Victoria University
of Bangladesh

Department of Computer Science & Engineering

Final Examination

Course Code CSE-323
Course Title: Computer Networks

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Answer to the question no 1(a)

 # a) Let us assume bandwidth Of each arrival Of A1 is 3kbps and that Of A2 is 4kbps. Given A1 = 1 and A2 = 2 Erls. If total Bandwidth supported by the network is 9kbps, then probability state will be with the condition: D1x1+D2x2<=15 Determine QoS of each traffic.

A1= 3 Kbps , A1= 1 Erls , A2= 2 Erls ,A2= 4 Kbps

Possible Probability State

3	$A_1^3/3!$	(0,3)	
2	$A_1^2/2!$	(0,2)	
1	A1	(0,1)	(1,1)
0	1	(0,0)	(1,0)
A1= 1		1	A2
A2= 2		0	1

Possible Probability State

3	$A_1^3/3!$	$A2A_1^3/3!$	
2	$A_1^2/2!$	$A2A_1^2/2!$	
1	A1	A2A1	$A1A_2^2/2!$
0	1	A2	$A_2^2/2!$
		1	A2
		0	1

Possible Probability State before Normalization

3	0.167	0.334	
2	0.5	1	
1	1	2	2
0	1	2	2
		1	2
		0	1

Qos of each traffic is 12.001

Answer to the question no 3(a)

 # a) Grameenphone is a mobile operator of combined traffic for n = 6 channels; where the offered traffic Of newly originating call is A and that Of handover call is A2=3. Find the blocking probability of the given network.

Answer:

$A_1^6/6!$	6	$A_1^6/6!$						
$A_1^5/5!$	5	$A_1^5/5!$	$A2A_1^5/5!$					
$A_1^4/4!$	4	$A_1^4/4!$	$A2A_1^4/4!$	$A_2^2/2!\ A_1^4/4!$				
$A_1^3/3!$	3	$A_1^3/3!$	$A2A_1^3/3!$	$A_2^2/2!\ A_1^3/3!$	$A_2^3/3!\ A_1^4/4!$			
$A_1^2/2!$	2	$A_1^2/2!$	$A2A_1^2/2!$	$A_2^2/2!\ A_1^2/2!$	$A_2^3/3!\ A_1^2/2!$	$A_2^4/4!\ A_1^2/2!$		
A1	1	A1	A2A1	$A1A_2^2/2!$	$A1.A_1^2/2!$	$A1.A_2^4/4!$	$A1.A_2^5/5!$	
1	0	1	A2	$A_2^2/2!$	$A_2^3/3!$	$A_2^4/4!$	$A_2^5/5!$	$A_2^6/6!$
	Channel 0		1	2	3	4	5	6
	1		A2	$A_2^2/2!$	$A_2^3/3!$	$A_2^4/4!$	$A_2^5/5!$	$A_2^6/6!$

A1=2

A2=3

$A_1^6/6!$	0.0889	$A_2^2/2!$	4.5
$A_1^5/5!$	0.267	$A_2^3/3!$	4.5
$A_1^4/4!$	0.667	$A_2^4/4!$	3.375
$A_1^3/3!$	1.333	$A_2^5/5!$	2.025
$A_1^2/2!$	2	$A_2^6/6!$	1.013

$A_1^6/6!$	6	0.0889						
$A_1^5/5!$	5	0.267	0.801					
$A_1^4/4!$	4	0.667	2.001	3.0015				
$A_1^3/3!$	3	1.333	3.999	5.9985	5.9985			
$A_1^2/2!$	2	2	6	9	9	6.75		
A1	1	2	6	9	9	6.75	4.05	
1	0	1	3	4.5	4.5	3.375	2.025	1.013
	Channel 0		1	2	3	4	5	6
	1		A2	$A_2^2/2!$	$A_2^3/3!$	$A_2^4/4!$	$A_2^5/5!$	$A_2^6/6!$

The blocking probability of A_1 traffic,

B1= 0.0889+0.801+3.0015+5.9985+6.75+4.05+1.013 = 21.7

The blocking probability of A_2 traffic,

B_2= 0.0889+0.801+3.0015+5.9985+6.75+4.05+1.013 = 21.7

Answer to the question no 4(a)

 # a) A city has a population of $4x10^6$. A mobile cellular service provider has 700 cells with 20 channels each to serve the people. On an average each user generates I call/hour with duration of 2.5 minutes. Determine market penetration of the service provider. Given the GoS (grade of service) of the network is 10%.

