10 - 100 Mbps
limit upto organisation.

Token 802.3
802.1 fiber

LAN TECHNOLOGY

LAN Dominated by 4 Architecture / Standards

1) ETHERNET
2) TOKEN BUS
3) TOKEN RING
} IEEE

4) Fiber (FDDI) Fiber Distributed Dual / Digital Interface

ANSI
American National Standard for Infromation Interchange.

P.T.R

PROJECT 802. 2,1

IEEE
802.2
802.3
802.4
802.5

In 1985 computer Society of IEEE started a Project called Pro 802

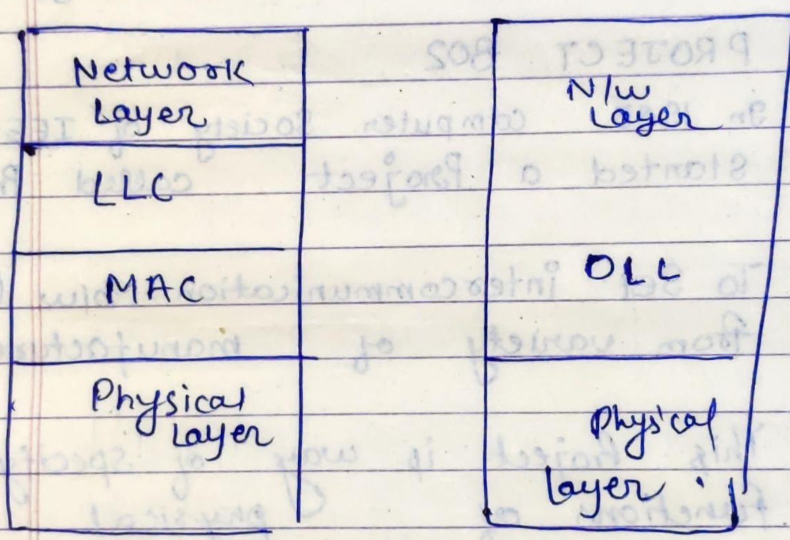
To Set intercommunication b/w Equipments from variety of manufacturer.

This Project is way of specifying functions of physical layer, Data Link Layer and upto some extent the n/w Layer to allow for Interconnectivity of Major LAN Protocols.

Relationship with OSI MODEL

The IEEE has sub-divided the Data Link layer into two Sub-layer i.e

logical link Control (LLC)
Medium Access Control (MAC)



LLC : The LLC is non-architectural specific and the frame in the N/w is called HDLC Frame which contains two set of Functions

Bone of contention

Date:

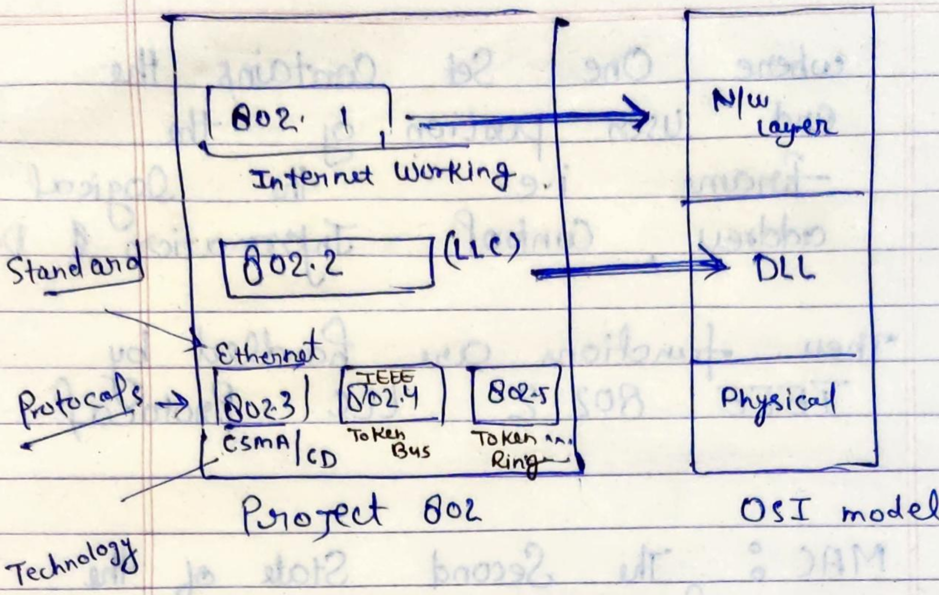
Page:

where One Set contains the end user portion of the frame i.e. the logical address, control Information & Data

These functions are handled by IEEE 802.2 LLC Protocol

MAC : The Second State of the function i.e. Medium Access control, resolves the Contention for the Shared media.

the main Root.



CSMA/CD

Carrier Sense Multiple Axes/ Collision Detection

IEEE 802.3

IEEE 802.3 Supports a lan standard Originally developed by Xerox and later invented by Joint b/w inter co-operation and Xerox.

This was called ethernet
The two major Categories of the ethernet are
ⓐ BaseBand
BroadBand

Baseband Specifies Digital Signal and IEEE divides the baseband category into 5 different Standard which are

10.Base 5
10 Base 2
10 Base - T
1 Base 5
100 Base T

Data Rate in Mbps

5/2 this signifies the distence in the multiple of 100. mtrs

T-(Type of Cable) Twisted

Broadband Specifies the analog Signal.

IEEE defines only one Specification for Broadband Category

10 Broad. 36

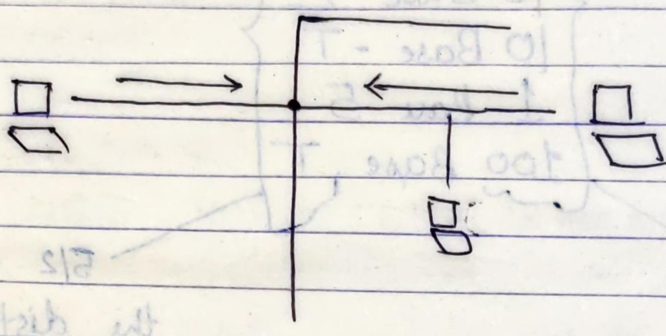
10Mbps

Maximum Cable Length into 3600 mtrs.

