HANOI UNIVERSITY

Faculty of Information Technology

CNE – Tutorial Guide

Week 4

IP Addressing and Subnetting

I. IP Addressing

1. Some Definitions:

- ***Address***: The unique number ID assigned to one host or interface in a network.
- ***Subnet***: A portion of a network sharing a particular subnet address.
- ***Subnet Mask***: A 32-bit combination used to describe which portion of an address refers to the subnet and which part refers to the host.
- ***Interface***: A network connection.

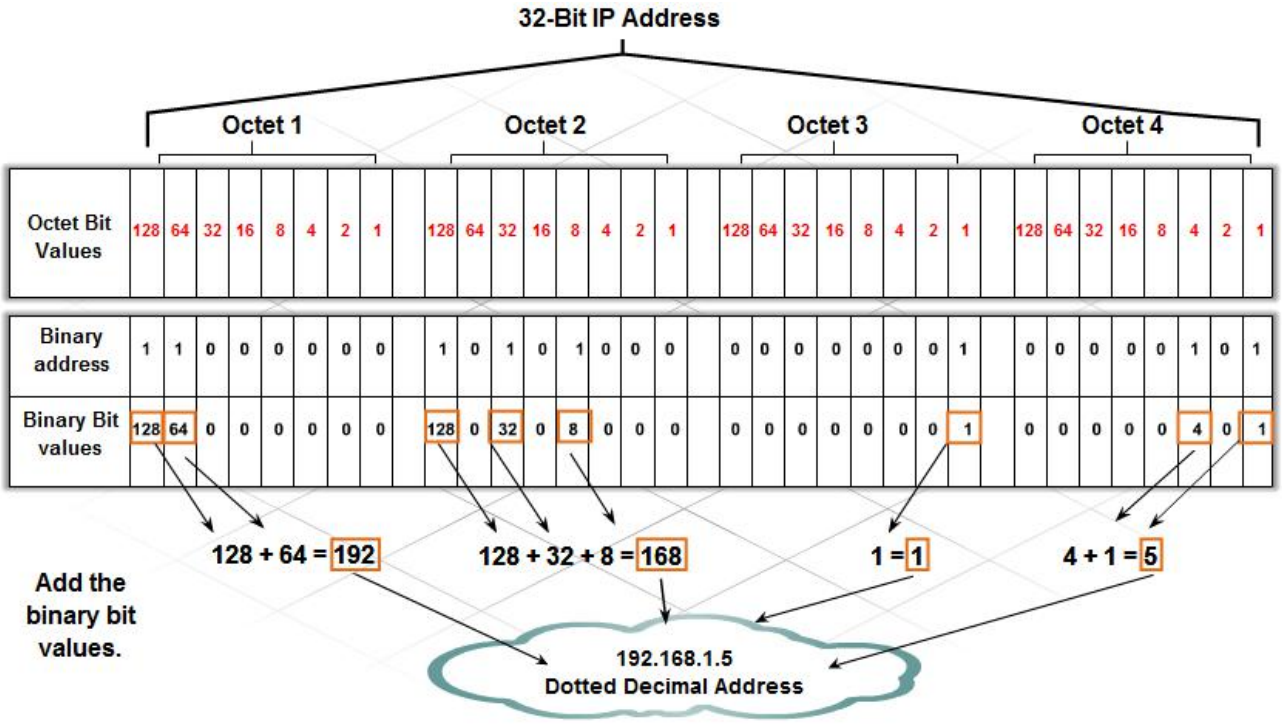


Figure 1 – 32 bit IP Addresses structure

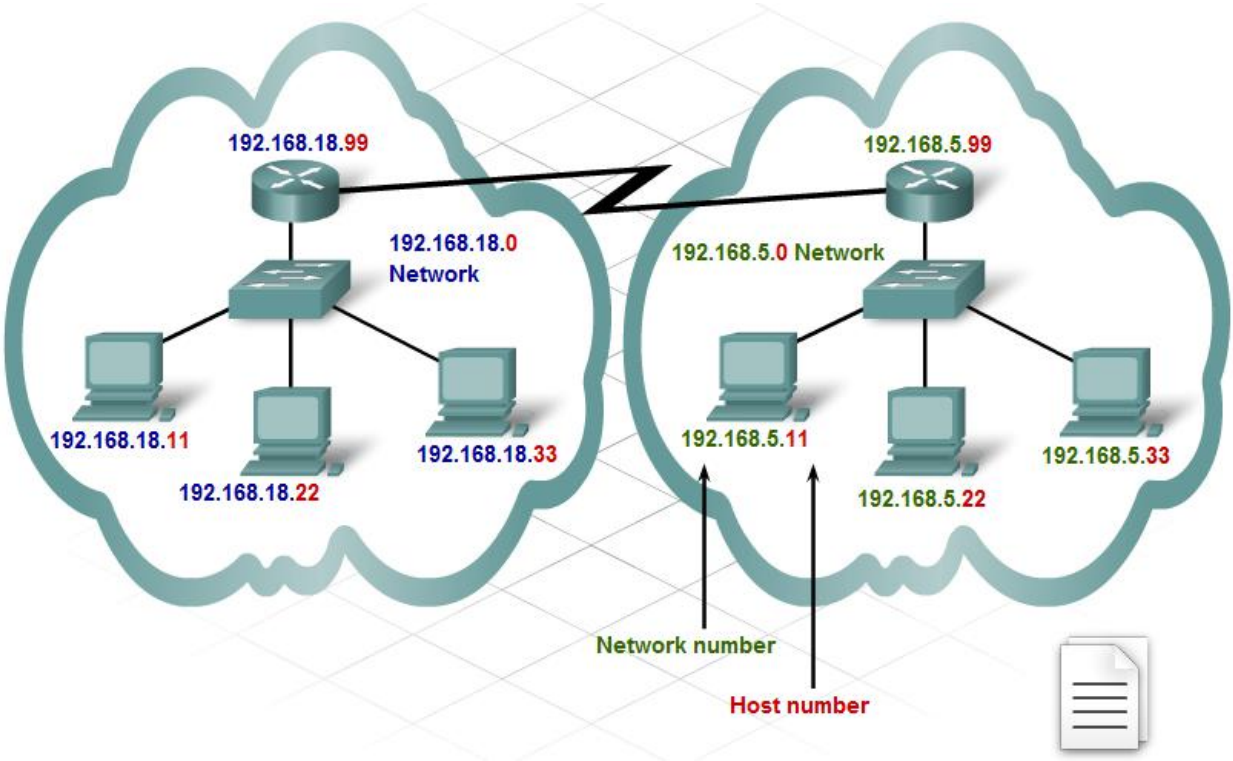


Figure 2 – Parts of an IP Address

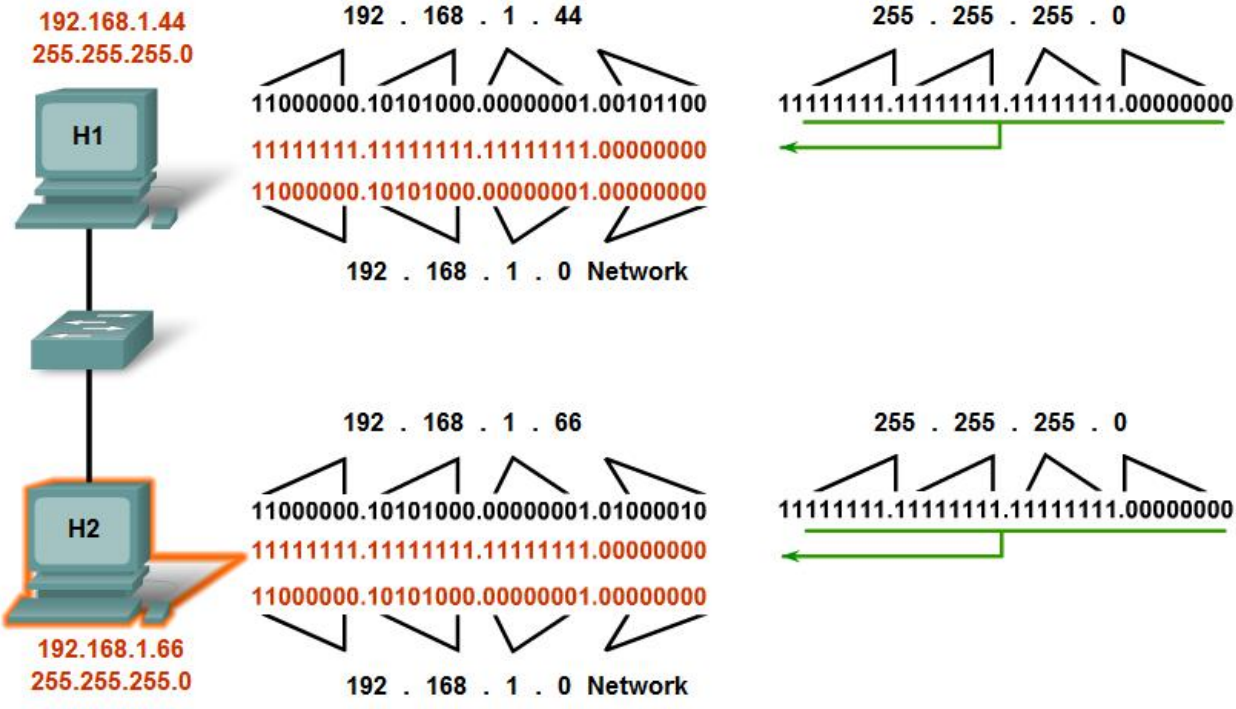


Figure 3 – How IP Addresses and Subnet Masks interact

2. Instruction:

1. How to convert IP address from dotted decimal notation to binary notation a. Using pen and paper:
