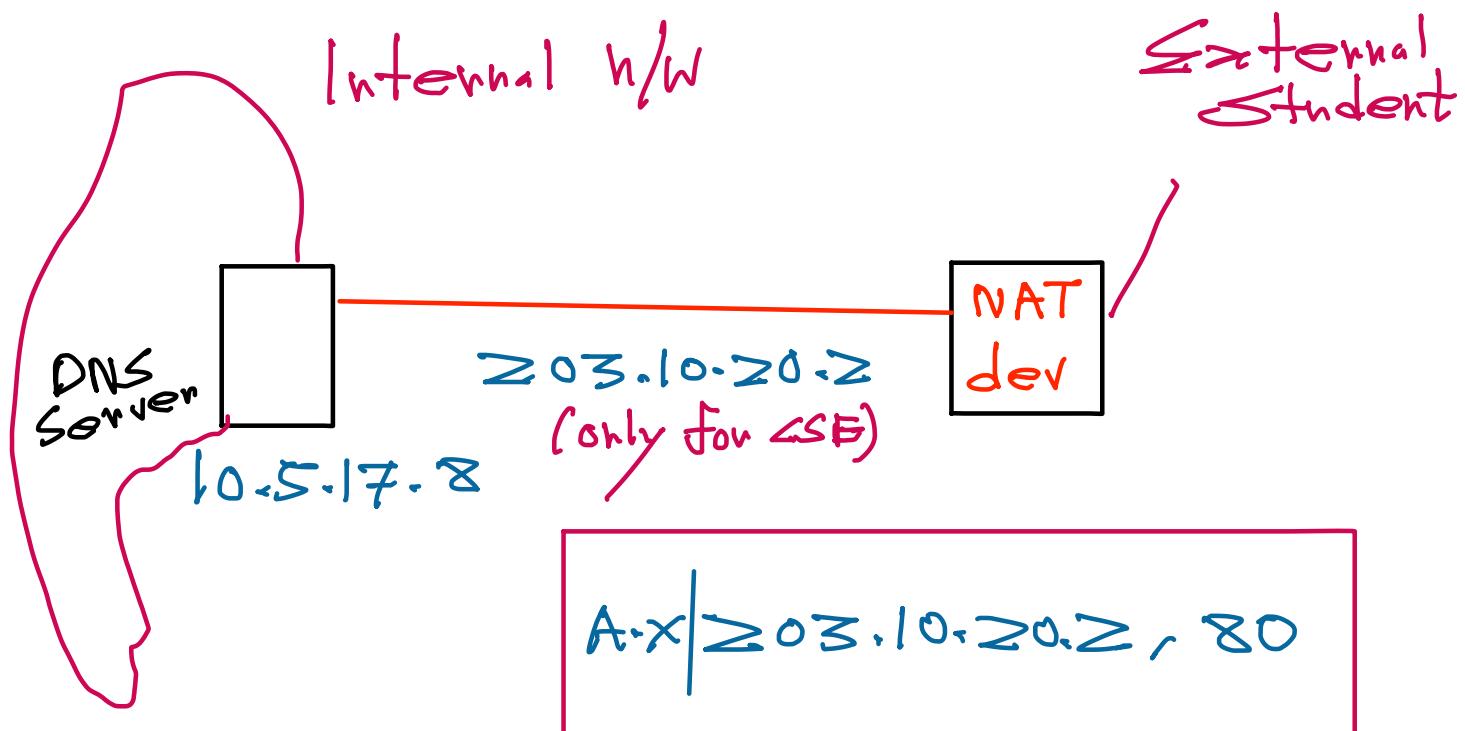


Q) Remove an timeout? Issues?

→ If any message comes from outside after a long time, may be sent wrong.

⇒ `se.ijtkgp.ac.in` → assign it a fixed public IP
⇒ also assign a private IP
 $10.5.17.8$



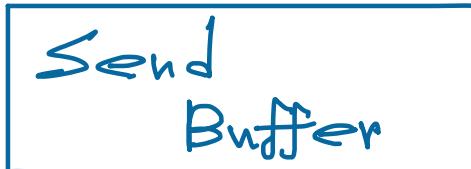
$10.5.17.8$ 80 is actually $103.10.20.2$ 80
Int IP Int Port Ext IP Ext Port NAT pair

$10.5.17.8$ 80 $103.10.20.2$ 80

Public-Private mapping table

$10.5.17.8$ 80 → Special Entry
 $\Rightarrow 103.10.20.2$ 80

TCP: Port, Communication, Send buffer, Recv buffer



(byte buffer)

o Socket
bind o (local IP/local host)

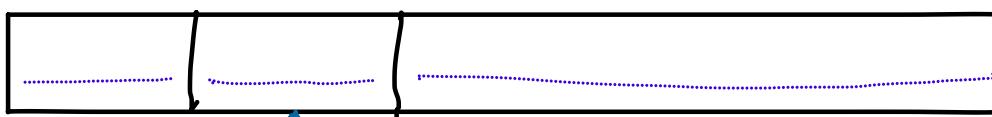
Connect o (L IP, L port, Remote IP,
Remote port)

Connection

(L IP, L port, *, *)
| | | |

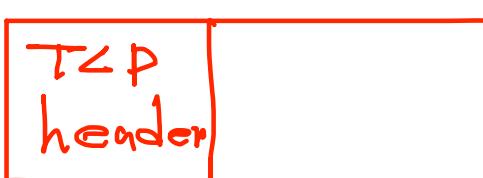
(-, -, ✓, ✓)

Send buffer:-



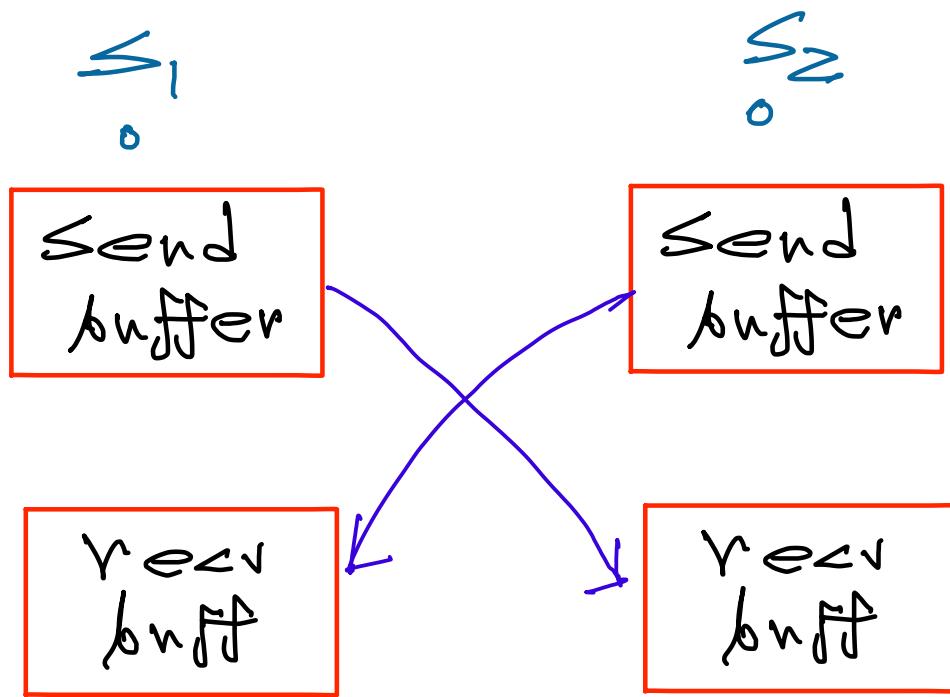
With each
connection

Pick part to send



→ In term of bytes
rather than frames

TCP Connection is full duplex.



