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Network Devices

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TRAINING

CENTER

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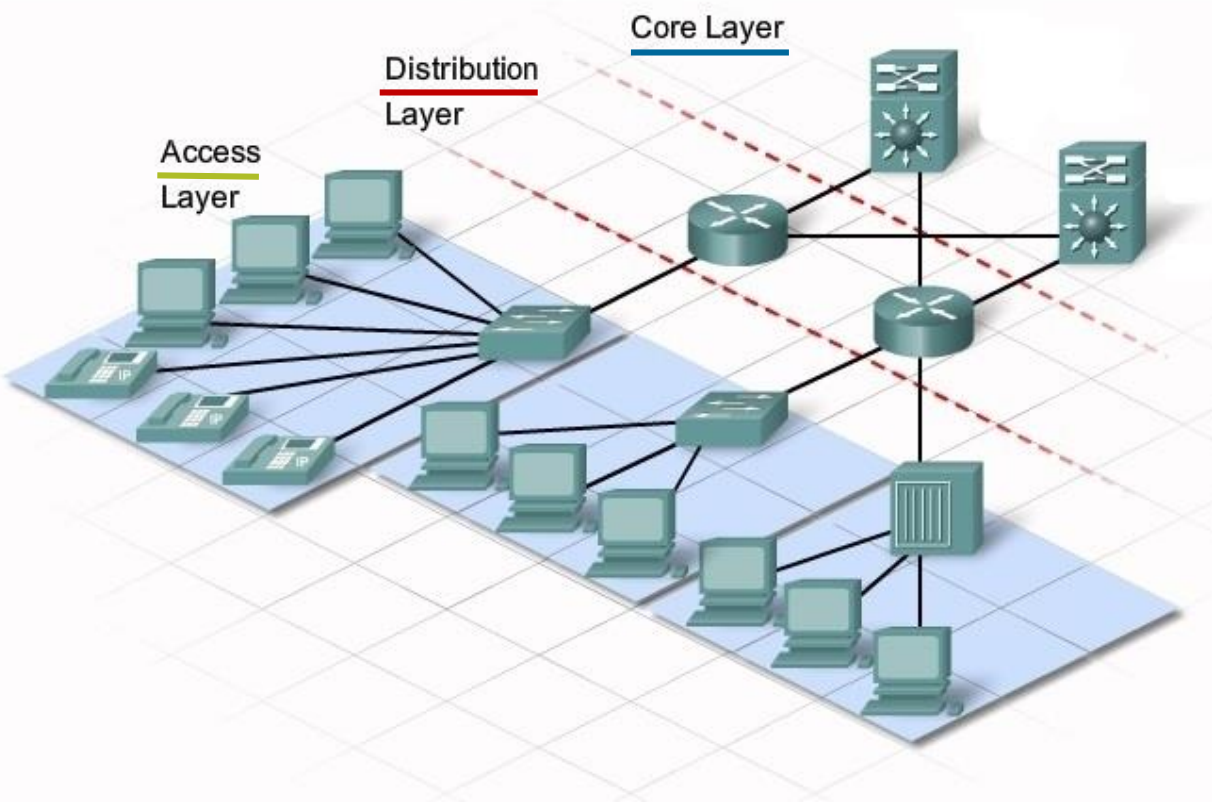
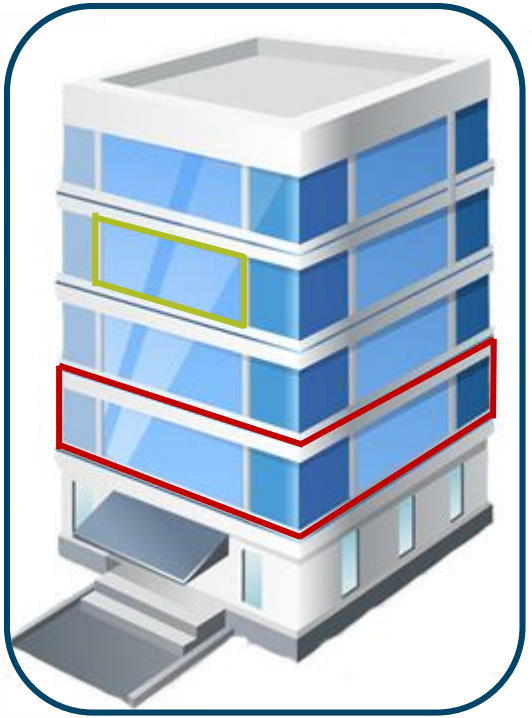
Agenda

