"Classless addressing":-

↳ Block → group of IP address

x.y.z.w /n ⟶ CIDR notation { Classless interdomain routing notation }
or
slash notation

202.71.63.84/26 ⟶ 11111111 11111111 11111111 11000000 (26 ones)

202.71.63.84 ↓ IP address

/26 ↪ mask

255.255.255.190

Rules of classless addressing :-

1st:- The addresses in block are continuous

2nd:- The 1st address of the block should be exactly divisible by number of addresses of a block.

(1) One of the address of Block is
201.55.99.125/26

No of addresses in a block

$= 2^{32-n}$ → mask

$= 2^{32-26} = 2^6 = 64$

Range of Block :

125 ⇒ 01111101   64) 64 (0

64 : 01000000

127 ⇒ 01111111

Range of ... 201.55.99.64/26 – 201.55.99.127/26

First Host = 201.55.99.65/26

Last Host = 201.55.99.126/26

DBA = 201.55.99.127/26

(2) One of the address of the block is

120.89.29.161/27

No of addresses: $= 2^{32-n} = 2^5 = 32$

Range of Block:

161 : ~~10000001~~

~~120.89.29.32~~

$\underbrace{101}\ \underbrace{00001}_{5\ bits}$

~~64~~ : 101 00000 = 160

101 11111 = 191

Range: 120.89.29.160/27 – 120.89.29.191/27

(3) 44.69.89.126/20

No of Addresses $= 2^{32-20} = 2^{12}$ bit $= 2^4 * 2^8$

Range of Block:

89.126 : 0101 1001 0111 1110

0101 0000 . 00000000

80.0

0101 1111 . 11111111

95.255

Range: ~~8~~ 44.69.80.0/20 – 44.69.95.255/20

4) One of the Address of Block is:

63.89.99.143/22

No of Addresses = 2^{32-22} = 2^{10} = $2^2 * 2^8$

99.143 :- 01100011 . 10001111

01100000 00000000

96 .0

01100011 11111111

99 . .255

Range: 63.89.96.0/22 – 63.89.99.255/22

5) Block Contains 32 IP Addresses then which of the following can be the first Address of Block?

a.) 160.50.16.16 — 32) 16 (X

b.) 160.50.16.8 — 32) 8 (X

~~c)~~ 160.50.16.160 — 32) 160 (5 —

d) None

* first Address of Block should be divisible by No of Addresses of that Block.

6) Block Contains 1024 IP Addresses then which of the following can be first Address of Block

1024 → 2^{10} ⇒ $2^2 * 2^8$ = 4, 256

a) 130.5.2.0 — 256) 0 (0 —

b) 130.5.4.1 — 4) 16 (2 —

~~c)~~ 130.5.16.0 —

d) None

7) If one of the address of the block is given as! 71.81.59.93/26

If this block is divided into 4 equal sub-blocks then calculate the Range of Block and Range of Sub-blocks.

No of N/ω = $2^{32-26} = 2^6 = 64$

other way:

0 - 63

93 64 - 127

128 - 191

192 - 255

93 :- 01011101

01000000

64

01111111

127

Range of Block : 71.81.59.64/26 - 71.81.59.127/26

No of Address in sub-block = $\frac{64}{4 \to \text{sub blocks}}$ = 16 :- 2^4

2^{32-28} mask of sub-block

64 :- 0100 0000 → Hosts

4 bits sub-block bits

:- 0100 1111

79

Range of 1^{st} subblock :-

71.81.59.64/28 - 71.81.59.79/28

Range of 2^{nd} sub-block :-

0101 0000 → 80

0101 1111 → 95

71.81.59.80/28 - 71.81.59.95/28

0110 1111 → 111 }

Range of 3rd sub-block :- 71.81.59.96/28 - 71.81.59.111/28

0111 0000 - 112

0111 1111 - 127

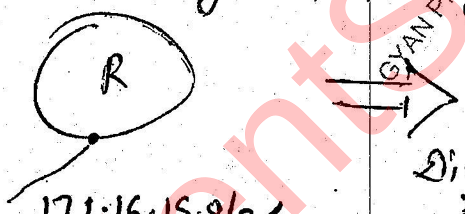
Range of 4th sub-block : 71.81.59.112/28 - 71.81.59.127/28.

