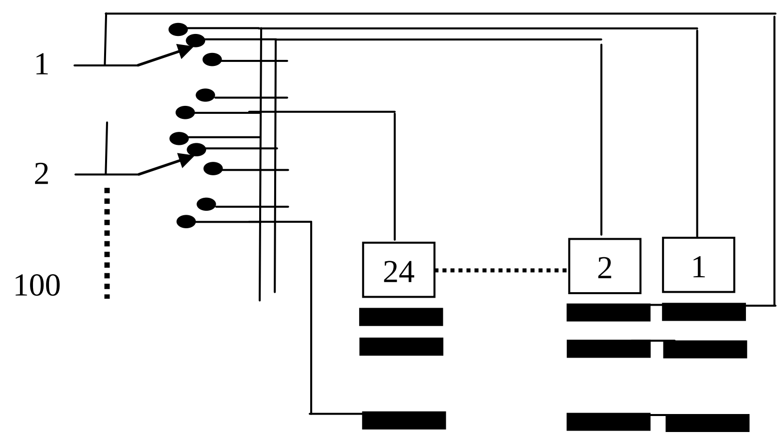
Q.2 a. A 100 line exchange is to be designed using uniselectors and two motion selectors that provide a switching capacity of 20. Give your requirement of components and explain how you will implement this exchange scheme.

Answer: T1, pg-58; T2, Pg-53

Number of two motion selectors required= Switching capacity=20
Number of uniselectors required= 100
Number of switching stages: Unisel + two motion =2
Traffic Handling capacity:
= (No. of switching stagesx Switching capacity)/Theoretical max. load
=2x20/100=0.40
Exchange Scheme:



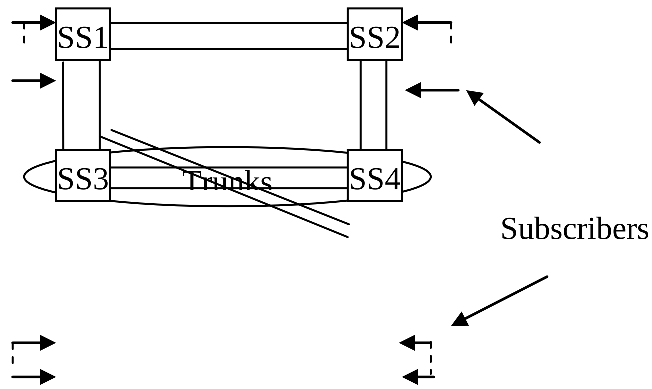
b. How trunking is useful in an telecommunication network? Explain typical trunking diagram?

Answer: T1, pg-5, 256; T2, Pg-5

In a terrestrial telecommunication network trunking is necessary:

- It is not possible to connect all subscriber to one Switching system.
- Several switching systems are needed at different geographical locations.
- These systems should be interconnected to establish connectivity between subscribers connected to these systems.
- This also helps in scalability of the network.

The links that run between switching systems are called trunks, the number of trunk line depends on the traffic between SSs. Generally the trunks are hierarchical to provide optimal connectivity between subscribers. Group switching, District switching and main switching center.



Q.3 a. How will you characterise a typical telephone traffic model? What are the parameters considered for such a model?

Answer: T1, pg-274

Any telephone system works for 24 hours a day but, the amount of traffic varies from hour to hour. Therefore the traffic model is to be built on statistical data of number of calls made and that go through. The assumptions are based on pure chance traffic and statistical equilibrium. For example the traffic is low during lunch hour but peaks during 10 hrs to 12hrs as also during 14hrs to 16hrs.There could be unpredictable peak hours also on certain days.

The model is therefore characterised by following parameters:

1. Busy Hour
2. Peak busy hour
3. Time consistent busy hour
4. Call completion rate
5. Busy hour call attempts
6. Traffic intensity in Erlangs

Probability models like Poissonian traffic is used for pure chance traffic. The arrival of a call and its termination is a random event but over a period can be averaged to.

b. What does Grade of Service indicate? In a telephone network there are 10 servers and 100 subscribers. During any time on an average 7 servers are busy. Calculate (i) the probability that all servers are busy and (ii) Grade of Service.

