Data communication

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Intro :-

Outline

Evolution of Data communication system

* According to the history of computing organization, data communication has its earliest roots is Samuel Morse's 1837 exhibition of a telegraph system.

* Alexander Graham Bell introduced the telephone in 1876.
* In 1947, Bell labs introduced the transistor.
* In 1958, US government expanded on these technologies, with it's launch of a communaton-
* oriented satelite.
* In 1975 fibre optic cables were used to link computers together in the NORAD headquarters (located in Colorado).

Data Communication is a process of exchanging data or information.

In the case of computer networks this exchange is done between two devices over a transmission medium.
This process involves a communication system that is made up of hardware and software.
The hardware part involves the sender and receiver devices and the intermediate devices through which the data passes.

The software part involves certain rules which specify what is to be communicated, how it is to be communicated, and when.
- It is also called a Protocol.

The communication process involves :-
the sender of information,
receiver of information,
language used for communication
and the medium used to establish
the communication.

Communication between computers also follows a similar process.

Q What is data communication. Draw & explain generic block diagram of data communication system.

Data communication refers to the exchange of data between a source and a receiver via the form of transmission media such as a wire cable.

A data communication system has five components:-

Message, Sender, Receiver, Transmission Medium, and Protocol.

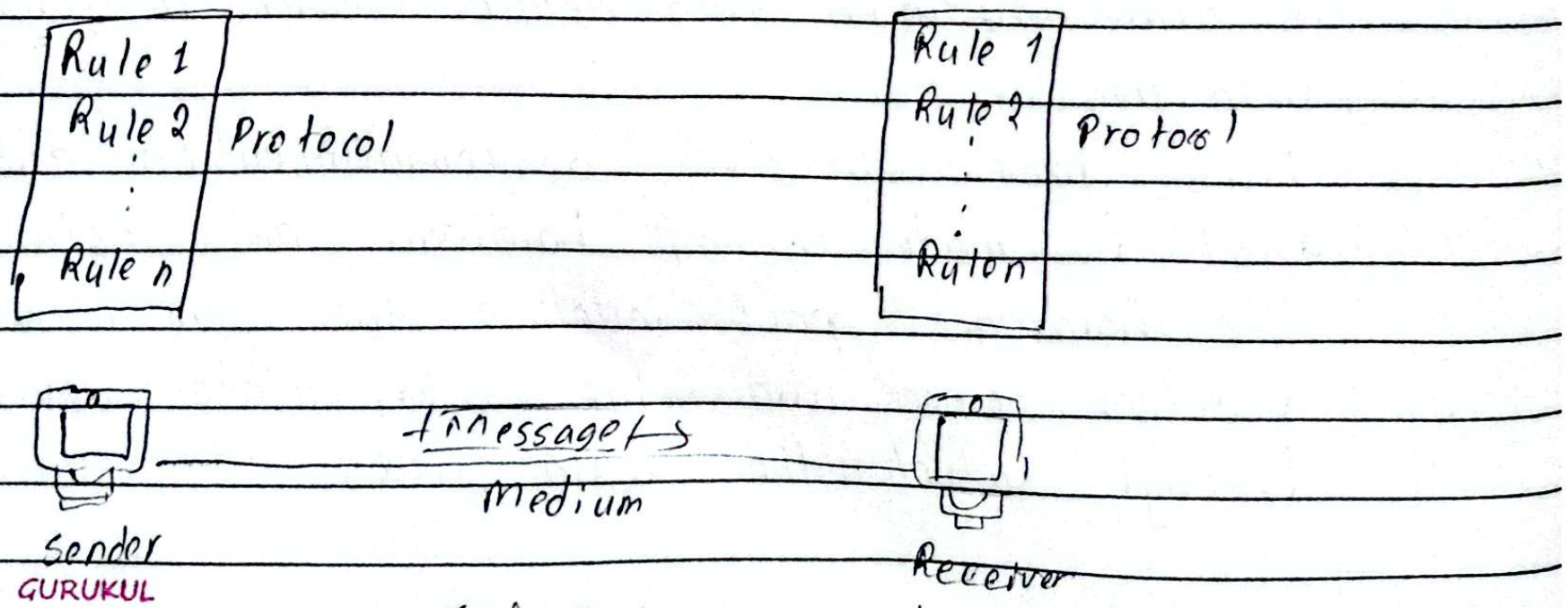

Fig: Data communication model

Introduction

Message :-
The message is the information (data) to be communicated.
Popular forms of information include text, numbers, pictures, audio, and video.

Sender :- The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera and so on.

Receiver :- The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television and so on.

Transmission medium :- The transmission medium is the physical path by which a message travels from sender to receiver.

Some examples includes :- twisted-pair wire, co-axial cable, fiberoptic cable, and radio waves.

Protocol :- A protocol is a set of rules that govern data communications.
It governs :
It represents an agreement between the communicating devices.

Q Draw the block diagram of data communication system.

