T S C N

UNIT 1

- INTRODUCTION
- Evolution of Telecommunication
- Basics of Switching
- Strowger switching System
- Cross-bar switching
- Electronic Space division switching.

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Introduction

- Telecommunication networks carry information signals among entities which are geographically far apart. An entity may be a computer, a human being, a facsimile machine, a teleprinter, a data terminal, and so on. Billions of such entities the world-over are involved in the process of information transfer which may be in the form of a telephone conversation or a file transfer between two computers or a message transfer between two terminals, etc.

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- In telephone conversation, the one who initiates the call is referred to as the calling subscriber and the one for whom the call is

  destined is the called subscriber.
- In other cases of information transfer the communicating entities are known as source and destination.
- The full potential of telecommunications is realized only when any entity in one part of the world can communicate with any other entity in another part of the world.
- Connectivity of telecommunication networks is achieved by the use of switching systems. This text deals with the telecommunication switching systems and the networks that use them to provide worldwide connectivity.

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Evolution of Telecommunication

- transmission of telegraphic signals over wires was the first technological development in the field of modern telecommunication
- telegraphy was introduced 1837 in Great Britain and in 1845 in France March 1876, Alexander Graham Bell demonstrated his telephone set and the possibility of telephony, i.e. long-distance voice transmission
- Graham Bell demonstrated a point-to-point telephone connection.

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A network with point-to-point links

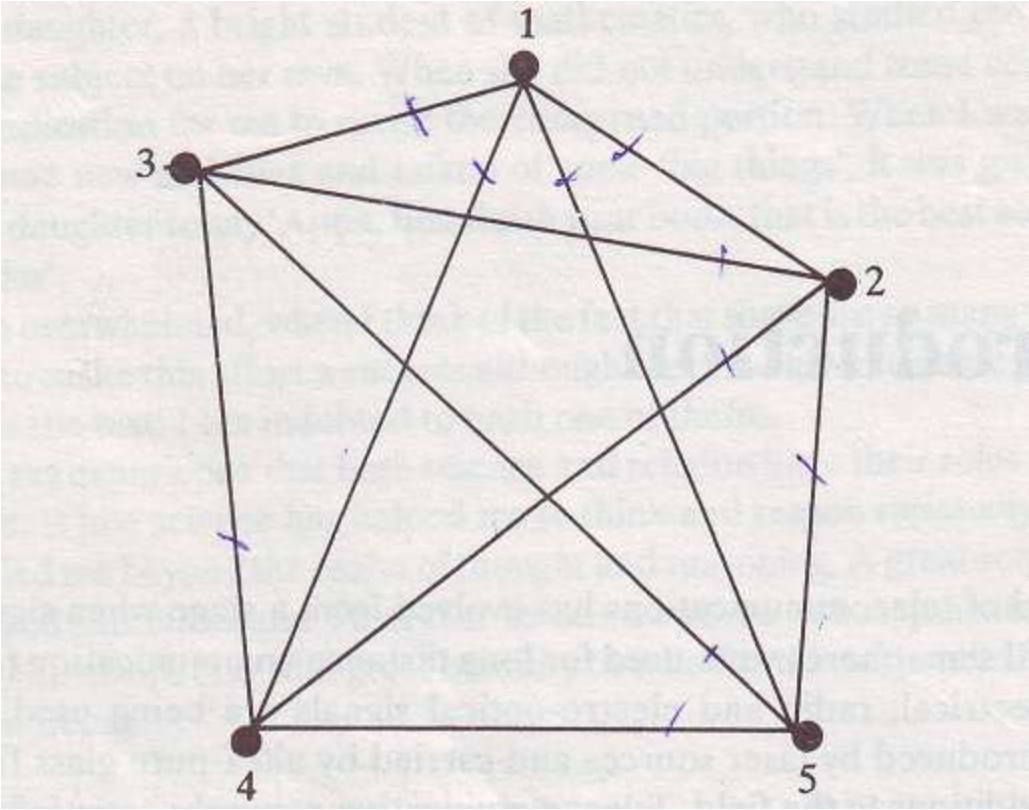

Fig 1

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- A network using point-to-point connections is shown in Fig. 1
- In such a network, a calling subscriber chooses the appropriate link to establish connection with the called subscriber.
- In order to draw the attention of the called subscriber before information exchange can begin, some form of signalling is required with each link. If the called subscriber is engaged, a suitable indication should be given to the calling subscriber by means of signalling.

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- In fig 1 there are five entities and 10 point-to-point links
- In a general case with n entities, there are $n(n-1)/2$ links.
- Let us consider the n entities in some order. In order to connect the first entity to all other entities, we require $(n-1)$ links.
- With this, the second entity is already connected to the first. We now need $(n-2)$ links to connect the second entity to the others.
- For the third entity, we need $(n-3)$ links, for the fourth $(n-4)$ links, and so on.
- The total number of links, L

$$L = (n-1)+(n-2)+(n-3)+ \text{-----------} +1+0= n(n-1)/2$$

- A network with point-to-point links among all the entities are known as fully connected network.

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- a large scale or even on a moderate scale demanded not only the telephone sets and the pairs of wires, but also the so-called switching system or the switching office or the exchange With the introduction of the switching systems the subscribers are not connected to directly to one another in stead, they are connected to the switching system as shown in Fig. 2 When a subscriber wants to communicate with another a connection is established between the two at the switching system

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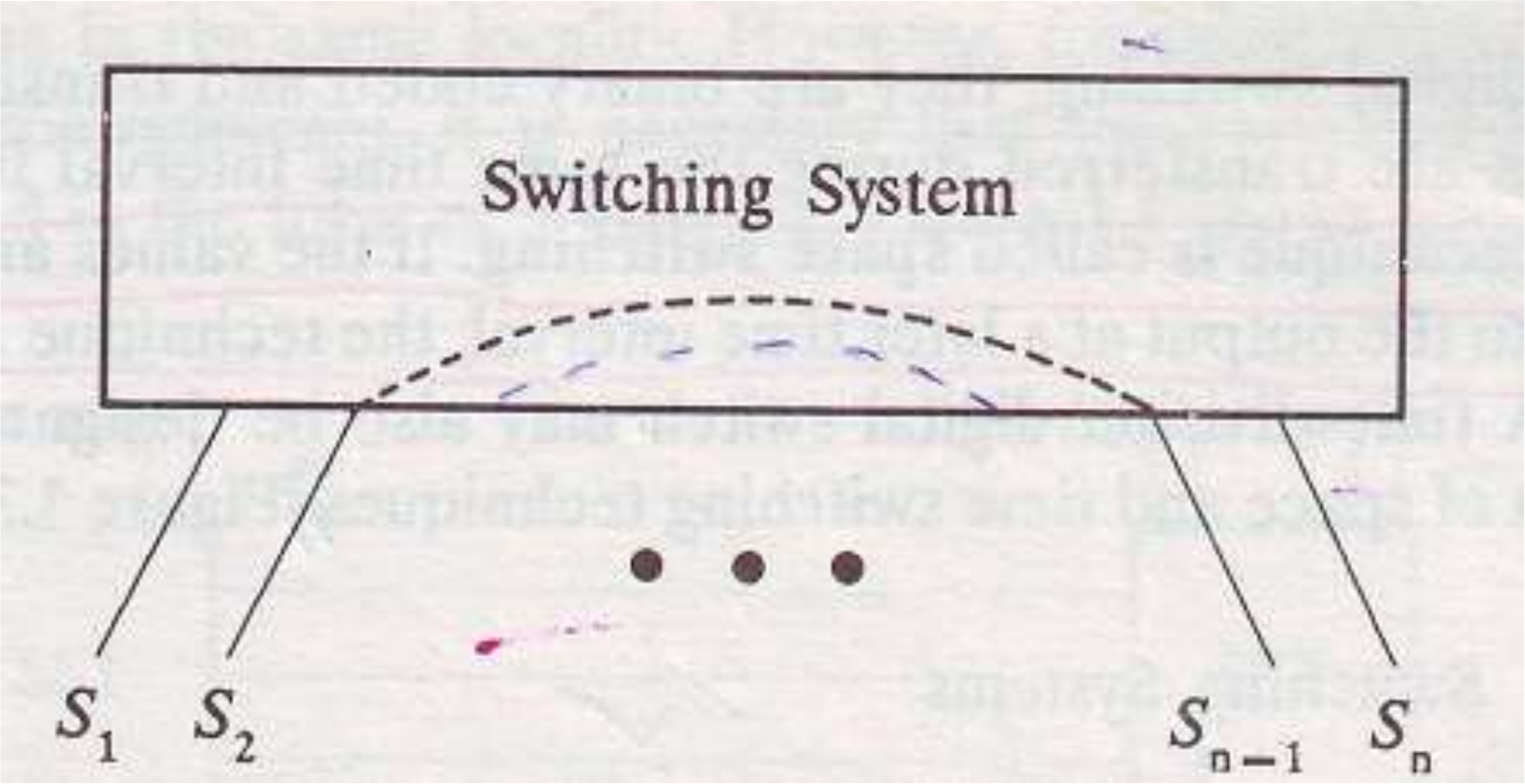

Fig. 2 Subscriber interconnection using a switching system

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- Figure 2 shows a connection between subscriber S_2 and S_{n-1}.
- In this configuration, only one link per subscriber is required between the subscriber and the switching system, and the total number of such links is equal to the number of subscribers connected to the system.
- Signaling is now required to draw the attention of switching system to establish or release connection.
- It should also enable the switching system to detect whether a called subscriber is busy and, if so, indicate the same to the calling subscriber .
- The functions performed by a switching system in establishing and releasing connections are known as control function.

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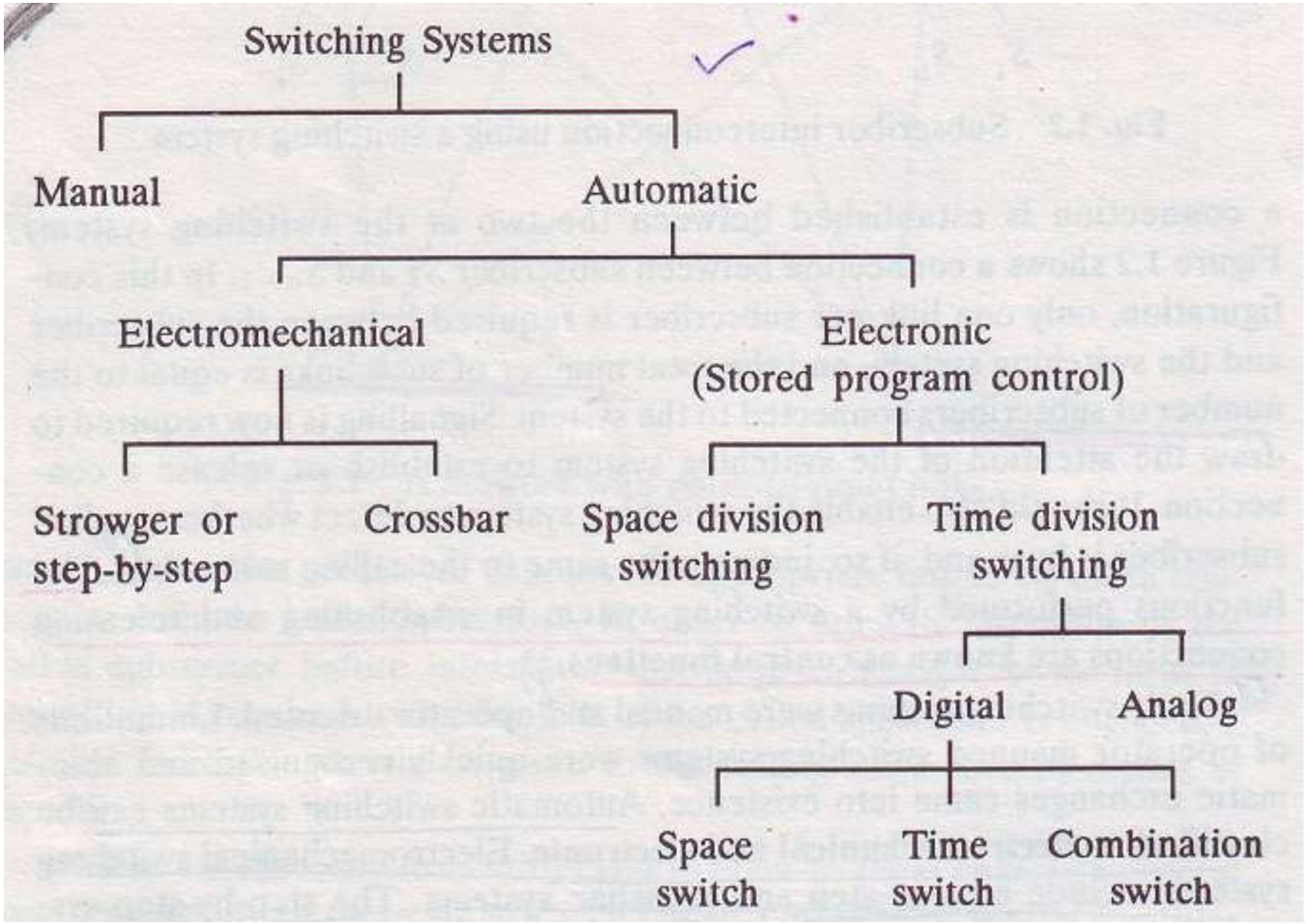
Classification of switching systems



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Switching systems

- Early switching systems were manual and operator oriented.
- Limitations of operator manned switching systems were quickly recognized and automatic exchanges came into existence. Automatic switching systems can be classified as electromechanical and electronics.
- Electromechanical switching systems includes STEP BY STEP and CROSSBAR SYSTEMS.
- The step by step systems is batter known's as strowger switching systems after its inventor A.B.strowger.
- CROSSBAR systems have hard wired control subsystems which use relays and latches. this subsystems have limited capability and it is virtually impossible to modified them to provide additional functionalities.
- In electronics switching systems, the control function performed by a computer or processor. Hence these systems are called storage program control (SPC)systems. New facilities can be added to a SPC system by changing the control program.
- the switching scheme used by electronic switching systems may be either space division switching or Time division switching.

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- a space division switching a dedicated path is established between the calling and called subscriber for the entire duration of call. Space division switching is also the technique used in Strowger and crossbar systems. An electronic exchange may use a crossbar switching matrix for space division switching. In other words, a crossbar switching system with SPC qualifies as an electronic exchange .
- In time division switching, the sampled values of the speech signals are transferred at a fixed intervals. time division switching may be analog or digital. In analog switching, the sampled voltage levels are transmitted as they whereas in digital switching, they are binary coded and transmitted . if the coded values are transferred during the same time interval from input to output, this technique is known as space switching . If the value are stored and transferred to the output at a later time interval , this technique is called time switching. A time division digital switch may also be designed by using a space and time switching techniques.