Note :- Even the net_id and sub-net id of Block and sub-blocks are same but we can distinguish them with the help of mask.

Ex :- 71.81.59.64/26 net-id - Block

71.81.59.64/28 - net-id- sub-block.

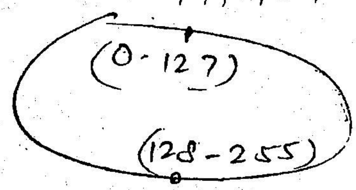
Equal Length subnetting :-



171.16.15.0/24

Divide into two equal LANs

$2^{32-24} = 2^8 = \frac{256}{2} = 128 = 2^7$



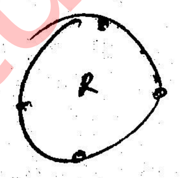
171.16.15.0/25

(0-127)

(128-255)

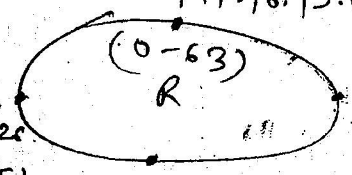
171.16.15.128/25

Que.



171.16.15.0/24

$2^{32-24} = 2^8 = \frac{256}{4} = 64 = 2^6$ = 26 mask



171.16.15.0/26

(0-63)

R

171.16.15.64/26

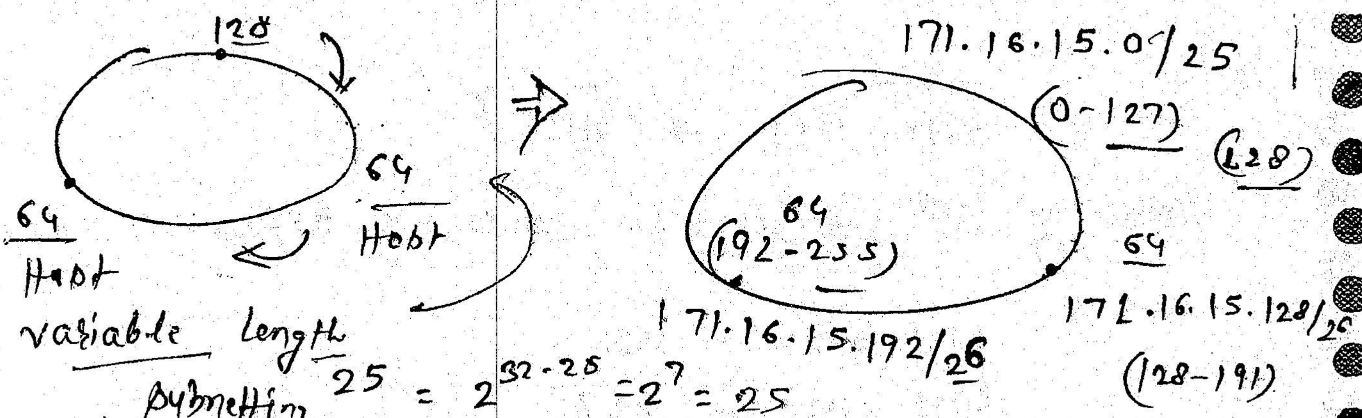
192

171.16.15.192/26

(192-255)

171.16.15.128/26

(128-191)



$25 = 2^{32-25} = 2^7 = 25$

$64 = 2^6 = 2^{32-6} = 26$ mask

(1) An ISP has a block 192.16.0.0/16

1 Group has 128 customers, each customer requires 256 IP addresses.

2nd group has 64 customers, each customer requires 128 IP addresses.