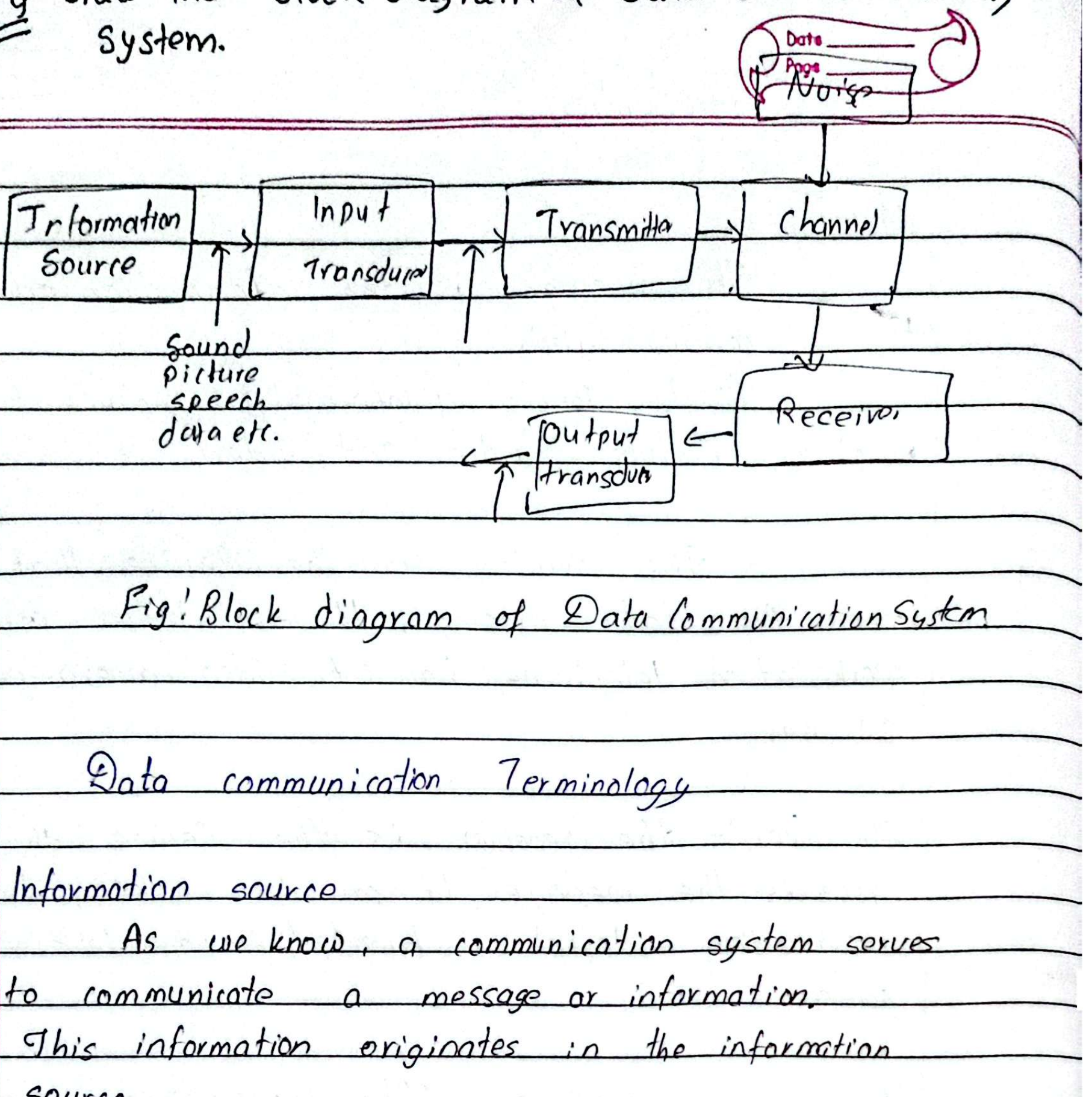

Fig: Block diagram of Data Communication System

Data communication Terminology

Information source

As we know, a communication system serves to communicate a message or information. This information originates in the information source.

In general, there can be various messages in the form of words, group of words, code, symbols, sound signals etc.

Input transducer

A transducer is a device that converts one form of energy into another form. The message from the information source may or may not be electrical in nature. In a case when the message produced by the information source is not electrical in nature, an input transducer is used to convert it into a time-varying electrical signal.

For example, in the case of radio broadcasting, a microphone converts the information or message which is in the form of sound waves into a corresponding electrical signal.

Transmitter

The function of the transmitter is to process the electrical signal from different aspects.

* For example in radio broadcasting the electrical signal obtained from the sound signal, is processed to restrict its range of audio frequencies (up to 5 kHz in amplitude modulation radio broadcast) and is often amplified.
* In wire telephony, no real processing is needed.
* However, in long-distance radio communication, signal amplification is necessary before modulation. Modulation is the main function of the transmitter.

In modulation, the message signal is superimposed upon the high-frequency carrier signal.

The Channel and The Noise

The term channel means the medium through which the message travels from the transmitter to the receiver.

In other words, we can say that the function of the channel is to provide a physical connection between the transmitter and the receiver.

During the process of transmission and reception the signal gets distorted due to noise introduced in the system.

BW = data transmission rate

What are the advantages of digital data communication over Analog data communication.

Feature	Analog Communication	Digital Communication.
Transmission media.	Sending information over a transmission media in the form of wave.	Sending information over a communication media ~~in the form of~~ through digital signal.
Signal	Continuously variable, both change in frequency and amplitude.	Discrete signal. change in either voltage or light levels.
Traffic measurements	Hz (for eg:- a telephone channel is 4 kHz)	Bits per second.
Bandwidth	low, so low data transmission rate	high, bandwidth hence supports high-speed data & emerging applⁿ.
Network capacity	low: one conversation per telephone channel	high:- multiplexers enable multiple conversations
Network manageability.	Poor; a lot of labour is needed for maintenance.	Good; smart devices produces alerts alarms, statistics & performance.

