L-01

Computer Networks

mmhasan@aiub.edu
Room: DNO721

IP/ logical address
- network → specific target net. G যিয়ে যাওয়ার জন্য routing হয়। router network use করে।
- host

Physical address → lowest level address
6 byte / 48 bit (Medium access control)
inside a network, communicate করার সময়
-security issue problem. thats why we need logical / IP address.
IPv4 (32 bit)

Port address → 16 bit
আমাদের প্রত্যেক process identify করে port address.
(Facebook, youtube...)

Binary to Decimal

0	1	0	0	1	1	0	1
128	64	32	16	8	4	2	1

64 + 8 + 4 + 1

= 77

Decimal to binary $(172)_{10} = (?)_2$

128	64	32	16	8	4	2	1
8	7	6	5	4	3	2	1
(1	0	1	0	1	1	0	0)$_2$

172
128
44
32
12
8
4
4
0

128	64	32	16	8	4	2	1
(0	0	0	1	0	1	0	0)$_2$

20
16
4
4
0

210

128	64	32	16	8	4	2	1
(1	1	0	1	0	0	1	0)$_2$

210
128
82
64
18
16
2
2
0

50

128	64	32	16	8	4	2	1
0	0	1	1	0	0	1	0

50
32
18
16
2
2
0

(65) 128 64 32 16 8 4 2 1

0 1 0 0 0 0 0 1

65
64
1
1
0

169

128 64 32 16 8 4 2 1

1 0 1 0 1 0 0 1

169
128
41
32
9
8
1
1
0

Decimal to binary

1 1 0 0 1 0 1 0

128 64 32 16 8 4 2 1

128 + 64 + 8 + 2

= 202

1 1 1 0 0 0 0 1

128 64 32 16 8 4 2 1

128 + 64 + 32 + 1

= ~~243~~ 225

128
64
32
1
225

1 0 1 0 1 1 1 1

128 64 32 16 8 4 2 1

128 + 32 + 8 + 4 + 2 + 1

= 175

128	64	32	16	8	4	2	1
1	1	0	1	1	1	0	1
		1				1	

128
64
32
8
4
2
1
240

IP address : Network part (target network)
Host part

bin to decimal

a

10000001 00001011 00001011 11101111 = 129.11.11.240

decimal to bin

b 221.34.7.82

11011101 00100010 00000111 01010010

34 | 32 | 2

221 | 128 | 93 | 64 | 29 | 16 | 13 | 8 | 5 | 4 | 1 | 0

82 | 64 | 18 | 16 | 2 | 2

0011
0.100

b

16.32.25.31

00010000 00100000 00011001 00011111

b

10001000 10010011 11100000 00000110

128
16
144

136.147.224.6

Range

128
64
32
224

range = difference +1

146.102.32.255

146.102.29.0

0 0 3 255

$(0\times256^3 + 0\times256^2 + 3\times256^1 + 255\times256^0) + 1 = 1024$

255

256 / 295
256
39

$\times 256$

146.102.32.0

146.102.29.255

0 0 2 1

$0\times256^3 + 0\times256^2 + 2\times256^1 \times 1\times256^0$

256) 295 (1
256
39

last address : range 200

14.11.45.96
199

14.11.46.39

10) 17 (2
16
7

Networking Basics

OSI layer — **TCP/IP**

- Application
- Presentation
- Session
- Transport — T
- Network — N
- Data link — D
- Physical — P

Application: close to user. ~~send~~ Take data from user. Sending end এ ~~চলে~~ কাজগুলো হয়, receiving end এ এর বিপরীত কাজগুলো হয়।

HTTP: web browsing

DNS: Domain name থেকে corresponding IP address return করে।

FTP: File transfer

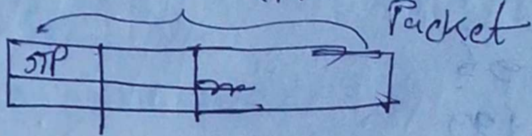
SMTP: Simple mail transfer protocol

Transport layer

application layer থেকে data collect করে → segment করে → data send করে।

Network layer

data কে packet বানানো হয়।



এজন্য routing layer network layer এ কাজ করে।

Data link

Data receive করে frame বানাবে। frame এর মধ্যে physical address থাকে। multiple network কে ~~networ~~ medi access দেয়।

Physical layer

close to transmission medium.

Connecting device

Hub এ ফিল্টারিং যুক্ত থাকে? Data filter করতে পারে না। switch: filter করতে পারে, mac address পড়তে পারে

Repeater: signal কে amplify করা এবং ~~re~~ send করা। (sound বাড়ানো) only have physical layer. ~~physical layer এ~~ regenerate signal within same network, 2 port device

Hub: repeater এর মতো কাজ করে, কিন্তু এর Port সংখ্যা বেশি। sender থেকে data নেয়ার পর বাকি সকল device এ data পাঠিয়ে দেয়, শুধুমাত্র receiver device ছাড়া data পাঠাবে।

Hub/Switch different LAN কে connect করতে পারে না। Bridge পারে।
Hub/Switch LAN কে বড় করতে পারে। LAN গুলো same protocol follow করলে Bridge, না হলে router

Collision Domain

network এর ঐ area যেখানে ২টা device simultaneously data transfer করে।

Hub এবং repeater same collision এ. বাকিরা আলাদা আলাদা।

Broad cast domain

router ছাড়া কেউ আলাদা আলাদা network identify করতে পারে না।
router এর link গুলো আলাদা আলাদা domain। ১টা ২টা, ১টা ৫টা

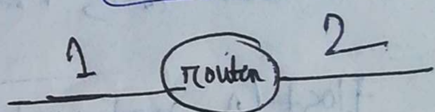
router → router

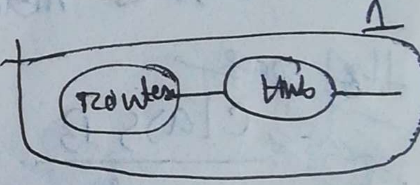
Problem-1

collision domain - 11টা

Hub গুনবো না

bridge, switch, router আলাদা





Broad cast domain - 5টা

* শুধুমাত্র router গুলো গুনে শেষ করতে হবে।

Hub: 1 broadcast, 1 collision

switch: প্রতিটি switch একটি করে broadcast domain, যতগুলো Port ততগুলো collision

Magic chart

128 192 224 240 248 252 254 255

1 1 1 1 1111 → 255
1 1 1 1 1110 → 254
1 1 1 1 1100 → 252
1 1 1 1 1000 → 248
1 1 1 1 0000 → 240
1 1 1 0 0000 → 224
1 1 0 0 0000 → 192

1000 0000 → 128

Lab-2

2 Part
network এবং host

IP Addressing II

IP address - 32 bit

octad → 8 bit

$2^8 = 256$
$2^7 = 128$

8 bit

(0-127) class A: start with: 0. 0111 1111 → 127
0000 0000 → 0

(128-191) class B: start with: 10 1000 0000 → 128
1011 1111 → 191

(192-223) class C: " " : 110.

(224-239) " D: " " : 1110

(240-255) " E: " " : 1111

No of n. 0000 এবং 127 এর মধ্যে যে সংখ্যা।

0 000 0000
↑ Network address
↑ host broadcast address

host এর network address এবং broadcast address বাদে বা।

~~Host space~~
~~host~~ Class B

no of net: 2^{16} ~~-2~~

~~host = $2^{16} - 2$~~

Class A

~~host~~: $2^{24} - 2$

class C : $2^8 - 2 = 254$

address block: 1 টা block এর under এ কয়টা host থাকে।

$$\text{Host} = 2^{32 - \text{Length of network}} - 2$$

256
128 64 32 16 8 4 2 1

Broadcast

Limited: যে network এর মধ্যে আছি, ঐ network এর মধ্যেই থাকা.

Direct: ~~[illegible]~~ এক network থেকে আরেক network broadcast করা.

আগে জানতে হবে IP address কোন class এ

networkIP: Lowest. network ঠিক রেখে বাকিসব 0 করে দেয়া,

Broadcast " : Highest one. network ঠিক রেখে বাকিগুলো 1 করে দেয়

Host : network এবং Broadcast বাদে বাকিসব.

(8, 16, 24)

172.10.12.10 → class B

Network address: 172.10.0.0

Broadcast " : 172.10.255.255

Host address : ~~172.10.0.1~~

172.10.0.1 ~ 172.10.255.254

204.130.120.10 [class C]

network address : 204.130.120.0

Broadcast " : 204.130.120.255

Host address : 204.130.120.1 ~ 204.130.120.254

100.13.10.1

Net. add : 100.0.0.0

B. " : 100.255.255.255

Host " : 100.0.0.1 ~ 100.255.255.254

10.5.3.5

Net. add : 10.0.0.0

Broad. " : 10.255.255.255

Host " : 10.0.0.1 ~ 10.255.255.254

192.168.10.15

Net ad: 192.168.10.0

Broad u : 192.168.10.255

Host u: 192.168.10.1 ~ 192.168.10.254

gateway address: Host address থেকে যেকোন একটা address দেয়া যায়। তবে সাধারণত broadcast এর আগেরটা gateway address হিসেবে নিই।

Mask

network add এর সব Host কে 0 করে দিলে subnet mask পাওয়া যায়।

21-45448-3

A B C D E F G H

18 → 8টা 1, বাকিগুলো 0.