IEEE 802.3 (Ethernet)

Access Method CSMA / CD

Carrier Sense Multiple axes



Unregulated Signals leads to overlap which inturns to Collision of packets which leads to damage the signals

The access mechanism used in ethernet is called Carrier Sense with Collision Detection

& in this ~~da~~ system any node which wishes to transmit must first Listen for existing traffic on Line.

the Device listen in by checking
by voltage
And If no voltage
is detected. that lines are
initiated and transmission is
initiated.

The final step is the detection of
(Collision.)
(Here the station wishing to
transmit.
First listens to make
Certain, the link is free
then transmitt its data
then listen again
P.T.R. if a Collision is detected,
the station quits the
current
then made Pre determinant of time
line to clear And Sense again.

DLL is responsible

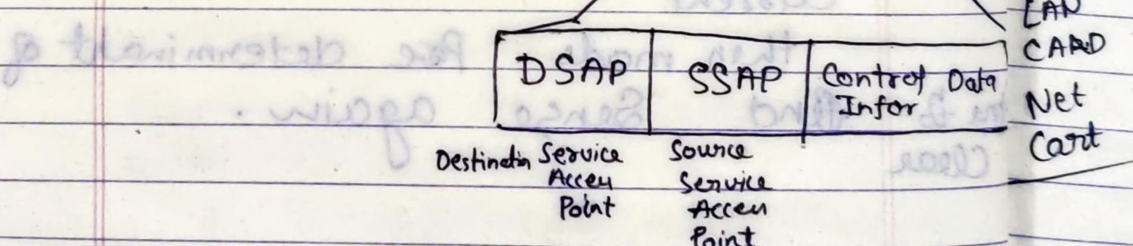
Date:
Page:

IEEE 802.3 FRAME FORMAT

IEEE 802.3 specifies One Type of Frame Containing Seven fields :-

Preamble,
SFD,
DA
SA,
Length / type of PDU (Protocol Data Unit),
802.2 frame,
CRC

P.T.R:



Preamble : The First field of 7 bytes (56 bits) of alternating 0's and 1's that alert the recieving System

Most First

IEEE MAC Frame
(media Access control)

LAN Address
↓
Machine Address

about the incoming and enable it to synchronous its input timing.

SFD :- (Start Frame Delimiter)

The second field of frame,
The signal begining at frame.
it tells the reciever that everything that follows is Data,
starting with Addresses.

DA (Destination Address)

SA : (Source Address)

LAN CARD
Net cart

CRC : Used for detecting the Errors.
Cyclic Redundancy check.

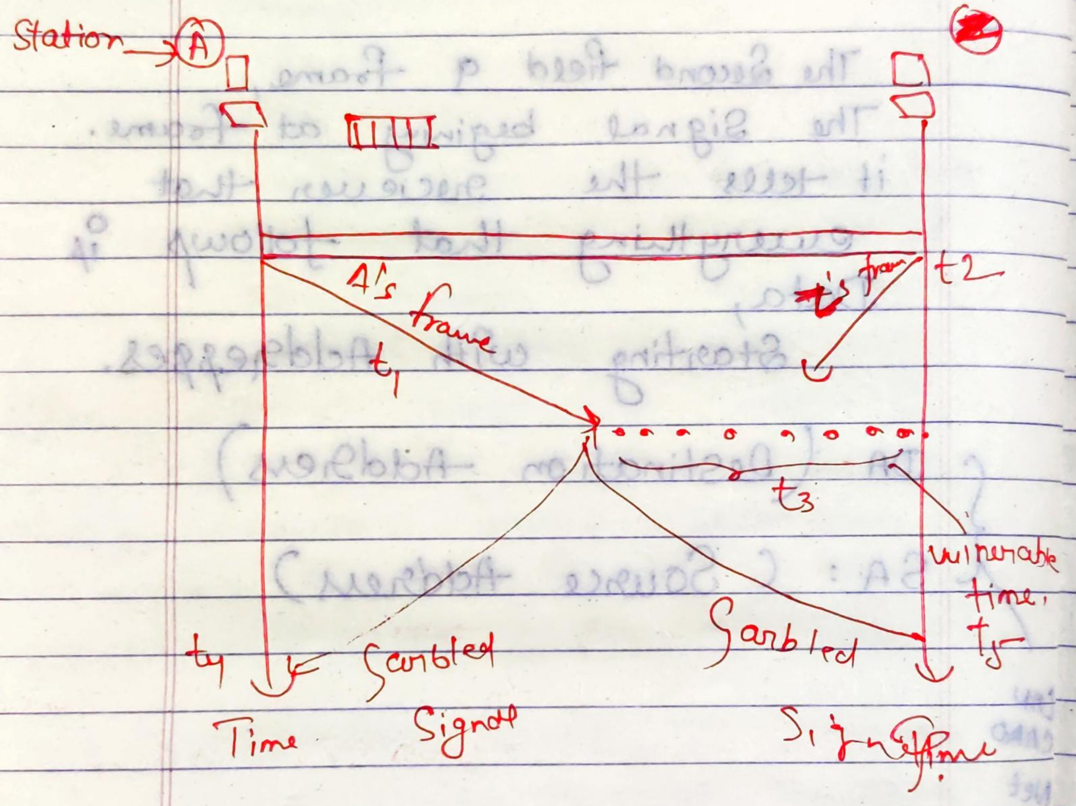
LRC longitudinal
VRC
Hamming Code technique

degradation of root identification/ trafic)

unregulate system/ access leads to the collision of n/w frame.

Why collision still exists in CSMA?

