

# NETWORK FUNDAMENTALS

## Introduction to Network

- A **network** is simply two or more computers connected together so they can exchange information.
- A small network can be as simple as two computer linked together by a single cable.
- Its goal is to provide faster services.



- User must explicitly log onto one machine, explicitly submit jobs, explicitly move files from one location to another etc.
- All these activities can be possible only with network. Therefore network is more important at every area.
- For Example: A company with many departments at different location area. So the track of products, inventories can be possible using network only.

## Introduction to Computer Network

- The merging of computers and communications has had a profound influence on the way computer systems are organized.
- The old model of a single computer serving all of the organization's computations has been replaced by one in which large number of separate but interconnected computers to do the job. These systems are called computer networks.

**Definition: Computer Network**

- The term “Computer Network” to mean a collection of autonomous (independent) computers interconnected by a single technology.
- Two computers are said to be interconnected if they are able to exchange information.
- For example: Newspaper will go on-line and be personalized. You can find any type of news that you want like about politics, celebrities, etc. It will be downloaded to our computer’s disk and also we can do print.

**Advantages of Computer Network**

- Resource Sharing
  - High Reliability
  - Scalability
  - File Sharing
  - Increased Storage Capacity
  - Increased Cost Efficiency
  - Communication
  - Flexible Access
- 
- **Resource Sharing:** Resource sharing is an important benefit of a computer network.
  - For example, if there are four people in a family, each having their own computer, they will require four modems (for the Internet connection) and four printers, if they want to use the resources at the same time. A computer network, on the other hand, provides a cheaper alternative by the provision of resource sharing. In this way, all the four computers can be interconnected, using a network, and just one modem and printer can efficiently provide the services to all four members.
  - **High Reliability:** To provide high reliability by having alternative sources of supply. For example, all files could be replicated on two or three machines, so if one of them is unavailable, the other copies could be used. In addition, the

presence of multiple CPU means that if one goes down, the others may be able to take over its work, although reduces performance.

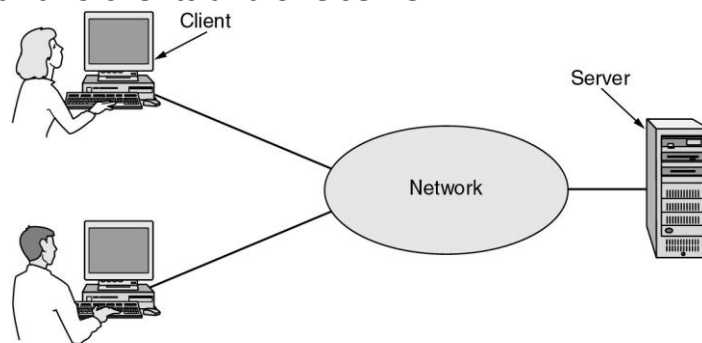
- **Scalability:** The ability to increase system performance gradually as the work load grows just by adding more processor. When system is full, it must be replaced by a larger one. With client-server model, new clients and new servers can be added as needed.
- **File Sharing:** The major advantage of a computer network is that it allows file sharing and remote file access. A person sitting at one workstation of a network can easily see the files present on the other workstation, provided he is authorized to do so. It saves the time which is wasted in copying a file from one system to another, by using a storage device.
- **Increased Storage Capacity:** As there is more than one computer on a network which can easily share files, the issue of storage capacity gets resolved to a great extent. A standalone computer might fall short of storage memory, but when many computers are on a network, memory of different computers can be used in such case. One can also design a storage server on the network in order to have a huge storage capacity.
- **Increased Cost Efficiency:** There are many softwares available in the market which are costly and take time for installation. Computer networks resolve this issue as the software can be stored or installed on a system or a server and can be used by the different workstations.
- **Communication:** Even outside of the internet, those on the network can communicate with each other via electronic mail over the network system. When connected to the internet, network users can communicate with people around the world via the network.
- **Flexible Access:** Networks allow their users to access files from computers throughout the network. This means that a user can begin work on a project on one computer and finish up on another. Multiple users can also collaborate on the same project through the network.

