Computer Networks: Assignment 7

22 May 2016

Solving and submitting your assignment

Requirements about the delivery of this assignment:

- Submit via Blackboard (`http://blackboard.ru.nl`);
- Upload one pdf file for written answers and all supplemental files in a single zip file;
- The file should take the name of your student number, for example student *s0123456* should submit a file named *s0123456.pdf*.
- Write both your name and student number into the document (and only your student number in the filename).

Deadline: Wednesday, May 31, 20:00 p.m. sharp!

Goals: After completing these exercises successfully you should be able to:

- know how TCP congestion control and throughput operate
- have a better understanding of how Link-State routing algorithm works and how to compute least-cost routing paths
- know how packet corruption is detected in modern networks

Marks: You will be graded with marks from 0 to 3 where 0 means not serious, 1 means serious but insufficient, 2 means sufficient and 3 means good. You can have at most 1 assignment graded 0. To get 1 or more, you MUST attempt to solve ALL exercises, even if the provided solution is not correct/complete. In other words, leaving an exercise out automatically turns your grade to 0. In your solution, please explain all answers clearly and concisely.

1 Congestion Window and Throughput (15 points)

Consider that only a single TCP (Reno) connection uses one 10Mbps link which does not buffer any data. Suppose that this link is the only congested link between the sending and receiving hosts. Assume that the TCP sender has a huge file to send to the receiver, and the receivers receive buffer is much larger than the congestion window. We also make the following assumptions: each TCP segment size is 1500 bytes; the two-way propagation delay of this connection is 150 msec; and this TCP connection is always in congestion avoidance phase, that is, ignore slow start.

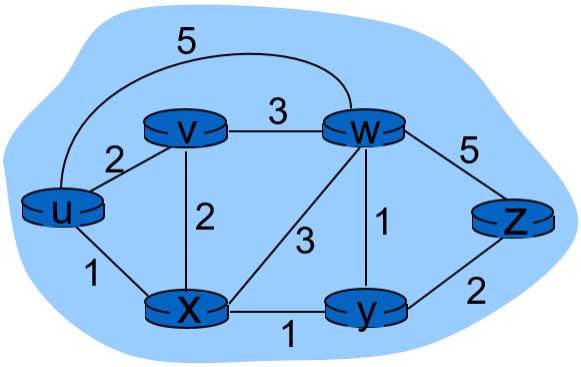
a) What is the maximum window size (in segments) that this TCP connection can achieve?

b) What is the average window size (in segments) and average throughput (in bps) of this TCP connection?

c) How long would it take for this TCP connection to reach its maximum window again after recovering from a packet loss?

2 Link-State Routing Algorithm (8 points)

For the following topology, perform all the steps of the Link-State (LS) algorithm from the perspective of node u, by filling in the LS table given in Table 1. Each step corresponds to a row in the table. After each step, a new node is added to the list of nodes for which the least-cost path is known (N'). Eventually, the list will contain all nodes and the algorithm stops.



The notations used are:

- D(v): cost of the least-cost path from the source node to destination v as of this iteration of the algorithm.
- p(v): previous node (neighbor of v) along the current least-cost path from the source to v.
- N' : subset of nodes; v is in N' if the least-cost path from the source to v is definitively known.

Step	N'	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)	D(z),p(z)
1	u	2,u	5,u	1,u	∞	∞
2	ux					
3						
4						
5						
6						

Table 1: LS table

3 Cyclic Redundancy Checks (15 points)

CRC is the main scheme used by a receiver to check if a packet received from a sender hasn't been corrupted. It involves a generator G, on which both the receiver and sender agree on. For some data to be sent, D, the sender appends r additional bits (denoted by R), such that D concatenated with R is exactly divisible by G. The CRC algorithm is detailed in section 5.2.3 of Computer Networking A Top Down Approach 6th Edition.

a) Briefly explain what the receiver does to check if the data received has been corrupted.

Now consider the CRC scheme with generator G = 1001, r = 3. Calculate the value of R for each of the given values of D.

b) 1001010101

c) 0101101010

d) 1010100000