Subnet mask

73. 22. 17. 25

11111111. 00000000. ———

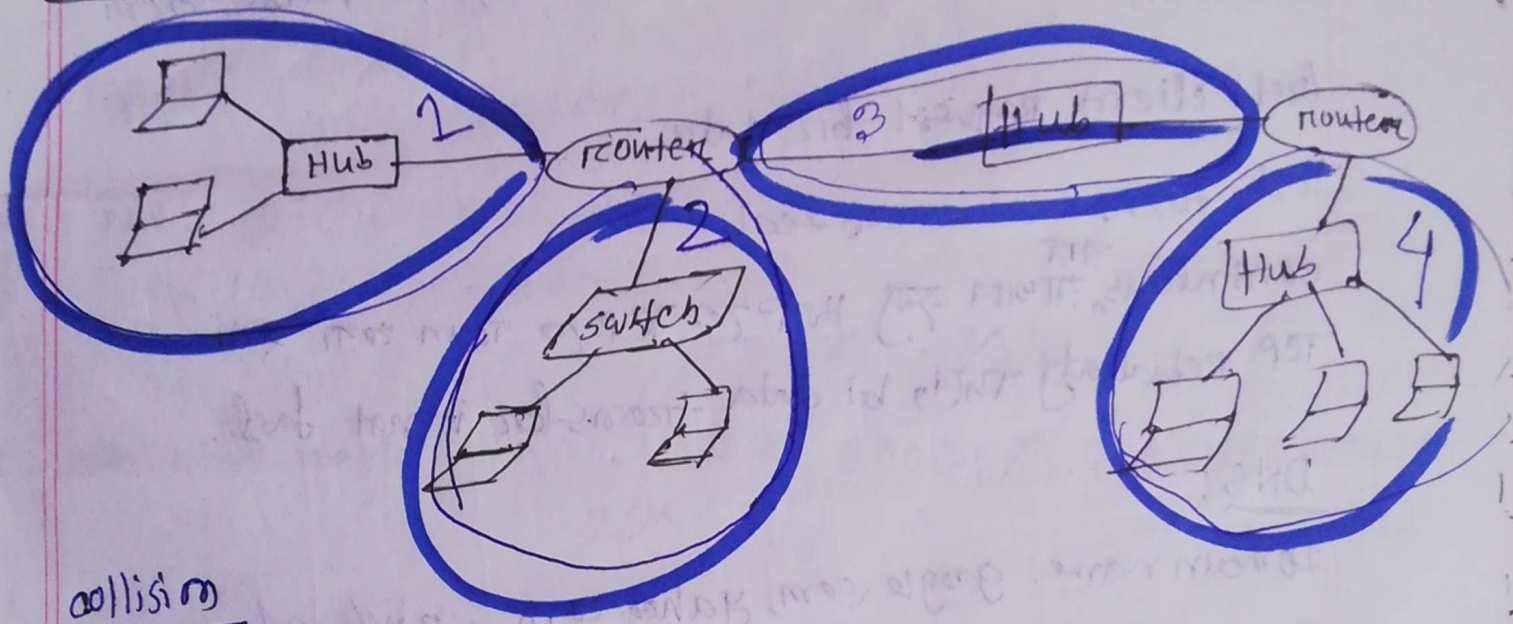
(73) → 01001001

AND ———————————

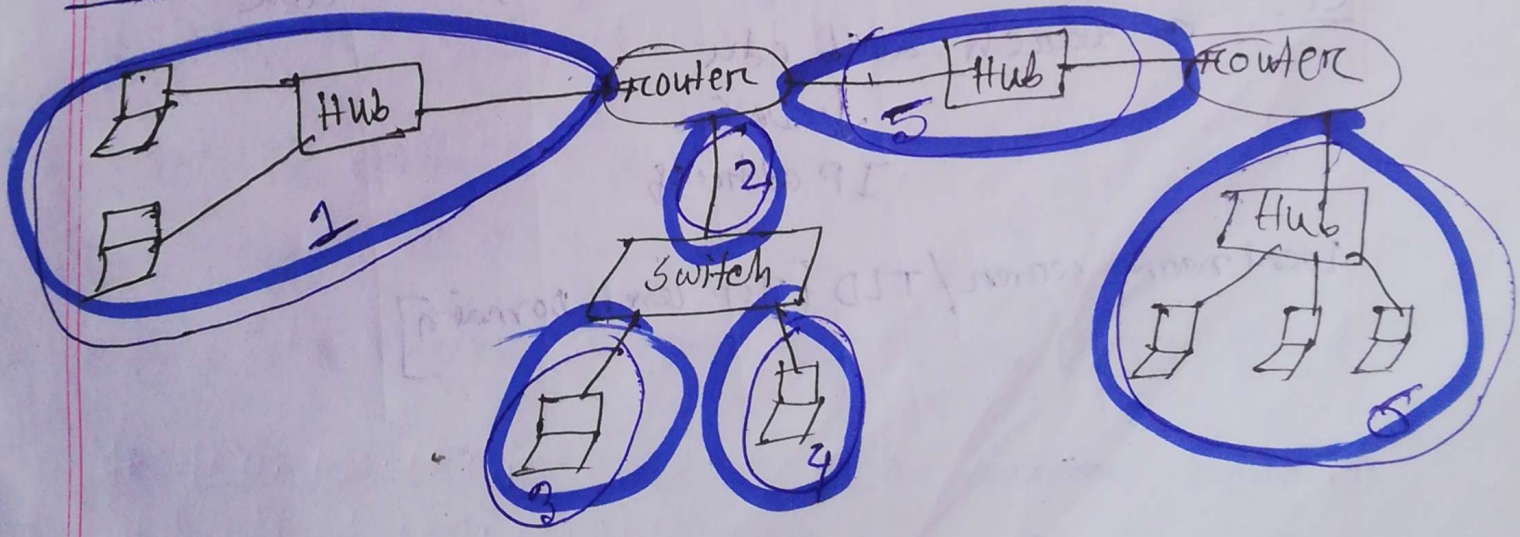
01001001 . 0. 0. 0

Theory - Lec-1 : Broadcast & collision domain

broadcast : separated by routers



collision



Theory Lec-02

Application Layer Protocol

Protocol: way of procedure
A set of rules. control communication.

Push protocol: server নিজে থেকে data পাঠাবে, always active.

Pull protocol: request এর against এ response আসে।
ex: HTTP

Get: client request for data
Post: Form used in web tech.
continuous data পাঠানোর জন্য HTTP কে TCP তে রান করা হয়।
TCP reliability দিবে, but data transfer is not fast.

DNS:

Domain name: google.com, yahoo.com, aiub.edu
ex:
search aiub.edu
↓ DNS
IP address

Local name server / TLD [Top level Domain]

Quiz: TCP/IP, Broadcast, collision, connecting device
Application layer
IP addressing, classful addressing

*** Recursive query: rootname server নিজে data দেয়।

*** Iterative " : " " অনুরোধ পাঠায়, refer করে।

i) 10.10.10.10/8 ii) 172.16.10.5/16

(i) BC address
(ii) Host range
(iii) Network mask

Network address

Ans:

10.10.10.10/8 [class A]

NA: 10.0.0.0
BC: 10.255.255.255
HR: 10.0.0.1 ~ 10.255.255.254
Network mask: 11111111 00000000 00000000 00000000
255 . 0 . 0 . 0

ii) 172.16.10.5/16 [class B]

NA: 172.0.0.0
BC: 172.255.255.255
HR: 172.0.0.1 ~ 172.255.255.254
Mask: 11111111 11111111 00000000 00000000
255 . 255 . 0 . 0
class C: 255.255.255.0

Lab-03 VLSM

2^5 [5 bit host, 27 network]

Require IP: BA, NA,

27 sub network mask

For B: 4টা

VLSM: network এর requirement এর উপর base করে IP address দেয়া।

Step 1: sub network গুলোকে descending order এ সাজাতে হয়।

Step 2: bit ধরে বের করা।

Step 3: sub network mask

Step 4: IP block

1111 | | |

255

32 64

2×2×2×2

$2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$2^6 = 64$

$2^7 = 128$

$2^8 = 256$

$2^9 = 512$

$2^{10} = 1024$

$2^{11} = 2048$

$2^{12} = 4096$

Ex-2

Subnet	No of IP req	borrow bit	No of allocated IP	Host & net bit	subnet mask	
A	50	$2^6 > 50$, 2^5	64	x=6, y=32-6=26	255.255.255.192	130.3.0.0 — 130.3.0.63
C	28	$2^5 > 28$, 2^4	32	x=5, y=32-5=27	255.255.255.224	130.3.0.64 — 130.3.0.95
B	4	$2^2 = 4$	4	x=2, y=32-2=30	255.255.255.252	130.3.0.96 — 130.3.0.99

130.3.0.0

/30

11111111 | 11111111 | 11000000 | 00000000
255 | 255 | 192 | 0

3] Consider your ID: AB-CDEFGH. Four networks: P, Q, R, S with IP requirements D×100, E×100, F×100, G×100. IP block 172.16.0.0/16

• ID = 21-45448-3

A=2 B=1 C=4 D=5 E=4 F=4 G=8 → H=3

P = D×100 = 5×100 = 500

Q = E×100 = 4×100 = 400

R = F×100 = 4×100 = 400

S = G×100 = 8×100 = 800

256 | 512 | 2
512
0

subnet	No of IP req	No of 'borrow bit	No of allocated bit	Host & network bit	subnet mask	172.16.0.0
S	800	$2^{10} > 800$ 2^9	1024	x=10 y=32-10=22	255.255. 252.0	172.16.0.0 – 172.16.3.255
P	500	$2^9 > 500$ $> 2^8$	512	x=9 y=32-9=23	255.255. 254.0	172.16.4.0 172.16.5.255
Q	400	$2^9 > 400$ $> 2^8$	512	x=9 y=32-9 =23	255.255. 254.0	172.16.6.0 – 172.16.7.255
R	400	$2^9 > 400$ $> 2^8$	512	x=9 y=32-9=23	255.255. 254.0	172.16.8.0 – 172.16.9.255

