

B1. Networks (25 points)

- (9 pts.) a) Describe five transport layer protocol (not service) functions found in either TCP or TP4.
- (6 pts.) b) Define four important transport layer quality of service parameters.
- (10 pts.) c) Consider the connection management phases of a simple, bare bones connection-oriented transport protocol.
- i) Specify a reasonable set of user primitives that an application can use to establish, use and release connections.
 - ii) Specify a reasonable set of TPDU's the protocol itself can use.
 - iii) Using your primitives and TPDU's, draw a state diagram for simple connection management, indicating the states, as well as the events causing state transitions.

B2. Networks (25 points)

Code division multiple access (CDMA) is a method for allocating bandwidth on a wireless channel.

- (5 pts.) a) Explain what are chips and what are chip sequences.
- (5 pts.) b) Show that $S_1 \times S_1' = -1$ where S_1 is the bipolar notation chip sequence of a station, S_1' is its negation, and $\times$ denotes the normalized inner product.
- (5 pts.) c) Show that, if all station chip sequences are pairwise orthogonal, then $S_1 \times S_2' = 0$ where S_1 and S_2 are the chip sequences of two stations, and S_2' is the negation of S_2 . $\times$ denotes the normalized inner product.
- (10 pts.) d) Chip sequences for stations A, B and C are given as:
- A: 0 0 0 1 1 0 1 1
 B: 0 0 1 0 1 1 1 0
 C: 0 1 0 1 1 1 0 0

Assume that all stations are synchronized in time (i.e., they all transmit chip sequences at the same instant), station A sends a 1, station B sends a 0, and station C sends a 1. Using bipolar notation, show in detail the transmitted sequence and how a station then recovers station C's transmitted bit.

B3. Networks (25 points)

Consider an Internet application for point-to-point voice communication. (That is, rather than using your telephone to call a friend in Europe, you speak into a microphone attached to your workstation and the other person receives your voice at his/her workstation's speaker.) For this application, discuss the following:

- (5 pts.) a) tradeoffs in using TCP vs UDP as the transport layer protocol
- (5 pts.) b) tradeoffs in using the general Internet vs. establishing a PPP connection between users
- (5 pts.) c) tradeoffs in using a voice compression technique vs. not using one
- (5 pts.) d) impact, if any, on general Internet congestion control and avoidance
- (5 pts.) e) tradeoffs in using a connection-oriented network layer vs the Internet's connectionless network layer.

B4. Networks (25 points)

Discuss the basic architecture and operation of a Token Bus LAN. Explain

- (5 pts.) a) how multiple stations are added to the LAN
- (5 pts.) b) how a station gracefully leaves the LAN
- (5 pts.) c) what occurs when a station that does not possess the token crashes
- (5 pts.) d) what occurs when a station that does possess the token crashes
- (5 pts.) What are the principle advantages/disadvantages of a token bus vs. a CSMA/CD protocol?