

# Logical Addressing & Subnetting | Neso Academy

 [nesoacademy.org/cs/06-computer-networks/ppts/03-logicaladdressing&subnetting](https://nesoacademy.org/cs/06-computer-networks/ppts/03-logicaladdressing&subnetting)

CHAPTER - 3

## *Logical Addressing & Subnetting*

Neso Academy

Logical Addressing & Subnetting Neso Academy CHAPTER - 3

### OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand IPv4 address in detail.
- ★ Notation of IPv4 address.
- ★ Know the Valid and Invalid IP address.

Neso Academy

Outcomes ★★★ Neso Academy

## IP ADDRESS

- ★ An IPv4 address is a 32-bit address that uniquely and universally defines the connection of a device (for example, a computer or a router) to the Internet.
- ★ An IPv4 address is 32 bits long.
- ★ Two devices on the Internet can never have the same address at the same time.
- ★ The address space of IPv4 is  $2^{32}$  or 4,294,967,296 (more than 4 billion).

IP Address ★★★★ Neso Academy

## NOTATIONS

- ★ There are two prevalent notations to show an IPv4 address: **binary notation** and **dotted decimal notation**.
- ★ **Binary Notation:** 01110101 10010101 00011101 00000010
- ★ **Dotted-Decimal Notation:** 117.149.29.2
- ★ Notation of IPv4 address: A.B.C.D (Only 4 octets)
- ★  $0 \leq A,B,C,D \leq 255$
- ★ 0.0.0.0 to 255.255.255.255

Notations ★★★★★ ≤ ★ Neso Academy

## VALID IP ADDRESSES

10.10.56.80

240.230.220.89

1.2.3.4

99.88.67.89

100.200.89.90

Neso Academy

Valid IP AddressesNeso Academy

## INVALID IP ADDRESS

56.89.1.2.5

10.065.34.56

200.28.256.8

Neso Academy

Invalid IP AddressNeso Academy

## ACTIVITY TIME!

Spot the error, if any, in the following IPv4 addresses.

Question	Answer
111.56.045.78	There must be no leading zero (045)
221.34.7.8.20	4 octets only in IPv4 address.
75.45.301.14	Range of each octet is between 0 and 255.
11100010.23.14.67	A mixture of binary and dotted-decimal notation is not allowed

Activity Time!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand the conversion of IP address from dotted-decimal to binary and vice versa.

Outcomes★Neso Academy

## CONVERSION (D-B AND B-D)

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1

MSB

LSB

Conversion (D-B and B-D)Neso Academy

### EXAMPLE 1

Convert the IPv4 address from binary to dotted-decimal notation.

10000001 00001011 01001011 11101111

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	0	0	0	0	0	0	1

$$128 + 1 = 129$$

Example 1128 + 1 = 129Neso Academy

**EXAMPLE 1**

Convert the IPv4 address from binary to dotted-decimal notation.  
10000001 00001011 01001011 11101111

**SOLUTION**

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	0	0	0	1	0	1	1

$$8 + 2 + 1 = 11$$

Example  $18 + 2 + 1 = 11$  Neso Academy

**EXAMPLE 1**

Convert the IPv4 address from binary to dotted-decimal notation.  
10000001 00001011 01001011 11101111

**SOLUTION**

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	1	0	0	1	0	1	1

$$64 + 8 + 2 + 1 = 75$$

Example  $164 + 8 + 2 + 1 = 75$  Neso Academy

## EXAMPLE 1

Convert the IPv4 address from binary to dotted-decimal notation.  
10000001 00001011 01001011 11101111

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	1	1	0	1	1	1	1

$$128 + 64 + 32 + 8 + 4 + 2 + 1 = 239$$

Example 1  $128 + 64 + 32 + 8 + 4 + 2 + 1 = 239$  Neso Academy

## EXAMPLE 1

Convert the IPv4 address from binary to dotted-decimal notation.  
10000001 00001011 01001011 11101111

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	0	1	1	1	1	1	1

129.11.75.239

Example 1 129.11.75.239 Neso Academy

## EXAMPLE 2

Convert the IPv4 address from dotted-decimal to binary notation  
145.14.6.8

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	0	0	1	0	0	0	1

1001 0001

Example 21001 0001Neso Academy

## EXAMPLE 2

Convert the IPv4 address from dotted-decimal to binary notation  
145.14.6.8

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	0	0	0	1	1	1	0

0000 1110

Example 20000 1110Neso Academy

## EXAMPLE 2

Convert the IPv4 address from dotted-decimal to binary notation  
145.14.6.8

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	0	0	0	0	1	1	0

0000 0110

Example 20000 0110Neso Academy

## EXAMPLE 2

Convert the IPv4 address from dotted-decimal to binary notation  
145.14.6.8

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	0	0	0	1	0	0	0

0000 1000

Example 20000 1000Neso Academy

## EXAMPLE 2

Convert the IPv4 address from dotted-decimal to binary notation  
**145.14.6.8**

### SOLUTION

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	0	0	0	1	0	0	0

10010001 00001110 00000110 00001000

Example 210010001 00001110 00000110 00001000Neso Academy

## HOMEWORK!

1. Change the following IP address from dotted-decimal notation to binary notation: **208.34.54.12**
2. Change the following IP address from binary notation to dotted-decimal notation: **11101111 11110111 11000111 00011101**

Homework!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand various classes of IPv4 Address.
- ★ Identify the class of IP address. (Activity)

Outcomes ★ Neso Academy

## CLASSES OF IPv4 ADDRESS

	First byte	Second byte	Third byte	Fourth byte
Class A	0			
Class B	10			
Class C	110			
Class D	1110			
Class E	1111			

a. Binary notation

	First byte	Second byte	Third byte	Fourth byte
Class A	0–127			
Class B	128–191			
Class C	192–223			
Class D	224–239			
Class E	240–255			

b. Dotted-decimal notation

Classes of IPv4 address Neso Academy

## CLASSES OF IPv4 ADDRESS

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0-127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets ( $2^7$ ) 16,777,214 hosts ( $2^{24}-2$ )
B	128-191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets ( $2^{14}$ ) 65,534 hosts ( $2^{16}-2$ )
C	192-223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets ( $2^{21}$ ) 254 hosts ( $2^8-2$ )
D	224-239	11100000 - 11101111	NA (Multicast)	-	-
E	240-255	11110000 - 11111111	NA (Experimental)	-	-

Classes of IPv4 address 00000000 - 0111111100000000 - 1011111110000000  
 - 110111111100000 - 111011111110000 - 11111111 Neso Academy

### ACTIVITY TIME!

Find the class of the following dotted decimal IPv4 addresses.

IP Address	Class
192.168.1.10	C
10.10.200.6	A
172.15.165.1	B
230.10.65.30	D (Multicast)

Activity Time! Neso Academy

## HOMEWORK!

Find the class of the following IPv4 address:

- a. 11110111 1110011 10000111 11011101
- b. 10101111 11000000 11110000 00011101
- c. 11011111 10110000 00011111 01011101
- d. 11101111 11110111 11000111 00011101

Homework!Neso Academy

## CLASSES OF IPv4 ADDRESS

	First byte	Second byte	Third byte	Fourth byte
Class A	0			
Class B	10			
Class C	110			
Class D	1110			
Class E	1111			

a. Binary notation

	First byte	Second byte	Third byte	Fourth byte
Class A	0–127			
Class B	128–191			
Class C	192–223			
Class D	224–239			
Class E	240–255			

b. Dotted-decimal notation

Classes of IPv4 addressNeso Academy

## VALID SUBNET MASKS

Subnet Value	Bit Value							
	128	64	32	16	8	4	2	1
255	1	1	1	1	1	1	1	1
254	1	1	1	1	1	1	1	0
252	1	1	1	1	1	1	0	0
248	1	1	1	1	1	0	0	0
240	1	1	1	1	0	0	0	0
224	1	1	1	0	0	0	0	0
192	1	1	0	0	0	0	0	0
128	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Valid Subnet masks Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Recall various classes of IPv4 Address.
- ★ Understand the purpose of subnet mask.
- ★ Identify whether the nodes belonging to same network or different network.

