جامعة الأهرام الكندية
AHRAM CANADIAN UNIVERSITY

Lecture (01)
Understanding Computer Networks

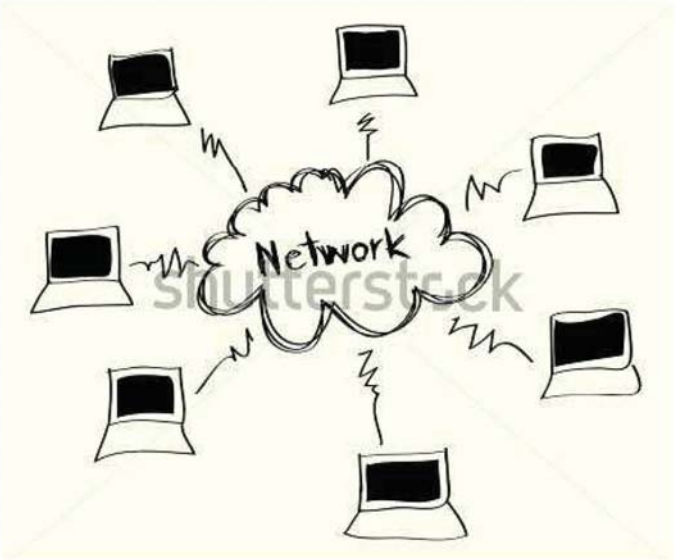
Dr. Ahmed M. ElShafee

Agenda

- -
- -

preface

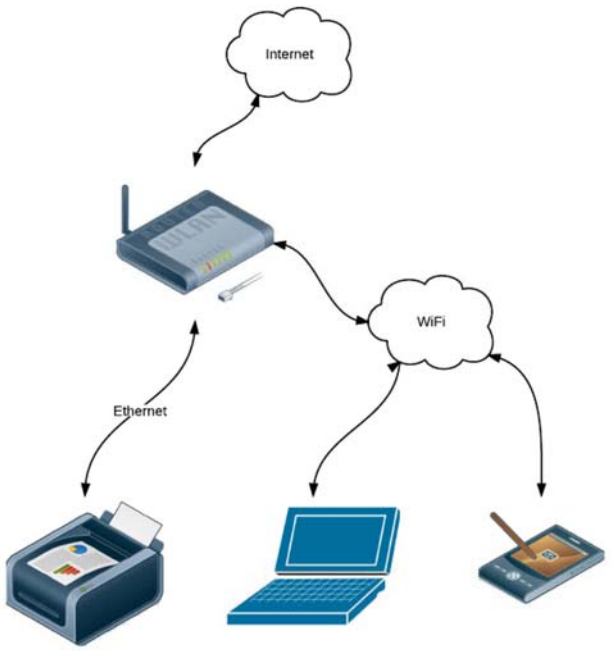
- Over the years, computer networks became more and more sophisticated.
- Now, networks use electrical cables, fiber-optic cables, or wireless radio signals to connect computers to each other.
- The purpose, however, has remained the same: sharing information and getting work done faster.



What Is a Network?

- A *network is two or more computers connected to each* other
- they can exchange
  - information, such as e-mail messages or documents,
  - or share resources, such as disk storage or printers.
- this connection is made via
  - electrical cables that carry the information in the form of electrical signals

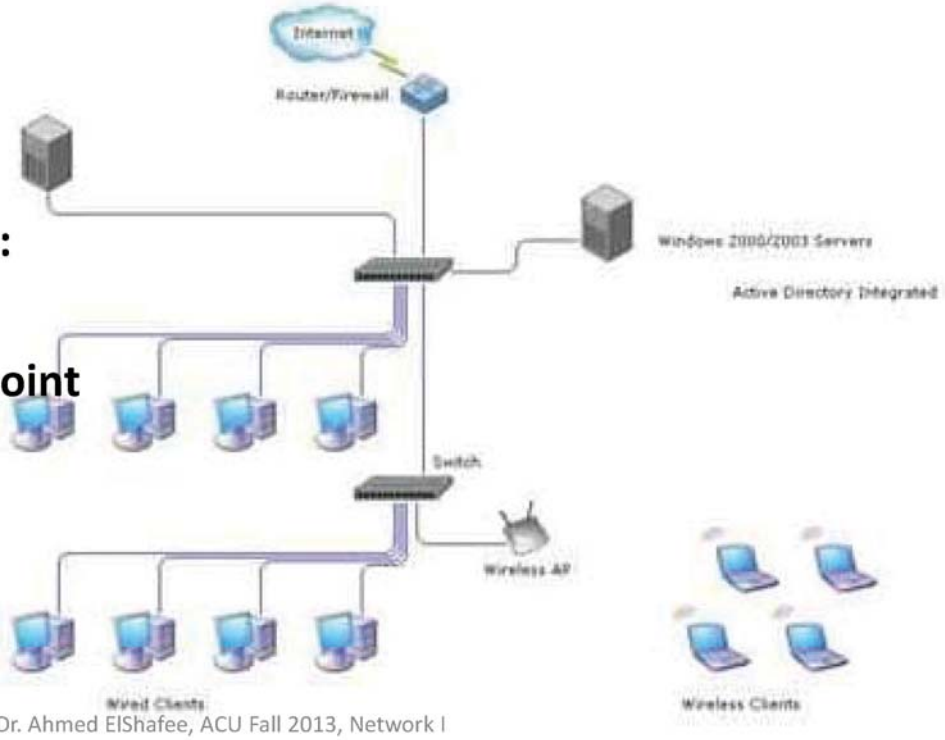
  - fiber-optic cables which have extremely high speeds by using impulses of light
  - Wireless networks let computers communicate by using radio signals, so the computers aren't restricted by physical cables.
- network also requires special software to enable communications



- early days of networking, you had to add this software to each computer on the network.
- Nowadays, network support is built in to all major operating systems, including all current versions of Windows, Macintosh operating systems, and Linux.

