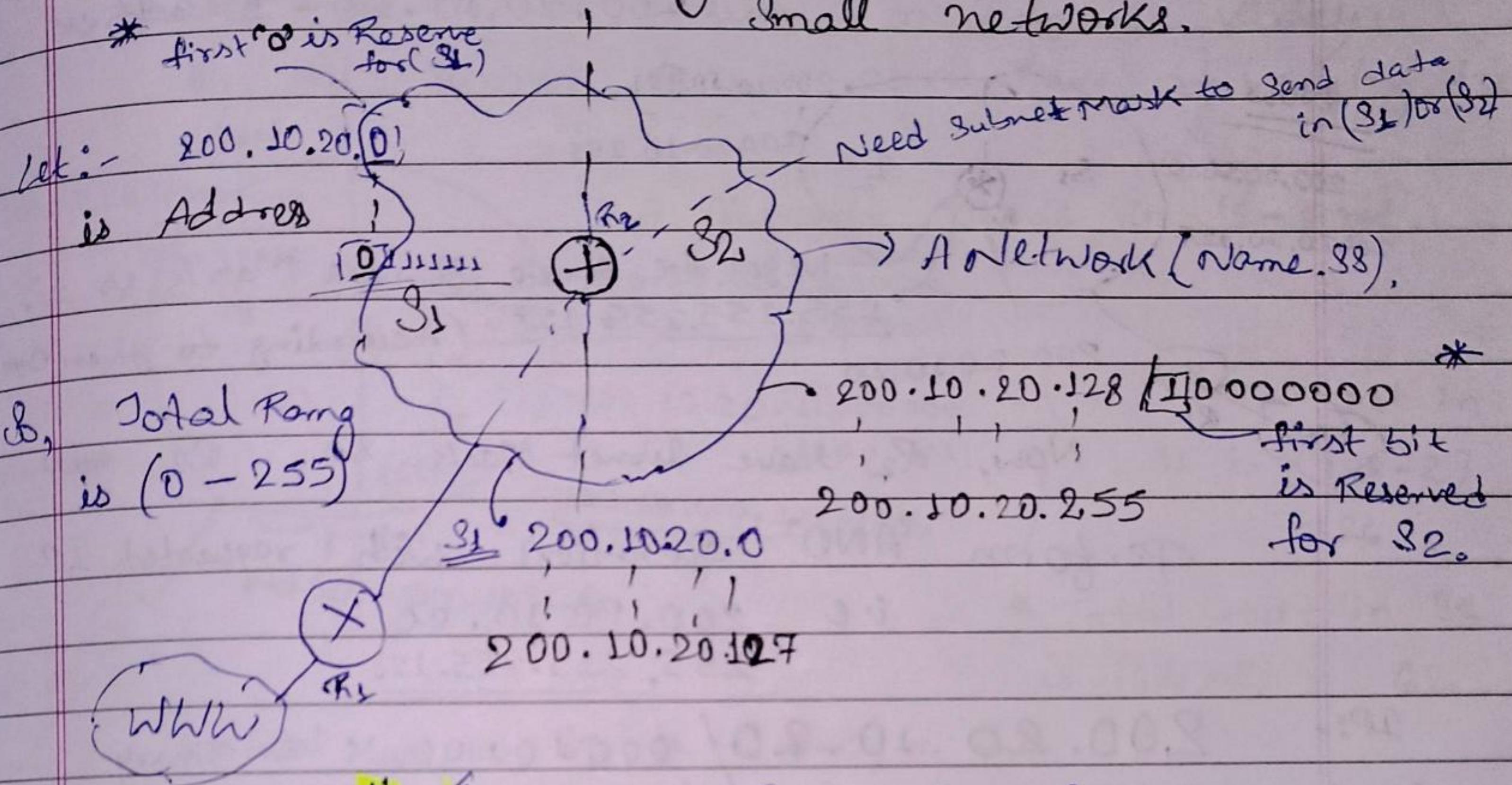


Subnetting in Classful Add.

PAGE NO.: 79 RBP
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* Subnetting :- Dividing the big network into small networks.



In above Scenario A Network of class C is divided in two part So, we have total Range (0 - 255)
 $(0 \text{ to } 255)/2$, $S_1 = 0 - 127$
* we can perform $S_2 = 128 - 255$ it by using subnetting concept.

• How to get Subnet mask :- * we know class C have

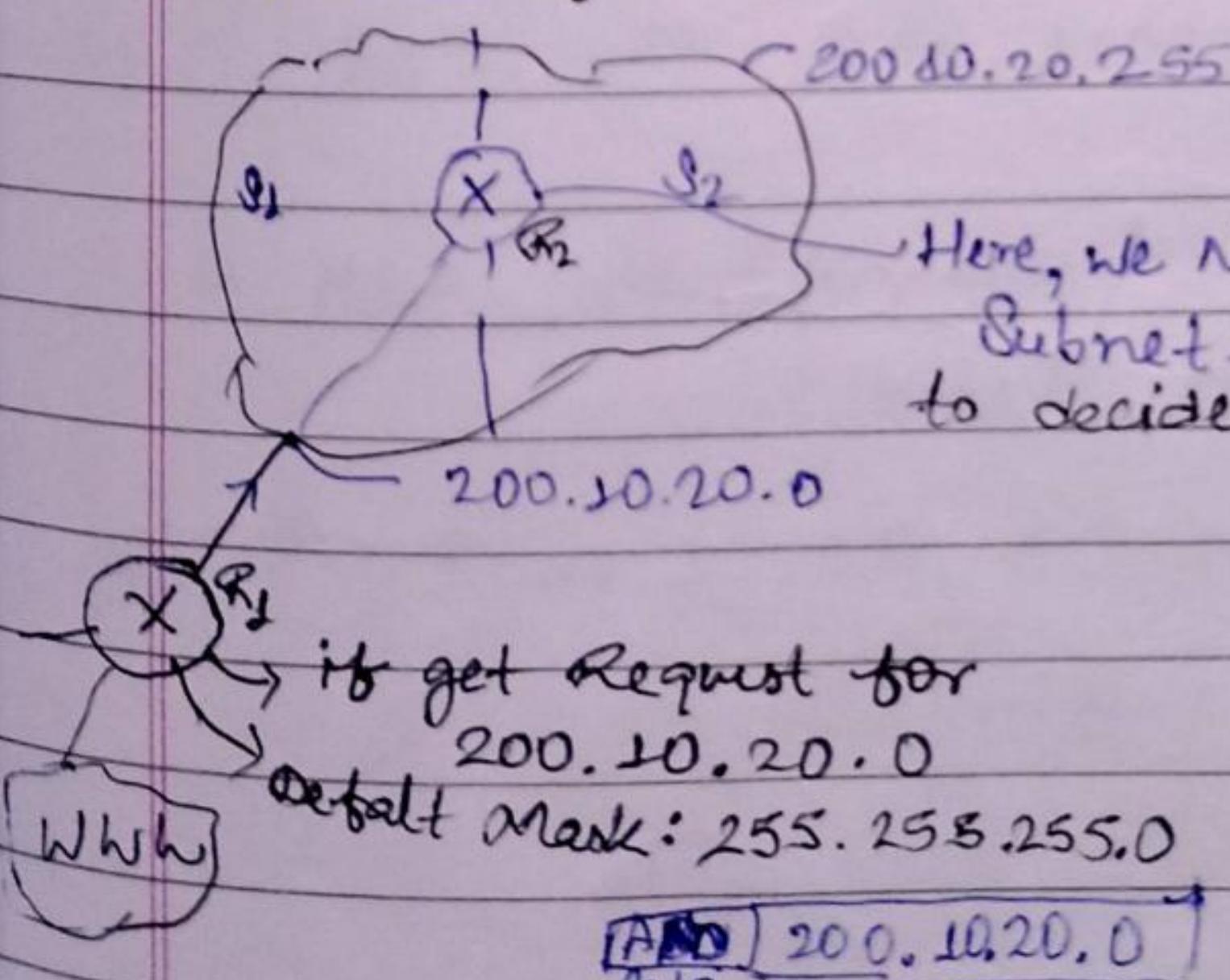
Default Mask :- 255.255.255.

in last 8bit we have to put ('1') for No. of reserved bit. So, In above we reserved first bit '0' or '1' for (S_1 or S_2)