Answer: T1, pg-301

In any telephone system the actual traffic flow is much less than the traffic offered. The indicator of traffic lost/rejected by the network is Grade of service. It is the ratio of lost traffic to offered traffic.

GoS=(N-R)Pr/(N-Ao) where N= No. of sudscribers =100 ; R= No. of servers=10
Ao=Average number of busy servers=7
Pr= Probability of all servers busy=(10-7)/10=0.3
GoS=(100-10)0.3/(100-7)= 0.29

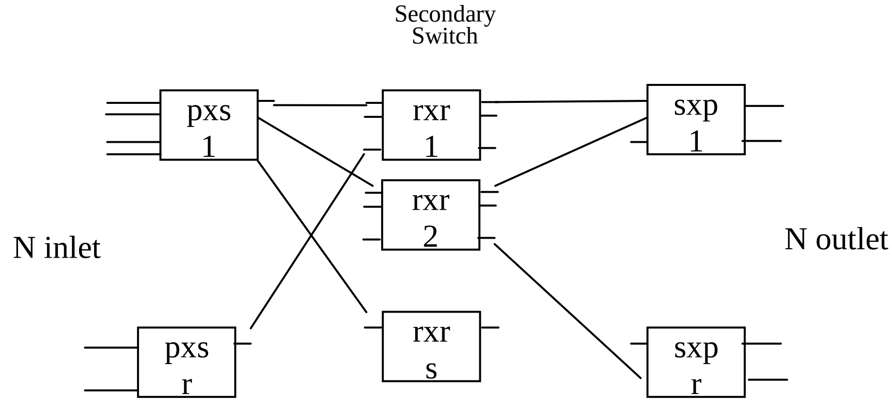
c. Draw the schematic of a Queuing system and explain its working.

Answer: T1, pg-304
There are a number of subscribers who send requests or data which amount to generating traffic. All requests cannot be put through the servers. All the servers are identical and can handle a set of traffic requests. When all servers are busy the new requests get into queue until the server becomes available.
While designing queuing systems, number of waiting requests, interarrival times between requests and time spent in queue.
Assumptions made:
Pure Chance traffic, Statistical equilibrium, Full availability, Calls which encounter congestion are put in a queue.During congestion it is not possible to keep subscribers in queue for infinite duration of time. This will reduce the grade of service and require large memory. Also it is not practicable, hence it is necessary that the queuing period is limited or is finite. Thus when the queue has become full the call is lost.

Q.4 a. Explain how blocking probability reduces in a three stage switching network system?

Answer: T1, pg-131

In a three stage network with N input and N outputs (NXN), the N inlets are divided into r blocks of p inlets and similarly the outlets.The first stage has pXs matrices, the second stage consists of rXr , s matrices. The third stage consists of sXp matrices.



In a two stage network the blocking probability is:
$P_B=[a+(1-a)b]^g$ where a are incoming links and b outgoing links here a=b=N
$P_B=[N+(1-N)N]^g$

In a three stage network the blocking probability is:
$P_B=[P_{B1}+c(1-P_{B1})]^g{}_3$ where P_{B1} is the blocking probability of secondary switch matrix. Which is similar to two a stage network.
It is therefore seen that blocking probability reduces in three stage network.

b. A three stage network is designed with the following parameters: p=q=16 and $\alpha=0.7$. Calculate the blocking probability of network for s=18 and s=31.

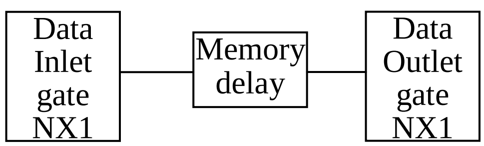
Answer:

i) $\alpha/k=p\alpha/s =16x0.7/18= 0.622$
$P_B=[1-(1- \alpha/k)^2]^s =[1-(1- 0.622)^2]^{18}=0.062$

ii) $\alpha/k=p\alpha/s =16x0.7/31= 0.361$
$P_B=[1-(1- \alpha/k)^2]^s =[1-(1- 0.361)^2]^{31}=8.6x10^{-8}$

Q.5 a. What is a Time Division Time switching system? Explain its modes of operation and how these modes help in determining the number of subscribers?

