Flow control refers to a set of Procedure use to restrict the amount of data the sender can send before waiting for acknowledgement.

The most Protocol flow control is set of Procedure that tells the sender how much data it can transmit before it must wait for an acknowledgment from the receiver.

The Receiving device must be able to inform a sending device before those limits are reached and to request that the transmitting device sent few frames or stop temporarily.

The rate of such Processing is often slower than the rate of transmission.
For this reason each receiving device has a block of memory called buffer reserved for storing incoming data until they are processed.

Two methods have been developed to control the flow of data across communication links

(i) Stop and Wait
In this method of Flow Control then Sender waits for an acknowledgement after every frame is sent i.e. the sender sends one frame and wait for an acknowledgement before sending the next frame.

The advantage is that each frame is checked and acknowledged before the next frame is sent

The disadvantage is that it is inefficiency i.e. it is slow. Each frame must travel all the way to the receiver and an ackno must travel all the way back before the next frame can be sent

If the distance b/w the devices is long then the time spent waiting for the acknowledgement b/w each frame can add significantly to the total transmission time.

<i> Sliding window.

In this method of flow control several frames can be sent which will be in transit at a time. The receiver acknowledges only some of the frame with a single ACK (Acknow to conform the recipt of multiple data frame

The sliding window refers to imaginary boxes both at the sender and the receiver.
Frames may be acknowledge at any point without waiting for the window to fill up and may be transmitted as long as the window is not full.
The frames are numbered using modulo-n which means they are numbered from 0 to (n-1) for example -> if n=8 then the frames are numbered as 0, 1 ---- 7, 0, 1, 2 ----

The window cannot cover the whole module. It covers 1 frame less.
When the receiver sends an ACK ( ) it includes the no. of next frame is expect to receive.
Sender window the left hand wall moves to the right when a frame is sent. The right hand wall moves to the right when ACK is received.

Once an ACK arrives, the window expands to allow in a number of new frames = No. of frames ACK (Acknowledge) by that ACK

The Receiver window At the begining of transmission the receiver window contains not (n-1) frame but (n+1) spaces for frames.

The receiver window therefore represent not the no. of frames received, but the no. of frames that may still be received before can ACK must be sent

The left hand wall moves to the right when a frame is received.

The right hand wall moves to the right when an ACK is sent.

Fig → Reverse Page

Error Control

It refers to the mechanism to detect and correct error that occur in the transmission of frames.

The Possibility of 3types of Errors are

(i) lost Frame - A frame fails to arrive at the receiver side.

(ii) Damaged Frame - A recorginagable frame arrives at the receiver side but some of the bits are in Error

(iii) lost ACK (Acknowledgment) → The ACK frame fails to arrive at the Sender side

Most Common techniques for error control are based on some or all of the followings

(i) Error Correction → It should be done using any one of the error detection and Correction technique (VRC, LRC, CRC, Hamming Code)

(ii) +ve ACK → The destination returns a +ve ACK to successfull received error free frame

(iii) Retransmission After time out → The source retransmit a frames that has not been acknowledge after a predetermined amount

of time

(iv) (-ve) ACK and Retransmission

The destination returns a (-ve) ACK to the frame in which an error is detected the source retransmit such frames

Collectively these Mechanism are refered to as Automatic Repeat Request (ARQ)

The effect of ARQ is to turn an unreliable data link into a reliable one.

