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).

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

Invalid IP Address

56.89.1.2.5

10.065.34.56

200.28.256.8

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

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

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

$\boxed{128 + 64 + 32 + 8 + 4 + 2 + 1 = 239}$

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

129.11.75.239

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

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

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)	–	–

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)

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 ($2^{24}-2$)
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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)	–	–

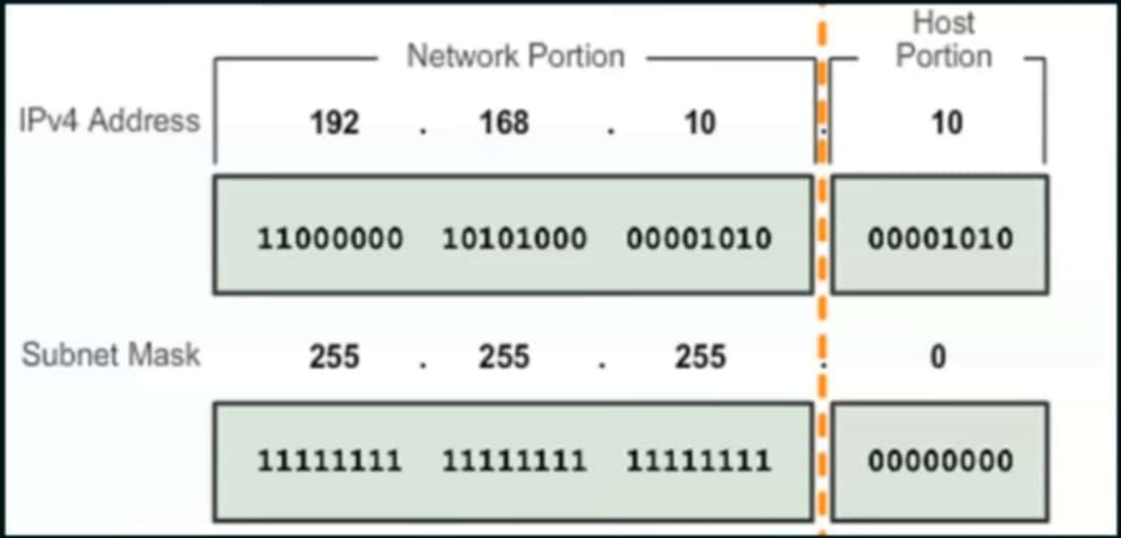
SUBNET MASK (SLASH NOTATION)

Class	Subnet Mask (in Decimal)	Subnet Mask (in Binary)	Slash Notation
A	255.0.0.0	11111111.00000000.00000000.00000000	/8
B	255.255.0.0	11111111.11111111.00000000.00000000	/16
C	255.255.255.0	11111111.11111111.11111111.00000000	/24

Subnet Mask

★ To define the network and host portions of an address, a 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



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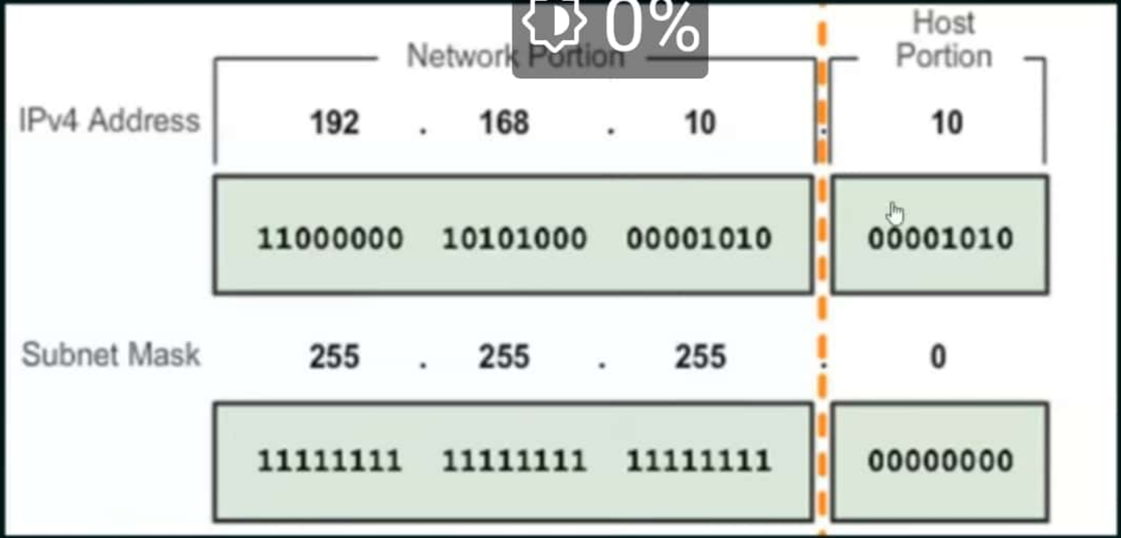


Subnet Mask

10.10.10.1
10.10.20.16
255.0.0.0 ; Same N/W

10.10.10.1
10.10.20.16
255.255.255.0 ; Different N/W

172.16.200.1
172.16.165.2
255.255.0.0 ; Same N/W

172.16.200.1
172.16.165.2
255.255.255.0 ; Different N/W

10.10.36.1
10.10.12.1
255.255.0.0 ; Same N/W

10.10.36.1
10.10.12.1
255.255.255.0 ; Different N/W

Subnet Mask

IP addresses	Subnet mask	IP addresses	Subnet mask
10.10.10.1 10.10.20.16	255.0.0.0 ; Same N/W	10.10.10.1 10.10.20.16	255.255.255.0 ; Different N/W
172.16.200.1 172.16.165.2	255.255.0.0 ; Same N/W	172.16.200.1 172.16.165.2	255.255.255.0 ; Different N/W
10.10.36.1 10.10.12.1	255.255.0.0 ; Same N/W	10.10.36.1 10.10.12.1	255.255.255.0 ; Different N/W

Different ways of transmission in IPv4

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

Different ways of transmission in IPv4

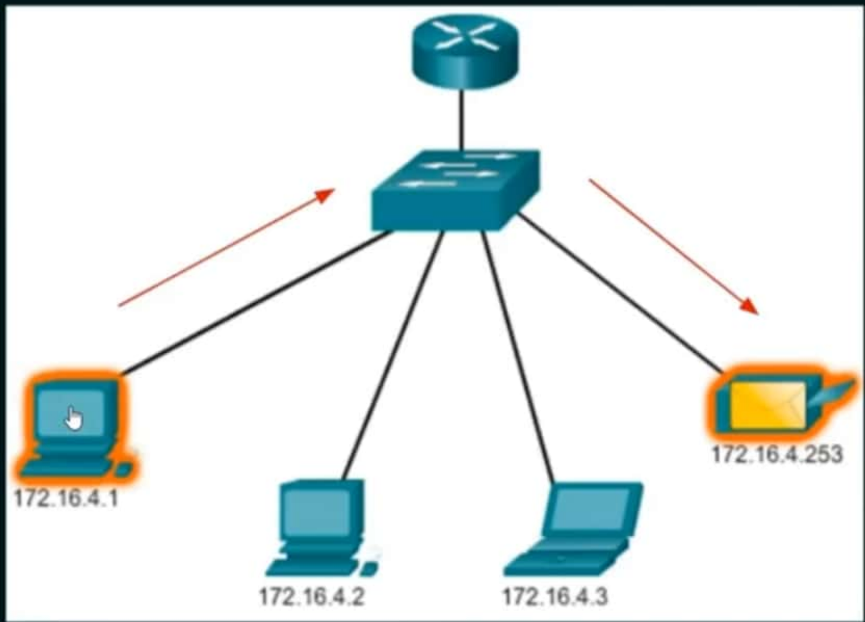
In an IPv4 network, the hosts can communicate one of three different ways:

1. Unicast
2. Broadcast
3. Multicast

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



Broadcast transmission

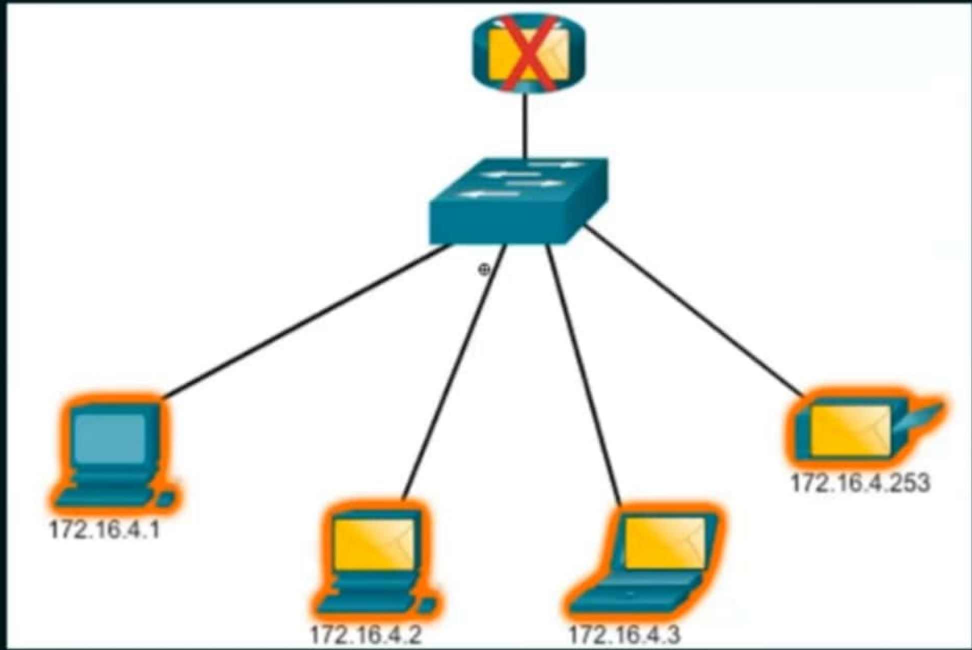
Broadcast Transmission: The process of sending a packet from one host to all hosts in the network.

Source: 172.16.4.1
Destination: 255.255.255.255

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!

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)

QUESTION

A host in a class C network has been assigned an IP address 192.168.17.9. Find the number of addresses in the block, the first address, and the last address.

SOLUTION:

Class C Network

N.N.N.H (255.255.255.0 or /24)

192.168.17.9

This network: 192.168.17.0 – 192.168.17.255

Number of addresses: $2^8 = 256$

Number of usable addresses: $256 - 2 = 254$

First Address: 192.168.17.0 (Network Address)

Last Address: 192.168.17.255 (Broadcast Address)

QUESTION

An address in a block is given as 185.28.17.9. Find the number of addresses in the block, the first address, and the last address.

SOLUTION:

Class B Network

N.N.H.H (255.255.0.0 or /16)

0%

185.28.17.9

This network: 185.28.0.0 – 185.28.255.255

Number of addresses: $2^{16} = 65536$

Number of usable addresses: $65536 - 2 = 65534$

First Address: 185.28.0.0 (Network Address)

Last Address: 185.28.255.255 (Broadcast Address)

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)

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

- ★ 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.

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

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).

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.

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.

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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 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

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

7:58 PM 8.5KB/s 47

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

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Comments

@arunkumar008 • 4 mo ago
All four are valid subnets ,, Excellent Video & Coaching ,.It helped me alot lot lot .. NESO ...

@subhadeepbhakat7765 • 1 yr ago
1. /12 (valid)
2. /5 (valid)
3. /17 (valid)
4. /30 (valid)
5. Invalid

Please let me know if I'm correct

17

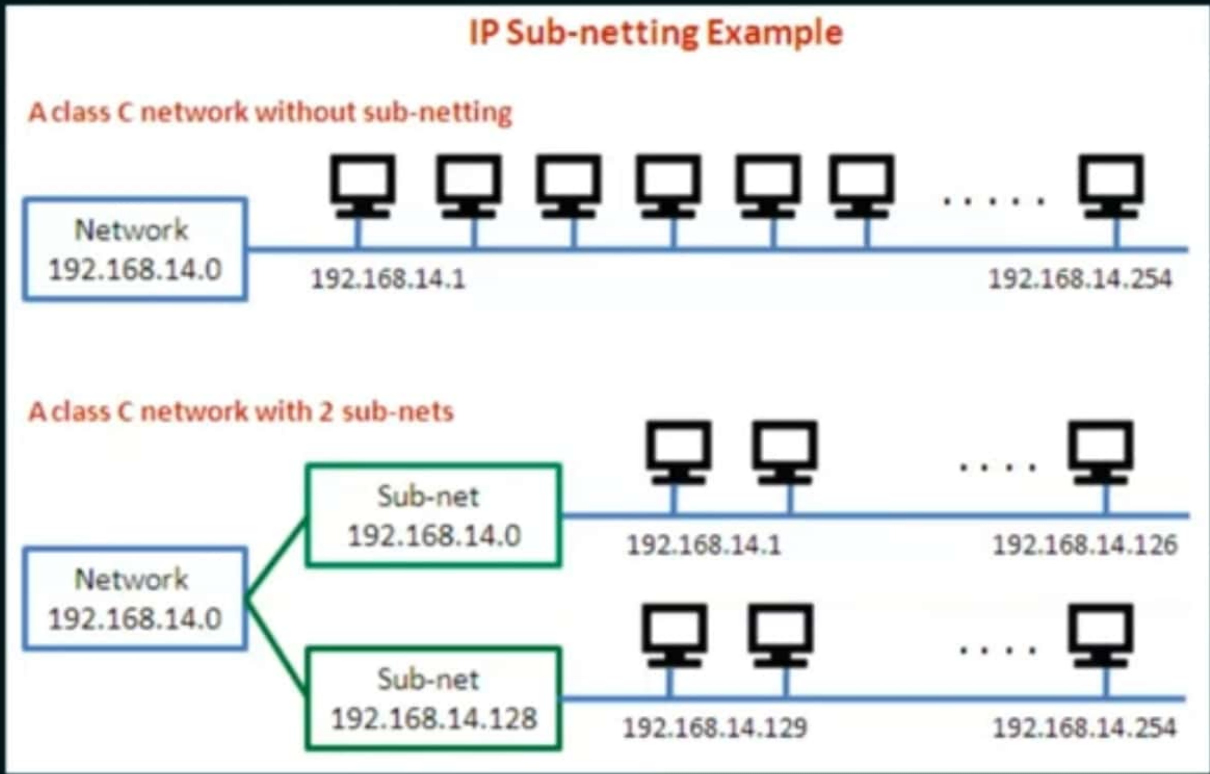
3 replies

@MdRizwan-qo3iu • 5 mo ago
Homework Question solution

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


IP Sub-netting Example
A class C network without sub-netting
Network
192.168.14.0
192.168.14.1
192.168.14.254
A class C network with 2 sub-nets
Network
192.168.14.0
Sub-net
192.168.14.0
192.168.14.1
192.168.14.126
Sub-net
192.168.14.128
192.168.14.129
192.168.14.254

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.

