

CT Assignment 038- Set Question

1. (a) what is Trunk switch?  
(b) Explain circuit switching, message switching and packet switching.  
(c) Describe technique of separating circuits.
2. (a) what is access switch?  
(b) How does a time-space-time switch work?  
(c) Explain time slot interchanger (TSI)
3. (a) what is traffic offered?  
(b) Describe Traffic engineering Trade offs.  
(c) Explain types of blocking
4. a) what is poisson Traffic model?  
(b) Differentiate time congestions and call congestion  
(c) Calculate probability of blocking.

5. (a) what are the failures of the poisson model as valid for situations with high blocking?

(b) Explain Erlang B model.

(c) Explain B Birth-Death process.

6. (a) Define Receiver.

(b) What is transmitter? Differentiate between early telephone system and todays telephone system.

(c) Show PSTN circuit model.

7. (a) What is DTMF signalling?

(b) What are the procedures of establishing a call?

(c) Describe pulse dialling.

8. (a) Define MSL. Explain each of the following:  
(b) Describe subscriber Loop.  
(c) How do you determine the target  
length of resistance?

Ans to the question no. 01

1.(a)

Trunk switch:

Trunk switch also called traffic switch. Trunk switch is defined as one to one connection which has one specific inlet that is must connect to one specific outlet.

1.(b) i) Circuit switching

- A path is established between the caller and destination
- Real time connection formed.

Example: PSTN.

ii) Message switching

- Also called store and forward.
- A message is first stored in a buffer and then sent on in its entirety

- No real time connection (i.e. connectionless)

### iii) Packet switching

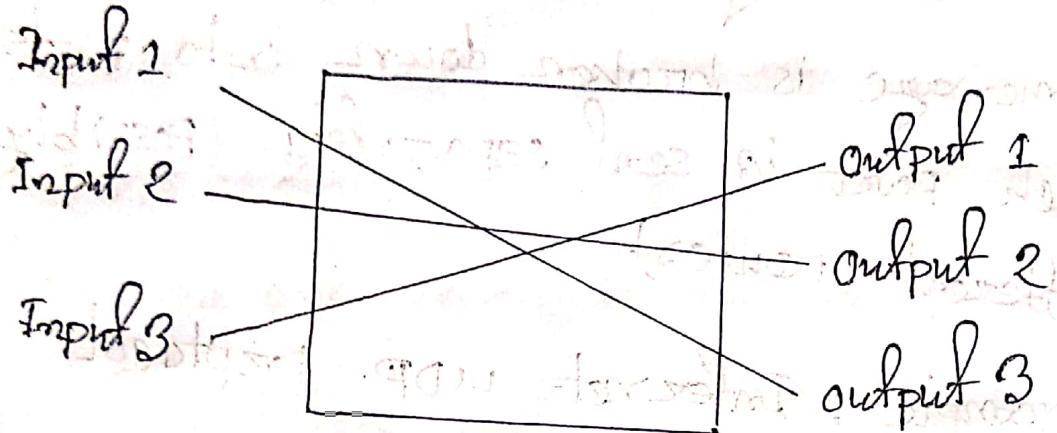
- A message is broken down into parts and each part is sent separately (possibly via different routes).

Example: Internet UDP protocol.

### 1(c) Separating circuits

- Four technologies for separating circuits
  - (i) space
  - (ii) RF frequency
  - (iii) Time
  - (iv) optical wavelength
- There is logically connect circuits coming into a switch with circuits at the output.

• Example "space division" equivalent interconnection pattern.



