Hwk 4 Answers

Chapter 4

1. **KR, #R2**
   The main function of the data plane is packet forwarding, which is to forward datagrams from their input links to their output links. For example, the data plane's input ports perform physical layer function of terminating an incoming physical link at a router, perform link-layer function to interoperate with the link layer at the other side of the incoming link, and perform lookup function at the input ports.

   The main function of the control plane is routing, which is to determine the paths a packet takes from its source to its destination. A control plane is responsible for executing routing protocols, responding to attached links that go up or down, communicating with remote controllers, and performing management functions.

2. **KR, #R6**
   Input port, switching fabric, and output ports are implemented in hardware, because their datagram-processing functionality is far too fast for software implementation. A routing processor inside a traditional router uses software for executing routing protocols, maintaining routing tables and attached link state information, and computing the forwarding table of a router. In addition, a routing processor in a SDN router also relies on software for communication with a remote controller in order to receive forwarding table entries and install them in the router's input ports.
   Data plane is usually implemented in hardware due to the requirement of fast processing, e.g., at nanosecond time scale. Control plane is usually implemented in software and operates at the millisecond or second timescale, for example, for executing routing protocols, responding to attached links that go up or down, communicating with remote controllers, and performing management functions.

3. **KR, #R14**
   (A typo in this question: the first question mark should be replaced by a period). Only FIFO can ensure that all packets depart in the order in which they arrived.

4. **KR, #R25**
   50% overhead.

5. **KR, #P2**
   a) No, you can only transmit one packet at a time over a shared bus.

b) No, as discussed in the text, only one memory read/write can be done at a time over the shared system bus.
c) 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.

6. **KR, #P7**
   Link Interface 0
   11000000
   through (32 addresses)
   11011111

   Link Interface 1
   10000000
   through(64 addresses)
   10111111

   Link Interface 2
   11100000
   through (32 addresses)
   11111111

   Link Interface 3
   00000000
   through (128 addresses) 01111111

7. **KR, #P8**
   223.1.17.0/26 223.1.17.128/25 223.1.17.192/28

8. **KR, #P15**
   MP3 file size = 5 million bytes. Assume the data is carried in TCP segments, with each TCP segment also having 20 bytes of header. Then each datagram can carry 1500-40=1460 bytes of the MP3 file
   Number of datagrams required: ceil((5x10^6)/1460) = 3425
   All but the last datagram will be 1,500 bytes; the last datagram will be 960+40 = 1000 bytes. Note that here there is no fragmentation – the source host does not create datagrams larger than 1500 bytes, and these datagrams are smaller than the MTUs of the links.

9. **KR, #P18**
   It is not possible to devise such a technique. In order to establish a direct TCP connection between Arnold and Bernard, either Arnold or Bob must initiate a

connection to the other. But the NATs covering Arnold and Bob drop SYN packets arriving from the WAN side. Thus neither Arnold nor Bob can initiate a TCP connection to the other if they are both behind NATs.