## Uses of Computer Networks

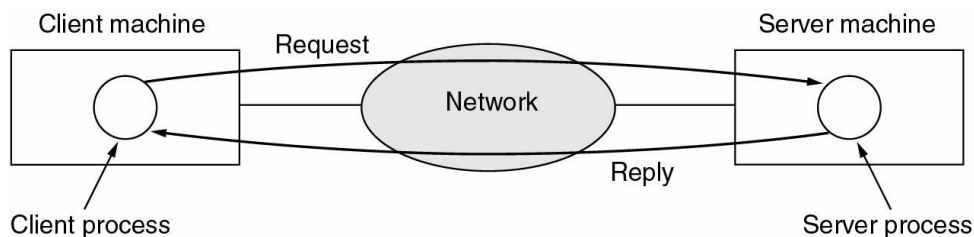
- Business Applications
- Home Applications
- Mobile Users
- Social Issues

## Business Applications of Networks

- The major goals of having computer network in business application:
- Resource sharing
- Powerful communication medium
- Doing business electronically
- Doing business with consumers over the internet (e-commerce)
- A network with two clients and one server.

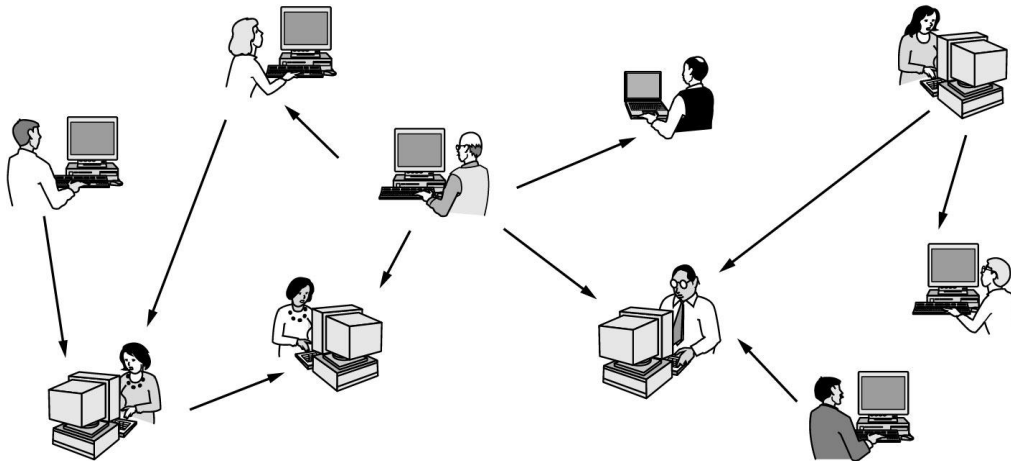


- The client-server model involves requests and replies.



## Home Network Applications

- Access to remote information
- Person-to-person communication
- Interactive entertainment
- Electronic commerce



– In peer-to-peer system there are no fixed clients and servers.

– Some forms of e-commerce.

Tag	Full name	Example
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on-line
P2P	Peer-to-peer	File sharing

## Mobile Network Users

– Combinations of wireless networks and mobile computing.

Wireless	Mobile	Applications
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

## Network Hardware

- Types of transmission technology
  - Broadcast links
  - Point-to-point links

## Broadcast Networks

- Broadcast network have a single communication channel that is shared by all the machines on the network.
- All the machines on the network receive short messages, called packets in certain contexts, sent by any machine.
- An address field within the packet specifies the intended recipient. Upon receiving a packet, machine checks the address field.
- If packet is intended for itself, it processes the packet; if packet is not intended for itself it is simply ignored.

## Example of Broadcast Networks

- If some one standing at the end of a corridor with so many rooms and shouting “Mr.XYZ”, come here. So many people available in rooms and corridor received this message but only Mr.XYZ responds. The other just ignore it.
- Another example is an airport announcement asking all flight passengers to report to gate number.

## Characteristics of Broadcast N/W

- It does allow the possibility of addressing a packet to all destinations by using a special code in address field.
- When a packet is transmitted, it is received by every machines on the network and if destination address matches then it is processed. This mode of operation is called broad-casting.
- Multi-casting: It is one kind of extension of broadcasting. Some broad cast systems support transmission to a subset of machines known as multi-casting.
- In multi-casting, one bit is reserved to indicate multi-casting, the remaining (n-1) address bits can hold a group number. When a packet is sent to a certain group, it delivered to all machines subscribing that group.