(S) Starting: 172.16.00.0

1023

172.16.3.255

256 | 1023 | 3
768
255

8 | 16 | 24 | 32

32-11
21

1

Subnet	No of IP req	No. of borrow bit	No. of allocated IP	No of Host & net. bit	subnet mask	130.3.0.0
C	2008	$2^{11} > 2008 > 2^{12}$	2048	x=11 y=32-11 =21	255.255. 248.0	130.3.0.0 255.255.248 130.3.7.255
B	300	$2^9 > 300 > 2^8$	512	x=9 y=32-9 =23	255.255 .254.0	130.3.8.0 130.3.9.255
A	100	$2^7 > 100 > 2^6$	64	x=7 y=32-7 =25	255.255. 255.128	130.3.10.0 130.3.10.128

Student Lab-task-1

Network C → 2008

Host = 11
net = 32-11 = 21
mask: 255.255.248.0

1	2	3	4	5	6	7	8	9	10	11
2	4	8	16	32	64	128	256	512	1024	2048

256 | 511 | 255 | 255

130.3.00000|000 00000000
00000|111 11111111

130.3.7.255

Block size
$2^{\text{Host bit}} - 2$

130.3 | 00000000.00000000

8 | 0 +1

7

205

20 21

2008

130.3.00001000.00000000 8.0

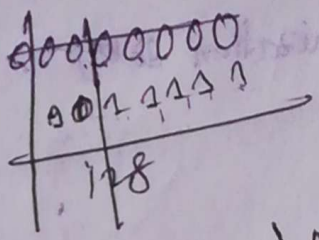
00001001.11111111

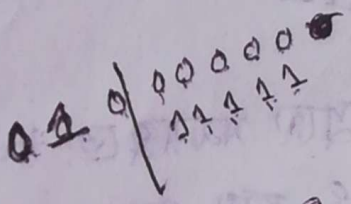
9 255

128 64 32 16 8 4 2 1

130. 3

130. 3. 00001010.

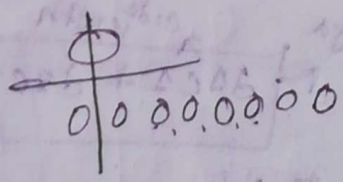




00001010

130 3 10

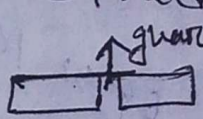
00001010



theory lec-4 : Multiple access technique

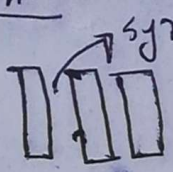
Channelization : divide করে দেয়া হয়

FDMA : n সংখ্যক users থাকলে, n সংখ্যক frequency band কে divide করে দেয়া হবে।



guard band = n-1

TDMA



CDMA : সবগুলো সময়ে transmit করা যাবে, full band width use করা হয়।

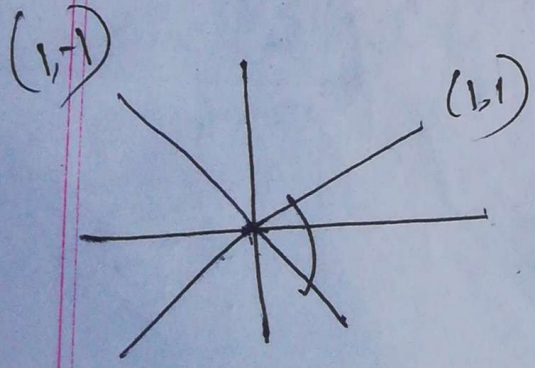
যার code, সেটা দিয়ে multiply করলে code টির length পাওয়া যাবে, অন্য code দিয়ে করলে 0.

data → $d_1c_1 + d_2c_2 + d_3c_3 + d_4c_4$ (code length) → Transmission sequence

d_1 মানে d_2 মানে data

How to generate code ?

orthogonal → লম্বভাবে



CDMA

$H^4 = \begin{bmatrix} H^2 & H^2 \\ H^2 & -H^2 \end{bmatrix}$

$H = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

$H^2 = \begin{bmatrix} H^1 & H^1 \\ H^1 & -H^1 \end{bmatrix}$

$H = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

$H^4 = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \begin{matrix} \rightarrow C_A \\ \rightarrow C_B \\ \rightarrow C_C \\ \rightarrow C_D \end{matrix}$

$-3 \times C_A = -3 \quad -3 \quad -3 \quad -3$

$+1 \times C_B = \quad 1 \quad -1 \quad 1 \quad -1$

$+5 \times C_C = \quad 5 \quad 5 \quad -5 \quad -5$

$-1 \times C_D = \quad -1 \quad 1 \quad 1 \quad -1$

$TV = \quad 2 \quad 2 \quad -6 \quad -10$

$R_x = [2 \quad 2 \quad -6 \quad -10]$

$R_x \times C_A = [2 \quad 2 \quad -6 \quad -10] \times \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$

$= 2+2-6-10$

$= -12$

A's data $= -12/4$

$= -3$

Controlled access

- there will be some control in mechanism.

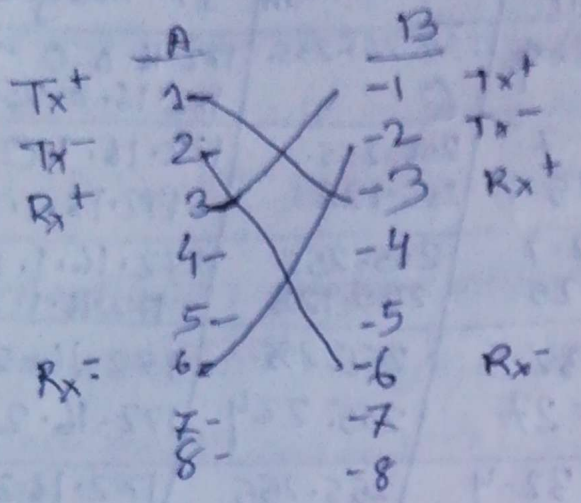
Reservation: set data এর জন্য slot activate করা।
n → wen, n-7 slot

Polling: 2 type of device [Primary (master), secondary (slave)]
Primary controll everything. secondary follow Primary
- data নেয়া (Pool)
- data sent ~~(না)~~ select)

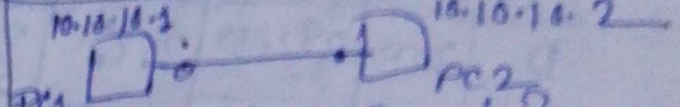
Token passing method: network এ আগে ring বানাতে হবে।
পাশের → circle — ring
pred. successor কে data দিবে।
token পাইলে data sent করা যাবে।

LAB-4 view ip config details: ipconfig

Ethernet cabling



Pin allotment: ethernet: straight



reachable or not?

Ping 10.10.10.2 [PC1 send four packets to PC2, if connectivity is there]

switch → PC: straight.

switch → switch: crossover

For connecting 2 different devices use: ethernet straight

#

subnet	No of Req IP	How many bits to borrow	Allocated IP	No of host & net bits	subnet mask	IP range
CSE	350	$2^9 > 350 > 2^8$	512	32-9 = 23	255.255.254.0	10.10.0.0 – 10.10.1.255
BBA	100	$2^7 > 100 > 2^6$	128	32-7 = 25	255.255.255.128	10.10.2.0 – 10.10.2.127
EEE	80	$2^7 > 100 > 2^6$	128	32-7 = 25	255.255.255.128	10.10.2.128 – 10.10.2.255

For connecting two devices of same kind: crossover

See physical address: ipconfig /all

mac address

Router: 2811
switch: 2960

(2)

Subnet	No of IP req.	Borrow bit	Allocated IP	Host & net bit	subnet mask	IP range
D	200	$2^8 > 256 > 2^7$	256	32-8=24	255.255.255.0	172.16.0.0 – 172.16.0.255
C	90	$2^7 > 128 > 2^6$	128	32-7=25	255.255.255.128	172.16.1.0 – 172.16.1.127
E	80	$2^7 > 80 > 2^6$	128	32-7=25	255.255.255.128	172.16.1.128 – 172.16.1.255
B	30	$2^5 > 30 > 2^4$	32	32-5=27	255.255.255.224	172.16.2.0 – 172.16.2.31
A	10	$2^4 > 10 > 2^3$	16	32-4=28	255.255.255.240	172.16.2.32 – 172.16.2.47

(3)

AB-C DE FG-H
21-4544 8-3

N1 = 100 x C = 100 x 4 = 400
N2 = 10 x D = 10 x 5 = 50
N3 = 50 x A = 50 x 2 = 100
N4 = 20 x G = 20 x 8 = 160

subnet	No of IP req.	Borrow bit	Allocated IP	Host & net bit	subnet mask	IP range
N1	400	$2^9 > 400 > 2^8$	512	32-9=23	255.255.254.0	192.168.0.0 – 192.168.1.255
N4	160	$2^8 > 160 > 2^7$	256	32-8=24	255.255.255.0	192.168.2.0 – 192.168.2.255
N3	100	$2^7 > 100 > 2^6$	128	32-7=25	255.255.255.128	192.168.3.0 – 192.168.3.127
N2	50	$2^6 > 50 > 2^5$	64	32-6=26	255.255.255.192	192.168.3.128 – 192.168.3.191

CN quiz-02

Data Link layer, VLSM

5) /30

11111111	11111111	11111111	11111100
255	255	255	252

∴ mask : 255.255.255.252

Random access Protocol (Theory: lec-4)

ALOHA any station can send data any time;
propagation delay: sender থেকে receiver পর্যন্ত যেতে যে সময় লাগে।

- data sent
- wait for acknowledgment (2× P.D)

Pure aloha

vulnerable time $= 2 \times T_{fr}$

Throughput $= G \times e^{-2G}$

G = no of station

Slotted ALOHA

Data rate 200 kbps [Per sec]

frame size = 200 [1 টা]

$T_{fr} = \frac{200}{200} = 1s$

for, Pure aloha vulnerable time $= 2 \times T_{fr} = 1 \times 2 = 2s$

extra

Host = n.a হলে, B.A হবে।

IP = n.a " B.a হবে

Book: total page: 171
math: 412 ~~430~~ 430

1-P

no waiting, free হলে transmit, collision হবার

Non-P station does not continually sense. wait for a random period of time. and repeat the algorithm. It leads to better channel utilization but longer delays than 1-P.