- INTRODUCTION
- NIC, REPEATER & HUB
- BRIDGE & SWITCH
- ROUTER, L3 SWITCH
- GATEWAY

Hierarchical internetworking model





ACCESS LAYER DEVICES

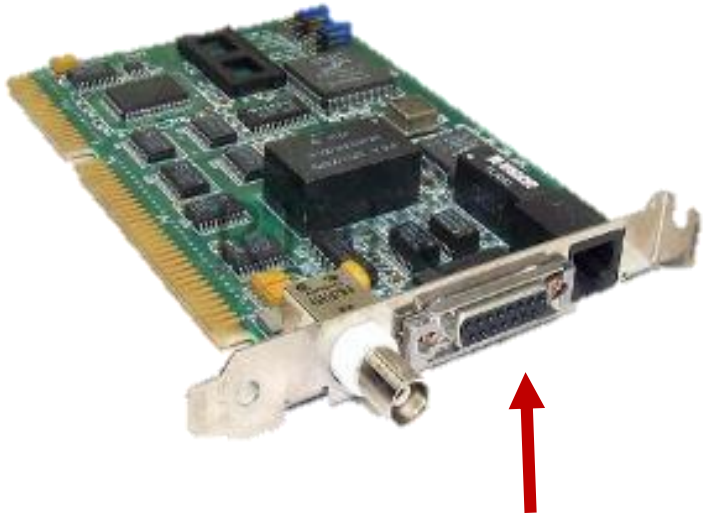
NIC: Network Interface Controller

- The NIC allows computers to communicate over a computer network, either by using cables or wirelessly.

- The NIC works both at physical layer and data link layer

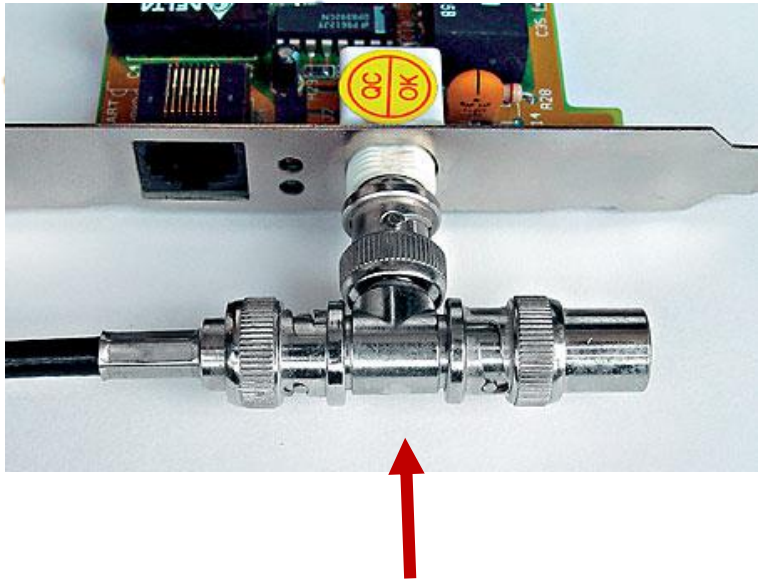
1. External (USB)
2. Internal (PCI)
3. Integrated

Connectors



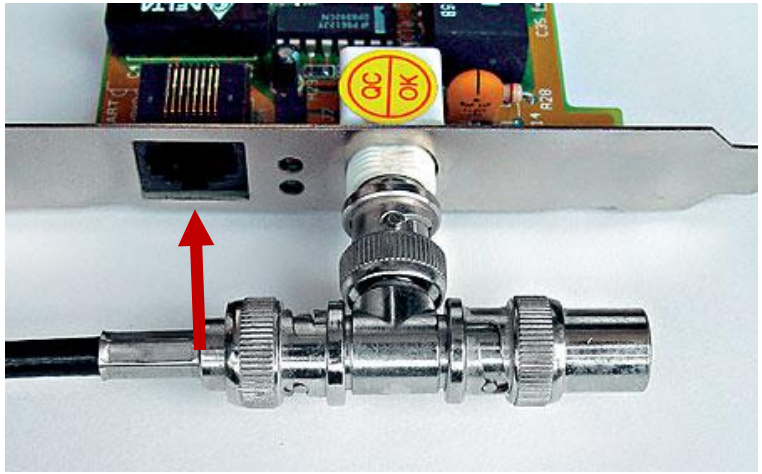
The Attachment Unit Interface (AUI) is a physical and logical interface for 10BASE5 Ethernet.
AUI connectors became rare beginning in the early 1990s when the 10BASE-T standard became more common and use of 10BASE5 declined

Connectors



BNC - a miniature quick connect/disconnect radio frequency connector used for coaxial cable.
It was used for the 10BASE-2 Ethernet standard.

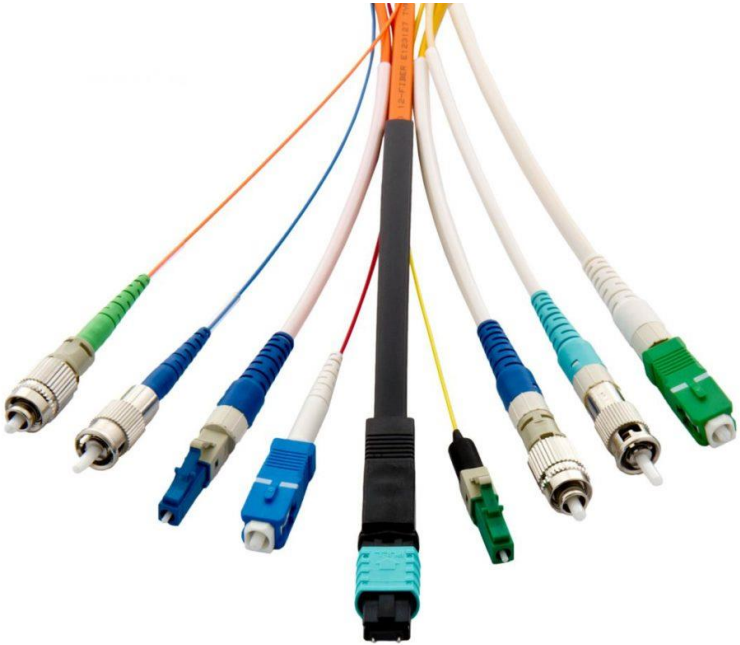
Connectors



The 8 position 8 contact (8P8C) connector is a modular connector commonly used to terminate twisted pair and multi-conductor flat cable.

