CS 6097 Wireless and Mobile Networking
Homework No. 3 dated Wednesday September 17, 2014

P 5.4 If each user keeps a traffic channel busy for an average of 5% time and an average of 60 requests per hour is generated, what is the Erlang value?

[Solution]

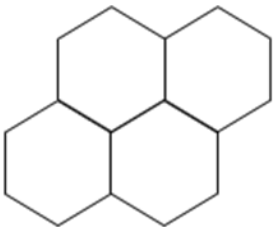
The request rate r = 60/3600 = 1/60 requests/sec
Holding time = 0.05×3600 = 180 sec
Therefore the offered traffic load in Erlangs is =request rate × holding time = (1/60)×180 = 3 Erlangs.

P 5.7 The size and shape of each cluster in a cellular need to be designed carefully so as to cover adjacent spoke in a non-overlapped manner. Define such patterns for the following cluster sizes:

(a) 4-cell
(b) 9-cell
(c) 13-cell
(d) 37-cell

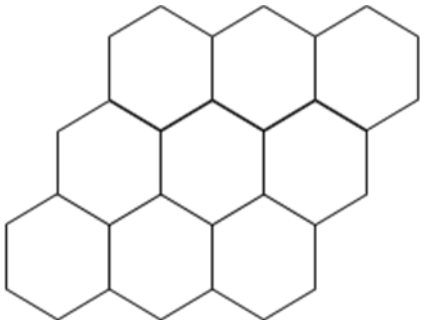
[Solution]