P-

generate Random. Probability high হলে transmit করবে applies slotted channel.

Lab-05

routing: Packet sent

IGP → Autonomous. [একই routing use করবে, same routing protocol use করবে হবে.

EGP → আলাদা আলাদা autonomous.

P-Persistant

It applies to slotted channel. when a station became ready to send, it sense the channel.
if idle, transmit with probability P.
Q = 1-P, it defers until the next slot.

CSMA/CD → for ethernet

- If two station sense the channel to be idle and transmitting simultaneously, they will both detect the collision almost immediately.
- Rather than finish transmitting their frames, they should stop transmitting as soon as the collision is detected.
- Quickly transmitting damaged frames saves time and bandwidth.

CSMA/CA → for wireless

- Avoid collisions by beginning transmission only after the channel is sensed to be idle.
- Unreliable due to the hidden node problem and exposed terminal problem.

Some RTS/CTS exchange.

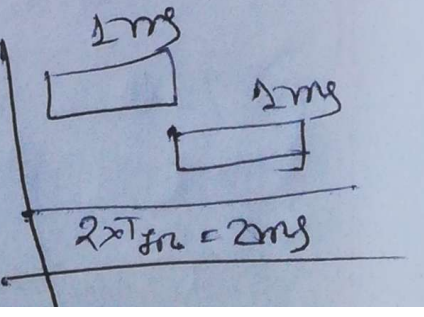
Operates in Data link layer (layer 2)

Pure ALOHA

$V = 2 \times T_{fr}$

$T_{fr} = \frac{500 \text{ bits}}{500 \times 10^3 \text{ bps}} = 1 \times 10^{-3} \text{ s}$

$2 \times T_{fr} = 2 \text{ ms}$



Router: 2811
switch: 2960

Lab

PC → switch

same device: cross over
different " : straight

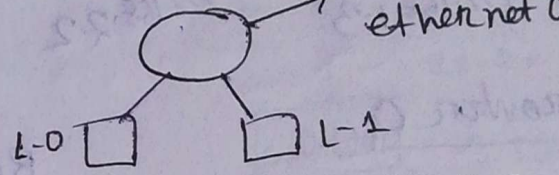
Fast ethernet

switch এর মাধ্যমে diff network msg sent হবে না।

192.168.10.2 ⟷ 192.168.10.3 ✓
192.168.11.2 ⟷ 192.168.10.3 ✗

Router-laptop

ethernet
cable: cross-over



ethernet 0: IP = 192.167.1.2
mask = 255.255.255.0

ethernet 1: info of PC2

192.167.1.2 192.167.2.2

For laptop 0, gateway will be ethernet 0.
For " 1, " " " " 1.

switch-router

ethernet

For increasing the port no of router

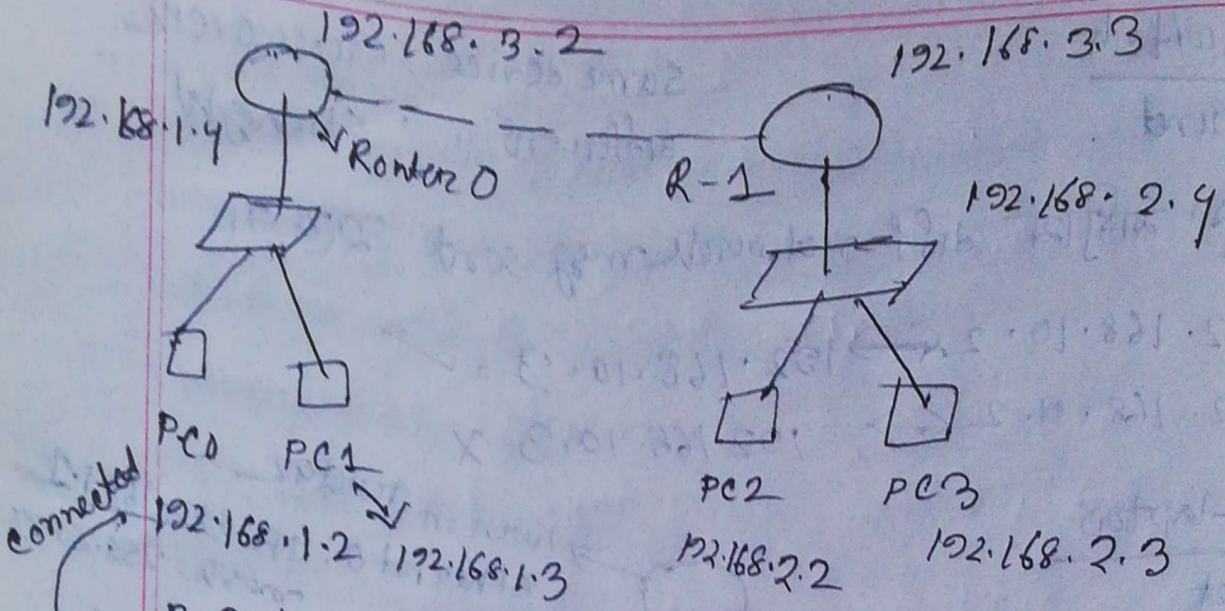
physical → turn of switch → WIC-2T → customize icon in logical view → zoom out (drag down) → turn on switch

Router-PC

cross over

Repeater is in this section (2nd ET)

