Lost frames are sent several times wasting bandwidth

① Error correction & detection.

→ Why errors?
  ↳ Ideal / errorless
  ↳ error prone links.

→ Types: → single (rare) (delay(nois is long)
  ↳ multiple (usual)
  ↳ burst (consecutive) Burst length (no

→ Redundancy or EDC bits

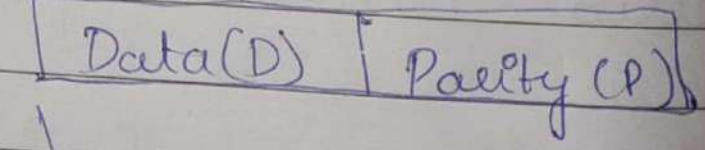
→ Detection vs correction

→ Forward error correction : reciever guesses the actual data using EDC bits (if small error)

→ Retransmission : sender retransmits

(sort 1)

Parity check.



Even

Odd

no. of 1's	P	Total 1's
odd	1	Even.
Even	0	Even

no. of 1's	P	total D+P
odd	0	odd
even	1	odd

D+P = Even ones

D+P = odd ones

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PIC →

FPC

0/0/2 → port number

↳ pic.

flexible pic

→ Even parity detects odd number of bits error

→ 2D parity add rowwise & columnwise both it can detect & correct one bit error

→ Hamming Code:

$2^r \geq m + r + 1$

$m = 3$ min $r = 3$.

Rw. Hamming

detect and correct errors.

Redundant bits are in between.

→ CRC (Cyclic)

→ Needs: 1) XOR

2) when n is multiplied by 2^k then left shift by k

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→ Sender and receiver agree on G (generator) with r+1 bits. Sender appends r bits after r times left shifting data.

data + r = codeword

codeword % G = 0 (no error)

Sender (S) = $(D \cdot 2^r)$ XOR R

LS by r appends r bits.

d + r % G = 0

So choose r accordingly.

Sender R = remainder of $\frac{D \cdot 2^r}{G}$

T = remainder of $\frac{S}{G}$

if T = 0 no error

Else error

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→ ARP - plug & play - TTL (20min - 1hr).
No admin role. Entry flushed if no traffic from the other host after TTL is expired

→ All routers / switches / hosts have own ARP table and logic to update & flu it. When system enters entry is made and removed after TTL.
Time at which populated is there.

→ Process: (Same Subnet).
→ No row for dest in senders ARP table.
→ Create ARP Query with dest IP and network adapter put broadcast mac address saying its broadcast.
→ So adapter broadcast ARP Query. When it reaches intended dest with matching IP
→ Broadcast: ff - (6) times

Different subnet
→ Dest IP is dest from diff subnet
→ MAC is it broadcast its MAC of router's interface

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→ Route replace its MAC to dest MAC.

Link layer switch

① When packet arrives from source switch does

MAC	Interface ID	Time.
m1	1	1:28
m2	3	1:30
m3.	2	1:35

So if m2 send on 3 interface.
After TTL discard entry.

It is self-learning. It's plug & play.

② filtering & forwarding
↓ ↓
discarding send to dest
↓
not sending

→ Send to all nodes in network if mac isn't known so that it's gets discarded if no matching MAC
→ If matching MAC check table transfer on Interface