## Point-to-point Networks

- It consist of many connections between individual pairs of machines.
- To go from source to destination, a packet may have to first visit one or more

intermediate machines, having multiple routs of different length.

- Point-to-point transmission with one sender and one receiver is sometimes called uni-casting.
- Geographically smaller localized network requires broad- casting while larger network usually used point-to-point network.
- Classification of interconnected processors by scale.

Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

## Client-Server Model

- In the simplest of terms, one can imagine a company's information system as consisting of one or more databases and some number of employees who need to access them remotely.
- In this model, the data are stored on powerful computers called servers.
- In contrast, the employees have simpler machines, called clients.
- The client and server machines are connected by a network.

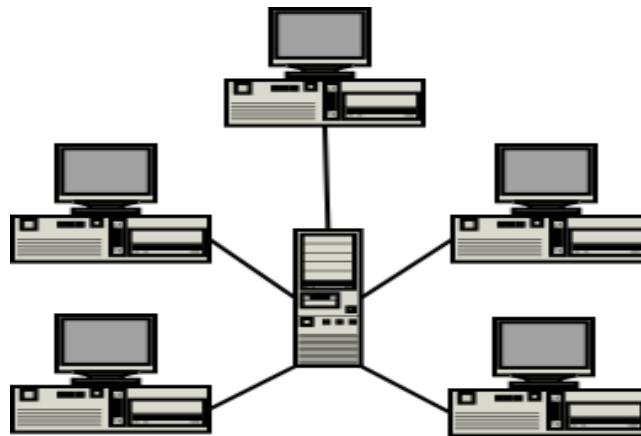
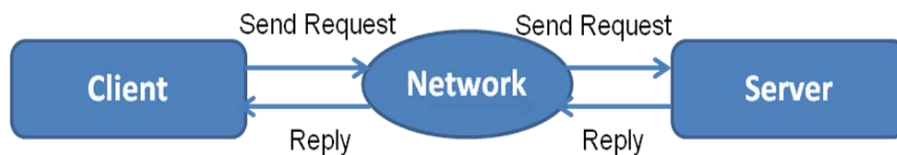


Figure: Client-Server Model

- This whole arrangement is called the client-server model.
- It is applicable when the client and server are both in the same building, but also when they are far away.
- For example: A person at the home accesses a page on the World Wide Web. In this, user's PC is client and Web server is being server.



- If we look at the client-server model in detail, there are two processes involved, one on the client machine and one on the server machine.
- Communication takes the form of the client process sending a message over a network to the server process.
- The client process then waits for a reply message.
- When the server process gets the request, it performs the requested work and send back a reply.

## Line Configuration

- Line configuration is the way two or more communication devices attach to a link
- A Link is the physical communication pathway that transfers data from one device to another.
- There are two type of line configuration:
  - Point-to-Point Line
  - Multipoint Line



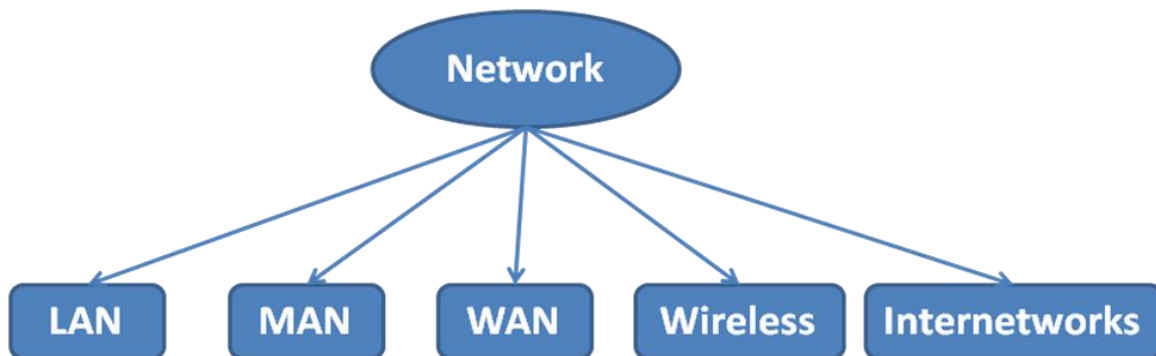
## Point-to-point Line Configuration

- A point-to-point line configuration provide dedicated link between two devices.
- The entire capacity of channel is reserved for transmission between two device.
- Use actual length of wire or cable to connect the two end including microwave & satellite link.
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- For Example: Infrared remote control & tvs remote control