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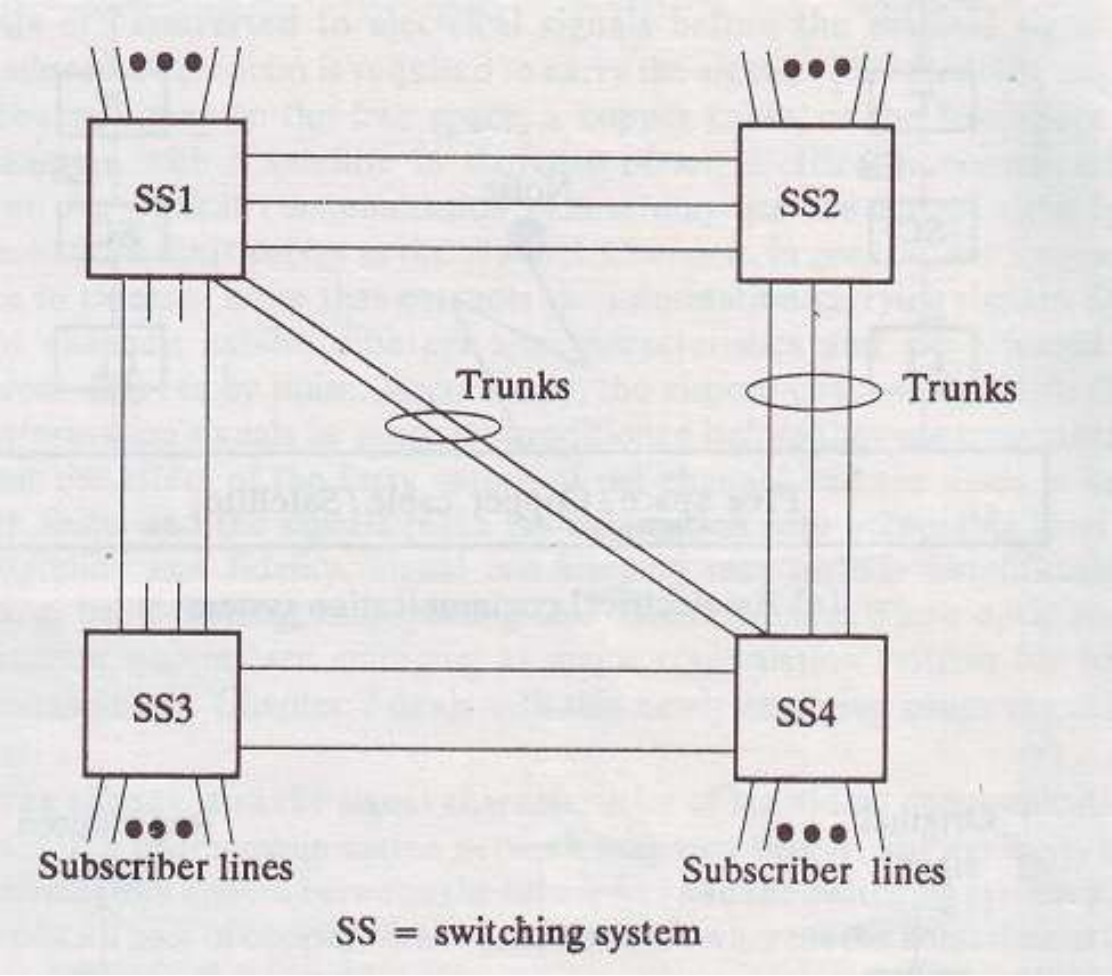
A telecommunication network



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- Subscribers all over the world cannot be connected to a single switching system unless we have a gigantic switching system in the sky and every subscriber has a direct access to the same.
- The major part of the telecommunication networks is still ground based, where subscribers are connected to the switching system via copper wires.
- Technological and engineering constraints of signal transfer on a pair of wires necessitate that the subscribers be located within a few kilometers from the switching system.
- By introducing a number of stand-alone switching systems in appropriate geographical locations, communication capability can be established among the subscribers in the same locality.
- however, for subscribers in different localities to communicate, it is necessary that the switching systems are interconnected in the form of a network.

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- The links that runs between the switching system are called trunks and those that runs to the subscribers premises are known as subscribers lines.
- The numbers of trunks may vary between pairs of switching system and is to determined on the basis of traffic between them.

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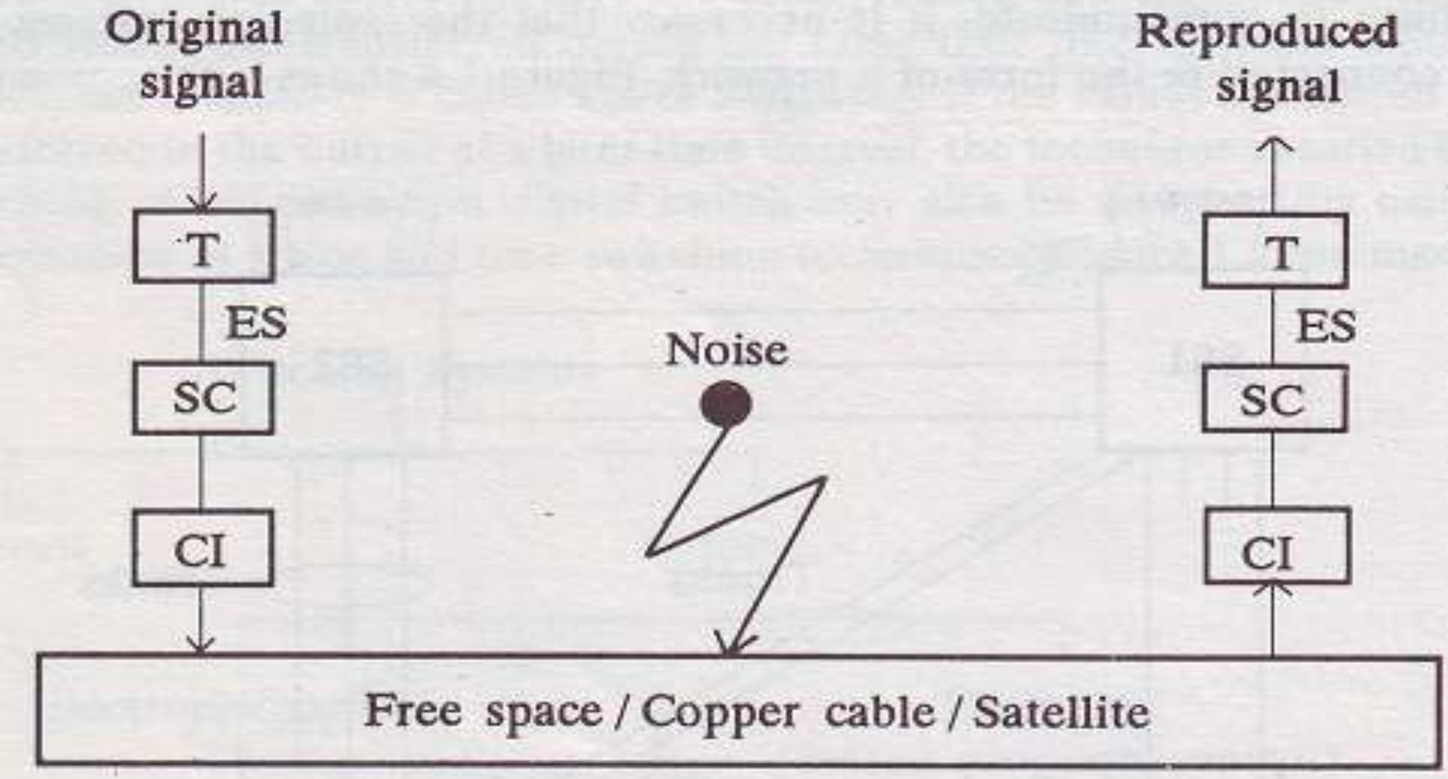
electrical communication systems



(a) An electrical communication system

CI = channel interface EOC = electrical to optical converter
ES = electrical signal OEC = optical to electrical converter
SC = signal conditioner T = transducer.

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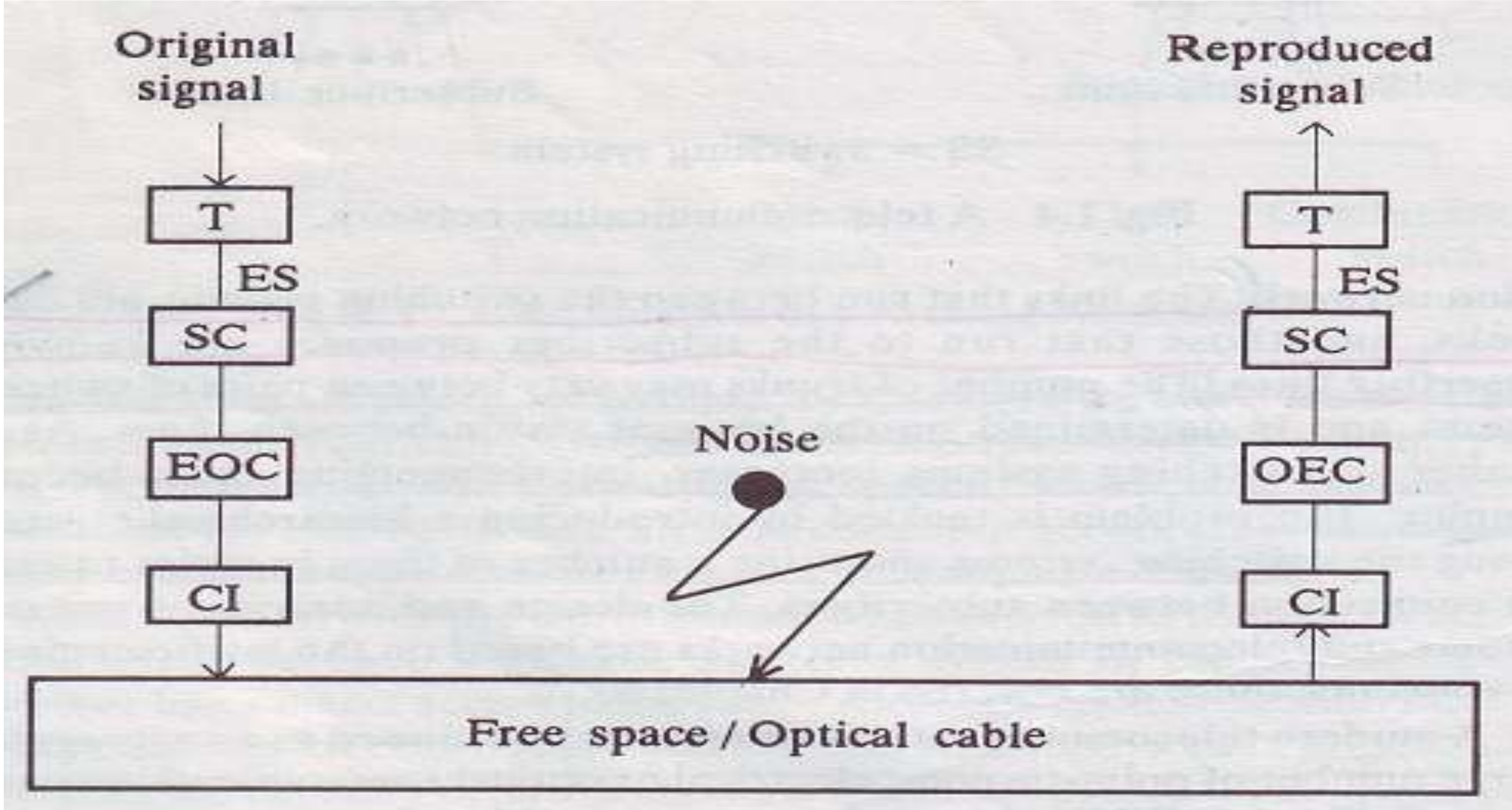
optical communication systems



(b) An optical communication system

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- A modern telecommunication network maybe viewed as an aggregate of a large number of point-to-point electrical or optical communication systems
- While this systems are capable of carrying electrical or optical signals, as the case may be, the information to be conveyed is not always in the form of these signals. For example, human speech signals need to be converted to electrical or optical signals before they can be carried by a communication system.
- Transducers perform this energy conversion. Present day optical sources require electrical signals as input, and the optical detectors produce electrical signals as output.
- Hence, the original signals are first converted to electrical signals and then to optical signal at the transmitting end of an optical communication system and at the receiving end optical signals are converted to electrical signals before the original signal is reproduced.
- A medium is required to carry the signals. this medium called the channel, that channel may be the free space, a copper cable or fiber optics cable.

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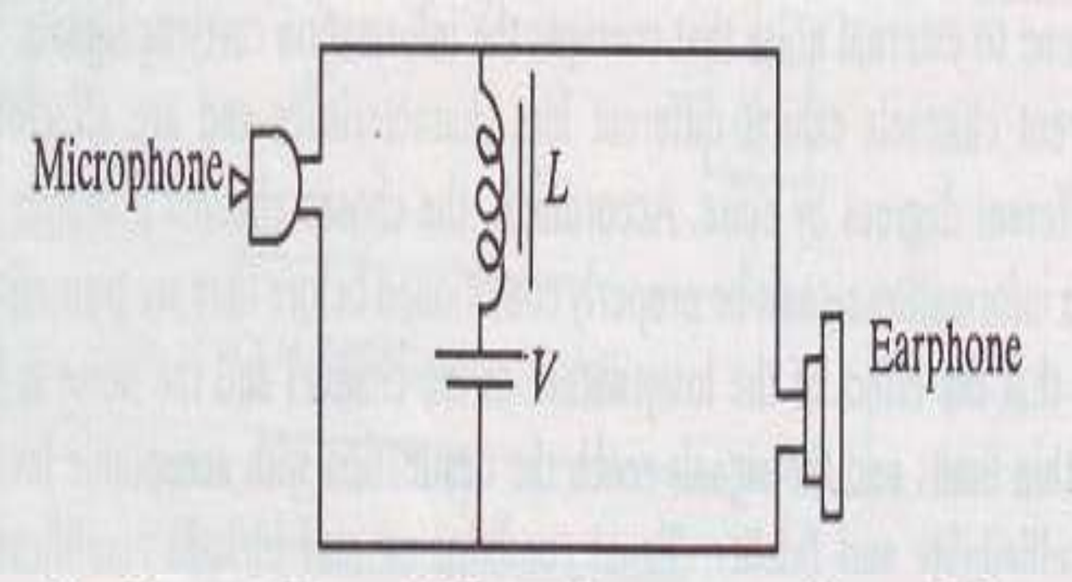
Simple Telephone Communication



A simplex telephone circuit.

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- In the simplest form of a telephone circuit, there is a one way communication involving two entities, one receiving (listening) and the other transmitting (talking).
- This form of one way communication known as simplex communication.
- The microphone and the earphone are the transducer elements of the telephone communication system.
- Microphone converts speech signals into electrical signals and the earphone converts electrical signals into audio signals.

