Introduction

Session 02

Network Component - VLSM Addressing – Summarization - ping

- Network component
  - Software component:
    - IP Address.
    - Protocol.
    - Port.

Note: what is IP address?

- is a series of numbers must given to Network interface card (NIC), each NIC must have unique IP address at level of network.

Note: what is Protocol?

- Sometimes referred to as an access method, a protocol is a standard used to define a method of exchanging data over a computer network such as local area network, Internet, Intranet, etc. Each protocol has its own method of how data is formatted when sent and what to do with it once received, how that data is compressed or how to check for errors in data. One of the most common and known protocols is HTTP(Hyper Text Transfer Protocol), which is a protocol used to transmit data over the world wide web (Internet).

Note: what is Port?

- On computer and telecommunication devices, a port (noun) is generally a specific place for being physically connected to some other device, usually with a socket and plug of some kind. Typically, a personal computer is provided with one or more serial ports and usually one parallel port. The serial port supports sequential, one bit-at-a-time transmission to peripheral devices such as scanners and the parallel port supports multiple-bit-at-a-time transmission to devices such as printers.
- In programming, a port (noun) is a "logical connection place" and specifically, using the Internet's protocol, TCP/IP, the way a client program specifies a particular server program on a computer in a network. Higher-level applications that use TCP/IP such as the Web protocol, Hypertext Transfer Protocol, have ports with preassigned numbers. These are known as "well-known ports" that have been assigned by the Internet Assigned Numbers Authority (IANA). Other application processes are given port numbers dynamically for each connection. When a service (server program)

initially is started, it is said to bind to its designated port number. As any client program wants to use that server, it also must request to bind to the designated port number.

Port numbers are from 0 to 65535. Ports 0 to 1024 are reserved for use by certain privileged services. For the HTTP service, port 80 is defined as a default and it does not have to be specified in the Uniform Resource Locator (URL).
- In programming, to port (verb) is to move an application program from an operating system environment in which it was developed to another operating system environment so it can be run there.
Example on ports:
- FTP (File transfer Protocol). → 21
- SSH (Secure Shell). → 22
- Telnet (Remote Login Service). → 23
- SMTP (Simple mail transfer protocol). → 25
- DNS (Domain Name Server). → 53
HTTP (Hyper Text Transfer Protocol). → 80
- POP3 (Post Office Protocol). → 110
- NNTP (Network News Transfer Protocol). → 119
- NTP (Network Time Prootcol). → 123
- IMAP (Internet Message Access protocol). → 143
- SNMP (Simple Network Management Protocol). → 161
- IRC (Internet Relay Chat). → 194
- HTTPS (Hyper Text Transfer Protocol Secure). → 443

■ VLSM Addressing

- o VLSM is stand for Variable Length Subnet Mask.

Note: IP address contain 4 oct & each oct start with 0 and end with 255. example: 192.168.0.1
Note: IP Address consist of 32 bit & every oct consist of 8 bit.

- o How convert Decimal (IP Address) to Binary?
  - IP address: 192.244.1.80

IP add	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
192	1	1	0	0	0	0	0	0
244	1	1	1	1	0	1	0	0
1	0	0	0	0	0	0	0	1
80	0	1	0	1	0	0	0	0

Binary of IP: 192 . 244 . 1 . 80
11000000 . 11110100 . 00000001 . 01010000

- What is Subnet Mask?
  - it is used to identify network address (Network ID) of an IP address.
  - IANA Constructing Default Subnet Mask.

Class	Default Mask	Host
C	255.255.255.0	254
B	255.255.0.0	65354
A	255.0.0.0	16777217

Note: Why we didn't use usually Class A for constructing our network?
- there are Three Type of connecting.
1- Uni-Cast. One to One. Ex: Open Session with Server that hosting Facebook.
2- Multi-Cast. One to Many. Ex: Chatting with Group of people at same Room.
3- Broad-Cast. One to All. Ex: Send Packet for all device in the network.
When using Class A to construct our network that has only 500 host, and we use protocol depend on Broad-cast type such as DHCP That causing Overload (Loop).
because Router Depend on Subnet mask when sending broad-cast message that mean router will send 16777217 broad-cast message.

- How we build custom Subnet Mask?
  - Example we need to make custom Subnet mask for 500 host only.
    - Main Law is:
      - hosts $\leq 2^h - 2$
        - let h equal 2 → $2^2 - 2 = 2$
        - let h equal 4 → $2^4 - 2 = 14$
        - let h equal 9 → $2^9 - 2 = 512$

Note: h is indicator for number of 0 in subnet mask.

Binary	**11111111**	**11111111**	**11111110**	**00000000**
Subnet	**255**	**255**	**254**	**0**

mask				

Subnet Mask: 255.255.254.0

- How we write IP address?
  - 1st step write Random IP address.
  - 2nd step convert Random IP address to Binary.

Random IP	10	80	80	80
Binary	00001010	01010000	01010000	01010000

- 3rd adding binary of Mask with Binary of random IP.

