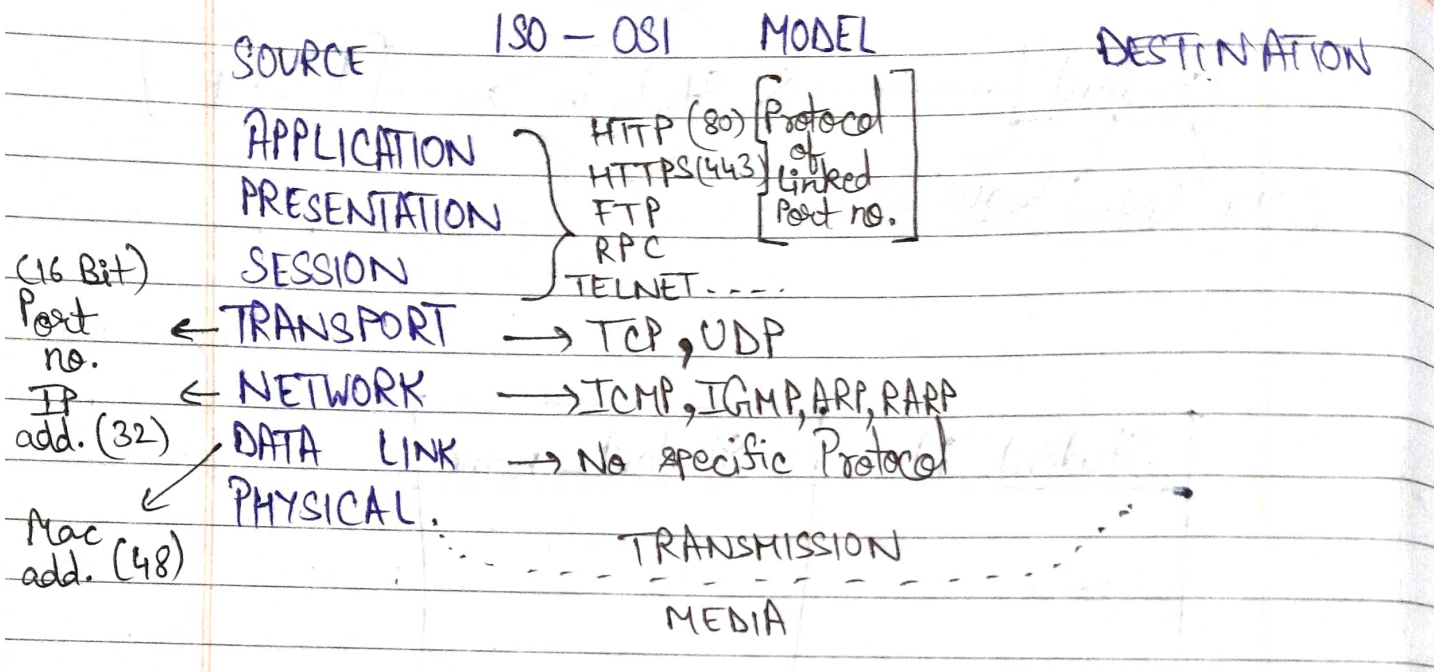
Computer Network

ISO – OSI MODEL



International standard organization proposed OSI MODEL (Open System Interconnection reference model) so that guideline/specification can be formulated or to ensure seamless between different nodes

DSI model comprises of following seven layers (ABOVE MODEL)

Whenever data transmission takes place

data packet moves through seven layer application to physical

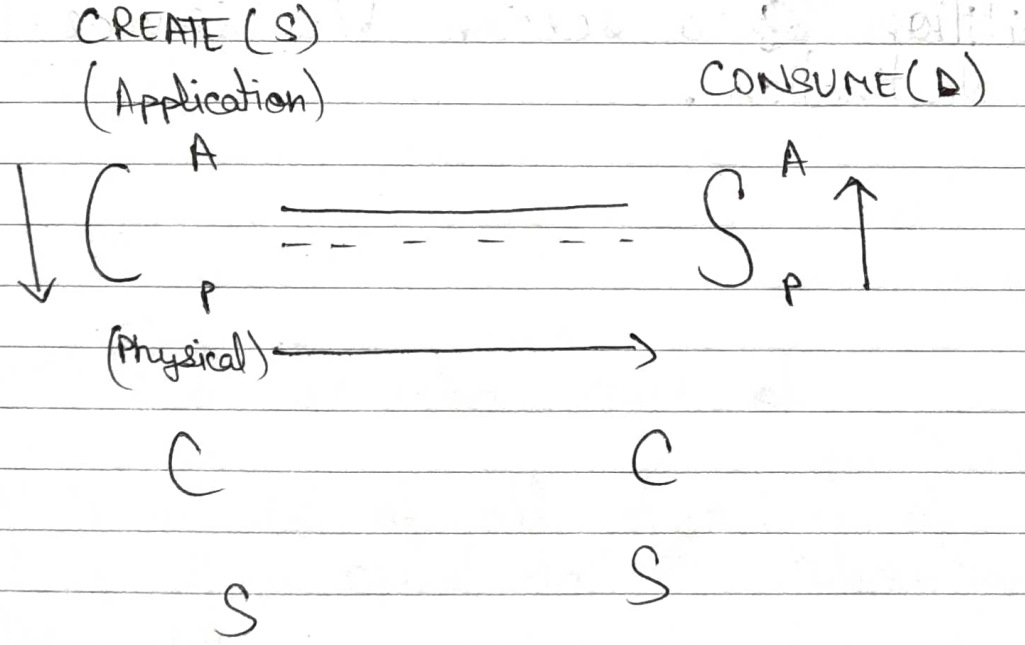
Default loop Back IP address | 127.0.0.1 |

~~DSL Wired Network~~

~~on diff~~

The various protocol that work on different protocols are as follows:

ICMP (Internet control message protocol)
IGMP (" group " ")
ARP (address resolution protocol)
RARP (Reverse address " ")



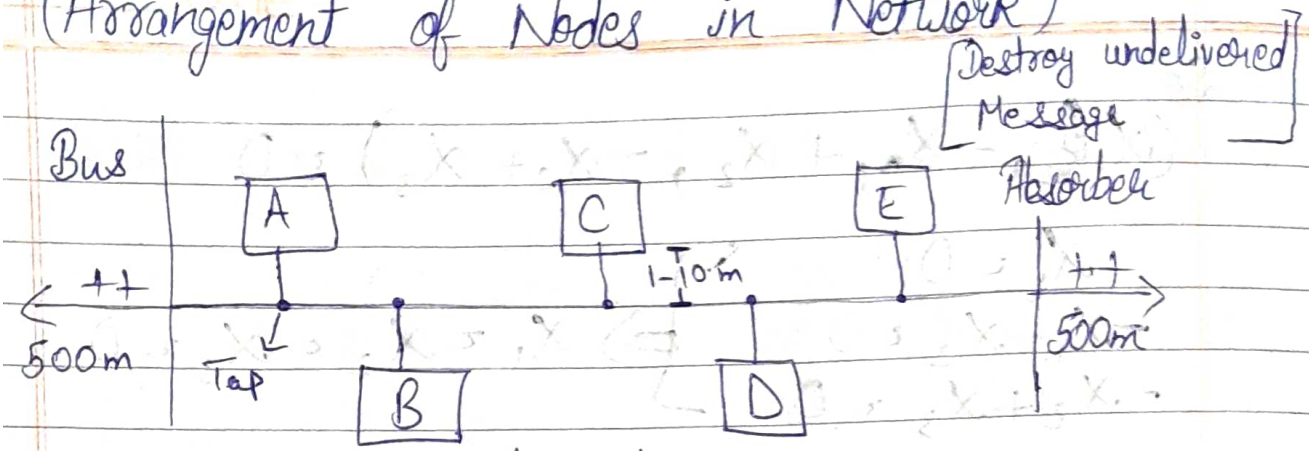
Application: The first layer of OSI model that is responsible for creation of message is application layer.

Presentation: If same message requires data translation, encoding, compression, encryption then it is handle by presentation layer.

Session: Session layer is responsible for stabilition of a session b/w source & destination.

Topology

(Arrangement of Nodes in Network)



CASE $A_F - D_F$ (Frame)

500 m

Same Network
DLL
MAC
(48 bit)

Diff. Network
NL
IP
(32 bit)

Casting
Broad → All
Multi → Specific group
Uni → One on one

→ If absorber not present, network will get congested / clloged.

TTL → Time to Live

Restart method use to revive ~~remove~~ clogged network.

Start frame delimiter

(7 bit)

Source address

(48 bit)

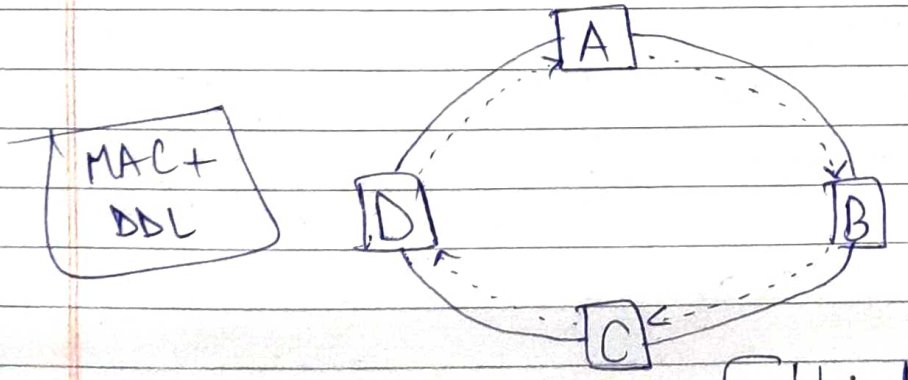
(46-1500B)

PREAMBLE	SFD	DA	SA	DATA	CRC
TTL	(1 bit)	Destination address	(48 bit)	PFNLOAD	Cydic Redudancy check

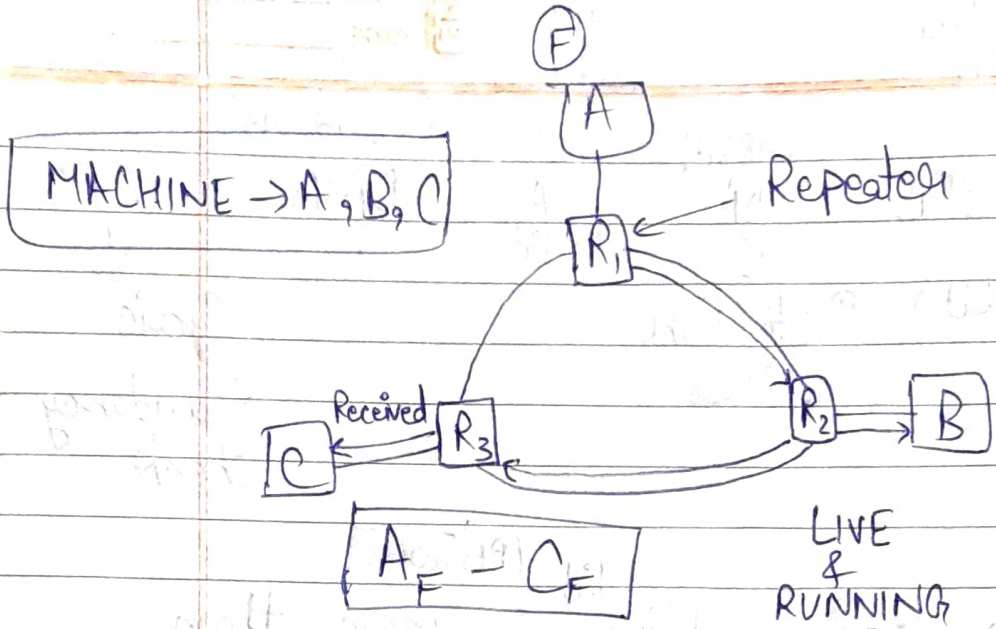
Overhead → padding bit is more than actual data bit.
Results in congestion in network.

If data is less than 46 bit, add padding and make it to 46 bit.
If data is more than 1500 bit, add another frame.

HAMMING — Error detection
— Correction



Uni-directional transmission
Clock or anti-clockwise.


F
A
MACHINE → A, B, C
Repeater
R1
Received
R3
R2
B
C
AF – CF
LIVE
&
RUNNING
EVEN
IF MACHINE CRASHES

127.0.0.1 → free IP address agr humne apni hi machine ko server & client bnana h.

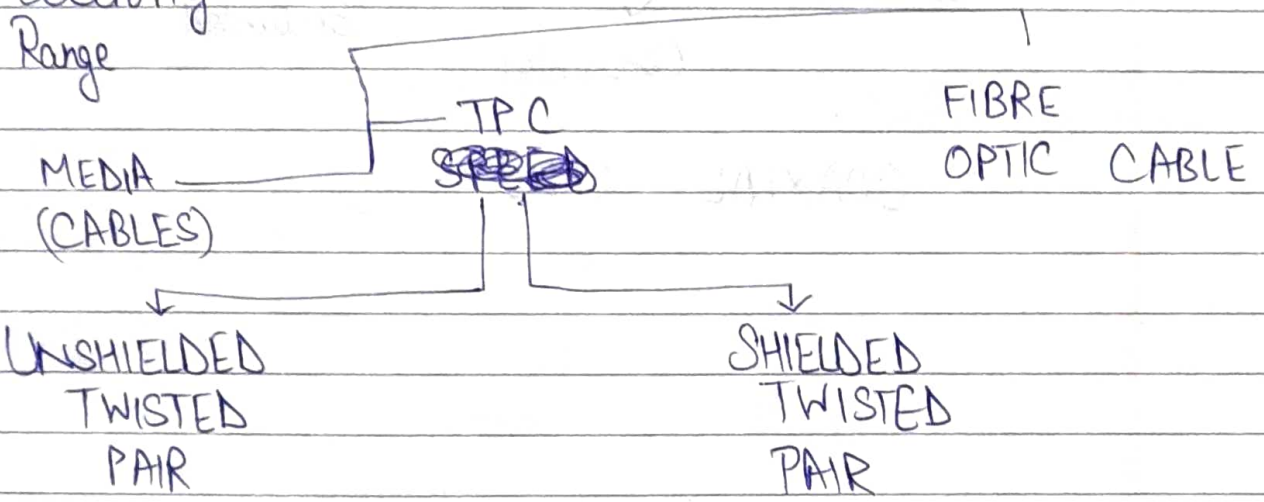
IEEE → Institute of electrical and electronics engineering

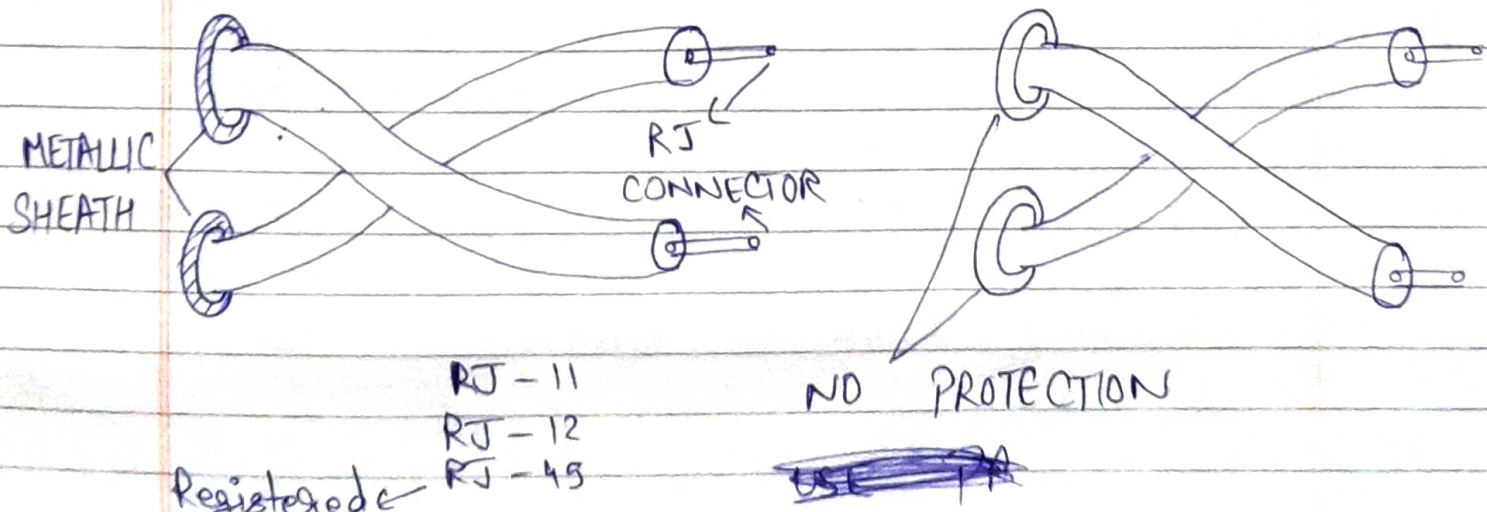
The media that facilitates transmission of data over network is Transmission media.