Ans. to the question no. 02

2(a)

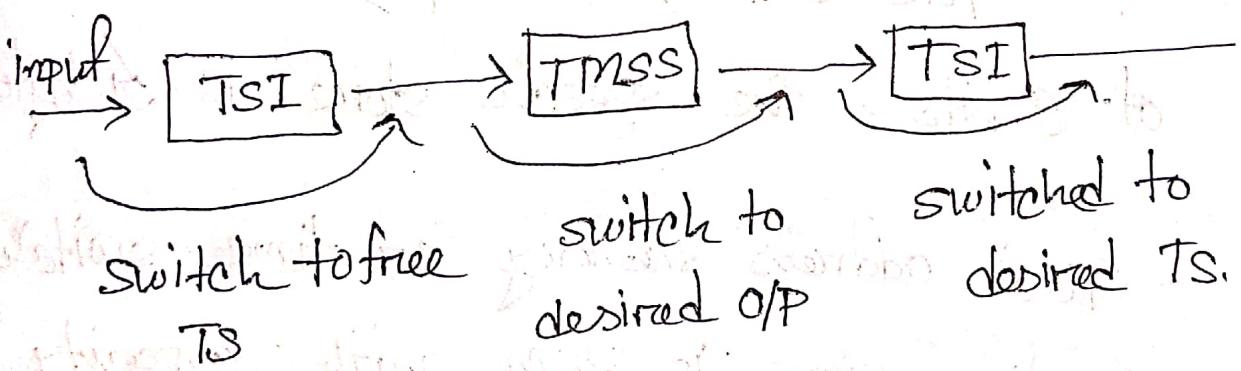
Access switch is considered as one to any connection which has one specific inlet must connect to any free outlet.

2(b) Time-space-time switching working

Process:

- First, find a time slot that is free from the input TSI to the TMSS and from the TMSS to the output TSI to connect to.

- Next, switch the input channels time slot in question to the free time slot.
- Then at the TMSS, connect the proper input line to the proper output line during free time slot.
- finally, at the output line's TSI, switch the free time slot to the time slot we wish to switch to.



Q. (a)

## Time slot interchanger:

- In a TSI, one time slot is switched to another.
- Performed through use of two memory stores:
  - Speech store is RAM with capacity to store one full frame of data.
    - For DSI (1.544 Mbps) with 24 channels of 8 bits, the speech store is 21 bytes long.
  - Speech address memory 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 DSI, the SAM has capacity to store 25 words of 5 bits per word (need 5 bits to store a number between 1 and 25).

Ans to the question no. 03

3.(a)

offered traffic ( $T_0$ ) equivalent to traffic intensity ( $A$ )  
It takes into account all attempted calls whether  
blocked or not and uses their expected holding  
times.

3(b)

### Traffic Engineering Trade offs

- Designs number of transmission paths or channels.
  - How many required normally.
  - what (if) there is an overload.
- Design switching and routing mechanisms
  - so How do we route efficiently?
    - E.g.
    - High usage trunk groups.
    - overflow trunk groups.
    - where should traffic flows be combined

- Design network topology
  - Number and sizing of switching nodes and locations
  - Number and sizing of transmission systems and locations.
  - Survivability.

Q(c)

### Three types of blocking models

i) Blocked calls cleared (Bcc)

- Blocked calls leave system and do not return.
- Good approximation for calls in 1st choice trunk group.

ii) Blocked calls held (Bch)

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

- If a server feeds up, the call picks up in the middle and continues.
- Not a good model of real world behaviour
- Tries to approximate call attempts efforts.

### iii) Blocked calls wait (BCW)

- Blocked calls enter a queue until a server is available.
- When a server becomes available the calls holding time begins.

Answer to the question no. 04

#### 4.(a) Poisson Traffic model:

- Poisson approximates Binomial with large  $m$  and small  $\lambda/m$ .

$$P_k = \frac{e^{-\lambda} \lambda^k}{k!}$$

where  $\lambda$  = mean # of busy sources and

$$\text{Poisson} = \lim_{m \rightarrow \infty} (\text{Binomial})$$

4.(b)

## Time Congestion vs Call Congestion

### • Time Congestion

- Proportion of time a system is congested (all servers busy).
- Probability of blocking from point of view of servers.

### • Call Congestion

- Probability that an arriving call is blocked.
- Probability of blocking from point of view of calls.

for call,  $P(B) = P(k > N)$

Probability that there are more source wanting service than there are servers.

