6/2/2020

Computer network. → transmission control protocol → Internet Protocol

TCP / IP Stack

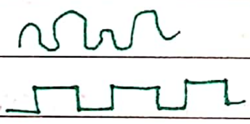
		TCP / IP Stack	
Sending a Massage	→ layers	Application layer	→ HTTP → SMTP → PoP3
		Transport layer	→ flow control → error control → consestion control
		Network layer	→ IP addressing → Rowting protocols
		Data link layer	→ logical link control sublayer "LLC" → Media access control sublayer "MAC"
		physical layer (row bits)	

Channel

Cable

Analog tranmission →

Digital tranmission →



* Note : Eeach layer presents services at form of protocols

← عبارة عن خدمة يقدمها كل layer

* Example of Application layer :

① HTTP : Hyper text transfer protocol (أول protocol)

HTTP requests : → Get
→ Post

* Domain name : Such that : * www. Yahoo . com
* ju. edu. jo

← لما أحط Enter معناها أنا بطلب ال HTTP server يوديني عال home Page
تاعت Yahoo (Get)

* IP address : عبارة عن ال ID لل domain (يعني بدال ما بكتب ال url ال Domain name
بكتب ال IP address)

② SMTP : Simple mail transfer protocol (بيعمل نقل المعلومة)

③ PoP3 : Post office protocol

Example | لما أحط الـ email الـ username والـ password بتأكد منهم وبوديك على Page تانية .

* Servers :

① Server machine : hardware (high specification لازم يكون :)

* Server machine بشغل more than one server program

② Server Program : "Protocol" عبارة عن

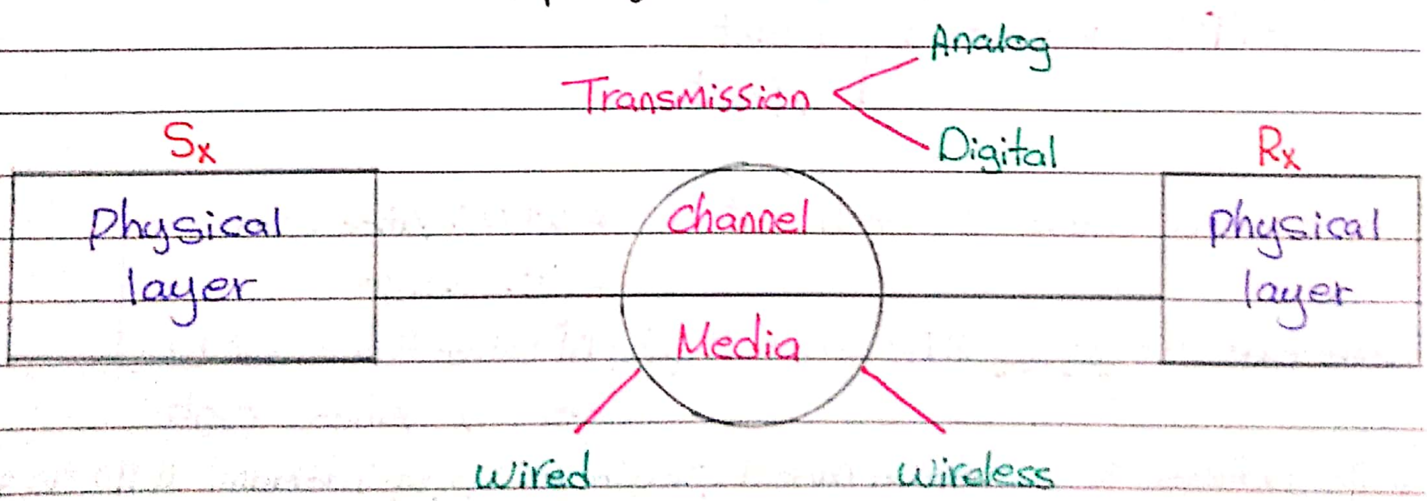
* لكل domain الـ Server program خاص فيه *

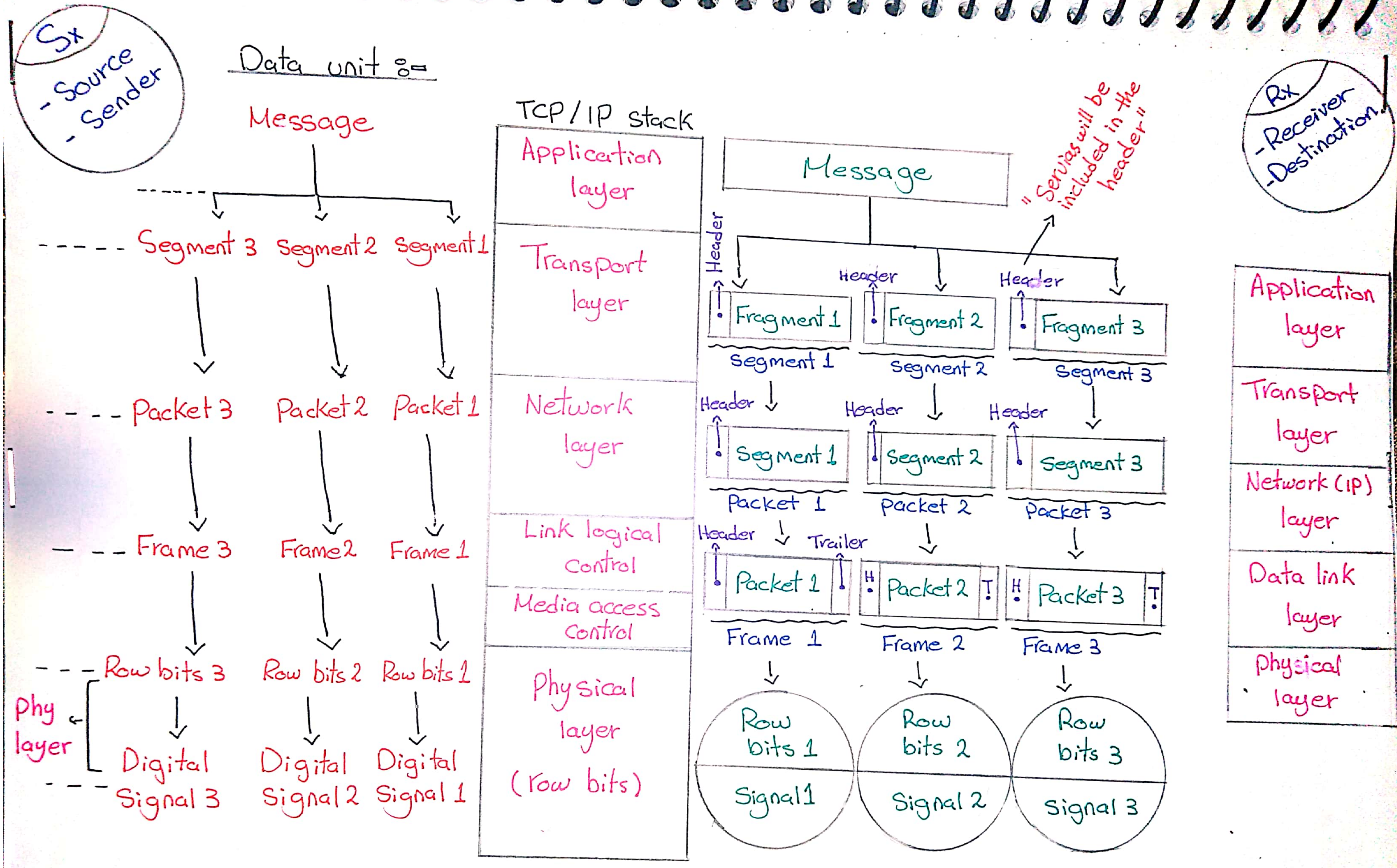
* Note : Source, sender → مرسل / receiver → مستقبل

9/2/2020

* Application layer : Protocols : HTTP, SMTP, PoP3, --
* Transport layer : Protocols : * TCP , UDP → user Datagram Protocol
* Network layer ("IP layer" تسمى أحيانا) : Protoclos : * IP
* link logical control ⎤ Data link layer
* Media Access control ⎦ مع بعض
* physical layer (raw bits)

* Note : TCP/IP Stack → "سمي بذلك لأن أهم 2 protocols في الـ system هم TCP/IP"

*



Sx
- Source
- Sender
Data unit :-
Message
Segment 3
Segment 2
Segment 1
Packet 3
Packet 2
Packet 1
Frame 3
Frame2
Frame 1
Row bits 3
Row bits 2
Row bits 1
Phy layer
Digital Signal 3
Digital Signal 2
Digital Signal 1
TCP/IP stack
Application layer
Transport layer
Network layer
Link logical control
Media access control
Physical layer (row bits)
Message
" Servias will be included in the header "
Header
Fragment 1
Fragment 2
Fragment 3
Segment 1
Segment 2
Segment 3
Packet 1
Packet 2
Packet 3
Trailer
H
T
Frame 1
Frame 2
Frame 3
Row bits 1
Row bits 2
Row bits 3
Signal1
Signal 2
Signal 3
Rx
- Receiver
- Destination
Application layer
Transport layer
Network (IP) layer
Data link layer
Physical layer

* protocols : A set of rules adhereed by communicating devise for the purpose of having timely, recognizable, and reliable transfer of information.

timely → Synchronous
recognizable → Format of data
reliable → Accurancy of data

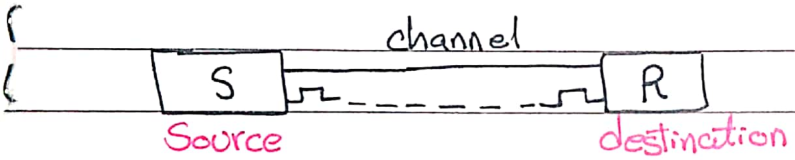
* performance → Delay
 → Throughput

Delay:
deterministic delays:
(T Prop) → ① Propagation delay
(T Trans) → ② transmission delay
(T proc) → ③ Processing delay

undeterministic delay:
(T Queu) → ④ Queuing delay

① Propagation delay (Tprop) : time elapsed from the moment that any bit is transmitted till the moment it is received by destination.