It is broadly classified into two categ:

Preferred Guided transmission media [cables]
unguided " " [OTA]

Advantage of ~~G.T.M~~ Guided
Speed
Security
Range





RJ - 11
RJ - 12
RJ - 45

Registered Jack

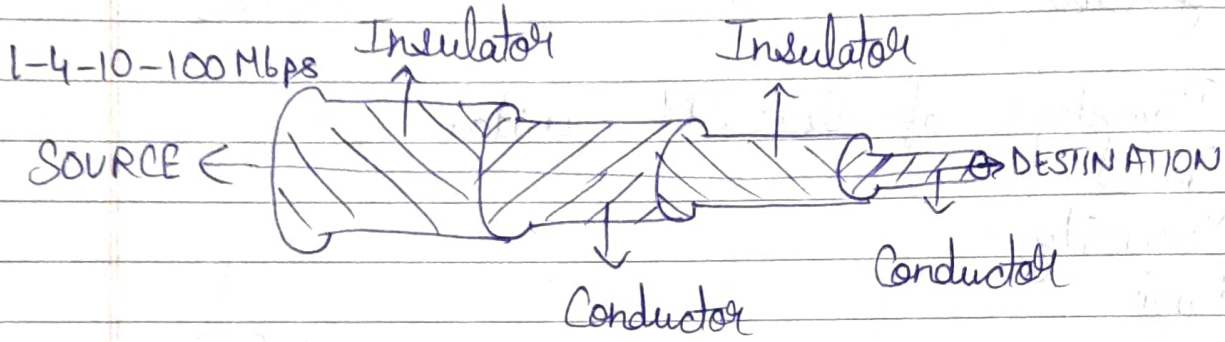
GOOD WRITE

TRANSMISSION IMPAIREMENT

NOISE
[ONE SIGNAL IS ENOUGH]

INTERFERENCE
[MULTIPLE SIGNAL REQUIRED]

~~element~~ elinimate
Guard band to ~~avoid~~ {cross talk} interference.



COAXIAL CABLE

1 Ques aaega hi aaega Minor, Major or GATE m, agr nhi aaya toh TKBKL.

MULTIPLEXING & MODULATION

Multiplexing
is a process of sharing a single channel where we know that channel can be any of the wired transmission media (UTP, STP, COAXIAL & FIBER

for efficient multiplexing to takes place, multiplexer takes

Modulator is

which is used for generation of carrier signal

FREQUENCY DIVISION MULTIPLEXING

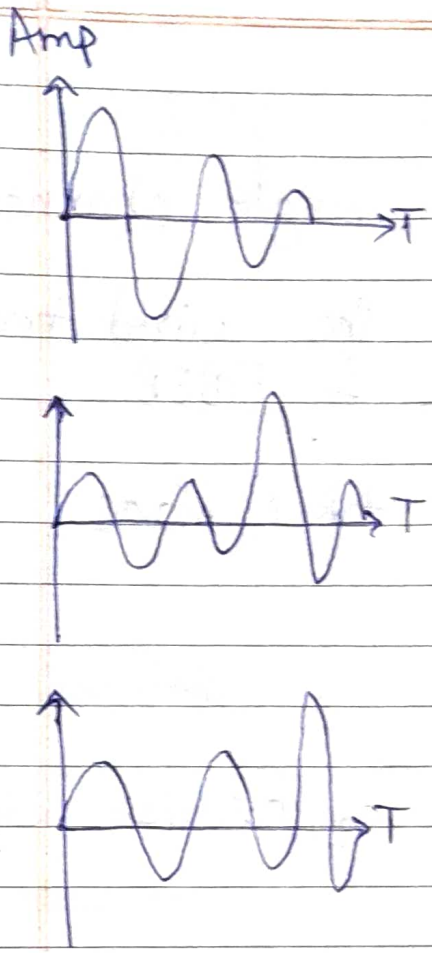
TIME " " → Synchronous TDM / Asynchronous TDM

WAVE " "

Modulation is defined as "process of bringing about the change in the frequency, space, or amplitude of carrier signal change in accordance with the

GOOD WRITE

DATE
PAGE



Time Divis

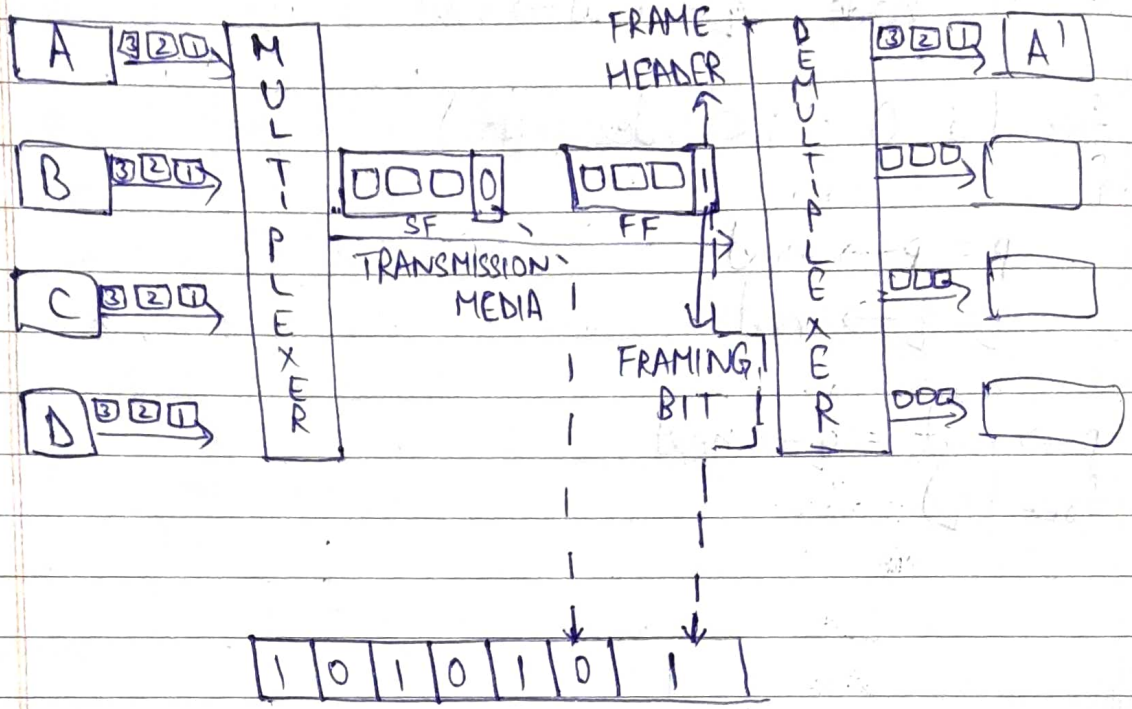
Time is allocated by the multiplexer to all devices in equal portion. It is classified into 2 categories :

Synchronous TDM	Asynchronous TDM
1) In this TDM, a frame generated by multiplexer contains the slot which are directly proportional to no. of input devices connected to multiplexer.	No. of slots in a frame generated by multiplexer is always less than no of input devices connected to multiplexer. This helps in saving network resources which in turn helps in reducing the congestion over the network.
2) Amount of data that can be accomodated in the slot of frame is fixed in size and it does not vary from frame to frame.	amount of data which multiplexer recieves from input device & arrange it in empty slots of the frame is variable in nature. Such a process of recieving data from input device & arranging it in slots of frame is called as interleaving.

MULTIPLEXING

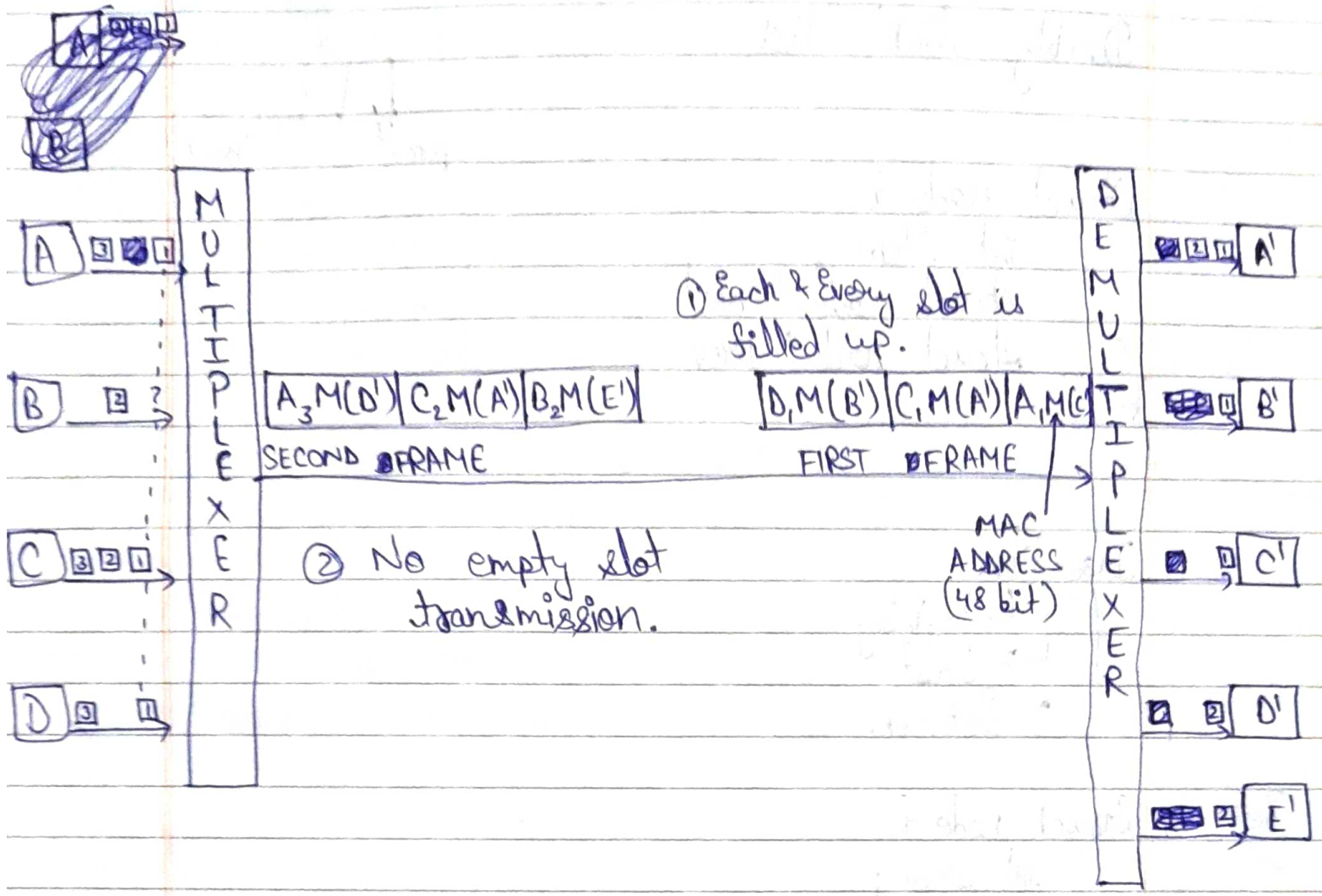
SYNCHRONOUS

TIME DIVISION MULTIPLEXING —



FRAMING BIT SYNCHRONIZATION PATTERN

ASYNCHRONOUS TIME DIVISION MULTIPLEXING

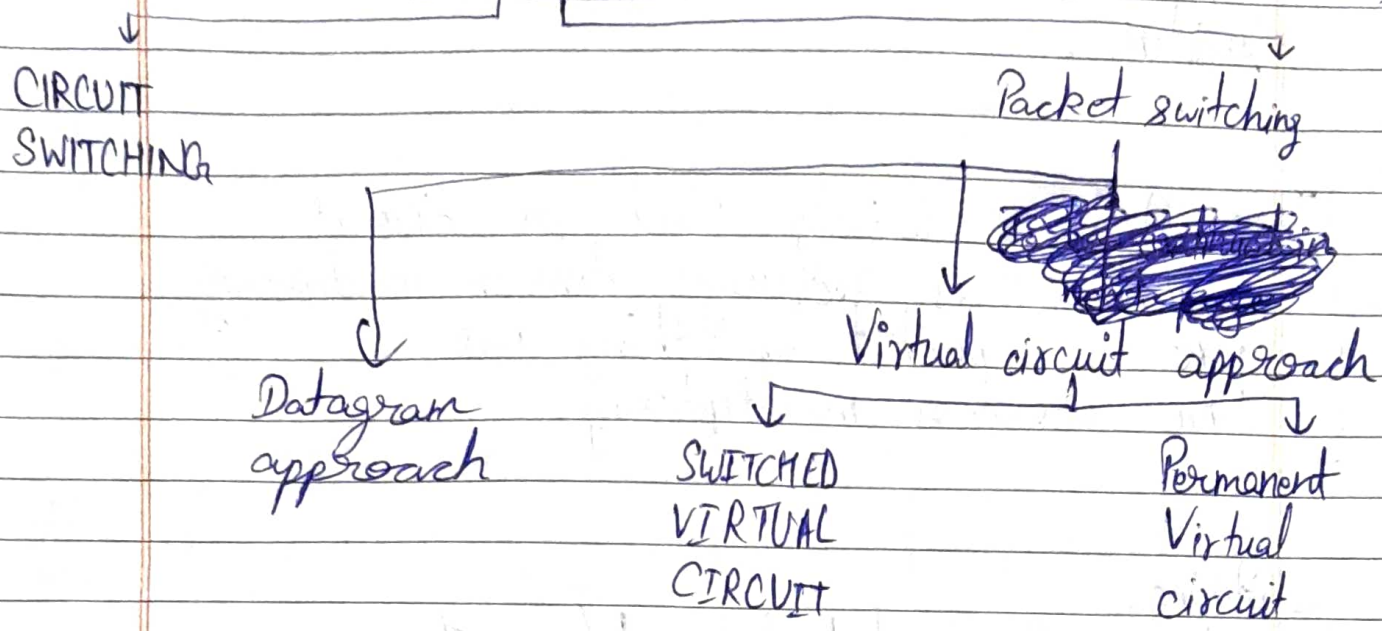


ipconfig/all

DATE: __/__/____
PAGE

[Network LAYER ON OSI]

SWITCHING [IP ADDRESS; 32 bit IPv4, 128 IPv6]



smooth/

For the seamless flow of data one of the most preffered device is switch.

switch usually operate on the Network layer

switching is classified in 2 categories

① circuit switching & ② Packet switching

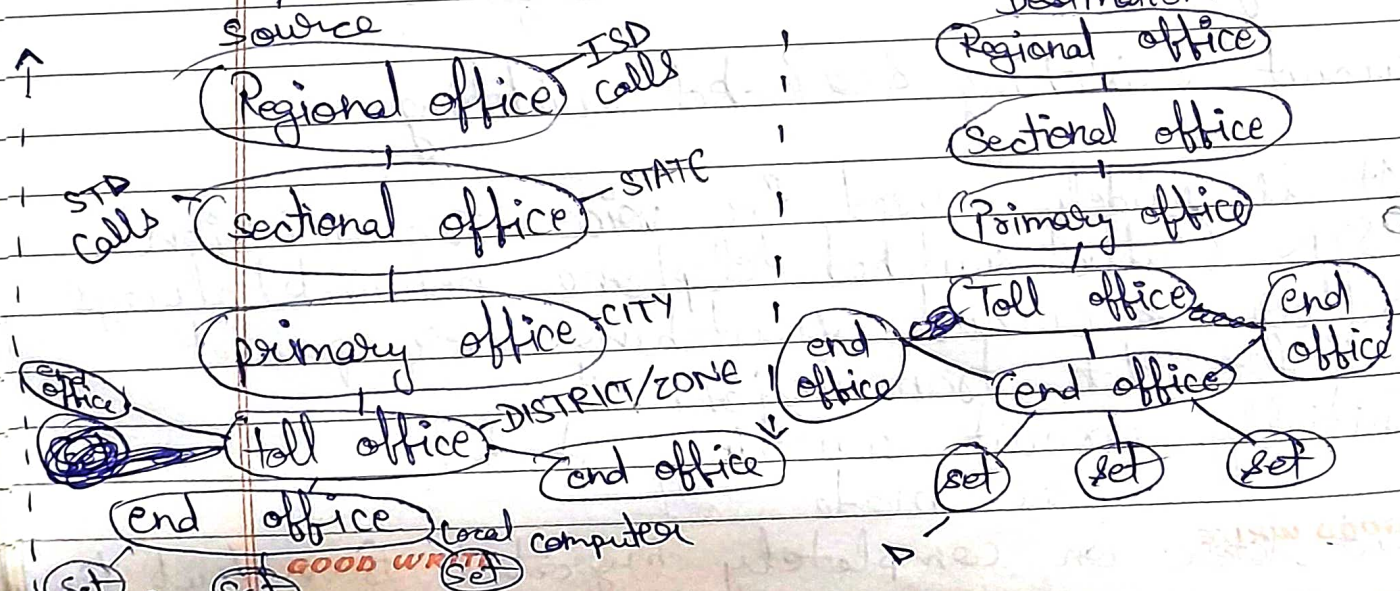
1) It is widely used for voice transmission. PSTN (Public switched telephone network) always preffer ⊗ circuit switching over packet for data transmission.
Initially circuit switching started as mode of
~~last~~ later on completely migrated from hub to

switch.

