CT-03

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1. (a) Explain different types of switching.
   (b) Explain space division switching with figure.
   (c) Briefly explain time division switching and optical switching.

2. (a) What are considered while designing switching network?
   (b) Differentiate between trunk switch and access switch.
   (c) How does multi-stage switch works? Write down this using a 100 × 100 switch.

3. (a) Explain time slot interchanger.
   (b) How is TSI performed? Explain.

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(c) How TSI system works?

4. (a) What is calling rate? Explain.

(b) Write down the equation of holding time and departure rate.

(c) What is the Erlang? How does the Erlang unit correspond to CCS (hundred call seconds)? What are its usages?

(d) Write down some grade of service related terms.

5. (a) Write down the percentage of different call attempts.

(b) Explain different blocking models.

(c) Briefly explain bionomial distribution and how it changes based on number of servers.

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6. (a) Differentiate time and call congestion.
(b) Design different network types.
(c) Differentiate between early and todays telephone system.
(d) What is transmitter and receiver.
(e) Draw the PSTN simple circuit model.

7. (a) Write down the events that happens while establishing of a call.
(b) Explain pulse dialing.
(c) Explain tone signalling.

8. (a) Explain briefly the Subscriber Loop plant.
(b) How to determine the target resistance of subscriber loop plant?
(c) Write down its network loss planning.

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Answer to the question no. 1(a)

Different types of switching is explained below:—

1) Circuit switching: In this switching a path is established between the caller and destination. Real time connection formed in this switching. Example: PSTN.

2) Message switching: It is also called store and forward. A message is first stored in a buffer and then sent on in its entirely step by step as resources become available. No real time connection. Example: E-mail.

3) Packet switching: A message is broken down into parts and each part is sent separately. Example: Internet UDP protocol.

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Answer to the question no. 1(b)

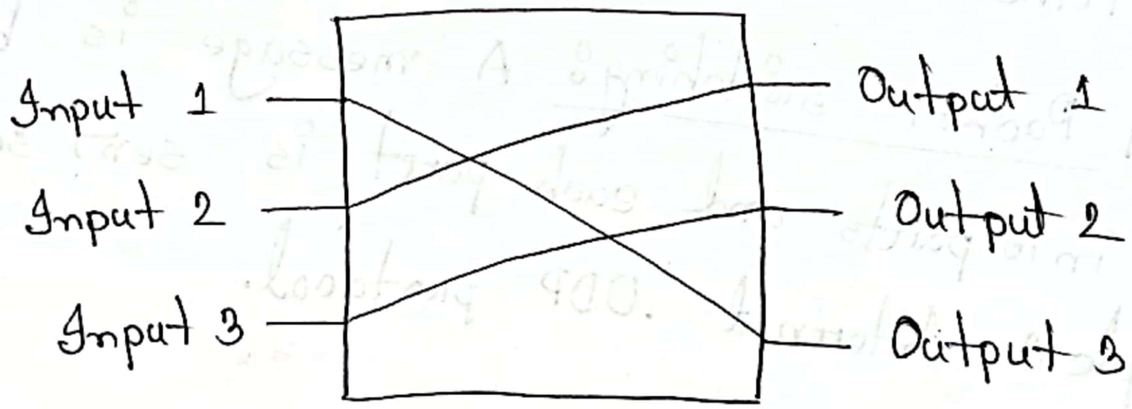
Space Division switching: Space division switching is connecting two channels that are separated in space. It can be mechanical and/or electronic.

Several problems:—

— Slow

— Bulky with lots of inter-connect wiring.

— Subject to cross talk



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Answer to the question no. 1(c)

Time Division Switching: In digital TDM systems, channels are divided by time slot, but switching is still possible. Switching is by a time-slot interchanger and is accomplished by rearranging the order in which data is read out of the buffer. Incoming data enters a speech store while the outgoing channels indicate to the speed address memory which incoming time slot it is assigned to. During each time-slot, the outgoing circuit reads the speech store slot corresponding to the SAM.

Optical switching: One wavelength can be turned into another. It is also called wavelength conversion or translation. Important in reducing blocking due to wavelength contention

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in routing and wavelength assignment problem. Optoelectronic conversion consists of optical receiver, conversion to electronic signal and then transmitter generates optical signal at the desired new wavelength.

