Classification of Computer Network based on Scale

Classification of N/W according to their 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

Classification of N/W according to their scale (LAN)

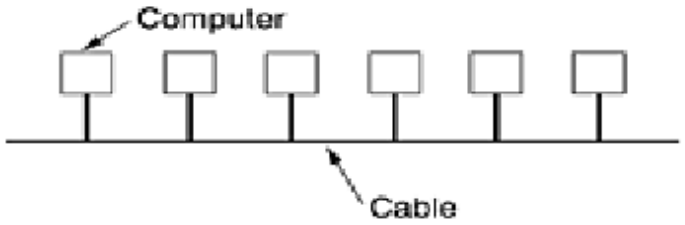
- Local area networks, generally called LANs, are privately-owned networks within a single building or campus of up to a few kilometers in size.
- They are widely used to connect personal computers and workstations in company offices and factories to share resources (e.g., printers) and exchange information.
- LANs are distinguished from other kinds of networks by three characteristics:

1. their size,
2. their transmission technology, and
3. their topology.

- LANs are restricted in size, which means that the worst-case transmission time is bounded and known in advance.

Classification of N/W according to their scale (LAN)

- LANs use a transmission technology consisting of a cable to which all the machines are attached.
- Traditional LANs run at speeds of 10 Mbps to 1000 Mbps, have low delay (microseconds or nanoseconds), and make very few errors.
- Newer LANs operate at up to 10 Gbps.
- Various topologies are possible for broadcast LANs.
- In a bus (i.e., a linear cable) network, at any instant at most one machine is the master and is allowed to transmit. All other machines are required to refrain from sending.



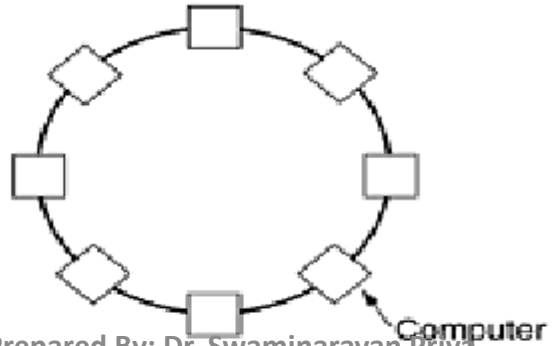
(a)

Classification of N/W according to their scale (LAN)

- An arbitration mechanism is needed to resolve conflicts when two or more machines want to transmit simultaneously.
- The arbitration mechanism may be centralized or distributed.
- IEEE 802.3, popularly called Ethernet, for example, is a bus-based broadcast network with decentralized control, usually operating at 10 Mbps to 10 Gbps.
- Computers on an Ethernet can transmit whenever they want to; if two or more packets collide, each computer just waits a random time and tries again later.

Classification of N/W according to their scale (LAN)