Network building blocks

- Small or large, all networks are built from the following basic building blocks:
- **Client computers**
- **Server computers**
- **Network interface:**
- **Cable**
- **Switches/Access point**
- **Network software**



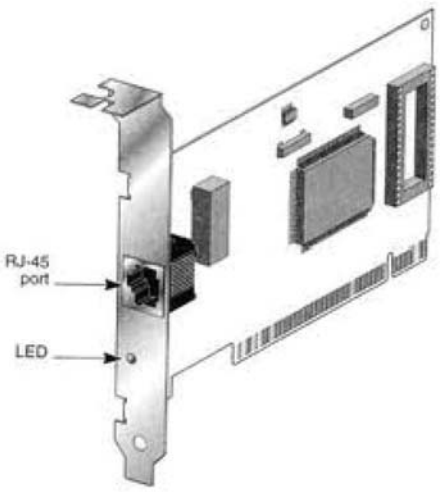
Client computers:

- The computers that end users use to access the resources of the network.
- They usually run a desktop version of Windows such as Windows 7, Vista, or XP.
- In addition, the client computers usually run some type of application software such as Microsoft Office.
- Client computers are sometimes referred to as ***workstations***.

Server computers:

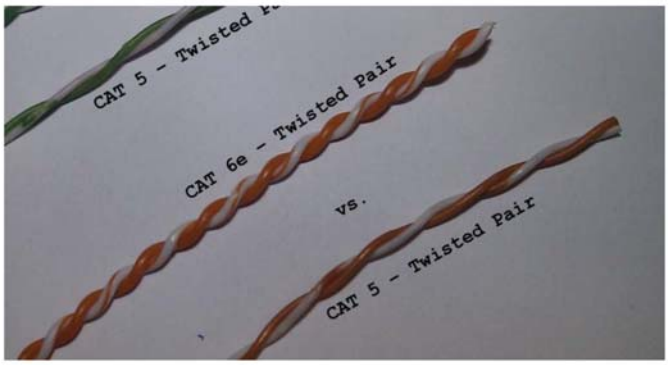
- Computers that provide
  - shared resources, such as disk storage and printers,
  - network services, such as e-mail and Internet access.
- Server computers run a specialized network
- operating system such as Windows Server 2008 or 2003, NetWare, or Linux, along with special software to provide network services.
- For example,
  - a server may run Microsoft Exchange to provide e-mail services for the network, or
  - it may run Apache Web Server so that the computer can serve Web pages.

- **Network interface:**
- An interface — sometimes called a *network port* — that's installed in a computer to enable the computer to communicate over a network.
- Almost all network interfaces implement a networking standard called *Ethernet.*

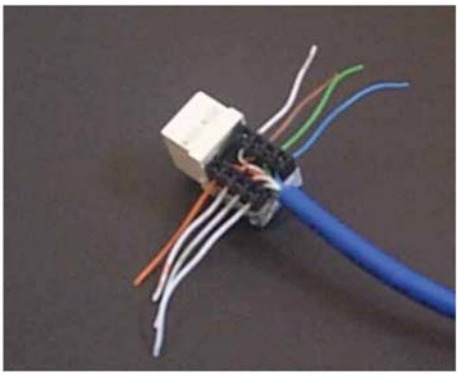


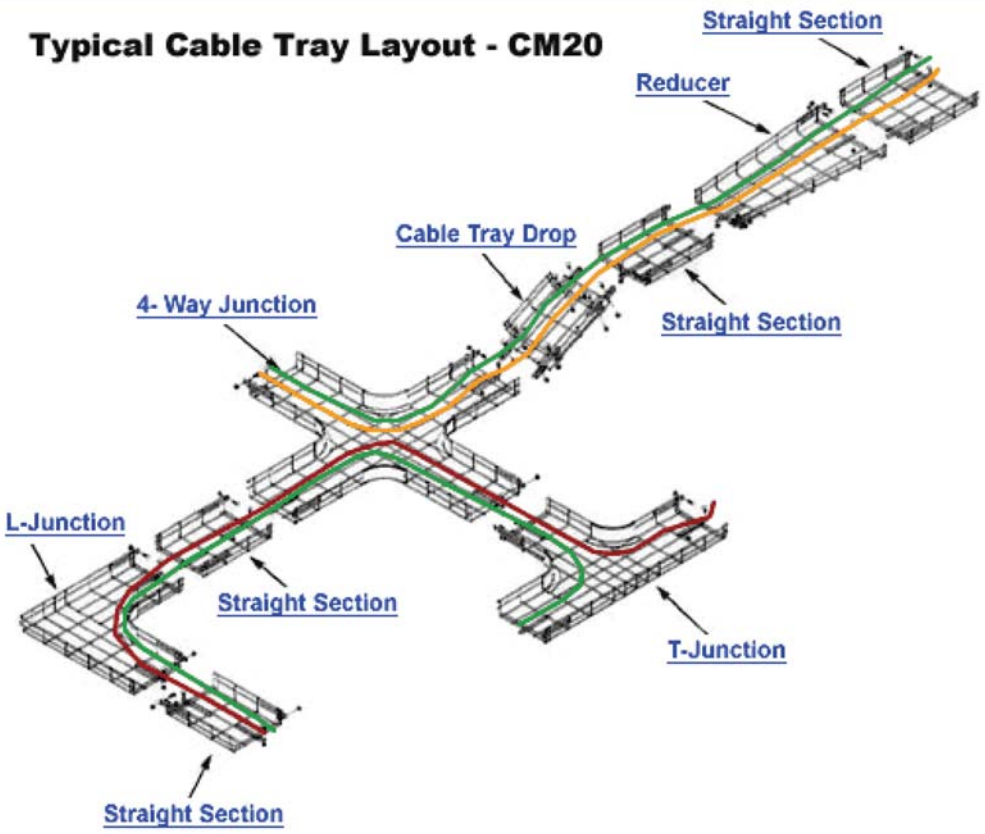
- A network interface is sometimes called a NIC, which stands for *network interface card,*
- in the early days NIC was a separate card need to be installed on PC motherboard, now it become an integrated part of desktop PC.

- **Cable:**
- Computers in a network are usually physically connected to each other using cable.
- Most networks today use a type of cable called *twisted pair,* also known by its official designation *10BaseT.*
- Twisted-pair cable is referred to as *Cat-5 or Cat-6 cable.*
- These terms refer to the standards that determine the maximum speed with which the cable can carry data, Cat-6 being rated for more speed than Cat-5.
- *Fiber-optic cable which is used for the highest-speed network* connections.
- Fiber-optic cable uses strands of glass to transmit light signals at very high speeds.