الوقت المنقضي من S إلى R :



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① Propagation delay (Tprop) :

Two factors have to be taken into consideration :

① Distance between A and B (m)

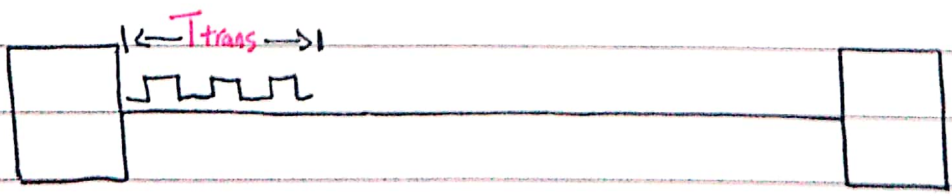
② Propagation speed

$$\therefore T_{prop} = \frac{D\,(m)}{V\,(m/s)} \quad (s)$$

copper wire : 2.3×10^{8} m/s → بسرعة التيار

fiber : 3×10^{8} m/s → بسرعة الضوء

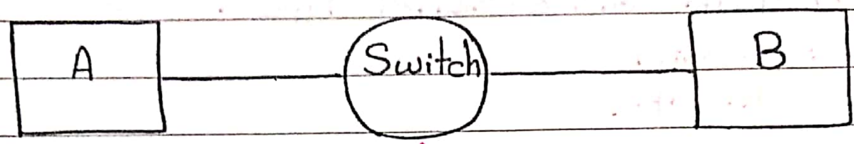
② Transmission delay : time elapsed from the moment the first bit is transmitted till the moment the last bit is transmitted



$\Rightarrow$ Data rate (R_b) = $\frac{1 \text{ bit}}{T_s}$ (bit / sec)

$$T_{trans} = \frac{\text{Length of Message (b)}}{\text{Data rate (b/s)}} \quad (L / R_b)$$

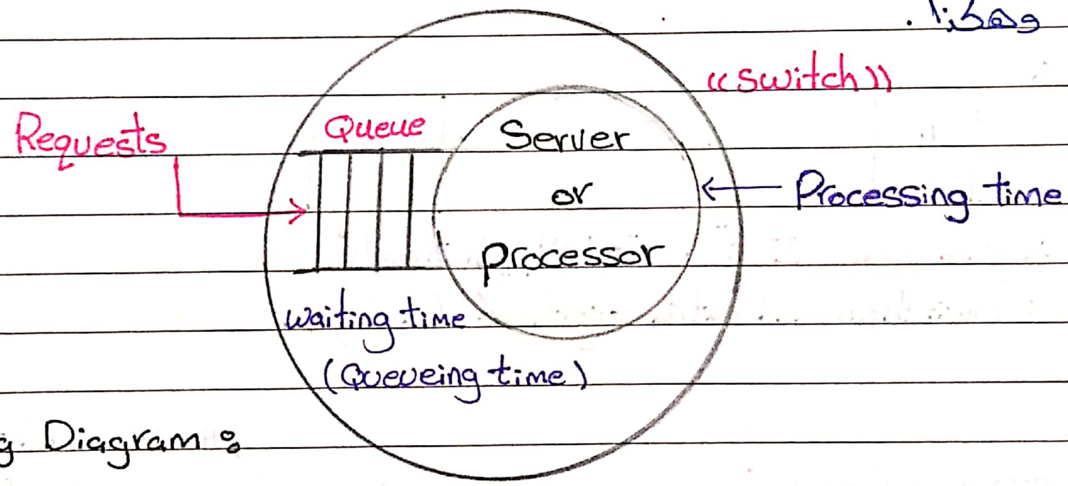
* Note :



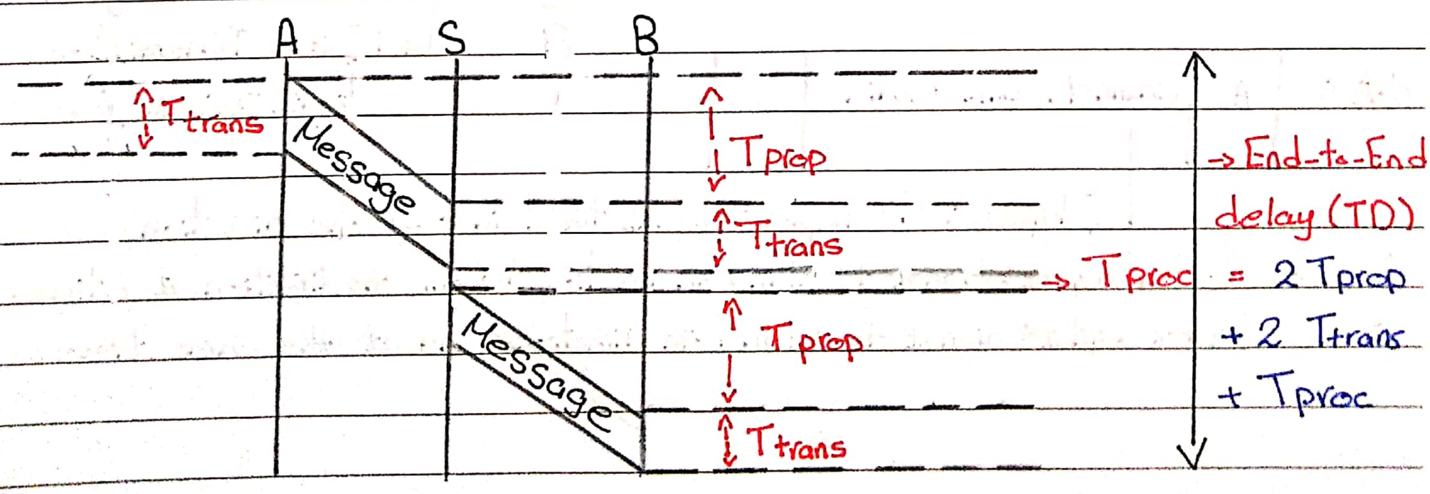
Internet working device → وظيفته: بنوصل فيه الأجهزة فبدل ما يطلع كذا من الأسلاك من كل جهاز بطلع سلك واحد بس.

* Switch ← يا 24 Ports يا 48 Ports *

* الـ Switch الهم levels يعني في Switch بنربط الـ PC وفي Switch بربط أكثر من Switch وهكذا.



* Timing Diagram :



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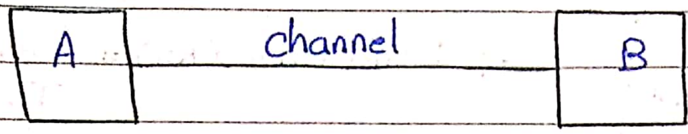
* Note :

Case I :

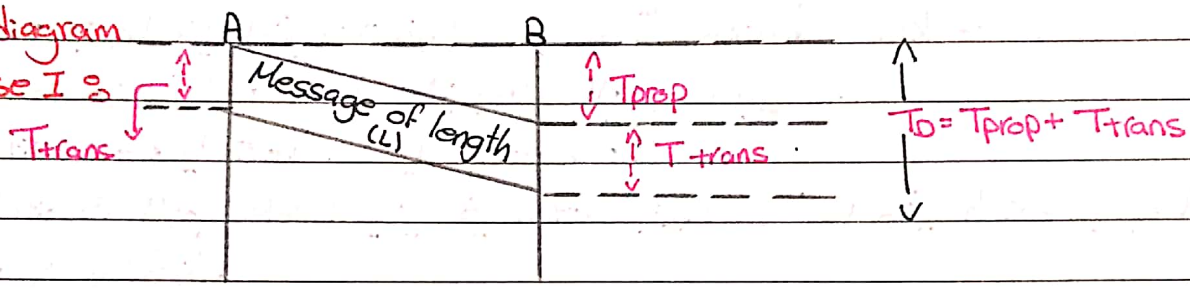


End-to-End delay (TD) : Time elapsed from the moment the first bit is transmitted till the moment the last bit is received.

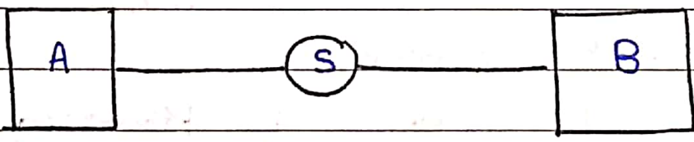
* Tip : $T_{prop} = \frac{d(m)}{V(m/s)}$ → Depends on the channel Type.