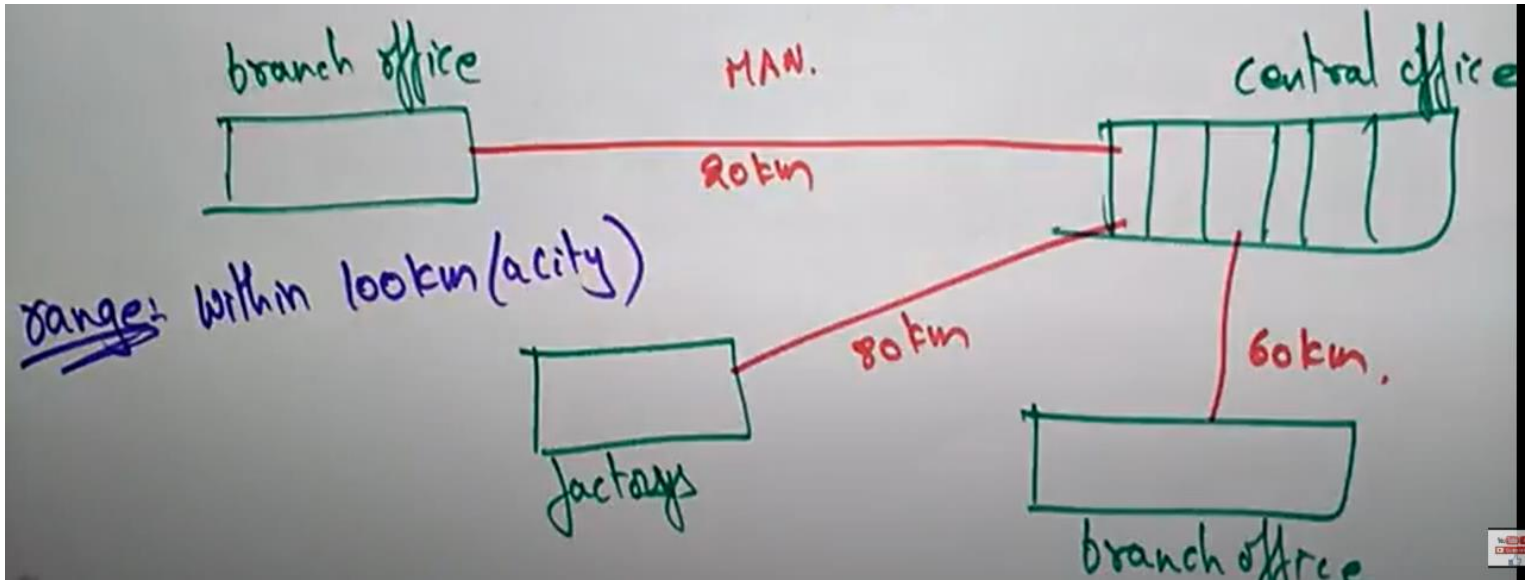
- A second type of broadcast system is the ring. In a ring, each bit propagates around on its own, not waiting for the rest of the packet to which it belongs. Typically, each bit circumnavigates the entire ring in the time it takes to transmit a few bits, often before the complete packet has even been transmitted.
- As with all other broadcast systems, some rule is needed for arbitrating simultaneous accesses to the ring. Various methods, such as having the machines take turns, are in use. IEEE 802.5 (the IBM token ring), is a ring-based LAN operating at 4 to 16 Mbps.
- FDDI (Fiber Distributed-Data Interface) is another example of a ring network.

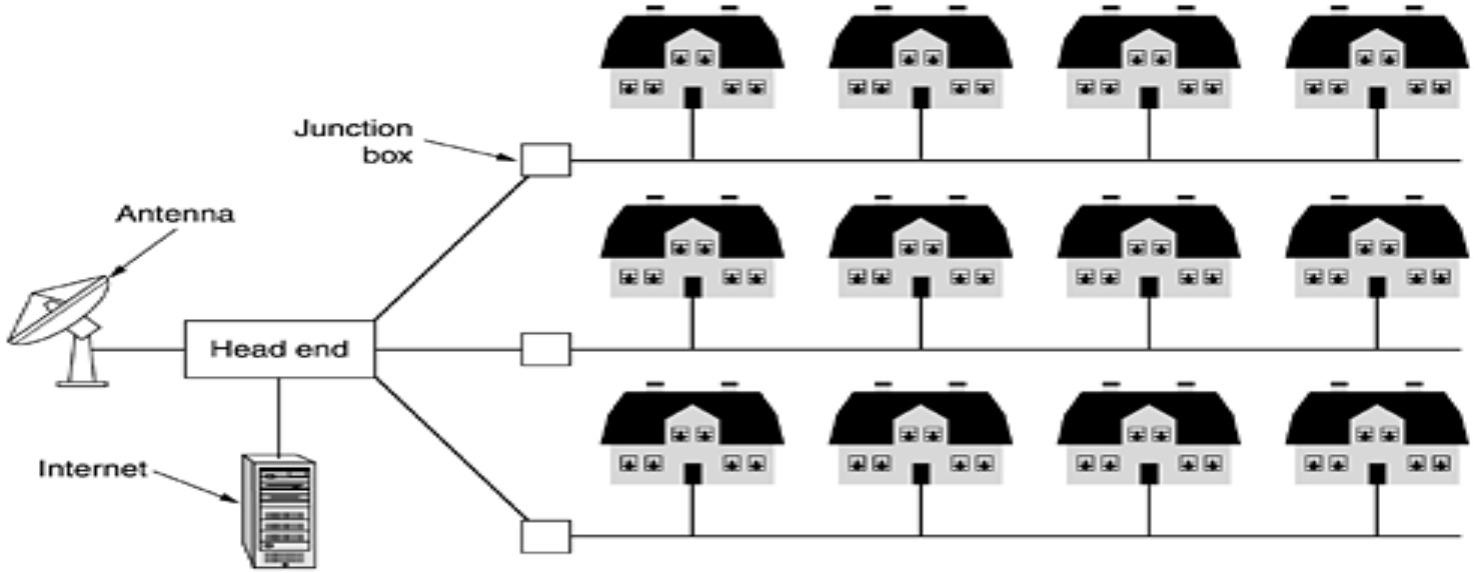


Classification of N/W according to their scale (MAN)

