
CHAPTER 19

Network Layer: Logical Addressing

Solutions to Odd-Numbered Review Questions and Exercises

Review Questions

1. An *IPv4* address is **32** bits long. An *IPv6* address is **128** bits long.
3. *Classful addressing* assigns an organization a Class A, Class B, or Class C block of addresses. *Classless addressing* assigns an organization a block of contiguous addresses based on its needs.
5. A *block in class A* address is *too large* for almost any organization. This means most of the addresses in class A are wasted and not used. A *block in class C* is probably *too small* for many organizations.
7. The *network address* in a block of addresses is the first address. The *mask* can be **ANDed** with any address in the block to find the network address.
9. Multicast addresses in *IPv4* are those that start with the **1110** pattern. Multicast addresses in *IPv6* are those that start with the **11111111** pattern.

Exercises

11.
 - a. $2^8 = 256$
 - b. $2^{16} = 65536$
 - c. $2^{64} = 1.846744737 \times 10^{19}$
13. $3^{10} = 59,049$
15.
 - a. **127.240.103.125**
 - b. **175.192.240.29**
 - c. **223.176.31.93**
 - d. **239.247.199.29**
17.
 - a. **Class E** (first four bits are 1s)
 - b. **Class B** (first bit is 1 and second bit is 0)

- c. **Class C** (first two bits are 1s and the third bit is 0)
 d. **Class D** (first three bits are 1s and the fourth bit is 0)
19. With the information given, the first address is found by ANDing the host address with the mask 255.255.0.0 (/16).

Host Address:	25	.	34	.	12	.	56
Mask (ANDed):	255	.	255	.	0	.	0
Network Address (First):	25	.	34	.	0	.	0

The last address can be found by ORing the host address with the mask complement 0.0.255.255.

Host Address:	25	.	34	.	12	.	56
Mask Complement (ORed):	0	.	0	.	255	.	255
Last Address:	25	.	34	.	255	.	255

However, we need to mention that this is the largest possible block with 2^{16} addresses. We can have many small blocks as long as the number of addresses divides this number.

- 21.
- a. $\log_2 500 = 8.95$ Extra 1s = 9 Possible subnets: **512** Mask: **/17** (8+9)
 b. $2^{32-17} = 2^{15} = \mathbf{32,768}$ Addresses per subnet
 c. **Subnet 1:** The first address in this address is the beginning address of the block or **16.0.0.0**. To find the last address, we need to write 32,767 (one less than the number of addresses in each subnet) in base 256 (0.0.127.255) and add it to the first address (in base 256).

First address in subnet 1:	16	.	0	.	0	.	0
Number of addresses:	0	.	0	.	127	.	255
Last address in subnet 1:	16	.	0	.	127	.	255

d. **Subnet 500:**

Note that the subnet 500 is not the last possible subnet; it is the last subnet used by the organization. To find the first address in subnet 500, we need to add 16,351,232 (499×32678) in base 256 (0.249.128.0) to the first address in subnet 1. We have $16.0.0.0 + 0.249.128.0 = \mathbf{16.249.128.0}$. Now we can calculate the last address in subnet 500.

First address in subnet 500:	16	.	249	.	128	.	0
Number of addresses:	0	.	0	.	127	.	255
Last address in subnet 500:	16	.	249	.	255	.	255

23.

- a. $\log_2 32 = 5$ Extra 1s = **5** Possible subnets: **32** Mask: **/29** (24 + 5)
 b. $2^{32-29} = \mathbf{8}$ Addresses per subnet

c. **Subnet 1:**

The first address is the beginning address of the block or **211.17.180.0**. To find the last address, we need to write 7 (one less than the number of addresses in each subnet) in base 256 (0.0.0.7) and add it to the first address (in base 256).

First address in subnet 1:	211	.	17	.	180	.	0
Number of addresses:	0	.	0	.	0	.	7
Last address in subnet 1:	211	.	17	.	180	.	7

d. **Subnet 32:**

To find the first address in subnet 32, we need to add 248 (31×8) in base 256 (0.0.0.248) to the first address in subnet 1. We have $211.17.180.0 + 0.0.0.248$ or **211.17.180.248**. Now we can calculate the last address in subnet 32 as we did for the first address.