Now

255.255.255.10000000

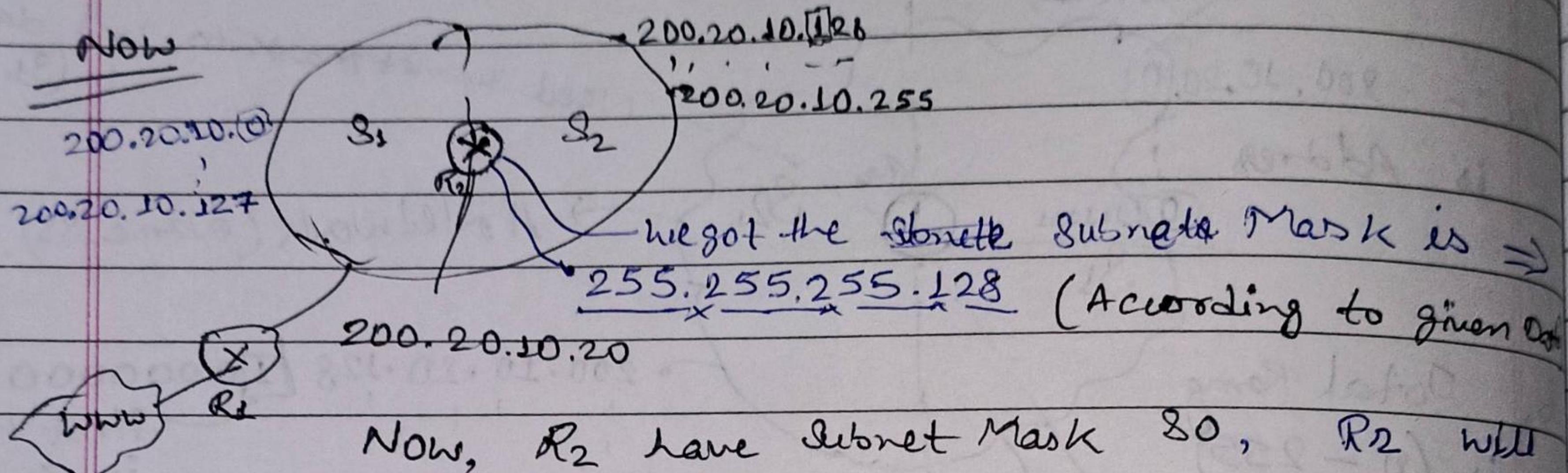
255.255.255.281 it



will assign to R2 ✓

Ex

Let's take a Example :- A Request with
200.20.10.20 - IP address



Now, R1 have Subnet Mask 80, R1 will

perform 'AND' operation with requested IP.
i.e 200.20.10.20
255.255.255.128

IP:-

200.20.10.20 / 00010100 : In Binary
Subnet mask 255.255.255.128 / 10000000

'AND' 00000000

So Data will be 00000000

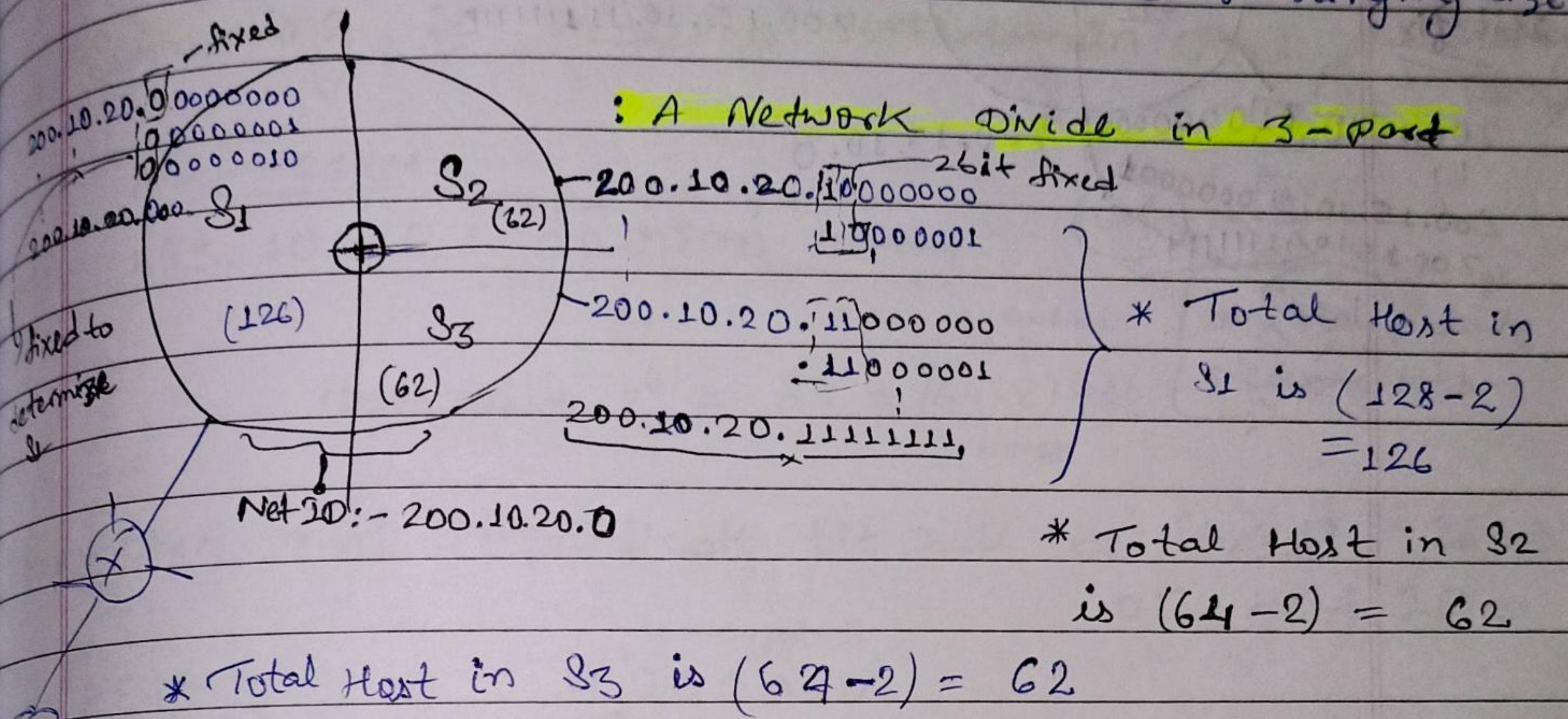
Forwarded to the (S1) Because 200.20.10.0 is
(S1's) Network ID.

✓ IP address = Network ID + Host ID

Variable length Subnet Masking (VLSM)

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- It allows to divide a Network according to your choice / use, It mean n can be variety.
- All subnet mask can have varying size



Subnet Mask :- It depends on No. of bits Reserved for any network in 'S1', * And defined class (A - C)
S1 is class - C, * Default Mask.

255.255.255.11000000, :- * Reserved bits will be 1, ✓

S2:- 255.255.255.11000000

S3:- 255.255.255.11000000

Host identification / network will decide the value of Subnet Mask AND IP address =

Ex:- 200.10.20.55 :- 255.255.255.10011011
S1

Classless Subnetting (CIDR)

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195.10.20.128 /26 → No. of Network bits
 $\hookrightarrow \text{Host ID} = 32 \text{ bit} - 26 = 6 \text{ bit}$

* Subnetting in classless Interdomain Routing (Subnetting in CIDR)

N/W ID: 26 bit
 195.10.20.10,00000 : binary
 \downarrow
 Host possible $2^6 = 64 = (64 - 2) = 62$ Net ID
 Note: Never change or manipulate Network bits.

Ques:- Then most significant bit will be 'fixed' So ⇒

OF Host ID ⇒

195.10.20.10 01111
 ↑
 Host ID
 10,00000
 Fixed (0'00'1)
 00001
 000010
 , 0111
 195.10.20.10 01111
 S1 (30) S2 (32)
 Usable (30) Usable (32)
 30 32
 30 32
 30 32

Ques:- first ID of 'S1' is 195.10.20.128/27 - Because Now No of fixed bits is 27
 to
 195.10.20.159/27

Ques:- 'S2' again the 'S2' most significant bit of Host ID will be fixed.

So, :- 195.10.20.10[1]00000

* Because we used '0' for (S1) no '1' are available now.

So,

Subnet 'S2' :- 195.10.20.10[0]1111

↓
 195.10.20.160 - 191/27

No. of fixed bits

CIDR

Numericals GATE

► classless interdomain (CIDR) receive a packet with address 131.23.151.76. The Router's routing table has following entities:-

* Prefix, Output Interface

- | | | | |
|------------------|---|---|-------------------------|
| 1. 131.16.0.0/12 | 3 | + | Wrong explained below ↳ |
| 2. 131.28.0.0/14 | 5 | | |
| 3. 131.19.0.0/16 | 2 | | |
| 4. 131.22.0.0/15 | 1 | ✓ | |

Q. Packet will be forwarded to which interface

Soln * we have to do 'AND' operation b/w 'interface'(in) and given id (131.23.151.76) :-

Int :- 131.23.151.76

/12 :- 1111111.11110000.00000000.00000000

131.

? AND
Operation
Value

Given:- 131.00010111.151.76

Interface :- 255.11110000.0.0

AND ▷ [131.16.0.0]

* This is matched with option (1) So

Answer is O/P Interface is 3;

Try another

131.23.151.76

2:- /14 :- 1111111.1111100.00000000.0

'AND' :- 131.00010100.0.0

[131.20.0.0] Not correct

C.N
M=5

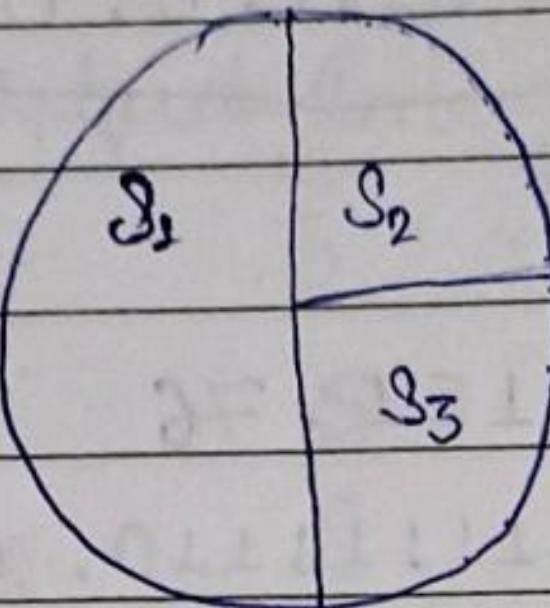
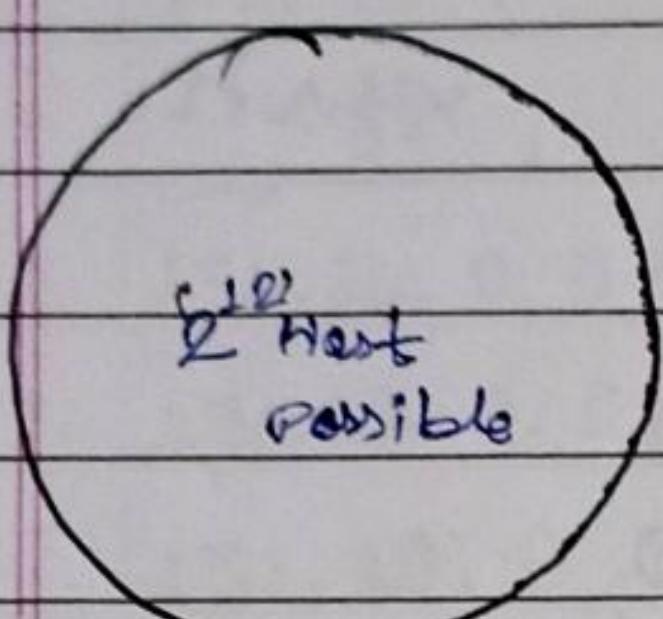
Variable Length Subnet Masking IN CIDR ↑

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- Variable length subnet Masking in clusters = CIDR



245.248.128.0/120

* Network id :- 245.248.1000000.0000000 as

* Host id :- $32 - 120 = 2^{12}$ /120 is given

Step To divide we have to fix most significant bit of Host bits (12).

So, $\frac{245}{8 \text{bit}}. \frac{248}{8 \text{bit}}. \frac{1000}{fixed 000}. 00000000$

1000.00000010
1.

245.248.10000111.11111111

⇒ Range of (S_1) = 245.248.128.0 \rightarrow 10 to

245.248.135.255 \rightarrow direct BC.

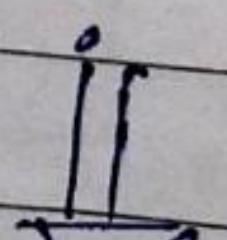
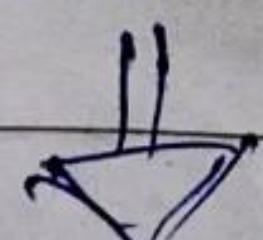
Note, 2^{12} is subnet mask of S_1 .

Step: $S_2 = \frac{245}{8} + \frac{248}{8} + \frac{1000}{5} = 121$ zero. (1).

We taken '1' at 2^{12} bit, because '0' is used for S_1 .

Next we have to divide S_2 in two part S_2 & S_3 .

So, again most significant bit of Host ID will be reserved.



ARP - Address Resolution Protocol - [Layer 2]

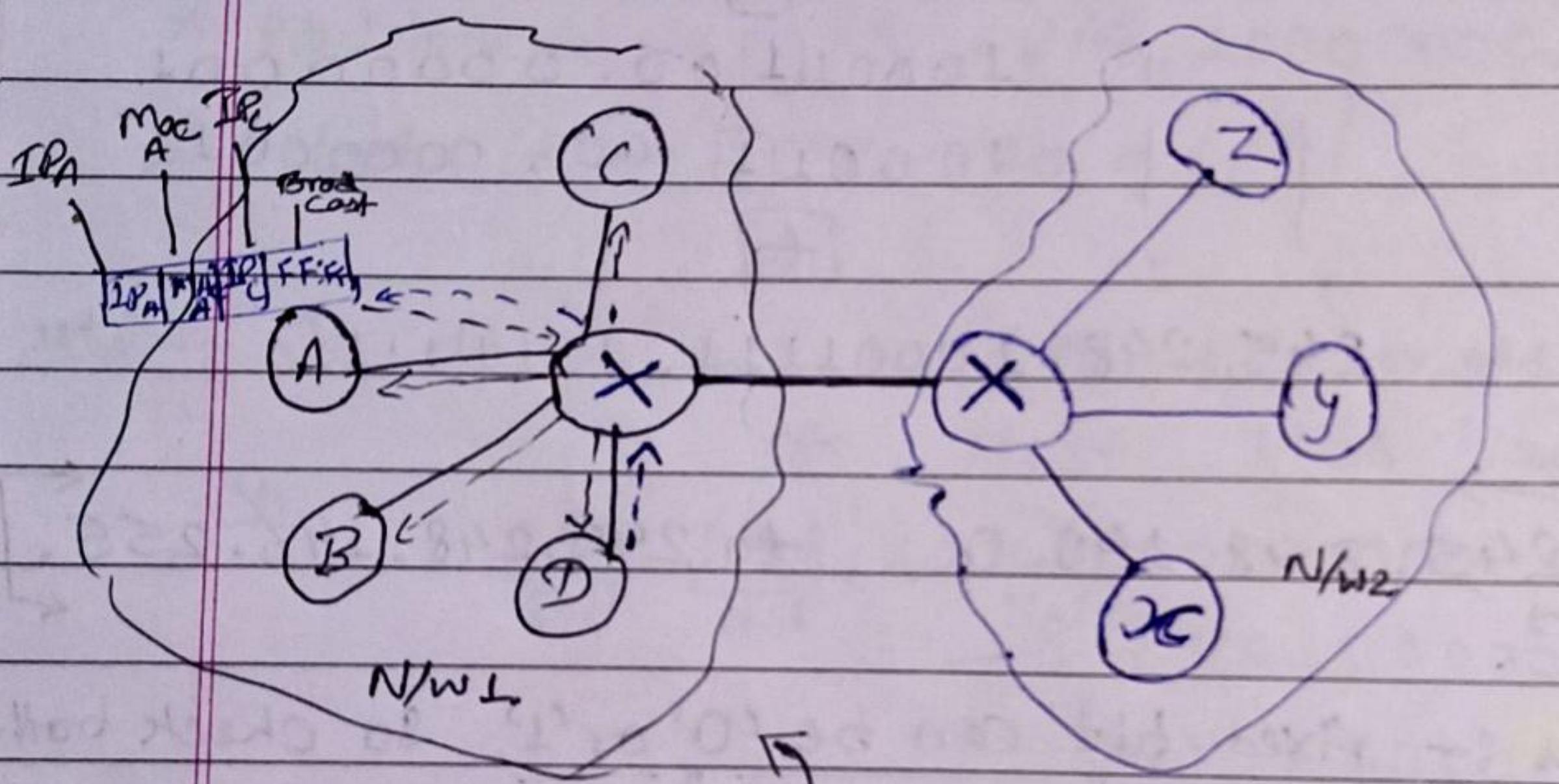
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* IP → Mac * Logical → Physical

⇒ ARP is a communication protocol used to find the MAC address of a device from its IP address. It is used in LAN or ethernet network.

