UCS → Universal character set
Router → connects 2 networks
sending side : Packet details are added
Recieving side : Packet details are removed

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OSI Layer

OSI → Open System Interconnection

message — Application layer : Generate message

message — Presentation layer : Data compressed / represented / encrypted

Segment — Session layer : Simplex : one way traffic only.
Half duplex : only one at a time
Full duplex : both sided

Segment — Transport layer : 172.16.1.1:0 → min
65535 max

Packet — Network layer : need addr on the basis of IP (server addr)
(Router)

Frame — Data link layer : → LLC = Logical link control (error detection)
MAC (48 bit) bind addr

Bits — Physical layer : Represented in binary form

Port
↳ User defined → 1024 - 65535
↳ Pre-defined → 0 - 1023
HTTP : 80
FTP : 21 } default
SMTP : 25

Error correction in packet
Maximum Transmission Unit (MTU)
↳ Fragmentation
↳ Segmentation

ASCII — 256 bits

Delay

a) Propogation delay / time wrt distance
b) Transmission delay / time wrt packet

Flow control : sender sending speed & reciever recieving speed.

Eg : S : 256 KBPS R : 128 KbPS
results in buffering.
In opp case buffering will be at sender side

Congestion control

Dispatch of the data of the bandwidth. It may be possible at different place.
→ channel
→ node

Flooding

If IP and SNM are of different class then folder sharing is not possible
Also known as (Class inter domain routing) CIDR

Max 4 Ethernet card can be inserted
↳ 1 Primary → IP
↳ SNM
↳ G/W
↳ DNS-1
↳ DN2-2
↳ 3 Secondary → IP
↳ SNM

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VLAN → Virtual LAN

Error Detection & Correction

Packets will travel in binary form and in an intermediate level if any error possible then it will generate an error.

Types of error

- Single bit
- Multibit
- Burst

Single bit error

1 0 1 1 0 1 1 0 → 1 0 1 0 0 1 1 0

Error in 4th bit

If more than 1 bits are changed then it is, multibit error.

If any consecutive error in generated and one or more chunk is their then it is called as burst.

⇒ Parity (also known as cardinality)

1. Even parity : no of 1's is even
2. Odd parity : no of 1's are odd

a) Linear parity

b) 2D parity

Disadv: Bit can be changed, error detection tough

CRC (Complete Redundancy (check)