UNDERSTAND SUBNETTING

10.10.10.1

10.10.10.9

255.255.255.0 or 255.255.0.0 or 255.0.0.0 ; Same Network

but...

10.10.10.1

10.10.10.9

255.255.255.248 ; Different Network

QUESTION

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

SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

2. 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

3. No. of hosts/subnet: $\boxed{\text{30 (11110) – 5 bits}}$ SG: $\boxed{32}$ Octet Position: $\boxed{4}$

   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

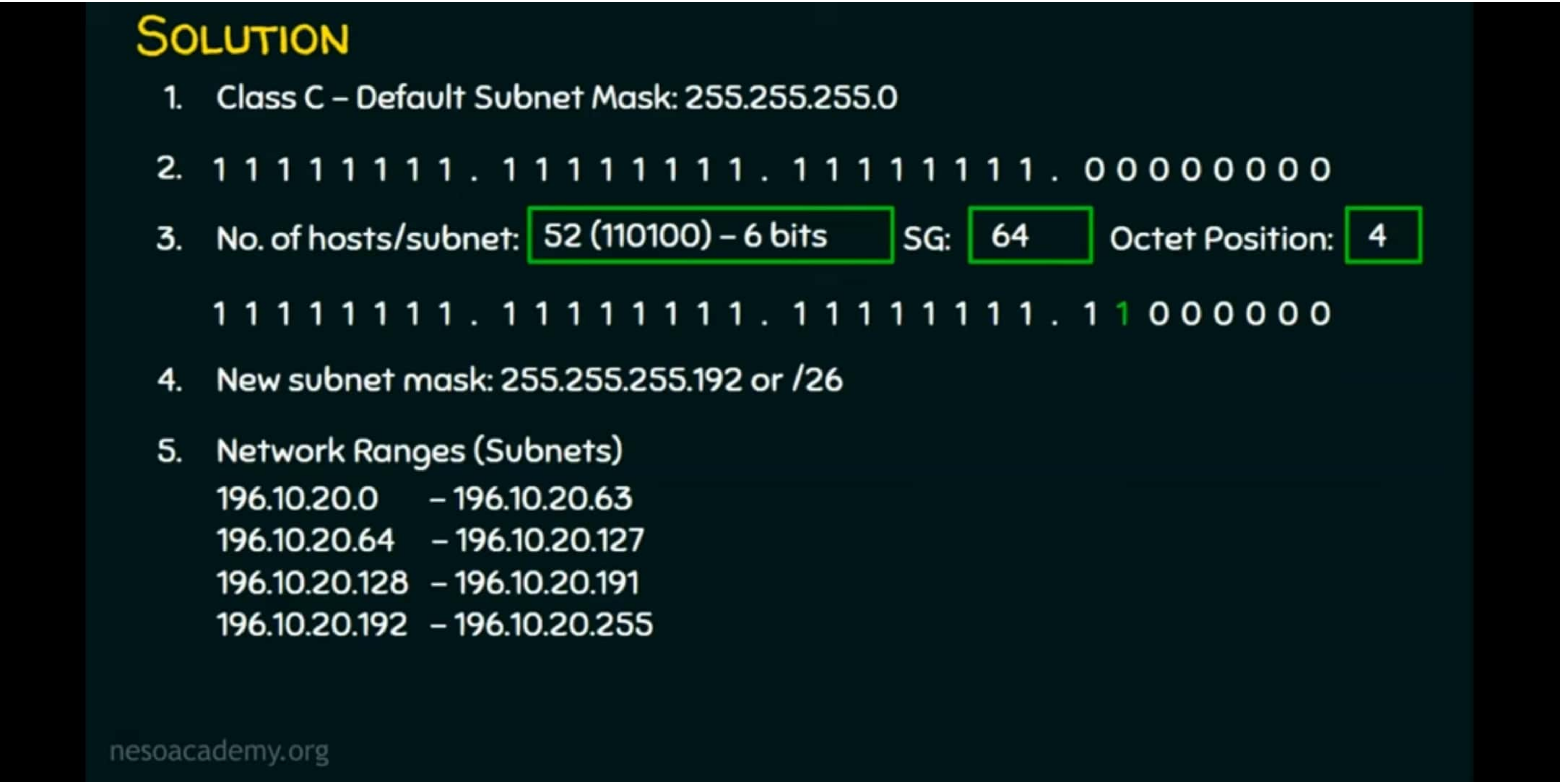
4. New subnet mask: 255.255.255.224 or /27

5. 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....

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
2. 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
3. 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
4. New subnet mask: 255.255.255.192 or /26
5. 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
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QUESTION

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

Solution

1. Class B – Default Subnet Mask: 255.255.0.0

2. 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

3. No. of hosts/subnet: $\boxed{\text{500(111110100)–9 bits}}$ SG: $\boxed{2}$ Octet Position: $\boxed{3}$

   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 0

4. New subnet mask: 255.255.254.0 or /23

5. Network Ranges (Subnets)

   150.15.0.0 – 150.15.1.255
   150.15.2.0 – 150.15.3.255
   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....

2^9 = 512 Hosts per Network (Subnet)
2^7 = 128 Subnets (Networks)

QUESTION

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

SOLUTION

1. Class A – Default Subnet Mask: 255.0.0.0

2. 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

3. No. of hosts/subnet: $\boxed{\text{100(1100100)–7 bits}}$ SG: $\boxed{128}$ Octet Position: $\boxed{4}$

   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

4. New subnet mask: 255.255.255.128 or /25

5. 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)

Solution

1. Class A – Default Subnet Mask: 255.0.0.0
2. 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
3. No. of hosts/subnet: $\boxed{\text{100(1100100)–7 bits}}$ SG: $\boxed{128}$ Octet Position: $\boxed{4}$

   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
4. New subnet mask: 255.255.255.128 or /25
5. 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 – 10.0.1.127
   10.0.2.0 – 10.0.2.127
   and so on....

2^7 = 128 Hosts per Network (Subnet)
2^{17} = 131072 Networks (Subnets)

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.

Comments

H.W.1 : Class C, 255.255.255.0, 40 Hosts Given so 101000 = 6 bits reserved from right to left, Subnet Generator = 64, Octet Position = 4, New Subnet Mask is 255.255.255.192 or /26, Number of Networks / Subnets = 2^2 = 4 and Usable Host IP Addresses = 2^6-2

H.W.2 : Class B, 255.255.0.0, 1000 Hosts Given so 1111101000 = 10 bits reserved from right to left, Subnet Generator = 4, Octet Position = 3, New Subnet Mask is 255.255.252.0 or /22, Number of Networks / Subnets = 2^6 and Usable Host IP Addresses = 2^10-2

H.W.3 : Class A, 255.0.0.0, 100 Hosts Given so 1100100 = 7 bits reserved from right to left, Subnet Generator = 128, Octet Position = 4, New Subnet Mask is 255.255.255.128 or /25, Number of Networks / Subnets = 2^17 and Usable Host IP Addresses = 2^7-2

8:30 PM ...2.8KB/s 41

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3. Break 15.0.0.0 into networks of 100 hosts each.

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Comments

Homework Answers✔✔✔✔

Answer 1: Given IP Add is 201.1.1.0, class C IP Address and default subnet mask is 255.255.255.0. Given number of hosts=40 which has 6 bits. So, Subnet generator will be 64 and Octet 4. New subnet mask will be 255.255.255.192 or /26. Number of subnets will be 2^2=4 and usable hosts in each subnet will be (2^6) - 2.

Answer 2: Given IP Add is 170.15.0.0, class B IP Address and default subnet mask is 255.255.0.0. Given number of hosts=1000 (binary 1111101000) which has 10 bits. So, Subnet generator will be 4 and Octet 3. New subnet mask will be 255.255.252.0 or /22. Number of subnets will be 2^6=64 and usable hosts in each subnet will be (2^10) - 2.

Answer 3: Given IP Add is 15.0.0.0, class A IP

8:30 PM ...0.3KB/s 41

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.

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Comments

be 2^2=4 and usable hosts in each subnet will be (2^6) - 2.

Answer 2: Given IP Add is 170.15.0.0, class B IP Address and default subnet mask is 255.255.0.0. Given number of hosts=1000 (binary 1111101000) which has 10 bits. So, Subnet generator will be 4 and Octet 3. New subnet mask will be 255.255.252.0 or /22. Number of subnets will be 2^6=64 and usable hosts in each subnet will be (2^10) - 2.

Answer 3: Given IP Add is 15.0.0.0, class A IP Address and default subnet mask is 255.0.0.0. Given number of hosts=100(binary 1100100) which has 7 bits. So, Subnet generator will be 128 and Octet 4. New subnet mask will be 255.255.255.128 or /25. Number of subnets will be 2^17 and usable hosts in each subnet will be (2^7) - 2.

QUESTION

Change the mood of the host from sad to happy.

192.168.1.127
255.255.255.224

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 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

Solution

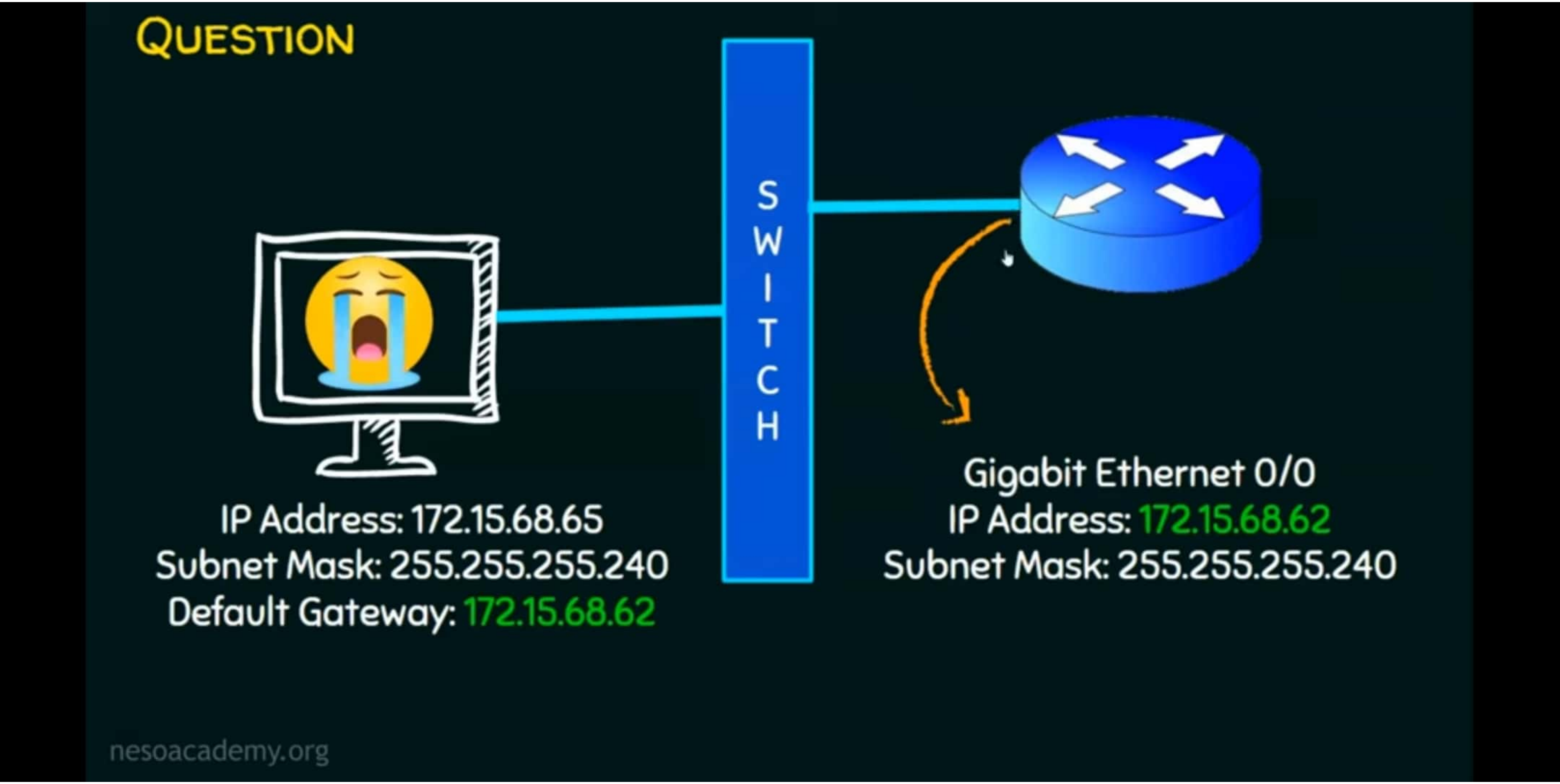
Subnet Mask: 255.255.255.224

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 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


QUESTION
SWITCH
IP Address: 172.15.68.65
Subnet Mask: 255.255.255.240
Default Gateway: 172.15.68.62
Gigabit Ethernet 0/0
IP Address: 172.15.68.62
Subnet Mask: 255.255.255.240
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Solution

