** Layer 2 devices :

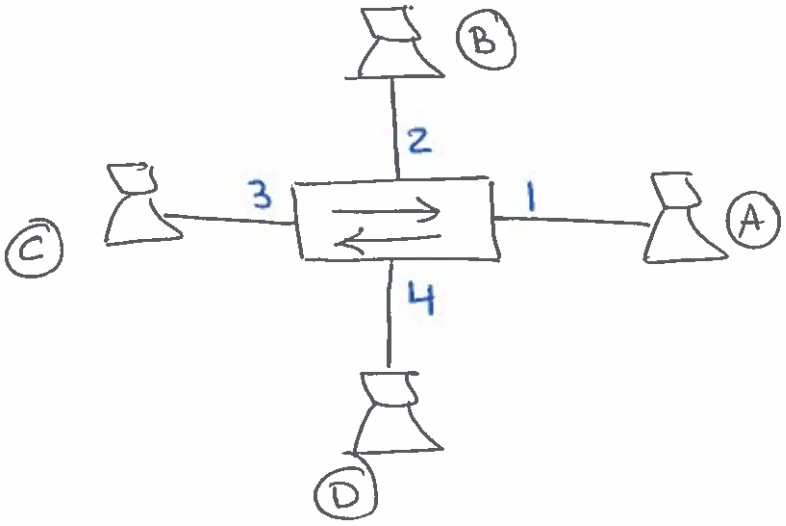
* Switching operation.
* Switching Modes.

* LAN switch functions : { Learning, forwarding, Removing L2 Loops (Listening) }

* Switch operation :

① Learning :

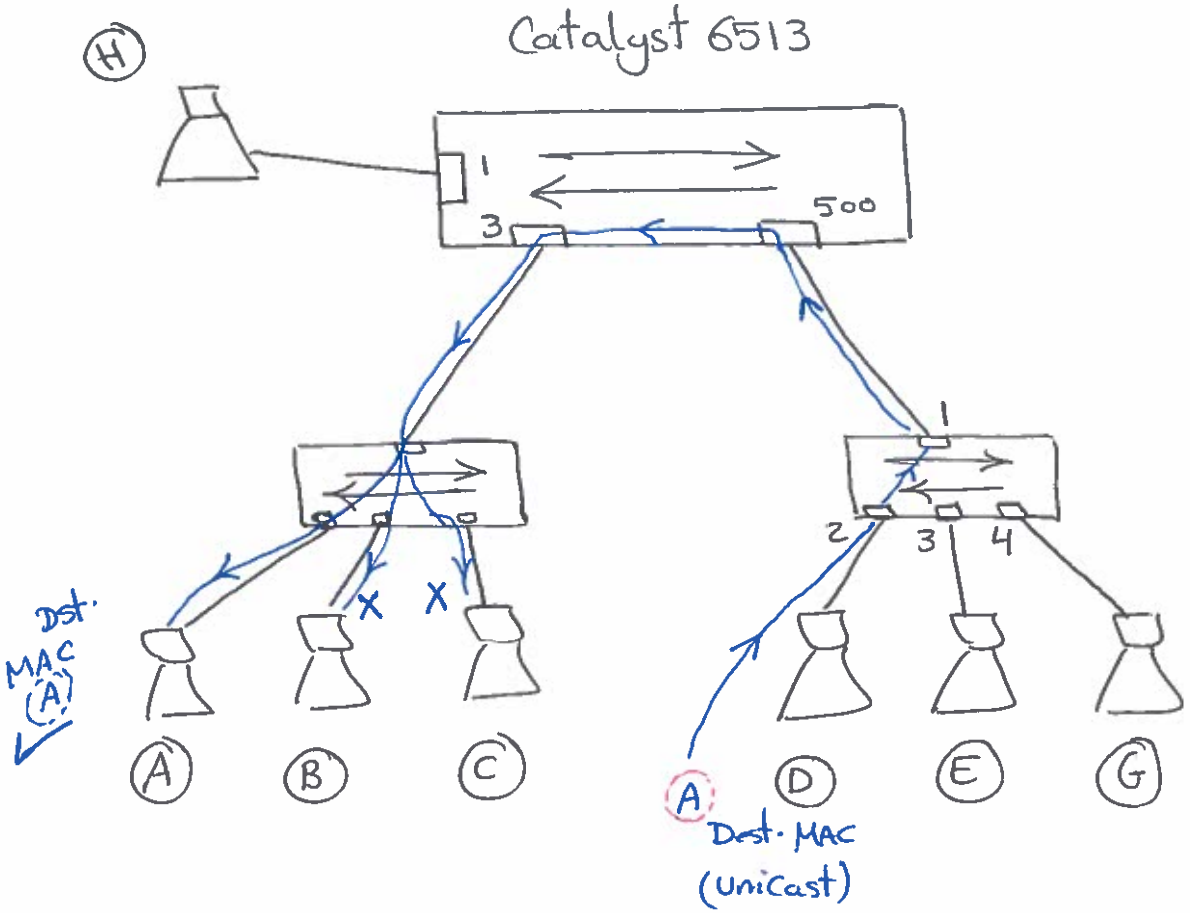
- Forming MAC address table by checking Source MAC in an inComing frames.