- the cables run through the walls and converge on a central room called a *wiring closet.*
- *But for smaller networks, the cables are* often just strung along the floor, hidden behind desks and other furniture whenever possible.



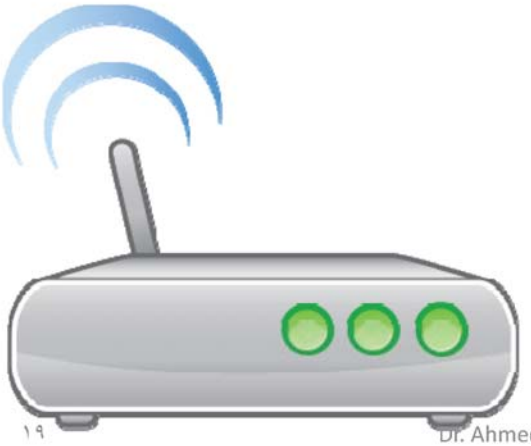


١٥

- **Switches:**
- Network cable doesn't connect computers directly to each other, each computer is connected by cable to a device known as a *switch.*
- *The switch, in turn, connects to the rest of the network.*
- Switch contains 5, or *8 or 16 or 24, or 48 ports.*
- Switches can be connected to each other to build larger networks.
- Older networks may use *hub instead of a switch.*
- *A hub provides the same function* as a switch, but it isn't as efficient.

Access Points for Wireless networks:

- In a wireless network, radio transmitters and receivers take the place of cables.
- The main advantage of wireless networking is its flexibility. With a wireless network, you don't have to run cables through walls or ceilings, and your client computers can be located anywhere within range of the network broadcast.
- The main disadvantage of wireless networking is that it's less secure and less efficient than a cabled network.



- **Network software:**
- Although network hardware is essential, what really makes a network work is software.
- Server computers typically use a special *network operating system (also known as a NOS)*
- Client computers need to have their network settings configured properly in order to access the network.

Network objectives

- **Sharing information:**
- **Sharing resources**
- **Sharing applications**

- **Sharing information:**
- Networks allow users to share information in several different ways
  - share individual files, two or more persons can work on the same file saved on cloud of file server
  - Exchanging messages, like Microsoft Outlook, or web mails.
  - online meetings, and chatting applications.
  - VOIP
  - videoconferences

- **Sharing resources**
- Printers: It's cheaper to buy a single high-speed printer with advanced features such as collating, stapling, and duplex printing that can be shared by an entire workgroup
- Hard drives: computer whose main purpose in life is to host shared hard drives is called a *file server.* individual folders on a networked hard drive are shared. The network administrator can allow different network users to have access to different shared folders.
- a network can be used to share an Internet connection

- **Sharing applications:**
- In any businesses users can work together on a single business application.
- For example, an accounting department may have accounting software that can be used from several computers at the same time.
- Or a sales-processing department may have an order-entry application that runs on several computers to handle a large volume of orders.

Machine types: Clients & servers

- Usually, the most powerful and expensive computers in a network are the servers. because every user on the network shares the server's resources.
- The cheaper and less powerful computers in a network are the clients.

- **Client server network**
- This server computer is dedicated solely to the task of providing shared resources, such as hard drives and printers, to be accessed by the network client computers.
- A network that relies on dedicated servers is sometimes called a *client/server network.*
- If you're going to dedicate a computer to the task of being a full-time server, you should use a full-fledged network operating system, such as Windows Server 2008.

- **Peer to peer network**
- Other networks take an alternative approach, enabling any computer on the network to function as both a client and a server.
- any computer can share its printers and hard drives with other computers on the network.
- This type of network is called a *peer-to-peer network*
- Peer-to-peer networking has been built in to all versions of Windows since Windows 95.
- Thus, you don't have to buy any additional software to turn your computer into a server. All you have to do is enable the Windows server features.

- The network server features that are built in to desktop versions of Windows (including Windows 7, Vista, and XP) aren't very efficient because these versions of Windows were not designed primarily to be network servers.

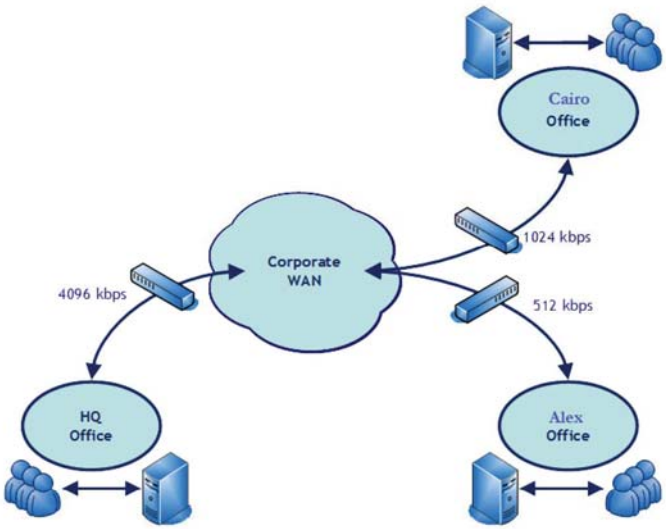
Network types

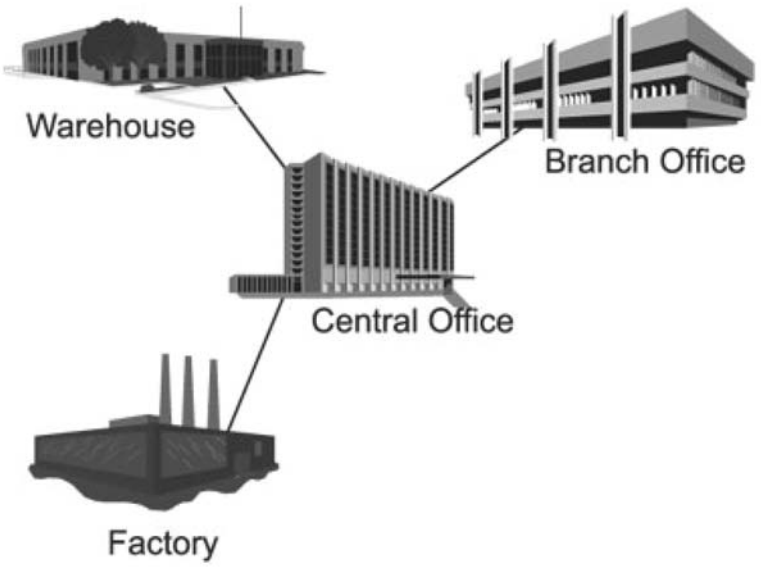
- Networks categorized based on the geographical size they cover
  - **Local area networks (LAN)**
  - **Wide area networks (WAN)**
  - **Metropolitan area networks (MAN)**

- **Local area networks (LAN):**
- *Is a network in which* computers are relatively close together, such as within the same office or building.
- *LAN doesn't imply that the network is small. A LAN* can contain hundreds or even thousands of computers.
- Usually a LAN is contained within a single building,
- LAN can extend to several buildings on a campus — provided the buildings are close to each other (typically within meters of each other, though greater distances are possible with special equipment).

