

## Comp 2322 Computer Networking

### Homework One

**Due time: 11:59pm, February 4, 2023, Saturday**

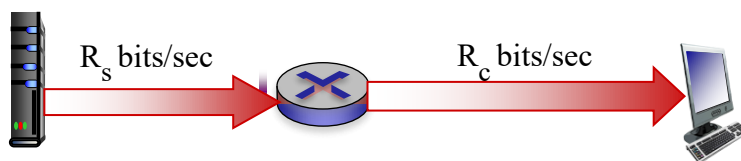
**Total marks: 10 points**

#### Submission Requirements:

You need to submit the homework to the blackboard via Learn@PolyU on or before the due time. Late submission will cause the marks to be deducted 25% per day.

#### Questions:

1. Consider a packet of length  $L$  which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let  $d_i$ ,  $s_i$ , and  $R_i$  denote the length, propagation speed, and the transmission rate of link  $i$ , for  $i = 1, 2, 3$ . The packet switch delays each packet by  $d_{proc}$ .
  - a) Assuming no queuing delays, in terms of  $d_i$ ,  $s_i$ ,  $R_i$  ( $i = 1, 2, 3$ ), and  $L$ , what is the total end-to-end delay for the packet? (2 points)
  - b) Suppose the packet is 1,500 bytes, the propagation speed on all three links is  $3 \times 10^8$  m/s, the transmission rates of all three links are 3 Mbps, the packet switch processing delay is 2 msec, the length of the first link is 4,500 km, the length of the second link is 3,000 km, and the length of the last link is 1,500 km. Please compute the end-to-end delay for the packet. (2 points)
2. Consider an end to end path from a server to a client shown as the figure. Assume that the links along the path from the server to the client are the first link with rate  $R_s$  bits/sec and the second link with rate  $R_c$  bits/sec. Suppose the server sends a pair of packets back to back to the client, and there is no other traffic on this path. Assume each packet of size  $L$  bits, and both links have the same propagation delay  $d_{prop}$ .



- a) What is the packet inter-arrival time at the destination? That is, how much time elapses from when the last bit of the first packet arrives until the last bit of the second packet arrives? (2 points)
- b) Now assume that the second link is the bottleneck link (i.e.,  $R_c < R_s$ ). Is it possible that the second packet queues at the input queue of the second link? Explain. (2 points)
- c) Now suppose that the server sends the second packet  $T$  seconds after sending the first packet. How large must  $T$  be to ensure no queuing before the second link? Explain. (2 points)