Answer: T1, pg-193
In a time division time switch a memory block is introduced instead of bus. It is a store and forward method. There is always a delay in forwarding the data. Therefore the equivalent scheme of time division time switch is as shown.



There are two modes of operation: Phased operation and slotted operation.
In the phased mode, in the first phase one memory write is involved per inlet and in the second phase two memory reads, one at control memory and the other at data memory. The time taken for the two phases of operation is

$$t_s=Nt_d+N(t_d+t_c)=3Nt_m$$

Therefore the number of subscribers $N=t_s/3t_m$

b. Calculate the number of trunks that can be supported on a time multiplexed space switch, that has 24 channels multiplexed in each stream. The memory access time is 80nsec and other process worst case is time 100nsec.

Answer: T1, pg-202
Number of channels M=24
Total t_s= 80+100=180 nsec
Assuming total frame operation time 125microsec
$N= 125x10^{-6}/(24x180x10^{-9})= 28.9$ or 28 subscribers per channel

Q.6 a. Draw the typical centralized stored programme control organization and explain how can a dual processor architecture be configured to operate in

(i) Stand by mode
(ii) Load sharing mode

Answer: T1, pg-193; T2, Pg-88

In an centralized stored control all control equipments are replaced by a single processor, it also takes care of ancillary tasks. Some times more than one processor is used for redundancy. Each processor could also have its own dedicated paths.
Stand by mode: Is the simplest dual processor configuration. One processor is active and the other stand by, Standby processor is brought online only when active processor fails (It can be cold stand by or hot stand by). During change over the stand by should copy the present state of the active processor and know the busy lines and idle lines, subscribers connected. In this case the connected subscribers get disturbed.
Availability in stand alone =(MTBF)/(MTBF+MTTR)
Load sharing: In this mode an incoming call is assigned randomly or in a predetermined order between the processors. Thus both processors are active all the time. The processors are not fully loaded so that in case of failure of one processor the other can take partial load of both the processors. Each processors have their own memories but exchange information between themselves to remain in sync. Calls on the failed processor only get disturbed. Load sharing gives much better performance than stand alone.
Availability in load sharing=A_D=$(MTBF)_D/(MTBF_D+MTTR)$
where $MTBF_D=(MTBF)^2/2MTTR$

b. Given that MTBF is 1500 hours and MTTR is 5 hours then calculate the unavailability for (i) single processor and (ii) dual processor.

Answer:

Unavailability single processor= MTTR/MTBF=5/1500=$3.33x10^{-3}$

Unavailability dual processor=$2(MTTR)^2/(MTBF)^2=2(5)^2/(1500)^2=22.22x10^{-6}$

Therefore the dual processor is no reliable than stand alone.

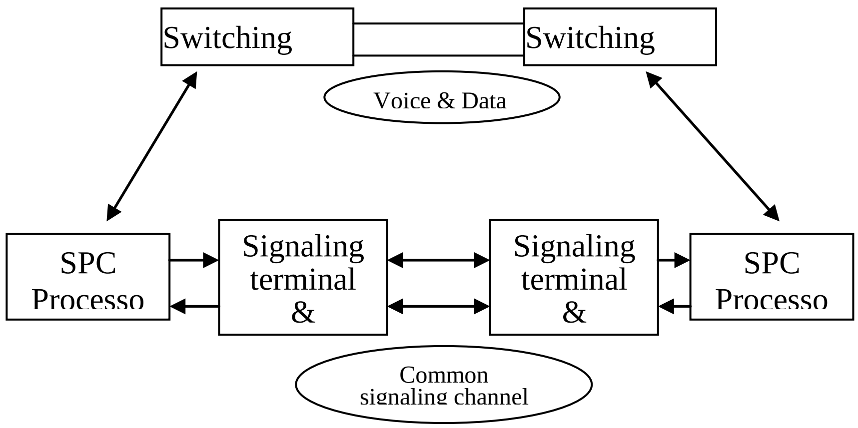
Q.7 a. What are the advantages of common channel signaling , draw the basic scheme for CCS and explain its principle of working.

