- **Computer Networks**
- **Al-Mustansiryah University**
- **Elec. Eng. Department College of Engineering**
  **Fourth Year Class**

# Chapter 6

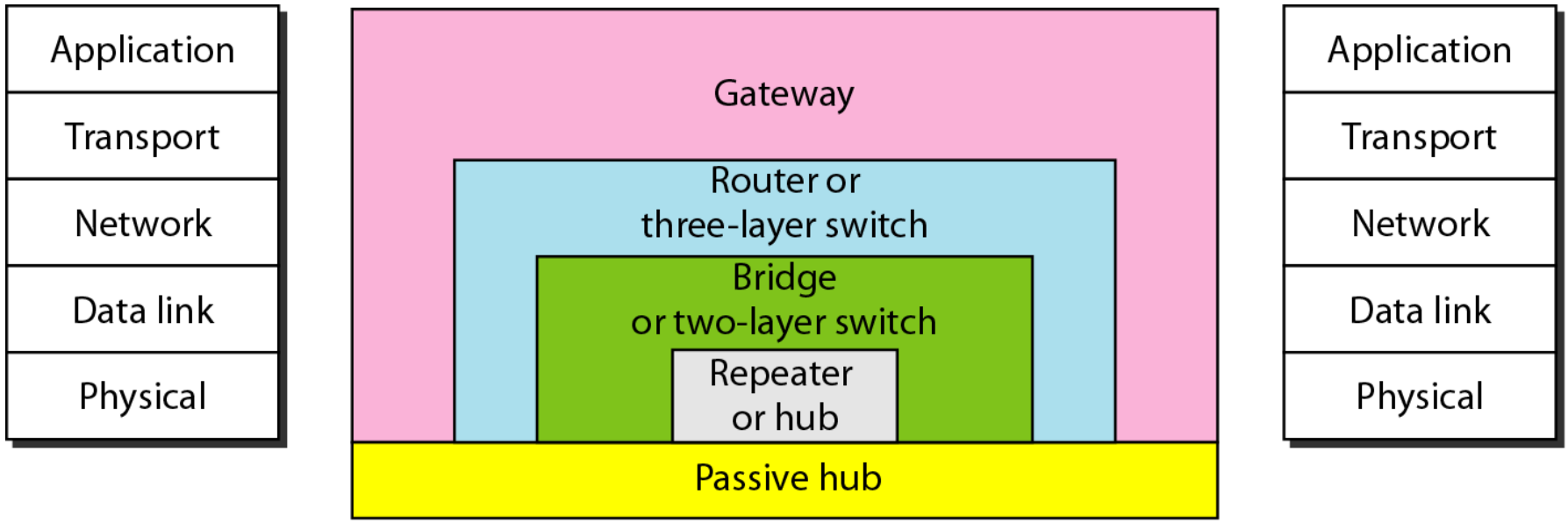
# Connecting Device

- Functions of network devices
- Separating (connecting) networks or expanding network
  - e.g. repeaters, hubs, bridges, routers, switches

# 6.1 Connecting Devices

- Five connecting devices
  - Repeaters
  - Hubs
  - Bridges
  - Switches
  - Routers