## Multipoint Line Configuration

- Also known as Multidrop line configuration.
- One or more than two specific devices share a single link capacity of the channel is shared either permanently or temporary.
- In a multipoint architecture, capacity of channel is shared in two ways:
- Spatial : Several devices can use the link simultaneously
- Time-Shared : Devices must take turns

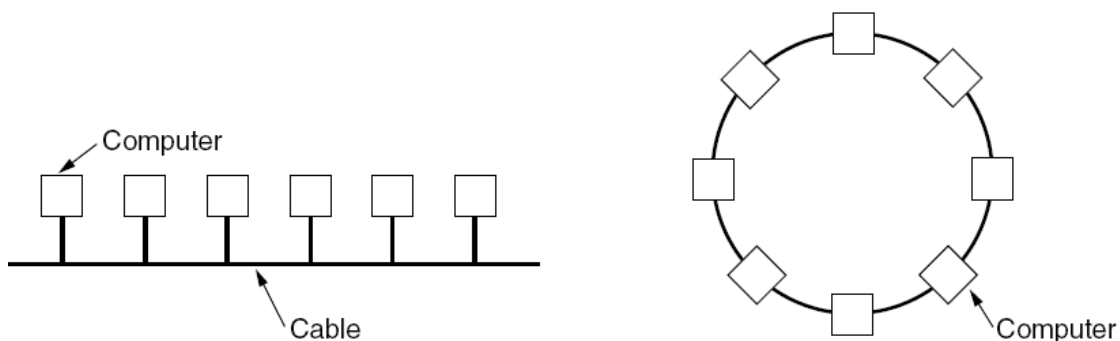
## Classification of Network



## Local Area Networks (LAN)

- Local area networks, generally called LANs, are privately-owned networks within a single building or campus of few kilometers in size.
- They are widely used to connect personal computers and workstations in company offices and factories to share resources and exchange information.

- LANs are distinguished from other kinds of networks by three characteristics:
  - their size
  - their transmission technology
  - their topology
- LANs are restricted in size, which means that the worst-case transmission time is bounded and known in advanced.
- LANs may use a transmission technology consisting of a cable to which all the machines are attached, like the telephone company party lines once used in rural areas.
- Traditional LANs run at speeds of 10Mbps to 100 Mbps. Newer LANs operate up to 10Gbps.
- Various topologies are possible for broadcast LANS like bus topology and ring topology.
- In a bus network, one machine is the master and is allowed to transmit data and other machines are required to refrain from sending. An arbitration mechanism is used to solve conflicts when two or more machines want to transmit data simultaneously.
- IEEE 802.3 known as Ethernet is an example of a bus-based broadcast network, operating at 10Mbps to 10Gbps.