Outcomes ★★★ Neso Academy

## CLASSES OF IPv4 ADDRESS

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0-127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets ( $2^7$ ) 16,777,214 hosts ( $2^{24}-2$ )
B	128-191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets ( $2^{14}$ ) 65,534 hosts ( $2^{16}-2$ )
C	192-223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets ( $2^{21}$ ) 254 hosts ( $2^8-2$ )
D	224-239	11100000 - 11101111	NA (Multicast)	-	-
E	240-255	11110000 - 11111111	NA (Experimental)	-	-

Classes of IPv4 address 00000000 -0111111100000000 -1011111110000000  
 -110111111100000 -111011111110000 -11111111 Neso Academy

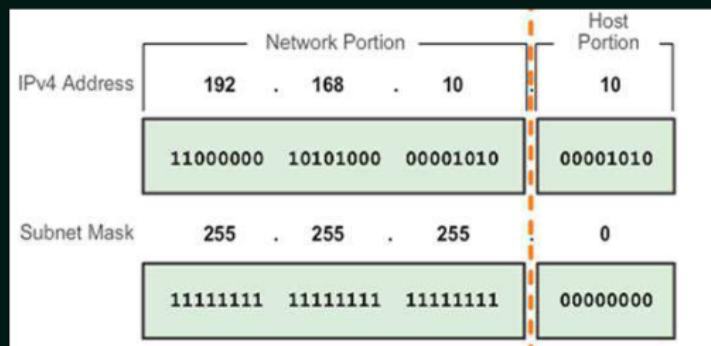
## SUBNET MASK (SLASH NOTATION)

Class	Subnet Mask (in Decimal)	Subnet Mask (in Binary)	Slash Notation
A	255.0.0.0	1111111.00000000.00000000.00000000	/8
B	255.255.0.0	11111111.11111111.00000000.00000000	/16
C	255.255.255.0	11111111.11111111.11111111.00000000	/24

Subnet mask (Slash notation) Neso Academy

## SUBNET MASK

- ★ To define the network and host portions of an address, devices use a separate 32-bit pattern called a subnet mask.
- ★ The subnet mask does not actually contain the network or host portion of an IPv4 address, it just says where to look for these portions in a given IPv4 address



Subnet Mask ★★ Neso Academy

## SUBNET MASK

10.10.10.1	255.0.0.0 ; Same N/W	10.10.10.1	255.255.255.0 ; Different N/W
10.10.20.16		10.10.20.16	
172.16.200.1	255.255.0.0 ; Same N/W	172.16.200.1	255.255.255.0 ; Different N/W
172.16.165.2		172.16.165.2	
10.10.36.1	255.255.0.0 ; Same N/W	10.10.36.1	255.255.25.0 ; Different N/W
10.10.12.1		10.10.12.1	

Subnet Mask  
255.0.0.0 ; Same N/W  
255.255.255.0 ; Different N/W  
255.255.0.0 ; Same N/W  
255.255.255.0 ; Different N/W  
255.255.0.0 ; Same N/W  
255.255.25.0 ; Different N/W  
Neso Academy

## HOMEWORK!

Which of the following is an invalid subnet mask?

- a. 255.255.0.0
- b. 255.0.0.0
- c. 255.0.255.255
- d. 255.255.255.0

Homework!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand Classful Addressing using Cisco Packet Tracer

Outcomes★Neso Academy

## CLASSES OF IPv4 ADDRESS

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	1-127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets ( $2^7$ ) 16,777,214 hosts ( $2^{24}-2$ )
B	128-191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets ( $2^{14}$ ) 65,534 hosts ( $2^{16}-2$ )
C	192-223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets ( $2^{21}$ ) 254 hosts ( $2^8-2$ )
D	224-239	11100000 - 11101111	NA (Multicast)	-	-
E	240-255	11110000 - 11111111	NA (Experimental)	-	-

Classes of IPv4 address 00000000 - 0111111100000000 - 1011111110000000  
- 110111111100000 - 111011111110000 - 11111111 Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand the different ways host can communicate using IPv4 address.

Outcomes ★ Neso Academy

## DIFFERENT WAYS OF TRANSMISSION IN IPv4

In an IPv4 network, the hosts can communicate one of three different ways:

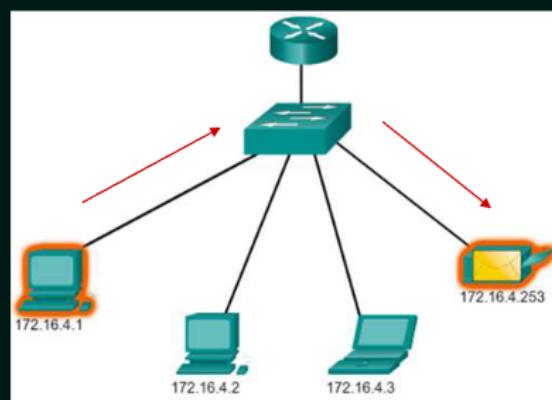
1. Unicast
2. Broadcast
3. Multicast

Different ways of transmission in IPv4 Neso Academy

### UNICAST TRANSMISSION

Unicast Transmission: The process of sending a packet from one host to an individual host.

Source: 172.16.4.1  
Destination: 172.16.4.253



Unicast transmission Neso Academy

## BROADCAST TRANSMISSION

Broadcast Transmission: The process of sending a packet from one host to all hosts in the network.

### Limited Broadcast:

Destination: 255.255.255.255

Routers do not forward a limited broadcast!

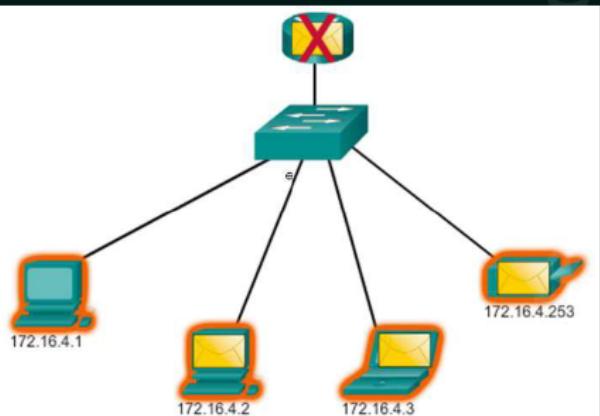
### Directed broadcast:

Destination: 172.16.4.255

Hosts within the 172.16.4.0/24 network!

Source: 172.16.4.1

Destination: 255.255.255.255



Broadcast transmissionNeso Academy

## MULTICAST TRANSMISSION

Multicast Transmission: The process of sending a packet from one host to a selected group of hosts, possibly in different networks.

- ★ Multicast transmission reduces traffic
- ★ The Multicast Address range: 224.0.0.0 to 239.255.255.255
- ★ Link local – 224.0.0.0 to 224.0.0.255 (Example: routing information exchanged by routing protocols)
- ★ Globally scoped addresses – 224.0.1.0 to 238.255.255.255 (Example: 224.0.1.1 has been reserved for Network Time Protocol)

★★★★★Multicast transmissionNeso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Find the number of addresses, network address and broadcast address of a class A network.

Outcomes★Neso Academy

## QUESTION

An organization follows class A for their internal network. One of the hosts in the network has an IP address 10.200.240.4. Find the number of addresses, the network address, and the broadcast address of the organization's network.

### SOLUTION:

Class A Network

N.H.H.H (255.0.0.0 or /8)

10.200.240.4

This network: 10.0.0.0 – 10.255.255.255

Number of addresses:  $2^{24} = 16,777,216$

Number of usable addresses:  $16,777,216 - 2 = 16,777,214$

First Address: 10.0.0.0 (Network Address)

Last Address: 10.255.255.255 (Broadcast Address)

QuestionNeso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Know about the public and private IP addresses.
- ★ Know the special use IPv4 addresses.

Outcomes ★★ Neso Academy

## PRIVATE IP ADDRESSES

- ★ Early network design, when global end-to-end connectivity was envisioned for communications with all Internet hosts, intended that IP addresses be globally unique. However, it was found that this was not always necessary as private networks developed and public address space needed to be conserved.
- ★ Computers not connected to the Internet, such as factory machines that communicate only with each other via TCP/IP, need not have globally unique IP addresses. Today, such private networks are widely used and typically connect to the Internet with network address translation (NAT), when needed.

Private IP Addresses ★★ Neso Academy

## PRIVATE IP ADDRESSES

- ★ Hosts that do not require access to the Internet can use private addresses
  - 10.0.0.0 to 10.255.255.255 (10.0.0.0/8)
  - 172.16.0.0 to 172.31.255.255 (172.16.0.0/12)
  - 192.168.0.0 to 192.168.255.255 (192.168.0.0/16)
- ★ The aforementioned are the three non-overlapping ranges of IPv4 addresses for private networks are reserved.

Private IP Addresses ★○○○★ Neso Academy

## SPECIAL USE IPv4 ADDRESSES

**Network and Broadcast addresses** – within each network the first and last addresses cannot be assigned to hosts

**Loopback address** – 127.0.0.1 a special address that hosts use to direct traffic to themselves (addresses 127.0.0.0 to 127.255.255.255 are reserved)

**Link-Local address** – 169.254.0.0 to 169.254.255.255 (169.254.0.0/16) addresses can be automatically assigned to the local host

**TEST-NET addresses** – 192.0.2.0 to 192.0.2.255 (192.0.2.0/24) set aside for teaching and learning purposes, used in documentation and network examples

**Experimental addresses** – 240.0.0.0 to 255.255.255.254 are listed as reserved

Special use IPv4 Addresses Neso Academy

## IN A NUTSHELL...

Private IP address is used to communicate within the same network. Using private IP data or information can be sent or received within the same network.