Due to ~~a~~ With the above comparision, we have conclude that the ~~analog~~ digital transmission is more advantageous

2023, spring

Q. What are standards explain the stand communicatron.

=> It's types are :- Data communication into two categorie

1) De Facto standar
2) De Jure standa

1) De Facto stand

- These are the adopted ~~by~~ & m
- These are not but are adopted

2) De Jure stan

- This means by

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more advantageous over analog transmission.
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Q.
=
What are standards? Explain its types also explain the standard organization in data communication.

=>

It's types are :-
Data communication standards are classified into two categories :-

1) De Facto standard
2) De Jure standard.

1) De Facto standard

- These are the standards that are ~~tr~~traditionally adopted ~~by~~ & meant by fact or by convention.

- These are not approved by any organization but are adopted by widespread use.

2) De Jure standard.

- This means by law or by ~~standard~~ regulation.

- These standards are legislated & approved by a body that is oficially recognized.

Standard Organization

The body which creates standards are standard Organization.

Standard are created by standard creation committees, forums & government regulatory agencies.

Examples of standard creation committees are:-

1) ISO:- International organization for standarization.
2) ITU-T:- International telecomunication Union - Telecommunication standards.
3) ANSI:- Americal National Standard Institute.
4) IEEE:- International Institute of Electrical & Electronics Engineer.
5) EIA:- Electronics Institute Associations.

Applications:-
Airline reservation system.
Automated Tellel machine.
Internet
· www · HTTP · URL · Browser · ISD
Entranet
Intranet.

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Unit-2

2021, 2022, 2020, 2017,

Differentiate between pa
Explain different modes

Parallel transmission :-
In parallel trans
the data are transm
separate communicatior

Serial transmission :-
In serial trans
of the data are tra

Lets differentiate both
factors :-

Factors	
no. of bits transmitted in one clock pulse	
no. of lines required to transmit n-bits.	
Speed of data transfer	
cost of transmission.	l is
Application	fo cc

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Unit-2

2021, 2022, 2020, 2017,

Differentiate between parallel & serial transmission. Explain different modes of serial transmission.

Parallel transmission :-

In parallel transmission no. of bits of the data are transmitted simultaneously on separate communication lines.

Serial transmission :-

In serial transmission various bits of the data are transmitted one after another.

Let's differentiate both according to their factors :-

Factors	Serial	Parallel
no. of bits transmitted in one clock pulse	one bit	n bits.
no. of lines required to transmit n-bits.	one line	n lines.
Speed of data transfer	slow	fast
cost of transmission.	low as one line is required.	high as n lines are required.
Application.	for long distance communication. from computer to computer.	for short distance comunication. computor to printer.

Types of serial transmission / Modes of ST.

1) Asynchronous transmission
2) Synchronous transmission

1. Asynchronous transmission.

Asynchronous transmission sends only one character at a time, where a character is either letter of alphabet, number or control character.

It is the
It works in half-duplex mode.

In this,
start bit indicates the beginning of the data which alert receiver about the new group of data.
Stop bit indicates the end of the data which let the receiver know that the byte is finished.

It is called asynchronous because at the byte level sender & receiver need not to be synchronized, but at within each byte receiver must be synchronized within incoming bitstream.

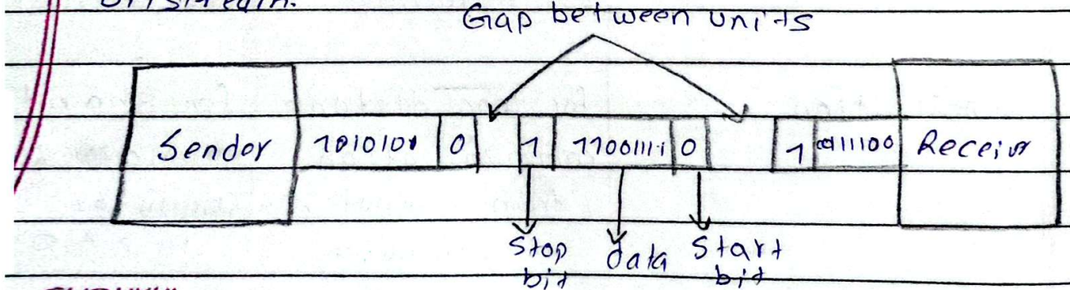

Fig: Asynchronous tra

2. Synchronous transmission

Do not use stop & sta
In this method bit stream
longer frames that may co
bytes.

There is no gap present b
in the data stream.
In order to receive data
& receiver operate at same
This communication is us
videochats.

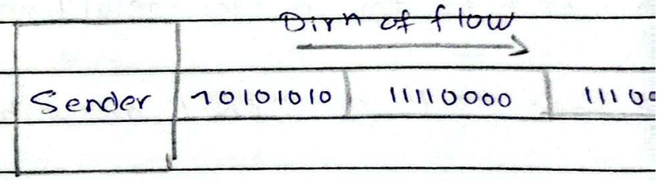

Fig: Synchronous tra

Difference

Factors	Asynchr
Data send at a time	one b
Stop & start bit	presen
Gap between ndataunits	presen
data transmission speed	slow
cost	low

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2. Synchronous transmission.

Donot use stop & start bits.
In this method bit stream is combined into longer frames that may contain multiple bytes.

There is no gap present between various bytes in the data stream.
In order to receive data error free, sender & receiver operate at same clock frequency.
This communication is used for videochats.