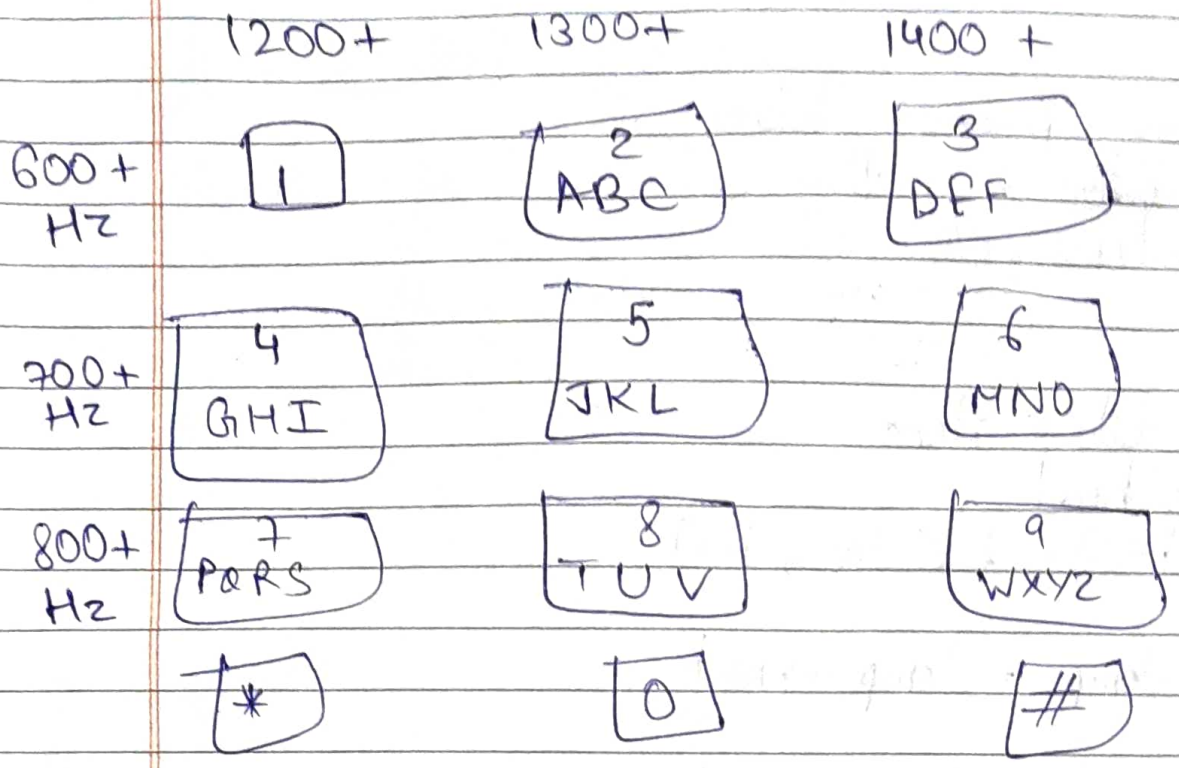
Multiplexing widely used in circuit switching is frequency division multiplexing whereas packet switching use time division multiplexing.

In circuit switching, entire path is dedicated b/w the source & destination & no other device is b/w during mode of communication, and no device can use transmission media during entire course of conversation. this results in wastage of network resources

the schematic representation in circuit switching as used in PSTN network is shown below:



EIA - Electronics industrial association



TOUCH TONE DIAL

PAD SYSTEM

8 DIGIT

DATE: __/__/____
PAGE _____

PACKET SWITCHING

- Datagram approach
- VIRTUAL CIRCUIT APPROACH
  - SWITCHED VIRTUAL CIRCUIT
  - PERMANENT VIRTUAL CIRCUIT

Packet switching is usually performed on network layer on OSI model.

Router on network is designed to perform packet switching using any of the ~~following~~ above 2 approach:

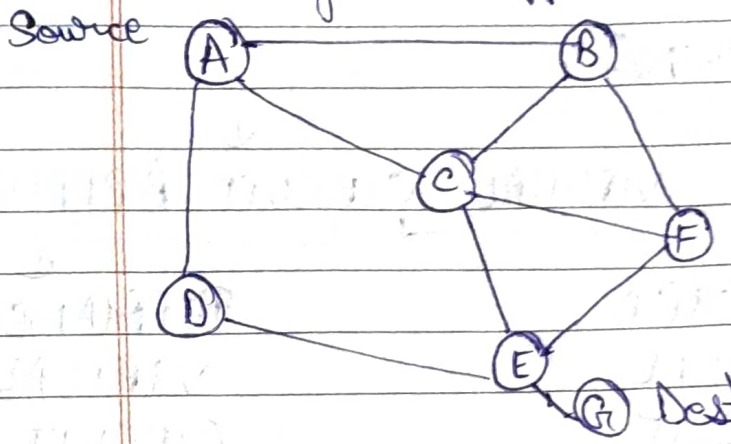
Datagram approach is also called as connectionless approach that usually operates at transport layer.

whereas virtual is popularly called as connection oriented approach, and usually operates on network layer

FAR → Fragmentation and Reassembling

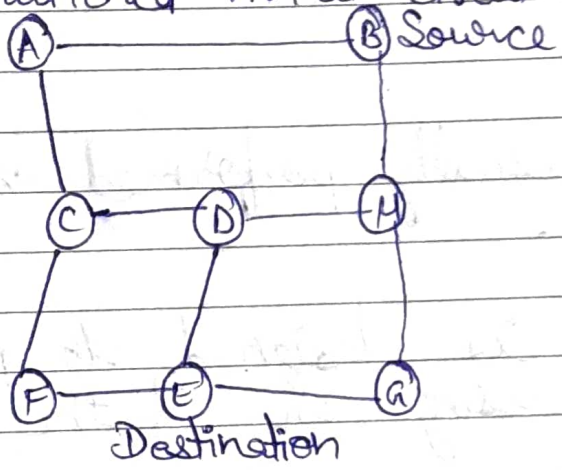
Network → Destination

↓ Datagram Approach



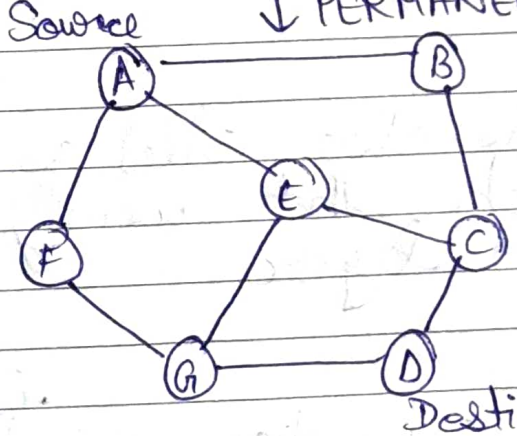
Connection less / TRANSPORT LAYER

↓ Switched virtual circuit



CONNECTION ORIENTED / NETWORK LAYER

↓ PERMANENT VIRTUAL CIRCUIT



CONNECTION ORIENTED / NETWORK LAYER

GOOD WRITE

Guard band → Gap b/w two given frequency while or calls

CIRCUIT SWITCHING	PACKET SWITCHING
① It is widely preferred for voice transmission.	It supports both voice & non-voice data transmission.
② It supports frequency division multiplexing technique.	It supports both synch. & Asynch. TDM technique.
③ In C.S, during process of comm. b/w source & dest., a dedicated path is established b/w the source & dest. which can be terminated only by source. This makes C.S inefficient for it's commercial use.	In P.S, dedicated path is established b/w source & dest., on the request of source & that can be aborted / terminated either by source or by dest. or TSP/NSP/ISP/TELECO. (Network service provider)
④ Finds its applicability PSTN.	Finds its applicability in ISDN. (Integrated services digital Network)
⑤ It is vulnerable to - diff. transmission impairement such as: Noise, interference (cross talk), attenuation.	P.S is not vulnerable to any Known transmission impairement.

GOOD WRITE

⑥ data transfer rate which can be achieved in C.S is low	Data transfer rate which can be achieved is very high
⑦ C.S is not classified into any categ.	P.S is classified in 2 categ. Datagram approach virtual approach e.g. V.A Further classifies into 2 categ. ① switched, permanent virtual circuit.

ISDN

It was first introduced by ITU [international telecomm. union] in 1976.

ISDN provides a set of protocols that aims to support transfer of both voice & non-voice & text based services over the network.
Services offered by ISDN are classified into following 3 categories

① Bearer Services ~~→ APP → PRES → SESSION~~
② Tele/transport services
③ Supplementary services

SID → Session ID

UTF-8
UTF-16
UTF-32
→ Universal character transformation format.

1) Services that are provided on the first 3 layer of OSI model are called as bearer services.

APP	PRES	SESSION
UI (Msg generation)	Translation/ encryption/ encoding 8 → ASCII 16 → UNICODE 32 → UCS	create a session b/w client & server on client demand.

GOOD WRITE

DATE: __/__/____
PAGE _____

2) The services that are provided on layer 4 to 7 are called as tele / transport services. These services if required can be manipulated by the telecom service provider. Eg of this service include teletax, telefax, etc.

3) Supplementary service

Services that are provided as complementary services or as a premium value service like caller identification, sms message, etc. are called as supplementary services.

These services if required can be manipulated by the telecom service provider.

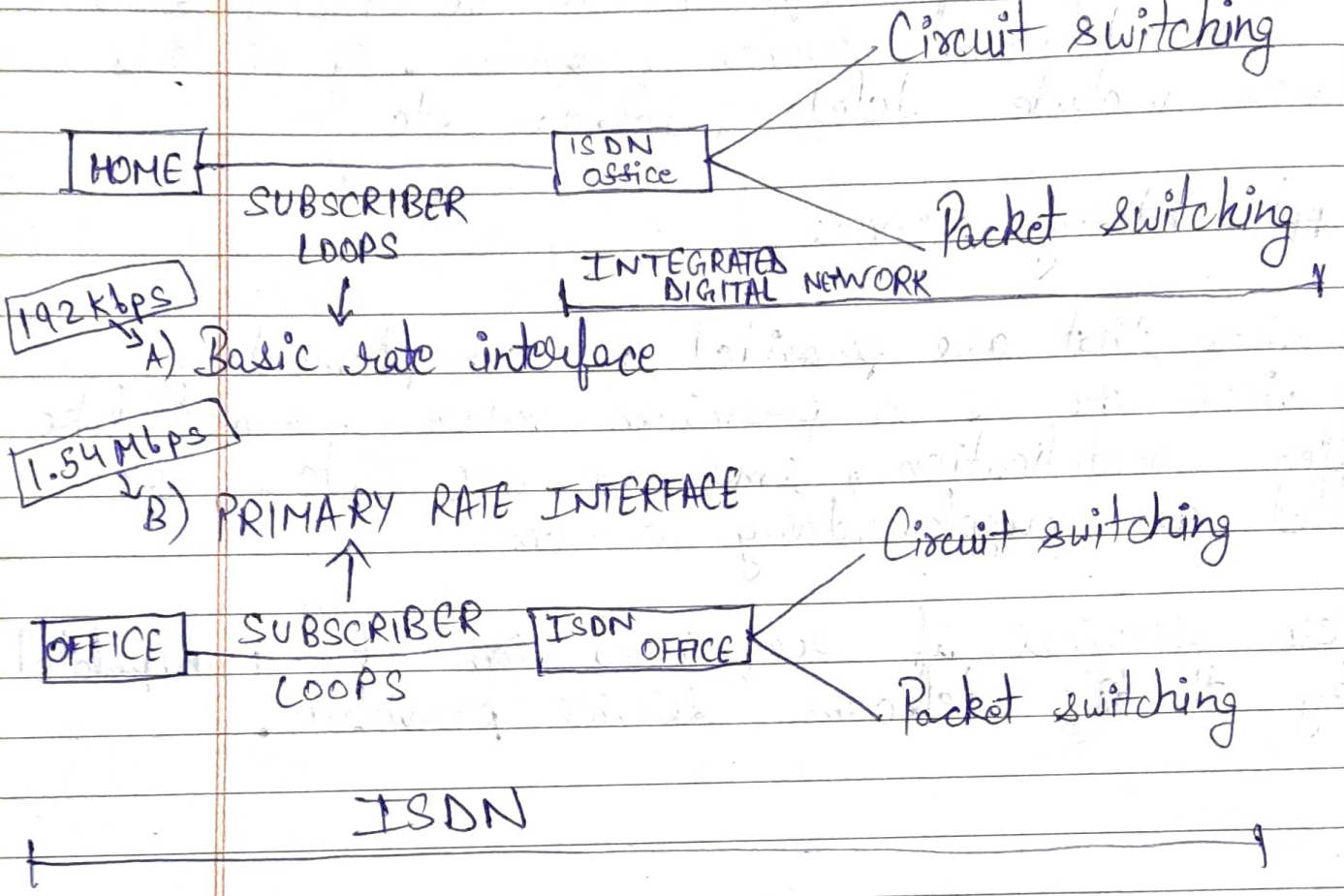
QOS

Quality of Service :

1. Waiting time
2. RSSI (Recieved signal strength indicator)
3. Network coverage
4. Call drop ⟶ (Zero / Hole region)
5. Customer service

* TRAI evaluates all companies on the basis of above services.

ARCHITECTURAL DIAGRAM



B (Bearer) Channel : 64 Kbps

D (DATA) Channel : 16 - 64 Kbps

H (HYBRID) Channel : 384 - 1920 Kbps

DATE: __/__/____
PAGE _____

ATM

Asynchronous transfer mode of the data communication combines the best of the multiplexing, switching and broadband ISDN.

ATM was first proposed by ITU i.e. International Telecommunication union.
It was proposed with objective of achieving high speed data transmission upto a data rate capacity of (10 - 100) Gbps.

ATM uses concept of inter-connecting multiple switches which compresses of virtual circuit & virtual path.
Multiple no. of virtual circuit connecting lines can be transmitted through a single virtual path.
Both virtual path & virtual circuit are used to define following two interface:
UNI → User to Network Interface.
NNI → Network " " ".

Size of a data packet that is transmitted to ATM is 53 bytes out of which 5 bytes are header and 48 bytes of data is payload section of data packet.