Public IP address is used to communicate outside the network. Public IP address is basically assigned by the Internet Service Provider(ISP).

In a nutshell...Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Know the drawbacks of classful addressing.
- ★ Understand the need for classless addressing.

Outcomes★★Neso Academy

## DRAWBACKS OF CLASSFUL ADDRESSING

- ★ **Lack of Internal Address Flexibility:** Big organizations are assigned large, “monolithic” blocks of addresses that don't match well the structure of their underlying internal networks.
- ★ **Inefficient Use of Address Space:** The existence of only three block sizes (classes A, B and C) leads to waste of limited IP address space.
- ★ **Proliferation of Router Table Entries:** As the Internet grows, more and more entries are required for routers to handle the routing of IP datagrams, which causes performance problems for routers. Attempting to reduce inefficient address space allocation leads to even more router table entries.

Drawbacks of classful addressing ★★★ Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand the need for classless addressing.
- ★ Identify valid and invalid subnet mask.

Outcomes ★★★ Neso Academy

## DRAWBACKS OF CLASSFUL ADDRESSING

- ★ **Lack of Internal Address Flexibility:** Big organizations are assigned large, “monolithic” blocks of addresses that don't match well the structure of their underlying internal networks.
- ★ **Inefficient Use of Address Space:** The existence of only three block sizes (classes A, B and C) leads to waste of limited IP address space.
- ★ **Proliferation of Router Table Entries:** As the Internet grows, more and more entries are required for routers to handle the routing of IP datagrams, which causes performance problems for routers. Attempting to reduce inefficient address space allocation leads to even more router table entries.

Drawbacks of classful addressing★★★Neso Academy

## CLASSLESS ADDRESSING

- ★ Formal name is Classless Inter-Domain Routing (CIDR).
- ★ Created a new set of standards that allowed service providers to allocate IPv4 addresses on any address bit boundary (prefix length) instead of only by a class A, B, or C address.
- ★ Classless addressing is possible with the help of subnetting.

Classless Addressing★★★Neso Academy

## VALID SUBNET MASKS

Valid Subnet Masks								
Subnet Value	Bit Value							
	128	64	32	16	8	4	2	1
255	1	1	1	1	1	1	1	1
254	1	1	1	1	1	1	1	0
252	1	1	1	1	1	1	0	0
248	1	1	1	1	1	0	0	0
240	1	1	1	1	0	0	0	0
224	1	1	1	0	0	0	0	0
192	1	1	0	0	0	0	0	0
128	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Valid Subnet masksNeso Academy

## VALID SUBNET MASKS

/n	Mask	/n	Mask	/n	Mask	/n	Mask
/1	128.0.0.0	/9	255.128.0.0	/17	255.255.128.0	/25	255.255.255.128
/2	192.0.0.0	/10	255.192.0.0	/18	255.255.192.0	/26	255.255.255.192
/3	224.0.0.0	/11	255.224.0.0	/19	255.255.224.0	/27	255.255.255.224
/4	240.0.0.0	/12	255.240.0.0	/20	255.255.240.0	/28	255.255.255.240
/5	248.0.0.0	/13	255.248.0.0	/21	255.255.248.0	/29	255.255.255.248
/6	252.0.0.0	/14	255.252.0.0	/22	255.255.252.0	/30	255.255.255.252
/7	254.0.0.0	/15	255.254.0.0	/23	255.255.254.0	/31	255.255.255.254
/8	255.0.0.0	/16	255.255.0.0	/24	255.255.255.0	/32	255.255.255.255

/1:10000000.00000000.00000000.00000000

Valid Subnet masksNeso Academy

## VALID SUBNET MASKS

/n	Mask	/n	Mask	/n	Mask	/n	Mask
/1	128.0.0.0	/9	255.128.0.0	/17	255.255.128.0	/25	255.255.255.128
/2	192.0.0.0	/10	255.192.0.0	/18	255.255.192.0	/26	255.255.255.192
/3	224.0.0.0	/11	255.224.0.0	/19	255.255.224.0	/27	255.255.255.224
/4	240.0.0.0	/12	255.240.0.0	/20	255.255.240.0	/28	255.255.255.240
/5	248.0.0.0	/13	255.248.0.0	/21	255.255.248.0	/29	255.255.255.248
/6	252.0.0.0	/14	255.252.0.0	/22	255.255.252.0	/30	255.255.255.252
/7	254.0.0.0	/15	255.254.0.0	/23	255.255.254.0	/31	255.255.255.254
/8	255.0.0.0	/16	255.255.0.0	/24	255.255.255.0	/32	255.255.255.255

/2 : 11000000.00000000.00000000.00000000

Valid Subnet masksNeso Academy

## VALID SUBNET MASKS

/n	Mask	/n	Mask	/n	Mask	/n	Mask
/1	128.0.0.0	/9	255.128.0.0	/17	255.255.128.0	/25	255.255.255.128
/2	192.0.0.0	/10	255.192.0.0	/18	255.255.192.0	/26	255.255.255.192
/3	224.0.0.0	/11	255.224.0.0	/19	255.255.224.0	/27	255.255.255.224
/4	240.0.0.0	/12	255.240.0.0	/20	255.255.240.0	/28	255.255.255.240
/5	248.0.0.0	/13	255.248.0.0	/21	255.255.248.0	/29	255.255.255.248
/6	252.0.0.0	/14	255.252.0.0	/22	255.255.252.0	/30	255.255.255.252
/7	254.0.0.0	/15	255.254.0.0	/23	255.255.254.0	/31	255.255.255.254
/8	255.0.0.0	/16	255.255.0.0	/24	255.255.255.0	/32	255.255.255.255

/3 : 11100000.00000000.00000000.00000000

Valid Subnet masksNeso Academy

## VALID SUBNET MASKS

<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>
<b>/1</b>	<b>128.0.0.0</b>	<b>/9</b>	<b>255.128.0.0</b>	<b>/17</b>	<b>255.255.128.0</b>	<b>/25</b>	<b>255.255.255.128</b>
<b>/2</b>	<b>192.0.0.0</b>	<b>/10</b>	<b>255.192.0.0</b>	<b>/18</b>	<b>255.255.192.0</b>	<b>/26</b>	<b>255.255.255.192</b>
<b>/3</b>	<b>224.0.0.0</b>	<b>/11</b>	<b>255.224.0.0</b>	<b>/19</b>	<b>255.255.224.0</b>	<b>/27</b>	<b>255.255.255.224</b>
<b>/4</b>	<b>240.0.0.0</b>	<b>/12</b>	<b>255.240.0.0</b>	<b>/20</b>	<b>255.255.240.0</b>	<b>/28</b>	<b>255.255.255.240</b>
<b>/5</b>	<b>248.0.0.0</b>	<b>/13</b>	<b>255.248.0.0</b>	<b>/21</b>	<b>255.255.248.0</b>	<b>/29</b>	<b>255.255.255.248</b>
<b>/6</b>	<b>252.0.0.0</b>	<b>/14</b>	<b>255.252.0.0</b>	<b>/22</b>	<b>255.255.252.0</b>	<b>/30</b>	<b>255.255.255.252</b>
<b>/7</b>	<b>254.0.0.0</b>	<b>/15</b>	<b>255.254.0.0</b>	<b>/23</b>	<b>255.255.254.0</b>	<b>/31</b>	<b>255.255.255.254</b>
<b>/8</b>	<b>255.0.0.0</b>	<b>/16</b>	<b>255.255.0.0</b>	<b>/24</b>	<b>255.255.255.0</b>	<b>/32</b>	<b>255.255.255.255</b>

