

NETWORK DEVICES

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Modulation

Modulation is the process of conversion of binary signal/digital signal to analog signal

Three types of modulation techniques

- 1.AM (Amplitude Modulation)
- 2.FM (Frequency Modulation)
- 3.PM (Phase Modulation)

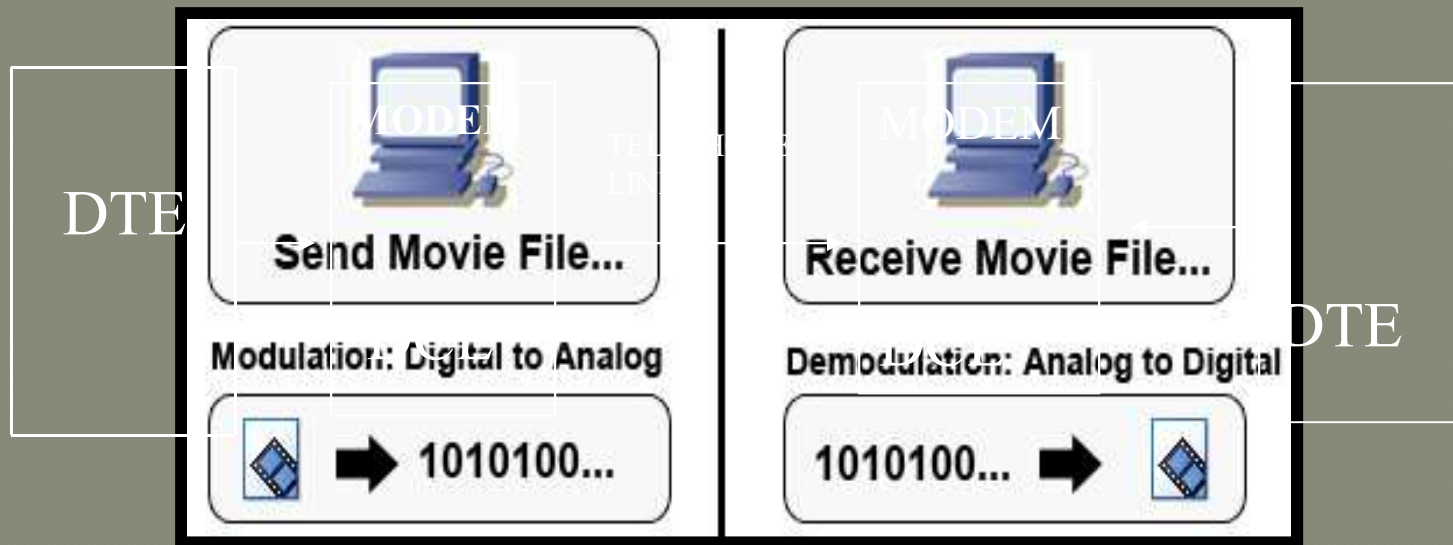
Modem

- A modem is a computer peripheral that allows us to connect and communicate with other computers



In other words, Modem (**M**odulator-**D**emodulator) is a communication device that converts binary signal into analog signals (Modulation) for transmission over the telephone lines and converts these analog signals back into binary form (Demodulation) at the receiving end.

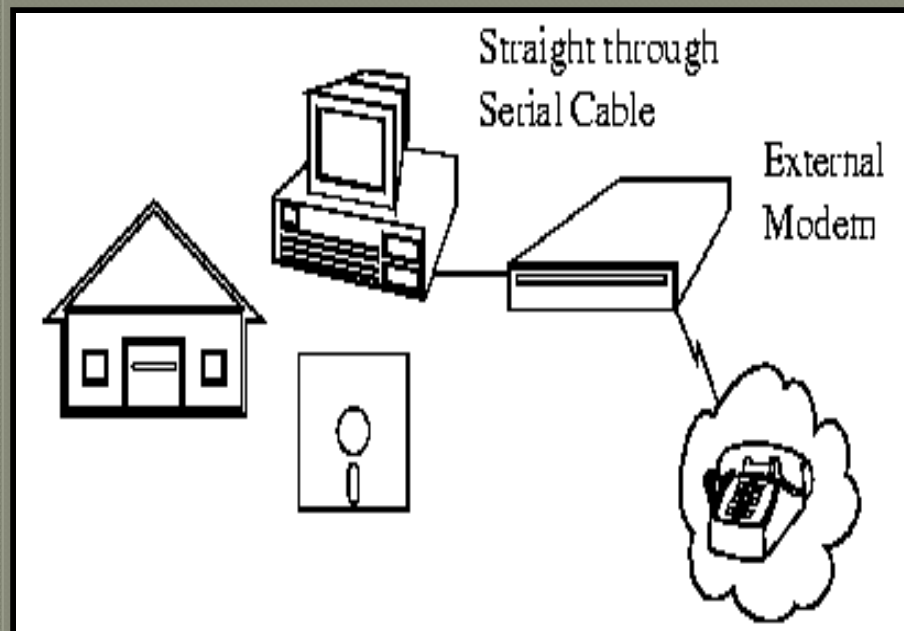
WORKING OF MODEM



TWO BASIC PHYSICAL TYPES OF MODEM:

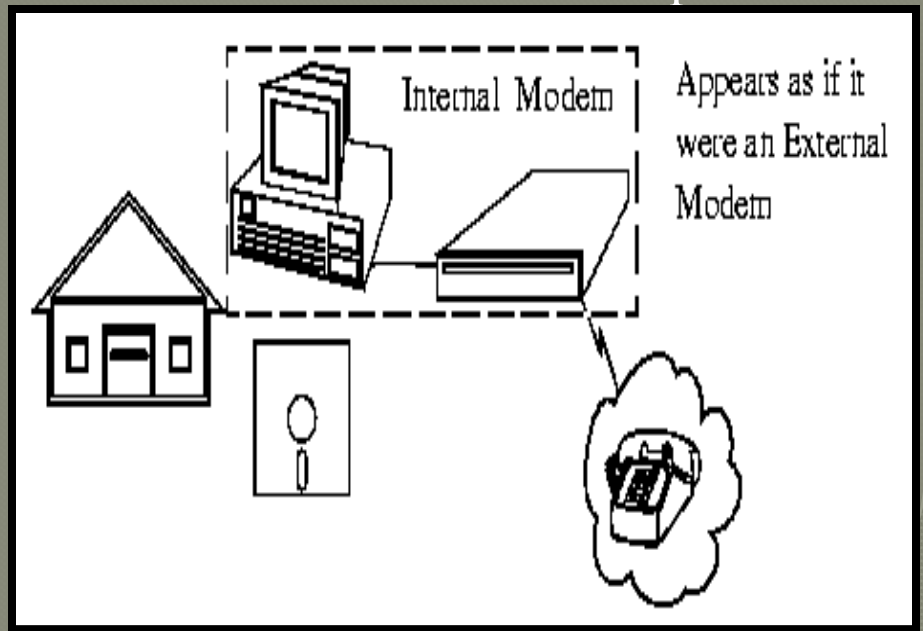
1. INTERNAL MODEM:

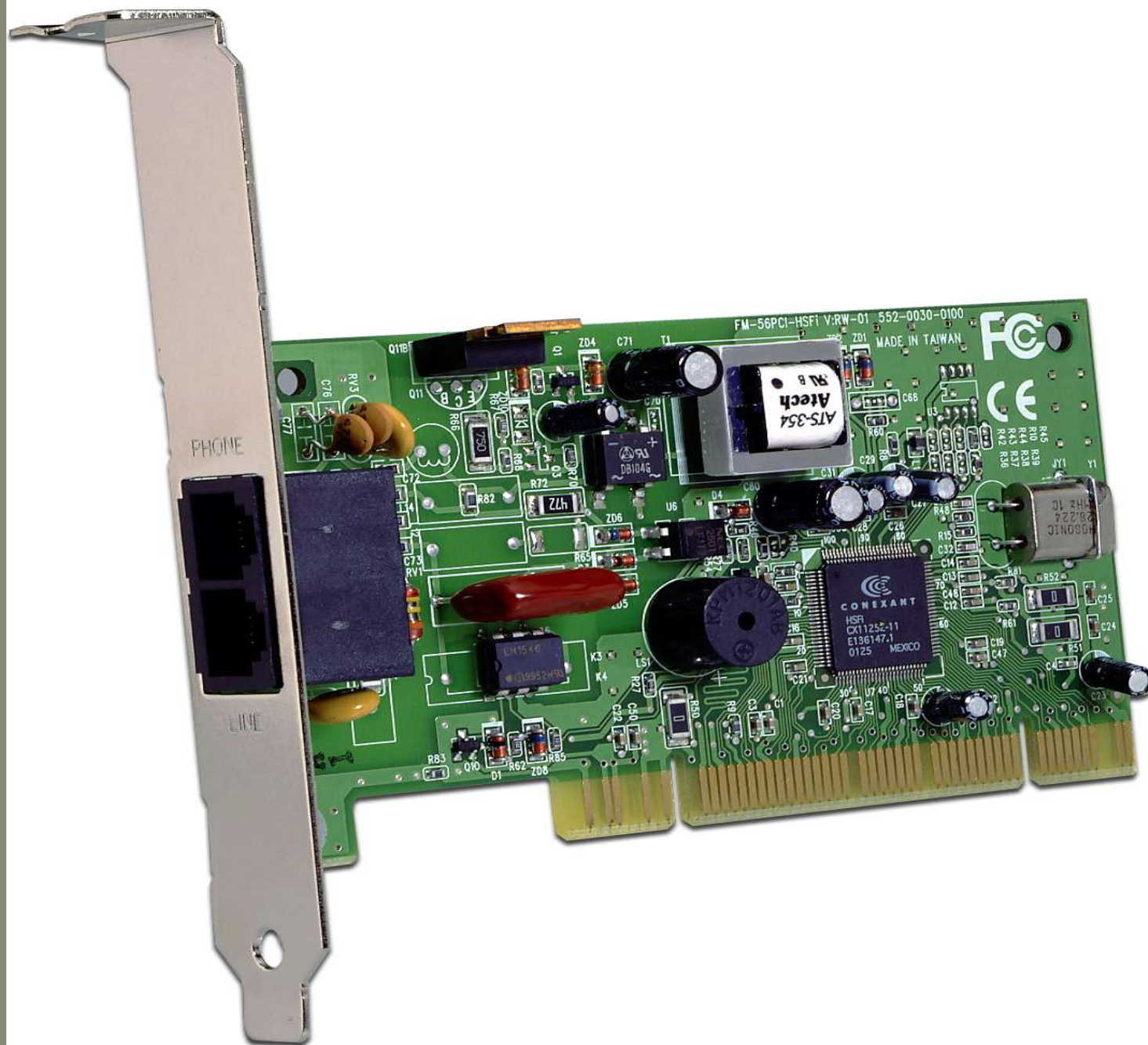
Modems that are fixed within the computers. The advantage of an internal modem is the lack of extra



