UCLA CS 118 Computer Networks

Homework Assignment 4

Due Dec 3

Directions: There are only 2 questions and both will be graded. There will be some final questions based on these problems. While I know you are busy with the project and other Finals preparation, please do try these problems by yourself as a form of exam preparation.

1. **Modifying Routing to Avoid Fragmentation:** We learned in class that in order to avoid fragmentation, IP tries various packet sizes till it finds one that works. Alternately, we could modify the routing protocol to compute the minimum of the maximum packet sizes of all links on the best route to each destination. In distance vector routing, a router R computes its own distance, $Distance(P, R)$ to a destination prefix P using the distances sent by its neighbors as follows: $Distance(P, R)$ = Minimum across all neighbors N of $Distance(P, N) + Distance(R, N)$. We want to see how to modify this protocol to *also* compute the minimum max packet size on the shortest distance route to D?
   - In Figure 1 what is the shortest path between R1 and P? What is the smallest packet size that is guaranteed to get through without fragmentation on this path?
   - Assume each router has receives the additional variables $Distance(P, N)$ and $MinMaxPacketSize\ (P,\ N)$ from each neighbor N. Write an equation to compute these two variables from the corresponding variables of all a routers neighbors
   - Assume we are calculating these estimates only for distances to P. Assume that at t=0, router R3 has $Distance\ (P,\ R3) = 1$ and $MinMaxPacketSize\ (P,\ R3) = 8000$ and all other routers have the distance and min packet size to P set to a default of infinity. Assume that at t = 0 each router sends an update to each neighbor. Draw several pictures of the same topology with the changing estimates of each router for its two variables based on the equation you wrote down until all estimates stop changing. After how much time do all the estimates converge (i.e., do not change any more).
   - Now assume the link to R2 to R4 crashes say at time t = 7. Draw similar pictures for the time it takes to converge after the crash.

2. **Link State Routing:** Consider the topology shown in Figure 2. The numbers at every node describe the current sequence numbers at every node for the LSP from router $R1$. Notice that $R1$'s current sequence number is lower than the sequence number that other nodes have stored from R1. This can happen if $R1$ has just crashed and restarted and there have been other crashes. Describe what happens if $R1$ starts by sending an LSP (from itself) to $R2$ and $R4$. Assume that all messages take 1 unit of time to send. For every instant of time, describe what messages are sent and the stored sequence number at all nodes. Do this for all instants of time until they all have consistent values. How long does it take to stabilize? Don't forgot the rule of sending back bigger LSP sequence numbers and the jump mechanism.

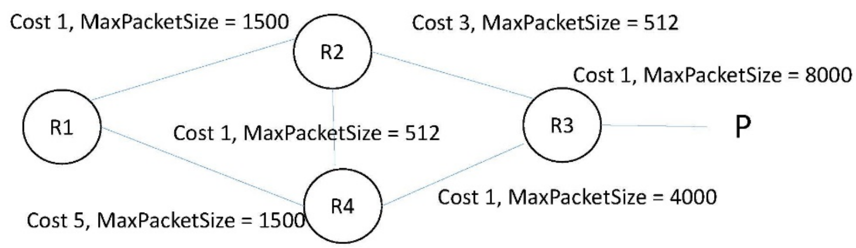

Figure 1: : Computing the Min-Max Packet Size on the shortest path by modifying routing

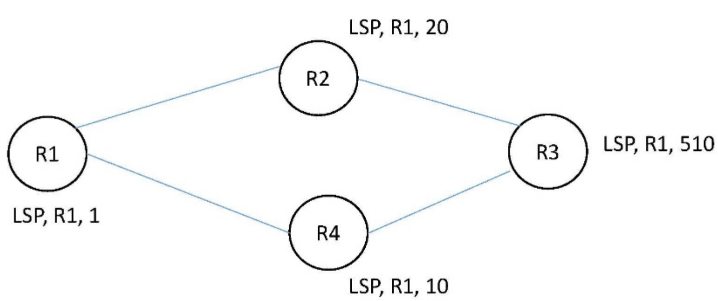

Figure 2: LSP propagation after a series of crashes and when R1 comes up with sequence number 1 when the rest of the network has various LSPs for R1 from the past