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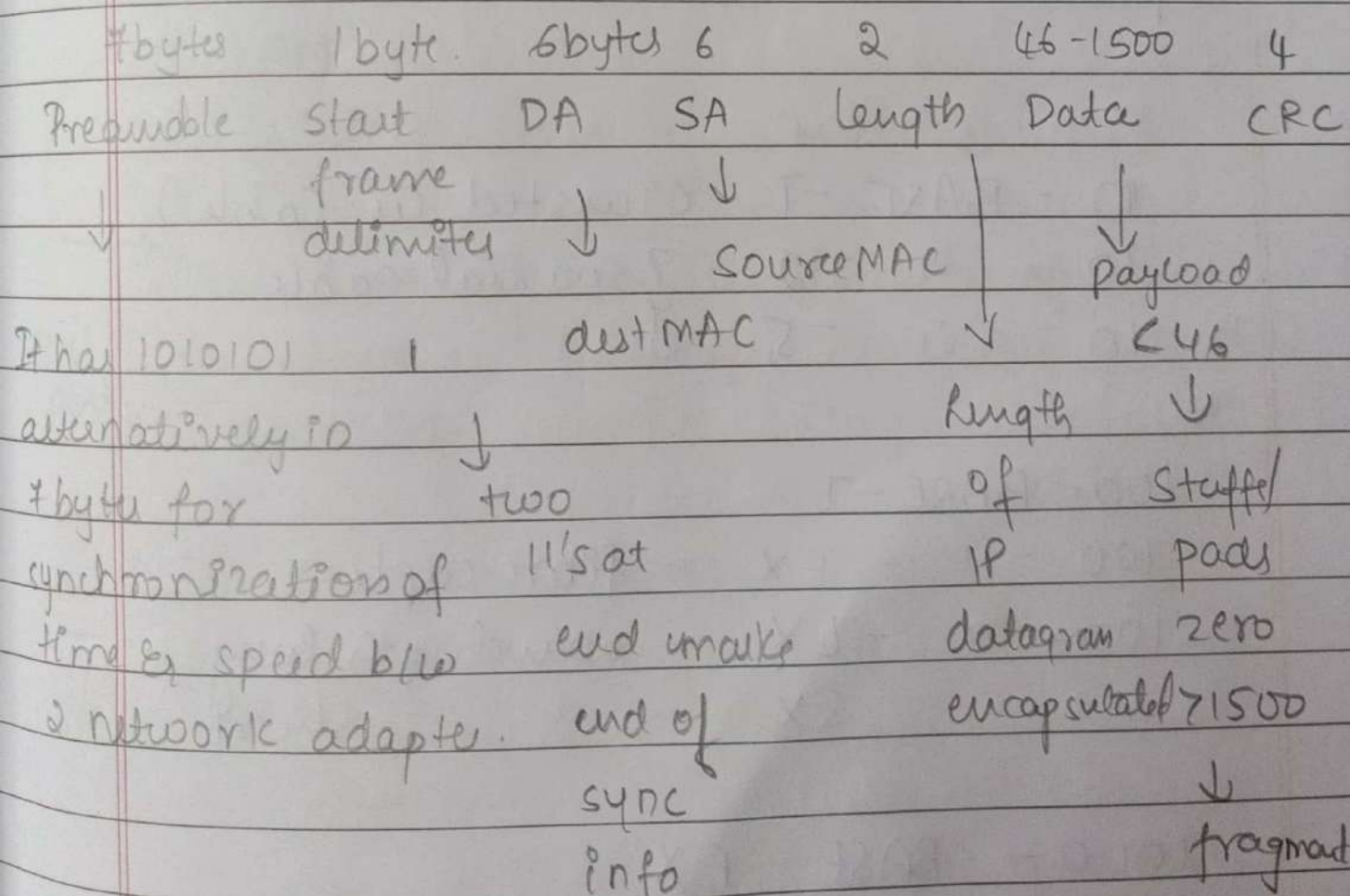
→ if packet has dest addr with interface link same as sender discard

Ethernet

→ It helps in switched LAN's or mac address forwarding.
→ IP header is encapsulated in Ethernet frame
→ frame format



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Repeaters

→ A microwave link is used as medium for 802.3 Ethernet

Ethernet technology

number - base - distance / type of cable
↓ ↓ ↓
Mbps baseband max distance signal
of data network can reach without
can be trans- repeater
ferred

10 - BASE - T (Twisted Cu Cable)
10 - " - 2 } coaxial cable
10 - " - 5 }

100 - BASE - T
100 - " - FX - fibre cable
100 - " - LX - wavelength long
SX - " short

1000 - BASE - FX
1Gbps
10G - BASE - FX

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→ Traffic isolation when more switches for few hosts in subnet

→ Only some ports of switch works for LAN's and traffic isolation is for ports

→ So when host leave virtual LAN we can shrink ports no for than LAN make it free. or give to another one.

→ But how it replaces switch managing LAN?