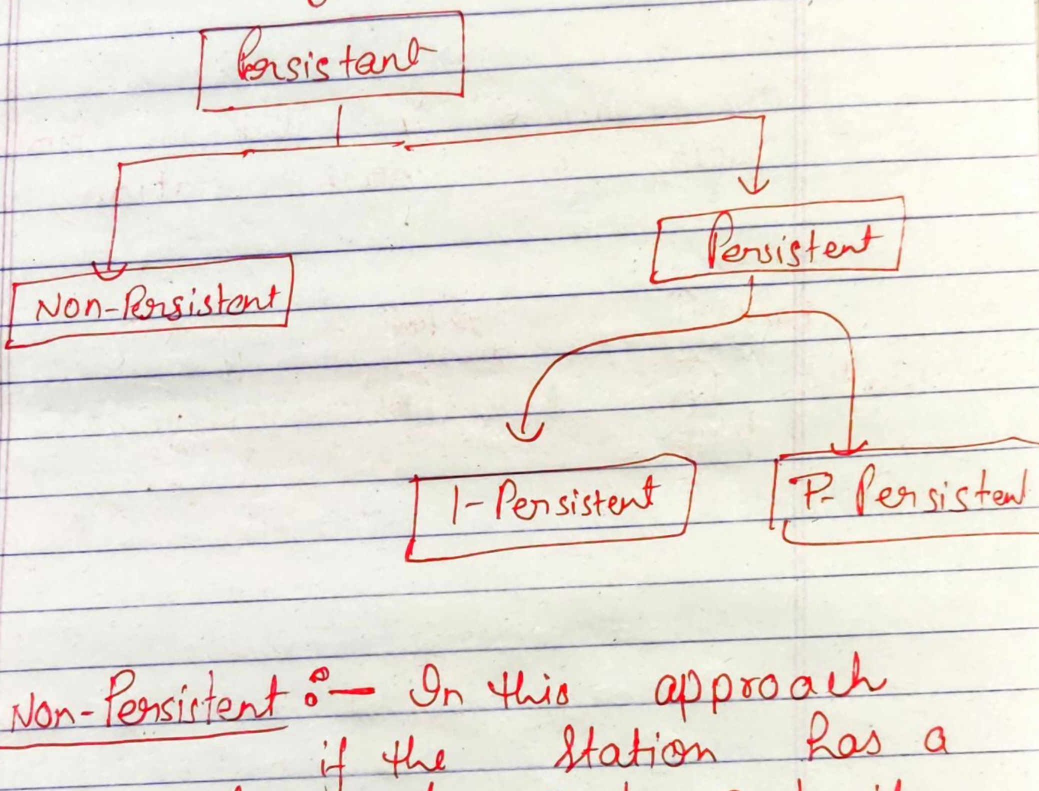
* Propogation delay



backoff

PERSISTENCE Strategy :

The Persistence strategy defines what a station should do if when sensing the medium, it finds it busy.

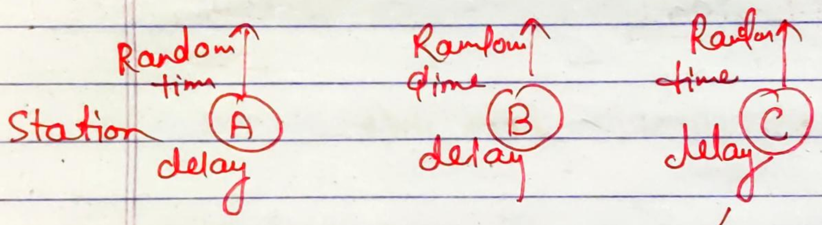


Non-Persistent :- In this approach if the station has a frame to send and it finds the line is idle, it sends immediately.

but if the line is not idle Station waits a random amount of time & then Senses the line again.

This approach reduces the chance of Collision

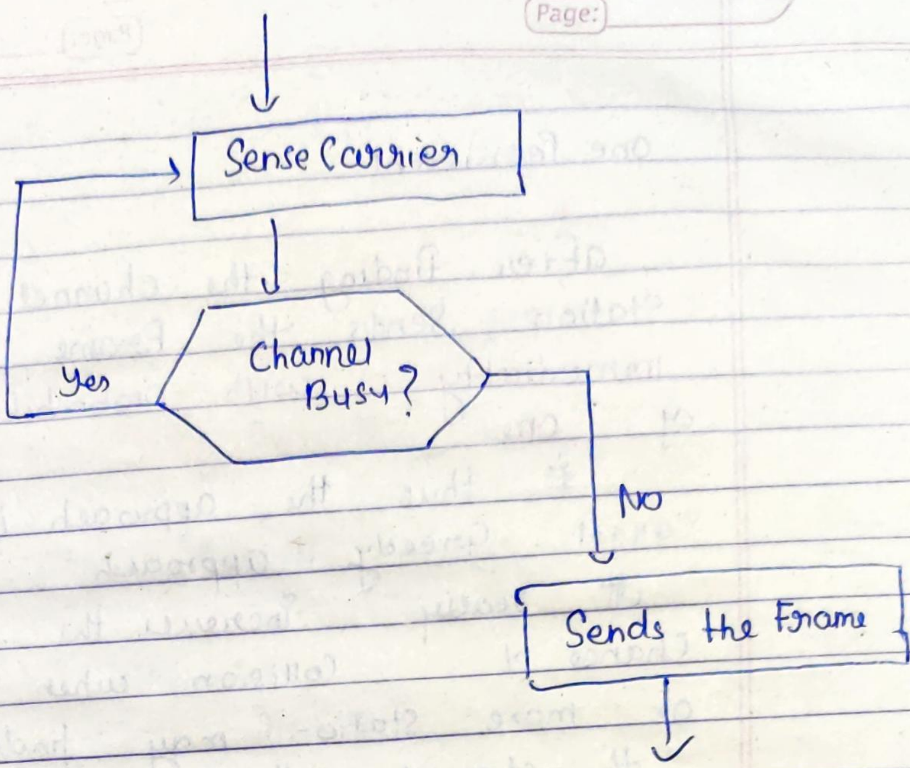
One reason is Random time delay for each Station



if found same the Random time for two different stations

→ degrade the performance

NON - Persistent



PERSISTENT APPROACH

In the persistent Strategy Staléon
Sense the Channel
if channel is idle
Station Sends the frame
Method has two differens approach
One Persistent
P- Persistent.