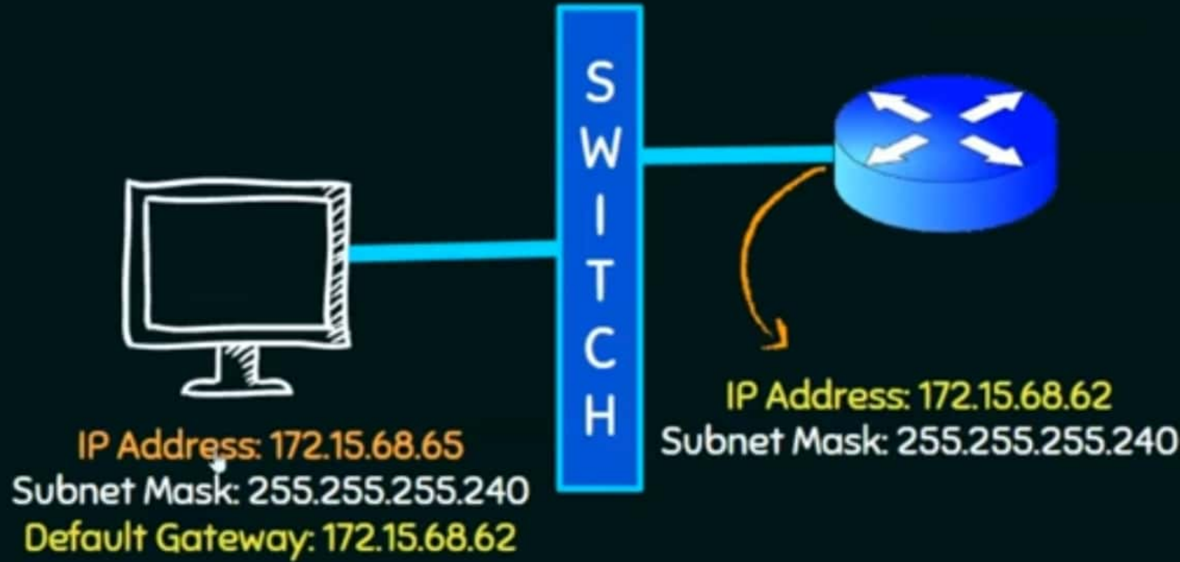
Subnet Mask: 255.255.255.240

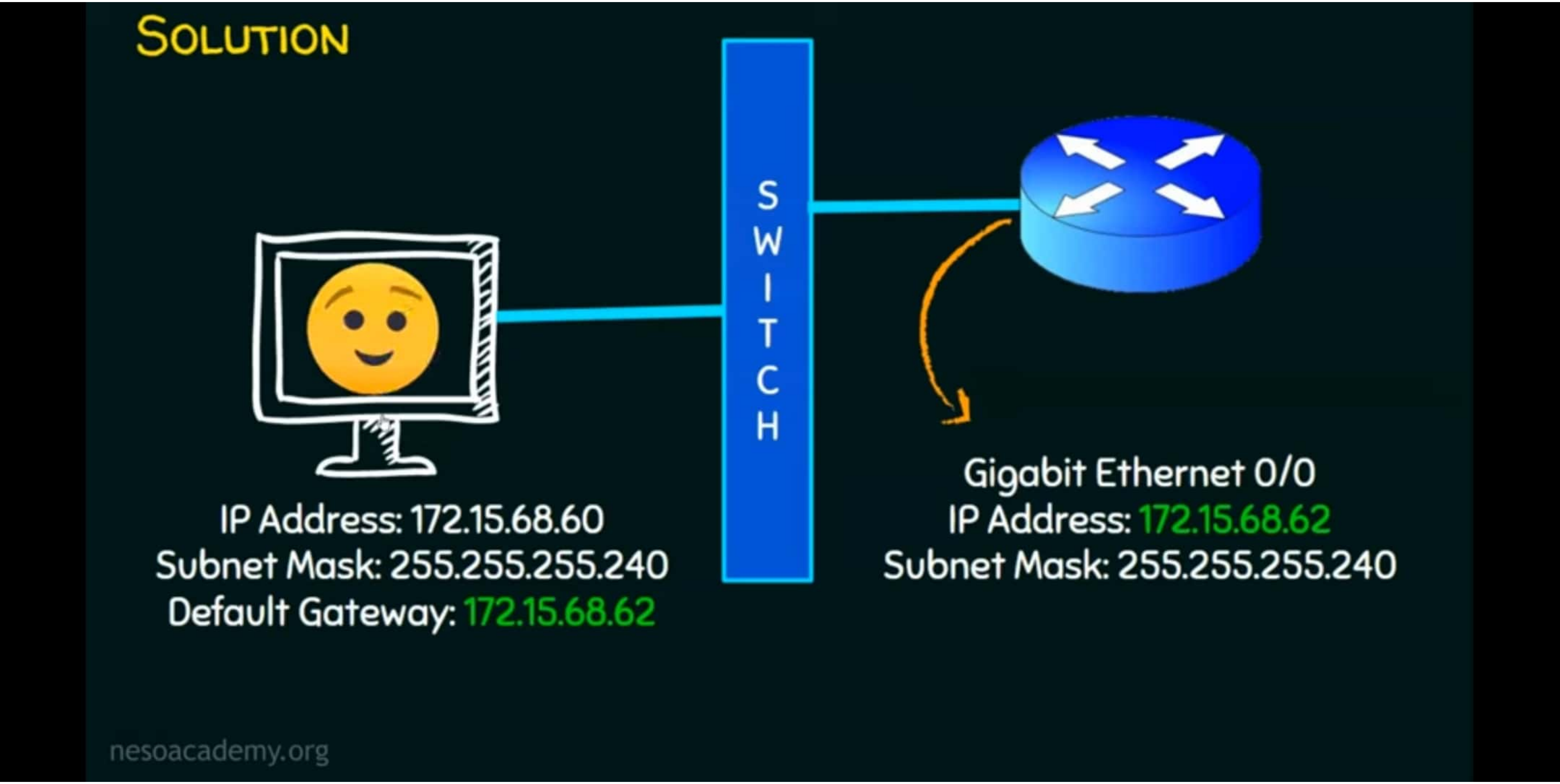
1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 0 0 0 0

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





SOLUTION
SWITCH
IP Address: 172.15.68.60
Subnet Mask: 255.255.255.240
Default Gateway: 172.15.68.62
Gigabit Ethernet 0/0
IP Address: 172.15.68.62
Subnet Mask: 255.255.255.240
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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?

Solution

Class B 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

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

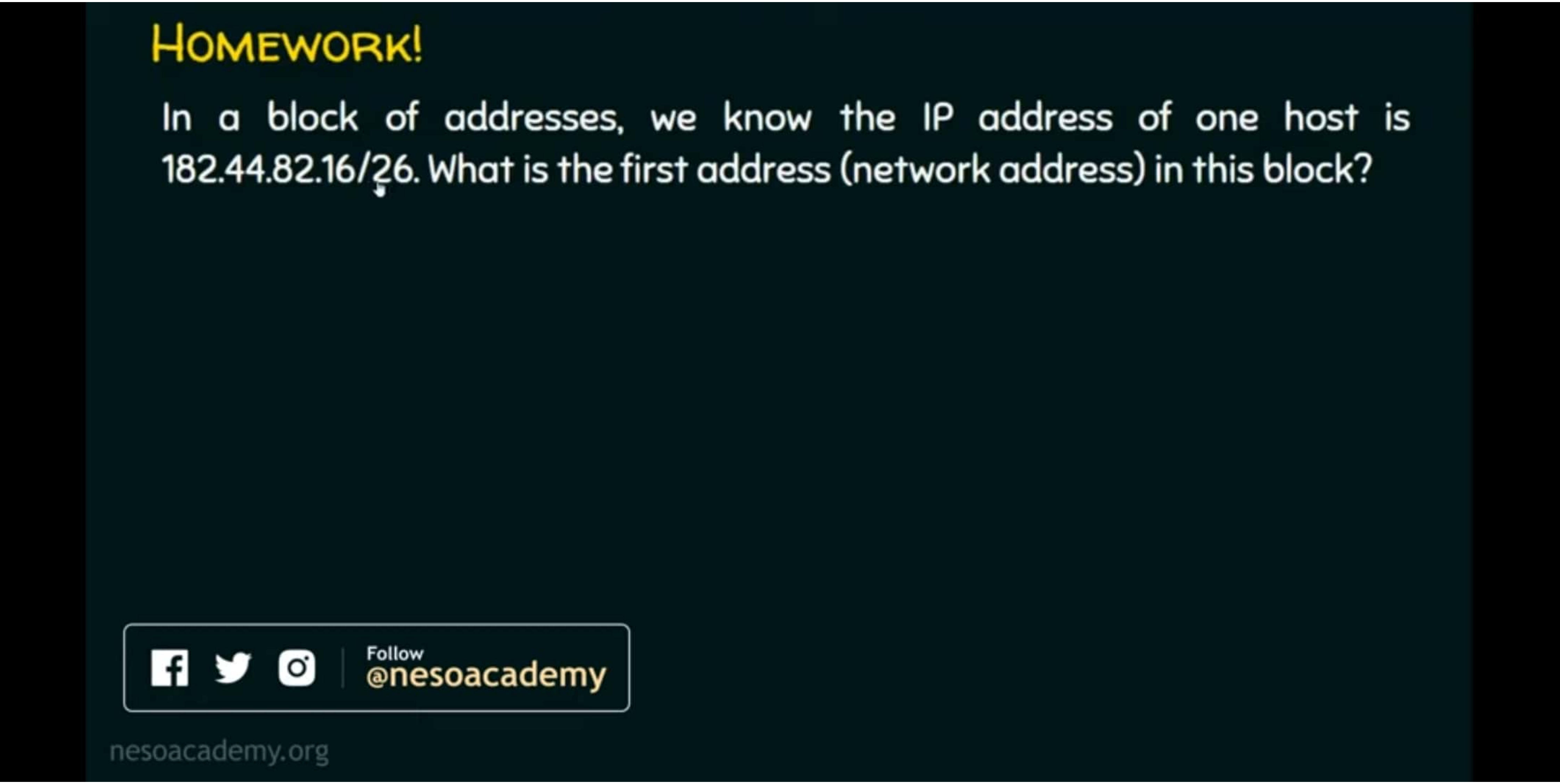
25.37.0.0 – 25.37.255.255

and so on

SOLUTION

	25	.	34	.	12	.	56
	0 0 0 1 1 0 0 1	.	0 0 1 0 0 0 1 0	.	0 0 0 0 1 1 0 0	.	0 0 1 1 1 0 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
AND	0 0 0 1 1 0 0 1	.	0 0 1 0 0 0 1 0	.	0 0 0 0 0 0 0 0	.	0 0 0 0 0 0 0 0
	25	.	34	.	0	.	0

$\boxed{\text{Network Address: 25.34.0.0}}$


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?
Follow
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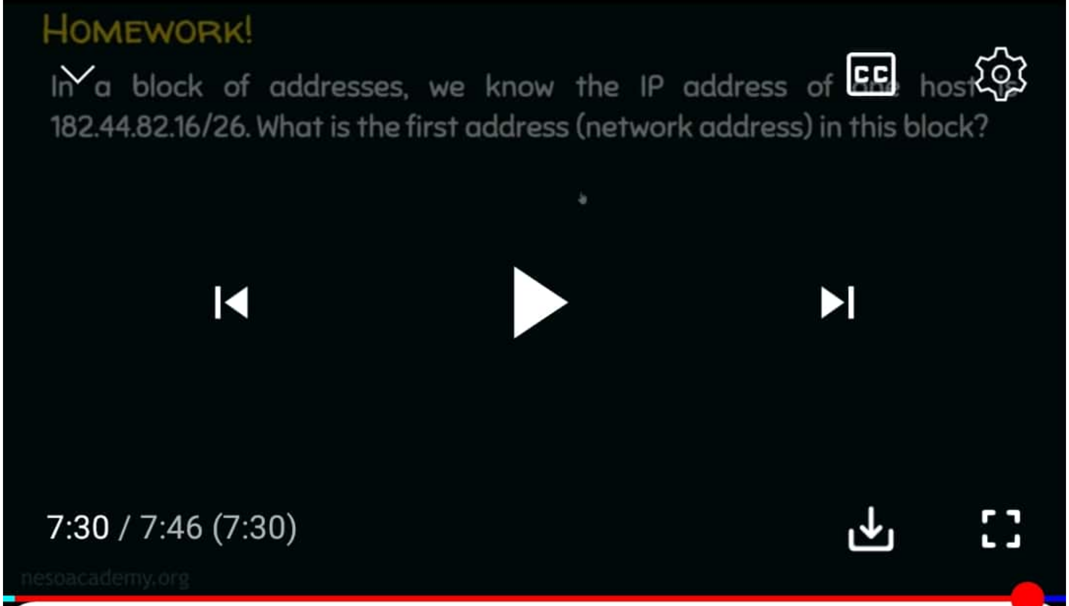

Comments

Thank You.

2

@FuturePlans • 9 mo ago

Please correct me if I am wrong...my solution is Given IP of Host 182.44.82.16/26..Class B with /26 bits of subnetting.. means subnet belongs to 4th octet last 6 bits reserved for hosts..Subnet Genrator bit would be 7 bit of 4th octet..which become 64 as SG..so starting network ip of given question is 182.44.82.0 while last IP of this subnet would be 182.44.82.63 and so on..

12

3 replies

@nangsuanlian1494 • 9 mo ago

I also think that this is incorrect because the class A belongs network 0-127, B belongs 128-191 ... So

SOLUTION

Class B 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

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

SOLUTION

	25	.	34	.	12	.	56
	0 0 0 1 1 0 0 1	.	0 0 1 0 0 0 1 0	.	0 0 0 0 1 1 0 0	.	0 0 1 1 1 0 0 0
	0 0 0 0 0 0 0 0	.	0 0 0 0 0 0 0 0	.	1 1 1 1 1 1 1 1	.	1 1 1 1 1 1 1 1
OR	0 0 0 1 1 0 0 1	.	0 0 1 0 0 0 1 0	.	1 1 1 1 1 1 1 1	.	1 1 1 1 1 1 1 1
	25	.	34	.	255	.	255

$\boxed{\text{Broadcast Address: 25.34.255.255}}$

10:11 PM ...21.6KB/s 29

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?

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Comments

@raffaulislam7423 • 4 mo ago (edited)

Is there any specific video to identify class??

1

@FuturePlans • 9 mo ago

Please correct me if I am wrong...my solution is Given IP of Host 182.44.82.16/26..Class B with /26 bits of subnetting.. means subnet belongs to 4th octet last 6 bits reserved for hosts..Subnet Genrator bit would be 7 bit of 4th octet..which become 64 as SG..so starting network ip of given question is 182.44.82.0 while last IP of this subnet would be 182.44.82.63 and so on..

7

1 reply

@kishannaikkishan4860 • 6 mo ago

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

Solution

Class B – 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

$2^{\text{No. of 1s}}$ = 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 3rd 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 0

New Subnet Mask: 255.255. 252.0

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]

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

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 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

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

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]

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

Solution

Class B subnet mask 255.255.0.0

6 bits are used for subnetting

255.255.11111100.00000000

New Subnet Mask: 255.255.252.0

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

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

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

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?