MAC Table (RAM)

MAC	Port
A	1
B	2
C	3
D	4

- Switch will flush inactive entries after 5 min of inactive by default.
- Switch can learn many devices on Same Switch port.
- Switch Can never Learn Same device on different ports.



MAC Table

MAC	Port
H	1
A	3
B	3
C	3
D	500
E	500
G	500

MAC Table

MAC	Port
D	2
E	3
G	4
A	1
B	1
C	1
H	1

* Note (A): Switch will flush inactive entries after 5 mins of inactivity by default.

* Note (B): Switch can learn many devices/MAC devices on same switch port

* Note (C): Switch can never learn same device on different ports.

* Note (D): Switch understands MAC address, but doesnot have it.

* Note (E): Hub doesnot have ASIC & Table (because it doesnot understand MAC address).

* Note (F): Switch can never learn same MAC on two different ports

MAC	Port	
A	1	
A	15	last update

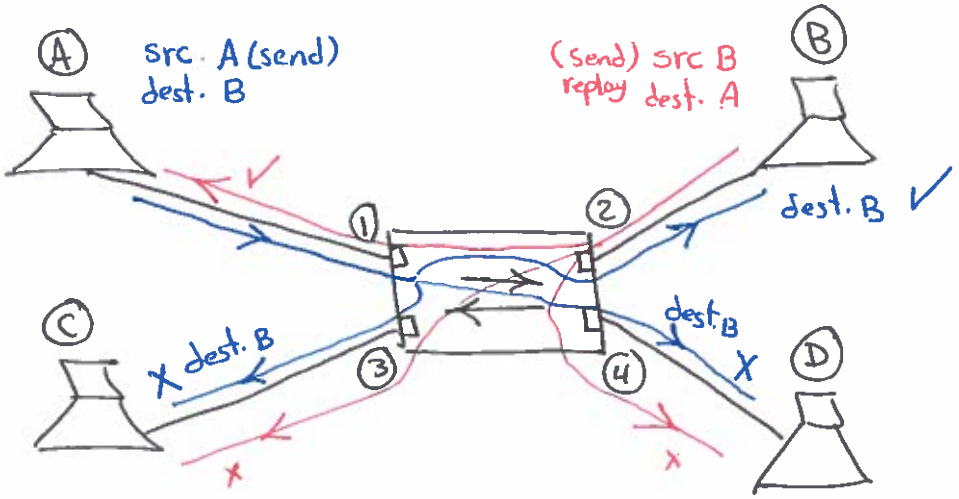
* Note (G): the switch will never learn the devices (even they are linked to it) if they do not connect to each other.

*Note (H) : once the devices connect to each other, the switch will learn the devices (MAC addresses) and their link to its ports.

---

(2) Forwarding :

- Switching frames to next hop (hop to hop ; DTE to DTE) by checking destination MAC in frames.



MAC Table (RAM)