3 versions of ARQ have been Standarjied

(i) Stop and wait ARQ

(ii) Go Back - n ARQ } Uses the Principle of Sliding window

(iii) Selective Repeat/Reject ARQ }

Stop and wait ARQ

Damaged data

Sender

Receiver

wait time

Data 0

ACK 1

Data 1

ACK 0

Data 0

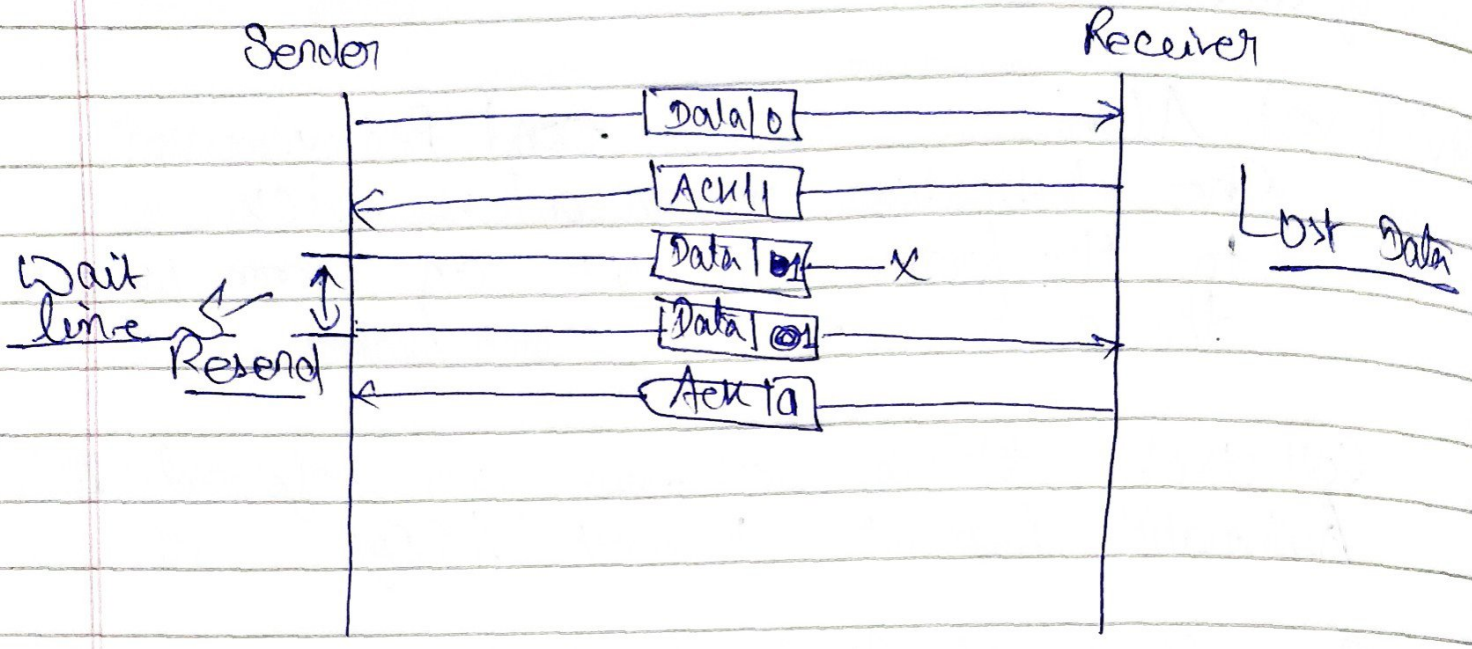
Error

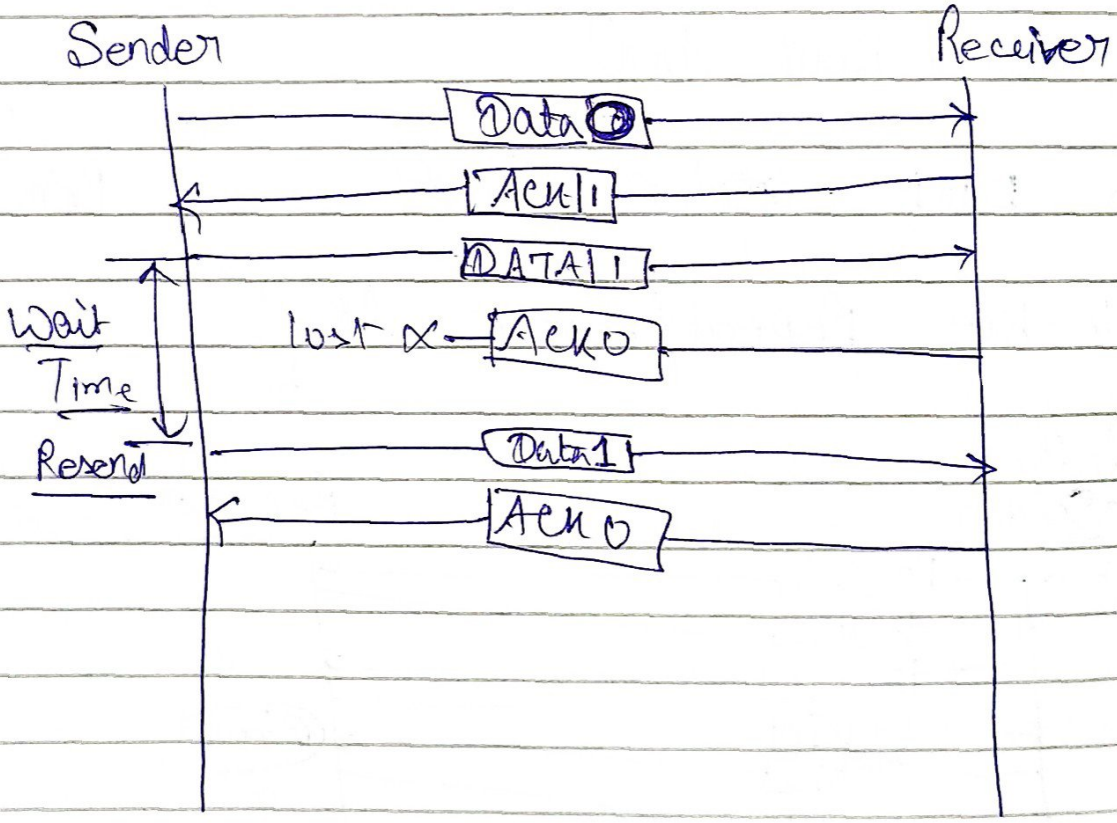
NAK 0

Resend