/19 : 11111111.11111111.11100000.00000000

Valid Subnet masksNeso Academy

## VALID SUBNET MASKS

<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>	<i>/n</i>	<i>Mask</i>
<b>/1</b>	<b>128.0.0.0</b>	<b>/9</b>	<b>255.128.0.0</b>	<b>/17</b>	<b>255.255.128.0</b>	<b>/25</b>	<b>255.255.255.128</b>
<b>/2</b>	<b>192.0.0.0</b>	<b>/10</b>	<b>255.192.0.0</b>	<b>/18</b>	<b>255.255.192.0</b>	<b>/26</b>	<b>255.255.255.192</b>
<b>/3</b>	<b>224.0.0.0</b>	<b>/11</b>	<b>255.224.0.0</b>	<b>/19</b>	<b>255.255.224.0</b>	<b>/27</b>	<b>255.255.255.224</b>
<b>/4</b>	<b>240.0.0.0</b>	<b>/12</b>	<b>255.240.0.0</b>	<b>/20</b>	<b>255.255.240.0</b>	<b>/28</b>	<b>255.255.255.240</b>
<b>/5</b>	<b>248.0.0.0</b>	<b>/13</b>	<b>255.248.0.0</b>	<b>/21</b>	<b>255.255.248.0</b>	<b>/29</b>	<b>255.255.255.248</b>
<b>/6</b>	<b>252.0.0.0</b>	<b>/14</b>	<b>255.252.0.0</b>	<b>/22</b>	<b>255.255.252.0</b>	<b>/30</b>	<b>255.255.255.252</b>
<b>/7</b>	<b>254.0.0.0</b>	<b>/15</b>	<b>255.254.0.0</b>	<b>/23</b>	<b>255.255.254.0</b>	<b>/31</b>	<b>255.255.255.254</b>
<b>/8</b>	<b>255.0.0.0</b>	<b>/16</b>	<b>255.255.0.0</b>	<b>/24</b>	<b>255.255.255.0</b>	<b>/32</b>	<b>255.255.255.255</b>

/30 : 11111111.11111111.11111111.11111100

Valid Subnet masksNeso Academy

## ACTIVITY TIME

### Valid and Invalid Subnet Masks

Subnet Mask (Decimal)	Subnet Mask (Binary)	Valid/ Invalid
255.255.255.240	11111111.11111111.11111111.11110000	Valid
255.230.255.0	11111111.11100110.11111111.00000000	Invalid
255.255.0.0	11111111.11111111.00000000.00000000	Valid
240.0.0.0	11110000.00000000.00000000.00000000	Valid
223.0.0.0	11011111.00000000.00000000.00000000	Invalid
255.0.255.0	11111111.00000000.11111111.00000000	Invalid

Activity TimeNeso Academy

## HOMEWORK!

Identify the Invalid subnet mask from the following.

- a. 255.240.0.0
- b. 248.0.0.0
- c. 255.255.128.0
- d. 255.255.255.252
- e. 255.255.242.0

Homework!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand subnetting.
- ★ Know the procedure to subnet a network.

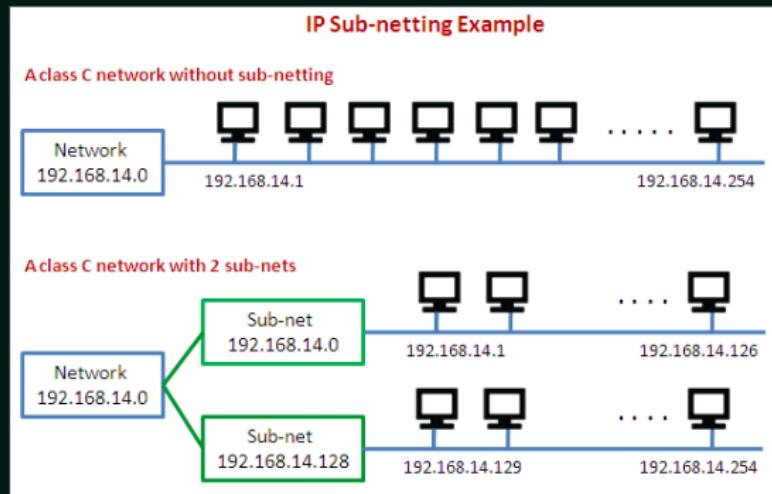
Outcomes ★★ Neso Academy

## SUBNETTING

- ★ A subnetwork or subnet is a logical subdivision of an IP network.
- ★ The practice of dividing a network into two or more networks is called subnetting.
- ★ Computers that belong to a subnet are addressed with an identical most-significant bit-group in their IP addresses.

Subnetting ★★★ Neso Academy

## SUBNETTING



Subnetting Neso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Subnetting -5 Steps Neso Academy

## UNDERSTAND SUBNETTING

10.10.10.1

255.255.255.0 or 255.255.0.0 or 255.0.0.0 ; Same Network

10.10.10.9

but...



10.10.10.1

255.255.255.248 ; Different Network

10.10.10.9



Understand subnetting Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Subnet the given network based on host requirements.

Outcomes ★ Neso Academy

## QUESTION

Subnet the IP address 216.21.5.0 into 30 hosts in each subnet.

Neso Academy

QuestionNeso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Neso Academy

Subnetting -5 StepsNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

SolutionNeso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Subnetting -5 StepsNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

SolutionNeso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Subnetting -5 StepsNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 30 (11110) – 5 bits SG: 32 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0

SolutionNeso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Subnetting -5 StepsNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 30 (11110) – 5 bits SG: 32 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 **1** 0 0 0 0 0

1. New subnet mask: 255.255.255.224 or /27

SolutionNeso Academy

## SUBNETTING – 5 STEPS

1. Identify the class of the IP address and note the Default Subnet Mask.
2. Convert the Default Subnet Mask into Binary.
3. Note the number of hosts required per subnet and find the Subnet Generator (SG) and octet position.
4. Generate the new subnet mask.
5. Use the SG and generate the network ranges (subnets) in the appropriate octet position.

Subnetting -5 StepsNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 30 (11110) – 5 bits SG: 32 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0

1. New subnet mask: 255.255.255.224 or /27

2. Network Ranges (Subnets)

216.215.0 – 216.215.31

216.215.32 – 216.215.63

216.215.64 – 216.215.95

216.215.96 – 216.215.127

216.215.128 – 216.215.159

and so on....

Solution★Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Verify the subnetting using Cisco Packet Tracer.

Outcomes★Neso Academy

## QUESTION

Subnet the IP address 216.21.5.0 into 30 hosts in each subnet.

Neso Academy

QuestionNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 30 (11110) – 5 bits SG: 32 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 **1** 0 0 0 0 0

1. New subnet mask: 255.255.255.224 or /27

2. Network Ranges (Subnets)

216.21.5.0 – 216.21.5.31

216.21.5.32 – 216.21.5.63

216.21.5.64 – 216.21.5.95

216.21.5.96 – 216.21.5.127

216.21.5.128 – 216.21.5.159

and so on....

Neso Academy

SolutionNeso Academy

## VERIFYING THE SUBNETTING USING CPT

### Subnetworks

216.21.5.0 – 216.21.5.31

216.21.5.32 – 216.21.5.63

216.21.5.64 – 216.21.5.95

New subnet mask: 255.255.255.224 or /27

216.21.5.96 – 216.21.5.127

216.21.5.128 – 216.21.5.159

and so on....

Verifying the subnetting using CPTNeso Academy

### QUESTION

Subnet the IP address 196.10.20.0 into 52 hosts in each subnet.

### SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 52 (110100) – 6 bits SG: 64 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 0 0 0 0 0 0

1. New subnet mask: 255.255.255.192 or /26

2. Network Ranges (Subnets)

196.10.20.0 – 196.10.20.63

$2^2 = 4$  Networks

196.10.20.64 – 196.10.20.127

$2^6 = 64$  Hosts per Network (Subnet)

196.10.20.128 – 196.10.20.191

196.10.20.192 – 196.10.20.255

QuestionSolutionNeso Academy

## QUESTION

Subnet the IP address 150.15.0.0 into 500 hosts in each subnet.

Neso Academy

QuestionNeso Academy

## SOLUTION

1. Class B – Default Subnet Mask: 255.255.0.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet:  $500(11110100)-9$  bits SG: 2 Octet Position: 3

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 0 . 0 0 0 0 0 0 0

1. New subnet mask: 255.255.254.0 or /23

2. Network Ranges (Subnets)

150.15.0.0 – 150.15.1.255

$2^9 = 512$  Hosts per Network (Subnet)

150.15.2.0 – 150.15.3.255

$2^7 = 128$  Subnets (Networks)

150.15.4.0 – 150.15.5.255

150.15.6.0 – 150.15.7.255

150.15.8.0 – 150.15.9.255

and so on....

Neso Academy

SolutionNeso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Subnet the given network based on host requirements.
- ★ Find the number of networks (subnets).
- ★ Find the number of hosts per network (subnet).

Outcomes ★★★ Neso Academy

## QUESTION

Subnet the IP address 10.0.0.0 into 100 hosts in each subnet.

Question Neso Academy

## SOLUTION

1. Class A – Default Subnet Mask: 255.0.0.0

1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 100(1100100)-7 bits SG: 128 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 0 0 0 0 0 0 0

1. New subnet mask: 255.255.255.128 or /25

2. Network Ranges (Subnets)

10.0.0.0 – 10.0.0.127

10.0.0.128 – 10.0.0.255

10.0.1.0 – 10.0.1.127

10.0.1.128 – 10.0.1.255

10.0.2.0 – 10.0.2.127

and so on....