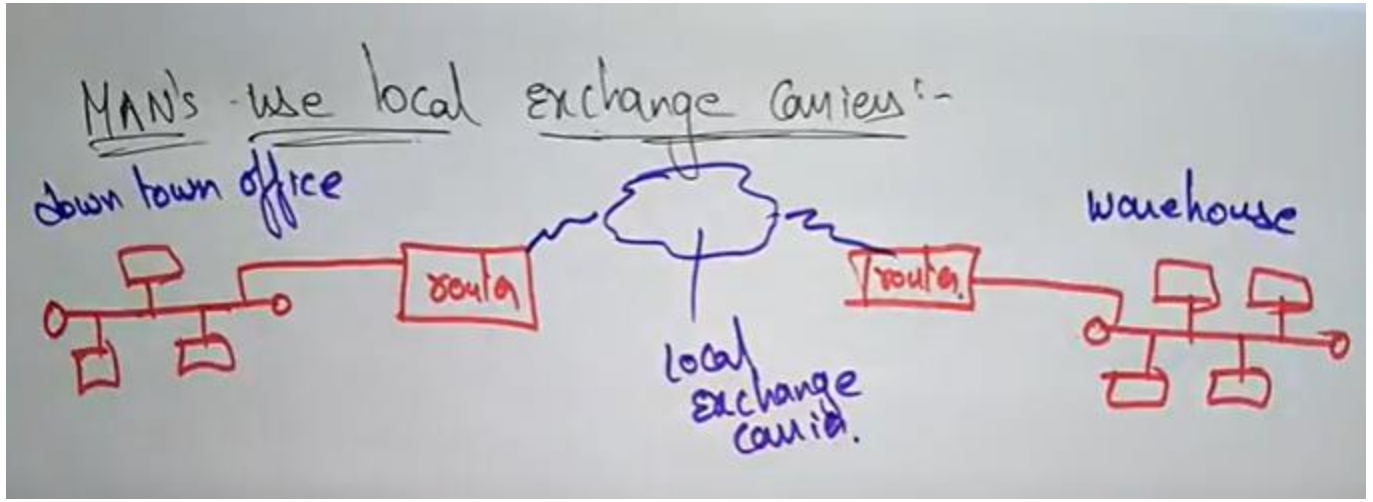
- A metropolitan area network, or MAN, covers a group of nearby corporate offices or a city.
- The best-known example of a MAN is the cable television network available in many cities.
- It may be a single network such as a cable television network or
- it may be a means of connecting a number of LANs into a large network, so that resources may be shared LAN-to-LAN as well as device-to-device.
- For eg. A company can use a MAN to connect the LANs in all of its offices through out a city.
- A MAN may be wholly owned and operated by a private company or it may be a service provided by a public company such as telephone company.
- It is costly
- It uses telecommunication media
- A MAN can support both data and voice.

MAN


branch office
MAN.
central office
80km
range: within 100km (a city)
80km
60km.
factory
branch office



