Solutions to exercise 3 in EITF25 Internet - Techniques and Applications - 2013

October 26, 2013

1

a

The total length of an minimal Ethernet frame is 72bytes. The minimum payload is 46 bytes, thus, $\frac{46 \text{ bytes}}{72 \text{ bytes}} = 64.0\%$ of the frame is payload.

Answer: 64.0%

b

The total length of an maximum Ethernet frame is 1526bytes. Moreover, the maximum payload is 1500 bytes, thus, $\frac{1500 \text{ bytes}}{1526 \text{ bytes}} = 98.0\%$ of the frame is payload.

Answer: 98.0%

2

a

The speed of light in vacuum c = 299792458m/s. As the propagation speed is 60 % of c it will take $\frac{2500 \text{ m}}{0.6 \cdot 299792458 \text{ m/s}} = 13.898$ microseconds for the signal to propagate the distance.

Answer: $13.9\mu s$

b

In CSMA CD, the maximal time for detecting a collision is the roundtrip time for a frame.

Answer: $27.8\mu s$

c

As established in problem 1 a), the minimal ethernet frame size is 72 bytes, as such sending $72 \cdot 8 = 576$ bits takes $\frac{576 \text{ bits}}{10(Mbps)} = 57.6$ microseconds.

Answer: $57.6\mu s$

d

In problem 2 b), we established that the maximum collision detection time on the link is $27.8\mu s$. We can thus conclude that given a transmission speed of 10 Mbps we need at least $27.8\mu s \cdot 10\text{Mbps} = 278$ bits to fill that time. Recall that in CSMA CD the sender only detects a collision while it is transmitting.

Answer: 278 bits

3

a

The specified token ring has a capacity of 16 Mbps, thus it will take $\frac{3 \text{ bits}}{16\text{Mbps}} = 0.19$ microseconds to transmit the 3 bits that make up the token flag.

Answer: $0.19\mu s$

b

The ring will be occupied for $0.19\mu s$ while the token is transmitted. Furthermore, the link thus need to be $\frac{3 \text{ bits}}{16 \text{ Mbps}} \cdot 0.6 \cdot c$ m/s $= 34$ meters long so that the transmitter is given enough time for its transmission to finish before it has propagated back to it.

Answer: 34 meters

4

The preamble and the SFD have been removed from the header, leaving the destination address (DA) and sender address (SD) at the front, with 6 bytes each.

a

The first consecutive 6 bytes represent the DA.

Answer: 08:00:20:7C:94:1C

b

The second consecutive 6 bytes represent the SA.

Answer: 00:00:39:51:90:37

IEEE 802.11b frame structure and RTS/CTS specifications

The 802.11b frame structure in Figure 1 is not present needed to solve problems 5 through 7.

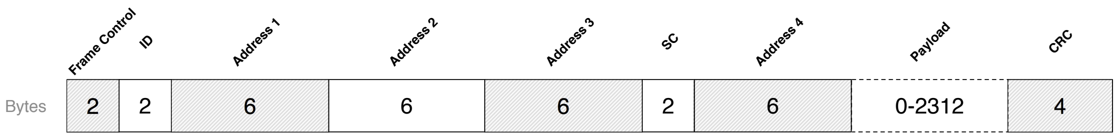

Figure 1: 802.11 frame structure

Additionally, Table 1 details the parameters in the 802.11b collision avoidance system.

Segment	Size	T_x time
DIFS	-	50 μs
SIFS	-	10 μs
RTS	160 bits	14.45 μs
CTS	112 bits	10.18 μs
ACK	112 bits	10.18 μs

Table 1: Transmission events

5

In 802.11b, the DIFS is $50\mu s$ and SIFS is $10\mu s$. The size of an RTS frame is 20 bytes, the CTS and ACK frames are made up of 14 bytes each. Furthermore, an arbitrary sequence of 1000 bytes, fits into one 802.11b frame (see Figure 1) of a total of 1034 bytes. The theoretical maximum transmission rate of 802.11b is 11 Mbps. The transmission will adhere to the sequence in Figure 2.

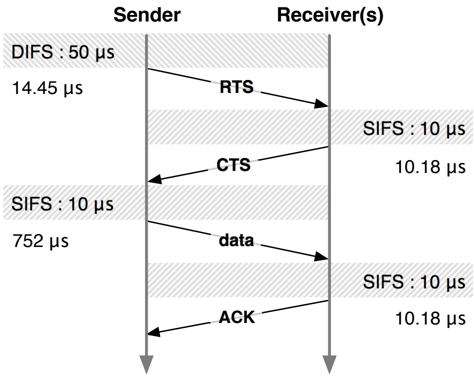

Figure 2: Transmission sequence

Aggregating the information in Table 1 and Figure 2 yields a total transmission time of 867 μs.

Answer: 867 μs

6

This problem builds on the findings and rationale in problem 5. However, in this instance the the packet is smaller, only 64 bytes, or 512 bits. Additionally, instead of a random time between frames we use a standard DIFS delay.

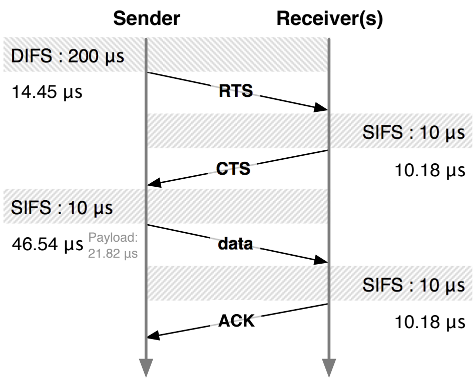

Figure 3: Transmission sequence

Following the sequence in Figure 3 yields a total transmission time of $311.35\mu s$ per frame. Referring to Figure 1, if a frame is 64 bytes long it holds 30 bytes of payload. The time spent sending the payload is thus $\frac{30 \cdot 8 \text{ bits}}{11\text{Mbps}} = 21.82\mu s$. As a result, $\frac{21.82\mu s}{311.35\mu s} = 7\%$ of the total transmission time is spent on the payload. Nevertheless, for every 311.35 μs we spend transmitting we purvey $30 \cdot 8 = 240$ bits of data, consequent our payload or effective transmission rate is $\frac{240 \text{ bits}}{311.35\mu s} = 0.77$ Mbps.

