Distributed Computing and Networking—CS 461

FINAL EXAM May 14, 1999

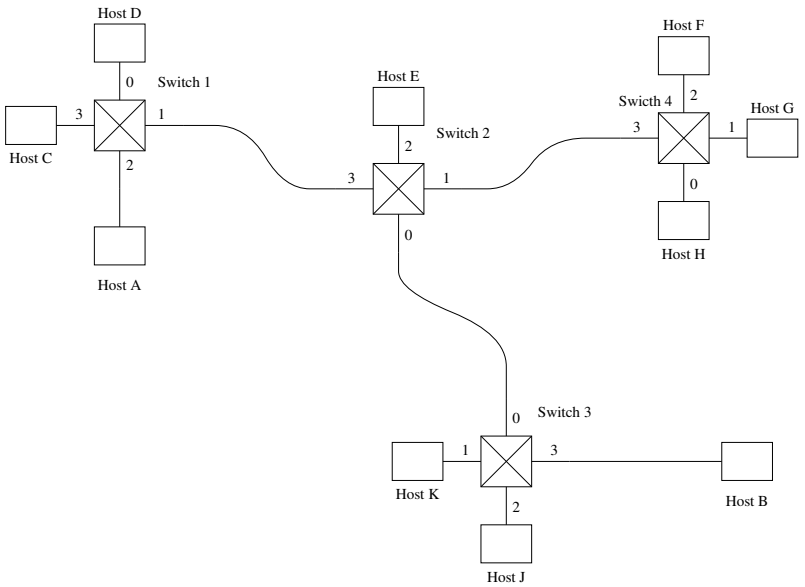
1. Suppose the round-trip propagation delay for Ethernet is 46.4 microseconds. This yields a minimum packet size of 512 bits (464 bits corresponding to propagation delay + 48 bits of jam signal). **[9 points]**

   (a) What happens to the minimum packet size if the delay is held constant, but the signaling rate rises to 100Mbps?

   (b) What are the drawbacks to this minimum packet size?

   (c) How might the specifications be written so as to permit a smaller minimum packet size?

2. Using the example network given below, give the VCI tables for all the switches after the following sequence of connections is established. Assume the connections are cummulative, that is, the first connection is still up when the second connection is established, and so on. Also assume that VCI assignment always picks the lowest unused VCI on an outbound link, starting with 0. **[12 points]**



- Host A connects to Host B
- Host C connects to Host G
- Host E connects to Host J
- Host D connects to Host B
- Host F connects to Host K
- Host H connects to Host A

3. Consider a sliding window protocol like MSP running on a 100Mbps network with a 50ms RTT. Suppose the protocol has an 8-bit advertized window field and a 32-bit sequence number field, both of which count packets rather than bytes. The protocol can send variable-length packets, with some fixed upper bound. **[10 points]**

   (a) How big, to the nearest KB, must packets be to keep the pipe full? (You may ignore the effects of header overhead.)

   (b) What is the upper bound on how long packets may be delayed in the network without the protocol running the risk of wrap-around. (Again, you may ignore the effects of header overhead.)

4. Recall the proposed TCP extensions allows window sizes much larger than 64KB. Suppose that you are using this extended TCP over a 1Gbps link with a latency of 250ms to transfer a 40MB file, and the TCP receive window is 1MB. Also, assume TCP sends 1KB packets, no congestion occurs, and no packets are lost. **[9 points]**

   (a) How many RTTs does it take until the send window reaches 1MB? Recall that the send window is initialized to the size of a single packet.

   (b) How many RTTs does it take to send the file?

   (c) If the time to send the file is given by the number of required RTTs times the link latency, what is the effective throughput for the transfer? What percentage of the link bandwidth is utilized?

5. Consider a TCP connection that's currently running with its congestion window equal to 32KB and an RTT equal to 50ms. **[9 points]**

   (a) TCP is considered a *self-clocking* protocol. What does this mean?

   (b) At what rate is the sender transmitting packets, on average?

   (c) What might cause this rate to not be smooth, such that the rate measured over small intervals varies significantly from the average over longer intervals? Give a specific example.

6. Define each of the following in **one** sentence. Which combination of the cryptography algorithms discussed in class (DES, RSA, MD5) is most likely used to implement each service? **[8 points]**

   (a) privacy

   (b) integrity

   (c) authentication

   (d) key management

7. Define each of the following in *one* sentence. Give an example of a protocol that uses each technique. **[8 points]**

   (a) implicit ACKs

   (b) selective ACKs

   (c) cummulative ACKs

(d) duplicate ACKs

8. Describe, in one or two sentences, how each of the following distributed systems maintain cache consistency. **[8 points]**

   (a) Domain Name System

   (b) Sprite File System

   (c) Andrew File System

   (d) Network File System