- * Types of ARP
- Proxy ARP
 - Gratuitous ARP
 - Reverse ARP (RARP)
 - Inverse ARP

NIC holds MAC Address.



* ARP does always Broadcast

* A want to communicate with D

* Possible Communication in ARP

1. Host to Host ($H \rightarrow H$)
2. Host to Router ($H \rightarrow R$)
3. Router to Host ($R \rightarrow H$)
4. Router to Router ($R \rightarrow R$)

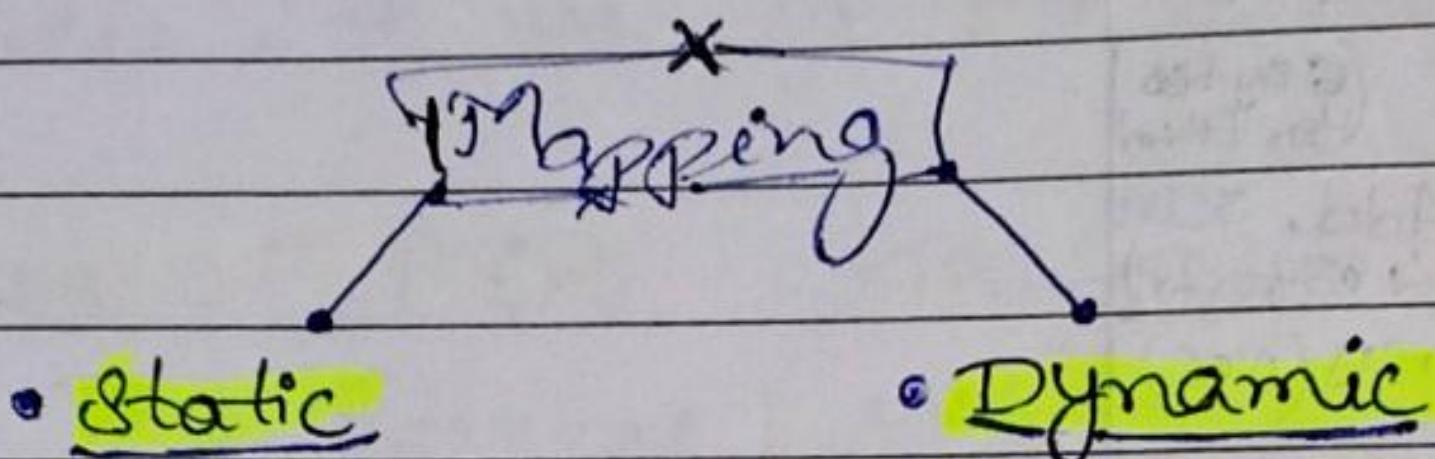
Note:- Broadcast: ARP Request and Unicast: ARP Reply

Communication Table :-

A R P Pa CK ET For:- ma: te	Hardware type (Ethernet or -)	Protocol type (IP or v6)
	Hardware Length (48 bit)	Protocol length (4B)
	Sender H/w Address	Operation (Req.-1)(Reply-2)
	Sender Protocol Add.	32bit (4B for IP)
	Target H/w Address (mac)	
	Target Protocol Address (IP)	

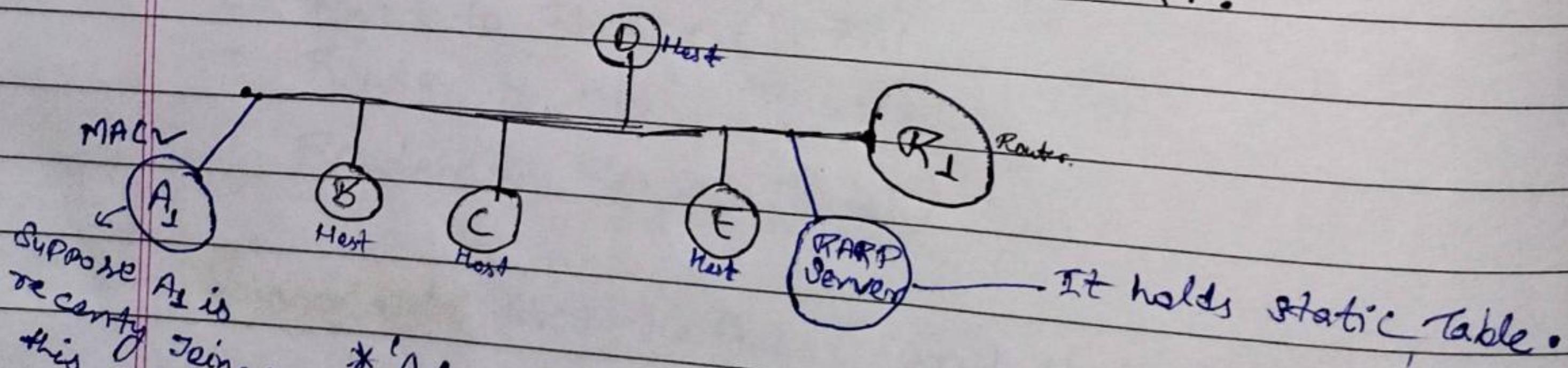
Address Mapping

- * **Address Mapping** - internet is made of a combination of physical N/w connected together by internetworking device such as routers.



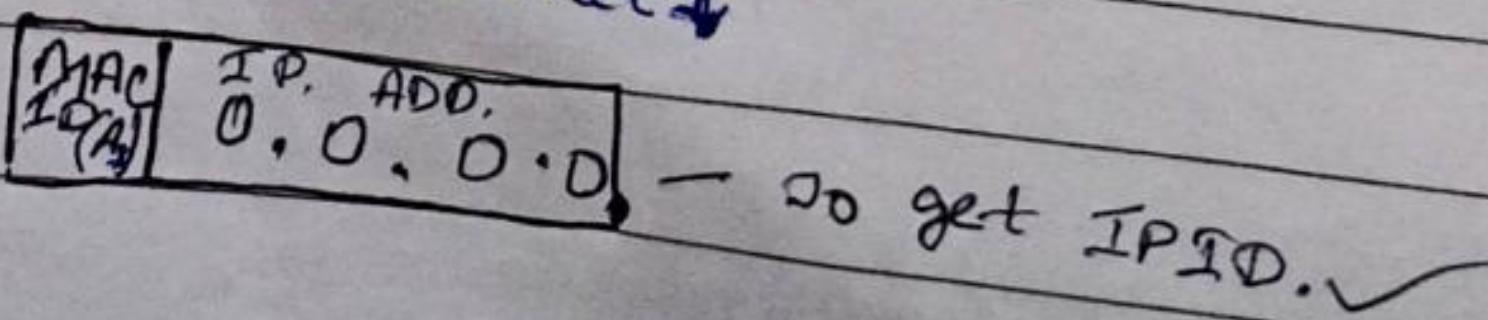
- ▷ In static, it creates a table that contains a logical address with a physical address.
- ▷ Dynamic - When a machine knows one of two addresses (logical or physical) through dynamic memory mapping, it may use this protocol to find the other one address. Done by ARP or RARP.
- ▷ **RARP** (Reverse Address Resolution Protocol :-

- In RARP, it finds IP address (of given MAC) just reverse of ARP.



Suppose A1 is recently joined this after. *'A1' only known (MAC) Address But, don't know IP.

* RARP Request packet



* RARP Server :- (It contains all connected Node's IP with MAC) Static Table

* How A₁ will request :-

Network Layer :- [MAC_{A₁}] IP 0.0.0.0

DLL :- [MAC_{A₁}] 0.0.0.0M FF:FF:FF:FF:FF:FE Data Link converts packet into frame, we know MAC ID for Broadcast.

MAC	IP
M _A	I _{P₁}
M _B	I _{P₂}
⋮	⋮
M _A	I _{P_A}

② RARP will reply with 'A₁'s IP Address by using / helping of static Table.

* Request, Received by All connect Nodes. * But, Response (unicast) Done by RARP Server.

RARP Not in use nowadays because we have better option as BOOTP and DHCP

C.N
M=5

BOOTP

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DATE: 07/8/22

- The Bootstrapping protocol is a Networking protocol used to by a client to obtain IP address from a server.
- * It designed to Replace 'RARP' protocol.
- Now, Bootstrapping is also going to be Replaced by DHCP, Its more flexible. (DHCP)
- ↳ It's lets a network user automatically be configured to receive an IP address and have an operating system booted without user involvement.
- * No disk Required.
- * It supports the use of motherboards.

DHCP

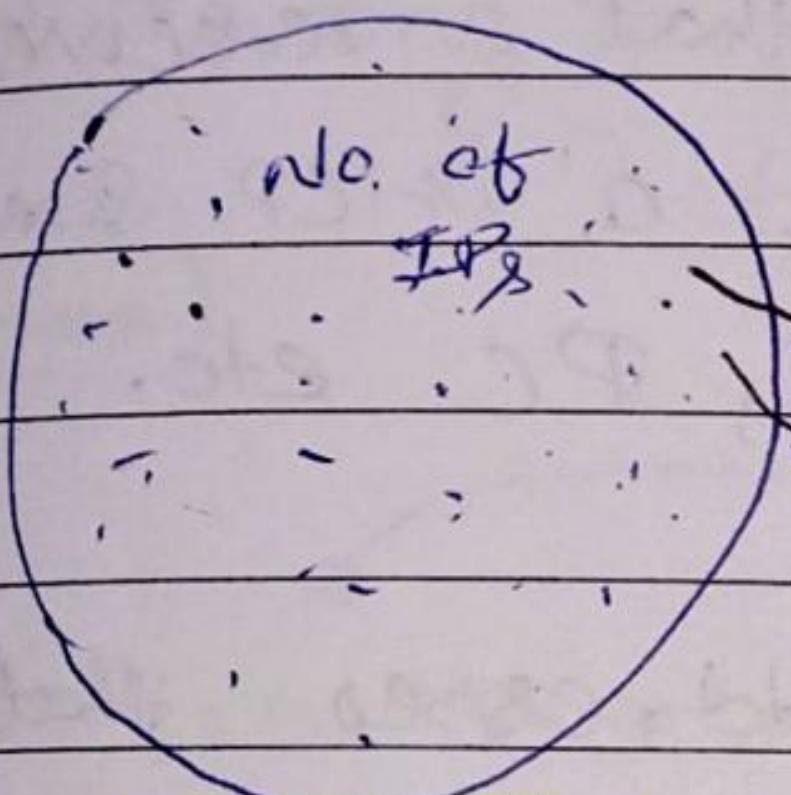
• Used for Broad N/W (Large No. of Host)
 • ~~Latent used~~
 Broadly used nowadays

Dynamic Host Control Protocol.

► It holds dual-type table :- Host Static & Host Dynamic Table.

	MAC	ID
Static:	M ₁	I ₁
	M ₂	I ₂

MAC	IP	Leave Time
M ₃	I ₃	10 min
M ₄	I ₄	12 min



Pool of IPs

* Here, DHCP contains static and also dynamic table, idea is

behind dynamic table it holds or assign IP for particular (lease time) and after that time

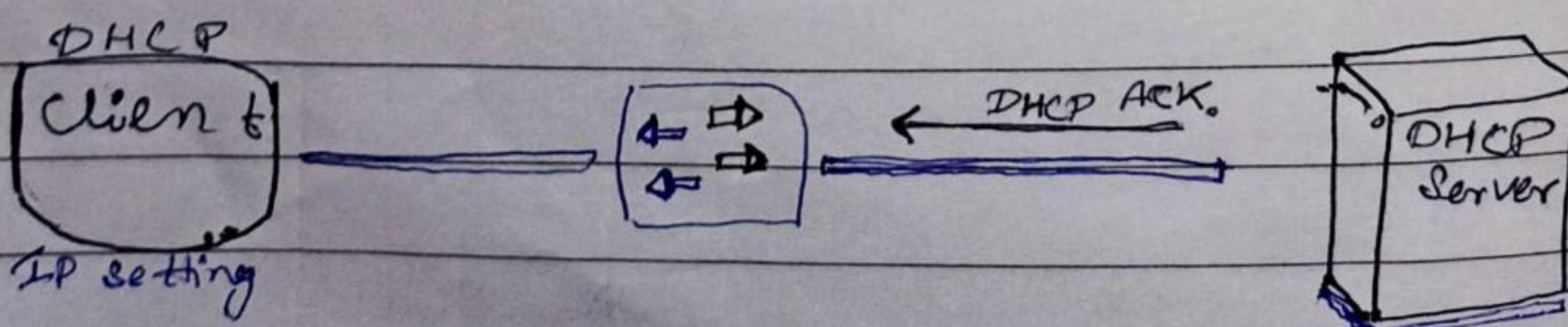
Host should have to request 'Renew' message to the DHCP for stay connected. If DHCP don't get 'Renew' from Host side then it remove that Host from table & release IP for (pool of IPs) means that IP will move to (pool) & idle for configuration.

