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CS/M.Tech(CSE)/SEM-1/CSTE-21/2009-10

2009

MOBILE COMMUNICATION – I

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. 1 and any *two* from the rest.

1. a) "Due to complexity of the environment it is impossible to derive theoretically a model which predicts the net resulting wave in radio propagation as a function of distance in real environment." Do you agree with this statement ? If yes, suggest a suitable method to deal with the above problem. 5

   b) Discuss how synchronization is achieved in a GSM network. State the reasons for delays in a GSM system for packet data traffic. 5

   c) Suggest a technique to improve network coverage and capacity in cellular systems. 5

d) In a TDMA cellular system, the one way bandwidth is 12·5 MHz. The channel bandwidth is 30 kHz and there are 395 voice channels in the system. The frame duration is 40 ms, with 6 time slots per frame. The system has an individual user data rate of 16·2 kbps in which the speech with error protection has a rate of 13 kbps. Calculate the efficiency of the TDMA frame. 5

2. a) Explain the "free space propagation model" to predict the strength of the received signal at a distance from the transmitter. 5

b) Describe the call flows that would be necessary for token based registration when the old VLR cannot be queried for the TMSI and the network must request that the MS send its TMSI before messages can be exchanged with the HLR. 5

c) Four received power measurements were taken at a distance of 100 m, 200 m, 1000 m and 3000 m from a transmitter. These measured values are given in the following table. Using Log normal shadowing model with d_0 = 100 m,

i) Estimate received power at d = 2 km.

ii) Find the minimum mean square error (MMSE). Estimate for the path loss exponent.

iii) Predict the likelihood that the received signal level at 2 km will be greater than – 60 dBm. 10

Distance from transmitter	***Received power***
100 m	0 dBm
200 m	– 20 dBm
1000 m	– 35 dBm
300 m	– 70 dBm

d) Discuss why the relative motion between station and the mobile results in random frequency modulation. 5

3. a) How is synchronization achieved in a GSM network ? What are the reasons for delays in a GSM system for packet data traffic ? 5

b) Discuss the factors influencing small-scale fading. 5

c) What is the significnce of Delay spread of a multipath channel ? 5

d) The PDC TDMA system uses a 42 kbps data rate to support 3 users per frame. Each user occupies two of the six time slots per frame.

i) What is the raw data rate provided for each user ?

ii) If the frame efficiency is 80% and the frame duration is 6·667 ms, determine the number of information bits sent to each user per frame.

iii) If half-rate speech coding is used, six users per frame are accommodated. Determine the number of information bits provided for each user per frame.

iv) What is the information data rate in half-rate PDC ? 10

4. a) Prove that for a hexagonal geometry, the co-channel reuse ratio is given by $Q = \sqrt{3N}$ where $N = i^2 + ij + j^2$. 8

b) We consider a cellular system in which total available voice channels to handle the traffic are 960. The area of each cell is 6 km^2 and the total coverage area of the system is 2000 km^2. Calculate (i) the system capacity if the cluster size, N (reuse factor), is 4 and (ii) the system capacity if the cluster size is 7. How many times would a cluster of size 4 have to be replicated to cover the entire cellular area ? Does decreasing the reuse factor N increase the system capacity ? Explain. 7

c) Usually picocells and microcells are made of splitting the macrocells. Develop a theory of designing macrocells by grouping the microcells and picocells. 5

d) Discuss how radio propagation characteristics determine the carrier-to-interference ratio at a given location. 5