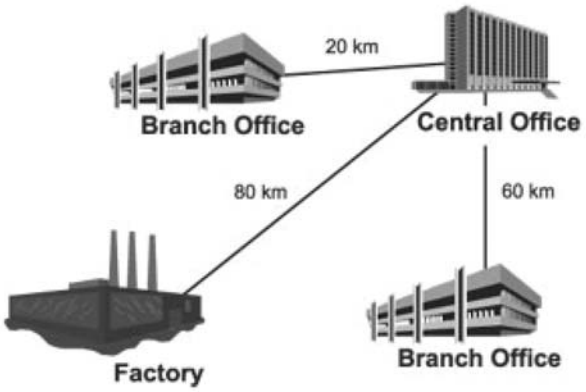
- **Wide area networks (WAN):**
- *Is a network that c*overs a large geographic area, such as an entire city or region, or even an entire country.
- It's the geographic distance, not the number of computers involved, that makes a network a WAN.

- WANs are typically used to connect two or more LANs that are relatively far apart.
- For example, a WAN may connect an office in Cairo with an office in Alexandria.
- If the office in Cairo and the office in Alexandria both have only one computer, the WAN will have a total of two computers but will span more than 200Kms.

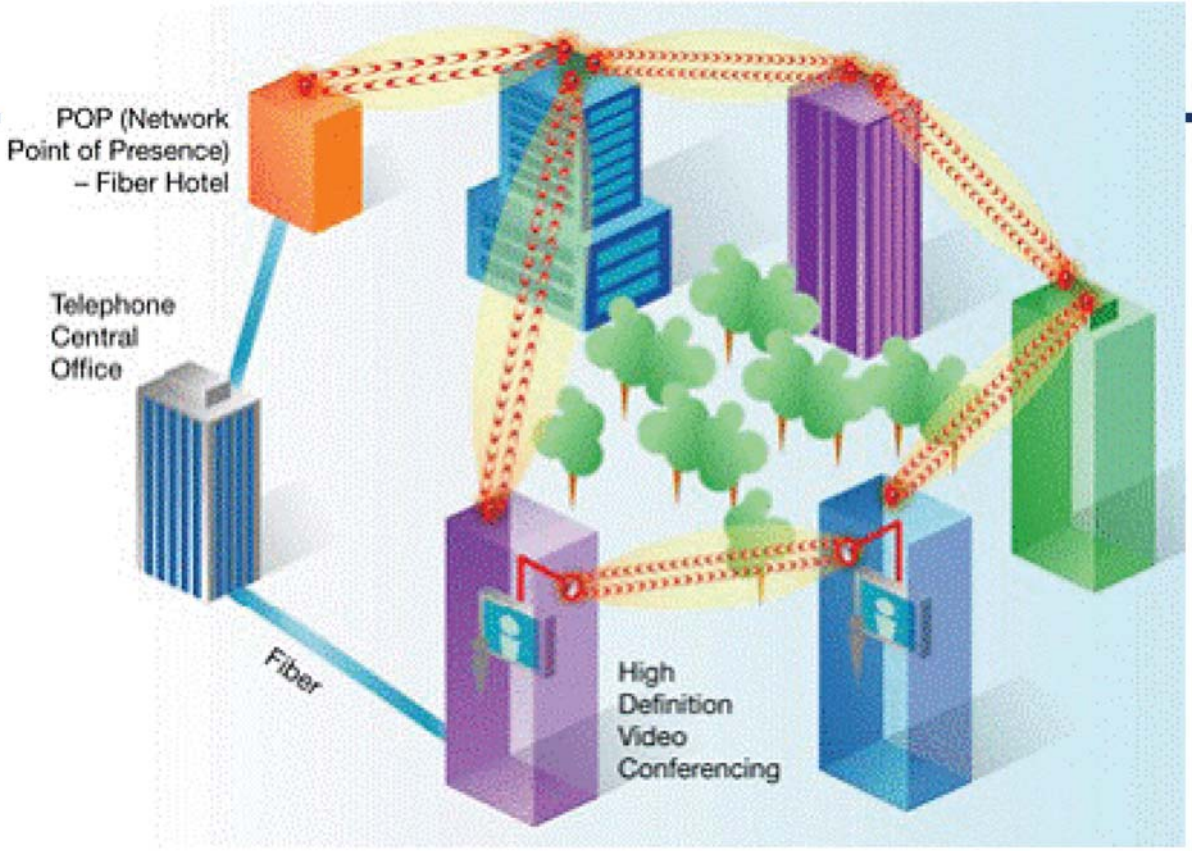




- **Metropolitan area networks (MAN):**
- Is a network that's smaller than a typical WAN but larger than a LAN.
- Typically, a MAN connects two or more LANs that are within the same city but are far enough apart that the networks can't be connected using a interconnected cables or wireless connections



- POP (Network Point of Presence) – Fiber Hotel



Network Topology

- *network topology refers to the shape of how the computers and* other network components are connected to each other.
- There are several different types of network topologies, each with advantages and disadvantages.
  - Bus topology
  - Star topology
  - Expanding stars
  - Ring topology
  - Mesh topology.