SolutionNeso Academy

## SOLUTION

1. Class A – Default Subnet Mask: 255.0.0.0

1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 100(1100100)-7 bits SG: 128 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 0 0 0 0 0 0 0

1. New subnet mask: 255.255.255.128 or /25

2. Network Ranges (Subnets)

10.0.0.0 – 10.0.0.127

10.0.0.128 – 10.0.0.255

10.0.1.0 – 10.0.1.127

10.0.1.128 – 10.0.1.255

10.0.2.0 – 10.0.2.127

and so on....

$2^7 = 128$  Hosts per Network (Subnet)

$2^{17} = 131072$  Networks (Subnets)

SolutionNeso Academy

## TRY ON YOUR OWN!

1. Break 201.1.1.0 into networks of 40 hosts each.
2. Break 170.15.0.0 into networks of 1000 hosts each.
3. Break 15.0.0.0 into networks of 100 hosts each.

Neso Academy

Try on your own!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

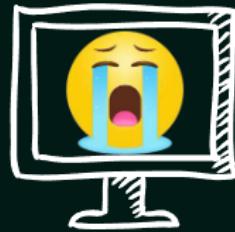
- ★ Troubleshoot the connectivity issue in the given subnet.

Neso Academy

Outcomes★Neso Academy

## QUESTION

Change the mood of the host from sad to happy.



192.168.1.127  
255.255.255.224

Neso Academy

QuestionNeso Academy

## SOLUTION

Subnet Mask: 255.255.255.224

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0

Subnet Generator (SG): 32

Network ranges:

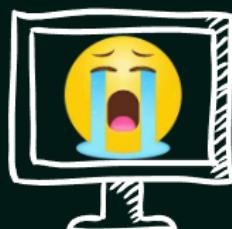
192.168.1.0 – 192.168.1.31

192.168.1.32 – 192.168.1.63

192.168.1.64 – 192.168.1.95

192.168.1.96 – 192.168.1.127

192.168.1.128 – 192.168.1.159



192.168.1.127  
255.255.255.224

Neso Academy

SolutionNeso Academy

## SOLUTION

Subnet Mask: 255.255.255.224

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0

Subnet Generator (SG): 32

**Network ranges:**

192.168.1.0 – 192.168.1.31

192.168.1.32 – 192.168.1.63

192.168.1.64 – 192.168.1.95

**192.168.1.96 – 192.168.1.127**

192.168.1.128 – 192.168.1.159



**192.168.1.  
255.255.255.224**

Neso Academy

SolutionNeso Academy

## SOLUTION

Subnet Mask: 255.255.255.224

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0

Subnet Generator (SG): 32

**Network ranges:**

192.168.1.0 – 192.168.1.31

192.168.1.32 – 192.168.1.63

192.168.1.64 – 192.168.1.95

**192.168.1.96 – 192.168.1.127**

192.168.1.128 – 192.168.1.159



**192.168.1.126  
255.255.255.224**

Neso Academy

SolutionNeso Academy

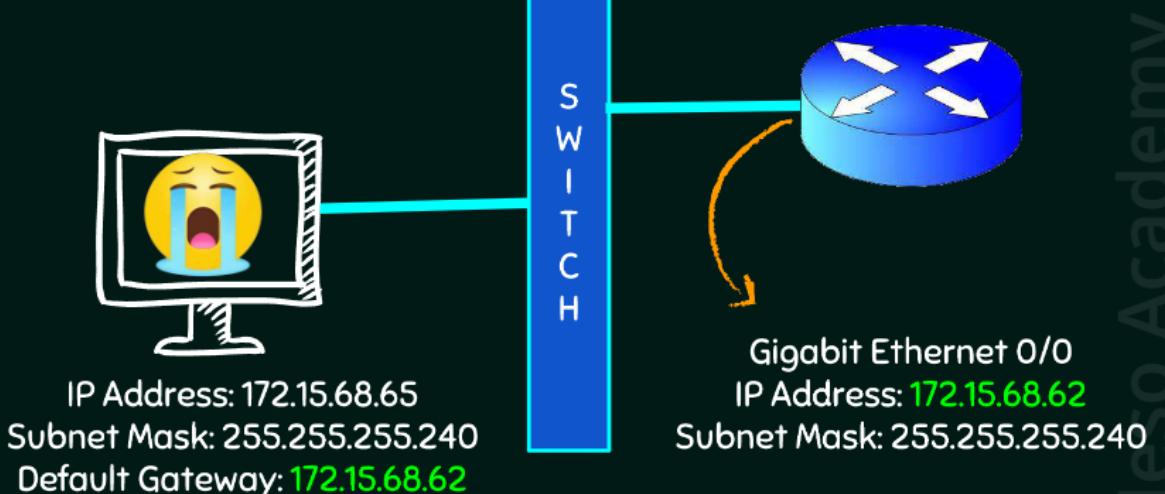
## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Troubleshoot the connectivity issue in the given subnet.

Outcomes★Neso Academy

## QUESTION



QuestionNeso Academy

## SOLUTION

Subnet Mask: 255.255.255.240

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 0 0 0 0

Subnet Generator (SG): 16

Network ranges:

172.15.68.0 – 172.15.68.15

172.15.68.16 – 172.15.68.31

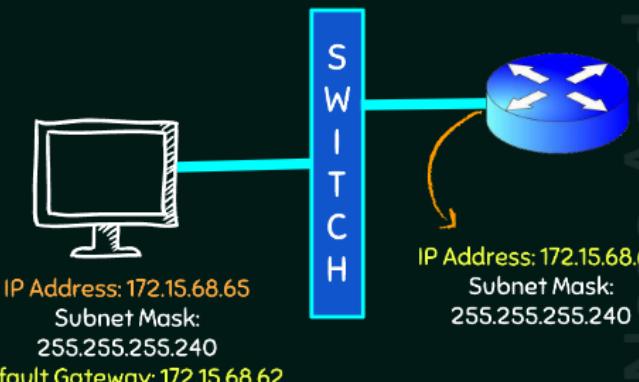
172.15.68.32 – 172.15.68.47

**172.15.68.48 – 172.15.68.63**

**172.15.68.64 – 172.15.68.79**

172.15.68.80 – 172.15.68.95

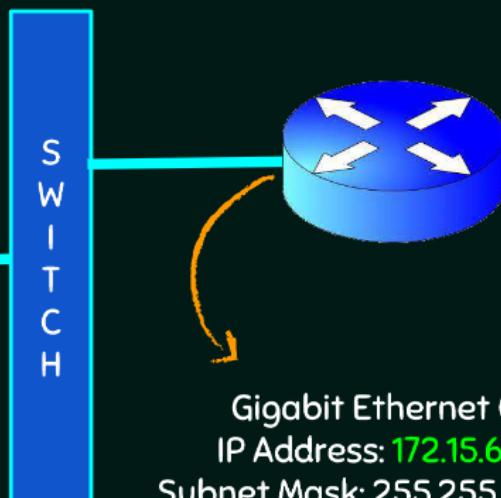
and so on



SolutionNeso Academy

## SOLUTION

IP Address: 172.15.68.60  
Subnet Mask: 255.255.255.240  
Default Gateway: 172.15.68.62



SolutionNeso Academy

## QUESTION

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) in this block?

QuestionNeso Academy

## SOLUTION

Class B subnet mask 255.255.0.0

1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0

SG = 1 and Octet Position = 2

Network Ranges (Subnets)

25.34.0.0 – 25.34.255.255

Network Address: 25.34.0.0

25.35.0.0 – 25.35.255.255

25.36.0.0 – 25.36.255.255

25.37.0.0 – 25.37.255.255

and so on

SolutionNeso Academy

## SOLUTION

25	.	34	.	12	.	56
00011001 . 00100010 . 00001100 . 00111000						
11111111 . 11111111 . 00000000 . 00000000						
<hr/>						
AND	00011001 . 00100010 . 00000000 . 00000000					
<hr/>						
25	.	34	.	0	.	0

 Network Address: 25.34.0.0

SolutionNeso Academy

## HOMEWORK!

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) in this block?

Homework!Neso Academy

## QUESTION

In a block of addresses, we know the IP address of one host is 25.34.12.56/16. What is the last address (limited broadcast address) in this block?