→ Efficient use of switches

→ Last port of one switch to another switch to increase multiple VLANS — VLAN Trunking.

first port

New Ethernet frame

SA VLAN TAG Length

4bytes

↓

identifies to which VLAN packet should go

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ATM, PDH, Ethernet

MPLS (multi protocol label switching)

1. Combines both circuit & packet switching network
2. MP - Independ of lower layer protocol (OLL)
3. LS - based on packets i/p labels it determines o/p label & sends just like in virtual circuit
4. They come with MPLS link switched routers
5. Extremely fast forwarding
6. MPLS table

i/p	o/p
	Replaces

7. Border protocol (L2 & L3)
8. Take IP packet from L3 then add label transmit to L2

How is it better at router

→ Packet arrives (IP) → does longest prefix match for dest ip in router's table
→ find o/p interface & forwards
→ so it takes long times

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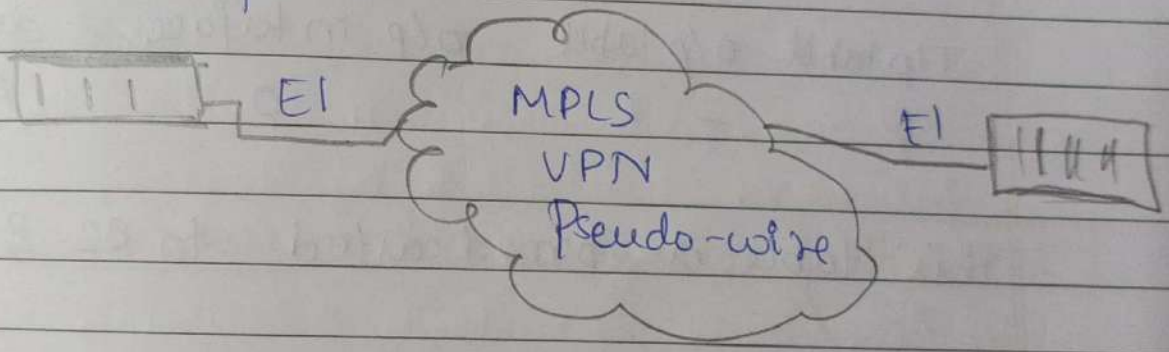
Virtual / Circuit switched network with VCI - virtual circuit identifier

I/p port	VCI	o/p port	VCI
		Replace	

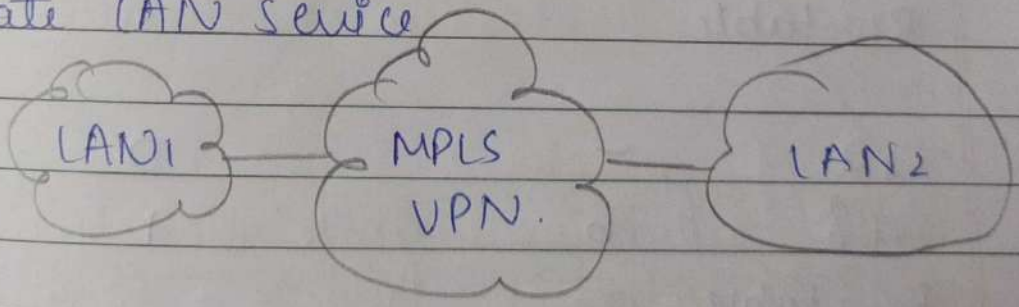
Router + Switch ⟹ label switch router.

Where?

→ Point to point



→ Private LAN service



→ LER - label edge router (at border)

→ LSR - label switch router (within network)