For time,

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

Probability that  
all servers are busy

4(c) Probability of blocking:

$$P(B) = P(k > N) = P(N) + P(N+1) + \dots + P(\infty)$$

$$= \sum_{k=N}^{\infty} \frac{e^{-A} \cdot A^k}{k!} = \sum_{k=N}^{\infty} \frac{A^k}{k!} e^{-A}$$

[where  $P(k) = \frac{e^{-A} A^k}{k!}$ ]

$$= 1 - \sum_{k=0}^{N-1} \frac{A^k}{k!} e^{-A}$$

$$P(B) = P(N, A) \leftarrow \text{offered}$$

Poisson  $\uparrow$  traffic  
 $N = \text{servers}$

Example,  $P(7, 10)$

Poisson  $P(B)$  with  $10E$

offered to 7 servers

Ans. to the question no. 5

5.(a)

Failure of the Poisson model,

① Poisson only good approximation when low blocking.

② Use Erlang B if high blocking.

Above are the failure of Poisson model as valid for situations with high blocking.

5.(b)

Erlang B Model,

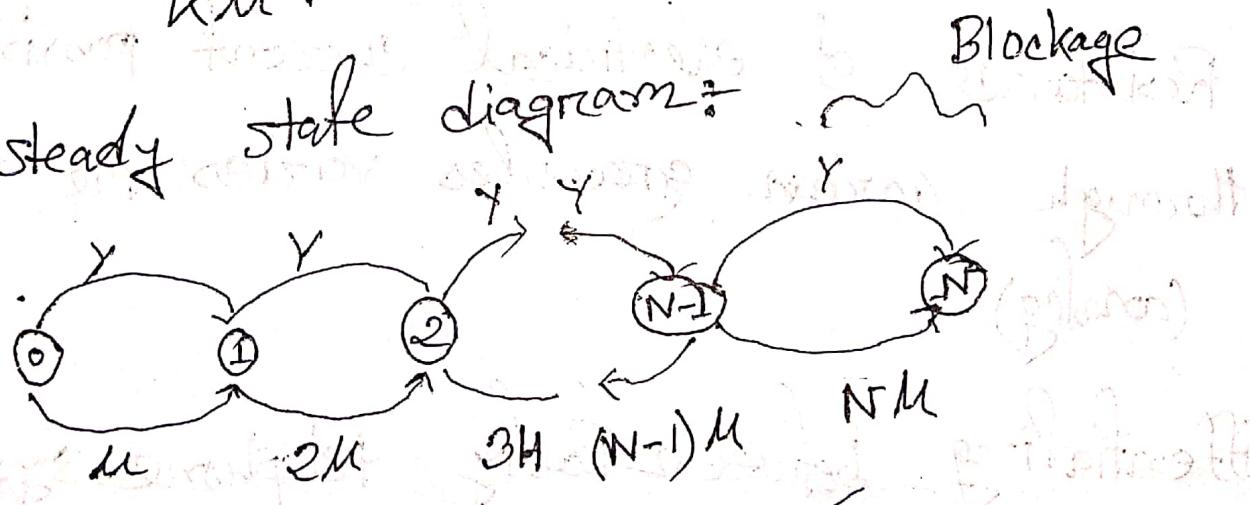
- More sophisticated model than Binomial or Poisson.
- Blocked calls cleared (BCC).
- Good for calls that can re-route to alternate route if blocked.
- No approximation for re-attempts if alternate route blocked too.

5.(c)

### Erlang - B Birth - Death Process:

- Consider infinitesimally small time dt during which only one arrival or departure (or none) may occur.
- Let  $\gamma$  be the arrival rate from an infinite pool of sources.
- Let  $\mu = \lambda$  be the departure rate per call.
- Let  $\mu = \lambda$  be the departure rate per call.  
- if  $k$  calls in system, departure rate is  $k\mu$ .

Steady state diagram:



Immediate service

Ans to the question no. 06

6.(a)

Receiver: Varying electrical current passing through windings on magnet, moves a diaphragm. Same as in a music loudspeaker.