DATE : __/__/____
PAGE _____

MULTIPLEXING / SWITCHING / ISDN

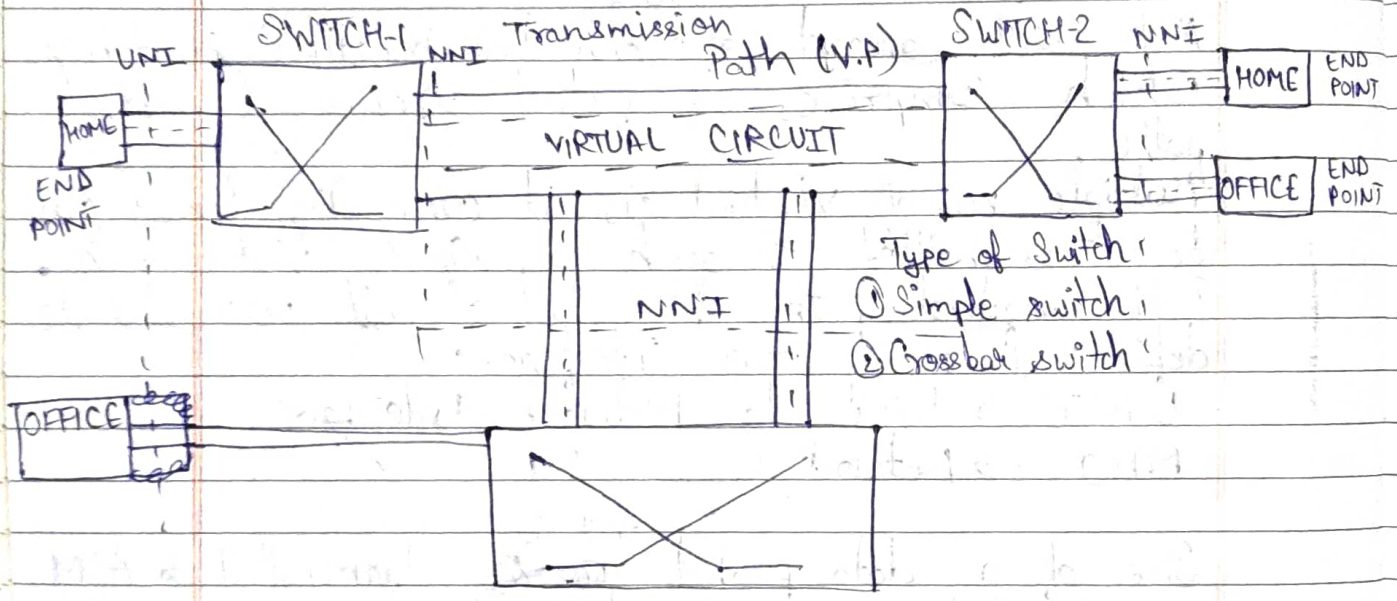
Frequency → modulation

TDM
- Synch
- Asynch

DP / CL

VC / CO
- I/O
- PVC / Dedicated path

ATM
- → Voice Bearer
- → Fax Tele/Transport
- → Caller ID/SMS Supplementary



Type of Switch:
1. Simple switch
2. Crossbar switch

Network layer / IP address

NOTE - TYPE STUFF

Network Devices : SINGLE Network

- Bus
- Star
- Ring
- Mesh
- Hybrid

→ MAC ADDRESS

Inter network Devices : MULTIPLE NETWORK

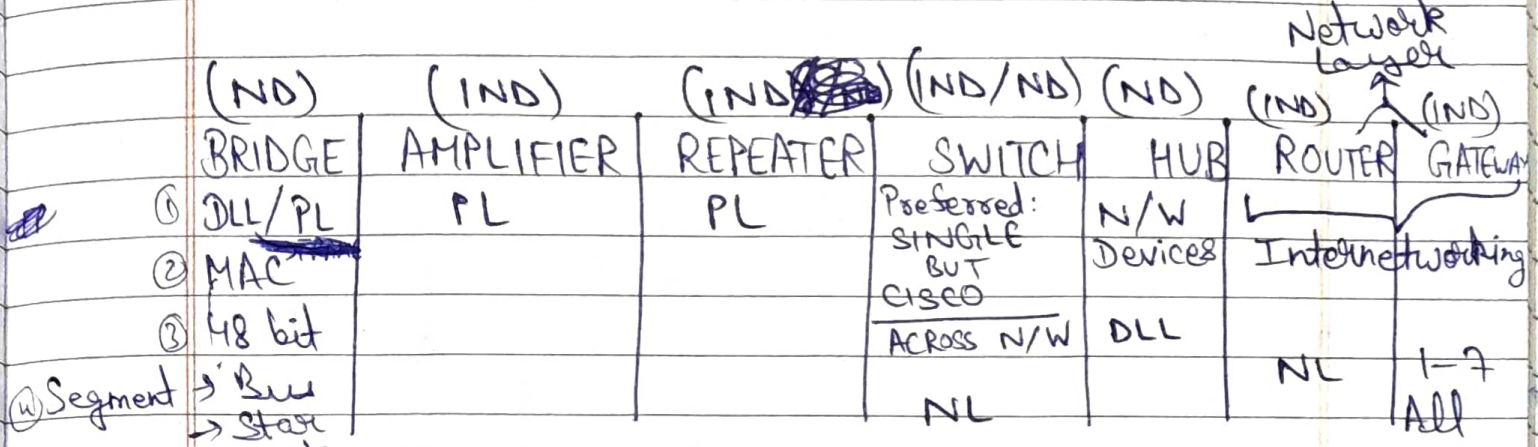
- PSTN
- WIRELESS
- ATM
- ISDN

SWITCH (Packet) , Bridge (frame)

2	83
2	41

Networking / Internetworking Devices

on network /



⑤ SIMPLE & LEARNING

1) Bridges are network devices that operate on the DLL and physical layer of OSI model.

2) Bridges use mac address for data transmission.

3) Bridges are widely used to connect multiple segments belonging to same network topology.

4) Bridges are of multiple type, broadly classified on the basis of their complexity and accordingly 2 broad categories that exist are simple & learning bridges

Simple:

5) Bridges in which information about all the nodes of a network is pre-stored are called as simple bridges.

Learning:

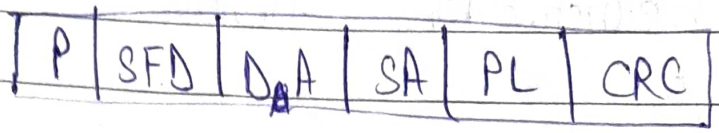
Bridges that learn about existence of other nodes in network dynamically on run time basis are called as Learning bridges.

GOOD WRITE

ipconfig /all

[SPP]

Min Req. →



LOS → Line of sight Transmission

Transmission

DATE: / /

PAGE

A P S T N DL P

Networking Devices Inter Networking Devices

Amplifier / Repeater → Only used for Long Distance.

Both amplifier & reapeater operates on the DLL / PL of OSI model.

Both amplifier & repeater are used to minimise impact of attenuation on long distance transmission of signal.

Both are used to

DATE: __/__/____
PAGE _____

Error Detection in Network :

→ During the process of Data transmission, at times data integrity gets violated by bit corruption or flipping of bit such a kind of condition situation ~~leads to it~~ raises need for error detection.
Error Detection is usually performed at Destination end or intermediate node end.
One of the most preferred way of Error Detection is by addition of parity bit along with data stream or bit stream.
Such a addition of ~~the~~ ~~addit~~ extra bit (Overhead) leads to concept of data redundancy.

→ PARITY BIT is usually generated by help of additional software program called as parity bit generator.

→ Parity bit Generator usually operates at the physical layer of OSI model.

→ For the efficient Error Detection many techniques have become popular over a period of time such as Vertical redudancy (V.R.C), Longitudal redudancy (L.R.C), cydic redudancy (C.R.C), checksum (C.S.)

Addition of extra bits

1943 → M
M
A
1950s → A
1955 → C
Q1 →
Q2 →
A → 1) E
2) T
3) F
4) A
Technique
6)
7)
Q3 → W

GOOD WRITE

DATE: __/__/____
PAGE _____

ERROR

① Vertical Redudancy Check Technique :

In The V.R.C.T following steps are performed :

i) The String to be transmitted from source to destination is taken as plain text from user.

ii) ASCII Value of each character of a string is determined

iii) The 7 bit binary ASCII code value of each character of string is computed the no. of ones is computed and if its is found to be even then parity bit of 0 is appended.

iv) The entire string is then transmitted from source to destination.

gg sipu

97	a	111	o
98	b	112	p
99	c	113	q
100	d	114	r
101	e	115	s
102	f	116	t
103	g	117	u
104	h	118	v
105	i	119	w
106	j	120	x
107	k	121	y
108	l	122	z
109	m		
110	n		

2	103
2	51 1
2	25 1
2	12 1
2	6 0
2	3 0
2	1 1
	0 1

g 1 1 0 0 1 1 1 1
g 1 1 0 0 1 1 1 1
s 1 1 1 0 0 1 1 1
i 1 1 0 1 0 0 1 0
p 1 1 1 0 0 0 0 1
0 1 0 1 1
u 1 1 1

GOOD WRITE

DATE: __/__/____
PAGE _____

2	115
2	57 — 1
2	28 — 1
2	14 — 0
2	7 — 0
2	3 — 1
2	1 — 1
	0 — 1

1100111111001111111001111101001011100001

↓

11101011

M+r = 42+6 = 48 bit

2	105
2	52 — 1
2	26 — 0
2	13 — 0
2	6 — 1
2	3 — 0
2	1 — 1
	0 — 1

1101001

2	112
2	56 — 0
2	28 — 0
2	14 — 0
2	7 — 0
2	3 — 1
2	1 — 1
	0 — 1

2	117
2	58 — 1
2	29 — 0
2	14 — 1
2	7 — 0
2	3 — 1
2	1 — 1
	0 — 1

GOOD WRITE

DATE : / /
PAGE

② Longitudinal Redudancy

J	: 1010101	①
S	: 1010011	②
A	: 1000001	③
R	: 1010010	④
	0010101	⑤

10101011010011100000110100100010101

CRCT :

Length of padding = n-1 (n is divisor)

Padding bit is always 0.

While doing division if leftmost bit is 0 then divide it by 0 0 0 0 .....

Eg:

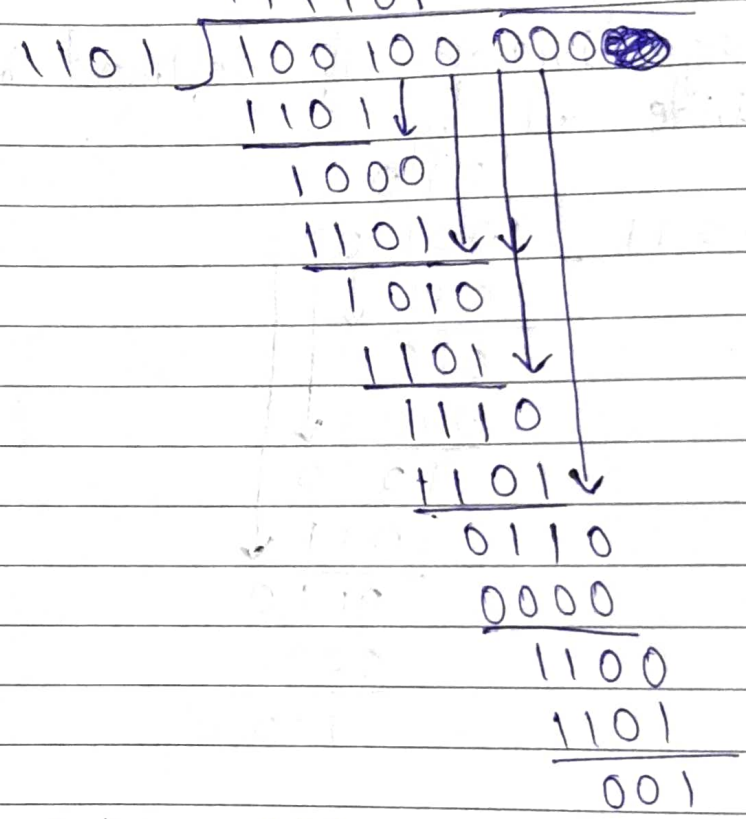
```
          1010
      ┌──────────
1011  │ 1001 000
      │ 1011
      │ ----
      │  0100
      │  0000
      │  ----
      │   1000
      │   1011
      │   ----
      │    0110
      │    0000
      │    ----
      │     110
```

Codeword 1010 110

Dataword Remainder

Divisor : 1101

Dividend : 100100



Remainder = 001

* Max. no of Padding can be 7 in an 8 bit frame.
* Most acceptable padding pattern is 00000...

DATE: __/__/____
PAGE _____

ERROR DETECTION TECHNIQUE

VRC	LRC	CHECKSUM	CRC
1) PB is integrated with data stream	PB is placed in trailer of data frame.	PB is placed in trailer of data frame.	PB is placed in trailer of data frame.
2) No padding (extra dummy bits) is required.	Padding is required to ensure that all frame are uniform & symmetric.	No padding is needed.	No padding is required.
3) No overhead.	Overhead, due to padding.	Steps performed: 1) Binary addition 2) 1's Complement.	Steps performed: a) Division of plaintext + (n-1) by divisor b) Concatenation of Remainder with plaintext.
4) Steps :- IEO → Horizontal. ↓ then If one even add 0.	Steps :- IEO → Vertical.		

PLAINTEXT: PeAcE

	L.C	U.C		L.C	U.C		L.C	U.C
a		65		k			u	
b				l			v	
c	99			m			w	
d				n			x	
e	101	69		o			y	
f				p		80	z	
g				q				
h				r				
i				s				
j				t				