3rd group has 16 customers, each customer requires 64 IP addresses. (respectively)

:- Distribution of IPs by ISP :-

1st group :- $256 :- 2^8 = 2^{32-8} = 24$ mask

1st customer : 192.16.0.0/24 – 192.16.0.255/24

2nd cust : 192.16.1.0/24 – 192.16.1.255/24

:

128th cust : 192.16.127.0/24 - 192.16.127.255/24

2nd group :- 128 IPs :- $2^7 = 2^{32-7} = 25$ mask

1st cust : 192.16.128.0/25 – 192.16.128.127/25

2nd cust : 192.16.128.127/25 - 192.16.128.255/25

~~64 cust : 192.16.64.0/25 – 192.16.64.127/25~~

~~1st cust~~

2nd group :-

1 series { 1st cust : 192.16.128.0/25 - 192.16.128.127/25

remain 128-255

2nd cust : 192.16.128.128/25 - 192.16.128.255/25

1 series = 2 customer

64 cust/2 = 32 series

+31 series = 32 series

59th cust : 192.16.159.0/25 - 192.16.159.127/25

60th cust : 192.16.159.128/25 - 192.16.159.255/25

3rd group :-

64 :- 6 = 26 mask

1st cust : 192.16.160.0/26 - 192.16.160.63/26

2nd cust : 192.16.160.64/26 - 192.16.160.127/26

1 series = 4 customer

as

3rd cust : 192.16.160.128/26 - 192.16.160.191/26

4th cust : 192.16.160.192/26 - 192.16.160.255/26

16 cust = 4 series

+3

last cust : 192.16.163.192/26 - 192.16.163.255/26

Que: Calculate the IP addresses that are left over with ISP after assiging those three groups. and the answer should be the scaling factor of powes of 2.

No of addresses $= 2^{32-n} = 2^{32-16} = 2^{16}$ = total addresses

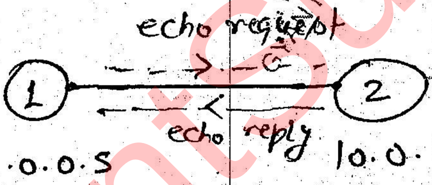
$$2^{16} - [\underbrace{128 * 256}_{1^{st}} + \underbrace{64 * 128}_{2^{nd}} + \underbrace{16 * 64}_{3^{rd}}]$$

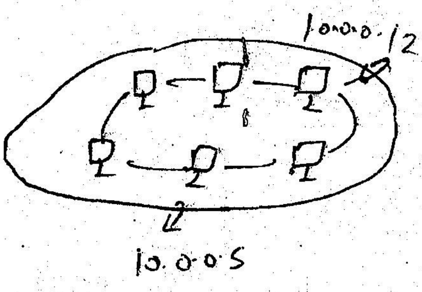
$$2^{16} - [2^7 * 2^8 + 2^6 * 2^7 + 2^4 * 2^6]$$

$$2^{16} - 2^{10}[32 + 8 + 1] \Rightarrow [2^6 - 32 - 8 - 1] \times 2^{10}$$
$$= 64 - 41 = 23 \times 2^{10}$$

$$\cancel{2^6 * (41)} : 2^{10} * 64 - 41 \times 2^{10} = 23 \times 2^{10}$$

"Ping" :- Packet Internet groper





Command :- C:\> Ping -t 10.0.0.12 ↵

	SIP	DIP
D	10.0.0.5	10.0.0.12

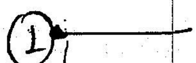
TTL = 4 msec, R.T.T. = 8 msec

"Ping is a networking command which is used to troubleshoot whether computers are properly connected or not."

other node connectivity check :- C:\> Ping -t 10.0.0.12 ↵

Destination unreachable. → Not connected.

[illegible] Troubleshooting :-



10.0.0.5

Command :- C:/> Ping -t 127.0.0.1 → Loop back Address

	S.IP	D.IP
D	10.0.0.5	127.0.0.1

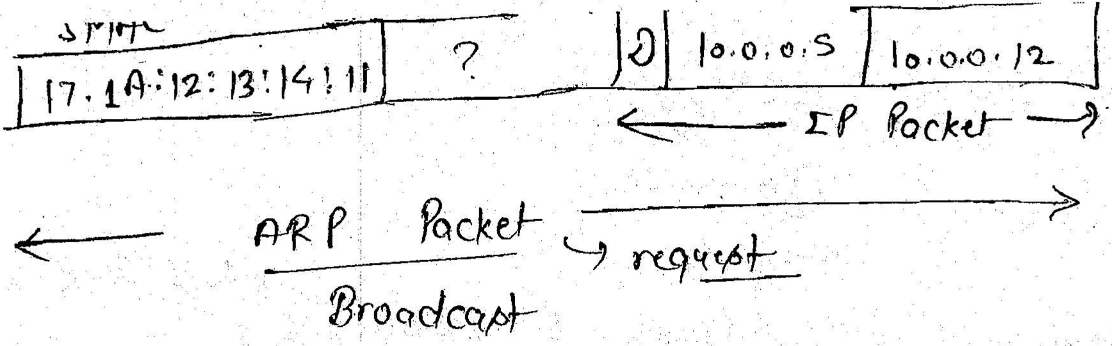
TTL = 2msec., R.T.T = 4msec.