RIP routing



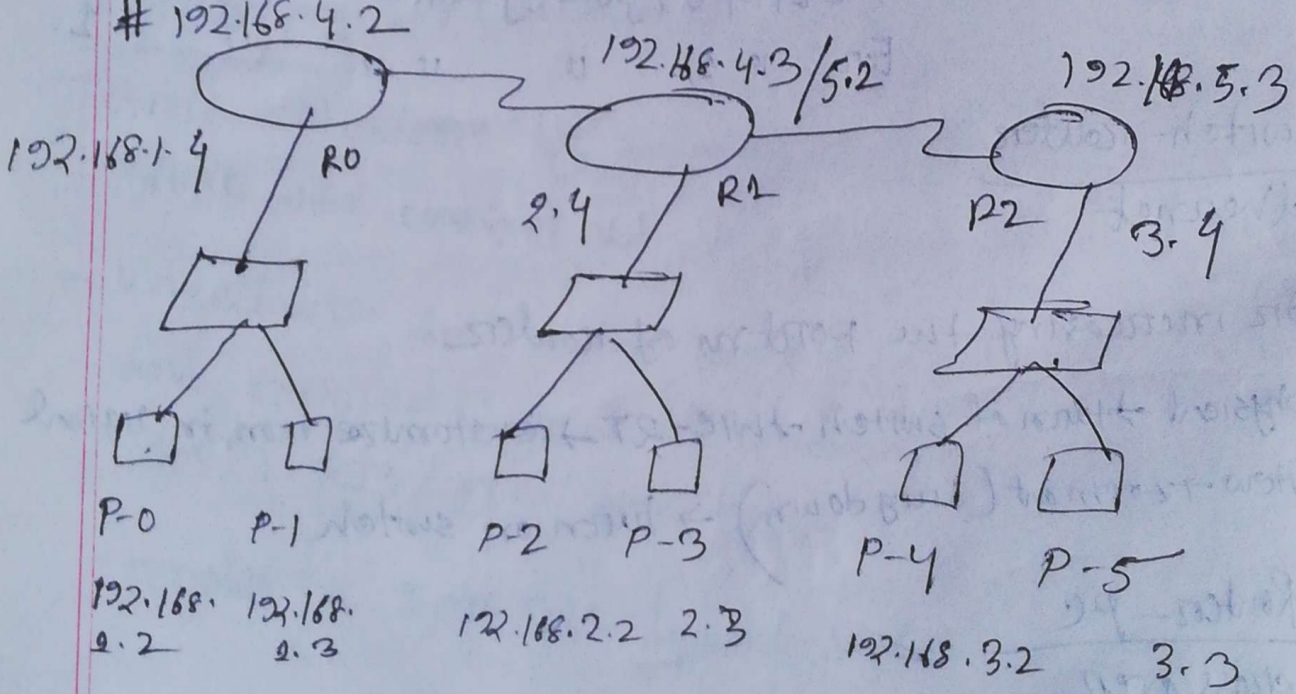
connected

RIP for router 0

network: 192.168.1.0
192.168.3.0

Router 1

192.168.2.0
192.168.3.0



RIP for router 0

Network. 192.168.1.0
192.168.4.0

Router 2

192.168.3.0
192.168.5.0

Router 1

192.168.2.0
192.168.4.0
192.168.5.0

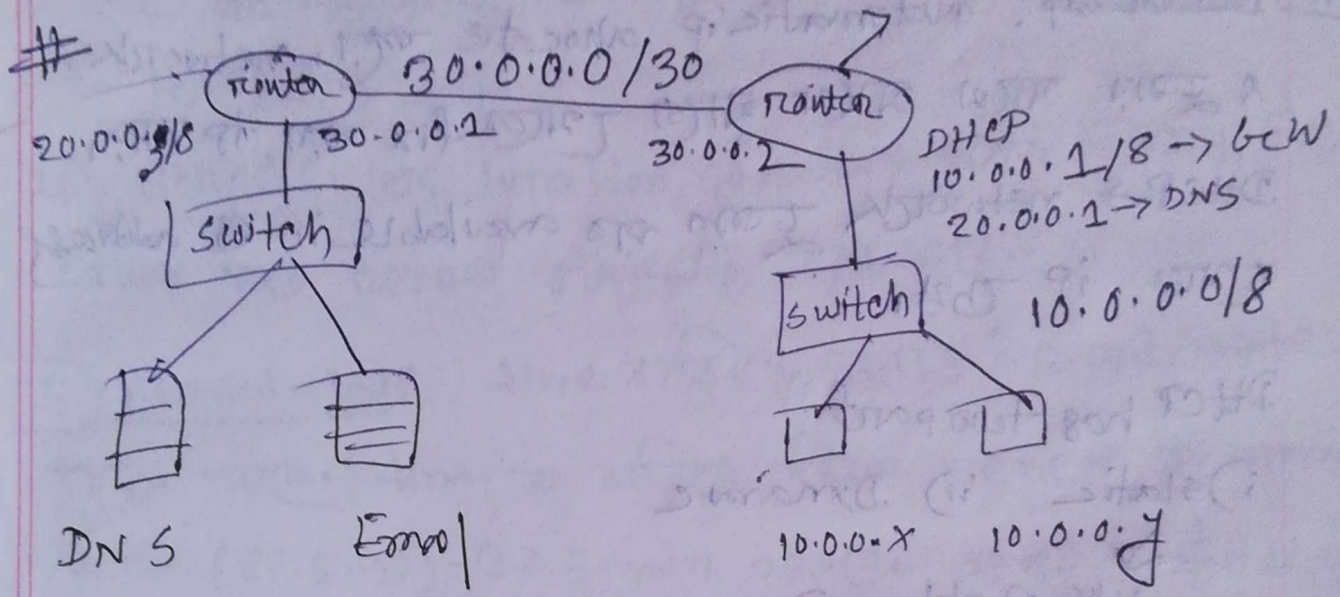
OBE-12 y theory-68
sheet-20 y

Lab-01 Final-term

User request এর জন্য: DNH DHCP server use করবে।

DNS -> gmail এর ip address.

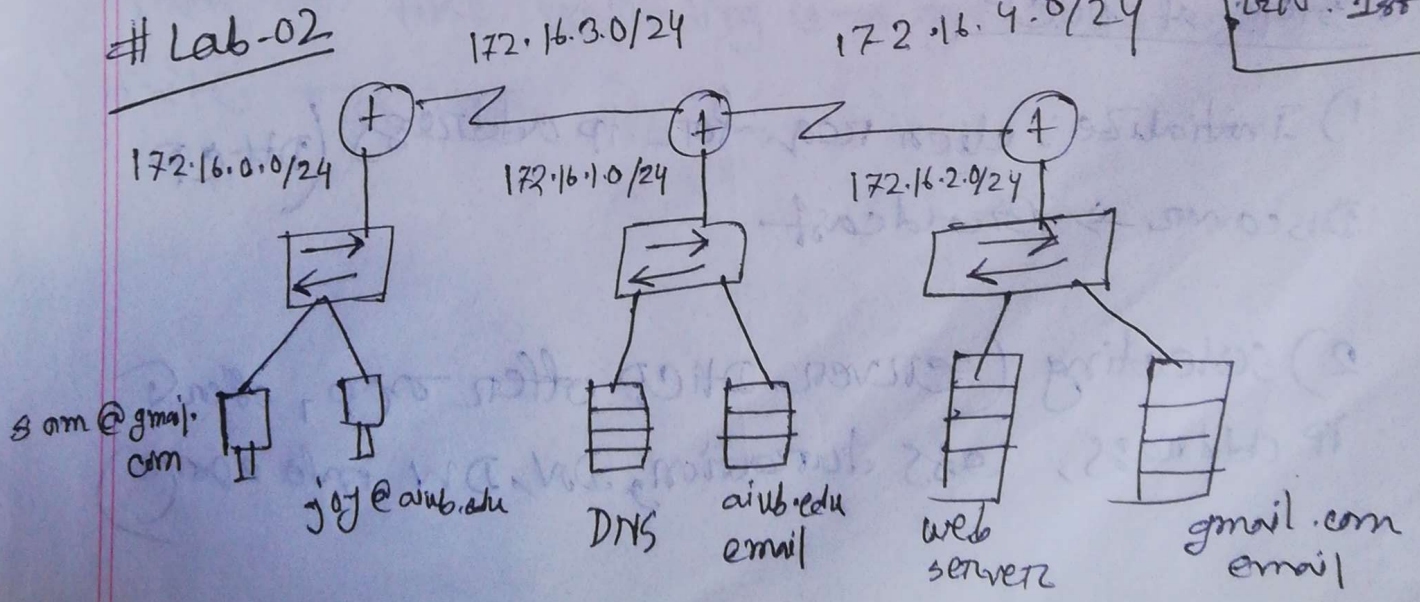
RIP
10.0.0.0/8 network
30.0.0.0/30



RIP
20.0.0.0/8
30.0.0.0/30

Routing: RIP v2
GW: 1st IP

Lab-02



Theory

1st quiz: 6 jan
2nd " : 20 jan

DHCP & ARP

DHCP: Dynamic host configuration protocol
Host কে IP address দেয়া, define range থেকে dynamically ip allocate করে।

Boot IP Bootstrap: automatic ip allocate করে, network এ ডুকার সাথে সাথে যাতে থেকে fix করা ip দেয়।
DHCP → network ডুকার পর available ip address থেকে ip দেয়।

DHCP has two part
i) static ii) Dynamic
↓
like Bootstrap IP.

less duration: কতক্ষণ ধরে ip address active থাকবে।

How DHCP work? → Process explained
=>

6 steps of DHCP

1) Initialize: client req for ip address (DHCP Discover → Broadcast

2) selecting (server DHCP offer করে, offers ip address, loss duration, DN, DW info দেয়)

client max 5 বার request করতে পারবে।

server যেগুলো offer করবে সেগুলো lock করে রাখবে যাতে 2টা same IP use করতে না পারে।

3) Requesting: যেকোন একটা offer select করে request করবে এবং server ack দিলে পরে bound state এ চলে যাবে।

4) Bound: less duration 50% সময় থাকে এখানে, 50% হলে renew state এ চলে যাবে।

5) Renew state: time বাড়িয়ে আবার bound state এ চলে যাবে। time না বাড়িয়ে দিলে renew এ থাকতে 87.5. (87.5-50)=37.5 min লাগবে। তারপর rebinding এ চলে যাবে।

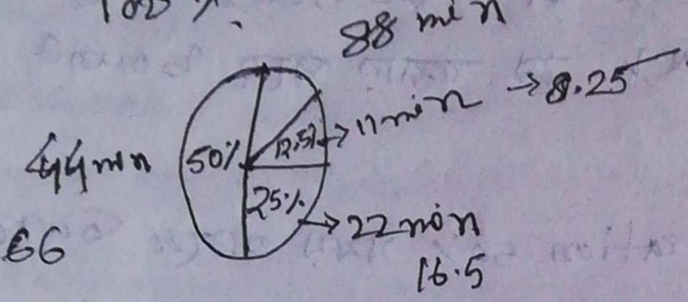
6) Rebinding: time বাড়ানোর জন্য server কে. request করবে, time দিলে সেটা নিয়ে bound এ চলে যাবে। নতুন time না দিলে 100% time rebinding এ ব্যয় করবে। তারপর init এ চলে যাবে।

DHCP problem

1. client looking

find %.

100 %.



Rebinding এ entry করবে হয়।

66 − 8.25

Rebinding এ যাবে সময় হবে 8.25.

New time − 66 min

RN: 33

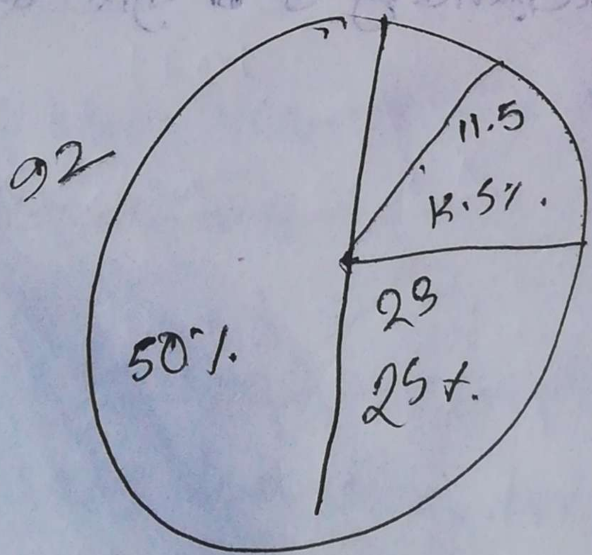
RB:

If user choose 3rd

Bound state এ থাকবে 46 min

RN: সময় আছে, 46. 46+22 = 68 → again go to bound

RB:



100
− 92
− 11.5
80.5

80.5 min পরে Rebinding এ entry

ARP

P.A না জানা হলে packet send করা যাবে না।

ARP req: broadcast. [sender এর info থাকে (ip, mac), destination এর ip থাকে, mac থাকে না) either ff... or 000...

Data link layer এ থাকে sender এর mac address, ip থাকে না।

* ARP req: broadcast
  ARP reply: unique

ARP cache timeout

communication faster করার জন্য info cache এ ~~রাখবো।~~ validity এর জন্য ~~কিছুক্ষণ~~ পর cache remove ~~করে দিবো।~~ এটাকে বলা হয় softstate problem.

generally 20 min এর জন্য cache রাখা হয়।

Question

working principle of ARP

softstate problem, scenario.

advantage, disadvantage of ARP.

