Class: 4th

MOBILE COMMUNICATIONS

Tetorial 4

Chapter Three

Traffic Engineering

By

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Q1\ We record data in the Table below by observing the activity of a single customer line during an eight-hour period from 9:00 A.M. to 5:00 P.M. Find the traffic intensity during the eight-hour period, and during busy hour (BH) which occurs between **3:00 P.M. and 5:00 P.M.**

Call no.	Call started	Call ended	Call duration (min.)
1	9:15	9:18	3.0
2	9:31	9:41	10.0
3	10:17	10:24	7.0
4	10:24	10:34	10.0
5	10:37	10:42	5.0
6	10:55	11:00	5.0
7	12:01	12:02	1.0
8	2:09	2:14	5.0
9	3:15	3:30	15.0
10	4:01	4:35	34.0
11	4:38	4:43	5.0

Solution

$$\lambda = \frac{11}{8} = 1.375 calls/hour$$

$$Total\ call\ minutes = 3 + 10 + 7 + 10 + 5 + 5 + 1 + 5 + 15 + 34 + 5 = 100\ minutes$$

The average holding time in hours per call is:

$$H = \frac{100}{11} \times \frac{1}{60} = 0.1515 hours/call$$

The traffic intensity is

$$A = \lambda H = 1.375 \times 0.1515 = 0.208 Erlangs = 7.5 CCS$$

The busy hour (BH) is between 3:00 P.M. and 5:00 P.M. Since there are only three calls between this periods, we can write:
Call arrival rate = 3/2 =1.5 calls/hour
The average call holding time during BH: **H= (15+5+34)/3 *1/60 = 0.3 hours/ call**
The traffic intensity during BH is: **A =λH = 1.5×0.3= 0.45Erlangs= 16.2 CCS.**

Q2/ We record data in the table below by observing the activity of a single customer line during an eight-hour period from 9:00 A.M. to 5:00 P.M. Find the traffic intensity

1- during the eight-hour period

2- during busy hours (BH) which occurs between 2:00 P.M. and 5:00 P.M. (i.e. 3 hour)

Call no.	Call started	Call ended	Call duration (min.)
1	9:15	9:18	3.0
2	9:31	9:41	10.0
3	10:17	10:24	7.0
4	10:24	10:34	10.0
5	10:37	10:42	5.0
6	10:55	11:00	5.0
7	12:01	12:02	1.0
8	2:09	2:14	5.0
9	3:15	3:30	15.0
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The busy hour (BH) is between 2:00 P.M. and 5:00 P.M.

The average call holding time during BH:

$$H = \frac{15+5+34+5}{4} = 14.75\text{min}/call = 0.245 hours/call$$

$$\lambda = \frac{4}{3} = 1.333 calls/hour$$

$$A = \lambda H = 1.333 \times 0.245 = 0.327 Erlangs$$

Q3 In order to determine voice traffic on a line, we collected the following data during a period of **90 minutes**. Calculate the traffic intensity in Erlangs and CCS.

Traffic data used to estimate traffic intensity.

Call no.	Duration of call (s)
1	60
2	74
3	80
4	90
5	92
6	70
7	96
8	48
9	64
10	126

Solution:

$$\frac{90}{60} = 1.5\ hour$$

$$\lambda = \frac{10}{1.5} = 6.667 calls/hour$$

Average call holding time:

$$H = \frac{(60+74+80+90+92+70+96+48+64+126)}{10} = 80\ sec/call$$

$$A_u = \lambda H = 6.667 \times \frac{80}{3600} = 0.148 Erlangs = 5.33 CCS$$

Q4\In a wireless network each subscriber generates two calls per hour on the average and a typicalcall holding time is **120 seconds**. What is the traffic intensity?

Solution:

$$A_u = \lambda \times H = 2 \times \frac{120}{3600} = 0.0667\ Erlangs = 2.4 CCS$$

Q5\ In order to determine voice traffic on a line, we collected the following data during a period of **120 minutes**. Calculate the traffic intensity in Erlangs and CCS.

Call no.	Duration of call (s)
1	**58**
2	**63**
3	**47**
4	**120**
5	**55**
6	**95**
7	**111**
8	**66**

$$\lambda = \frac{8}{2} = 4\ calls/hour$$

Average call holding time:

$$H = \frac{58 + 63 + 47 + 120 + 55 + 95 + 111 + 66}{8} = \frac{615}{8} = 76.875\ sec/call$$

$$A_u = \lambda \times H = 4 \times \frac{76.875}{3600} = 0.08542\ Erlangs = 3.075 CCS$$

Q6 Define Sectoring **and Cell splitting**

Solution:

1. **Sectoring**: is the technique for decreasing co-channel interference by using directional antennas. A single Omni-directional antenna at the base station is replaced by several directional antennas, each radiating within a specified ***sector***.
2. **Cell splitting**: is the process of subdividing a congested cell into smaller cells, each with its own base station and a corresponding reduction in antenna height and transmitter power.