Week 6-7

UMak-CCIS
2024-2025

IP Subnetting

Prof. Percival D. Adao, MIT

Expected Learning Outcomes

UMak-CCIS
2023-2024

1. Discuss why do we need to subnet the IP Address
2. Understand IP subnetting
3. Subnet IP Via Subnet
4. Subnet IP Via Host

Why do we need to subnet IPv4 Address ?

UMak-CCIS
2023-2024

IP ADDRESS CLASSES

Public IP Addresses

Address Class	Network ID : (First Octet)	Network Mask	Classful Prefix Notation	No. of Networks	No. of Hosts
Class A	1.0.0.0 – 126.255.255.254 (0)	255.0.0.0	/8	126	16,777,214
Class B	128.0.0.0 – 191.255.255.254 (10)	255.255.0.0	/16	16,384	65,534
Class C	192.0.0.0 – 223.255.255.254 (110)	255.255.255.0	/24	2,097,152	254

Class D 224 - 239 (Multicasting)
Class E 240 - 255 ("Experimental" , Reserved for future used)

Private IP Addresses

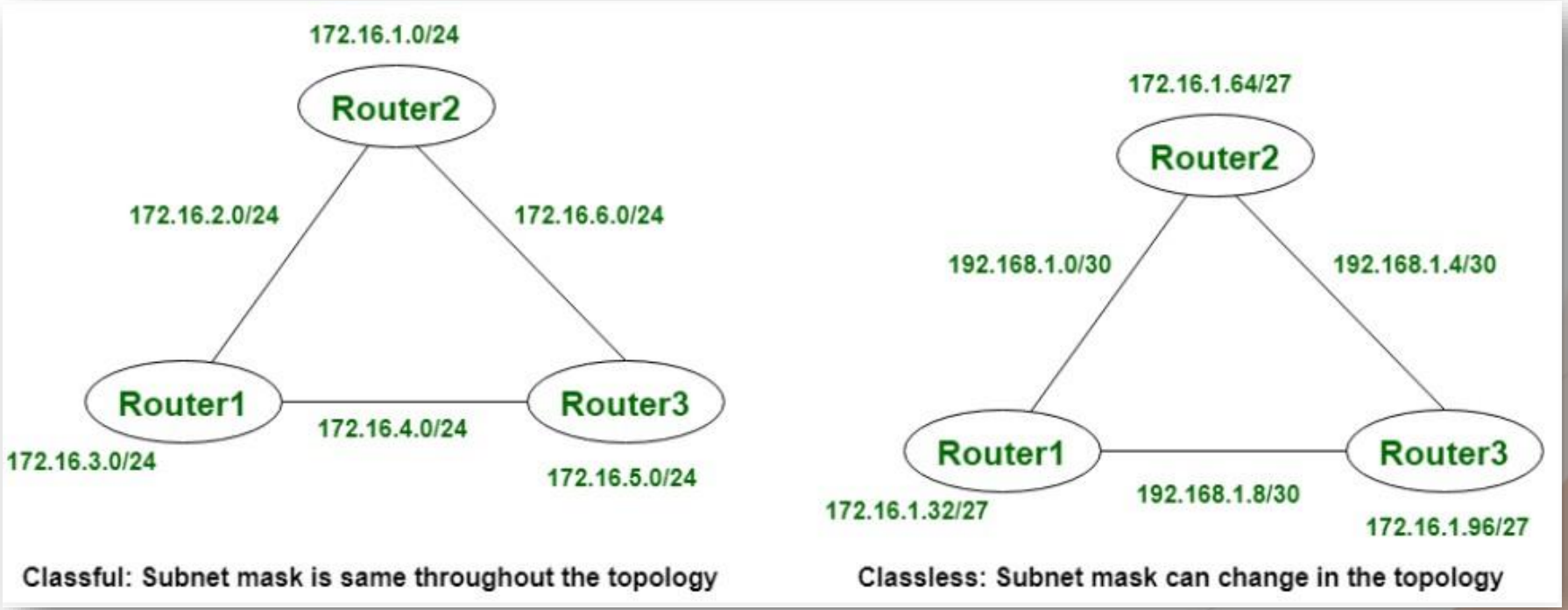
Class A 10.0.0.0 – 10.255.255. 254
Class B 172.16.0.0 – 172.31.255.254
Class C 192.168.0.1 – 192.168.255.254

127.0.0.0 IP Address used for "loop back or PING"
Loop Back – Signal sent to another station and send back again to its original destination.
PING – Packet INternet Groper

