Homework 1

Due: 18 February 2011, 4pm

Problem 1 - Packet switching versus circuit switching

(a) If circuits provide guaranteed bandwidth to users, why is packet switching preferred over networks such as the Internet?

(b) How do circuit and packet switched networks deal with overload? What is the user experience as the demand progressively increases on both types of networks?

(c) In packet-switched networks, as load increases, what component of end-to-end delay increases? Other than average delay, is any other metric affected?

Problem 2 - Modulation and Encoding

(a) A typical analog phone line will carry frequencies between 300 Hz and 3,300 Hz and has a signal-to-noise ratio of 30 dB.

a. Will this support a 56Kbps modem?

b. What changes can you make to the channel to support such a rate?

c. What if you restrict the modem to use only a binary signal (that is, only two levels are possible)?

(b) PPP, like BISYNC, is a byte-oriented protocol that uses byte-stuffing. The special flag byte 0x7E needs to be escaped if it appears anywhere in the data, as it signifies the start and end of a frame. The escape byte in PPP is 0x7D. (PPP also XORs the escaped byte with 0x20, but you can ignore that).

a. What is the transmitted sequence for the sequence of bytes 01 7E 65 7D 7E 61 ?

b. If you are transmitting n bytes, what is the worst case expansion?

(c) Consider HDLC, which uses bit stuffing to escape 01111110.

a. If you are transmitting a payload of n bytes using HDLC ($8n$ bits), what is the worst-case expansion, as a function of n, that you can get? For what pattern?

b. How can you detect a bit-stuffing error with this scheme?

Problem 3 - Bandwidth, Delay, and Windows

Consider a copper cable of 800 Km connecting two computers. Consider the speed of transmission in copper to be 2×10^8 m/s.

a. What is the propagation delay in this link?

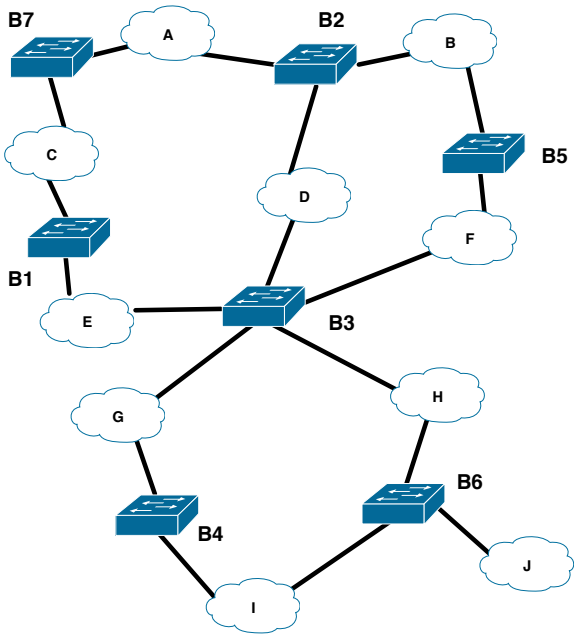
b. Consider that the nodes can transmit at 10 Mbps (10×10^6bps). What is the transmission delay for a 1250-byte packet in this link?

c. Assuming that acknowledgment packets have negligible transmission delay, what is the throughput that you can obtain from this link using a stop and go protocol? (You can only count a bit transmitted after it has been acknowledged).

d. With the same assumptions, and with no losses in the link, how large does your sending window have to be in a sliding window protocol to fill the pipe?

e. If you set the receiver window to the same size as the sending window, how many sequence numbers will you need?

Problem 4 - Ethernet Networks



In the switched ethernet network above, which bridge ports will be disabled after the spanning tree algorithm finishes? Consider the bridges to be ordered B1, B2, ... B7.