Spring 24, CS 3611: Computer Networks

Solution to Homework 4

Solution to problem 1

1. No, you can only transmit one packet at a time over a shared bus.
2. No, only one memory read/write can be done at a time over the shared system bus.
3. No, in this case the two packets would have to be sent over the same output bus at the same time, which is not possible.

Solution to problem 2

1.

Destination Prefix	Link Interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3

2.

Destination Prefix	Link Interface
11100000 00 (224.0/10)	0
11100000 01000000 (224.64/16)	1
1110000 (224/7)	2
11100001 1 (225.128/9)	3
otherwise	3

3.

Destination Prefix	Link Interface
11000000 00010001 01010001 01010101	3 (matching 5^{th} entry)
11100000 01000000 11000011 00111100	1 (matching 2^{nd} entry)
11100001 10000000 00010001 01110111	3 (matching 4^{th} entry)
11001000 10010001 01010001 01010101	3 (matching 5^{th} entry)

Solution to problem 3

1. Subnet A: 214.20.255/24 (256 addresses)

   Subnet B: 214.20.254.0/25 - 214.20.254.0/29 (128-8 = 120 addresses)

   Subnet C: 214.20.254.128/25 - 214.20.254.128/29 (128-8 = 120 addresses)

   Subnet D: 214.20.254.0/31 (2 addresses)

   Subnet E: 214.20.254.2/31 (2 addresses)

   Subnet F: 214.20.254.4/31 (2 addresses)

2. To simplify the solution, assume that no datagrams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upper-left interior subnets, respectively.

Router 1

Longest Prefix Match	Outgoing Interface
11010110 00010100 11111111	Subnet A
11010110 00010100 11111110 0000000	Subnet D
11010110 00010100 11111110 0000010	Subnet F

Router 2

Longest Prefix Match	Outgoing Interface
11010110 00010100 11111111 0000000	Subnet D
11010110 00010100 11111110 0	Subnet B
11010110 00010100 11111110 0000001	Subnet E

Router 3

Longest Prefix Match	Outgoing Interface
11010110 00010100 11111111 0000010	Subnet F
11010110 00010100 11111110 0000001	Subnet E
11010110 00010100 11111110 1	Subnet C

Solution to problem 4

The reasons for replacing IPv4 with IPv6 include but not limited to:

- To provide more IP addresses, IPv6 have larger IP address space.
- To simplify the IP header and speed up the routing processing.
- To support more features, including QoS, IP security etc.

Solution to problem 5

If the rate at which packets arrive to the fabric exceeds switching fabric rate, then packets will need to queue at the input ports. If this rate mismatch persists, the queues will get larger and larger and eventually overflow the input port buffers, causing packet loss. Packet loss can be eliminated if the switching fabric speed is at least n times as fast as the input line speed, where n is the number of input ports.

Solution to problem 6

Assuming input and output line speeds are the same, packet loss can still occur if the rate at which packets arrive to a single output port exceeds the line speed. If this rate mismatch persists, the queues will get larger and larger and eventually overflow the output port buffers, causing packet loss. Note that increasing switch fabric speed cannot prevent this problem from occurring.

Solution to problem 7 The maximum size of data field in each fragment = 768 (because there are 20 bytes IP header). Thus the number of required fragments = $\lceil \frac{2000-20}{768} \rceil = 3$. Each fragment will have Identification number 432. Each fragment except the last one will be of size 788 bytes (including IP header). The last datagram will be of size 464 bytes (including IP header). The offsets of the 4 fragments will be 0, 96, 192. Each of the first 2 fragments will have flag=1; the last fragment will have flag=0.

Solution to problem 8

network	network prefix	network mask	network	network prefix	network mask
LAN0	206.0.64.0	255.255.255.255	LAN7	206.0.66.128	255.255.255.192
LAN1	206.0.64.0	255.255.255.128	LAN8	206.0.66.192	255.255.255.192
LAN2	206.0.64.128	255.255.255.128	LAN9	206.0.67.0	255.255.255.192
LAN3	206.0.65.0	255.255.255.128	LAN10	206.0.67.64	255.255.255.192
LAN4	206.0.65.128	255.255.255.128	LAN11	206.0.67.128	255.255.255.192
LAN5	206.0.66.0	255.255.255.192	LAN12	206.0.67.192	255.255.255.192
LAN6	206.0.66.64	255.255.255.192			

Solution to problem 9

a) TCP slow start is operating in the intervals [1,6] and [23,26]

b) After the 16th transmission round, packet loss is recognized by a triple duplicate ACK. If there was a timeout, the congestion window size would have dropped to 1.

c) After the 22nd transmission round, segment loss is detected due to timeout, and hence the congestion window size is set to 1.

d) The threshold is initially 32, since it is at this window size that slow start stops and congestion avoidance begins.

e) The threshold is set to half the value of the congestion window when packet loss is detected. When loss is detected during transmission round 16, the congestion windows size is 42. Hence the threshold is 21 during the 19th transmission round.

f) The threshold is set to half the value of the congestion window when packet loss is detected. When loss is detected during transmission round 22, the congestion windows size is 28. Hence the threshold is 14 during the 23th transmission round.

g) During the 1st transmission round, packet 1 is sent; packet 2-3 are sent in the 2nd transmission round; packets 4-7 are sent in the 3rd transmission round; packets 8-15 are sent in the 4th transmission round; packets 16-31 are sent in the 5th transmission round; packets 32-63 are sent in the 6th transmission round; packets 64 – 96 are sent in the 7th transmission round. Thus packet 90 is sent in the 7th transmission round.

h) The congestion window and threshold will be set to half the current value of the congestion window (8) when the loss occurred. Thus the new values of the threshold and window will be 4.

i) Threshold is 21, and congestion window size of 17th round is reset 1 then do slow start, so the congestion window size of 20th round is 8.