2. EXTERNAL MODEM:

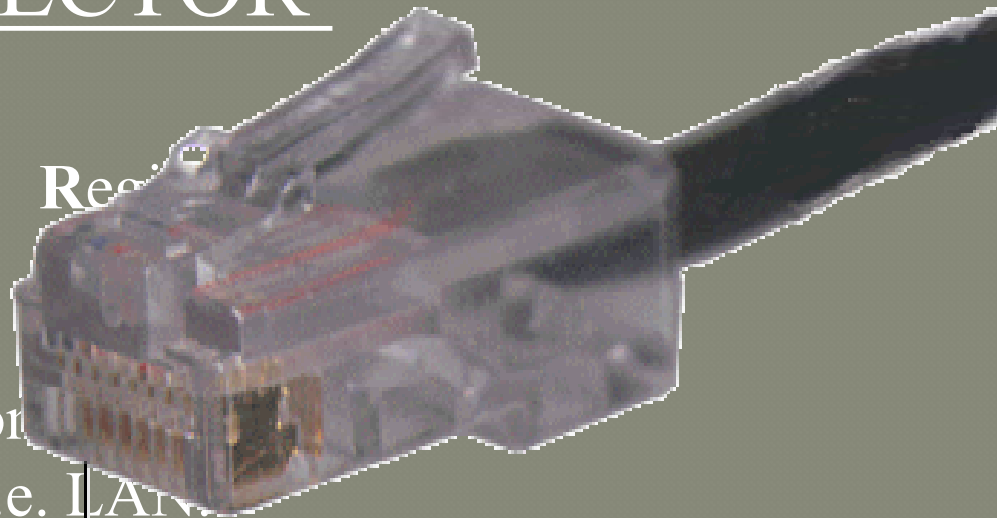
Modems connected externally to the computer. External modems require a power source and extra wires to connect to the computer.





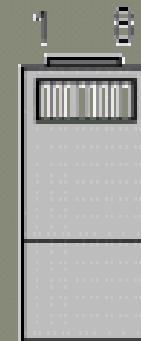
RJ-45 CONNECTOR

RJ-45 stands for Registered Jack- 45. It is an connector which is used to connect computer local area networks i.e. LAN. RJ-45 Connector is much wider than RJ-11 as it houses 8 wires instead of four

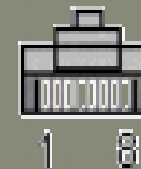


Pin 1

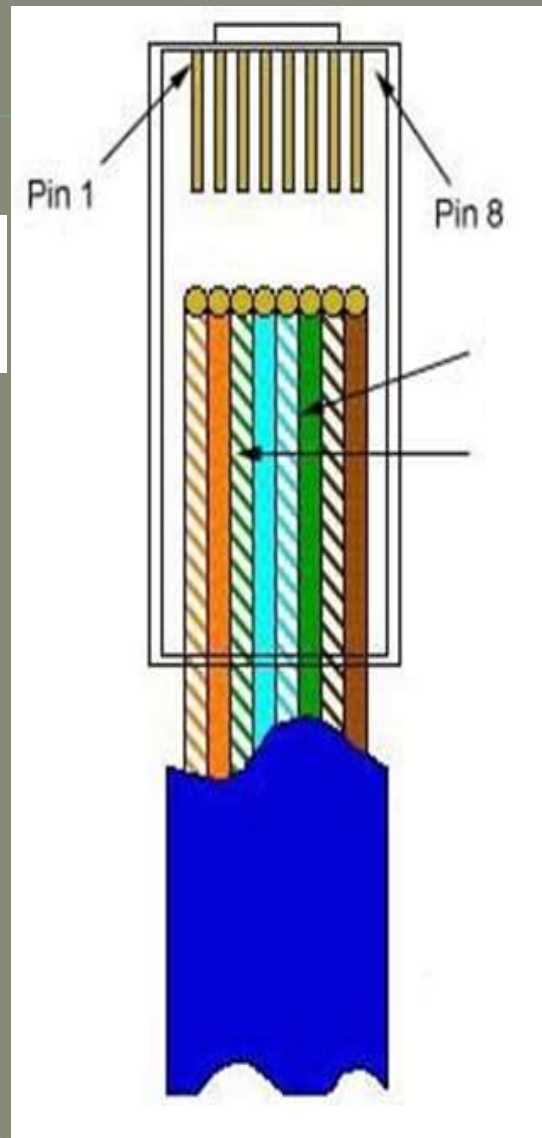
TOP:



FRONT:



Pins 1 & 2 are the Transmit Pins
Pins 3 & 6 are the Receive Pins
Pins 4, 5, 7, and 8 are not used



Notice that the Green pair has to be separated before crimping on the RJ45 plug. If this is not done, the Recieve Data will be split between 2 pairs and performance will degrade!

ETHERNET :

Ethernet is the dominant cabling and low level data delivery technology used in Local Area Networks (LAN's).

It was developed by Xerox corp. along with DEC and Intel.

Features:

1. Ethernet transmits data up to ten million bits per second.
2. Ethernet supports networks built with twisted pair, thin and thick coaxial and fiber optic cabling.
3. Each device on an Ethernet network operates independently and equally, precluding the need for a central controlling device.
4. Ethernet supports a wide array of data types, including TCP/IP, ,apple talk, and IPX.
5. To prevent the loss of data, when two or more devices attempt to send packets at the same time, Ethernet detects collisions.

ETHERNET CARD

(NETWORK INTERFACE CARD)

A network interface card is a piece of computer hardware designed to allow computers to communicate over a computer network.

The computers that are part of Ethernet have to install a special card called Ethernet Card.

An Ethernet supports three types of connections:

1. RJ-45 connection, if it is designed for twisted pair
2. BNC Connector, if it is designed for coaxial cable
3. AUI connector

HUB

A Hub is a hardware device used to connect several computers together. A hub contains multiple ports.