GOOD WRITE

2	80
2	40 0
2	20 0
2	10 0
2	5 0
2	2 1
2	1 0
	0 1

2	101
2	50 1
2	25 0
2	12 1
2	6 0
2	3 0
2	1 1
	0 1

2	65
2	32 1
2	16 0
2	8 0
2	4 0
2	2 0
2	1 0
	0 1

2	99
2	49 1
2	24 1
2	12 0
2	6 0
2	3 0
2	1 1
	0 1

P → 1010000
e → 1100101
A → 1000001
c → 1100011
E → 1000101

2	69
2	34 1
2	17 0
2	8 1
2	4 0
2	2 0
2	1 0
	0 1

VRC

10100000 1100101 0 1000001 0 1100011 0 1000101 1

LRC

```
  1010000
  1100101
  1000001
  1100011
  1000101
 ---------
  1010010
```

10100001100101100000111000111000101 1010010

1 → 0001
2 → 0010
3 → 0011
4 → 0100

1+0 → 1
1+1 → 10
1+1+1 → 11
1+1+1+1 → 100

DATE: __/__/____
PAGE _____

CHECK SUM

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

  1 0 1 1 1 1 0
```

```
    1 1 1
  1 1 1 1 1
  1 0 1 0 0 0 0
  1 1 0 0 1 0 1
  1 0 0 0 0 0 1
  1 1 0 0 0 1 1
  1 0 0 0 1 0 1
  1 0 1 1 1 1 0
-------------------
1 1 1 1 1 1 1 0 0
  ↑_____↑
-------------------
  1 1 1 1 1 1 1 1
```

↓ 1's complement

0 0 0 0 0 0 0 0

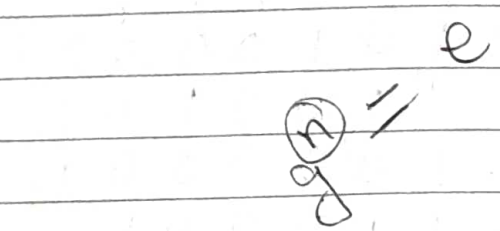
eg: $x^7 + x^5 + x^2 + x + 1$ → $x^7 + 0x^6 + x^5 + 0x^4 + 0x^3 + x^2 + x + 1$

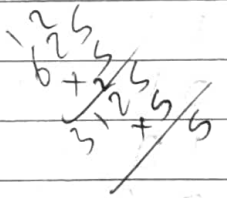
1	0	1	0	0	1	1	1

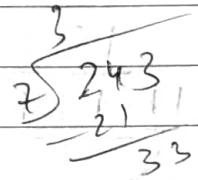
DATE: / /
PAGE

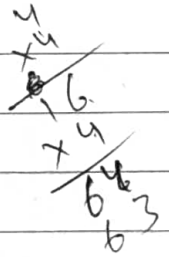
```
          1101001
      ------------
1101 | 10100000000
       1101
       ----
        1110
        1101
        ----
         0110
         0000
         ----
          1100
          1101
          ----
           0010
           0000
           ----
            0100
            0000
            ----
             1000
             1101
             ----
              101 ←
```

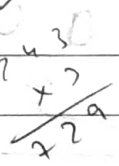
1010000101











DATE : __/__/____
PAGE _____

Computer Networks

Error correction technique

Technique that is widely used for detection of errors that are committed during process of data transfer is called ECT.

One of most popular & widely used ECT is "Hamming Technique" given by R.W. Hamming.
This technique involves addition of additional bits of data depending on length of bit stream that is transmitted to source to destination.
Given below is chart that gives no. of additional bits to be added with the original bit stream.

Bit Stream Length (m)	Redudant bits (r)	Total length (m+r)
1	2	3
2	3	5
3	3	6
4	3	7
5	4	9
6	4	10
7	4	11

0 : 0000	6 : 0110	12 : 1100
1 : 0001	7 : 0111	13 : 1101
2 : 0010	8 : 1000	14 : 1110
3 : 0011	9 : 1001	15 : 1111
4 : 0100	10 : 1010	
5 : 0101	11 : 1011	

GOOD WRITE

7 bit stream → 4 redudant bits

r_1, r_2, r_4, r_8

r_1: 1, 3, 5, 7, 9, 11, 13, 15
r_2: 2, 3, 6, 7, 10, 11, 14, 15
r_4: 4, 5, 6, 7, 12, 13, 14, 15
r_8: 8, 9, 10, 11, 12, 13, 14, 15

} Error in specified position.

Bit stream: 10011101 / 1001

r_8 r_4 r_2 r_1

Pattern of bits

Original data

d_7	d_6	d_5	r_8	d_4	d_3	d_2	r_4	d_1	r_2	r_1
1	0	0	1	1	1	0	0	1	0	1
			r_8				r_4		r_2	r_1

DATA

100 1110 01 01 Data Stream

100 1 010 01 01 → Received

11 10 9 8 7 6 5 4 3 2 1

r_1 1 1 0 0 0 1 : 1
r_2 0 1 1 0 0 1 : 1
r_4 0 0 1 0 : 1
r_8 1 0 0 1 : 0

0111 → 7th position, mistake found.

GOOD WRITE

Computer Networks

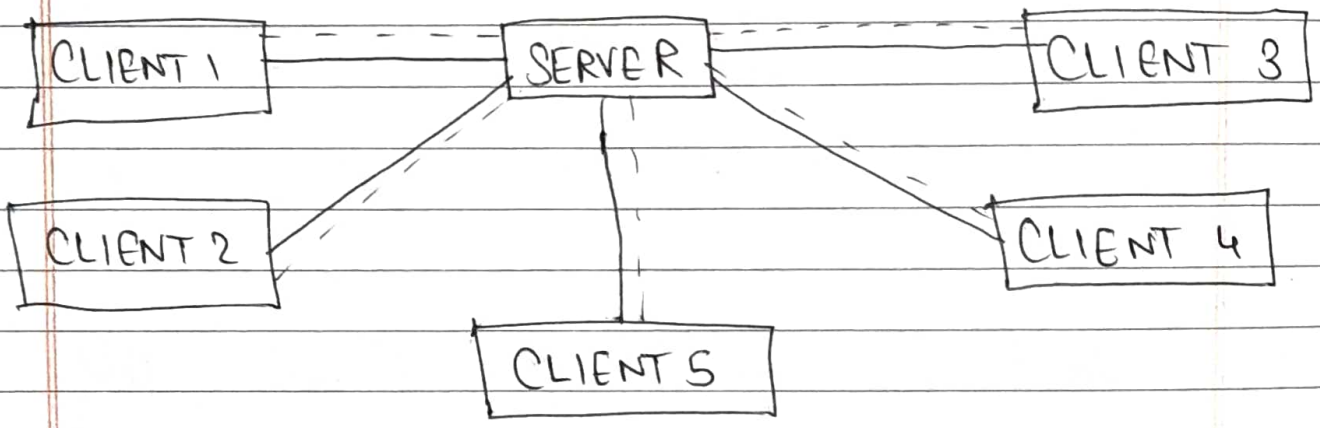
DATE: __/__/____
PAGE _____

Issues in data link layer

Line Discipline
(Who should send the data?)

Flow Control
(How much amount of data to be send?)

ERROR CONTROL
(ED & CB
Retransmission, if required)



~~FLOW CONTROL:~~

LINE DISCIPLINE

- Enquiry acknowledgement
  - Usually used in point to point transmission
- POLL / SELECT

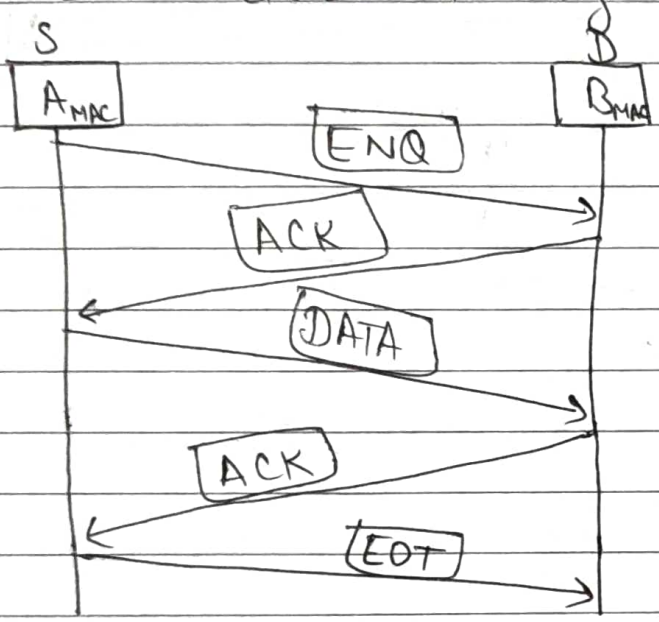
PING → Packet internet group

DATE: __/__/____
PAGE _____

Enquiry acknowledgement:

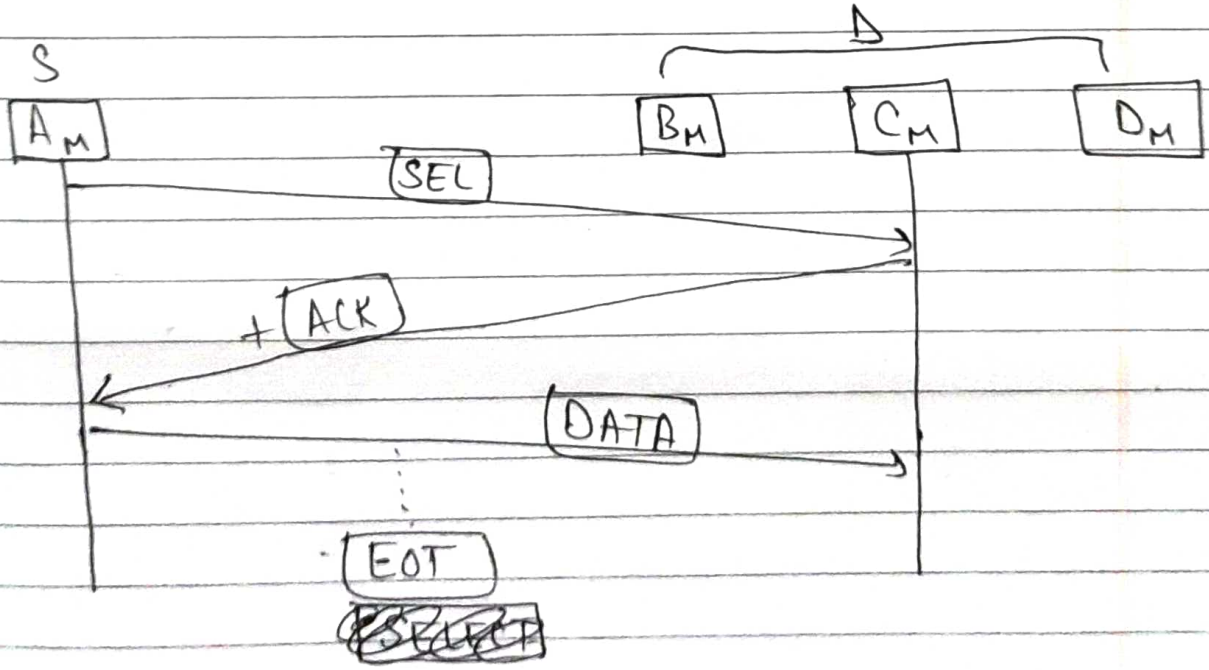
In enquiry acknowledgement technique the source generate a data frame and transmit it to destination.
Destination replies back by sending acknowledgement to source node and thereafter data transmission starts.
Data transmission goes on unless & until EOT frame is transmitted by source node.

Line Discipline

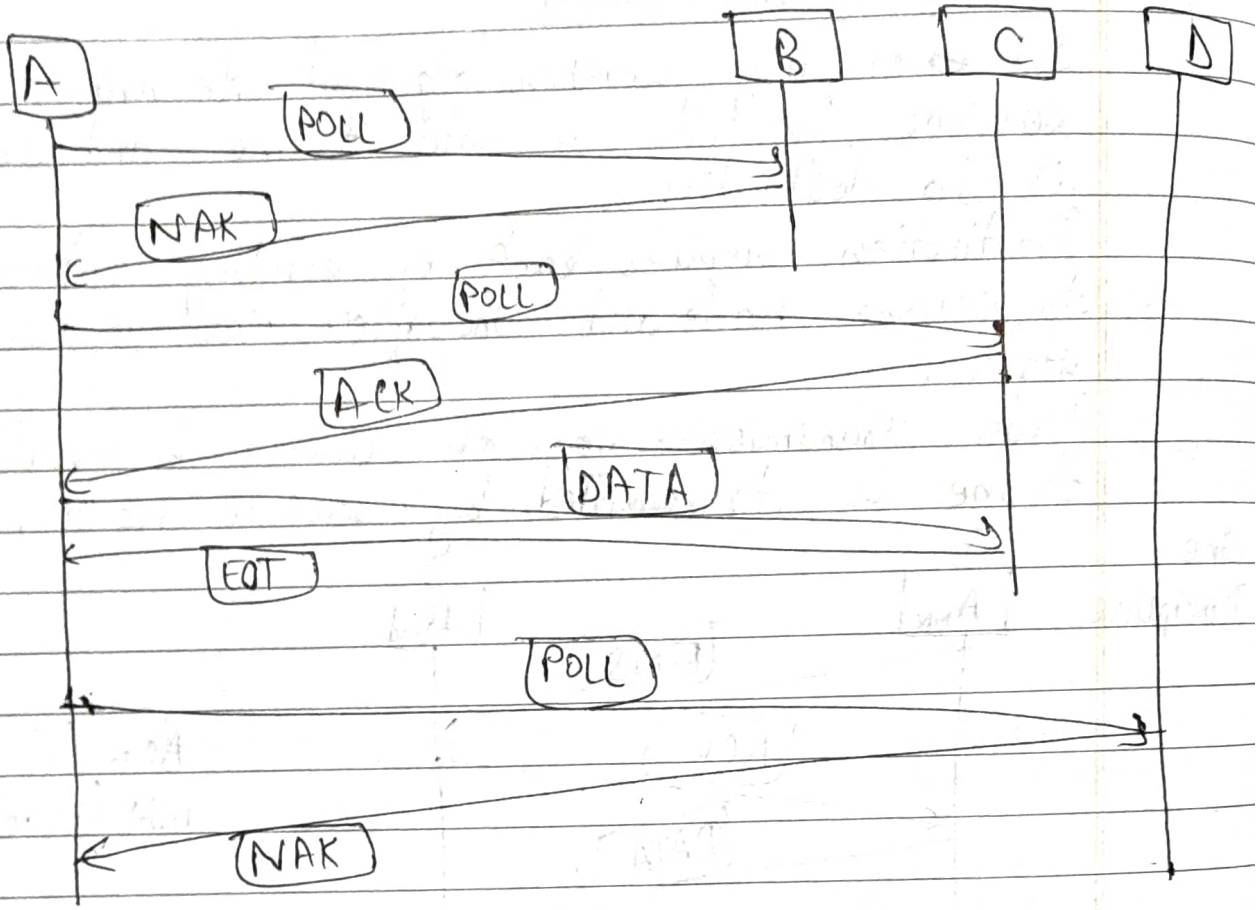


ACK (+ acknowledgement)
NAK (− acknowledgement)

SELECT



GOOD WRITE


A
B
C
D
POLL
NAK
POLL
ACK
DATA
EOT
POLL
NAK

DATE: __/__/____
PAGE _____

Flow control

To implement F.C mechanism at data link layer two techniques have been provided

1. Stop and wait.
2. Sliding window