People call it RJ-45, but ...

Connectors



Fiber-optic cable is used in Ethernet since 1987 and FOIRL standard.

Nowadays it is widely used in backbone networks, due to the maximum distance between network nodes up to 40 km in 100GBase-ER4 type with maximum transfer rate 100Gbit/s.

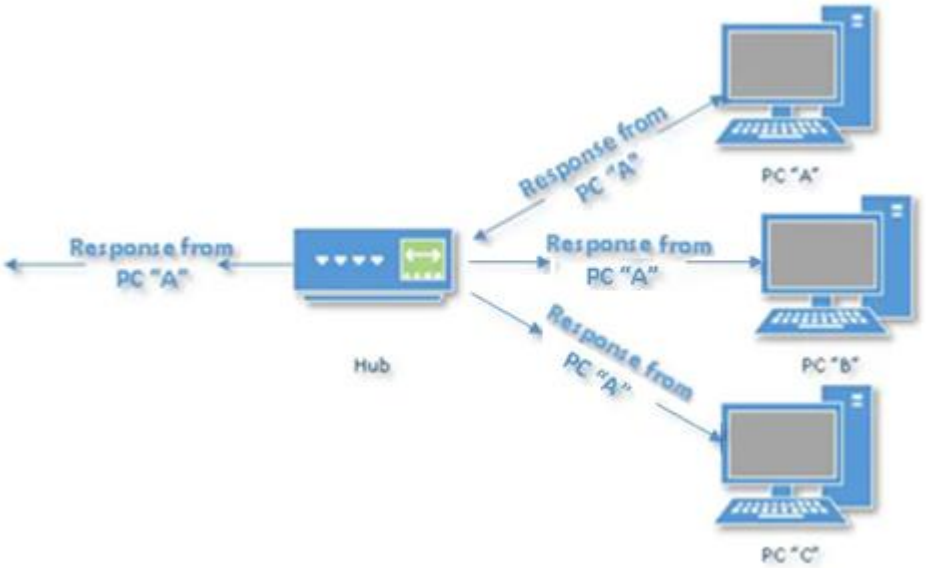
Repeater and Hub

Repeater is an electronic device that receives a signal and retransmits it. Repeaters are used to extend transmissions so that the signal can cover longer distances

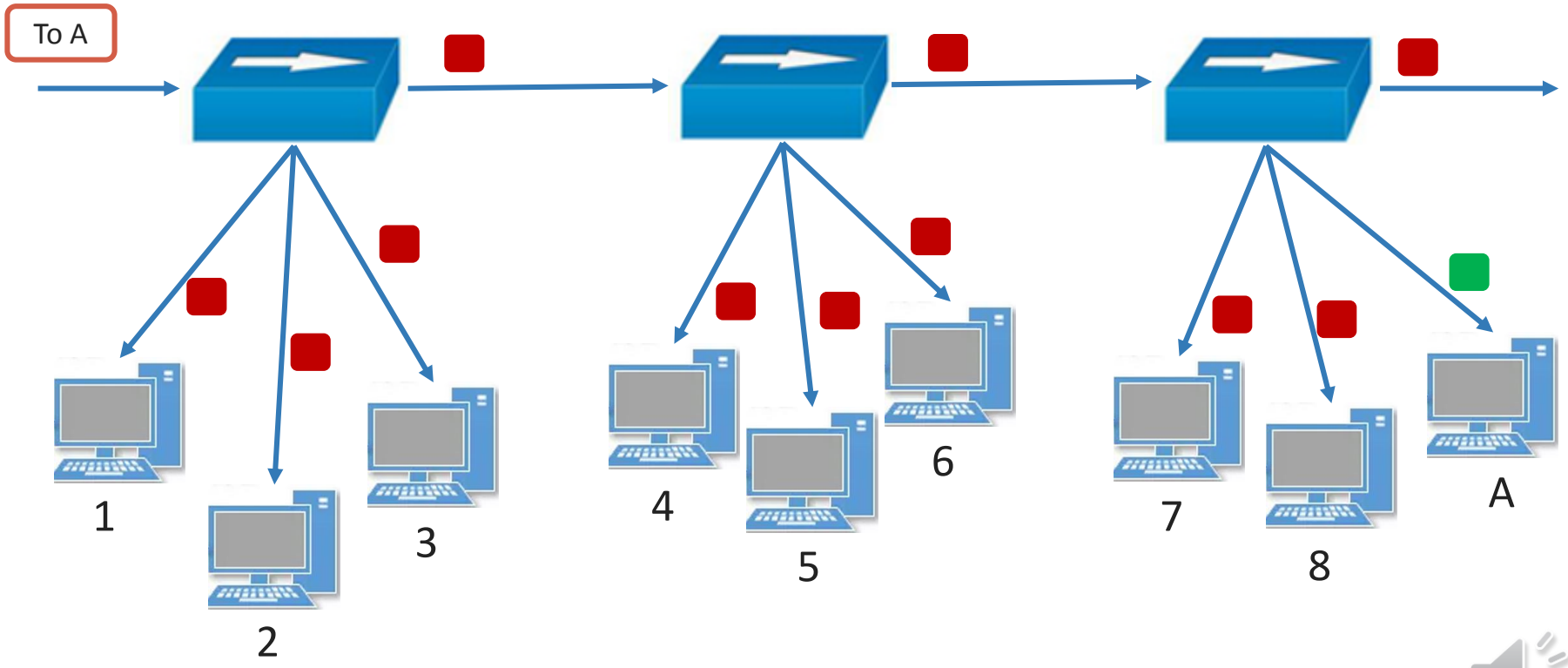
Hub is a network hardware device for connecting multiple Ethernet devices together and making them act as a single network segment. It is a multiport repeater