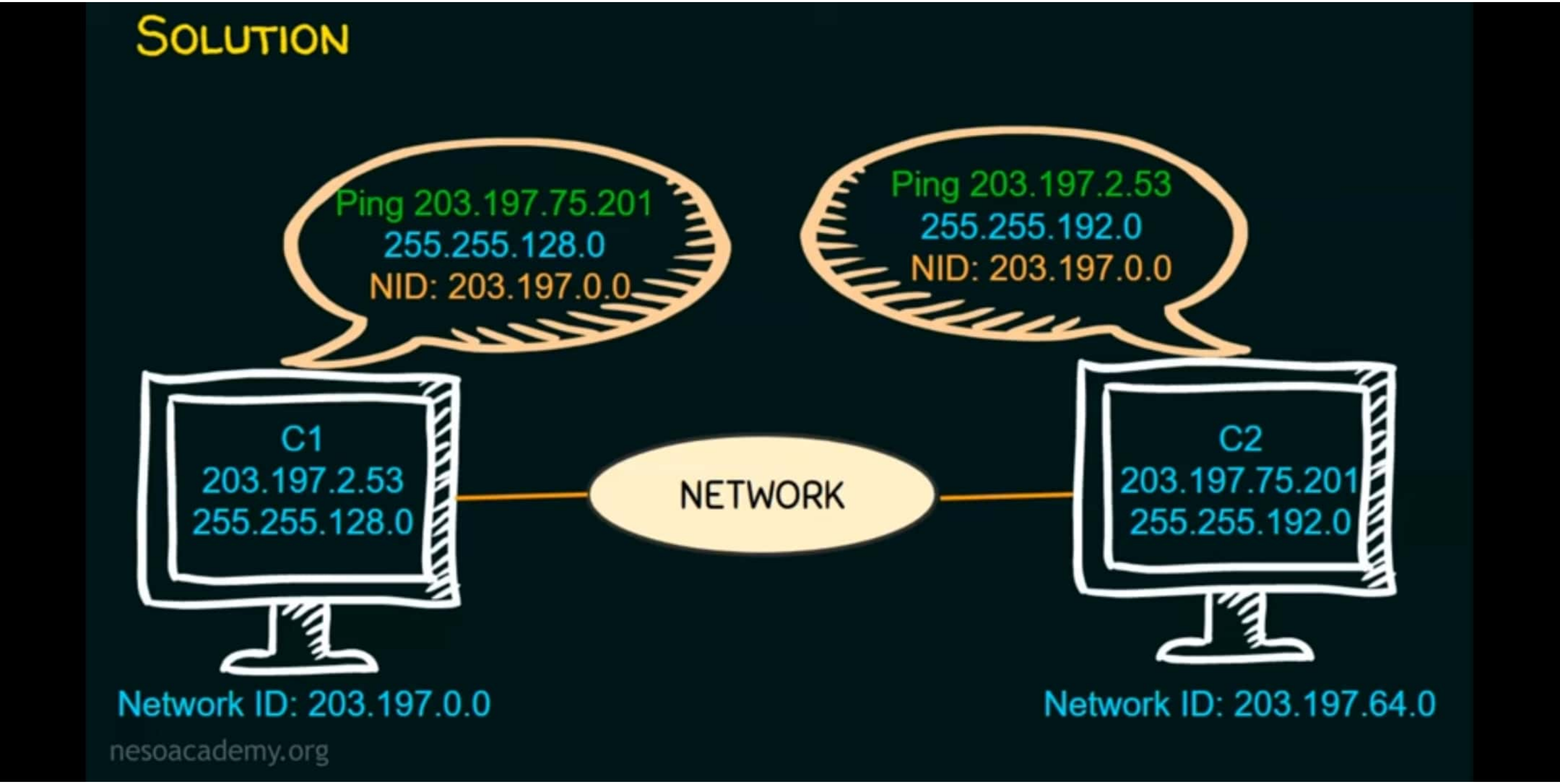
[GATE CS 2006]

(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.


SOLUTION
Ping 203.197.75.201
255.255.128.0
NID: 203.197.0.0
Ping 203.197.2.53
255.255.192.0
NID: 203.197.0.0
C1
203.197.2.53
255.255.128.0
NETWORK
C2
203.197.75.201
255.255.192.0
Network ID: 203.197.0.0
Network ID: 203.197.64.0
nesoacademy.org

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

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

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
255.255.11111111.00000000	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

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

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}

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}

Classes of IPv4 address

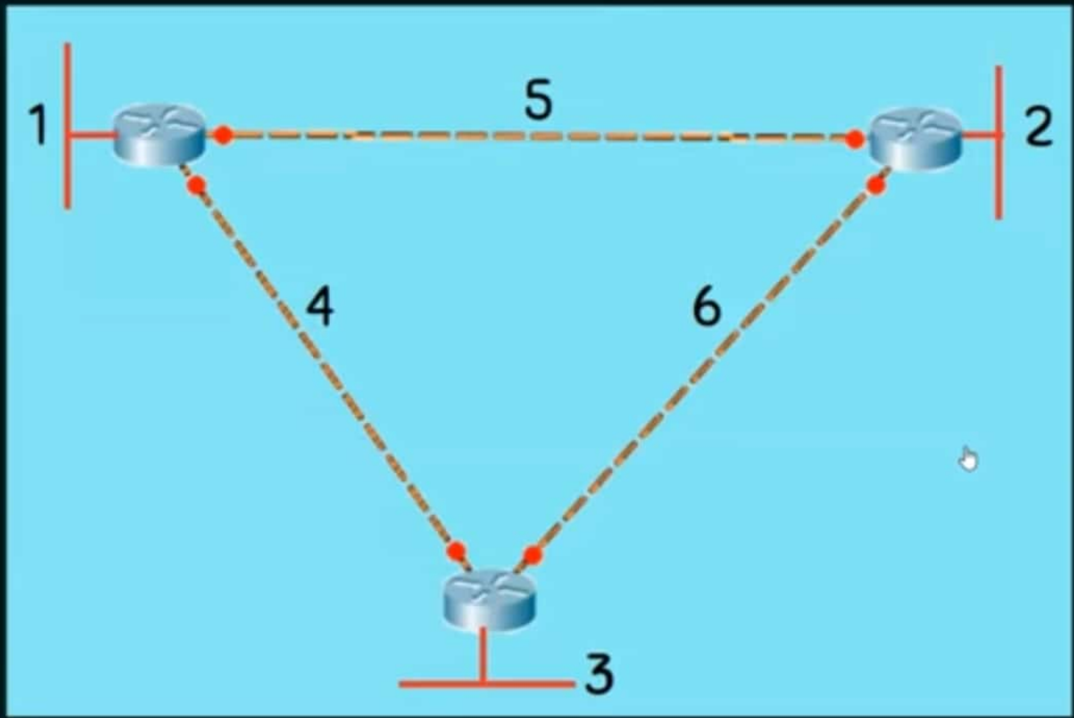
Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0–127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets (2^7) 16,777,214 hosts (2^{24}–2)
B	128–191	10000000 - 10111111	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)	–	–

FLSM Vs VLSM

FLSM = Fixed Length Subnet Masking

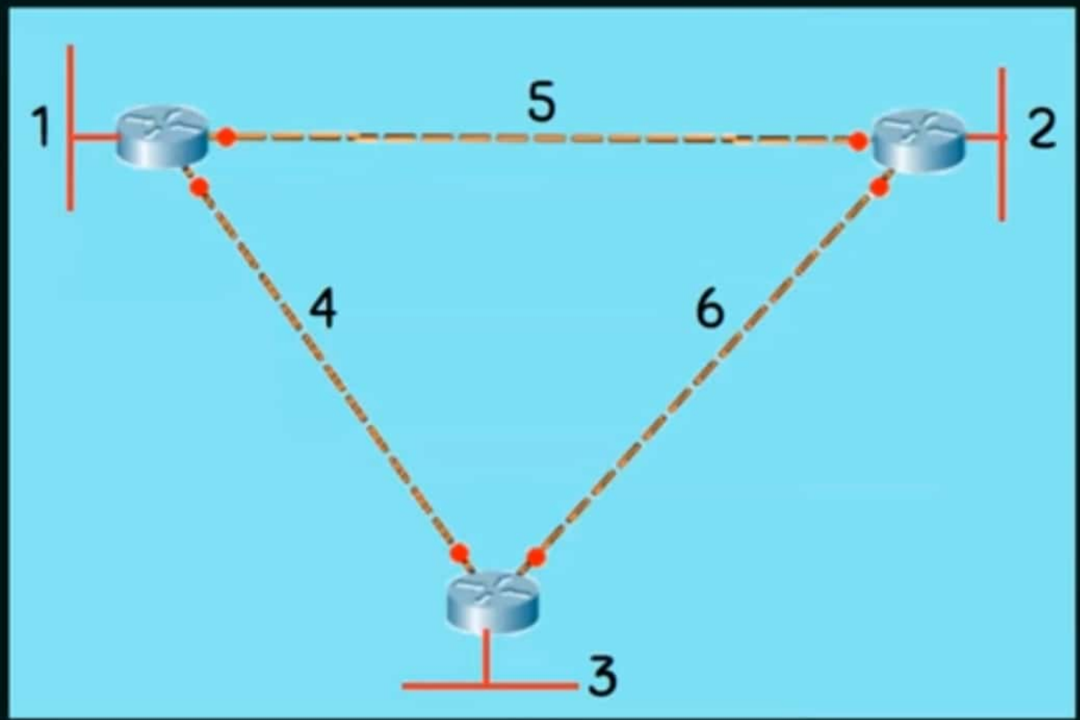
VLSM = Variable Length Subnet Masking

HOW MANY NETWORKS ARE THERE?



HOW MANY NETWORKS ARE THERE?

20 hosts



10 hosts

6 hosts

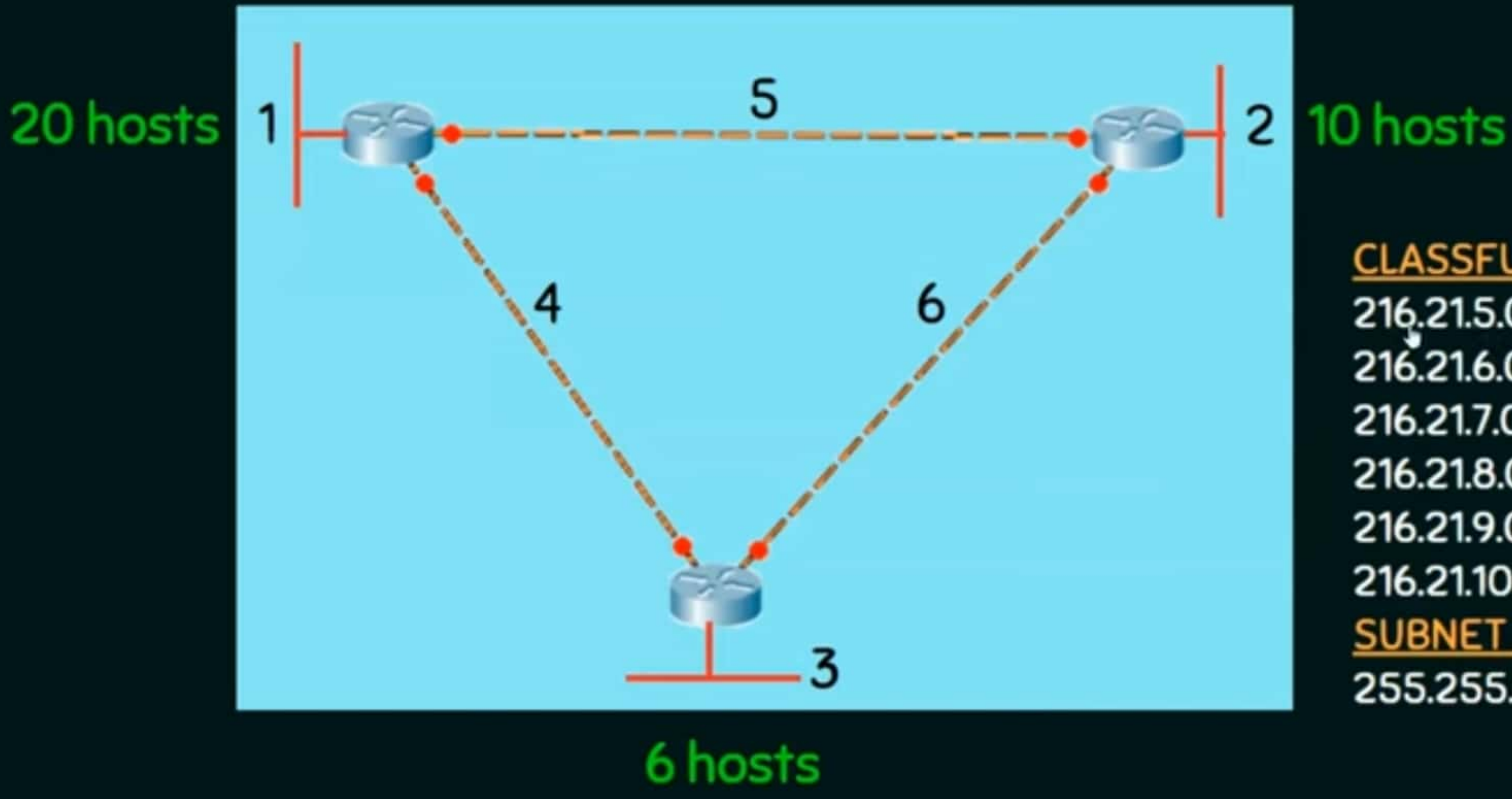
CLASSFUL ADDRESSING

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?



CLASSFUL ADDRESSING

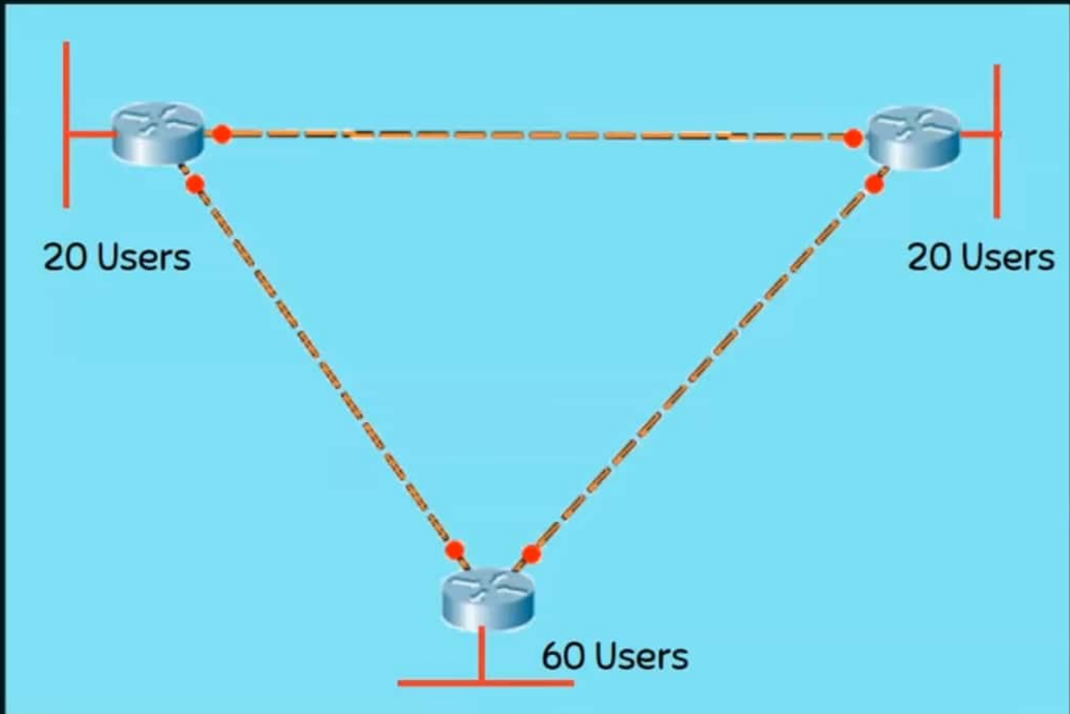
216.21.5.0 – 216.21.5.255
216.21.6.0 – 216.21.6.255
216.21.7.0 – 216.21.7.255
216.21.8.0 – 216.21.8.255
216.21.9.0 – 216.21.9.255
216.21.10.0 – 216.21.10.255

