

TopppersNotes

GATE

**COMPUTER SCIENCE &
INFORMATION TECHNOLOGY**

VOLUME-II

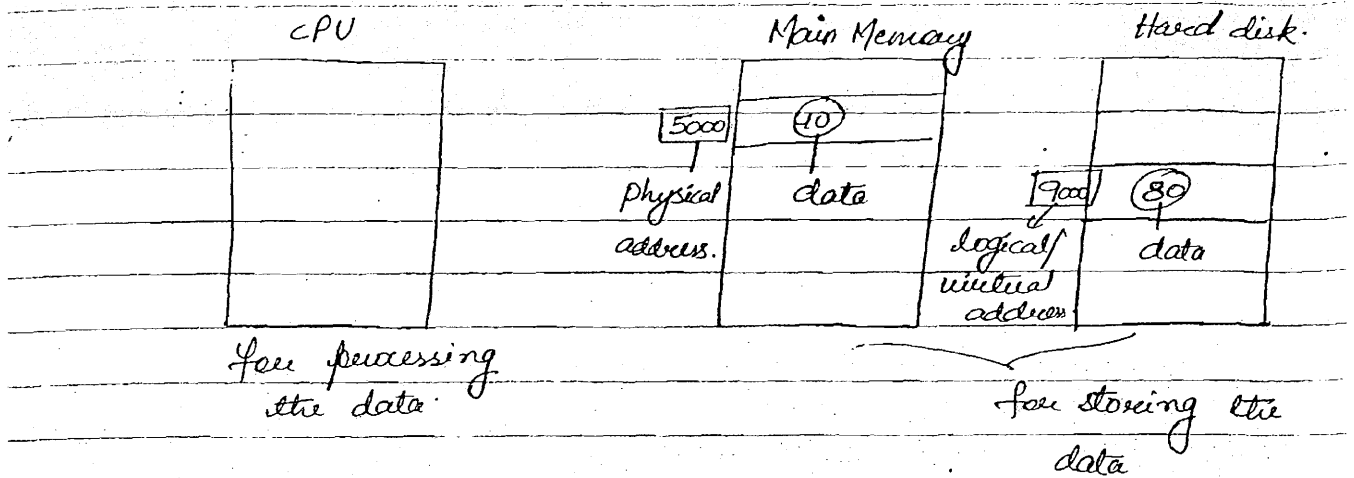
**COMPUTER NETWORKS
COMPUTER ORGANIZATION
& DATA STRUCTURES**

Sierra Innovations Pvt. Ltd.

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COMPUTER NETWORK



•> Compl N/w is all about how the data is transferred from 1 computer to another through cable.

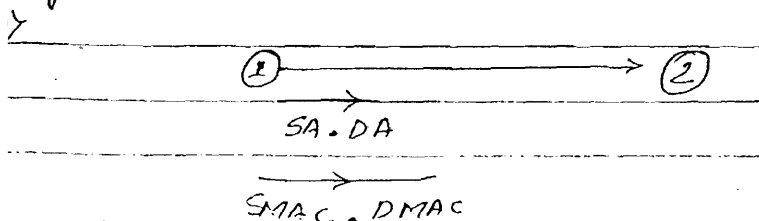
•> The address pointing to 1 local^{ty} in MM is called physical address.

•> The address pointing to a location in hard disk is called as virtual address.

•> NIC card address
 or,
 MAC address
 or,
 physical address
 or,
 Ethernet address

} by default it is 48 bit address.

•> In n/w, address of computer is called physical address. On motherboard there is a NIC card & the address of NIC card is called as NIC card address.



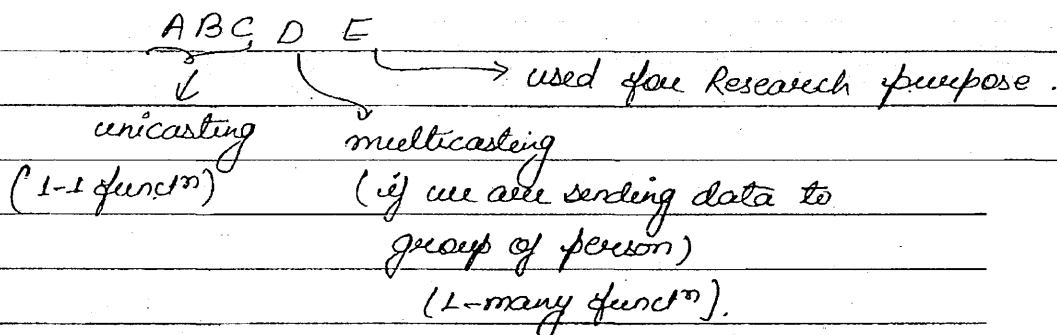
↳ MAC card address can't be used for identification in transmitting as they don't have unique structure.

