PATUAKHALI SCIENCE AND TECHNOLOGY UNIVERSITY

COURSE CODE CCE 313
Computer Networks Sessional

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Chapter 5
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Chapter 5: IPv4 Addresses

Exercises

1. What is the address space in each of the following systems?

   a. a system with 8-bit addresses

   Ans: 2^8 = **256 addresses**

   b. a system with 16-bit addresses

   Ans: 2^{16} = **65,536 addresses**

   c. a system with 64-bit addresses

   Ans: 2^{64} = **$1.844674407 \times 10^{19}$ addresses**

2. An address space has a total of 1,024 addresses. How many bits are needed to represent an address?

   Ans: $\log_2(1024)$ = **10 bits**

3. An address space uses three symbols: 0, 1, and 2 to represent addresses. If each address is made of 10 symbols, how many addresses are available in this system?

   Ans: 3^{10} = **59,049 addresses**

4. Change the following IP addresses from dotted-decimal notation to binary notation:

   a. 114.34.2.8

   Ans: 01110010 00100010 00000010 00001000

   b. 129.14.6.8

   Ans: 10000001 00001110 00000110 00001000

   c. 208.34.54.12

   Ans: 11010000 00100010 00110110 00001100

   d. 238.34.2.1

   Ans: 11101110 00100010 00000010 00000001

5. Change the following IP addresses from dotted-decimal notation to hexadecimal notation:

   a. 114.34.2.8

   Ans: 0x72220A

   b. 129.14.6.8

   Ans: 0x810E0608

   c. 208.34.54.12

   Ans: 0xD022360C

   d. 238.34.2.1

   Ans: 0xEE220201

6. Change the following IP addresses from hexadecimal notation to binary notation:

   a. 0x1347FEAB

   Ans: 00010011 01000100 01111110 10101011

   b. 0xAB234102

   Ans: 10101011 00100011 01000001 00000010

   c. 0x0123A2BE

   Ans: 00000001 00100011 10100010 10111110

   d. 0x00001111

   Ans: 00000000 00000000 00010000 00001111

7. How many hexadecimal digits are needed to define the netid in each of the following classes?

   a. Class A

   Ans: 2 hex digits (8 bits)

b. Class B
Ans: 4 hex digits (16 bits)

c. Class C
Ans: 6 hex digits (24 bits)

8. Change the following IP addresses from binary notation to dotted-decimal notation:
   a. 01111111 11110000 01100111 01111101
   Ans: 127.240.103.125

   b. 10101111 11000000 11111000 00011101
   c. 11011111 10110000 00011111 01011101
   d. 11101111 11110111 11000111 00011101

9. Find the class of the following IP addresses:
   a. 208.34.54.12
   Ans: Class C

   b. 238.34.2.1
   Ans: Class D

   c. 242.34.2.8
   Ans: Class E

   d. 129.14.6.8
   Ans: Class B

10. Find the class of the following IP addresses:
    a. 11110111 11110011 10000111 11011101
    Ans: Class E

    b. 10101111 11000000 11110000 00011101
    Ans: Class B

    c. 11011111 10110000 00011111 01011101
    Ans: Class C

    d. 11101111 11110111 11000111 00011101
    Ans: Class D

11. Find the netid and the hostid of the following IP addresses:
    a. 114.34.2.8
    Ans:

Class	Netid	Hostid
A	114	34.2.8

    b. 132.56.8.6
    Ans:

Class	Netid	Hostid
B	132.56	8.6

    c. 208.34.54.12
    Ans:

Class	Netid	Hostid
C	208.34.54	12

d. 251.34.98.5

Ans: It's class E, which doesn't have a defined netid and hostid. Therefore, all bits in a Class E address are used for the network ID, and it is not typically used for standard networking.

12. Find the number of addresses in the range if the first address is 14.7.24.0 and the last address is 14.14.34.255.

Ans: We can subtract the first address from the last address to find the number of addresses in the range.