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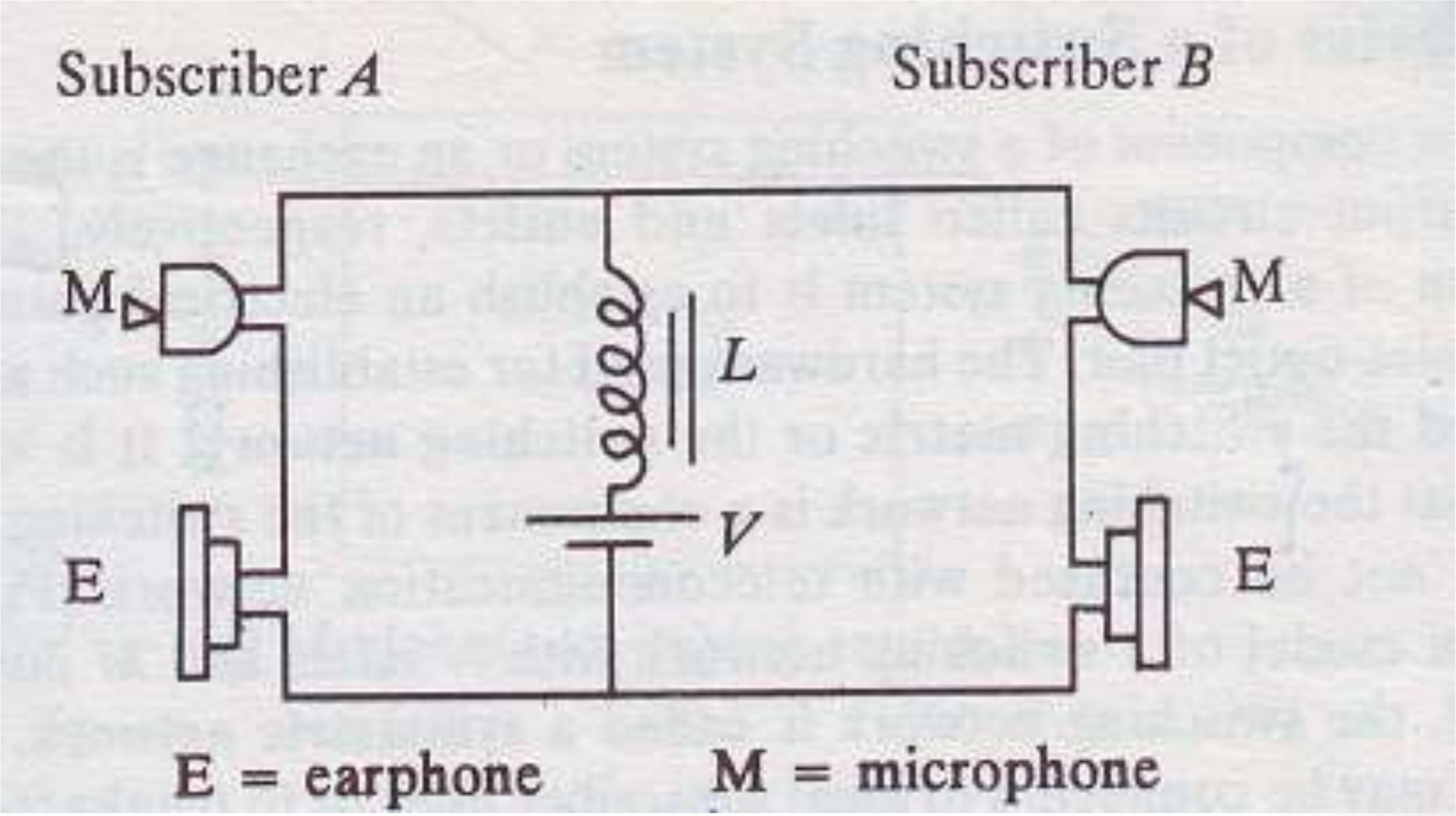
A half-duplex telephone circuit



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- In a normal telephone communication system, information is transferred both ways.
- An entity is capable of both receiving and sending although these do not take place simultaneously.
- An entity is either receiving or sending at any instant of time. When one entity is transmitting the other is receiving and vice versa.
- Such a form of communication where the information transfer takes place both ways but not simultaneously is known as half-duplex communication.
- If the information transfer takes place in both directions simultaneously, then it is called full duplex communication.

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Basics of a Switching System

- A major components of switching system or an exchange is an sets of inputs and outputs circuits called inlets and outlets.
- The primary function of a switching system is to establish an electrical path between a given

  inlet outlet layer. The hardware used for establishing such a connection is called the switching matrix or the switching network.

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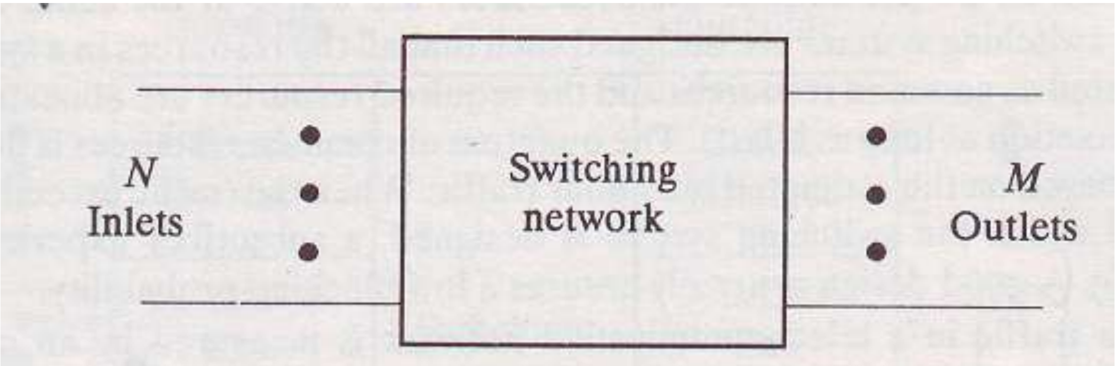
- Switching network is a component of the switching and should not be confused with telecommunication network.
- A model of a switching network with N inlets and M outlets .when N = M, the switching network is called a symmetric network.



(a) Model of a switching network

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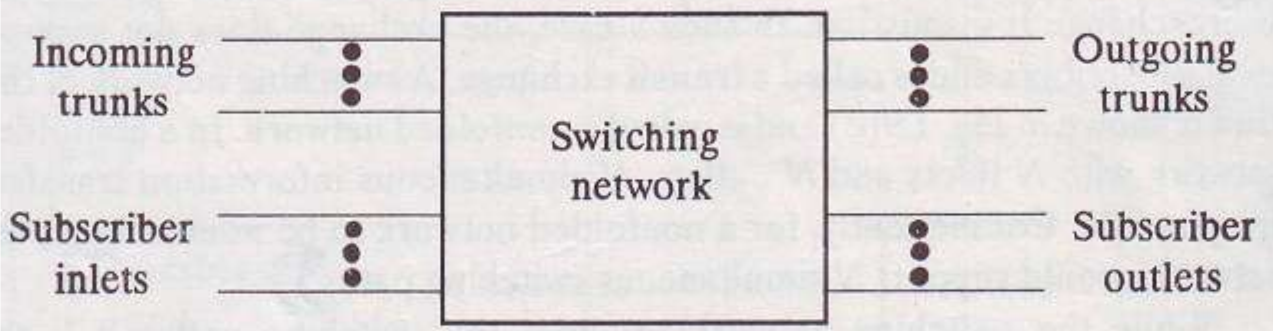
- The inlets / outlets may be connected to a local subscriber lines or to trunks from to other exchanges as shown in figure.



(b) Inlets/outlets connections

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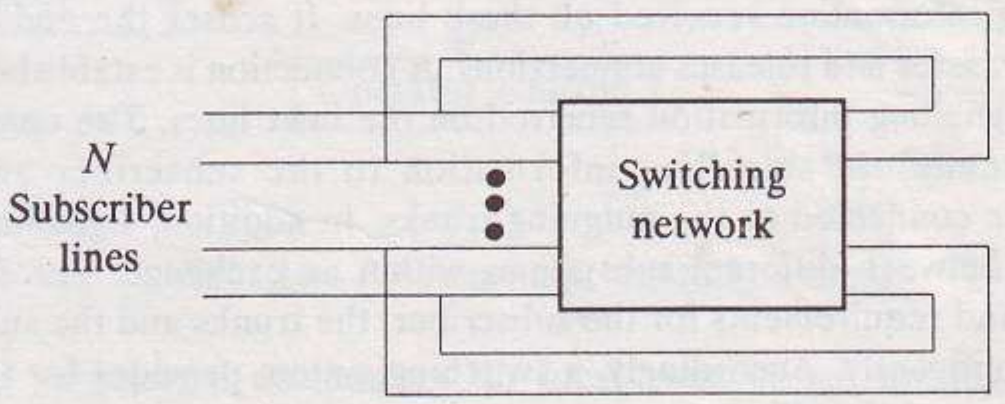
- When all the inlets/outlets are connected to the subscriber lines, the logical connection appears as shown in figure. the output lines are folded back to the input and hence the network is called a folded network.



(c) Folded network

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- four types of connections may be established:

1. local call connection between two subscribers in the system
2. Outgoing call connection between a subscriber and an outgoing trunk.
3. Incoming call connection between an incoming trunk and a local subscriber.
4. Transit call connection between an incoming trunk and an outgoing trunk.

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- in the folded network with N subscribers, there can be a maximum of N/2 simultaneous calls or information interchanges.
- The switching network may be designed to provide N/2 simultaneous switching paths, in which case the network is said to be nonblocking.
- IN a nonblocking network, as long as a called subscriber is free, a calling subscriber will always be able to establish a connection to the called subscribers.

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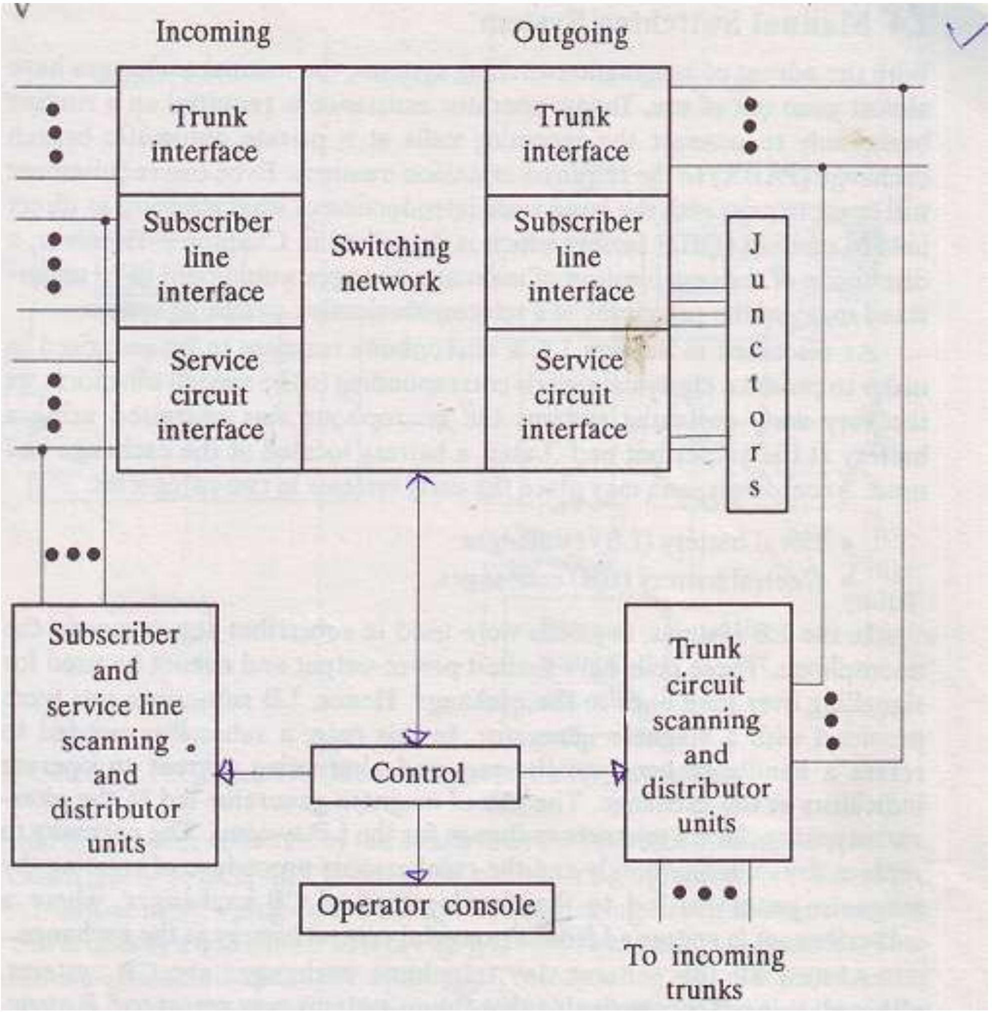
Elements of a switching system



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- A switching system is composed of elements that perform switching, control and signaling function. Figure 1.10 shows the different elements of a switching system and their logical interconnections.
- The subscriber lines are terminated at the subscriber line interface circuits, and trunks at the trunk interface circuits. There are some service lines used for maintenance and testing purposes.
- Junctor circuits imply a folded connection for the local subscriber and the service circuits.
- It is possible that some switching systems provide an internal mechanism for local connections without using the junctor circuits.
- Line scanning units sense and obtain signaling information from the respective lines.
- Distributor units send out signaling information on the respective lines. Operator console permits interaction with the switching system for maintenance and administrative purposes.

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- In some switching system the control subsystem may be an integral part of the switching network itself. Such systems are known as direct control switching systems.
- Those systems in which the control subsystem is outside the switching network are known as common control switching systems.
- Strowger exchanges are usually direct control systems, whereas crossbar and electronics exchanges are common control systems.
- All storage program control systems are common control systems.
- Common control system is also known as indirect control or register control.

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Strowger Switching Systems

- Automatic switching systems have a number of advantages over the manual exchanges. A few important ones are:
- In a manual exchange, the subscriber needs to communicate with the operator and a common language becomes an important factor.
- In multilingual areas this aspect may pose problems. On the other hand, the operation of an automatic exchange is language independent.
- A greater degree of privacy is obtained in automatic exchanges as no operator is normally involved in setting up and monitoring a call.
- Establishment and release of calls are faster in automatic exchanges. It is not unusual in a manual exchange, for an operator to take quite a few minutes to notice the end of a conversation and release the circuits. This could be very annoying particularly to the business subscribers who may like to make a number of calls in quick succession.
- In an automatic exchange, the time required to establish and release a call remains more or less of the same order irrespective of the load on the syster4 or the time of the day. In a manual system, this may not be true.

