

Solutions to Sample Questions

1) What are some of the possible services that a link-layer protocol can offer to the network layer? Which of these link-layer services have corresponding services in IP and TCP?

Answer: framing: there is also framing in IP and TCP; link access; reliable delivery: there is also reliable delivery in TCP; flow control: there is also flow control in TCP; error detection: there is also error detection in IP and TCP; error correction; full duplex: TCP is also full duplex.

2) Show by a virtue of an example other than the one in Figure 5.6 of the textbook that two-dimensional parity checks can correct and detect a single bit error. Also, show an example of a double-bit error that can be detected but not corrected.

Answer: Suppose we begin with the initial two-dimensional parity matrix:

```
0000
1111
0101
1010
```

With a bit error in row 2, column 3, the parity of row 2 and column 3 is now wrong in the matrix below:

```
0000
1101
0101
1010
```

Now, suppose there is a bit error in row 2, column 2 and column 3. The parity of row 2 is now correct! The parity of columns 2 and 3 is wrong, but we can't detect in which rows the error occurred!

```
0000
1001
0101
1010
```

The above example shows that a double bit error can be detected (if not corrected).

3) Why would the token passing protocol be inefficient if a LAN had a very large perimeter?

Answer: When a node transmits a frame, the node has to wait for the frame to

propagate around the entire ring before the node can release the token. Thus, if L/R is small as compared to T_{prop} , then the protocol will be inefficient.

4) How big is the MAC address space, the IPv4 address space and the IPv6 address space?

Answer: 2^{48} MAC addresses; 2^{32} IPv4 addresses; 2^{128} IPv6 addresses.

5) Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?

Answer: An ARP query is sent in a broadcast frame because the querying host does not know which adapter address corresponds to the IP address in question. For the response, the sending node knows the adapter address to which the response should be sent, so there is no need to send a broadcast frame (which would have to be processed by all the other nodes on the LAN).

6) In CSMA/CD, after the fifth collision, what is the probability that a node chooses $K=4$? The result $K=4$ corresponds to a delay of how many seconds on a 10Mbps Ethernet?

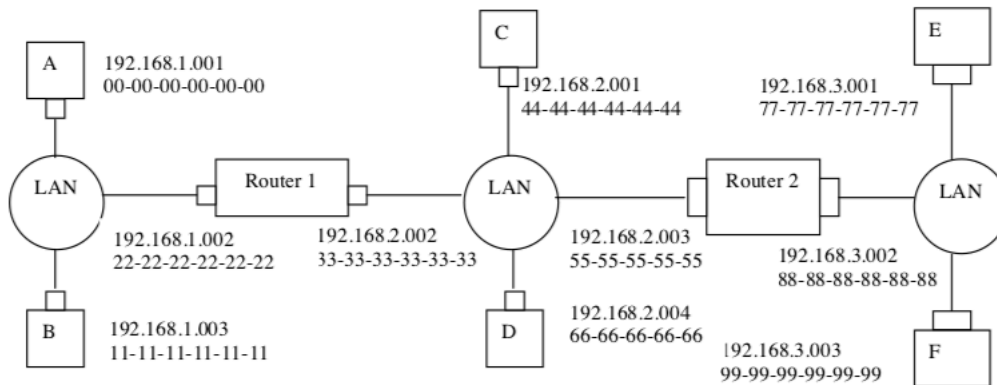
Answer: After the 5th collision, the adapter chooses from $\{0, 1, 2, \dots, 31\}$. The probability that it chooses 4 is $1/32$. It waits 204.8 microseconds.

7) Suppose nodes A, B and C each attach to the same broadcast LAN through their adapters. If A sends thousands of IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C's adapter *process* these frames? If so, will C's adapter *pass* the IP datagrams in these frames to C (that is, the adapter's parent node)? How would your answers change if A sent frames with the MAC broadcast address?

Answer: C's adapter will process the frames, but the adapter will not pass the datagrams up the protocol stack. If the LAN broadcast address is used, then C's adapter will both process the frames and pass the datagrams up the protocol stack.

Answer 8:

a and b)



c)

1. Forwarding table in E determines that the datagram should be routed to interface 192.168.3.002.
2. The adapter in E creates an Ethernet packet with Ethernet destination address 88-88-88-88-88-88.
3. Router 2 receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 198.162.2.002.
4. Router 2 then sends the Ethernet packet with the destination address of 33-33-33-33-33-33 and source address of 55-55-55-55-55-55 via its interface with IP address of 198.162.2.003.
5. The process continues until the packet has reached Host B.

d)

ARP in E must now determine the MAC address of 198.162.3.002. Host E sends out an ARP query packet within a broadcast Ethernet frame. Router 2 receives the query packet and sends to Host E an ARP response packet. This ARP response packet is carried by an Ethernet frame with Ethernet destination address 77-77-77-77-77-77.