## Figure 6.1 *Five categories of connecting devices*

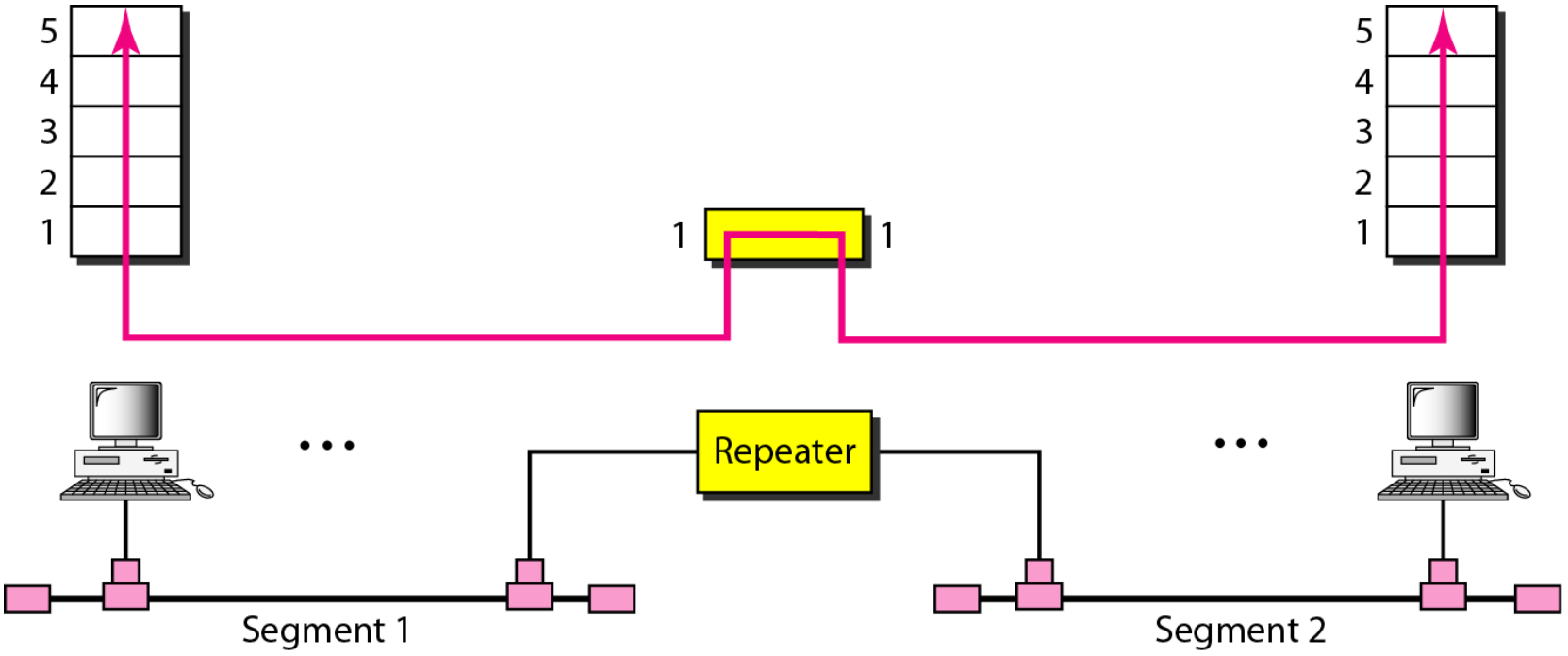


# 1)Repeaters

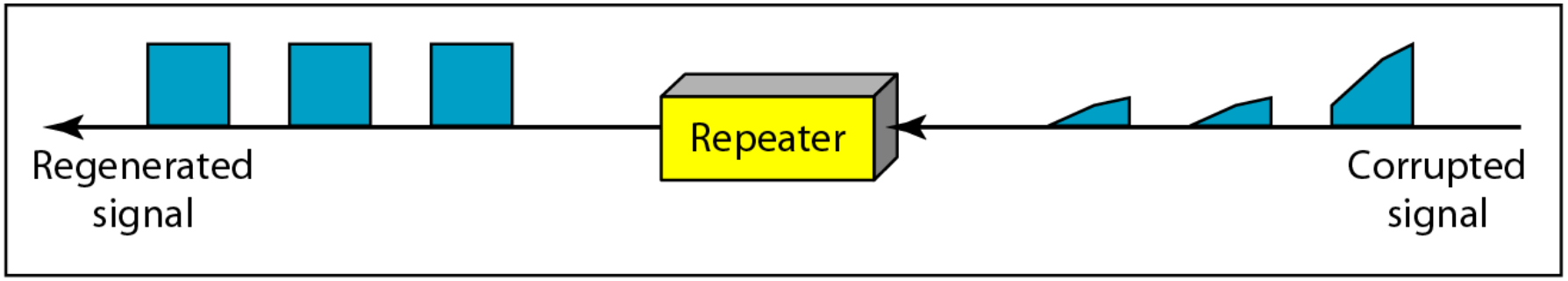
- A **physical layer** device the acts on **bits** not on **frames** or packets
- When a bit (0,1) arrives, the repeater receives it and **regenerates** it, the transmits it onto all other interfaces
- Used in LAN to **connect cable segments** and **extend** the **maximum cable length** ➔ extending the **geographical LAN range**
- Repeaters do not implement any **access method**
  - If any two nodes on any two connected segments transmit at the same time **collision** will happen