Seq No \rightarrow
↓
Ack No \leftarrow

Connection Establishment:-

\Rightarrow Need not start byte be 0.

\Rightarrow Why don't you start at 0? (THINK)

\Rightarrow This is the only time SYN is 1

Client:

Syn ≥ 000

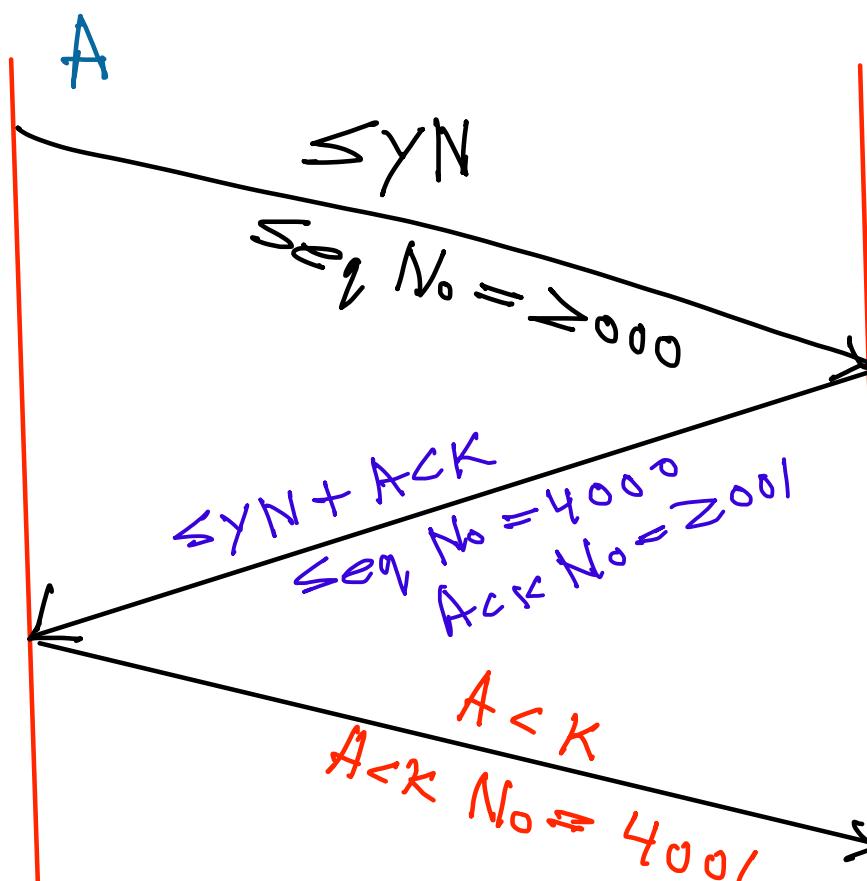
\nwarrow first byte I will send

is ≥ 001

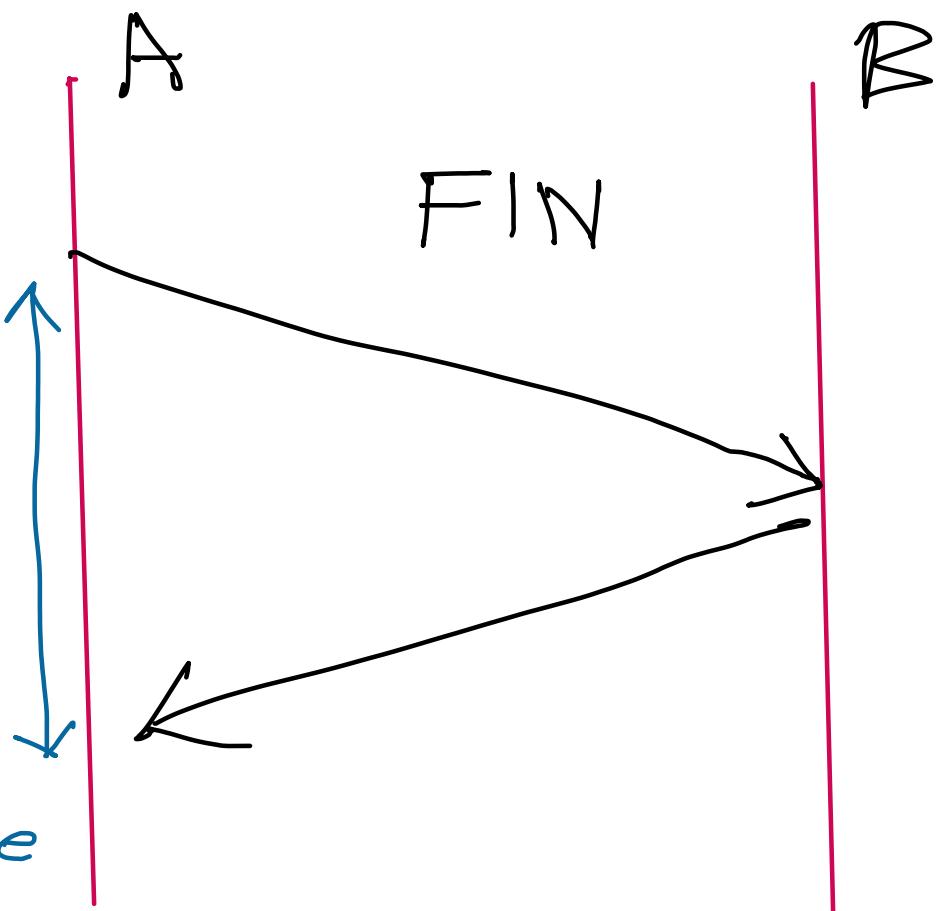
Server:

Send 4000 and ack ≥ 001

request.