$T_{trans} = \frac{L(bits)}{Rb(bps)}$

Timing diagram case I :



Case II :



Timing Diagram case II : "الرسمة اللي بالصفحة ورا"

* Summary : Switches add extra overhead (delay).

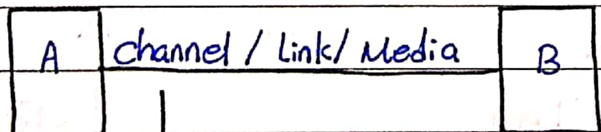
* Link Efficiency (L_E) :

* Signals → Analog / → Digital

Advantages of Digital Transmission

له في الصفحة التالية

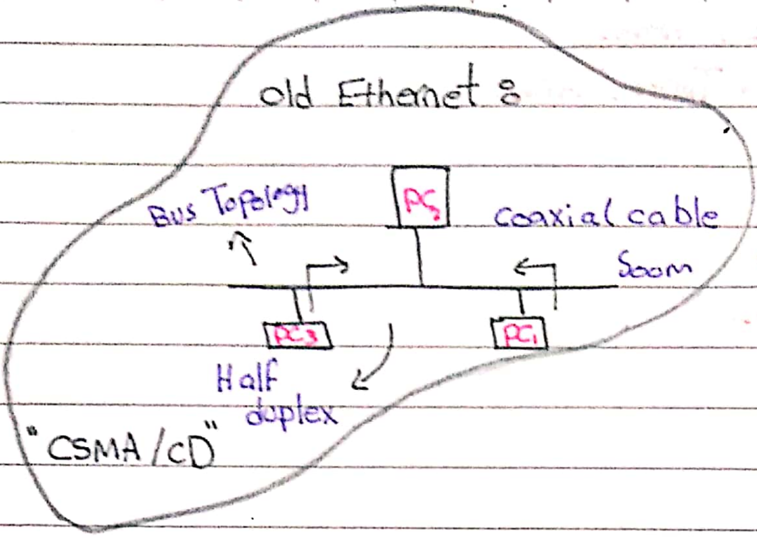
* Note :



→ Types : ① Simplex : Signals travel in only one direction.

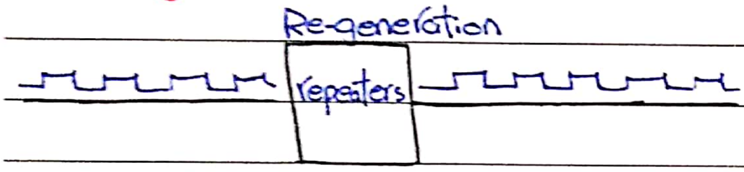
② Half duplex : Signals travel in both directions but only one direction at a time.

③ Full duplex : Signals travel in both directions and at the same time.



* Advantages of Digital transmission :

- Digital circuits require repeaters which basically exclude the noise Propagation while analog circuits require amplifiers which amplify the noise , making the quality worse.



- Easy to apply encryption to digital data.
- Better integration if all signals are in one form.
- Easy to multiplex large channel capacities.
- Higher Bandwidth
- lower error rate

توصل نتيجة

*Throughput : The rate at which the signal is reliably delivered to the destination. (bps)

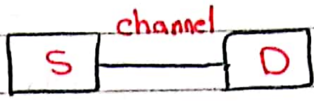
objective : Is to maximize the channel throughput.

$$\text{Throughput} = \frac{\text{Length of the Message (L)}}{\text{End-to-End delay (TD)}}$$

"قديش المسج بدها لتوصل بدون مشاكل" ل "Throughput"

$$L_E = \frac{T_{trans}\ (Sec)}{TD\ (sec)}$$ (ما إلها وحدة)

* $LE_{case I} = \dfrac{T_{trans} / T_{trans}}{T_{trans} + T_{prop} / T_{trans}}$



$LE_{case I} = \dfrac{1}{1 + \dfrac{T_{prop}}{T_{trans}}} = \dfrac{1}{1+\alpha}$, $\alpha = T_{prop} / T_{trans}$

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$LE_{case 2} = \dfrac{T_{trans}}{2T_{prop} + 2T_{trans} + T_{prop}}$ → very small " الدكتور بيحكيلك "

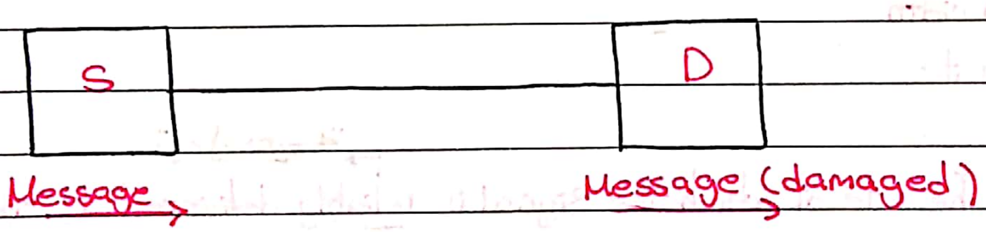
$L.E = \dfrac{1}{2(1+\alpha)}$, $\alpha = \dfrac{T_{prop}}{T_{trans}}$

* Throughput $= \dfrac{L}{T_D}$ (bps)

The rate at which the data is relibly delivered to the destination.

* Note : Relation between damaged packets (Frames) and delay :

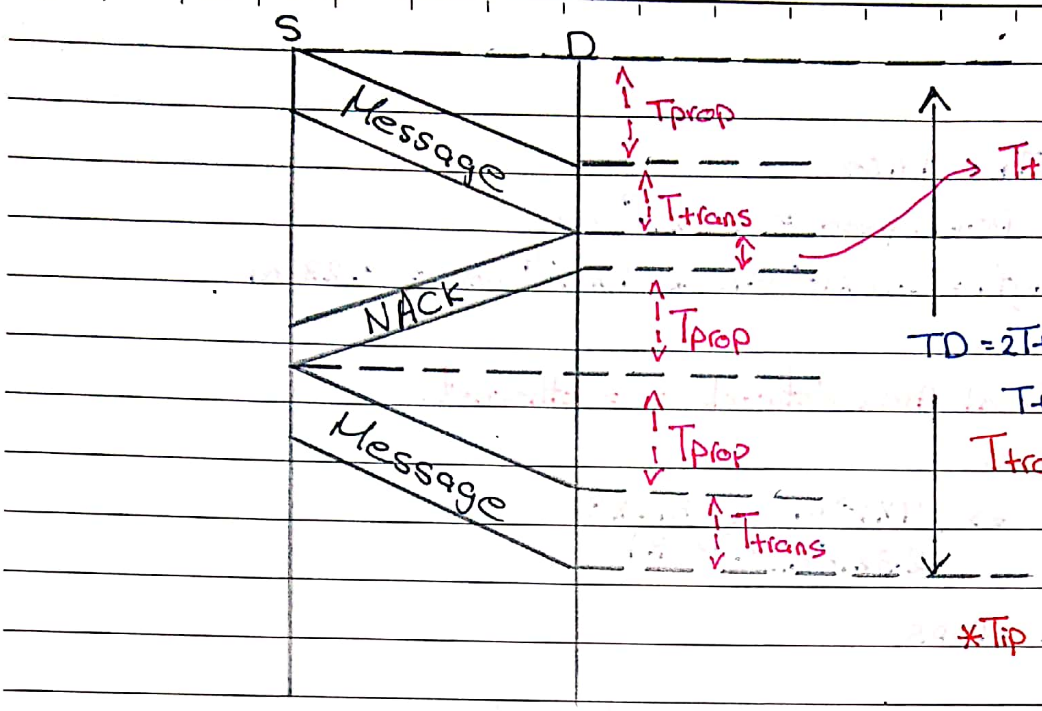
*



← ask for retransmission :

Acknowledgment

- Positive (PAck or Ack)
- Negative (N Ack or REJ)



$TD = 2T_{trans} + 3T_{prop} + \cancel{T_{trans\ NACK}} \to 0$

$T_{trans\ NACK} = \dfrac{L}{R_b} \to 0$

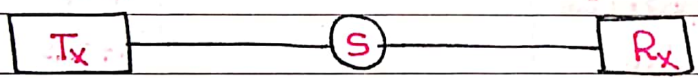
*Tip: NACK is very short Message.