HDMI
HDMI Input
HDMI Super Extender by CAT5e
Receiver
CAT5e #2
CAT5e #1

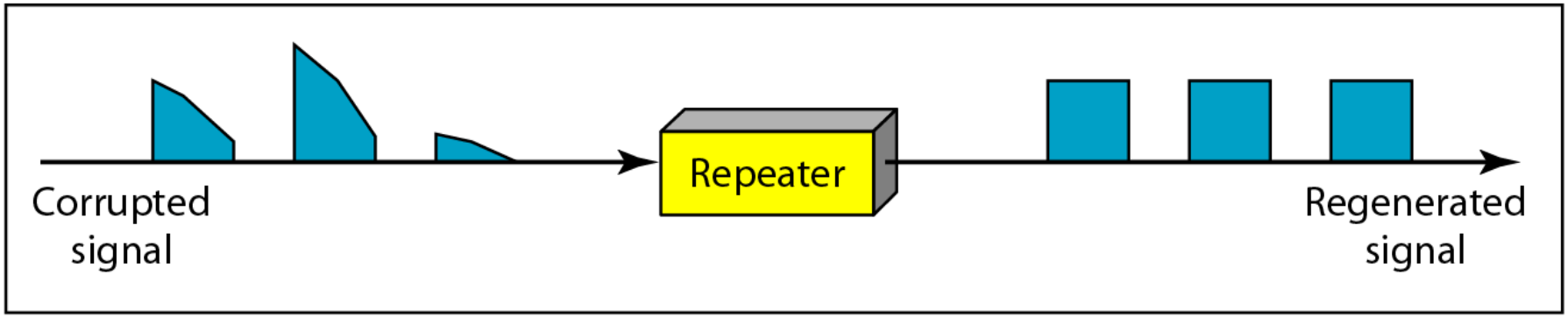
## Figure 6.2 *A repeater connecting two segments of a LAN*



## Figure 6.3 *Function of a repeater*




a. Right-to-left transmission.



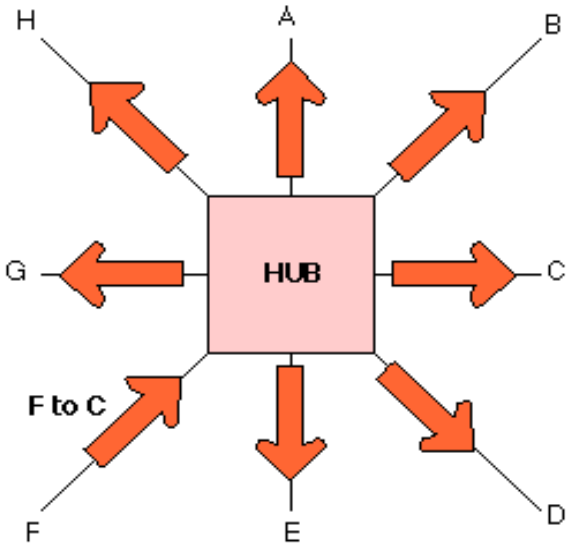

b. Left-to-right transmission.

# 2)Hubs

- Acts on the **physical layer**
- Operate on bits rather than frames
- Used to connect stations adapters in a **physical** star topology but **logically** bus
- Hub receives a bit from an adapter and sends it to **all** the other adapters without implementing any access method.
- does not do **filtering** (forward a frame into a specific destination or drop it) just it copy the received frame onto **all other links**
- Multiple Hubs can be used **to extend** the network length