• So, in n/w for transmitting b/w 1 comp & another computer classful addressing is used.

↳ MAC address alone can't be used as an entity in transmitting the data becoz every company has their own representation. So they introduced classful addressing / logical addressing or IP addressing [given by IANA (Internet assigned Number authority) organization].

IPv₄ - 32 bit address.

The different classes of classful addressing are:-

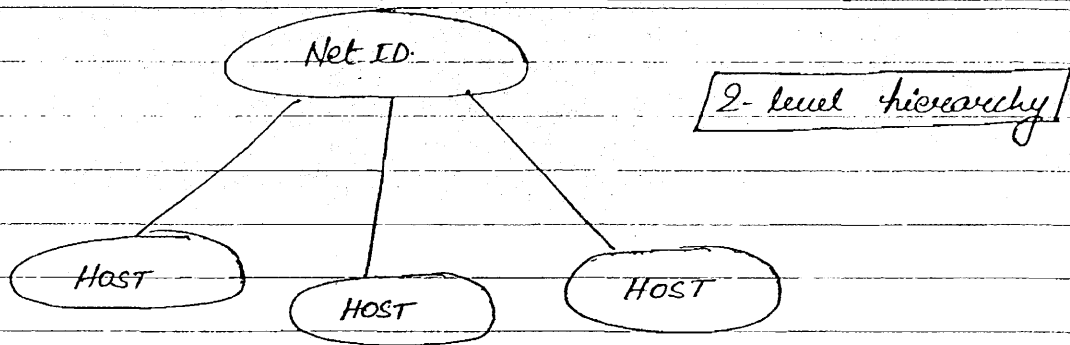


Broadcasting → 1 - all funcⁿ

↳ By default implicit address is MAC address.

• The explicit address that is given by the user to the comp is known as IP Address.

• Classful addressing supports 2 level hierarchy.



• When the computer is given an IP address, it is called as host.

• For entire LAN n/w, a number is given, that no. is called as Net ID.

or,

Entire n/w will be represented by a no. called net ID.

• Representatⁿ :-

(a) Binary notation :-

- IP represented in the form of 0's & 1's.
- User isn't flexible with this notatⁿ.
- Computer is flexible with this notatⁿ.

Eg:- if IP is 32 bit it is represented as -
 01010111 10101111 10101111 10101010

(b) Dotted Decimal notatⁿ :-

- each octet is separated by a • (dot)
- User is flexible with this type of notatⁿ.

Eg:- 74.63.89.126.

Eg:- $63_{10} \Rightarrow (00111100)_2$

$80_{10} \Rightarrow (01010000)_2$

$$(97)_{10} \Rightarrow (01100001)_2$$

$$\begin{array}{r} 64 \\ 32 \\ \hline 96 \end{array}$$

$$(12)_{10} \Rightarrow (01110000)_2$$

$$\begin{array}{r} 64 \\ 32 \\ 16 \\ \hline \end{array}$$

$$(24)_{10} \Rightarrow (11100000)_2$$

$$\begin{array}{r} 128 \\ 64 \\ \hline \end{array}$$

$$112$$

$$(40)_{10} \Rightarrow (11110000)_2$$

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ \hline 224 \end{array}$$

$$64$$

$$32$$

$$16$$

$$8$$

$$(127)_{10} \Rightarrow (01111111)_2$$

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ 16 \\ 8 \\ \hline 256 \end{array}$$

$$120$$

$$4$$

$$2$$

$$1$$

$$(43)_{10} \Rightarrow (1000111)_2$$

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ \hline 243 \end{array}$$

$$(213)_{10} \Rightarrow (11110011)_2$$

Maximum value with 8 bit (octet) = 255 (11111111)

Minimum value with octet = 0 ie (00000000).

In binary notation, first few bits will decide the type of class.