The result is 0.7.10.255. We convert this number to base 10 and add 1 to it,

Number of addresses = $(0 * 256^3) + (7 * 256^2) + (10 * 256^1) + (255 * 256^0) + 1 = 461568$

13. If the first address in a range is 122.12.7.0 and there are 2048 addresses in the range, what is the last address?

Ans: We convert the number of addresses minus 1 to base 256, which is 0.0.7.255. Then we add this number to the first address,

The last address is (122.12.7.0 + 0.0.7.255) = 122.12.14.255

14. Find the result of each operation:

a. NOT (22.14.70.34)

Ans: 233.241.185.221

b. NOT (145.36.12.20)

Ans: 110.219.243.235

c. NOT (200.7.2.0)

Ans: 55.248.253.255

d. NOT (11.20.255.255)

Ans: 244.235.0.0

15. Find the result of each operation:

a. (22.14.70.34) AND (255.255.0.0)

Ans: 22.14.0.0

b. (12.11.60.12) AND (255.0.0.0)

Ans: 12.0.0.0

c. (14.110.160.12) AND (255.200.140.0)

Ans: 14.70.128.0

d. (28.14.40.100) AND (255.128.100.0)

Ans: 28.0.32.0

16. Find the result of each operation:

a. (22.14.70.34) OR (255.255.0.0)

Ans: 255.255.70.34

b. (12.11.60.12) OR (255.0.0.0)

Ans: 255.11.60.12

c. (14.110.160.12) OR (255.200.140.0)

Ans: 255.238.172.12

d. (28.14.40.100) OR (255.128.100.0)
Ans: 255.142.108.100

17. In a class A subnet, we know the IP address of one of the hosts and the subnet mask as given below:

    ```
    IP Address: 25.34.12.56
    Subnet mask: 255.255.0.0
    ```

    What is the first address (subnet address)? **25.34.0.0**
    What is the last address? **25.34.255.255**

18. In a class B subnet, we know the IP address of one of the hosts and the subnet mask as given below:

    ```
    Address: 131.134.112.66
    Subnet mask: 255.255.224.0
    ```

    What is the first address (subnet address)? **131.134.96.0**
    What is the last address? **131.134.127.255**

19. In a class C subnet, we know the IP address of one of the hosts and the subnet mask as given below:

    ```
    Address: 202.44.82.16
    Subnet mask: 255.255.255.192
    ```

    What is the first address (subnet address)? 202.44.82.0
    What is the last address? 202.44.82.63

20. Find the subnet mask in each case:
    a. 1024 subnets in class A **255.255.192.0**
    b. 256 subnets in class B **255.255.255.0**
    c. 32 subnets in class C **255.255.255.224**
    d. 4 subnets in class C **255.255.255.252**

21. In a block of addresses, we know the IP address of one host is 25.34.12.56/16. What is the first address (network address) and the last address (limited broadcast address) in this block?
    Ans: The first address is 25.34.0.0 and the last address is 25.34.255.255.

22. In a block of addresses, we know the IP address of one host is 182.44.82.16/26. What is the first address (network address) and the last address (limited broadcast address) in this block?
    Ans: The first address is 182.44.82.0 and the last address is 182.44.82.63.

23. In fixed-length subnetting, find the number of 1s that must be added to the mask if the number of desired subnets is _____ .
    a. 2 **Ans:** 1
    b. 62 **Ans:** 6
    c. 122 **Ans:** 7
    d. 250 **Ans:** 8

24. An organization is granted the block 16.0.0.0/8. The administrator wants to create 500 fixed-length subnets.

    1. Find the subnet mask. **Ans:** 255.255.128.0
    2. Find the number of addresses in each subnet. **Ans:** 2^{15}
    3. Find the first and the last address in the first subnet. **Ans:** 16.0.0.0 - 16.0.127.255
    4. Find the first and the last address in the last subnet (subnet 500).
       Ans: 16.249.128.0 - 16.249.255.255

25. An organization is granted the block 130.56.0.0/16. The administrator wants to create 1024 subnets.
    1. Find the subnet mask.
    2. Find the number of addresses in each subnet.
    3. Find the first and the last address in the first subnet.
    4. Find the first and the last address in the last subnet (subnet 1024).

    Ans: same as 24/ check Rising's other solution...

26. An organization is granted the block 211.17.180.0/24. The administrator wants to create 32 subnets.
    1. Find the subnet mask.
    2. Find the number of addresses in each subnet.
    3. Find the first and the last address in the first subnet.
    4. Find the first and the last address in the last subnet (subnet 32).

