ITS323 – Quiz 5 Answers

Name: _____

ID: _____ Mark: _____ (out of 10)

Question 1 [5 marks]

Consider the network in Figure 1. The data rate of each link is 1Mb/s. Table 1 gives the one-way propagation delay for each link (it is the same in both directions).

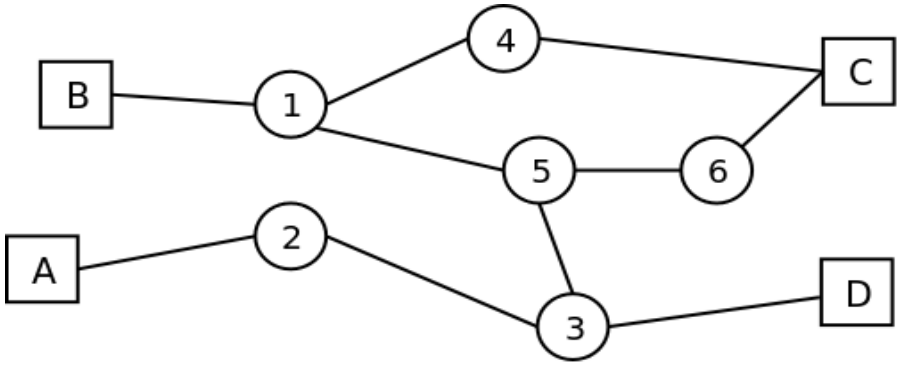

Figure 1: Switching Network: Squares are stations; Circles are Switches

Link	Propagation [us]	Link	Propagation [us]
B-1	10	6-C	35
1-4	20	A-2	10
1-5	15	2-3	25
4-C	20	3-5	15
5-6	40	3-D	35

Table 1: Link Properties

a) Assume a Circuit Switching connection has already been established on the path B-1-5-6-C / A-2-3-D / A-2-3-5-6-C / B-1-5-3-2-A. If the source starts transmitting 10,000 bits of data at time 0, at what time is the data fully received by the destination? (Give your answer in microseconds, *us*) [2 marks]

Answer

Total propagation delays for the links are:

B-1-5-6-C: 10 + 15 + 40 + 35 = 100us

A-2-3-D: 10 + 25 + 35 = 70us

A-2-3-5-6-C: 10 + 25 + 15 + 40 + 35 = 125us

B-1-5-3-2-A: 10 + 15 + 15 + 25 + 10 = 75us

Transmission time of 10,000 bits at 1Mb/s is 10,000us.

With circuit switching, once the circuit (connection) has been established, the delay is the transmission time plus total propagation.

B-1-5-6-C: 10,100us

A-2-3-D: 10,070us

A-2-3-5-6-C: 10,125us

B-1-5-3-2-A: 10,075us

b) Assume Datagram Packet Switching is used instead, with all packets following the same path as in part (a). A packet carries 1000 bits of data (although there is a header, ignore its size in calculations). At what time is the data fully received by the destination? (Give your answer in microseconds, *us*) [3 marks]

Answer

There are 10 packets. With datagram packet switching, the packets are sent immediately. In general, the total time to send the data is: transmission time of all packets + total propagation time + time to transmit last packet on the 2nd, 3rd, … and last link.

Transmission time of all packets: 10 x 1000 @ 1Mb/s = 10,000us

B-1-5-6-C: 10,000 + 100 + 3*(1000/1Mb/s) = 13,100us

A-2-3-D: 10,000 + 70 + 2*(1000/1Mb/s) = 12,070us

A-2-3-5-6-C: 10,000 + 125 + 4*(1000/1Mb/s) = 14,125us

B-1-5-3-2-A: 10,000 + 75 + 4*(1000/1Mb/s) = 14,075us

Question 1 [5 marks]

Consider the network in Figure 2. The data rate of each link is 1Mb/s. Table 2 gives the one-way propagation delay for each link (it is the same in both directions). Hosts (end-users) are squares and switches are circles.

