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DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2014-15 (2.0 hours)

EEE6432 Wireless Packet Data Networks and Protocols

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1. a. Among the following multiple access control protocols, point out which are contention-based and which are conflict-free protocols: TDMA, Aloha, Point Coordination Function, FDMA, CDMA, and CSMA. (6)
- b. List three differences between pure Aloha and CSMA/CD protocols. (6)
- c. When the number of stations is very large, the Poisson distribution ($p[x] = (e^{-\lambda} * \lambda^x) / (x!)$) can be used to analyse the performance of a multiple access network. In this formula, $p[x]$ is the probability of generating x number of frames in a period of time and λ is the average number of generated frames during the same period of time. Using the Poisson distribution: (8)
 - i) Find the probability that a pure Aloha network generates x number of frames during the vulnerable time. Note the vulnerable time for this network is two times the frame transmission time (T_{fr}).
 - ii) Find the probability that a pure Aloha network can successfully send a frame during the vulnerable time.
 - iii) Find the throughput of a pure ALOHA network.
2. a. Briefly describe the services provided by the datalink layer. (6)
- b. The timer of a system using the Stop-and-Wait ARQ Protocol has a time-out of 6ms. Draw the flow diagram for four frames if the roundtrip delay is 4ms. Assume the first frame (frame0) is lost. (6)
- c. The timer of a system using the Stop-and-Wait ARQ Protocol has a time-out of 4ms. Draw the flow diagram for four frames if the roundtrip delay is 6ms. Assume no frame is lost or damaged. (8)
3. a. Explain what cyclic codes are. What are the advantages of cyclic codes? (6)
- b. The divisor in a cyclic code is normally called the generator polynomial or simply the generator. Discuss the characteristics that a generator polynomial should have in order to detect one single bit error, all odd bit errors and two isolated bit errors. (8)

- c. Given the CRC-8 generator is $x^8 + x^2 + x + 1$. Answer the following questions: (6)
- Does it detect a single error? Defend your answer.
 - Does it detect a burst error of size 6? Defend your answer.
 - What is the probability of detecting a burst error of size 9?
4. a. “In WCDMA network, the coverage for different services (e.g., voice service, 128kbps data service and so on) is the same.” (6)
- Do you agree or disagree with the above statement? Explain why.
- b. Suppose there is a cell A in a WCDMA network. Cell A is not on the edge of the coverage area. When there are more active users (i.e., more users are using the network) in cell A's neighbouring cells, which one of the following is true? (6)
- Explain why.
- The capacity of cell A will decrease.
 - The capacity of cell A will increase.
 - The capacity of cell A will be the same regardless how many active users in its neighbouring cells.
- c. Consider a simple uplink CDMA communication system as shown in Figure 1. Suppose we have 2 mobiles (mobile 1 and mobile 2) to send data signal 1 and data signal 2 to the base station, respectively. Data signal 1 is a symbol with value of -4. Data signal 2 is a symbol with value of 2. The symbol duration T_b is 1 second. Each data signal is spreaded by a spreading code. The chip duration T_c of the spreading code is 0.25 second. The spreading code 1 is '1 1 -1 -1' and the spreading code 2 is '1 -1 1 -1'. The spreaded signals are transmitted to the base station and recovered by the base station. Please answer the following questions. (8)
- Calculate the spreading gain N ;
 - Compute the spreaded signal 1, spreaded signal 2 and composite signal, respectively.
 - Compute the despreaded signal 1 and despreaded signal 2 at the base station side.
 - Compute the values of the recovered signal 1 and recovered signal 2.

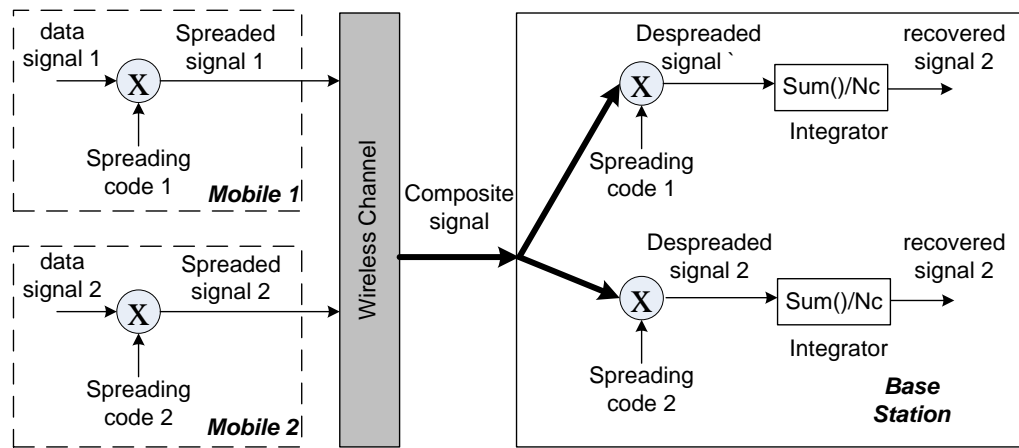


Figure 1 Uplink CDMA communications