SUBNETTING

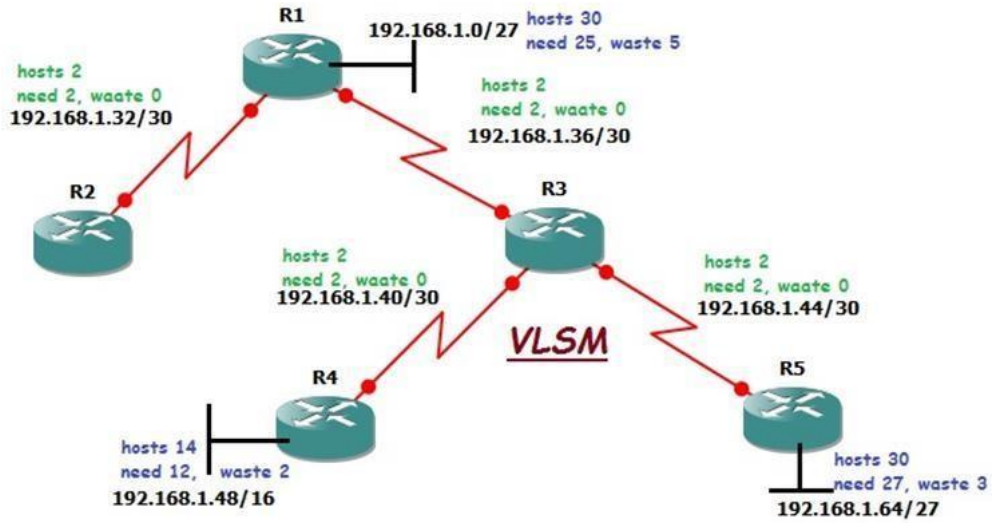
UMak-CCIS
2023-2024

The process of subdividing a Class A, B, or C network and into smaller portions called subnets. Subnetting is used to break the network into smaller more efficient subnets to prevent excessive rates of Ethernet packet collision in a large network. Such subnets can be arranged hierarchically, with the organization's network address space partitioned into a tree-like structure. Routers are used to manage traffic and constitute borders between subnets.



Variable Length Subnet Mask (VLSM)

is a means to specify a different subnet mask for the same network number on different subnets. With VLSM, a network administrator can use a long mask on networks with few hosts and a short mask on subnets with many hosts. To use VLSM, the routing protocol must support it.



Classless Inter-Domain Routing (CIDR)

UMak-CCIS
2023-2024

CIDR was introduced to improve both address space utilization and routing scalability in the Internet. It was needed because of the rapid growth of the Internet and growth of the IP routing tables held in the Internet routers.

CIDR moves way from the traditional IP classes (Class A, Class B, Class C, and so on).

In CIDR , an IP network is represented by a prefix, which is an IP address and some indication of the length of the mask. Length means the number of left-most contiguous mask bits that are set to one. So network 172.16.0.0 255.255.0.0 can be represented as 172.16.0.0/16. CIDR also depicts a more hierarchical Internet architecture, where each domain takes its IP addresses from a higher level.

This allows for the summarization of the domains to be done at the higher level. For example, if an ISP owns network 172.16.0.0/16, then the ISP can offer 172.16.1.0/24, 172.16.2.0/24, and so on to customers. Yet, when advertising to other providers, the ISP only needs to advertise 172.16.0.0/16.

Host and Subnet equivalent per Octet

UMak-CCIS
2023-2024

Example form Class **C** subnet

Direction of Subnet → (converted per octet)

	/25	/26	/27	/28	/29	/30	/31	/32
	128	192	224	240	248	252	254	255
OCTET →	I	I	I	I	I	I	I	I
	128	64	32	16	8	4	2	1

(conversion from 4th – 2nd octet depending on network class) ← Direction of Host

Overview of the Subnetting Table

Start form Class A

Class A has /8

UMak-CCIS
2023-2024

IP SUBNETTING SUMMARY

Class A Host/Subnet Table

Number of Bits Borrowed from Host Portion	Subnet Mask	Effective Subnets	Number of Hosts/Subnet	Number of Mask-bit
1	255.128.0.0	2	8388606	/9
2	255.192.0.0	4	4194302	/10
3	255.224.0.0	8	2097150	/11
4	255.240.0.0	16	1048574	/12
5	255.248.0.0	32	524286	/13
6	255.252.0.0	64	262142	/14
7	255.254.0.0	128	131070	/15
8	255.255.0.0	256	65534	/16
9	255.255.128.0	512	32766	/17
10	255.255.192.0	1024	16382	/18
11	255.255.224.0	2048	8190	/19
12	255.255.240.0	4096	4094	/20
13	255.255.248.0	8192	2046	/21
14	255.255.252.0	16384	1022	/22
15	255.255.254.0	32768	510	/23
16	255.255.255.0	65536	254	/24
17	255.255.255.128	131072	126	/25
18	255.255.255.192	262144	62	/26
19	255.255.255.224	524288	30	/27
20	255.255.255.240	1048576	14	/28
21	255.255.255.248	2097152	6	/29
22	255.255.255.252	4194304	2	/30
23	255.255.255.254	8388608	2*	/31

1st barrowed bit

METHODS OF IP SUBNETTINGS

METHODS OF IP SUBNETTINGS

Find the Number of Subnets & the Number of Valid Hosts per Subnet

SUBNETTING USING FINGERS METHODS

UMak-CCIS
2023-2024

Subnetting using fingers methods-find INCREMENT

UMak-CCIS
2023-2024

Subnetting using fingers methods-find INCREMENT (part 2)