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- Rotary Dial Telephone
- In manual exchanges a, calling subscriber may communicate the identity of the called subscriber in a natural and informal language to the operator.
- For example, a called subscriber may be identified by his name or profession or designation. In an automatic exchange, in formal communication is not possible and a formal numbering plan or addressing scheme is required to identify the subscribers.
- Numbering plan, in which a subscriber is identified by a number, is more widely used than addressing scheme in which a subscriber is identified by alphanumeric strings.
- A mechanism to transmit the identity of the called subscriber to the exchange is now required at the telephone set.
- TWO methods are prevalent for this purpose:
- Pulse dialling
- Multifrequency dialling

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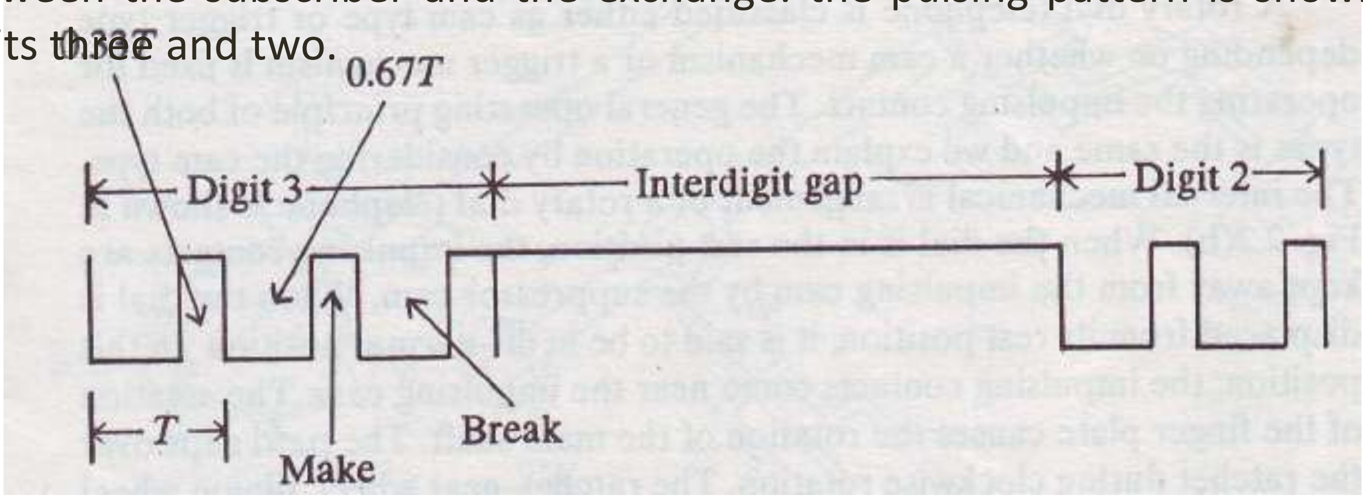
- In this form of dialling, a train of pulses is used to represent a digit in the subscriber number.
- The number of pulses In a train is equal to the digit value it represents- except the case of which is represented by to pulses.
- Successive digits in a number are represented by a series of pulse trains.
- Two successive trains are distinguished from one another by a pause in between them, known as the interdigit gap.
- The pulses are generated by alternately breaking and making the loop circuit between the subscriber and the exchange. the pulsing pattern is shown in Fig.for digits three and two.



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- In introducing dial pulsing mechanism in the telephone set, the following points have to be considered:
- Since the pulses are produced by make and break of the subscriber loop, there is likelihood of sparking inside the telephone instrument.
- The transmitter, receiver and the bell circuits of the telephone set may be damaged if the dialling pulses are passed through them.
- The dialling habits of the users vary widely and hence all timing aspects should be independent of user action.

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- Rotary dial telephone uses the following for implementing pulse dialling:
- Finger plate and spring
- Shaft, gear and pinion wheel
- Pawl and ratchet mechnisham.
- Impulsing cam and suppressor cam or a trigger mechanism
- Impulsing contact
- Centrifugal governor and worm gear
- Tlansmitter, receiver and bell by-pass circuits.

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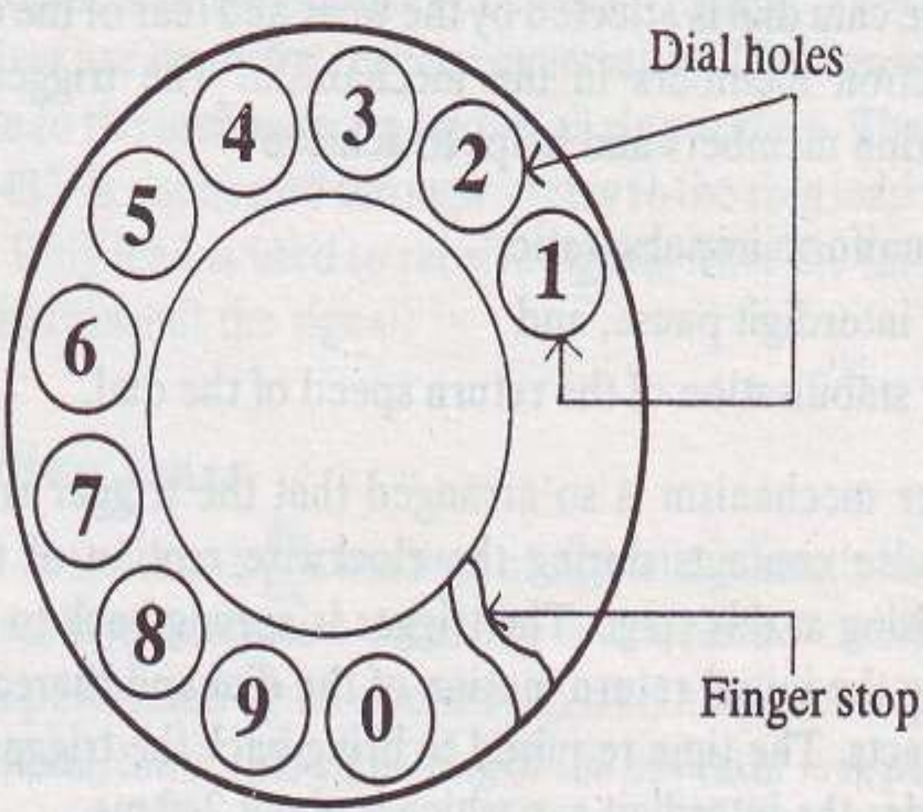

(a) Finger plate arrangement

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- The arrangement of the finger plate is shown in Fig.(a). The dial is operated by placing a finger in the hole appropriate to the digit to be dialled, drawing the finger plate round in the clockwise direction to the finger stop position and letting the dial free by withdrawing the finger.
- The finger plate and the associated mechanism now return to the rest position under the influence of a spring.
- The dial pulses are produced during the return travel of the finger plate, thus eliminating the human element in pulse timings.
- A rotary dial telephone is classified either as cam type or trigger type depending on whether a cam mechanism or a trigger mechanism is used for operating the impulsing contact. The general operating principle of both the types is the same and we explain the operation by considering the cam type.

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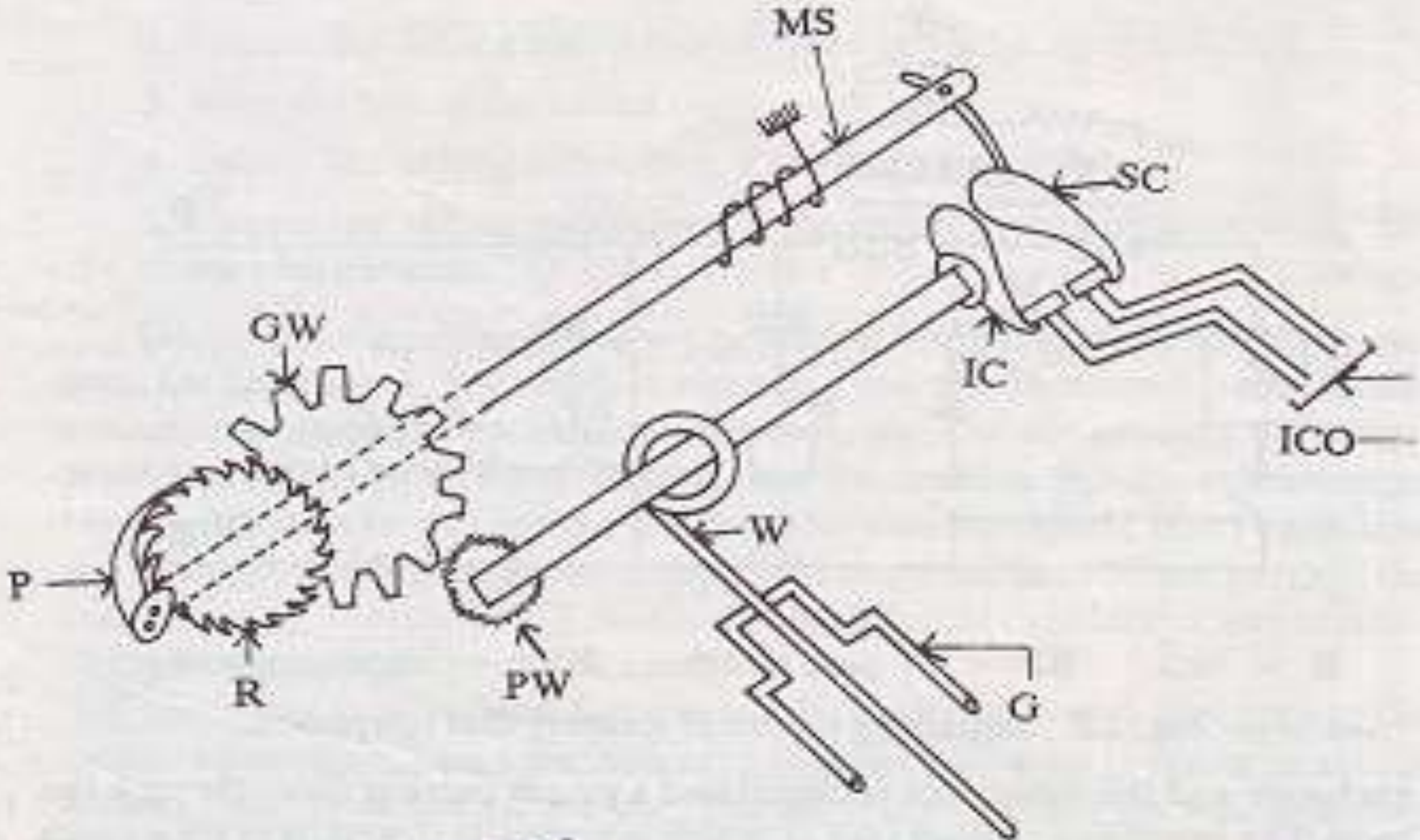

(b) Impulsing mechanism

G = governo GW = gear wheel IC = impulsing cam
ICO = impulsing contacts MS = main shaft P = pawl
PW = pinion wheel R = rachet SC = suppressor cam
W = worm gear

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- The internal mechanical arrangement of a rotary dial telephone is shown in Fig.(b).
- When the dial is in the rest position, the impulsing contacts are kept away from the impulsing cam by the suppressor cam.
- When the dial is displaced from its rest position, it is said to be in off-normal position. In this position, the impulsing contacts come near the impulsing cam.
- The rotation of the finger plate causes the rotation of the main shaft. The pawl slips over the ratchet during clockwise rotation.
- The ratchet, gear wheel, pinion wheel and the governor are all stationary during the clockwise movement of the dial. When the dial returns, the pawl engages and rotates the ratchet. The gear wheel, pinion wheel and the governor all rotate. The governor helps to maintain a uniform speed of rotation.
- The impulsing cam which is attached to a pinion shaft now breaks and makes the impulsing contacts which in turn causes the pulses in the circuit. The shape of the impulsing cam is such that the break and make periods are in the ratio of 2:1. When the dial is about to reach the rest position, the suppressor cam moves the impulsing contacts away from the impulsing cam.

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Signalling Tones

- a number of signalling functions are involved in establishing, maintaining and releasing a telephone conversation.
- These functions are.performed by an operator in a manual exchange. In automatic switching systems, the verbal signalling of the operator is replaced by a series of distinctive tones.

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- five subscriber related signalling functions are performed by the operator:

1. Respond to the calling subscriber to obtain the identification of the called party.
2. Inform the calling subscriber that the call is being established.
3. Ring the bell of the called party.
4. Inform the calling subscriber, if the called party is busy.
5. Inform the calling subscriber, if the called party line is unobtainable for some reason.

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- The signalling function 1 is fullfill by sending a dial tone to the calling subscriber. this tone indicate that the exchange is ready to accept the dialled digits from the subscriber. The subscriber should start dialling only after hearing the dial tone Otherwise, initial dial pulses may be missed by the exchange which may result in the call landing on a wrong number.
- The dial tone is 33Hz or 50Hz or a00Hz continuous tone as shown in Fig. The 400 Hz signal is usually modulated with 25 Hz or 50 Hz

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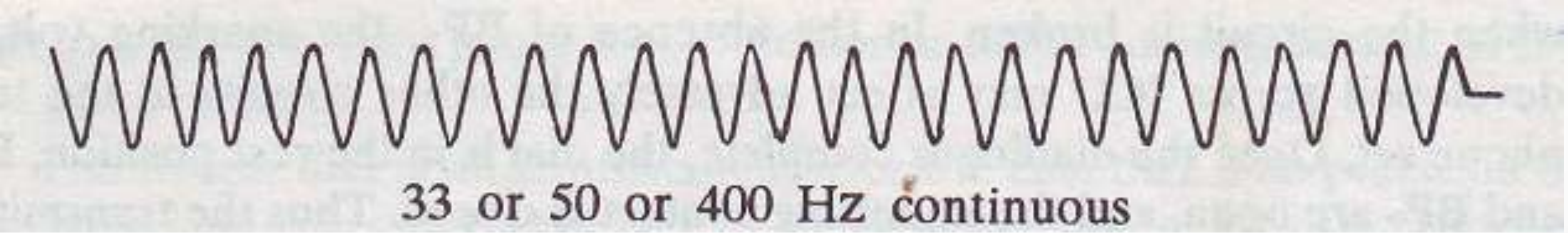
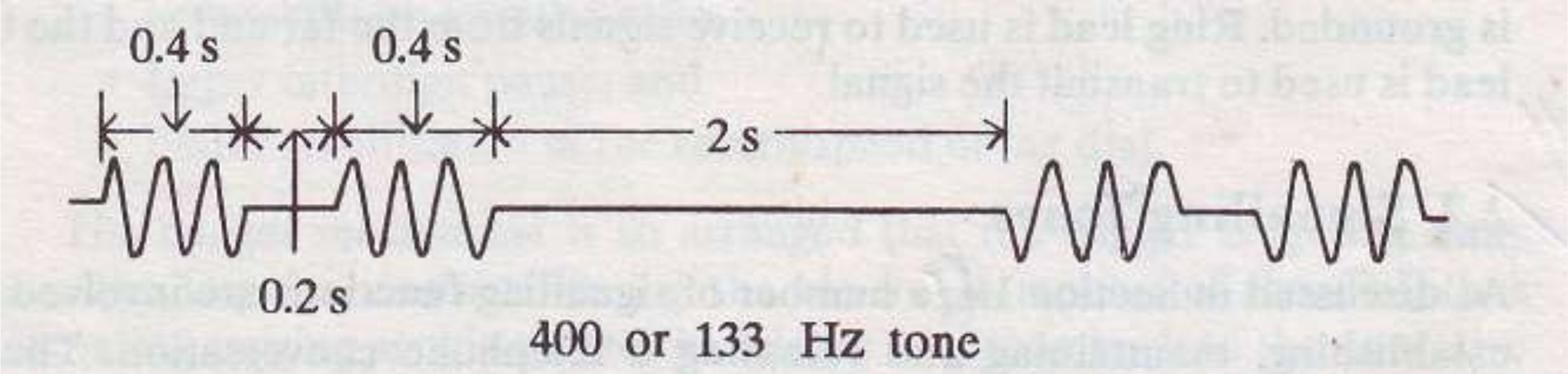


dial tone

- When the called party line is obtained, the exchange control equipment sends out the ringing current to the telephone set of the called party. This ringing current has the familiar double ring pattern.
- Simultaneously, the control equipment sends out a ringing tone to the calling subscriber, which has a pattern similar to that of shown in the fig.
- The two rings in the double-ring pattern are separated by a time gap of 0.2 s and two double-ring patterns by a gap of 2s.
- The ring burst has a duration of 0.4 s. The frequency of the ringing tone is 133 Hz or 400 Hz, sometimes modulated with 25 Hz and 33Hz.