Node:

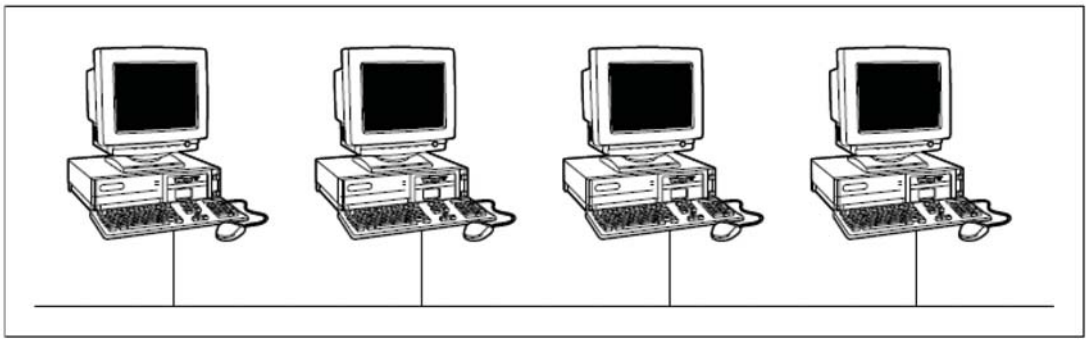
- A *node is a device that's connected to the network.*
- a node is the same as a computer.
- Network topology deals with how the nodes of a network are connected to each other

Packet:

- A packet is a message that's sent over the network from one node to another node.
- The packet includes the address of the node that sent the packet, the address of the node the packet is being sent to, and data.

Bus topology

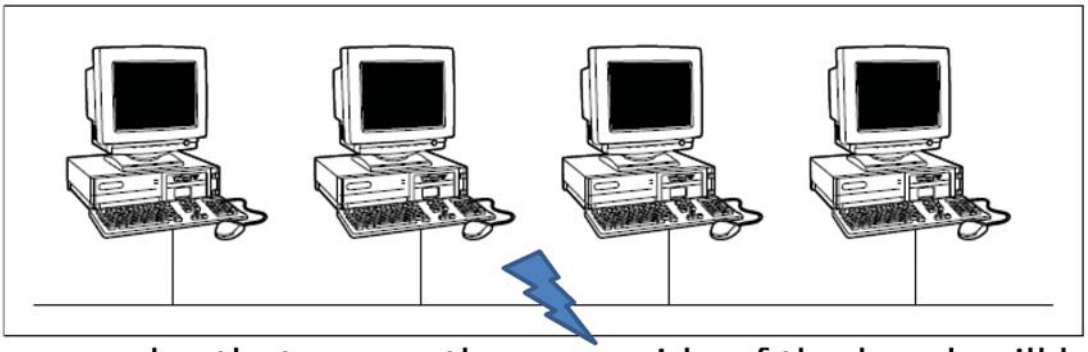
- nodes are placed together in a line



- Assume that the entire network is a single cable, with each node “tapping” into the cable so it can listen in on the packets being sent over that cable

- every node on the network can see every packet that’s sent on the cable.
- Each node looks at each packet to determine whether the packet is intended for it.
- If so, the node claims the packet. If not, the node ignores the packet.
- This way, each computer can respond to data sent to it and ignore data sent to other computers on the network.

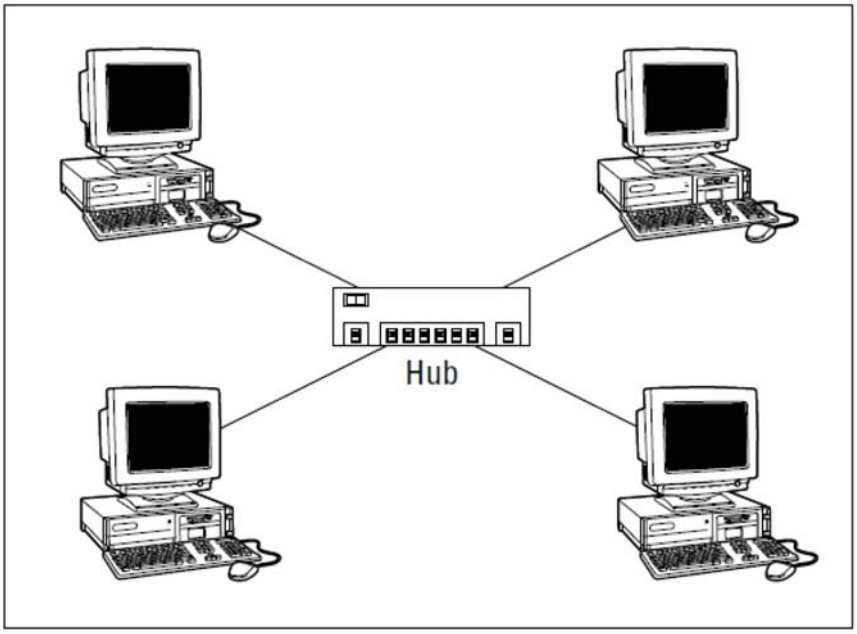
- If the cable in a bus network breaks, the entire network is effectively disabled, the nodes on opposite sides of the break can't continue to communicate with each other as data can't span the gap



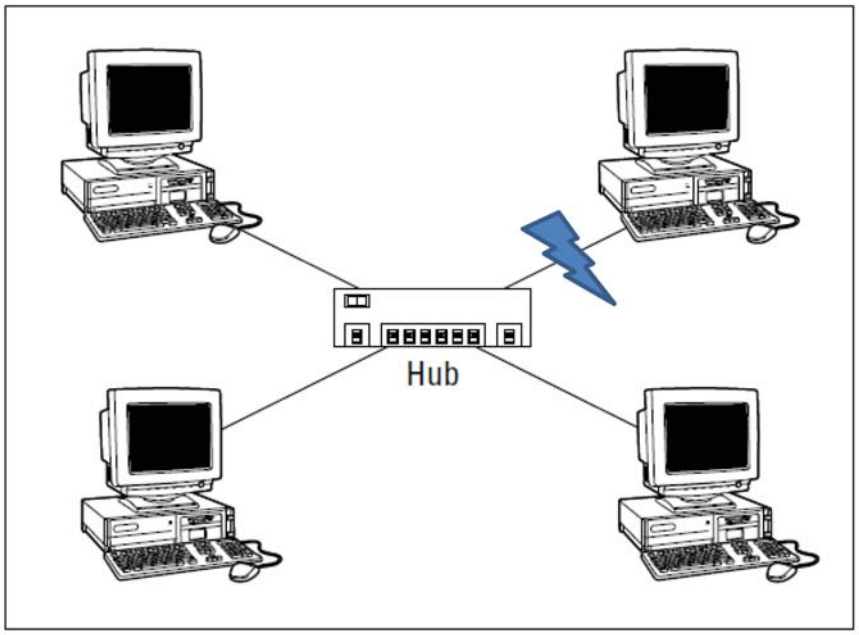
- those nodes that are on the same side of the break will be unable to communicate with each other, because the open end of the cable left by the break disrupts the proper transmission of electrical signals.