Components of DHCP :-

- DHCP Server
- DHCP client
- IP pool
- Subnet
- Lease
- DHCP relay

- ▷ **DHCP Server**: It is networked device running the DHCP service that holds IP addresses and related configuration information. This is typically a server of a router but could be anything that acts as a host, such as an SD-WAN appliance.
- ▷ **DHCP Client**: It is endpoint that receives configuration info. from a DHCP Server. It can be like laptop, IoT, PC etc.
- ▷ **IP ADD. pool**: It is the range of addresses that are available to DHCP client.
- ▷ **Subnet**: It is the partitioned segments of the IP networks. It is used to keep Networks Managed.
- ▷ **Lease**: It is the length of time for which a DHCP client holds the IP address info., when a lease expired, the client has to renew.

- * **Benefits OF DHCP**:
1. Centralized administration of IP configuration.
 2. Dynamic Host config.
 3. Seamless IP host config.
 4. Flexibility and Scalability.



Forwarding and Unicast

Routing Protocols

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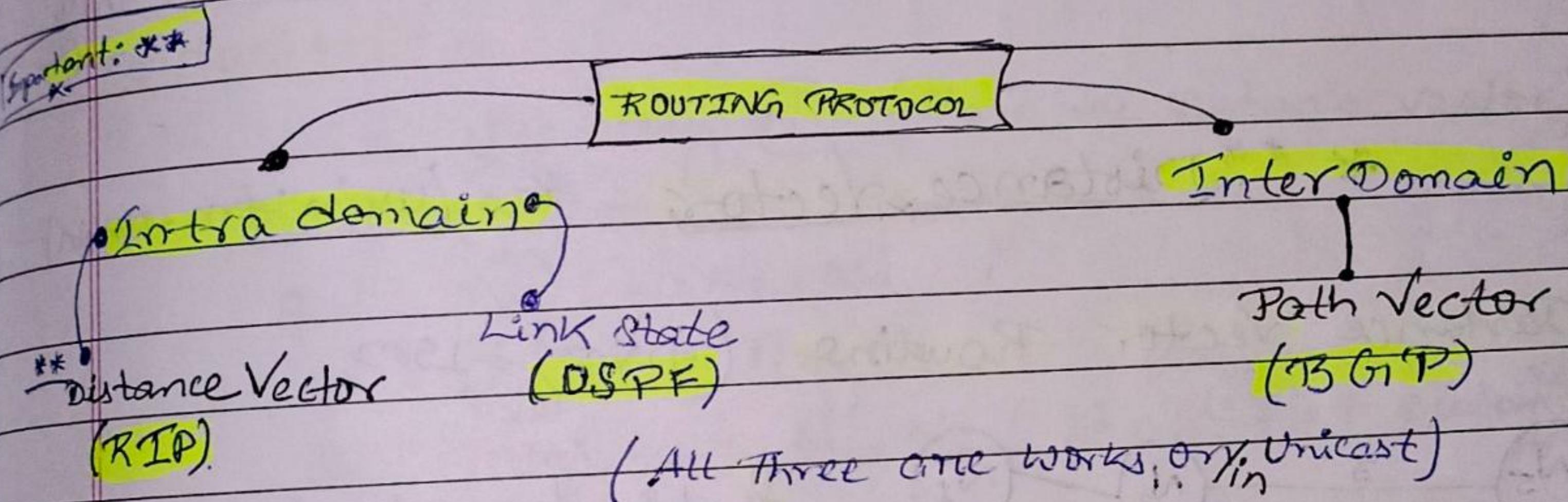
DATE: 7/08/22

Important Role of Network Layer

Layer is 'Forwarding' the packets.

► To make Dynamic Table, it uses Routing protocols.

↳ Routing protocol is set of rules for communication b/w Nodes and Router.



Internally we divided the Internet in Autonomous

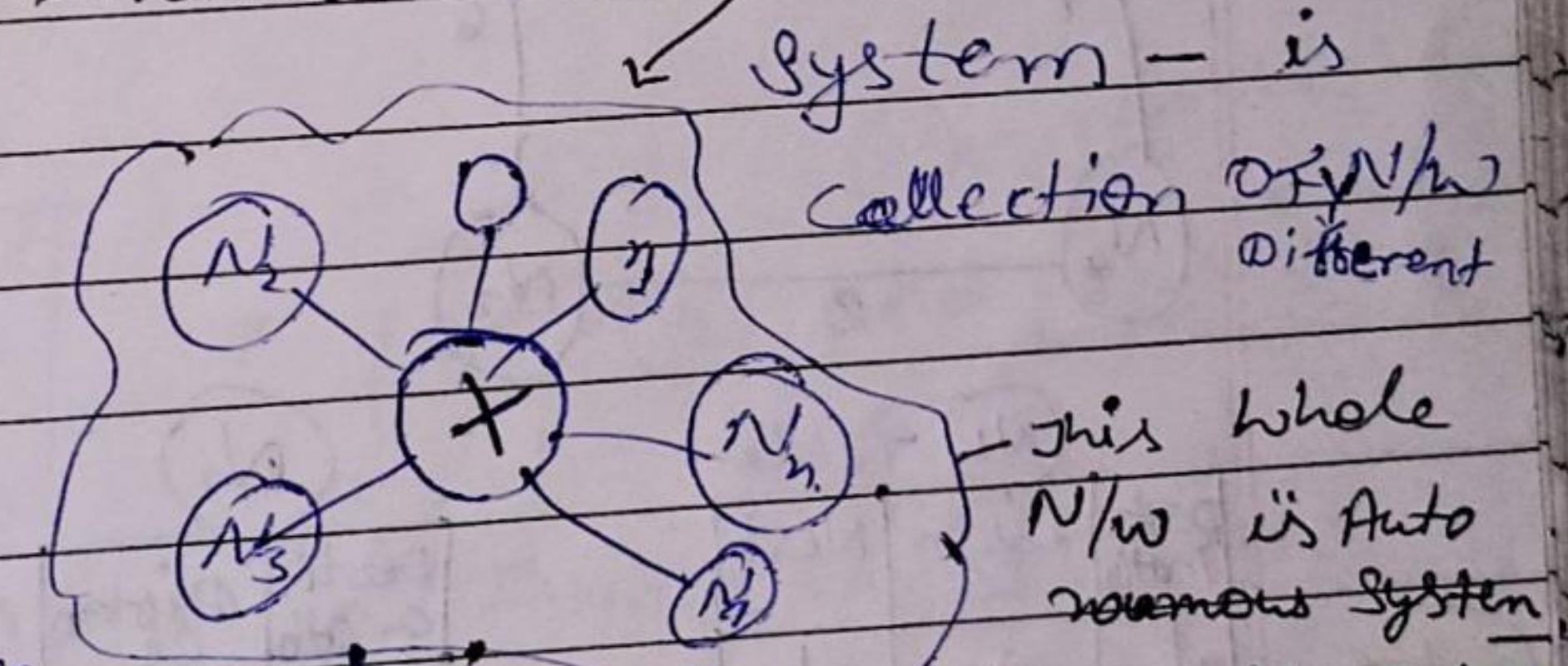
Inter Domain Decides:-/

How to ^{share/} communicate two

Autonomous System as given

on right side fig. Pune &

mumbai

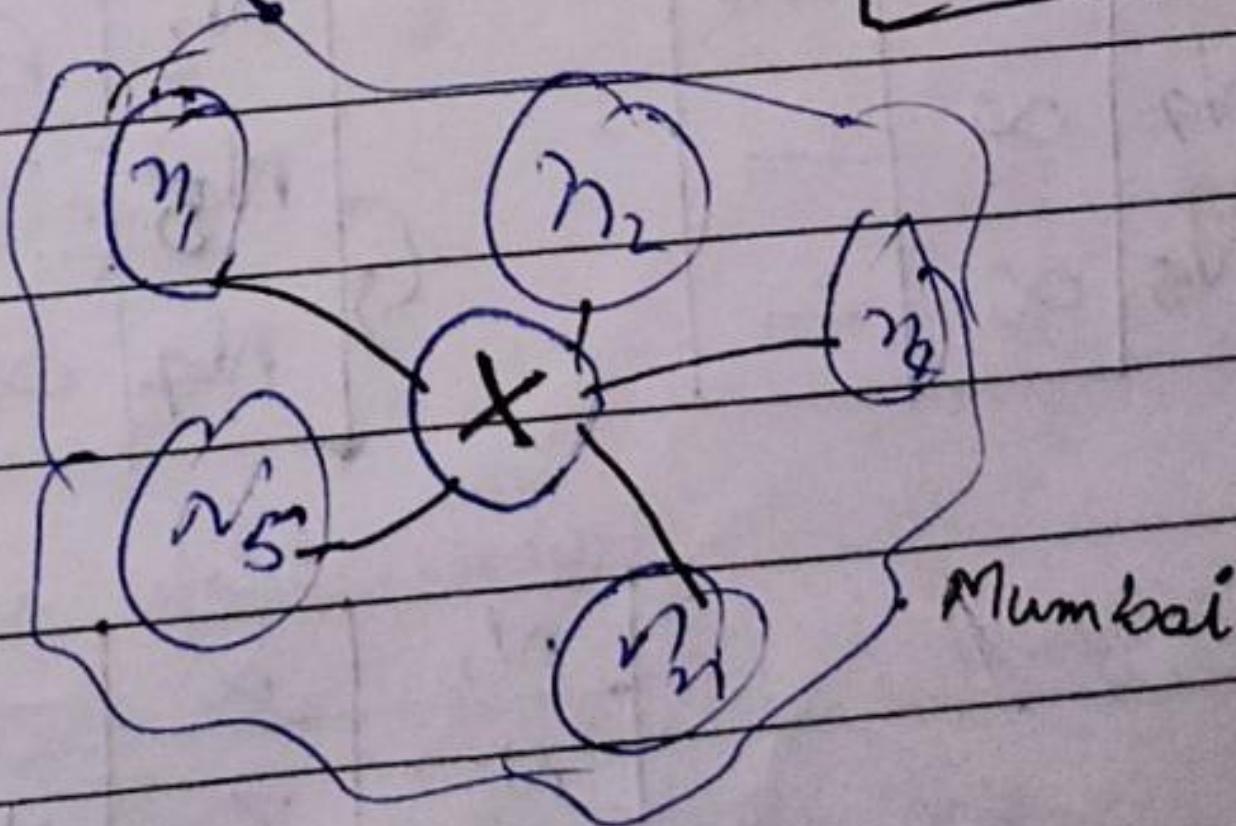


If we have to communicate/

shares the data within the

Autonomous System is

decides 'Intra-Domain'



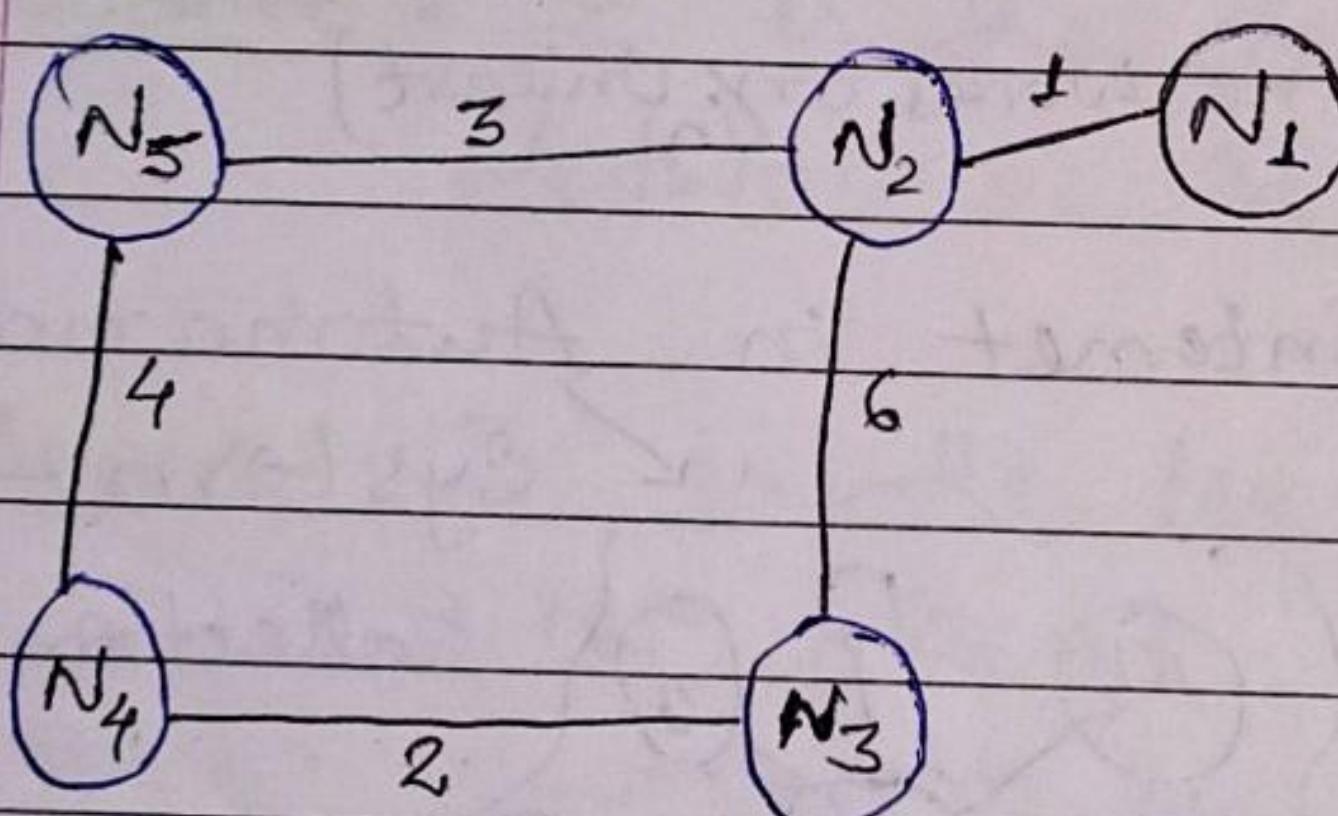
* Distance vector implements through (RIP) -
Real Routing info. protocol is used to share data/message within 'Intra-Domain'