A wants to terminate its send



Current timeout = 100 ms

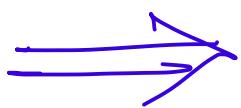
Real \uparrow 150 ms

Estimator will take some time to jump to 150

During this time segments will timeout

Karn's \Rightarrow Increase temporarily to ≥ 200

Q) What happens on a timeout



The state diagram has things that you cannot react through the socket calls you learnt

\Rightarrow So, Rather think of a socket call you made & then follow state diagram

active open — "connect" call

passive open — "accept" call

close \Rightarrow Send a "FIN"

close \Rightarrow TIME-WAIT

FIN overtakes data? Wait for everything to come and you discard, till then hold on the port

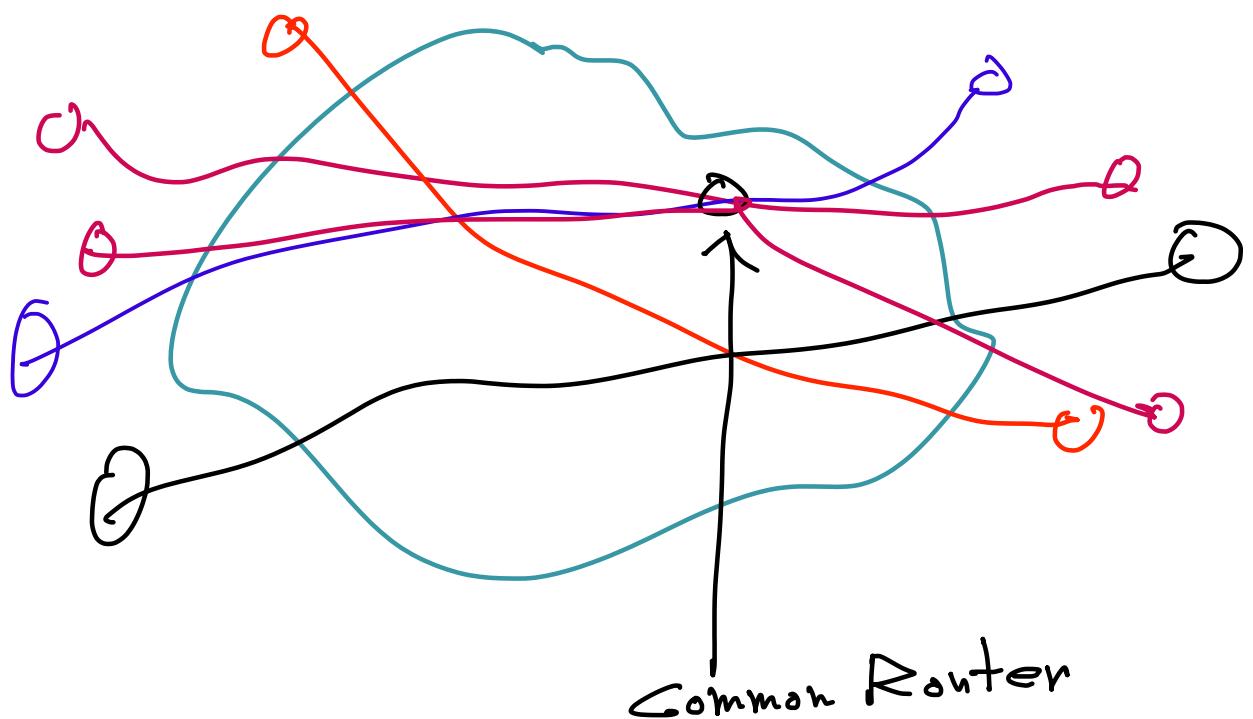
MSL - Maximum Segment Lifetime.
setsockopt \Rightarrow REVERSE ADDR

Initially, assume you have enough data to send

Sender has a "sending Rate"
— Rate at which segments are sent out

How to determine the rate

Receiver Window Size
(Goal: Not to swank the receiver (flow control))



\Rightarrow Network Capacity :-

(How much can the n/w accept?)

Goal: — Not to but too many packets go as to congest the n/w

\Rightarrow No ACK due to congestion \Rightarrow I put more packets.

Congestion Signals for TCP:-

1. Loss (Delay-Based << A)

2. Delay (Loss-Based << A)

Most TCP << A's are loss based

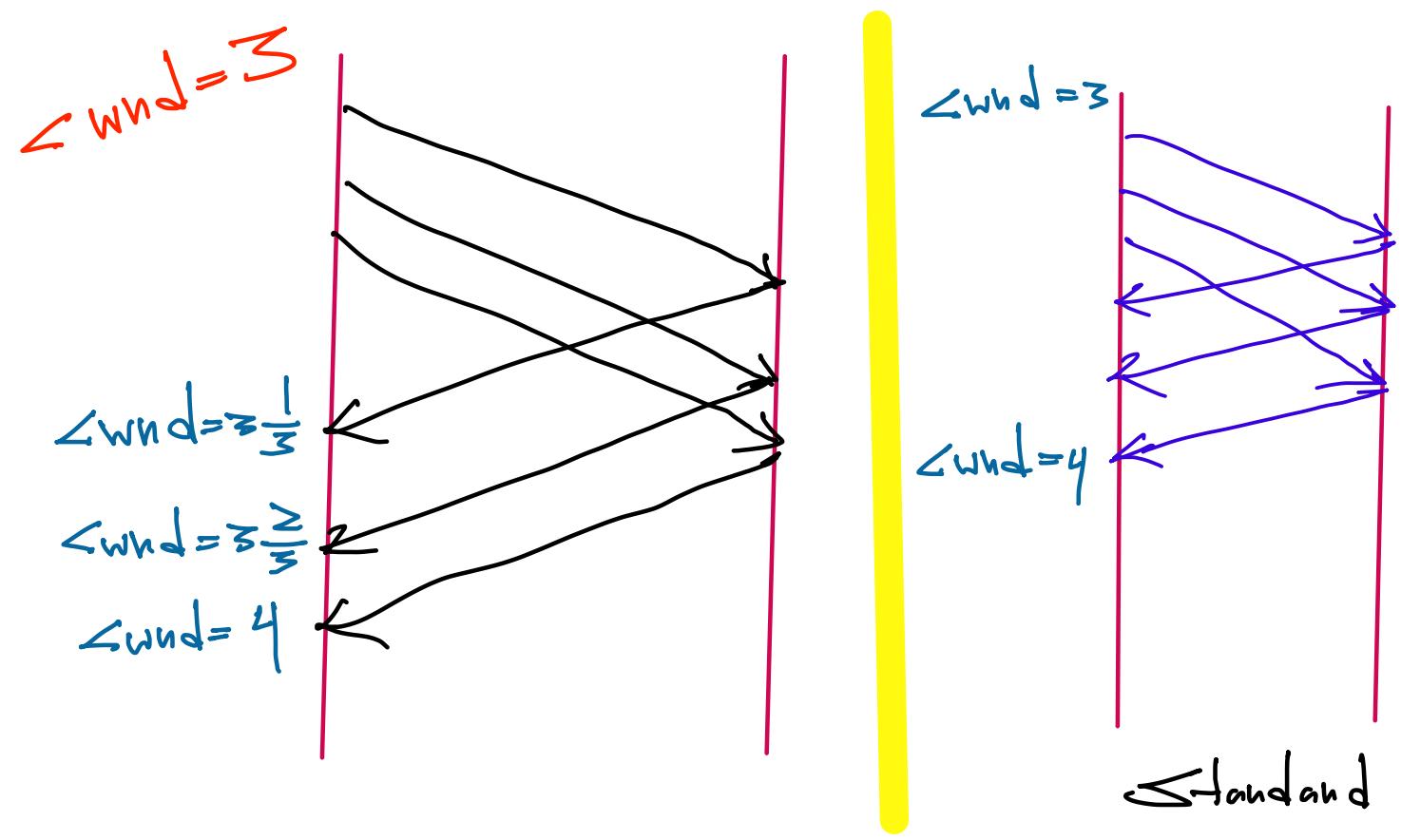
Explicit Congestion Control:-

1.) Remember that there can be a mechanism using ECN fields of IP, & flags of TCP to indicate to sender that some router is having congestion

2.) So, why it is not universally used?