Answer:

Answer:- Traffic intensity /user = $\lambda \cdot t_h = 1 \cdot (1/60) \cdot 2.5 = .042$ Erlgs

For each cell, n = 20, B = 10%

From Erlang's table, the offered traffic, A = 17.61

Number of users/cell = 17.61/.042 = 419.286

Total Number of users = 700 × 419.286 = 293500.2

penetration rate = (Number of users/total population) ×100

= (293500.2/4×10^6) ×100

= 0.0734×100

= 7.34%

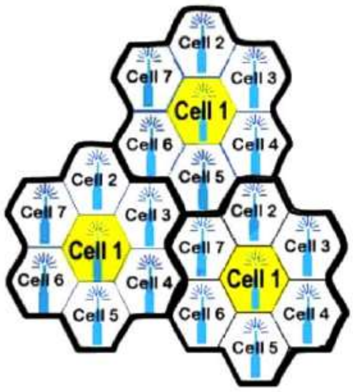
b) Define "Frequency Reuse" and draw "A Cellular Network"

Answer:

Frequency Reuse

The concept of frequency reuse is based on assigning to each cell a group of radio channels used within a small geographic area

- Cells are assigned a group of channels that is completely different from neighbouring cells
- The coverage area of cells is called the footprint and is limited by a boundary so that the same group of channels can be used in cells that are far enough apart
- Cells with the same number have the same set of frequencies



Frequency Reuse Example

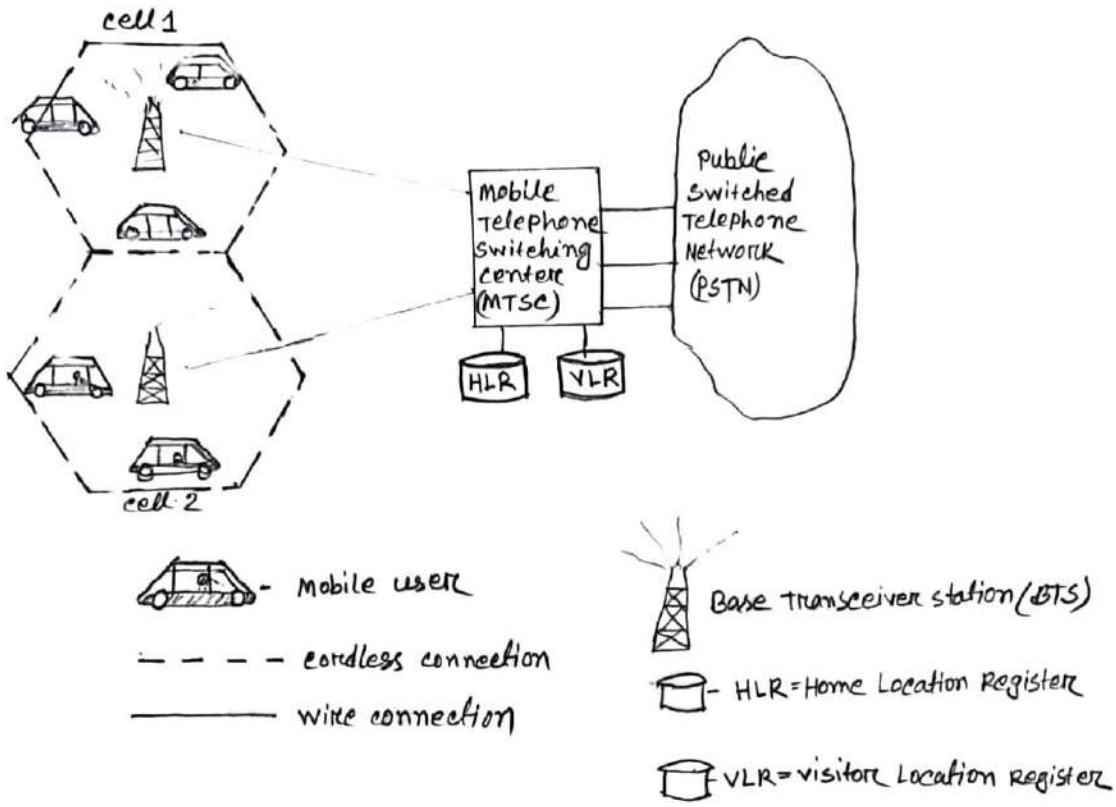
What would be the minimum distance between the centers of two cells with the same band of frequencies if cell radius is 1 km and the reuse factor is 12?