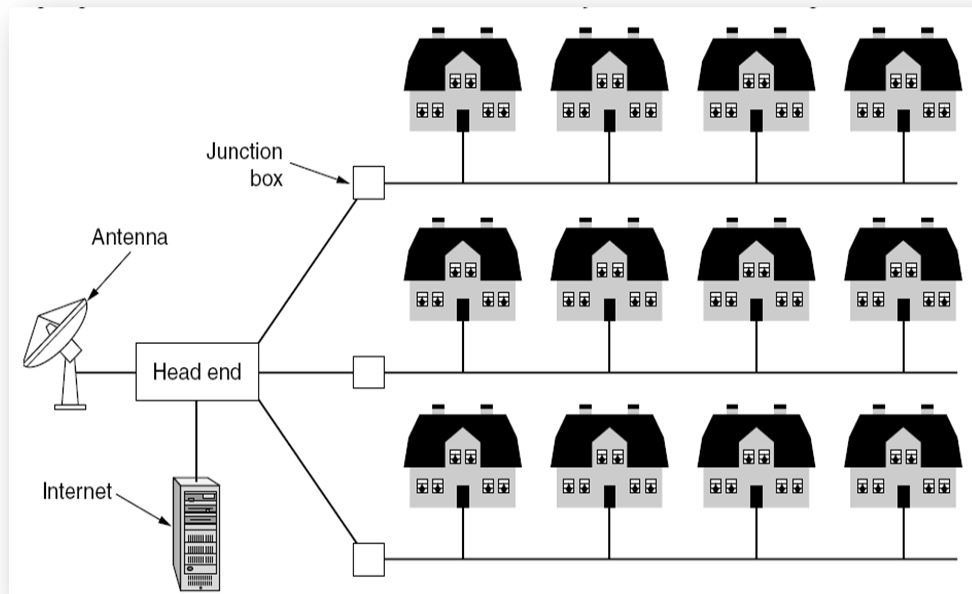


- A second type of broadcast system is the ring.
- In a ring, each bit propagates around on its own, not waiting for the rest of the packet to which it belongs.
- IEEE 802.5 (the IBM token ring), is a ring-based LAN operating at 4 and 16Mbps.

- FDDI is another example of a ring network.
- Depending on how the channel is allocated, broadcast networks can be further divided into two categories:
  - o Static
  - o Dynamic
- A typical static allocation would be to divide time into discrete intervals and use a round robin algorithm, allowing each machine to broadcast only when its time slot comes up.
- Static allocation wastes channel capacity when a machine has nothing to say during its allocated slot, so most systems attempt to allocate the channel dynamically.
- Dynamic allocation methods for a common channel are either centralized or decentralized.
- In the decentralized channel allocation method, there is a single entity, for example, a bus arbitration unit, which determines who goes next.
- It might do this by accepting requests and making a decision according to some internal algorithm.
- In the decentralized channel allocation method, there is no central entity; each machine must decide for itself whether to transmit.

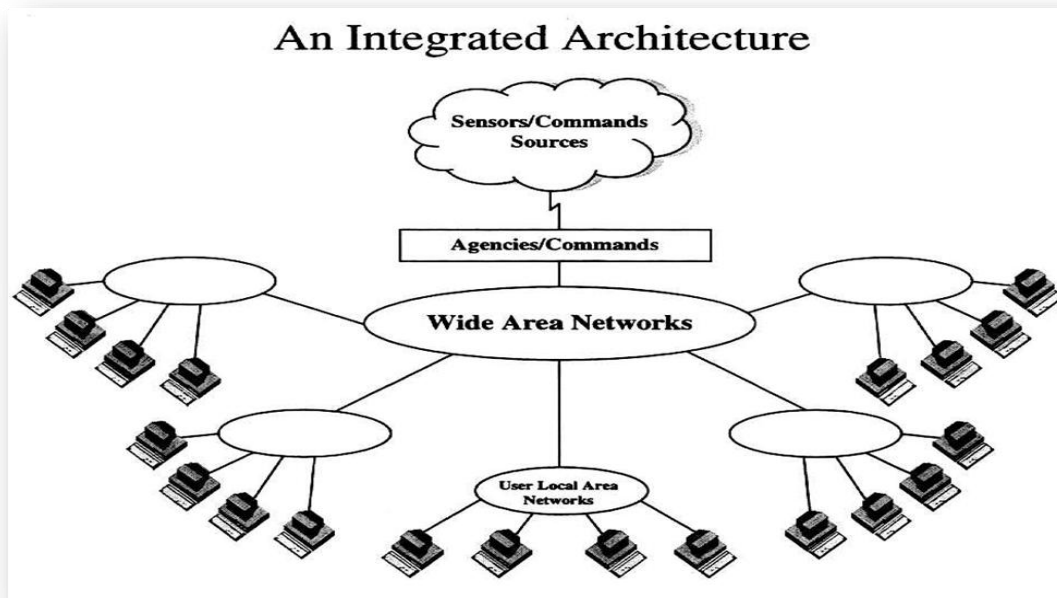
## **Metropolitan Area Networks**

- A metropolitan area network, or MAN, covers a city.
- The best known example of a MAN is the cable television network available in many cities.
- Basically it is a bigger version of LAN.
- It can be either private or public network.
- It can cover a group of corporate offices or sub branches and head offices located in the same city.
- It has one or two cables and does not contain switching element.
- It uses broadcast medium 802.6 for two cables.
- It has a special design known as Distributed Queue Dual Bus. (DQDB)