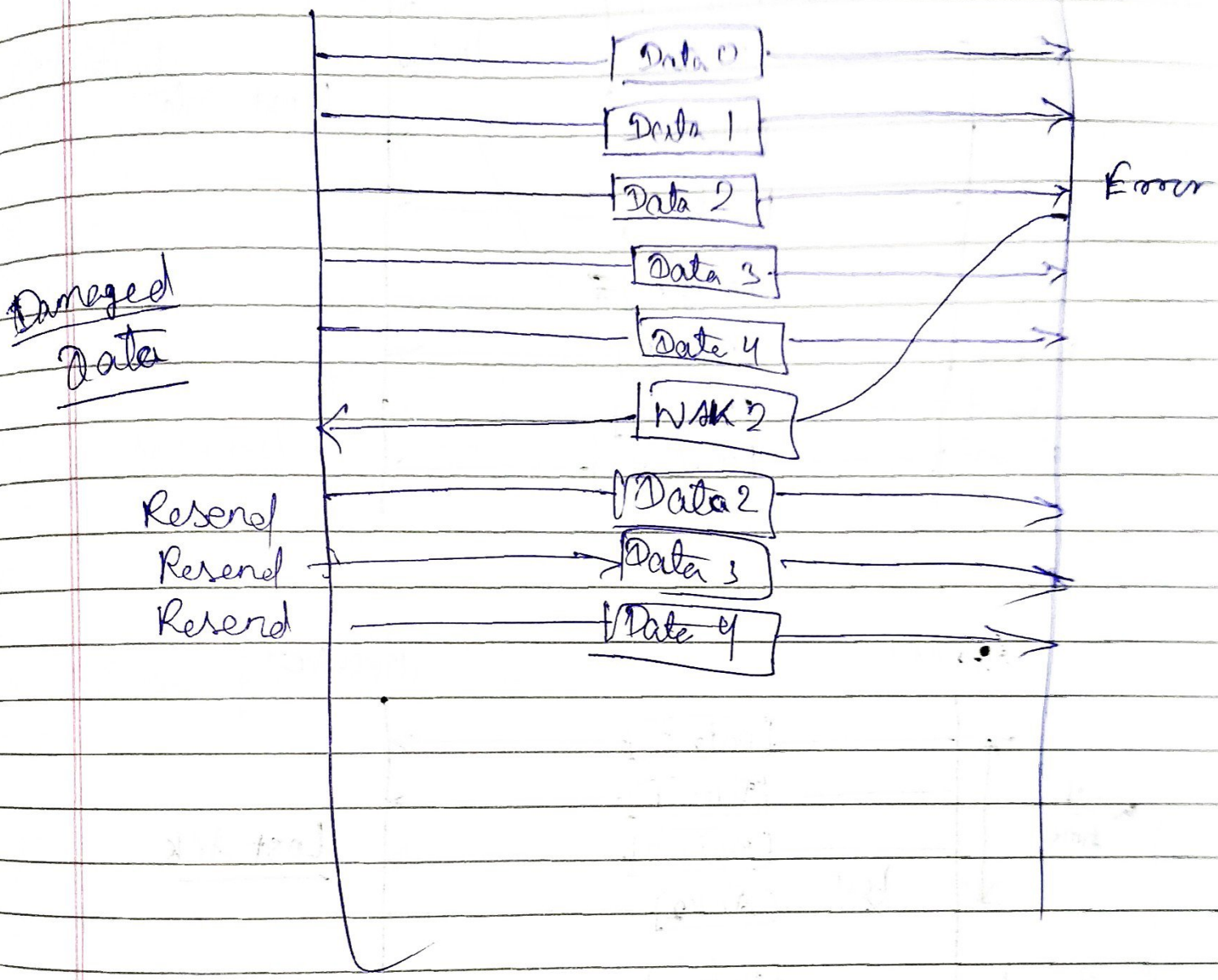
Data 0

ACK 1

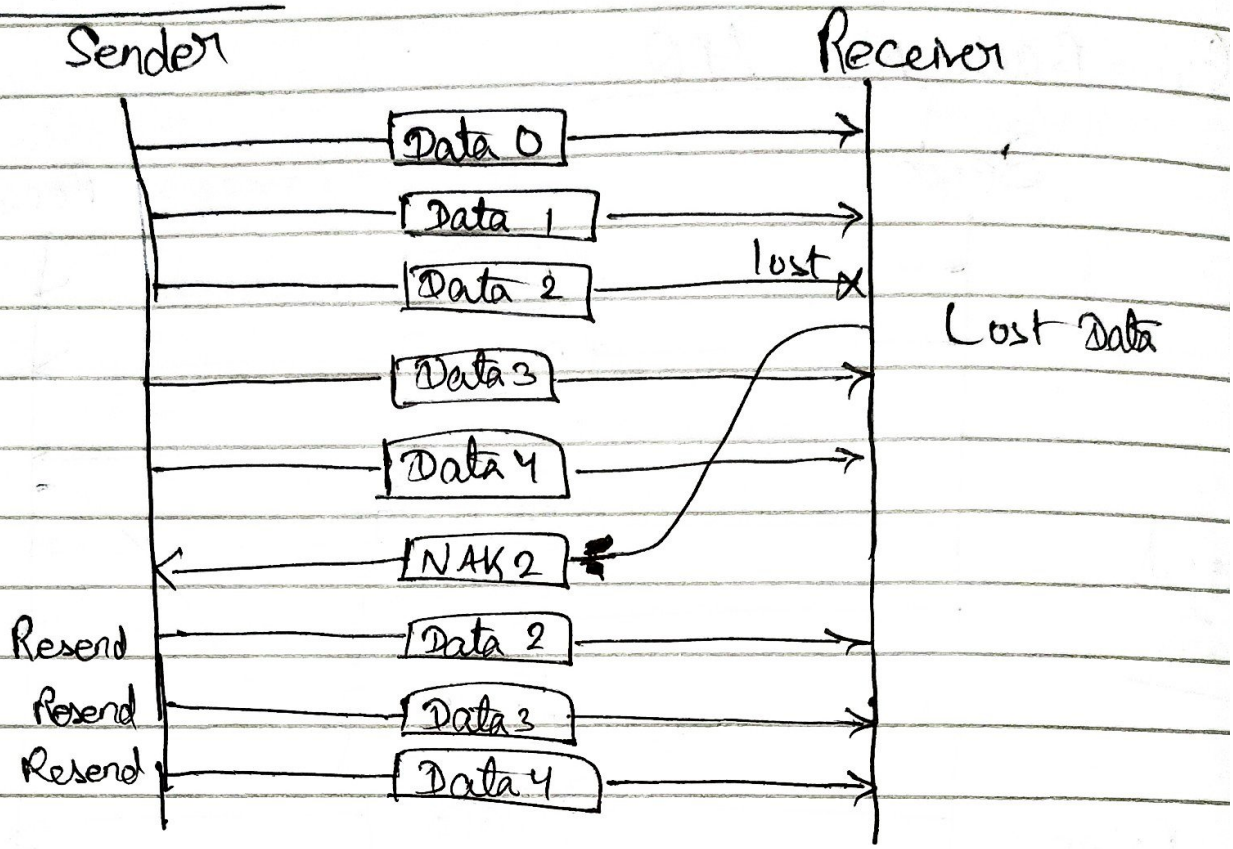

Sender
Receiver
Data 0
ACK 1
Data 1
Data 0
ACK 0
Lost Data
Wait time
Resend

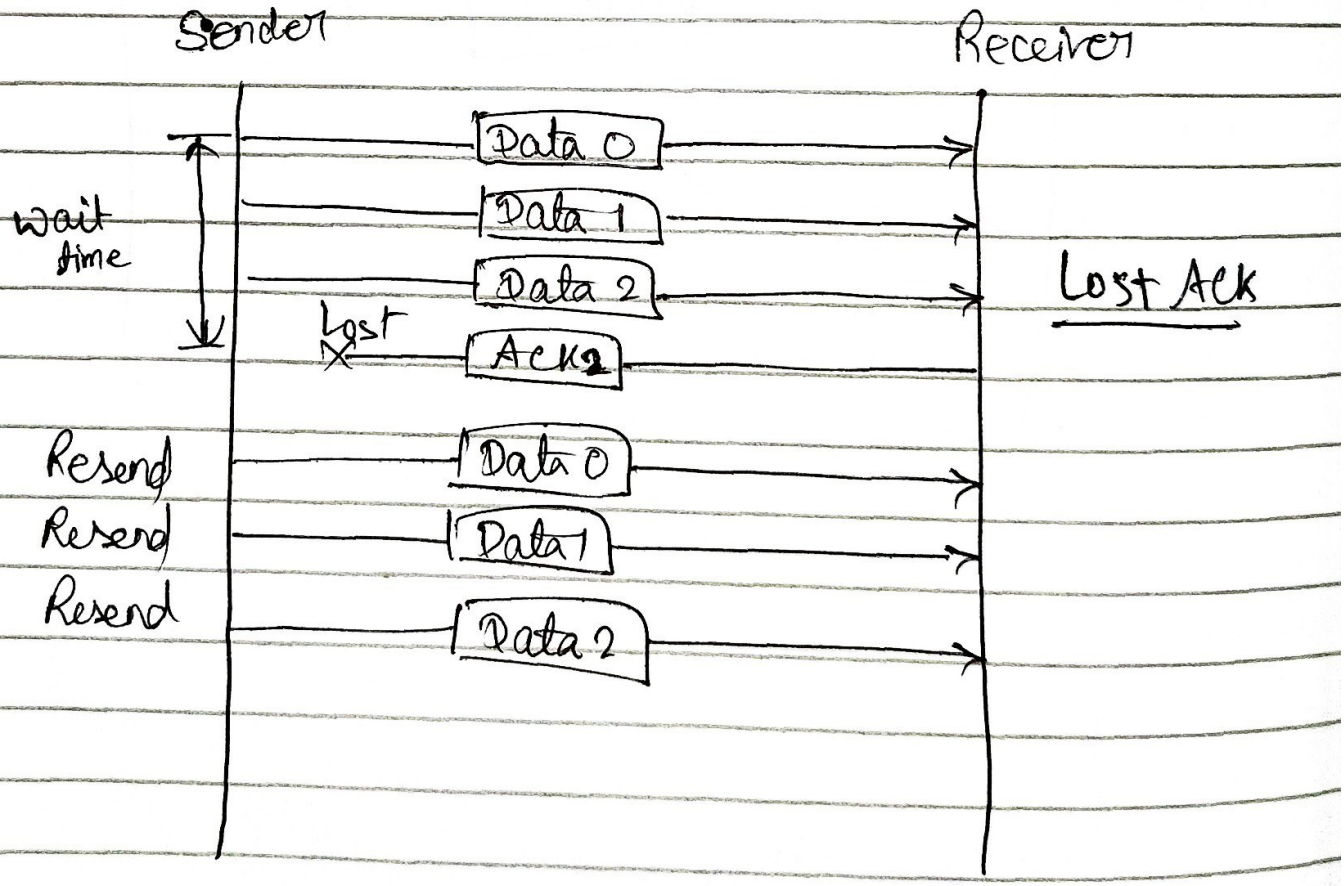

Sender
Receiver
Data 0
ACK 1
DATA 1
Lost
ACK 0
Wait Time
Resend
Data 1
ACK 0

Go-Back-N ARQ

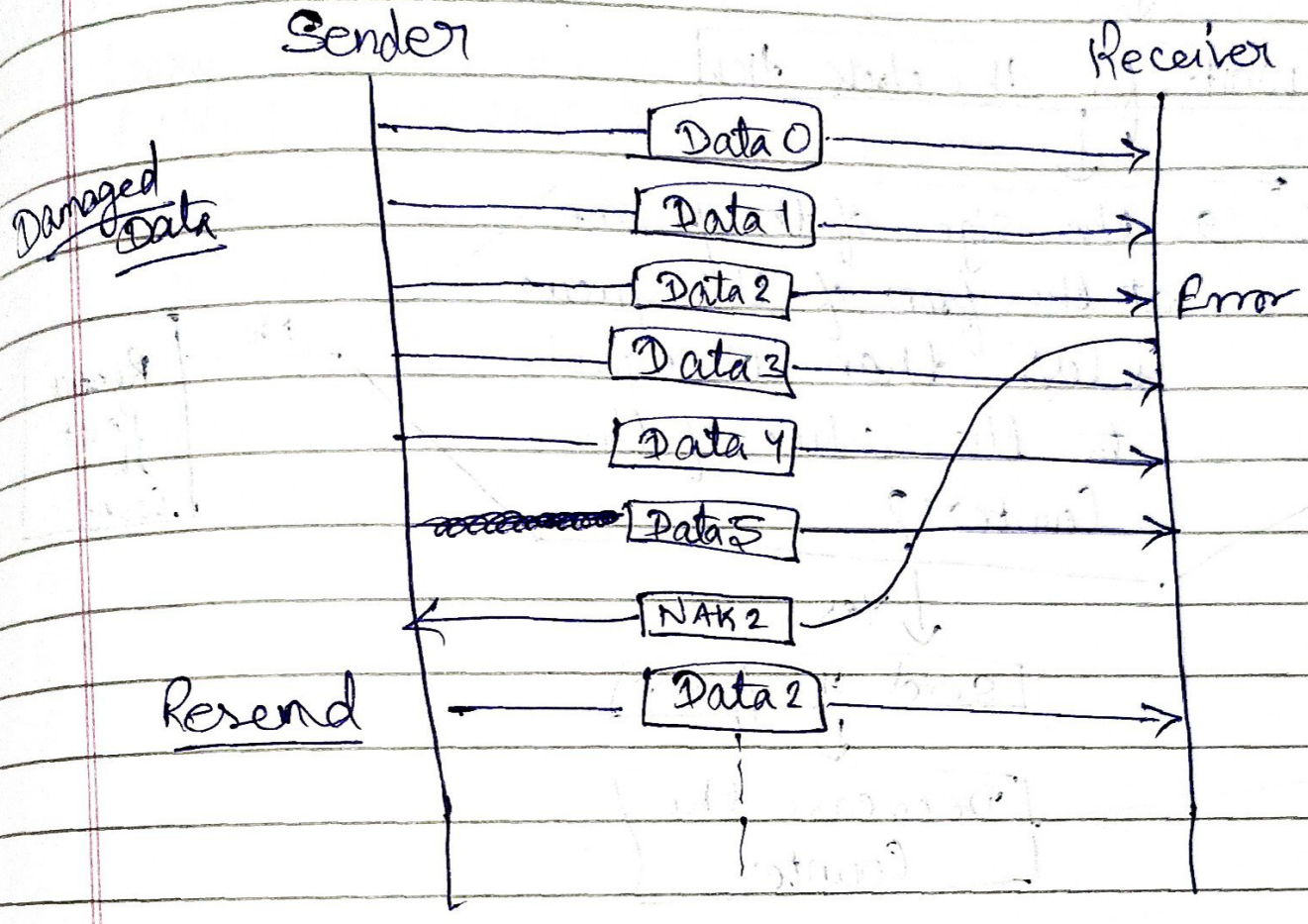

Sender
Data 0
Data 1