QuestionNeso Academy

## SOLUTION

Class B subnet mask 255.255.0.0

1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0

SG = 1 and Octet Position = 2

Network Ranges (Subnets)

25.34.0.0 – 25.34.255.255

25.35.0.0 – 25.35.255.255

25.36.0.0 – 25.36.255.255

25.37.0.0 – 25.37.255.255

and so on

Broadcast Address: 25.34.255.255

SolutionNeso Academy

## SOLUTION

25 . 34 . 12 . 56  
00011001 . 00100010 . 00001100 . 00111000  
00000000 . 00000000 . 11111111 . 11111111  
MaskComplement

Neso Academy

SolutionNeso Academy

## SOLUTION

25 . 34 . 12 . 56  
00011001 . 00100010 . 00001100 . 00111000  
00000000 . 00000000 . 11111111 . 11111111  
OR  
00011001 . 00100010 . 11111111 . 11111111  
25 . 34 . 255 . 255

Broadcast Address: 25.34.255.255

Neso Academy

SolutionNeso Academy

## HOMEWORK!

In a block of addresses, we know the IP address of one host is 182.44.82.16/26. What is the last address (limited broadcast address) in this block?

Homework!Neso Academy

## QUESTION

An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be

[GATE CS 2005]

- (A) 255.255.0.0
- (B) 255.255.64.0
- (C) 255.255.128.0
- (D) 255.255.252.0

QuestionNeso Academy

## SOLUTION

Class B – 255.255.0.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0

$2^{\text{No. of 1s}}$  = Total Number of Subnets.

$2^{\text{No. of 0s}}$  = Total Number of hosts per subnet.

Total number of subnets required: 64 ( $2^6$ )

Reserve 6 1s in 3<sup>rd</sup> octet.

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 0 0 . 0 0 0 0 0 0 0

New Subnet Mask: 255.255.252.0

Neso Academy

Solution Neso Academy

## QUESTION

An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be

[GATE CS 2005]

- (A) 255.255.0.0
- (B) 255.255.64.0
- (C) 255.255.128.0
- (D) 255.255.252.0 ✓

Neso Academy

Question ✓ Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Subnet the given network based on network requirements.

Outcomes★Neso Academy

## QUESTION

An organization has purchased a class C IP address 216.215.0 and it would like to use it for 5 departments. Subnet accordingly.

QuestionNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 52 (110100) – 6 bits SG: 64 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 0 0 0 0 0 0

1. New subnet mask: 255.255.255.192 or /26

2. Network Ranges (Subnets)

196.10.20.0 – 196.10.20.63

196.10.20.64 – 196.10.20.127

196.10.20.128 – 196.10.20.191

196.10.20.192 – 196.10.20.255

SolutionNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 52 (110100) – 6 bits SG: 64 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 0 0 0 0 0 0

1. New subnet mask: 255.255.255.192 or /26

2. Network Ranges (Subnets)

196.10.20.0 – 196.10.20.63

196.10.20.64 – 196.10.20.127

196.10.20.128 – 196.10.20.191

196.10.20.192 – 196.10.20.255

$2^2 = 4$  Networks

$2^6 = 64$  Hosts per Network (Subnet)

SolutionNeso Academy

## QUESTION

If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

[GATE CS 2008]

- (A) 1022
- (B) 1023
- (C) 2046
- (D) 2047

QuestionNeso Academy

## SOLUTION

Given subnet mask including subnetting 255.255.248.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 0 0 0 . 0 0 0 0 0 0 0 0

$2^5 = 32$  subnets possible

$2^{11} = 2048 - 2$  hosts possible per subnet.

Because the first address and last address are not used for host.

Therefore maximum number of hosts per subnet is 2046

SolutionNeso Academy

## QUESTION

If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

[GATE CS 2008]

- (A) 1022
- (B) 1023
- (C) 2046 ✓
- (D) 2047

Question✓Neso Academy

## QUESTION

The address of a class B host is to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

[GATE CS 2007]

- (A) 62 subnets and 262142 hosts
- (B) 64 subnets and 262142 hosts
- (C) 62 subnets and 1022 hosts
- (D) 64 subnets and 1024 hosts

QuestionNeso Academy

## SOLUTION

Class B subnet mask 255.255.0.0

6 bits are used for subnetting

255.255.1111100.00000000

New Subnet Mask: 255.255.252.0

$2^6 = 64$  subnets possible. (Maximum subnets:  $64 - 2 = 62$ )

$2^{10} = 1024$  hosts possible. (Maximum hosts:  $1024 - 2 = 1022$ )

Solution Neso Academy

## QUESTION

The address of a class B host is to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

[GATE CS 2007]

- (A) 62 subnets and 262142 hosts
- (B) 64 subnets and 262142 hosts
- (C) 62 subnets and 1022 hosts ✓
- (D) 64 subnets and 1024 hosts

Question ✓ Neso Academy

## QUESTION

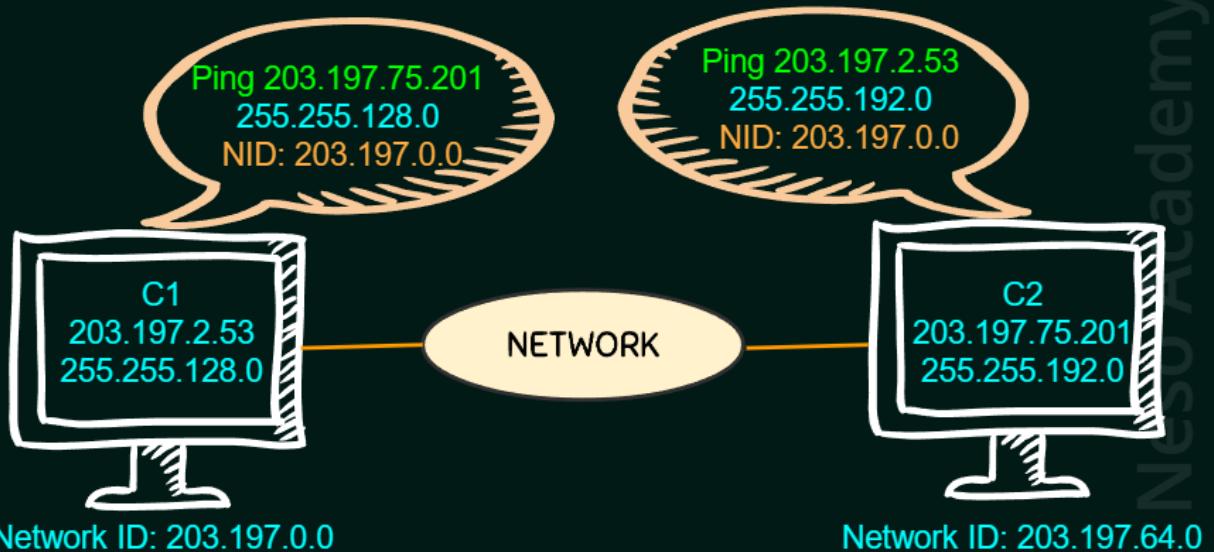
Two computers C1 and C2 are configured as follows. C1 has IP address 203.197.2.53 and netmask 255.255.128.0. C2 has IP address 203.197.75.201 and netmask 255.255.192.0. Which one of the following statements is true?

[GATE CS 2006]

- (A) C1 and C2 both assume they are on the same network.
- (B) C2 assumes C1 is on same network, but C1 assumes C2 is on a different network.
- (C) C1 assumes C2 is on same network, but C2 assumes C1 is on a different network.
- (D) C1 and C2 both assume they are on different networks.

QuestionNeso Academy

## SOLUTION



Solution  
C1 203.197.2.53 255.255.128.0  
C2 203.197.75.201 255.255.192.0  
Network ID: 203.197.0.0  
Network ID: 203.197.64.0  
Ping 203.197.75.201 255.255.192.0  
Ping 203.197.2.53 255.255.128.0  
NID: 203.197.0.0  
NID: 203.197.0.0  
Neso Academy

## QUESTION

Two computers C1 and C2 are configured as follows. C1 has IP address 203.197.2.53 and netmask 255.255.128.0. C2 has IP address 203.197.75.201 and netmask 255.255.192.0. Which one of the following statements is true?

[GATE CS 2006]

- (A) C1 and C2 both assume they are on the same network.
- (B) C2 assumes C1 is on same network, but C1 assumes C2 is on a different network.
- (C) C1 assumes C2 is on same network, but C2 assumes C1 is on a different network. ✓
- (D) C1 and C2 both assume they are on different networks.

Question✓Neso Academy

## QUESTION

Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both use the same netmask N. Which of the values of N given below should not be used if A and B should belong to the same network ?