How it works

- Hub works by **repeating** transmissions received from one of its ports **to all** other ports. It can detect start of physical layer packets, an idle line and sense a collision which it also propagates by sending a jam signal.
- A hub **cannot** further **examine** or **manage** any of the traffic that comes through it.
- A hub has **no memory** to store data and can handle only **one transmission** at a time



What if…



Features

- Simple
- Cheap
- Extends total distance of the network

- Operates in half-duplex mode
- Network inefficiency

Bridge

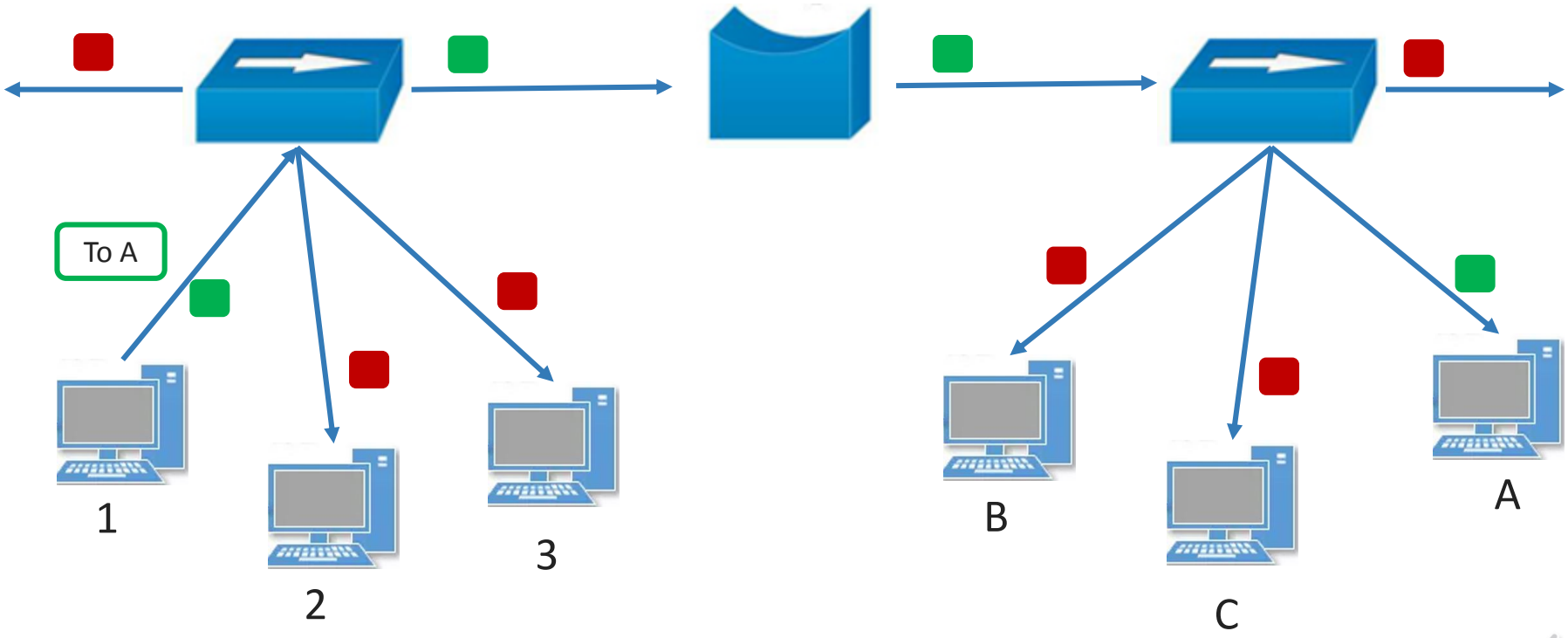
A network bridge is a computer networking device that creates a **single** aggregate **network** from multiple communication networks or network segments. It works in the **data-link** layer of the OSI model.

