CS 555: Computer Networks and Data Communication
Spring 2004
Midterm Examination
Points: 150
March 3, 2004 (5:45-7:00 PM)
Time allowed: 75 minutes
CLOSED BOOK, CLOSED NOTES, OPEN MIND
Answer All Questions

Turning in this exam under your name confirms your continued support for the honor code of Old Dominion University and further indicates that you have neither received nor given assistance in completing it.

Name: _____ SSN: _____

Question #	Possible points	Obtained points
1	30	
2	30	
3	30	
4	30	
5	30	
Total	150	

FINAL ANSWER SHOULD BE WRITTEN IN THE ALLOTTED TABLES.

SHOW ALL YOUR WORK

Question 1:

(1a) A 9600-baud modem employs the constellation diagram shown in Figure 1.

(i) How many amplitude levels and phase levels are employed here?

(ii) What is the data rate (in kbps) of the modem?

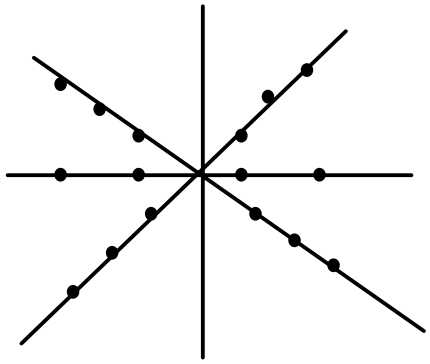

Figure 1. Modem constellation Diagram

(1b) An analog signal with the highest harmonic of 20 kHz is being transmitted via a digital channel using delta modulation. What is the maximum resulting data rate (in kbps)?

(1c) A message of 3000 bytes is being sent using packet switching from node A to node C via node B (see Figure 2). Determine the time between the first bit leaving node A and the last bit reaching node C. Ignore processing delay at each node. (Propagation speed = 250 km/millisecond)

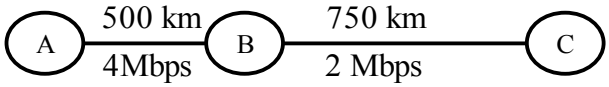

Figure 2.

Question	Points	Answer
1a	8	# Of amplitude levels = # Of phase levels = Data rate (kbps) =
1b	8	Maximum data rate (kbps) =
1c	14	Time (milliseconds) =

WORK AREA:

Question 2:

(2a) Determine the checksum generated for a 5-bit frame of 10101 using the generating polynomial $G(x)= x^2+1$?

(2b) If stations A and B use a 30-kbps satellite channel (round-trip delay = 270 milliseconds) to communicate using 1000-byte frames with stop-and-wait protocol, what is the maximum data rate that may be obtained if 1 in 5 frames are in error?

(2c) What bit stream is sent out by a data link layer that uses bit stuffing to send the following string of data: **1111101110111100**?

Question	Points	Answer
2a	10	Checksum:
2b	10	Maximum data rate (kbps):
2c	10	Bits sent out:

WORK AREA:

Question 3:

(3a) If stations A and B use a 50-kbps satellite channel (round-trip delay = 270 milliseconds) to communicate using 1000-byte frames using Go-back-n protocol with 4-bit sequence numbers, what is the maximum data rate that may be obtained if 1 in 4 frames are in error?

(3b) Node A, of question (3a), just began transmitting and transmitted all frames in its window. What actions (if any) are taken by A's data link layer when it receives an **ACK 3** from B?

(3c) What is the obtained maximum data rate if stations A and B in question **3a** employ a selective-repeat protocol?

Question	Points	Answer
3a	10	Maximum data rate (kbps)=
3b	10	Actions:
3c	10	Maximum data rate (kbps)=

WORK AREA:

Question 4:

(4a) Provide an intuitive explanation for higher performance of 0.1-persistence CSMA when compared to 0.5 persistent CSMA at high loads.