Answer: T1, pg-218; T2, Pg-382

Common channel signaling has following advantages:

1. Information exchange between processors is faster and efficient use of voice / data channels.

2. More services can be provided.
3. Signals can be added or changed using software.
4. No need of additional line signaling equipment.
5. Traffic can be pure duplex and fewer circuits required.
6. Additional signals regarding calls can be sent while call is in progress.
7. Common channel can be used for M & M of network.



b. Draw the architecture of SS7 and explain the importance of each layer.

Answer: T1, pg-221

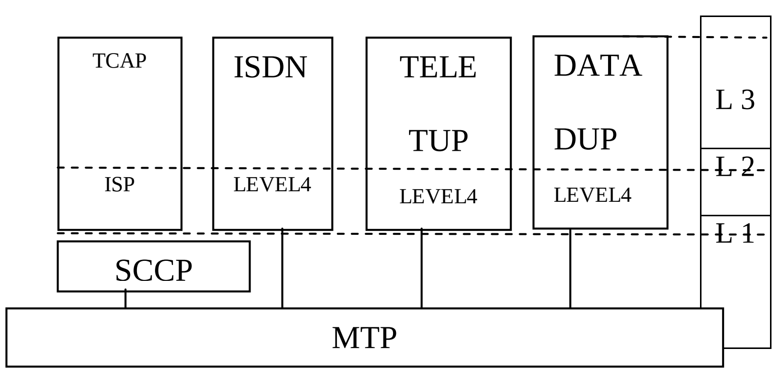
The CCITT, SS7 consists of following 4 levels as compared to OSI which has 7 layers: Physical, Data-link, Signaling-Network, User Part

Physical layer incorporates 1-3 layers of the ISO and has Message transfer Part (MTP) Signalling connection control part (SCCP). It also identifies the user part Application and services (ISDN, Telephone, Data).

Level 1, sends bit streams over physical path in a time slot consisting of 24 PCM/TDM cannels at 1.5Mbps.

Level 2 incorporates transport, session and presentation layers; This performs the function of error control, link initialization, error rate monitoring, flow control etc.

Level 3, is equivalent to application layer and takes care of functions required for signaling,



Q.8 a. What is the need of packet switching when circuit switches exist? How statistical multiplexing is different from STDM?

Answer: T1, pg-233; T2, Pg-177

Message switching is not suitable for data traffic. The data traffic is continuous long duration files and requires continuous and fast response. To avoid queuing in packet switching the messages are split into small packets and sent at a fast rate.
Conventional multiplexing allocates dedicated channel and slots to transfer data, but this is very inefficient way to transfer bursty traffic. The solution to this is statistical multiplexing or intelligent mux, in which depending on the packet size and queuing condition the terminal is instructed to send packets. This is a store and forward technique. This is therefore a asynchronous mode of transmission. In a synchronous TDM the number of channels that can be accommodated is given by k/m where k is the transmit bit rate over data link and m the terminal bits generated per sec. Where as in Asynchronous or Stat-mux it depends on the time the terminal is active 'a' and the mean bit rate 'am'.
Then the number of channels is given by = (k/m)(b/a) where 'b' is the permissible delay in store and forwarding. Thus if 'a' is low or activity is low asynchronous can handle many more channels than synchronous.

b. Give four comparison of bus and ring networks.

Answer: T1, pg-241; T2, Pg-451

Q.9 Write short notes on:

(i) Private networks

(ii) Charging in telecommunication network

Answer: Page Number 272, 277-279 of Text Book

Text Books

1. Telecommunications Switching, Traffic and Networks, J.E.Flood, Pearson Education, 2006.

2. Telecommunication Switching Systems and Networks, Thiagarajan Viswanathan, Prentice Hall of India Pvt. Ltd, 2006.