HW II, 4390/Summer 2018

All questions count equally.

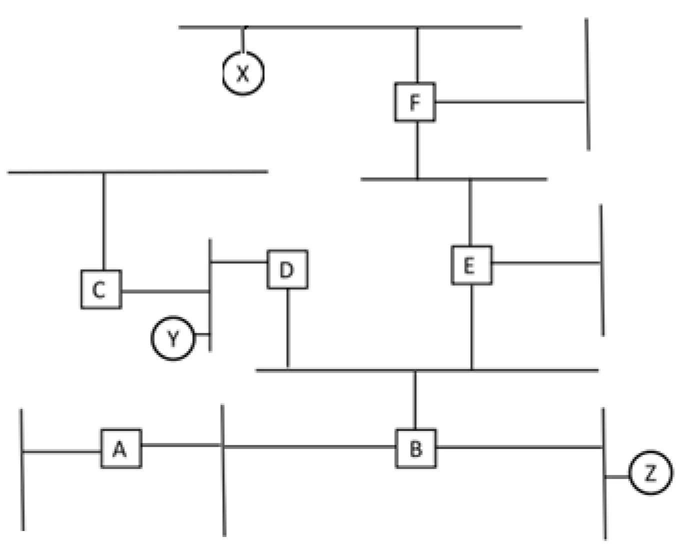
Question 1 (Individual Acknowledgement Protocol)

a) Give an example (i.e. a scenario) in which the channel can duplicate, reorder, and lose messages that results in incorrect behavior of the individual acknowledgement protocol even though timeouts are accurate.
b) (Part (b) is independent of part (a)). Assume that channels can reorder and lose messages, but not duplicate them. Assume timeouts are not accurate. What restrictions would you impose to make sure that the protocol works correctly? (Assume that there is an upper bound on message lifetime, perhaps a very large bound but a real bound nonetheless).

Question 2 (Switching)

a) Why can we have the packet header in virtual circuit switching to be much smaller than the typical header in datagram switching?
b) Assume that we are using datagram switching (i.e. we are not using virtual circuits). Is it possible to guarantee bandwidth to each source-destination pair? Are there disadvantages of doing this using datagram switching?
c) What is the big-O complexity of processing the header of a packet if we are using virtual circuits? Briefly explain why.
d) Why in virtual circuits do we need a datagram routing table (in addition to the virtual circuit table)
e) In the Internet, we have the option of doing source routing (IP does have an option for this). What do you think could be the uses for it? Can you come up with two of them?

Question 3 (Ethernet Bridges, i.e. switches)



Consider the above extended LAN, where squares are bridges (also known as switches) and circles are hosts.
Assume we start in a state where all bridges have no knowledge of any hosts.

a) Assume first that X sends an ARP REQUEST message looking for Y. After this completes, what has each bridge learned?
b) Assume then that Y sends an ARP REPLY message to X. After this completes, what has each bridge learned?
c) Assume that after (a) and (b) above complete, Z sends an ARP REQUEST looking for Y. After this completes, what has each bridge learned?

Question 4 (Distance Vector Routing)

Modify the code for the distance vector routing protocol such that every node p has an input array

linkCost: array [G] of integer

where linkCost[g] is the cost of the link from the node to the neighbor g (assumed simply to be one in the current code). In addition to this, also add split-horizon with poisoned-reverse to the code.

Question 5 (Broadcast for link state routing)

Consider a modification of the broadcast for link-state routing protocol as follows. Each node p has an additional array variable as follows:

parent: array [NID] of G

Initially, all nodes have all values of array parent set to nil. Then, when any node p receives a bc(q, t, v) message from neighbor g, it does the following:

- If parent[q] = nil then
  - ts[q] := t; d[q] := v; parent[q] := g;
  - forward bc(q,t,v) to all neighbors except g.
- If parent[q] != nil and g != parent[q] then throw the message away
- If parent[q] != nil and g = parent[q] and ts[q] < t then
  - ts[q] := t; d[q] := v; parent[q] := g;
  - forward bc(q,t,v) to all neighbors except g.
- If parent[q] != nil and g = parent[q] and ts[q] >= t then throw the message away

Assuming that there is no message loss in any channel, and that no node ever dies, does this protocol work? (I.e. each node always learns the latest value of d[q] for all other nodes q). Argue why yes or why no.

