HW 2, CS 6390, Spring 2016

Question 1: MOSPF and PIM
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a) Assume that for a multicast group we have a sender that generates data periodically (say, one packet per second), and assume we have NO receivers. For each of PIM and MOSPF, describe how the multicast data is handled in this case.

b) Assume you have a group for which there are several receivers, but no senders. For each of MOSPF and PIM, describe the type of information that the routers need to maintain in their memory.

c) Given what you answered in (b) above, show me a scenario in which MOSPF routers maintain much more information than PIM routers.

d) Compare the multicast tree built by MOSPF against the multicast tree built by PIM in terms of optimal transmission of data from senders to receivers.

Question 2: PIM
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Assume we have the following network configuration (I am drawing it in text so bear with me)

LAN A -|- Router A -|- Router B -|- RP

where RP is the randevouz point.

Assume that for a group G, there is a receiver in LAN A, also a sender in LAN A, and no other receivers or senders.

Show the steps and the messages that occur in this configuration from the appearance of the receiver (I assume the receiver appears first) followed by the appearance of the sender (some time later after the receiver appears)

Question 3: Interdomain PIM and SSM
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Two parts, both count equally

a) List all the steps necessary in Interdomain PIM for a receiver to
be able to receive data from a multicast source along the "optimal path" from the source.

b) Assume a router will support both ASM (any source multicast) and also SSM (source-specific multicast). Let X be a class D address in the range defined for ASM, and Y be a class D address in the range defined for SSM.

(i) Assume the router receives a message of the form Join(*,X), what should it do with this message?

(ii) Assume the router receives a message of the form Join(*,Y), what should it do with this message?

(iii) Assume the router receives a multicast message with source S and destination X. What should it do with this message?

(iv) Assume the router receives a multicast message with source S and destination Y. What should it do with this message?

Question 4: Virtual Circuits
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a) Consider a link A --> B along the path from a source S to a destination D. Why is B (and not A) the one choosing the virtual circuit ID of the data from S to D?

b) Why is it possible to have very small virtual circuit IDs? (e.g. two bytes long)

c) Consider the attached figure. There is a virtual circuit from p to u, another from q to v, from r to 2, from s to x, and from t to y. The virtual circuit numbers are indicated in the links. Along the path A - B - C - D, B and C are not aware of the individual circuits, and a single virtual circuit ID is used. Only A and D are aware of the individual circuits. (i) How would you accomplish this? (ii) Show me the virtual circuit tables of A and D.

Question 5: DSR
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a) Consider the DSR protocol. Assume a source sends a RREQ looking for a destination. Assume that no node has the destination in their cache, and assume that no messages are lost, and there are no node or link failures. Show me an example in which the optimum path (i.e. least number of hops) is not the path found during route discovery (a longer path is found instead).
b) In the DSR protocol, I wrote the following: (The source) "Piggybacks Route Error on new Route Request to clear intermediate nodes' route caches, preventing the return of an invalid route" Show me a scenario where this is necessary. I.e., if the source did not piggy-back the router error message on the new route request message an invalid route is received by the source in the route reply.

Question 6 OLSR

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a) Assume a node X receives from its neighbor Y a topology control TC message that originated at node S. To which neighbors will X forward this message? (think … we did not cover it in class but it is straightforward)

b) Argue convincingly (i.e. prove) that in OLSR, the path found from a source S to a destination node always has only multi-path-relays as intermediate nodes (i.e. every node along the path from S to D, except perhaps S and D themselves, are MPRs).

Question 7 (Fair Queuing)

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Assume you have a fair queuing scheduler with an output link whose capacity is 1 million bits/sec.

Assume it has as input three flows, A, B, and C, and at time t, all the queues are empty. Assume that at time t + 1 millisec., one packet from A, of size 100,000 bits, arrives. Also, at time t+10 millisec, a packet each of flows B and C arrives, of size 10,000 bits each.

(a) At time will each of these packets exit the virtual (fake) server?

(b) At what time will each of these packets exit the real scheduler (i.e., the real server?)

Question 8: Fair Queuing

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a) Consider two packets, p1 and p2, (perhaps of different flows, perhaps of the same flow). Assume that F(p1) < F(p2). I.e., the label given to p1 is less than that of p2. Argue that these labels do not need to be modified one they are assigned. I.e., they do not need to change regardless of the arrival of new flows or the termination of existing flows.

b) Consider an interval of time, [t1, t2], and assume that the number of flows that are backlogged (still having bits in the queue) of the fake server remain constant during the interval. Let V(t1) = X, i.e., the virtual time (or round number) at time t1 is X. Argue that

V(t2) = X + (t2-t1)*C/B

where C is the capacity of the output channel and B is the number of backlogged flows during the interval [t1, t2].