→ It depends on I/P MPLS I/P label & not IP

→ attaches I/P label according to dest IP

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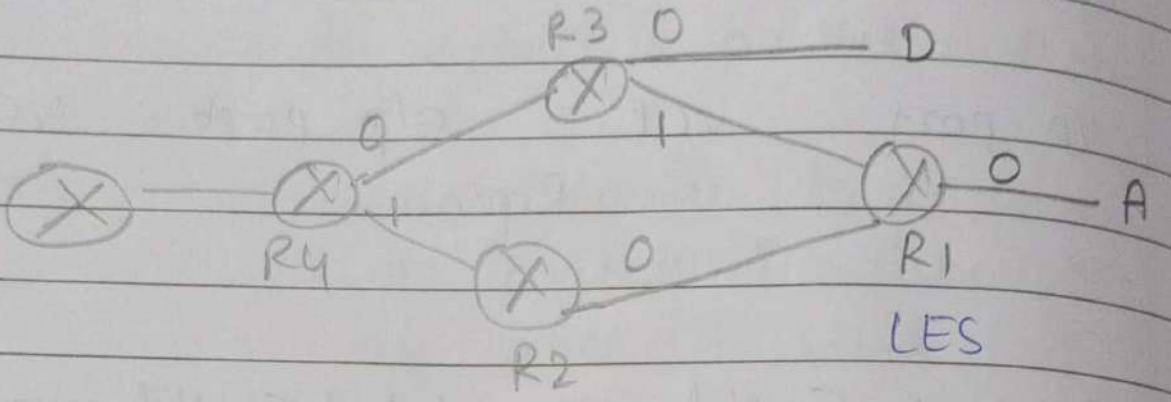
LER, LSR has MPLS table.
All router have MPLS table.



Route R1

I/p label	o/p label	o/p interface	dest
6	-	0	A

This table is broadcasted to R2 & R3

R3 table.

12	-	0	D
18	6	1	A

R2 table

15	6	0	A

R2 & R3 broadcast to R4

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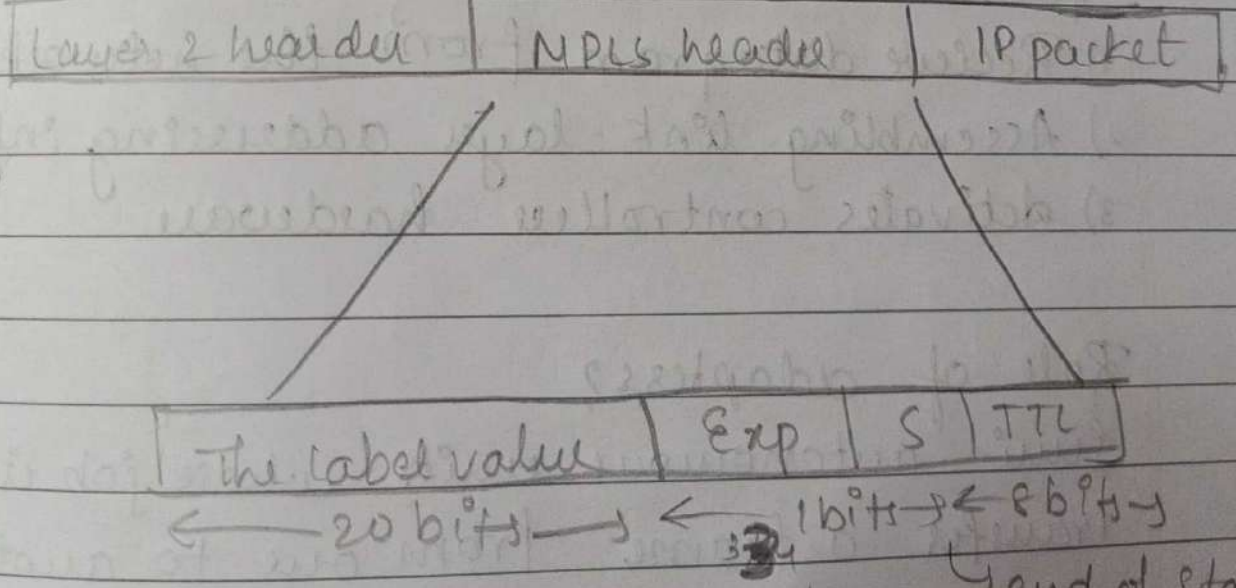
R4 is incoming edge router
So no i/p label.
R4's table

i/p L	o/p L	o/p I	dst
–	12	0	D
–	18	0	A
–	15	1	A // R2
–			

So quick forwarding

MPLS header is added b/w L2 & L3



. 4 byte long
28 Exp → experimental bit