Data → 100100

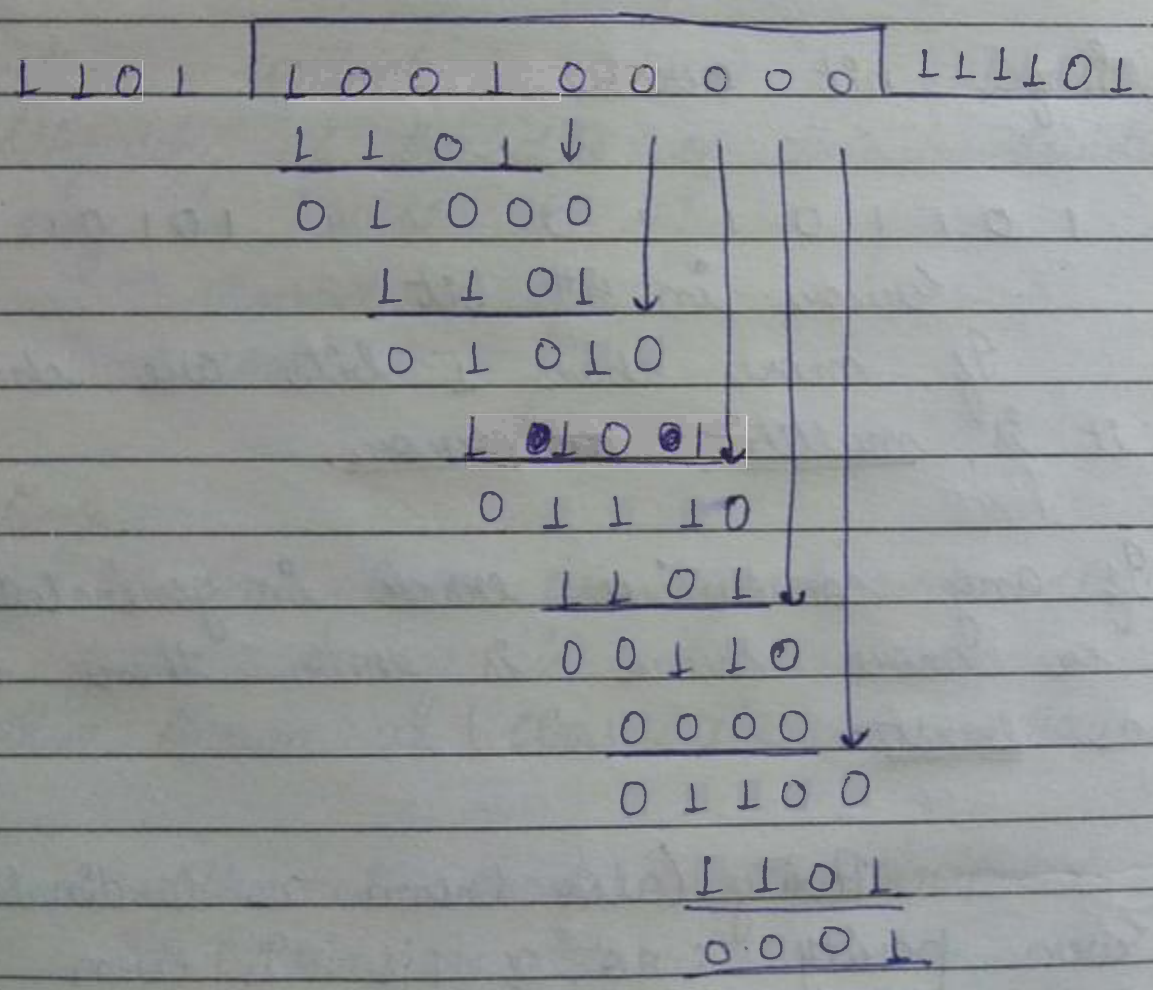
Generator → 1101

There is a one code that helps to detect error

Add zero = no of bit of generator − 1.

= 4 − 1 = 3.

Through differential division.



So, dispatch 100100 001

as 001 is remainder

For polynomial
Convert to binary as per CRC rule
Data = $x^5 + x^2$
Generator = $x^3 + x^2 + 1$

x^3+x^2+1 | $x^5 + x^2$ | $x^2 + x$

$x^5 + x^4 + x^2$

$0 \quad x^4 + x^3$

$x^4 + x^3 + x$

$0 \quad x^3 + x$

d) Internet checksum

original data → 10101001
00111001

```
  1 0 1 0 1 0 0 1
+ 0 0 1 1 1 0 0 1
  1 1 1 0 0 0 1 0
```

1's compliment ⇒ 00011101

```
  1 0 1 0 1 0 0 1
  0 0 1 1 1 0 0 1
  0 0 0 1 1 1 0 1
  1 1 1 1 1 1 1 0
```

1's compliment → 00000000

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Hamming Code

= Actual data + Dummy

$2^D \geq B + D + 1$

B → actual bit

D → Dummy bit

Let $B = 7$

$2^D \geq 7 + D + 1$

$\therefore D = 4$

$\Rightarrow 7 + 4 = 13$ bit

Bit sequence.

$B_7\ B_6\ B_5\ D_4\ B_4\ B_3\ B_2\ D_3\ B_1\ D_2\ D_1$

Data bit = 1001101

$D_1 = (1, 3, 5, 7, 9, 11) = ?1010 1 = 110101$

$D_2 = (2, 3, 6, 7, 10, 11) = ?1 1 1 01 = 0 1 1 1 0 1$

$D_3 = (4, 5, 6, 7) = ?011 = 0011$

$D_4 = (8, 9, 10, 11) = ?001 = 1001.$

Sent data = 1001**0**100101

$D_1 = 1$ $D_2 = 1$ $D_3 = 1$ $D_4 = 0$

$\Rightarrow 0111 = 7.$

Again finding parities to detect position of error.

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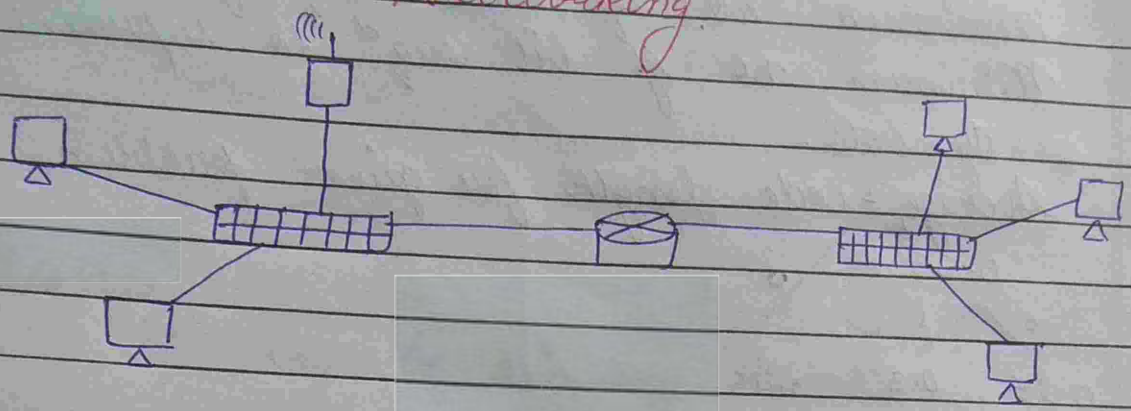
Inter Networking



