Review Guide for Midterm

1. Show the seven layer OSI network model. What is the major benefit of the layered network models?

- Answer: Application: Application specific protocols
- Presentation: Format of exchanged data
- Session: Connection management
- Transport: Process-to-process channel
- Network: Host-to-host packet delivery
- Data Link: Framing of data bits
- Physical: Transmission of raw bits

Benefits include reduces complexity, standardizes interfaces, facilitates modular engineering, facilitates interoperability, etc.

2. Name the OSI layer or layers in which medium access control (MAC) is addressed and state whether MAC is typically handled in hardware, in software, or in both in the Internet architecture.

Data link layer

Hardware

3. Explain how a receiver detects the end of a frame with length-based framing.

The length is indicated in the header of the frame.

4. Explain how a receiver detects the end of a frame with sentinel-based framing.

Special String/Characters

5. Describe the benefits of error correction over error detection, and vice versa.

When error is detected, there is no need of retransmission. It will achieve better performance when error probability is relatively large.

6. What is the major advantage of CRC check? Under what circumstances will error detection using CRC fail?

if the error polynomial $E(x)$ is a multiple of $C(x)$

7. Describe the problem solved by medium access control (MAC).

Given multiple senders on same media, MAC aims to provide:

- Fair arbitration
- Good performance

8. Why does Ethernet use binary exponential backoff during contention resolution?

Adapt to network condition, fairness.

9. Why does Ethernet have a minimum packet size? How is it determined?

Answer: To ensure that a sender can detect a collision, so it should still be sending when the collision signal propagates to the sender.

The packet size = maximum RTT * bandwidth of the link

10. Suppose packets on a wireless link consist of N data bits and H header bits each, where H is fixed. Suppose bits are received in error with probability P, independently of each other, and that N is adjusted to maximize the throughput of data in bits per second. If P gets larger, does the optimal value of N get larger or smaller? Why?

Smarller, since the retransmission probability is getting larger.

11. Consider a frame consisting of two characters of four bits each. Assume that the probability of error is 10^{-3}, independent for each bit. What is the probability that the frame is received correctly? Add a parity bit to each character. Now what is the probability?

$(1 - 10\hat{}3)^{8}$

$(1 - 10\hat{}3)^{10}$

If you add parity chances of bit errors increase, but chances of undetected errors decrease.

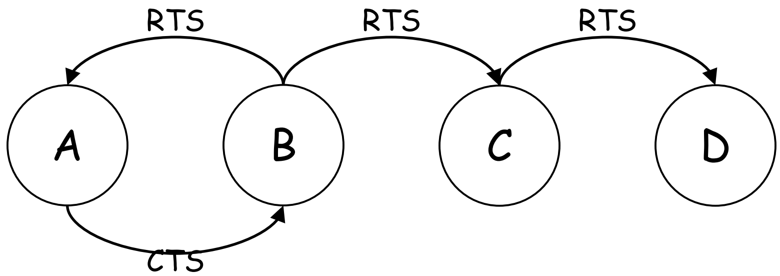
12. What does 4B/5B encoding accomplish, besides expanding the number of bits by 25%?

- limits length of 0-runs, guaranteeing a transition (in NRZI) every four bits transitions are necessary for clock recovery

13. Explain the hidden terminal problem and how it is solved. Explain the exposed terminal problem and how it is solved.

I skip the explanation for hidden terminal problem. The answer can be found in the lecture notes. Here is the solution for exposed terminal problem.

- C receives an RTS from B to A. C is unsure whether it can transmit to D.
- C waits to hear a CTS from A. If no CTS is heard, C is free to transmit to D.



14. In CSMA/CA, when transmission may occur?

Please refer to CSMA/CA on the lecture notes for hidden and exposed terminal problems.

15. What is the Hamming Distance? What is the Hamming Distance of Hamming's (7, 4) code?

Please refer to the lecture notes. The hamming distance is 3.

16. Given a fixed data size in a frame, how many parity bits are needed to achieve 1-bit error correction?

If data size is N, and M is the number of parity bits, they should satisfy N+M+1<= 2^M.

17. Upon receiving a message using Hamming code, how to check if there is an error or not?

Please refer to the lecture notes.

18. What is the channel capacity of a noisy channel? When computing SNR how to convert it a decibel value?

B log_2(1+S/N)

Decibel value = 10 log_10 (S/N)

19. How the forwarding with datagram, virtual circuit, and source routing work?

Please refer to the lecture notes.

20. How virtual circuits are established and tear down?
Please refer to the lecture notes.

21. Explain the main drawback of the stop-and-wait ARQ algorithm.

By only allowing one outstanding packet, bandwidth is not used efficiently (i.e. stop-and-wait does not keep the pipe full)

22. In a sliding window protocol with RWS=SWS=7, a very large set of possible sequence numbers (assume no wrapping), and in-order packet arrivals, can a receiver receive frame number 10 if it is currently expecting frame 17? Explain.

Yes, if all the acks of 10-16 frames are dropped.

23. What is the relationship between Receive Window Size (RWS), Next Frame Expected (NFE) and Last Frame Acceptable (LFA) in a sliding window protocol?

LFA – NFE + 1 ≤ RWS

24. How many bits are used as packet sequence number? (or How to determine the minimum sequence number used in sliding window algorithm?) Then, what is the minimum number of bits you need for the sequence number?

Maximum number of outgoing frames = Throughput delay product / frame size.
Maximum needed sequence number is two times of the above value.
Then, log_2(MaxSeqNum) will be needed. (We take the ceiling)

25. What do “learning” bridges actually learn? What do they use this information for?

“Learn” which hosts live on which LAN

Maintain forwarding table

Only forward when necessary

Reduces bridge workload

26. How do the distance vector routing and link state routing algorithm work? What is the major drawback of these algorithms?

Please refer to the lecture notes.