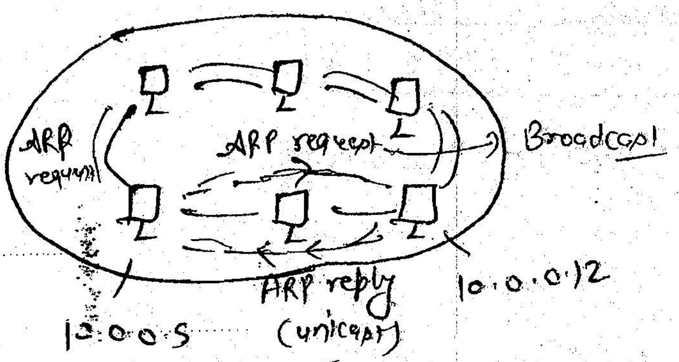
Loop back address :- It is used for the troubleshooting the self computer whether the computer is properly connected to the port or not.

* Loop-back address packet will never enter into the Network.
* Loop back Address will always be a Destination Address.

	S.IP	D.IP
D	0.0.0.0	127.0.0.1
	DHCP	Loop back

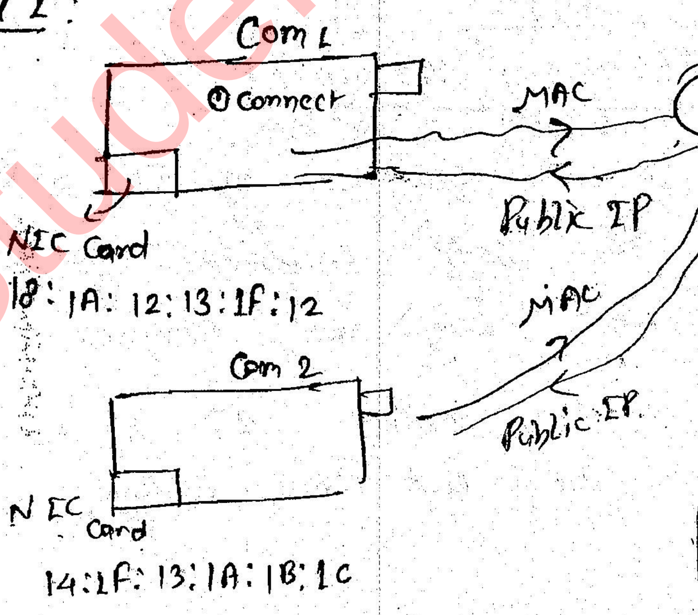
* Even if computer is not assigned any IP still we can troubleshoot the self computer by using DHCP client and Loop back Address.
* Note:- In IPV_4 the entire 127 series is wasted for loop back testing. 127.x.y.3.





* ARP request packet is a broadcast query packet { It contains Source IP, Source MAC, Destination IP but doesn't know Destination MAC }.
* ARP reply is a unicast packet, replied with the MAC Address.
* ARP packet encapsulate the IP packet.

Practical 1 :

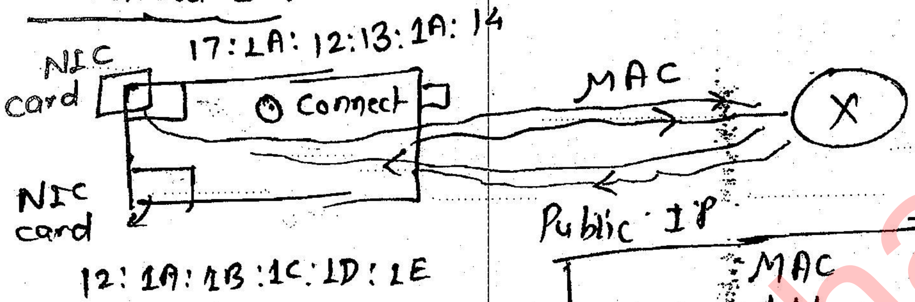


Enable	MAC Address	Public IP
✓ ~~X~~	18:1A:12:13:1F:12	7.8.9.1
✓	14:1F:13:1A:1B:1C	7.8.9.1
✓	18:1A:12:13:1F:12	9.5.6.1

★ A Computer can have multiple IP addresses at different instance of time.