   - *Binary to decimal:* The right most bit, or least significant bit, of an octet holds a value of 2^0. The bit just to the left of that holds a value of 2^1. This continues until the left-most bit, or most significant bit, which holds a value of 2^7. So if all binary bits are a one, the decimal equivalent would be 255 as shown here:

     ```
      1   1  1  11111
     128 64 32 16 8 4 2 1 (128+64+32+16+8+4+2+1=255)
     ```

     Here is a sample octet conversion when not all of the bits are set to 1:

     ```
     0  1000001
     0  64 0 0 0 0 0 1 (0+64+0+0+0+0+0+1=65)
     ```

   - Decimal to binary: Given the IP address 208.80.92.2

     208 - 128 = 80 so we write 1 in the first bit. 80 - 64 = 16 so we write 1 in the second bit. 32 cannot be subtracted from 16 so we write 0 in the third bit. 16 - 16 = 0 so we write 1 in the forth bit. There's nothing left so we write 0s in the remaining bits.

     ```
     208          128  64  32  16  8  4  2 1
                   1   1   0   1  0  0  0 0
     ```

     Similarly,

     ```
     80           128  64  32  16  8  4  2 1
                   0   1   0   1  0  0  0 0
     92           128  64  32  16  8  4  2 1
                   0   1   0   1  1  1  0 0
     2            128  64  32  16  8  4  2 1
                   0   0   0   0  0  0  1 0
     ```

     Now we have the binary notation of 208.80.92.2 is:
     `11010000.01010000.01011100.00000010`

b. Using Windows Calculator

- Open Calculator: ***All Programs →Accessories → Calculator***
- In the menu bar: ***View → Scientific mode***
- To convert from decimal to binary, click ***Dec*** radio button, type the number and then click **Bin** radio button, you can see the number has changed from decimal to binary.
- Similarly, we can use Windows Calculator to convert from binary to decimal.

3. Exercises:

Read the lecture slides and tutorial instruction carefully before doing these exercises!