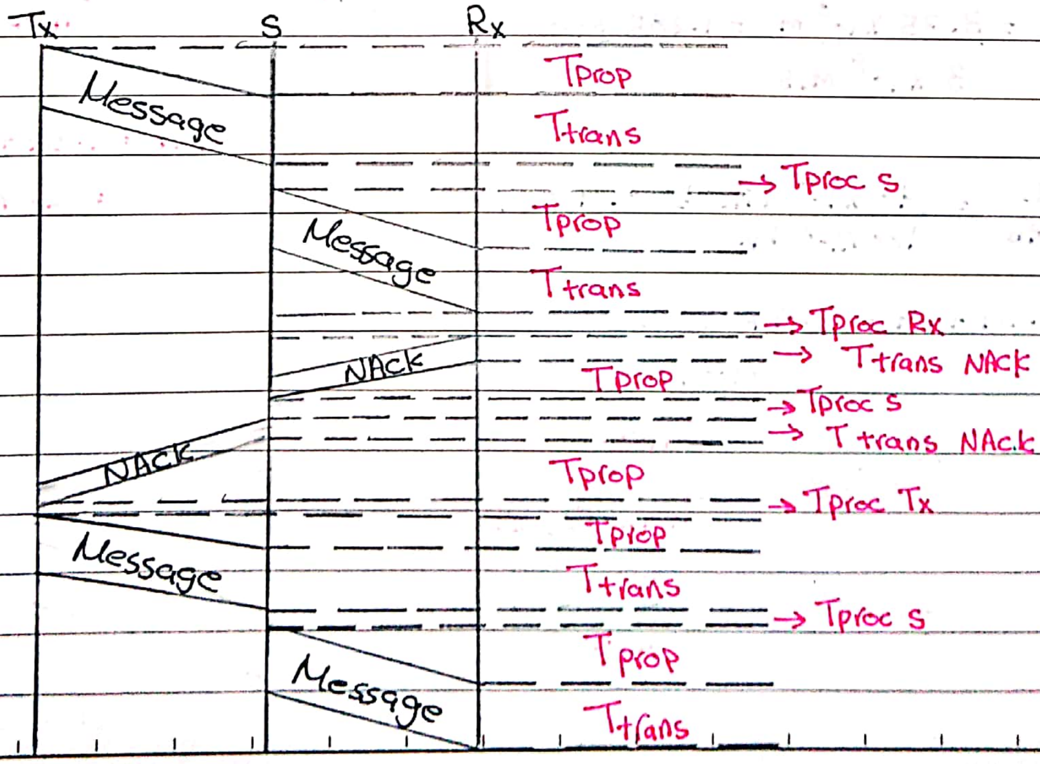
* Summary:

- Delay ↑ → "لما يزيد ال delay بقل ال Throughput"
- Throughput ↓

*Note: In general, Acks are additional overhead.

*





Question paper 8

Q1 : Sol : (a) $T_b = 1\,nsec$

(b) Prop. speed $= 2.3 \times 10^{8}\ m/s$

length $= 2.3 \times 10^{8}\ m/s \ast 1 \times 10^{-9}\ sec = 0.23\ m$

Q2 : * LAN = Local Area Network → Ethernet.

Sol : $T_{prop} = T_{trans}$

$$\frac{d}{v} = \frac{L}{R_b} \Rightarrow \frac{4 \times 10^{3}\ m}{2.3 \times 10^{8}\ m/s} = \frac{512 \times 8}{R_b}$$

$\Rightarrow R_b = 235.52\ Mbps$

Q3 : Sol : MC "Earth" — Point-to-Point link — Moon

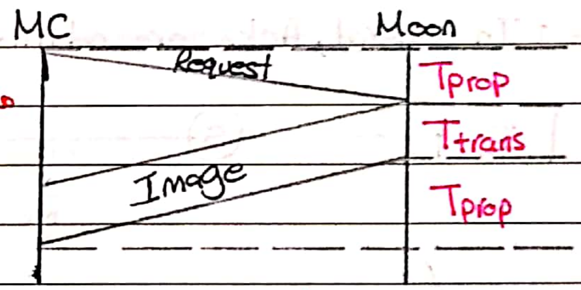
$3.85 \times 10^{8}\ m$

$100\ Mbps\ (100 \times 10^{6}\ bps)$

Prop. speed $= 3 \times 10^{8}\ m/s$

Image size $= 40 \times 10^{6}$ bits

*T_{trans} request $= 0$ → مش معطي عنها معلومات.



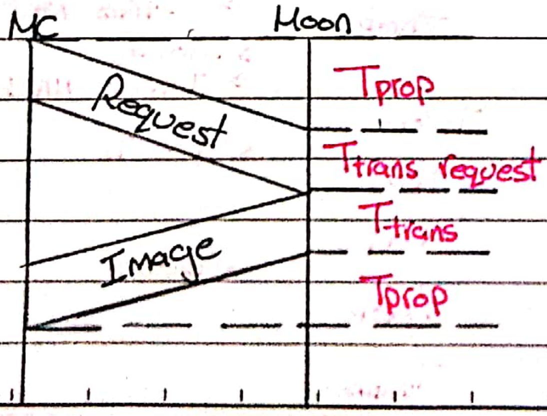
① $T_{prop} = \frac{d}{v} = \frac{3.85 \times 10^{8}\ m}{3 \times 10^{8}\ m/s} = 1.285\ sec$

↳ $TD = 2.57 + 0.4 = 2.97\ Sec$

② $T_{trans} = \frac{L}{R_b} = \frac{40 \times 10^{6}\ bits}{100 \times 10^{6}\ bps} = 0.4\ sec$

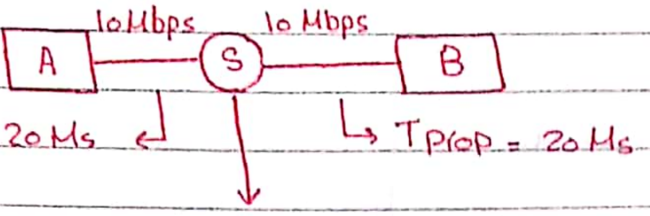
$\therefore TD = 2.57 + .4 = 2.97$ sec.

* Note :



18/2/2026

Q4 : a:



Store-and-forward device

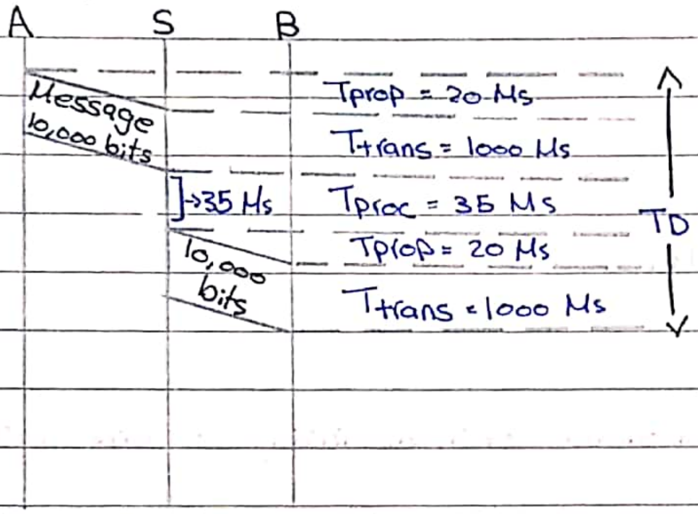
1: Store
2: Process
3: Forward

Time = 35 μsec

Tproc = 35 μsec

Message 10,000 bits Required TD ?

Sol : Timing Diagram:



$T_{trans} = \frac{10,000 \text{ bits}}{10 \times 10^6 \text{ bps}} = 1 \text{ ms} = 1000 \ \mu s$

$\therefore TD = 2075 \ \mu sec$

* Tip : $T_{trans} = \frac{L \text{ (bits)}}{R_b \text{ (bps)}}$ → Source data rate.

* Very important Note :

أقل منه بصير بس بصير بدي "buffers" ← $\boxed{R_b \leq \text{Channel capacity "C"}}$

* Note : T_b → bit duration ⇒ $R_b = \frac{1 \text{ (one bit)}}{T_b}$ (bps)

$| \leftarrow T_b \rightarrow |$

Five Apple

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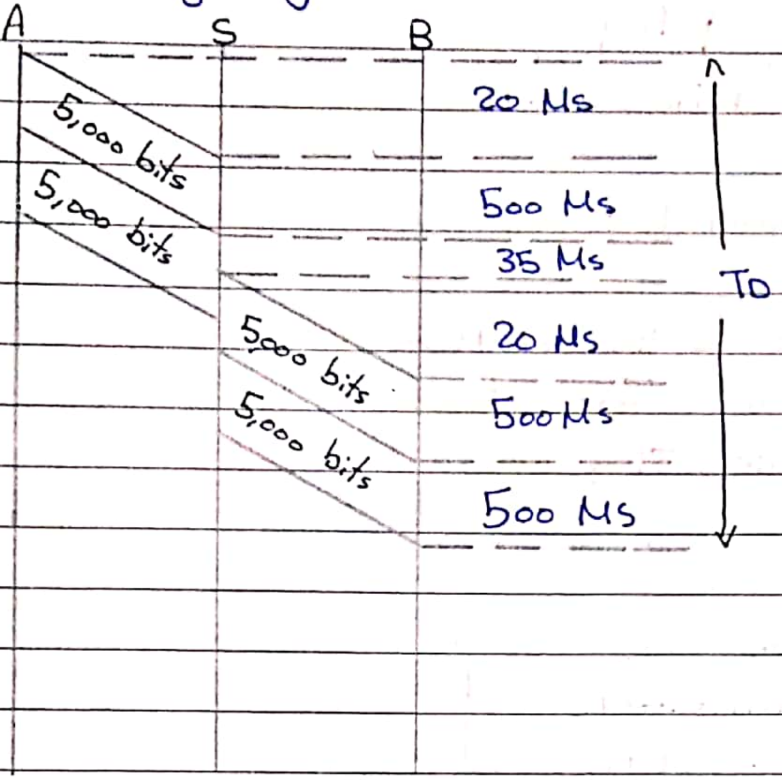
b: Sol: Timing Diagram:

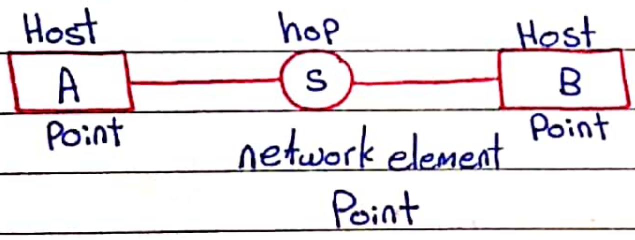


$T_{trans} = \frac{5000 \text{ bits}}{10 \times 10^6 \text{ bps}} = 500\ \mu sec$

$\therefore TD = 1575\ \mu sec$

* physical layer: is responsible of transmitting row bits between Two hosts (Points)

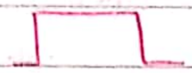
* Note:



Q: How bits "0" and "1" are mapped into digital Signals?