Question 6 (link-state routing)

Assume every node sends link-state advertisements (LSA) every 30 seconds, and that the flooding of a LSA takes about 2 seconds. Assume there is a routing loop (nodes pointing to each other) at time t. What is the maximum time that the loop could remain? (assuming no topology changes and no link cost changes). Briefly explain why.

Question 7 (Ethernet)

Assume that a system administrator makes a mistake, and he/she uses too many repeaters (i.e. hubs) in the network, yielding an end-to-end propagation delay that is larger than the allowed by the standard. Show me a scenario (in detail) of how this can cause an improper behavior of the network.

Question 8 (MACA)

Assume that we have two values, r and R (r < R). We call r the "receiving range" and R the "interference range"

When two nodes, A and B, are r meters apart, if A transmits, then B can correctly receive the information transmitted by A.

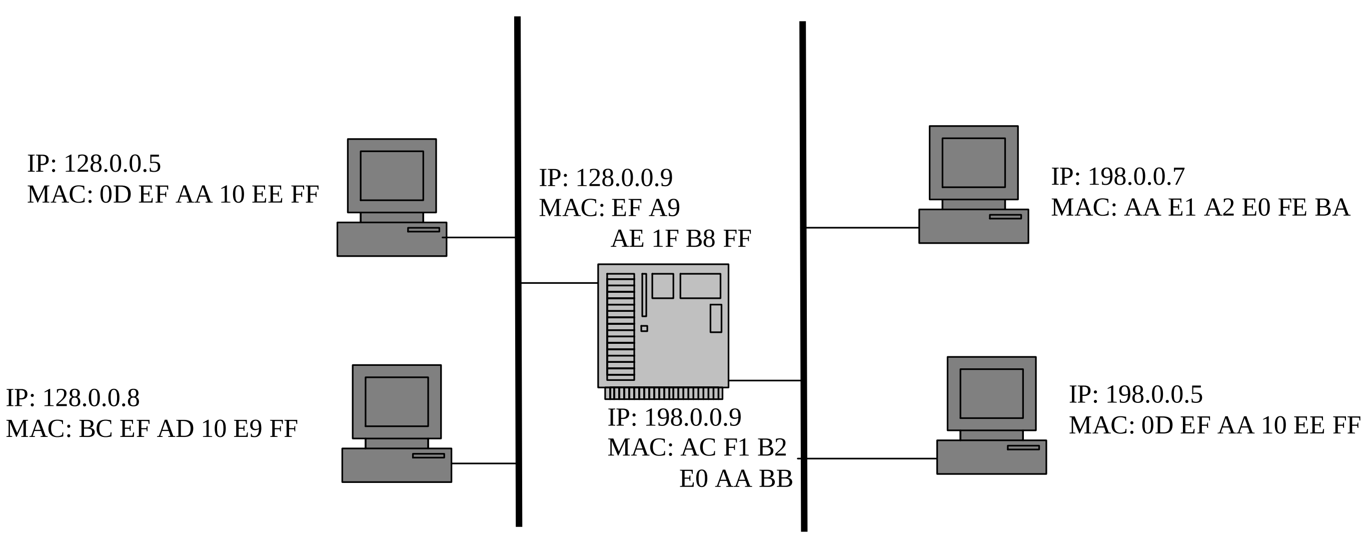
However, if the distance from A to B is greater than r but at most R, then: a) B will be able to sense that someone is transmitting, but it cannot correctly read the information, and b) if B is receiving a message from another node C, and A transmits, B's reception of C's message is corrupted.

Under these conditions, show me a scenario where a collision occurs when r < R, and the same scenario would not result in a collision if r = R.

Note that in the slides we have assumed that r = R.

Question 9 (IP Addressing)

Consider the following figure



a) Note that hosts 198.0.0.5 and 128.0.0.5 have the same physical (MAC) address. Will this cause any problems? Argue why yes or why no.
b) Assume that host 198.0.0.7 sends a TCP message to host 128.0.0.8 using the broadcast physical (MAC) address. Will the TCP process in host 198.0.0.5 receive (i.e. see) a copy of this message? Will the IP process in host 198.0.0.5 receive (i.e. see) a copy of this message? Argue why yes or why no

Question 10 (IP configuration)

Assume you have a PC attached to an Ethernet, and the PC has been turned off for days. Then, you turn the PC on, and after it boots, you try to fetch the web page www.cs.utdallas.edu. List all the packets that the PC will transmit over the Ethernet before the first message from www.cs.utdallas.edu is received by the PC.