Star topology

- each network node is connected to a central device called a *hub or a switch.*



- If a cable in a star network breaks, only the node connected to that cable is isolated from the network. The other nodes can continue to operate without interruption



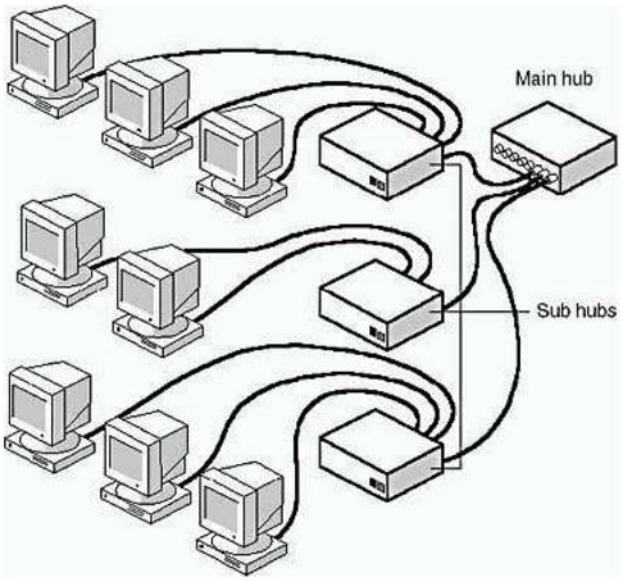
distinction between a hub and a switch.

- a *hub doesn't know anything about the computers* that are connected to each of its ports.
- So when a computer connected to the hub sends a packet to a computer that's connected to another port, the hub sends a duplicate copy of the packet to all its ports.
- a switch knows which computer is connected to each of its ports.
- As a result, when a switch receives a packet intended for a particular computer, it sends the packet only to the port that the recipient is connected to.

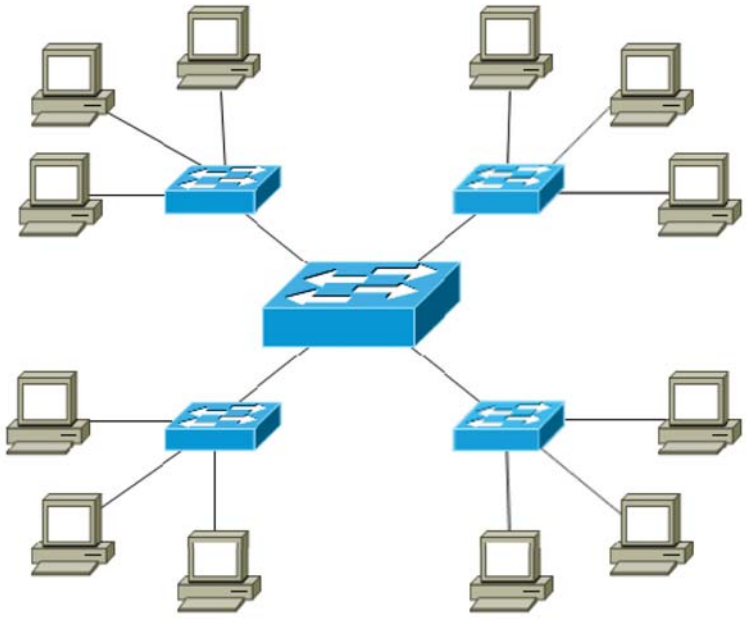
- only networks that use switches have a true star topology (physical and logical).
- Networks that uses hubs are physically start by logically a bus
- In a true (logically) star topology networks, as when a switch is used, each computer sees only those packets that were sent specifically to it, as well as packets that were specifically sent to all computers on the network (those types of packets are called *broadcast packets).*

Expanding stars

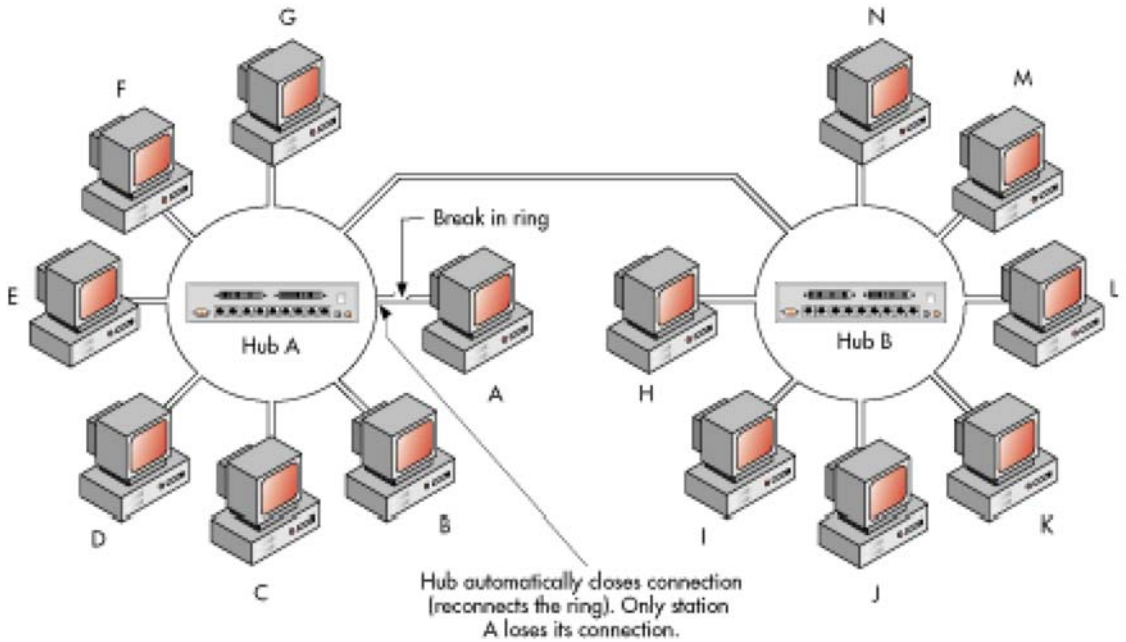
- A simple bus or star topology is suitable only for small networks, with a dozen or so computers.
- For larger networks, it's common to create more complicated topologies that combine stars and buses.
- For example, a bus can be used to connect several stars. In this case, two or more hubs or switches are connected to each other using a bus.