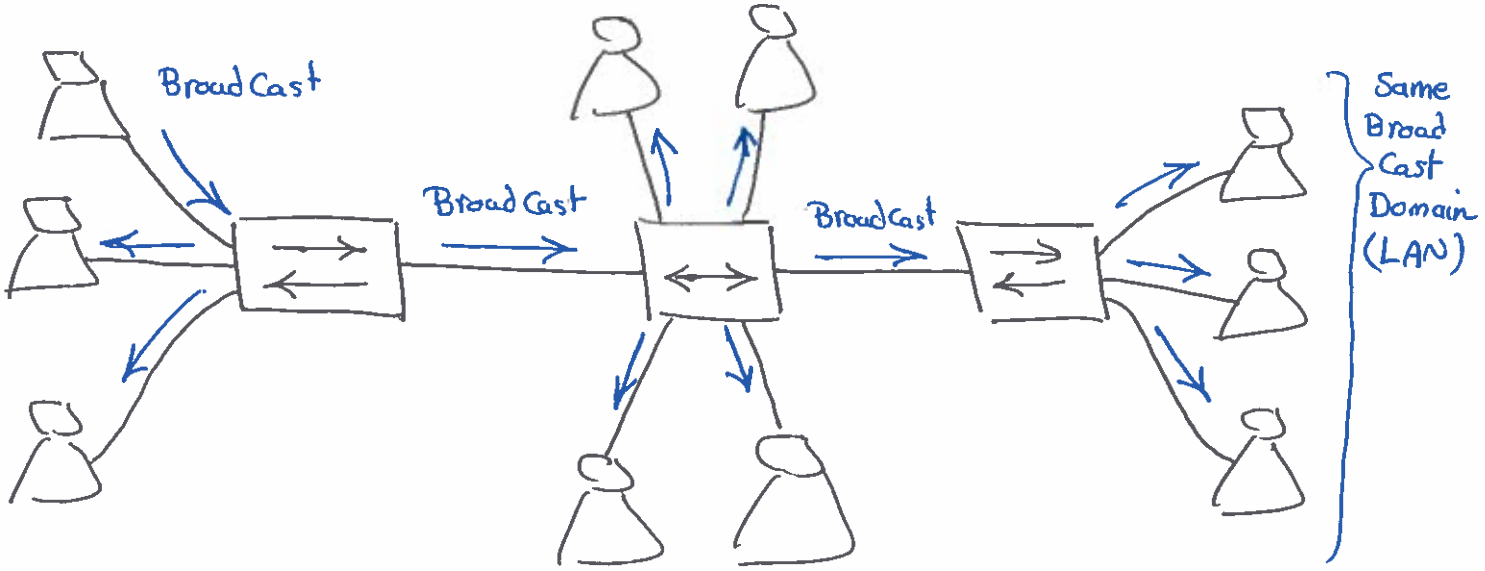
MAC	Port
A	1
B	2

- the switch will flood if the dest. MAC unknown (not in table) or multicast or broadcast.

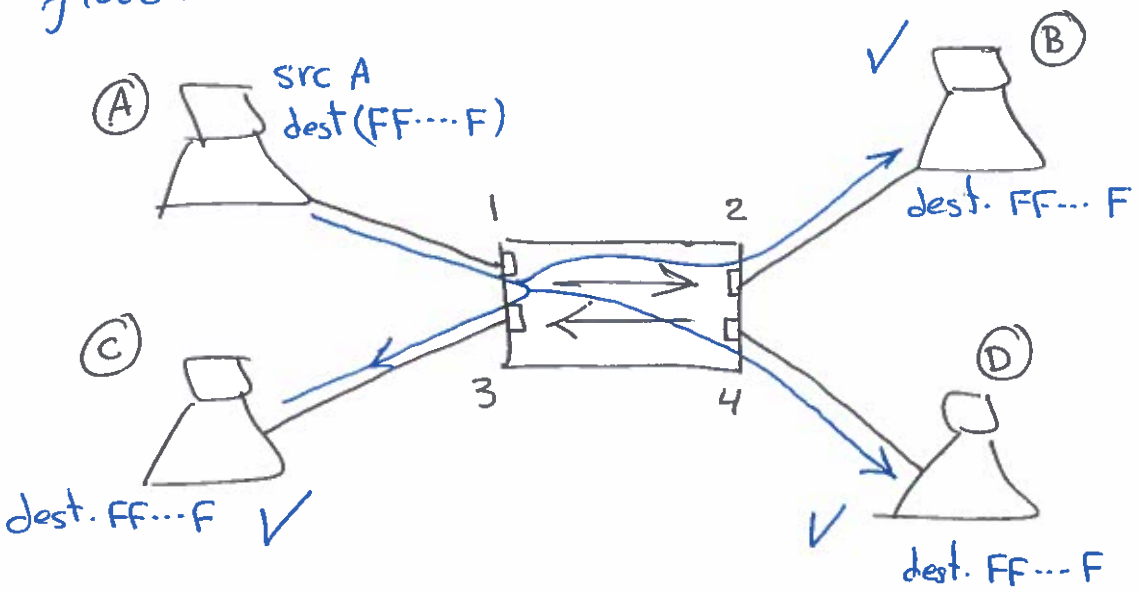
"BUM"

; if the dest. MAC is unknown (not in MAC Table), the switch will flood the data to all devices.