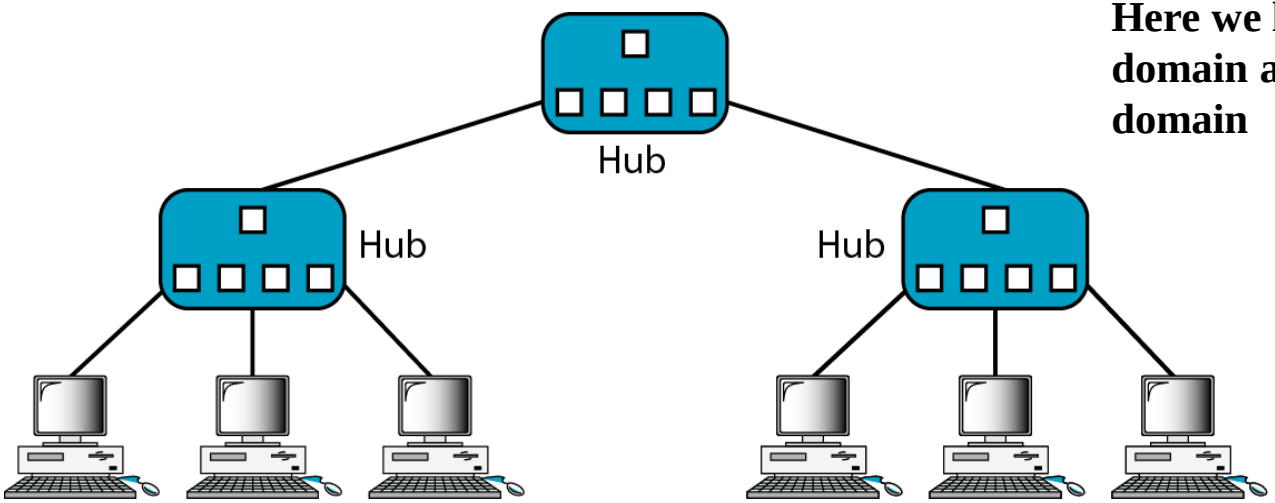
# Hubs

- The entire hub forms **a single collision domain**, and **a single Broadcast domain**
  - **Collision domain**: is that part of the network when two or more nodes transmit at the same time collision will happen.
  - **Broadcast domain:** is that part of the network where each NIC can 'see' other NICs' traffic **broadcast messages.**



# Interconnecting with hubs

- Backbone hub interconnects LAN segments
- **Advantage**:
  - Extends max distance between nodes
- **Disadvantages**
  - Individual segment collision domains become one large collision domain ➔ (**reduce the performance**)
  - Can't interconnect different Ethernet technologies because **no buffering** at the hub

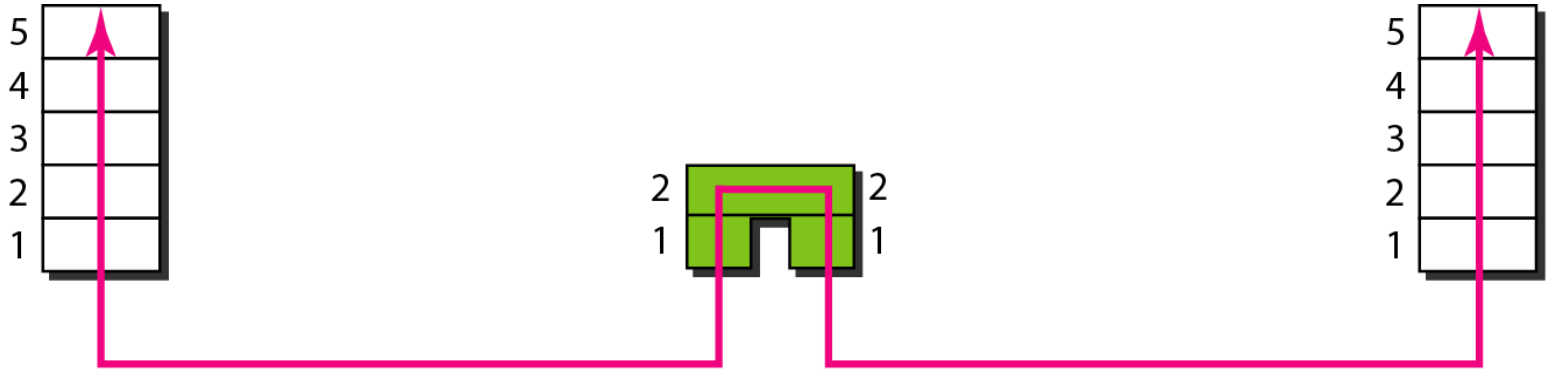



**Here we have a single collision domain and a single broadcast domain**

# 3)Bridges

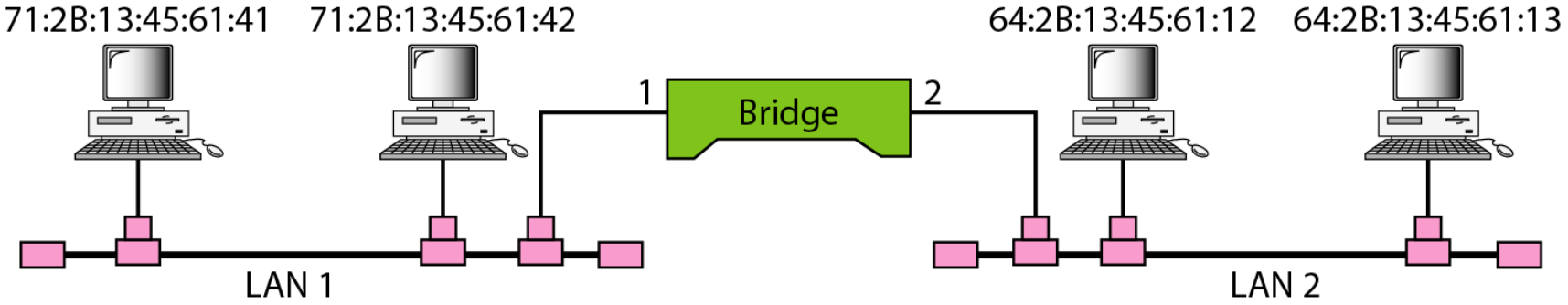
- Acts on the **data link** layer (MAC address level)
- Used to **divide** (segment) the LAN into smaller LANs segments, or to **connect** LANs that use identical physical and data link layers protocol
- Each LAN segment is a **separate collision domain**
- Bridge does not send the received frame to all other interfaces like hubs and repeaters, but it performs **filtering** which means:
  - Whether a frame should be **forwarded** to another interface that leads to the destination or **dropped**
- A bridge has a table used in filtering decisions.