    Ans: same as 24

27. Write the following mask in slash notation (/n):
    1. 255.255.255.0 **Ans:** /24
    2. 255.0.0.0 **Ans:** /8
    3. 255.255.224.0 **Ans:** /19
    4. 255.255.240.0 **Ans:** /20

28. Find the range of addresses in the following blocks:
    1. 123.56.77.32/29 **Ans:** 123.56.77.32 - 123.56.77.39
    2. 200.17.21.128/27 **Ans:** 200.17.21.128 - 200.17.21.159
    3. 17.34.16.0/23 **Ans:** 17.34.16.0 - 17.34.17.255
    4. 180.34.64.64/30 **Ans:** 180.34.64.64 - 180.34.64.67

29. In classless addressing, we know the first and the last address in the block. Can we find the prefix length? If the answer is yes, show the process and give an example.
    Ans: Yes, we can find the prefix length.
    Process:
    1. Subtract the first address from the last address to find the number of addresses in the block.
    2. Use $n = 32 - \log_2 N$

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

30. In classless addressing, we know the first address and the number of addresses in the block. Can we find the prefix length? If the answer is yes, show the process and give an example. **Ans:** Yes, we can find the prefix length.
    Process:
    1. Use $n = 32 - \log_2 N$

    For example, if the first address is 17.24.12.64 and the number of addresses is 64, then we can find the prefix length as follows:
    $n = 32 - \log_2 N = 32 - \log_2 64 = 26$

31. In classless addressing, can two blocks have the same prefix length? Explain.
    Ans: Yes, two blocks can have the same prefix length.
    Explanation:
    The prefix length indicates the number of bits used for the network portion of the address. Two

different blocks can have the same number of bits allocated for the network portion, resulting in the same prefix length. However, the actual addresses within those blocks will be different.

32. In classless addressing, we know the first address and one of the addresses in the block (not necessarily the last address). Can we find the prefix length? Explain.
Ans: No, we cannot find the prefix length.
Knowing only one address within the block does not provide enough information to determine the size of the block or the number of addresses it contains. Without knowing either the last address or the total number of addresses in the block, we cannot calculate the prefix length.

33. An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to 2600 customers as follows:
    1. The first group has 200 medium-size businesses; each needs approximately 128 addresses.
    2. The second group has 400 small businesses; each needs approximately 16 addresses.
    3. The third group has 2000 households; each needs 4 addresses.

    Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.

    Ans:

    - For the first group (200 medium-size businesses needing 128 addresses each):
        ‣ Each business requires a /25 subnet (128 addresses).
            1. First subnet: 150.80.0.0/25 - 150.80.0.127
            2. Second subnet: 150.80.0.128/25 - 150.80.0.255
            3. Last subnet: 150.80.99.128/25 - 150.80.99.255
        ‣ Total addresses used: 200×128 = 25,600 addresses.

    - For the second group (400 small businesses needing 16 addresses each):
        ‣ Each business requires a /28 subnet (16 addresses).
            1. First subnet: 150.80.100.0/28 - 150.80.100.15
            2. Second subnet: 150.80.100.16/28 - 150.80.100.31
            3. Last subnet: 150.80.124.240/28 - 150.80.124.255
        ‣ Total addresses used: 400×16 = 6,400 addresses.

    - For the third group (2000 households needing 4 addresses each):
        ‣ Each household requires a /30 subnet (4 addresses).
            1. First subnet: 150.80.125.0/30 - 150.80.125.3
            2. Second subnet: 150.80.125.4/30 - 150.80.125.7
            3. 2000th subnet: 150.80.156.60/30 - 150.80.156.63
        ‣ Total addresses used: 2000×4 = 8,000 addresses.

    - Total addresses used: 25,600 + 6,400 + 8,000 = 40,000 addresses.

    - Total addresses available: 65,536 - 40,000 = 25,536 addresses.

34. An ISP is granted a block of addresses starting with 120.60.4.0/20. The ISP wants to distribute these blocks to 100 organizations with each organization receiving 8 addresses only. Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.

    Ans:
    - Each organization requires a /29 subnet (8 addresses).
        1. First subnet: 120.60.4.0/29 - 120.60.4.7
        2. Second subnet: 120.60.4.8/29 - 120.60.4.15

3. Last subnet: 120.60.7.24/29 - 120.60.7.31
- Total addresses used: $100 \times 8 = 800$ addresses.
- Total addresses available: 4096 - 800 = 3296 addresses.

35. An ISP has a block of 1024 addresses. It needs to divide the addresses to 1024 cus-tomers. Does it need subnetting? Explain your answer.
    Ans: No, it does not need subnetting.
    Since the ISP has exactly 1024 addresses and needs to allocate one address to each of its 1024 customers, it can directly assign one address to each customer without the need for subnetting. Each customer can be assigned a unique address from the available block.