First address in subnet 32:	211	.	17	.	180	.	248
Number of addresses:	0	.	0	.	0	.	7
Last address in subnet 32:	211	.	17	.	180	.	255

25.

- a. The number of address in this block is $2^{32-29} = 8$. We need to add 7 (one less) addresses (0.0.0.7 in base 256) to the first address to find the last address.

From:	123	.	56	.	77	.	32
	0	.	0	.	0	.	7
To:	123	.	56	.	77	.	39

- b. The number of address in this block is $2^{32-27} = 32$. We need to add 31 (one less) addresses (0.0.0.31 in base 256) to the first address to find the last address.

From:	200	.	17	.	21	.	128
	0	.	0	.	0	.	31
To:	200	.	17	.	21	.	159

- c. The number of address in this block is $2^{32-23} = 512$. We need to add 511 (one less) addresses (0.0.1.255 in base 256) to the first address to find the last address.

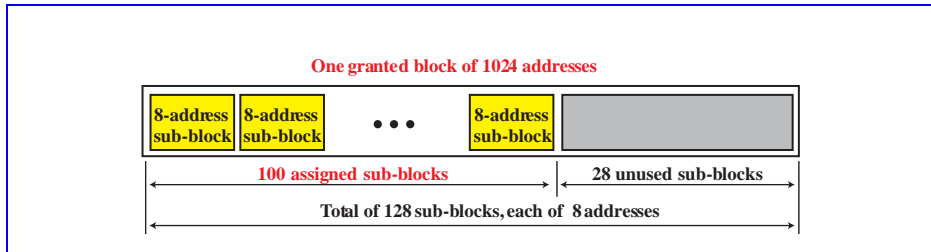
From:	17	.	34	.	16	.	0
	0	.	0	.	1	.	255
To:	17	.	34	.	17	.	255

- d. The number of address in this block is $2^{32-30} = 4$. We need to add 3 (one less) addresses (0.0.0.3 in base 256) to the first address to find the last address.

From:	180	.	34	.	64	.	64
	0	.	0	.	0	.	3
To:	180	.	34	.	64	.	67

27. The site has $2^{32-22} = 2^{10} = 1024$ from **120.60.4.0/22** to **120.60.7.255/22** addresses. One solution would be to divide this block into **128** 8-address sub-blocks as shown in Figure 19.1. The ISP can assign the first 100 sub-blocks to the current customers and keep the remaining 28 sub-blocks. Of course, this does not mean the future customer have to use 8-address subblocks. The remaining addresses can later be divided into different-size sub-blocks (as long as the three restrictions mentioned in this chapter are followed). Each sub-block has 8 addresses. The mask for each sub-block is **/29** ($32 - \log_2 8$). Note that the mask has changed from /22 (for the whole block) to /29 for each subblock because we have 128 sub-blocks ($2^7 = 128$).

Figure 19.1 Solution to Exercise 27



Sub-blocks:

1st subnet:	120.60.4.0/29	to	120.60.4.7/29
2nd subnet:	120.60.4.8/29	to	120.60.4.15/29
...
32nd subnet:	120.60.4.248/29	to	120.60.4.255/29
33rd subnet:	120.60.5.0/29	to	120.60.5.7/29
...
64th subnet:	120.60.5.248/29	to	120.60.5.255/29
...
99th subnet:	120.60.7.16/29	to	120.60.7.23/29
100th subnet:	120.60.7.24/29	to	120.60.7.31/29

1024 – 800 = **224** addresses left (from **120.60.7.31** to 120.60.7.155)

29.

- a. **2340:1ABC:119A:A000::0**
 b. **0:AA::119A:A231**

- c. **2340::119A:A001:0**
 - d. **0:0:0:2340::0**
- 31.
- a. *Link local address*
 - b. *Site local address*
 - c. *Multicast address* (permanent, link local)
 - d. *Loopback address*
33. **58ABC1**
- 35.
- a. **FE80:0000:0000:0000:0000:0000:0123** or **FE80::123**
 - b. **FEC0:0000:0000:0000:0000:0000:0123** or **FEC0::123**
37. The node identifier is **0000:0000:1211**. Assuming a 32-bit subnet identifier, the subnet address is **581E:1456:2314:ABCD:0000** where **ABCD:0000** is the subnet identifier.