## Figure 6.5 *A bridge connecting two LANs*

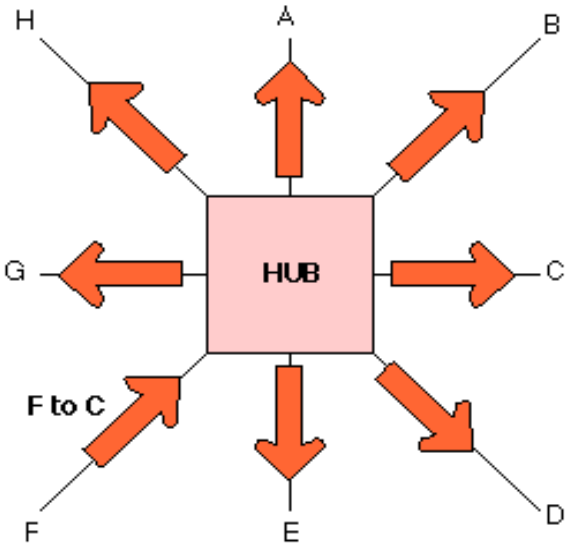



| Address | Port |
|---|---|
| 71:2B:13:45:61:41 | 1 |
| 71:2B:13:45:61:42 | 1 |
| 64:2B:13:45:61:12 | 2 |
| 64:2B:13:45:61:13 | 2 |