- Each of these hubs or switches is then the center of a star that connects two or more computers to the network.
- This type of arrangement is commonly used in buildings that have different floors.
- The bus that connects the switches is sometimes called a *backbone.*

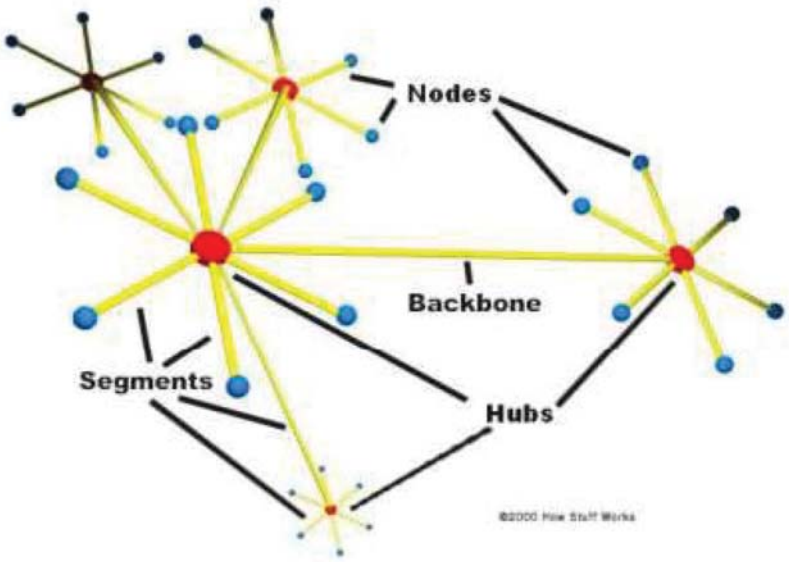


-



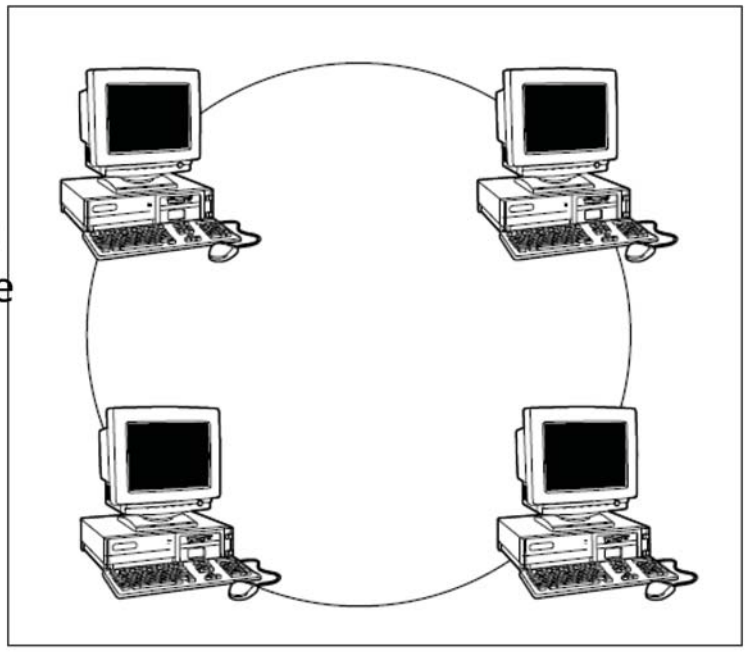
daisychaining

- Another way to expand a star topology is to use a technique called *daisychaining.*
- When you use daisy-chaining, a switch is connected to another switch as if it were one of the nodes on the star.
- Then, this second switch serves as the center of a second star.



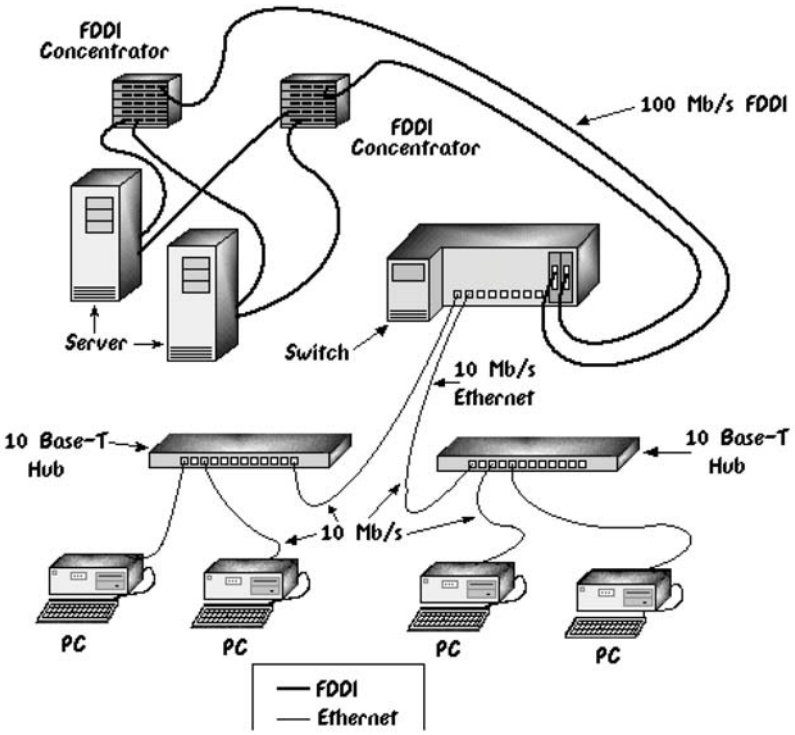
Ring topology

- In a ring topology, packets are sent around the circle from computer to computer.
- Each computer looks at each packet to decide whether the packet was intended for it.
- If not, the packet is passed on to the next computer in the ring.