Answer to the question no. 2(a)

Several points are considered while designing switching network :—

1. Blocking ~~points to cor~~ versus non-blocking switchinges
2. Number of cross-points
3. Reliability
4. Overload
5. Growth
6. Cost and technology

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Answer to the question no. 2(b)

Difference between trunk switch and access switch is given below:—

Trunk Switch:

→ One-to-one connection
→ One specific inlet must connect to one specific outlet.

Access Switch:

→ One-to-any connection
→ One specific inlet must connect to any free outlet.

Answer to the question no. 2(c)

Consider a switch with a 100×100 inter-connect function.

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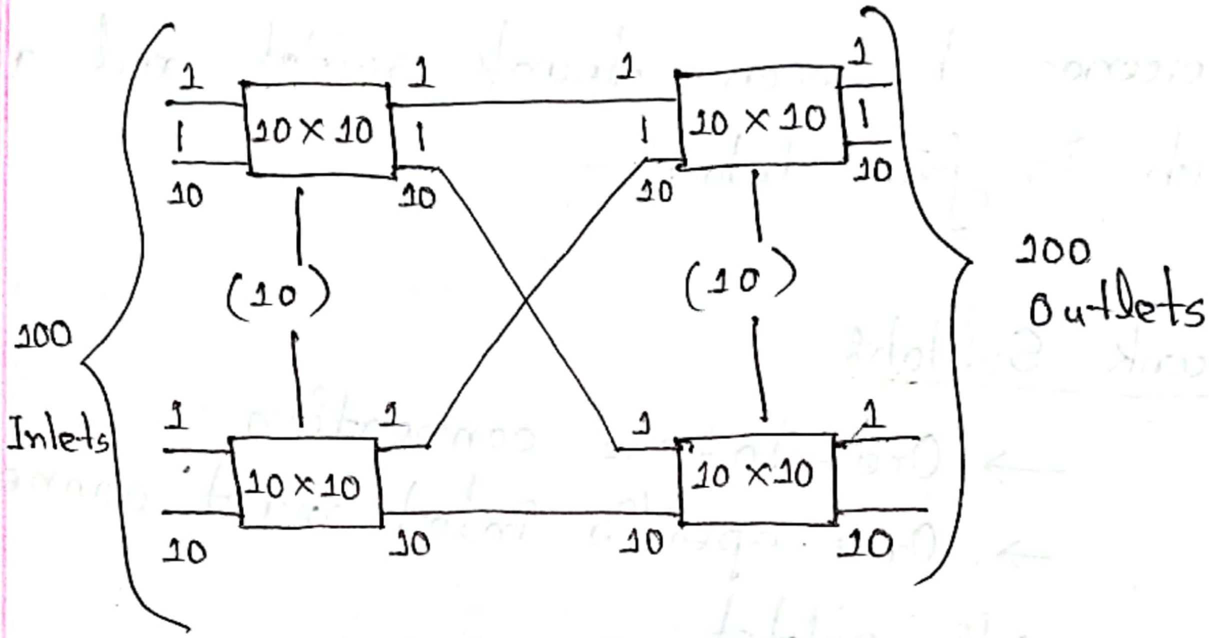
How it works:-



1. Divide the 100 inlets into groups of 10
2. 1st outlet each stage 1 block is connected to an inlet of the 1st stage 2 block.
3. 2nd outlet of each stage 1 block is connected to an inlet of the 2nd stage 2 block.
4. 3rd outlet of each stage 1 block is connected to an inlet of the 3rd stage 2 block.
5. ith outlet of each stage 1 block is

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connected to an inlet of the ith stage 2 block

Answer to the question no. 3(a)

Time Slot Interchanger (TSI):

— A TSI is a time switch. Switches one time slot channel in a single physical input to another time slot channel on a single physical output. Functionally equivalent to an n×n space divided switch where n is the number of time slots per frame.

Answer to the question no. 3(b)

TSI performed through use of two memory stores:—

1. Speech store is RAM with capacity to store one full frame of data.

→ For DS1 (1.544 Mbps) with 24 channels of 8 bits, the speech store is 24 bytes long.

→ For E1 (2.048 Mbps) with 32 channels of 8 bits, the speech store is 32 bytes long.

2. Speech Address memory (SAM) or time switch connection store is RAM with capacity to store a 'word' for each ~~time~~ slot, each word being a number identifying a specific time slot.

→ For DS1, the SAM has capacity to store 24 words of 5 bits per word for a total of 24×5 bits.

→ For E1, the SAM has capacity to store 32 words of 5 bits per word for a total of 32×5 bits.