\rightarrow Receiver, Sender, Router all should agree

\Rightarrow Data centers using ECN
(Centralized Control)



Socket

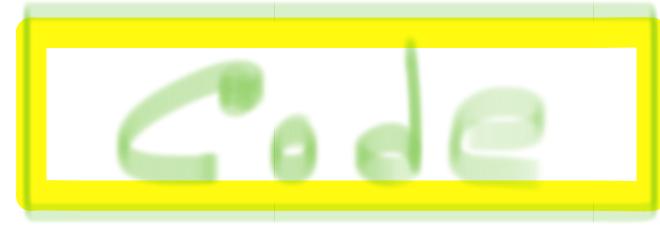
bind

connect/accept

Send

recv

Shutdown/Close



listen(∞)
→ Wait for 5

Socket() :-

→ find a free entry in fd table

→ allocate send/recv buffer

→ // book keeping variables

bind() :-

→ check if already allocated

→ otherwise add it

connect() :- active open

→ Three way handshake

→ Not bound? ⇒ Find unallocated port

→ send SYN, Wait for ACK

accept() :-

passive open

SYN,ACK ←

→ Wait to recv a SYN segment

→ Another SYN comes?

→ Put it in Queue (listen)

also creates
a socket

Send():-

① blocking! → Wait until you are able to find free space in send buffer

recv():-

② blocking! → Wait until you read data

→ Window size changes

5000

≥ 50

≥ 50 byte

1750 byte

recv(_____, ___, ≥ 50 , __)

shutdown():-

shutdown(Sockfd) ≤ HTT-WR

→ Send a FIN segment, wait for an ACK

close()

→ One side closer():-

→ Other side recv() → 0

→ Other side send! → What happens?

Q) What happens on a ACK?

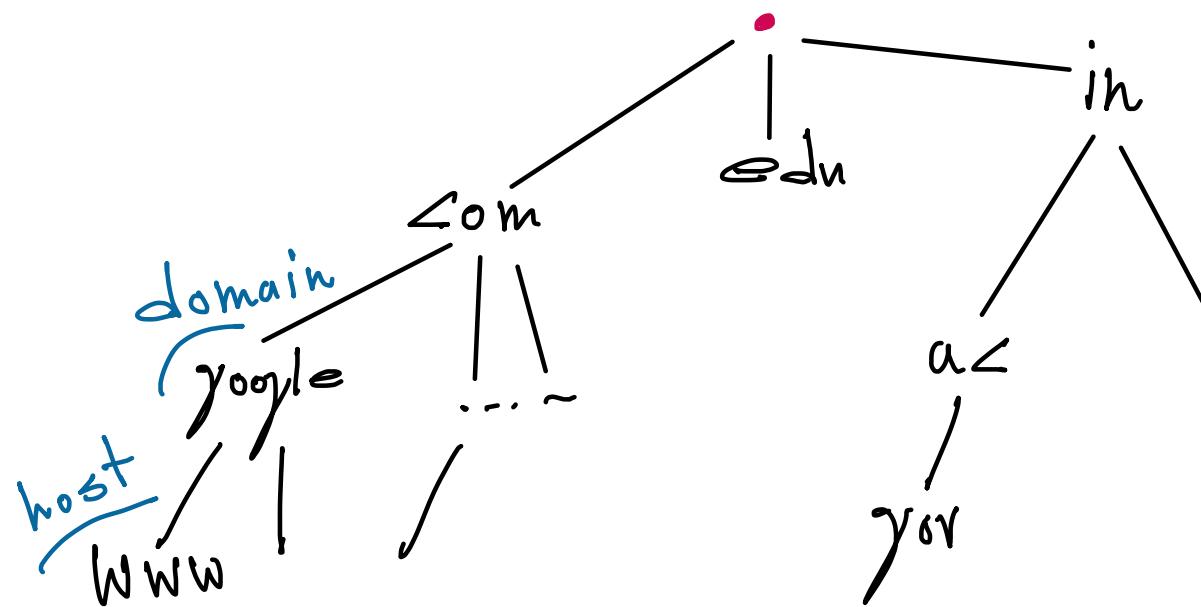
Application: — SMTP / HTTP / POP
/ SSH / Telnet / FTP