* ARP cache is used to make a network more efficient

Theory

Error control code

cyclic redundancy check

Copied

sender sends data, receiver এর কাছে some bit after যোগ করে। Is there any detect the error

⇒ CRC sends some extra bit with msg

FCS generate

$P = k+1$

↓ Pattern ↘ extra redundant bit

Polynomial to binary

$x^0 + x^1 + x^2 + \dots$

example 1

$M(x) = x^3 + x^2 + 1$

~~$x^3 + x^2$~~

$= x^3 \times 1 + x^2 \times 1 + x^1 \times 0 + x^0 \times 1$

$= 1101$

$P(x) = x^3 + x + 1 = 1011$

FCS: msg এর সাথে k সংখ্যক 0 add করতে হবে,

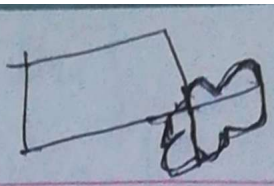
$P = 4 \Rightarrow k = 3$

reminder সাথের k সংখ্যক.

sending vector

(T = msg + k সংখ্যক reminder)

1 my = P-1



At receiver

Pattern P দিয়ে ভাগ. rem=0. that's means no error in receive my.

rem আসলে error. then receiver sender কে ack পাঠাবে না, sender আবার data send করবে।

~~Generation of FCS~~

ex-2

m= 10100011101

P = 110101

Length of P=6 . k=P-1 =5 zeros at the end of m

S = 10100011101 00000

S/P → to find 5 bits reminder

P=110101

```
1 0 1 0 0 0 1 1 0 1 0 0 0 0 0
1 1 0 1 0 1
-------------------------------
  1 1 1 0 1 1
    1 1 0 1 0 1
    -----------
        1 1 1 0
```

Linear block code: error detect & correction
করা।

Step
generate transmit seq. with generator matrix

$P = k \times q$ [size of P matrix]

column no → redundent matrix

$P_{3\times3}$ [msg → 3 bit
redundent → 3 bit]

Q = redundent bit

error detection

Parity check matrix, $H = [I_q \; P^T_{k\times q}]$

$S = r \times H^T$
↓ receive sequence

if $S = [0\ 0\ -\ -\ 0]$ → error free
$S = [0\ 1\ 0\ -\ -]$ → error

error correction

S যে সারের H^T যে কলাম row match করে দিবা?
match করলে যেই bit টি alter করতে হবে।

$G = [P_{k \times q} \; I_k]$

$H = [I_q \; P^T_{k \times q}]$

Homework

6

$G = [P_{k \times q} \; I_k]$

$H = [I_q \; P^T_{k \times q}]$

$k = 4, \; q = 3$

$P_{4\times3} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

$I_4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$H = I_4 \cdot P^T_{4\times3}$

$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^T$

$H = I_3 \cdot P_{4\times3}$

$= \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{bmatrix}$

2

$S = RH^T$

$= [1 \; 1 \; 0 \; 1 \; 0 \; 1 \; 0]$

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

$= [1 \; 1 \; 1]$

connected: 11 00 00 10
g m

*** IPV6 (Theory)

128 bit [2^{128} টি unique device এ IP দিতে পারে]

In hexa each word: 4 bit

:: → একবারের বেশি use করা যাবে না।

:: → 4 টি 0.

1010 1010
A A

0:0:FFFF::

1234:2346::1111

0:1::12eb:1000

::FFFF:24:123:12.6

No broadcast in IPv6. use multicast

1 2 4 8 16 32 64 128

= 255

128 192 224 240 248 252

254 255

10000000

IPv4 to IPv6

Link Local to MAC

FE80

Six Hextet: FF (শেষে)
7th Hextet FE (শুরুতে)

} link local এ mac address thakbe.

* mac address পাওয়ার জন্য প্রথম 4 Hexdate বাদ দিতে হবে। Go to 5th Hexdate.
7 bit flip

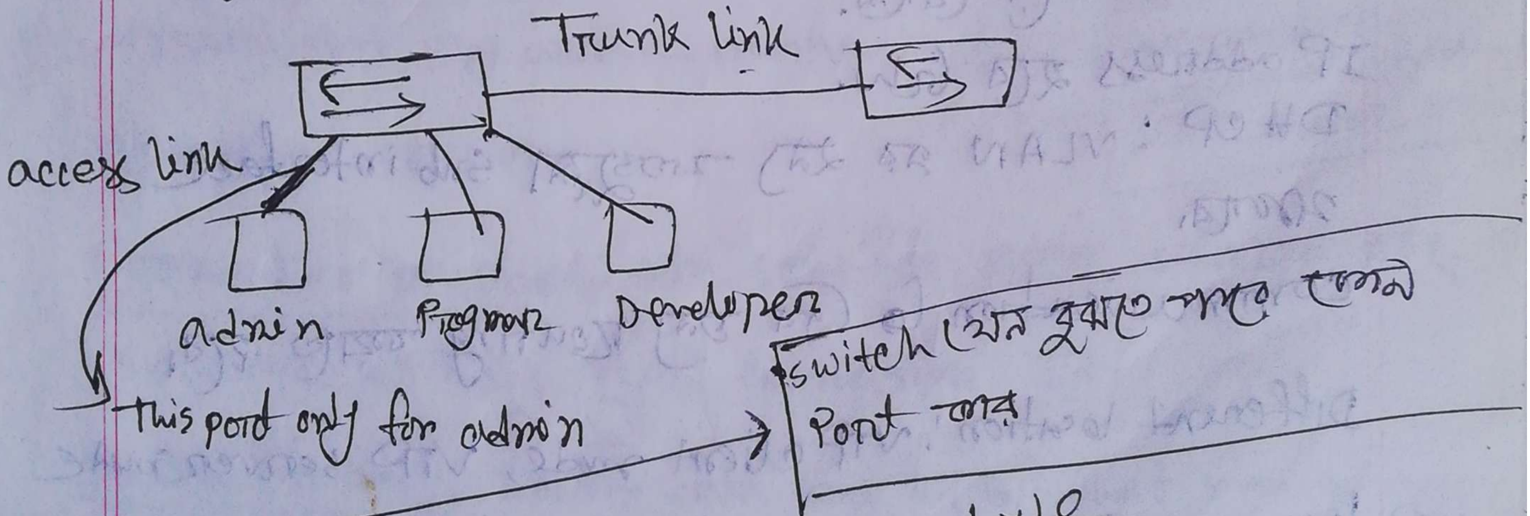
LAB

VLAN & VTP

Flat net: একটা network থাকে, একটাই broadcast address থাকে।

VLAN: একটা switch এর সাথে multiple network connect থাকে।

switch 1: network 2, switch no 2: network 1
⇒ একই switch এ হলেও আলাদা আলাদা network এ থাকা যায়।

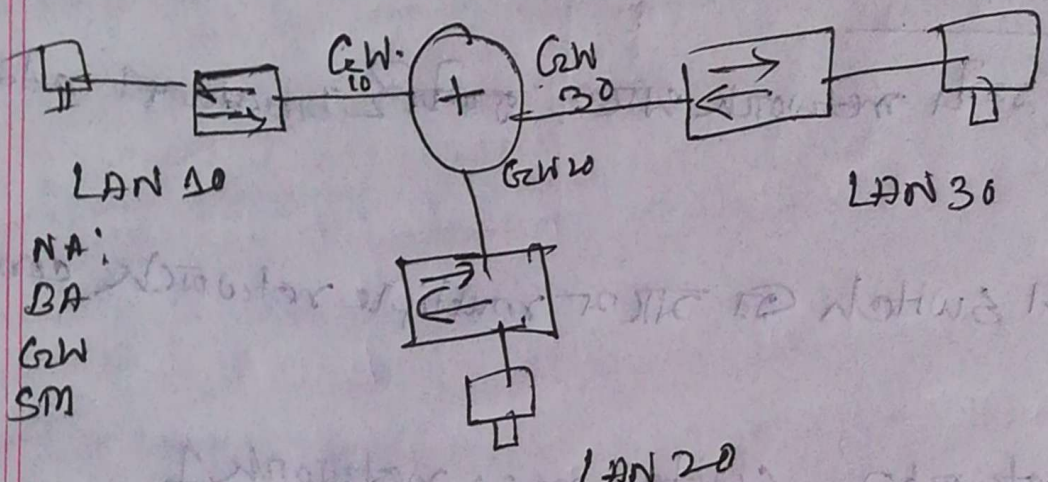


tagging language: frame এর সাথে 4 byte tag insert করে দিতে হবে।

ROS, VTP, flat, VLAN → theory exam

Router on a stick

communication between different types of user.



sub interface: যতগুলো VLAN থাকবে ততগুলো sub interface থাকবে।

IP address হবে GW.