SUBNET MASK:

255.255.255.0 or /24

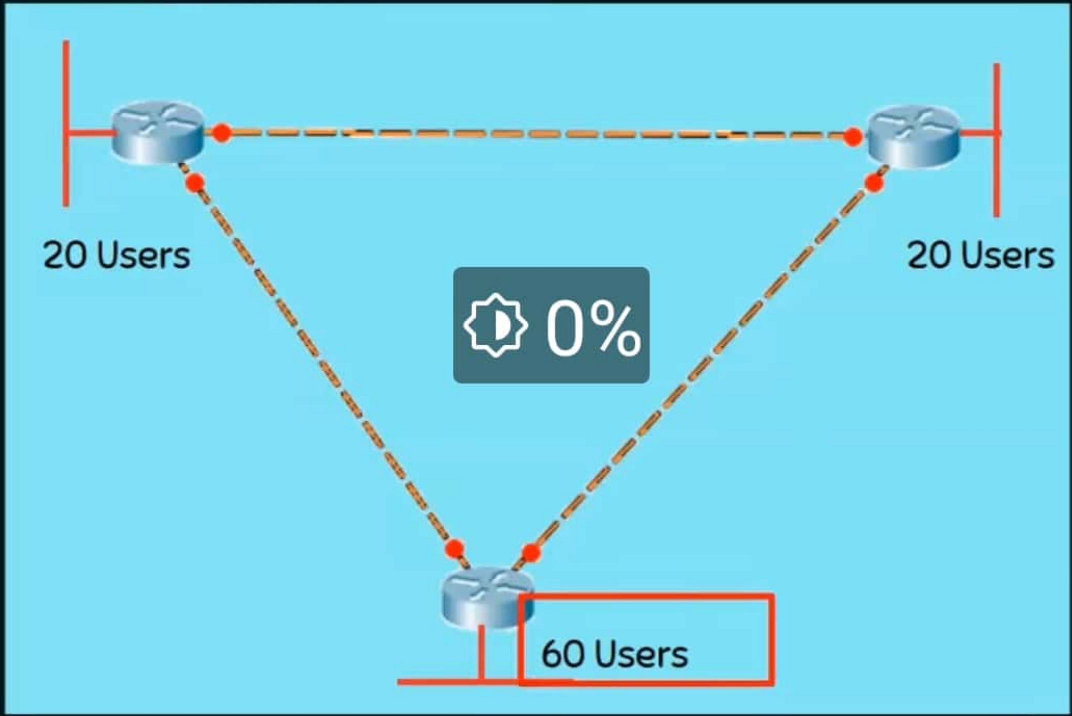
Question

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



Key Idea

Start with the largest subnet first



SOLUTION

1. Class C – Default Subnet Mask: 255.255.255.0

2. 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

3. No. of hosts/subnet: $\boxed{\text{60 (111100) – 6 bits}}$ SG: $\boxed{64}$ Octet Position: $\boxed{4}$

   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

4. New subnet mask: 255.255.255.192 or /26 (Only for the biggest network)

5. Network Ranges (Subnets)

   192.168.10.0 – 192.168.10.63 /26 (Handover this to 60 Users Network)
   192.168.10.64

Solution

1. Class C – Default Subnet Mask: 255.255.255.0

2. 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

3. 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 1 1 0 0

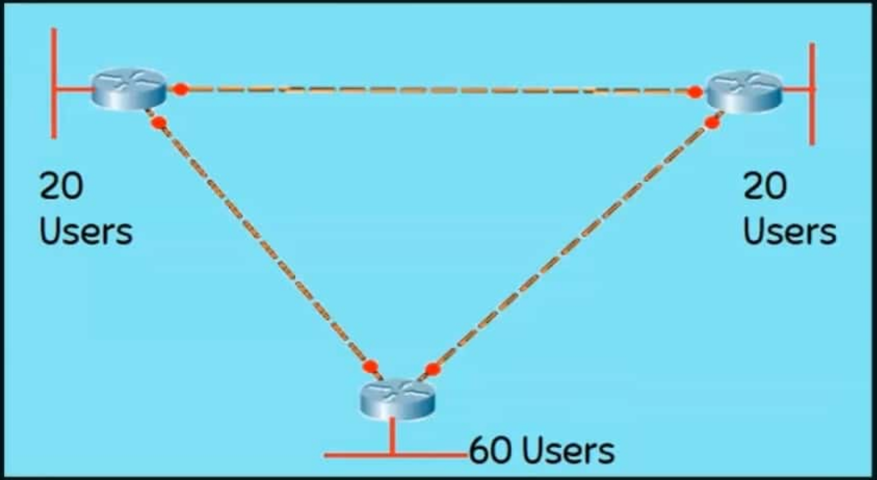
4. New subnet mask: 255.255.255.252 or /30

5. 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)

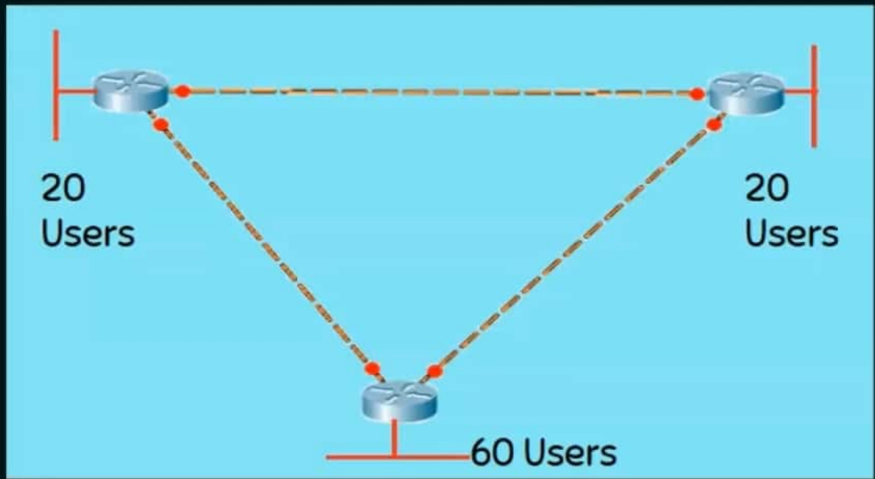
SOLUTION

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)



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)



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]

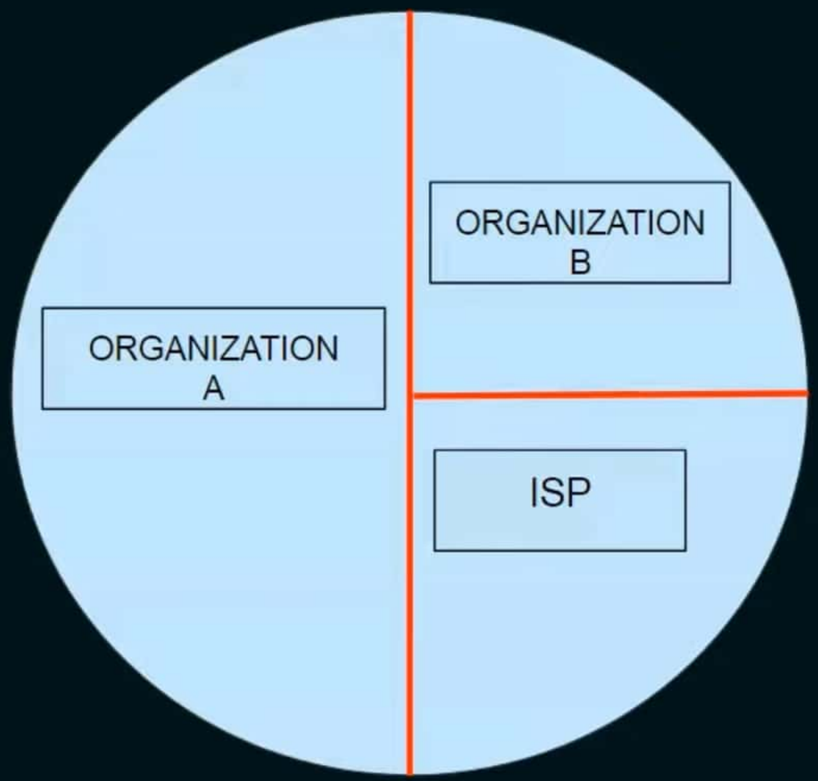
(A) 245.248.136.0/21 and 245.248.128.0/22

(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



Solution

1. Subnet Mask: /20

   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 0

2. No. of hosts = $2^{\text{No. of 0's}} = 2^{12}$
3. 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 1 1 0 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

4. 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

5. 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 1 0 0 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

Solution

1. Subnet Mask: /20

   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 0

2. No. of hosts = $2^{\text{No. of 0's}} = 2^{12}$
3. 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 1 1 0 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

4. Handover another quarter of address to ISP itself.

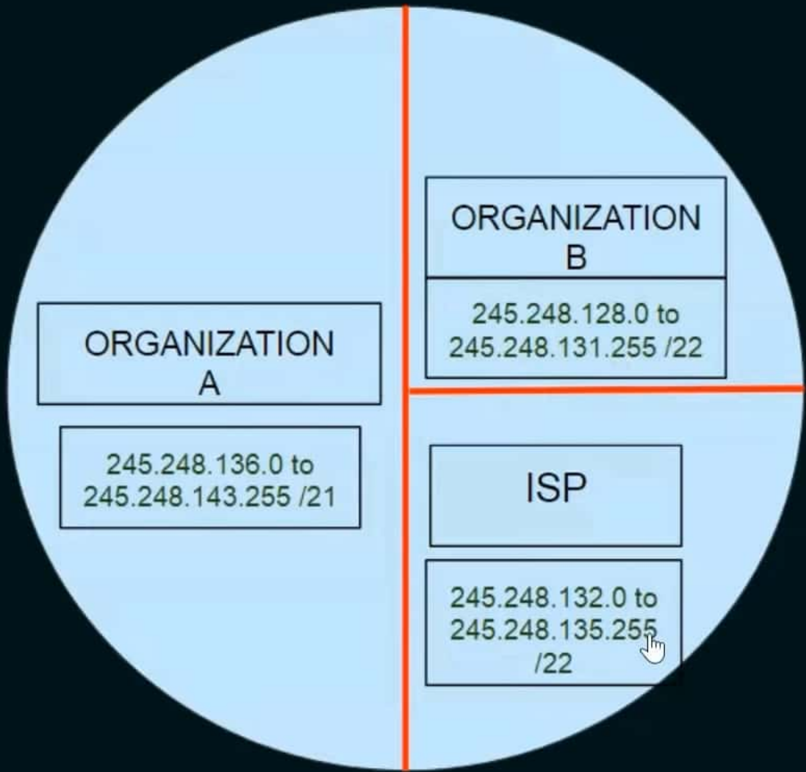
   SG=4, OP=3, Starting Address = 245.248.132.0 / 22 to 245.248.135.255 /22

5. 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 1 0 0 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

SOLUTION



ORGANIZATION A
245.248.136.0 to 245.248.143.255 /21
ORGANIZATION B
245.248.128.0 to 245.248.131.255 /22
ISP
245.248.132.0 to 245.248.135.255 /22

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

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

IDC part II (week 6-12) 6 weeks will cover three layers of interest

Slides:

Example

Given the network address 17.0.0.0, find the class, the block, and the range of the addresses.

Solution

The class is A because the first byte is between 0 and 127.
The block has a netid of 17.
The addresses range from 17.0.0.0 to 17.255.255.255.

IDC part II (week 6-12) 6 weeks will cover three layers of interest

Slides:

Example

Given the network address 220.34.76.0, find the class, the block, and the range of the addresses.

Solution

The class is C because the first byte is between 192 and 223.
The block has a netid of 220.34.76.
The addresses range from 220.34.76.0 to 220.34.76.255.

of 32, 16, and 16 addresses.

Q. As an example, suppose an organization is given the block 17.12.40.0126, which contains 64 addresses. The organization has three offices and needs to divide the addresses into three sub-blocks of 32, 16, and 16 addresses.

- Suppose the mask for the first subnet is nl, then 2^{32-n1} must be 32, which means that n1 = 27
- Suppose the mask for the second subnet is n2, then 2^{32-n2} must be 16, which means that n2 = 28
- Suppose the mask for the third subnet is n3, then 2^{32-n3} must be 16, which means that n3 = 28
- In subnet 1, the address 17.12.14.29127 can give us the subnet address if we use the mask /27 because
  1. **Host :** 0001 0001 00001100 0000 1110 000 1110l
  2. **Mask :** /27
  3. **Subnet :** 00010001 00001100 00001110 00000000 ..... (17.12.14.0)
- In subnet 2, the address 17.12.14.45/28 can give us the subnet address if we use the mask /28 because

2. **Mask** : /27
3. **Subnet** : 00010001 00001100 00001110 00000000 ..... (17.12.14.0)

- In subnet 2, the address 17.12.14.45/28 can give us the subnet address if we use the mask /28 because
  1. **Host** : 00010001 00001100 00001110 00101101
  2. **Mask** : /28
  3. **Subnet** : 00010001 00001100 00001110 00100000 ..... (17.12.14.32)
- In subnet 3, the address 17.12.14.50/28 can give us the subnet address if we use the mask /28 because
  1. **Host** : 00010001 00001100 00001110 00110010
  2. **Mask** : /28
  3. **Subnet** : 00010001 00001100 00001110 00110000 ..... (17.12.14.48)

- Suppose the mask for the first subnet is nl, then 2^{32-n1} must be 32, which means that n1 = 27

- Suppose the mask for the second subnet is n2, then 2^{32-n2} must be 16, which means that n2 = 28

- Suppose the mask for the third subnet is n3, then 2^{32-n3} must be 16, which means that n3 = 28

- In subnet 1, the address 17.12.14.29127 can give us the subnet address if we use the mask /27 because

    1. **Host** : 0001 0001 00001100 0000 1110 000 1110l

    2. **Mask** : /27

    3. **Subnet** : 00010001 00001100 00001110 00000000 ..... (17.12.14.0)

- In subnet 2, the address 17.12.14.45/28 can give us the subnet address if we use the mask /28 because

    1. **Host** : 00010001 00001100 00001110 00101101

    2. **Mask** : /28

    3. **Subnet** : 00010001 00001100 00001110 00100000 ..... (17.12.14.32)

3. What is the Difference Between Classful and Classless Addressing
   – *Comparison of Key Differences*

Key Terms

Classful, Classless Addressing, Classless Inter-Domain Routing (CIDR), IP Address

CLASSFUL ADDRESSING
VERSUS
CLASSLESS ADDRESSING

CLASSFUL ADDRESSING	CLASSLESS ADDRESSING
An IP address allocation method that allocates IP addresses according to five major classes	An IP address allocation method that is designed to replace classful addressing to minimize the rapid exhaustion of IP addresses
Less practical and useful	More practical and useful
Network ID and host ID changes depending on the classes	There is no boundary on network ID and host ID

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What is Classful Addressing

Classful addressing categorizes the IP addresses into five major classes: class A, B, C, D, and E.