★ This concept is known as same MAC multiple IP addresses at different instances of time.

Practical 2 :-



	MAC Address	IP Address	Enable
	12:1A:1B:1C:1D:1E	15.7.2.1	✓ ✗
	17:1A:12:13:1A:14	15.7.2.1	✓

★ A computer can have multiple MAC addresses to support fault tollerence.

★ This concept is known as multiple MAC and same IP ~~at~~ different instance of time.

① which of the following can be used as both the source IP as well as the Destination IP

(a) 10.255.255.255 (DBA) class A

(b) 172.16.255.255 (DBA) class B

(c) 10.5.6.1 ✓

(d) 255.255.255.255 (LBA)

(2) which of the following IP can be advertized to Internet?

a) 10.1.2.3
b.) 172.16.0.5
c) 192.168.1.5

$\left.\begin{matrix} \\ \\ \\ \end{matrix}\right\}$ Private IPs

d) 17.5.6.9

(3) IP = 192.168.1.9

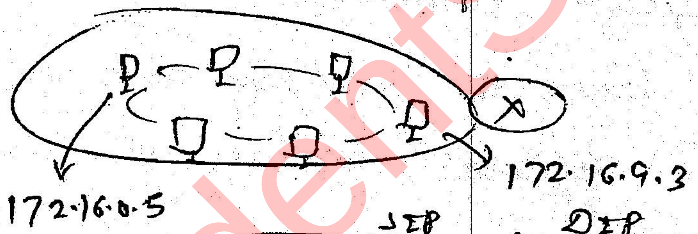
Calculate Host on this Network.

= 0.0.0.9

IP_1 = 192.168.1.9 → AND

wild card mask = Compliment of mask = 0.0.0.255

= 0.0.0.9 → No of Hosts on N/w



	SIP	DIP
D	172.16.0.5	172.16.9.3

‖ Same Network

	SIP	DIP
D	0.0.0.5	0.0.0.9

Host on this Network

(1) ⟶ (2)

10.0.0.5 172.16.0.5

	SIP	DIP
D	10.0.0.5	172.16.0.5

≃

	SIP ✗	DIP
D	0.0.0.5	0.0.0.5

Not on same N/w.

(4) IP = 201.55.66.88

Subnet mask = 255.255.255.128 → No Network × only subnet.

:- Network wishes to form subnets
or
:- (Explicitly zero subnet, DBA subnet are configured)

11111111. 11111111 11111111 1 0000000

$\underset{S}{1}\ \underset{h}{0000000}$

No of subnet $= 2^n = 2^1 = \underline{2}$ subnets

* (No -2 as given condition)

(i) zero subnet_Id = 0 0000000 = 201.55.66.0

(ii) First Host of zero_subnet = 0 0000001 = 201.55.66.1

(iii) Last Host of zero subnet = 0 1111110 = 126
= 201.55.66.126

(iv) DBA of zero subnet = 0 1111111 = 127
= 201.55.66.127

(v) DBA subnet - Id = 1 0000000
= 201.55.66.128

(vi) DBA subnet first Host = 1 0000001
= 201.55.66.129

(vii) Last Host of DBA subnet = 1 1111110
= 201.55.66.254

(ix) DBA of DBA subnet = 1 1111111
= 201.55.66.255

(1) IP, = 202.99.89.119

Subnet mask = 255.255.255.224

Network wishes to form subnet means i.e No N/ω i.e. No -2

No of Subnets = 224 : $\underbrace{111}_{S}\underbrace{00000}_{H}$

= 2^3 = 8 subnets (No -2 given condition)