6.(b)

Transmitter: (Carbon granule microphone)

- Air pressure of sound waves impact on diaphragm varying pressure on carbon granules
- Resistance of electrical current passing through carbon granules varies the current (analog)

Differentiating between Early telephone system and today's telephone system are given below,

- Early telephone system:

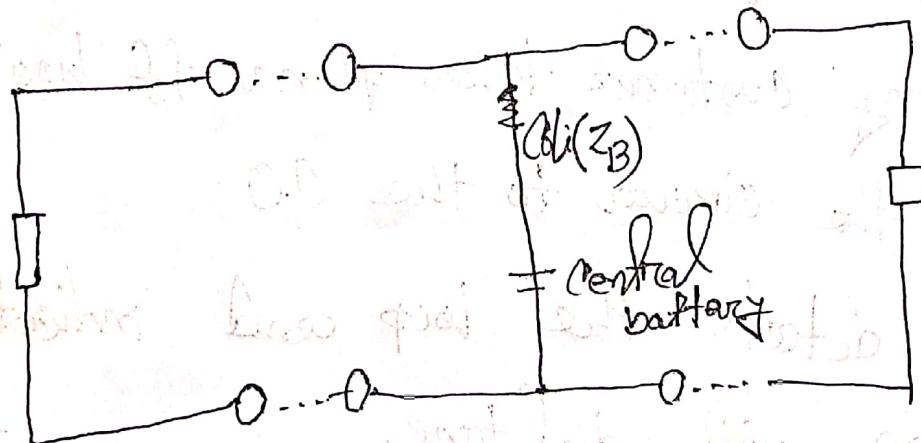
- Powered by self-contained local battery
- Ringing created by cranking generator.

- Today's telephone system:
  - Powered through the line by battery at the central office (-48v)
  - circuit is closed when handset is lifted from the cradle.

6.(c)

PSTN or POTS: simplified circuit model of any connection.

Speech current:



"The coil is a 'transmission-bridge coil' with a high impedance ( $Z_B$ ) preventing out the speech current from shorting out at the central battery"

Ans to the ques no. 07

7.(a)

### DTMF signalling

- Faster than pulse dialling (1-2 seconds for ten digit numbers)
- Reduces call set up time.
- Each digit produced by combination of 2 pure frequency tones.
  - Reduces chances of error or interference.

7(b)

### Establishing 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 customers hears dial tone and dials numbers.

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 stop ringing, then establishes call.
9. One party opens loop by hanging up and exchange clear connection.

7.(c)

Pulse dialling:

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

- ii) Each pulse lasts  $0.1$  second.
- iii) Inter-digit pause (IDP) must be  $> 0.5$  second.
  - If not, current digit may combine with previous digit.
- iv) Ten digit phone number typically takes 6-15 seconds total.
- v) This is the kind of signalling old rotary dial "phones" produced.

Ans. to the ques no. 08

8.(a) SRL defines as Singing return loss which has minimum attenuation to reflected power at any frequency coming back from the  $2w-4w$  interface.

8.(b)

### Subscriber Loop:

- i) Wire network from the central office to the station sets.
- ii) Largest portion of capital capabilities (50%) and workforce requirement (30% - 40%).
- iii) Prime candidate for replacement by optical fibre but costs often prohibitive.
- iv) Main goal is to design and work with length limits.
  - limited by resistance and attenuation along the line.

8(c)

Target resistance determination,

- we need a high enough current at the customer premises to operate the station set (20mA minimum in North America).

- use  $V = IR$  with a known battery voltage of - 48v.
- $48v \geq 20mA \times R \rightarrow R \leq 2400\Omega$  total.
- Budget  $\approx 400\Omega$  for the battery faced bridge at the customer.
- Budget  $\approx 300\Omega$  for other miscellaneous wire resistance (e.g. subplot wiring, etc)
- The subscriber loops wire resistance must not exceed  $1700\Omega$ .