Computer Communication & Networks

Lecture 12

Datalink Layer: Multiple Access

Data Link Layer Topics to Cover

Framing

Error Detection and Correction

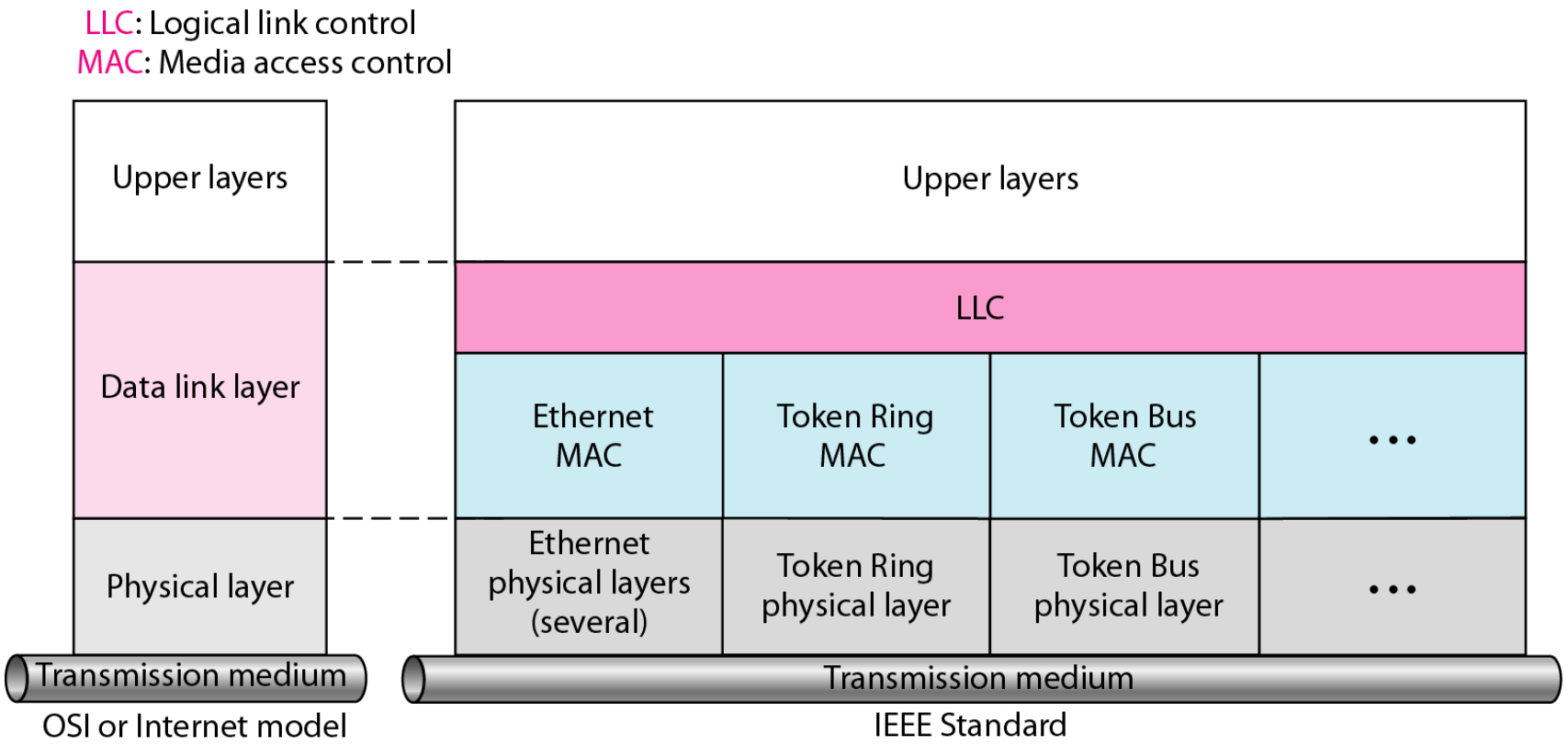
Data Link Control and Protocols

Multiple Access

Local Area Networks

Wireless LANs

IEEE standard for LANs



Ethernet

"Dominant" LAN technology:

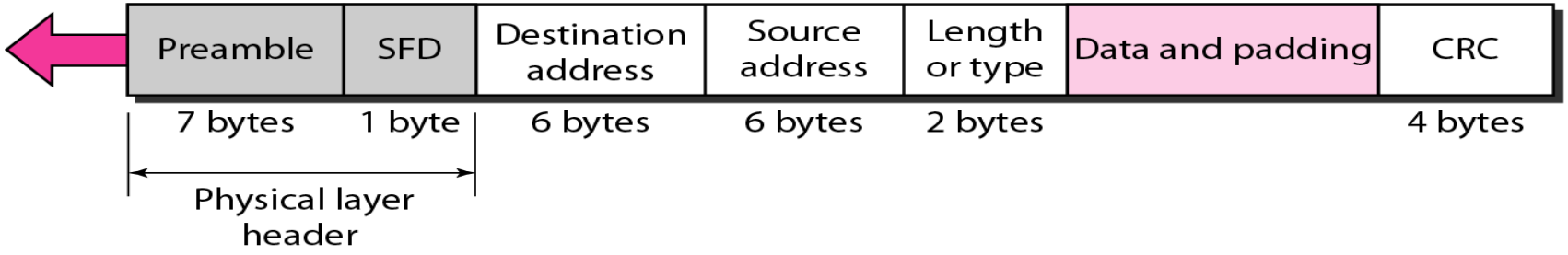
- First widely used LAN technology
- Simpler, cheaper than previous
- Kept up with speed race: 10, 100, 1000 Mbps

Ethernet Frame Structure - 1

Sending adapter encapsulates IP datagram (or other network layer protocol packet) in Ethernet frame

Preamble: 56 bits of alternating 1s and 0s.

SFD: Start frame delimiter, flag (10101011)

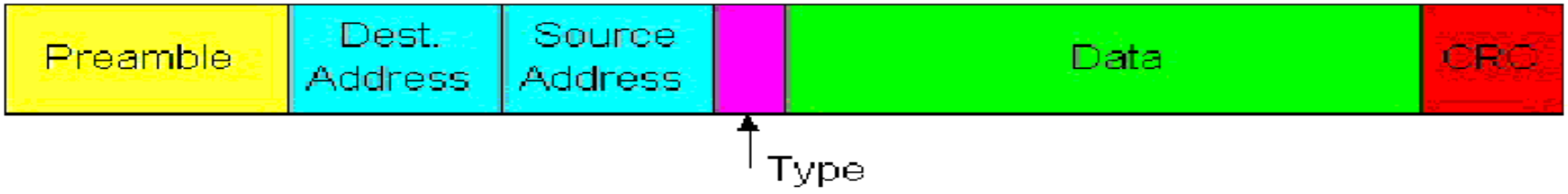


Preamble:

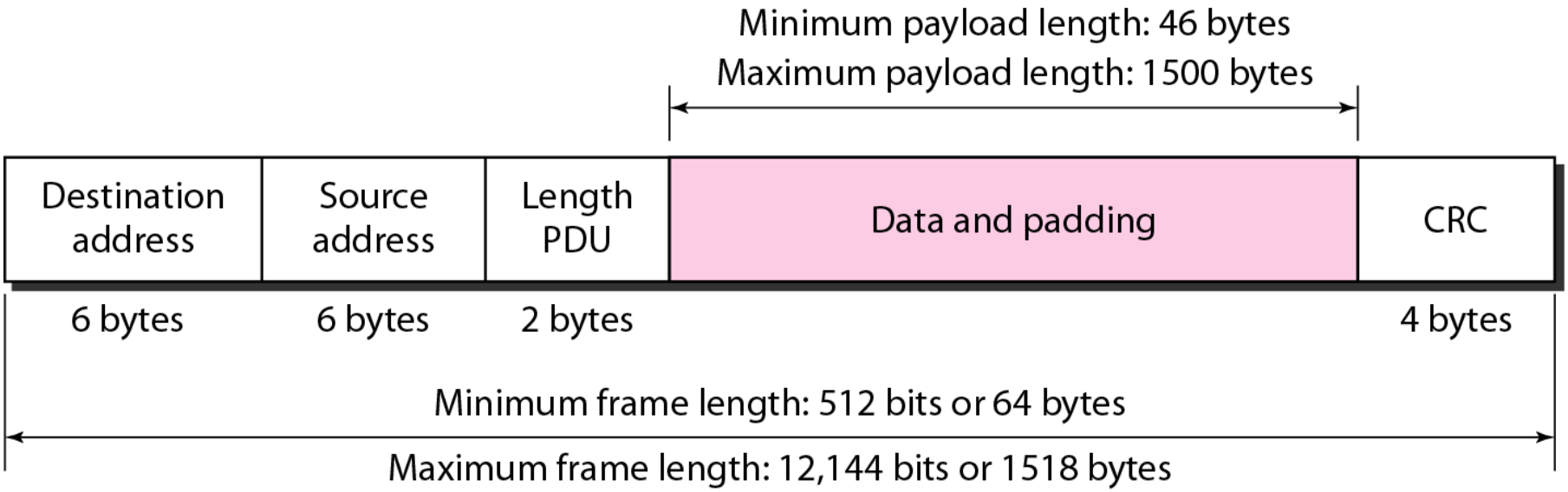
- 7 bytes with pattern 10101010 followed by one byte SFD: 10101011
- Used to synchronize receiver, sender clock rates

Ethernet Frame Structure - 2

- Addresses: 6 bytes, frame is received by all adapters on a LAN and dropped if address does not match
- Type: indicates the higher layer protocol, mostly IP but others may be supported such as Novell IPX and AppleTalk)
- CRC: checked at receiver, if error is detected, the frame is simply dropped



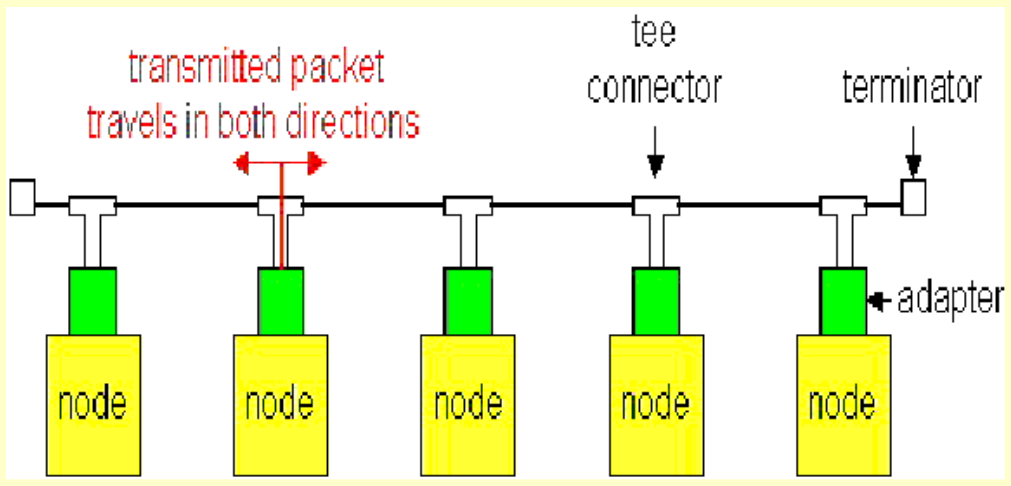
Minimum and Maximum Lengths



- Why there is an upper limit!!

