Çankaya University
Department of Computer Engineering
2014 - 2015 Spring Semester

CEng 290 - Data Communications

Final Examination

1) Fill in the blanks with appropriate terms from the list:

1. Garage door openers, radio controlled toys etc. use ________________ bands.

2. The ratio of signal power to noise power is called ________________ .

3. The rules 1)If medium idle, transmit; 2)If medium busy, listen until idle; then transmit immediately describe the ________________ CSMA protocol.

4. In a stop-and-wait protocol, the sender sends one frame and then waits for an ________________ .

5. A valid Ethernet frame carries a minimum of ________________ bytes and a maximum of ________________ bytes of data.

6. If there is an error in a packet, the receiver will detect this when it computes ________________ .

7. Temporarily delaying acknowledgements so that they can be added to next outgoing data frame is known as ________________ .

8. Token-ring protocol is a ________________ protocol.

9. In pure ALOHA, suppose it takes 8 ms to send a frame. Then, the vulnerable time period is ________________ ms.

10. In slotted ALOHA, suppose it takes 8 ms to send a frame. Then, the vulnerable time period is ________________ ms.

11. The channel utilization of slotted ALOHA is ________________ than pure ALOHA.

12. In ______________________ protocol, the sender first listens to the channel. If somebody is transmitting, it waits.

13. If the sender receives no acknowledgement and the timer expires, it sends the frame with the same ______________________ .

14. After the first collision, each station waits 0 or 1 time slots. (The choice is random) After the second collision, each waits 0,1,2 or 3 time slots and so on. This is called ______________________ .

15. A valid Ethernet frame must have a minimum length of ______________________ bytes.

16. If the receiver does not have sufficient buffer and if the sender is sending frames too quickly, packets may be lost. This is called ______________________ .

17. To solve the hidden terminal problem in wireless communications, the sender first sends a short ______________________ message and the receiver replies with a ______________________ message. After that, the data is sent.

18. The receiver will send a NAK if the frame it receives is ______________________

Checksum, Flooding, Acknowledgement, Sequence number, Piggybacking, Corrupted, Late, Contention, CTS, ISM, Collision free, 0, 2, 4, 8, 16, 46, 64, 1500, Better, Worse, ALOHA, CSMA, Binary Exponential Backoff, Collision Avoidance, RTS, Access point, MACA, SNR, Multiplexing, Rate adaptation, 1-persistent, Non-persistent, 802.11, Gigabit, Sliding window protocol.

2) Consider a 1 Mbps satellite channel with 50 ms round trip propagation delay. We want to send a 1000 bit frame, and we will not send a second frame until we receive acknowledgement for the first frame.

a) What percent of the available bandwidth are we using?

b) Now suppose the round trip delay is doubled. Can we say that the bandwidth usage is reduced to half?

3) A 1500 km long line with bandwidth 1.544 Mbps is used to transmit 64 byte frames. Propagation speed is 150 000 km/s. We are using selective repeat protocol.

a) If we use the full bandwidth, how many frames are on the line simultaneously?

b) How many bits do we need for sequence numbers?

4) A large population of ALOHA users manages to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec. What are the chances of success on the first attempt?

5) Consider five wireless stations, A, B, C, D, and E.

- Station A can communicate with all other stations.
- B can communicate with A, C and E.
- C can communicate with A, B and D.
- D can communicate with A, C and E.
- E can communicate A, D and B.

a) When A is sending to B, what other communications are possible?

b) When B is sending to C, what other communications are possible?

Answers

1)

1. ISM
2. SNR
3. 1-persistent
4. Acknowledgement
5. 46, 1500
6. Checksum
7. Piggybacking
8. Collision free
9. 16
10. 8
11. Better
12. CSMA
13. Sequence number
14. Binary Exponential Backoff
15. 64
16. Flooding
17. RTS, CTS
18. Corrupted

2) a) $\dfrac{1000 \text{ bits}}{10^6 \text{ bits/sec}} = 10^{-3}s = 1 \text{ ms}$

Together with the round trip delay, this is 51 ms. We are using the channel for 1 ms only, so the bandwidth usage is:

$$\frac{1}{51} = 0.0196 = 1.96\%$$

b) This time usage is

$$\frac{1}{101} = 0.0099 = 0.99\%$$

It is almost reduced to half, but not exactly.

3) a) $\dfrac{1500 \text{ km}}{150\,000 \text{ km/sec}} = 10^{-2}s$

$$1.544 \times 10^6 \text{ bits/sec} \times 10^{-2}s = 1.544 \times 10^4 \text{ bits}$$

$$\frac{1}{8} \times 1.544 \times 10^4 \text{ bits} = 1930 \text{ bytes}$$

$$1930 \text{ bytes}/64 = 30.16 \text{ frames}$$

b) Using the selective repeat protocol, the sequence numbers must be double the number of frames.

$2 \times 30.16 = 60.32$

$2^5 < 60.32 < 2^6$

$\Rightarrow$ we need 6 bits.

4) $G = 50$ req/sec $\times 40 \times 10^{-3}$ sec$=2$ requests.

No one else must communicate during one slot.

Using $\dfrac{e^{-G}G^n}{n!}$ with $n = 0$, we obtain:

$e^{-2} = 0.1353$

5)

C

B A D

E

a) Nobody can talk. Everybody will hear A, so there will be interference.

b) E can talk to D. There will be no interference, because D can not hear B, and C can not hear E.