1. Convert these IP addresses from dotted decimal notation to binary notation:

192.168.6.254
74.125.91.104
209.85.171.104

2. Convert these IP addresses from binary notation to dotted decimal notation:
   11010010.11110101.00110100.11100011
   11011110.11111111.00011111.01110110
   01110100.00110010.00001110.11010001

3. Given these IP addresses, define which are private IP addresses, public IP addresses or reserved IP addresses:
   192.168.15.252
   63.254.209.10
   203.162.35.99
   169.254.24.6
   127.0.0.1
   10.131.149.202
   172.16.48.226
   18.7.22.69

4. Define the class, default subnet mask, network number, host number, IP block of each IP address above.

II. Subnetting

1. Instruction

Read this article about Understanding Subnetting:
http://www.cisco.com/en/US/tech/tk365/technologies_tech_note09186a00800a67f5.shtml#ustand_subnet

2. Practice:

If we have an IP block 172.16.0.0/25, how can we assign these IP to the given network?

```
172.          16.       0.       0
10101100.00010000.00000000.00000000
11111111.11111111.11111111.10000000 (25 first bits is the netid)
255.          255.     255.     128
```

172.168.16.0.0/25 means 25 first bits of this IP address is the netid. Therefore, the mask of this network is: 11111111.11111111.11111111.10000000 binary or 255.255.255.128 decimal.

Based on the IP block 172.16.0.0/25 and the Subnet Mask, we can find the IP range of this network:

- The first IP address:

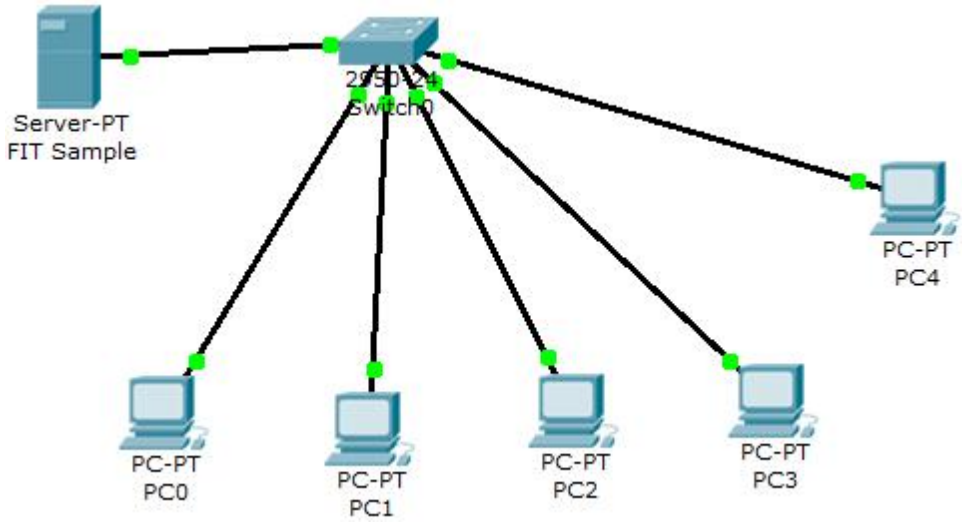
```
10101100.00010000.00000000.00000000
     172.      16.       0.        0
```

- The last IP address:

```
10101100.00010000.00000000.01111111
     172.      16.       0.      127
```

3. Practice with Packet Tracer:

Given IP block: 172.16.0.0/25. Configure all IP addresses of the PCs in this network.



- Setup the server.
- Use DHCP to automatically assign IP to PC0, PC1, PC2, PC3
- Use static IP for PC4, try using IP address out of this network's IP range.

Use ping and tracert to test the network.

What is your conclusion?
/25 mask 11111111 11111111 11111111 10000000 - 255.255.255.128
Ips = $2^7 = 128$
Hosts = 128-2=126

4. Exercises:

Given the IP block: 130.50.15.6/22.

- Find the subnet mask, IP range of this network.
- Configure all IP addresses of the PCs in this network (practice with Package Tracer)

Subnet mask: 1111 1111 . 1111 1111 . 1111 1100. 0000 0000
255. . 255 . 252 .0
130.50.15.6/22 = 130.50. 0000 1111 . 0000 0110
First IPs: 130.50. 0000 1100 . 0000 0000 = 130.50.12.0/22
Last IPs: 130.50. 0000 1111 . 1111 1111 = 130.50.15.255/22