5/sep/17 CN

Medium Access Techniques

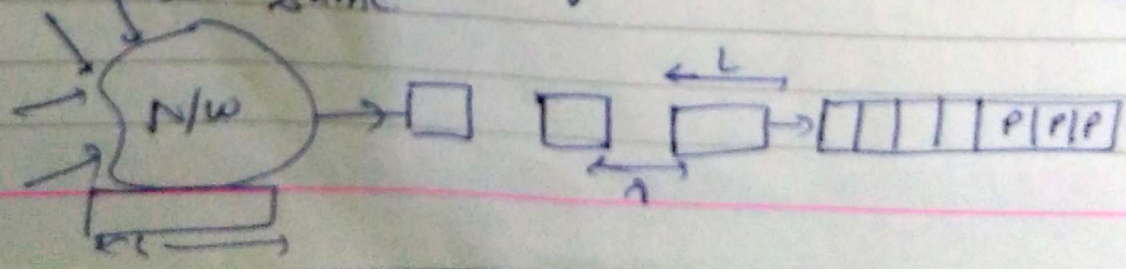
Contention Based	Contention free
Aloha	Token Bus
slotted Aloha	Token Ring
CSMA (slotted, nonslotted)	wireless - CSMA/CA
↳ non persistent	
1 - persistent	
P - persistent	
CSMA/CD	

Assumptions:

Assumption are that only two systems are there who are trying to access common shareable medium.
Medium is mostly the wired medium.
length of the package generated by different source is same.
Tp & Tt is same.
propogation & Transmission time is same.

1 server & Multiple no. of nodes.
In order to analyse these protocol first make assumption then Model it.

Rate of transmission of common shareable medium is same.



Tpropagation

Tx

poison distribution method

N No. of packets arrived in time ~~on~~ interval

so probability of packets at time t interval

$$P_{nt} = \frac{(\lambda t)\, e^{-\lambda t}}{\lfloor n}$$

λ – interpacket arrival delay

delay

queueing process

propagation, Tx, Queue delay, processing time as well.

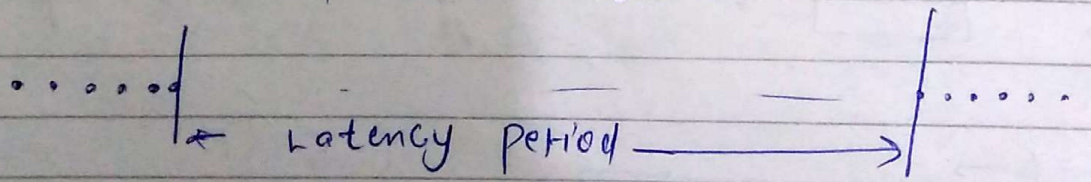
Terms:

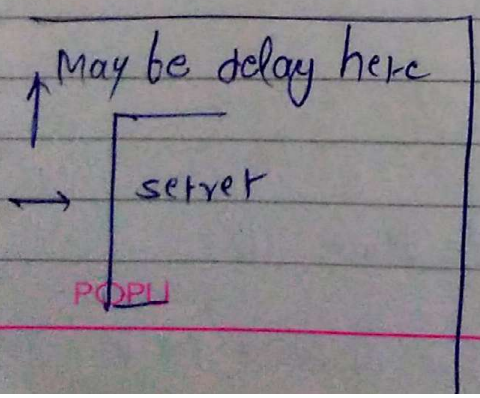
(a) Throughput (s) successful packet arrived at Receiving system

(b) Latency

Ratio = Successful P / Total generated P

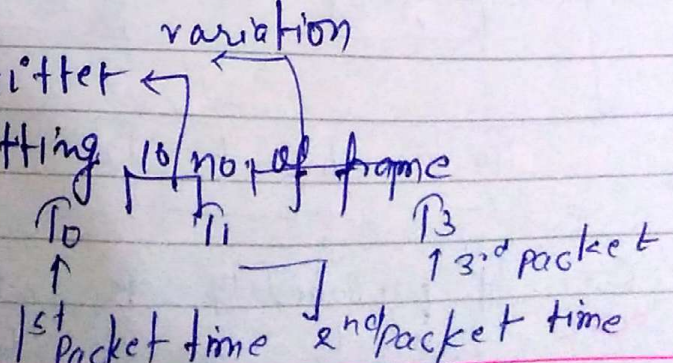
Total time from generated & injected to Received at last side.





(c) zitter

if transmitting



variation in time interval for arriving packets is known as jitter.

Offered Load (G)

It is the total No. of packet which is injected in a Total Network.

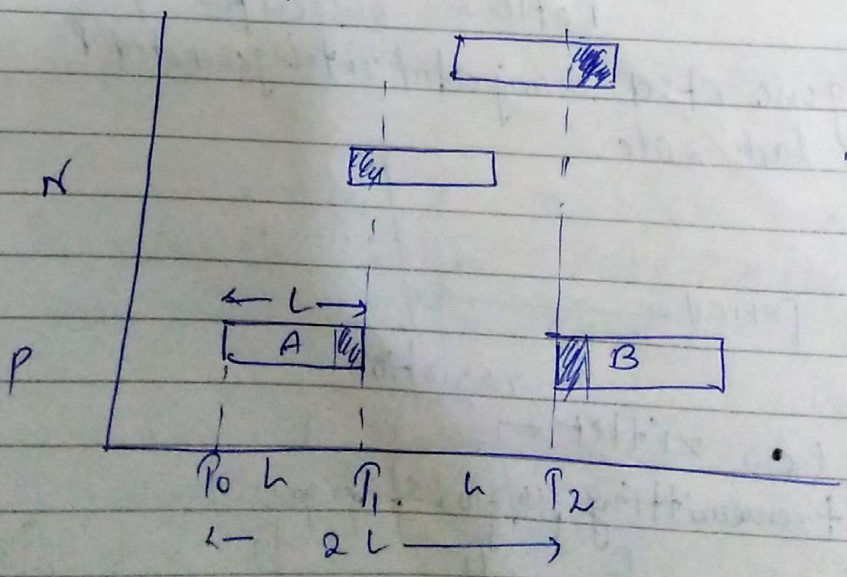
If λ is arrival time and L is the length of packet and if R is the rate of data transmission.

$$\text{Throughput } S = \frac{\lambda L}{R}$$

$$G = \frac{\lambda T L}{R}$$

T → Retransmission time

Aloha protocol



Q. G probability K attempts so that all packets can be transferred.

The Probability of transmitting the G load in K

attempts assuming the poison distibution method.

$$P_k = \frac{G^k e^{-aG}}{k!}$$

a = volnerable time period.

probability of no retransmission
if k=0 (i.e. No retransmission of any packet)

$$P_0 = e^{-aG}$$

Aloha protocol $a = 2L$ if $L=1$
$a = 2$ its pure Aloha

2 unit of time.
$2T_x$ T_x length of packet.

for a given load G

$$S = G \times P_0$$

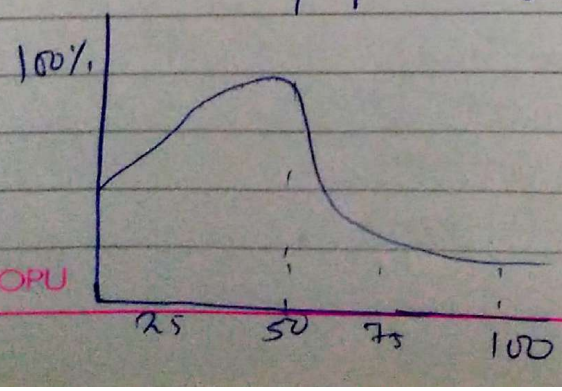
↓ Throughput of Network
all packets which are not correpted

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

if $G = 0.5$
$G = 50\%$ $S = 1/2e = \frac{1}{2 \times 2.7} = \frac{1}{5.4} = .18$