DNS

Name resolution

nslookup google.com

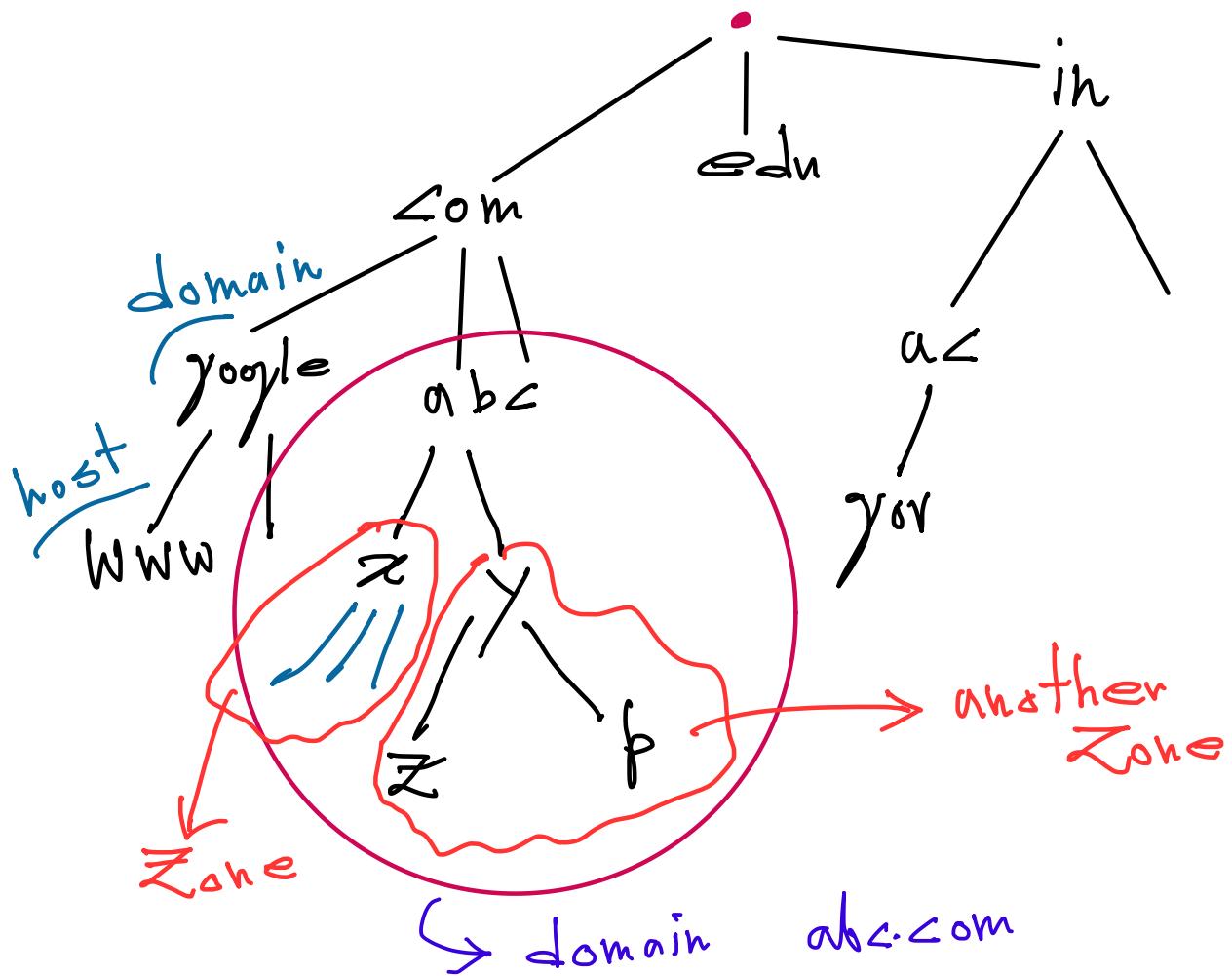
→ IPs of load balancers



Each node = name

= Concatenation of the names

from root to itself, inverse order
with dot in between



Each Zone \Rightarrow One Server

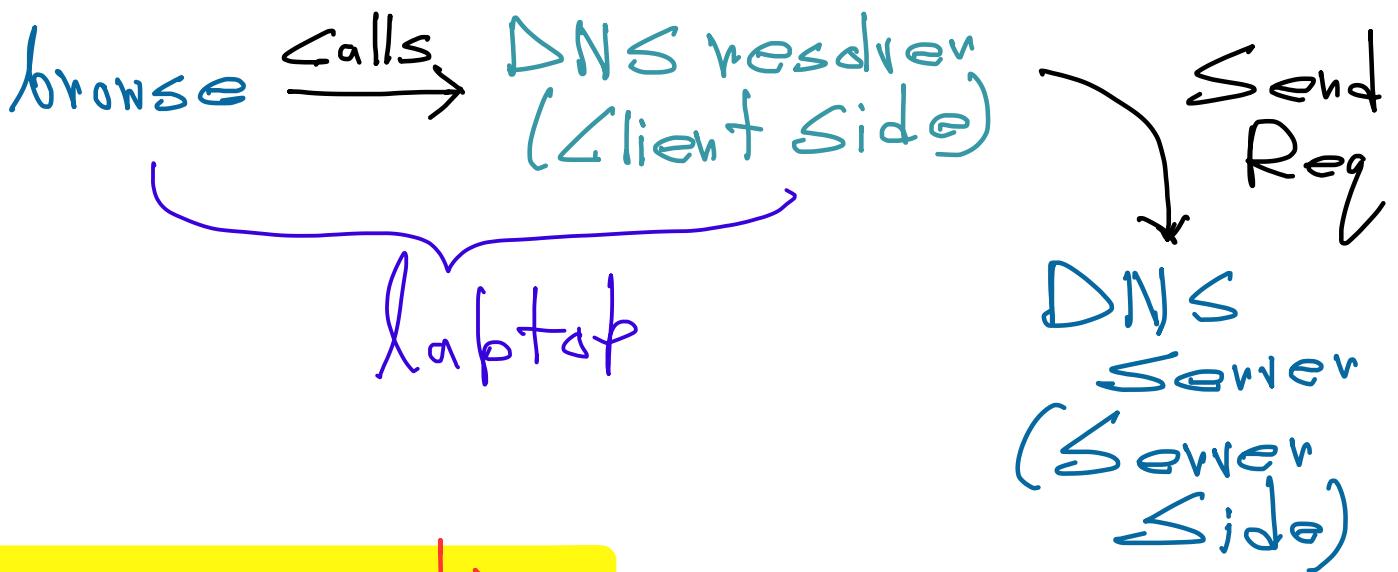
WWW.google.com

\rightarrow Root \rightarrow .com Server

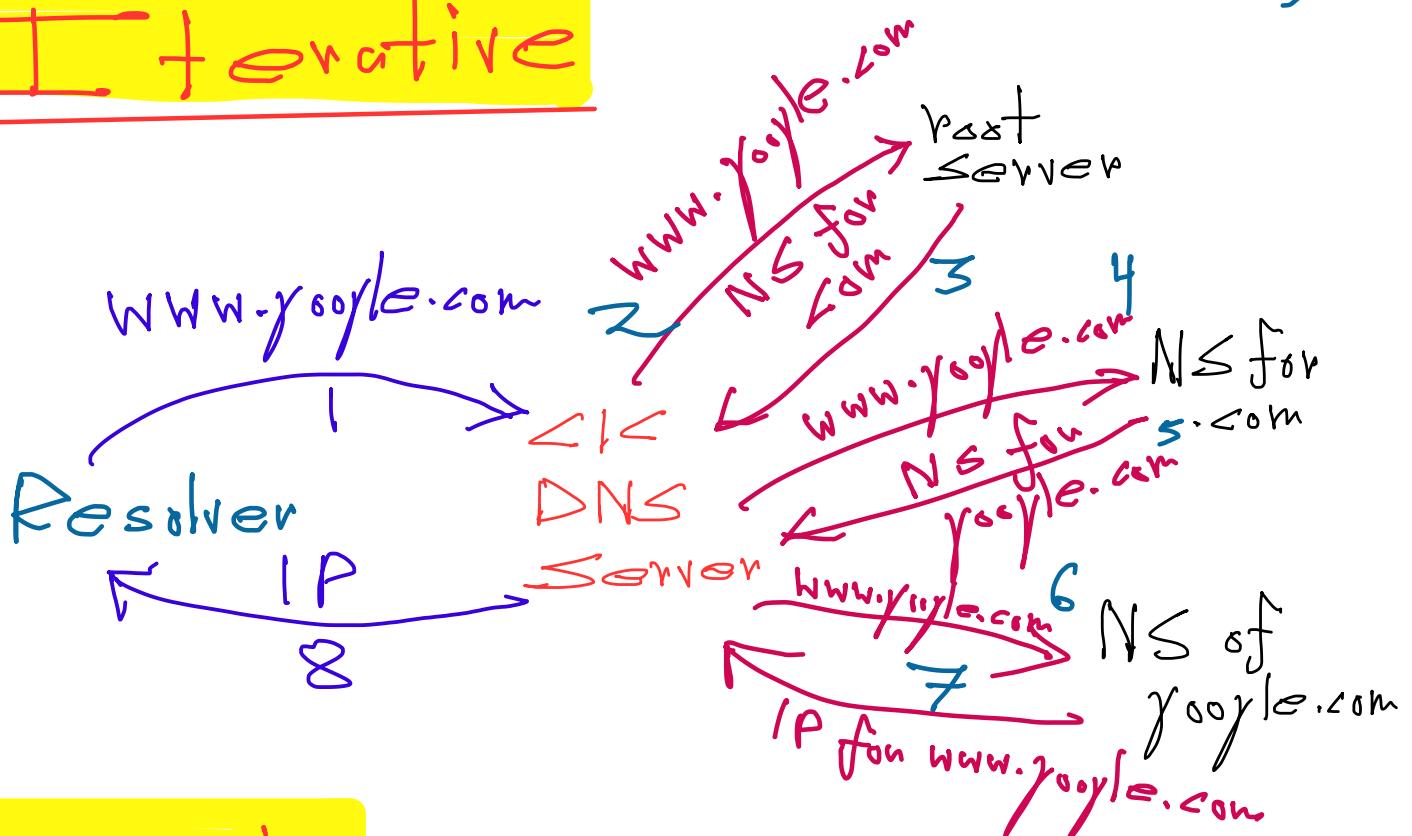
\downarrow