In Stop & wait flow control technique, The sender transmits data frame and wait for the acknowledgement to come from destination. If no acknowledgement comes then sender retransmits data frame, assuming either data frame was lost or acknowledgement was lost in previous transmission. This technique is only used to send one data frame at a time.

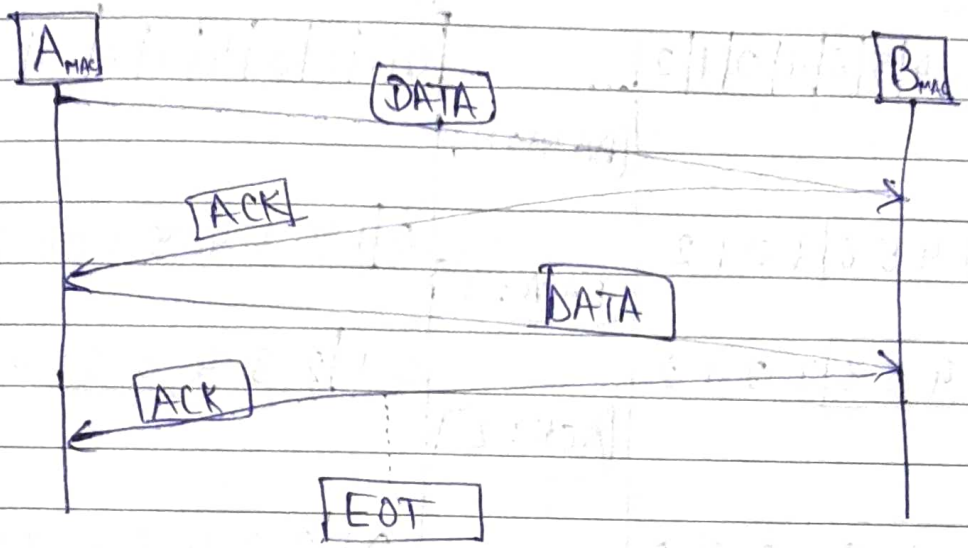
The sliding window flow control technique is used to handle the simultaneous transmission of multiple number of data frame as name indicate a window is established both at source & at destination end which shifts to the right on successful transmission of data frame or on successful receipt of acknowledgement.

Window size = $n-1 = 8-1 = 7$ (0 .... 6)

(n ↓ frame size)

DATE: __/__/____
PAGE: _____

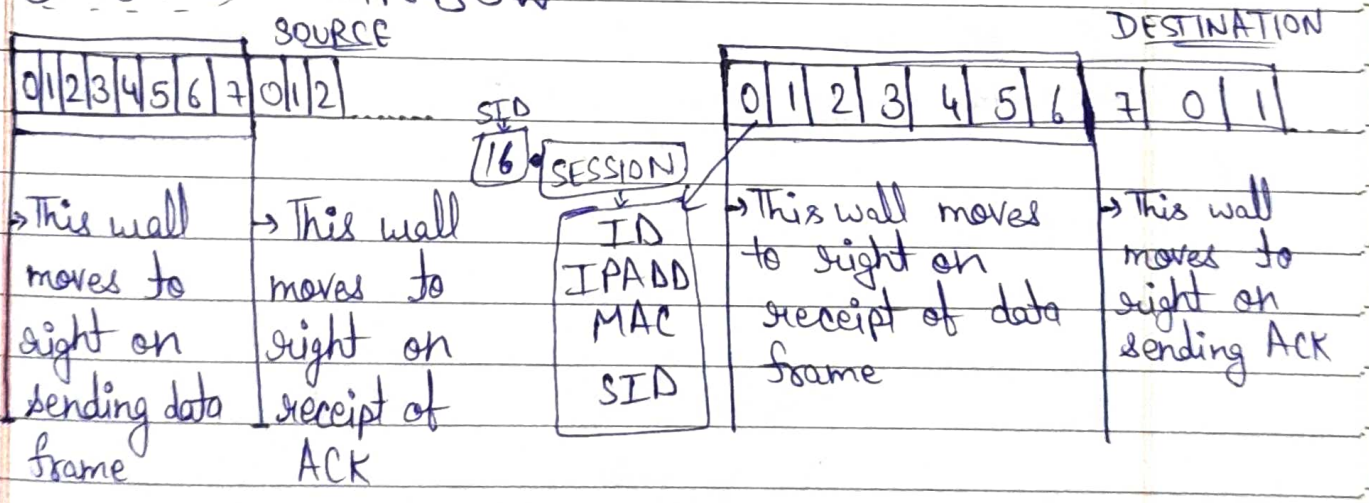
SENDER DESTINATION



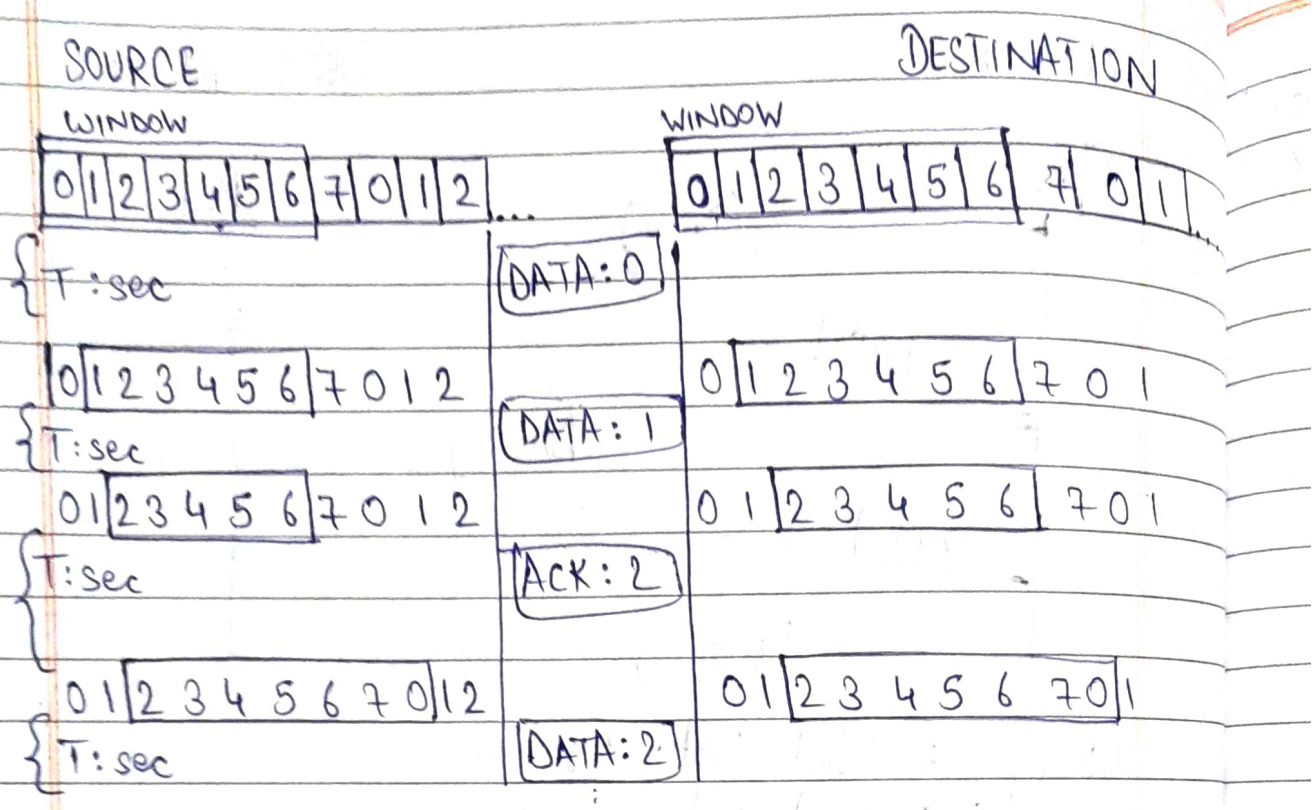
Case 1 : Lost Data frame

Case 2 : Lost Ack frame

Sharing & Sliding ← SLIDING WINDOW



GOOD WRITE



ERROR CONTROL TECHNIQUES

- Stop & wait ARQ [Automatic Repeat Request]
- Sliding window ARQ
  - Go-back n
    1. Lost Data frame
    2. Lose Ack
    3. Error in Data frame
  - Selective Reject

→ Stop & wait ARQ

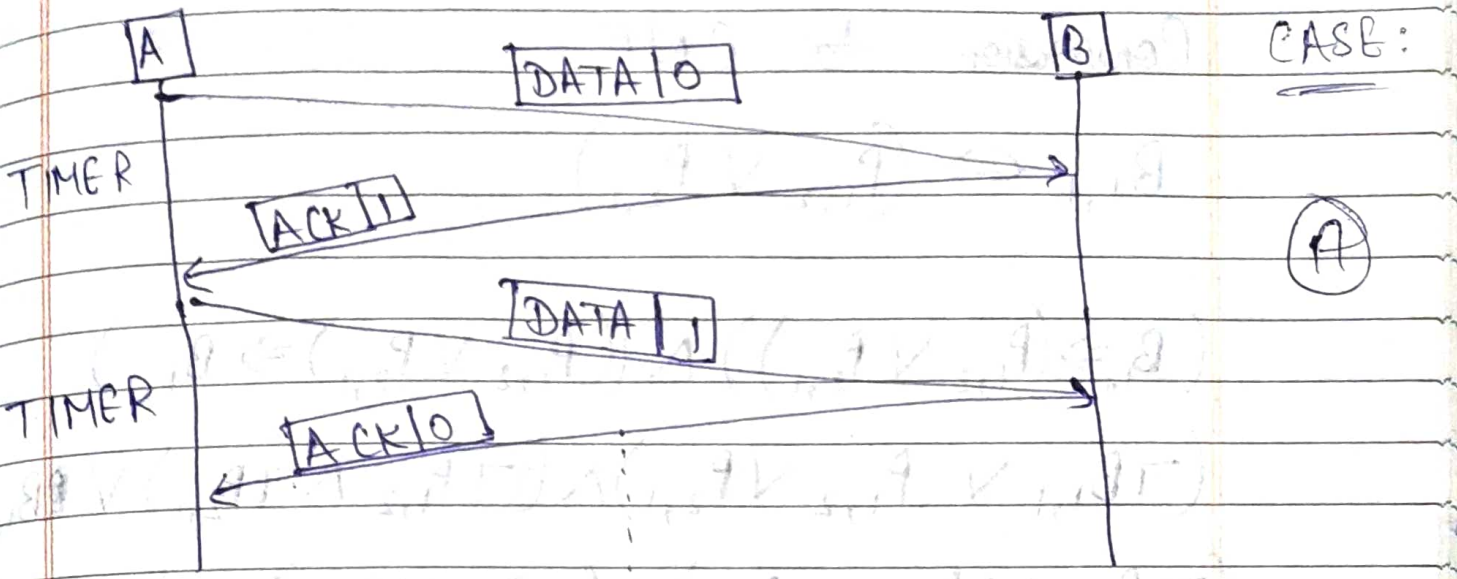
In this technique the source transmit a data frame, starts a timer and wait for acknowledgement to come from destination side. This technique is successfully able to handle following 3 cases:

1) loss in data frame.
2) Loss in acknowledgement frame.
3) Discarding of already transmitted data frame by destination.

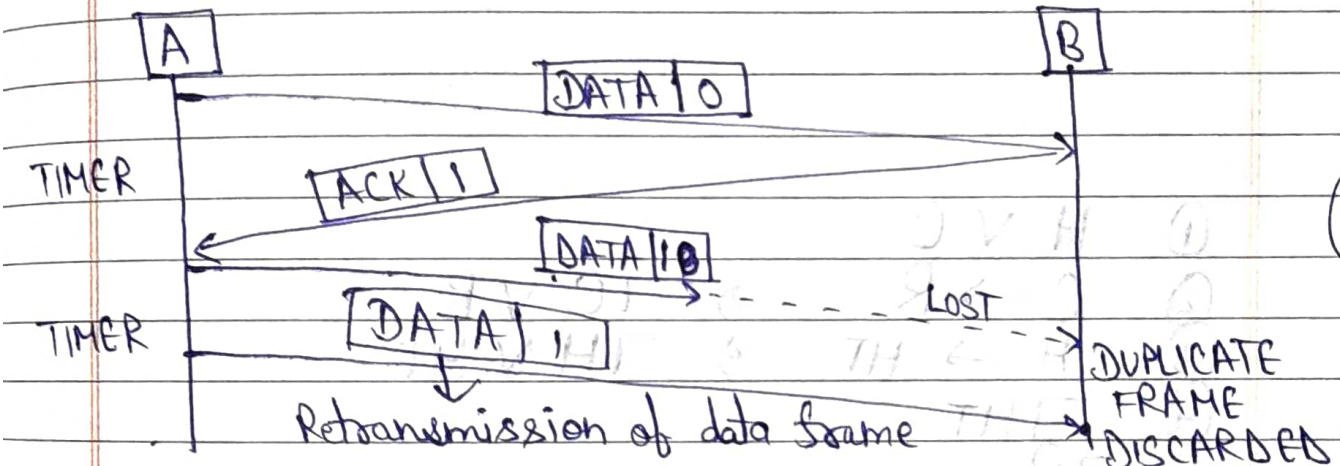
The stop and wait ARQ is primarily depend on the usage of timer by source node. The value of timer is incremented if delayed response is received from destination and is decremented if quick response is received from destination.

DATE: __/__/____
PAGE _____

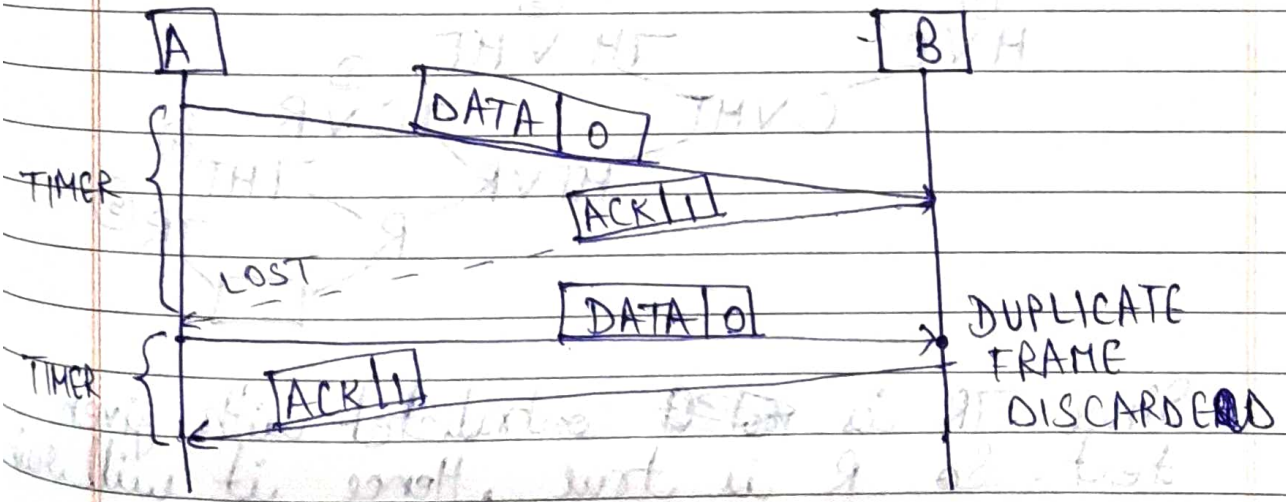
CASE:



(A)



(B)

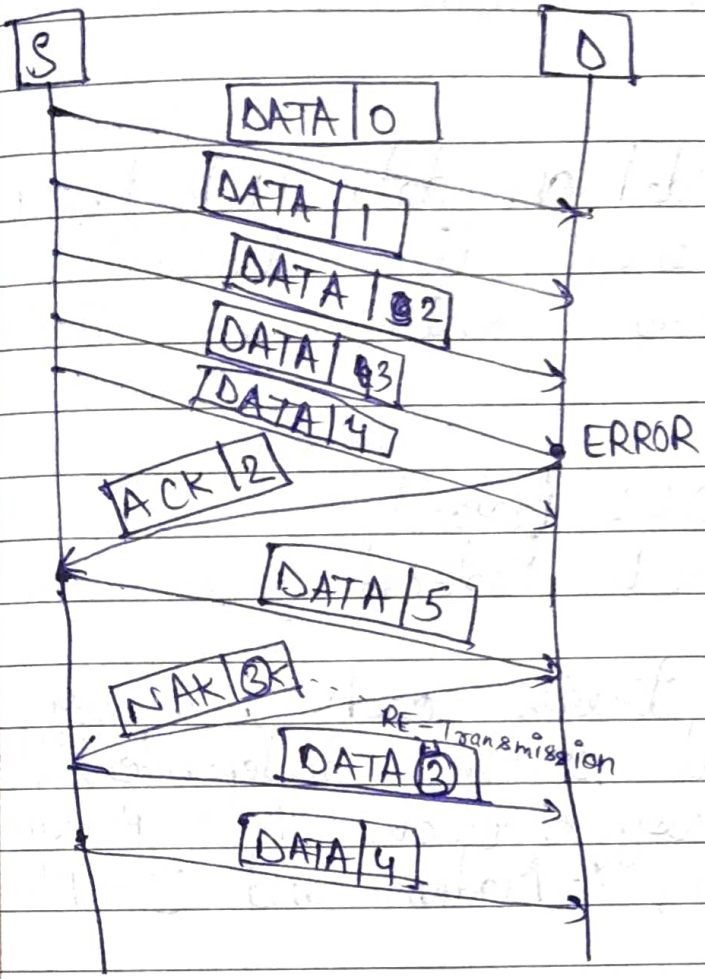


(C)

Computer Networks

DATE: __/__/____
PAGE _____

Error Control



If [Ack | m] is lost and [NAK | n] is recieved then re-transmission will happen from [DATA | p+1], where p is last [Ack | p] received.

If no prior [Ack] was recieved then re-transmission will happen from [DATA | 0].

Data Link Layer Protocols

The protocols provided on data link layer to efficiently manage line discipline flow control and error control are divided in 2 broad categories

1 → Asynchronous DLL Protocol
2 → Synchronous DLL Protocol

1) Protocols that treats each and every character of bit stream independently are called as asynchronous DLL Protocol. For eg: X-Modem, Y-Modem and Z-Modem protocols.

2) Protocol that treats entire bit stream in one go and chops / slice into section of equal no of bit stream are called as synchronous DLL Protocol. For eg: HDLC Protocol (Highlevel Data-Link layer Control Protocol)

HDLC

HDLC is Highlevel Data-Link layer Control Protocol first introduced by IBM in 1979 it was primarily designed to support simplex, half duplex, full duplex transmission over point to point and point to multipoint link.

Computer Networks

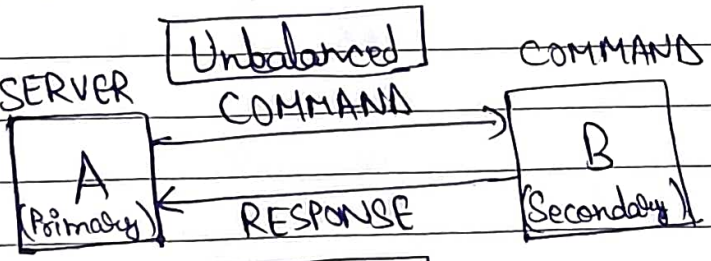
DATE: __/__/____
PAGE _____

HDLC

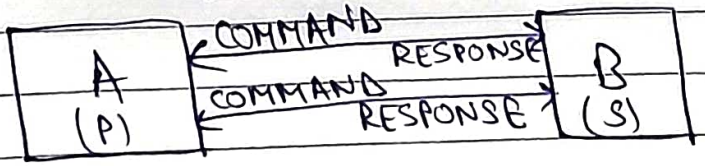
1) Configuration
   a) Unbalanced
   b) Balanced
   c) Symmetrical
2) Response modes
   a) Normal response mode
   b) Asynchronous response mode
   c) ASynchronous balanced mode
3) Types of frames:
   a) Information frame
   b) Supervisory frame
   c) Unnumbered frame

The network that uses the HDLC mode of data transmission provides following type of configuration, response mode and frame categories which are elaborated as follows:

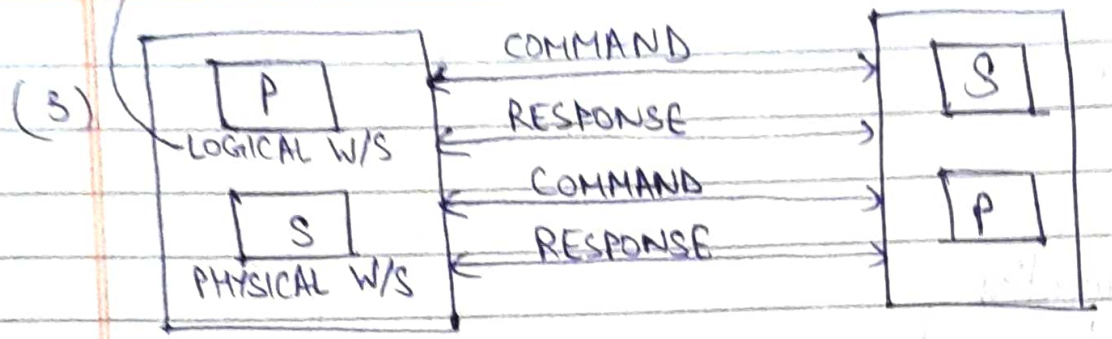
(1)



(2)



Logical Process
↑ running on Physical W/S.



In normal response mode, secondary workstation has to take permission from primary work station before transmitting data.

Asynchronous R M , secondary W/S does not have to take permission from primary W/S to transmitt data. Whenever channel is ideale secondary W/S can transmit the data.

- In Asynchronous Balanced Mode , both primary and secondary W/S synchronize with each other before transmitting a data, so that, no problem of collision arrises on : network.

CSMA | CA CSMA | CD

DATE: __/__/____
PAGE _____

CSMA → Carrier Sense multiple access
CA → Collision Avoid
CD → Collision Detection

HDLC provides 3 types of frame:

→ Whenever data needs to be transmitted between primary and secondary W/S, information frame is used to carry payload between source and destination.