IP - 172.16.2.91
SNM - 255.255.0.0
G/W - 172.16.1.1
DNS 1 - 8.8.8.8
DNS 2 - 4.2.2.2

In CMD
PING 192.168.1.10

IP - 192.168.1.10
SNM - 255.255.255.0
G/W - 192.168.1.1
DNS 1 - 8.8.8.8
DNS 2 - 4.2.2.2

Router configuration

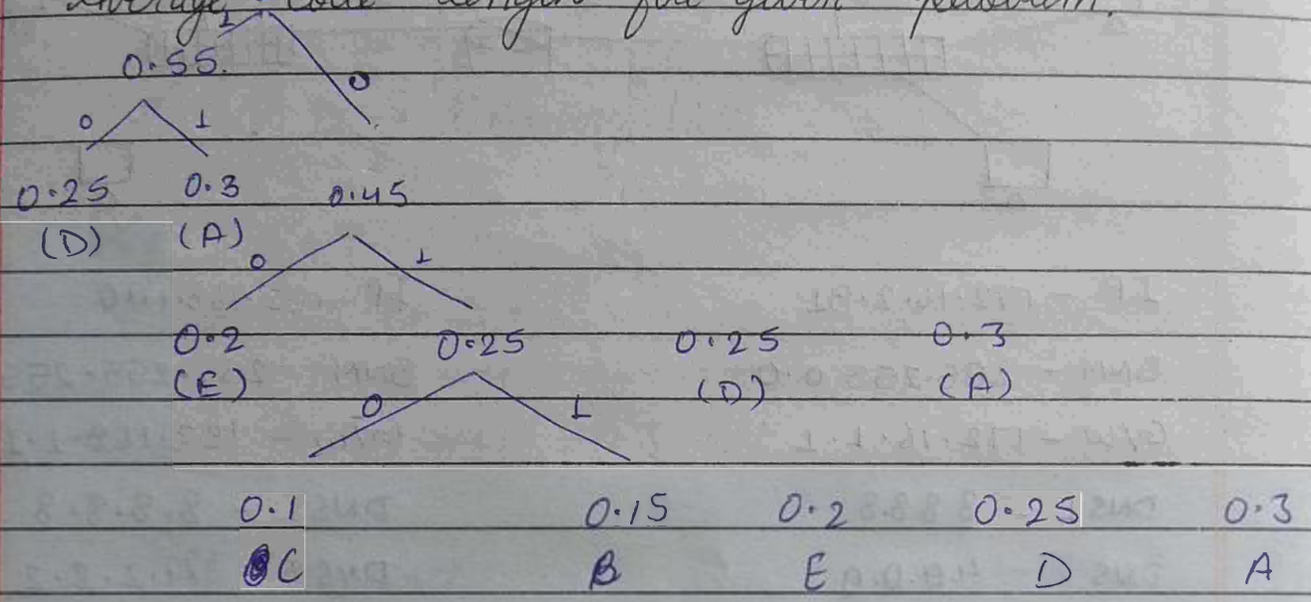
```
Router > en
Router # conf t
Router (conf) # int fa 0/0
Router (conf_if) # ip add 172.16.1.1 255.255.0.0
Router (conf_if) # no sh
Router (conf_if) # exit
Router (conf) #
```

Ques Hauffman coding for symbol A with probability 0.3 & B with 0.15, C with 0.1
D with 0.25, E with 0.2

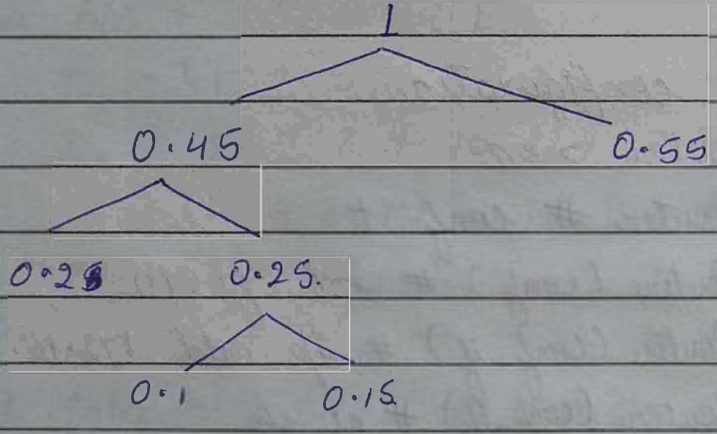
a) Minimum no of bits req^d for B.

b) Minimum no of bit req^d to represent all symbols.

c) Average code length for given problem.



1. B (0 1 1).



2) A = 2 (11)
B = 3 (011)
C = 3 (010)
D = 2 (10)
E = 2 (00)

no of bit = 2 + 3 + 3 + 2 + 2
= 12

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3) Avg : $(2 \times 0.3) + (3 \times 0.15) + (3 \times 0.1) + (2 \times 0.25) + (2 \times 0.2)$

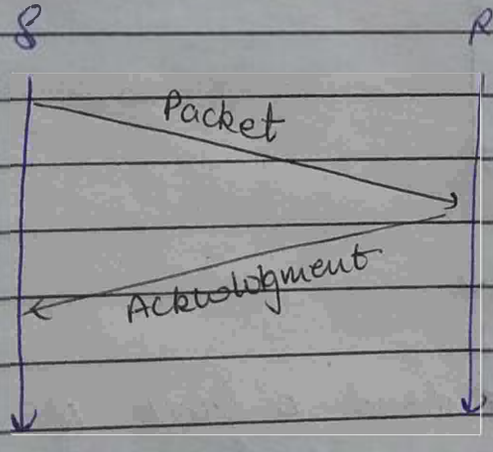
$= 2.25$

Message
It may be in any format

Segment : Parts

Packet : which has header (containing ip)

Frame : header has mac address.