google.com Zone
name server

Root servers! —

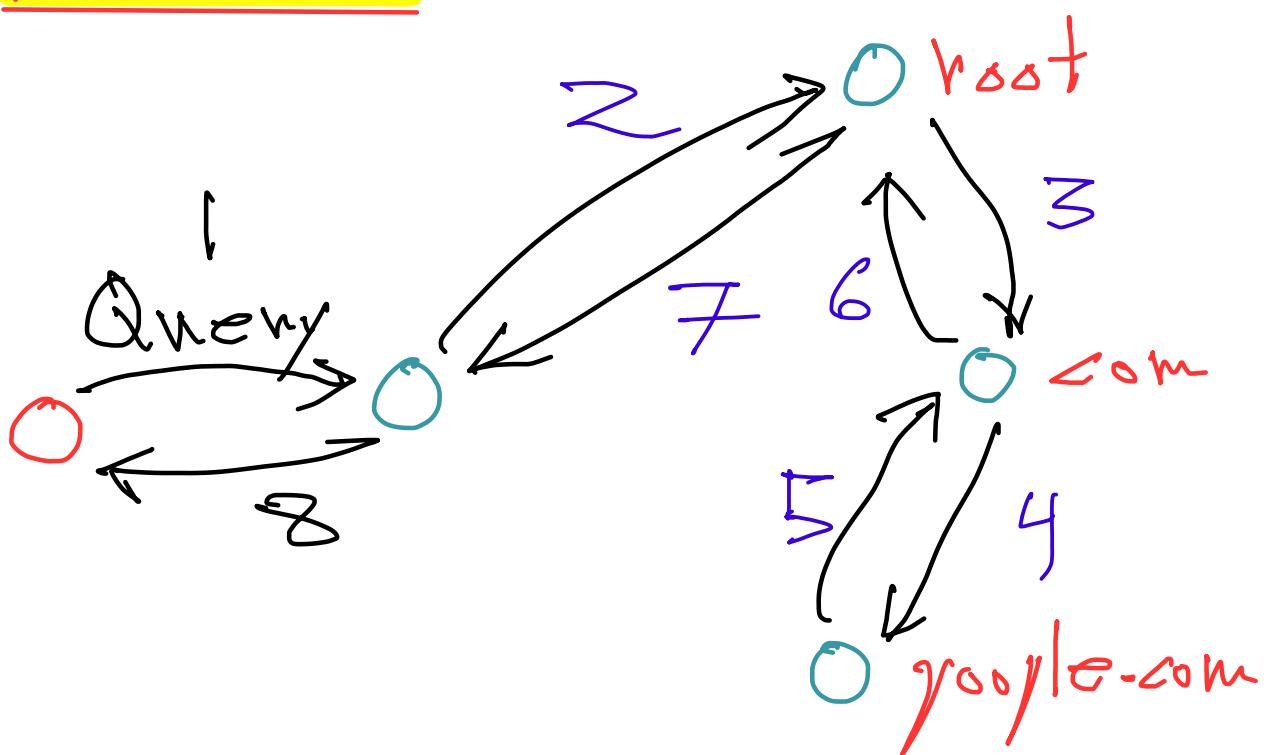
- Zonefile for root zone
- Contains name server IP addresses of all TLDs



Iterative



Recursive



➤ Higher level of the tree
➡ Only Iterative

Recursive:- Needs more state
to be Kept

Zone file ex

land5.com

SOA mcl.land5.com

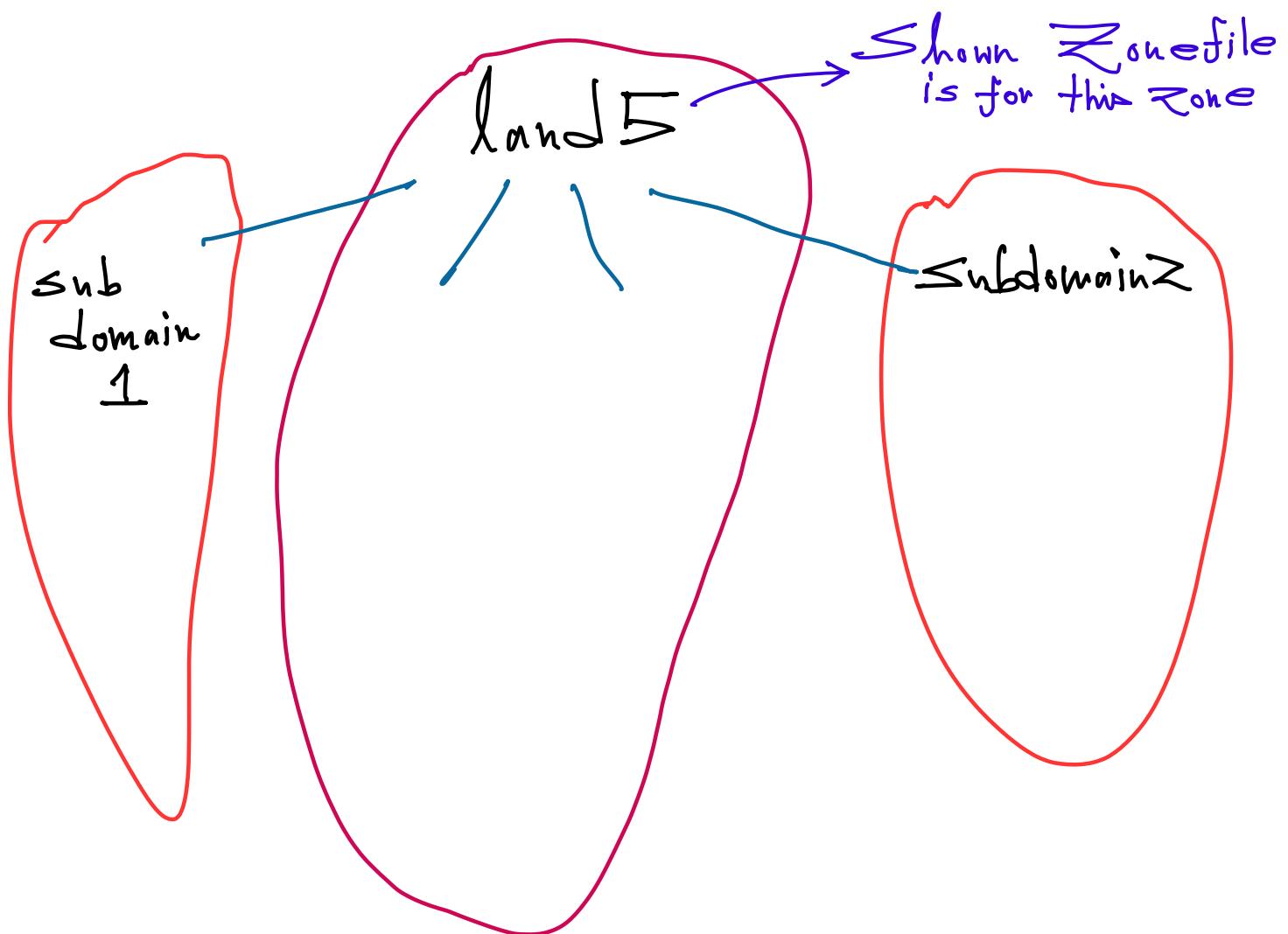
— name of Name server of
the Zone land5.com (primary)