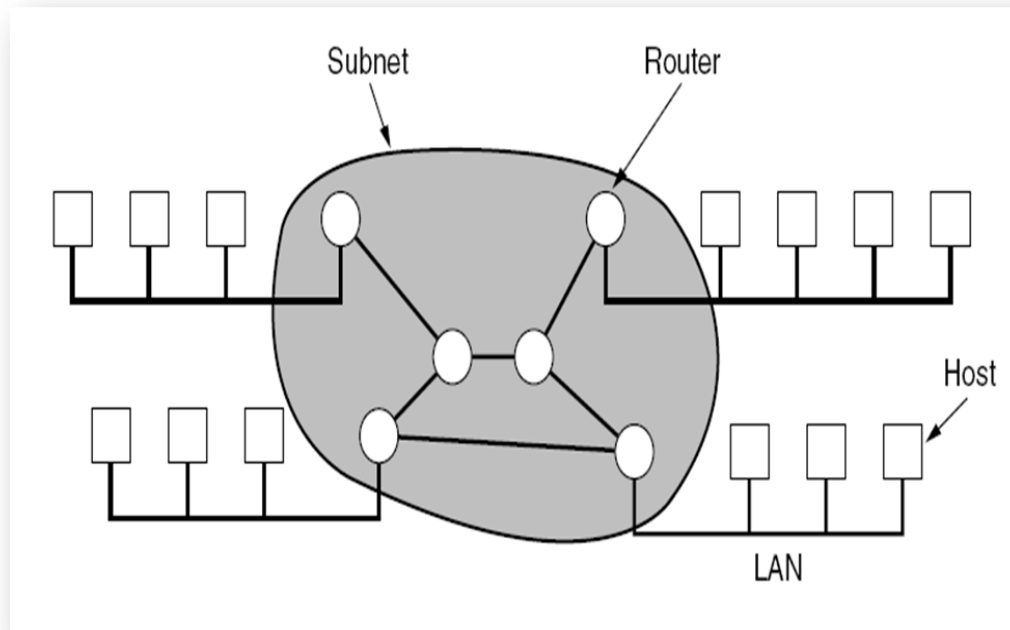


## Wide Area Network (WAN)

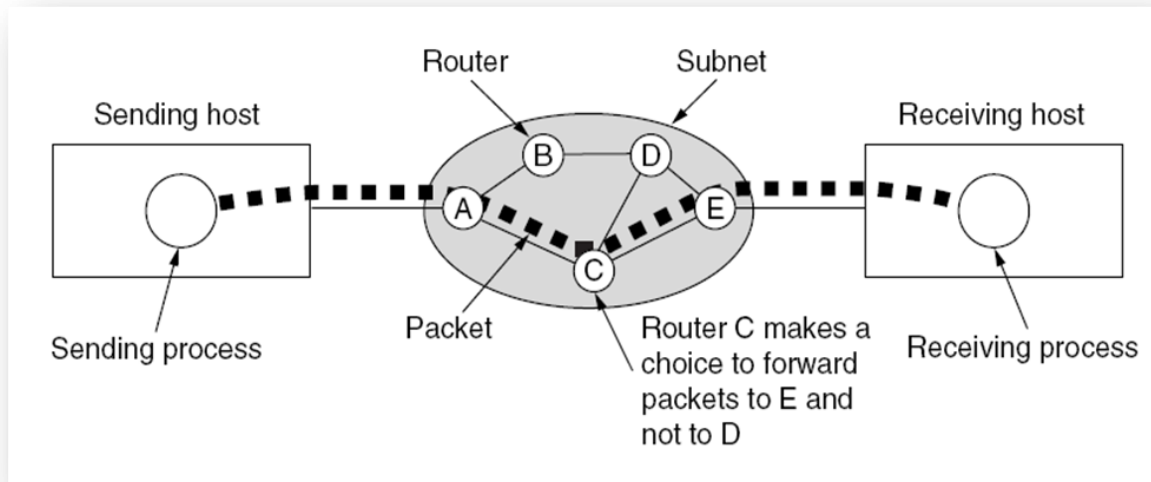
- A wide area network, or WAN, spans a large geographical area, often a country or continent.
- It contains a collection of machines intended for running user (i.e., application) programs and call these machines hosts.
- The hosts are connected by a communication subnet, or just subnet for short.
- The hosts are owned by the customers (e.g., people's personal computers), whereas the communication subnet is typically owned and operated by a telephone company or Internet service provider.
- The job of the subnet is to carry messages from host to host, just as the telephone system carries words from speaker to listener.
- In most wide area networks, the subnet consists of two distinct components: transmission lines and switching elements.