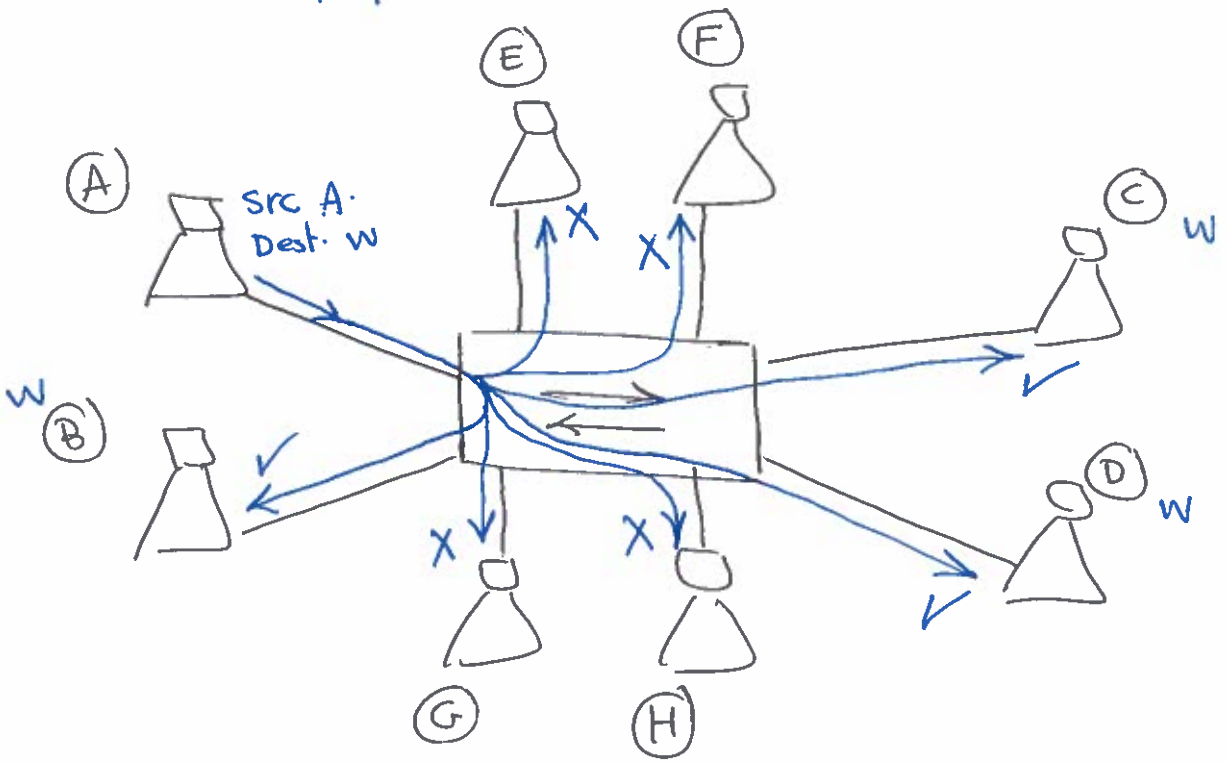
- All devices on a switch (& Hub) are in the same broadcast domain = LAN.



- if dest. MAC is Broadcast (FF.... F), the switch will flood.



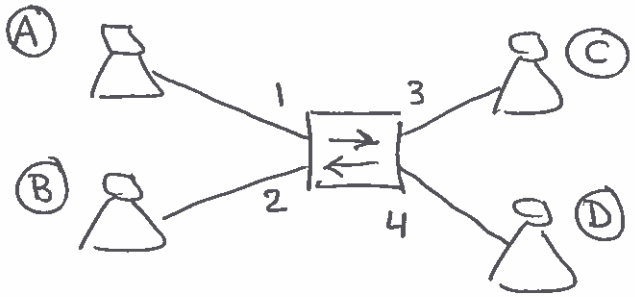
- if dest. MAC is Multicast (01005e)(xxx xxx), the (Software) Switch will flood.



- forwarding is done using microsegmentation
  ↓
  switch's interior wires

- All devices on switch can operate in full duplex.
  ↓
  Can both T_x & R_x at the same time