→ The frame that is used in HDLC protocol to implement flow control and error control mechanism is called as supervisory frame. This frame is responsible for execution of stop & wait and sliding window flow control & error control technique.

The payload section is an optional section in supervisory frame.

→ The frame that is widely used to manage line Discipline or transmission media is called unnumbered frame. As name indicate these frame do not possess any number or id and they are widely used to implement Line discipline such as ENQ / ACK and POLL / SELECT.

HDLC FRAME FORMAT

	①	②	③	④	⑤	⑥ PROTOCOL
	FLAG	ADDRESS	CONTROL	INFORMATION	Frame Check Sequence (FCS)	FLAG
FRAME →				PAYLOAD		

1) FLAG (Start, End): 01111110 Bit pattern.
   (0 ← Indication)

2) Address :

   P → S (Address of 'TO' node)

   P ← S (Address of 'FROM' node)

Computer Network

00 : RR → Reciever Ready } P→S
10 : RNR → " Not " }
01 : REJ → Reject }
11 : SREJ → Selective reject } P←S

* (H) is more important than (T).

High Level D L L Control Protocol

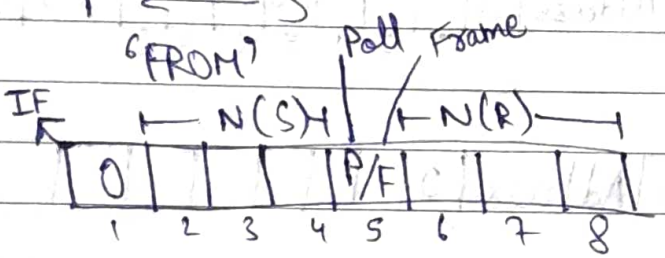
Information Frame

Flag (H) 8bit	Address 48 bit	Control 8 bit	Information	FCS	Flag (T)
1	2	3	4	5	6

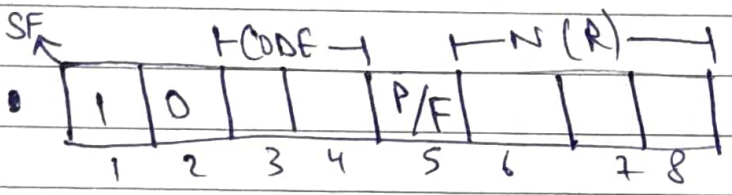
Supervisory:

Unnumbered:

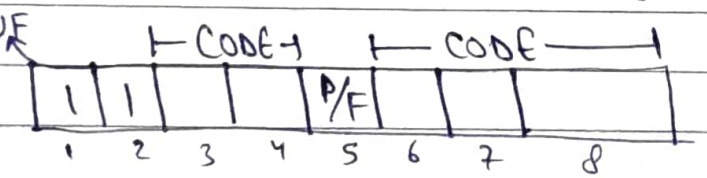
1) Flag : 01111110
2) Address Field : P ⟶ S "TO"
   P ⟵ S "FROM"
3) Control Field :



4) Information (Payload) :



5) FCS (EDC) :



N(S) : Sequence number of frame being send

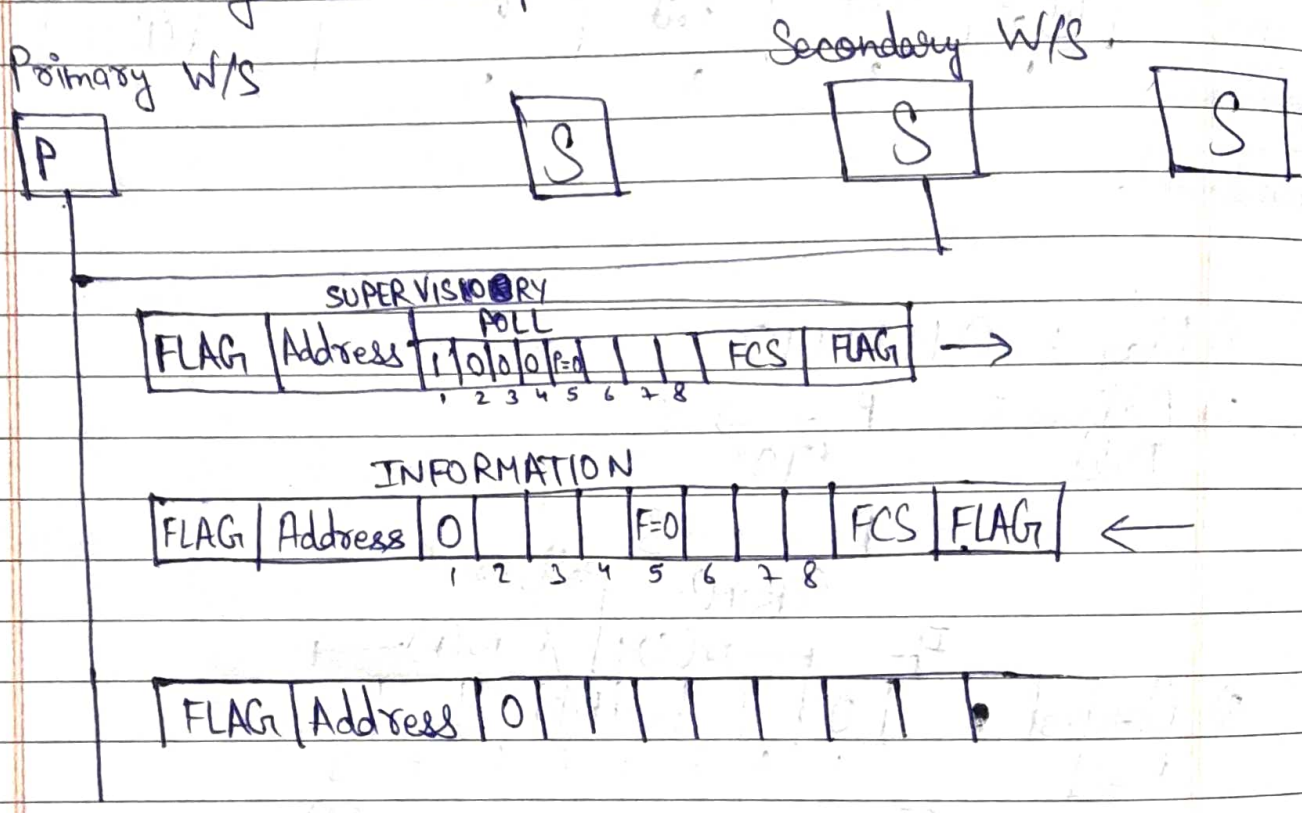
N(R) : Sequence " " next frame expected

Piggybacking Ack

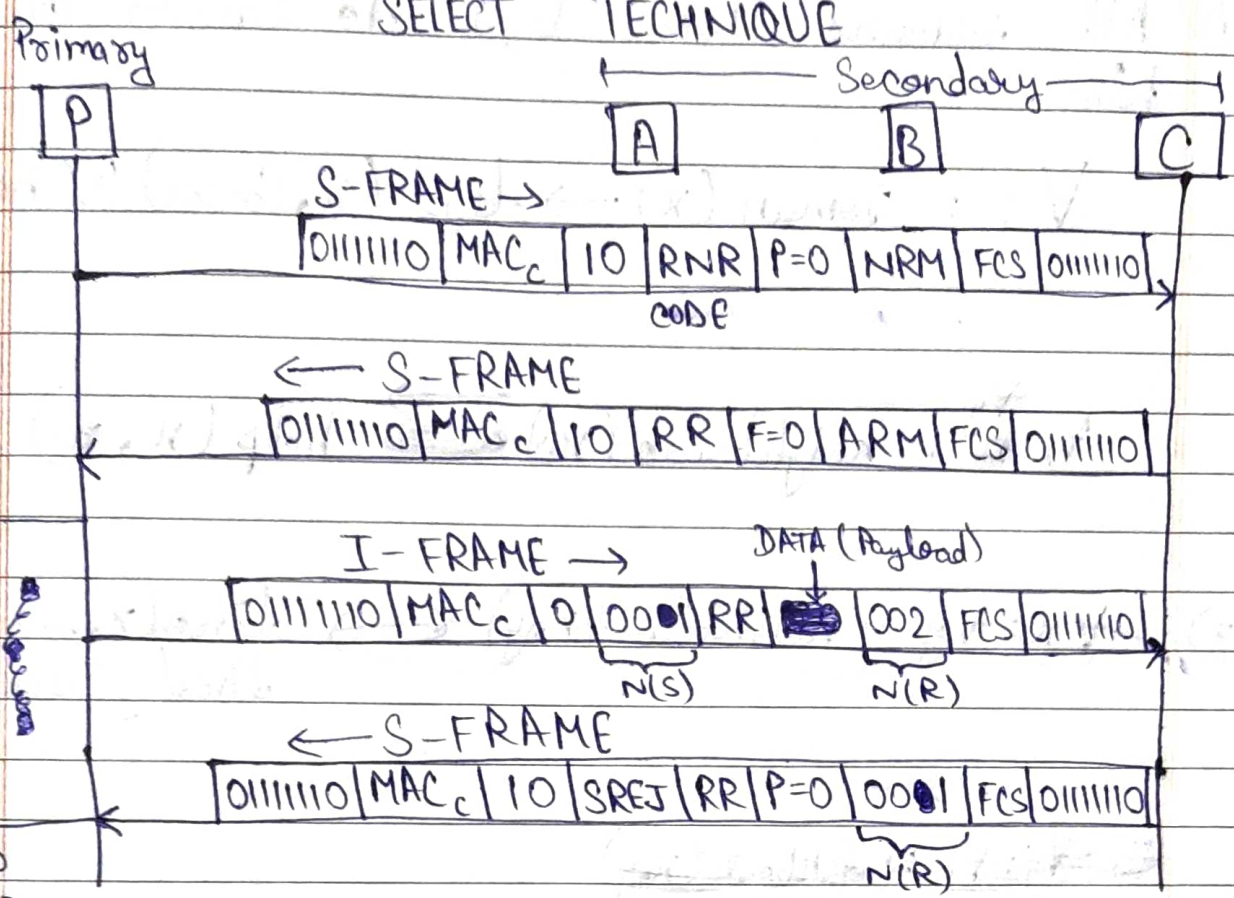
GOOD WRITE

RR → Reciever should get ready, data is about to come.

RNR → Don't got any more data to send go on sleep mode.



Data Transmission using HDLC



SONET → Data Link Layer

Synchronous optical network

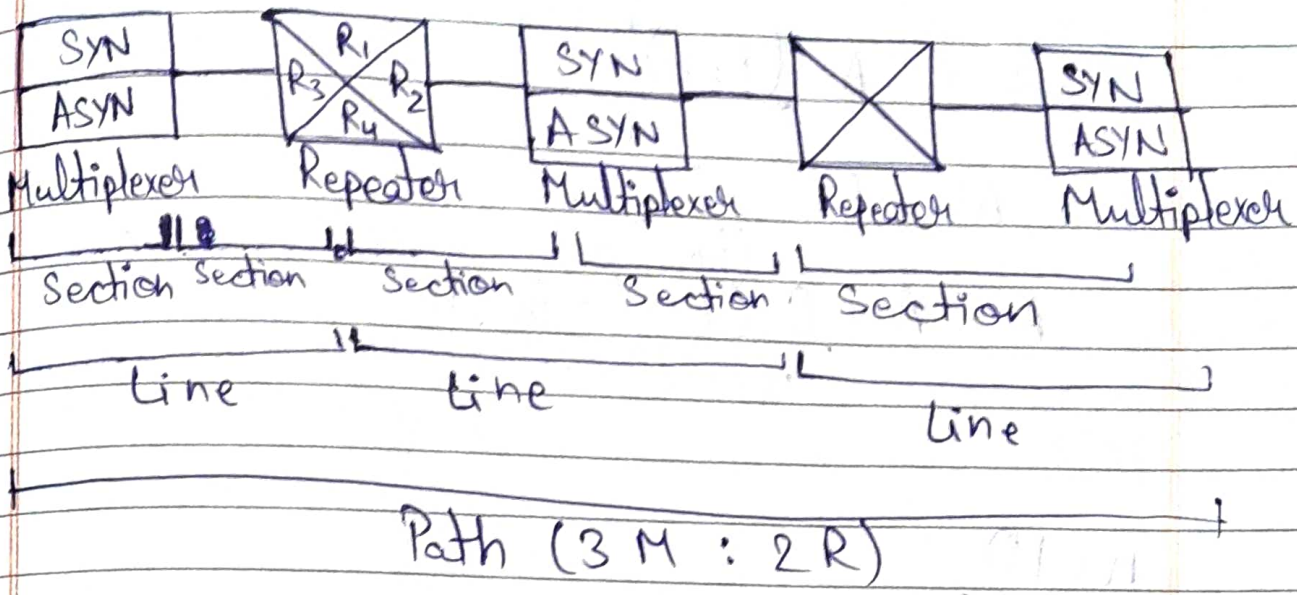
The network that is used to standardize the fiber optic communication across DLL and PL of OSI model is called as Synchronous optical network.
This name was first coined by ANSI (American National Standard Institution) it is also reffeered by SDH (Synchronous Digital Hierachy).
This name was first coined by ITU-T.

The sonet was initially designed to support data transfer rate ranging from 50 mbps – 1000 mbps with the technical configuration of STM1 – STM4.
(STM → Synchronous Transport module)

The sonet uses a combination of multiplexers and repeaters / regenerators to achieve high speed data transmission. The sonet provides the following section on DLL:

1) Line section 2) Path section 3) Optical section

The sonet just like HDLC support data transmission in form of frame, where each frame can carry 810 bytes of data per second



CN

DATE __/__/____
PAGE _____

ROUTING TECHNIQUE

1) Distance vector Routing
2) Link state Routing

To efficiently transfer data packet from source to destination various routing techniques such as Link state routing & distance vector routing. These work on Network Layer of OSI Model & therefore uses IP address in Network.

Both of these technique ensures that the congestion can be reduced as much as possible by selecting most optimised path for traversal of data packets.

The data is transmitted in form of IEEE 802.3 frame which is further encapsulated in packet format. All routing techniques creates a routing table that contain multiple column such as network ID, cost of traversal, next hop address and time stamp, etc.

Routing techniques are widely used to transmit data across nodes of similar or dissimilar network. Some of routing techniques just focuses on finding the path between source &

GOOD WRITE

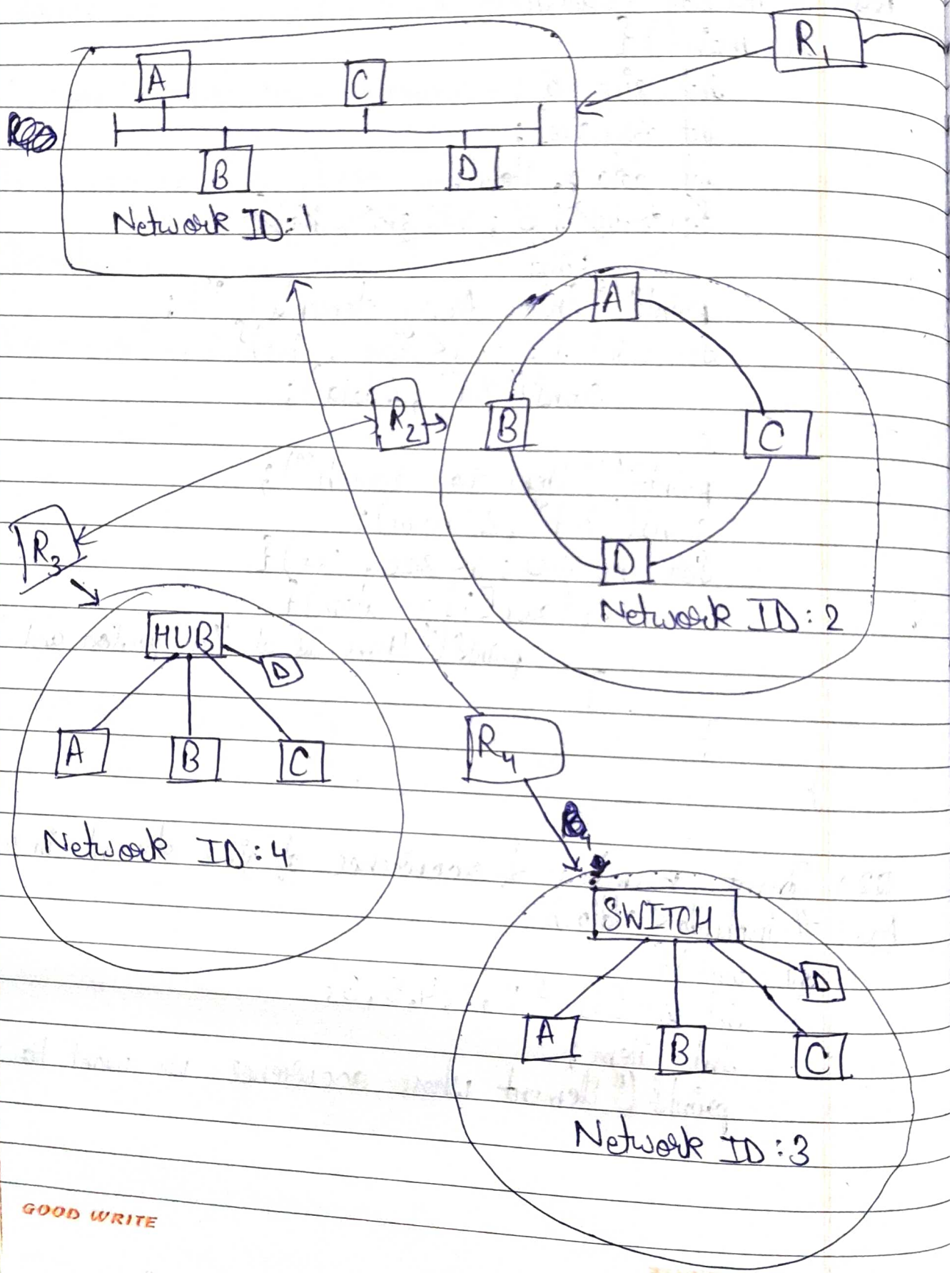
destination and some routing technique focuses on determining shortest path between source & destination node.

Routing technique used in wired or wireline network can not be used in wireless network because of mobility of nodes.

CN

DATE: __/__/____
PAGE _____

Distance Vector Routing



GOOD WRITE

NID	COST	NHA

ROUTING TABLE OF R_1

Q) Design 4 IEEE 802.3 complined network which are interconnected by Routers having following network configuration. (Dissimilar Network)

$R_1 \leftrightarrow R_2$
$R_2 \leftrightarrow R_3$
$R_3 \leftrightarrow R_4$
$R_4 \leftrightarrow R_1$

Create a Routing Table using a distance vector Routing Technique and exhibit routing table status after 4 timer ticks.