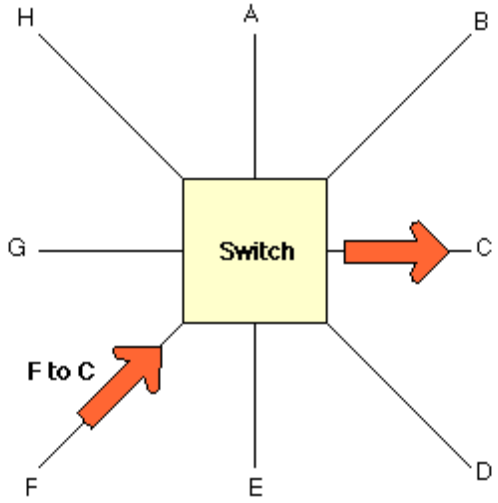
Bridge Table



# Bridges Vs. Hubs




*A Hub sending a packet form F to C.*

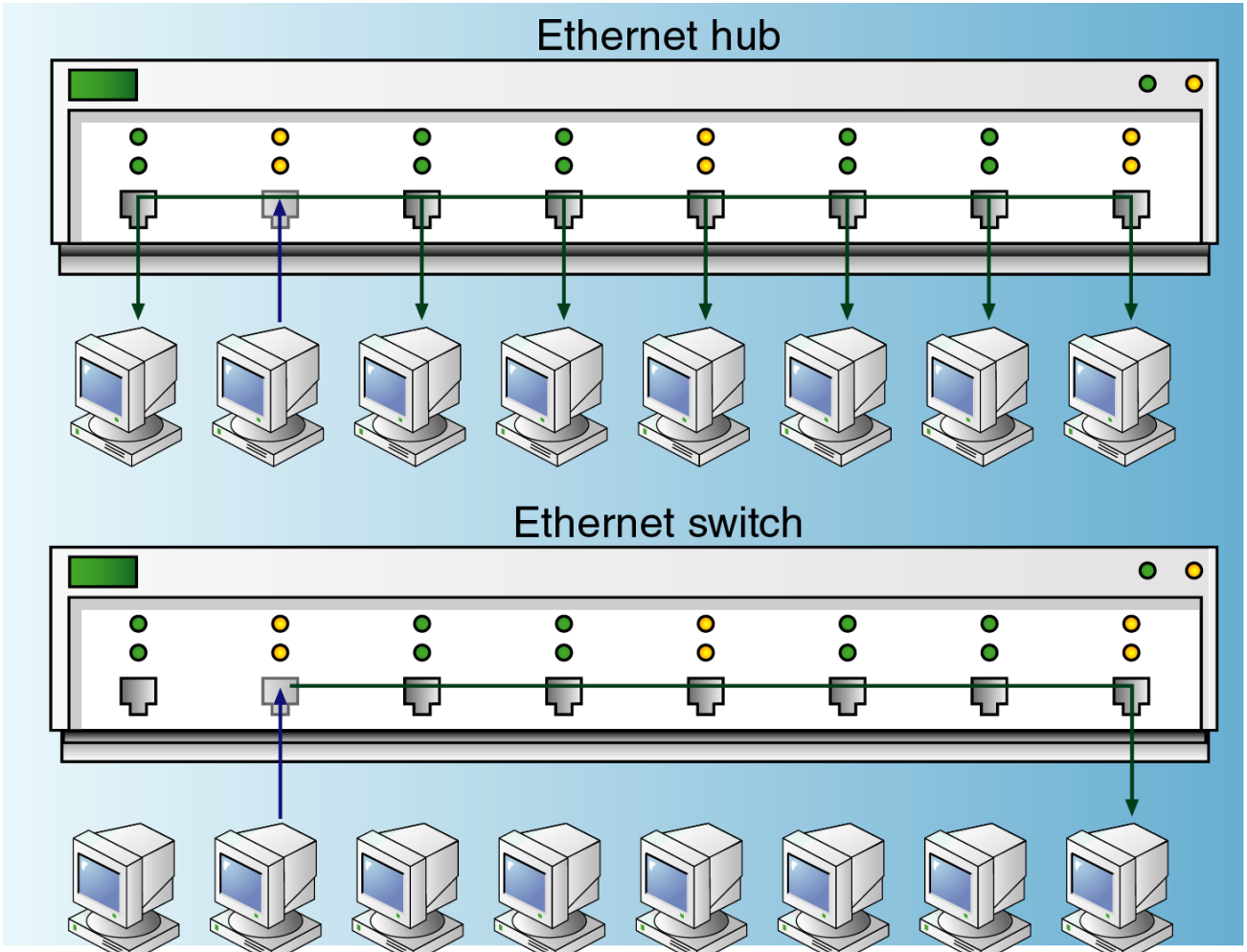



*A bridge sending a packet from F to C*

# 4)Switches

- Usually used to connect individual computers not LANs like bridge.
- Allows more than one device connected to the switch directly to transmit **simultaneously .**
- Can operates in **Full-duplex** mode (can send and receive frames at the same time over the same interface).
- Performs MAC address recognition and frame forwarding in **hardware.**


NETGEAR
5 PORT 10/100 Mbps Fast Ethernet Switch
NETGEAR
Auto 10/100 Mbp Switching
On = Link
Blink = Act
100M
10M
PWR
1
2
3
4
5


Ethernet hub
Ethernet switch

# Types of Switches

- Switches can use different forwarding techniques—two of these are **store-and-forward** switching and **cut-through** switching.
- In **store-and-forward** switching, an entire frame must be received before it is forwarded.
- **Cut-through switching** allows the switch to begin forwarding the frame when enough of the frame is received to make a forwarding decision. This reduces the latency through the switch.
- Store-and-forward switching gives the switch the opportunity to evaluate the frame for errors before forwarding it.
- Cut-through switching does not offer this advantage, so the switch might forward frames containing errors.

# 5) Routers

- Operates at network layer = deals with **packets** not **frames.**
- Connect LANs and WANs with similar or different protocols together.
- Switches and bridges **isolate collision domains** but forward broadcast messages to **all LANs** connected to them. Routers **isolate both** collision domains and broadcast domains.
- Acts like normal stations on a network, but have **more than one** network address (an address to each connected network).
- Routers **Communicate with each other** and exchange routing information.
- Determine best route using **routing algorithm** by special software installed on them.


PWR
SYS
WLAN
4
3
2
1
WAN
QSS
Advanced Wireless N Router
TL-WR941ND

## Figure 6.11 *Routers connecting independent LANs and WANs*