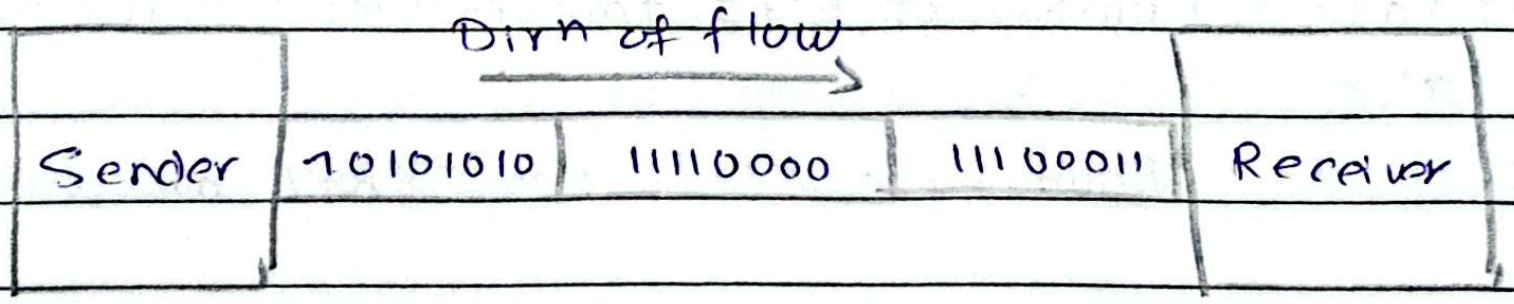


Fig: Synchronous transmission.

Difference

Factors	Asynchronous	Synchronous
Data send at a time.	one byte	n byte.
Stop & start bit	present	absent
Gap between ndataunits	present	absent
data transmission speed	slow	fast
Cost	low	high.

2023 spring

2) Define bit rate and baud rate. Explain with a scenario to show bit rate is not always equal to baud rate with suitable diagram & calculations.

=> Bit rate

The number of bits per second that can be transmitted along with a digital network.

As the name emplies, it is the rate at which bits are transferred from one location to another.

It is measured in bps, ~~m~~.k bps, mbps.

Bit rate = number of bits transmitted / total time(s)

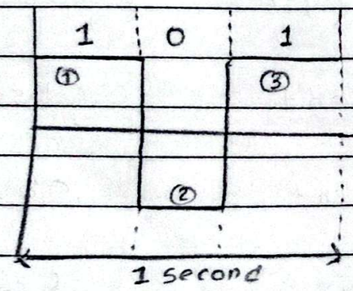
also,

bit rate = Baud rate x bits per signal or symbol.

Baud rate

Baud rate is the rate at which the signal element or changes to the signal occurs per second when it passes through a transmission medium.

Baud rate = no. of signal element / total time(s).



In fig,

Number of signal element = 3

Number of bits transmitted

(1,0,1) = 3

So,

here, Bit rate = 3/1 = 3 bits per second.

Baud rate = 3/1 = 3 baud per second.

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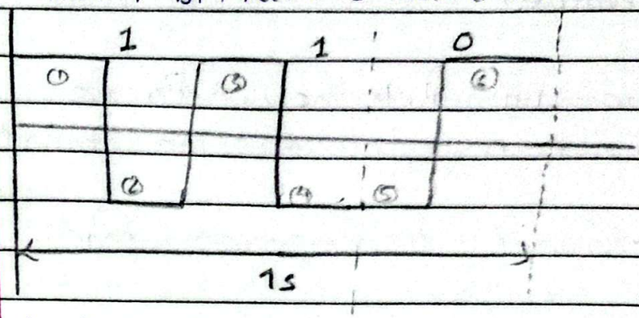
Here, bit rate = Baud rate.



In this fig, no. of signal element.
no. of bits transmitt

So,

here, Bit rate = 3/1 = 3 bps

Baud rate = 6/1 = 6 baud bps

here, Bit rate ≠ Baud ra

hence, bit rate is not al
baud rate.

Why baud rate is importa

Baud rate is important beca

It can determine the blu
for transmission of signal.

Also used for calculation of

It is a tuning parameter.

It specifies how fast dat
over a serial line or seria

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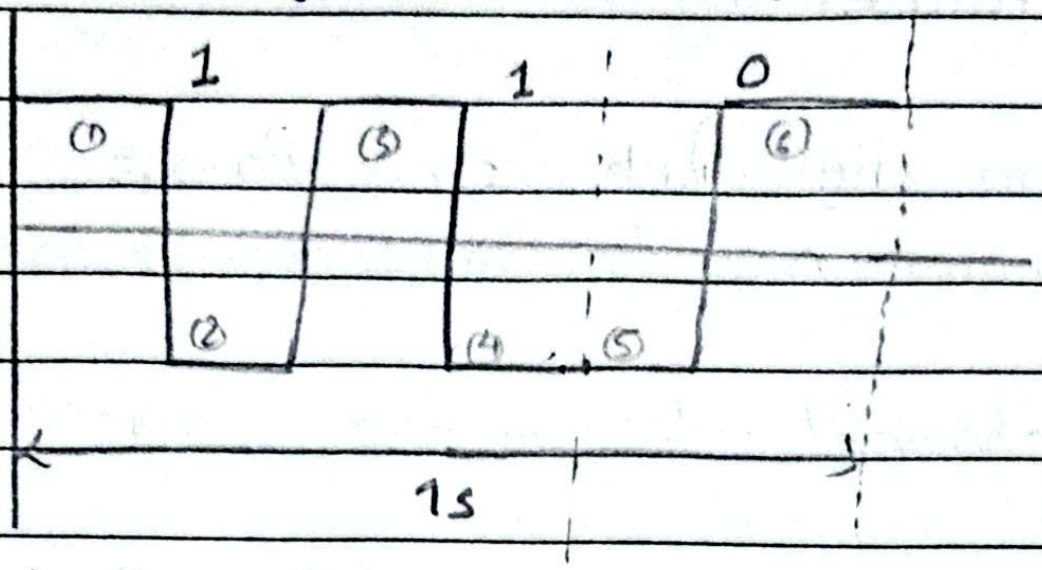
Here, bit rate = Baud rate.