Transparent bridges - connects networks with **common protocols** of the channel and physical layers of the OSI model

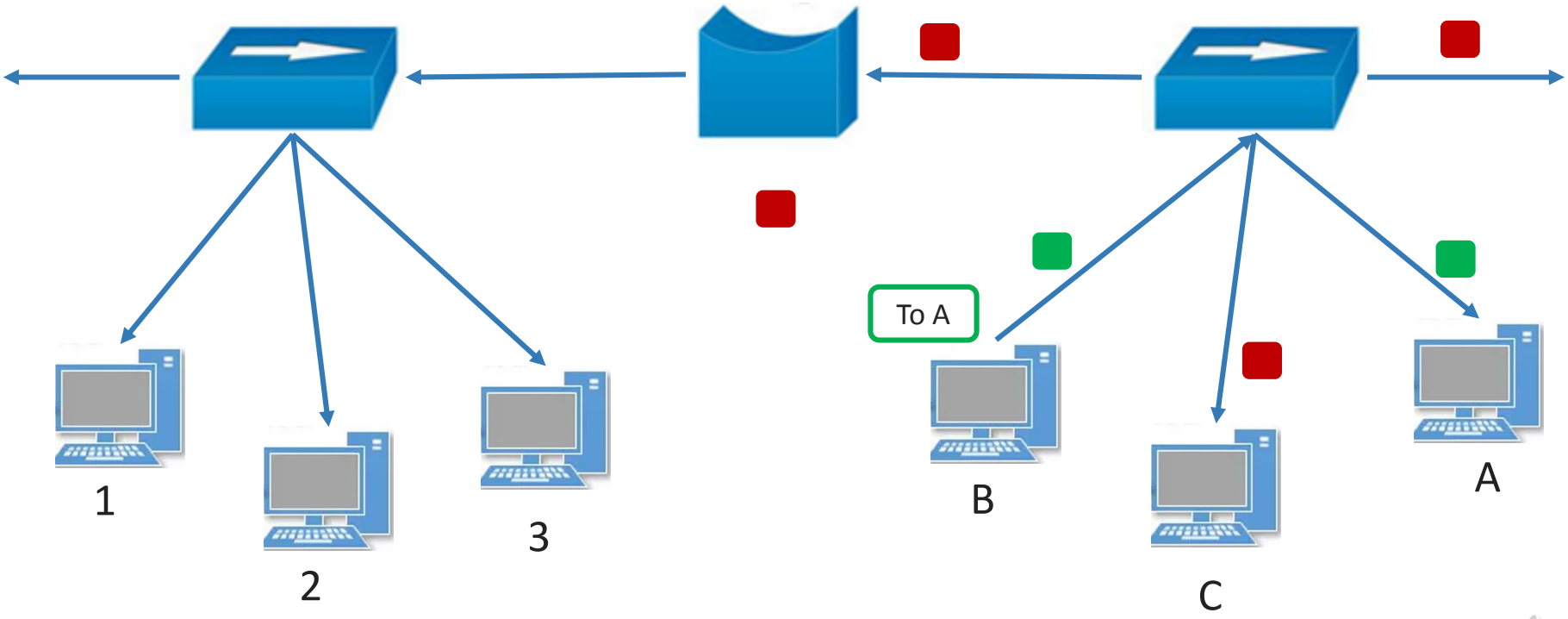
Translating bridges – connects networks with **various** data link and physical layer **protocols**

Encapsulating bridges – connects networks with **common protocols** of the channel and physical layers **through** networks with **other protocols**

How it works



How it works



Features

- collision domain restriction
- delay frames addressed to the node in the sender segment
- restriction of transition from domain to domain of error frames

Bridges increase network latency by 10-30%. This increase in latency is due to the fact that the bridge during data transfer requires additional time to make a decision.