In dotted decimal notation, the first octet will decide the type of class.

CLASS A:- Net ID bit - 8 bits (1 bit for identification).
 host bit \rightarrow 24 bit

Net ID always starts with 0.

Minimum value:- 0 0000000 - 0

Maximum value:- 0 11111111 - 127.

Range - 0 - 127.

From $2^7 \rightarrow$ 2 no's are special host ID ie

0 & 127

$127.x.y.z$
 \hookrightarrow loop back address.

$0.0.0.0$
 \hookrightarrow DHCP closet

IP.
 special addresses.

$0 (2^8 - 2)$ $(2^{24} - 2)$
 Net ID host
 8 bits (24 bit).

Each host can net ID can have $2^{24} - 2$ host.

Eg:- (43). 57.89.126
 \hookrightarrow 43 in b/w 0-127. So it is class A.

CLASS B:-

Starting 2 bits should be (10).

Minimum value = $10 \overset{2^8}{000000} \overset{2^0}{0} = 128$
 Maximum value = $10 \overset{2^8}{111111} \overset{2^0}{1} = 191$.

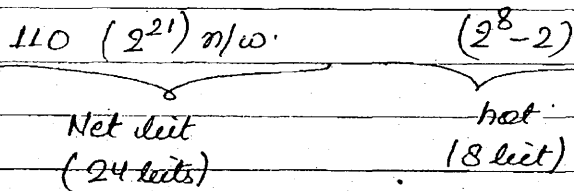
8 bit used for class identification (128-191)

class B:- $10 (2^{16})$ networks $(2^{16} - 2)$
 Net bits Host
 (16 bits) (16 bits).

\hookrightarrow this 16 bit is basically for class identification.
 i.e. No. of class B n/w.

4 **CLASS C** :-

- Starting 3 bits are **110**
 - Max value — 110.11111 — 192
 - Min value — 110.00000 — 223
- } (192-223)



• Each n/w can have $(2^8 - 2)$ hosts.

NOTE :-

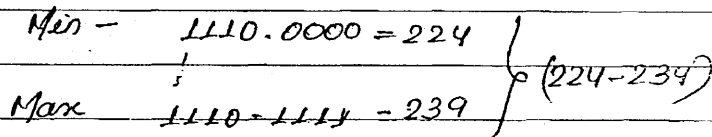
• All the above 3 classes supports unicasting.

If we want to give IP address to computer, it can be given only through either class A, B or C becoz all these class have host part.

CLASS D :-

• Starting 4 bits are **1110**.

1110



• But we can't assign it as IP address becoz it has no host part. It is a group only.
 used for multicasting.

CLASS E :-

• Starting bits are 1111

• 1111

1111.0000 - 240

|

1111.1111 - 255

} (240 - 255)

• Used for research purpose.

NETWORK MASK / DEFAULT MASK :-

• It is a tool for solving some of the n/w problem.

• Rule of Mask :-

- 1) Make all n/w bits as 1's
- 2) Make all host bits as 0's.

Eg:- Mask of class A :-

11111111.00000000.00000000.00000000
 ↳ 255.0.0.0

Mask of class B :-

11111111.11111111.00000000.00000000
 ↳ 255.255.0.0

Mask of class C :-

11111111.11111111.11111111.00000000
 ↳ 255.255.255.0

• There will be no mask for class D & E as they don't have n/w bits & host bits.

• For a n/w mask, n/w bits will be all 1's and host bits will be all 0's.

IP = 200.15.40.89.

- (1) Calculate the N/w ID.
- (2) Calculate direct broadcast address of n/w.

Solⁿ:- IP₁ = 200.15.40.89.

class = C

Mask of class C = 255.255.255.0

Perform the bitwise AND operatⁿ b/w IP & Mask.