- Open shortest path first (OSPF) is work on 'link state'.
- Border Gateway Protocol is work on 'Link State'

Note - RIP, OSPF, BGP are used for 'Unicast' only

* ** Distance Vector * (use in intra-domain)

* Distance Vector Routing (DVR) = 2980



- 1) we have to maintain shortest Path distance table b/w nodes.
- 2) for share data/conn.
- Each & every Router/Node knows the No. of nodes are connected in that N.

<u>N1</u> Table			<u>N2</u>			<u>N3</u>			<u>N4</u>		
Destination	Distance	Next	Destination	Distance	Next	Destination	Distance	Next	Destination	Distance	Next
N ₁	0	N ₁	N ₁	1	N ₁	N ₁	∞	—	N ₁	∞	—
N ₂	1	N ₂	N ₂	0	N ₂	N ₂	6	N ₂	N ₂	∞	—
N ₃	∞	—	N ₃	6	N ₃	N ₃	0	N ₃	N ₃	2	N ₄
N ₄	∞	—	N ₅	3	N ₅	N ₄	2	N ₄	N ₄	0	N ₅
N ₅	∞	—	N ₄	∞	—	N ₅	∞	—	N ₅	4	—

Dest.	Delta	Next
N ₁	∞	—
N ₂	3	N ₂
N ₃	∞	—
N ₄	4	N ₄
N ₅	0	N ₅

first iteration is completed,

* only neighbor * only distance vector

* Actually each Nodes at Starting point only known their neighbor Nodes & their distance.

* Each nodes will share their 'Dist' column, array to only neighbor, After completed 1st step.

Eg:- $N_1 \rightarrow N_2$: N_1 share Distance sheet with $\{N_2\}$ only.

• Same as $N_2 \rightarrow \{N_1, N_5, N_3\}$ because These all are their neighbor.

Conclusion :-

at N_1 only $\{N_2\}$ (Share the distance vector)

at $N_2 \rightarrow N_1, N_5, N_3$ (")

at $N_3 \rightarrow N_2, N_4$ (")

at $N_4 \rightarrow N_3, N_5$

at $N_5 \rightarrow N_4, N_2$ (Share $\{N_5\}$, get distance vector of N_4 , table N_2)

= How to Update Values/Data :-

New (N_i) table				\bigcirc neighbor
	cost.	dist.	Next	
1	1	N_1	0	N_1
2	0	N_2	1	N_2
3	6	N_3	7	N_3
4	∞	N_4	∞	-
5	3	N_5	4	N_2, N_5

* $N_1 \rightarrow N_2$ and $N_2 \rightarrow N_1$
 $= 1 + 0 = 1$

* $N_1 \rightarrow N_3$ and $N_3 \rightarrow N_2$
 $= 1 + 6 = 7$

* $N_1 \rightarrow N_2$ and $N_2 \rightarrow N_4$
 $= 1 + \infty = \infty$

* ~~$N_1 \rightarrow N_2$ and $N_2 \rightarrow N_5$~~
 $= 1 + 3 = 4$

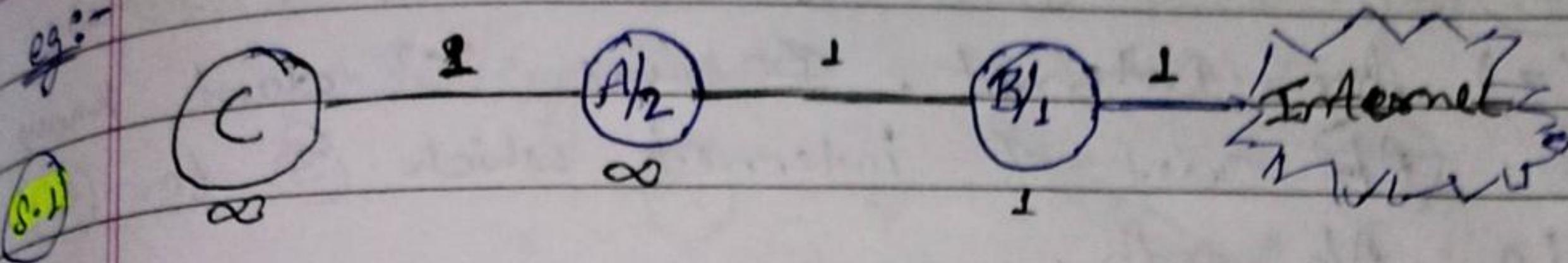
In first 'Hello' Broadcast message is maintained the all connected Node's Routing Table with/in Shortest distance path. It work parallelly

Count to Infinity

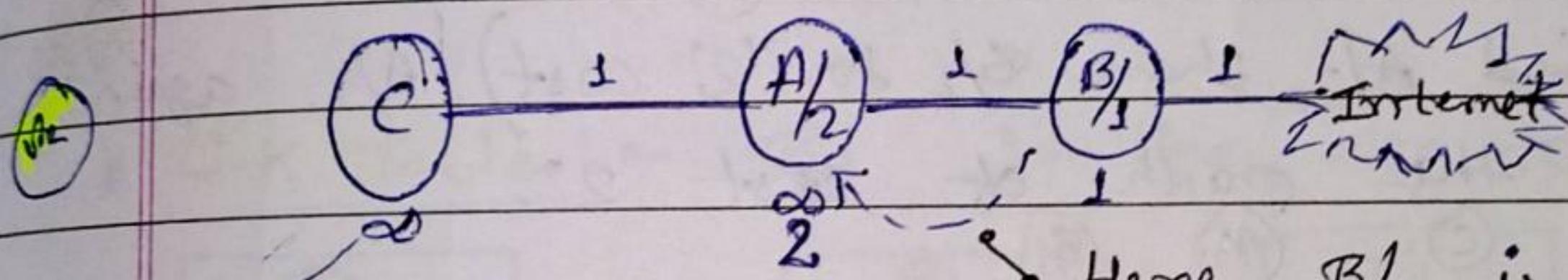
Problem:

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e.g:-



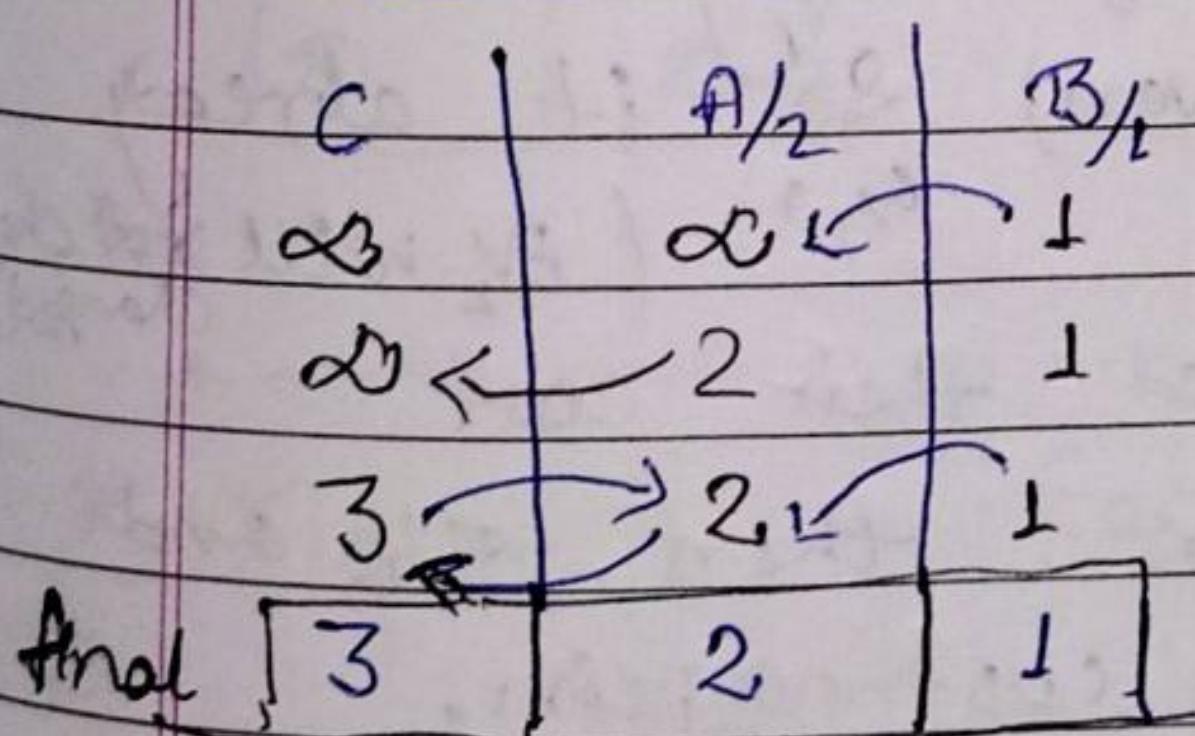
- $B/1$: is connected to $A/2$, and Internet (Both one neighbor)
So, $B/1$ can connect with internet at
- Same $A/2$: is connected to ' $B/1$ ' and ' C ' (Both one neighbor) '1' cost.
Initially But, $A/2$ don't know where is internet initially
 $\hookrightarrow C$ is also don't know where is 'internet'.



Here, $B/1$ is neighbor of $A/2$, so $B/1$ shares the cost of 'Internet' i.e $\boxed{1 + 1 = 2}$

$C \xrightarrow{\infty} A/2$:- Now $A/2$ same works as a neighbor of ' C ' & share the cost of Internet
 $= 2 + 1 = 3$

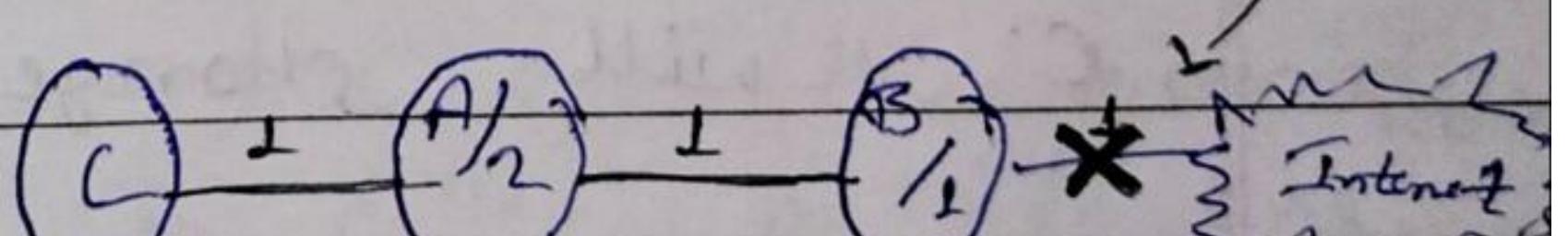
* Final Normal Case:-



* Special case/Worst :-

- Due to some reason connection of Internet break.