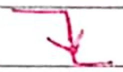
Sol: Three encoding Schemes
① Non - return-to-Zero (NRZ)
② NRZ-Inverted (NRZ-I)
③ Manchester encoding

① NRZ → "0" 

"1" 

② NRZ-I → "1" there is a transition of the current state.

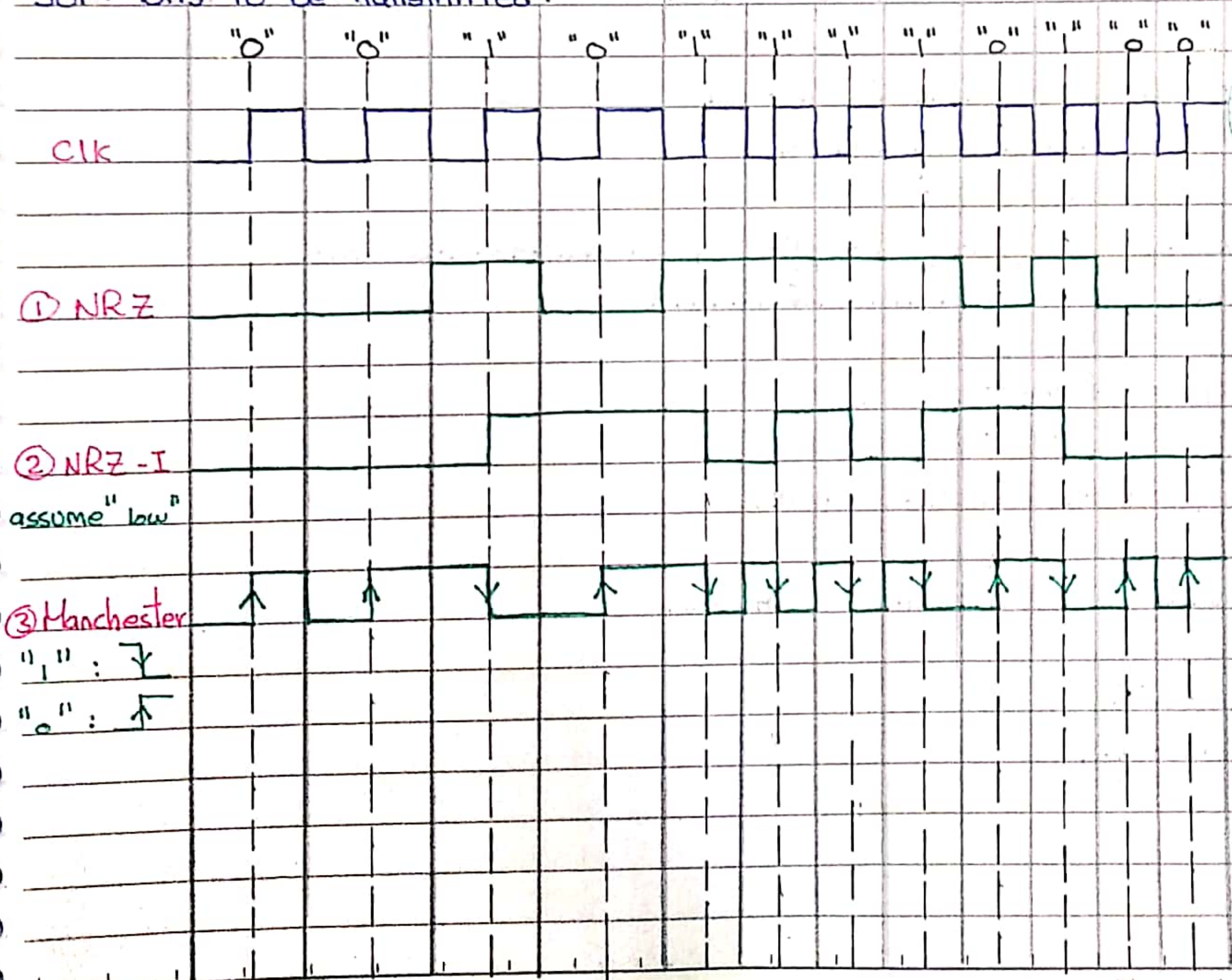
"0" No transition.

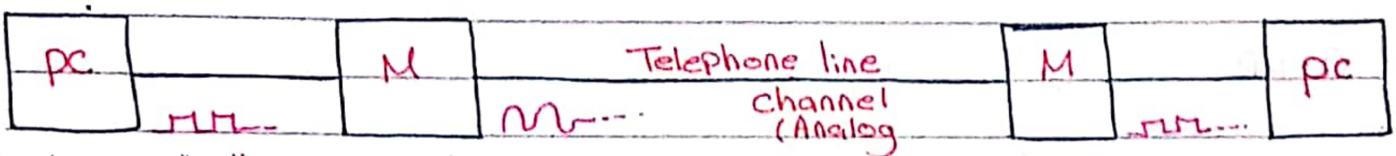
③ Manchester → "1" 

"0" 

Ex: A wants to send sequence of bits to B: 001011110100, what are the generated Signals assuming NRZ, NRZ-I, and Manchester?

Sol: Bits to be transmitted:





"Data rate R_b" (bits/sec)

"Modulation/Demodulation"

"Symbol rate R_s" (symbols/sec)

"pulse code Modulation"

* Note : Bandwidth

- Analog → Low
- Digital → high

* Grouping ? n bits/symbol

∴ R_s Symbols/sec * n bits/symbol $= R_s * n$ bits/sec $\stackrel{?}{=}$ Data rate

* Channel : Shannon's theorem

(channel capacity)

$R_b \leq C$ $\stackrel{?}{=}$

* $R_b \leq C = \underline{W} \log_2 (1 + \underline{SNR})$ → Signal-to-noise ratio

bps ↲ ↳ channel Bandwidth in HZ

$$SNR = \frac{\text{Signal Power}}{\text{Noise Power}}$$

* Pulse code Modulation (PCM)

- Sampling → (Nyquist Theorem)
- Quantization
- Encoding

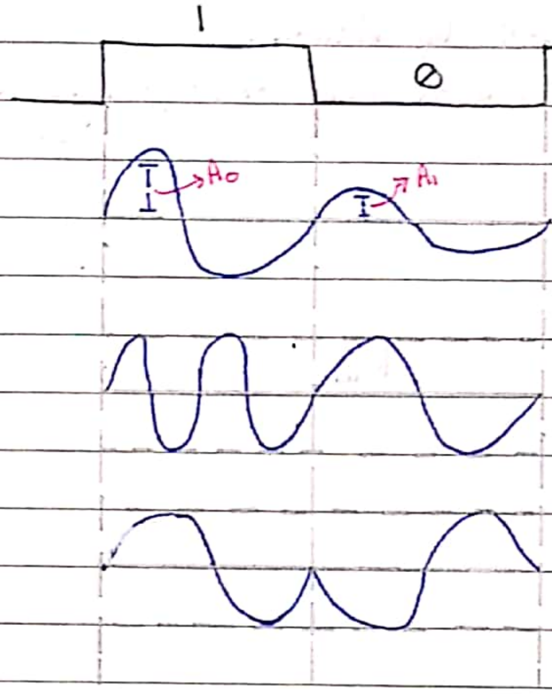
• Modulation Techn(s) :

① Amplitude shift keying (ASK)
② Frequency shift keying (FSK)
③ Phase shift keying (PSK)

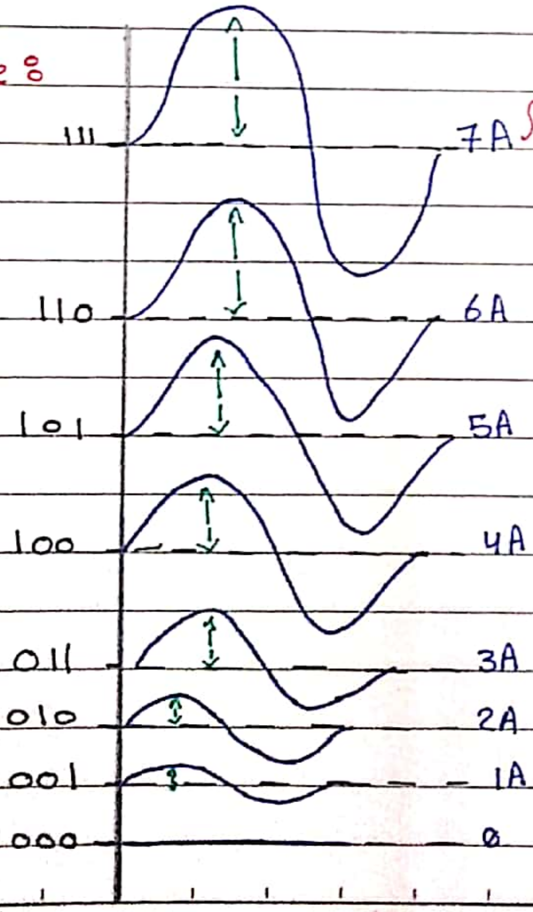
① Amplitude shift keying (ASK) :

② Frequency shift keying (FSK) :

③ Phase shift keying (PSK) :



* Note :



$(2^n - 1)A \Rightarrow n = 3$ bits / symbol.