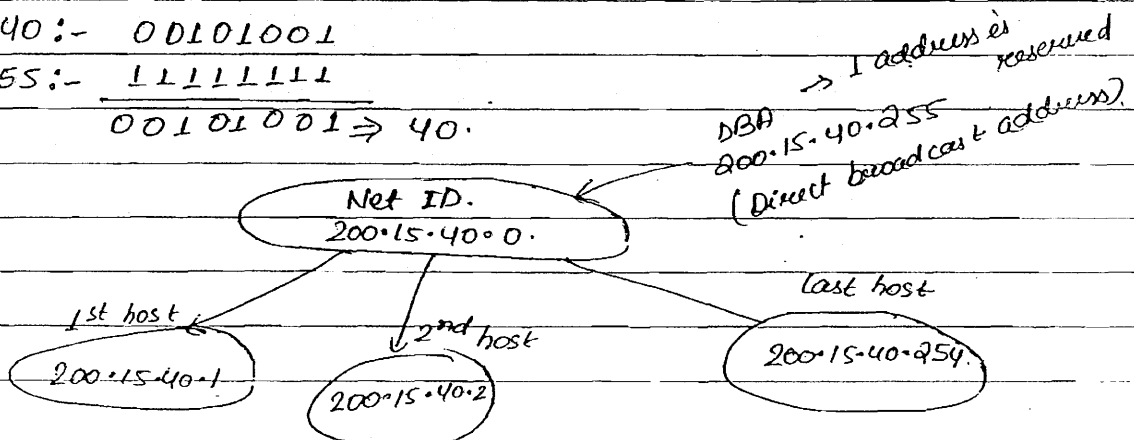
x	y	O/P.
0	0	0
0	1	0
1	0	0
1	1	1

In real time, router performs the bitwise AND operatⁿ.

Network ID:- 200.15.40.0

89:- 01011001		64
0:- 00000000		16
		80
0:- 00000000 ⇒ 0		

40:- 00101001		
255:- 11111111		
00101001 ⇒ 40.		



0 can't be used as it is used for Net ID.

• So, no. of host we are subtracting 2 decog 1 is used for net ID and 2nd one is reserved for direct broadcast address (DBA) of a n/w.

Shortcut:-

$$\underline{200.15.40.89}$$

class C.

$$\text{Net ID} = 200.15.40.0.$$

$$\text{DBA} = 200.15.40.255$$

• For a net ID, host bits will be 0's.
 • The DBA of the n/w, host bits will be all 1's.

② IP = 144.39.59.119.

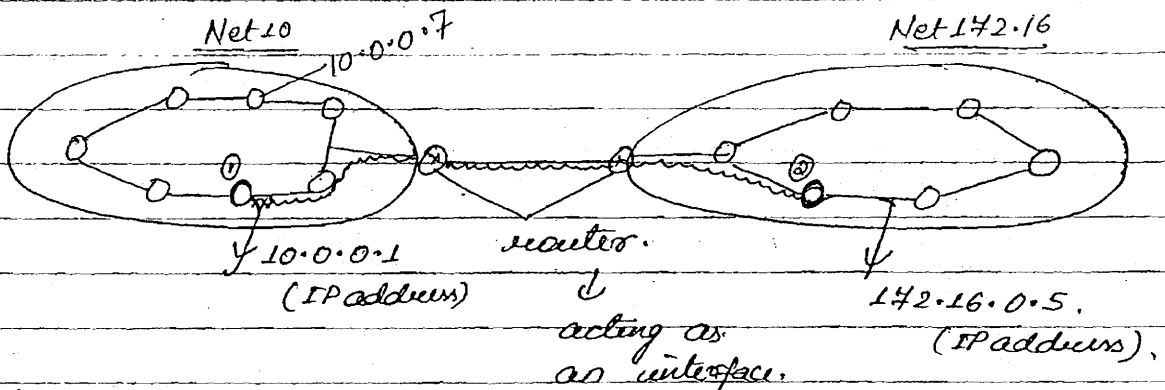
class - B.

$$\text{N/w ID} = 144.39.0.0.$$

$$\text{DBA of n/w} \rightarrow 144.39.255.255.$$

PSEUDO APPROACH OF PACKETS:-

N/w where all computers are connected.



Computer ① & ② want to transmit the data & both the computer are on different LAN.

		SIP	DIP	
(i)	D	10.0.0.1	172.16.0.5	UNICAST Packet b/w 2 N/w.
		$10 \neq 172.$		

So, router will forward the data.

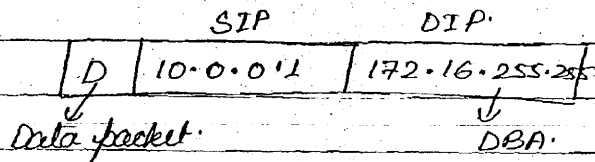


Destination router will check the destination address. If it matches, the packet will be transferred to the desired computer.