(a) 4-cell cluster

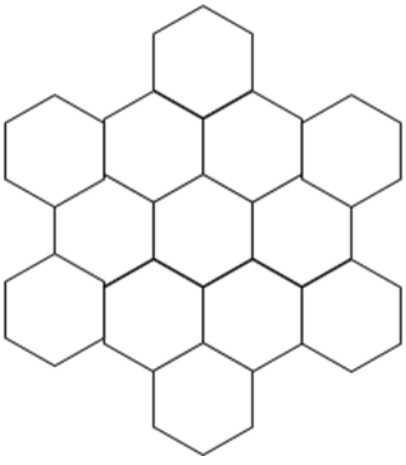


4-cell cluster

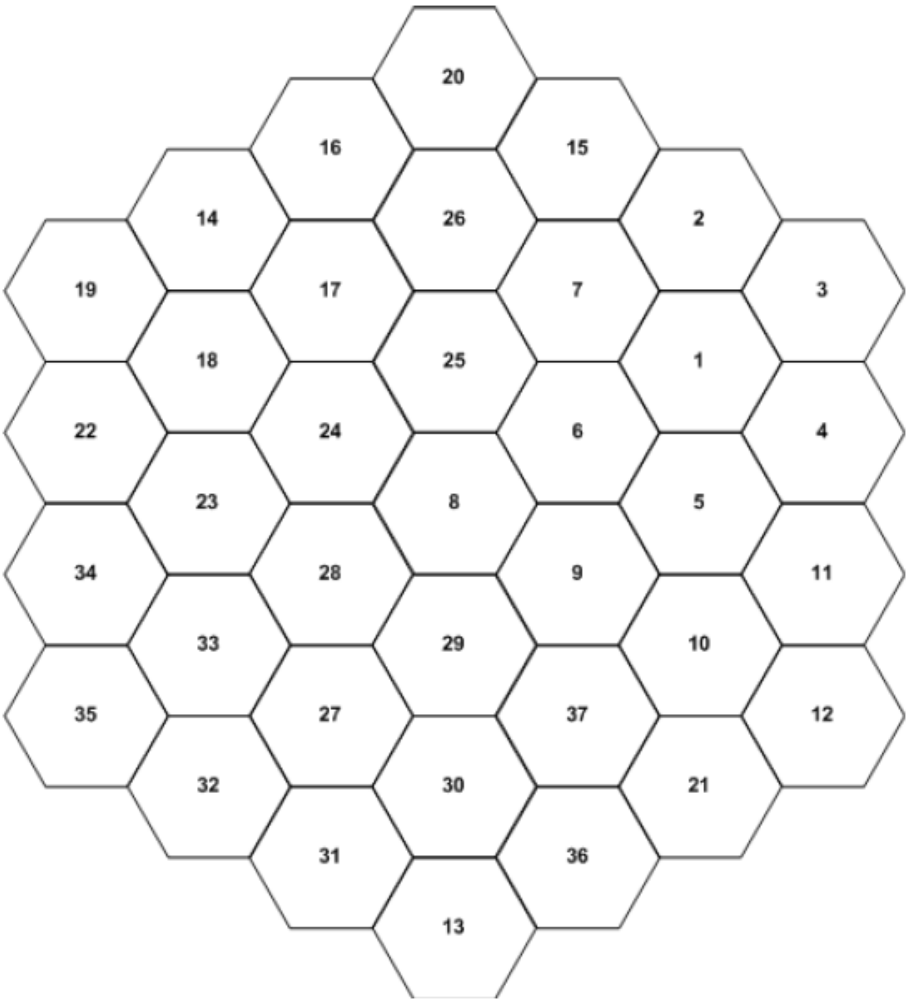
(b) 9-cell cluster



(c) 13-cell cluster

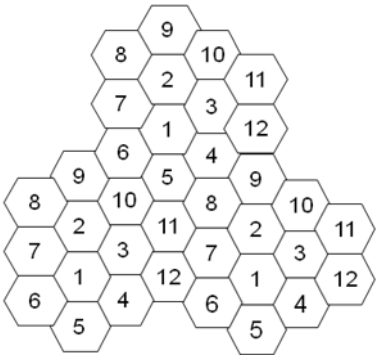


(d) 37-cell cluster



37-cell cluster

P 5.9 For the following cell pattern,



(a) Find the reuse distance if radius of each cell is 2 km.
(b) If each channel is multiplexed among 8 users, how many calls can be simultaneously processed by each cell if only 10 channels per cell are reserved for

control, assuming a total bandwidth of 30 MHz is available and each simplex channel consists of 25 kHz?

(c) If each user keeps a traffic channel busy for an average of 5% time and an average of 60 requests per hour are generated, what is the Erlang value**[Solution]**

(a) $D = \sqrt{3N}R = \sqrt{3\times12}\times2 = 12\,\text{km}$. One duplex channel = 2 (BW of one simplex channel) = 2 ∗ 25 = 50 kHz.

(b) Number of channels = $\frac{30\times10^3}{50} - 10\times12 = 600 - 120 = 480$ channels

Number of channels per cell = $\frac{480}{12} = 40$ channels per cell

Total number of calls per cell = 8 ∗ 40 = 320 calls per cell

(a) The request rate $\lambda = \frac{60}{3600} = \frac{1}{60}$ requests per second

Holding time = 5% = .05 ∗ 3600 = 5 ∗ 36 = 180 seconds

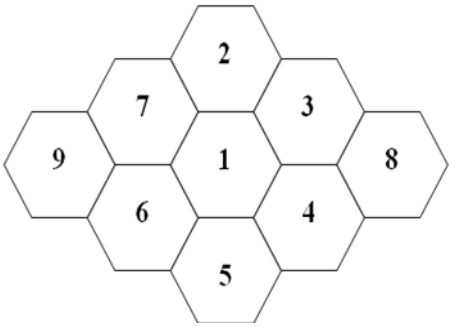
Therefore the offered traffic load in Erlangs

is $\alpha =$ $\left(\text{Request rate}\right)\times\left(\text{Holding time}\right) = \frac{1}{60}\times180 = 3$ Erlangs

P 5.10 A TDMA-based system shown in the Figure, has a total bandwidth of 12.5 MHz and contains 20 control channels with equal channel spacing of 30 kHz. Here, the area of each cell is equal to 8 km^2, and cells are required to cover a total area of 3600 km^2. Calculate the following:

(a) Number of traffic channels per cell

(b) Reuse distance



[Solution] (a) Number of traffic channels per cell is given by

$$\frac{\frac{12.5\times10^6}{30\times10^3}}{9} \approx 44 \text{ traffic channels per cell.}$$

(b) Area of Hex cell= $\frac{3\sqrt{3}}{2}R^2$ giving R^2=16/5.196=3.079 and R=1.75

Reuse distance is $D = \sqrt{3N}R = \sqrt{3\times9}\times1.75 = 9.12$ km