Grouping / Signaling

* let us assume having 100^k symb/sec
* Determining the minimum data rate required ?

Sol : $R_0 = 300$ kbps.

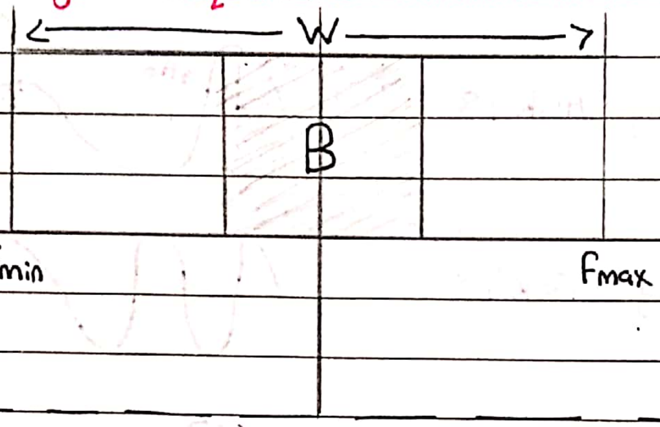
- Shannon's theorem :

Channel capacity = is the Maximum rate supported by the channel

$R_b \le C = W \log_2 (1 + SNR)$

W (HZ) : is the range of frequencies that can pass through the channel without degradation.

B (HZ) : is the range of frequencies available in the signal.



W >> B

23/2/2020

Ex : If we want to send data at a rate of 8000 bps through a channel that has a bandwidth of 1000 HZ. what is the minimum SNR required?

Sol : Shannon's theorem : $R_b \le C = W \log_2 (1 + SNR)$

Channel capacity (C) (bps)

$8000 \text{ bps} = 1000 \text{ HZ} \log_2 (1 + SNR)$

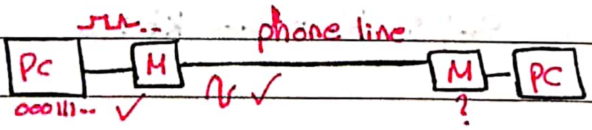
$\Rightarrow 1 + SNR = 2^8 = 256$

$\therefore SNR = 255$

* SNR = $\dfrac{\text{Signal power}}{\text{Noise power}}$

Higher is better

phone line



PCM = Pulse code Modulation

Sampling   Quantization   Encoding

Analog to Digital Conversion:
(A/D)

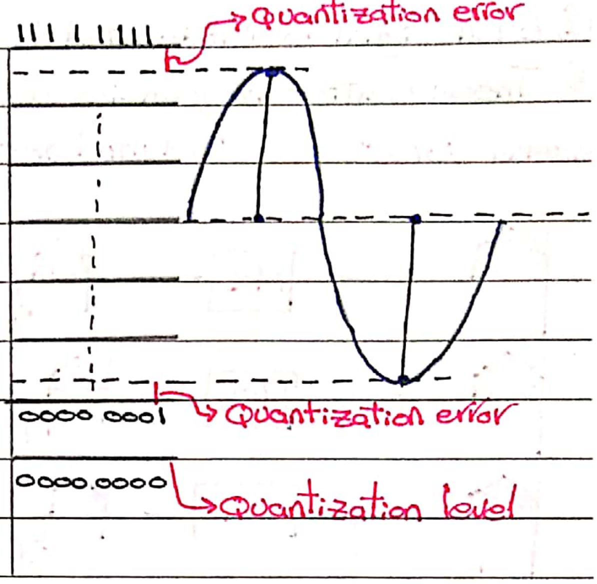
- Sampling
  - Nyquist theorem
- Quantization
- Encoding

∴ Sampling frequency (f_s):

$$f_s = \frac{1}{T_s} \geq 2 f_m$$

f_m → frequency of the signal being sampled.

Ex: let us say we have 8-bit A/D, then we will have 2^8 quantization levels :-



* PC — M — Phone line — M — PC

8-bit A/D convertor

- PC → data rate R_b
- M → symbol rate R_s (Grouping)
- Phone line: $f_s \geq 2 f_m$ ↑ Voice signal
- PC → Sampling frequency f_s, 8 bits / sample

Voice signal ↓

$f_m = 4\,KHZ$

∴ $f_s = 8000$ samples/sec

$$8000 \frac{\text{Samples}}{\text{Sec}} * 8 \frac{\text{bits}}{\text{Sample}} = 64\,\text{Kbps}$$

↳ Basic data rate of public Switched Telephone network (PSTN)

- Multiplexing :
  - ↳ Frequency division multiplixing (FDM) → Analog transmission
  - ↳ Time division multiplixing (TDM) → Digital transmission

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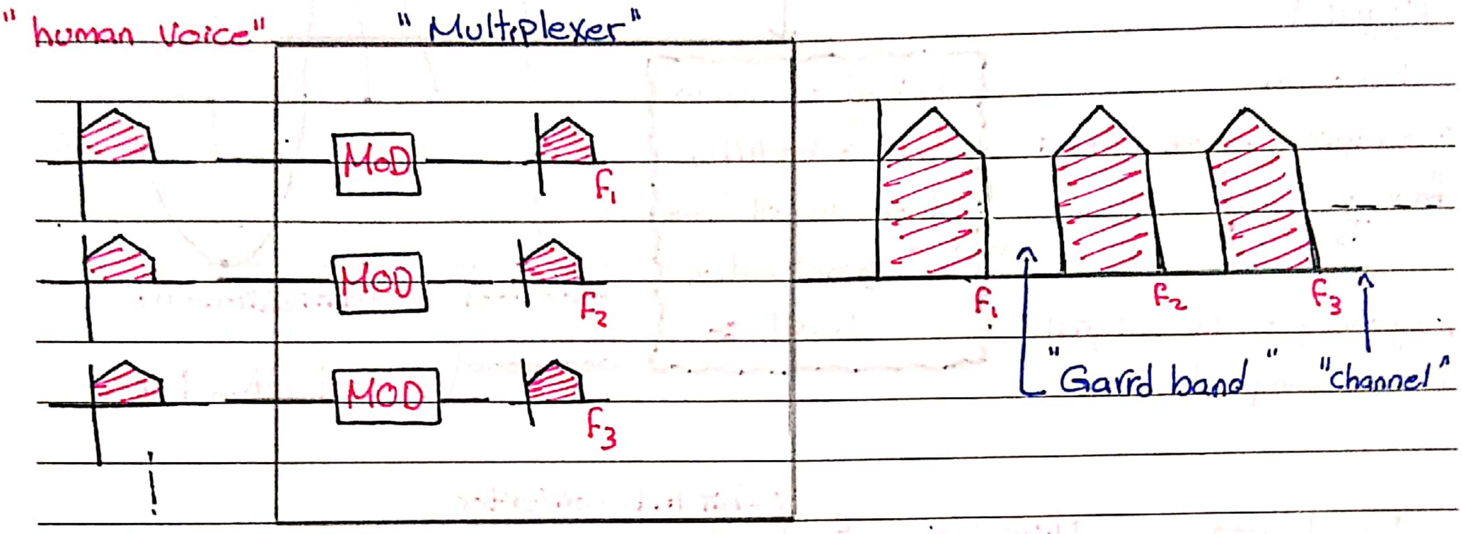
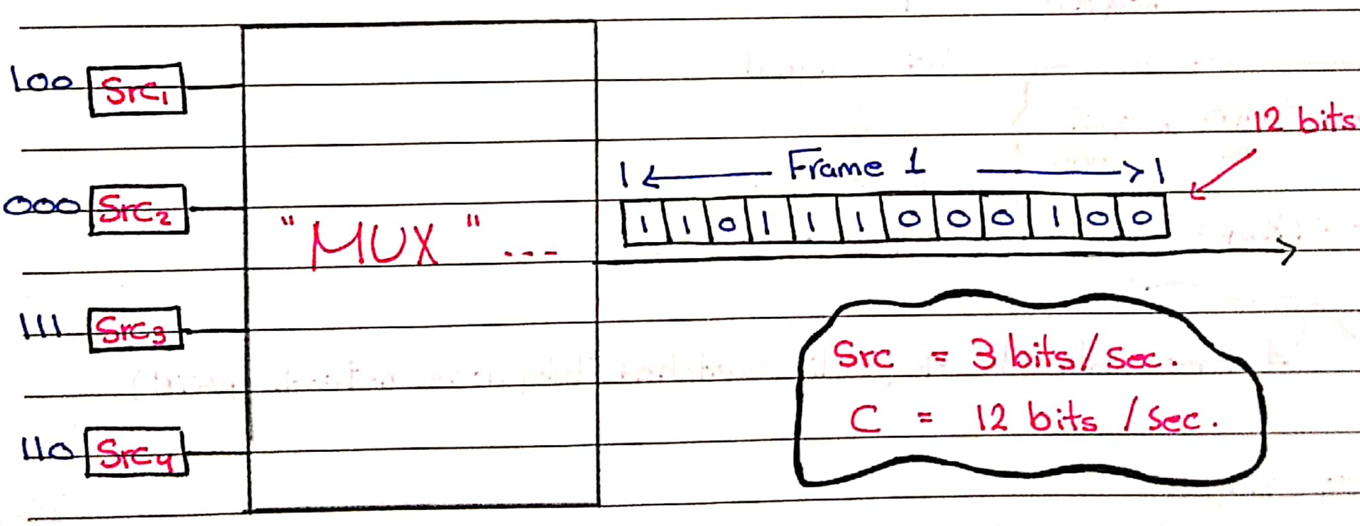
FDM : ① useful when the bandwidth of the channel exceeds the required bandwidth of the signal.