Date:
Page:

One Persistent

after finding the channel idle Station sends the frame immediatly with probability of one & thus the approach is called Greedy approach it really increases the chance of collision when two or more station may finds the channel idle and sends their frame immediatly.

P- Persistent :

In this approach, when the Station finds the Channel idle it may or may not sends the frame, i.e. it sends the frame with Probability of 'P' and ~~refrains~~ refrains (does not sent) with sending the frame with probability '1 - P' many / Random numbers

Random Number algorithm.

— ☐ station

Sends the frame = 'P'

Refrains from sending = '1 - P'

The station generates a random number from 0-100

if Random number is less than 20.

then the station / Sender will Send frame

Otherwise

refrain

* Exponential BACK OFF ALGORITHM

In the EBA Method
the Station waits an
amount of time betwen

0 and $2^N \times$ (Maximum Propogation delay

where N is the number of
attempted transmission.

The Station that has frame to send
Sets the Back OFF parameter (N)
to zero.
It then Senses the
line or Channel using
One of the Persistent
Strategies and after
Sending the frame.

If station does not hear
a Collision untill it has
Sent the Whole frame
the transmission is
Called Succesfull.
But if station
hears the collision, it
Sends the jam

1 bit's reachable from one boundary to other

Signal to inform the other stations and alert them that the collision has occured.

& then all the other station discard the part of the frame recieved.

The station has tried again & then increments the value of the backoff parameter if this value exceeds the limits the station should abort the procedure & if the value does not crosses the limit then the station again wait for a random time and tries again.

N=15
for ethernet = Max Propogation delay
= 51.2 μsec

Date:
Page:

BACKOFF Time :

$$\boxed{\text{BACKOFF Time} = r \times \text{Slot time}}$$

r is random integer between $\boxed{0 \text{ and } 2^N - 1}$

Slot time = round trip time + time needed to Send the jam Signal.

Travel one Side to other and time to get a acknowledgement back

Numerical in Backoff Algorithm

For EtherNet $51.2\ \mu s$ — Slot Time.

Suppose A Station Sends a Frame But It detects a Collision and It tries for two or more times but detects a collision each time finally it is Successfull for the 4^{th} Time. Calculate the Backoff Time for Each Trial of the Station.

Try	K (Backoff factor)	2^{K-1}	Random Integer 0 to $(2^{k-1})_{max}$	Back off time
1	1	$2^{(1)-1}$ 1	0 to 1 [0,1]	1) $0\times51.2 = 0$; 1×51.2 51.2
2	2	$2^{(2)-1}$ 3	0 to 3 [0,3]	2) 51.2 102.4; 3×51.2 153.6
3	3	$2^{(3)-1}$ 7	0 to 7 [0,7]	4×51.2 204.8; 5×51.2 256.0; 6×51.2 307.2; 7×51.2 358.4
4	— No-Collision because of Succesfull	No collision Succesfull	No-collision Succesfull.	

Date:
Page:

IEEE 802.4

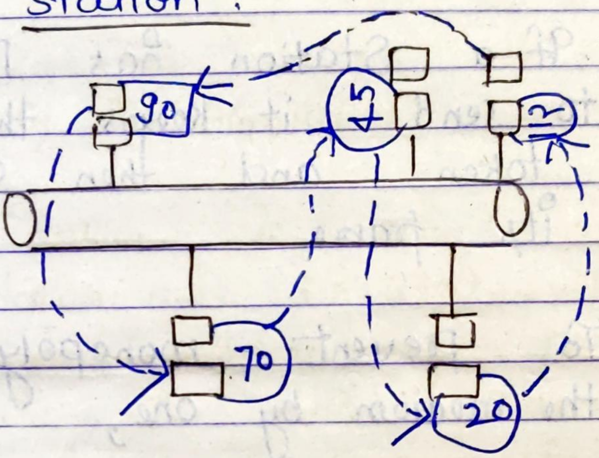
TOKEN BUS :-

Ethenet is not a Suitable protocol for minimum Delay as a no. of Collision is not predictable and delay in the Sending Data is not the Fixed Value.

Token BUS (IEEE 802.4) Combines the feature of Ethernet and the token. thus it forms a Bus Topology and a Collision free feature of token Ring. i.e. why it is the PHYSICAL BUS that operates as a Logical Ring using tokens.

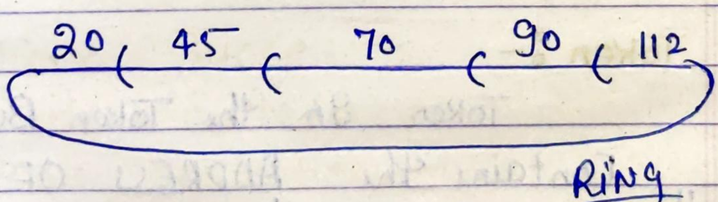
AND the Logical Ring is formed Based on Physical Address of the Stations in descending Order.

Each Station considers the Station with the Lower Address Station as the "Next Station" and Station with immediate higher address as the "Previous Station".



Physical : Bus TOPOLOGY

Operational Part : follow Ring Topology



Date:
Page:

TOKEN PASSING :

To control access to the shared medium a small token frame circulates from station to station in the logical Ring

If a station has Data-frame to send it keeps the token and then sends its frame

To prevent monopoly of the medium by one,

The protocol defines specified period of time that each station hold the token.

Token :-

Token In the Token Bus N/W contains the "ADDRESS OF THE NEXT STATION." (having lowr address)

because stations are physically organised in bus

and token received by all Station
The next Station defines the address which has the rights to Keep the Token & Sends its Data Frames.

RING MANAGEMENT

If a token is lost or token is created, there should be a monitoring procedure and for Ring management Token Bus uses 7 Bus FRAME

1) Token
2) Claim Token
3) Set Succesor
4) Solicite Succesor$_1$
5) Solicite Succesor$_2$ {Removes the Contention}
6) Resolve Contention
7) Who Follows.

FRAME FORMAT OF TOKEN RING

The Frame format of Token Ring is having 8 fields

It is a genral Frame Format at the mac layer.