$$D/R = \sqrt{3N}$$

$$D = (3 \times 12)^{1/2} \times 1 \text{ km}$$

$$= 6 \text{ km}$$

A cellular Network



Answer to the question no 5(a)

 # a) Draw and briefly describe the "Hidden Terminal Problem".

Answer:

The hidden terminal problem is a problem that occurs in wireless networks where two or more nodes are trying to transmit data to a common receiver, but their transmissions interfere with each other because they are not aware of each other's existence.

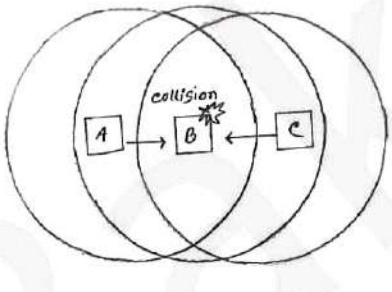
In a hidden terminal scenario, two nodes (A and B) are located in a way that neither node can hear the transmissions of the other. However, both nodes can hear the receiver (R).

If node A starts transmitting data to the receiver, node B may start transmitting data at the same time, causing a collision at the receiver. This can result in reduced network performance and lost data.

The hidden terminal problem can be solved using various techniques, such as carrier sensing, RTS/CTS (Request to Send/Clear to Send) protocols, and adaptive rate control. These techniques allow nodes to coordinate their transmissions and avoid interfering with each other.

The hidden terminal problem is a common issue in wireless networks and must be carefully considered when designing and deploying these networks to ensure optimal performance and reliability.

The problem we mentioned here is called Hidden Terminal Problem



Hidden Terminal problem.

A and B can hear each other. B and C can hear each other. But A and C cannot hear When A is sending data to B, C cannot sense this activity and hence C is allowed to send data to B at the same time. This will cause a collision at B.

Consider the effect of RTS/CTS:
RTS alerts all stations within range of source (i.e., A) that exchange is under way;
CTS alerts all stations within range of destination (i.e., B).

Second Problem: Multipath propagation (Multipath fading) due to presence of reflecting and refracting and scatterers hence cause multiple versions of the signal arrive at the receiver.

With small variation of distance and time cause wide variation of received signal called **small scale fading** experienced in a dense city.

Answer to the question no 5(b)

 # b) Define cell cluster and Draw a cell cluster of "Frequency Reuse using 7 frequencies allocations"

Answer:

Cell Cluster

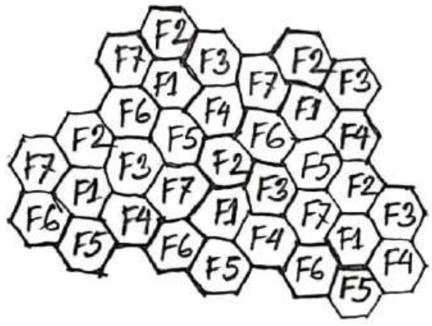
Cells in a cellular network are generally "grouped" together into cell clusters. Cellular networks are generally designed as a repeated cluster pattern The number of cells in a cluster (typically 4,7, 12 or 21) is a trade-off between the traffic capacity in the cluster and its interference with the adjacent cluster of cells (where the same frequencies will be re-used).

A cell cluster is a group of adjacent cells in a cellular network that are used to provide coverage and capacity to a specific geographic area. In a cellular network, cells are the basic building blocks and are responsible for providing coverage and capacity to users. The cells are divided into smaller areas, called cell clusters, in order to increase the capacity of the network and manage the load more efficiently.

A cell cluster is typically made up of a group of cells that share the same frequency and use the same radio resources. The cells within a cell cluster are strategically placed to provide coverage to a specific area and to prevent interference between cells. In addition, cells within a cell cluster can communicate with each other in order to exchange information and coordinate their activities.

Cell clustering is an important aspect of cellular network design and is used to optimize the capacity and performance of the network. By dividing cells into cell clusters, the network can allocate its resources more efficiently and provide better quality of service to users.

Frequency Reuse using 7 Frequencies allocations.



Each cell is generally 4 to 8 miles in diameter with a lower limit around 2 miles.

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