(4b) In an eight-station (stations A-H) LAN using adaptive tree walk protocol, if stations B, E, and F contend for a slot starting at **slot 0,** determine the slot numbers in which each of the three stations will be successful. (A-H are connected in that order from left to right in the tree)

(4c) Wireless stations A-E in Figure 3 employ MACAW algorithm for multiple access. First C transmits RTS to A to which A responds back with CTS. When and what information (if any) is learnt about the medium by the other four stations? (Hint: Illustrate through a diagram with time as the X-axis)

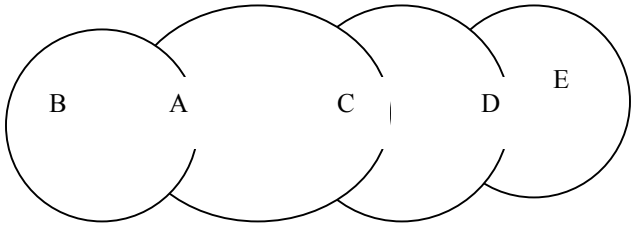

Figure 3. Wireless stations

Question	Points	Answer
4a	10	**0.1 persistent vs. 0.5-persistent:**
4b	10	**Slot for B:** **Slot for E:** **Slot for F:**
4c	10	**When and what information (for B, D, E, F)**

WORK AREA:

Question 5:

(5a) Ten stations are connected using a 1-Gbps 2-km 802.3 LAN (propagation speed of 200 km/millisecond). What is the minimum frame length (bytes) needed?

(5b) Represent the data string **110011** using Manchester encoding and differential Manchester encoding.

(5c) Referring to the Bluetooth data frame (Figure 4), answer the following:

(i) Why is the header repeated three times?
(ii) Why is the address field only 3 bits in length?
(iii) What do the bits F and A represent?

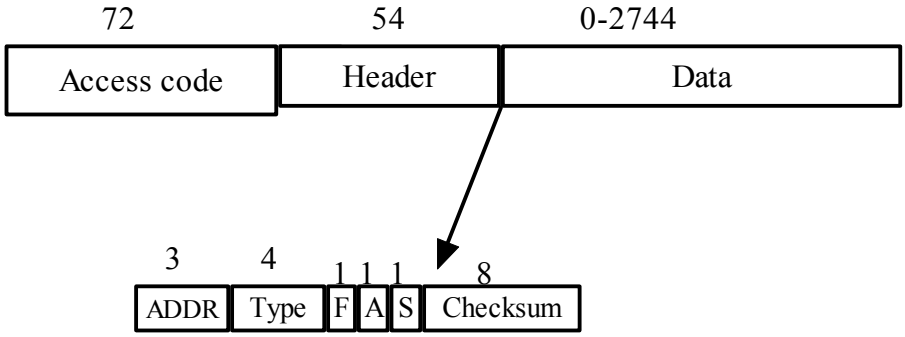

Figure 4. Typical Bluetooth Dataframe

Question	Points	Answer
5a	10	**Minimum frame length (in bytes) =**
5b	10	**Manchester encoding:** **Differential Manchester:**
5c	10	**(i)** **(ii)** **(iii)**

WORK AREA:

Appendix for Midterm Examination

- Signal-to-noise ratio (dB) $= 10 \log_{10} (S/N)$
- Attenuation in decibels $= 10 \log_{10}$ (Transmitted power/received power)
- Maximum data rate $= 2 H \log_2 V$ bits/sec
- Maximum number of bits/sec $= H \log_2 (1+S/N)$
- $Pr[k] = G^k e^{-G}/k!$
- $S=Ge^{-2G}$
- $S=Ge^{-G}$
- $E = e^G$
- $P_k = e^{-G}(1-e^{-G})^{k-1}$
- Channel efficiency $= P/(P+2\Gamma/A)$
- Channel efficiency$=1/(1+2BLe/cF)$

Stop-and-wait: $U = \dfrac{(1-P)}{(1+2a)}$

Selective reject: $U = \begin{cases} 1-P & N>2a+1 \\ \dfrac{N(1-P)}{(1+2a)} & N < 2a+1 \end{cases}$

Go-back-N: $U = \begin{cases} \dfrac{1-P}{1+2aP} & N>2a+1 \\ \dfrac{N(1-P)}{(1+2a)(1-P+NP)} & N < 2a+1 \end{cases}$