Cairo University
Faculty of engineering
Communication Engineering

Assignment 3

Name: Abdelaziz Salah Mohammed Abdou, BN:1, Sec:2

1. **In queuing model described by M/M/1, explain what these parameters stand for.**

That means that the system has a Poisson arrival process, an exponential service time distribution, and one server.

2. **Show the main difference between the fundamental assumptions of Erlang first Formula (B-Formula) and the Erlang Second formula (C-Formula).**

Erlang first Formula (B-Formula):

a- Calls occur individually and collectively at random, i.e., in accordance with Poisson distribution (this implies a very large no of calling sources).

b- A state of statistical equilibriums exists.

c- Calls originating when all trunks are being busy are lost, and their holding time is Zero.

d- Negative exponential holding time is assumed.

Probability of blocking at the switch due to congestion or "all trunks (links) busy":

$$E_B(A) = \frac{A^N / N!}{\left[1 + \frac{A}{1!} + \frac{A^2}{2!} + \ldots\ldots \frac{A^N}{N!}\right]}$$

Erlang second Formula (C-Formula):

The same assumptions of lost call system are still valid except (c) which is replaced by:

- Calls originating when all trunks are busy, wait for service as long as necessary, and are connected immediately when a trunk becomes free.

Blocking probability will be given by:

$$E_{2,N}(A) = \frac{\frac{A^N}{N!}\frac{N}{N-A}}{\sum_{r=0}^{N-1}\frac{A^r}{r!} + \frac{A^N}{N!}\left(\frac{N}{N-A}\right)}$$

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3. **A small community with 400 subscribers is to be served with a remote switch. Assume that the average subscriber originates 0.15 Erlang of traffic. Also assume that 30 % of the origination are local (intra-community) calls and that 70% are transit calls to the serving central exchange.**

(a) How many Erlangs of traffic are offered to the central exchange?

400 * 0.15 * 70% = 42

(b) How many trunk lines are needed for 1% blocking of the transit traffic?

From the table at B=2%, nearest load is 55

4**. Four clusters of data terminals are to be connected to a computer by way of leased circuits. The traffic from each cluster used separate group of shared circuits.**

(a) **Assume that 25 terminals are in each cluster and each terminal is active 25% of the time. Determine the number of circuits required for each cluster assuming that the maximum desired blocking probability is 2%. Find the total number of circuits.**

Total traffic per cluster A =25*0.25=6.25 E

at B=2%, the nearest load is 6.61 E, no. of circuits is 12 Circuits

(b) What would happen if the traffic intensity is doubled?

If the traffic intensity is doubled, 2*6.25 = 12.5 E

at B=2%, N= 19 E

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(c) Repeat (a) and (b) if the traffic from all clusters is connected onto one group of circuits?

All terminals are in one cluster.

(a) A= 4*25*0.25=25 E, N=34 circuits
(b) A= 4*25=50 E, N=61 circuits

(d) What do you conclude from the results of these two different network configurations?

From these results.

Doubling the traffic does not mean doubling the number of circuits because the relation is not linear.

In case of 4 separate clusters, each cluster requires 12 circuits, while in case of all terminals in one cluster, the no. of required circuits is less, 34 instead of 4*12.

So, the utilization of circuits is better. But in case of a link failure, all terminals will be disconnected, while in 4 cluster configurations, only part of terminals will be disconnected.

5. Give examples of the applications that use LEO and MEO satellite systems.

LEO satellites are commonly used for: Communications, military reconnaissance, spying and other imaging applications.

MEO satellites also require a constellation of satellites to provide geographic coverage.

MEO satellites are commonly used for: positioning information like GPS, GLONASS and Galileo.

6. Is it possible that terrestrial networks become preferential than communication satellite systems?

No because each one is used in a specific application.

So, the correct answer is Optical fiber cables provides higher bandwidth, hence high bit rate at low latency (delay).