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Answer to the question no. 3(c)

How TSI system works is given below:—

1) Data is written to the speech store cyclically as it comes in sequentially, one time slot at a time.

2) Path set up control signalling tells the SAM to store the name of the input time slot in the appropriate location corresponding to the output time slot it must be switched to.

3) Data is read a-cyclically from the speech store in the order of the output time slots as stored in the SAM.

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Answer to the question no. 4(a)

Calling rate is also called arrival rate or attempts rate. Average number of calls initiated per unit time. Each call arrival is independent of other calls. Call attempt arrivals are random in time. Until otherwise, we assume a "large" calling group or source pool.

If receive α calls from a terminal in time T, then

$$\gamma = \frac{\alpha}{T}$$

If receive α calls from m terminals in time T, then

$$\underbrace{\gamma_g = \frac{\alpha}{T}}_{\text{Group calling rate}} \qquad \underbrace{\gamma = \frac{\alpha}{mT}}_{\text{Per terminal calling rate}}$$

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Answer to the question no. 4(b)

Holding time (h):

→ Mean length of time a call lasts

→ Probability of lasting time for more is also -ve exponential in nature:

$$p(T \geq t) = e^{-t/h} \qquad t \geq 0$$

$$p(T \geq t) = 0 \qquad t < 0$$

→ Real voice calls fits very closely to the negative exponential from above

→ As non-voice "calls" begin to dominate, more and more calls have a constant holding time characteristic.

Departure Rate:

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

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Answer to the question no. 4(c)

The Erlang is the dimension less unit of traffic intensity. It is named after Danish mathematician A.K. Erlang. It is usually denoted by symbol E.

How the Erlang unit correspond to ccs:-

$$1 \text{ ccs/hour} = \frac{100 \text{ call. seconds}}{1 \text{ hour} \times 60 \text{ min/hr} \times 60 \text{ sec/min}}$$

$$= 0.027 \text{ E}$$

$$36 \text{ ccs/hour} = \frac{3600 \text{ call. seconds}}{1 \text{ hour} \times 60 \text{ min/hr} \times 60 \text{ sec/min}}$$

$$= 1\text{E}$$

Typical usages:

1. Residence phone -> 0.02E
2. Business phone -> 0.15E
3. Interoffice phone → 0.70E

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Answer to the question no. 1(d)

Grade of service related terms :-

1| Busy hour

– One hour period during which traffic volume or call attempts is the highest overall during any given time period.

2| Peak Busy hour

– Busy hour for each day, usually varies from day to day.

3| Busy Season

– 3 months (not consecutive) with highest average daily busy hour

4| High Day Busy hour

– One hour period during busy season with the highest load.

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Answer to the question no. 5(a)

Typical call attempts breakdown—

1. Calls completed - 70.7%
2. Called party no answer - 12.7%
3. Called party busy - 10.1%
4. Call abandoned - 2.6%
5. Dialing Error - 1.6%
6. Number changed or disconnected - 0.4%
7. Blockage or failure - 1.9%

Answer to the question no. 5(b)

Blocking models:

1. Blocked calls cleared:

1) Blocked calls leave system and do not return.

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2) Good approximation for calls in 1^{st} choice trunk group.

Blocked Calls held:

1) Blocked calls remain in the system for the amount of time it would have normally stayed for.

2) If a server frees up, the call picks up in the middle and continues

3) Not a good model of real world behaviour

4) Tries to approximate call reattempt efforts

Blocked calls wait:

1) Blocked calls enter a queue until a server is available

2) When a server becomes available, the call's holding time begins

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Answer to the question no. 5(c)

Binomial distribution is a block calls held (BCH) type of blocking model.

Here, m sources

A Erlangs of offered traffic

per source, $T_0 = A/m$

probability that a specific source is busy, $P(B) = A/m$

$$P(K) = \binom{m}{K}\left(\frac{A}{m}\right)^K\left(1-\frac{A}{m}\right)^{m-K}$$

$$= \left(\frac{m!}{K!(m-K)!}\right)\left(\frac{A}{m}\right)^K\left(1-\frac{A}{m}\right)^{m-K}$$