root.land5.com

— The admin for this zone has email
id root@land5.com

8H

— Secondary will pull the zonefile
from primary every 8 hour.



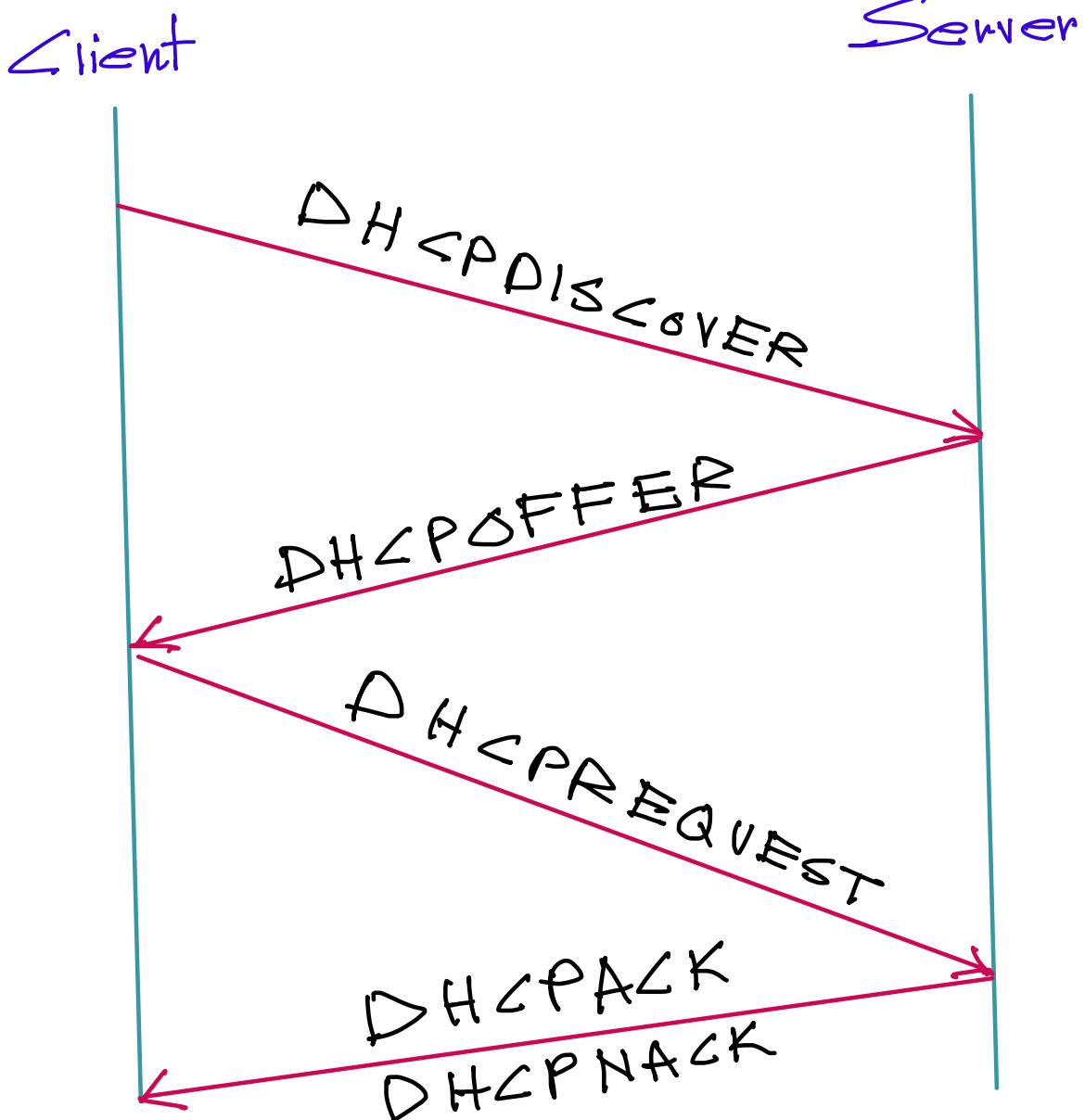
a<.in
iitx.a<.in → Forward

Q) Start with blank Zonefile

D H < P

Manual Allocation

MAC	IP



KNOW NOTHING

Send Port = 67, Dest IP = All 1
 Source IP = All 0

- ⇒ Assume At least 1 DHCP server per subnet (Break it later)
- ⇒ Maybe more than 1 DHCP server

→ May get multithread DHCP OFFER

2 approach:

