CS 6097 Wireless and Mobile Networking
Homework No. 4 dated Wednesday September 24, 2014

P1.19. If a total of 33 MHz of bandwidth is allocated to a particular cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice channels, compute the number of simultaneous calls that can be supported per cell if a system uses:

(a) FDMA
(b) TDMA with 8-way time multiplexing

Assume that additional bandwidth is reserved for the control channels.

[Solution]

(a)

$$\frac{33\times10^{6}}{25\times10^{3}\times2}=660.$$

(b)

$$\frac{33\times10^{6}\times8}{25\times10^{3}\times2}=5280.$$

P 6.5 In a given system with shared access, the probability of "n" terminals communicating at the same time is given by

$$p(n)=\frac{(1.5G)^{n}e^{-1.5G}}{(n-1)!},$$

where G is the traffic load in the system. What is the optimally condition for p?

[Solution]

The optimal condition for p is when $n = 1$
and then

$$p(n)=(1.5G)^{n}e^{-1.5G}$$

$$p'(n)=0$$

$$G=\frac{n}{1.5*1.5}$$

At this condition, there is only one terminal is transmitting at a time so that no collision occurs.

P 6.8 Can we use CSMA/CD in cellular wireless networks? Explain your answer with solid reasoning.

[Solution]

We cannot use CSMA/CD in wireless networks because the sender node cannot detect the collisions during its transmission.

P 6.13 What in your opinion should be the criteria to select the value of the contention window? Also explain how you will decide the value of the time slot for CSMA/CA.

[Solution]

We should allow the nodes to choose the contention window value randomly over a large range of values. The range of values should be more than the nodes present in the network. Otherwise collisions will be certain. When the traffic load is heavy then the contention window should be large. When load is less and number of nodes is also less then we can use smaller contention window.

P 6.17 Suppose the propagation delay is α, SIFS is α, DIFS is 3α, and RTS and CTS are 5α, respectively, for CSMA/CA with RTS/CTS.

(a) What is the earliest time for the receiver to send the CTS message?
(b) If the data packet is 100α long, what is the shortest time for the receiver to send the ACK signal?
(c) Explain why SIFS is kept smaller than DIFS.
(d) Can you make SIFS = 0?

[Solution]

(a) If a terminal has a packet ready to transmit, it will sense the medium first. If the medium is idle for DIFS, it will transmit RTS, then waits for the CTS from the receiver. Therefore, the earliest time for the receiver to send CTS massage is:

$$3\alpha + 5\alpha + \alpha + \alpha = 10\alpha.$$

(b) When the sender receives the CTS from the receiver, it waits for SIFS, and then sends its data packet. Therefore, the shortest time for the receiver to send the ACK signal is:

$$3\alpha + 5\alpha + \alpha + \alpha + 5\alpha + \alpha + \alpha + 100\alpha + \alpha + \alpha = 119\alpha.$$

Note that we should include the propagation delay also.

(c) This is to give priority to some packets. For example after transmitting the DATA packets the receiver should be allowed to send ACK packets without any collisions. To accomplish this, we transmit the ACK packets immediately after SIFS time interval before any other node can transmit and interrupt the ACK packet.

(d) No. SIFS is the turnaround time required to change from transmit (receive) mode to receive (transmit) mode. Thus it is compulsory to have finite SIFS time.