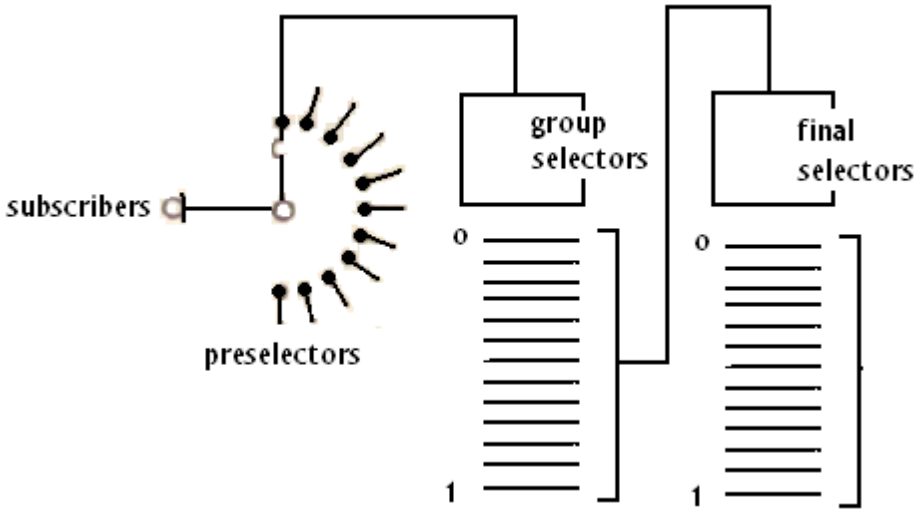
Q.2a. With neat diagrams explain the configuration of a step-by-step switching system.

Ans:

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.



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.

Ans: 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.**
2. **Addressing.**
3. **Finding and path setup.**
4. **Busy testing**
5. **Supervision.**
6. **Clear down.**
7. **Billing**

Sec 3.5 of Book 1

Q.3 a. Define calling rate and holding time.

Ans:

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 (μ) in calls per hour is given as

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

b.On average, during the busy how, a company makes 120 outgoing calls of average duration 2 minutes. It receives 200 incoming calls of average duration 3 min. To obtain a grade of service of 0.01 for both incoming and outgoing calls, how many exchange lines are required if:

(i) Incoming and Outgoing calls are handled on separate group of lines

(ii) A common group of lines are used for both incoming and outgoing calls. [refer

Table 1]

3(b) Outing Traffic = 120 x 2/60= 4E

Incoming Traffic = 200 x 3/60 =10E

Total traffic = 4+10 = 14E

From Table(4.1) for 0.01 4OS

1) 4E traffic needs 10 lines
10E traffic need 18 lines

Total lines needed for separate handling 10 + 18 = 28 lines

2) For common group of lines

14 E traffic needs 23 lines

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 non blocking. 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%.

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.Compare single stage and multi stage networks.

Sr. No.	Single Stage	Multi Stage
1.	Inlet to outlet connection is through a single cross point.	Inlet to Outlet connection is through multiple cross points
2.	Use of single cross point per connection results in better quality link.	Use of multiple cross points may degrade the quality of a connection.
3.	Each individual cross point can be used for only one inlet/outlet pair connection.	Same cross point can be used establish connection between a number of inlet/outlet pairs.
4.	A specific cross point is needed for each specific connection.	A specific connection may be established by using sets of cross points.
5.	If a cross points fails, associated connection cannot be establish- There is no redundancy.	Alternative cross-points and paths are available.
6.	Cross points are inefficiently used. Only one cross point in each row or column of a square or triangular switch matrix is even in use , even if all the lines are active.	Cross points are used Efficiently
7.	Number of cross points is Prohibitive	Number of cross points is reduced significantly
8.	A large number of cross points in each inlet/outlet leads to capacitive loading.	There is no capacitive loading problem
9.	The network is non blocking in character	The network is blocking in character
10.	Time for establishing a call is less.	Time for establishing a call is more.

C Define grading in telecommunication switching networks.

Ans:

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.

Q.5 a. What is time multiplexed space switching? With a neat diagram explain its operation.

Ans: Time division switches where an inlet or an outlet corresponded to a single subscriber line with one speech sample appearing every 125 μs on the line. Such switches are used in local exchanges. We now consider switches that are required in transit exchanges. Here, the inlets and outlets are trunks which carry time division multiplexed data streams. We call such switches time multiplexed switches. A time multiplexed time division space switch is shown in Fig. There are N incoming trunks and N outgoing trunks, each carrying a time division multiplexed stream of M samples per frame. Each frame is of 125-μs time duration. In one frame time, a total of MN speech samples have to be switched. One sample duration, 125/M microseconds, is usually referred to as a time slot. In one time slot, N samples are switched. Fig shows an output-controlled switch. The output is cyclically scanned. There is a 1-to-M relationship between the outlets and the control memory locations, i.e. there are M locations in the control memory corresponding to each outlet.

