Solutions to Practice Problems

Practice Problem 11.1

Suppose an application entity generates 2904 bytes of data. Suppose also that by the time this data arrives at the data link layer, 96 bytes of header information has been added. At the data link layer, the maximum frame size is 1518 bytes, of which 18 bytes are its header. (a) How many frames will be used? (b) How many total bytes must be transmitted? (c) What percentage of the transmitted bits are from the application layer?

Solution:

(a) \(2904 + 96 = 3000\) bytes arrive at the data link layer. Now, within each frame, only 1518 of these 3000 bytes can be sent (a data link layer's payload contains \(1518 - 18 = 1500\) bytes). \(3000 / 1500 = 2\) frames. So, two frames must be sent.

(b) Each Data Link Layer frame still needs its header, so when sending 2 frames, the header needs to be added to each frame, so the total bytes sent will be \(2 \times 1518 = 3036\) bytes total.

(c) \(2904 \text{ bytes of data} / 3026 \text{ bytes total} = 0.96 = 96\%\)

Practice Problem 11.2

Let’s consider the same problem, this time with 2905 bytes of data generated at the application layer. Suppose also that by the time this data arrives at the data link layer, 96 bytes of header information has been added. At the data link layer, the maximum frame size is 1518 bytes, of which 18 bytes are its header. (a) How many frames will be used? (b) How many total bytes must be transmitted? (c) What percentage of the transmitted bits are from the application layer?

Solution:

(a) \(2905 + 96 = 3001\) bytes arrive at the data link layer. Now, within each frame, only 1518 of these 3001 bytes can be sent (a data link layer's payload contains \(1518 - 18 = 1500\) bytes). \(3001 / 1500 = 2.000666666666667\). So, three frames must be sent.

(b) Each Data Link Layer frame still needs its header, so when sending 3 frames, the header needs to be added to each frame, so the total bytes sent will be \(3 \times 1518 = 4,554\) bytes total.

(c) \(2905 \text{ bytes of data} / 4554 \text{ bytes total} = 0.6379007465963988 \approx 64\%\)

Practice Problem 11.3

You caught one of your crewmembers attempting to gamble online on one of your ship's computers. After putting him on report, he tells you that the computer did not seem to be working. For each of the network problems below, state which layer of the TCP/IP model the problem resides in.

(a) Our computer cannot communicate with a website due to an error in the routing algorithm used by an intermediate node.

(b) Our computer cannot communicate with a website because your crewmember spilled his drink on the cable adapter, causing a short.

(c) Our computer cannot communicate with a website due to the fact that the two users (us and them) are using different end-to-end error control algorithms.

(d) Our computer cannot communicate with a website because we are using the XYZ-encryption algorithm, but the website server is using the (incompatible) ABC-decryption algorithm.
Solution: (a) Network layer  (b) Physical layer  (c) Transport layer  (d) Application layer

Practice Problem 11.4

For the boxes below, fill in the names of the layers for the TCP/IP - 5 layer reference model and then place the appropriate letter in the blank associated with the layer for the proper description of its services.

Layer 5
Layer 4
Layer 3
Layer 2
Layer 1

a) Provides a definition of mechanical and electrical standards for communication system
b) Concerned with transferring packets across a communication network
c) Responsible for end to end transfer of data
d) Primary function is to format and transfer files between communication message and the user’s software
e) Frames of data are transferred across a single link

Solution:

From top to bottom:

Application – d  Transport – c  Network – b  Data Link – e  Physical – a