More than 50% ≃ 18%

if $G = 100\%$,
$G = 1$ $S = \frac{1}{e^2} = \frac{1}{7.74} = .1353$

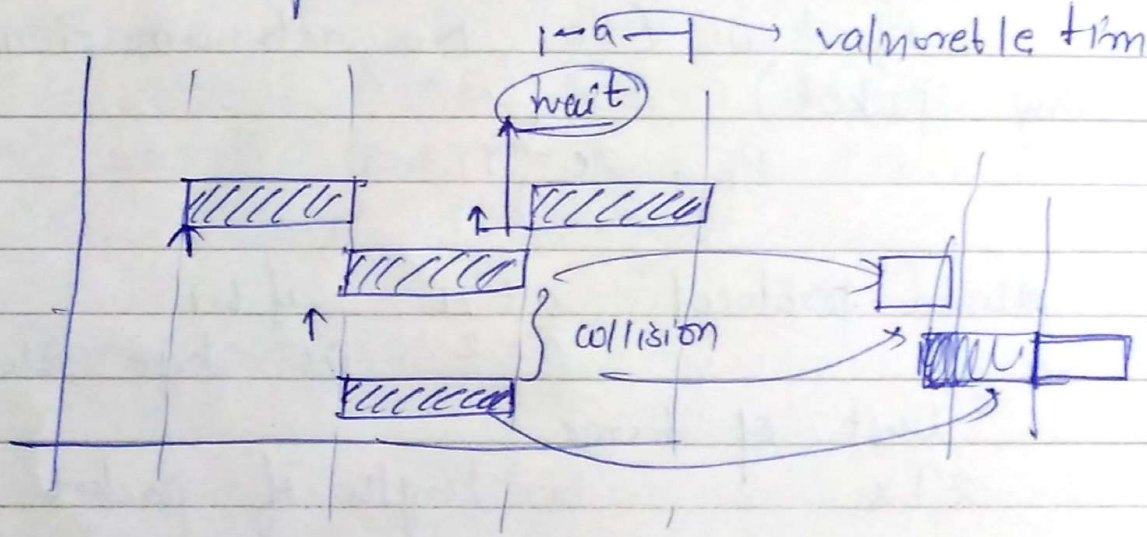


So, this is a not good protocol.

Back off time : $\frac{T_x (k+1)}{2}$

Alternate method,

Slotted Aloha is protocol we are using Packets can transfer in this time interval only.



$S = 4e^{-4}$

If $4 = 1$ or low load

$S = 1/e = 0.38\%$

$= 38/100$ packets

Q. 4 graph for Aloha & Slotted Aloha.

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Contention Based protocol

CSMA (non slotted / slotted)

- non persistant
- 1 persistant
- P persistant

Carrier Sense Multiple access protocol

why?

Better alternate

huge valnerable time

↓

reduce by CSMA

If system is idle anyone can speak.
if already someone is speaking other person should listen as soon as it completed

1 persistent

if busy channel as soon as it gets free say immediately collision will occur.
only when 1 is transmitting & 1 is receiving.

p persistent

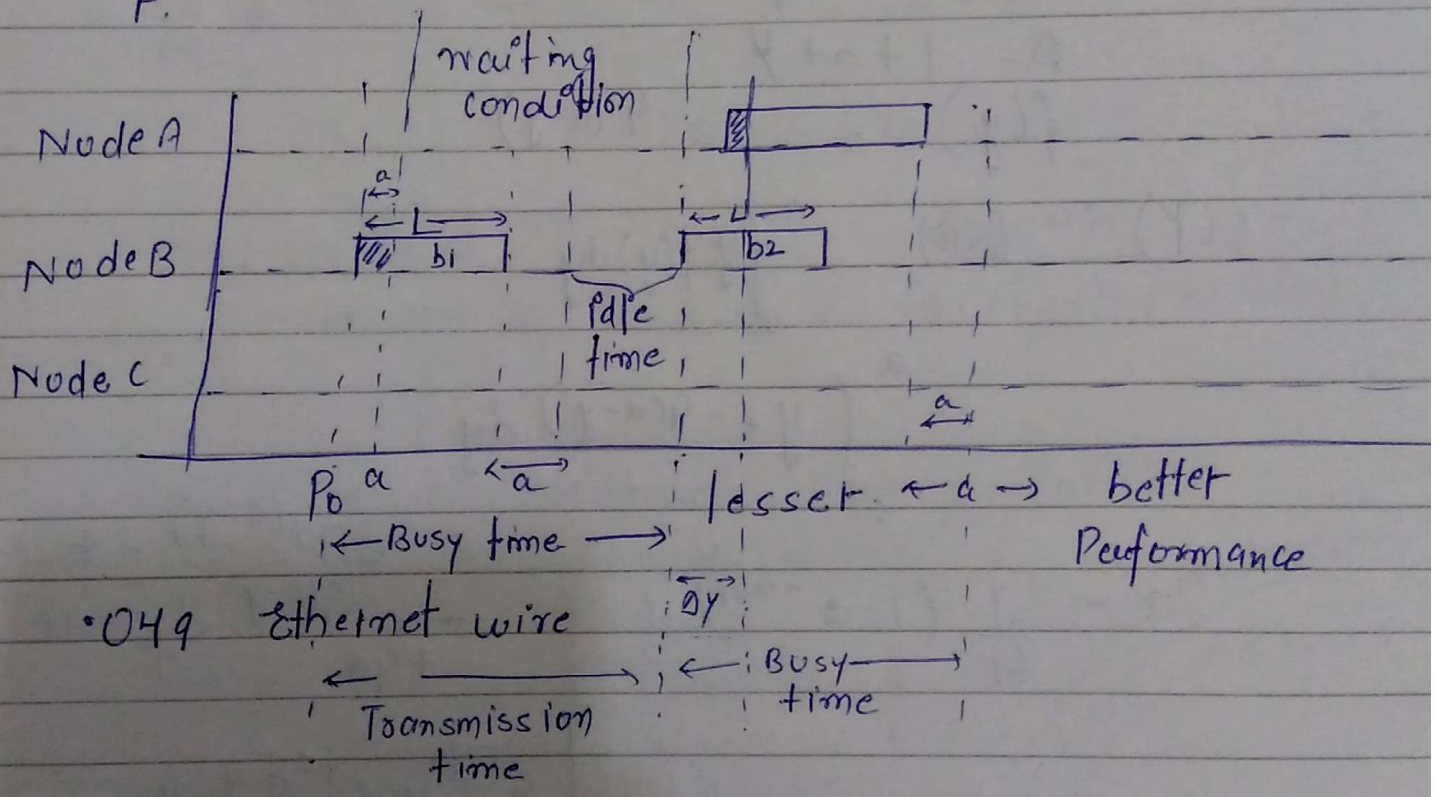
p probability assign

If the channel is idle then send with Probabi
busy then continously

POPU sense that channel till it is free
& then resense.

1 Persistent
if channel is idle then send
if busy wait .. send if free (Immediately) without waiting

P persistent
if idle transmit with probability P.
if Busy Continously sense the channel till it become idle & transmit with probability P.



Sensing is in whole time.
Non-persistent CSMA.

If I remove Idle time from above I will be in 1-persistent.
probability is some delay. which is in p-persistent type of protocol.

POPU

$S = \frac{E(U)}{E(I)+E(B)}$ (average using time) (idle time, Busy time)

Offered load is G.

