CS 4231 Midterm

1. (10%) Define the following parameters for a switching network:

   N = number of hops between two given end systems

   L = message length in bits

   B = data rate, in bits per second (bps), on all links

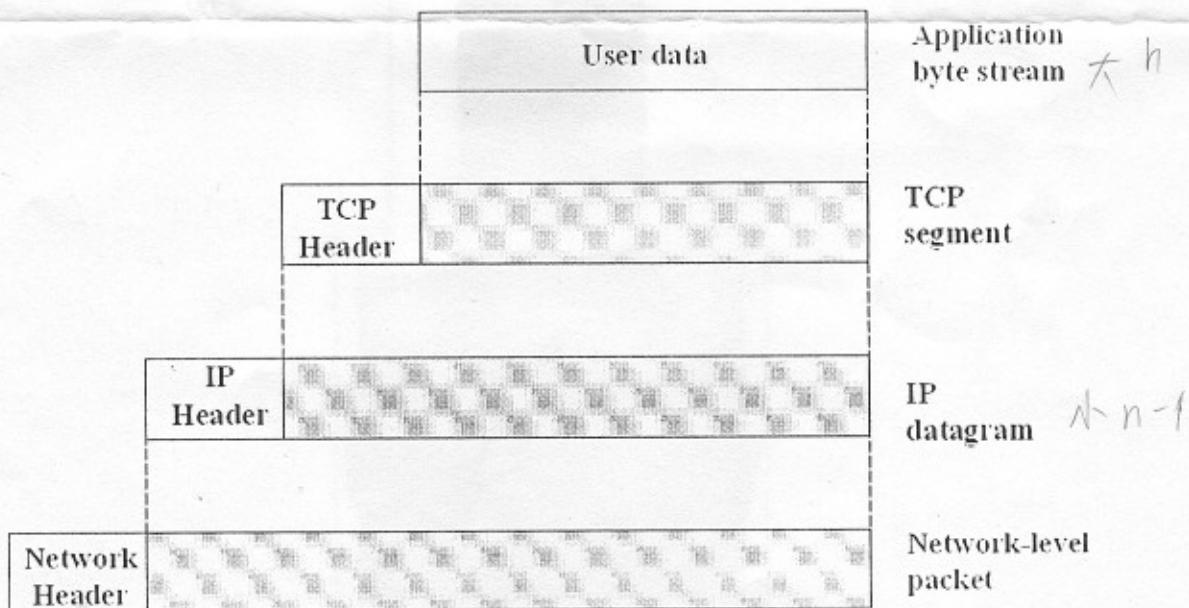   P = fixed packet size, in bits

   H = overhead (header) bits per packet

   S = call setup time (circuit switching or virtual circuit) in seconds

   D = propagation delay per hop in seconds

   For N = 5, L = 3200, B = 9600, P = 1024, H = 16, S = 0.2, D = 0.001, compute the end-to-end delay for circuit switching, virtual circuit packet switching, and datagram packet switching, Assume that there are no acknowledgments. Ignore processing delay at the nodes.

2. (5%) In the following figure, exactly one protocol data unit (PDU) in layer N is encapsulated in a PDU at layer (N-1). It is also possible to break one N-level PDU into multiple (N-1)-level PDUs (segmentation) or to group multiple N-level PDUs into one (N-1)-level PDU (blocking).

   a. In the case of segmentation, is it necessary that each (N-1)-level segment contain a copy of the N-level header? Justify your answer.

   b. In the case of blocking, is it necessary that each N-level PDU retain its own header, or can the data be consolidated into a single N-level PDU with a single N-level header? Justify your answer.

		Application
	User data	byte stream

TCP Header		TCP segment

IP Header		IP datagram

Network Header		Network-level packet

3. (5%) Do we still need flow control if the network capacity is huge? Justify your answer.

4. (10%) What are the differences between gateway, router, bridge, LAN switch, hub, and repeater? Which layer do they work at?

5. (5%) An adaptive switch comprises of *store-and-forward switch* and *cut-through switch*. Explain how an adaptive switch functions.

6. (5%) A simple medium access control protocol would be to use a fixed assignment time division

multiplexing (TDM) scheme. Each station is assigned one time slot per cycle for transmission. For the bus, the length of each slot is the time to transmit 100 bits plus the end-to-end propagation delay. Stations monitor all time slots for reception. Assume a propagation time of 2×10^8 m/s. For 10 stations, what is the throughput per station for a 1-km, 100-Mbps baseband bus?

7. (5%) What is the major difference between persistent and nonpersistent CSMA?

8. (5%) What is Binary Exponential Backoff Algorithm?