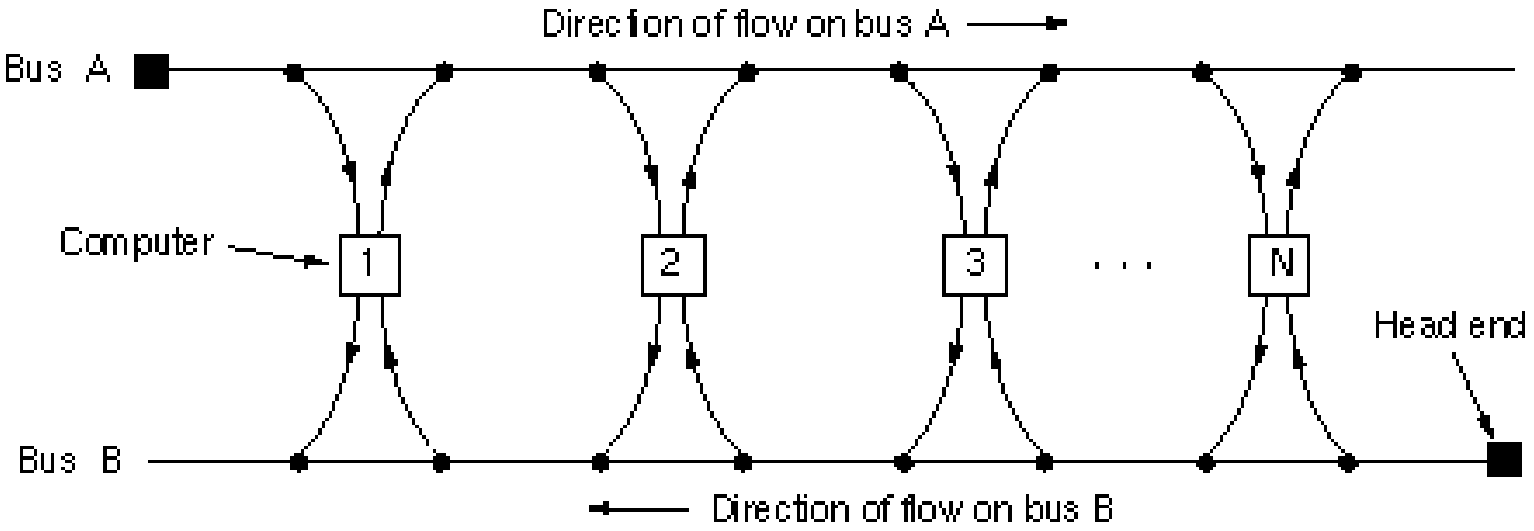
MAN uses Local Exchange Carriers



A metropolitan area network based on cable TV.

- **A MAN mostly works on the data link layer, which is Layer 2 of OSI Model**
- **Speed of MAN ranges in terms of Mbps**

- **A MAN just has one or two cables and doesn't contain switching elements, which transport packets over one of several potential output lines. Not having to switch simplifies the design.**
- **The main reason for each distinguishing between MAN as a special category is that a standard had been adopted them, and this standard is now being implemented.**
- **It is called DQDB (Distributed Queue Dual Bus) or 802.6 standard.**



- DQDB consists of two unidirectional cables (buses) to which all the computers are connected.
- Each bus has a head-end, a device that initiates transmission activity.
- Traffic that is indented for a computer to the right of the sender uses the upper bus and traffic to the left uses the lower one.

Classification of N/W according to their scale (MAN)

- A key aspect of a MAN is that there is a broadcast medium to which all the computers are attached.

- Devices used for MAN implementation:
  1. Modem (Intern-connecting devices such as HUB,Switch,router)
  2. Wire/Cable

- Real life examples of MAN
  1. Cable TV Network in a city
  2. Telephone Networks providing high-speed DSL lines
  3. Many telephone companies provide a popular MAN service called SMDS (Switched Multi-megabit Data Services)

- Switched multimegabit data service (SMDS) was a connectionless service used to connect LANs, MANs and WANs to exchange data.