Average using time $E(U)$ is

$$E(U) = e^{-aG}$$

$$E(I) = \frac{1}{G}$$

$$B = 1 + a + Y$$

$$f(y) = e^{-G(a-y)}$$

$E(Y)$ ~~$E(B)$~~ $\int_0^a y f(y)\,dy$

$$\int_0^a y e^{-G(a-y)}\,dy$$

$a - \frac{1}{G}(1-e^{-aG})$

$e^{-G(a-y)} = t$

$-\frac{e^{-G(a-y)}}{+G}\,dy = dt$

$\int e^{-Ga} * e^{+ay}\, y\, dy$

$e^{-Ga} \int e^{ay} y\, dy$ $\quad \int e^{ay}$

$e^{-Ga}\left[(e^{ay} - a^2 e^{ay})\right]$

$e^{-Ga}[e^{a^2} - a^2 e^{a^2})$

$e^{-Ga+a^2}[1-a^2]$

$E(Y) = e^{(a^2-Ga)}(1-a^2)$

POPU

Local Area N/w by [Gerd Kerset]

$$E(B) = 1 + a + \{a - \frac{1}{G}(1 - e^{-aG})\}$$

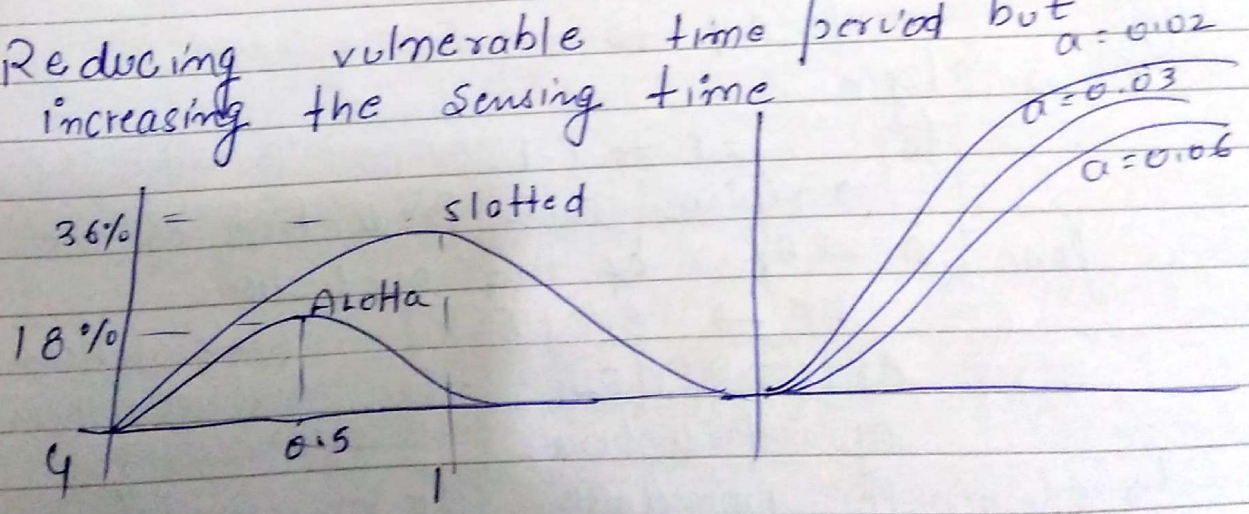
$$S = \frac{E(U)}{E(I) + E(B)}$$

$S =$

$$\frac{1}{G} + a - \frac{1}{G} + \frac{e^{-aG}}{G} = a + \frac{e^{-aG}}{G}$$

$$S = \frac{G e^{-aG}}{G a + e^{-aG}} \quad | \quad \frac{G e^{-aG}}{G(1+2a) + e^{-aG}}$$

Reducing vulnerable time period but increasing the sensing time



if $G = 1/2$ $a = 0$

$\frac{1}{2}[(1/2) + 1]$ $\frac{1}{2} \times \frac{2}{3} = .33$

$\frac{1}{(n+1)}$

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Ques 1. Thousand bit frames to be transmitted over a communication channel at the rate of 20kBPS. Determine the link efficiency using ALOHA and slotted ALOHA.

Solution

Packets can be generated?

$$\frac{2\times10\times10^3 \text{ Bps}}{1000} = 20 \text{ frame}$$

$$\frac{1000 \text{ bits}}{1000 \text{ bit}} = 2000 \text{ frame}$$

$$\frac{2000\times18}{100} = 360 \text{ frame}$$

↑ ALOHA

$$\frac{2000\times36}{100} = 720 \text{ frames}$$

↑ slotted ALOHA

(b) Q. No. of Retransmission for Alohla & slotted aloha?

$$\frac{N\times18}{100} +$$

$$\underbrace{\frac{N\times82}{100}}_{N_1} + \underbrace{\frac{N_1\times82}{100}}_{N_2} + \frac{N_2\times82}{100}$$

$$= \frac{1}{1-r}$$

Que 2. for a given offered load G (30%). determine the link Efficiency for the Aloha & slotted Aloha assuming Valnerable time is.