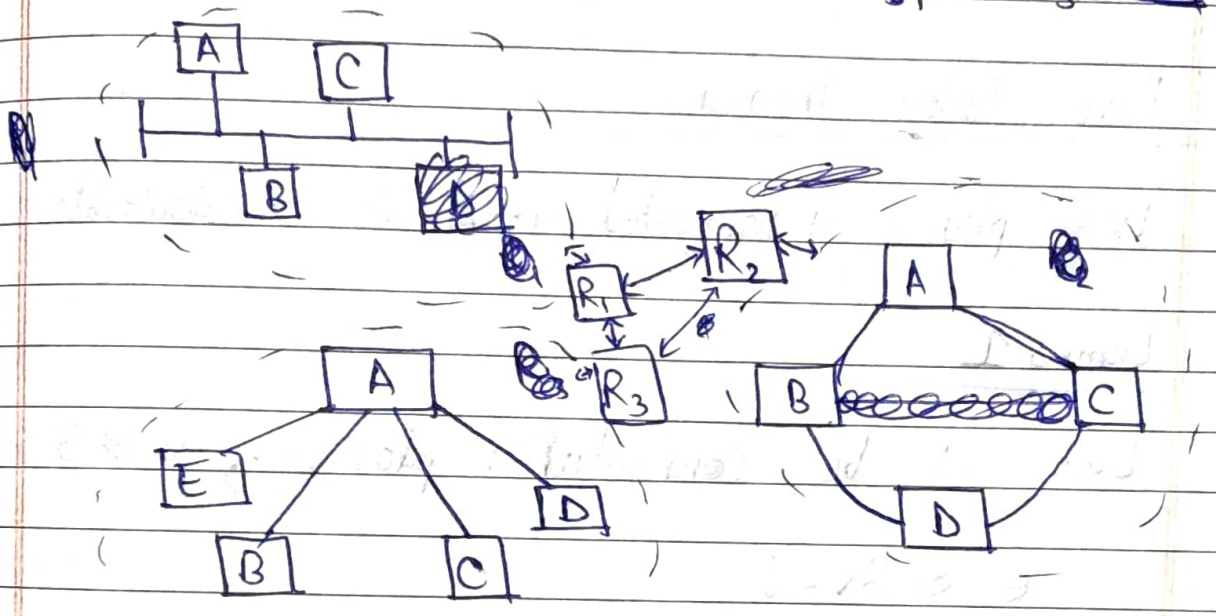
Designing a network diagram is worth half marks of total.

DATE: __/__/____
PAGE _____

Design 3 interconnected network which are non-uniform and dissimilar in nature. Perform routing using any of routing technique and show the status of routing tables after 3 timer ticks.

Make suitable assumptions wherever necessary.

$R_1 \leftrightarrow R_2$ $R_2 \leftrightarrow R_3$ R_3



ROUTING TABLE

R_1

NID	COST	NHA	TS
1	1	—	10:04:15
2	2	R_2	10:04:45

R_2

NID	COST	NHA	TS
2	1	—	10:05:03
1	2	R_1	10:05:33

R_3

NID	COST	NHA	TS
3	1	—	10:07:04

GOOD WRITE

DATE: __/__/____
PAGE _____

System

TMS

QOS → Quality of Service
- → Congestion
- → Security
- → State of Transmission Media

W_C : 3
W_A : 2
W_B : 1

1st tick count: 30

Routing V.Imp
CN

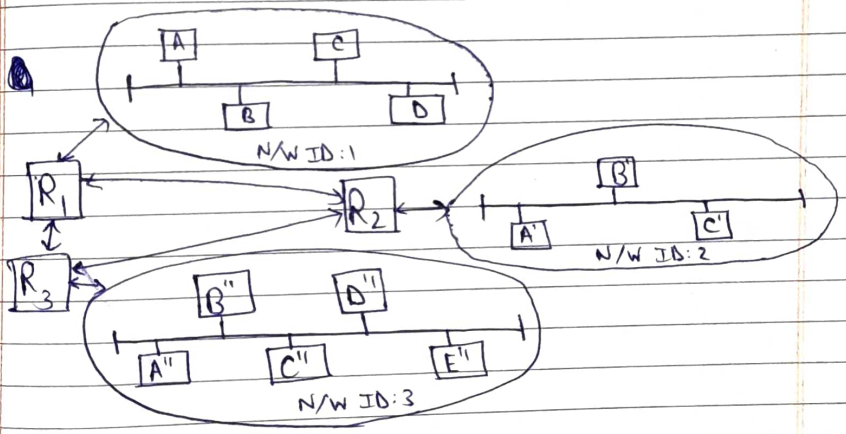
Q→ 56, 57, 61 → 298
Q→ 63 → 299
Q→ ~~56, 57~~ → ~~647~~

Pg. DATE: __/__/____ PAGE _____

Q: Design a 3 IEEE 802.3 complined network interconnected by 3 routers having network configuration as follows:

$R_1 \leftrightarrow R_2$
$R_2 \leftrightarrow R_3$
$R_3 \leftrightarrow R_1$

Using Link state routing depict status of routing table after 4 timer ticks. Assuming network to be similar and non-uniform in nature.



NOTE: Connection between router should be connected with Dashed lines.

R1

NID	COST	NHA	QOS
1	3	—	GOOD

R2

NID	COST	NHA	QOS
2	3	—	G

R3

NID	COST	NHA	QOS
3	3	—	G

GOOD WRITE

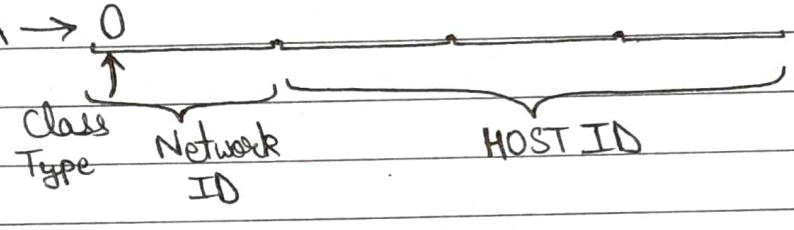
Page No.
Date :

IP ADDRESS

NETWORK LAYER

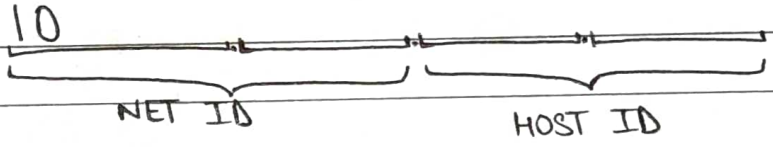
On network layer of OSI model, ~~for cause~~ efficient data transmission router uses IP address. All IP address in IPV4 addressing scheme are 32 bit long. Whereas in IPV6 addressing scheme they are 128 bit long.
In IPV4 addressing scheme follows classfull addressing whereas IPV6 addressing scheme follow classless addressing.
The range of IP addresses in IPV4 addressing scheme are as follows:

Class A → 0

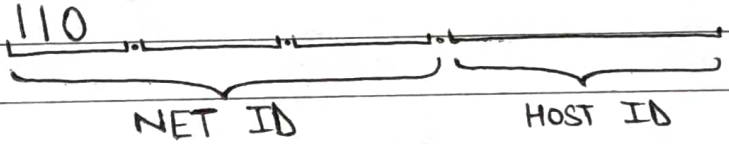


NET ID : 8 bit
HOST ID : 24 bit

Class B → 10



Class C → 110



Class D → 1110

Class E → 1111

Class A	0.0.0.0 – 127.255.255.255
B	128.0.0.0 – 191.255.255.255
C	192.0.0.0 – 223.255.255.255
D	224.0.0.0 – 239.255.255.255
E	240.0.0.0 – 255.255.255.255

Page No.
Date :

* Masking → Extracting Network ID from IP address

127.0.0.1 → Default loop back IP address

2^{16} : 0 to 65,535 ← 0 to 1023 (R)
1024 to 49,151 (Paid)
49,152 to 65,535 (Free)

Page No.
Date :

CN

Transport Layer Protocol : TCP

Frame Format

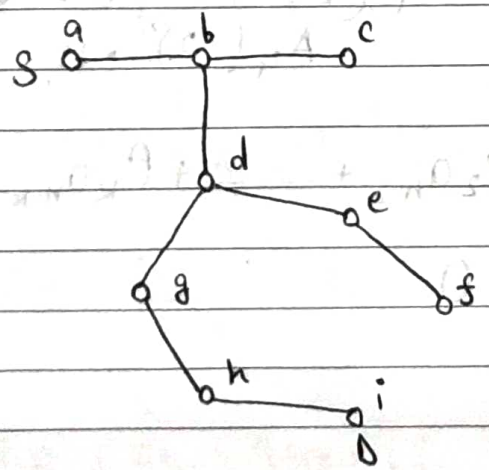
Source Port address (16b)	Destination Port address (16b)
Sequence number (32b)	
Acknowledgement number (32b)	
HLEN (4b)	Control (6b) / Reserved (6b) / Window size (16b)
Urgent Field (16b)	EDAC (16b)
Options & Padding (32b)	

FLAG
ACK
SYN
FIN
PSH
RST

'SWITCHING' ←

TCP : CO-TS

UDP : CL-TS



TCP	UDP
Full Form	Full Form
Reliable	Unreliable
Slow / Delay	Fast
Switching	Datagram packet switching
Virtual Circuit switching	
Switched V.C / Permanent V.C	
Connection oriented Transport Service	Connection less Transport Service

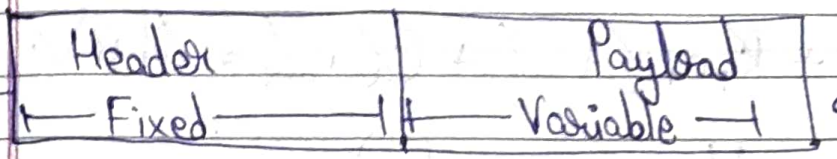
Page No.
Date :

UDP PROTOCOL

UDP Header Format

Source Port address (16 b)	Destination Port address (16 b)
Total Length (16 b)	ED & C (16 b)

TCP	UDP
1) Transmission Control Protocol.	User unreliable Datagram Protocol.
2) Slow (with added delay) but reliable & efficient.	Fast but ~~and~~ unreliable.
3) Acknowledgement is desired.	No Acknowledgement.
4) Uses Packet switching (Switched virtual circuit / Permanent V.C)	Uses Datagram Packet switching approach.
5) faciliates Connection oriented Transport service.	faciliates connection less Transport service.
6) follows fix path for data transmission.	Packets are free to take any suitable path.
7) Priority of packet can be set.	No priority.



Networking for big data

Data which is too large or too complex to be handled by any traditional data processing software is termed as big data.

The different V's of big data are as follows:

1) Volume → Always Increasing → TB, PB .... [Servers]
2) Variety → Audio/video/text : .pdf, .jpg, .png ....
3) Value → Shelflife < Life long / Short lived
4) Veracity → Accuracy & truthfulness of data < Commercial & critical / Non-commercial & non-critical
5) Velocity → Data transfer rate.
(Need High Speed Network's)

Page No.
Date :

CN

Networking for Big Data

Life cycle of Data :