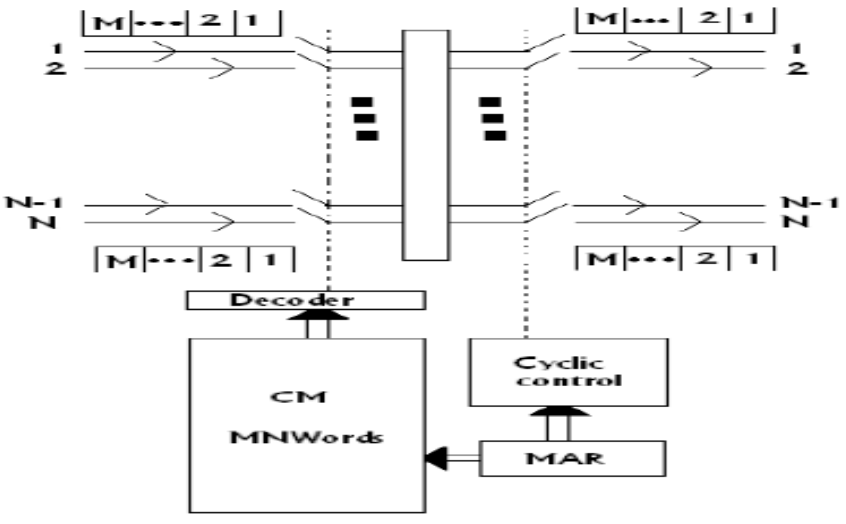


FIG – Time Multiplexing Space Switch

The control memory has MN words. If we view the control memory as M blocks of N words each, a location address may be specified in a two dimensional form,(i,j),where i is the block address and j is the word within the block. We have $1< i < M$ and $1< j < N$. The block address i corresponds to the time slot i and the word address j to the outlet j. The first N locations of the control memory correspond to

the first time slot, the next N locations, i.e. locations N + 1 to 2N when addressed linearly, or locations (2,1) to (2,N) when addressed in a two dimensional form, correspond to the time slot 2 and so on. Therefore, if the location (i,j) contains an inlet address k, it implies that inlet k is connected to the outlet j during the time slot i. The number of trunks that can be supported on this switch is given by N =125/ Mt , Where t is the switching time including memory access time per inlet-outlet pair.

b.Calculate the maximum access time that can be permitted for the data and control memories in a TSI switch with a single input and single output trunk multiplexing 2500 channels. Also, estimate the cost of the switch and compare it with that of a single stage space division switch.

$$t_m = \frac{125 \text{ X } 10^3}{2500 \text{ X } 2} = 25 \text{ ns}$$

C= 2 X 2500 = 5000 units

This switch is non blocking and supports full availability. An equivalent single stage space division which uses a matrix of 2500 X 2500. Hence, the cost of such a switch is 6.25 million units

Cost advantage of time switch = $\frac{6.25 \text{ X } 10^6}{5000} = 1250$

Q.6a. What is stored program control (SPC)? Give the different configurations of centralized SPC. Discuss the advantages of SPC automation in telephone switching. (8)

Ans: **stored program control systems**, a program or set of instructions to the computer i stored in its memory and the instructions are executed automatically one by one by th processor. Carrying out the exchange control functions through programs stored in th memory of a computer led to this name.