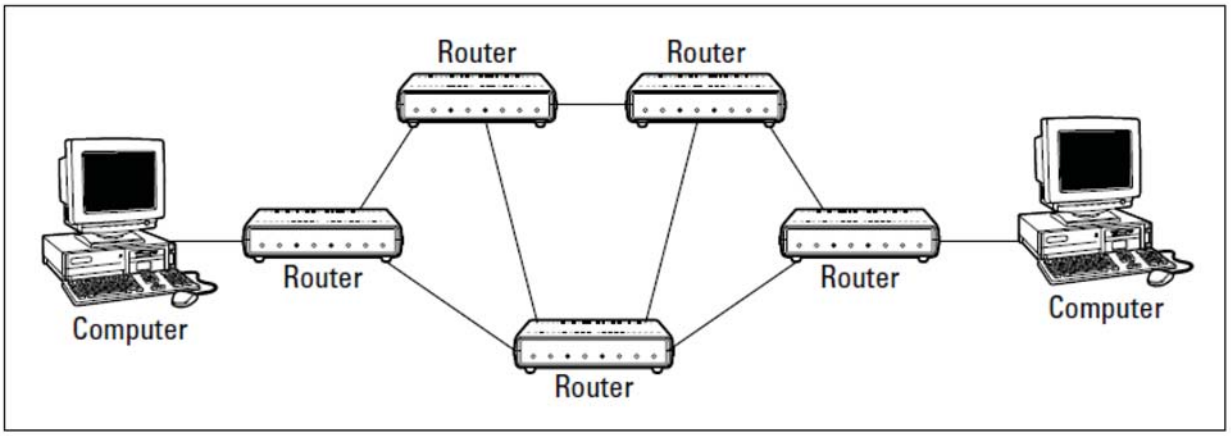
- Years ago, ring topologies were common in LANs, as two popular networking technologies used rings: ARCNET and Token Ring.
- ARCNET is still used for certain applications such as factory automation, but is rarely used in business networks.
- Token Ring is still a popular network technology for IBM midrange computers.
- Although plenty of Token Ring networks are still in existence, not many new networks use Token Ring any more

- Ring topology was also used by FDDI (***Fiber Distributed Data Interface***), one of the first types of fiber-optic network connections.
- FDDI has given way to more efficient fiber-optic techniques,



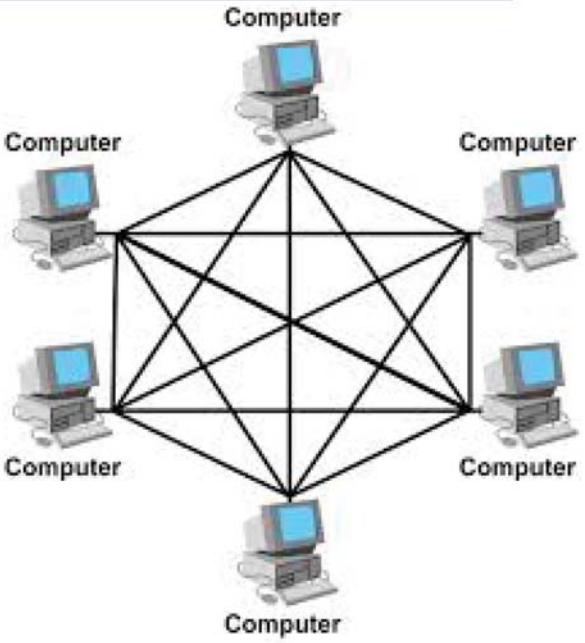
Mesh topology

- *mesh, has multiple connections* between each of the nodes on the network,

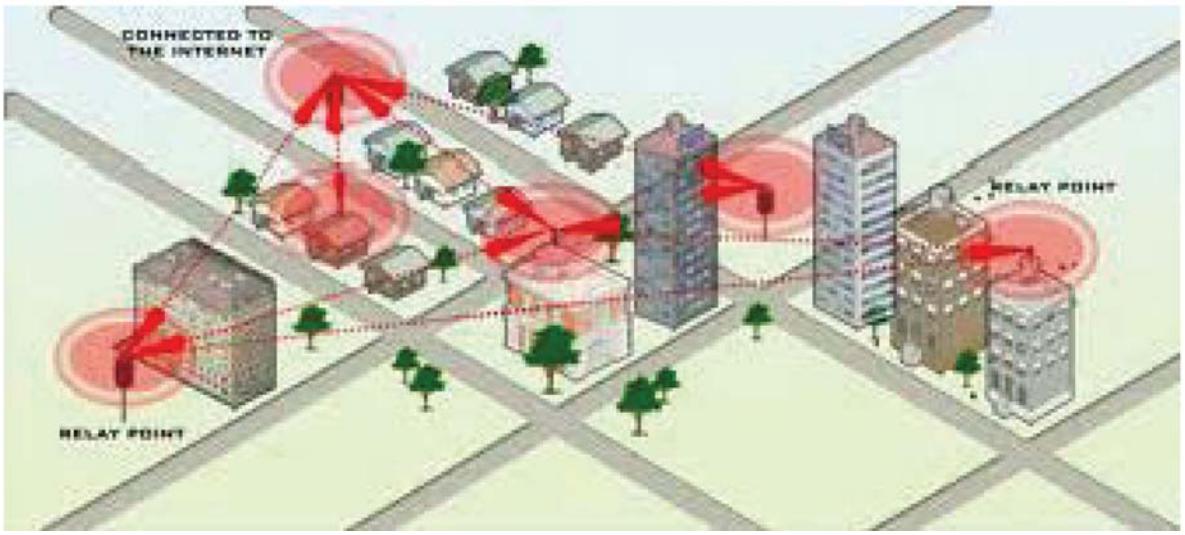


- The advantage of a mesh topology is that if one cable breaks, the network can use an alternative route to deliver its packets.

- Mesh networks aren't very practical in a LAN setting.
- For example, to network eight computers in a mesh topology, each computer would have to have seven network interface cards, and 28 cables would be required to connect each computer to the seven other computers in the network.
- Obviously, this scheme isn't very scalable.



- However, mesh networks are common for metropolitan or wide area networks.
- These networks use devices called *routers to route packets from* network to network.



- For reliability and performance reasons, routers are usually arranged in a way that provides multiple paths between any two nodes on the network in a meshlike arrangement.

Thanks,..

See you next week (ISA),…