(b) Ringing tone

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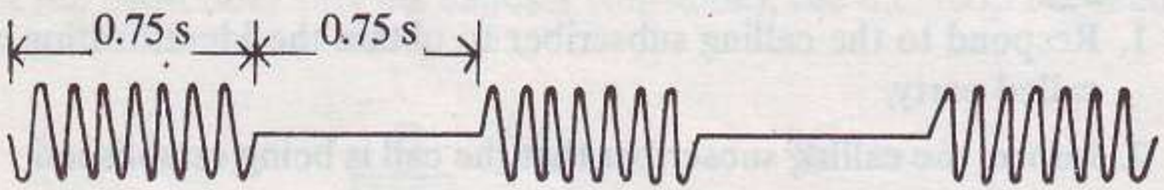
- Busy tone shown in the fig. it is bursty 400Hz signals with silence periods in between them. The burst duration and silence duration have the same value of 0.75s or 0.375s.
- A busy tone is sends the calling subscriber whenever the switching equipments and junction line is not available to put through the call and the called subscriber line is engaged.



(c) Busy tone

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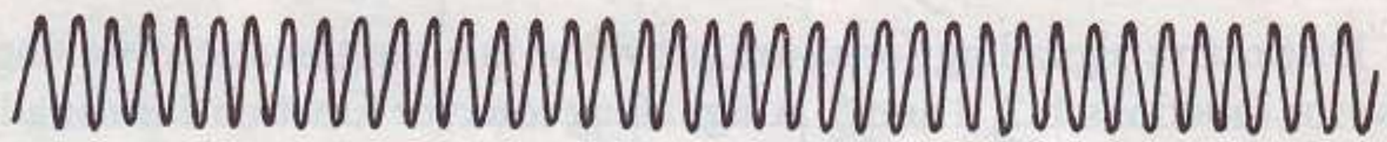
- Figure shows the number unobtainable tone which is a continuous 400Hzsignal. This tone maybe sent to the calling subscriber due to a variety of reasons such as the called party line is out of order or disconnected, and an error in dialling leading to the selection of a spare line. In some exchanges the number unobtainable tone is 100 Hz intermittent with 2.5s on period and 0.5s.



(d) Number unobtainable tone

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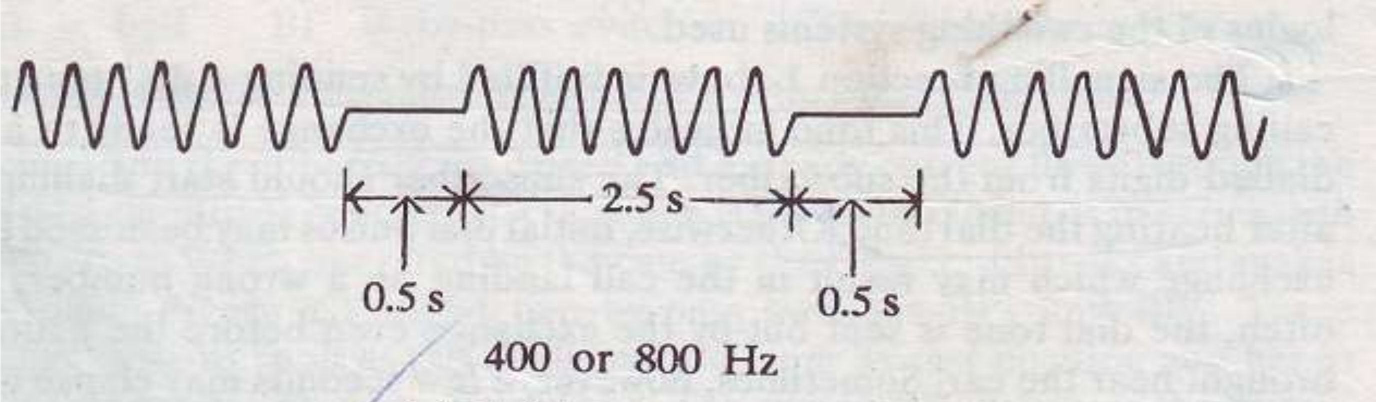
- The routing tone or call in progress tone is 400 Hz or 800 Hz intermittent pattern in electromechanical systems, it is usually 800 Hz with 50 per cent duty ratio and 0.5 s on/off period.
- In analog electronic exchanges it is a 400 Hz pattern with 0.5 s on period and 2.5 s off period.
- In digital exchanges; it has 0.1 s on/off periods at 400 Hz.
- When a subscriber call is routed through a number of different types of exchanges, one hears different call-in progress tones as the call progresses through different exchanges . Figure shows a routing tone pattern.



(e) Call-in-progress tone

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Strowger Switching Components

- the Strowger system, there are two types of selectors which form the building blocls for the switching system:
- Uniselector
- Two motion selector
- These selectors are constructed using electromechanical rotary switches. The drive mechanism of a rotary switch is shown in Fig.

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- Whenever the electromagnet is energized , the armature is attracted to it and the pawl falls one position below the present tooth position.
- The ratchet wheel, however, does not move and is held in position by the detent. When the electromagnet is de-energised , the armature is released and returns to its rest position due to the restoring action of the spring.
- During this reverse motion of the armature, the pawl moves the ratchet wheel one position up where it is held in position by the detent. The clearance between the armature and the electromagnet is such that during the forward movement of the armature the pawl slips over the ratchet exactly by one position.
- As the ratchet wheel rotates up by one position, the wiper moves across one contact position in the direction indicated.
- Thus, if the electromagnet is energized and de-energised five times by applying five pulses, the wiper moves by five contacts. The mechanism shown in Fig.(a) is known as reverse drive type as the ratchet wheel moves when the armature returning to its rest position.
- It is possible to arrange the mechanism in such a way that the wheel moves during the forward motion of the armature in which case it is known as forward drive type. Reverse drive type is generally used in uniselectors and the forward drive type in two-motion selectors.

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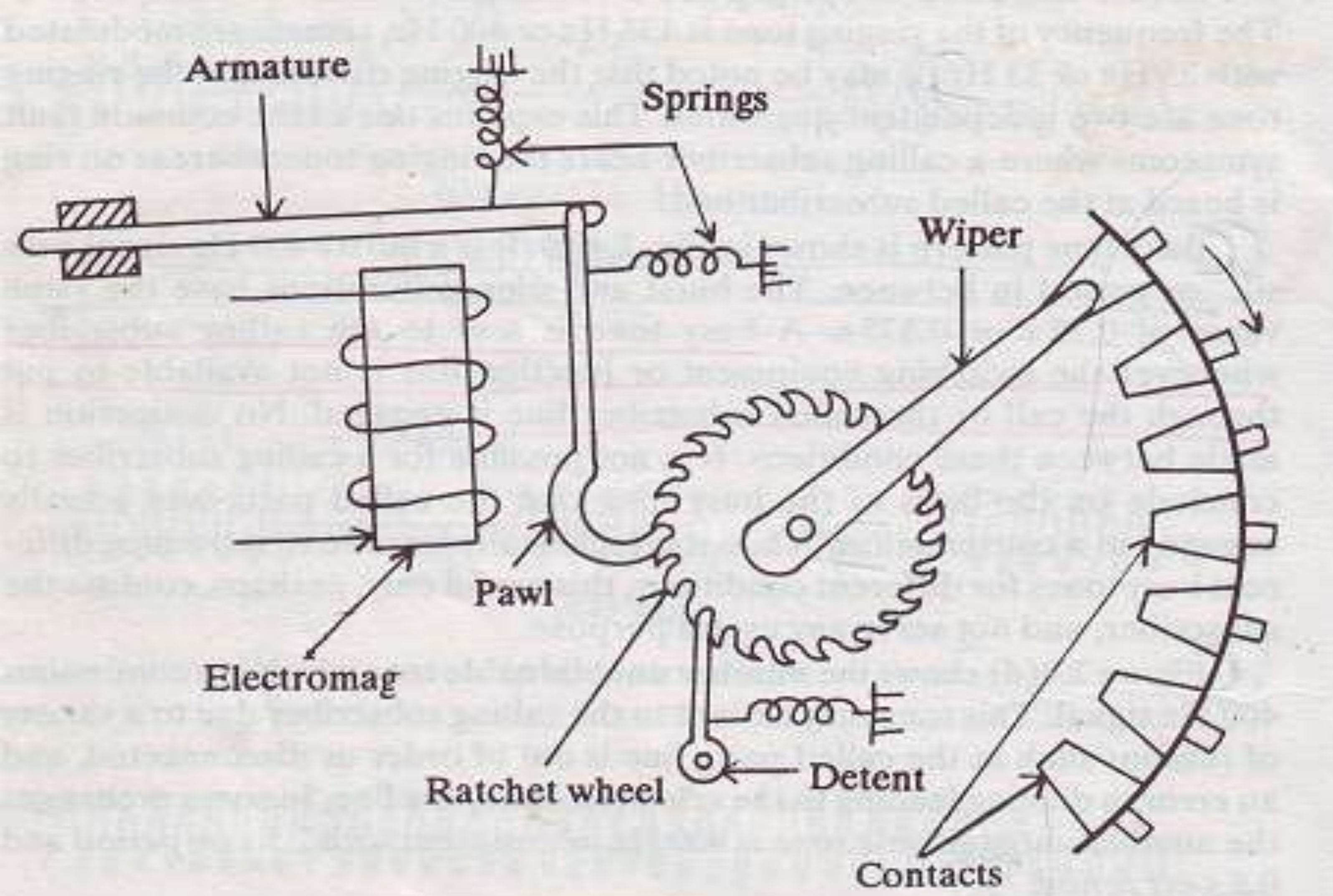

(a) Drive mechanism of a rotary switch

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Uniselector

- a uniselector is one which has a single rotary switch with a bank of contacts.
- Typically, there are four banks of which three are used for switching and the fourth one is used for homing.
- The three switching banks have 25 or 11 contacts each. The first contact in each bank is known as the home contacts and the remaining as switching contacts.
- The homing bank has only two contacts: one at the first position corresponding to the home contacts of the other banks and the other extending as an arc from the second position to the last position.
- This arc contact is often referred to as the homing arc. Depending upon the number of switching contacts, uniselectors are identified 10-outlet or 24-outlet uniselector

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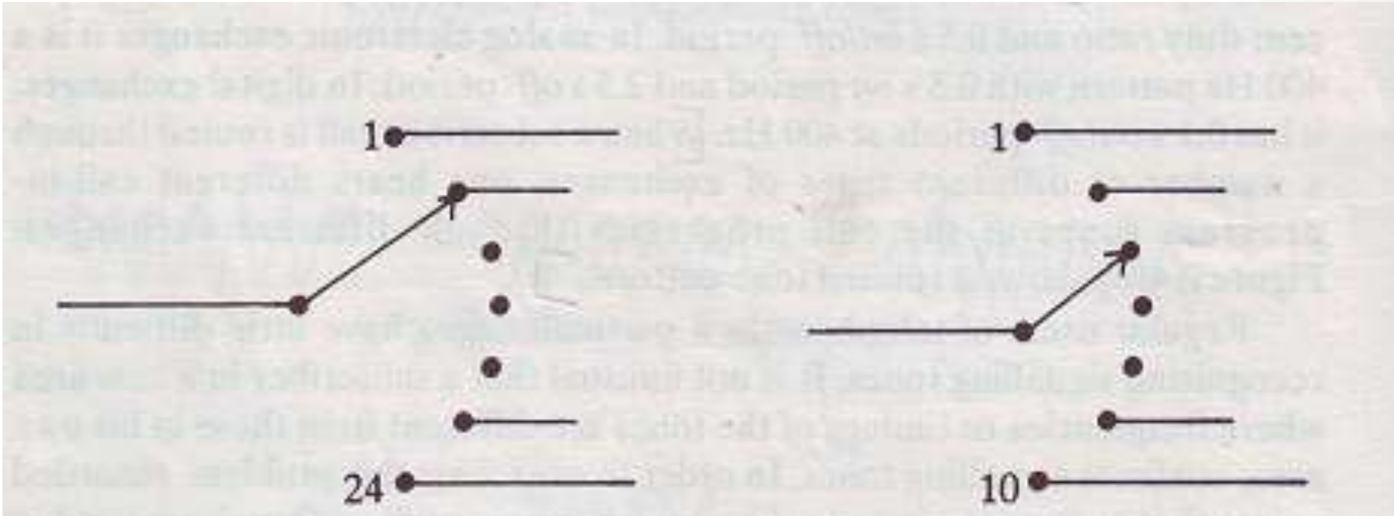

(b) Schematic representation of uniselectors

The proper functioning of a uniselector is dependent on a number of factors.

- Energizing current level
- Inertia of the moving system
- Friction between wipers and bank contacts
- Friction in drive assembly Tension in restoring springs
- Adjustment of interrupter contacts.

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A two motion selector

- A two motion selector is capable of horizontal as well as vertical stepping movement. It has two rotary switches one provide vertical motion to wiper assembly , and the other providing horizontal movement for the wipers.
- The term rotary switch is used in a generic sense to imply a pawl and ratchet arrangement irrespective of whether such an arrangement is being used to cause vertical or horizontal motion. The horizontal movement rotary.
- switch of a two-motion selector has an interrupter contact as in the case of uniselector .
- Normally, there are 11 vertical positions and 11 horizontal contacts in each vertical position, The lowest vertical position and the first horizontal contact in each vertical level are home positions, and the remaining ones are the actual switching positions. Thus, the wiper in a two-motion selector has access to 100 switching contact.