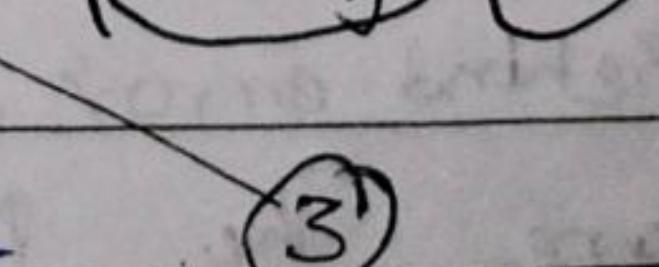
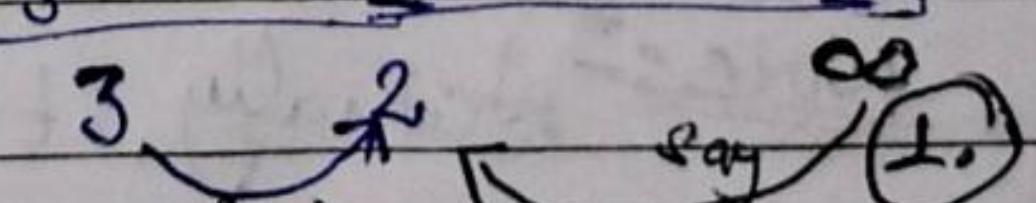
Now,



* $B/1$ know that path is break (using 'Hello' msg) So, it

Change the cost (1) to (∞) ✓

① Now, B shared updated cost that am unable (∞) cost for internet to the $(A/2)$.

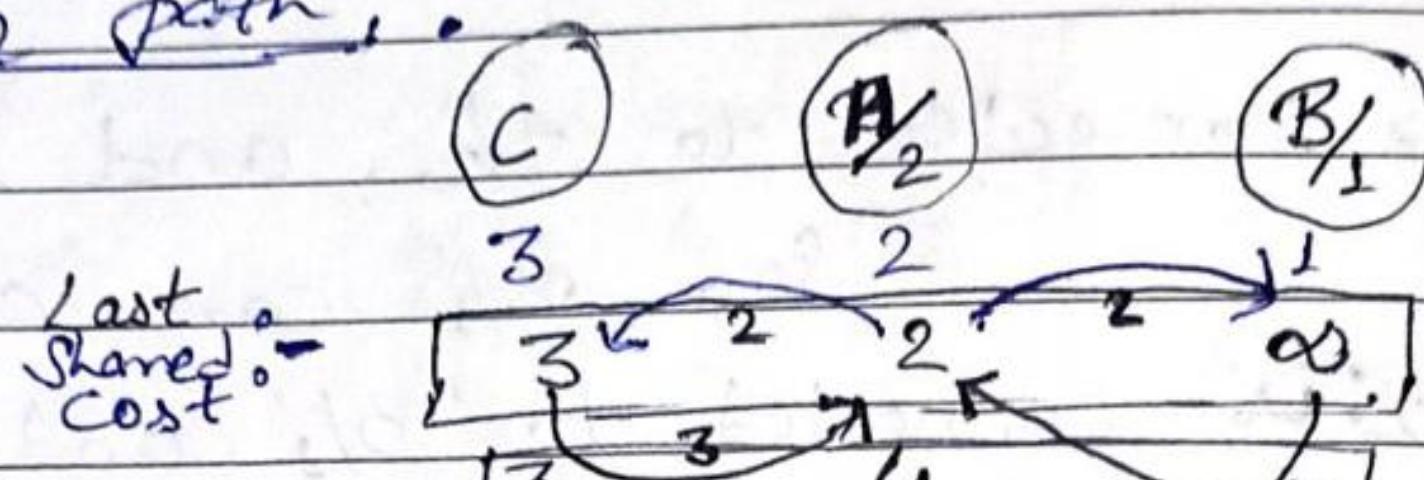


③

Infinite Problem in DVR

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- ③ But $A_{1/2}$ get response from 'C' that I have path cost (3) for Internet. Because 'C' don't know that $A_{1/2}$ cost of internet which ③ for C is via $A_{1/2}$ path.

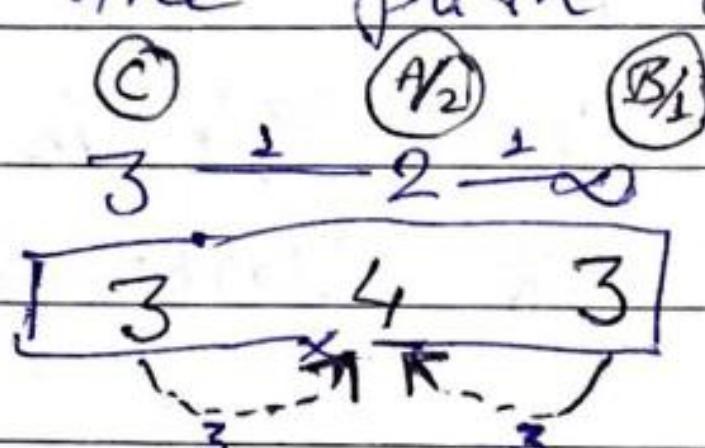


* According to C A is update \Rightarrow

\Rightarrow Parallelly at a same time (When B_1 share to $A_{1/2}$ 'as' cost and $A_{1/2}$ share B_1 for '2' cost) $A_{1/2}$ again don't know the path of cost '2'.

So,

Now



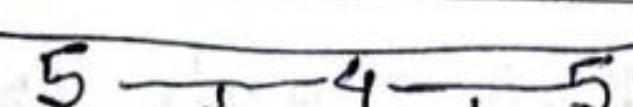
Same ~~process~~ process happening again and again

so, In next

* $A_{1/2}$ get response for cost from B_1 and C (3) & (3) respectively. But $A_{1/2}$ to 'C' on ' B_1 ' is '1' (given) so it already '4' ($A_{1/2}$ will ~~not~~ change)

Then same time $A_{1/2}$ is shared their cost i.e. 4 to both neighbor then B_1 and C will change the cost again.

X Now:-



Note:- Actually it going to be infinity (∞).

Reasons:- Behind error, the problem is they A, B, C only share the Matrix value of cost, (they don't tell the path (via) to each-other). So

it occurred.

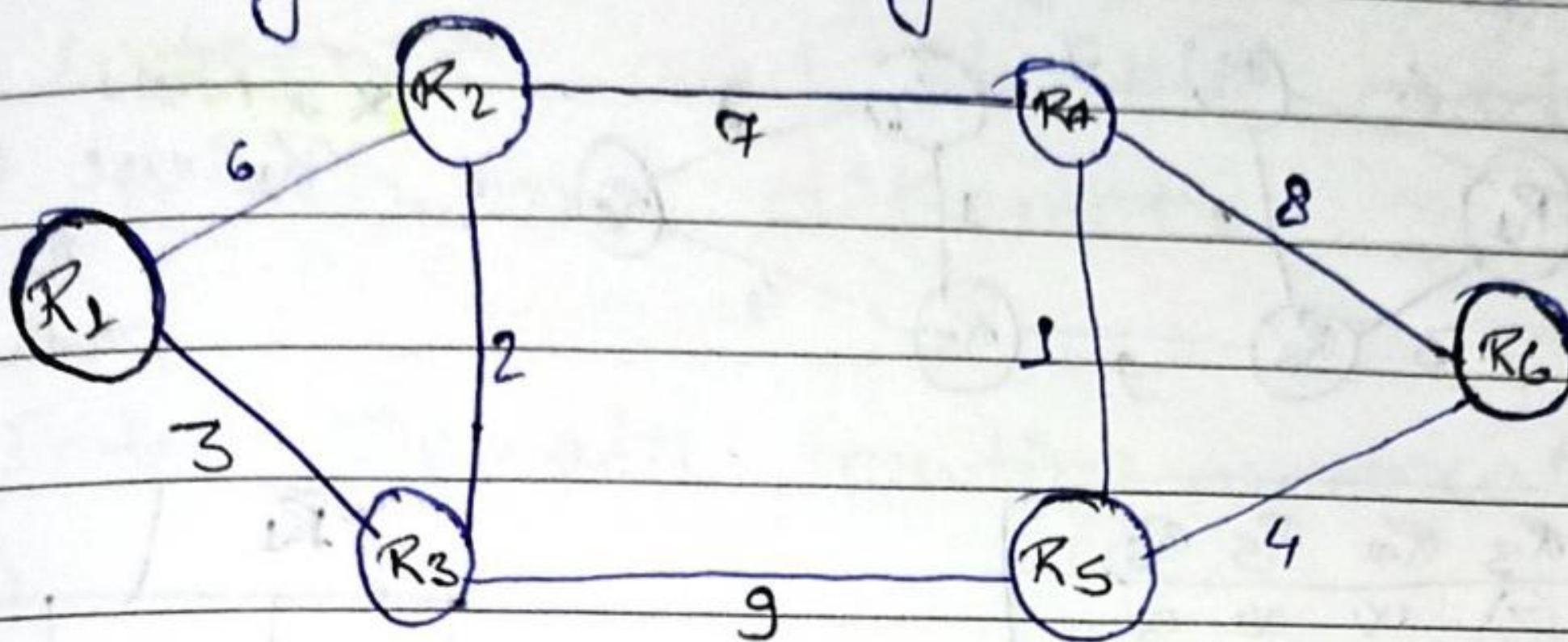
Link State

ROUTING

Dijkstra
Algo used.

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→ DVR, link state etc are used to make/make Routing table by 'Router'.



→ Initially All connected Routers (of n/w) is make a Link State Table.

* Link Table :- By sending ^{'HELLO'} msg to ~~over all~~. It maintain neighbor/distance.

R1	
R2	6
R3	3 X

R1	
Seq. No., TTL etc	
R2	6
R3	3

R2	
R1	6
R3	2
R4	7

All are Link Table

R3	
Info.	
R1	3
R5	9
R2	2

R5	
R3	9
R4	1
R6	4

R6	
Info.	
R4	8
R5	4

R4	
Info.	
R2	7
R5	1
R6	8

This is available in all Table (R1 - Rn)

* Flooding :- Each router sends the information to every other router on this internet work except its neighbors. is called as flooding.

Border Gateway Protocol (BGP)

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■ BGP is used to Exchange routing information for the internet and is the protocol used b/w ISP which are different.

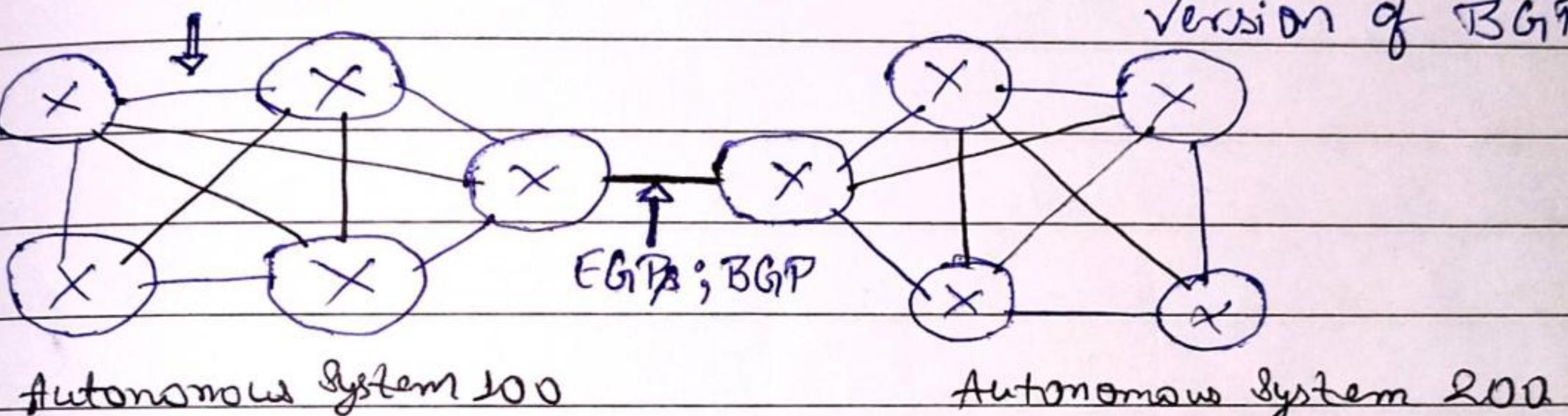
* Inter-Domain routing protocol.

* First Network was ARPANET. * BGP Version 4:-

RIP, IGRP, OSPF,

It is used current

version of BGP (RFC 1771)



- + Features :-
- Open Standard
 - Exterior Gateway Protocol
 - Inter AS-Domain routing
 - Classless Path Vector
 - Supports internet
 - path Vector

* BGP Packet Format *

MARKER(32)	
LENGTH (16)	TYPE (8)

- 1). Marker is a 32-bit field which is used for the Authentication purpose
- 2). It is 16 bit field defines the total Length of the message, including Header
- 3). Type, is an 8-bit for type of Packet.