- Transmission lines move bits between machines. They can be made of copper wire, optical fiber, or even radio links.
- Switching elements are specialized computers that connect three or more transmission lines.
- When data arrive on an incoming line, the switching element must choose an outgoing line on which to forward them.
- These switching computers have been called by various names in the past; the name router is now most commonly used.
- In this model, each host is frequently connected to a LAN on which a router is present, although in some cases a host can be connected directly to a router.



- In most WANs, the network contains numerous transmission lines, each one connecting a pair of routers.
- If two routers that do not share a transmission line wish to communicate, they must do this indirectly, via other routers.
- When a packet is sent from one router to another via one or more intermediate routers, the packet is received at each intermediate router in its entirety, stored there until the required output line is free, and then forwarded.
- A subnet organized according to this principle is called a store-and-forward or packet-switched subnet.
- Generally, when a process on some host has a message to be sent to a process on some other host, the sending host first cuts the message into packets, each one bearing its number in the sequence.
- These packets are then injected into the network one at a time in quick succession.
- The packets are transported individually over the network and deposited at the receiving host, where they are reassembled into the original message and delivered to the receiving process.



- Not all WANs are packet switched.
- A second possibility for a WAN is a satellite system.
- Each router has an antenna through which it can send and receive.
- All routers can hear the output from the satellite, and in some cases they can also hear the upward transmissions of their fellow routers to the satellite as well.

### Classification of interconnected processors by scale.

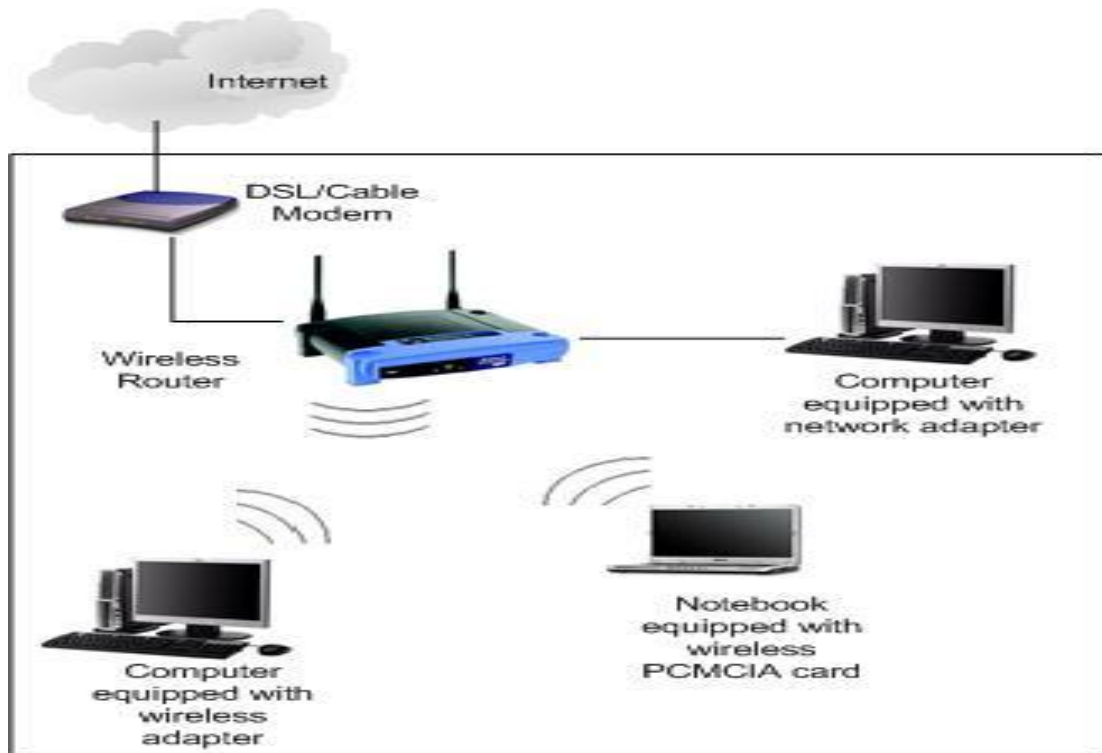
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### Wireless Networks