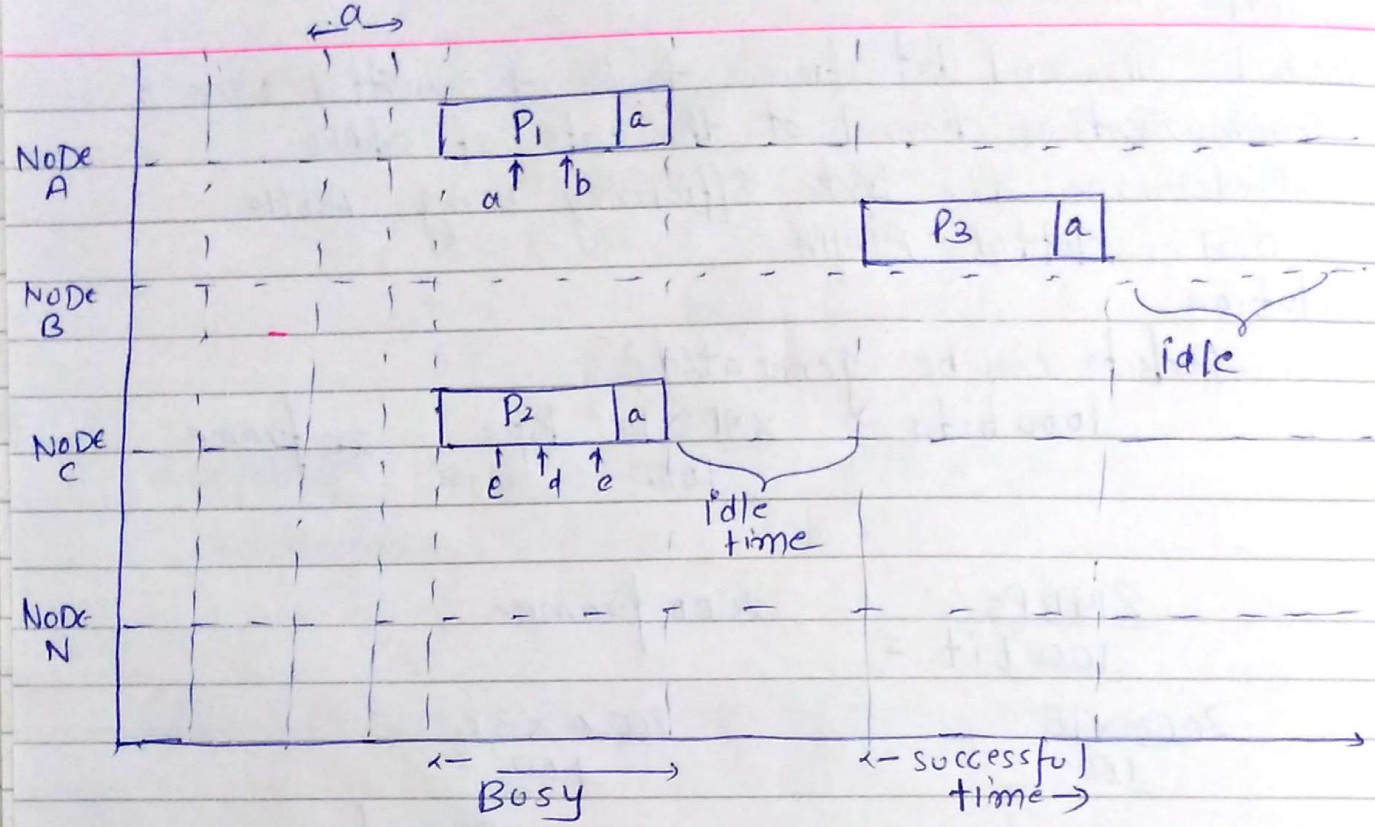
Ge^{-2G}

Nslotted $= 2\times1\times3$

$\cdot3e^{-\cdot06} = (\cdot28)$

Ge^{-G} ∄ slotted

$\cdot3e^{-\cdot03} = (\cdot29)$



$G = 50\%$

$G = 75\%$

$4 =$

$$\frac{4}{1+4}$$

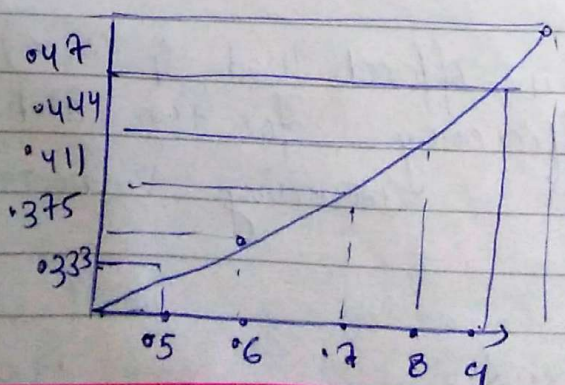
$$\frac{\cdot 5}{1\cdot 5} = \cdot 333$$

$$\frac{\cdot 6}{1+\cdot 6} = \frac{\cdot 6}{1\cdot 6} = \cdot 375$$

$$\frac{\cdot 7}{1\cdot 7} = \cdot 411 \qquad \frac{\cdot 8}{1\cdot 8} = \cdot 444$$

$$\frac{\cdot 9}{1\cdot 9} = \frac{1}{2} = \cdot 5$$

$$\frac{\cdot 9}{1\cdot 9} \downarrow \cdot 47$$



POPU

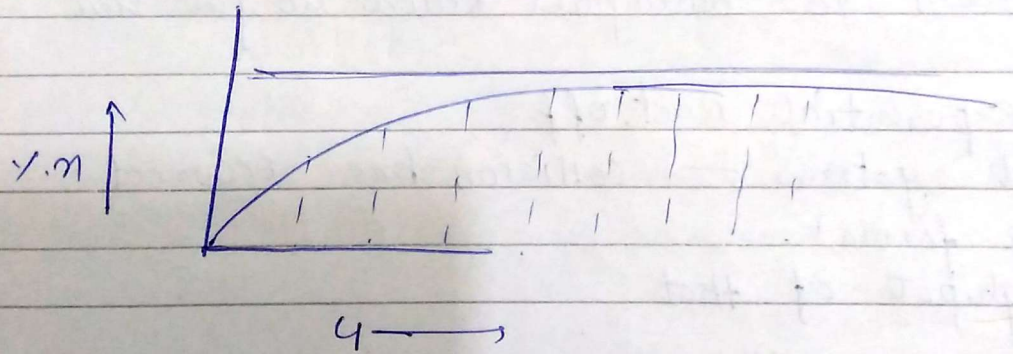
1 , 1.5, 2, 2.5, 3 — 4

$\frac{1}{2}$, $\frac{1.5}{2.5}$, $\frac{2}{3}$, $\frac{2.5}{3.5}$, $\frac{3}{4}$

↓ ↓ ↓ ↓ ↓

.50 .60 .6666 .714 .75

graph of $1 - \frac{1}{1+x}$



CSMA CD protocol : (collision Detection)

what happen if packet collides?
Back off
Retransmitted
↓ acknowledge

Based on Ethernet Protocol
DIX ~~digit~~ design initially by xerox corporation

Preamble 6 6 2

AAAA	DST Add	SRC Add	Type	control	data = 1500	CRC

8 - 16 byte

802.3 MAC 6 MAC 6 2 2 1500 4

AB	DST Add	SRC Add	length	Control	data	CRC

10|0|0111

Repeater

5 4 3 Role:

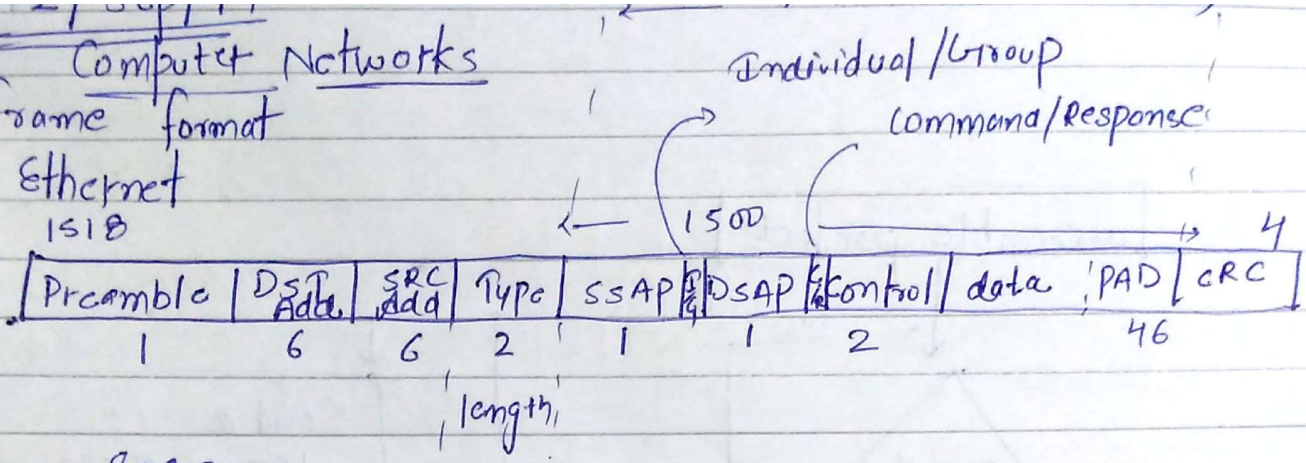
↓ Segment

→ max. three populated segments

Computer Networks

Frame format

Ethernet



802.3

1500

1. If channel is idle
   ↳ either transmit immediately using NP, 1P. protocol.

2. If channel is busy
   Continuously sense for it to be idle
   ↳ 1p, Np after idle time transmit
   Ifs (Inter frame space) which is 9.6 μs
   in a fully populated Network.
   [1024 Computer, 5 4 3 - rule Ifs = 9.6 μs).
   if p persistent transmit with probability P.
   wait (1-P)

Min - 64 ——collision send jamming signal
Max - 1500 send 64 . . .

Backoff time Ifs → 96 bits
9.6 μs

51.2 μs End to end delay

1 μs required 1 byte.