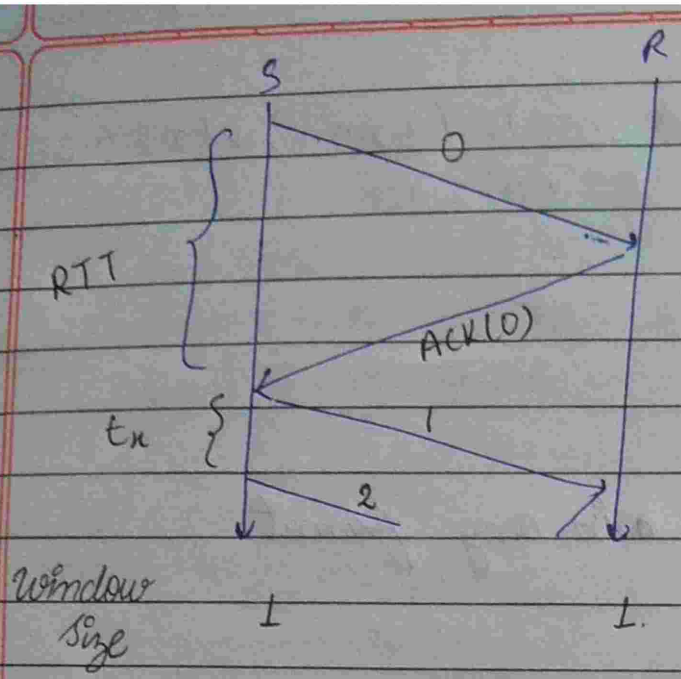
Arrow represents time

Types of Protocols

1. Stop 'N' wait

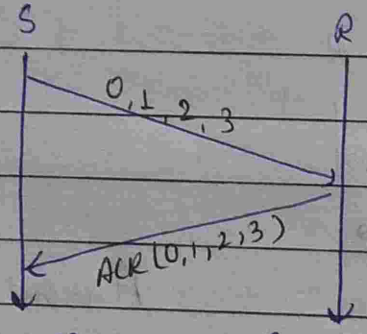
RTT (Round trip time) ⇒ Time to send packet + time in which acknowledgement is recieved.

Time of ACK = Time of packet dispatch



Acknowledgment of next packet doesn't allow to send next packet.

2) Go back 'N'



window size $\Rightarrow 2^n - 1$

Here we will ~~not~~ send a bunch of packets or all packets at a time and in similar pattern we will recive acknowledgment.

From the packet sequence, we identify
lost packet
duplicate packet
shuffling of packets if present.

Sliding window

Case 1 : Stop 'N' wait

Sliding window will move when it will recieve an acknowledgement of previous one

Case 2 : Go back 'N'

window size = $2^n - 1$

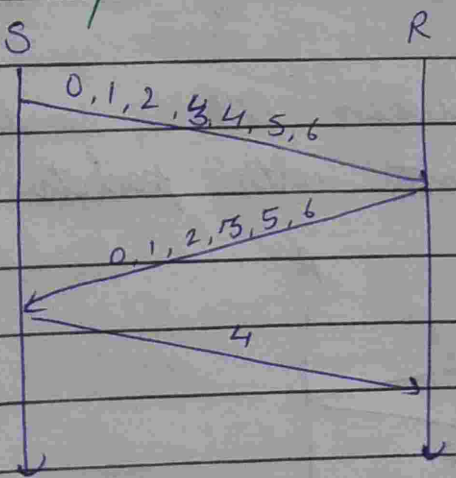
Let $n = 4$ { n = no of bits

$2^4 - 1 = 15$

Here, also acknowledgment is compulsory but not necessary to get ack at the same time

If any ack on packet is missed out then all packets are send again.

3 Selective Repeat



Window size = $2^n - 1$.

When a sender sends a package to reciever It may get damaged or lost. It causes RTT time out at Sender side and as a part of remedy same packet is send again

Many types of errors are raised in ARQ (Automatic Repeat Request)

Common problems
- → Packet lost
- → Acknowledgment lost
- → Errors
- → Shuffling
- → Damage / lost frame
- → Damage / lost acknowledgment

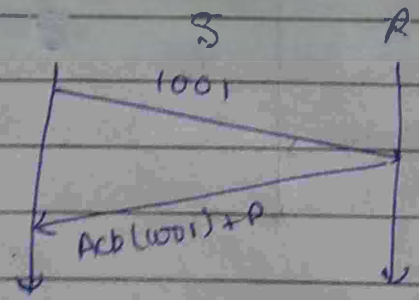
Sequence Number & Acknowledgment

Types of SN

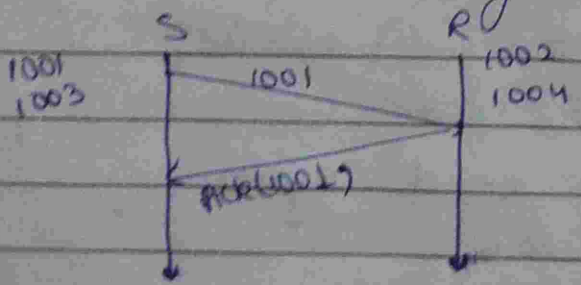
a) Constantly increasing

It may increase in different & equal manner of gap

Piggy baking is when either sender or reciever sends acknowledgment with packets.