When we have N servers $(N < m)$,

1) We can have at most N busy sources at a time

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2) All N servers must be busy before we have blocking

$$P(B) = P(K \geq N) = P(K = N) + P(K = N+1) + \dots + P(K = m)$$

$$= \sum_{K=N}^{m} \binom{m}{K} \left(\frac{A}{m}\right)^{K} \left(1 - \frac{A}{m}\right)^{m-K}$$

$$= 1 - \sum_{K=0}^{N-1} \binom{m}{K} \left(\frac{A}{m}\right)^{K} \left(1 - \frac{A}{m}\right)^{m-K}$$

If $K > N$,

1) Impossible to have more ~~K~~ busy sources than servers to serve them

2) Doesn't accurately represent reality

3) In this model, we still assign $P(K > N) = A/m$

4) Acts as good model of real behaviour

Answer to the question no. 6(a)

Time congestion:

1) Proportion of time a system is congested (all servers busy)

2) Probability of blocking from point of view servers

3) $P(B) = P(k \geq N)$

Call congestion:

1) Probability that an arriving call is blocked

2) Probability of blocking from point of view of calls

3) $P(B) = P(k > N)$

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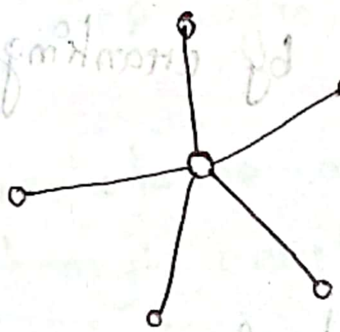
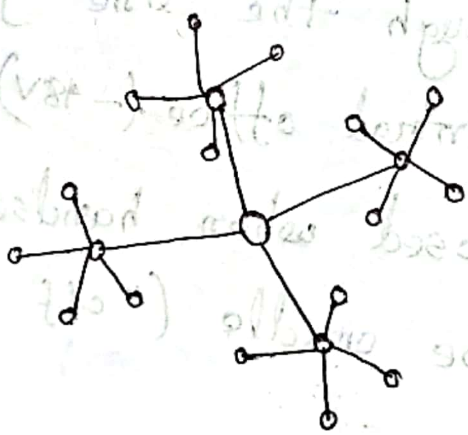
Answer to the question no. 6 (b)

Different network types are designed below:-

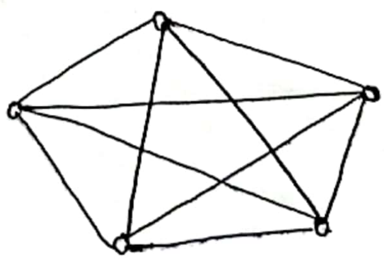
a) Pure STAR:



b) Double STAR:



c) Full MESH:



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Answer to the question no. 6. (c)

Early Telephone system:

1. Powered by self contained local battery
2. Ringing created by cranking generator

Today's Telephone System:

1. Powered through the line by battery at the central office (–48V)
2. Circuit is closed when handset is lifted from the cradle ("off hook").

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Answer to the question no. 6(d)

Transmitter:

1. It is a carbon granule microphone

2. Air pressure of sound waves impact on diaphragm, varying pressure on carbon granules

3. Resistance of electrical current passing through carbon granules varies the current (analog).

Receiver: Varying electrical current passing through willdings on magnet, moves a ~~diaphg~~ diaphragm, same as in music loudspeaker.

Answer to the question no. 6(e)