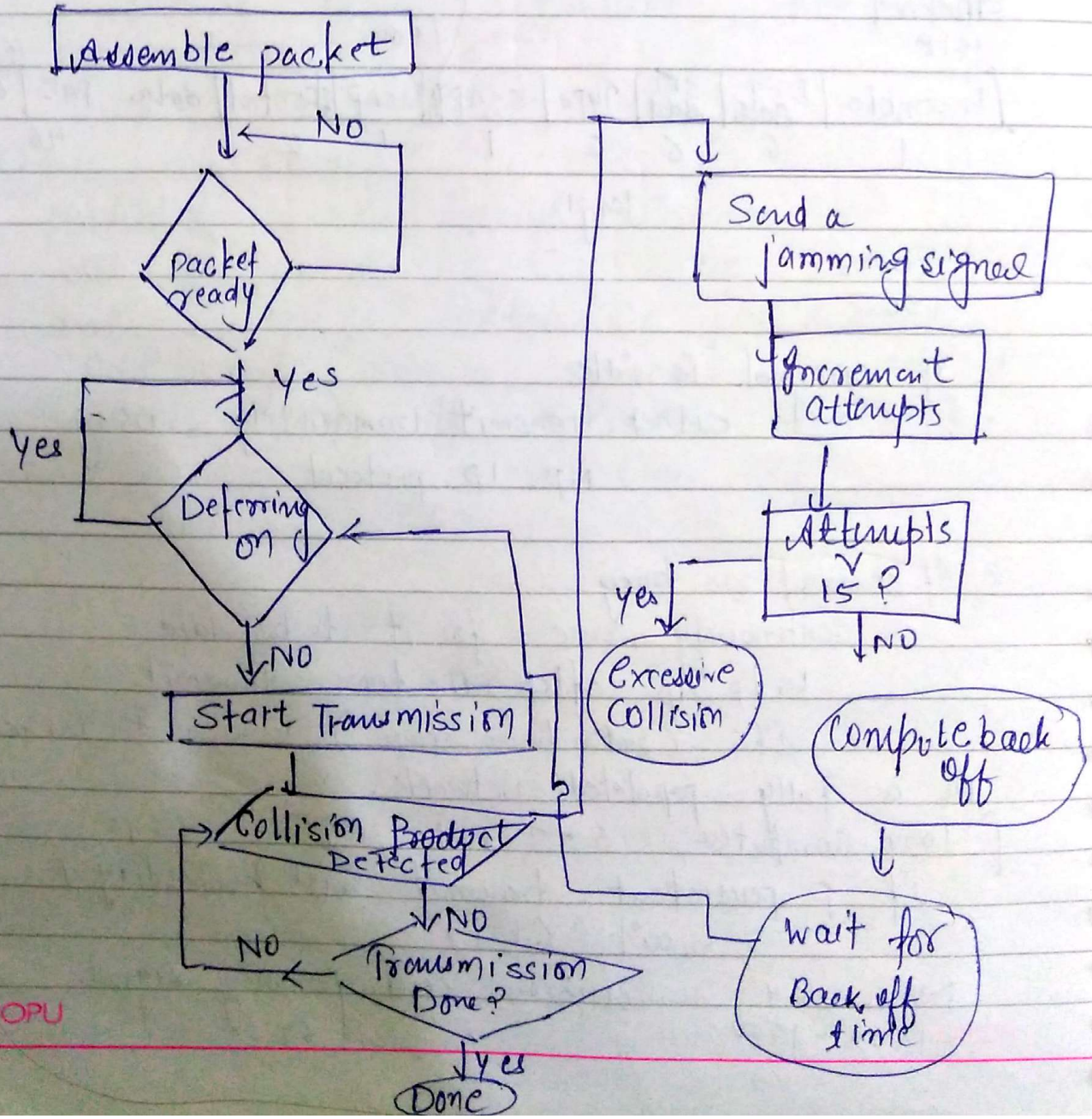
512 bits / 8 bytes can be transmitted
= 64 byte

AAAAAA . . . . . jamming signal

fully populated network.

32, 48, 64

If Collision occur



2^k k = No. of attempts

$0 \leq k \leq 10$

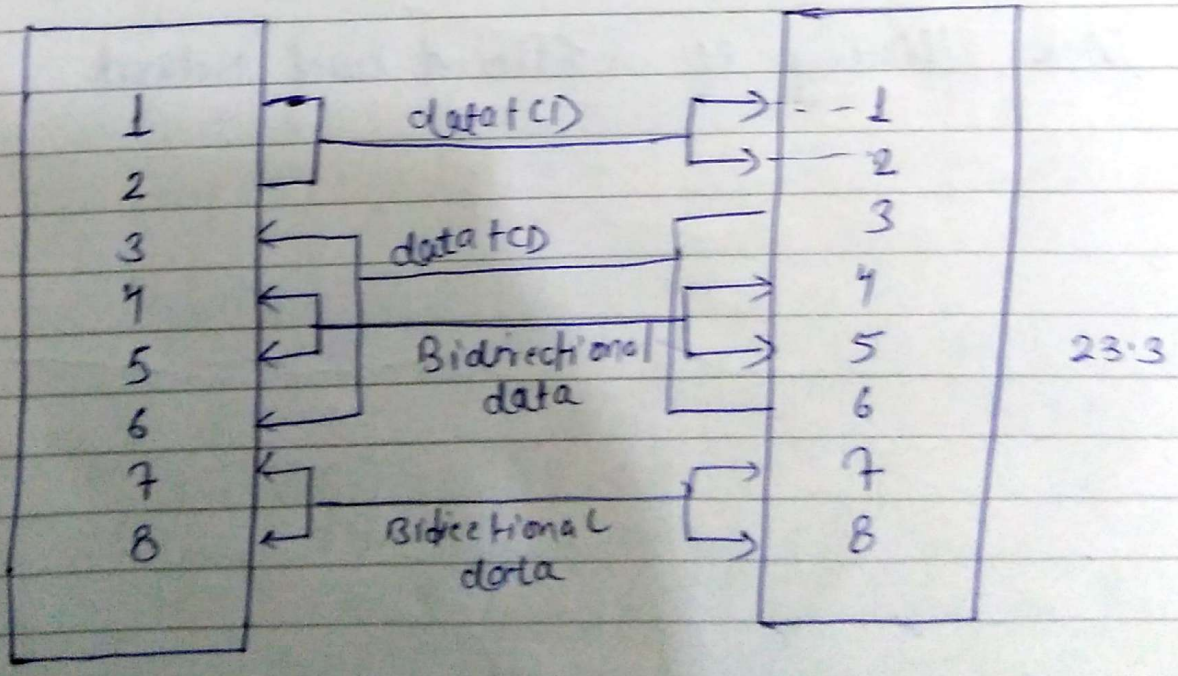
2^k → backoff time

If $k > 15$ error 404 packet will not be transmitted.

Ifs → wireless → because packet should ensure other packet has transmitted after 9.6 μs delay seize the transmission line.

(10Mbps) 4B5B Encoding technique with NRZI
(100MBPs) 8B6B

Earlier we used Manchester encoding (10MBPs)



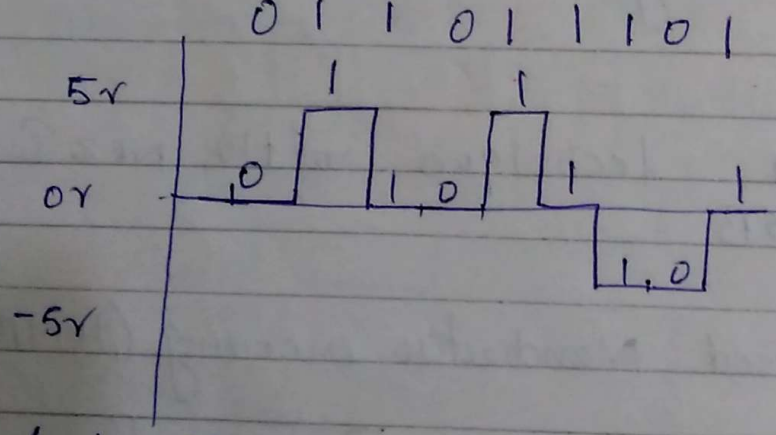
↑ divide

Three level 33 MBPS NRZ
4B-5B

4B 5B
↳

transferring 100 MB NRZ-I
↳ 125 MB

MLT3 Multilevel transmission 3
large data with minimum frequency



Link Efficiency of Ethernet based Network.