Hubs forward any data

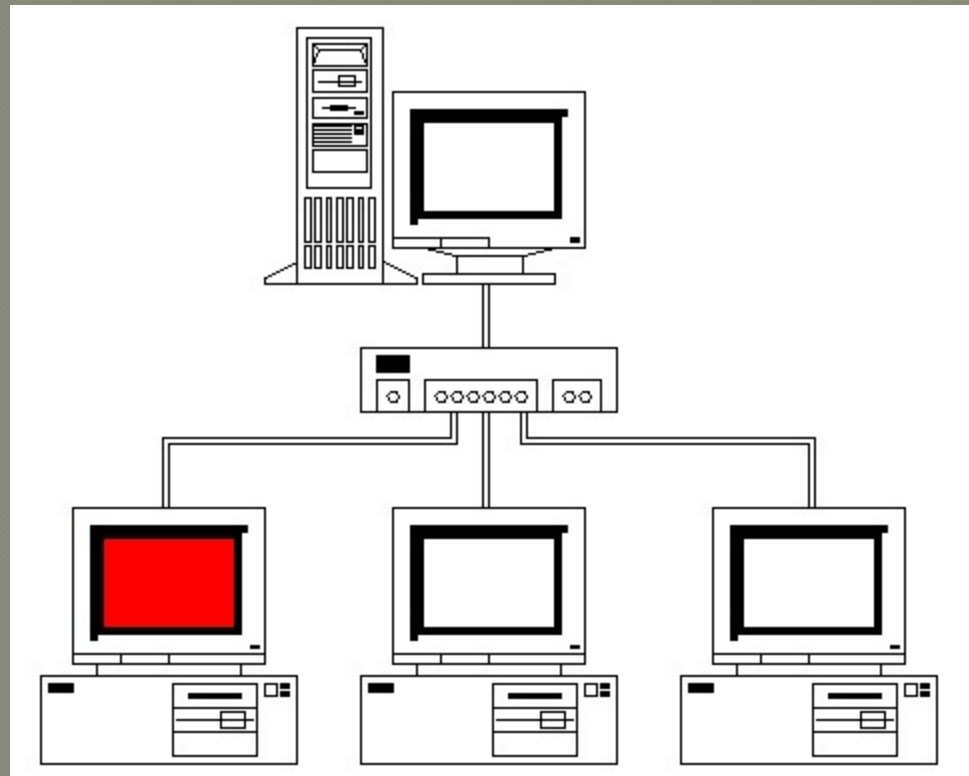
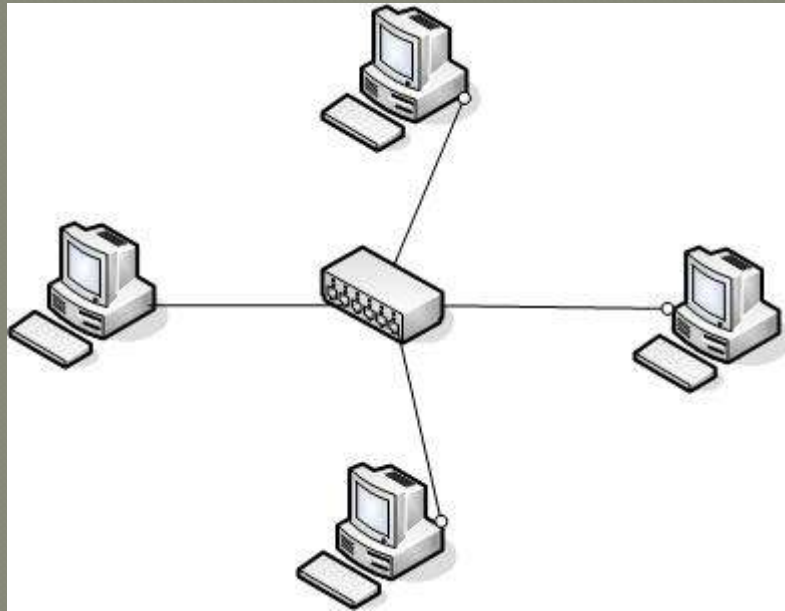
Hubs are either Passive or Active.

ACTIVE HUBS:

Electrically amplifies the signal as it moves from one connected device to the other.

PASSIVE HUBS:

Allows the signal to pass from one computer to another without any change.





Networking Devices

∩ **Repeaters**

∩ **Hubs**

∩ **Collisions**

∩ **Bridges**

∩ **Routers**

SWITCH



- ⌚ **A switch is a device that is used to segment networks into subnetworks called subnets.**
- ⌚ **Allow different nodes of a network to communicate directly with each other.**
- ⌚ **Allow several users to send information over a network at the same time without slowing each other down.**
- ⌚ **Responsible for filtering-transforms data in a specific way and for forwarding packets between LAN segments.**



REPEATER:

What internetworking devices operate at the physical layer (layer 1) of the OSI model?

- ∞ When signals first leave a transmitting station, they are clean and easily recognizable. However, the longer the cable length, the weaker and more deteriorated the signals become as they pass along the networking media.**
- ∞ Repeaters can be installed along the way to ensure that data packets reach destination**



What is the disadvantage associated with using a repeater?

- ∞ it can't filter network traffic. Data, sometimes referred to as bits, arriving at one port of a repeater gets sent out on all other ports**
- ∞ data gets passed along by a repeater to all other LAN segments of a network regardless of whether it needs to go there or not.**



What internetworking device can be used to filter traffic on the network?

