Computer networks

Exercises

1. What is the address space in each of the following systems?
a. A system with 8-bit addresses
b. A system with 16-bit addresses
Solution:
a. 2 ^8 = 256
b. 2^ 16 = 65536

2. An address space has a total of 1024 addresses. How many bits are needed to represent an address?
Solution:
2 x = 1024 → x = log base2 1024 = 10

3. Change the following IP addresses from dotted-decimal notation to binary notation.
a. 114.34.2.8
b. 129.14.6.8

Solution:
a.01110010 00100010 00000010 00001000
b.10000001 00001110 00000110 00001000

4. Change the following IP addresses from binary notation to dotted-decimal notation.
a. 01111111 11110000 01100111 01111101
b. 10101111 11000000 11111000 00011101
Solution:
a.127.240.103.125
b.175.192.240.29

5. Find the class of the following IP addresses.
a. 208.34.54.12
b. 238.34.2.1
c. 114.34.2.8

Solution:
a) Class C (first byte is between 192 and 223)
b) Class D (first byte is between 224 and 239)
c) Class A (first byte is between 0 and 127)

6. Find the class of the following IP addresses.
a. 11110111 11110011 10000111 11011101
b. 10101111 11000000 11110000 00011101

Solution:
a. Class E (first four bits are 1s)
b. Class B (first bit is 1 and second bit is 0)

7. Find the netid and the hostid of the following IP addresses.
· a. 114.34.2.8
b. 132.56.8.6

Solution:
netid: 114 hostid: 34.2.8
netid: 132.56 hostid: 8.6

8. In a block of addresses, we know the IP address of one host is 25.34.12.56/16.
What are the first address (network address) and the last address (limited broadcast address) in this block?
Solution:
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.

9. An organization is granted the block 16.0.0.0/8. The administrator wants to create
500 fixed-length subnets.
a. Find the subnet mask.
b. Find the number of addresses in each subnet.
c. Find the first and last addresses in subnet 1.
d. Find the first and last addresses in subnet 500

Solution:
log base 2 (500) = 8.95
Extra 1s = 9 Possible subnets: 512 Mask: /17 (8+9)
32-17=15
b. 2^15 = 32,768 Addresses per subnet
c. Subnet 1: The first address in the 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 × 32768) in base 256 (0. 249.128.0) to the first address in sub-
net 1. We have 16.0.0.0 + 0.249.128.0 = 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

10. An organization is granted the block 130.56.0.0/16. The administrator wants to
create 1024 subnets.
a. Find the subnet mask.
b. Find the number of addresses in each subnet.
c. Find the first and last addresses in subnet 1.
d. Find the first and last addresses in subnet 1024.

Solution:
a) log base2(1024) = 10
Extra 1s = 10 Possible subnets: 1024

Mask: /26 32- 26=6
b. 2^6= 64 Addresses per subnet
c. Subnet 1:
The first address is the beginning address of the block or 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).
First address in subnet 1:130.56.0.0
Number of addresses:0.0.0.63
Last address in subnet 1:130.56.0.63
Subnet 1024:
To find the first address in subnet 1024, we need to add 65,472 (1023 × 64) in base 256 (0.0.255.92) to the first address in subnet 1. We have 130.56.0.0. + 0.0.255.192 = 130.56.255.192. Now we can calculate the last address in subnet 500 as we did for the first address.
First address in subnet 1024:130.56.255.192
Number of addresses:0.0.0.63
Last address in subnet 1024:130.56.255.255

11. Write the following masks in slash notation (/n).
a. 255.255.255.0
b. 255.0.0.0
Solution:

a)The mask 255.255.255.0 has 24 consecutive 1s → slash notation: /24
b)The mask 255.0.0.0 has 8 consecutive 1s → slash notation:/8
12. Find the range of addresses in the following blocks.
a. 123.56.77.32/29
b. 200.17.21.128/27
Solution:

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

the reserved range.

13. Find the range of address in following blocks.

180.34.64.64/30

Subnet mask

11111111 11111111 11111111 11111100

30	2
Net ID	Host ID

180·34·64· 0100 0000 — Network address for organization

180·34·64·64

180·34·64· 0100 0001 — first address for host

180·34·64·65

180·34·64·0100 0010 — Last address for host

180·34·64·66

180·34·64·0100 0011 — Broadcast address

180·34·64·67

14.

Suppose a router has four interfaces, numbered 0 through 3. The network administrator wants the following address ranges to be forwarded to these interfaces as follows:

-> interface 0
Address 11100000 00000000 00000000 00000000
through 11100000 11111111 11111111 11111111

-> interface 1
Address 11100001 00000000 00000000 00000000
through 11100001 00000000 11111111 11111111

-> interface 2
Address 11100001 00000001 00000000 00000000
through 11100001 11111111 11111111 11111111

-> interface 3
All other addresses --------------------> Interface 3

a) Provide a forwarding table that has four entries, using longest-prefix matching, and forwards packets to the correct link interfaces.

11100000	→	Interface 0
11100001 00000000	→	Interface 1
11100001	→	Interface 2
All other addresses	→	Interface 3

b) Consider three datagrams with the following addresses. For each one, which interface would they be sent to?

i) 11001000 10010001 01010001 01010101

ii) 11100001 00000000 11000011 00111100

iii) 11100001 10000000 00010001 01110111

i. Interface 3
ii. Interface 1
iii. Interface 2

Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of form a.b.c.d/x) for the four subnets?

Answer:

IP address range: 128.119.40.128 - 128.119.40.191

Four subnets:

- 128.119.40.64/28
- 128.119.40.80/28
- 128.119.40.96/28
- 128.119.40.112/28

128·119·40·128/26

IP address range

first address ⇒ 128·119·40·128

128·119· 0010 1000 1000 0000

6 bit

host ID

for last address set host ID part to all 1

128·119·0010 1000 1011 1111

128.119.40.191

range of IP => 128.119.40.128 TO 128.119.40.191

Four subnet

we need 2 bits

128.119.40.64/26

128.119.40.0100 0000

128.119.40.64/28 – subnet 1

128.119.40.0101 0000

128.119.40.80/28 – subnet 2

128.119.40.0110 0000

128.119.40.96/28 – subnet 3

128.119.40.0111 0000

128.119.40.112 – subnet 4