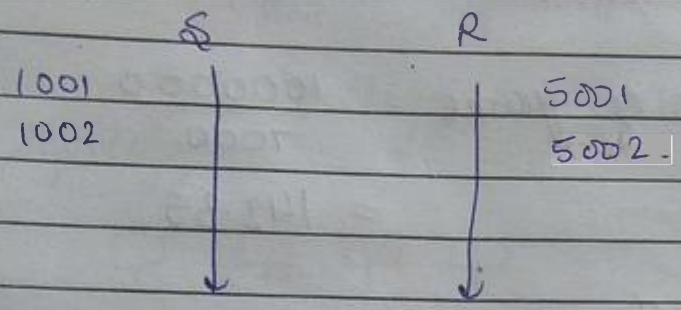


b) The constant increasing number can be interleaved



Packet sequence can be interleaved

c) Sender & reciever can introduce separate sequence over packets



Ques A system uses stop 'N' wait protocol, if each packet carry 1000 bit of data, how long does it take to send 10^6 bits of data. If the distance between S and R is 5000 km & propogation speed is 2×10^8 m/sec.

$n = 1000$ bit

no of packets $= \frac{10^6}{10^3} = 1000$ packets.

2×10^8 m — 1 sec

5×10^6 m — $\frac{5 \times 10^6}{2 \times 10^8} = 2.5 \times 10^{-2}$ sec

$= 25$ msec.

$t_t = 2t_p$

$= 2 \times 25$ msec

total time

$= 1000 \times 2 \times 25$ msec

$= 50$ sec

ues 2 What what will be the result if protocol is go back n with ws = 7

1 packet = 1000 bit

7 packet = 7000 bit

total no of frame = $\frac{1000000}{7000}$

= 142.85.

2×10^8 m —— 1 sec

5×10^6 m —— $\frac{5 \times 10^6}{2 \times 10^8}$

= 25 m sec.

total time = $2 \times 25 \times \frac{1000}{7}$ msec

= 7.142 sec.

es3 Calculate window size if packet size is 50 byte and progation delays is ~~50 byte~~ 40 ms. Bandwidth is 150 mbps.

1 sec —— 150×10^6 bits.

t_p = 40 msec.

RTT = 80 msec.

80 msec —— $150 \times 10^6 \times 80 \times \frac{1}{1000}$

~~150~~ $\times 15 \times 10^6$

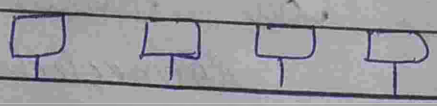
no of pkt = $\frac{\text{total bits}}{\text{size of each packet}}$ = $\frac{15 \times 10^6}{50 \times 8}$ = 37500

Network Topology

Topology refers to the way in which a network is layed out physically

Types of topology

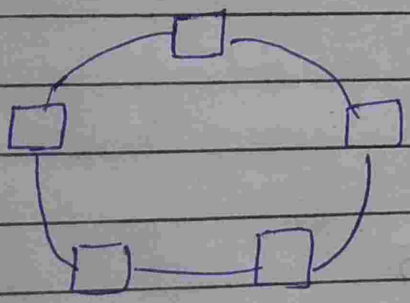
1 Bus topology



Advantage :- Least cost and infrastructure

Drawback :- need switch / router for connecting forest (isolated network)

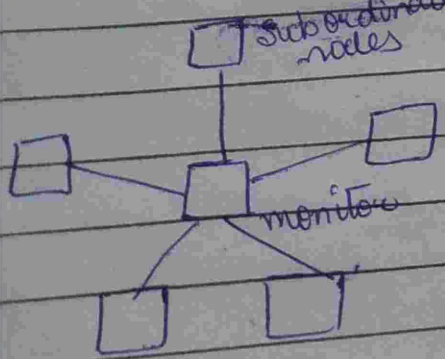
2 Ring topology



Drawback : flooding

Advantage : if any node is disconnected then the alt path is available.

3 Star topology

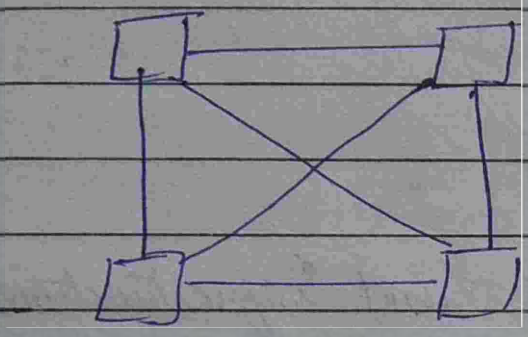


Star defines the exact client server architecture.

It has one centralised node and rest are non centralised.

Diadvantage :- If centralised node is crashed it may lead to situation where the non centralised node will going to have an isolated network

Mesh topology



All nodes are connected to each other

In a cross point mesh with 10 lines will going to have how many junctions and how many pairs of connection lines