- Wireless network is a network set up by using radio signal frequency to

communicate among computers and other network devices.

- Sometimes it's also referred to as WiFi network or WLAN.
- This network is getting popular nowadays due to easy to set up feature and no cabling involved.
- You can connect computers anywhere in your home without need of wires.

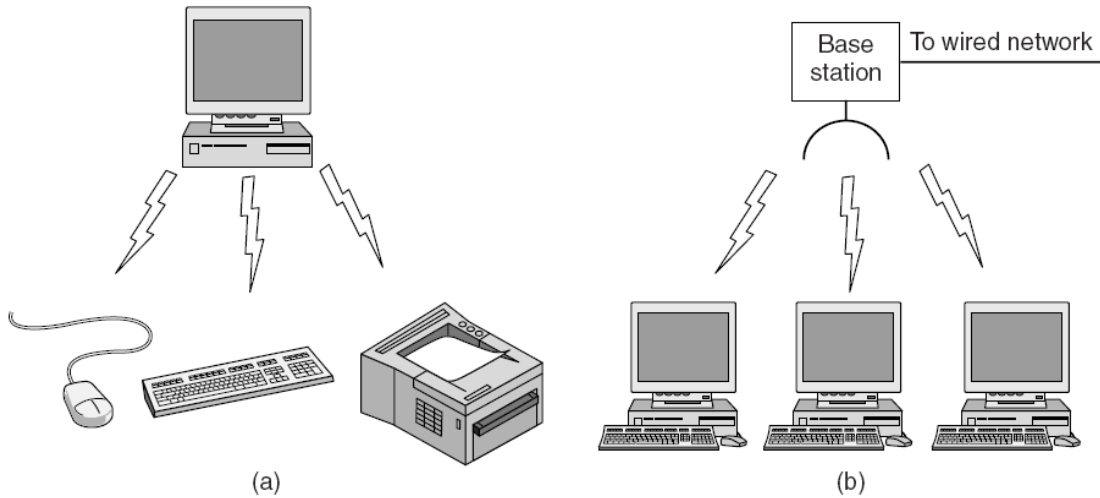


- To a first approximation, wireless networks can be divided into three main categories:
  1. System interconnection
  2. Wireless LANs
  3. Wireless WANs
- Consequently, some companies got together to design a short-range wireless network called Bluetooth to connect these components without wires.
- Bluetooth also allows digital cameras, headsets, scanners, and other devices to connect to a computer by merely being brought within range. No cables, no driver installation,
- The next step up in wireless networking are the wireless LANs.
- These are systems in which every computer has a radio modem and antenna



with which it can communicate with other systems.

- Wireless LANs are becoming increasingly common in small offices and homes.
- There is a standard for wireless LANs, called IEEE 802.11, which most systems implement and which is becoming very widespread.



- The third kind of wireless network is used in wide area systems.
- Almost all wireless networks hook up to the wired network at some point to provide access to files, databases, and the Internet.

## Internetworks

- A collection of interconnected networks is called an internetwork or internet.
- A common form of internet is a collection of LANs connected by a WAN.
- Subnets, networks, and internetworks are often confused.
- Subnet is the collection of routers and communication lines owned by the network operator.