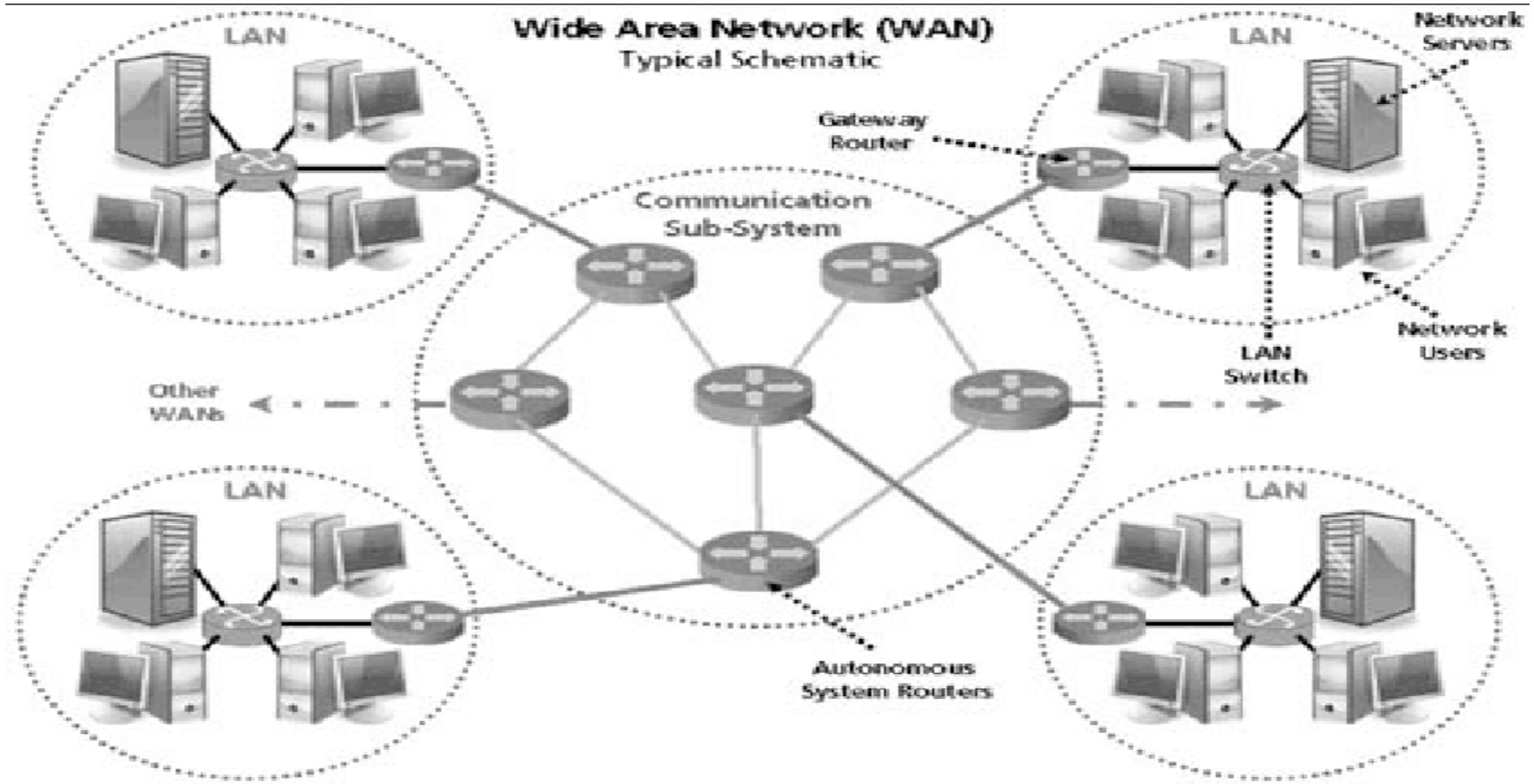
- SMDS was based on the IEEE 802.6 DQDB (Distributed Queue Dual Bus) standard.

Pros and Cons of MAN

- **Advantages of MAN**
- The dual bus used in MAN helps the transmission of data in both directions simultaneously
- **Disadvantages of MAN**
- More cable requirement for MAN connection from one place to another
- It is difficult to make system secure from the hackers

Wide Area Network

- ✓ **Wide Area Network, or WAN, is a geographically distributed network composed of local area networks (LANs) joined into a single large network using services provided by common carriers.**



Classification of N/W according to their scale (WAN)

WAN (Wide Area Network)

- Wide area networks (WANS) are commonly implemented in enterprise networking environments in which company offices are in different cities, states, or countries or on different continents.
- Not constrained to one physical location
- A WAN spans a large geographical area, often a country or continent.
- It enables users to share and access applications
- It provides long-distance transmission of data, voice, image and video information over large geographical areas.

- WAN may utilize public or private communication devices usually combinations and can therefore span an unlimited numbers of miles.