(2) IP, = 202.99.89.119

Subnet mask = 255.255.255.224

Network is divided into subnets means i.e Network is Present

So -2 will be done

No of subnets = $2^n - 2$ = $2^3 - 2$ = 6

MAC Address :- (Scope is local)

⇒ 48 bit Address

↳ (i) unicast MAC address. 18:1A:12:13:14:15 → Hexa code

0001 1000 → 8 bits → If zeros rightmost unicast MAC

↳ (ii) Multicast MAC Address 19:12:13:1B:1F:12

0001 1001 → multicast MAC Address

↳ Rightmost bit 1

↳ (iii) Broadcast MAC Address

FF:FF:FF:FF:FF:FF

⇒ Interface Id ⇒ Extended MAC (64 bit Address) IPv6

MAC Address ⇒ 80-1A-12-1F-16-12

+ FFFE

* Extended MAC ↓

801A-12FF-FE1F-1612 ← 80-1A-12-FF-FE-1F-16-12

IPV6 :

↳ version 6

↳ 128 bit Address

IPV6 Address = Network Prefix (64 bits) + Extended MAC (64 bits)

IPV4 :– Dotted decimal notation

↳ 32 bits 84.74.75.102 4 octats

IPV6

↳ 128 bits $\frac{128}{8} = 16$ octats Not Preferred

↳ Hexadecimal Notation

$\frac{128}{16} = 8$

$$IPV_6 = \underbrace{\overbrace{FE80:1234:F100:1210}^{\text{Network Prefix}}:\overbrace{1A1F:1234:1A12:101F}^{\text{Extended MAC}}}_{128\ \text{bits}}$$

① IPV6 ⇒ FE80: 1234:1A12 : 1F12 : 0000 : 12F3 : 1412 : 1A1E ✓

⇓

FE80 : 1234 : 1A12 : 1F12 :: 12F3 : 1412 : 1A1E ✓

② IPV6 ⇒ FE80 : 1413: 1F12 : 0 : 0 : 0 : 0 : 1A12 ✓

⇓

FE80 : 1413 : 1F12 :: 1A12 ✓

★ Note :- In IPV6 Address If there are continuous zeros, zeros can be replaced by :: (double colon).

③ IPV6 = 2000: 0: 0 : 1A10: 0:0:141A : 1312

{ 2000 :: 1A10 :: 141A : 1312 ✗

2000 :: 1A10 : 0:0:141A:1312 ✓

. . . : 141A : 1312

Note:- whenever the zeros in the IPv_6 present in discontinuous manner then at only one junction zeros are replaced with ::

4) FE80::

7 fields will be placed by router at ::

5) ::

0:0:0:0:0:0:0:0 ⇒ (unspecified address)

= 0.0.0.0 IPv_4

(6) ::1

0:0:0:0:0:0:0:1 ⇒ {loop back address}.

(7)

	SIP	DIP
D	::	::1

→ Troubleshooting of self Computer

(8) FE80::/64 ⇒ (Link local Address)

→ (Private IP address in IPv_4)

(9) 2000::/3 ⇒ (Global unicast address)

→ (Public IP address in IPv_4)