14/sep/17

Through put analysis of CSMA/CD protocol:-

Round trip time = 2 Tp

Intermediate device

classical 100 Mbps — 2.5 km

S ---- D

51.2 μs

512 bits ← In this length

$\frac{512}{8}$ 64 bytes

CSMA/CD v/s CSMA

↳ If Collision → reinjected → Binary backoff exponential

Entire packet has to be transmitted whether collision occur at beg or end.

↳ Performance analysis

Let R be the no. of station in a fully populated CSMA based classical ethernet N/w spread on 2.5 km, 1024 computer with 100 Mbps speed.

POPU

↳ let round trip time be the 2Tp
let p be the probability of contention
Contentions ~~are~~ occur where station
tries to acquire the channel is also
2Tp. what is the prob. that one

$$P_A = k(p)(1-p)^{k-1}$$

$$\boxed{P_A = kC_1 p (1-p)^{k-1}}$$

there are j no. of contention slots in time interval probability

$$P_j = P_A(1-P_A)^{j-1}$$

↳ Mean no of contention interval is

$$\sum_{j=1}^{\infty} jP_j = \sum_{j=1}^{\infty} jP_A(1-P_A)^{j-1}$$

$$P_A(1-P_A)^0 + 2P_A(1-P_A)^1 + 3P_A(1-P_A)^2$$

$$+ \cdots$$

$$= \frac{1}{P_A} = e$$

ean Contention interval Out of total this

$$\frac{2\,t_{prop.}}{P_A} = 2\,t_{prop} \times e$$

let Tx be the transmission time then

POPU Throughput $S = \frac{T_x}{T_x + T_p + 2T_{prop} \times e}$

$$S = \frac{T_x}{T_x + T_{prop} + 2 \times T_{proop} \times e}$$

$$S = \frac{1}{1 + (1+2e)a}$$

$$S = \frac{1}{1 + (1+5.44)a} = \frac{1}{1 + 6.44a}$$

$$\boxed{S = \frac{1}{1+6.44a}}$$

$\{ a = .01 \quad a = .1 \}$

determine S for N/W

$a = 0.01$

$$S = \frac{1}{1 + .0644} = \frac{1}{1.0644}$$

$$\boxed{S = .9394}$$

$a = .1$

$$\frac{1}{1 + .644} = \frac{1}{1.644}$$

$$S = \boxed{.6082}$$

Spread ↑ a ↓

CSMA $S = \frac{q e^{-aq}}{q(1+2q)1 e^{-aq}}$

$q = 0.01$

$a = .1$

$$S = \frac{e^{-a}}{1 + 2a e^{-a}}$$

0.01

$\frac{e^{-0.01}}{1+.02+e^{-0.01}}$ $\frac{e^{-.1}}{1+.2+e^{-.1}}$

$\frac{.9048}{1+.2+.9048}$

$\frac{.990}{1+.02+.99}$

.9

43%

$\frac{.99}{1}$ ~~.09~~ .99

49%

Q. Tt, Tp, Rate of data transmission, Speed of signal = 10^{-8} m/s

Calculate a different Load determine performance. CSMA/CD / CSMA ?

program?

Token Bus

IFS?

H.W. why 9.6 μs delay on each packet on CSMA/CD.

$\frac{96}{8}$ = 12byte

Q. 1 packet transmitted

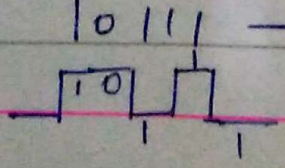
Q. 0-15 ? → 5B

4B

Using 4B-5B rule

Make that chart?

1011 → NRZI



POPU

19/Sep/19

CSMA/CD (Non slotted non persistent)

10 Mbps

and 2.5 km

Spread

$a = 0.01$

$q = 1$

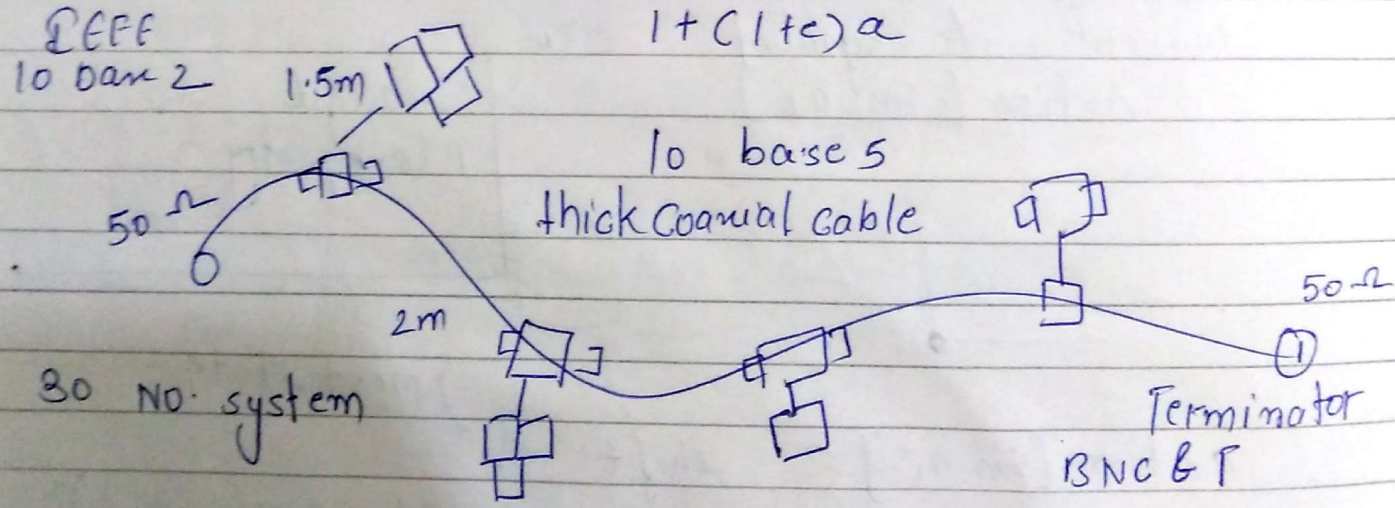
$$S = \frac{1}{1 + (1+2a)a}$$

Slotted

$$S = \frac{1}{1 + (1+a)a}$$

EFFE

10 Base 2



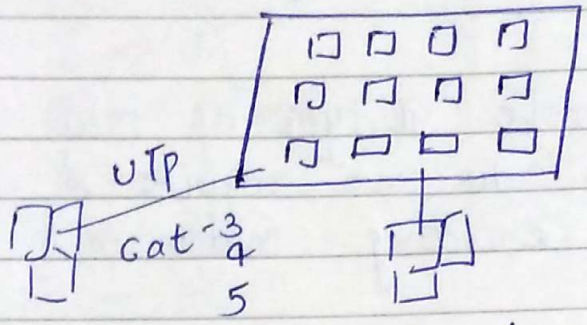
10 24 systems using 5-4-3 Rule

limitation:

- any loose connection entire N/w fails.
- Increase speed
- Better Mechanism
- Manchester encoding is used.

POPU

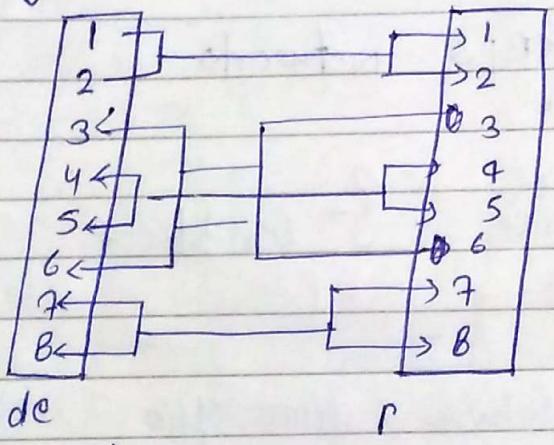
Memory size was limited.
Should use hub/switch / Repeater



33 NO.

stackable

frequency domain network



Repeater/hub

$33\frac{1}{3}$ MBps

25 MHz freq

$\frac{6}{8}$ $33\frac{1}{3}$ Mbps : 25 Baud rate

data is represented by Permaty 6T encoding.