Destination Address Source Address

Preamble	SD	FC	DA	SA	AD	FCS	ED

Data

PREAMBLE	SD	FC	DA	SA	Data	FCS	ED
1/more Byte	1Byte	1 Byte	6 Byte	6Byte	0 to 8190 Byte	4 Bytes	1 Byte

TYPES OF FRAME

- Data Frame
- control Frame

Date:
Page:

PREAMBLE

* actually added by Physical Layer and Not considered as a part of the Frame

It acts like a Engine to fram
It is of 1 or more Bytes

* START DELIMITOR :

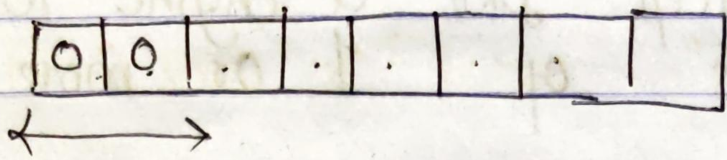
This field is of 1 Byte Long.
It is used to alert the recieving Station to the arrival of frame

* FRAME CONTROL :

It is of 1 Byte long
It defines the Type of the Frame

Learn

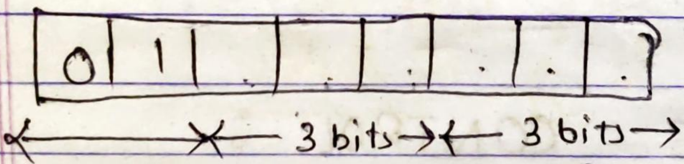
control Frame



8 bits.

000000 - Claim token.

Data Frame



type

Priority

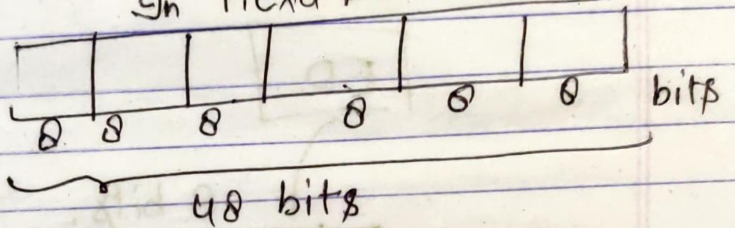
CRC - Cyclic Redundency Check
LRC

Date:
Page:

DA :
Destination Address.
It is of 6 Bytes.
It is Called Physical Address | M/c Address

It is pointed on Net Card.

In Hexa Decimal



SA :
* Source Address
* It is of 6 Bytes

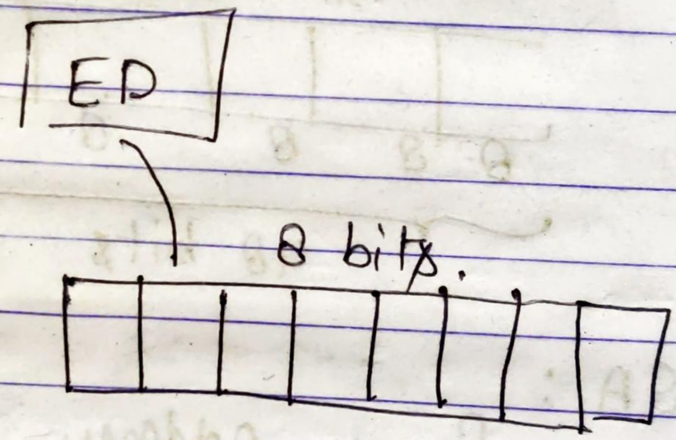
DATA : Contains the Data Coming from LLC layer,

FCS :
The FCS field called frame Control Sequence
It is is 4 bytes long and Contains a CRC-32 error Detection Sequence.
CRC is a field/application to which Error detection.

Date:
Page:

END DELIMITOR

ED is the 1 Byte long field and used to Alert the recieving Station to the Termination of frame.



1 → Data is ~~far~~ further Coming

N → Non-Data
There is no-Data further Coming.

- Random Access Tech.
P.T.R
- Pure Aloha
- Slotted Aloha.

Date:
Page:

Q. Consider a Building CSMA/CD N/w running at 1 GBPs over 1 Km Cable with No repeater.
The Signal Speed in the Cable is 200,000 Km/s

1) what is the minimum Frame Size

minimum Frame Size (bit Send per unit time)

Given Band Width = 1 GB.ps.
Speed = 200,000 Km/s

In One Second Meter distence Covered

$1 \text{ Sec} = 200000 \times 10^3$ mtrs

$1 \text{ mtr} = \frac{1}{2 \times 10^8}$

$1 \text{ K.m} = \frac{1}{2 \times 10^5}$ 10^{-6}

$= 0.5 \times 10^{-5}$
$= 5 \times 10^{-6}$ sec
$= 5 \times 10^{-6}$ sec.
$= 5 \mu s$.

Date:
Page:

Total Fram Time

{sending & Recieving both}

Round. Trip time =

$2 \times 5 \mu s$
$= 10 \mu s$

In 1 Sec. $1024 \times 1024 \times$ byte

$\Rightarrow 10^9$ bit

Min frame Size $\Rightarrow$

$10 \times 10^{-6} \times 10^9$ bits
10^4
$= 10 \times 10^3$
$= 10K$ bits
$= 10$ bytes.

Media Access

Random access. Control access.

1024 X 1024

4096

2048 X

X X

RANDOM ACCESS METHOD

Pure aloha

Slotted aloha

[- Aloha Protocol]

Medium Access — Control Access — (Token Passing) / Random Access

In Random Access method there is no priority set to (set frame to the Network.)

None is Superior

No one have control over others in the network

In RANDOM Access Method No Station is superior to another Station and none of them are assigned the control to Other

Each Station can transmitt when it desires On Condition that it follows the predefined procedures,

There is no Scheduled Time for a Station to Transmit, there is no rule which specify to the Station which Should Send next.

In the Random Access Method Each Station has a right to the control the Station when there are more Stations tries to send The collision Occurs.