Until I get an IP

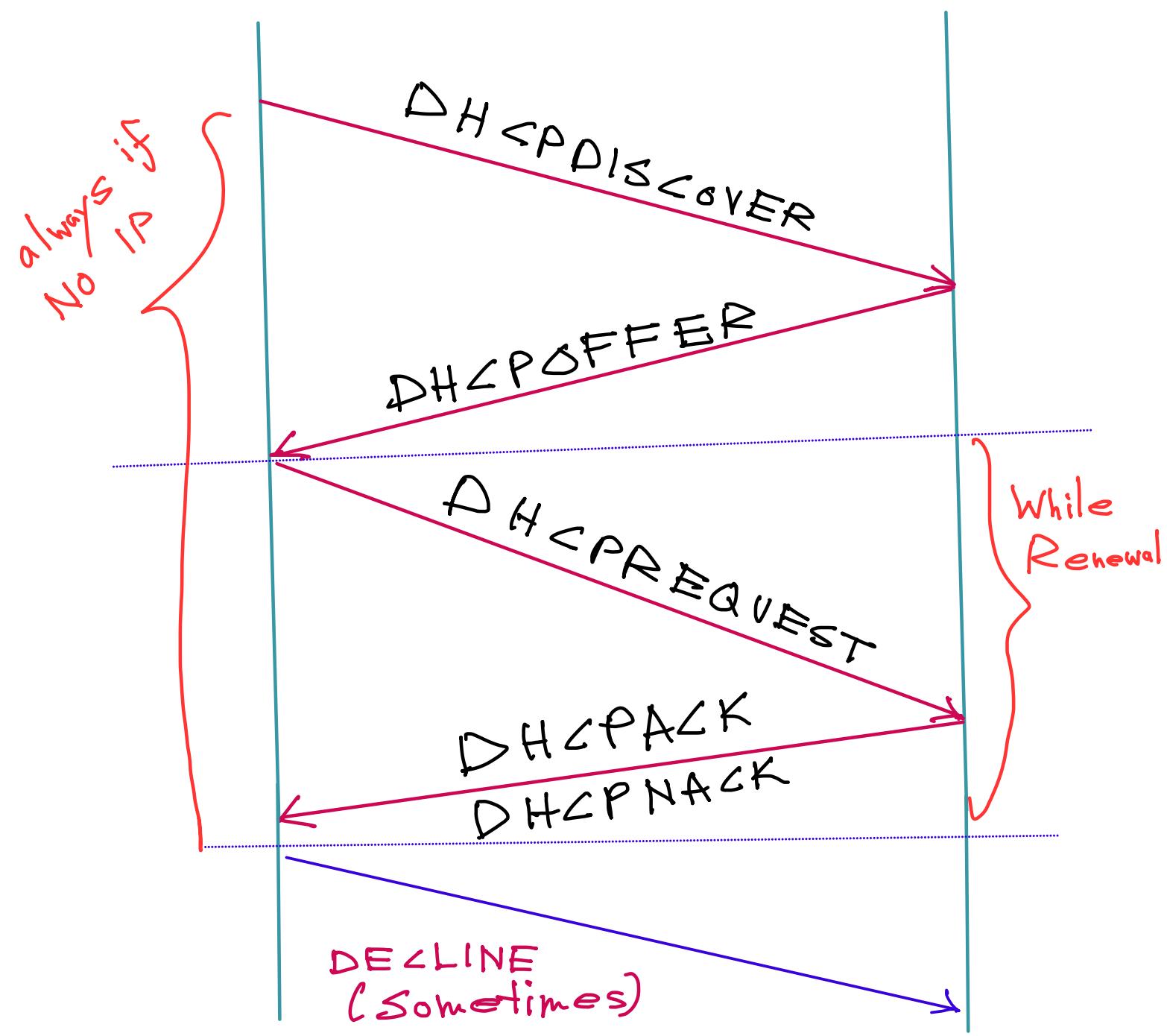
Drop every IP

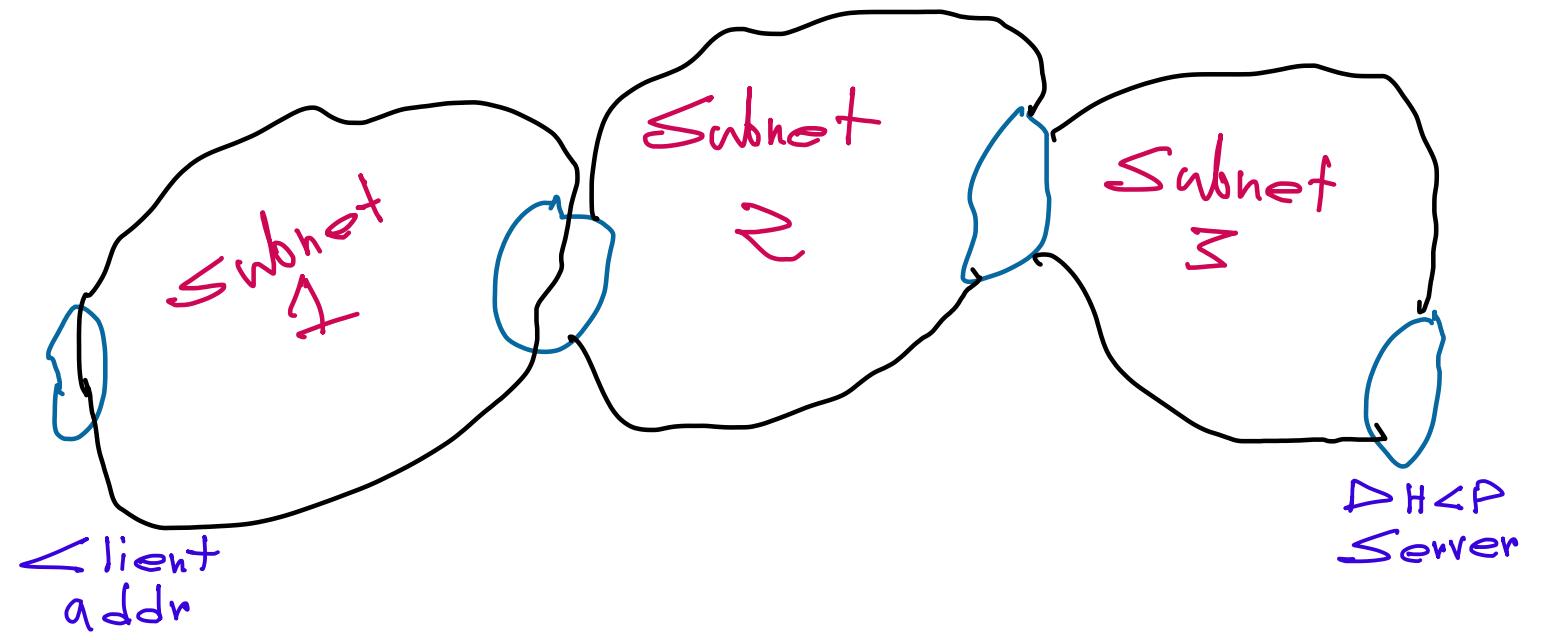
Drop everything except broadcast

Is it UDP? Is it Port 68?

Client

Server

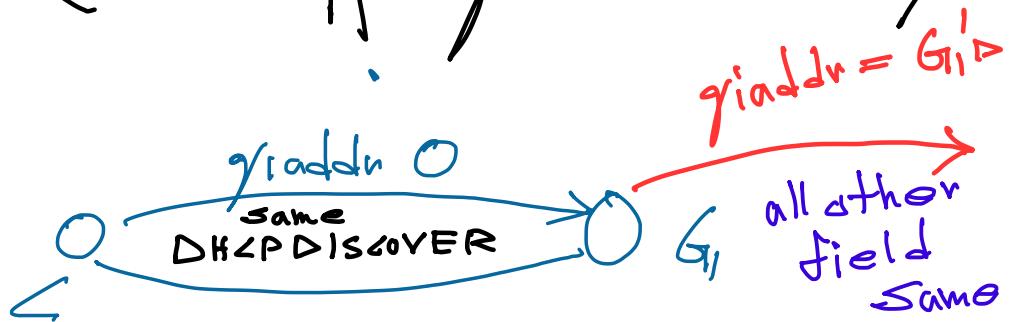




DHCP DISCOVER will get dropped at C1 & will not be provided to subnets C2 & C3

Soln:-

Let G₁ get a "proxy" for C1



- 1) Broadcast IP
- 2) UDP port 67

Header:-

TCP, UDP, IP, ICMP, Ethernet