Switch

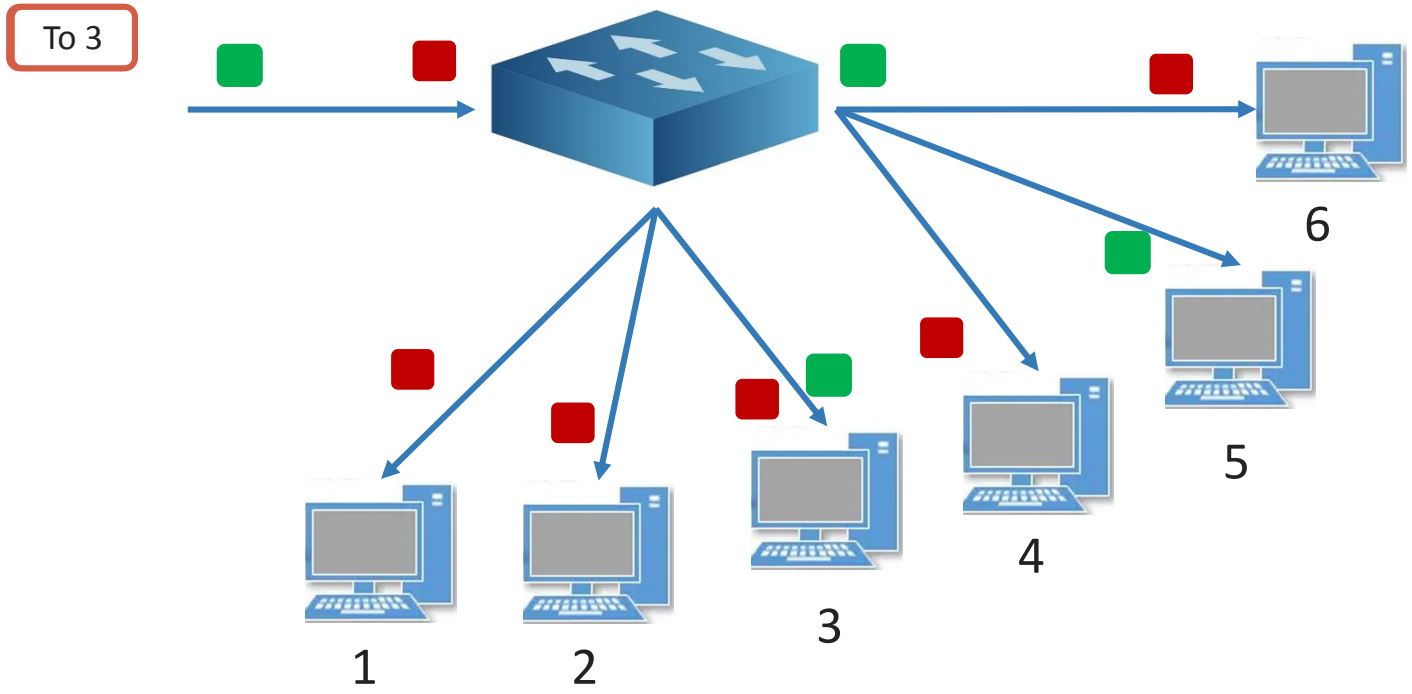
A network switch is a multiport network bridge that **uses MAC addresses** to forward data at the data link layer of the OSI model.

Unlike less advanced repeater hubs, which broadcast the same data out of each of its ports and let the devices decide what data they need, a network switch **forwards data** only to the devices that need to receive it

Three ways of switching

- Store&Forward
- Cut-Through
- Fragment-Free

How it works



Features

- They help in reducing workload on individual host PCs.
- They increase the performance of the network.
- Networks which use switches will have less frame collisions. This is due to the fact that switches create collision domains for each connection.
- Switches can be connected directly to workstations.

- They are more expensive compare to network bridges.
- Network connectivity issues are difficult to be traced through the network switch.
- Broadcast traffic may be troublesome.
- Proper design and configuration is needed in order to handle multicast packets.

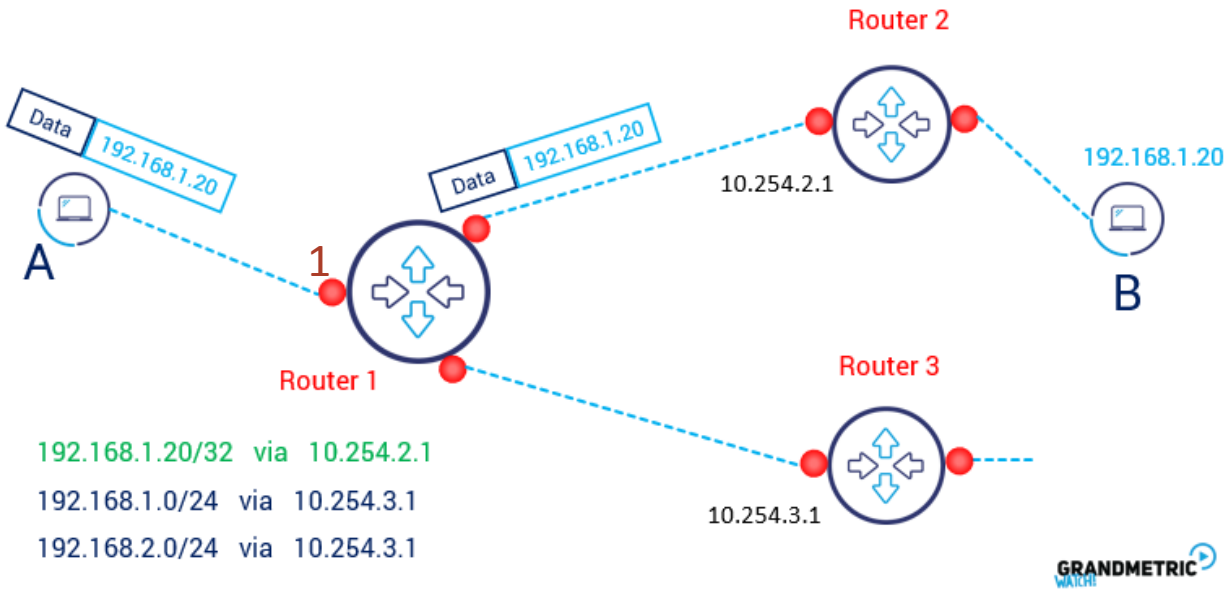
DISTRIBUTION AND CORE LEVEL DEVICES

Router

A router is a networking device that forwards data packets between computer networks.

