Telecommunication Traffic Engineering

Unit 3
Lecture 1

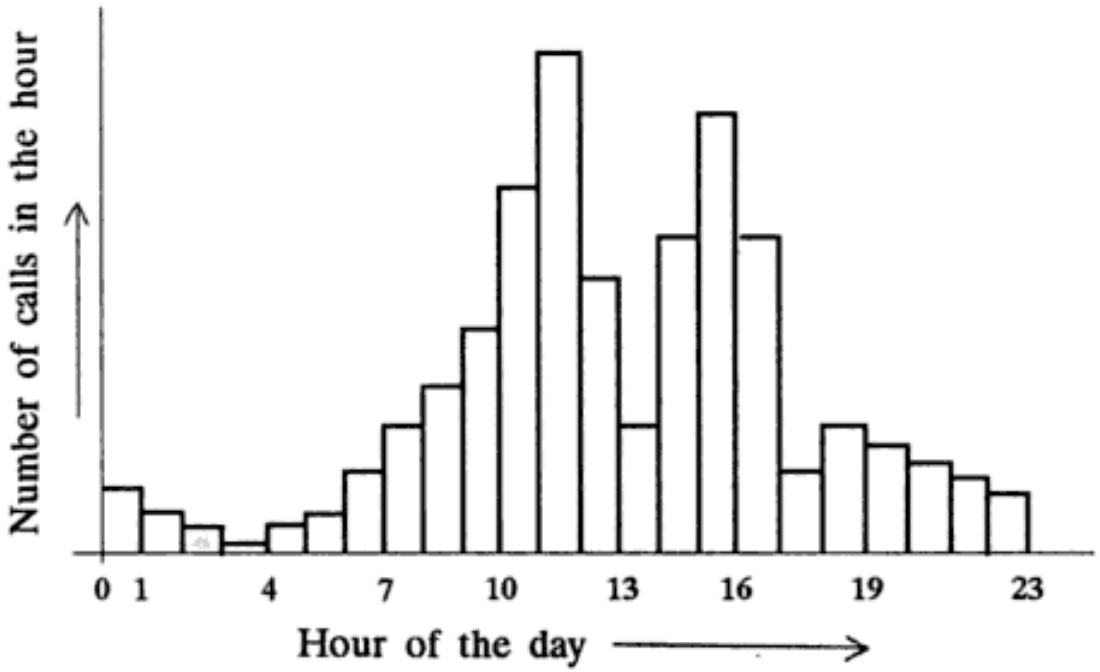
Network Traffic Load

- Busy Hour : In a day, the 60 minute interval in which the traffic is highest.
- Peak busy hour: The busy hour each day ,it usually varies from day to day or over number of days.
- Time Consistent Busy hour: The 1 hour period starting at the same time each day for which the average traffic volume or the number of call attempts is greatest over the days under consideration.

Network Traffic Load and parameters

- Busy hour calling rate (BHCA) : the number of call attempts in busy hour.
- Call completion rate (CCR): ratio of the number of successful calls to the number of call attempts.
- Busy hour calling rate: average number of calls originated by a subscriber during the busy hour.

Traffic load on a typical working day during the 24 hours is shown in the graph below.



Typical telephone traffic pattern on a working day.

Question Sample :

An exchange serves 2000 subscribers. If the average BHCA is 10,000 and the CCR is 60%, calculate the busy hour calling rate.

Solution

$$\text{Average busy hour calls} = \text{BHCA} \times \text{CCR} = 6000 \text{ calls}$$

$$\text{Busy hour calling rate} = \frac{\text{average busy hour calls}}{\text{total number of subscribers}} = 3$$

The busy hour calling rate is useful in sizing the exchange to handle the peak traffic. In a rural exchange, the busy hour calling rate may be as low as 0.2, whereas in a business city it may be as high as three or more. Another useful information is to know how much of the day's total traffic is carried during the busy hour. This is measured in terms of **day-to-busy hour traffic ratio** which is the ratio of busy hour calling rate to the average calling rate for the day. Typically, this ratio may be over 20 for a city business area and around six or seven for a rural area.

- All common subsystems of a telecommunication network are collectively termed as servers. Term link and trunk can also be used.
- Occupancy of servers in a network is termed as traffic intensity A0. defined as:

$$A_0 = \frac{\text{period for which a server is occupied}}{\text{total period of observation}}$$

- A0 is dimensionless and called ERLANG (E) to honor Danish telephone engineer A.K. Erlang who did pioneer work in traffic engineering.

Question Sample :

In a group of 10 servers, each is occupied for 30 minutes in an observation interval of two hours. Calculate the traffic carried by the group.

Solution

$$\text{Traffic carried per server} = \frac{\text{occupied duration}}{\text{total duration}}$$

$$= \frac{30}{120} = 0.25 \text{ E}$$

Total traffic carried by the group $10 \times 0.25 = 2.5$ E

Erlang measure indicates the average number of servers occupied and is useful in deriving the average number of calls put through during the period of observation.

Question Sample :

A group of 20 servers carry a traffic of 10 erlangs. If the average duration of a call is three minutes, calculate the number of calls put through by a single server and the group as a whole in a one-hour period.

Solution

$$\text{Traffic per server} = \frac{10}{20} = 0.5\ \text{E}$$

i.e. a server is busy for 30 minutes in one hour.

$$\text{Number of calls put through by one server} = \frac{30}{3} = 10\ \text{calls}$$

$$\text{Total number of calls put through by the group} = 10 \times 20 = 200\ \text{calls}$$

- Centum Call Second : call time product means one call for 100 seconds duration or 100 calls for 1 second duration each or any other combination.
- Call second (CS) and call minutes (CM) are also used to measure a traffic intensity.
- 1 E= 36 CCS = 3600 CS =60 CM
- Average call arrival rate C, Average holding time t_h we can the express load offered to the network in terms of these parameters.
- $A=Ct_h$

Where C and t_h must be expressed in like time units.

Question Sample :

A subscriber makes three phone calls of three minutes, four minutes and two minutes duration in a one-hour period. Calculate the subscriber traffic in erlangs, CCS and CM.

Solution

$$\text{Subscriber traffic in erlangs} = \frac{\text{busy period}}{\text{total period}} = \frac{3+4+2}{60} = 0.15\,\text{E}$$

$$\text{Traffic in CCS} = \frac{(3+4+2)\times 60}{100} = \frac{540}{100} = 5.4\,\text{CCS}$$

$$\text{Traffic in CM} = 3 + 4 + 2 = 9\,\text{CM}$$

Question Sample :

Over a 20-minute observation interval, 40 subscribers initiate calls. Total duration of the calls is 4800 seconds. Calculate the load offered to the network by the subscribers and the average subscriber traffic.

Solution

Mean arrival rate $C = 40/20 = 2$ calls/minute

Mean holding time $t_h = \dfrac{4800}{40 \times 60} = 2$ minutes/call

Therefore,

Offered load $= 2 \times 2 = 4$ E

Average subscriber traffic $= 4/40 = 0.1$ E