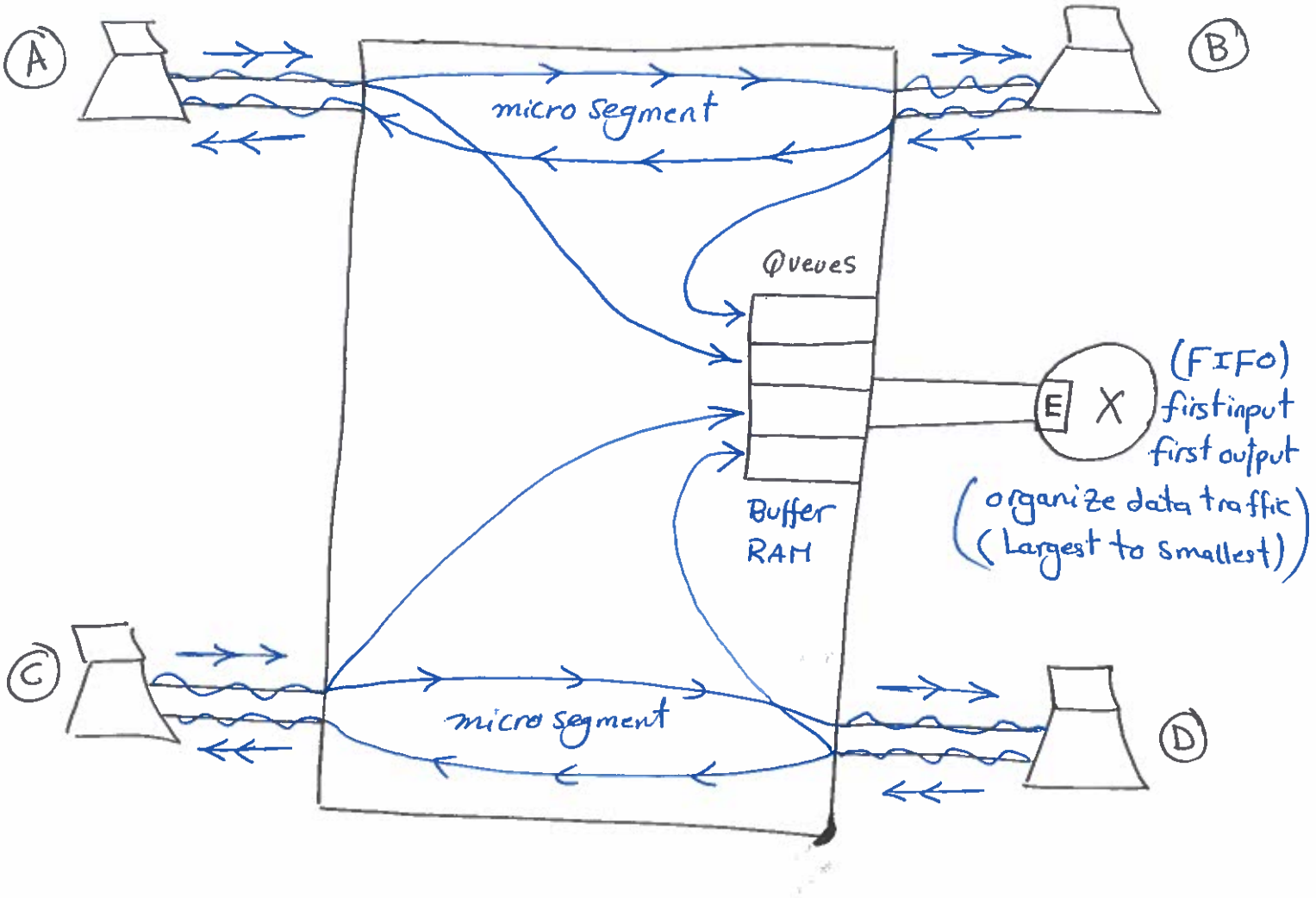
- All devices on switch are in separate Collision domains
  ↓
  (No Collision/Interface)
  &
  (logical Topology = Mesh)



four separate Collision domains

- No. of Cables (microSegmentation) = $n(n-1)$

  n: No. of devices



- No Collisions :
  - Micro Segmentation : (Separate Collision domains).
  - Buffering : Area of memory where the switch stores the data (RAM).
  - when all devices send data to WAN (Congestion), Bufferes will be used to prevent Collision by passing data through Queues → FIFO.

Half duplex : CSMA/CD

Carrier Sense Multiple Access / Collision Detection.

- All devices on all hub can operate in half duplex.

  ↙

  (Can either Tx or Rx at same time)

- All devices on all hub are in Same Collision domain

  ↙

  (Collision/Interface)

  &

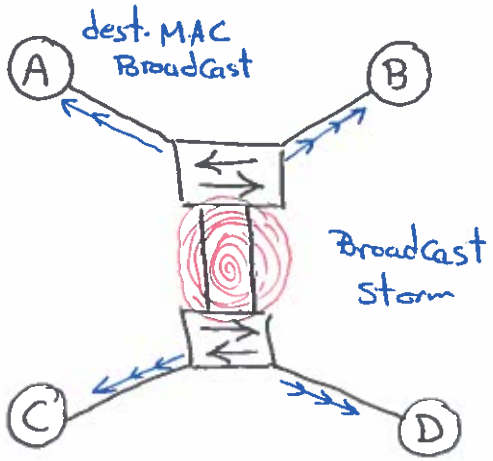
  (Logical Topology = Bus)

CSMA/CD :

- it defines how network devices respond when two devices use a data channel simultaneously and encounter data collision.