In this fig, no. of signal elements = 6
no. of bits transmitted (1,1,0) = 3

So,

here, Bit rate = $3/_1$ = 3 bps

Baud rate = $6/_1$ = 6 $\frac{baud}{bps}$

here, Bit rate ≠ Baud rate
hence, bit rate is not always equal to baud rate.

Why baud rate is important?
Baud rate is important because:-
It can determine the bw requirements for transmission of signal.
Also used for calculation of Bit rate.
It is a tuning parameter.
It specifies how fast data can be sent over a serial line or serial interface.

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Transmission channel

The medium by which the data is transmitted is known as transmission channel.

Transmission channel = transmission modes.

Three modes:-

1) Simplen mode.
2) Half-duplex mode
3) Full-duplen mode.

Simplen mode.

In this mode, the communication is unidirectional as in a one-way streed.
Only one of the two devices can transmits the other can only receive.

Example:- keyboard can only introduce input monitor can only give output.

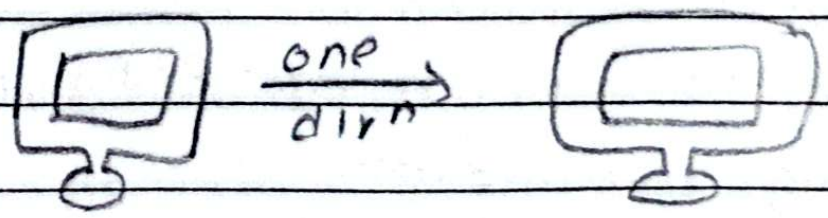

fig: Simplex mode.

function - RS-232C
Explain -

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Half-duplen mode.

In half-duplen mode, each station can both transmit and receive, but not at the same time.

While one device is sending the other only can receive & vice versa.

Eg:- Walkie-talkie

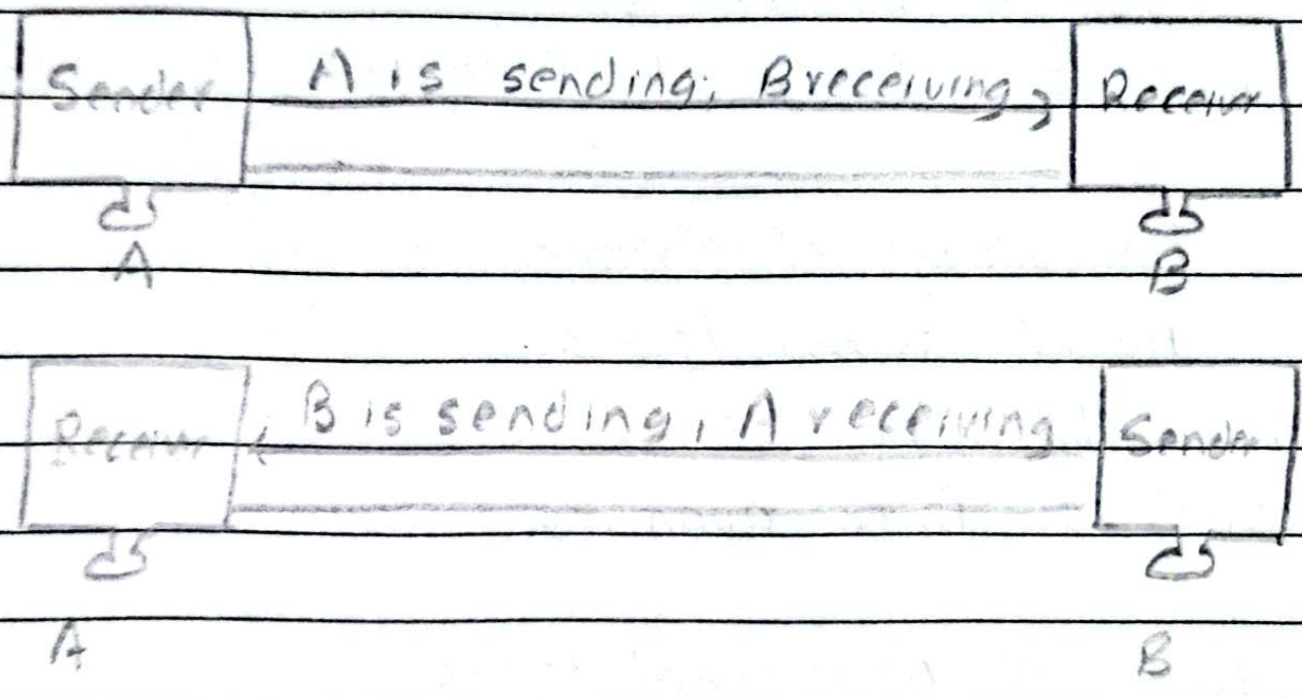

Fig: Half duplen mode

Full-duplen mode.