Answer: 0.77 Mbps

7

This problem builds on the findings in problems 5 and 6. For simplicity sake, we assume that the bit error is limited to the data frame.

a

With a bit error probability of 0.1% a fame has a $1 - (1 - 0.001)^{512} = 40.1\%$ chance of being corrupt.

Answer: 40.1 %

b

A frame will arrive successfully after $\frac{1}{1-0.401} = 1.67$ attemps.

Answer: 1.67 times

c

The resulting bitrate is thus $\frac{0.77\text{Mbps}}{1.67} = 0.46$ Mbps.

Answer: 0.46 Mbps

8

The class is determined by the range of the first octet.

Class	First octet range
A	1-126
B	128-191
C	192-223
D	224-239
E	240-255

Table 2: IP class vs. first octet

a

As according to Table 2.

Answer: C

b

As according to Table 2.

Answer: D

c

As according to Table 2.

Answer: A

d

As according to Table 2.

Answer: B

e

As according to Table 2.

Answer: E

9

a

The address is of class A, as such the first 8 bits remark the net ID, leaving the remaining 24 bit to the represent the host ID.

Answer:
Net ID : 114.0.0.0
Host ID : 0.34.2.8

b

The address is of class B, as such the first 16 bits remark the net ID, leaving the remaining 16 bit to the represent the host ID.

> **Answer**:
> Net ID : 171.34.0.0
> Host ID : 0.0.14.8

c

The address is of class C, as such the first 24 bits remark the net ID, leaving the remaining 8 bit to the represent the host ID.

> **Answer**:
> Net ID : 192.8.56.0
> Host ID : 0.0.0.2

10

a

The mask splits the class-less IP address into two identifiers.

> **Answer**:
> Net ID : 130.235.0.0
> Host ID : 0.0.185.49

b

Converting the decimal address to binary yields:

Address	`10000010.11101011.10111100.11110111`
net ID mask	`11111111.11111111.11000000.00000000`
net ID	`10000010.11101011.10000000.00000000`

The above sum yields a net ID of 130.235.128.0 Conversely, we retrieve the host ID by inverting the mask, as seen below:

Address	`10000010.11101011.10111100.11110111`
host ID mask	`00000000.00000000.00111111.11111111`
host ID	`00000000.00000000.00111100.11110111`

Which yields a host ID of 0.0.60.247. As you may have noticed you only need to tend to the 2-byte address + mask segments where the mask is greater than one and less that 255.

> **Answer**:
> Net ID : 130.235.128.0
> Host ID : 0.0.60.247

c

Similarly. Here the mask is only interesting at the 3^{rd} 2-byte segment.

> **Answer**:
> Net ID : 120.14.0.0
> Host ID : 0.0.22.16

d

Similarly. Here the mask is only interesting at the 3^{rd} 2-byte segment.

> **Answer**:
> Net ID : 141.181.0.0
> Host ID : 0.0.14.16

11

a

I the /n notation, n is the length of the mask in bits. For example, the mask, 255.128.0.0 $\rightarrow$ 11111111.1000000.00000000.00000000 has 9 bits, and can thus be expressed as /9.

a

The mask i represented by $8 \cdot 3 = 24$ bits.

> **Answer**: /24

b

8 bits represent the mask.

> **Answer**: /8

c

Following the reasoning in the sample above, 19 bits.

> **Answer**: /19

d

Following the reasoning in the sample above, 20 bits.

> **Answer**: /20

12

Stateless IP address mask specifications.

a

27 net ID bits leaves 5 bits to represent $2^5 = 32$ host addresses.

Answer: 32

b

23 net ID bits leaves 5 bits to represent $2^9 = 512$ host addresses.

Answer: 512

c

30 net ID bits leaves 5 bits to represent $2^2 = 4$ host addresses.

Answer: 4

d

29 net ID bits leaves 5 bits to represent $2^3 = 8$ host addresses.

Answer: 8

13

a

Leading consecutive zeros can be concatenated.

$$\text{3440:1ABC:119A:A000:}\underline{\text{0000:0000:0000}}\text{:0001}$$

Answer: 3440:1ABC:119A:A000::1

b

Following the same reasoning as above yields.

$$\underline{\text{000}}\text{0:}\underline{\text{00}}\text{AA:}\underline{\text{0000:0000:0000:0000}}\text{:119A:A231}$$

Answer: 0:AA::119A:A231

c

Following the same reasoning as above yields.

2340:0000:0000:0000:0000:119A:A001:0000

Answer: 2340::119A:A001:

d

Following the same reasoning as above yields.

0000:0000:8000:2340:0000:0000:0000:0000

Answer:
0:0:8000:2340:

14

a

Follow the reverse reasoning in problem 13.

Answer: 0000:0000:0000:0000:0000:0000:0000:0000

b

Follow the reverse reasoning in problem 13.

Answer: 0000:00AA:0000:0000:0000:0000:0000:0000

c

Follow the reverse reasoning in problem 13.

Answer: 0000:1234:0000:0000:0000:0000:0000:0003

d

Follow the reverse reasoning in problem 13.

Answer: 0123:0000:0000:0000:0000:0000:0001:0002