Data 2
Data 3
Data 4
Error
Damaged Data
NAK 2
Data 2
Data 3
Data 4
Resend
Resend
Resend

Go – Back – N


Sender
Receiver
Data 0
Data 1
Data 2
lost
Lost Data
Data 3
Data 4
NAK 2
Resend
Data 2
Resend
Data 3
Resend
Data 4

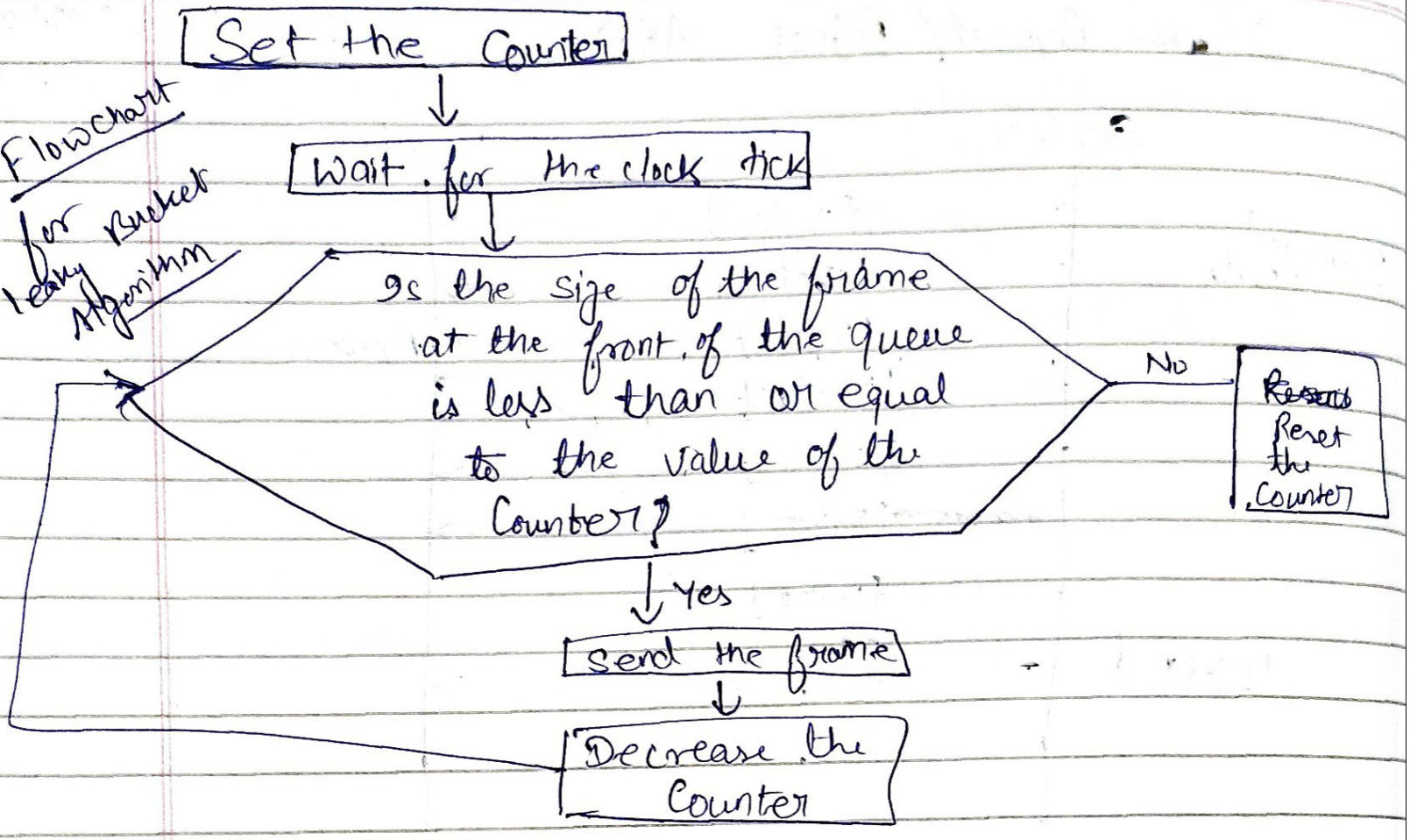

Sender
Receiver
Data 0
Data 1
wait time
Data 2
Lost Ack
Lost
Ack 2
Resend
Data 0
Resend
Data 1
Resend
Data 2