Router will match the n/w ID. If the net ID is same it will discard the packet and if it is different

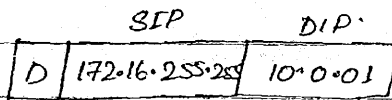
Router will match the SIP & DIP. If they match the data packet will be discarded, otherwise it will be forwarded.

(ii) Computer 1 wants to transmit data to all the computers of Net 172.16.



Data packet from source will be transferred to router. Router will match the

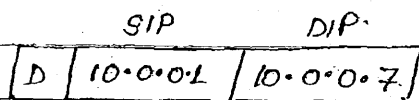
(iii)



↳ Not valid. [as many computer is transmitting data to single computer.]

DBA will always be used as destination address

(iv)



Packet will come to router, router will delock the packet.

Packet will discard & reach the DIP.

So it is unicast packet within the n/w

No. of routers passing/crossing = 0.

** Special case:- Computer wants to transfer data within all the computers in the same LAN.

	SIP	DIP
D	10.0.0.1	255.255.255.255

↳ limited broadcast address
(scope is local).

10.255.255.255 → can't be used as it will be used by other n/w but here we are on the same LAN.

- DBA → broadcast on other n/w
- LBA → broadcast within same n/w.
- There is no purpose to broadcast on whole internet.

	SIP	DIP
D	255.255.255.255	10.0.0.1

→ Not valid.

All the computers on the LAN are sending packet to same computer which is practically Not possible.

• So, limited broadcast address will always be used as the destination address.

#

IP ADDRESS.

Private IP addresses.

Public IP address.

• works only in LAN

• scope is local.

• free of cost.

• Range :- 10.0.0.0 - 10.255.255.255

• scope is globally unique.

• these IP are under the control of ISP (internet service provider).

service provider.

1 private n/w ← 172.16.0.0 - 172.31.255.255 (16-31 → 16)
 16 private n/w ← 192.168.0.0 - 192.168.255.255
 256 private IP n/w

Eg:- 144.15.16.5
↳ public IP.

• Not free of cost.

192.168.5.1
↳ private IP.

• By simply loading an network-
-ing operatⁿ system we
will get the private IP.

• Drawback :- won't get the
internet service as its
scope is local. It will work
only in LAN.

4 ASSIGNMENT OF PRIVATE IP ADDRESSES IN A LAN:-

In a LAN various client computers are connected. There is a
server computer (admin).

Server ⇒ window 2003, window NT (along with DOS protocols,
network protocols are also loaded)

Client ⇒ window XP (only DOS protocols are loaded).

Server will be loaded with the ^{group of} IP addresses.

Admin assigns one of the IP to the server from the group of
IP addresses. Admin needs to inform about IP to all the
clients. So admin will use a packet and transmit it
from server to all the clients. So, server's IP will be
known by all the clients.

None of the clients have the IP address. So client will
request for IP address.

0.0.0.0 → DHCP client/default address

is used when a computer has no IP & still it wants
to transmit the data.

→ The request packet will directly go to server. At server there will be admin. Admin will pick one of the IP from the group and assign it to the client.

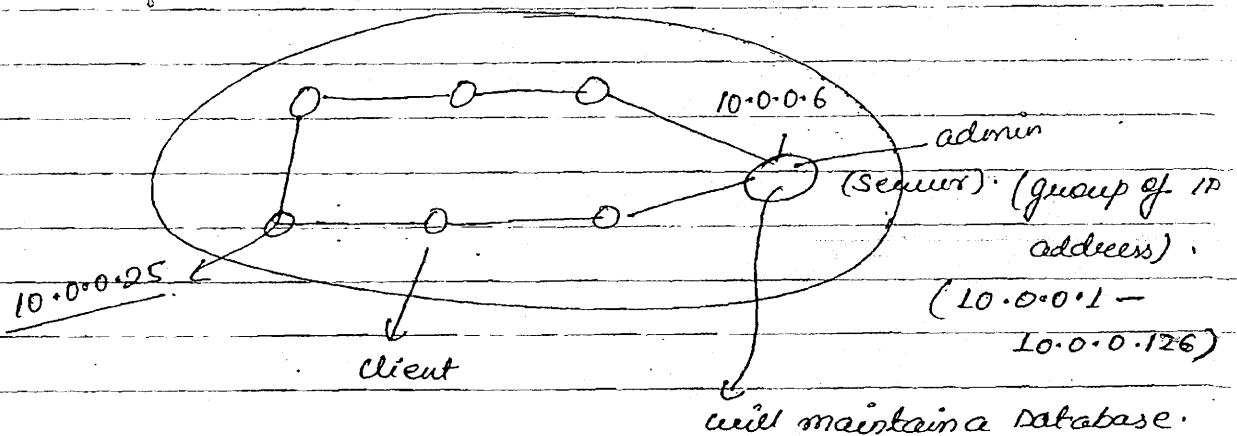
→ Each client will have the same IP i.e. 0.0.0.0 so the client will also send the MAC address along with IP. With MAC address the address admin will identify the client.