$\frac{6}{8} \times 33.3$

$\frac{3}{4} \times 33.3 : 3 \times 8.1 : 24.3 \simeq 25$

Q. difference b/w bit & baud rate?

Bridge Limitation

Loop ✗

Common Broadcast ✗

Gigabit type of N/w:

If in order to make GB type of N/w what Modifications do we require & physical layer in encoding mechanism

8B 10B

And what will be the link Efficiency for GB Network.

(a) 100 MBps & 1000 MBps Networks.

Coaxial, fibre optic

Monomer ✓

Multimer

Step

Graded Index

- limitations

(b) In our institute which fibre optic 100 MBps - which cable support this.

Numerical aperture

Refractive Index

advantages

Cladding - plastic / glass

21/Sep/17

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a server — a client (10% of hard disk)

↓ star - Ethernet — Collision truncate Binary backoff Algorithm.

↓ stop as soon as collision occur.

Big packet are not good for LAN.

More Reliable & secure Network

IEEE 802.5 Token Bus

Ring

larger packet transmit without contention

Balance

↓

all in my control

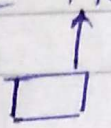
unbalance

↓

Not in my control

acw mostly

Token 3byte Monitor



1. starting frame delimiter 1
2. control 1 byte
3. End & Error correction

Command and data frame

Maximum data 4500

$T_x > T_p$ → again to source

$T_x < T_p$ → midway mein rukegya

No Contention 100% throughput

1	1	1	6byte	6byte	(4500 bytes) max.	4	1	1
start delimitor	Access Control	Frame control	destn add	SRC add	data 4500 bytes	Fcs	Ending delimiter	fra sta

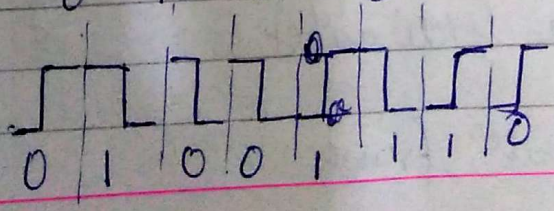
start delimiter	access control	Ending frame delimiter

SD field

j	k	0	1	k	0	0	0

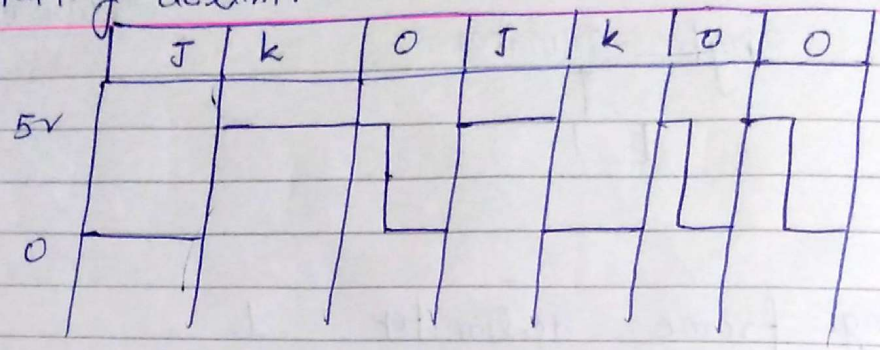
Manchester encoding

0 1 0 0 1 1 1 0



POPU

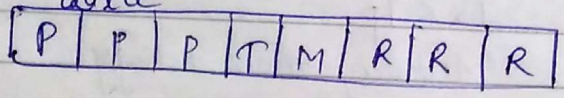
Starting delimiter



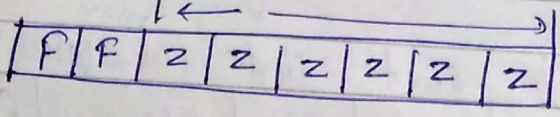
Access Control

P priority
R Reservation
0 - Token
1 - data

Monitor



Frame control



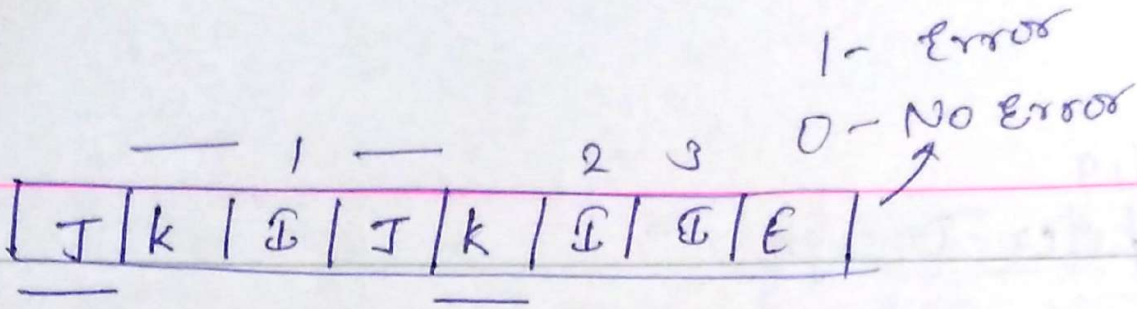
FF = 00 Control data
FF = 01

→ Mac address / Control Specified Information too

SA 6 byte
DA

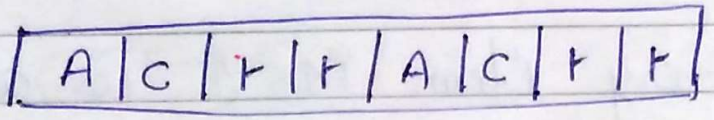
Same as Ethernet Protocol

data field = Max 4500 bytes
FCS frame check sequence (4 byte)
ED End frame delimiter
E: Error
I: Intermediate Frame



J, k - violation Code

Frame Status



A : 1 Address recognized
C : 1 Frame Copied
r : 1 unused / Reserved bits

Link Efficiency of Token ring.

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26/ sep/17

Network layer

Protocols TCP/IP

OSI Model

SNICP SNDCP SNDAP	IPV4 ICMP ARP/RARP	IP Layer

Routing
OSPF (Link state + Dijkstra Algo)
RIP (Distance vector)

ARP/RARP — IPV4 32 bit logical address
IPV6

Q. Services provided by IP layer?
Network layer depends on → different topology
Internet → fragmentation & Reassembly

Routing Table → Routing (physical + logical)

If contention / delay
if 1500 byte → Contention → reduce packet size
1000 + 500

Intermediate device = Router
Time to leave is noted.
if Error in Middle then retransmit

when Internet we cannot reassemble as time out Condition arises.