* Types of Autonomous System (AS) :-

1. Stub AS
2. Multihomed
3. Transient
- 4.

M
CN = 51

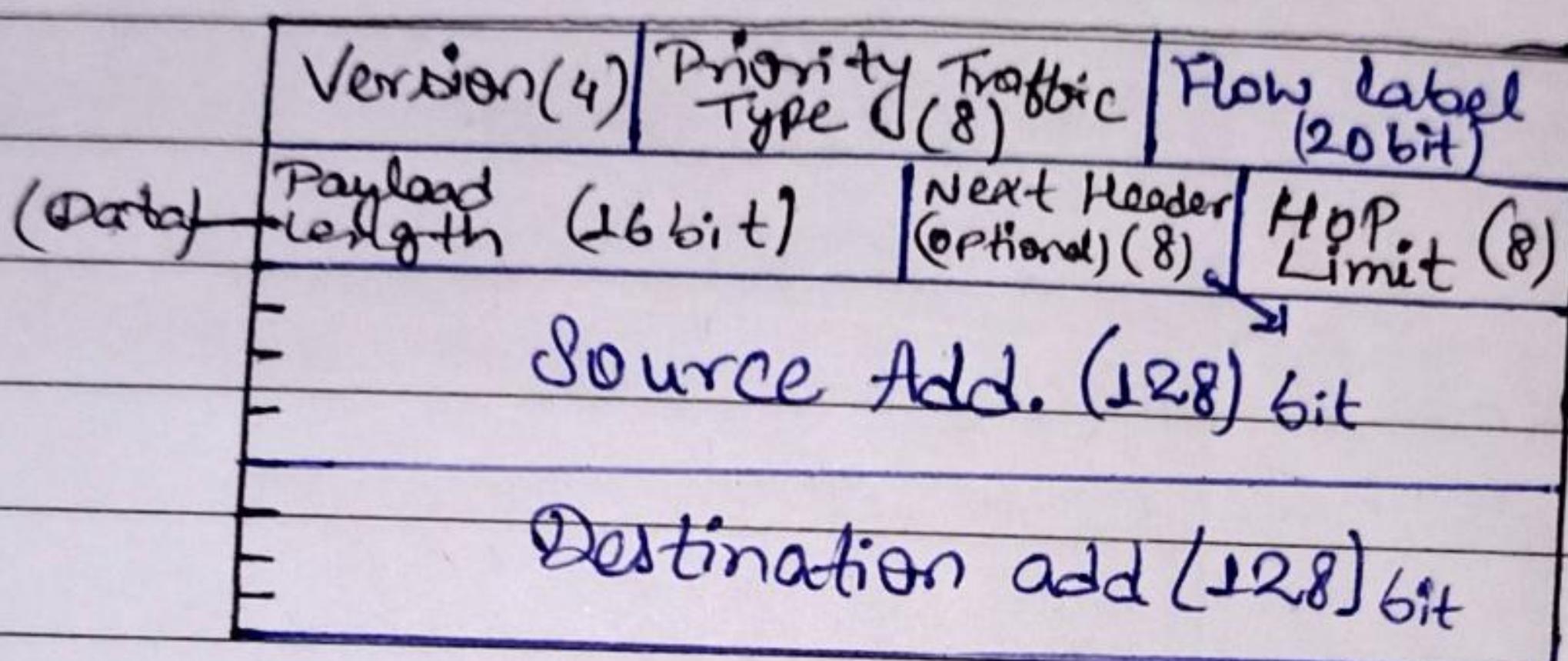
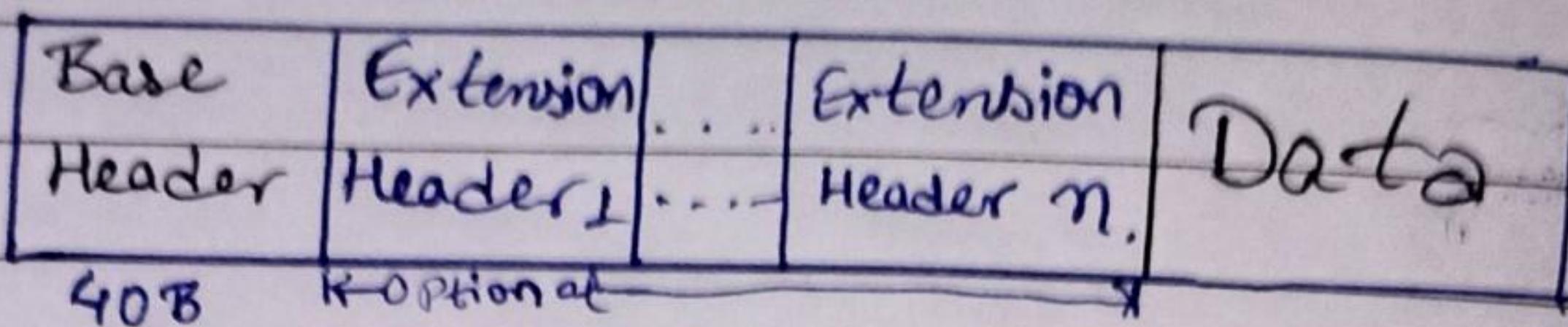
TP v 6

HEADER

Data gram Service

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* No. of IPs possible :- $2^{128} =$
* Hexadecimal * (*)



Base Header :- 40Bytes (320 bits)

Extension headers :-

Values

- 1. Routing H. (43) decimal
- 2. Hop by Hop (0) "
- 3. Fragment H. (44) ..
- 4. Authentication H. (51) ..
- 5. Destination H. (60) ..
- 6. Encapsulating security (50) ..
- 7.

① Version - It define version
i.e. IPv6 = (0110)

② Priority - It eliminate congestion
give priority to some packets

③ Flow-level - It use for real-time , by a source to label the packets belonging to the same flow in order to request special handling by intermediate IPv6 routers

o payload length / data — It contains Data (size can be 65535) (0 - 65535) B.

* But additional feature are there as "Jumbo Grams" it allows (upto 4GB), it uses with extension Header.

o Next header — It contain extension header for additional info / Features.

o Hop limit / TTL :- This field indicates the max. No.

(0 - when packet will be drop) of intermediate nodes IPv6 packet allowed to travel. It decreasing at every nodes (last 0).

o Source Address :- Address of Sender Host.

o Destination Header ^{Add.} :- It contain Address of Receiver Node.

Priority	meaning
0	No Specific Traffic
1	Background Data
2	Unattended ^{Data} traffic
3	Reserved
4	Attended Data ^{Traffic}
5	Reserved
6	Interactive Traffic
7	Control traffic.

[Header description] :-

1). Routing H. :- predefined (user) path to Achieve Destin.

2). Hop by Hop :- To provide all Hop (IN Path) ^{following} Some inform.

3). Fragment H. :- Dividing the packets / Data, only it done by (source).

4). Authentication :- It work as (checksum),

To keep integrity, security of Data.

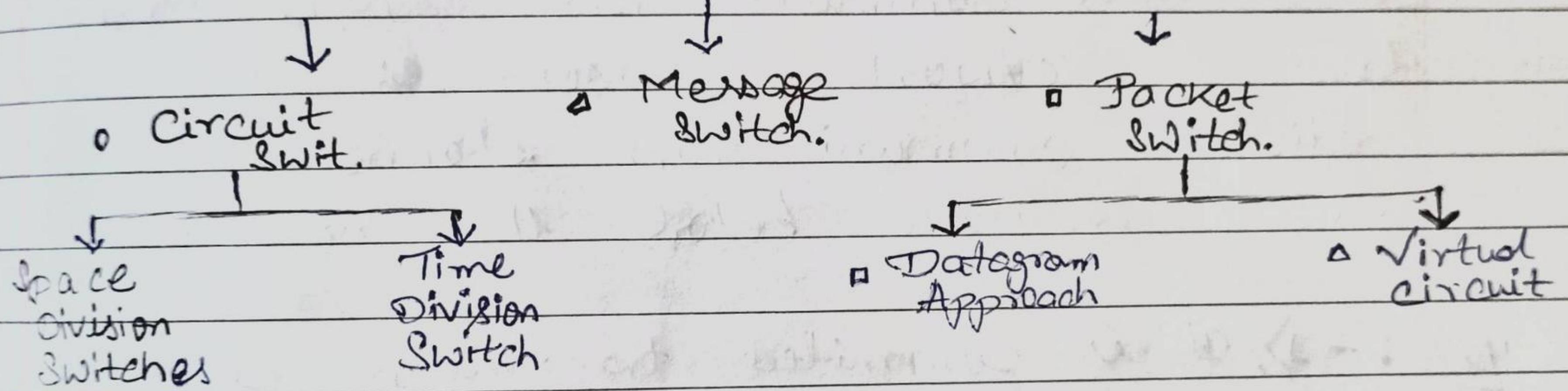
5). Destination H. :- It used for that only "Destination" can read this Extension Header (Destined).

Switching

- * In large Networks, there can be multiple paths from sender to receiver. The Switching technique will decide the best route for Data transmission.
- ↳ This Technique used to connect the System for making one-to-one communication.

Classification

Switching



M
S
C.N.

Circuit Switching

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- It works on physical layer
- Contiguous flow
- Dedicated path
- No need of headers (Source Dest)
- Efficiency less.
- Delays less (direct path)

$\text{Total Time} = \text{Setup time} + T_{TF} + P_D + \text{Tear Down Time}$

$$\therefore T_{TF} = \frac{M}{BW} ; [P_D = \frac{D}{v}] \quad v: \text{velocity}$$

► It is a method of implementing a tele communication N/w in which two network nodes establish a dedicated communication channel through the network before the nodes may communicate.

ADVANT:- 1). It is committed transmission channel is established b/w the computers which give a guarantee data rate.
2). There is no delay in data flow because of the dedicated transmission Path.

DISADVANT:- 1). It takes a long time to establish a connection.
2). More bandwidth is required in setting up dedicated channel.

Packet Switching

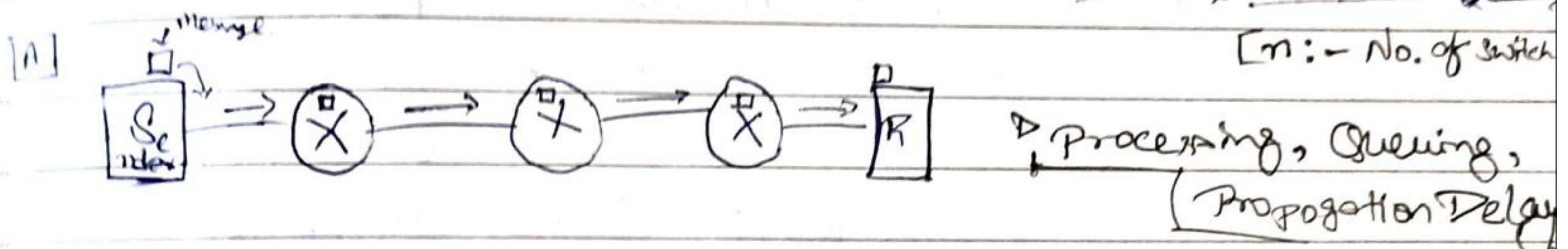
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- ▷ Works on Data-link & N/w layer
 - ▷ Store and forward (It stores data in buffer)
 - ▷ Pipeline used
 - ▷ Efficiency High than (circuit sw.).
- ▷ Delay high due to store features.

- ▷ Connection-oriented
 - ▷ connection less pack. sw

$$\text{Total Time} = n(T_f) + P_D$$

[n :- No. of switch]



▷ Processing, Queuing,
(Propagation Delay)

In above, we can see that 'Sender' send the data in form 'packets' and in path (No. of switches available) each store switches stores the Packet & forward.

- ▷ It is the transfer of small pieces of data across various networks. These data 'chunks' or 'packets' allow for faster, more efficient data transfer.

Advantages

- ① more efficient in terms of bandwidth, since the concept of reserving circuit.
- ② Minimal transmission latency.
- ③ cost-effective & comparatively cheaper to implement.
- ④ More reliable as a destination can detect the missing packet.

