H channels are suitable for high data rate applications such as video, teleconferencing and so on. Table gives ISDN channel and its specifications.

Channel	Bit rate (kbps)	Interface	Purpose
B	64	BRI	Bearer services
HD	384	PRI	6 B channels
H11	1536	PRI	24 B channels
H12	1920	PRI	30 B channels
D	16	BRI	Administrative and control signalling
D	64	PRI	”

**Q9 (b) Explain the concept of Network management and the various services associated with network management.**

**Answer** Page Number 254-286 of Text Book I

#### Text Books

- 1. Telecommunications Switching, Traffic and Networks, J.E.Flood, Pearson Education- 2006.**
- 2. Telecommunication Switching Systems and Networks, Thiagarajan Viswanathan, Prentice Hall of India Pvt. Ltd, 2007.**