11. A three stage switching structure supports 128 inlets and 128 outlets. It is proposed to use 16 first stage and third stage matrices.

A) What is the number of switching elements in the network if is nonblocking.

B) At peak periods, the occupancy rate of an inlet is 10%. If the number of switching elements required for nonblocking operation is reduced by a factor of 3, what is the blocking probability of the network?

Ans: Number of inlets n = 128, number of blocks r = 16,

Number of inlets in each block, p = N/r = 128/16 = 8

Number of switching elements S = 2p-1 = 2*8 – 1 = 15

We know that $S = spr + sr^2 + spr = 15*8*16 = 15*16^2 + 15*8*16 = 7680$

Occupancy α = 10/100 = 0.1

Blocking probability $P_B = [1 - (1 - \alpha/k)^2]^{s'}$

S' = 7680/3 = 2560   and k = 3

$P_B = 0.002$

12. Determine the switch advantage ratio of a three stage network with N inlets and N outlets for the cases when (a) N = 128 (b) N = 32768

Ans:

(a) N = 128

For single stage network

$S_1 = N^2 = 28^2 = 16384$

For three stage networks

$S_3 = 4N * \text{sqrt}(2N) = 4*128*\text{sqrt}(2*128) = 8192$

Switch advantage ratio = 16384/8192 = 2

(b) N = 32768

For single stage network

$S_1 = N^2 = 32768^2 = 1.07 * 10^9$

For three stage networks

$S_3 = 4N * \text{sqrt}(2N) = 4*32768*\text{sqrt}(2*32768) = 33.55 * 10^6$

Switch advantage ratio $= 1.07 * 10^9/33.55 * 10^6 = 31.88 = 32$

13. A three stage network is designed with the following parameters: M = N = 512, p = q = 16 and α = 0.7. Calculate the blocking probability of the network if (a) s = 16 (b) s = 24 (c) s = 31 using the Lee equation. Determine the inaccuracy of the result in case of (c).

Ans:

α = probability that a given inlet is active

k = No. of links between first-second stage pairs

M = N = 512   p = q = 16   α = 0.7

(a) s = 16

s = k * p

k = s/p = 16/16 = 1

$P_B = [1 - (1 - \alpha/k)^2]^s = 0.22$

(b) s = 24

k = s/p = 24/16 = 1.5

$P_B = [1 - (1 - \alpha/k)^2]^s = 0.0032$

(c) s = 31

k = s/p = 31/16 = 1.93

$P_B = [1 - (1 - \alpha/k)^2]^s = 8.6 * 10^{-8}$

Q.1. 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. **(6)**

Ans:

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

$$C = 2 \text{ X } 2500 = 5000 \text{ units}$$

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

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

Q.4.. A three stage network is designed with the following parameters: M=N=512, p= q = 16 and $\alpha = 0.65$. Calculate the blocking probability of the network, if s=16. Symbols carry their usual meanings. **(8)**

Ans:

The blocking probability

$P_B = [1-(1- \alpha /k)^2]^s$

Where

$\alpha = 0.65$

$k = p/s = 16/16 = 1$

$P_B = [1-(1-0.65)^2]^{16}$

$[1-(0.35)^2]^{16} = 0.123$ **Ans.**

Q.11. A three stage switching structure supports 100 inlets and 400 outlets. Find the number of cross points, and the number of primary and secondary switches used in the design. **(6)**

Ans:

We know that

$$m = \frac{M}{M+N} \quad \text{and} \quad n = \frac{N}{M+N}$$

m = 100

1. if m=5, n=20, there are :
   20 primary switches of size 5 x 5
   5 secondary switches of size 20 x 20
   20 tertiary switches of size 5 x 20
2. if m = 4, n =16, there are:
   25 primary switches of size 4 x 4
   4 secondary switches of size 25 x 25
   25 tertiary switches of size 4 x 16

Q.13. In a two stage network there are 512 inlets and outlets, r=s=24. If the probability that a given inlet is active is 0.8, calculate:

(i) The switching elements
(ii) Switching capacity
(iii) Blocking probability **(6)**

Ans:

N =M =512 , α =0.8 , r=s=24

(i) The number of switching elements:
$S= M_s + N_r = 512 \times 24 + 512 \times 24$

(ii) Switching Capacity
SC =rs =24 x 24

(iii) Blocking Probability

$$P_B = \frac{M\alpha(s-1)-((M/r-1))\alpha}{rs(s-1)}$$

$$= \frac{512 \times 0.8(23) - (512/24-1)0.8}{24 \times 24\,(23)} = 0.7$$

Q16. A 1000 line exchange is partly folded and partly nonfolded. 40% of the subscribers are active during peak hour. If the ratio of local to external traffic is 4:1, estimate the number of trunk lines required.

Ans: 4 : 1 = 800 : 200

Switching pattern = 200

400 (folded) + 200 (Unfolded) = 600 patterns

Therefore 800 lines of local traffic and 200 lines of external traffic. For 800 lines of folded traffic, the number of switching pattern = 400 / 2 = 200

Out of 600 patterns, 40% are active.

No. of busy lines = 0.4 X 600 = 240

4 : 1 = 192 : 48

192 lines are used for local traffic. 48 lines are used for trunk lines.