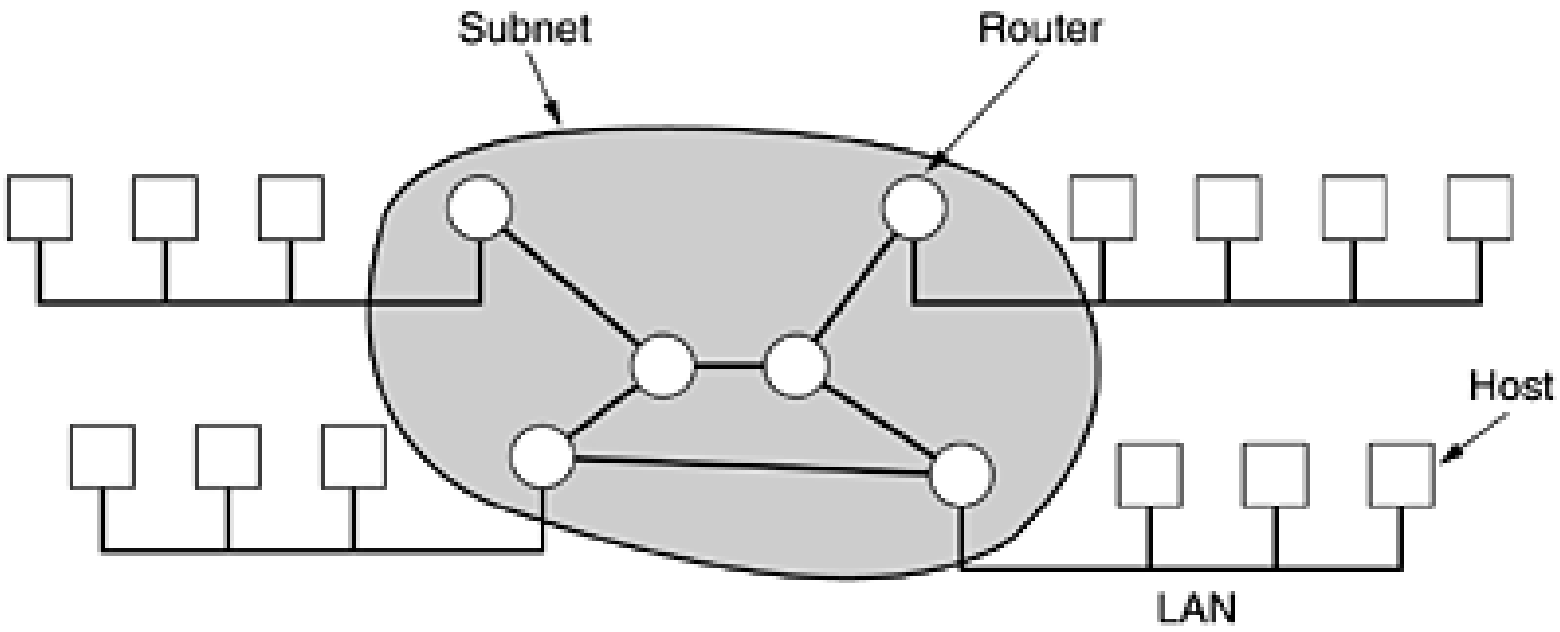
Wide Area Network

- A **leased line** is a **dedicated connection** between your premises and the local exchange.
- **Broadband** is **not a dedicated connection** between your premises and the local exchange.

- **An enterprise network**: A **WAN** that is wholly **owned** and **used** by a single company is often, referred to as an enterprise network.

- **WAN must have capacity for Bandwidth, Connectivity and user access**
- **Organization can use VPN (Virtual Private Network) to facilitate Connectivity and security between LANs**
- **Company can increase Bandwidth using leased line but it comes with high setup cost**
- **It also requires Antivirus software or firewalls for security**

Classification of N/W according to their scale (WAN)



Relation between hosts on LANs and the subnet.