$$\Rightarrow \frac{n(n-1)}{2}$$

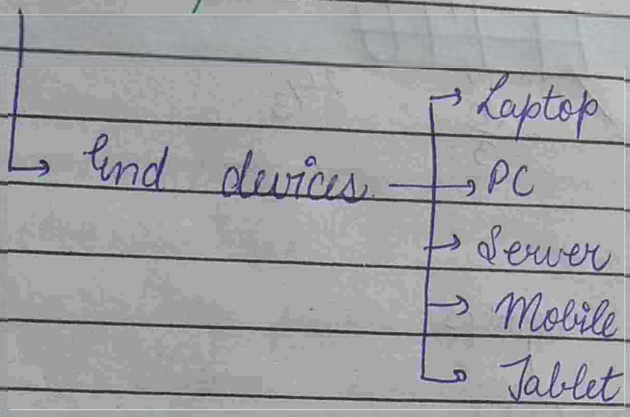
$$n = 2$$

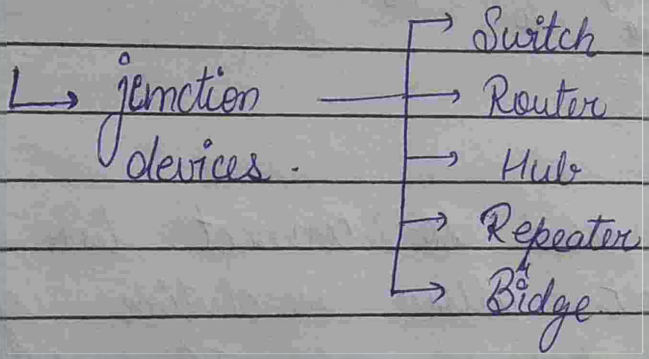
$$\Rightarrow \frac{10(10-1)}{2} = 45$$

Max no of cross points that can be used at a time are 50%. ie, 22

Network Hardware & Software

Network H/w





Switch.

It is a junction device which is used to connect multiple nodes in network

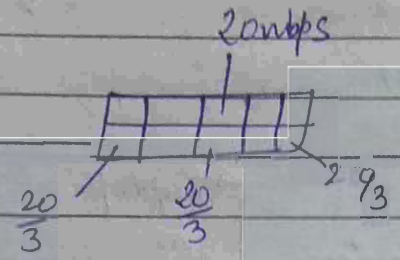
Collision Domain

It is an area or network which defines the flooding range and it also defines the no of communication points

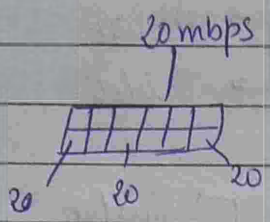
Hub

It is used to distribute the network through folding.

L1 Switch works as hub



L2 Switch



Router

It is used to connect two different network. It doesn't allow resolution of mac address. Hence, it passes only IP address.

Repeater

It removes noise and passes the signal ahead / forward.

Spoofing : To pretend to be someone else

Breach : Security laps

Snooping : just watching (stalking)

Bridge

It looks at the destination of packet before sending it. It restricts the duplicate information to be forwarded to a certain node.

It restricts transmission on other lan segment if destination is not found — acts as disadvantage when compared to Switch.

Network Software

- Wireshark
- Cisco packet tracer
- Hyper terminal
- IPS / IDS ~~protocol~~ interface
- Metasploit
- NS2

1. Wireshark : It is a network traffic monitoring tool.
2. Cisco Packet Tracer : CPT is a tool to practice or plan a live scenario of interacting node & function devices.
3. Hyperterminal : It is a tool to configure router.
4. IPS / IDS Interface : Intrusion prevention / detection system works to sense breach in packets incoming & outgoing through network.
5. Metaspoilt : Its used to spoof the identity of a node by proxyfying the IP address.
6. Network Stimulator version 2 (NS2) : It is a tool to stimulate the network for

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multicasting, unicasting and broadcasting networks in wired & wireless scenarios.

X'mission Media

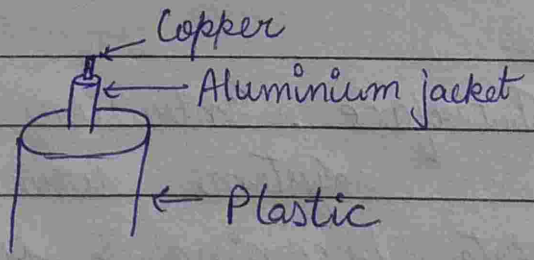
Guided
→ Twisted cable
→ Coaxial cable
→ Fibre optic
→ LAN

Unguided
→ Air / aerial route

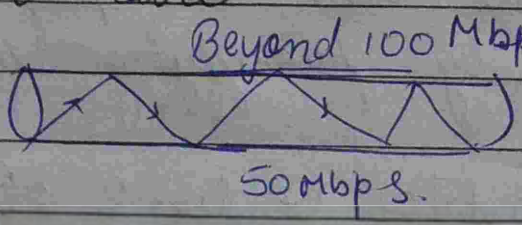
Guided network depends on source cable

1 Twisted pair cable
Due to less noise, they are of 2 types
↳ Shielded – has coating
→ unshielded – no coating present

2 Coaxial



3. Optical fiber cable



4. LAN (Local Area Network) Cable
(After 100 m)

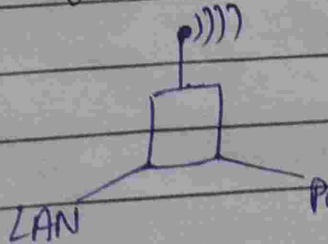
8 wires are there

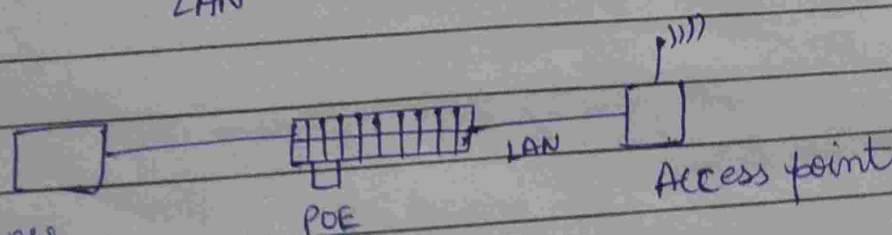
		one side of wire	other side
Data carriers	OW (Orange & white)	OW	G W
	O (Orange)	O	B
	GW	GW	GW
	B (Blue)	B	B
These 4 are power wires.	BW	BW	B W
	G (Green)	G	G
	BrW	BrW	BrW
	Br (Brown)	Br	Br
		(Straight)	(cross)

Rule (1324) for cross wire.