In #full-duplen mode, both station can transmit & receive.

Eg:- Telephone network

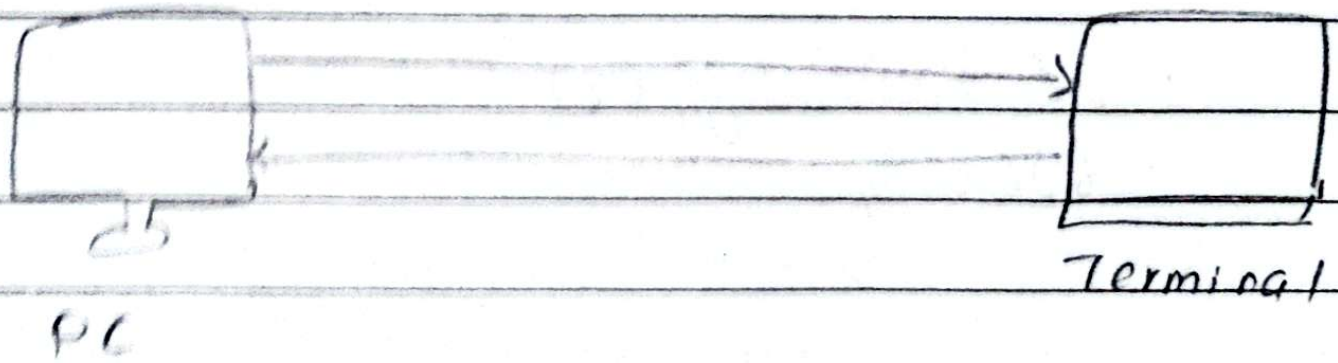

Fig: Full-duplen mode

Q | Define channel capacity with necessary theorem

Channel capacity:-

max info rate that a channel can transmit.

Two theoretical formula:-

Noiseless channel:-
Nyquist for a noiseless channel

Nyquist theorem states:-
Bit Rate = 2 * Bandwidth * $\log_2(L)$ bits/sec

blw = bandwidth of channel
L = no. of signal levels.
Bitrate = bits per second.
Bandwidth is fined quantity

data Rate $\propto$ no. of signal levels

Eg:

Input1: Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. What can be the maxm bit rate?.

Bit rate = 2 * Bandwidth * $\log_2(L)$ bps

= 2 * 3000 * $\log_2(2)$
= 6000 bps.

We need to send 265 Kbps over a noiseless channel with a bandwidth of 20kHz. How many signal levels do we need?

Bit rate = 265 kbps = 265000 bps
bandwidth = 20kHz = 20000 kHz.
L = ?

Bit rate = 2 * bandwidth * $\log_2(L)$ bps
$265000 = 2 * 20000 * \log_2(L)$
$\frac{265000}{2*20000} = \log_2(L)$
$\log_2(L) = 6.625$
~~$L = \ln(6.625)$~~
$L = 2^{6.625}$
$L = 98.7$ levels.

Noisy channel :- Shannon capacity
In reality, we cannot have noiseless channel

Capacity = bandwidth * $\log_2(1 + SNR)$ bits/sec.

SNR = signal to noise ratio.
channel capacity $\propto$ ~~SNR~~ Power of signal

as, $SNR = \frac{\text{Power of signal}}{\text{Power of noise}}$

Signal-to-noise ratio expressed in dB.
$SNR_{dB} = 10 * \log_{10}(S/N)$

Eg:
$10 * \log_{10}(1000) = 30$ dB

Inp1:
A telephone line normally has a bandwidth of 3000 Hz (300 to 3300 Hz) assigned for data communication. The SNR is usually 3162. What will be the capacity for this channel?

Olp 1:- $C = \text{bandwidth} * \log_2(1+SNR)$ bps

$= 3000 * \log_2(1+3162)$

$= 34882$

$= 34860$ bps.

Inp2: The SNR is often given in decibels. Assume that SNR (dB) is 36 & the channel bandwidth is 2MHz. Calculate the theoretical channel capacity.

Olp 2:-

$SNR(dB) = 10 * \log_{10}(SNR)$

$SNR = 10^{(SNR(dB)/10)}$

$= 10^{(3.6)}$

$= 3981$

$b/w = 2MHz = 2 * 10^6$

$C = 2 * 10^6 * \log_2(1+SNR)$

$= 24$ MHz.

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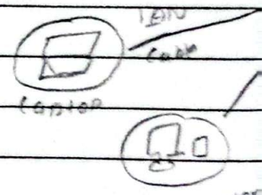
List different types of n
topology.

=> Network topology refers
of computers on the n
of the network.