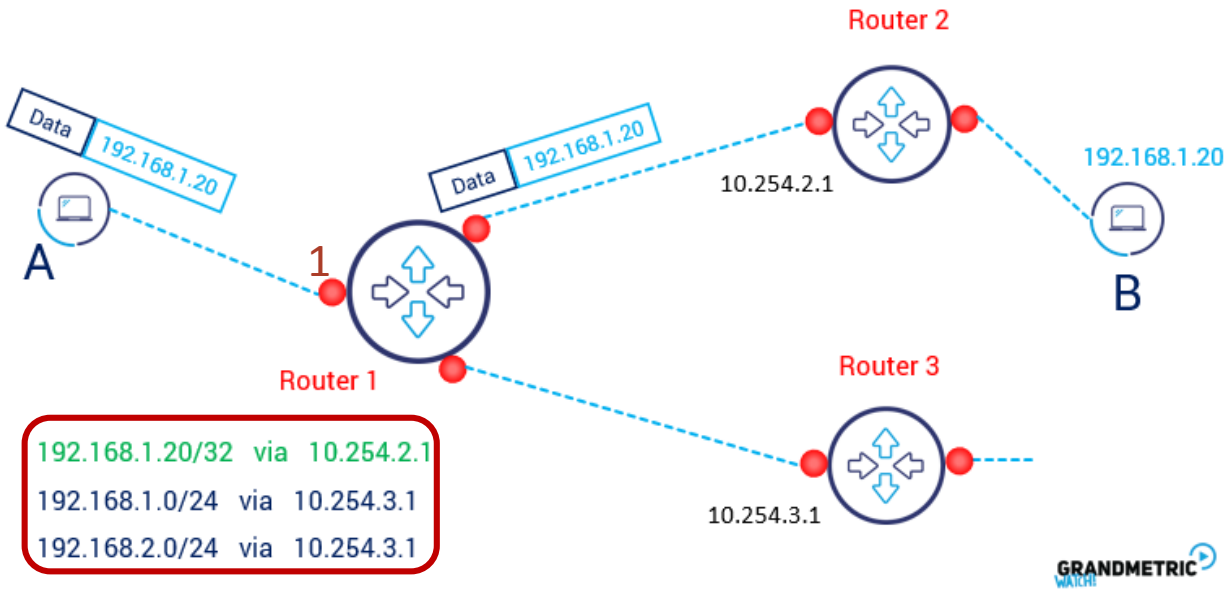
The main purpose of a router is to **connect** multiple networks and **forward** packets destined either for its own networks or other networks. A router is considered a layer-3 device because its primary forwarding decision is based on the information in the layer-3 IP packet, specifically the destination IP address

How it works



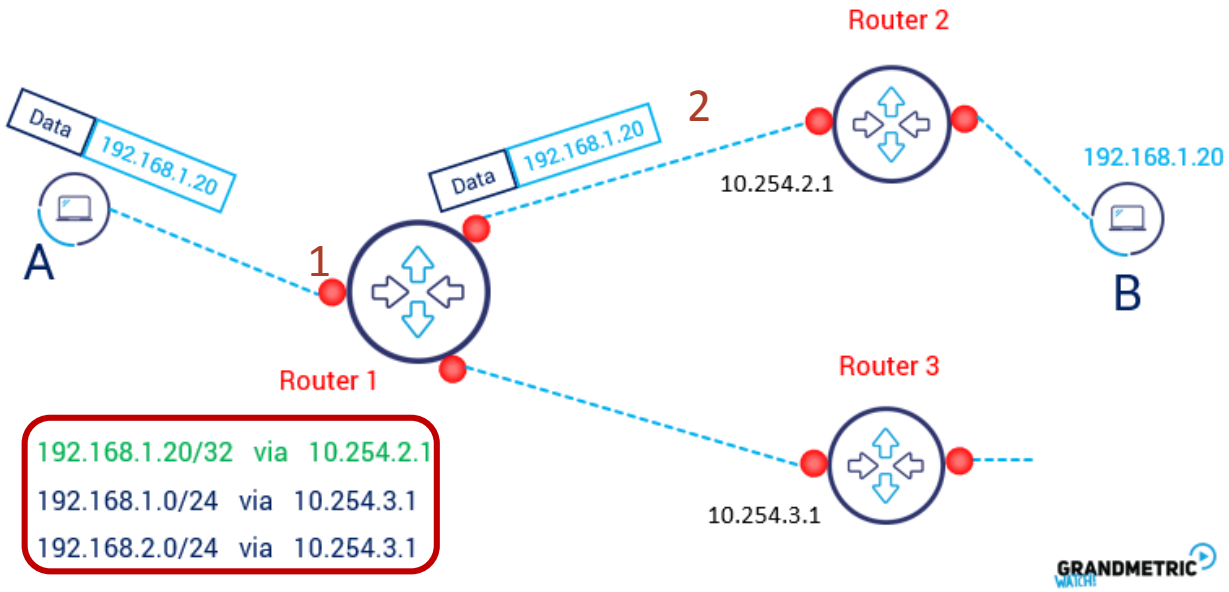
1. When a **packet is coming on interface** (ingress), the router needs to know which interface it has to use to send out the packet (egress).

