Networks Prelims 2008

1. (25pts)

a. (6 points) Describe the circumstances in which you would prefer to use Go-Back-N over Selective Repeat and the circumstances in which you would prefer to use Selective Repeat over Go-Back-N.

b. (6 points) Suppose the Stop-and-Wait Protocol is being used to send messages over a channel in which there is no packet loss, there are no bit errors, but the channel can re-order messages. Will the protocol work correctly to achieve reliable data transfer over this channel? Use a timing diagram to support your answer. In the timing diagram, clearly indicate the sequence numbers associated with any data messages or ACKs.

c. (4 points) A channel has a transmission rate of 1 Mbps and a signal propagation speed of 2 x 10^8 m/sec. The Stop-and-Wait Protocol is being used to send packets of size 1000 bytes over this channel. Assume that the size of an ACK is negligible, there is no processing time at either end, and the channel is error-free and loss-free. What should be the maximum distance between the two nodes so that the efficiency of the protocol is at least 80%?

d. (3 points) A source node and a destination node are connected by a 1 Gbps link with a distance of 4000 km and a signal propagation speed of 2 x 10^8 m/sec. Assume that packets of size 125,000 bytes are to be transmitted, ACK size is negligible, there is no processing time at any of the nodes, and the channel is error-free and loss-free. A sliding-window protocol is to be used with the objective of ensuring continuous data transmission. What should be the minimum window size for this protocol?

e. (6 points) In the configuration of part (d), now suppose that the link is divided into 4 equal-sized links by placing three intermediate nodes between the source and destination nodes. Each link is still 1 Gbps and all other assumptions are same as in part (d). What should be the minimum window size to ensure continuous data transmission for each of the following cases?

(i) the sliding window protocol is used end-to-end.

(ii) an independent sliding window protocol is used on each hop.

2. (25pts)

a. (4 points) What is meant by hierarchical routing? Discuss how hierarchical routing makes it possible to scale routing to extremely large networks as compared to conventional non-hierarchical routing algorithms. What are the disadvantages of hierarchical routing?

b. (6 points) What are the differences between the goals of inter-AS routing protocols and the goals of intra-AS routing protocols?

c. (6 points) What are the major differences between RIP and BGP? Relate these differences to the specific goals that you described in part (b).

d. (3 points) Datagram networks route each packet as a separate unit, independent of all others. By contrast, each data packet in a virtual-circuit network follows a predetermined route. Does this observation mean that virtual-circuit networks do not need the capability to route individual packets from an arbitrary source to an arbitrary destination? Explain your answer.

e. (6 points) Each packet in a virtual-circuit network carries a VC number in its header that identifies the virtual circuit to which the packet belongs. The VC number for a given virtual circuit generally changes on each link along the route for that virtual circuit. What are the reasons that the virtual circuit does not use the same VC number on all the links traversed by it? Describe how this mechanism is implemented and what happens as a packet travels from one router to the next on its way to the destination.

3. (25pts)

Web browsers-servers use one of six variations for communicating web pages:

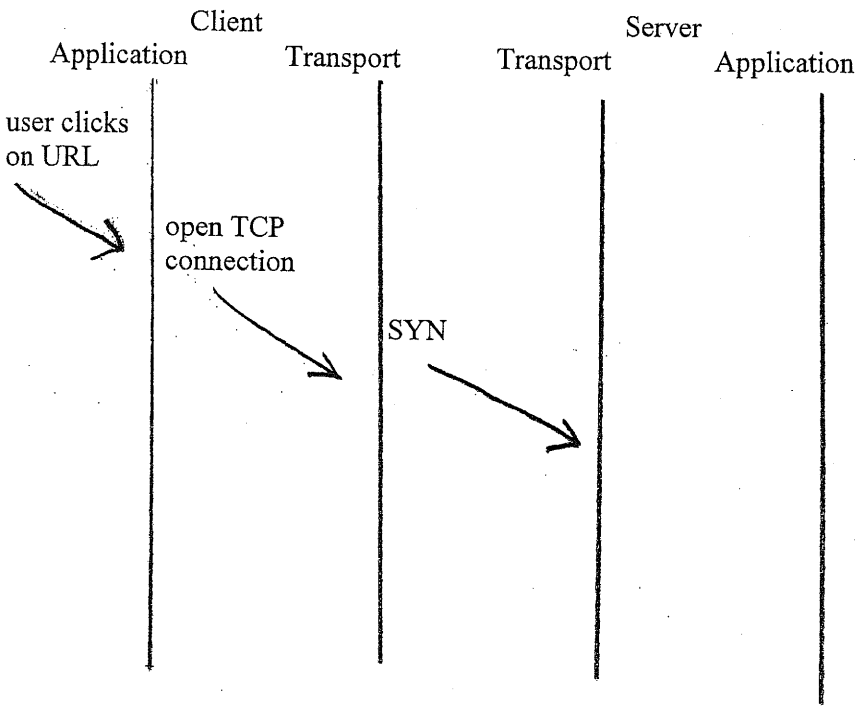
1. Non-persistent HTTP with sequential transport connections
2. Non-persistent HTTP with parallel transport connections
3. Persistent HTTP with sequential transport connections and no pipelining
4. Persistent HTTP with parallel transport connections and no pipelining
5. Persistent HTTP with sequential transport connections and pipelining
6. Persistent HTTP with parallel transport connections and pipelining

Consider a browser downloading a web page "index.html" from the server www.udel.edu. This web page contains URL pointers to 3 imbedded images "I1.jpg", "I2.jpg", and "I3.jpg". Images I1 and I3 are on the same server as index.html. Image I2 is on the server www.MIT.edu.

Use timing diagrams to show the details of both the application PDUs (protocol data units) and TCP-PDUs which would be transferred **for variations 1, 4, and 5 above.**

Your diagrams should indicate:

- whether the browser or server opens (closes) each connection
- when each connection is opened (closed)
- port numbers used for each connection



4. (25pts)

Consider the group of IPv4 network addresses: 200.175.64.0/18

Note: $128_{10} = 10000000_2$ $175_{10} = 10101111_2$ $64_{10} = 01000000_2$ $18_{10} = 00010010_2$

a. (2pt) How many host addresses are in this network?
b. (2pt) What are the first and last host addresses in this network?
c. (4pts) Divide 200.175.64.0/18 into four equal-sized subnets. Specify each subnet in decimal-dotted/prefix notation. Also, what are the exact first and last address of the 4th subnet?
d. (4pts) From the 2nd subnet that you defined in your answer to part (c), sequentially allocate two subnets each with exactly 32 host addresses. Specify each subnet in decimal-dotted/prefix notation. Also, what are the first and last address of the 2nd subnet?

Consider three LANs interconnected by two routers, as shown in the diagram below.

a. (1pt) Annotate the diagram to include adapters interfaces.
b. (1pts) Assign IPv4 addresses to all of the interfaces. For LANs 1, 2, 3, use addresses of the form 1.1.1.xxx, 2.2.2.xxx, 3.3.3.xxx, respectively.
c. (1pt) Assign MAC (i.e., Ethernet) addresses to all of the interfaces.
d. (6pts) Consider sending an IPv4-PDU from E to B. Assume all host and router ARP tables are up-to-date. Show all of the Ethernet-PDUs that will be transmitted. For each Ethernet-PDU, indicate 4 values: Ethernet source/destination, and IPv4 source/destination addresses.
e. (4pts) Same as (d) except assume the ARP table in host E is empty, and all other ARP tables are up-to-date. Show the contents of the additional Ethernet-PDUs that will be transmitted, i.e., Ethernet-PDUs that were not generated in your answer for (d).