TSIN02 Internetworking

Exercise class 1 solutions

Exercise 1: Assume that the minimum frame size is 65 bytes or 520 bits. We have L = T x R, where L is the length of the frame, T is the time, and the R is the data rate. We can say, T = L / R. The time can be calculated as

T = L / R = (520 bits) / (10,000,000) bits/second = 0.000052 s = 52 μs

Exercise 2: The padding needs to make the size of the data section 46 bytes. If the data received from the upper layer is 42 bytes, we need 46 - 42 = 4 bytes of padding.

Exercise 3: a. Similarities:
Each station has an equal right to the medium.
Each station senses the medium.

b. Differences:
CSMA/CD: A station can send if it senses no signal on the line.
CSMA/CA: A station needs to inform other stations that it needs the medium
for a specific amount of time.
CSMA/CD: A collision can occur.
CSMA/CA: Collisions are avoided.

Exercise 4: One advantage and one disadvantage for a connectionless service:
a. The connectionless service has at least one advantage. A connectionless service is simple. The source, destination, and the routers need to deal with each packet individually without considering the relationship between them. This means there are no setup and teardown phases. No extra packets are exchanged between the source and the destination for these two phases.
b. The connectionless service has at least one disadvantage. The packets may arrive out of order; the upper layer that receive them needs to reorder them.

Exercise 5: The delay in the connection-oriented service is always more than the delay in the connectionless service no matter the message is long or short. However, the ratio of the overhead delay (setup and teardown phases) to the data transfer delay (transmission and propagation) is smaller for a long message than a short message in a connection-oriented service.

Exercise 6: A router is normally connected to different link (networks), each with different MTU. The link from which the packet is received may have a larger MTU than the link to which the packet is sent, which means that router needs to fragment the packet. IPv6 does not allow fragmentation at the router, which means the source needs to do some investigation and make the packet small enough to be carried through all links.

Exercise 7: We can subtract the first address from the last address in base 256. The result is 0.0.3.255 in this base. To find the number of addresses in the range (in decimal), we convert this number to base 10 and add 1 to the result.

Number of addresses = $(0 \times 256^3 + 0 \times 256^2 + 3 \times 256^1 + 255 \times 256^0) + 1 = 1024$.

Exercise 8: a) $2^8 = 256$ addresses

b) $2^{16} = 65536$ addresses

c) $2^{64} = 1.846744737 \times 10^{19}$ addresses

Exercise 9: $3^{10} = 59,049$ addresses

Exercise 10: a) 1, b) 6, c) 7, d) 8

Exercise 11: a) $\log_2 1024 = 10$, Extra 1s = 10, possible subnets: 1024, Mask: /26

b) $2^{32-26} = 64$ addresses in each subnet

c) First subnet:
the first address in subnet 1: 130.56.0.0.
To find the last address, we need to write 63 (one less than the number of addresses in each subnet) in base 256 (0.0.0.63) and add it to the first address (in base 256).
last address in subnet 1: 130.50.0.63.

d) Last subnet (Subnet 1024):
To find the first address in subnet 1024, we need to add 65,472 (1023 x 64) in base 256 (0.0.255.92) to the first address in subnet 1.
the first address in subnet 1024: 130. 56. 255.192.
Now we can calculate the last address in subnet 1024 as we did for the first address.
last address in subnet 500: 130.56.255.255.

Exercise 12: If the first and the last addresses are known, the block is fully defined. We can first find the number of addresses in the block. We can then use the relation

$$N = 2^{32} \longrightarrow n = 32 - \log_2 N$$

to find the prefix length. For example, if the first address is **17.24.12.64** and the last address is **17.24.12.127**, then the number of addresses in the block is 64. We can find the prefix length as

$n = 32 - \log_2 N = 32 - \log_2 64 = 26$

The block is then 72.24.12.64/26.

Exercise 13: Many blocks can have the same prefix length. The prefix length only determines the number of addresses in the block, not the block itself. Two blocks can have the same prefix length but start in two different points in the address space. For example, the following two blocks

127.15.12.32/27 174.18.19.64/27

have the same prefix length, but they are definitely two different blocks. The length of the blocks are the same, but the blocks are different.

Exercise 14: **Group 1**

For this group, each customer needs 128 addresses. This means the suffix length is $\log_2 128 = 7$. The prefix length is then 32 - 7 = 25. The range of addresses are given for the first, second, and the last customer. The range of addresses for other customers can be easily found:

1st customer: 150.80.0.0/25 to 150.80.0.127/25
2nd customer: 150.80.0.128/25 to 150.80.0.255/25
....
200th customer: 150.80.99.128/25 to 150.80.99.255/25

Total addresses for group 1 = 200 x 128 = 25,600 addresses

Group 2

For this group, each customer needs 16 addresses. This means the suffix length is $\log_2 16 = 4$. The prefix length is then 32 - 4 = 28. The addresses are:

1st customer: 150.80.100.0/28 to 150.80.100.15/28
2nd customer: 150.80.100.16/28 to 150.80.100.31/28
....
400th customer: 150.80.124.240/28 to 150.80.124.255/28

Total addresses for group 2 = 400 x 16 = 6400 addresses

Group 3

For this group, each customer needs 4 addresses. This means the suffix length is $\log_2 4 = 2$. The prefix length is then 32 - 2 = 30. The addresses are:

1st customer: 150.80.125.0/30 to 150.80.125.3/30
2nd customer: 150.80.125.4/30 to 150.80.125.7/30
....
64th customer: 150.80.125.252/30 to 150.80.125.255/30
65th customer: 150.80.126.0/30 to 150.80.126.3/30
....
2000th customer: 150.80.156.252/30 to 150.80.156.255/30

Total addresses for group 3 = 2048 x 4 = 8192 addresses
Number of allocated addresses: 40,192
Number of available addresses: 25,344