Disadvantages

- ② It

Datagram Switches

PAGE NO.:

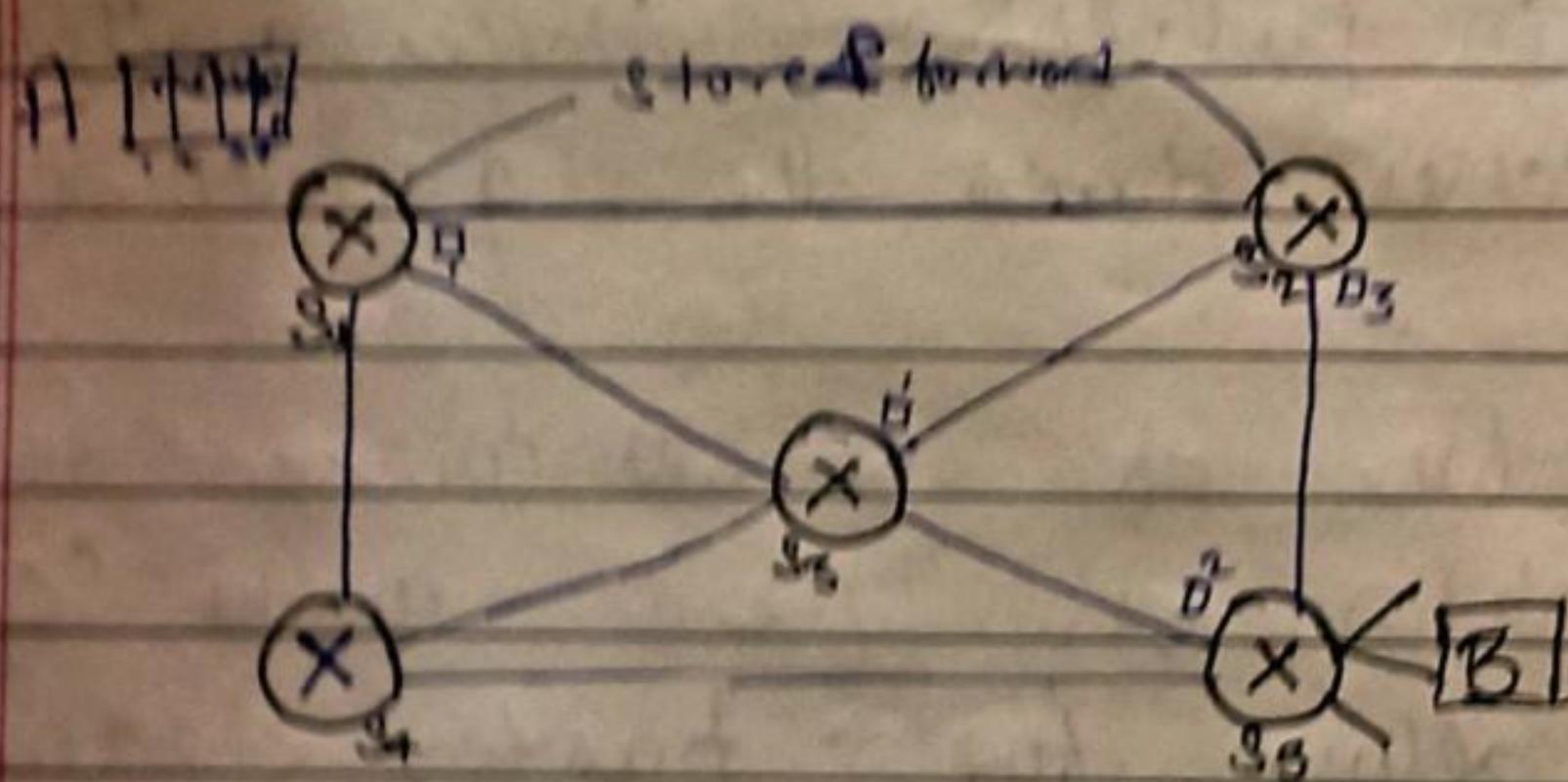
DATE: / /

- * Connection less
- * No Reservation
- * Out of order
- * Used in Internet.
- * Del in the layer.
- * High overhead.

• It follows different/random path to reach destination.
So, we need to assign header in No. ↑.

→ In Datagram, each data packet or Datagram is routed independently from the source to the Destination even if they belong to the same message.

The N/W treats the packets as it exists alone



⇒ In Datagram, BW, CPU, buffer is ^{'NOT'} reserved from sender to receiver

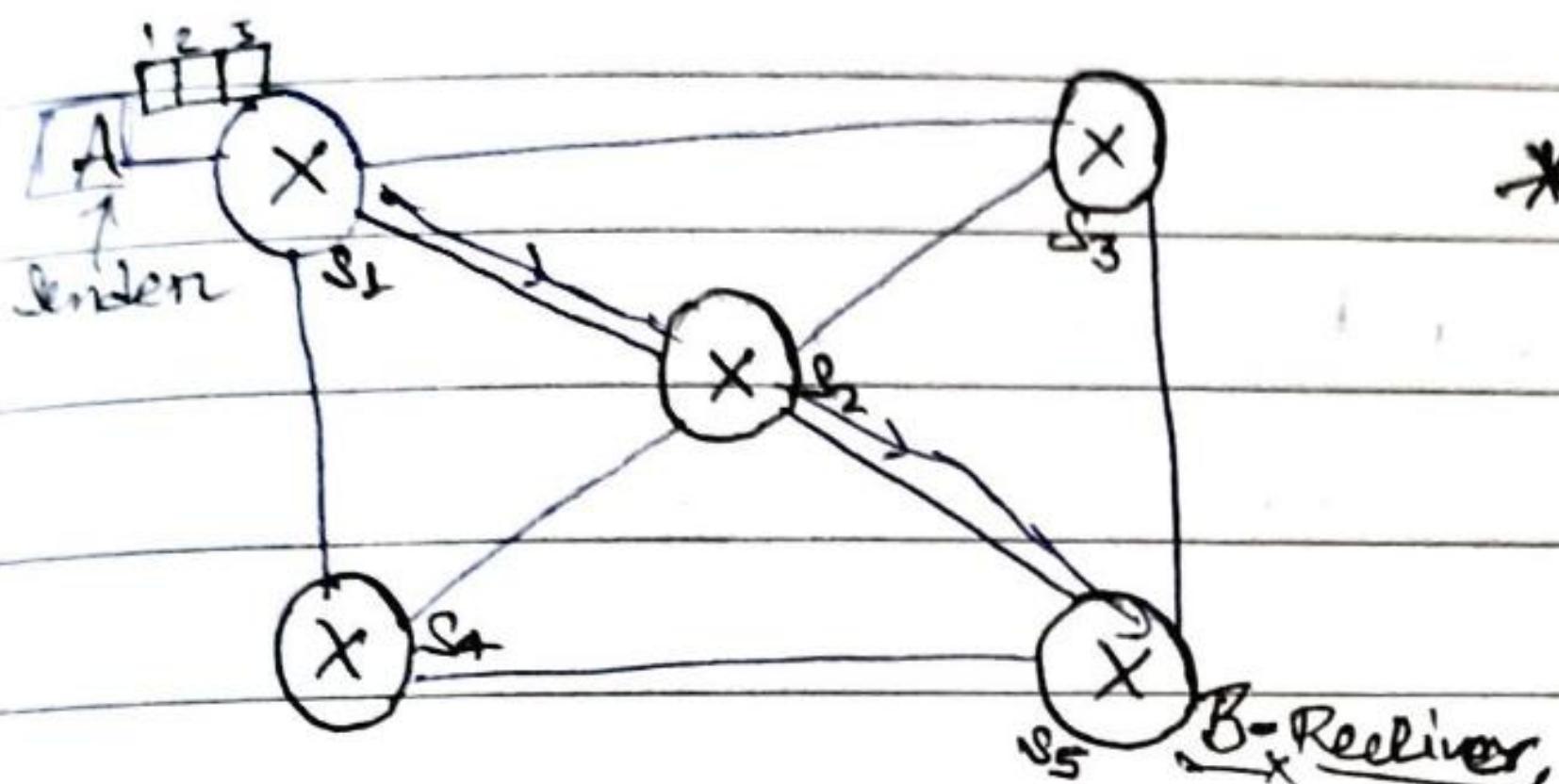
→ The dynamic decision making of Datagram Packet Switched N/W improves the performance of Data Transmission.

ADVANTAGES:
• It provides greater flexibility
• It performs fast re-routing of data packets at the time of N/W congestion or failure.

Virtual Circuit

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- * follow same path.
- * inorder
- * connection oriented
- * Set-up & tear-down
- * high cost than 'datagram'
- * Reliable.
- * low head



* In Virtual circuit Switch the BW, CPU, buffer is reserved b/w Sender to Receiver; It mean the messages will pass

• Some work is done by ARP from the Reserved path.
B in above Diagram } To Reserve path a packet move from Source to Destination

* low packet loss.

& b/w that every switch which crossed by ~~the~~ go global packet will reserve

ADVANTAGE:- ① Packets are delivered for exchange data/ msg. to the receiver in the same order sent by the sender.

② virtual circuit is a reliable N/W circuit.

③ There is no need for overhead in each packet.

④ Single global packet overhead used only

DISADVANTAGE:- ① It costly to implement.

② It provides only connection-oriented service.

③ Always need a new connection for set up.

MESSAGE Switching

⑤
H/w changes
PF que

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Predecessor of packet

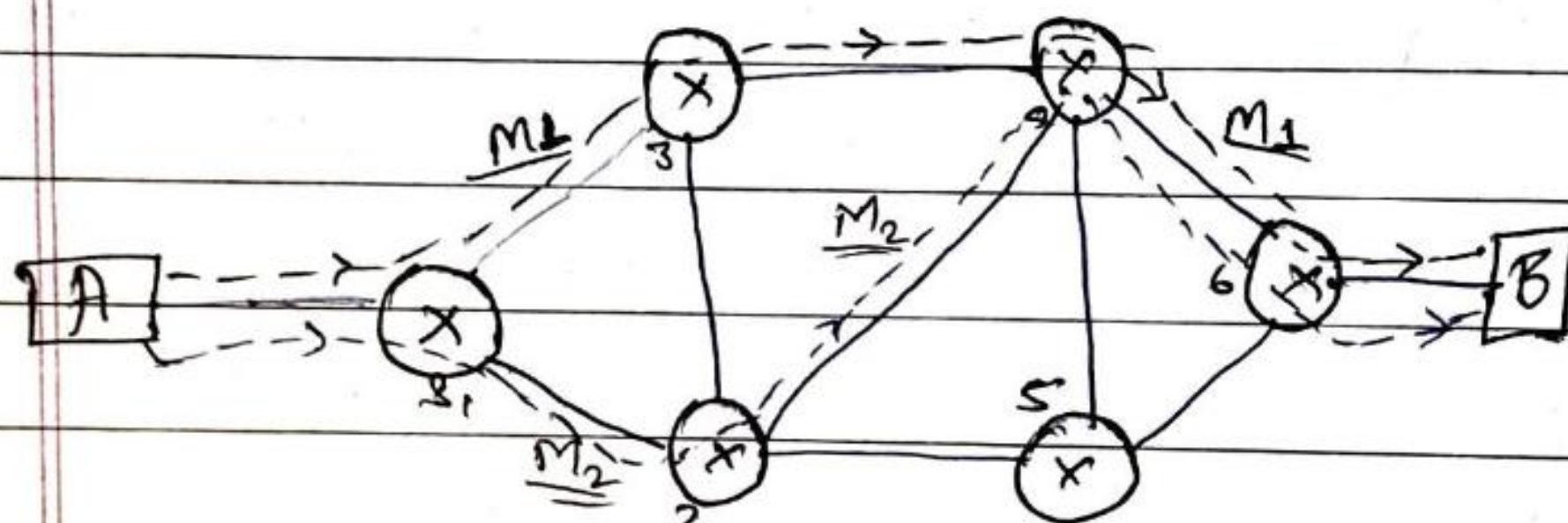
* Data (in message form)

▶ Store and forward.

▶ Hop by Hop delivery.

It was a technique developed as an alternative to circuit switching before packet switch was introduced.

- There is No establishment of dedicated path b/w sender and receiver, it just move one-by-one.



- Message Delivery - It implies wrapping the entire information in a single message and transferring it from the source to destination node. Each message must have a header that contains the message routing info., including the 'source' & receiver.

▶ ADVANTAGES:-

- It reduces the traffic congestion in the N/W

- Data channels are shared by the N/W devices
- Priority technique for each messages which make effi.
- It allows for infinite message length

Applicat: - Most Electronic Mail Systems delivery process is based on message switching.

LOGICAL ADDRESSING

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- * First 8bit represents the 'Network ID'
- Rest of represents the Host / No. of User
- ▷ Logical Addressing :- IPv4, IPv6.
 $\frac{32b}{\text{IPv4}}$ $\frac{128b}{\text{IPv6}}$
- # IPv4, IPv6 - combination of Host ID & Network ID
↓
format: 8bit . 8bit . 8bit . 8bit MAC Address
- * An IP address is a logical address that is assigned by software residing in the router or Server, and that Logical address can change from time to time.
- The Data link layer implements the physical addressing and Network layer implements the logical addressing.
- ▷ Routing :- When a packet reaches the router's input link, the router will move the packets to the router's output link.
for ex:- a packet from S1 to R1 must be forwarded to next router on the path to S2.

Forwarding Table

Header Value	Output Link
0100	3
0101	2
0111	2
1001	1