9. (5%) In CSMA/CD, can we guarantee the first generated frame be the one transmitted successfully first? Justify your answer.

10. (5%) Why Collision Detection (CD) is not practical for wireless LANs?

11. (10%) Comparing IEEE 802.3 CSMA/CD and IEEE 802.11 CSMA/CA, do they go to the backoff state under the same condition? That is, when does each of them perform the backoff procedure?

12. (5%) In IEEE 802.11, if the medium is busy, all stations will defer their transmission until the medium is free. Suppose there is one station waiting to transmit a DCF frame, and the other station is waiting to transmit a PCF frame. Do they have any chance to collide together when both of them find the medium is free? Justify your answer.

13. (10%) What is "hidden terminal" problem in wireless networks? How does IEEE 802.11 prevent this problem?

14. (10%) The following figure shows a typical flow for WLAN authentication by using IEEE 802.1x. In the figure, the supplicant's username and password are sent to the authentication server separately by different flows. Why not simply use a single flow to send username and password together? Justify your answer.
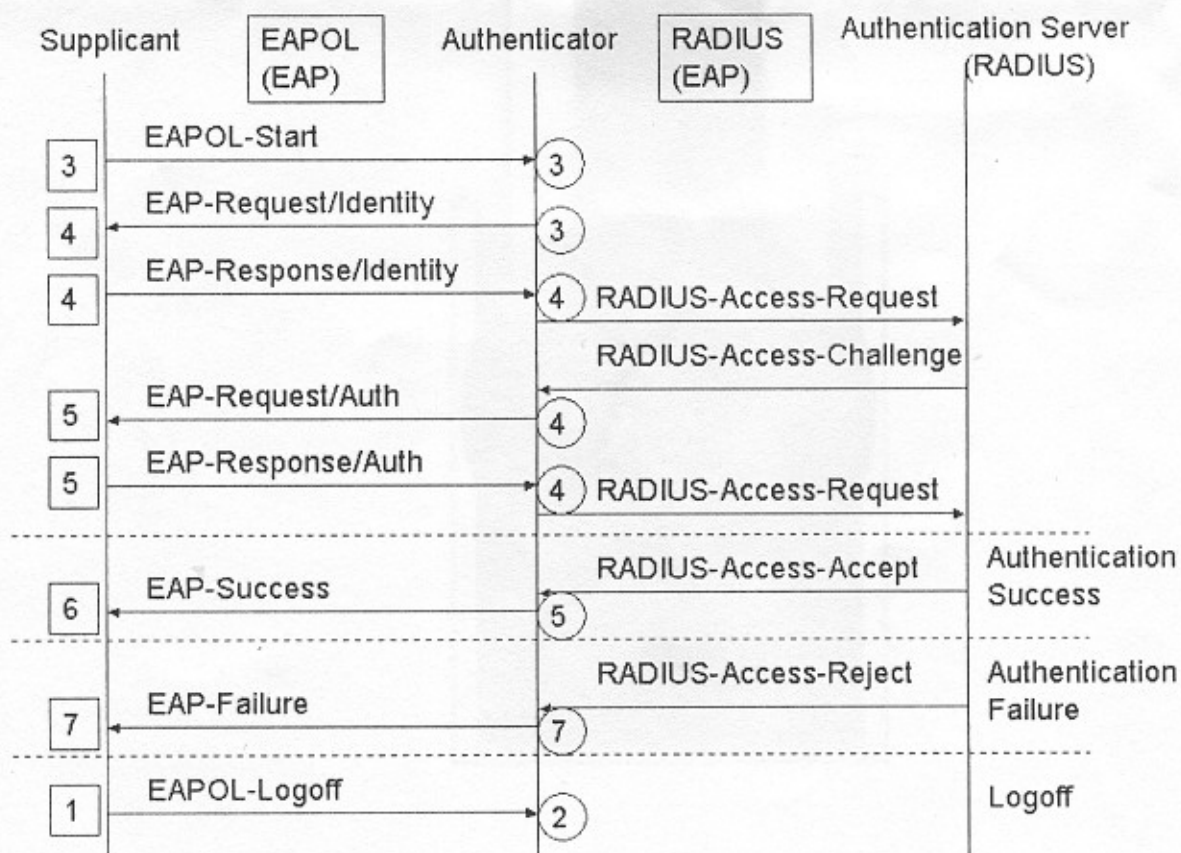
15. (5%) In IEEE 802.11e EDCA, there are four distinct access categories. An access category with larger AIFS has higher or lower priority? An access category with larger maximum contention window size has higher or lower priority? Justify your answer.