② Each signal is modulated to a different carrier frequency.

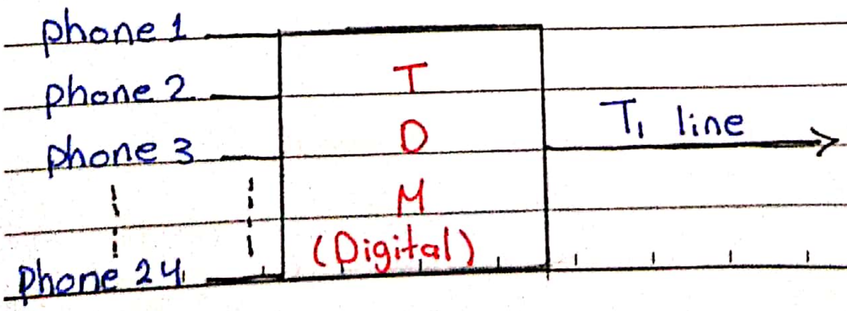
③ These carrier frequencies are separated so signals do not develops.



TDM : - useful when the capacity of the channel exceeds the data rate (R_b) of the source (signal to be transmitted).

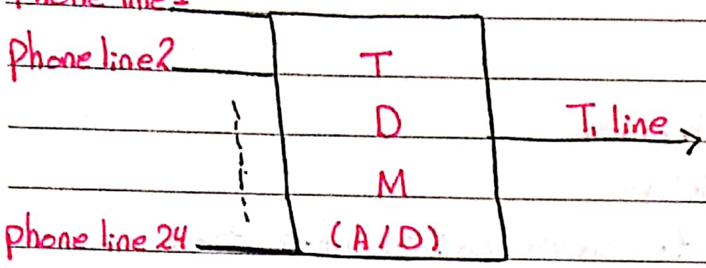


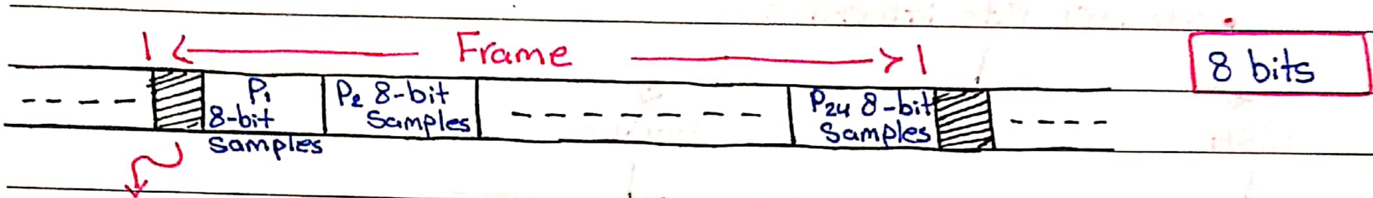
• Digital Carrier system



25/2/2020

- Digital carrier system





framing bit used for synchronization

24 * 8-bit samples + 1 bit / sample = 193 bits / sample

193 bits / sample * 8000 samples / sec = 1.544 M bits / sec

8 bits / sample — capacity of T_1 line

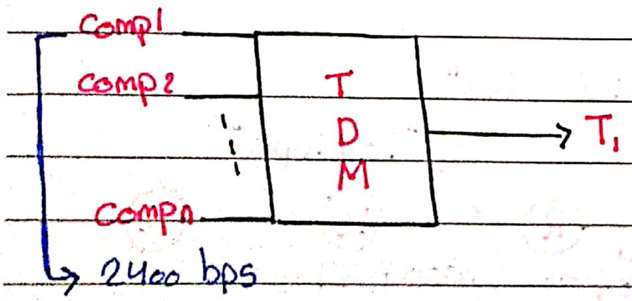
EX: Suppose we are going to design a TDM carrier that support 30 voice channels which use 16-bit samples at a samplity rate of 8000 samples / sec. Determine the required bit rate ($\sim T_1$ capacity)?

Sol: (30 * 16 bits / sample + 1 bit / sample) * 8000 samples / sec

= 3.84 Mbps.

EX: Find the number of the following devices that can be accomodated by a T_1 line assuming that 1% of the line capacity is used for synchronization?

- 2400 bps computer terminals.



Sol. (1.544 Mbps)

$$= \left[\frac{1544000 * 0.99}{2400} \right] = 636$$

Slide 4 physical layer :

ISDN :

- Basic rate interface
  - Two B.channels
    each 64 kbps
  - 1 D channel
    16 kbps
    used to carry control information
- Primary rate interface
  - USA
    - 23 B.channels
      each 64 kbps
    - 1 D channel
      64 kbps
  - Europe
    - 30 B.channels
    - 1 D channel
    - 64 kbps

27/12/2020

* Note : Internet access

- Ethernet
  local Area Network (LAN)
- Directly to Internet service provider (isp)

* Set of networking Technologies used for LANs and working at both data link and physical layers.

Ethernet cabling system

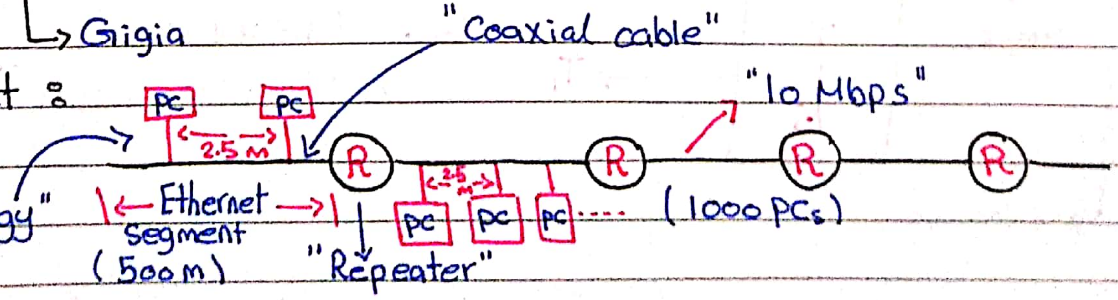
- LLC
- MAC "Ethernet"

* Ethernet :
- old
- fast
- Gigia

*old Ethernet :

(2.5 km)

"Bus Topology"



* Ethernet cabling system :

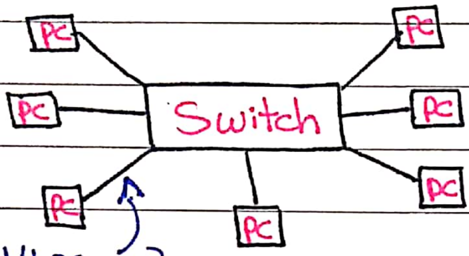
① old Ethernet : 10 Base 5 → 500 m

cable of rate 10 Mbps ↳ Baseband transmission (Digital)

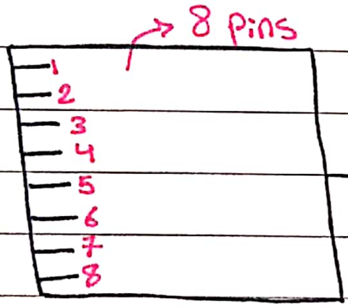
② fast Ethernet :