[GATE CS 2010]

- (A) 225.255.255.0
- (B) 255.255.255.128
- (C) 255.255.255.192
- (D) 255.255.255.224

QuestionNeso Academy

## SOLUTION

IP Address of A: 10.105.1.113 and IP Address of B: 10.105.1.91

225.255.255.0	255.255.255.128	255.255.255.192	255.255.255.224
255.255.1111111.00000000	255.255.255.10000000	255.255.255.11000000	255.255.255.11100000
SG=1 OP=3	SG=128 OP=4	SG=64 OP=4	SG=32 OP=4
10.105.1.0 – 10.105.1.255	10.105.1.0 – 10.105.1.127	10.105.1.0 – 10.105.1.63	10.105.1.0 – 10.105.1.31
10.105.2.0 – 10.105.2.255	10.105.1.128 – 10.105.1.255	10.105.1.64 – 10.105.1.127	10.105.1.32 – 10.105.1.63
10.105.3.0 – 10.105.3.255	10.105.2.0 – 10.105.2.127	10.105.1.128 – 10.105.1.191	10.105.1.64 – 10.105.1.95
10.105.4.0 – 10.105.4.255	10.105.2.128 – 10.105.2.255	10.105.1.192 – 10.105.1.255	10.105.1.96 – 10.105.1.127
✓	✓	✓	X

Solution ✓✓XNeso Academy

## QUESTION

Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both use the same netmask N. Which of the values of N given below should not be used if A and B should belong to the same network ?

[GATE CS 2010]

- (A) 225.255.255.0
- (B) 255.255.255.128
- (C) 255.255.255.192
- (D) 255.255.255.224 ✓

Question ✓ Neso Academy

## QUESTION

In the IPv4 addressing format, the number of networks allowed under Class C addresses is

[GATE CS 2012]

- (A)  $2^{14}$
- (B)  $2^7$
- (C)  $2^{21}$
- (D)  $2^{24}$

QuestionNeso Academy

## CLASSES OF IPv4 ADDRESS

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0-127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets ( $2^7$ ) 16,777,214 hosts ( $2^{24}-2$ )
B	128-191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets ( $2^{14}$ ) 65,534 hosts ( $2^{16}-2$ )
C	192-223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets ( $2^{21}$ ) 254 hosts ( $2^8-2$ )
D	224-239	11100000 - 11101111	NA (Multicast)	-	-
E	240-255	11110000 - 11111111	NA (Experimental)	-	-

Classes of IPv4 address 00000000 -011111110000000 -101111111000000

-110111111100000 -111011111110000 -11111111 Neso Academy

## QUESTION

In the IPv4 addressing format, the number of networks allowed under Class C addresses is

[GATE CS 2012]

- (A)  $2^{24}$
- (B)  $2^{16}$
- (C)  $2^{21}$  ✓
- (D)  $2^{24}$

Question✓Neso Academy

## HOMEWORK!

In the IPv4 addressing format, the number of hosts allowed under Class C addresses is

[GATE CS 2012]

- (A)  $2^1$
- (B)  $2^7$
- (C)  $2^{21}$
- (D)  $2^{24}$

Homework!Neso Academy

## OUTCOMES

Upon the completion of this session, the learner will be able to

- ★ Understand FLSM.
- ★ Know about VLSM.

Outcomes ★★ Neso Academy

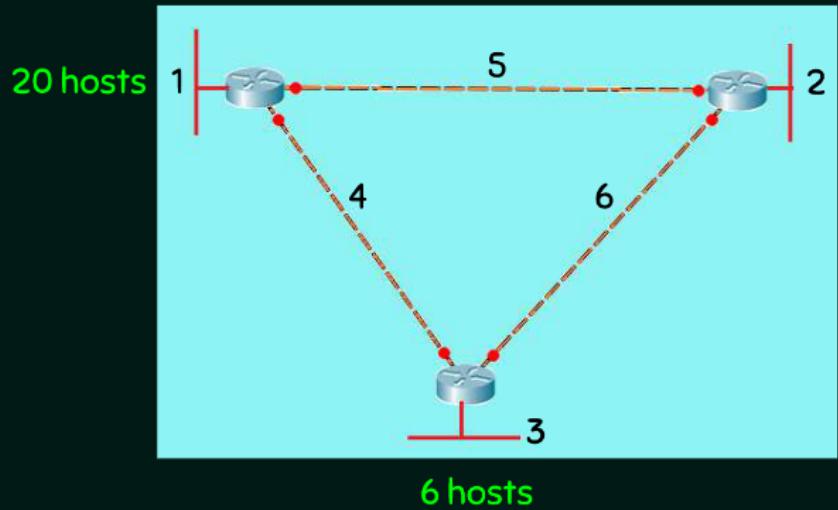
## FLSM Vs VLSM

FLSM = Fixed Length Subnet Masking

VLSM = Variable Length Subnet Masking

FLSM Vs VLSM Neso Academy

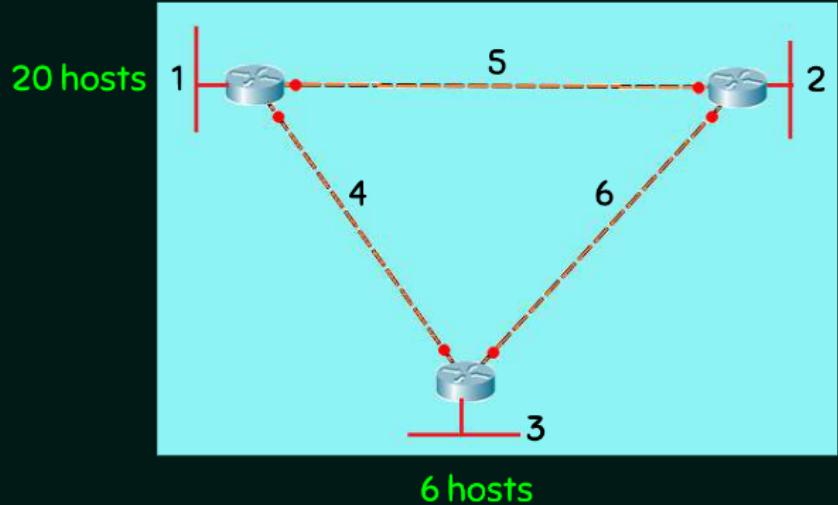
## HOW MANY NETWORKS ARE THERE?



CLASSFUL ADDRESSING  
216.21.5.0 – 216.21.5.255  
216.21.6.0 – 216.21.6.255  
216.21.7.0 – 216.21.7.255  
216.21.8.0 – 216.21.8.255  
216.21.9.0 – 216.21.9.255  
216.21.10.0 – 216.21.10.255  
SUBNET MASK:  
255.255.255.0 or /24

How many networks are there? Neso Academy

## HOW MANY NETWORKS ARE THERE?

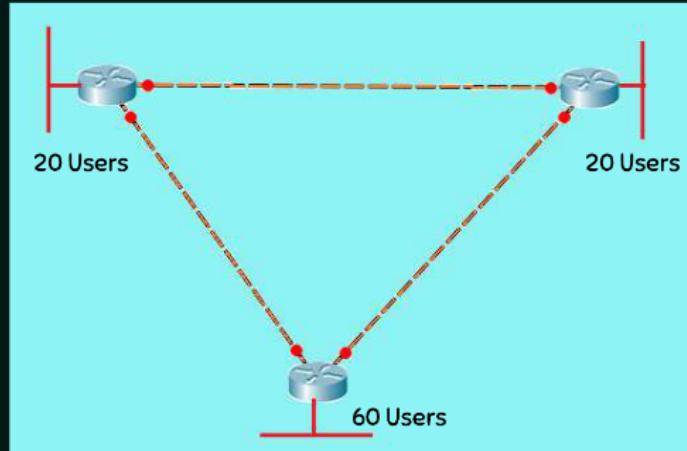


CLASSLESS ADDRESSING  
216.21.5.0 – 216.21.5.31  
216.21.5.32 – 216.21.5.63  
216.21.5.64 – 216.21.5.95  
216.21.5.96 – 216.21.5.127  
216.21.5.128 – 216.21.5.159  
216.21.5.160 – 216.21.5.191  
NEW SUBNET MASK:  
255.255.255.224 or /27

How many networks are there? Neso Academy

## QUESTION

Subnet 192.168.10.0/24 to address the network by using the most efficient addressing possible.

