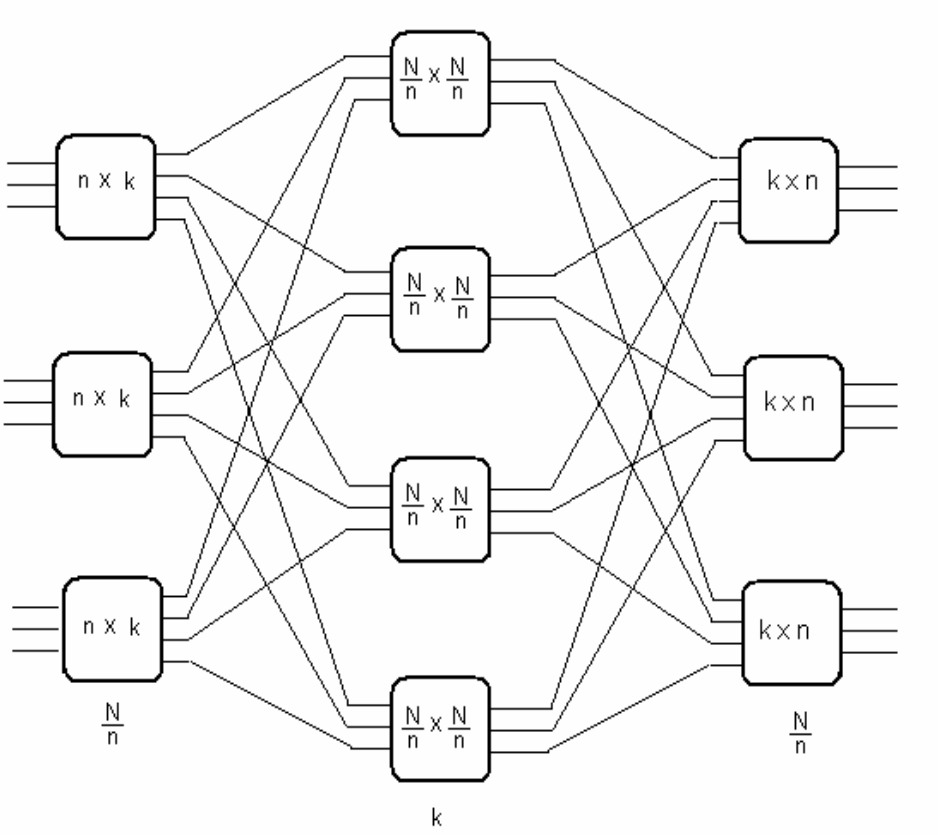
Module 9

Digital Switching

Lesson

30

Multistage Switching



GROUPING

When the number of incoming traffic becomes unmanageable by a single operator then grouping is important.

- What if a user from 1 group wants connection to a user in another group?

Each group has a switchboard with all the Outgoing lines and only the incoming lines of that group. More than one group might want a particular line, then the operator has to know first whether the destination is free, and then only he can connect to that line in his switchboard.

Out of N lines. , N/n groups of n lines are made.

Multistage switches provide better blocking performance than single stage switches, as they provide alternative paths for a particular source-destination pair.

- What is the optimum value of n in a 3-stage switch?

k is the number of second stage switches. These second stage switches are shared. Each user has got multiple path for reaching a particular user. The system can support k simultaneous calls. So k should be as large as possible to educe the probability of blocking. But large k means larger size, complex control and hence more costly.

Number of cross connects in the above structure is

$$N_x = 2\frac{N}{n}(n \times k) + k\left(\frac{N}{n} \times \frac{N}{n}\right)$$

$$\text{i.e. } N_x = 2Nk + k\frac{N^2}{n^2}$$

Differentiating the above expression with respect to k and equating with 0, we get the condition for minimum value of N_x we obtain

$$n = \sqrt{\frac{N}{2}}$$

$$\text{thus } N_{x\min} = 4N\left(\sqrt{2N} - 1\right)$$

Comparing the number of cross points for the single stage switch and the three stage switch we observe that the three stage switch requires lesser cross points than the single stage switch.

But the cost is not reduced in a straightforward manner with the ratio as control cost increases in the three stage switch. However the overall cost (control + switch) shall be less than the single stage cost.

Blocking is not solely dependent on switching fabric, but also on the nature of the incoming traffic. i.e. number of calls per unit time and the call holding time.

T α C, h ie T α Ch, T= kCh

k = 1 Erlang if C=1 unit , h=1 unit in a time of 1 unit.

In telephone traffic the unit of time is 1 hour. We find the busiest hour, busiest day, busiest week and find the traffic at that hour.

Offered Traffic means how many calls originated in 1 hour and how long does each call last.

Increasing the number of stages will lead to advantage in the number of Cross Points. But the complexity also increases, so overall advantage is not much.

Now in computerized exchanges computers handle control. So speed and memory of computers are important. BHCA shows how many calls it can process in the busiest hour. Low BHCA means that even if switches are free, they cannot be utilized as the control processing is not enough.

☞*BHCA stands for Busy Hour Call Attempts.*

We have to make a trade off between switching fabric and control at every stage, based on the requirements. Trade off between GOS and switching matrix. Multiplexing is for use of a single transmission medium by different users. The length of transmission line is immaterial. We can then very well have a switch instead that is multiplexed. Using this technique as many as 30 users can be served by a single cross point. If we perform this multiplexing for all the cross points then the number of cross points is reduced, however the control complexity increases. We have to now see how much the complexity increases. The sampling for the multiplexing should be done at the Nyquist rate (8 kHz for voice), so that users do not feel the discontinuity. For 32 users full rotation is to be done in 125 μs. Thus the switching speed is 4 μs. Depending on the switching speed the number of users can be varied.

Objective Questions

30.01

Subjective Questions

30.11

Level 2 Questions

30.21

Source:http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Communication%20network/pdf/9.2%20Lesson%2030.pdf