Selective Repeat / Reject ARQ



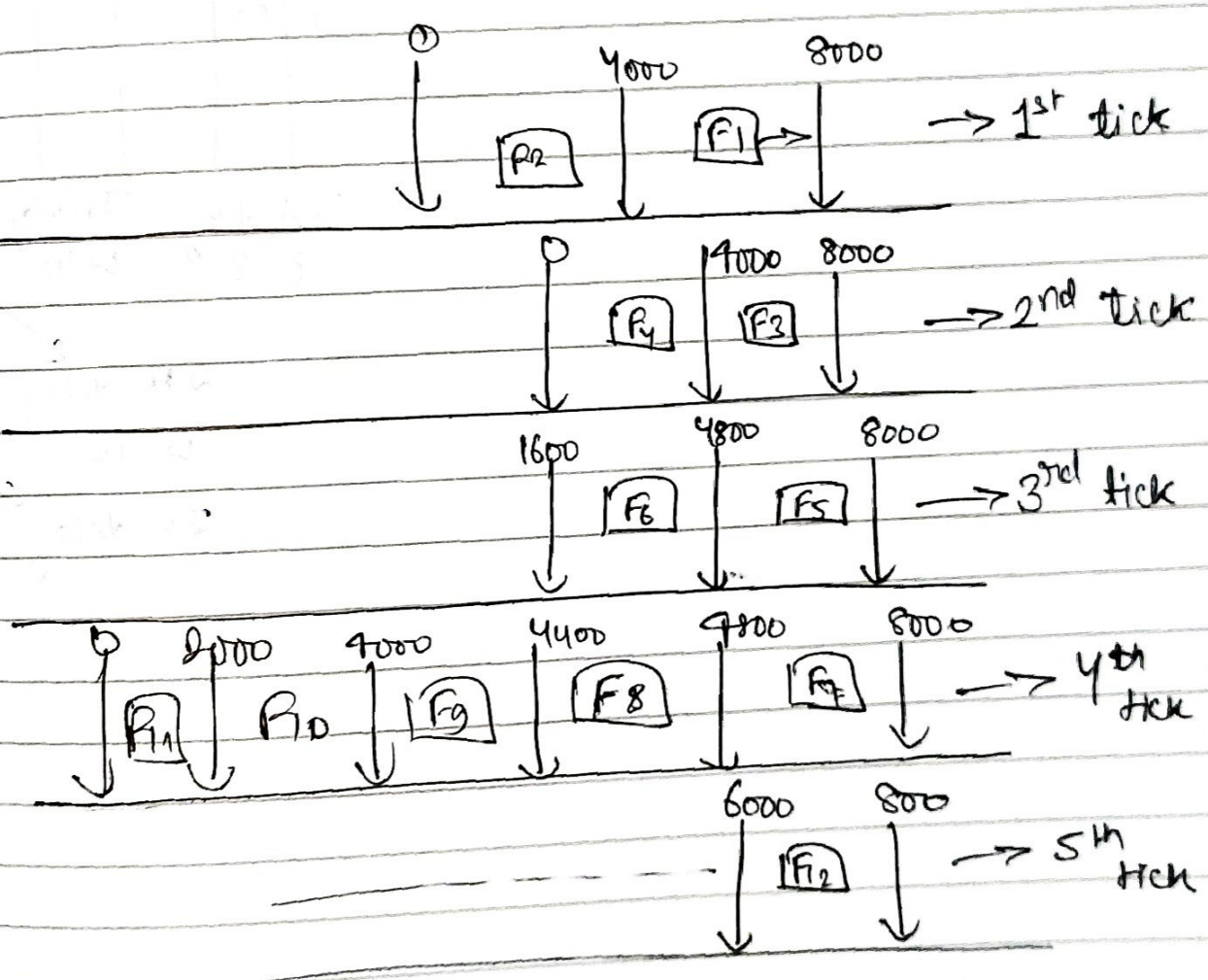
Draw for Lost Data and lost ACK

Flowchart for Leaky Bucket Algorithm



Each output interface in a switch is design using the leaky bucket Algorithm to send 8000 bits per second (1tick). If the following frames are receive in sequence, so the frames that are sent during each sec-second

Frames 1, 2, 3, 4 : 4000 bytes/sec
Frames 5, 6, 7 : 3200 bytes/sec
Frames 8, 9 : 4000 bytes/sec
Frames 10, 11, 12 : 2000 bytes/sec.



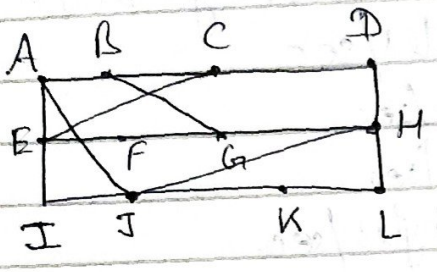
Tick Can be Considered in Second and Microsecond

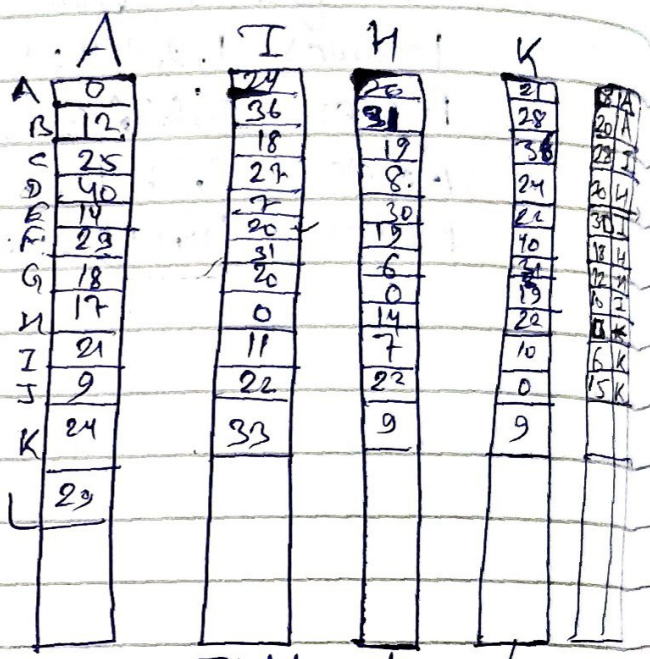
LAN | Connecting two LAN | Larger Area

R Repeater | B Bridge | R Router | G Gateway → one network to another network

Date 21/03/24
Page

Distance vector Routing Algorithm
or
Bellmann-Ford Routing Algorithm





0+8 = 8

minimal value — delay J-A

JA delay is 8

Ji delay is 10

JH delay is 12

JK delay is 6

New estimated delay from J

Welben ford Routing Algorithm

Collision → Avidance C → Collision Detection

Carrier Sense Multiple Action → CSMA

minimal
Find the value from J to G (least Path)

J to G

J to A + A to G = 8+18=26

J to I + I to G = 10+31=41

J to K + K to G = 6+31=37

J to (H + H) to G = 12+6=18 → Minimal value

DVRA

operate by ~~adding~~ having each router maintain a table a vector, giving the best known distance to each destination and which line to use to get their these tables are updated by exchanging information with the neighbours.

It is also known as Bellmann-Ford Routing Algorithm.

In DVRA

each router maintains a routing table indexed by and counting one entry for each router in the subnet.

This entry contains two parts

(i) The preferred outgoing line to use for the destination

(ii) An estimate of the time or distance to that destination

The Matrix use might be number of hubs, time delay, total numbers of packets queued along the path of something similar.

The router is assume to know the distance to each of its neighbour. If the matrix is hops, the distance is just one hop.

If the Matrix is queue length then the router simply examine each queue

If the Matrix is queue then the router can measure it directly with special packets at regular interval of time the table is updated depending on the delay.

Transmission Impairment

↳ in which transmission fail

⇐ factors that distort your transmission

(i) Attenuation
(ii) Delay Distortion
(iii) Noise
- → Thermal Noise
- → Intermodulation Noise
- → Impulse Noise
- → Crosstalk

Disturbances in the network

classmate
Date 23/01/23
Page

IP addressing (32 bit -> 4 octet) (4 x 8 = 32 bits)

An IP address is a 32 bit address it is unique and universal the identifier use in the network layer of the internet model to identify each device connected to the Internet is called Internet Address or IP address.

It defines the connection of a host or a router to the user net.

It is unique means address define one and only one connection to the internet

Two devices on the internet can never have the same address at the same time.
However if a device has two connection to the internet through two networks then it has two IP addresses.

