CE3005: Computer Networks

Part I: Tutorial – 4

(Fall 2016)

1. Consider a packet switched network. Two nodes, node S and node D, are connected through an intermediate node I. A message of size 1000 bytes is transmitted from node S to node D. The message is fragmented into four packets each with a 50-byte header. All links run the same data rate. Determine the minimum data rate of the links to achieve 100ms of total transmission delay. (Hint: *pipeline effect*)

2. A packet switching node receives packets at an average Poisson rate of 16 packets per second. Each packet can be routed to either of the two outgoing links. An arriving packet is routed to the first link with probability β or to the second link with probability $(1-\beta)$. Find the value of β such that the average number of packets in the queues (including in service) at the two links are equal. Assume that packet lengths have exponential distribution. It is given that the first link can serve packets at the average rate of 16 packets per second while the second link can serve at the rate of 4 packets per second.

   What percentage of time is the first server busy? What percentage of time is the second server busy? Why the two servers are busy for the same percentage of the time?

3. A packet switching node receives packets at an average Poisson rate of 4 packets per second. An arriving packet is buffered in the queue (there is only one outgoing link) if the server is busy or it moves directly to the server if the server is free. Assume that packet lengths have exponential distribution with mean service rate of 6 packets per second. A departing packet joins back the queue with probability 0.2 or leaves the system with probability 0.8. Find the average number of packets in the system. (Hint: *queue with feedback*)

4. The Computer Centre of the University is connected to the Internet using a 2.048 Mbps link. During the peak periods, utilization of the link is 24 %. For reasons of economy, the Computer Centre decides to downgrade the link to 512 Kbps. Assuming that the volume of traffic remains the same, calculate the percentage increase in the delay at the gateway which sends packets on the link. Assume that the packet lengths have exponential distribution with a mean of 1000 bits, and the arrival of the packets at the gateway follows a Poisson process.