Ethernet Technologies: 10Base2

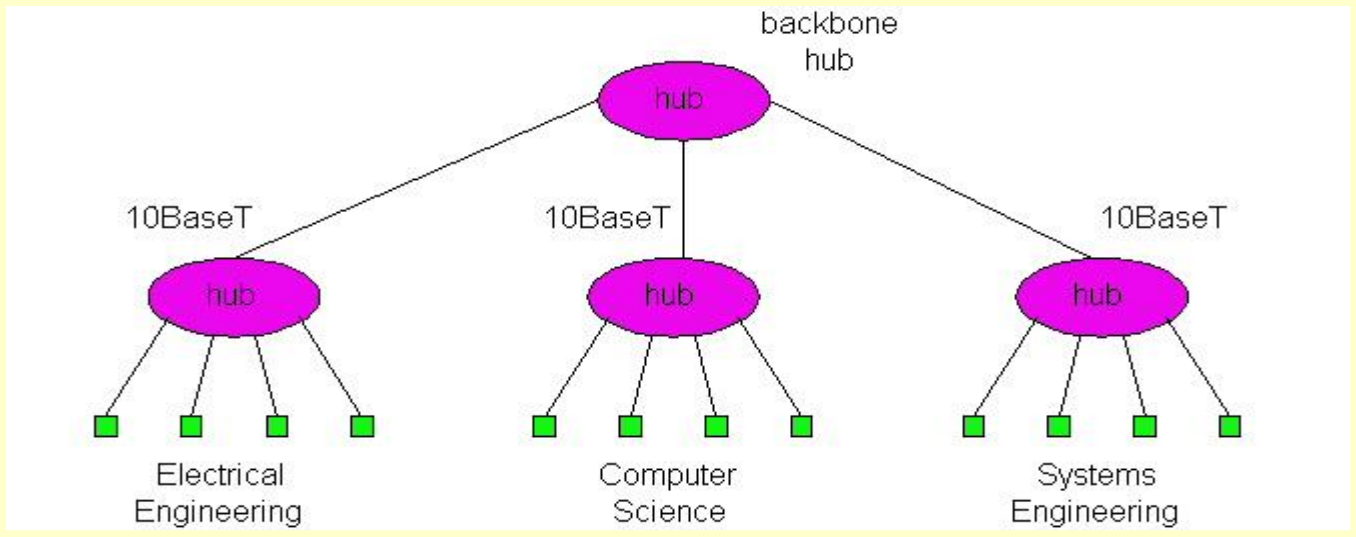
- 10: 10Mbps; 2: under 200 meters max cable length
- Thin coaxial cable in a bus topology
- MAX 30 users on one segment.



- Repeaters used to connect up to multiple segments
- Repeater repeats bits it hears on one interface to its other interfaces: physical layer device!