Binary Notation

In this IP address is displayed as 32 bits to make the address more readible one or more space is usually inserted b/w each octet (8 bits). Each octet is often referred as a bit in common an IP address refers to as a 32 bit address, a 4 octet address or a 4 bit address

Dotted Decimal Notation

1000000 00001011 000000

128 . 11 .

a.b.c.d

Q. Change the following IP address from binary Notation to Dotted Decimal Notation

(i) 1000001 00001011 00001011 11101111

(ii) 1111101 10011011 11111011 00001111

Soln ⇒ (i) Soln ⇒ 129.11.11.239

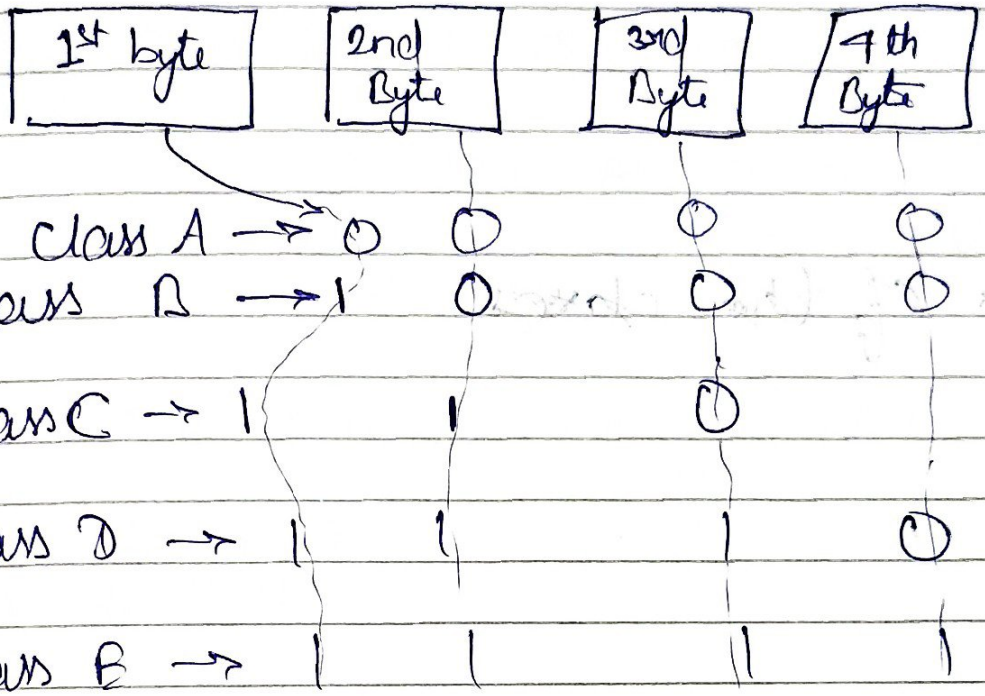
(ii) Soln ⇒

Q. Change the following IP address from dotted Decimal Notation to binary notation

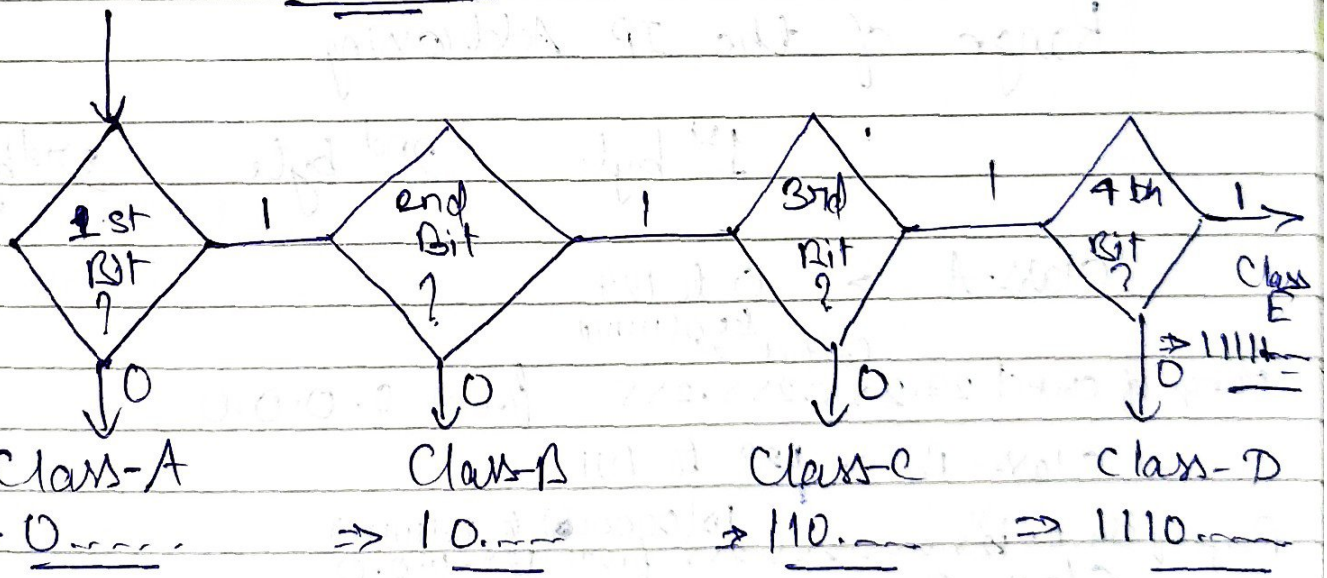
1. 111.56.45.78
2. 75.45.37.78

Classful Addressing

Five classes of address available in this IP addressing
A, B, C, D, E



Flowchart



Unicast Multicast and Reserve Addresses

Broadcast → one to many (Multicast

Addresses in class A, B and C are unicast Communication from one source to one destination

A Host need to have atleast one unicast address to be able to send or receive Packets

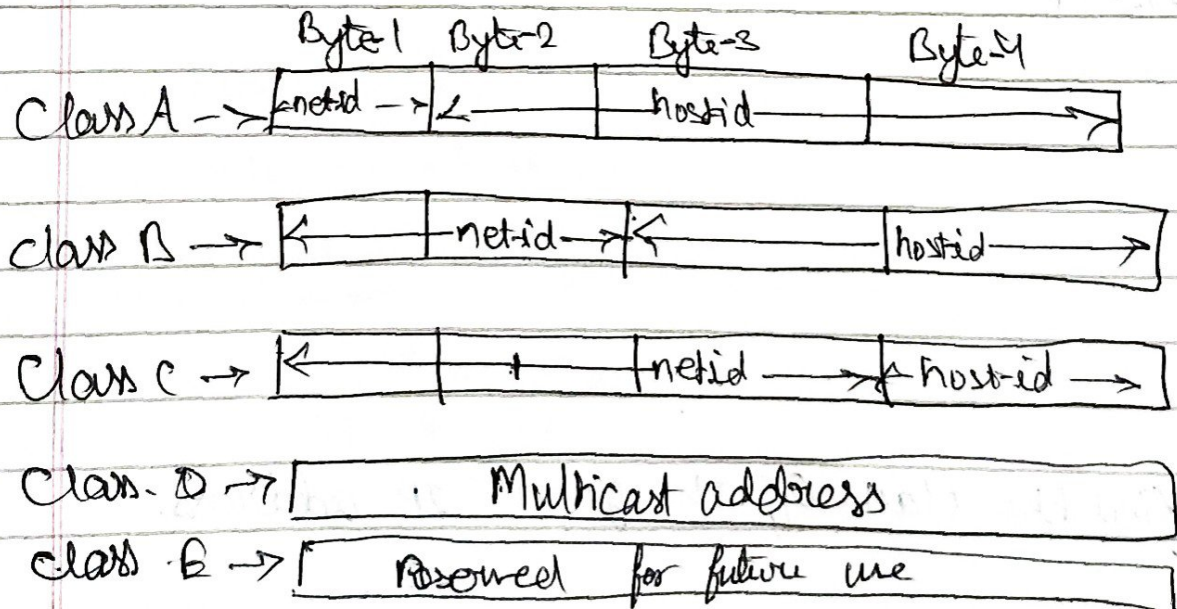
Address in class D are for multicast Communication, from one source to a group of destination

A multicast address can be used only as a destination address, but never as a source address.