* Remove layer 2 loops:

  using STP (Spanning Tree protocol)

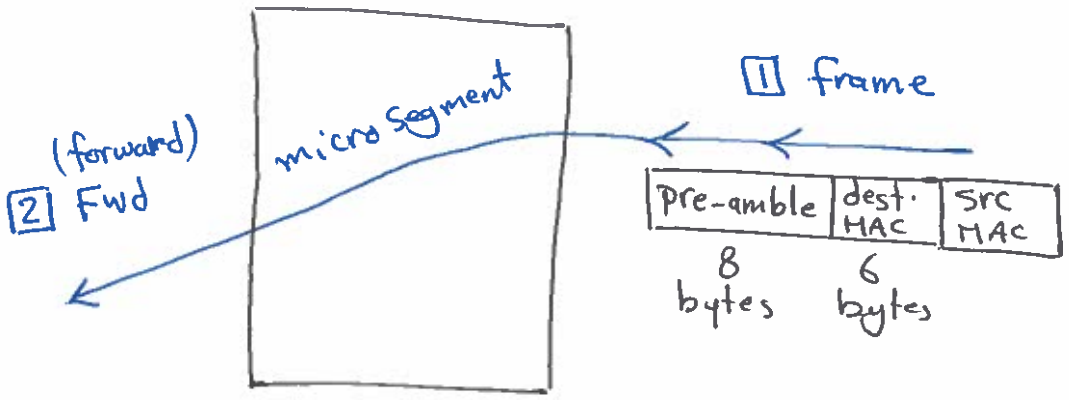


* Switching Methods/Modes (forwarding Methods'/Modes):

- ① Cut through.
- ② Store & forward.
- ③ Adaptive Cut through (By Cisco).

① Cut through:

- switch wait 14-bytes (8 bytes pre-amble + 6 bytes dest MAC) of frame then forward (open microsegmentation).
(microsegment of frame)

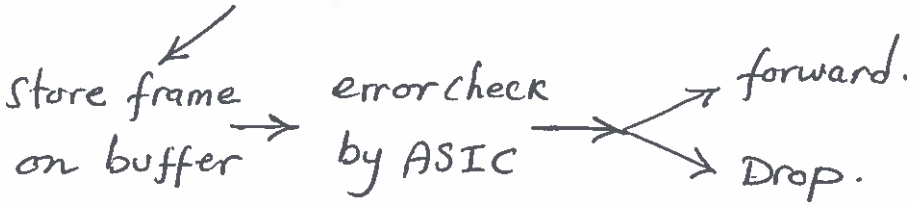


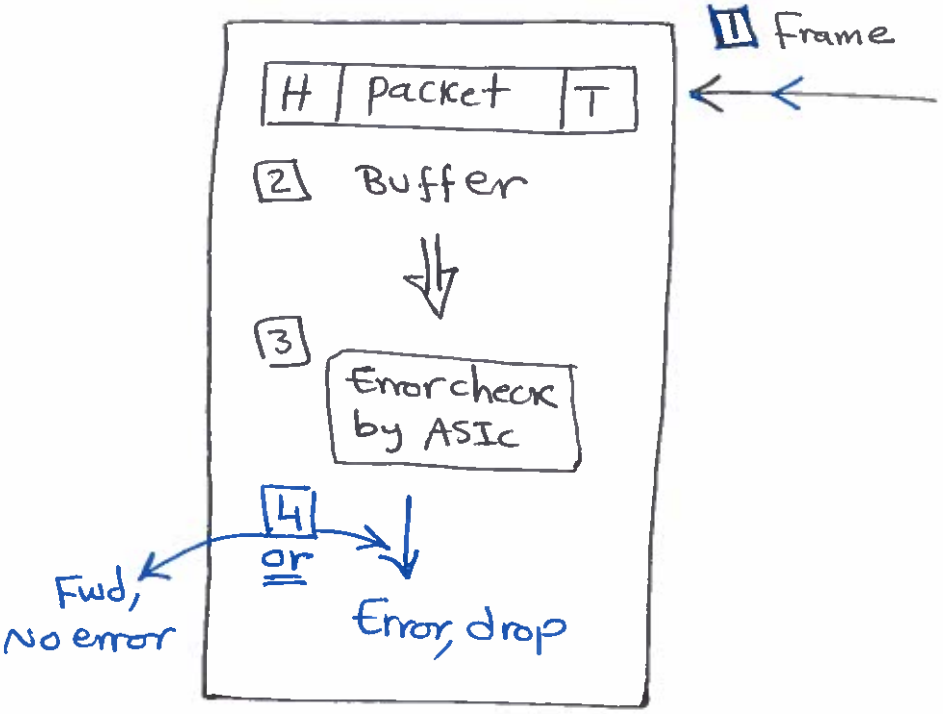
Disadv.