ALOHA Protocol

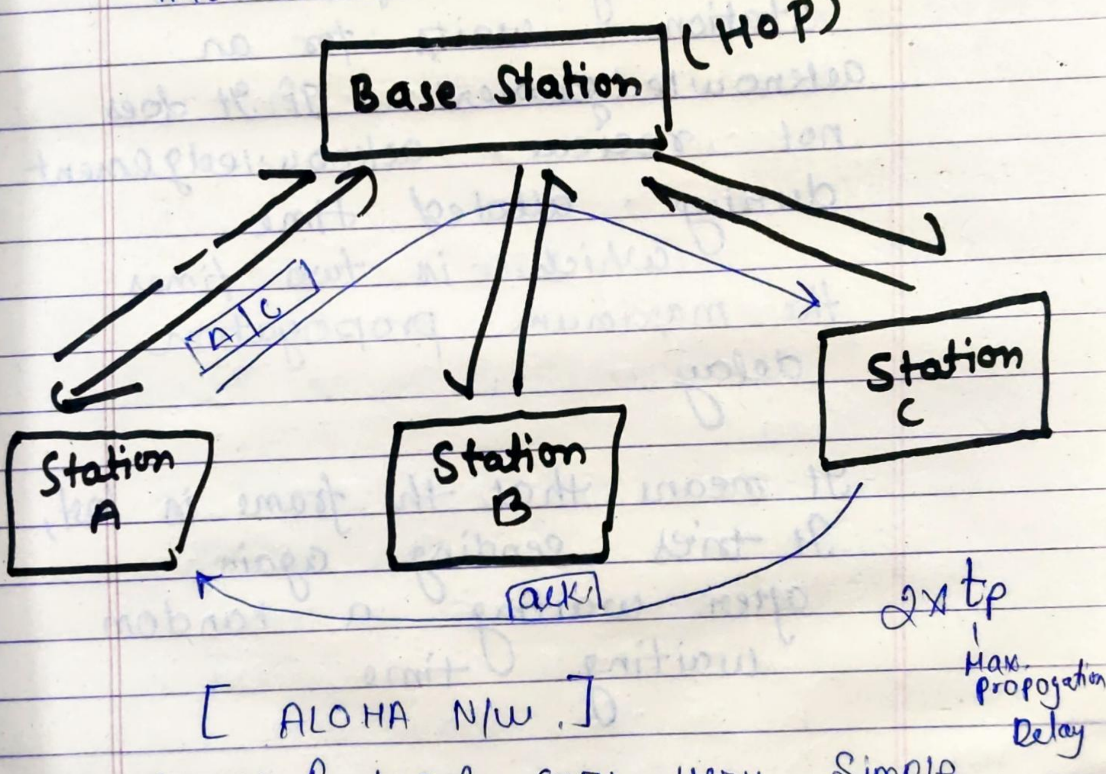
The First RA Method which use very simple procedure to access the medium using multiple access (MA) was called ALOHA.

It was developed at the University Hawaii in early 1970

It was designed to be used on a Wireless LAN with a Data Rate of 9600 bps

The Basic idea behind the aloha network was that the Base station is the Central Controller And Every Station that needs to sends the frame to another station, first Sends it to the Base Station

The Base Station Recieves the the Frame and relays it to the intended destinatination.



[ALOHA N/W.]

ALOHA Protocol were very Simple

ALOHA BASED ON FOLLOWING POINTS

1) MULTIPLE ACCESS,

Any station sends the frame anytime when it have to send.

2) No Carrier Sense
3) No checking For Collision
4) After Sending the frame the Station waits for an acknowledgement : If It does not recieve acknowledgement during alloted time which is two times the maximum propogation delay

It means that the frame is lost, It tries sending again after waiting a random waiting time

Vulnerable Time :

It is the time in which there is possibility of the Collision and

In Case of Pure ALOHA

The Vulnerable time is

$2 \times t_{frame}$ Unit time

Send Time

Recieving Time of acknowledgement.

Proof - Pure
P.T.O. ALOHA

Date:
Page:

ALOHA PROTOCOL

The Basic idea of Aloha
transmitt immediatly
Determine whether the
a Sender waits for an
acknowledgement

$= 2 \times T_p$

Tp (propogation Time)

if No acknowledgement is
recieved in this
time
A BackOFF AlGO.
is used to Select the
Random Reselect Transmission
Time
There Will be collisions
if more than One Stations
tries to Send the frame
in the same Slot which
is equal ONE UNIT TIME

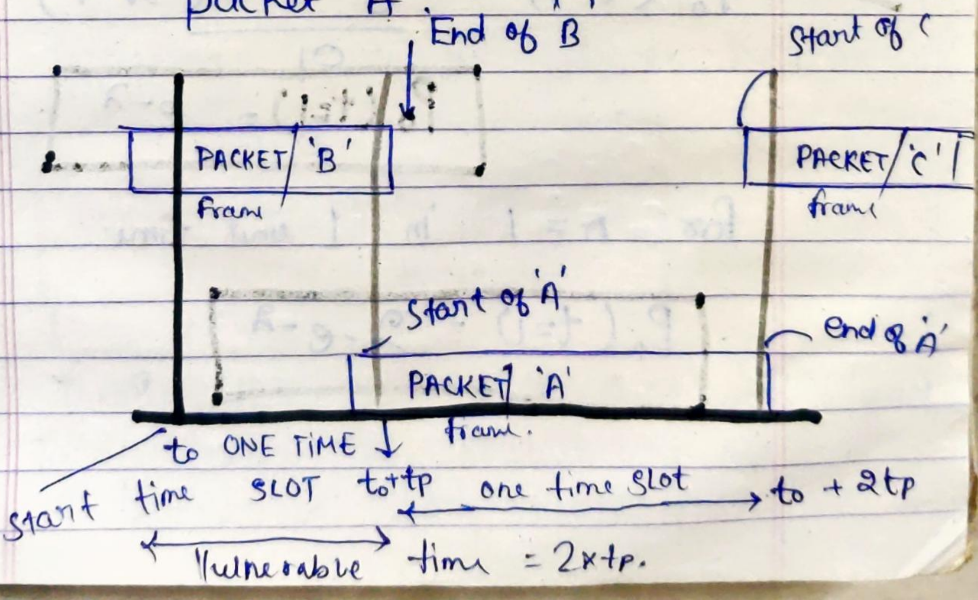
i.e. T_p

Consider a Station which attempts to Send a packet 'A' with Starting time

equals to $T_0 + T_p$;
with an ending time of $T_0 + 2T_p$

if Another Station had tried to Send the Packet B b/w T_0 and $T_0 + T_p$ then the end of the Packet be collide with Starting of Packet A.

