Introduction to Computer Networks - Midterm Exam.

Caution: If you make any assumption to answer the following questions, you should clarify it explicitly.

1. Suppose an Ethernet link as follows: Link capacity = 1 MByte/second; Packet size = 1 KByte; Minimum inter-packet spacing interval = 0, that is, a node may send packets immediately after the current transmission; Backoff slot time = 0.1 msec.; Maximum number of backoff slots = 3; and Time interval wasted by a collision (including collision detection and jamming signal) = 0.1 msec.

Algorithm for sending a packet

1: if the link is idle, transmit a packet immediately
2: else go back to 1
3: if the transmission is successful
4: go back to 1
5: else
6: set a backoff timer randomly selected from one to three slots
7: if other node transmits a packet before the timer expires
8: drop this packet and go back to 1 to send the next packet
9: else
10: transmit a packet immediately after the timer expires
11: if the transmission is successful
12: go back to 1
13: else
14: drop this packet and go back to 1 to send the next packet

There are three nodes in the link, and each node attempts to send packets as many as possible. Answer the following questions:

(a) What is the probability of a packet transmitted eventually? (10 pt.)

(b) How long time does it take to complete transmission of a packet successfully from the first attempt to send the packet? (10 pt.)

(c) Calculate the utilization of the link. (15 pt.)

(d) What is the average throughput of each node? (5 pt.)

2. Consider an IEEE 802.11 wireless LAN. Its sending rate is 1 MByte/second, and packet size is 1 KByte. Collision rate is 0.2, and the cost for each collision is the same as the cost for each transmission. Assume that DIFS is zero, and there is no backoff. Then, the link utilization is 80%. Now, when we employ RTS/CTS to avoid collision, calculate the link utilization of the network. Here note that the link utilization means the fraction of time spent for sending data packets not RTS/CTS. Packet sizes of RTS and CTS are 50 byte each, and assume that the collision probability is linearly proportional to the packet size. (20 pt.)

3. Explain the differences between IPv4 and IPv6. (10 pt.)

4. Explain the followings briefly. Specify which layer they are included in, respectively. Give full names for acronyms. (2 pt. for each)

(a) MAC; (b) CSMA/CD; (c) CSMA/CA; (d) Sliding window; (e) ICMP; (f) ARP; (g) RIP; (h) OSPF; (i) TTL; (j) fragmentation; (k) BGP; (l) Multicast; (m) Checksum; (n) CRC; and (o) Routing