How it works



Router checks this against the **routing table** which has entries related to each known **destination.** Each routing entry stores **destination address** and address of next device on the path called **next hop** device

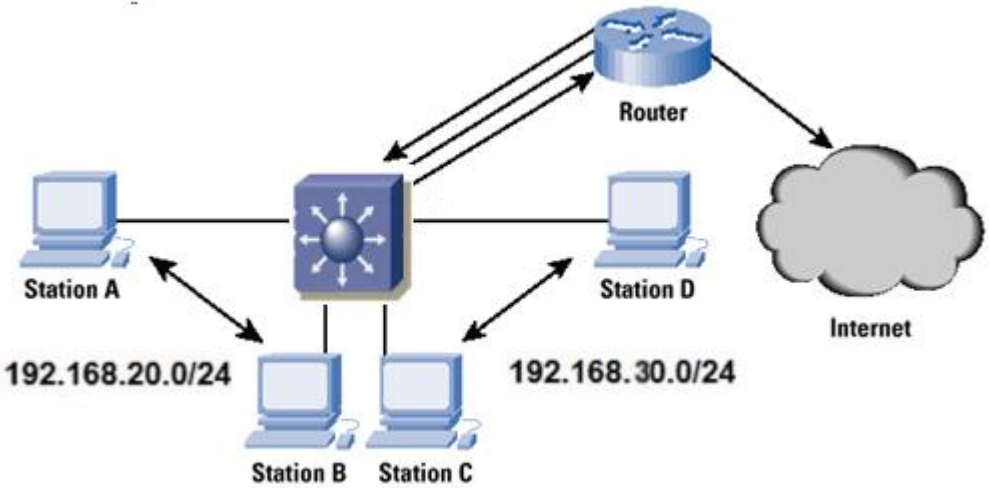
How it works



2. Now, having next hop address, router can determine the outgoing interface (egress) and send the packet.
The same thing happens on the Router 2 and the data reachs the destination address

L3 switch

Layer 3 switch combines the functionality of a switch and a router. It acts as a switch to connect devices that are on the same subnet or virtual LAN at lightning speeds and has IP routing intelligence built into it to double up as a router. It can support routing protocols, inspect incoming packets, and can even make routing decisions based on the source and destination addresses.



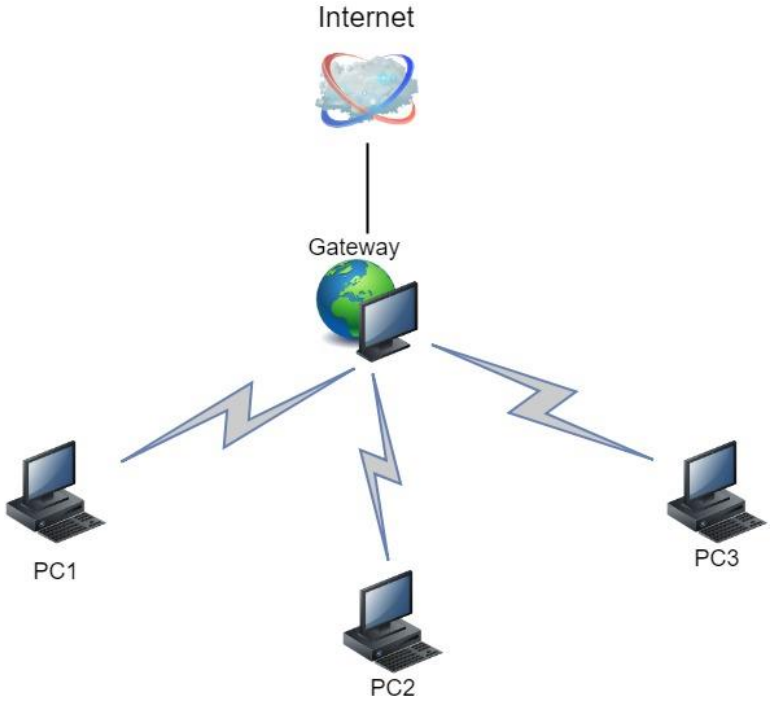
Features

- Support routing between virtual LANs
- Improve fault isolation
- Security management
- Separate routing tables, and as a result, segregate traffic better
- Support flow accounting and high-speed scalability
- Lower network latency as a packet doesn’t have to make extra hops to go through a router

- Cost
- Complex configuring and administering
- Slower than L2 switches
- Mostly applicable only for large intranet environments with many device subnets and traffic

Gateway

- Gateway is a hardware router or software for interfacing computer networks using different protocols (for example, local and global).
- Gateways are distinct from routers or switches in that they communicate using more than one protocol to connect a bunch of networks and can operate at any of the seven layers of the OSI model.
- Usually firewalls - traffic filtering software - installed on gateways to provide network security.



Modem

A modem (modulator-demodulator) – is a hardware device that converts data into a format suitable for a transmission medium so that it can be transmitted from one computer to another (historically along telephone wires). Modems can be used with almost any means of transmitting analog signals from light-emitting diodes to radio. A common type of modem is one that turns the digital data of a computer into modulated electrical signal for transmission over telephone lines and demodulated by another modem at the receiver side to recover the digital data.

THANK YOU