DHCP: VLAN যত হবে ততগুলো sub interface থাকবে।

communication এর জন্য routing থাকতে হবে।

Different location: VTP client mode, VTP server mode

VTP transparent mode: নতুন update নিবে না, কিন্তু পাস করে। (company → MD → HR).

trunk link এ দুইটা advertisement forward করা হয়।

Production, note

VLAN create

1) num (1-4000) = Normal: 1-1005, extended, factory set

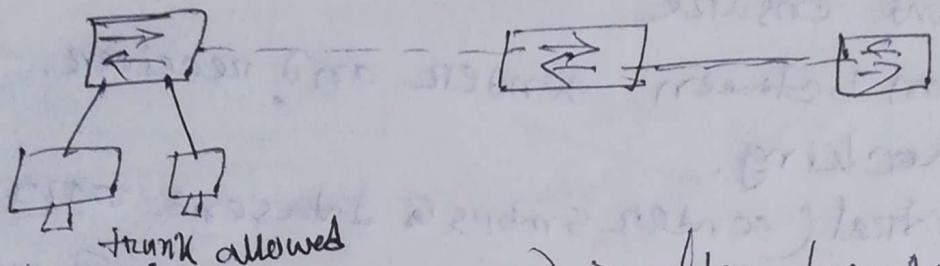
2) name

int trang fa0/1-10

Final Q 2

i) IPv6

ii) TCP/UDP



(switch port access vlan all) → after trunk

optional

Transport Layer (A→P→N)

ensure that msg arrive intake.

connection: session

web browsing

HTTP send data

TCP make connection between sender & receiver

Connection oriented: data sent এর আগে sender এবং reciver এর মধ্যে একটা connection হয়।

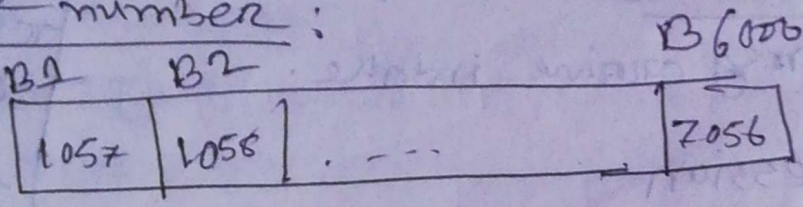
Connection less: যেখানে data sent করার without making any connection. For faster communication. কোনো guarantee নাই data successfully যাবে পৌছাবে না, No acknowledgment

UDP

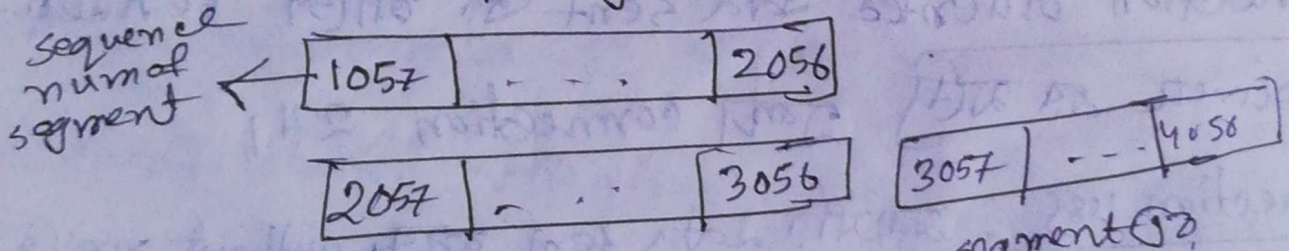
Process to process communication.
No track for data send successfully or not
connection less so data may loss.
use it beause faster and simple

TCP: opposite of UDP.
slower but ensure
connection between sender and receiver.
error checking.
flow control (sender 5mbps ও data send করছে পারে,
receiver 1 mbps ও receive করতে পারে, তাই sender
কে 1mbps ও send করতে হবে।)

Sequence number:



1000 byte



segment ও?

URG: Priority flag. activate করলে priority high.

PSH: Pause communication stop. restart

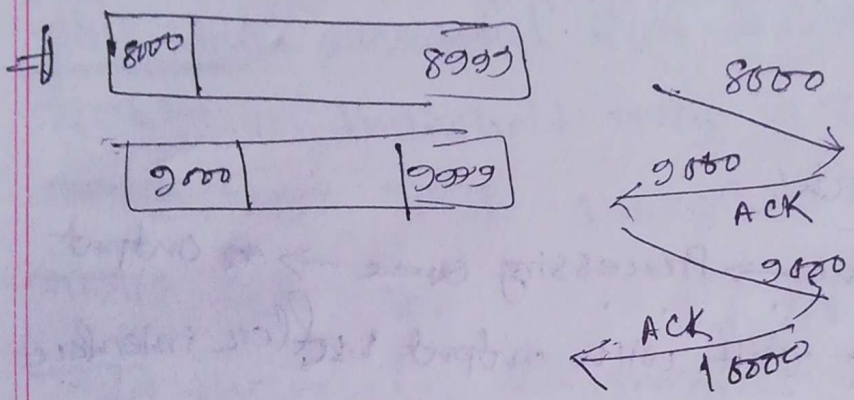
RST: restart communication.

SYN: initial connection ও? ২য় synchronization মানে,

FIN: Finish. Last packet of data. sender ও FIN activate হবে।

TCP three way handshaking / session establishment

do not consume any sequence number.



Lost acknowledgement

segment পাঠালাম, server receive করছে, ack করার সময় network ও হারায়ে গেছে।

92 8bytes: 92—99

receiver ওরা data ২ বার পাইবে, ২য় বার packet receive করে packet discard করে দিবে। তে করে Processing time লাগে (error checking). এতে as a result energy also save.

Acknowledge arrive before timeout

cumulative

TCP II

Congestion: host load capacity. [রাস্তার মত road]

congested: data pass করা না।

Congestion control:

Congestion in network:

Input buffer queue → Processing queue → output buffer queue → exit with output buffer interface

reason why congestion

1) input এ যত পরিমাণ data আসছে, Processor process করতে পারছে না। (Input queue overflow)

2) Processor process fast but output buffer exit slow.

Congestion control

1) congestion window: network এর যতটুকু byte data যাবে।

2) Sending rate: RTT → round trip time

network free হলে congestion/sending rate বাড়াবে, congested হলে কমাবে।

Loss event → more severe

i) timeout: Packet send, but do not receive ack

ii) 3 duplicate: data send 1, ack 3 times.

timeout হলে 3 duplicate এর থেকে timeout severe.

timeout হলে,

slow start. successful হলে double করে দিবো, 1->2->4->8...

যতক্ষণ না threshold পর্যন্ত না যাবে ততক্ষণ double করতে থাকবো। threshold এ reach হলে linearly বাড়াতে হবে। miss/peak value

নতুন threshold হবে max এর অর্ধেক।

3 duplicate হলে,

fast recovery. threshold এর পরে থেকে আবার start করবো linearly.