> **Class A addresses** allocate first 8 bits for the network and the remaining bits for the host.

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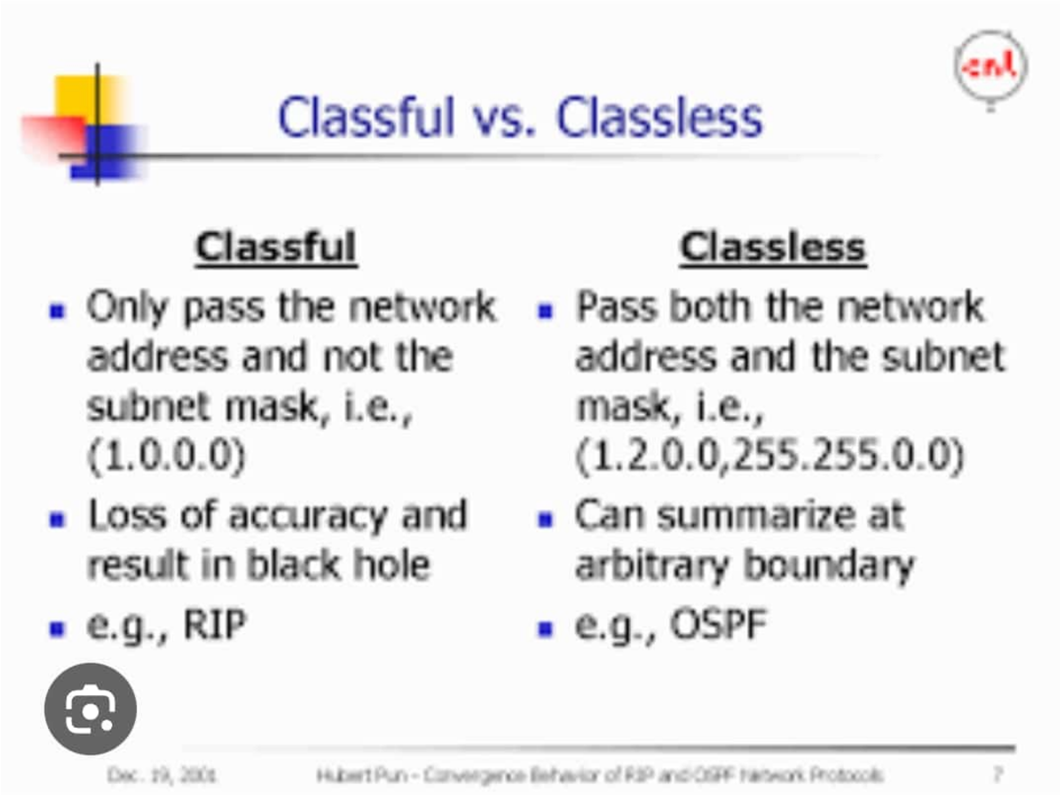

What Is Classless And Classful

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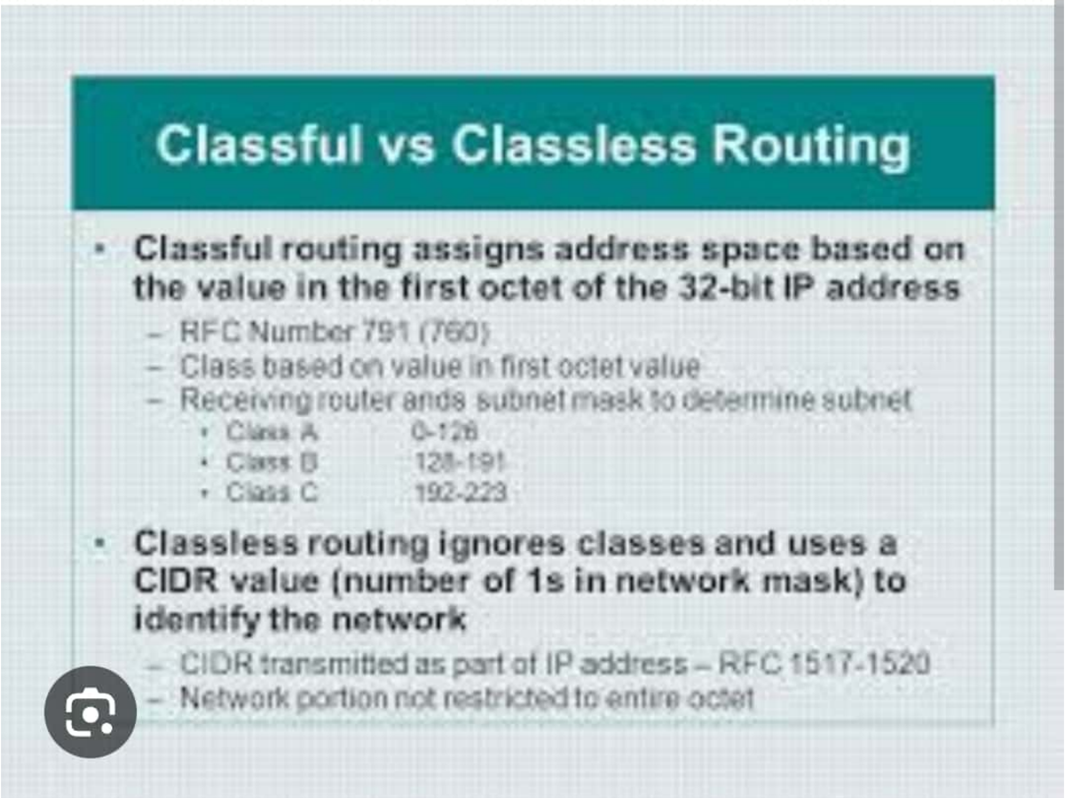

What Is Classless And Classful Ip Address

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Parameter	Classful Routing	Classless Routing
VLSM Support	Not Supported	Supported
Subnet Mask in updates	Does not include Subnet mask in routing updates	Includes Subnet mask in routing updates
Major Subnet	Subnets are not advertised to a different major subnet	Subnets are advertised to a different major subnet
Discontiguous Subnets	Discontiguous subnets are not visible to each other	Discontiguous subnets are visible to each other
Example protocols	RIPv1	RIPv2 , EIGRP,OSPF and BGP
Exchange of Routing updates	Exchange Routing updates at regular intervals	Exchange Routing updates only when changes occur in network topology
Hello messages	Do not use Hello messages	Uses Hello messages for neighbor status check
Bandwidth consumption	Consumes more network bandwidth	Consumes less network bandwidth
Addresses	Addresses have 3 parts – • Network • Subnet • Host	Addresses have 2 parts – • Subnet or prefix • Host

What Is Classful And Classless Ip Addressing

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Table 4-2 *Comparing the Use of the Terms Classless and Classful*

As Applied To	Classful	Classless
Addresses	Addresses have three parts: network, subnet, and host.	Addresses have two parts: subnet or prefix, and host.
Routing protocols	Routing protocol does not advertise masks nor support VLSM; RIP-1 and IGRP.	Routing protocol does advertise masks and support VLSM; RIP-2, EIGRP, OSPF.
Routing (forwarding)	IP forwarding process is restricted in how it uses the default route.	IP forwarding process has no restrictions on using the default route.

L Hong To Rtai
What Is The Difference B...

Sr. No.	Classful Routing Protocol	Classless Routing Protocol
1	Do not carry subnet mask information within the routing updates	Carry subnet mask information within the routing updates
2	Exchange routing updates at the regular time intervals	Exchange routing tables only when the changes occurs in the network topology
3	Use Periodic updates	Use Triggered updates
4	Do not use Hello messages	Use Hello messages to check the status of neighbor routers
5	Consume more network bandwidth	Consume less network bandwidth
6	Do not support CIDR and VLSM	Support CIDR and VLSM
7	Examples: RIP and IGRP	Examples: OSPF and IS-IS

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5. What Is The Difference...

Classful vs. Classless

Classful
- Only pass the network address and not the subnet mask, i.e., (1.0.0.0)

Classless
- Pass both the network address and the subnet mask, i.e., (1.2.0.0,255.255.0.0)

As Applied To	Classful	Classless
Addresses	Addresses have three parts: network, subnet, and host.	Addresses have two parts: subnet or prefix, and host.

Example 5.13

An address in a block is given as 73.22.17.25. Find the number of addresses in the block, the first address, and the last address

Solution

1. The number of addresses in this block is

   $N = 2^{32-n} = 2^{24} = 16{,}777{,}216$

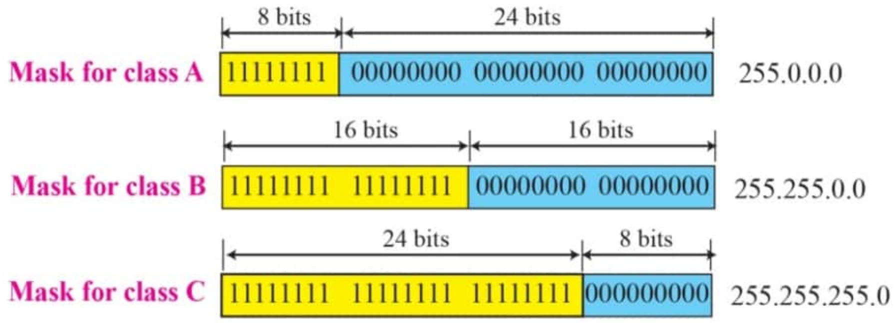
2. To find the first address, we keep the left most 8 bits and set the rightmost 24 bits all to 0s. The first address is 73.0.0.0/8 in which 8 is the value of *n*.

3. To find the last address, we keep the leftmost 8 bits and set the rightmost 24 bits all to 1s. The last address is 73.255.255.255

Chapter 5 IPv4 Address

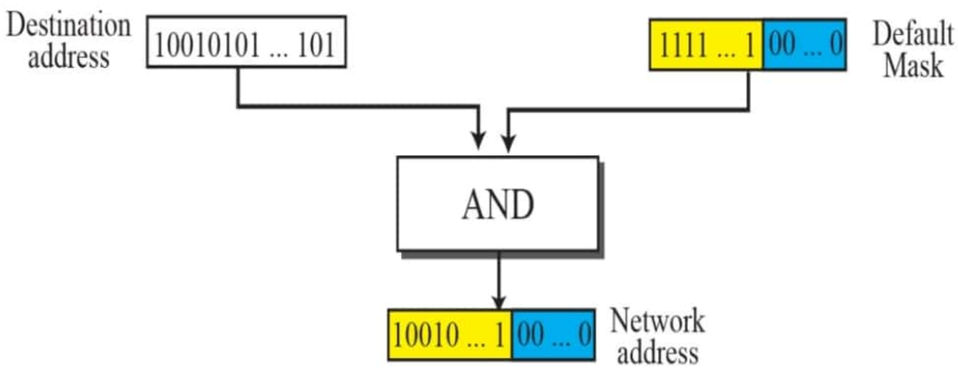
Network Mask

- Used to extract the network address from the destination address of a packet
- Called a default mask



Chapter 5 IPv4 Address

Finding a Network Address using the Default Mask



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Chapter 5 IPv4 Address

Example 5.16

A router receives a packet with the destination address 201.24.67.32. Show how the router finds the network address of the packet.

Solution

Since the class of the address is B, we assume that the router applies the default mask for class B, 255.255.0.0 to find the network address.

Destination address	->	201	.	24	.	67	.	32
Default mask	->	255	.	255	.	0	.	0
Network address	->	201	.	24	.	0	.	0

Chapter 5 IPv4 Address

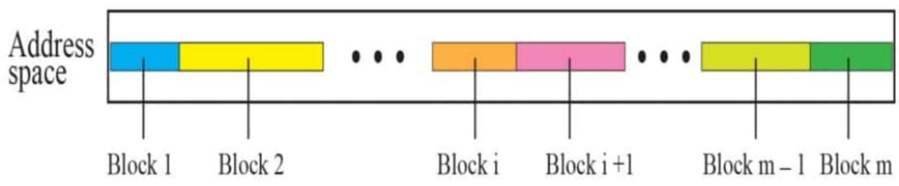
5.3 Classless Addressing

- Classful address did not solve the address depletion problem
  - Distribution of addresses and the routing process more difficult
- With the growth of the Internet, a larger address space was needed as a long-term solution
- Although the long-range solution has already been devised and is called IPv6, a short-term solution was also devised to use the same address space but to change the distribution of addresses
  - Classless addressing

Chapter 5 IPv4 Address

Variable-length blocks in Classless Addressing

- In classless addressing, whole address space id divided into variable length blocks
  - Theoretically, we can have a block of 2^0, 2^1, 2^2, … 2^{32} addresses



Chapter 5 IPv4 Address

Example 5.27

One of the address in a block is 167.199.170.82/27. To find the number of addresses in the network, the first address, and the last address.