① cable rate of capacity 100 Mbps

② Network Topology : Star



100 Mbps → Twisted pair cable → Shielded / unshielded



Twisted Pair cable

Pins : 1,2 → Sending

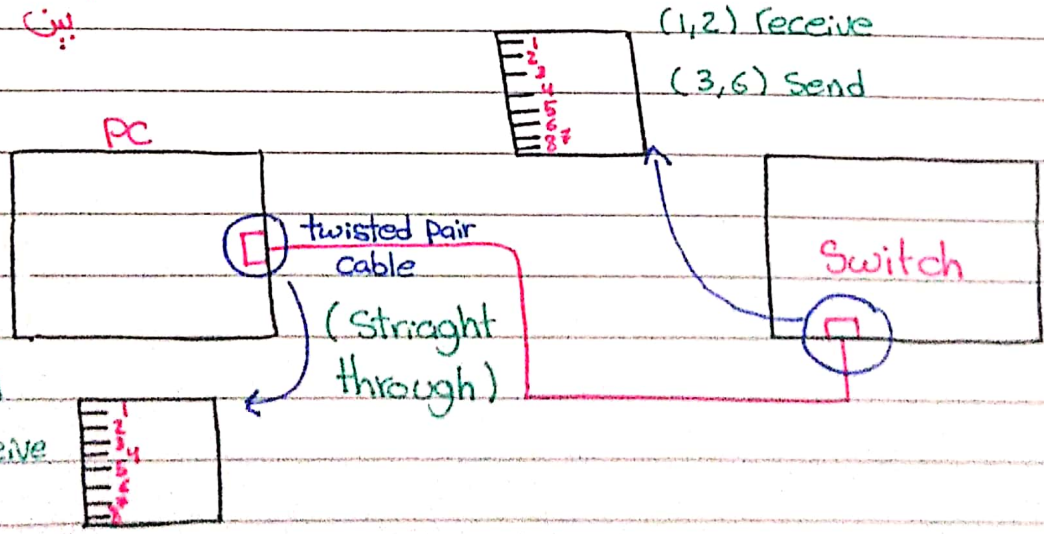
Pins : 3,6 → Receiving

The Rest are unused →

* Note : Twisted pair cable

- Straight through ↓ "Switch و PC بين"
- Cross over ↳ "2 Switches بين"
- roll over → "Router و PC بين"

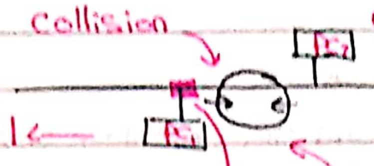
* Note :



1/3/2020

* old Ethernet : Collision Coaxial Cable "Big Problem"

Half duplex



Bus Topology

* collision is possible.

transceiver

* Carrier Sense Multiple Access / collesion detected.

CSMA / CD

* Channel (Multiple) access Protocol.

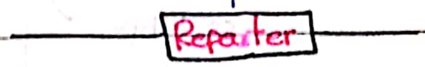
MAC Sub layer.

* Note :

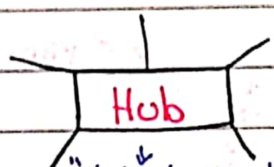
	Network devices
Data link layer	
Physical layer	- Repeaters - Hubs

* Note : *

"Two ports"

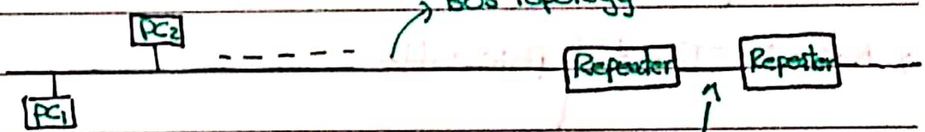


*



"Multiple ports"

* Tip : 1. old Ethernet

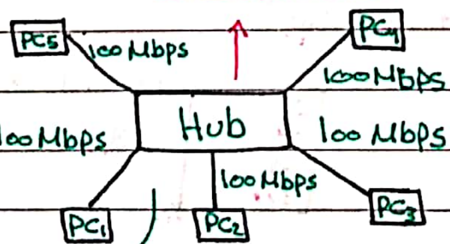


Bus Topology

Single collision domain

layer 1 device

2.



100 Mbps twisted pair cable

Single collision domain

It looks like a star topology but

* it acts like bus topology.

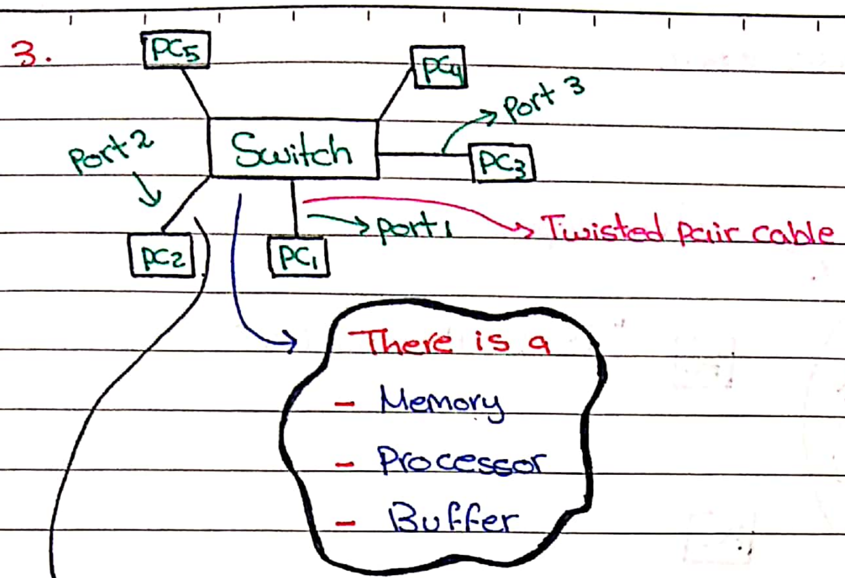
- No memory
- No processor
- No buffer
- Nothing

* Hub constraints :

1. Single collision domain

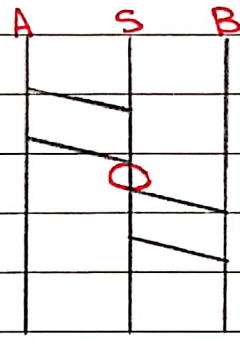
2. All ports should have the same rate

3.

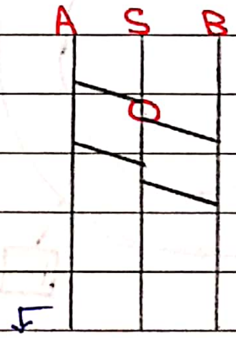


- Full duplex.
  (No collision).
- 100 % star Topology.
- Can connect cables with different rates.

* Store-and-Forward Switching



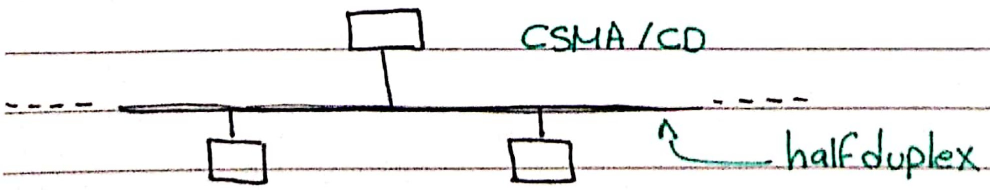
* Cut-through switching



"is better as far as the delay is concered".

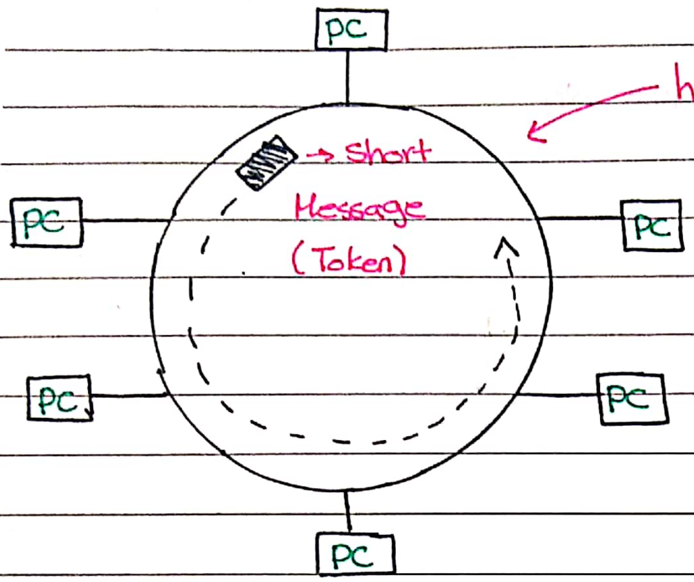
3/3/2020

* old Ethernet : 10 Mbps IEEE 802.3



Scanned with CamScanner

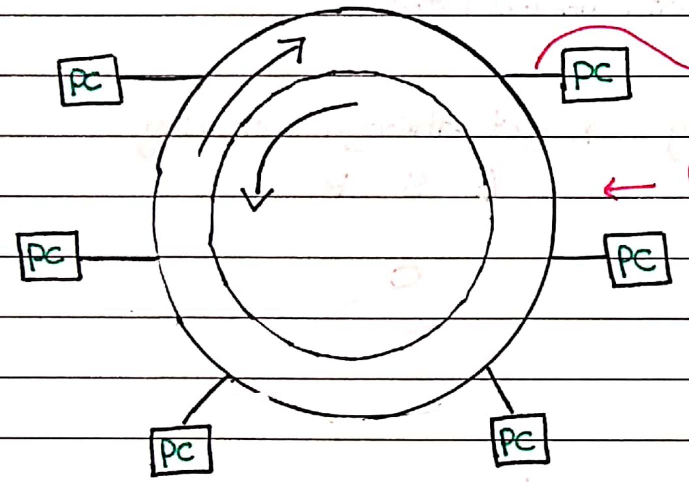
* Token Ring : (16 Mbps) IEEE 802.5



half duplex

" 100 % No collision "

* Fiber Data Distribution Interface: (100 Mbps) IEEE 802.7



موصول عالحلقتين

← Fiber

Dual ring

* Fast Ethernet :

- 100 Mbps
- Star topology
- No collision

(Fullduplex links)