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- two-motion selector is sometimss known as a 330-point or 440-point selector. For homing the wiper assembly, it is driven beyond the 11th contact position by the horizontal rotary magnet and its interrupter contact. The wiper assembly then falls vertically to the home level and returns to the horizontal home position under the influence of a restoring spring & In some designs, a third magnet, known as release magnet is used for homing

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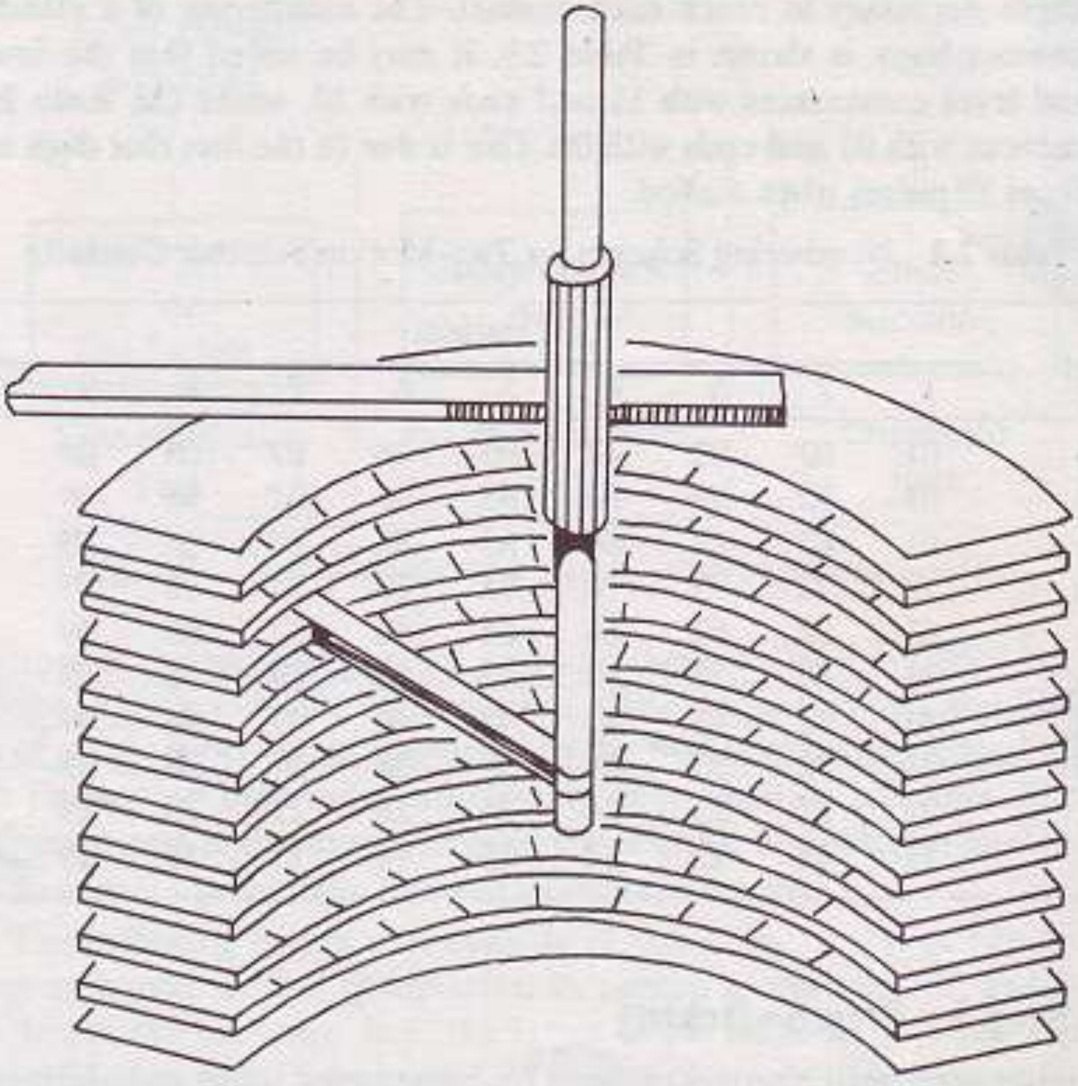

(a) Two-motion selector arrangement

(b) Schematic representation

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Step-by- Step Switching

- a step-by-step switching system may be constructed using uniselectors or two-motion selectors or a combination of both.
- The wiper contacts of these Selectors move indirect response to dial pulse or other signals like off hook from the subscriber telephone.
- The wiper steps forward by ones contact at a time and moves by many contacts as the number of dial pulse received.

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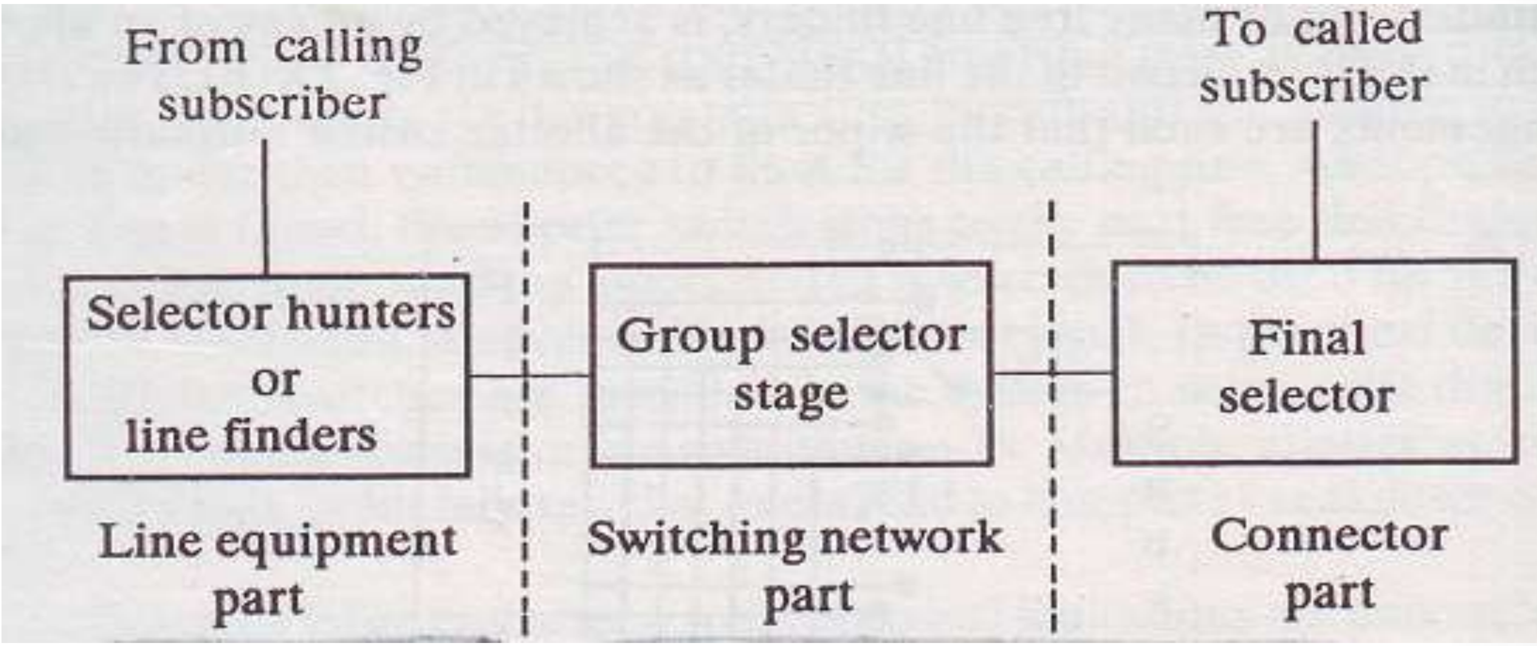
- step by-step switching system-has three major parts as shown in fig.
- The line equipment part consists of selector hunters or line finders and other two part is consists of selectors.



Configuration of a step-by-step switching system

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- The selector hunter and line finder consists of two fundamental ways in which a subscriber gains access to common switching resources.
- A selector hunter searches and seizes a selector from the switching matrix part. There is one selector hunter for each subscriber.
- The selector hunter scheme is sometimes called subscriber uniselector scheme as there is a dedicated uniselector for each subscriber in the system.
- Line finders are associated with the first set of selectors in-the switching matrix part and there is one line finder for each selectors in the sets.
- A line finder searches and finds line of the subscriber to be connected to the first selector associated with it.
- Line finders are built using uniselectors or two-motion selectors. The line equipment part is also known as preselector stage. The selector hunters and line finders are generically referred to as preselectors.
- The switching matrix part consists of one or more sets of two-motion selectors known as first group selector, second group selector, and so on.
- The larger the exchange size, the larger is the number of group selector stages. The connector part comprises one set of two-motion selectors known as final selectors

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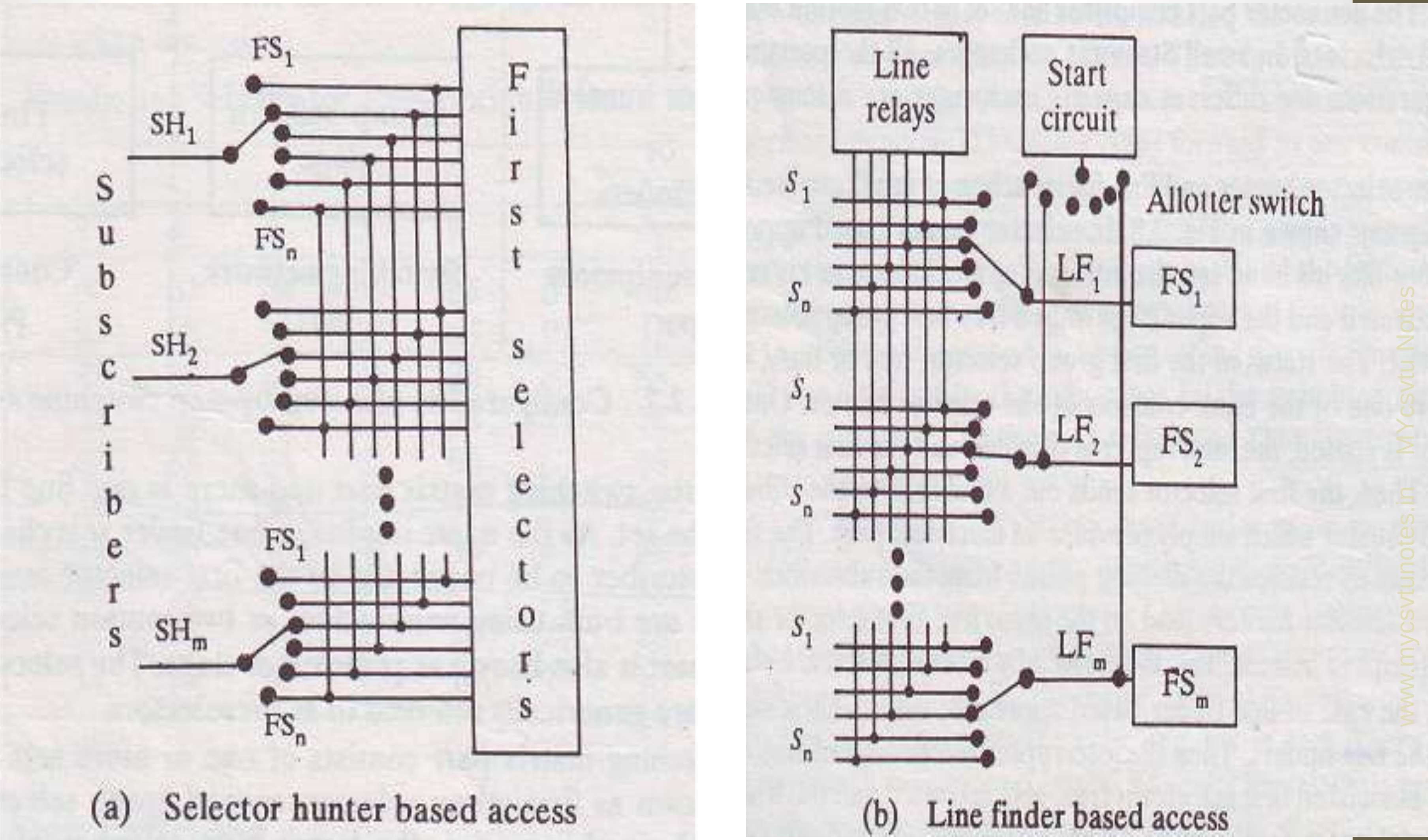

(a) Selector hunter based access

(b) Line finder based access

FS = first selector LF = line finder SH = selector hunter

Subscriber access to Strowger switching system

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Crossbar Switching
Principles of Crossbar Switching

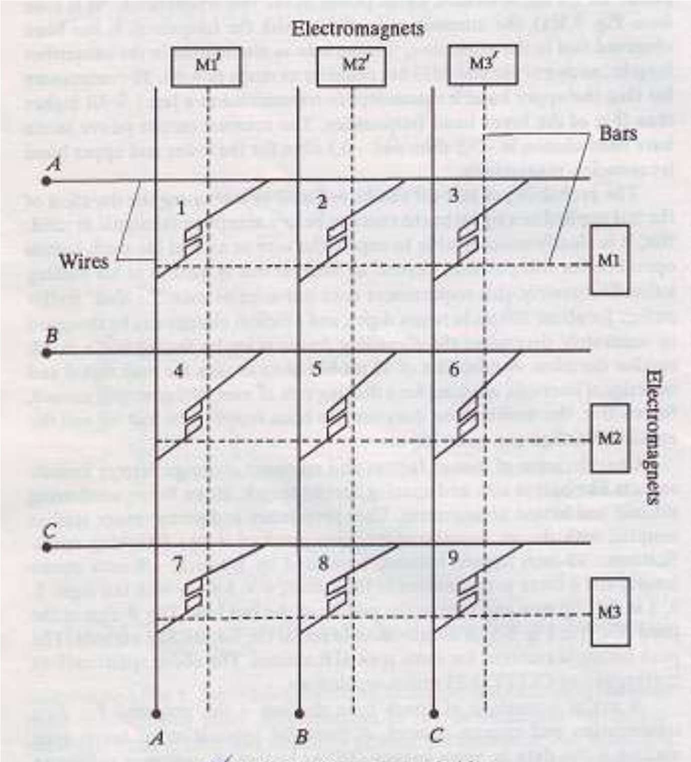

Fig. 3.6 3 × 3 crossbar switching.