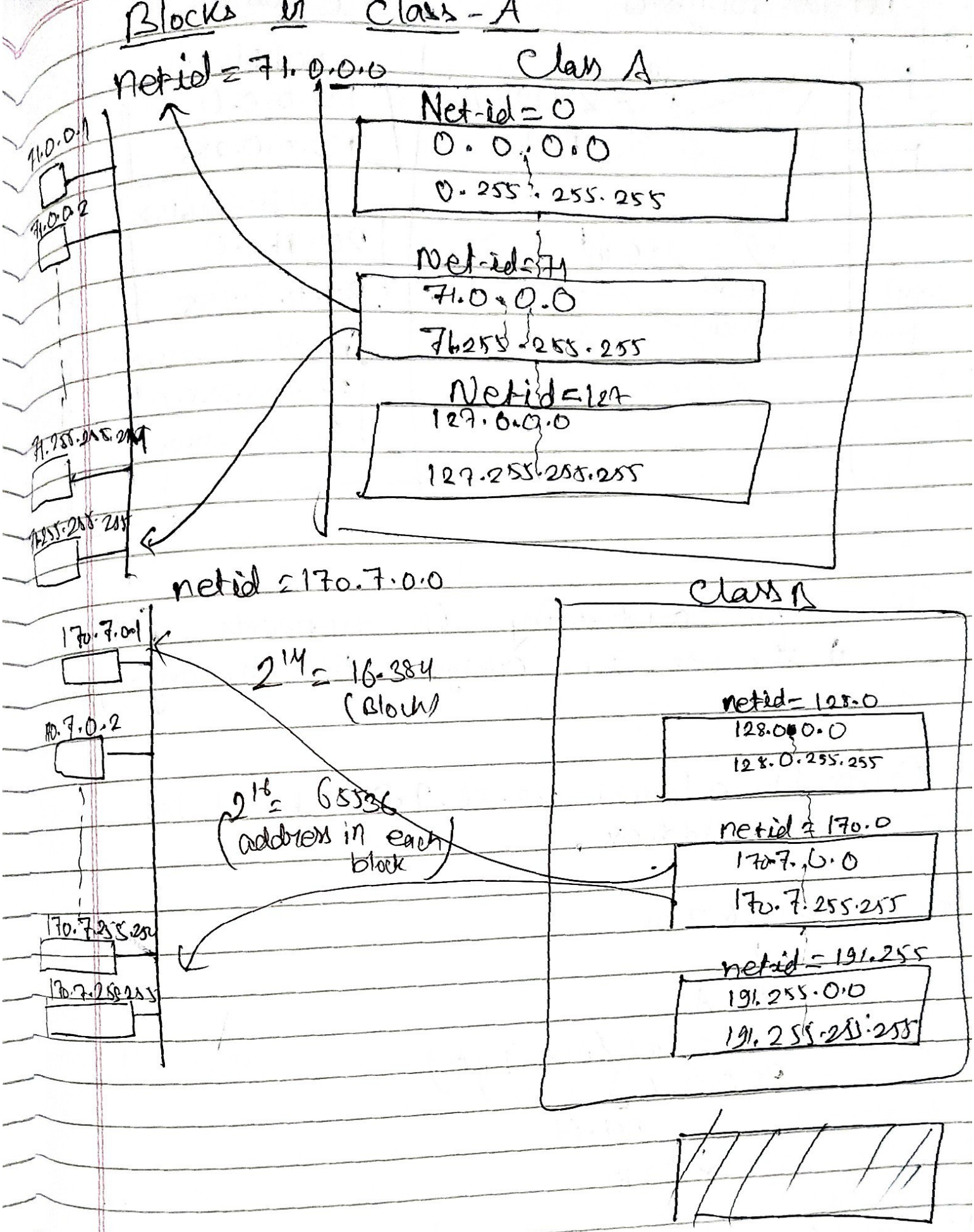
Addressing class E are reserved or original ideas wants to use them for special Purposes

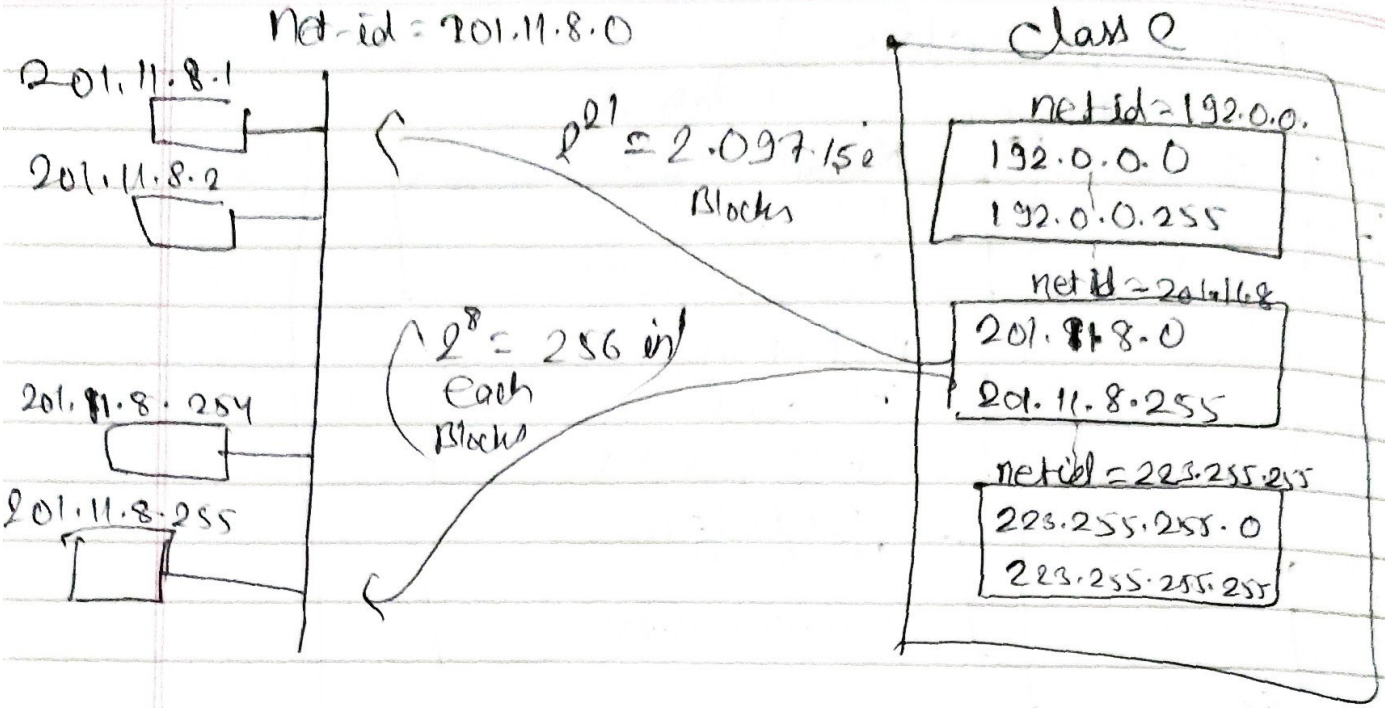
They have been used only in a few cases.

Netid and Hostid



Blocks in Class - A





⇒ In classfull addressing the network address is the one ie assign to the organization

Q⇒ Given the address 23.56.7.91 b find the network address.

Sol'n⇒ 23.56.7.91

↓

Class A

net id = 23 (first byte)

23.0.0.0 ← net-id

$2^{7-2} = 128$

Q⇒ Given the address 132.6.17.85, find the network address.