- ∞ One way to solve the problems of too much traffic on a network and too many collisions is to use an internetworking device called a bridge.**
- ∞ A bridge eliminates unnecessary traffic and minimizes the chances of collisions occurring on a network by dividing it into segments**

Bridge

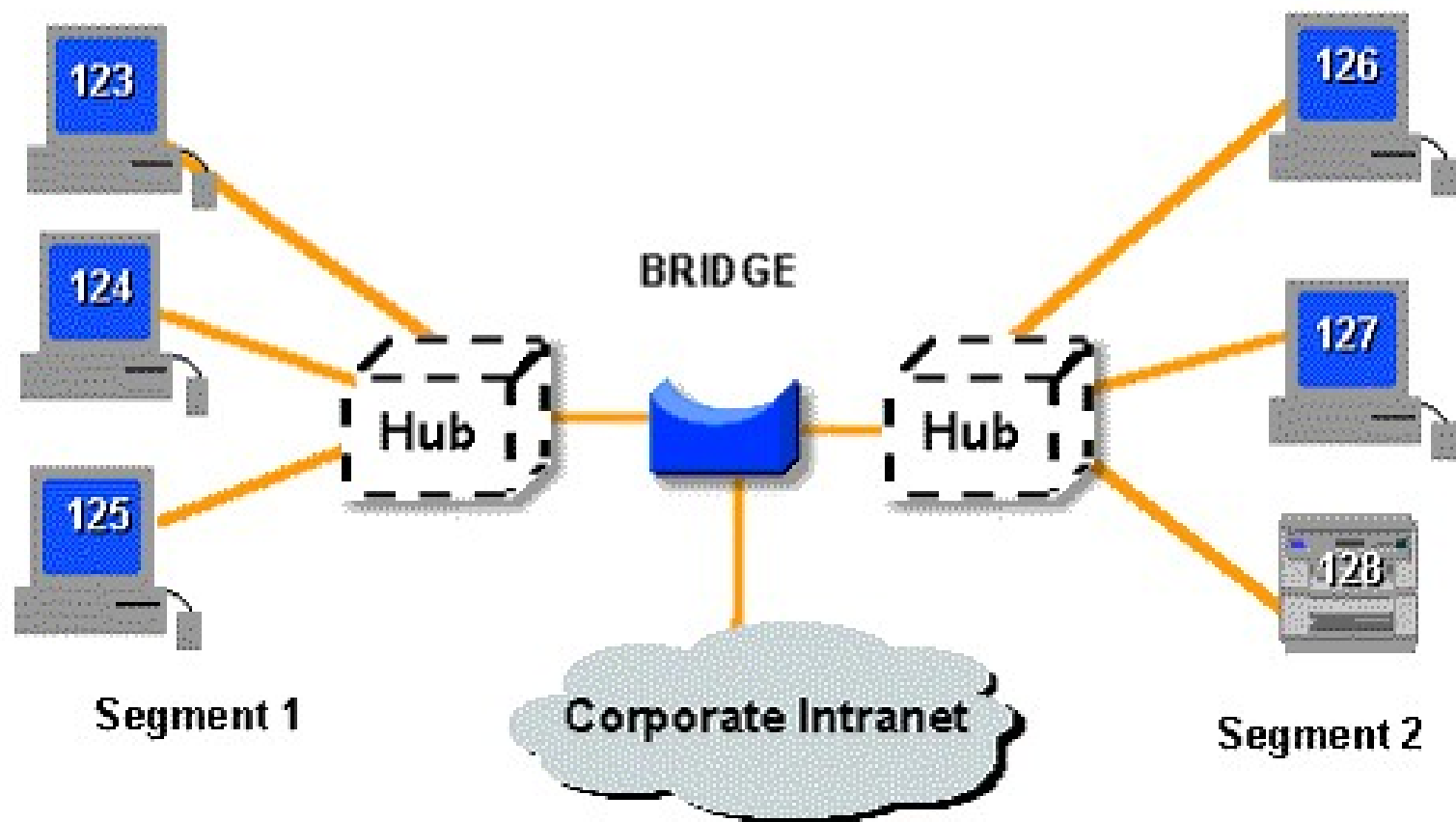


Device that connects and passes packets between two network segments;

More intelligent than hub—analyze incoming packets and forwards (or drops) based on addressing information.



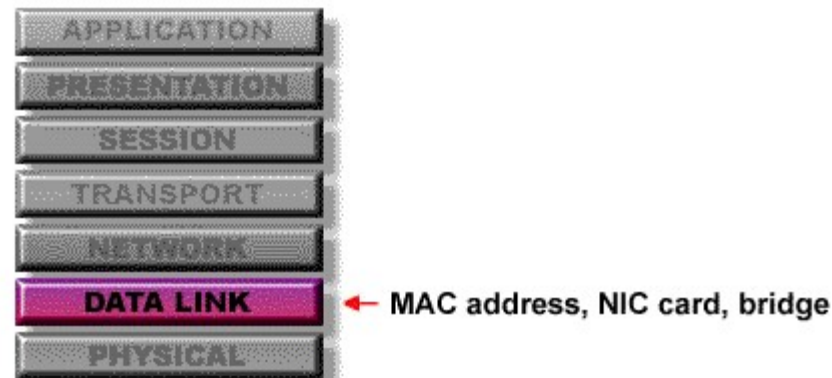
Bridge Example



Next

At what layer of the OSI model do bridges operate?

- Because bridges operate at the data link layer, layer 2, they are not required to examine upper-layer information.





How are bridge data-forwarding decisions limited?

- ⌚ Although bridges use tables to determine whether or not to forward data to other segments of the network, the types of comparisons and decisions they make are relatively low level, simple ones



What types of network traffic problems is a bridge incapable of solving?