AND SIMILAR Situation met if 'C' packet Send by another Station with Starting time $T_0 + 2T_p$ it will collide with packet A.



The vulnerable time in which Collision occurs
2 frames will be corrupted.

PERFORMENCE OF PURE ALOHA

Probability of collision Exactly

n frames arrival during the Time interval of length 't' is given by Poisson's Distribution

$$\underbrace{P_n}_{n\text{-frame}}(\underbrace{t}_{time}) = \frac{e^{-\lambda \cdot t} \cdot (\lambda \cdot t)^n}{n!}$$

for $n = 0$, in 1 unit time.

no collision

$$P_0(t=1) = \frac{e^{-\lambda \cdot 1}(\lambda \cdot 1)^0}{0!}$$

$$\boxed{P_0(t=1) = e^{-\lambda}}$$

for $n = 1$ in 1 unit time

$$\boxed{P_1(t=1) = \lambda \cdot e^{-\lambda}}$$

By the poission's Formula → thus we can derive throughput I/p - of pure Aloha ∴ workdone per unit time.

Let 'S' represent the Throughput i.e. the average no. of transmission per unit time (t_p) and

G is the offered Load, i.e. the number of the packets arriving in a time t_p

Throughput Succesfull transmitted frames. Send - recieve

Load is the sended frames.

Replacing n with 'k' in the above Probability relation

$$P_K(t) = \frac{e^{-\lambda t}(\lambda t)^K}{K!}$$

where

$$\boxed{G = \lambda t}$$

Replacing λt in the above Relation

$$\boxed{P_K(t) = \frac{e^{-G}\, G^K}{K!}}$$

Through Put 's' is then the offeried Load G times the probability of transmission i.e. Succesfull.

P.T.O

Date:

Page:

$S = G P_0$

P_0 is probability is when there is no Collision occurs

Probability of the 0 frames in the Two frames Transmission time

$$P_k(\cancel{t}) = \frac{e^{-\lambda t} \cdot (\lambda t)^k}{k!}$$

$t = 2$

$k = 0$

$$P_0(2) = \frac{e^{-2\lambda} \cdot (2\lambda)^0}{0!}$$

$$\boxed{P_0(2) = e^{-2\lambda}}$$

$G = \lambda t$

$\therefore \boxed{G = \lambda}$ { becoz t is unit time

$\therefore$

$$\boxed{P_0(t=2) = e^{-2G}}$$

$S = G P_0$

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

For maximum Throughput

$S_{max} = \frac{dS}{dG} = 0$ (by Maxima and Minima)

$\frac{d}{dG}(G \cdot e^{-2G})$

$-2G e^{-2G} + e^{-2G}$

$\Rightarrow e^{-2G}(1 - 2G) = 0$

$\Rightarrow 1 - 2G = 0$

$\Rightarrow 1 = 2G$

$= G = \frac{1}{2}$

$\boxed{G = 0.5}$

In Pure Aloha, the offered load is 50%.
thus $S_{max} = 0.5\, e^{-1}$

$e = 0.2717$ $\qquad e^{-1} \quad \frac{1}{e}$

$$S_{max} = \frac{0.5}{0.2717}$$

$= \frac{5}{[illegible]} \qquad e = 0.2717$

$\Rightarrow \quad 0.5 \times \frac{1}{0.217}$

$\Rightarrow \frac{1}{2e}$

$= 0.184$

$= \cancel{18.4}\,\%$

$G = 1/2$

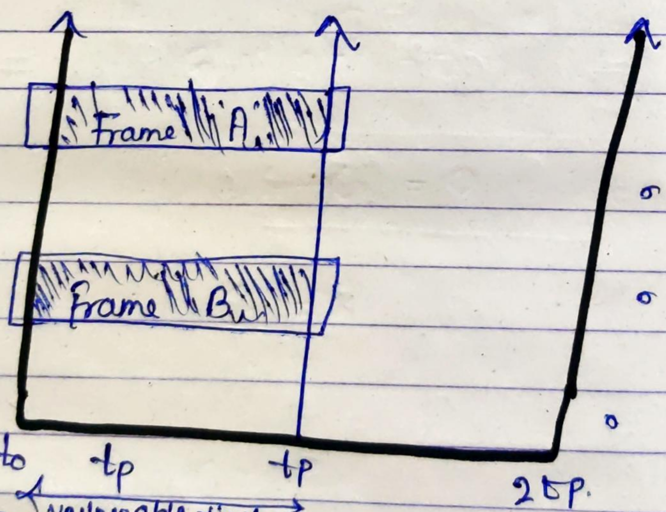
$S = 1.84$ 18.4 %

In < Pure - 2 frame per unit time. 2tp
Slotted - 1 frame per unit time. tp

SLOTTED ALOHA :

In case of slotted aloha the time unit is divided into slot of 't' unit each. and It requires Each Station to Begin the transmission only at the begining of slot

if Station is ready to send the frame in middle of Slot, It has to wait untill the Start of the next slot.



So in this method, the collision occurs, when two station ready to send their frame in Same Slop.

Vulnerable/Generation time is the time where collision occurs.

