Topic 3

ECE 257A: Multi-User Communications and Networking

Fall 2007

Problem Set. 3 (Due Nov 27, 07)

1. Problem 5 of Problem Set 2 (if you have not handed it in before).

2. Give a network consisting of 7 or less nodes, for which Bellman equation for the shortest path (B.E) has more than one solutions. Specify two distinct solutions. Give another example, where BE does not have a solution.

3. Consider a multi-hop wireless network which is modeled by a graph with L edges denoted by set $E = \{e_1, e_2, \ldots, e_L\}$ and cost structure $c_l, l \in E$ which represent the cost of any one transmission attempt over link l. Furthermore, any edge e_l is assigned a packet loss probability p_l. Packet losses are detected instantaneously, and transmissions are repeated on a link until the packet is successfully received. We are interested in routing a packet from a source node s to a destination node t on a path P such that expected cost in minimized. How would you go about finding such path? Can you define a Bellman type equation? Can you devise an algorithm?

4. Consider a similar multi-hop wireless network which is modeled by a graph with L edges denoted by set $E = \{e_1, e_2, \ldots, e_L\}$. Furthermore, any edge e_l is assigned a packet loss probability p_l. We are interested in routing a packet from a source node s to a destination node t on a path P whose overall loss probability is minimized. Assume losses on a link is independent of success/failures in the past and/or over other links. Now assume that you have already written a program which follows Dijkstra algorithm to calculate the shortest paths for any given network. Can you use this program (without changing a line of code) to solve the new problem?

   Hint: You need to redefine the appropriate link costs.

5. In all routing policies we have studied, we only considered 1 destination at a time. The stability of back pressure algorithms can be extended to the case of multiple destinations. Consider a

network with N nodes and d flows (each flow is a stream of data between a source-destination pair).

Modify the back pressure algorithm such that it is stable for all admissible traffic (note that at any time, now, you have the choice of which flow to forward in addition to which neighbor to forward the packets to).

Hint: The set of destinations is what you really care about not the flows.