- it forwards the frames without checking errors.

② Store & forward :

- switch wait full frame then forward





Disadv : it takes time to check error, then forward.

③ Adaptive - Cut through : By Cisco

- Mix between cut through & store and forward

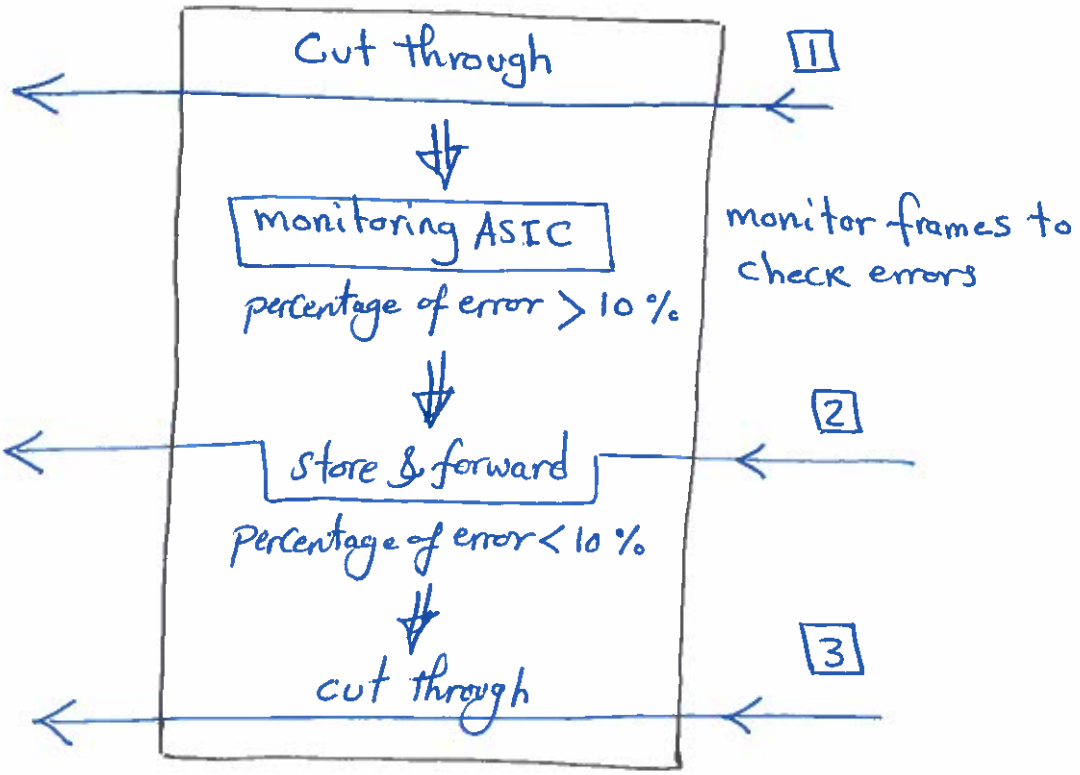
Combined

- Start for 1 min. as Cut through, then check error.

if error "< 10%" ⟹ Still the Same "Cut through"

if error "≥ 10%" ⟹ run as store & forward

- Monitoring ASIC "up to 60 Tbps".



** Internet Layer / Network Layer : PDU = Frame

* Logical Address.
* Routing operation.

- Internet layer/Network layer is responsible for end-to-end data delivery. ; PDU packet.

* Logical Address :

- it is Software address giving by Configration used to send data from end-to-end.

N		H
Network Part		Host part
10	.	1
10	.	2
	⋮	

IANA ← Service Provider مقدم خدمة

California, U.S.

1/1/1983 1999

- Ex: IPV4, IPV6 (TCP/IP),
Apple Talk, IPx (Not for internet access);

- Service provider : Internet Assigned Number Authority
IANA

- It divide to { Network part N جزء مقدم خدمة
Host part H جزء العميل/الشركة

MAC Address	IP Address
- physical Address - Burnt on RoM of NIC - Hardware Address - Hop-to-Hop "IEEE"	- Logical Address - Given by Configuration. - Software Address - End-to-End "IANA"

Layer 2 Technology	Layer 2 Address
- Ethernet, Wifi - X.25 - Frame Relay - ATM, DSL	- MAC 48-bits - X.25 8-bits - DLCI 10-bits "Data Link Circuit ID" - VPI/VCI 16-bits "Virtual path ID/Virtual Circuit ID"