Date:
Page:

PROBABILITY ANALYSIS :

$S = G P_0$

P_0 probability of 0 frames in a one frame transmission time.

$$P_K(t) = \frac{e^{-\lambda t}(\lambda t)^K}{K!}$$

$t = 1, \quad K = 0$

$$P_0(t=1) = \frac{e^{-\lambda}(\lambda)^0}{0!}$$

$$P_0(t=1) = e^{-\lambda}$$

$G = \lambda t$

$t = 1$

$G = \lambda$

$S = G P_0$

$S = \lambda P_0$

$$\boxed{S = \lambda e^{-G}}$$

$$\boxed{S = G e^{-G}}$$

For Maximum ThroughPut

$$S_{max} = 0$$

$$\frac{dS}{dG} = 0$$

$$\frac{d}{dG}\left(Ge^{-G}\right) = 0$$

$$\frac{dG}{dG} e^{-G} + G\frac{d}{dG}(e^{-G}) = 0$$

$$e^{-G} + (-1)G e^{-G} = 0$$

$$e^{-G}(1 - G) = 0$$

$$e^{-G} = 0$$

or

$$1 - G = 0$$

$$\boxed{G = 1}$$

putting $G = 1$

$$S_{max} = e^{-1} = \frac{1}{e}$$

$$S = uG\, e^{-G}$$

$$S = (1)\, e^{-1}$$

$$= e^{-1}$$

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

$$= \frac{1}{0.2717}$$

$$= \frac{100}{27.17}$$

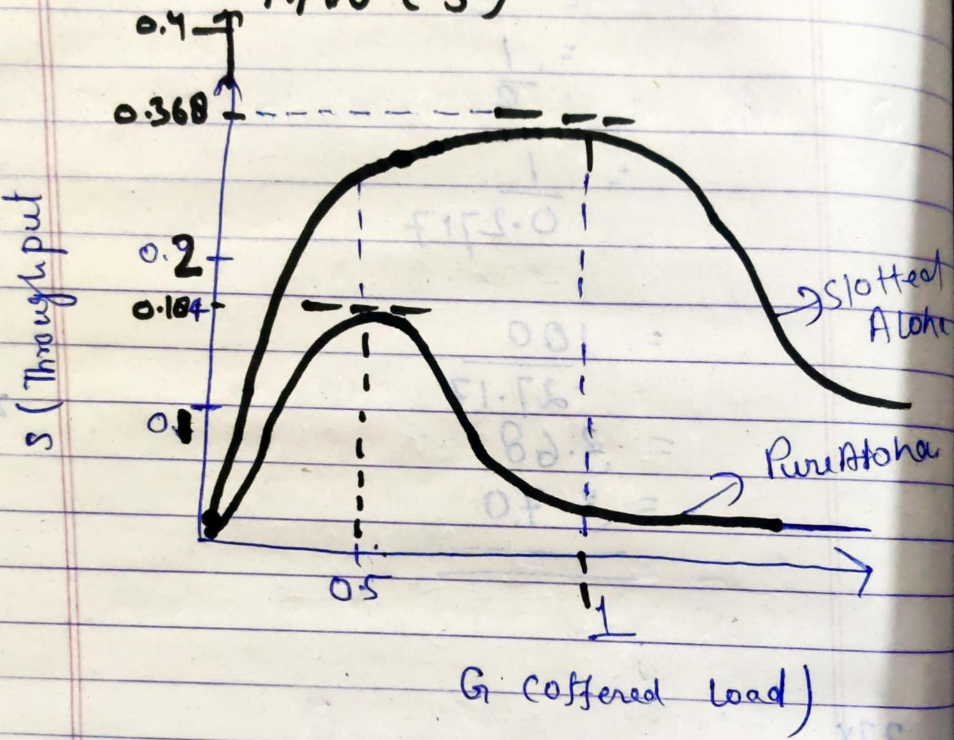
$$= 3.68$$

$$= 3.70$$

Date:
Page:

P.T.R.

RELATION B/W OFFERED LOAD (G) & THROUGHPUT OF N/W (S)



$\frac{2 \times 2.717}{4.4384}$ $\frac{.184 \times 2}{}$

$\frac{1.414}{}$

Q Calculate the throughput S for a pure aloha N/W if the offered load is 0.75.

$G = 0.75$

$S = ?$ (P.A.)

$(2.717)^{3/2}$

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

$S = 0.75 \times e^{-2 \times 0.75}$

$= 0.75 \times e^{-1.50}$

$= 0.75 \times e^{-3/2}$

$= 0.75 \times \frac{1}{(e)^{3/2}}$

$= 0.75 \times \frac{1}{4.4816} = 0.2232$

$=$ ~~3.36~~ $0.167.$

Date:
Page:

Q. A Slotted Aloha channel has averaged 10% of slots idle.

2009-10

a) What is the offered Load (G)

b) What is throughput (S)

(c) Is the channel underloaded overloaded.

$t = 10.$

$G = \lambda$

$S = G e^{-G}$

$S = G e^{-\lambda}$

100 में 10 में collision नहीं होगा

$\frac{10}{100}$

$P_0 = e^{-\lambda}$

$10\% = e^{-\lambda}.$

$0.1 = e^{-\lambda}$

$0.1 = \frac{1}{e^{\lambda}}$

$P_0 = \frac{1}{10}$

$P_0 = 0.1$

$e^{\lambda} = \frac{1}{0.1} \Rightarrow e^{\lambda} = 10$

$e^{G} = 10$

$G \quad 0.434 = 1$

$G = \frac{1}{0.434}$

$\log e^{G} = \log 10$

$\Rightarrow G \log e = \log 10$

$\Rightarrow G = \log 10 \Rightarrow$

if $G < 1$ - network is underLoad.
if $G > 1$ - n/w is overLoad.
if $G = 1$ - n/w is Pure.

if $G > S$ Load is High (Higher Collision

if $G < S$ Load is Low

if $S > 1$ No. of frame Generated are more than the Channel can handle.

if $S < 1$ No. of frames Generated are less than the Channel can handle.

$$\boxed{G = 2.30}$$

$S = \cancel{G e^{-G}}$

$= \cancel{2.30 \times e^{-2.30}}$

$= \cancel{22.981}$

2.3×0.1

$$\boxed{S = 0.23}$$

c) $G < 1$ — N/w is Overloaded.