10BaseT and 100BaseT - 1

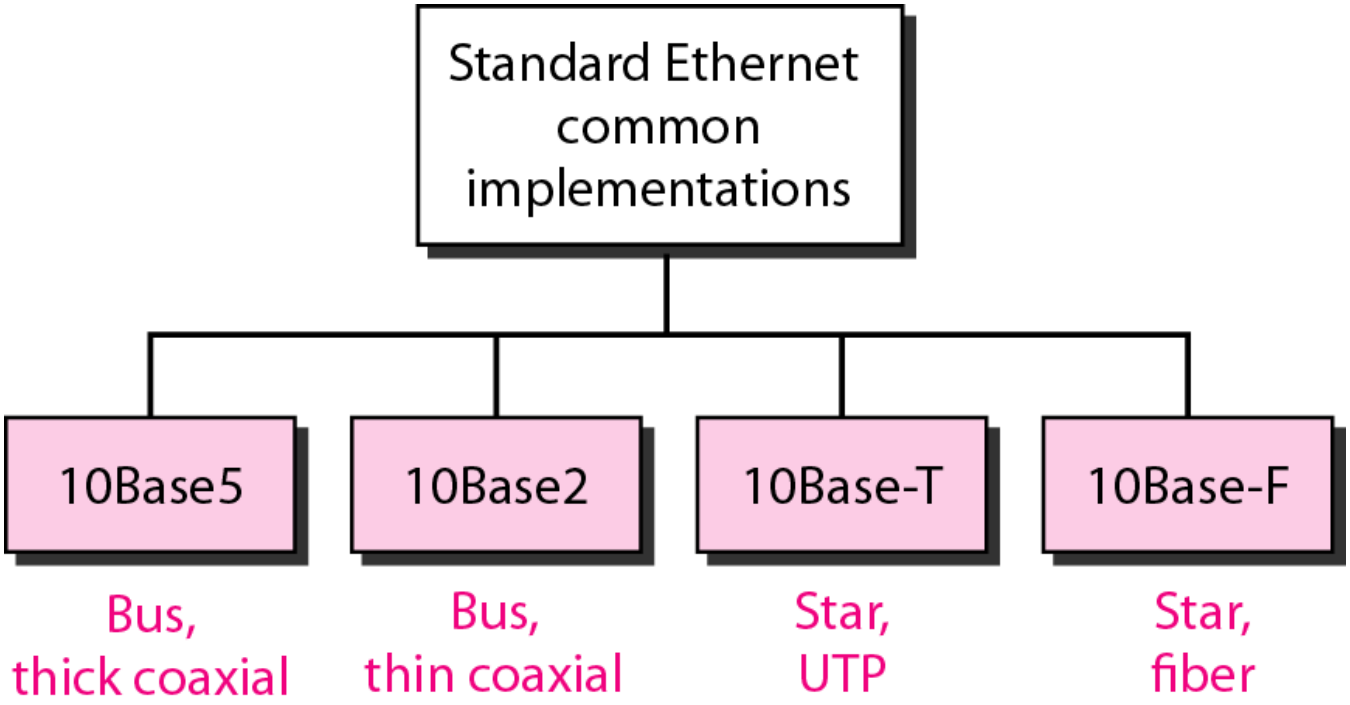
- 10/100 Mbps rate; latter called “Fast ethernet”
- **T** stands for Twisted Pair
- Hub to which nodes are connected by twisted pair, thus “star topology”
- CSMA/CD implemented at hub



Gbit Ethernet

- Use standard Ethernet frame format
- Allows for point-to-point links and shared broadcast channels
- In shared mode, CSMA/CD is used
- Full-Duplex at 1 Gbps for point-to-point links

Categories of Standard Ethernet

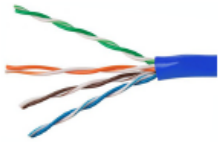
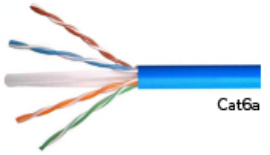


Categories of Standard Ethernet

Summary of Standard Ethernet Implementations

Characteristics	*10Base5*	*10Base2*	*10Base-T*	*10Base-F*
Media	Thick coaxial cable	Thin coaxial cable	2 UTP	2 Fiber
Maximum length	500 m	185 m	100 m	2000 m
Line encoding	Manchester	Manchester	Manchester	Manchester

GbE / GigE

TYPE	SPEED	CABLE	CABLE IMAGE
Fast Ethernet	10/100Mbps	Cat5	
Gigabit Ethernet	10/100/1000Mbps	Cat5e/Cat6a	

