

## **CS 640: Introduction to Computer Networks**

### **Homework 2**

Handed out: 10/05/2007,  
Due: 10/16/2006, in class

Please type out or neatly print your answers. Add as much detail as you deem fit to your answers. For full credit you must explain how you obtained the answer and not just print the final result. Collaboration is discouraged strongly. Please try to work on your own. If you are stuck, you can discuss with your fellow students, but you are encouraged to talk to the course personnel first.

### **1. Encoding**

Show the 4B/5B encoding and the resulting NRZI signal for the following bit sequence:

1101 1110 1010 1101 1011 1110

Use the code words from <http://en.wikipedia.org/wiki/4B5B>

### **2. Sliding Window**

2.1 Suppose you are designing a sliding window protocol for a 1Mbps point-to-point link to the Moon, which has a one way latency of 1.25s. Assuming that each frame carries 1KB of data, what is the minimum number of bits you need for the sequence number?

2.2 Draw a timeline diagram for the sliding window algorithm with  
*sending window size = receiver window size = 2 packets*  
for the situation where frame 4 is lost. Use a time out of 2RTT.

### **3. Ethernet**

3.1 Assume that two hosts are trying to communicate over a 100Mbps Ethernet segment. Many other hosts also connected to this segment. The hosts wish to exchange a 40B IP packet (including IP, TCP and application headers and payload). What is the minimum number of padding bytes that the sending host's Ethernet adaptor will add? Assume that electromagnetic signals travel at the speed of  $10^8$  m/s over 100Mbps Ethernet cable. Also assume that the maximum allowed segment size is 1000m.

Suppose nodes A and B are on the same 10Mbps Ethernet segment. Say the propagation delay between them is 250 bit times.

3.2 Suppose at time  $t = 0$ , B starts to transmit a frame. Suppose A also transmits at  $t = x$ , but before completing its transmission, it receives bits from B (hence, a collision occurs

at A). Assuming node A follows the CSMA/CD protocol, what is the *maximum* value of x?

3.3 Suppose at time  $t = 0$ , both nodes start to transmit a frame. At what time do they detect a collision? Assuming both nodes transmit a 48-bit jam signal after detecting a collision, at what time (in bit times) do A and B sense an idle channel? How many seconds is this for 100Mbps Ethernet?

#### 4. **Ethereal**

You are required to analyze the given network traces using Ethereal and answer the following questions. Network traces are provided for analysis (in the form of .cap files). They can be downloaded from <http://www.cs.wisc.edu/~akella/CS640/F07/work.html> . In order to access this tool, you just need to type /s/ethereal/bin/ethereal at the command prompt. Then wait as the GUI for ethereal shows up in the screen. Then select File-->Open from the top menu. Browse to locate the required .cap file. Open the .cap file and you can easily analyze the details of each packet in the trace. For more details on using ethereal, visit [www.ethereal.com](http://www.ethereal.com).

Answer the following questions about the traces tcp\_2transmit.cap and udp\_2transmit.cap network traces. (Please refer to Ethernet, IP, TCP packet datagram in lecture notes and you should be able to find the corresponding field between capture data and the headers)

4.1. Within the IP packet header, what is the value in the upper layer protocol field i.e. TCP, UDP, ICMP?

4.2. Which fields in the IP header always change from one datagram to the next?

4.3. Describe the pattern you see in the values in the Identification field of the IP datagram.

4.4. In the udp\_2transmit.cap trace, there is a data transfer of 5000 bytes (data capture of 2 ~ 6). However, to transfer these 5000 bytes of data, there are some overheads. Define overhead as  $(\text{Non-Data Bytes} / \text{Total bytes}) * 100$ . Calculate the overhead for the UDP transfer.

Answer the following questions about the traces tcp\_pcattcp\_n1.cap and tcp\_2transmit.cap

4.5. In tcp\_pcattcp\_n1.cap, which of the packets contain only a header and no data? Why?

4.6. In the tcp\_2transmit.cap, data is being transferred across two machines. What is the value of the Ethernet address for the two machines?

4.7. In the tcp\_2transmit.cap, give the hexadecimal value for the two-byte Frame type field in Ethernet package header.

## 5. Traceroute revisited

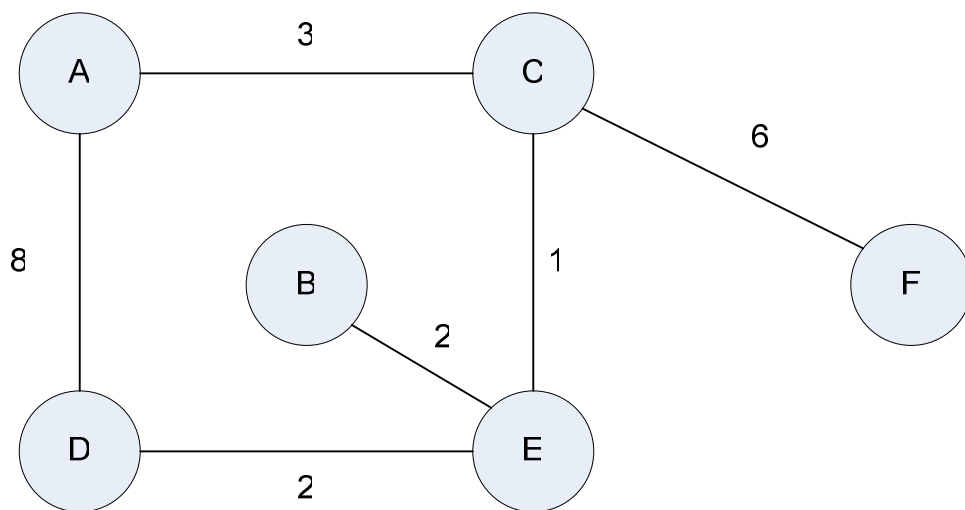
For this problem, you must familiarize yourself with the unix “*whois*” utility (run “man whois”). Repeat the traceroutes from homework 1. You need not paste the outputs from your traceroutes. (you should use `whois -h whois.radb.net <IP>` to find the proper information)

5.1 What are the AS numbers of the ISPs en route to each destination? (if you cannot find the AS number, you only need to indicate that)

5.2 How many ISPs is UW-Madison connected to? What are their AS numbers?

5.3 UW-Madison has direct connections to a few other ISPs as well. Name at least two such ISPs. Explain how you arrived at the answer.

## 6. Distance Vector



For the network given in the figure above, show the global distance-vector tables like those of Table 4.5 and 4.8 in textbook when

6.1. Each node knows only the distances to its immediate neighbors

6.2. Each node has reported the information it had in the preceding step to its immediate neighbors.

6.3. Step (6.2) happens a second time

### 7. Link-State

For the network given in the question 6, show how the *link-state* algorithm builds the routing table for node D

### 8. Routing

Suppose a router has built up the following routing table:

<u>SUBNET NUMBER</u>	<u>SUBNET MASK</u>	<u>NEXT HOP</u>
128.96.39.0	255.255.255.128	Interface 0
128.96.39.128	255.255.255.128	Interface 1
128.96.40.0	255.255.255.128	R2
192.4.153.0	255.255.255.192	R3
(default)	(n/a)	R4

Assume the router does a longest prefix match. Describe what the router does with a packet addressed to each of the following destinations:

8.1 128.96.39.10

8.2 128.96.40.12

8.3 128.96.40.151

8.4 192.4.153.17

8.5 192.4.153.90

### FAQ

See course web-page.