Datawires
- Send data
- Recieve data
- Send Acknowledgment
- Recieve acknowledgement

Power of Ethernet : It is a device





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Transmission Control Protocol (TCP)

→ connection oriented network
→ Connection less protocol
→ connection less network
→ Dynamic path

⇒ TCP provides end to end connection
⇒ It's connection oriented protocol
⇒ It's reliable transfer protocol because it follow RTT

ROUND TRIP TIME (RTT)

→ It provides flow control & conjunction control both
→ The most prominent services provided by TCP is client server architecture
→ It provides full duplex services.
→ It also provide sequence number over the packet.
→ The data limit in TCP is 65535 bytes.
→ It also provides point to point service

S.Port (16) DPort (16)

6/3/19

Congestion Control - Self

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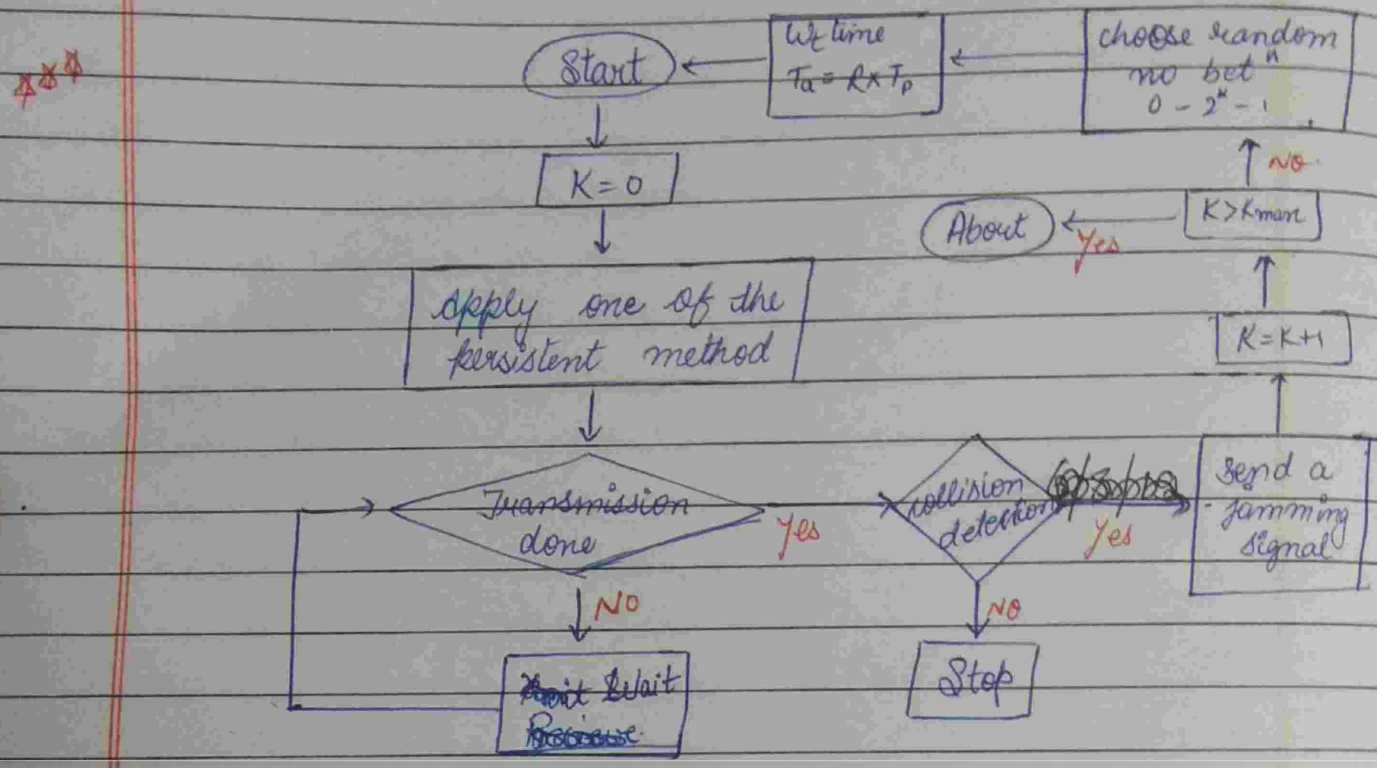
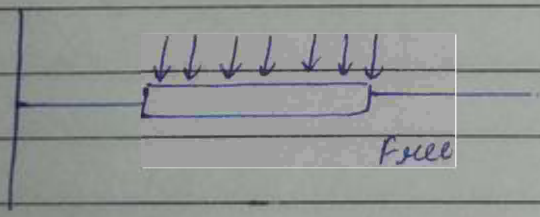
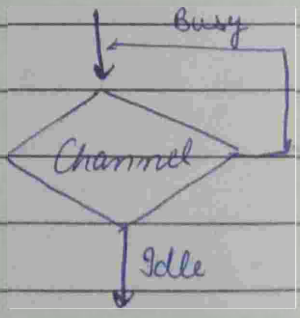
Flow Diagram of CSMA/CD