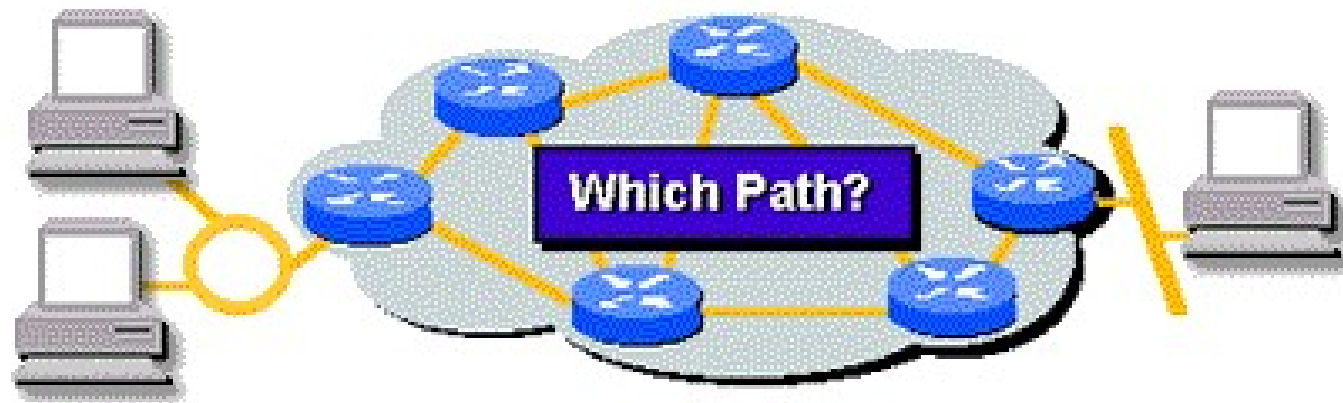
- ∞ Bridges work best where traffic from one segment of a network to other segments is not too great.**
- ∞ However, when traffic between network segments becomes too heavy, the bridge can become a bottleneck and actually slow down communication.**

What are routers?



- ⌚ **Routers are another type of internetworking device.**
- ⌚ **These devices pass data packets between networks based on network protocol or layer 3 information.**
- ⌚ **Routers have the ability to make intelligent decisions as to the best path for delivery of data on the network.**

Network Layer: Path Determination



- Layer 3 functions to find the best path through the internetwork





What network problems can routers help resolve?

- ∞ The problem of excessive broadcast traffic can be solved by using a router.**
- ∞ Routers are able to do this, because they do not forward broadcast frames unless specifically told to do so**



How do routers differ from bridges?

- ⌚ **Routers differ from bridges in several respects. First, bridging occurs at the data link layer or layer 2, while routing occurs at the network layer or layer 3 of the OSI model.**
- ⌚ **Second, bridges use physical or MAC addresses to make data forwarding decisions. Routers use a different addressing scheme that occurs at layer three**



How do routers work?

⌚ **Routers are used to connect two or more networks. For routing to be successful, each network must have a unique network number**

GATEWAY

- Device that connects dissimilar networks.
- Operates at the highest level of abstraction.
- Expands the functionality of routers by performing data translation and protocol conversion.
- Needed to convert Ethernet traffic from LAN to San(Systems Network Architecture)traffic legacy system.
- Then routes the SNA traffic to the mainframe.
- When Mainframe answers, Reverse process occurs.
- Establishes an intelligent connection between a local network and external networks with completely different structures.

Types OF Network

**There are 3 types
of Network:**

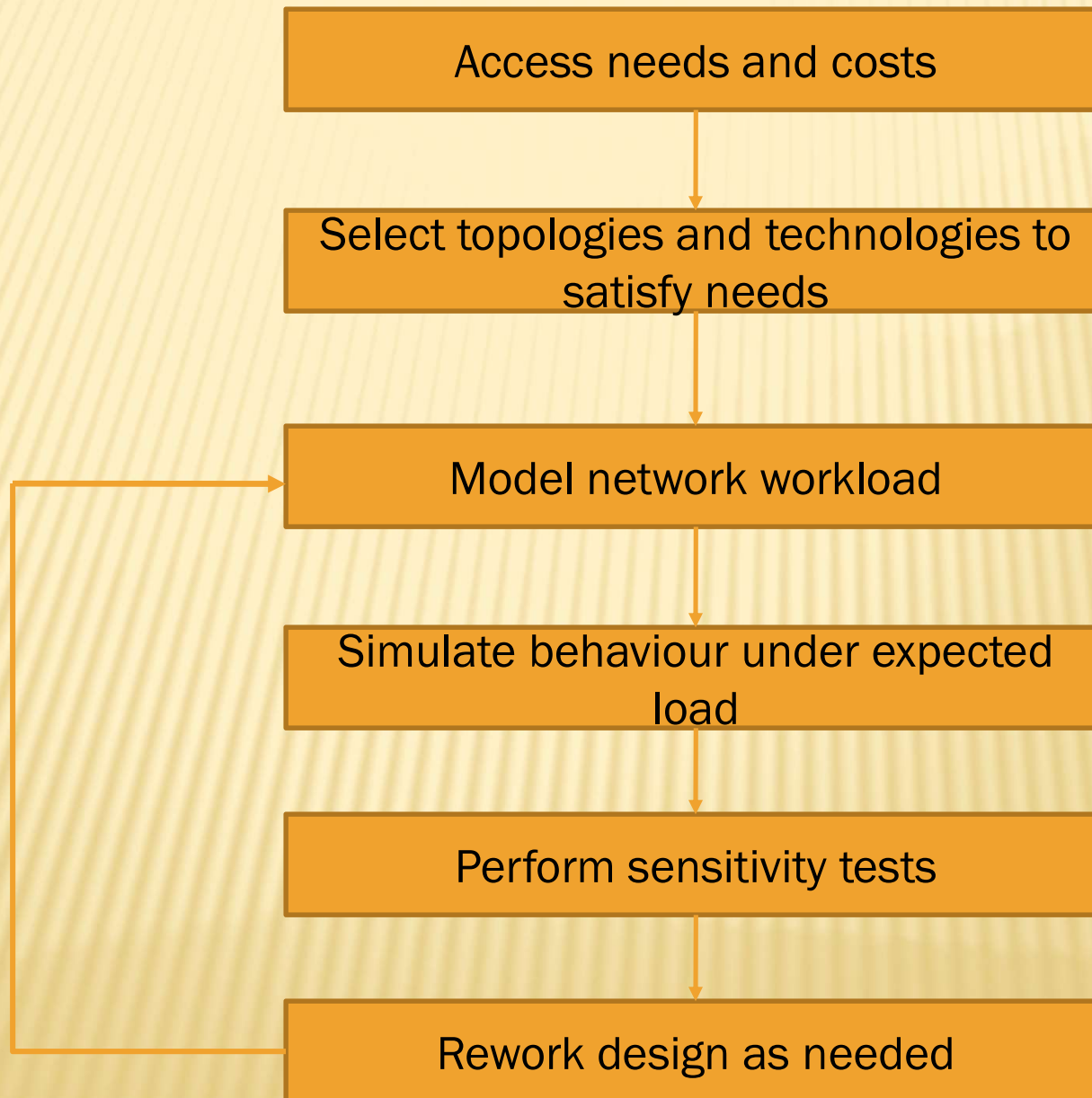
- ➡ **Local Area Networks(LANs)**
- ➡ **Metropolitan Area Networks(MANs)**
- ➡ **Wide Area Networks(WANs)**