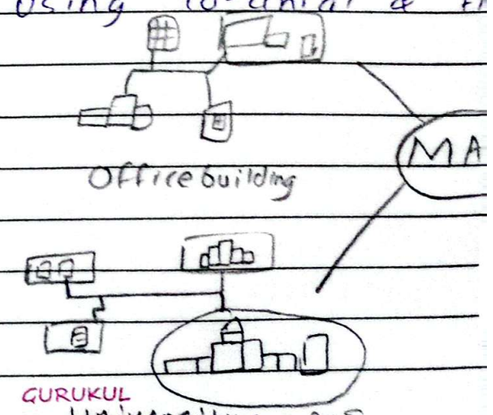
Different types of

Local Area Network.
A computer networ
communication. They are
with the purpose to s
info



LAN

Metropolitical area net
MAN is a computer
Eg: cable television com
using co-axial & fi



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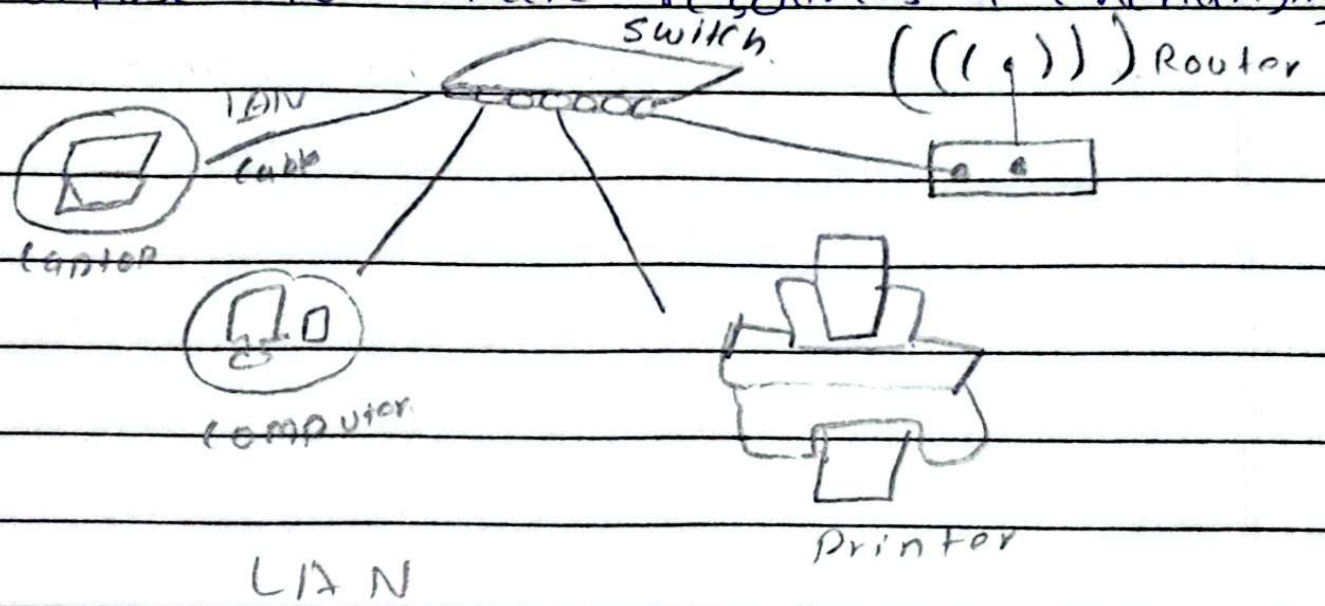
List different types of network & explain its topology.

:) Network topology refers to the arrangement of computers on the network or the shape of the network.

Different types of network are:-

Local Area Network.

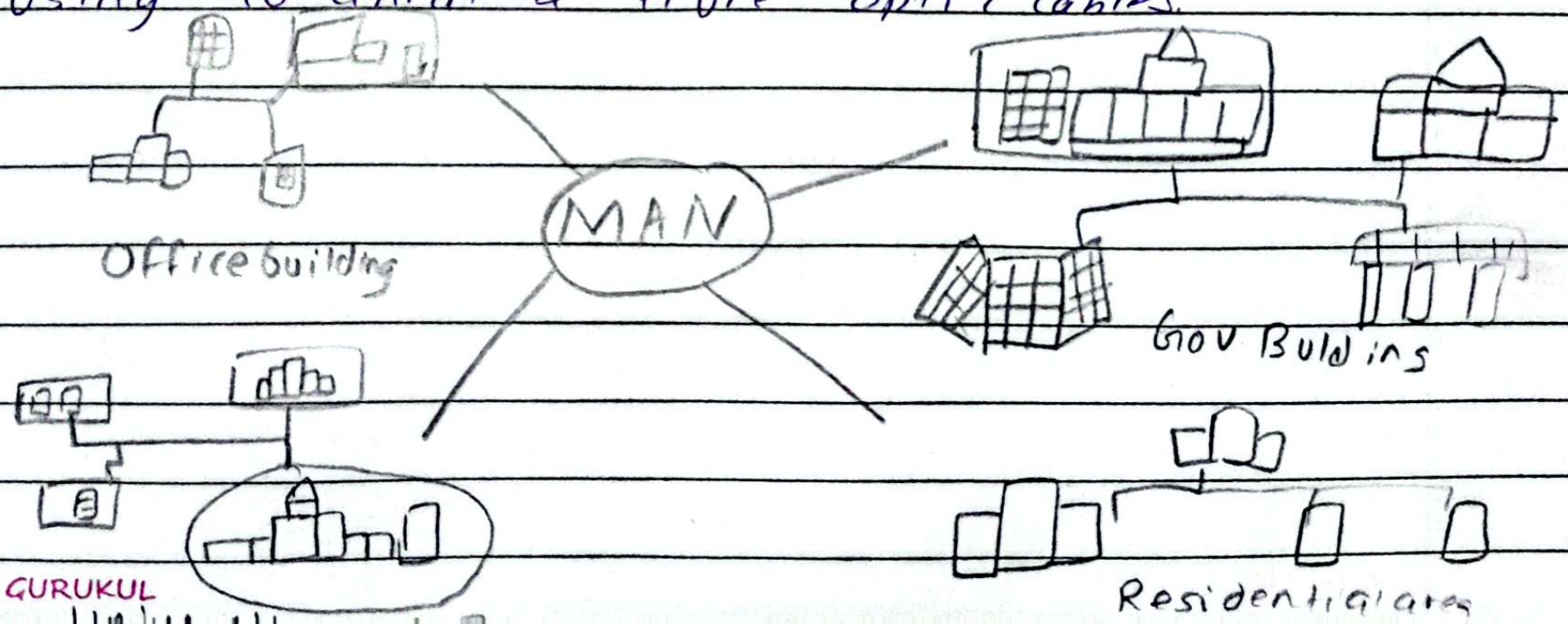
A computer network widely used for local communication. They are privately owned networks with the purpose to share recources & exchanging info