Solution

The value of *n* is 27. The network mask has twenty-seven 1s and five 0s. It is 255.255.255.240.

a. The number of addresses in the network is $2^{32-n} = 2^5 = 32$

b. We use the AND operation to find the first address. The first address is 167.199.170.64/27

Address in Binary	10100111	11000111	10101010	01010010
Network mask	11111111	11111111	11111111	11100000.
First address	10100111	11000111	10101010	01000000

Chapter 5 IPv4 Address

Example 5.27(cont'd)

C. To find the last address, we first find the complement of the network mask and the OR it with the given address : the last address is 167.199.170.95/27

Address in Binary	10100111	11000111	10101010	01010010
Network mask	0000000	00000000	00000000	00011111
Last address	10100111	11000111	10101010	01011111

Chapter 5 IPv4 Address

Extracting Block Information

- The number of addresses in the block can be found as

$$N = 2^{32-n}$$

- The first address in the block can be found by ANDing the address with the network mask

First address = (any address) AND (network mask)

- The last address in the block can be found by either adding the first address with the number of addresses or, directly, by ORing the address with complement (NOTing) of the network mask

Last address = (any address) OR [NOT (network mask)]

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Chapter 5 IPv4 Address

Block Allocation

- The ultimate responsibility of block allocation is given to a global authority called ICANN(Internet Corporation for Assigned Names and Address)
- Assign a large block of addresses to an ISP (Internet Service Provider)
- For the proper operation of the CIDR, there are three restrictions
  - The number of requested addresses, N, needs to be power of 2.
  - The value of prefix length can be found from the number of addresses in the block
  - The requested block needs to be allocated where there are a contiguous number of unallocated addresses in the address space

Chapter 5 IPv4 Address

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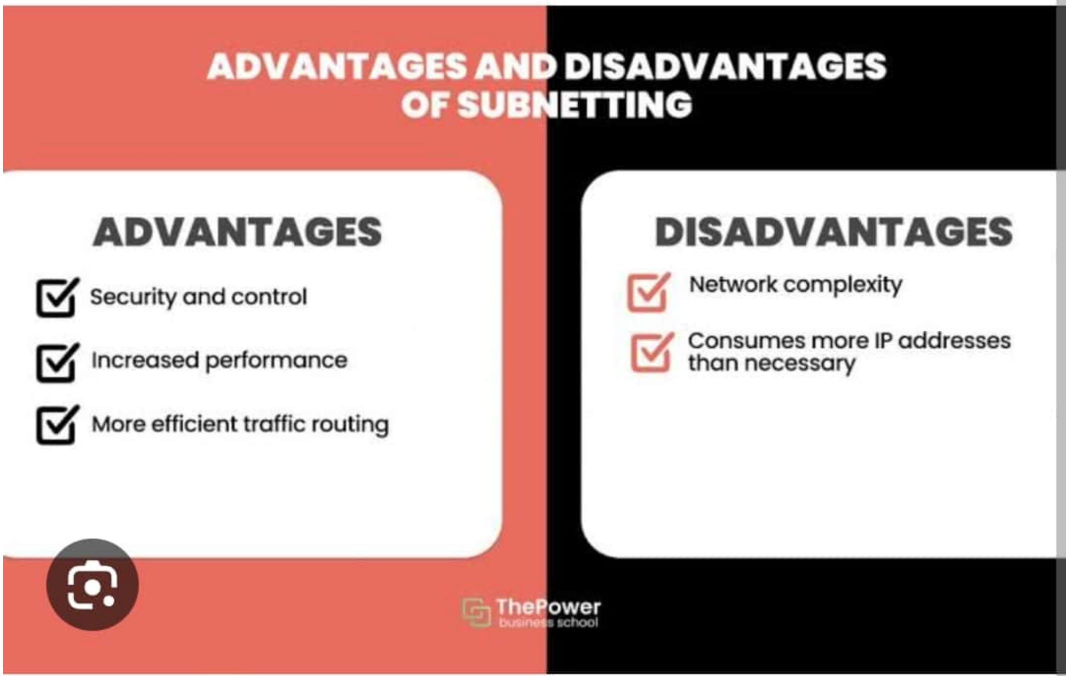

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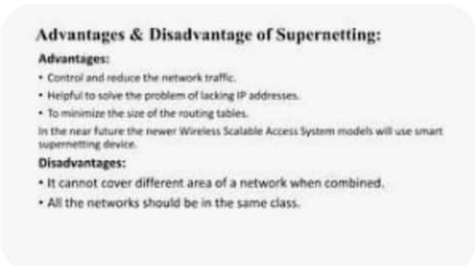

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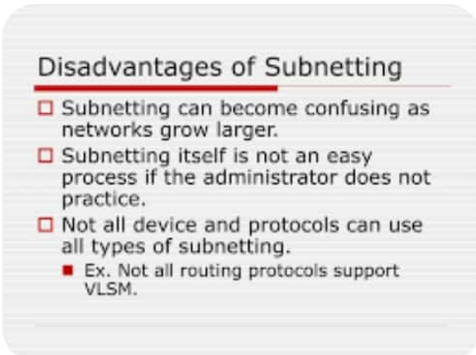

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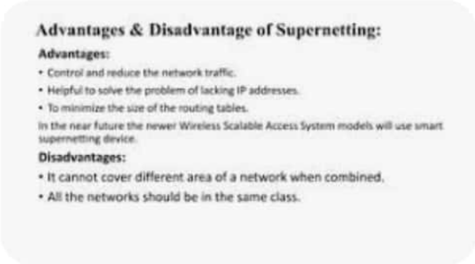

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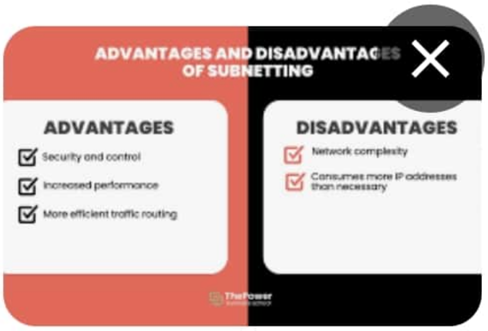

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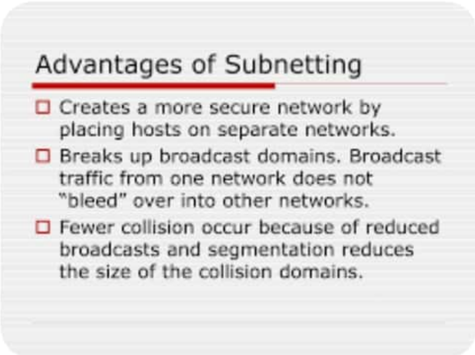

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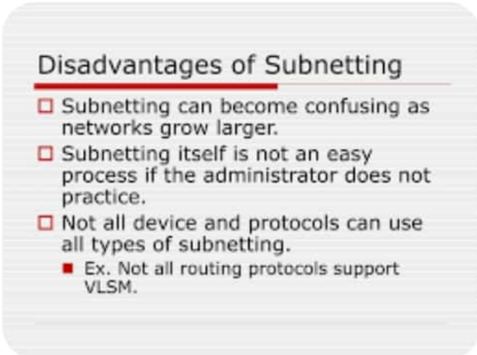

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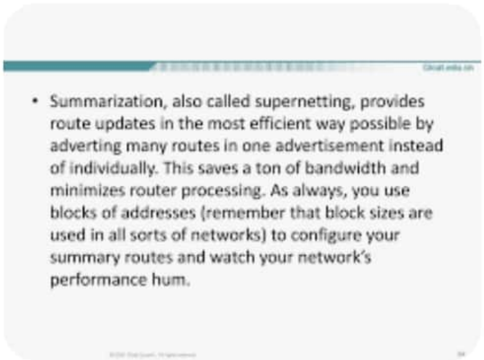

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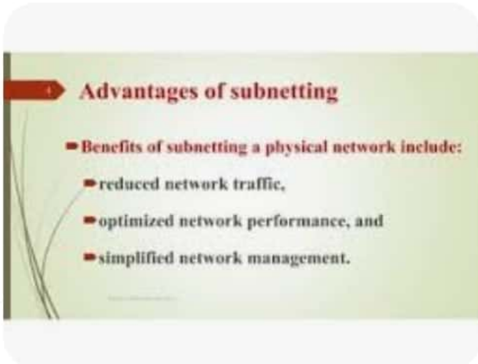
Subnetting Basics benefit...



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IP__Address__Subnettin...

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Question 199/225

<< Prev Question   Next Question >>

What is the maximum number of hosts that a network segment 192.168.2.16/28 can support?

- **A.** 14
- **B.** 8
- **C.** 7
- **D.** 16
- **E.** 15

Hide answers/explanations

Correct Answer: A

Addressing Table

Device	Interface	IP Address	Subnet Mask	Def. Gateway
R1	Fa0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	192.168.2.1	255.255.255.0	N/A
R2	Fa0/0			N/A
	S0/0/0			N/A
PC1	N/A			
PC2	N/A			

Complete the table

192.168.1.0/24 – classful subnet address

Task: design IP addressing scheme such that each subnet has enough IP addresses for at least 20 hosts.

24 bits for network ID

8 bits for host ID

# of hosts = $2^8 - 2 = 254 > 20$ hosts

Solved Task 1: Subnet the Address Space. Step 1: Examin...

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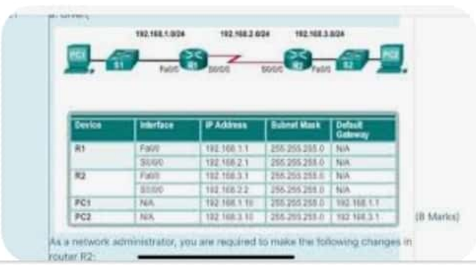

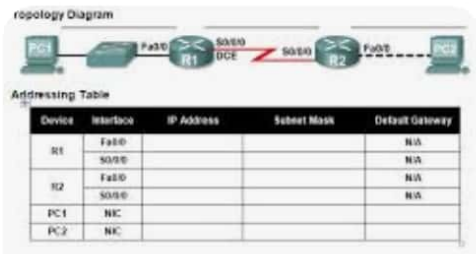

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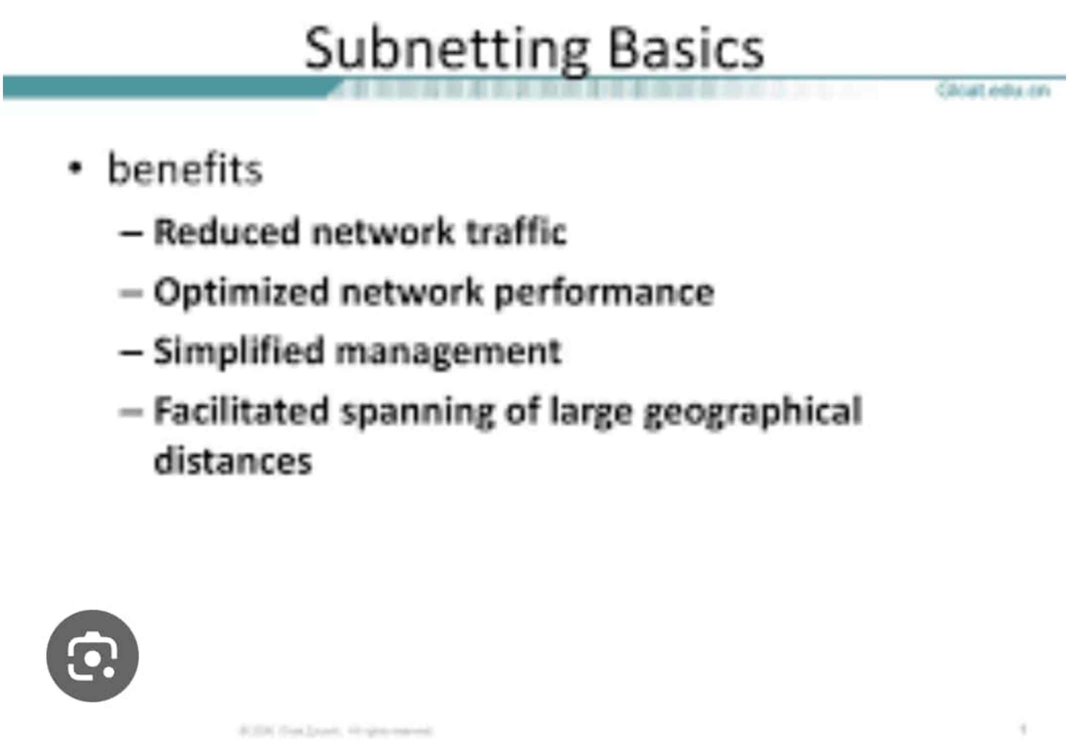

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Advantages of IPv6 over IPv4

- **Larger address space**. An IPv6 address is 128 bits long. Compared with the 32-bit address of IPv4
- **Better header format**. Options of IPv6 are separated from the base header and inserted, when needed, between the base header and the upper-layer data. This simplifies and speeds up the routing process
- **New options**. IPv6 has new options to allow for additional functionalities
- **Allowance for extension**. IPv6 is designed to allow the extension of the protocol if required by new technologies or applications
- **Support for resource allocation**. There are 2 new fields, traffic class and flow label have been added to enable the source to request special handling of the packet
- **Support for more security**. The encryption and authentication options provide confidentiality and integrity of the packet

PPT - Next Generation IP Protocol: IPv6 PowerPoint...

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IPv6 Advantages

- More efficient address space allocation
- End-to-end addressing; no NAT anymore!
- Fragmentation only by the source host
- Routers do not calculate header checksum (speedup!)
- Multicasting instead of broadcasting
- Built-in security mechanisms
- Single control protocol (ICMPv6)
- Auto-configuration
- Modular headers structure

Benefits of IPv6 over IPV4

- Provides a substantially larger IP Address space than IPV4
- Better ability for auto configuring devices
- Consisting of simplified header structures leading to faster routing
- Provides better security for applications and networks
- Provides better Quality of Service
- Provides better multicast and other cast abilities
- Offers better mobility features
- Offers ease of Administration
- Follows the key design principles permitting a smoother transition

IP header

An **IP header** is a prefix to an IP packet that contains information about the IP version, length of the packet, source and destination IP addresses, etc. It consists of the following fields:

Version (4 bits)	Header length (4 bits)	Priority and Type of Service (8 bits)	Total length (16 bits)
Identification (16 bits)		Flags (3 bits)	Fragmented offset (13 bits)
Time to live (8 bits)	Protocol (8 bits)	Header checksum (16 bits)	
Source IP address (32 bits)			
Destination IP address (32 bits)			
Options (up to 32 bits)			

Here is a description of each field:

- **Version** – the version of the IP protocol. For IPv4, this field has a value of 4.
- **Header length** – the length of the header in 32-bit words. The minumum value is 20 bytes, and the maximum value is 60 bytes.
- **Priority and Type of Service** – specifies how the datagram should be handled. The first 3 bits are the priority bits.
- **Total length** – the length of the entire packet (header + data). The minimum length is 20 bytes, and the maximum is 65,535 bytes.
- **Identification** – used to differentiate fragmented packets from different datagrams.
- **Flags** – used to control or identify fragments.
- **Fragmented offset** – used for fragmentation and reassembly if the packet is too large to put in a frame.
- **Time to live** – limits a datagram's lifetime. If the packet doesn't get to its destination before the TTL expires, it is discarded.
- **Protocol** – defines the protocol used in the data portion of the IP datagram. For example, TCP is represented by the number 6 and UDP by 17.
- **Header checksum** – used for error-checking of the header. If a packet arrives at a router and the router calculates a different checksum than the one specified in this field, the packet will be discarded.
- **Source IP address** – the IP address of the host that sent the packet.
- **Destination IP address** – the IP address of the host that should receive the packet.
- **Options** – used for network testing, debugging, security, and more. This field is usually empty.

Consider the following IP header, captured with **Wireshark**:

```
Internet Protocol Version 4, Src: 192.168.5.45 (192.168.5.45), Dst: 91.198.174.192 (91.198.174.192)
    Version: 4
    Header Length: 20 bytes
  Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
      0000 00.. = Differentiated Services Codepoint: Default (0x00)
      .... ..00 = Explicit Congestion Notification: Not-ECT (Not ECN-Capable Transport) (0x00)
    Total Length: 52
    Identification: 0x4116 (16662)
  Flags: 0x02 (Don't Fragment)
      0... .... = Reserved bit: Not set
      .1.. .... = Don't fragment: Set
      ..0. .... = More fragments: Not set
    Fragment offset: 0
    Time to live: 128
    Protocol: TCP (6)
  Header checksum: 0x0000 [validation disabled]
      [Good: False]
      [Bad: False]
```

Difference between Unicast, Broadcast and Multicast in Computer Network

The **cast** term here signifies some data(stream of packets) is being transmitted to the recipient(s) from the client(s) side over the communication channel that helps them to communicate. Let's see some of the "cast" concepts that are prevailing in the computer networks field.