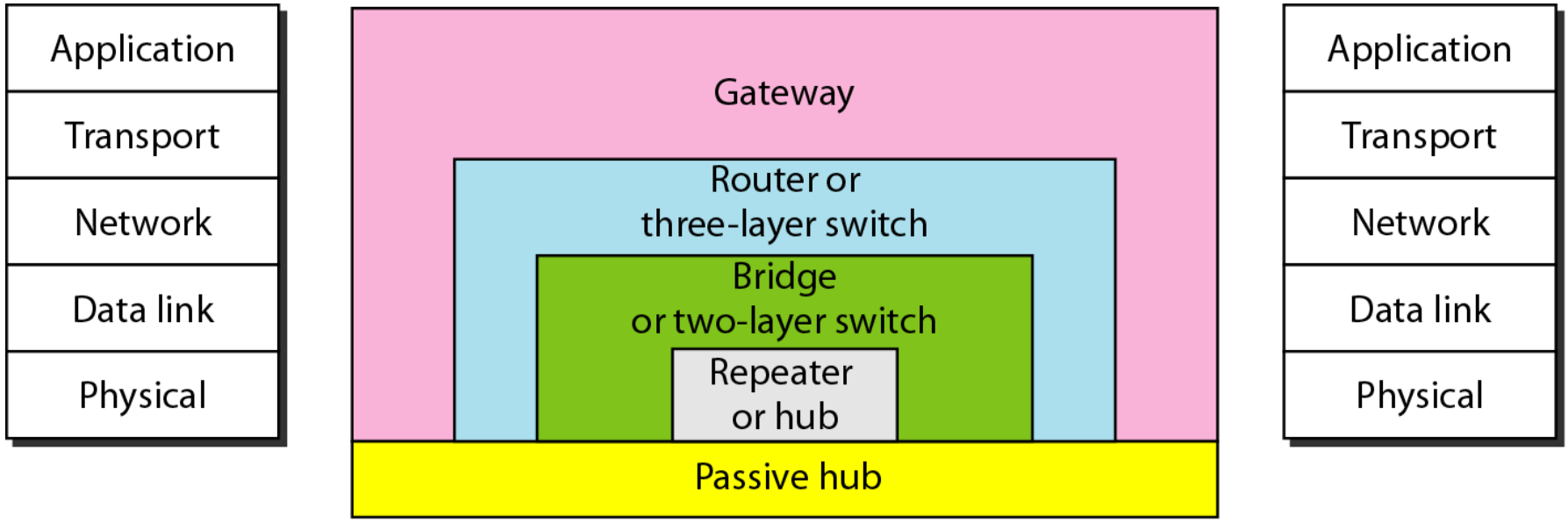
1000Base-T

Categories of Standard Ethernet

Gigabit Ethernet

IEEE STANDARD	VERSION	CABLE TYPE	MAX SPECIFIED DISTANCE IN METERS (M) OR KILOMETERS (KM)
802.3z	1000Base-CX	Balanced twinax or STP	25 m
802.3z	1000Base-SX	Fiber optic	220 m
802.3z	1000Base-LX	Fiber optic	5 km
802.3ab	1000Base-T	UTP	100 m
802.3bp	1000BASE-T1	STP	15 m
802.3ab	1000BASE-TX	UTP	100 m
802.3ap	1000BASE-KX	UTP	1 m

Five Categories of Network Devices



Five Categories of Network Devices

Feature	Hub	Switch	Bridge	Router
OSI Layer	Physical (Layer 1)	Data Link (Layer 2)	Data Link (Layer 2)	Network (Layer 3)
Function	Broadcasts data to all ports	Forwards data to specific MACs	Connects 2 LAN segments	Connects different networks (e.g., LAN to WAN)
Traffic Handling	No filtering, just repeats signal	Filters & forwards based on MAC	Filters traffic by MAC	Routes packets by IP address
Intelligence	None	Medium (MAC address aware)	Medium (MAC address aware)	High (IP address aware, supports routing protocols)
Broadcast Domain	One	One	One per segment	Typically splits broadcast domains
Use Case	Outdated; rarely used now	Common in modern LANs	Used to reduce traffic in LANs	Used for connecting networks and internet access
Speed	Slower (shared bandwidth)	Faster (dedicated bandwidth per port)	Moderate	High, often includes firewall & NAT