LAN

Metropolitial area network.

MAN is a computer network spread over a city. Eg: Cable television. Computer in MAN are connected using co-axial & fibre optic cables.



Wide Area network.

WAN is a network that connects computers over long distances like cities, countries, continents or word wide.

It uses telephone line, satelite links, & radio links to connect.

Internet is a common example of WAN.

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Past Qsn (Repeated 3,4--times)

OSI layer architecture is reference model. Support & explain basic function of each layer.

Open System Interconnection (OSI) model

The OSI model is layered framework for the design of network systems that allows communication between all types of computer system.

It consists of seven separate but related layers, each of which defines a part of the process of moving information across a network.

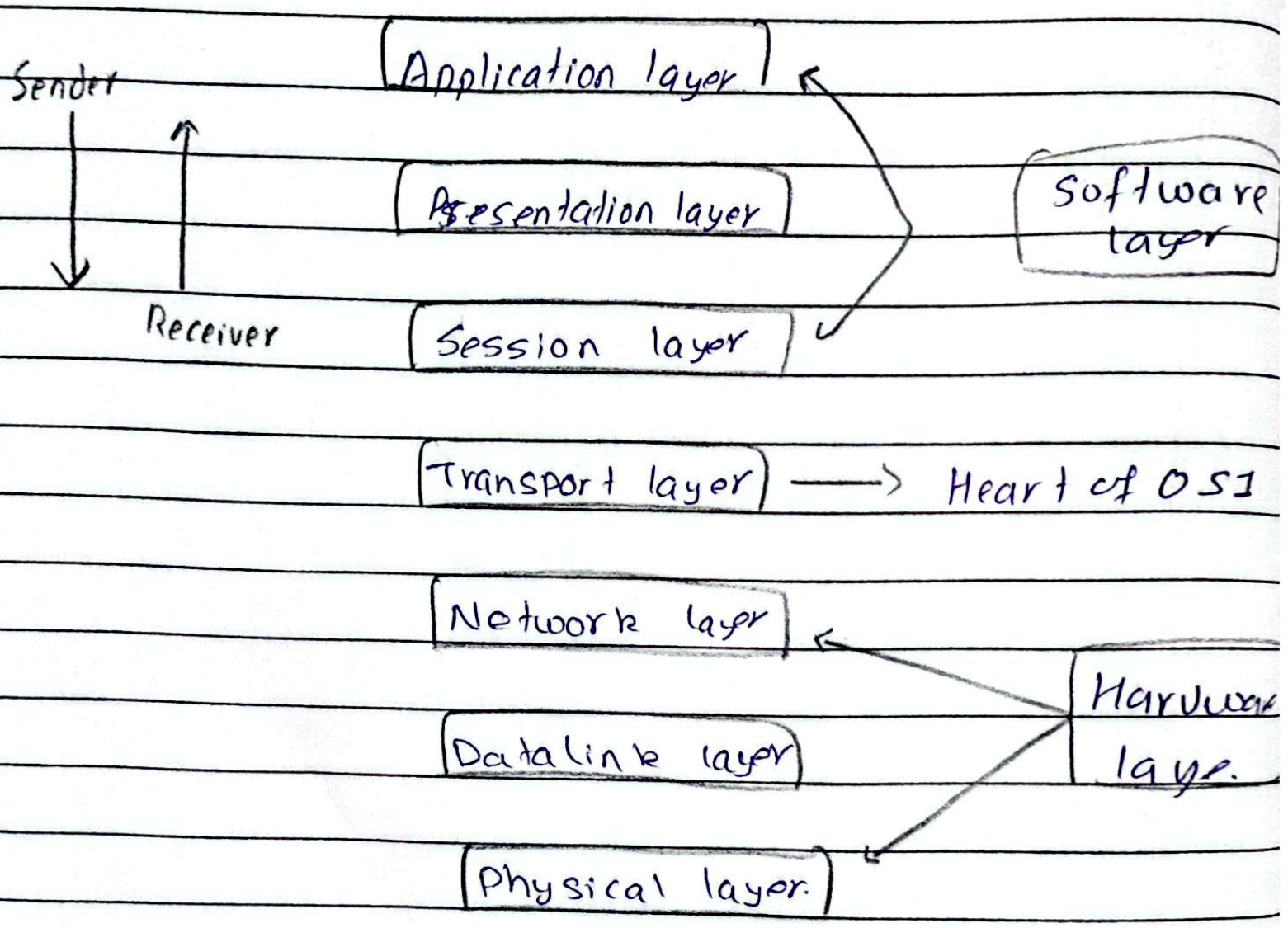

Fig: 7 layers of OSI Model