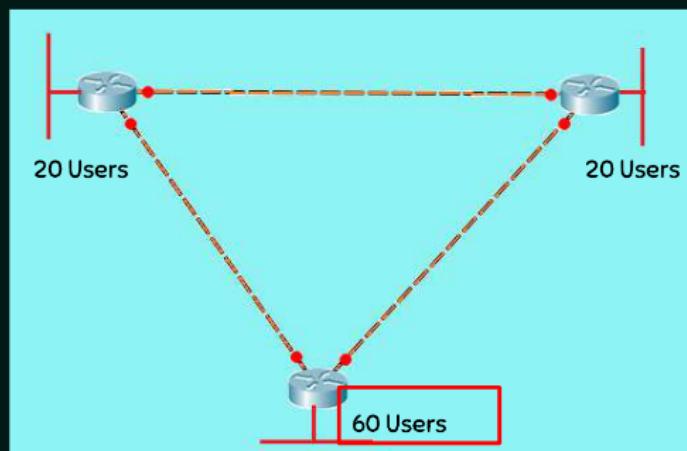


Neso Academy

QuestionNeso Academy

## KEY IDEA

Start with the largest subnet first



Neso Academy

Key IdeaNeso Academy

## SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

2. No. of hosts/subnet: 2 (10) – 2 bits SG: 4 Octet Position: 4

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 1 0 0

1. New subnet mask: 255.255.255.252 or /30

2. Network Ranges (Subnets)

192.168.10.0 – 192.168.10.63 /26 (Handover this to 60 Users Network)

192.168.10.64 – 192.168.10.95 /27 (Handover this to 20 Users Network)

192.168.10.96 – 192.168.10.127 /27 (Handover this to another 20 Users Network)

192.168.10.128–192.168.10.131 / 30 (Handover this to Crossover Link)

192.168.10.132–192.168.10.135 / 30 (Handover this to Crossover Link)

192.168.10.136 –192.168.10.139 / 30 (Handover this to Crossover Link)

SolutionNeso Academy

## SOLUTION

192.168.10.0 – 192.168.10.63 /26 (Handover this to 60 Users Network)

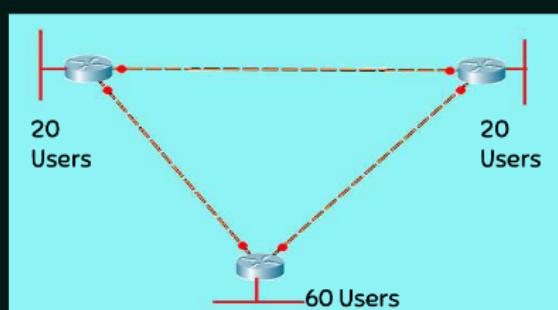
192.168.10.64 – 192.168.10.95 /27 (Handover this to 20 Users Network)

192.168.10.96 – 192.168.10.127 /27 (Handover this to another 20 Users Network)

192.168.10.128–192.168.10.131 / 30 (Handover this to Crossover Link)

192.168.10.132–192.168.10.135 / 30 (Handover this to Crossover Link)

192.168.10.136 –192.168.10.139 / 30 (Handover this to Crossover Link)



SolutionNeso Academy

## QUESTION

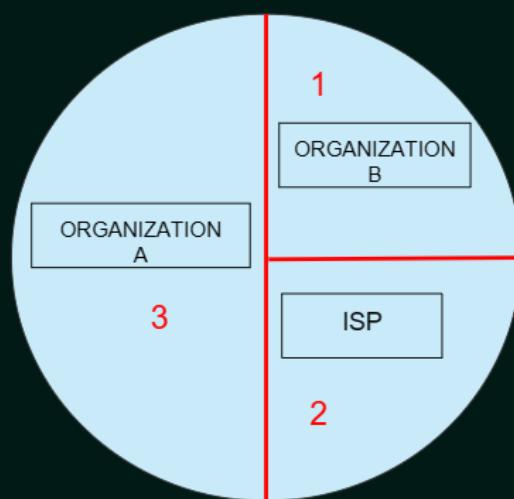
An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it: 245.248.128.0/20. The ISP wants to give half of this chunk of addresses to Organization A, and a quarter to Organization B, while retaining the remaining with itself. Which of the following is a valid allocation of addresses to A and B?

[GATE CS 2012]

- (A) 245.248.136.0/21 and 245.248.128.0/22
- (B) 245.248.128.0/21 and 245.248.128.0/22
- (C) 245.248.132.0/22 and 245.248.132.0/21
- (D) 245.248.136.0/24 and 245.248.132.0/21

QuestionNeso Academy

## QUESTION



QuestionORGANIZATIONBISPORGANIZATIONA123Neso Academy

**SOLUTION**

1. Subnet Mask: /20

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 0 0 0 . 0 0 0 0 0 0 0

1. No. of hosts =  $2^{\text{No. of 0's}} = 2^{12}$

2. Handover quarter of the address to Organization B =  $2^{12}/4 = 2^{12}/2^2 = 2^{10}$

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 0 0 . 0 0 0 0 0 0 0

SG=4, OP=3, Starting Address = 245.248.128.0 /22 to 245.248.131.255 /22

1. Handover another quarter of address to ISP itself.

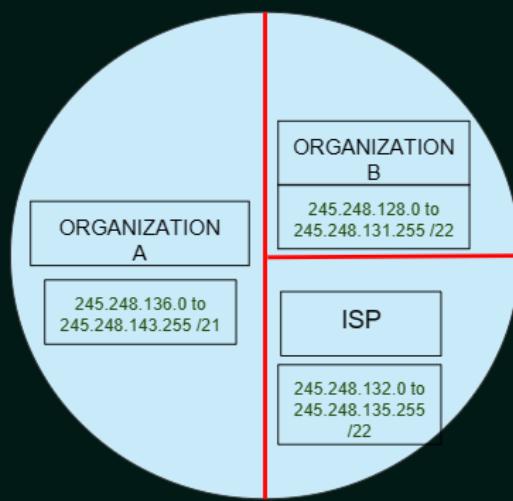
SG=4, OP=3, Starting Address = 245.248.132.0 /22 to 245.248.135.255 /22

1. Handover half of the addresses to Organization A =  $2^{12}/2 = 2^{11}$

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 . 1 1 1 1 1 0 0 . 0 0 0 0 0 0 0

SG=8, OP=3, Starting Address = 245.248.136.0 /21 to 245.248.143.255 /21

SolutionNeso Academy

**SOLUTION**

ORGANIZATIONBISPORGANIZATIONASolution  
245.248.128.0 to 245.248.131.255 /22  
245.248.132.0 to 245.248.135.255 /22  
245.248.136.0 to 245.248.143.255 /21  
Neso Academy

## QUESTION

An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it: 245.248.128.0/20. The ISP wants to give half of this chunk of addresses to Organization A, and a quarter to Organization B, while retaining the remaining with itself. Which of the following is a valid allocation of addresses to A and B?

[GATE CS 2012]

- (A) 245.248.136.0/21 and 245.248.128.0/22 ✓
- (B) 245.248.128.0/21 and 245.248.128.0/22
- (C) 245.248.132.0/22 and 245.248.132.0/21
- (D) 245.248.136.0/24 and 245.248.132.0/21

Question✓Neso Academy

## QUESTION

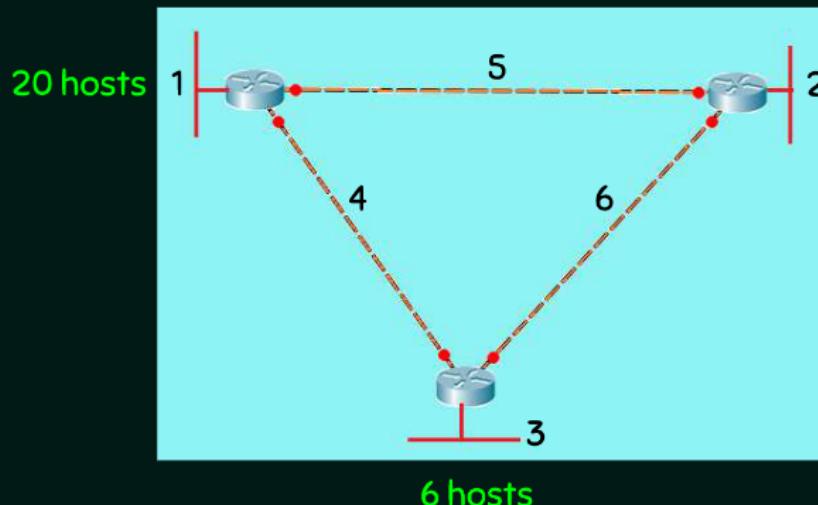
An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it: 245.248.128.0/20. The ISP wants to give half of the chunk of addresses to Organization A, and a quarter to Organization B, while retaining the remaining with itself. Which of the following is a valid allocation of addresses to A and B?

[GATE CS 2012]

- a. 245.248.136.0/21 and 245.248.128.0/22
- b. 245.248.128.0/21 and 245.248.128.0/22
- c. 245.248.132.0/22 and 245.248.132.0/21
- d. 245.248.136.0/24 and 245.248.132.0/21

QuestionNeso Academy

## HOW MANY NETWORKS ARE HERE?



216.21.5.0 – 216.21.5.31  
216.21.5.32 – 216.21.5.63  
216.21.5.64 – 216.21.5.95  
216.21.5.96 – 216.21.5.127  
216.21.5.128 – 216.21.5.159  
216.21.5.160 – 216.21.5.191

New subnet mask:  
255.255.255.224 or /27