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The basic idea of crossbar switching is to provide a matrix of $n \times m$ sets of contacts with only $n + m$ activators or less to select one of the $n \times m$ sets of contacts. This form of switching is also known as coordinate switching as the switching contacts are arranged in a xy-plane. A diagrammatic representation of a crosspoint switching matrix is shown in Fig. 3.6. There is an

array of horizontal and vertical wires shown by solid lines. A set of vertical and horizontal contact points are connected to these wires. The contact points form pairs, each pair consisting of a bank of three or four horizontal and a corresponding bank of vertical contact points. A contact point pair acts as a crosspoint switch and remains separated or open when not in use.) The

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- contact points are mechanically mounted (and electrically insulated) on a set of horizontal and vertical bars shown as dotted lines. The bars, in turn, are attached to a set of electromagnets.
- When an electromagnet, say in the horizontal direction, is energised, the bar attached to it slightly rotates in such a way that the contact points attached to the bar move closer to its facing contact points but do not actually make any contact.
- Now, if an electromagnet in the vertical direction is energised, the corresponding bar rotates causing the contact points at the interiection of the two bars to close.
- This happens because the contact points move towards each other. As an example, il electromagnets M2 and M3' are energised, a contact is established at the crosspoint 6 such that the subscriberB is ionnected to the subscriber C. In order to fully understand the working of the crossbar switching, let us consider a 6 x 6 crossbar schematic shown in Fig.
- The schematic shows six subscribers with the horizantal bars representing the inlets and the vertical bars the outlets.

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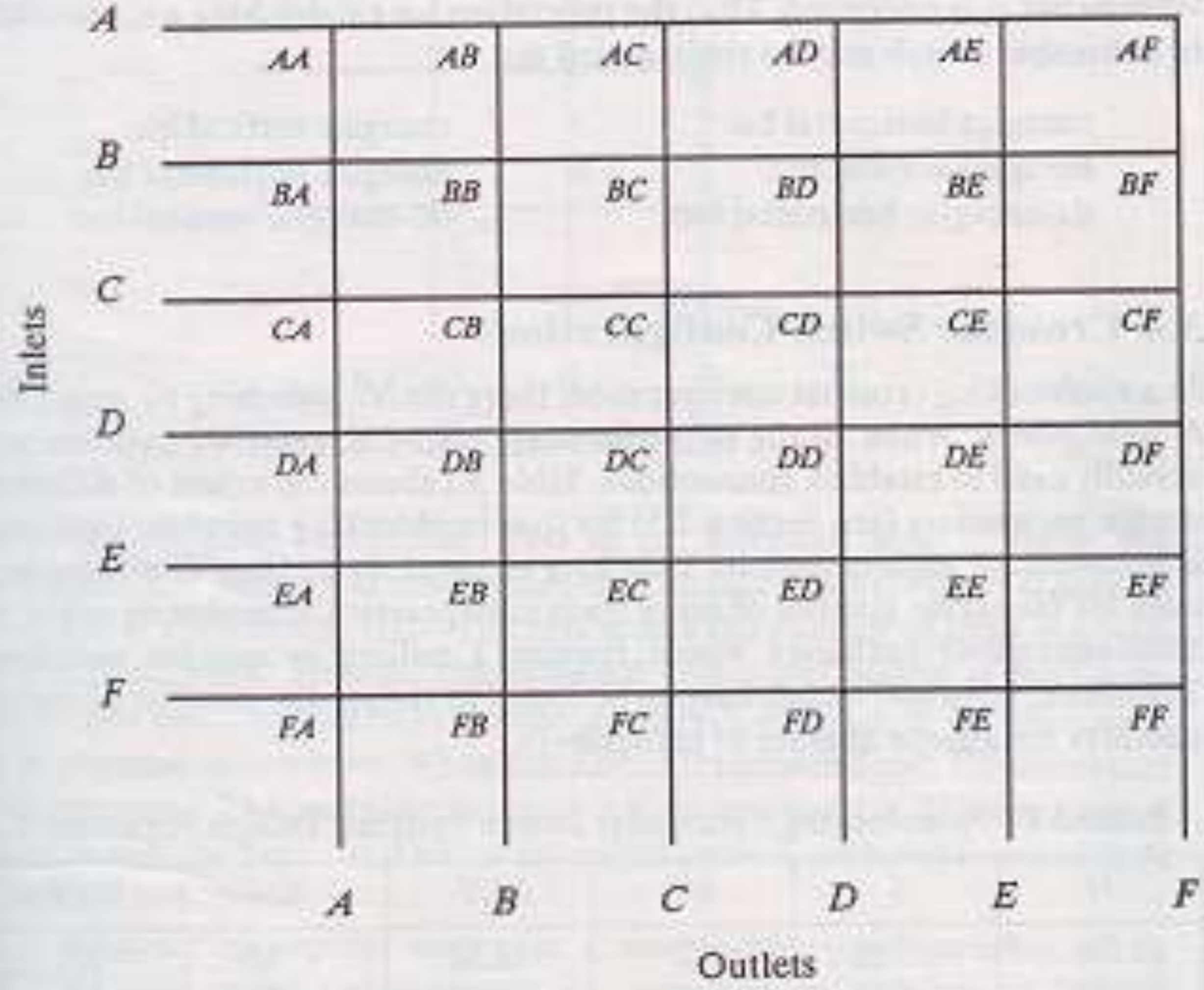

Fig. 3.7 6 × 6 crossbar matrix.

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- Now consider the establishment of the following connections in sequence: A to C and B to E. First the horizontal bar, A is energised. Then the vertical bar C is energised.
- The cross point , AC is latched and the conversation between, A and C can now proceed. Suppose we now energize the horizontal bar of B to establish the connection to E.

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Electronic Space Division Switching

- Early crossbar systems were slow in call processing as they used electromechanical components for common control subsystems. Efforts to improve the speed of control and signalling between exchanges led to the application of electronics in the design of control and signalling subsystems.
- a number of developmental efforts made use of vacuum tubes, transistors, gas diodes, magnetic drums and cathode ray tubes for realising control functions. Circuits using gas tubes were developed and employed for timing, ring translation and selective ringing of party lines.
- Switching engineers soon realised that, in principle, the registers and translators of the common control systems could be replaced by a single digital computer.

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Stored Program Control

- Modern digital computers use the stored program concept. Here, a program or a set of instructions to the computer is stored in its memory and the instructions are executed automatically one by one by the processor.
- Carrying out the exchange control functions through programs stored in the memory of a computer led to the nomenclature stored program control (SPC).

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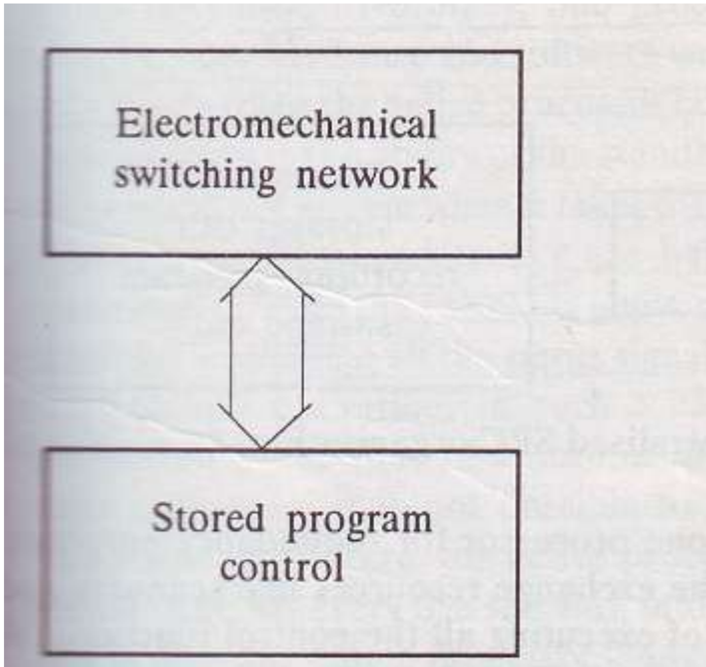
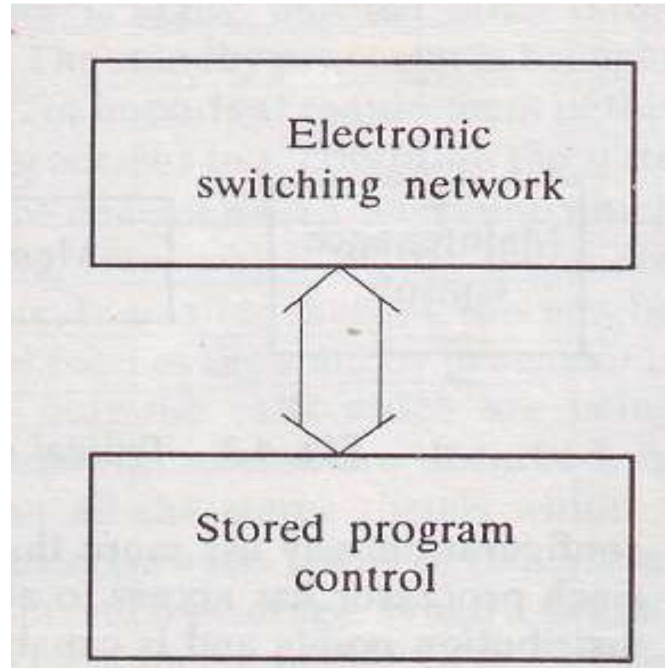
Electronic space division switching systems



(a) Electromechanical switching



(b) Electronic switching

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▪ Centralized SPC

- In centralised 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 in ESS using centralised SPC is shown in Fig.
- A centralised SPC configuration may use more than one processor for redundancy purposes. Each processor has access to all the exchange resources like , scanners and distribution points and is capable of executing all the control functions.

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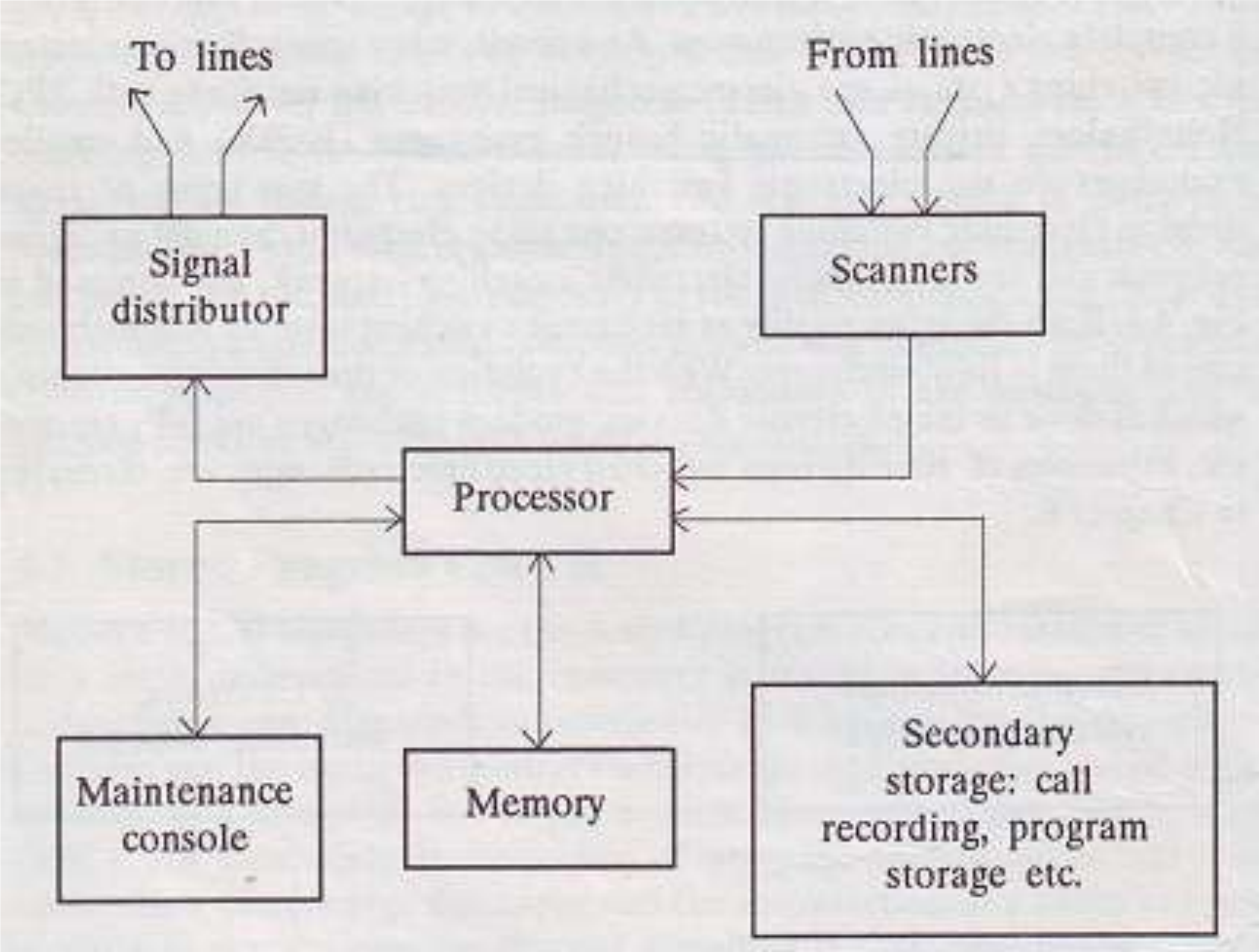

Typical centralized SPC organization

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- A redundant centralised structure is shown in Fig.. Redundancy may also be provided at the level of exchange resources and function programs.
- In actual implementation, the exchange resources and the memory modules contain ring the programs for carrying out the various control functions may be shared by processors, or each processor may have its own dedicated access paths to exchange resources and its own copy of programs and data in dedicated memory modules.