→ At server, admin will maintain a database for which IP is assigned to which client (with their MAC address).

	SIP	DIP
D	10.0.0.6	255.255.255.255

Server to all the other computers on LAN.

	SIP	DIP
D	0.0.0.0	10.0.0.6
	MAC	↳ IP of server
	(17:1A:12:13:14:15)	



IP address	MAC address
10.0.0.25	17:1A:12:13:14:15

Once the server is loaded with n/w operating system, it will get group of private IP addresses. Out of which one IP is assigned to the server.

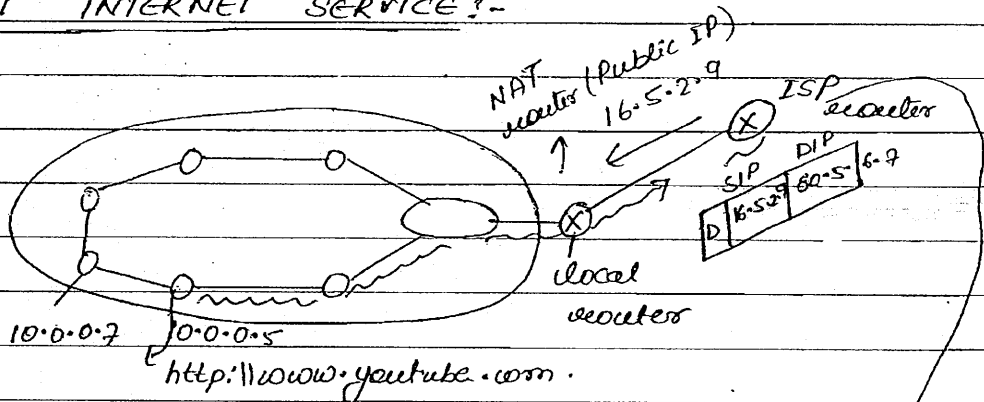
The server's IP is informed to all clients using limited broadcasting.

NOTE :-

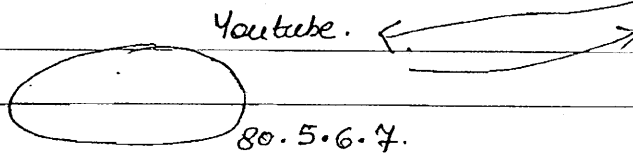
When the client isn't having an IP address still it wants to transmit the data, it can use [0.0.0.0] as the source address.

Along with this request packet MAC address is transmitted. So that admin can understand which IP is assigned to which computer.

F HOW TO GET INTERNET SERVICE :-



Only 1 or 2 IP is sufficient for whole LAN.



	SIP	DIP
D	10.0.0.5	80.5.6.7

⇓

NAT router will convert the private IP to the packaged public IP.

	SIP	DIP
D	16.5.2.9	80.5.6.7

⇓

When the youtube will reply, again at local router public IP will be converted to private IP.

NAT → N/w address transmitter.

If more than 1 computer are requesting the same internet service then they will be converted to same public IP & will be distinguished based on the MAC address.

Private IP	Public IP	MAC add.	Port
10.0.0.5	16.5.2.9	-	-
10.0.0.6	16.5.2.9	-	-

} mismatch in any field value will be used for the identification of the computer

• NAT router converts private IP into public IP when the packet is going out of the n/w.

• It converts public IP into private IP when the packet is coming inside the network.

• Beoz of private IP address, public IP addresses are efficiently utilized as on 100 private IP address only 1 or 2