Feature	Unicast	Broadcast	Multicast
Definition	A communication where a message is sent from one sender to one receiver.	A communication where a message is sent from one sender to all receivers.	A communication where a message is sent from one sender to a group of receivers
Transmission	Data is sent to a single recipient	Data is sent to all recipients in a network	Data is sent to a group of recipients
Addressing	Uses a unique destination address	Uses a special broadcast address	Uses a special multicast address
Delivery	Guaranteed delivery	Not all devices may be interested in the data	Not all devices may be interested in the data
Network Traffic	Generates the least amount of network traffic	Generates the most amount of network traffic	Generates moderate network traffic
Security	More secure because data is sent to a specific recipient	Less secure because data is sent to all devices in the network	Moderately secure because data is sent to a specific group of devices
Examples	Email, file transfer	DHCP requests, ARP requests	Video streaming, online gaming
Destination	Single receiver	All receivers	Grop of receivers
Bandwidth usage	Moderate	High	Moderate
Latency	Low	High	Moderate

1. Unicast:

This type of information transfer is useful when there is a participation of a single sender and a single recipient. So, in short, you can term it a one-to-one transmission. For example, if a device having IP address 10.1.2.0 in a network wants to send the traffic stream(data packets) to the device with IP address 20.12.4.2 in the other network, then unicast comes into the picture. This is the most common form of data transfer over networks.

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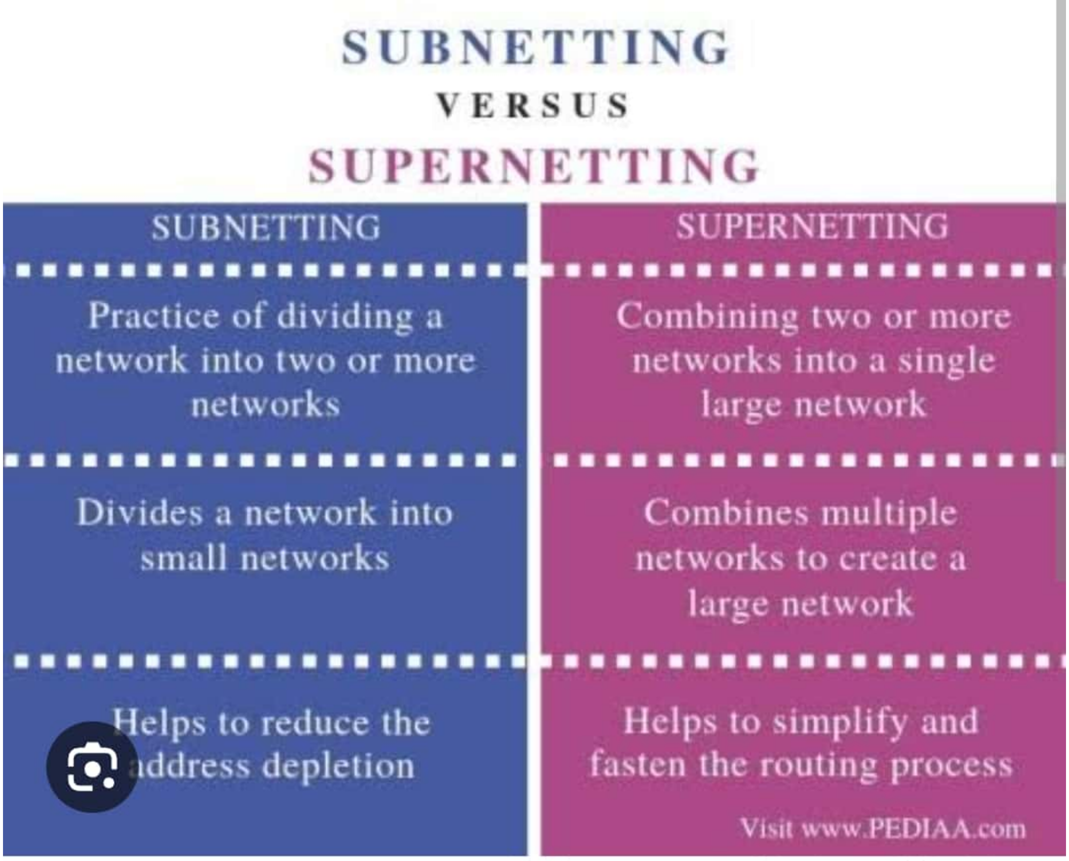

SUBNETTING VERSUS SUPERNETTING

SUBNETTING	SUPERNETTING
Practice of dividing a network into two or more networks	Combining two or more networks into a single large network
Divides a network into small networks	Combines multiple networks to create a large network
Helps to reduce the address depletion	Helps to simplify and fasten the routing process

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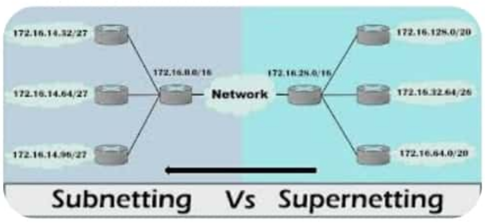
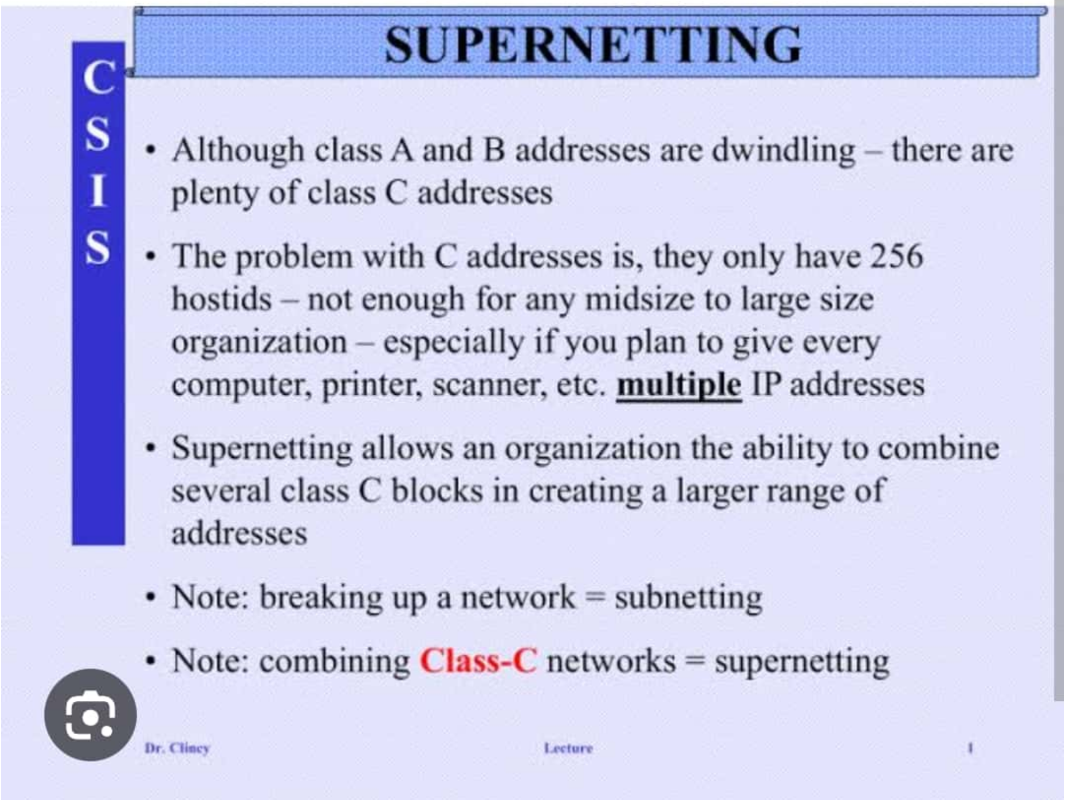
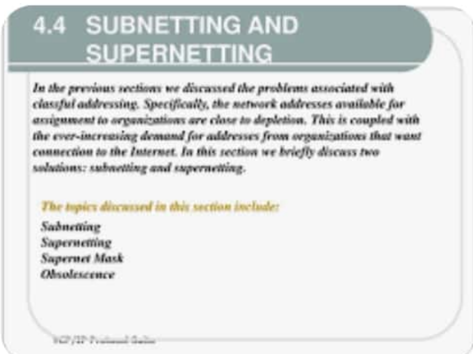


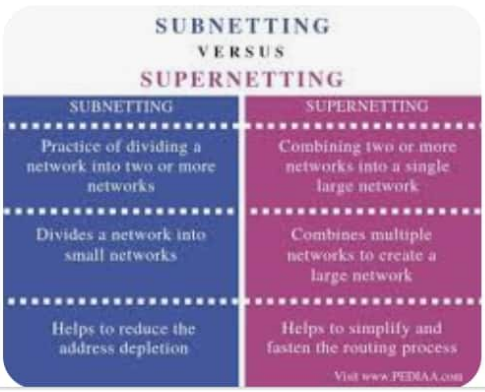
Tech Differences

Difference Between Subn



IPv4 Addresses 3





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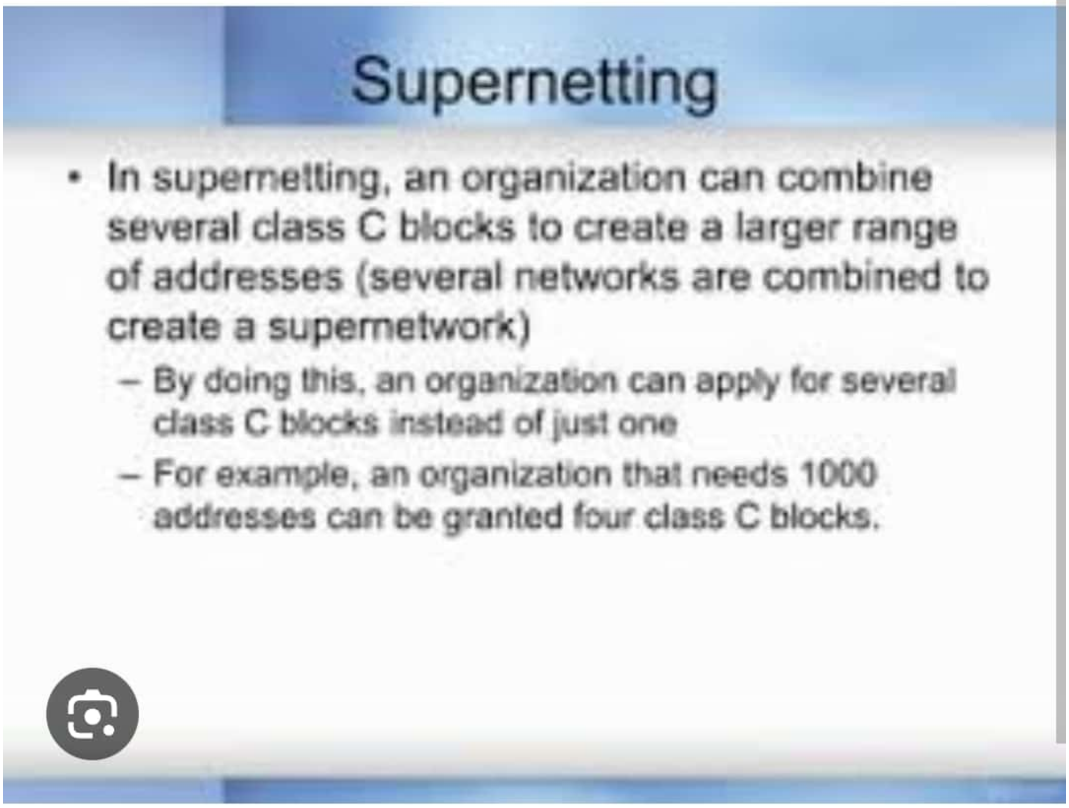

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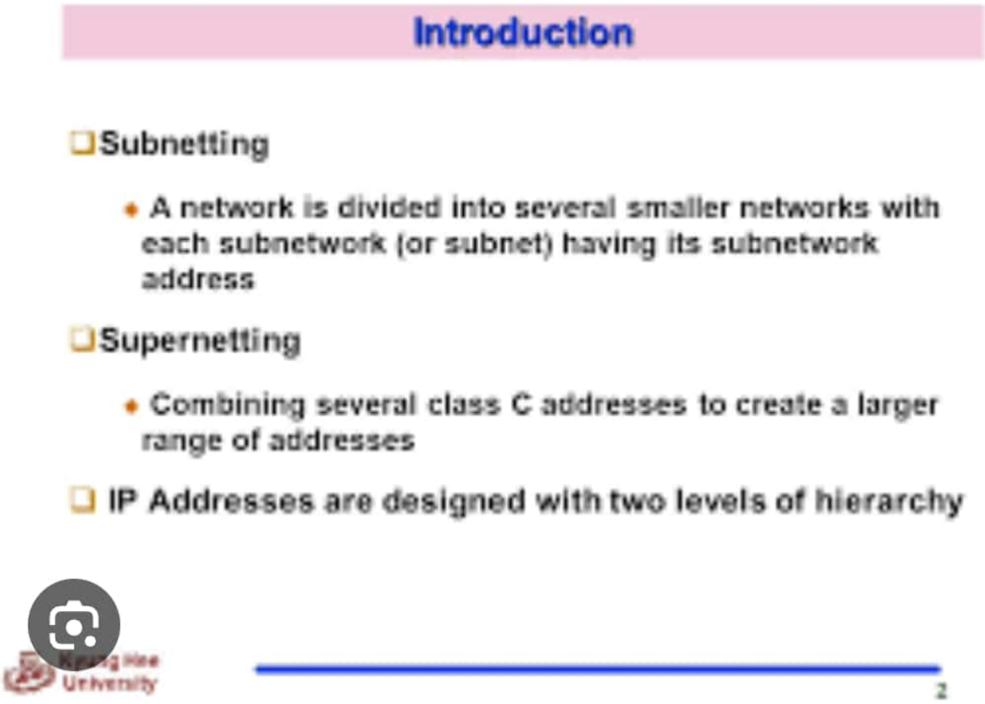

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Basic of Comparison	Subnetting	Supernatting
Description	Subnetting is a technique of dividing a network into two or more sub-networks.	Supernetting is a technique of aggregating various networks to form to form one single large network.
Implementation	Subnetting is implemented via Variable-length subnet masking.	Supernetting is implemented via classless inter-domain routing.
Importance	Subnetting helps to reduce the address depletion.	Supernetting helps to simplify and fasten the routing process.
Mask Bits	In Subnetting, the mask bits are removed towards the right of the default mask.	In Supernetting, the movement of the masked bits is towards the left of the default mask.
Effect	In Subnetting, the network address's number of bits are significantly increased.	In Supernetting, the host address's number of bits are significantly increased.

Difference Between Subnetting and Supernetting

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