'PSTN' or 'POTS' simplified circuit model of any connection is given below:-

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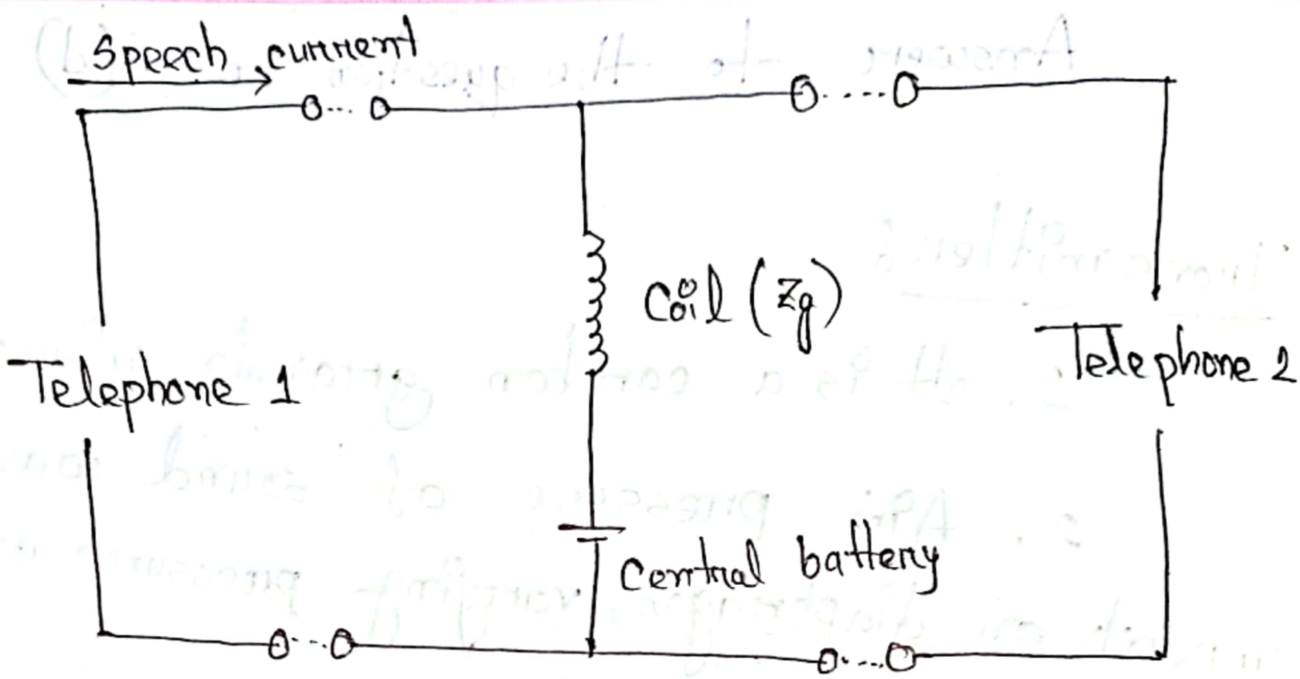

The coil is a 'transmission bridge coil' with a high impedance (Z_g).

Answer to the question no. 7(a)

Establishing of a call —

1. Calling customer takes phone off hook which closes the circuit to the c.o

2. c.o detects the 'loop' and indicates readiness with dial tone.

3. Calling customer hears dial tone and dials number

4. The network checks on the called party status and decides on a routing for the connection.

5. If connection possible, the called party is alerted.

6. 'Ring tone' is returned to the caller

7. The called party picks up the handset and closes his/her loop.

8. Exchange detects second loop and 'trips' or stops ringing, then establishes call

9. One party opens loop by hanging up, and exchange clears connection.

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Answer to the question no. 7(b)

'Pulse dialing'

1. Line is rapidly disconnected and reconnected in sequence with one pulse for digit value "1", two pulses for digit value "2' etc

2. Each pulse lasts 0.1 second

3. Inter digit pause (IDP) must be >0.5 second.

4. Ten digit phone number typically takes 6-15 seconds ~~total~~.

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5. This is the kind of signaling old "rotary dial" phones produced.

Answer to the question no. 7(c)

Tone signalling:

1. Faster than pulse dialling (1-2 seconds for ten digit number).

   — Reduces call set up time

2. Each digit produced by combination of 2 pure frequency tones.

   — Reduces chances of error or interference.

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Answer to the question no. 8(a)

Subscriber loop plant:

1. Wire network from the central office to the station sets.

2. Largest portion of capital expenditure and workforce requirements

3. Prime candidate for replacement by optical fibre but costs often prohibitive

4. Main goal is to design and work with length limits.

– Limited by resistance and attenuation along the line.

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Answer to the question no. 8(b)

How to determine the target resistance on subscriber loop plant is given below:—

1. We need a high enough current at the customer premises to operate the station set.

2. Use $V = IR$, with a ~~known~~ known battery voltage of $-48V$.

3. $48V > 20mA \times R \longrightarrow R \leq 2400\Omega$ total

4. Budget $\approx 400\Omega$ for the battery feed bridge at the C.O

5. Budget $\approx 300\Omega$ for other miscellaneous wire resistances.

6. The S.L's wire resistance must not exceed 1700Ω.

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Answer to the question no. 8(c)

Network Loss planning:

1. Received Volume control

→ Subscribers must have a received signal level within an appropriate range.

→ Not too loud and not to quiet

2. Stability or Oscillation control

→ Manage reflections that can result if there's a poor mismatch of the 2-wire line impedance and the hybrid balance impedance.

→ Singing can result.

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3. Talker Echo

→ Talker should not hear his/ her own voice reflected back.

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