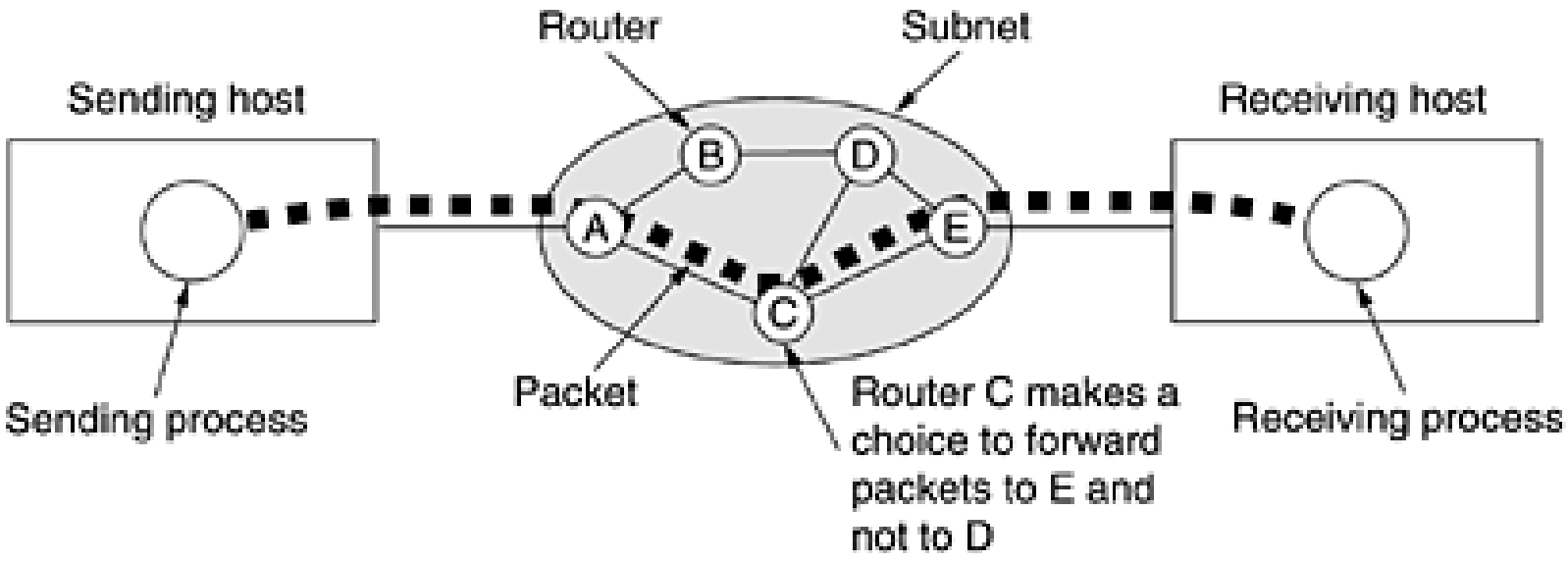
Classification of N/W according to their scale (WAN)

- **WAN contains a collection of machines intended for running user (i.e., application) programs.**
- **These machines are hosts. The hosts are connected by a communication subnet, or subnet.**
- **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.**

Classification of N/W according to their scale (WAN)

- **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 are known as router.**
- **Here 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.**
- **The collection of communication lines and routers (but not the hosts) form the subnet.**

Classification of N/W according to their scale (WAN)



A stream of packets from sender to receiver

Classification of N/W according to their scale (WAN)

- 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.
- Nearly all wide area networks (except those using satellites) have store-and-forward subnets. When the packets are small and all the same size, they are often called cells.

Classification of N/W according to their scale (WAN)

- In Packet-switched subnet, 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. A stream of packets resulting from some initial message is illustrated in previous figure.

Feature	LAN	WAN
Speed	1000 Mbps	150 Mbps
Bandwidth for Transmission	High	Low
Data Transfer Rate	High	Low
Geographical Coverage	Small	Large
Connecting Hardware	10Base-T Cable	Leased Line or Satellite
Technology Used	Token Ring & Ethernet	ATM, Frame Relay, X.25
Transmission Errors	Few	More
Setup Cost	Low	High
Maintenance Costs	Less	More
Network Topology	Peer to Peer	Client Server Model
Security	More Secure than WAN	Open to Threats
Standard	Ethernet	T1
Signal Deterioration	No	Yes
Equipment Needed	Hub, Switch	Router, Modem
Expansion	Using a NIC	Using an Extra Router
Range	1 km	Up to 10000 kms
Printer Sharing	Yes, if in the same LAN	No

Classification of N/W according to their scale (Wireless Network)

- Wireless networks can be divided into three main categories:

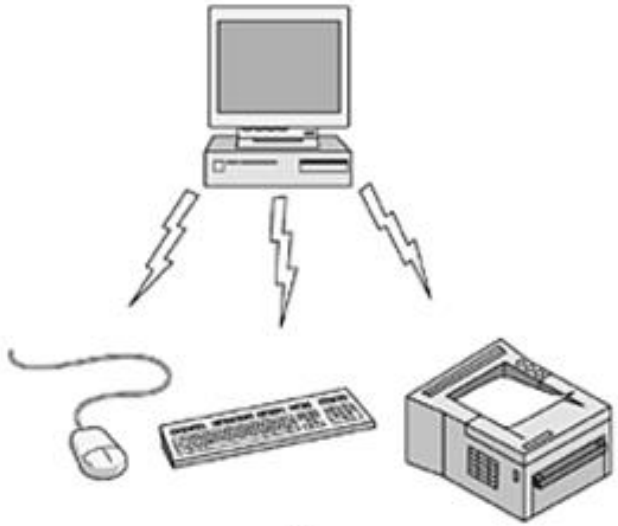
1. System interconnection. 2. Wireless LANs. 3. Wireless WANs.