General Network Design Process

In general ,the network design problems consists of the following 3 general elements:

- ➡ **Environmental given:** Includes the locations of hosts, servers, terminals and other nodes
- ➡ **Performance constraints:** Consists of network reliability, traffic throughput and host/client computer speeds
- ➡ **Internetworking variables:** Includes the network topology, line capacities, and packet flow assignments

General Network Design Process



Good Network Design Process

The 80-20 Rule

In a properly designed small to medium sized network environment, 80% of the traffic on a given network segment is local and not more than 20 % of the network traffic should need to move across a backbone.

LAN Hardware

The section covers the following hardware technologies as they can be applied to LAN design:

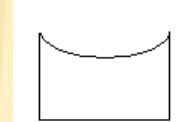
➡ **Repeaters**



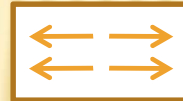
➡ **Hubs**



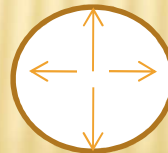
➡ **Bridges**



➡ **Switches**



➡ **Routers**

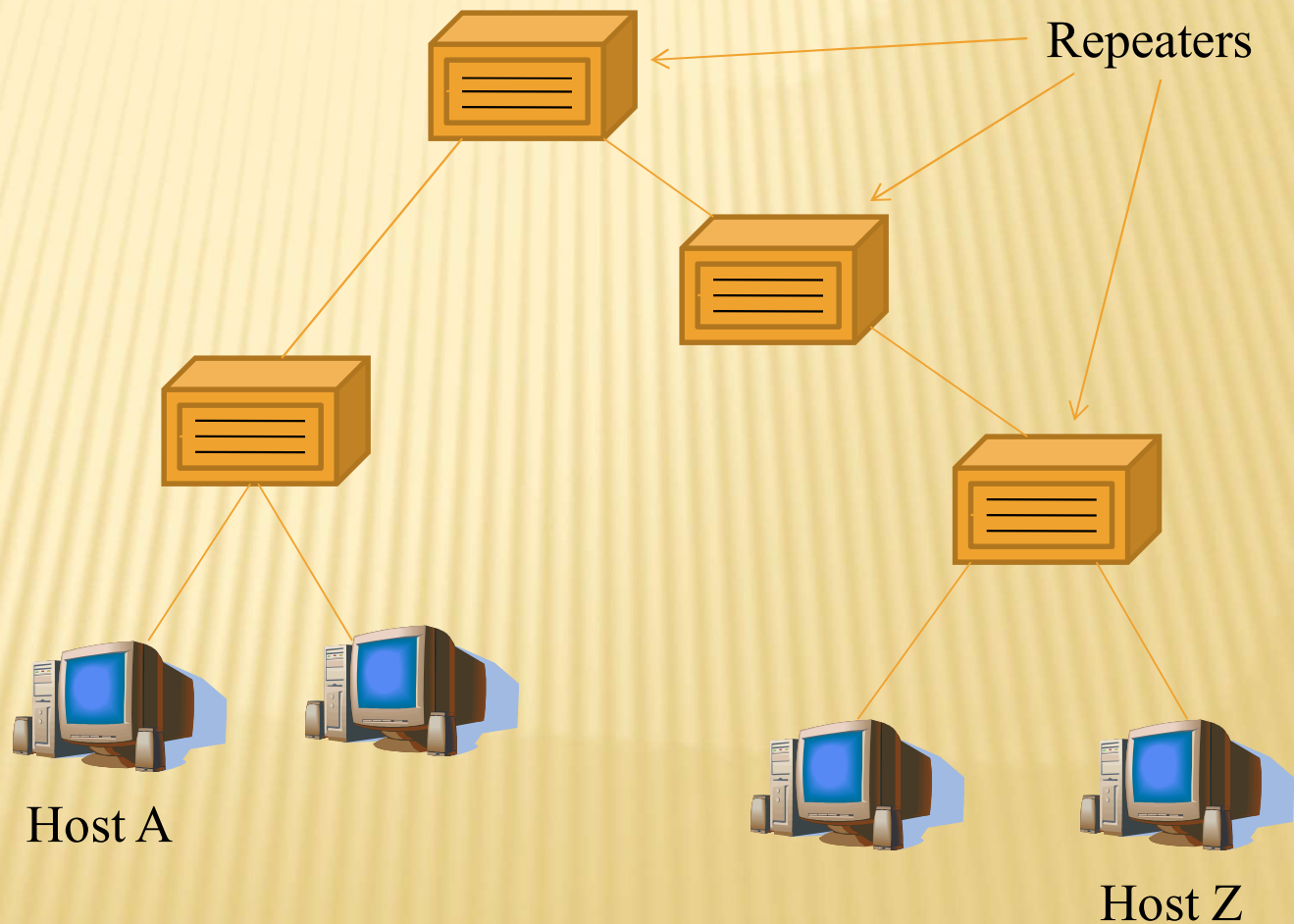


➡ **Combining hubs , switches, and routers**

Repeaters

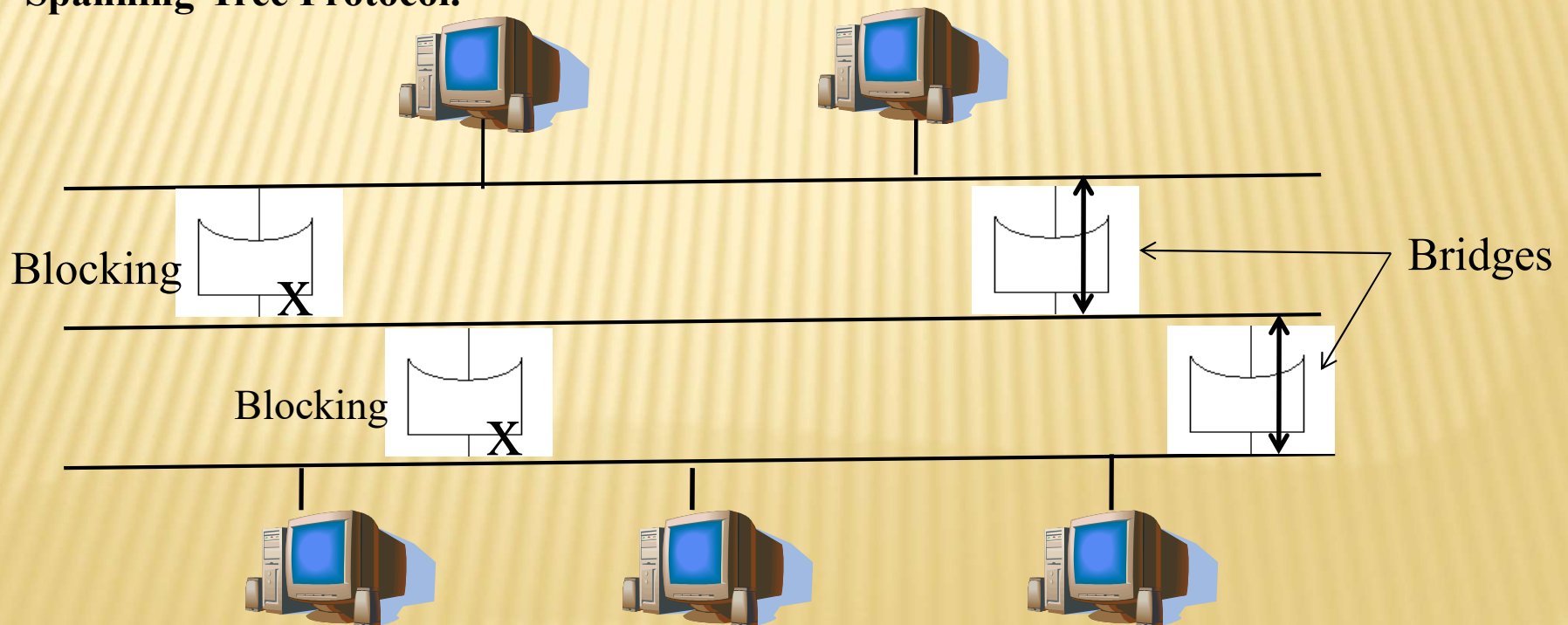
5-4-3 Rule

The maximum path between 2 stations on the network should not be more than 5 segments with 4 repeaters between those segments and no more than 3 populated segments.



Bridges

Bridges are used to connect separate segments of a network. Bridges implement the Spanning-Tree Protocol to build a loop free network topology. This means that on a network ,one or more bridges may be blocked if they are forming a loop . Bridges communicate with each other, exchanging information such as priority and bridge interface MAC address. They select a root bridge and then implement the Spanning-Tree Protocol.



Problem With Hubs

Hubs share Bandwidth among all attached devices. Hubs cannot filter traffic. They broadcast data to all devices

Solution

The solution is to use a smarter bridge called BRIDGE. Bridges can filter network traffic based on MAC.

Problem with a Switch

A switch cannot stop traffic (data packets) destined for a different LAN segment from travelling to all other LAN segments.

Solution

*The solution is to use a **ROUTER**. The Routers filter network traffic based on IP address. The IP address tells the Router which LAN segment the network traffic belongs to.*