Indian Institute of Technology Bombay

Department of Electrical Engineering

Handout 28 — EE 706 Communication Networks

Assignment 7 : **50 points** — **Due date**: April 8th, 2010

1. Consider a four-node wireless network consisting of nodes A, B, C, and D situated on the four corners of a square with side of length 100 m. Each node has a transmission range of 101 m. Assume that all the nodes use the same frequency band to transmit their signals, i.e. a collision occurs if two nodes transmit to the same destination which is in their transmission range. [10 points]

   (a) Give an example of the hidden node problem which arises in this network. How does the RTS-CTS mechanism solve this problem?

   (b) Give an example of the exposed node problem which arises in this network. How does the RTS-CTS mechanism solve this problem?

2. The following frames (including the preamble) are observed by a receiving node which is connected to a Ethernet-based LAN. They are shown here in hexadecimal format. [10 points]

   - AAAA AAAA AAAA AAAA FFFF FFFF FFFF 000D 8845 595C 0800 ....
   - AAAA AAAA AAAA AAAB 0018 181C 90C1 001C C0AF AD1A 05DC ....
   - AAAA AAAA AAAA AAAA 0018 181C 90C1 001C C0AF AD1A 08DD ....
   - AAAA AAAA AAAA AAAB 0018 181C 90C1 001C C0AF AD1A 05D0 ....

   For each frame, give the following information.

   (a) Is the frame format 802.3 Ethernet or DIX Ethernet?

   (b) What are the source and destination MAC addresses in the frame?

   (c) Can you decipher the manufacturer of the destination network card for each frame?

   (d) What do the last 2 bytes (which are shown) mean for each frame? Give answers specific to the value of the 2 bytes in each case.

3. In binary exponetial backoff, the nodes involved in the nth collision randomly wait for $0, 1, 2, \ldots, 2^n - 1$ slots before transmitting. So each node involved in the nth collision generates a random number in the set $\{0, 1, 2, \ldots, 2^n - 1\}$. Suppose three nodes A, B and C are involved in collisions and generate the following random numbers to resolve their collision

   - A: 0, 2, 1
   - B: 0, 2, 5, 2
   - C: 0, 2, 5, 9

If the first collision occurs at time $t = 0$ and the slot size is one second, when does the successful transmission for each node complete? [5 points]

4. A hypothetical CSMA/CD system has four copper twisted-pair segments connected together by three repeaters. Each segment is 400 metres long. The one-way processing delay at a repeater is 10 microseconds. We wish to operate this system at 10 megabits per second. If the speed of the signal in copper is 2×10^8 metres per second, what is the minimum size of the frame in such a system which will ensure that a collision never goes undetected? [5 points]

5. Suppose an IPv4 packet arrives at a router which is not capable of fragmentation, what are the fields in the IPv4 header which the router can possibly change? If the router is capable of performing fragmentation what are the fields which can possibly be changed? [5 points]

6. Calculate the Internet checksum of the following bits which are given in hexadecimal format: FFABBCD0 0010EE99 AAAA0000 0000CCDD [5 points]

7. Suppose a 1520 byte IPv4 datagram which has 1500 bytes of data and 20 bytes of header arrives at a router. It needs to be forwarded along a link which has an MTU of 500 bytes. So the router decides to do fragmentation. Write down the number fragments sent, the number of bytes in each fragment, the specific bytes contained in each fragment (assuming the original data bytes are numbered 1 to 1500), the value of the IPv4 offset field in each fragment's header, and the value of the IPv4 MF flag in each fragment's header. [5 points]

8. Generate subnetwork addresses and subnet masks to divide a single class C address 192.83.12/24 among four physical networks with 50 hosts each. [5 points]