OSPF/RIP Protocol ← Fred A halsall Book

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work on N/w layer

(a) logical address assign krna (32 bit)

class A	class B	class C	class D
50%	12.5%	6.25%	

(American agency)

24 bit MAC ID

8 bit N/w ID

$2^7 = 128$ but all 0 = 126 address

$2^{24} - 2$

class	7-8	16	24	32
A	0 / Net ID		HOST ID	

16k. 16000

$2^{14} - 2$

	3	15/16		
B	1 0	Net ID	HOST ID	$2^{16} - 2$

$2^{21} - 2$

	23-24		
C	1 1 0	N/w ID	HOST ID

$2^8 - 2 = 254$

D 1 1 1 0

(only use Avg cost for Multicost Broadcasting)

IP → MAC ARP

MAC → IP RARP

Centralized system distributed system

Routing Intermediate Table

3/oct/19

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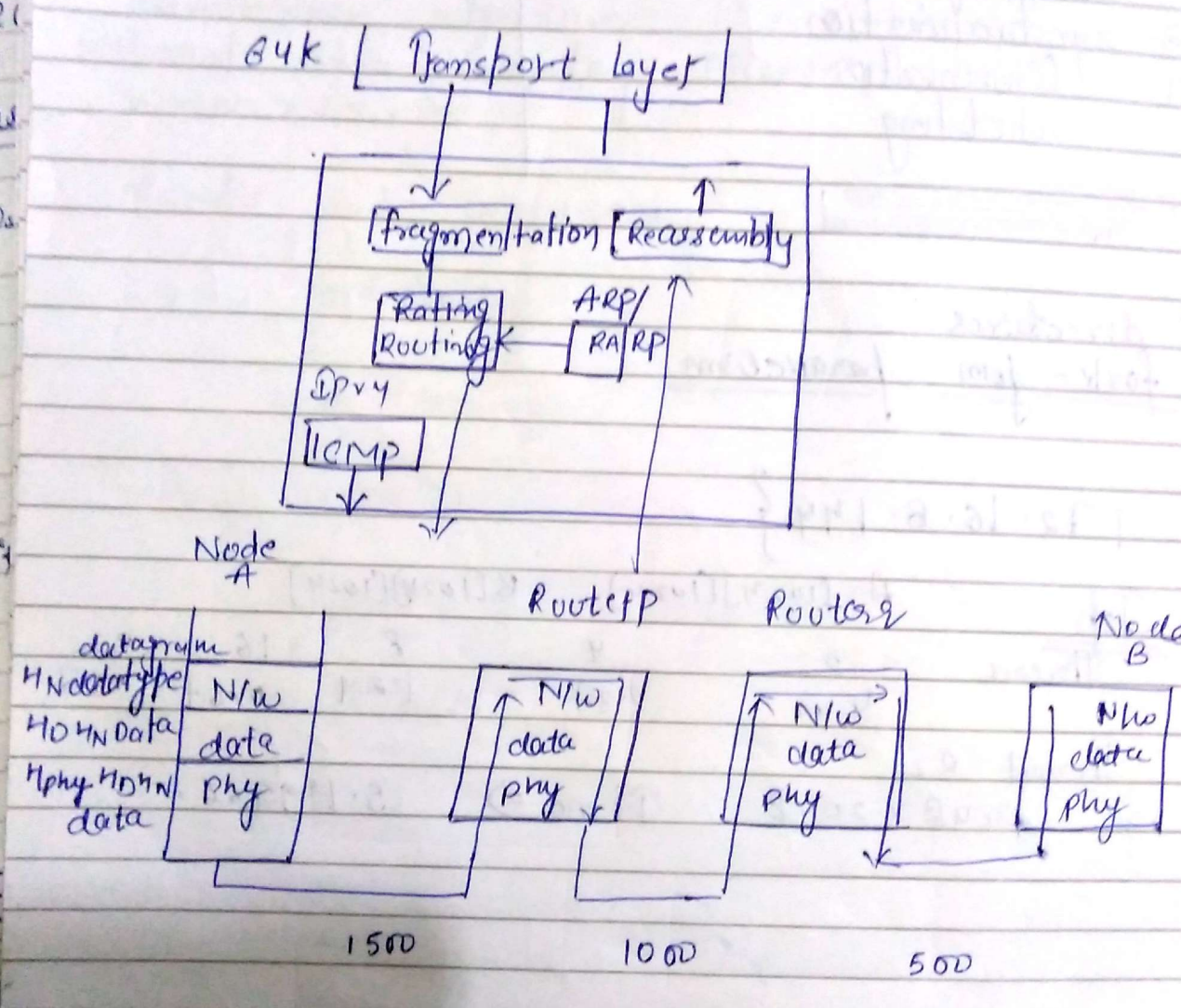
Computer Network



1500 Ethernet frame format will change here 4500 FDDI

headers of datagram will change

Node A (1500 Ethernet) — Router — Token Ring (4500) — Router — Node B (1500 Ethernet)

ARPANET

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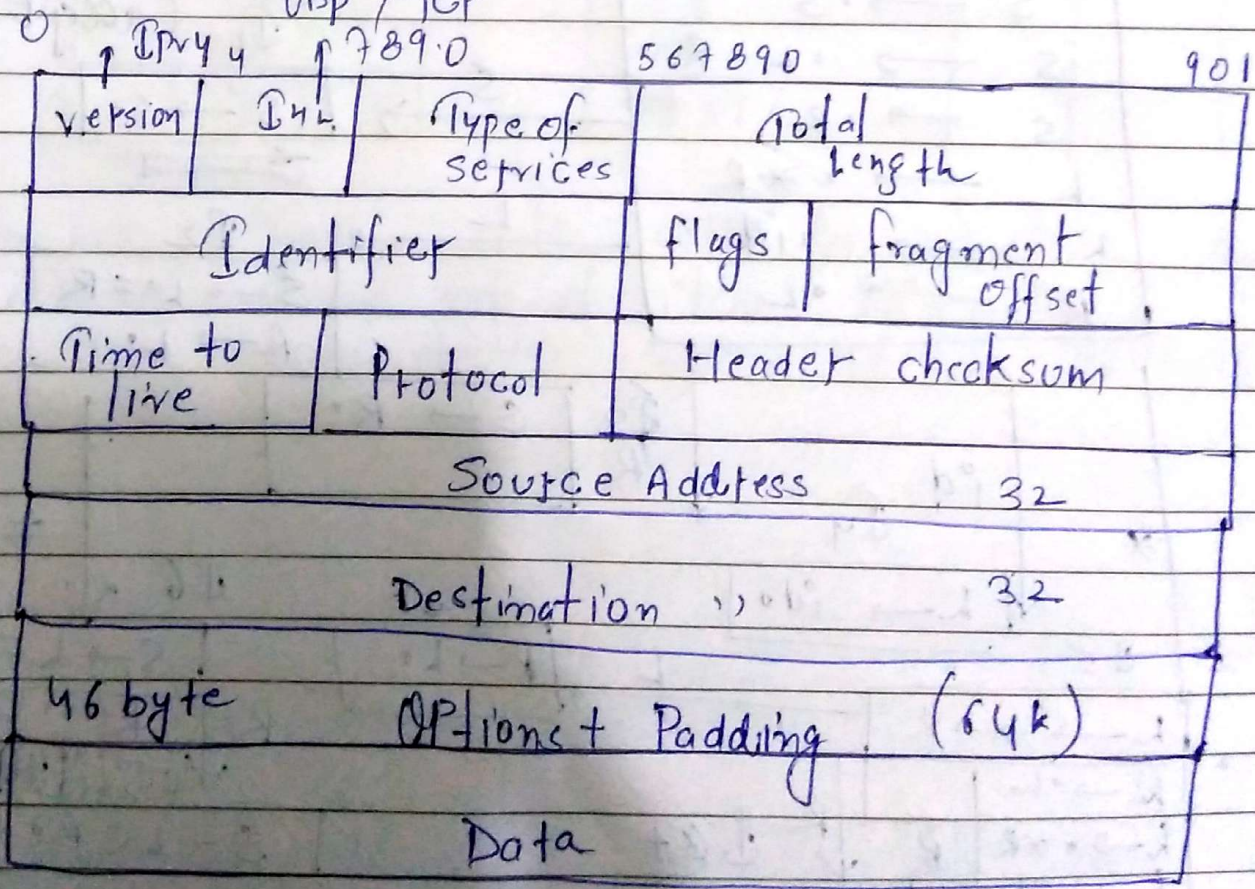
frame format of IPv4 ?
Addressing protocol
why we require logical address if we already have physical " ?

- Unicast
- Multicast e.g. all associate professors
- Broadcast - all - — .

→ discuss

- IPv4 ✓
- IPv5 ✗ ?
- IPv6 ✓ 128 bits

additional headers are included in IPv6



format of IPv4.

6 flags find ?