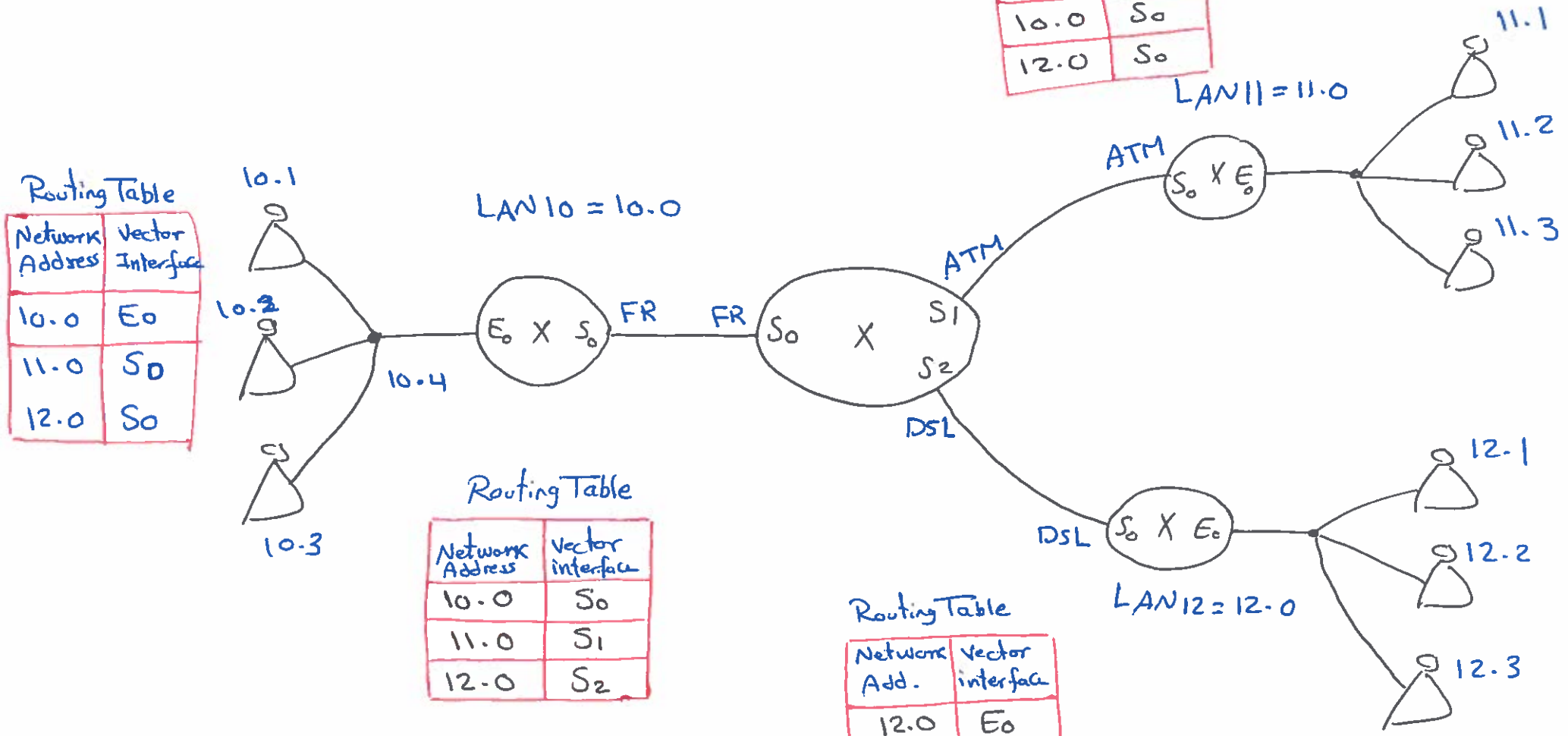
Function	Router	Switch
learning	- forming IP address Table (Routing table) using software (routing protocols) (RIP_OSPF)	- forming MAC table address by checking src. MAC.
forwarding	- Compare dest. IP to the routing table ; if dest IP : - Known → Router will forward - unKnow → " " drop. - BroadCast → " " process	- Compare dest. MAC to the MAC table. if dest MAC : - Know → switch will forward - unKnow → " " flood - BroadCast → " " flood ; BUM → flood

* Routing :

"Finding the best path to final end using Routing protocol"

Routing Table

Net. Add.	vector interface
11.0	E_0
10.0	S_0
12.0	S_0



Routing Table

Network Address	Vector Interface
10.0	E_0
11.0	S_0
12.0	S_0

Routing Table

Network Address	vector interface
10.0	S_0
11.0	S_1
12.0	S_2

Routing Table

Network Add.	Vector interface
12.0	E_0
10.0	S_0
11.0	S_0