Note: **→ 0 + 1 = 0** **→ 0 + 0 = 0**
→ 1 + 1 = 1

Binary of Mask	**11111111**	**11111111**	**11111110**	**00000000**
Binary of IP	**00001010**	**01010000**	**01010000**	**01010000**
Binary subnet	**00001010**	**01010000**	**01010000**	**00000000**
subnet	**10**	**80**	**80**	**0**

- 4rd step Looking for oct that has last 1 of Binary of mask and change bits at Binary of Random IP Address to 1 starting at order of last 1 of binary of mask.

Binary of Mask	**11111111**	**11111111**	**1111111**0	**00000000**
Binary of IP	**00001010**	**01010000**	**01010000**	**01010000**
Binary BC IP	**00001010**	**01010000**	**0101000**1	**11111111**
Broad-Cast IP	**10**	**80**	**81**	**255**

Note: - First Valid IP = Subnet IP + 1

- last Valid IP = Broad-cast IP – 1

- Number of Network = $2^{\text{Number of 1 at oct w}}$

where w is 11111111 11111111 11111110 0000000

- block size = x – y

where x is 10.80.80.0 where y is 10.80.82.0

Subnet IP	First Valid IP	Last Valid IP	Broad-Cast IP
10.80.80.0	**10.80.80.1**	**10.80.81.254**	**10.80.81.255**
10.80.82.0	**10.80.82.1**	**10.80.83.254**	**10.80.83.255**
10.80.84.0	**10.80.84.1**	**10.80.85.254**	**10.80.85.255**

Subnet 10.80.80.0/255.255.254.0 OR
10.80.80.0/23
10.80.82.0/23
10.80.84.0/23

Note: CIDR stand for Classless Interdomain Routing
→ /23 call 'CIDR'

- Class of IP address for first oct
  - From 1 → 126 Class A
  - From 128 → 191 Class B
  - From 192 → 223 Class C

Note: this numbers can't be used for NIC.
- 127 because it used for Localhost (loopback).
- 224 → 239 Class D it used for Multi-cast protocol.
- 240 → 255 Class E used for future purpose.

- How to know subnet for random IP address?

- IP address: 10.80.85.50/19
  - 1st convert CIDR to Binary of mask

Mask	11111111	11111111	11100000	00000000

  - 2nd get Block size through last 1 at oct that contain 1 and 0, in this case block size = 32.
  - Solution

subnet Mask: 10.80.0.0
10.80.32.0
subnet for IP 10.80.64.0
10.80.96.0

■ Summarization

- o Is summarize number of subnets to general subnet and subnet mask.
  - At least number of subnets must be similar at one oct.
  - Subnet 192.100.45.55
  - Subnet 192.254.25.34
  - Subnet 192.150.44.105
    - 1st step re-arrange subnet

1- 192.100.45.55
2- 192.150.44.105
3- 192.254.25.34

    - 2nd step change the oct of first subnet and last subnet that after similar oct to binary

100	01100100
254	11111110
Adding	00000000

Note: how we can add this 2 oct
any two opposite bits are similar the result equal to 1, if we find any two opposite bits not similar result equal to 0 and all bits after that bit equal to 0.

General Subnet: **192.0.0.0/8**
Subnet Mask: **255.0.0.0**

Note: IP Can't start with 0 or ending with 0

- Ping
  - Command: ping yahoo.com

    Result: Pinging yahoo.com [98.138.253.109] with 32 bytes of data:
    Reply from 98.138.253.109: bytes=32 time=211ms TTL=46
    Reply from 98.138.253.109: bytes=32 time=212ms TTL=46
    Reply from 98.138.253.109: bytes=32 time=212ms TTL=46
    Reply from 98.138.253.109: bytes=32 time=210ms TTL=46
  - Explain
    - Reply from 98.138.253.109 → IP Address of hosting.
    - Byte = 32 → Size of Packet
    - Time = 211ms → time of sending packet and receive ack.
    - TTL = 46 → stand for Time To Live, started value is 225 and ending with 0, indicating to number of routers between sender and receiver.
      example : TTL = 234
      mean 255 – 234 = 21 routers

Note: Trace Route is command to show details of routers that your packet move through them.
command : tracert yahoo.com

Class	1st Octet Decimal Range	1st Octet High Order Bits	Network/Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (Usable Addresses)
A	1 – 126*	0	N.H.H.H	255.0.0.0	126 (2^7 – 2)	16,777,214 (2^{24} – 2)
B	128 – 191	10	N.N.H.H	255.255.0.0	16,382 (2^{14} – 2)	65,534 (2^{16} – 2)
C	192 – 223	110	N.N.N.H	255.255.255.0	2,097,150 (2^{21} – 2)	254 (2^8 – 2)
D	224 – 239	1110	Reserved for Multicasting			
E	240 – 254	1111	Experimental; used for research			

Note: Class A addresses 127.0.0.0 to 127.255.255.255 cannot be used and is reserved for loopback and diagnostic functions.

Private IP Addresses

Class	Private Networks	Subnet Mask	Address Range

A	10.0.0.0	255.0.0.0	10.0.0.0 - 10.255.255.255
B	172.16.0.0 - 172.31.0.0	255.240.0.0	172.16.0.0 - 172.31.255.255
C	192.168.0.0	255.255.0.0	192.168.0.0 - 192.168.255.255