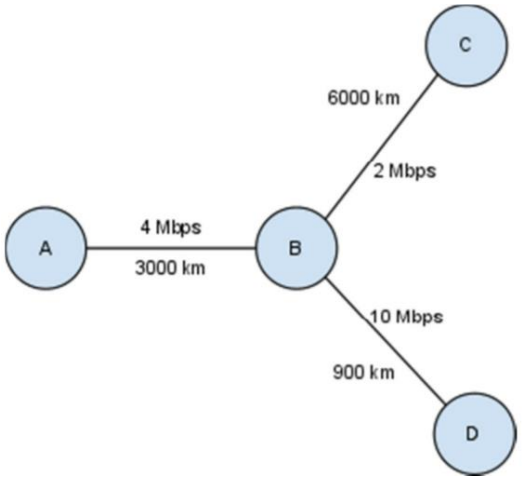
National University of Computer and Emerging Sciences, Lahore Campus

Course:	Computer Networks	Course Code:	CS307
Program:	BS(Computer Science)	Semester:	Fall 2019
Duration:	20 Minutes	Total Marks:	20
Date:	11 Sep, 2019	Quiz:	1
Section:	E	Page(s):	1

Name_____ Roll No._____

Question 1: **[Marks 8]**

Assume data travels through the links at the speed of light.



(a) What is the transmission delay if

- A sends a 500byte packet to B
- B sends a 500byte packet to D

(b) What is the propagation delay between

- A to B
- B to D

Question 2: **[Marks 6]**

A wants to send a 500byte packet to **D** through **B**. **B** is supposed to follow the store-and forward model, that is, B will receive the whole packet from A and then start transmitting the packet to **D**.

(a) What is the **end-to-end delay** seen by the packet?
(b) What will be the throughput from A to D?

Question 3: **[Mark 6]**

(a) If **D** starts sending 500 byte packets back-to-back to **B**, then how many packets will **D** have transmitted before B starts receiving the first packet sent by D?
(b) What does this value have to do with the term "**bandwidth-delay product**"? **(Extra Credit)** **[Marks 3]**

1) (a) Transmission Delay = Size of Transfer / Link Bandwidth
A to B: Transmission Delay = (500/ ((4/8) x 10^6)) = **0.001s or 1ms**
B to D: Transmission Delay = (500/ (10/8) x 10^6)) = **0.0004s or 0.4ms**

(b) Propagation Delay = Distance of link / Speed of light
A to B:
Propagation Delay = 3000 / (3 x 10^5) = **10ms or 0.01s**
B to D: Propagation Delay = 900 / (3 x 10^5) = **3ms or 0.003s**

2) (a) End to end delay between A to D = (Delay between A to B) + (Delay between B to D)
Delay on a link = Transmission Delay + Propagation Delay
Therefore, Delay between A to B = 1 + 10 = 11ms, Delay between B to D = 0.1 + 3 = 3.1ms.
End to end delay between A to D = 11ms + 3.1ms = **14.1ms or 0.0144s**

(b) Throughput = min{ A-B, B-D } = min{ 4mbps, 10mbps} = **4mbps**

3) (a) For D to B, the propagation delay is 3 x 10^{-3}, and the bandwidth is 10Mbps.
Therefore,
Bandwidth-Delay product is (10/8 x 10^6) x (3 x 10^{-3}) = 3750 bytes
This translates to 3750/500 = **7.5 packets**

(b) This is similar to computing the volume of a pipe. The amount of data that will be "in flight" on a network link is the product of its bandwidth and the propagation delay.