132.6.17.85

↓

Class B

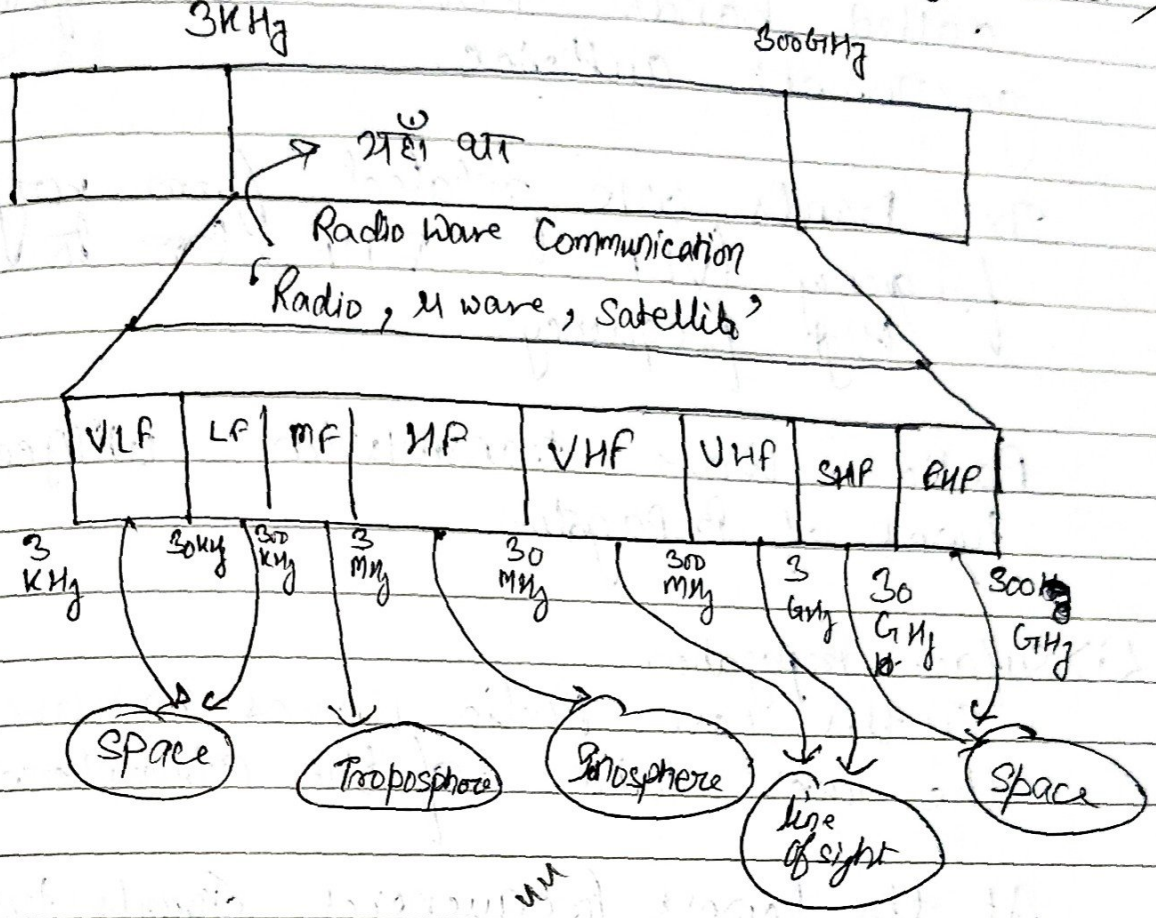
net id = 132.6.0.0

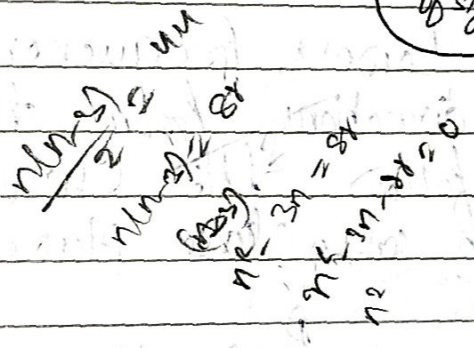
Date 28/07/24

Unguided Medium

(Theoritical Concept You have to read from Books)

(Radio Frequency Allocation)





EHF → Extremely
SHF → Super
UHF → Ultra
VHF → Very

Unguided Media or wireless Communication transport electromagnetic waves without using a physical Conductor signals are broadcast through air and thus are available to any one who has a device capable of receiving them

Radio Frequency Allocation

Radio Communication is divided into 8 ranges called bands each band regulated by government authories.

These bands are related from very low low frequency (VLF to EHF) (or to Extremely High frequency

Radio Ware transmission utilized 5 different types of Propagation.

(i) Sufac Propagation

In this case Radio waves travel through the lowest Portion of the atmosphere

At the lowest frequencies signals travel in all directions from the transmitting Anteena and follow the curvature of the Planet it can also take place in sea water

(ii) Troposphereric Propagation

It can work in two ways: either a signal can be directed in a straight line from Anteena to Anteena or it can be broadcast at an Angle into the upper layers of the Troposphere where it is reflected back down to the earth surface.

(iii) Ionospheric Propagation

In this case higher frequency radiowaves radiate upward into the Ionosphere where they are reflect back to the earth

This type of transmission allows for greater distances to be cover with ~~lower~~ low Power Output

(iv) Line of Sight Propagation

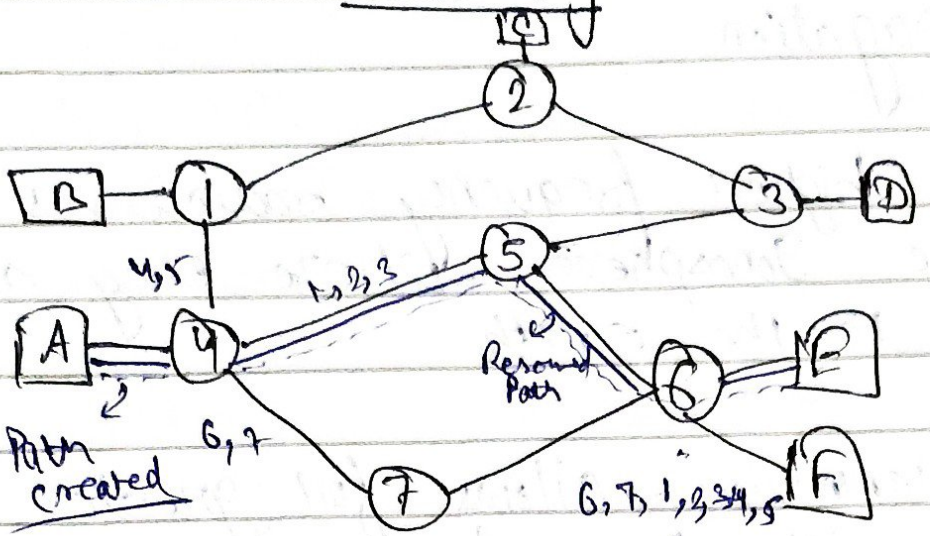
In this case very high frequency signals are transmitted in straight line directly from Anteena to Anteena.

Anteena must be directional, facing each other either tall enough or close enough together not to be effected by the curvature of earth.

(v) Space Propagation

It utilizes satellite relays delays in place atmospheric refraction.
A broadcast signal is received by an orbiting satellite which reach rebroadcast the signal to the intented receiver back on the earth.

Switching



: Circuit Switching
Packet Switching

O → Communication N/W

□ → Network/N/W Station

Switching

→ ① Circuit Switching

→ ② Packet Switching

→ ⓐ Datagram approach
ⓑ virtual ~~circuit~~ circuit
} Circuit Switching approach

Each Package independently ---> Datagram.