:- IPv_6 ⇒ stateless Auto configuration

(i) Neighbour solicitation

→ Neighbour request

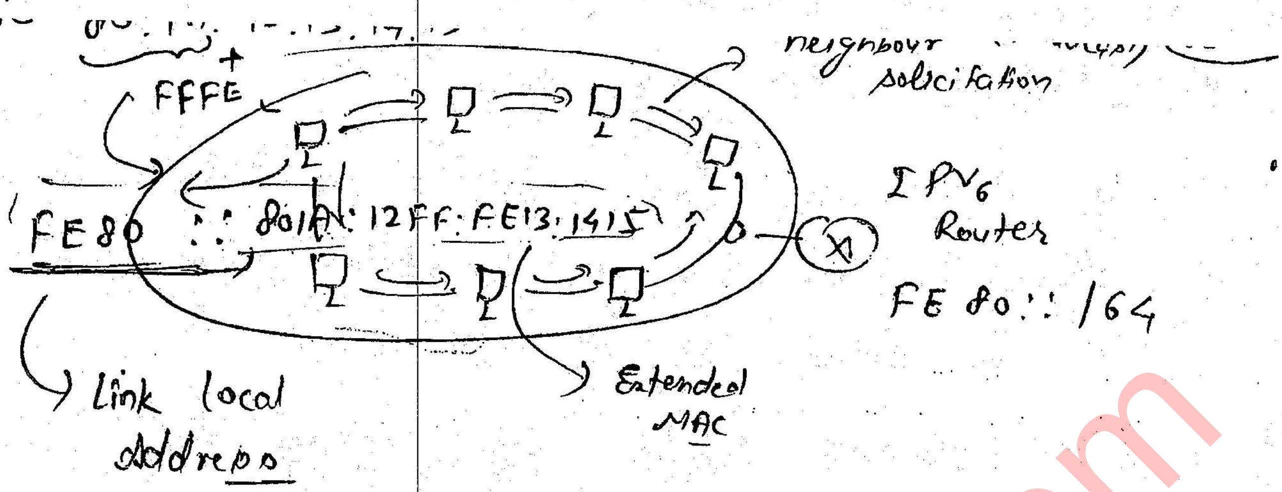
→ broadcast message

→ Neighbour reply

(ii) Router solicitation

→ Router request message

→ router reply.



★ Neighbour solicitation message is to ensure that No two systems will have the same MAC Address.

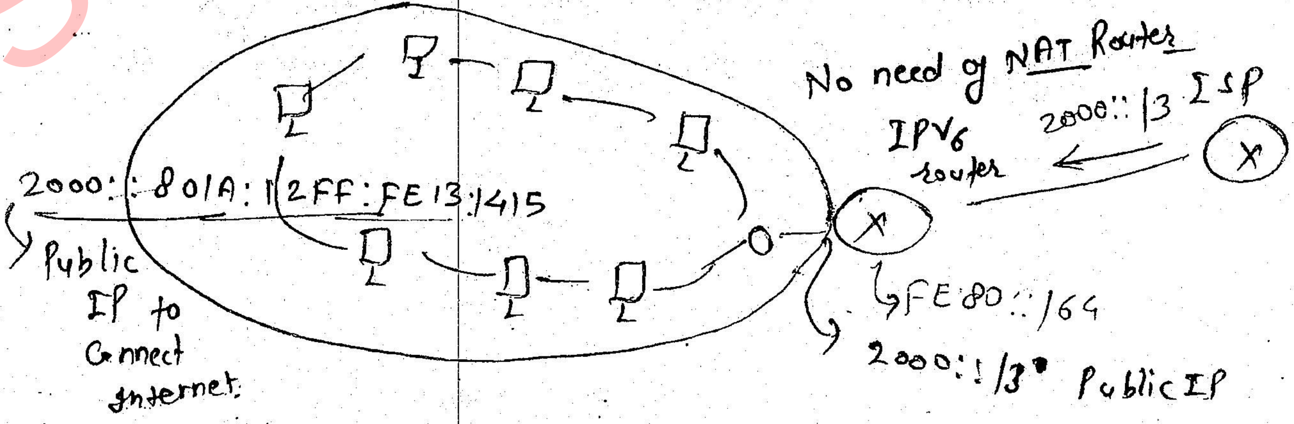
★ Router Solicitation message is to findout the nearby router to that LAN, so that it can collect Network portion or Net-id Portion.

★ <u>Note</u> :- IPV6 doesn't depend on ARP protocal because MAC Address itself is a part of IP Address.

Global unicast Address :-

2000::/3 ⇒ 001,0 0000 0000 0000

3 bits always same i.e. /3



* In IPv6 a computer can have multiple IP addresses at the same time

* In IPv6 we dont need a NAT router because there is no need of translation from public IP to private IP or vice versa.

* IPv6 doesn't require any mapping table for IP address to MAC address mapping.

* for mobile Networks or wireless N/w IPv6 is best suitable because of its stateless auto configuration.

* In IPv6 by default, It doesn't depend on DHCP server

* IPv6 ⤷ support Anycast address

difference b/w multicast, unicast :-

→ "In Anycast Address All Nodes will be given the same address, but the service is provided by the nearest device."

→ In multicast address, All nodes will be given the same address and the message is transferred to the group of system of that IP.