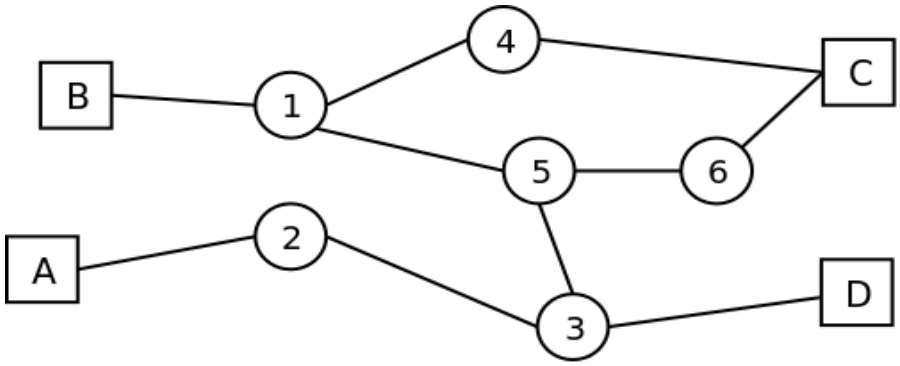

Figure 2: Switching Network: Squares are stations; Circles are Switches

Link	Propagation [ms]	Link	Propagation [ms]
B-1	10	6-C	15
1-4	2	A-2	1
1-5	3	2-3	5
4-C	3	3-5	2
5-6	1	3-D	4

Table 2: Link Properties

Assume Virtual Circuit Packet Switching is to be used on the path B-1-4-C/B-1-5-6-C/B-1-5-3-D/A-2-3-D. At time 0, the source host has 100,000 bits of data to send to the destination. Connection Request packets are 1,000 bits in length, as are Connection Response packets.

a) How long does it take for the source host to fully receive the Connection Response? (Give your answer in milliseconds). [2 marks]

Answer

The Connect Request has a transmission duration of 1ms (as does the Connect Response). For each link on the path, the packet must be transmitted and propagate along the link. Once fully received, the next switch transmits the packet again.

Total time for Connect Request: transmission on 1st link + propagation of 1st link + transmission on 2nd link + propagation of 2nd link + … (repeated for each link)

B-1-4-C: 3 * 1 + 10 + 2 + 3 = 18ms

B-1-5-6-C: 4 * 1 + 10 +3 + 1 +15 = 33ms

B-1-5-3-D: 4 * 1 + 10 + 3 + 2 + 4 = 23ms

A-2-3-D: 3*1 + 1 + 5 + 4 = 13ms

Same applies for Connect Response, and therefore the total time is:

B-1-4-C: 36ms

B-1-5-6-C: 66ms

B-1-5-3-D: 46ms

A-2-3-D: 26ms

b) If each packet can carry 10,000 bits of data (although there is a header, you can ignore its size in calculations), how long does it take for the destination host to fully receive the data? (Give your answer in milliseconds) [3 marks]

Answer

There are 10 packets. In general, the total time to send the data is: transmission time of all packets + total propagation time + time to transmit last packet on the 2nd, 3rd, … and last link.

Transmission time of 1 packet = 10000 @ 1Mb/s = 10ms. Transmission time of all packets: 100ms.

B-1-4-C: 100 + 10 + 2 + 3 + 2*10= 135ms

B-1-5-6-C: 100 + 10 +3 + 1 + 15 + 3*10= 159ms

B-1-5-3-D: 100 + 10 + 3 + 2 + 4 + 3*10= 149ms

A-2-3-D: 100 + 1 + 5 + 4 +2*10 = 130ms

Question 2 [3 marks]

Explain two advantages/disadvantages of datagram packet switching (compared to circuit switching).

Answer

Datagram packet switching allows end hosts to use different line rates. Circuit switching requires hosts to use the same line rate.

Datagram packet switching is non-blocking, leading to graceful degradation of service to users. Circuit switching is blocking, meaning only a fixed number of users obtain service.

Datagram packet switching can be efficient when the amount of traffic sent varies over time, i.e. it can handle peaks/troughs of traffic better than circuit switching.

See below for disadvantages.

Explain two advantages/disadvantages of circuit switching (compared to datagram packet switching).

Answer

Circuit Switching can guarantee the quality of service (performance) delivered to end-users. Datagram packet switching cannot.

Circuit Switching allows for simpler switches with respect to processing data. Datagram packet switches must look at each packet and process the header, leading to more complex switches.

See above for disadvantages.

Question 3 [2 marks]

With a datagram packet switching network, assume hosts are sending at a total of 2Mb/s on average into the network. The network capacity is 2Mb/s. Explain *two* performance metrics that may change (and how they change), if the hosts send at a total of 3/1Mb/s.

Answer

If the hosts increase their sending rate, then the queuing delay will increase and the packet loss will increase. (And the opposite if the hosts decrease their sending rate.