TWO METHODS OF IP SUBNETTINGS

A. Using the given no of Subnets (Via Subnet)

Ex. As a company administrator you are required to subnet the subscribed IP from ISP which is 10.0.0.0 /8 into 10 subnets

(short method)

/8 = 255.0.0.0
/16 = 255.255.0.0
/24 = 255.255.255.0

STEPS:

1. Convert the given IP Address into binary bits

10 subnets = 1010 = 4 bits

TWO METHODS OF IP SUBNETTINGS

UMak-CCIS
2023-2024

2. Add the converted bits to the given subnet mask

   /8 + /4 = /12 /12 is the new subnet

3. Convert the new subnet bits to decimal

   /12 = 255.240.0.0

/8 = 255.0.0.0
/16 = 255.255.0.0
/24 = 255.255.255.0

4. Determine what octet and what increment

   (O, i)

   Octet = 2nd Increment = 16i

TWO METHODS OF IP SUBNETTINGS

UMak-CCIS
2023-2024

5. Show the subnet

Octet = 2nd Increment = 16i

10.0.0.0 /8 given IP Address

10.16.0.0 /12 1st subnet

10.16.0.1 /12 1st usable IP address of the first subnet

10.31.255.254 /12 Last usable IP address of the first subnet

10.16.0.1 – 10.31.255.254 1st subnet range

10.31.255.255 /12 Broadcast IP address

10.32.0.0 /12 2nd subnet

10.48.0.0 /12 3rd subnet and so on…

TWO METHODS OF IP SUBNETTINGS

Ex. No.2

An enterprise network needed to subnet into 25 subnetworks using the given IP address of 172.16.0.0 /16. Find the new subnet, Increment, first and last usable IP and the IP address range.

172.16.0.0 /16 subnet to 25 Subnets

25 = 11001 = 5 bits

/16 + /5 = /21 /21 = 255.255.248.0

Octet = 3rd Octet Increment = 8i

172.16.0.0 /16 given IP Address

TWO METHODS OF IP SUBNETTINGS

172.16.8.0 /21 1st subnet

172.16.8.1 /21 1st usable IP address of the first subnet

172.16.15.254 /21 Last usable IP address of the first subnet

172.16.15.255 /21 Broadcast IP address

172.16.8.1 – 172.16.15.254 1st Usable IP address range

172.16.16.0 2nd subnet range

TWO METHODS OF IP SUBNETTINGS

UMak-CCIS
2023-2024

B. Using the number of required host (VIA HOST)

(short method)

Steps: Convert the given host into binary bits

1. If the equivalent bits are all ones (1s) add 0 (+ 0) to make it a binary numbers.
   3 = 11 (2 bits) it should be 011 = 3 bits

   7 = 111 (3bits) it should be 0111 = 4 bits

   15 = 1111 (4 bits) it should be 01111 = 5 bits

   And so on…

I	I	I	I	I	I	I	I
128	64	32	16	8	4	2	1

1. Subtract the converted bits to /32
2. Convert the new subnet mask to decimal
3. Determine what Octet and what Increment **(O, i)**
4. Show the subnet

TWO METHODS OF IP SUBNETTINGS

UMak-CCIS
2023-2024

Ex. No.1 Subnet the network in which it is required to have the capacity to handle 4 hosts per subnet. The given IP address by the ISP is 172.19.10.0 /16. Identify the first and last usable IP of the 1st subnet, its broadcast and network address and the 2nd subnet.

172.19.10.0 /16 4 hosts / subnet
4 = 100 = 3 bits/32 - /3 = /29
/29 = 255.255.255.248
Octet = 4th Increment = 8i
172.19.10.8 /29 1st subnet
172.19.10.9 /29 1st usable IP address
172.19.10.14 /29 Last usable IP address
172.19.10.15 /29 Broadcast IP address
172.19.10.16 /29 2nd subnet

TWO METHODS OF IP SUBNETTINGS

UMak-CCIS
2023-2024

Ex. No.2 An enterprise network needed to subnet its network with 63 hosts per subnet. The given IP address is 190.100.0.0 /16. Identify the usable IP Address range of the 1st subnet, its broadcast and network address and the 2nd subnet.

190.100.0.0 /16 63 hosts / subnet
63 = 111111 = 6 bits + 0 bit = 7 bits
/32 - /7 = /25
/25 = 255.255.255.128
Octet = 4th Increment = 128i

190.100.0.128 /25 1st subnet

190.100.0.129 /25 1st usable IP address

190.100.0.254 /25 Last usable IP address

190.100.0.255 /25 1st Broadcast IP address

190.100.0.129 - 190.100.0.254 1st Usable IP address range = 126 usable IP add.

190.100.1.0 /25 2nd subnet

Q. A.

Thank You