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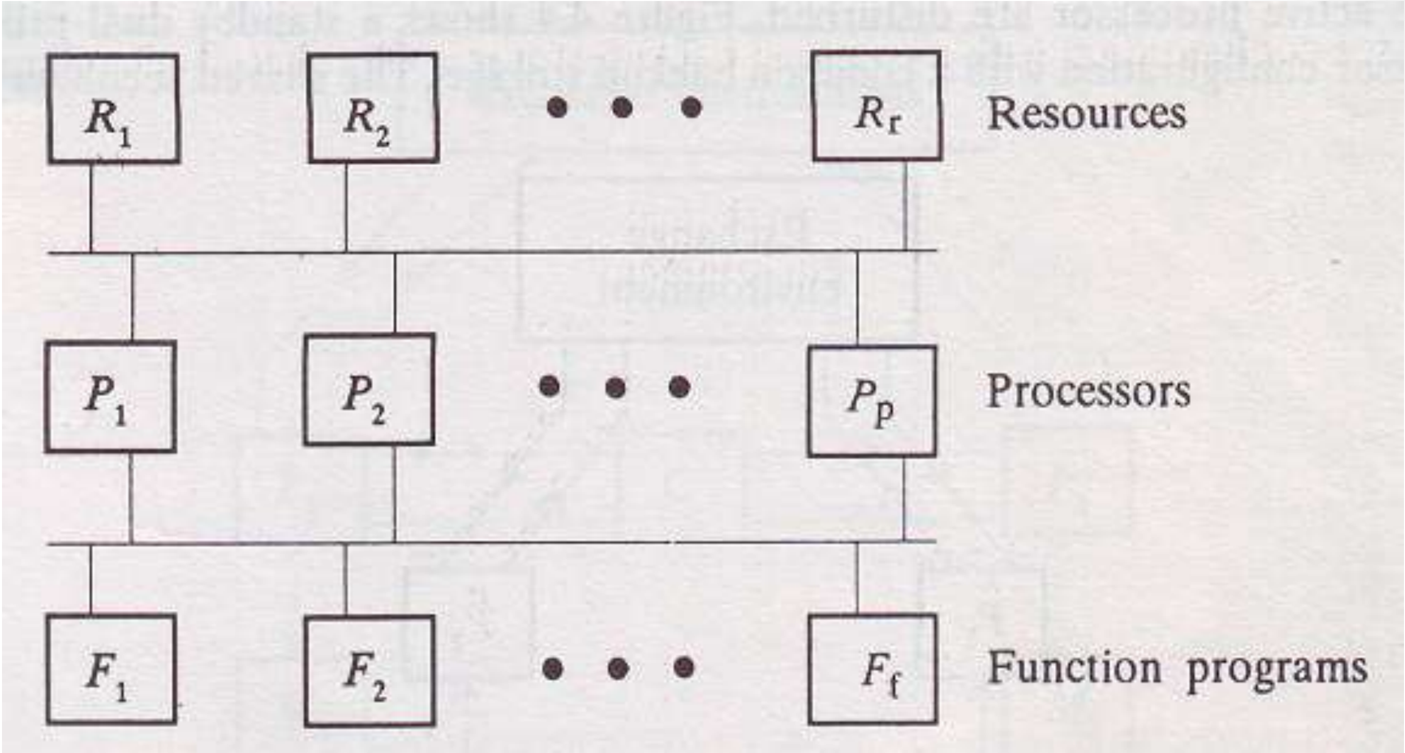

A redundant centralised control structure

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- In almost all the present day electronic switching systems using centralised control, only a two-processor configuration is used. A dual processor architecture may be configured to operate in one of three modes:

1. Standby mode
2. Synchronous duplex mode
3. Load sharing mode

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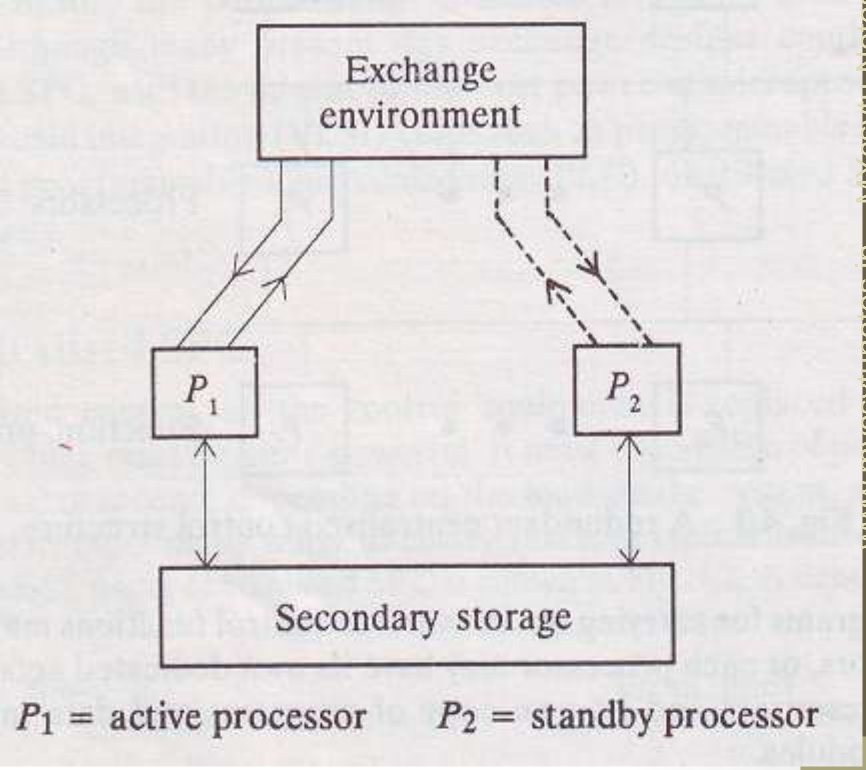
Standby mode

- Standby mode of operation is the simplest of dual processor configuration operation.
- Normally one processor is active and others processor is on standby mode, both hardware and software wise.



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synchronous duplex mode

- In synchronous duplex mode of operation, hardware coupling is provided between the two processors which execute the same set of program and compare the result continuously.
- If mismatch occurs the faculty processer is identified and taken out of service within a few milliseconds.
- When the system is operating normally , the two processors have the same data in their memories at all times and simultaneously receive all information from the exchange environment.
- One of the processors actually controls the exchange, whereas the other is synchronized with the former but does not participate in the exchange control.

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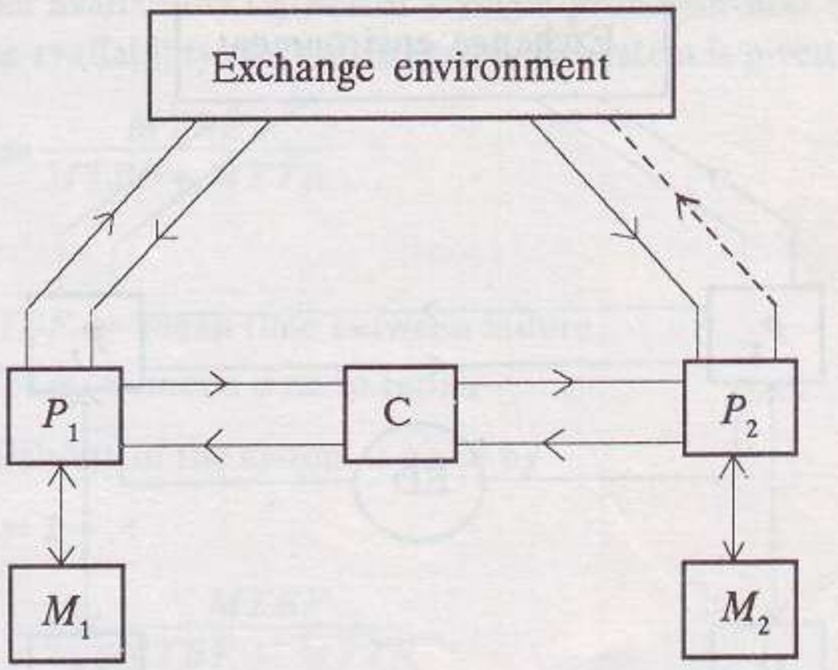
Synchronous duplex operation



C = comparator *M* = memory *P* = processor

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load sharing mode

- In load sharing operation, an incoming call assign randomly or in the predetermine order to one of the processers which than handles the call right through completion.
- Thus both the processers are active simultaneously and share the load and the resources dynamically.
- Both the processors have access to the entire exchange environment which is sensed as well as controlled by these processors. Since the calls are handled independently by the processors, they have separate memories for storing temporary call data.

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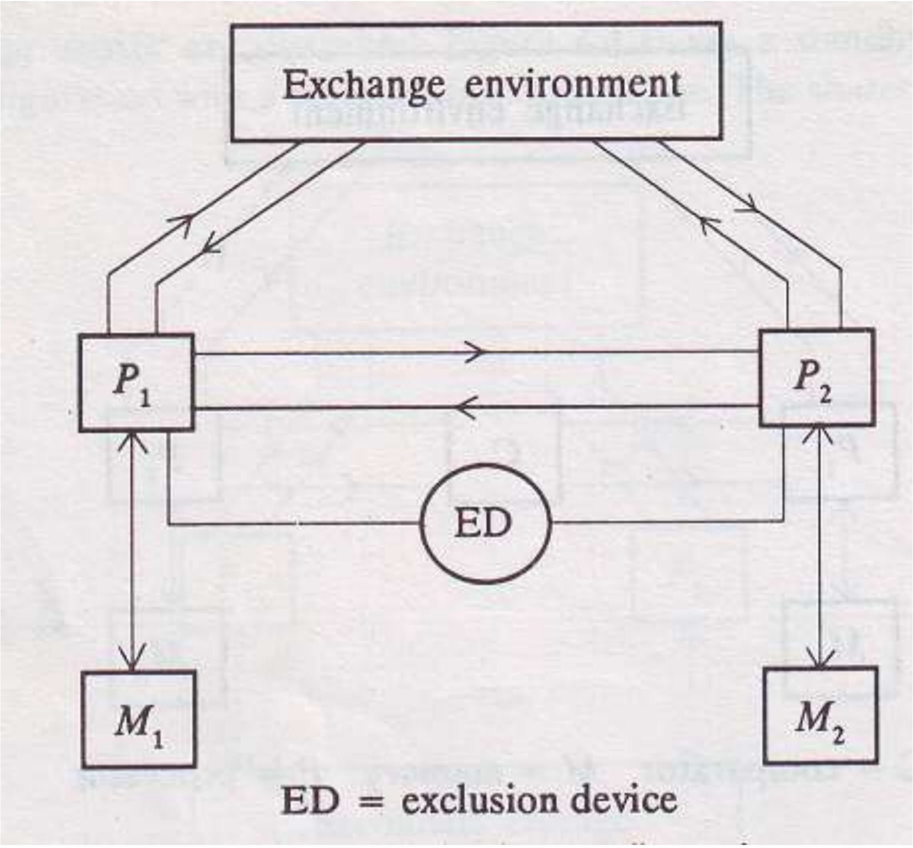
Load sharing configuration



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Distributed SPC

- In the distributed control, the control function are shared by many processers within the exchange itself .
- this type of structure owes its existence to the low cost microprocessors . this structure offers better availability and reliability then the centralized SPC.
- Exchange composed function may be decomposed horizontally or vertically for distributed processing.
- In the vertical decomposition the exchange environment is divided in to several blocks and each block is assigned to a processer that perform all control function related to that block of equipments. The total control system now consists of several control units coupled together.
- In the horizontal decomposition each processer perform only one or some of the exchange control functions. A chain of different processers may be used to perform the events monitoring, call processing and O&M functions

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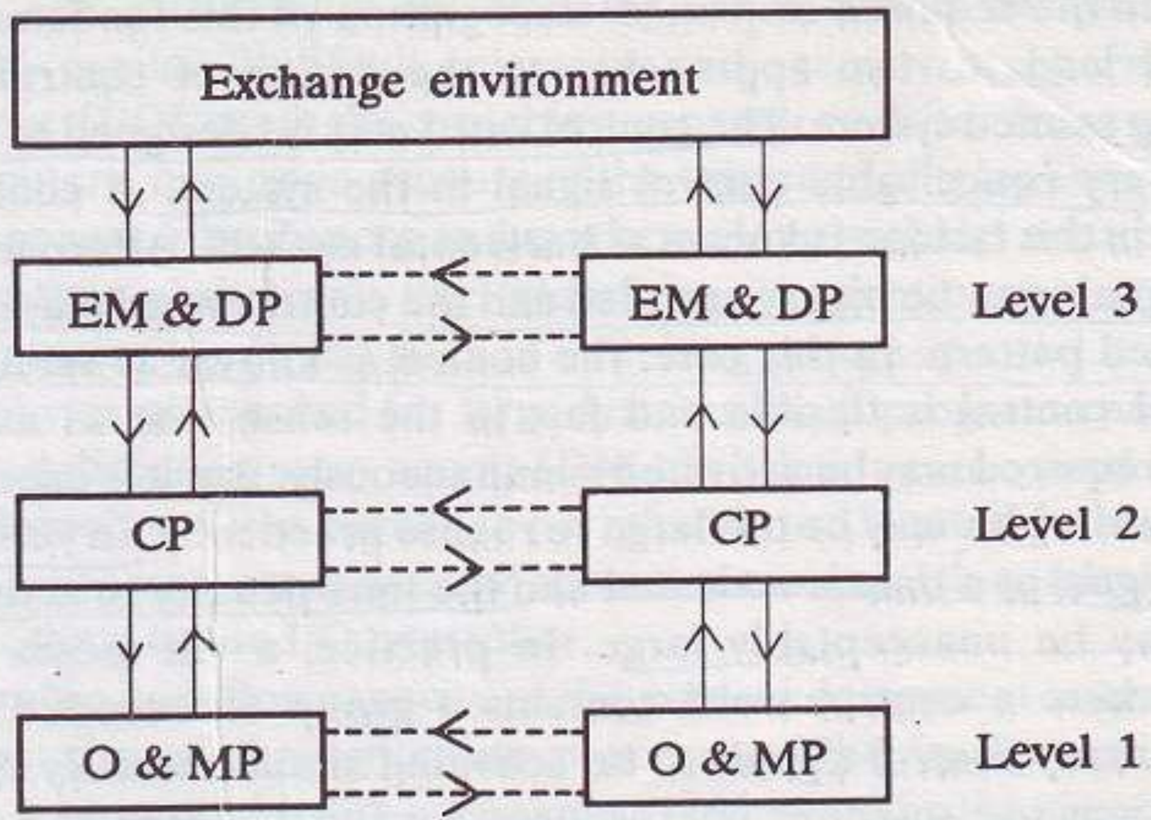

CP = call processor EM&DP = event monitoring and distribution processor O&MP = operation and maintenance processor

Dual chain distributed control.

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Level3 Processing

- Levels three processers handles scanning, distribution and marking functions. The processers and the associated device are located physically closed to the switching networks, junctors and signaling equipments.
- processing at this level results in the setting or sensing of one or more binary conditions in flip-flops or registers. It may be necessary to sense and alter a set of binary conditions in a predefined sequence to accomplish a control function. Such simple operations are efficiently performed either by wired logic or micro programmed devices.

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Level2 Processing

- Level 2 processor is usually termed as switching processors.
- Switching processors are not fundamentally different from general purpose digital computers. There are, however, certain characteristics that are specific to switching processors, as in the case of processors employed in process control or other industrial real time applications.
- Processor instructions, for instance, are designed to allow data to be packed more tightly in memory without unduly increasing the access time.
- Single bit and half-byte manipulation instructions are used extensively in switching applications.
- Special instructions for task and event queue management, which would enable optimal run times for certain scheduler functions, are desirable.

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Level1 Processing

- The level 1 control handles operations and maintenance (O&M) functions which involves the following steps:
- Administer the exchange hardware and software.
- Add, modify or delete information in translation tables.
- Change subscriber class of service.
- Put a new line or trunk into operation.
- Supervise operation of the exchange.
- Monitor traffic.
- Detect and locate faults and errors .
- Run diagnostic and test programs.
- Man-machine interaction.

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- The complex nature of the functions demands a large configuration for the level 1 computer involving large disk or tape storage.
- As a result, O&M processor in many cases is a standard general purpose computer, usually a mainframe.
- The complexity and volume of the software are also the highest when compared to level 2 and 3 processing. The O&M functions are less subject to real time constraints and have less need for concurrent processing.

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