- System interconnection is all about interconnecting the components of a computer using short-range radio. Almost every computer has a monitor, keyboard, mouse, and printer connected to the main unit by cables, but 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, just put them down, turn them on, and they work. For many people, this ease of operation is a big plus.

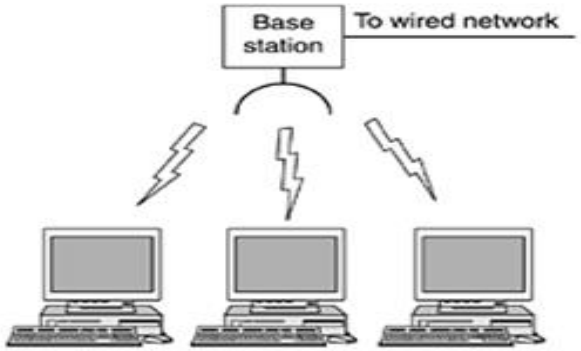
Classification of N/W according to their scale (Wireless Network)

- In the simplest form, system interconnection networks use the master-slave paradigm of Fig. 1-11(a).
- The system unit is normally the master, talking to the mouse, keyboard, etc., as slaves. The master tells the slaves

- what addresses to use,
- when they can broadcast,
- how long they can transmit,
- what frequencies they can use,
- and so on



- **Wireless LANs :**
- These are systems in which every computer has a radio modem and antenna with which it can communicate with other systems. Often there is an antenna on the ceiling that the machines talk to, as shown in Fig. 1-11(b).
- However, if the systems are close enough, they can communicate directly with one another in a peer-to-peer configuration.
- Wireless LANs are becoming increasingly common in small offices and homes, where installing Ethernet is considered too much trouble, as well as in older office buildings, company cafeterias, conference rooms, and other places.
- There is a standard for wireless LANs, called IEEE 802.11, which most systems implement and which is becoming very widespread.



(b)

Classification of N/W according to their scale (Wireless Network)

- **Wireless WANs : The radio network used for cellular telephones is an example of a low-bandwidth wireless system. This system has already gone through three generations.**
- **The first generation was analog and for voice only.**
- **The second generation was digital and for voice only.**
- **The third generation is digital and is for both voice and data.**
- **In a certain sense, cellular wireless networks are like wireless LANs, except that the distances involved are much greater and the bit rates much lower.**
- **Wireless LANs can operate at rates up to about 50 Mbps over distances of tens of meters.**
- **Cellular systems operate below 1 Mbps, but the distance between the base station and the computer or telephone is measured in kilometers rather than in meters.**
- **The initial focus is high-speed wireless Internet access from homes and businesses, bypassing the telephone system. This service is often called local multipoint distribution service. A standard for it, called IEEE 802.16, has also been developed.**

Classification of N/W according to their scale (Home Networks)

- **The fundamental idea is that in the future most homes will be set up for networking. Every device in the home will be capable of communicating with every other device, and all of them will be accessible over the Internet.**
- **Many devices are capable of being networked. Some of the more obvious categories (with examples) are as follows:**

1. **Computers (desktop PC, notebook PC, PDA, shared peripherals).**
2. **Entertainment (TV, DVD, VCR, camcorder, camera, stereo, MP3).**
3. **Telecommunications (telephone, mobile telephone, intercom, fax).**
4. **Appliances (microwave, refrigerator, clock, heater, lights).**
5. **Telemetry (utility meter, smoke/burglar alarm, thermostat).**

Smart Home

- Your refrigerator reminds you about buying vegetables while coming back home or reminds you that you are overeating
- You may be informed about some stranger trying to break into you house in your absence or baby sitter taking a nap instead of taking care of the baby
- The smart spectacles start making noise to help the old people finding out where they have forgotten them
- You can yell out "where are my keys?" and your keys would reply "Here we are"
- You realize that you have forgotten to switch off the lights of your house after reaching office and instruct remotely to do so to your house monitoring system via Internet or phone
- The shower adjusts the temperature of the water looking at your preferences and the temperature outside

- Projects: Aladdin by Microsoft, Aware Home by Georgia Institute of Technology, Gator-Tech Smart House by University of Florida
- Protocols: x10 , ZigBee