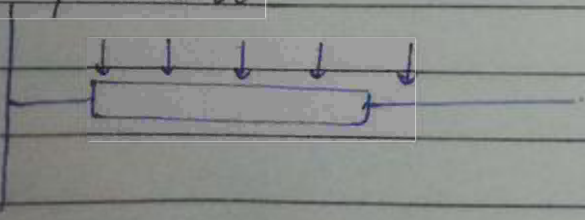


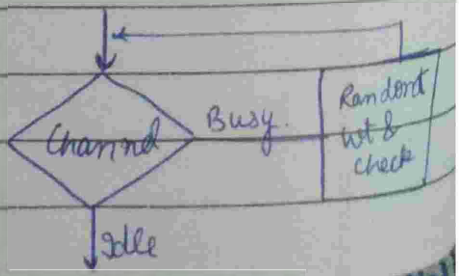
1 persistent





Non persistent





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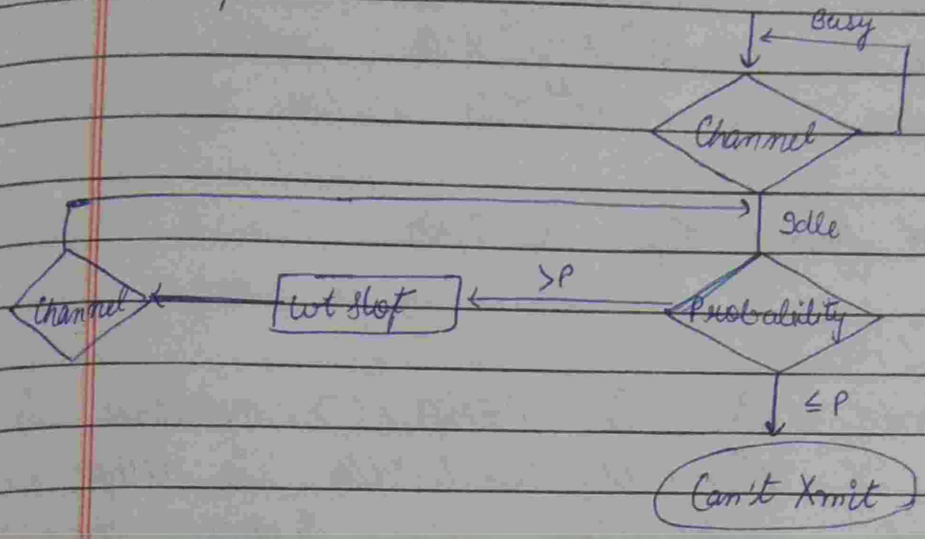
P-persistent



Transmission rate in CSMA is 10 MbPS.
Min frame you can send is 512 bits.
Slot time, waiting time $= \frac{512 \text{ bits}}{10 \text{ MbPS}} = 51.2 \mu\text{sec}$

$K_{max} = 16$

Jamming signal is collision detecting signal send to sources.

L2Q19 Consider building CSMA/CD network at 1 GbPS. over 1 km cable. What is min frame size if signal speed applicable for cable is 200000 km/sec.

1 sec ——— 200000 km

1 km ——— $\frac{1}{200000}$ sec $= 5 \mu\text{sec}$.

$T_p = 5 \mu\text{sec}$

$R.T.T = 2 \times T_p = 10 \mu\text{sec}$

Channel utilisation $= \frac{1}{1+2a}$ $\quad a = \frac{T_p}{T_t}$

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1 sec —— 10^9 bits

10 μsec —— $10^9 \times 10^{-6} \times 10$

$= 10^4$ bits

So, min frame size is 10 Kb

Ques Min frame size in CSMA/CD network is 48 bytes. If channel bandwidth is 1Mbps Then find propogation delay. Suppose channel utilisation is 50%.

48 bytes — 48×8 bits.

$\Rightarrow 0.5 = \frac{1}{1+2a}$

$1 + 2a = 2$

$a = 0.5$

$T_p = \frac{T_t}{2}$.

T_t = 10^6 bit —— 1 sec.

48×8 bit —— $\frac{384}{10^6}$ sec.

$T_p = \frac{10^{-6} \times 384}{2} = 192$ μsec.

Ques In an ethernet station, a nodes data collides 4 times to transmit the frame. How long might it wait before next attempt?

$K = 0$ initially

after 4 collisions $K = 4$ $\quad 2^K - 1 = 2^4 - 1 = 15$.

T_a (wait time) $= R \times T_p$.

So any random no bet^n 0 – 15

min at 0, 0×51.2 μsec $= 0$ μsec

mid at 7, 7×51.2 μsec $= 358.4$ μsec

max at 15, 15×51.2 μsec $= 768$ μsec

15/3/19

SNR Ratio
1.95 – 1.98
numericals.
Book