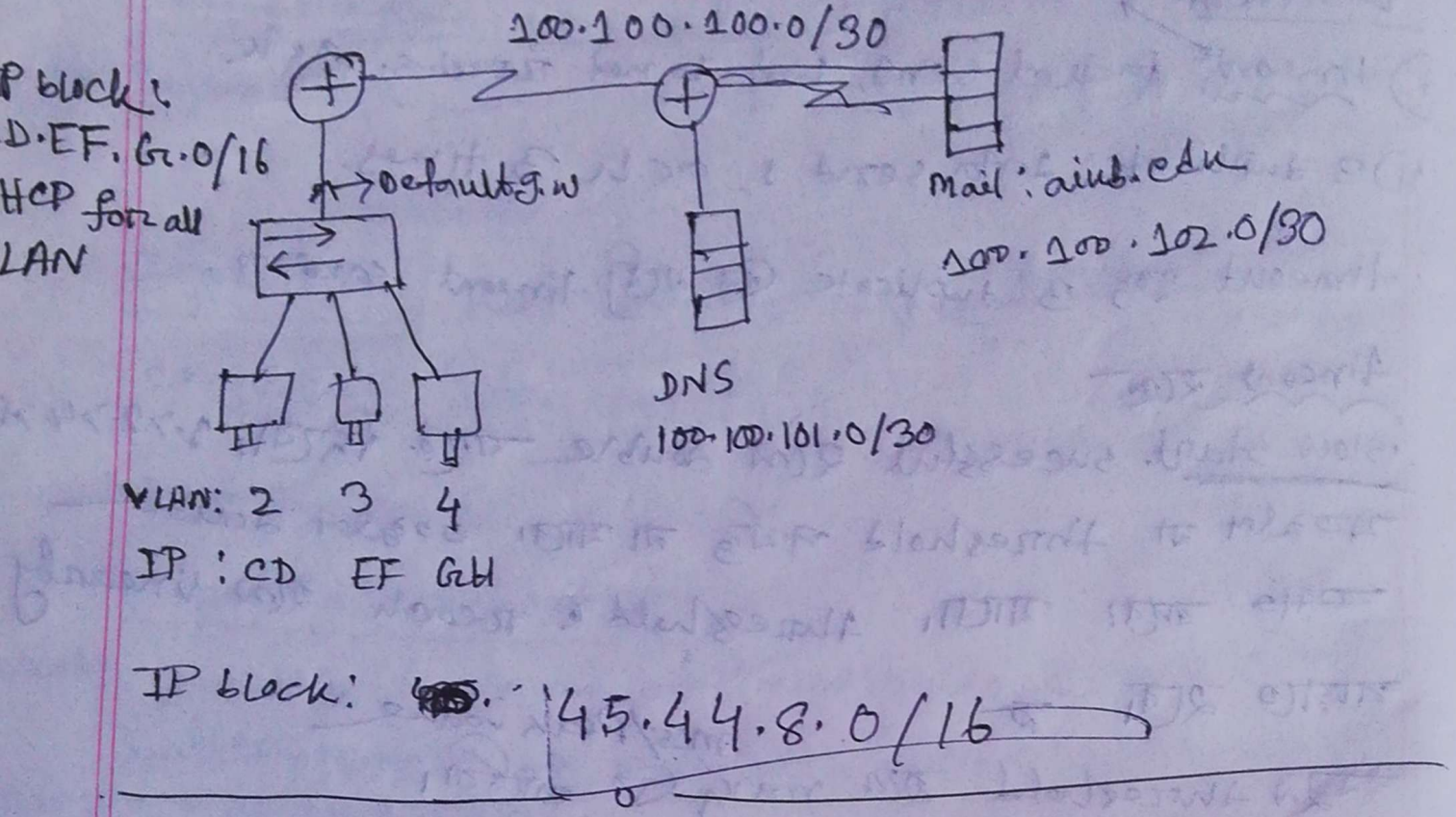
TCP Tahoe

Lab

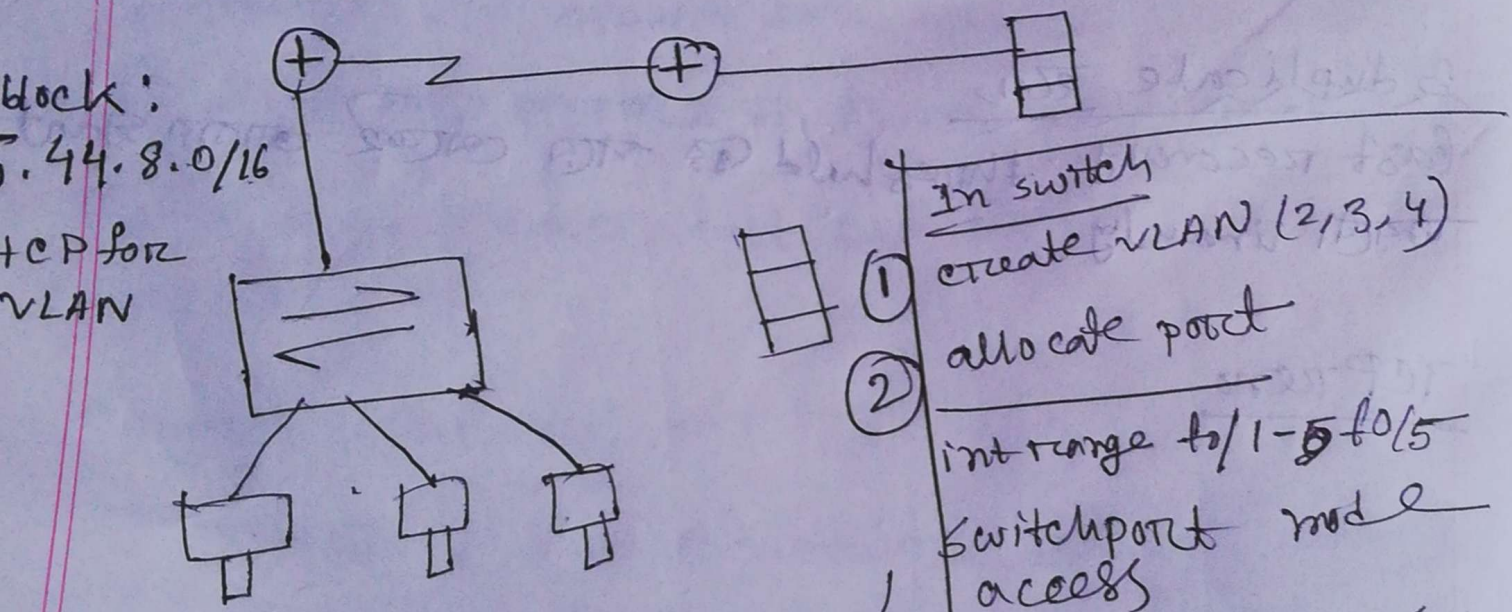
Routing : OSPF

AS : 170

ID: AB-CDEFGH-H



IP block: [redacted].45.44.8.0/16



In switch

① create VLAN (2,3,4)

② allocate port

int range fa0/1-5 fa0/5

switchport mode access

switchport access VLAN 2

6-10 11-15

③ trunk

int fa0/16

switchport mode trunk

trunk allowed all

Router 0

en, conf t

int fa0/0

no shut, exit

now TLOS করতে হবে subinterface এর জন্য

int fa0/0.2 → subinterface

now allocate ip

encapsulation dot1q 2

ip address 192.168.0.1 255.255.255.0

exit

int fa0/0.3

encapsulation dot1q 3

ip address 192.168.1.1 255.255.255.0

exit

int fa 0/0.4

encap

ip address 192.168.2.1 255.255.255.0

DHCP.

~~dhcp pool~~

int fa 0/0.2

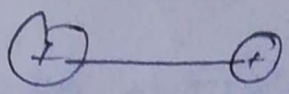
ip dhcp pool dpool2

network 192.168.0.0 255.255.255.0 (↗ 1.0, 2.0)

default-router 192.168.0.1 → sub interface এর ip

dns-server 100.100.101.2 (↘ 1.1, 2.1)

exit



dt → no clock
dc → clock

R0 ⟷ R1

R0
se0/3/0
ip address 100.100.100.1 255.255.255.252
no shut
exit

routing ro

router ospf 170
network 192.168.0.0 0.0.0.255 area 0 (wildcard (subnet ke opposite))
" " 1.0 "
" " 2.0 "

network 100.100.100.0.0.0.0.3 area
exit

router 1

~~ip address 100.100.100.2~~
int fa0/0
ip address 100.100.101.1 255.255.25.252
no shut
exit

int fa0/1
ip address 100.100.102.1 255.255.25.252
no shut
exit
int se/3/0
ip address 100.100.100.2 255.255.255.252
no shut
exit

router ospf 170
network 100.100.100.0 0.0.0.3 area 0
" 100.100.101.0 " "
" 100.100.102.0 " "
exit

Set IP for DNS server
100.100.101.2 → IP
255.255.255.2 → SM
100.100.101.1 → GW
⇒ DNS

Set IP for mail

service → email

(Record)

NAT

Home wifi router: → Private network
192.168.0.0 - 192.168.0.255/024

advantage: extra layer of security থাকে।
seperate from outside home.
do not connect directly with internet

NAT → solve ip shortage temporarily.

PAT: IP add + Port add

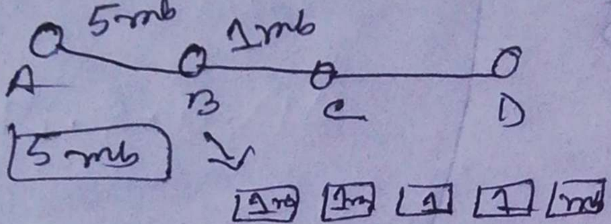
Q: Basic working principle of NAT, PAT

Pooling of IP address

Load balancing

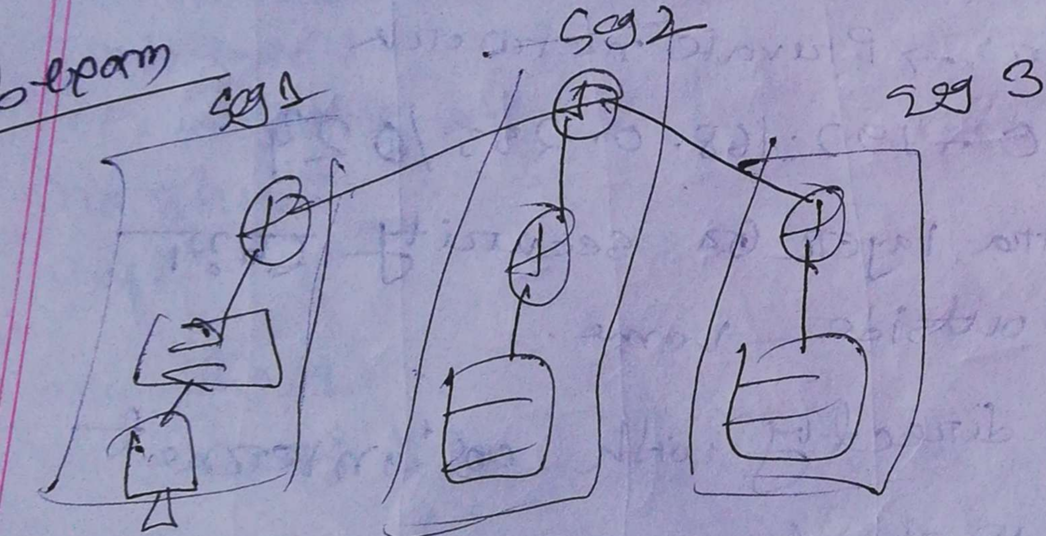
S1, S2, S3: external ip add এর req করতে হবে।

Fragment: want to send packet (3 no position এ পাঠাবে, size 5 mbps):



C/D 5টা fragment
কে defragment
করবে।

NAT 2nd device কে চিনবে না।



DHCP, mail config, vlan, VTP

Lab-07

Switch-0

1. switch>en
   config t
2. vlan 10
   name faculty
   exit
   vlan 20
   name student
   exit
3. int range fa0/2-fa0/15
   switchport mode access
   switchport access vlan 10
   exit
   int range fa0/16-fa0/24
   switchport mode access
   u access vlan 20
   exit
4. int fa0/1
   switchport mode trunk
   u trunk allowed vlan all

Router-0

1. en
   conft
   hostname AIUB
2. int fa0/0
   no shut

Step-3: create subinterface

int fa0/0.10
encapsulation dot1q 10
ip address 172.16.0.126 255.255.255.128
exit

mask analysis

255.255.255.128 = /25

10000000 → 2^7

usable ip

172.16.0.0 – 172.16.0.127

172.16.0.1 – 172.16.0.126

remove NA and BC

int fa0/0.20
encapsulation dot1q 20
ip address 172.16.0.190 255.255.255.192
exit

analysis

192/26

11 000000 → 2^6

172.16.0.128 – 172.16.0.191

gw: 190

int se0/3/0
ip add 192.168.10.1 255.255.255.252
no shut

11111100

/30 → 255.255.255.252

routing protocol

router ospf 55

network 192.168.10.0 0.0.0.3 area 0

network 172.16.0.0 0.0.0.127 area 0

network 172.16.0.128 0.0.0.63 a

255 - 255 = 0
255 - 255 = 0
255 - 255 = 0
255 - 252 = 3