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

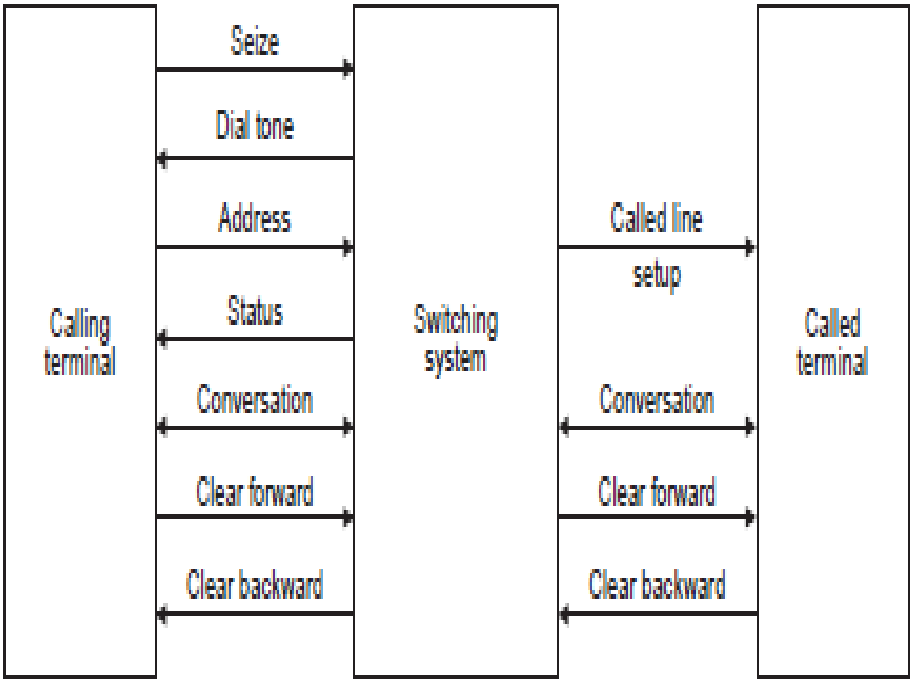
1. **Standby mode**: In this mode, one processor is active and the other is on standby, both hardware and software wise. The standby processor brought online when active processor fails. An important requirement of this configuration is the ability of the standby processor to reconstitute the state of the exchange system when it takes over the control.
2. **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.
3. **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.

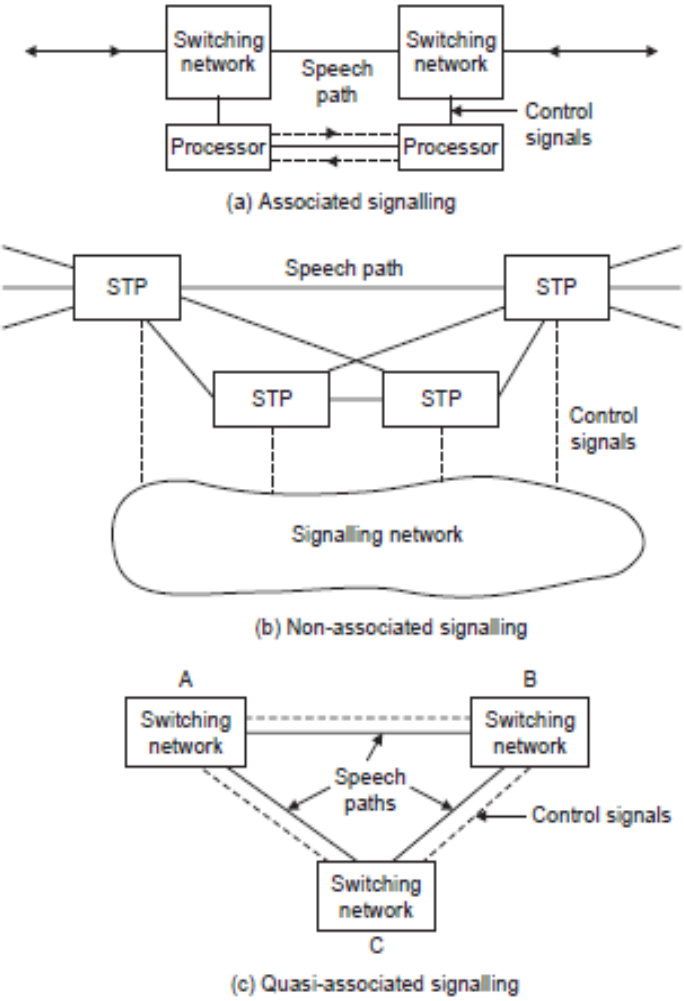
Advantages of SPC:

(i) Easy to control
(ii) Easy to maintain
(iii) Flexible

b. Draw the signal exchange diagram for a local call used to represent the sequence of events between the subscriber and exchanges.



Q.7 a. Explain Channel Associated mode, Channel Non-Associated mode and Quasi-associated mode of common channel signalling networks.



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 control of the networks from the switching machines themselves. In multiexchange 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.

b. Enlist the advantages and disadvantages of in band and out band voice signaling.

Ans:

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. What is 'ALOHA' protocol? How is slotted ALOHA different from pure ALOHA? Discuss both in detail.

Ans : Book 1 of 9.3.1

b.Explain the Asynchronous Transfer Mode (ATM) in detail.

Ans : Book 1 of 9.5.2

Q.9 Explain any TWO in detail:

(i) Cellular radio networks

(ii) Intelligent networks

(iii) Private networks

Ans : Book 1 of 10.5, 10.6, 10.7

Textbook

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, 2006**