Why Use Networks?
All networks offer advantages relative to using a standalone computer—that is, a computer that is not connected to other computers and that uses software applications and data stored on its local disks. Most importantly, networks enable multiple users to share devices (for example, printers) and data (for example, spreadsheet files), which are collectively known as the network’s resources. Sharing devices saves money. For example, rather than buying 20 printers for 20 staff members, a company can buy one printer and have those 20 staff members share it over a network. Sharing devices also saves time. For example, it’s faster for coworkers to share data over a network than to copy data to a removable storage device and physically transport the storage device from one computer to another. Before networks, transferring data via floppy disks was the only possible way to share data.
Another advantage to networks is that they allow you to manage, or administer, resources on multiple computers from a central location. Imagine you work in the Information Technology (IT) department of a multinational bank and must verify that each of 5000 employees around the globe uses the same version of a database program. Without a network you would have to visit every employee’s machine to check and install the proper software. With a network, however, you could check the software installed on computers around the world from the computer on your desk. Because they allow you to share devices and administer computers centrally, networks increase productivity. It’s not surprising, then, that most businesses depend on their networks to stay competitive.

Types of Networks
Computers can be positioned on a network in different ways relative to each other. They can have different levels of control over shared resources. They can also be made to communicate and share resources according to different schemes. The following sections describe two fundamental network models: peer-to-peer and client/server.

Peer-to-peer Networks
The simplest form of a network is a peer-to-peer network. In a peer-to-peer network, every computer can communicate directly with every other computer. By default, no computer on a peer-to-peer network has more authority than another. However, each computer can be configured to share only some of its resources and keep other resources inaccessible to the network. Traditional peer-to-peer networks typically consist of two or more general-purpose personal computers, with modest processing capabilities. Every computer is capable of sending and receiving information to and from every other computer, as shown in Figure 1-1.

![Figure 1-1: Network sharing on a single peer-to-peer network](image)

The advantages of using traditional peer-to-peer networks are:
◆ They are simple to configure.
◆ They are typically less expensive to set up and maintain than other types of networks.
The disadvantages of using traditional peer-to-peer networks are:
◆ They are not very flexible. As a peer-to-peer network grows larger, adding or changing significant elements of the network may be difficult.
◆ They are also not necessarily secure—meaning that in simple installations, data and other resources shared by network users can be easily discovered and used by unauthorized people.
◆ They are not practical for connecting more than a handful of computers, because they do not always centralize resources.

**Client/Server Networks**

Another way of designing a network is to use a central computer, known as a server, to facilitate communication and resource sharing between other computers on the network, which are known as clients. Clients usually take the form of personal computers, also known as workstations. A network that uses a server to enable clients to share data, data storage space, and devices is known as a client/server network.

Every computer on a client/server network acts as a client or a server. Clients on a network can still run applications from and save data to their local hard disk. But by connecting to a server, they also have the option of using shared applications, data, and devices. Clients on a client/server network do not share their resources directly with each other, but rather use the server as an intermediary. Figure 1-2 illustrates how resources are shared on a client/server network.

To function as a server, a computer must be running a network operating system (NOS), a special type of software designed to:
◆ Manage data and other resources for a number of clients
◆ Ensure that only authorized users access the network
◆ Control which type of files a user can open and read
◆ Restrict when and from where users can access the network
◆ Dictate which rules computers will use to communicate
◆ Supply applications to clients

Usually, servers have more memory, processing, and storage capacity than clients. They may even be equipped with special hardware designed to provide network management function beyond that provided by the network operating system. For example, a server may contain an extra hard disk and specialized software so that if the primary hard disk fails, the secondary hard disk automatically takes its place.

Although client/server networks are typically more complex in their design and maintenance than peer-to-peer networks, they offer many advantages over peer-to-peer networks, such as:
◆ User logon accounts and passwords for anyone on a server-based network can be assigned in one place.
◆ Access to multiple shared resources (such as data files or printers) can be centrally granted to a single user or groups of users.
◆ Problems on the network can be tracked, diagnosed, and often fixed from one location.
◆ Servers are optimized to handle heavy processing loads and dedicated to handling requests from clients, enabling faster response time.
◆ Because of their efficient processing and larger disk storage, servers can connect more than a handful of computers on a network.

**LANs, MANs, and WANs**

As its name suggests, a local area network (LAN) is a network of computers and other devices that is confined to a relatively small space, such as one building or even one office. Small LANs first became popular in the early 1980s. At that time LANs might have consisted of a handful of computers connected in a peer-to-peer fashion. Today’s LANs are typically much larger and more complex client/server networks. For example, imagine an office building in which each of a company’s departments runs its own LAN and all the LANs are connected. This network may contain many servers, hundreds of workstations, and several shared CD-ROM devices, printers, plotters, and fax machines. Figure 1-3 roughly depicts this type of network (in reality, the network would probably contain many more clients). As you progress through this book, you will learn about every part of this diagram. In the process, you will learn to integrate these pieces so as to create a variety of networks that are reliable, secure, and manageable. Often separate LANs are interconnected and rely on several servers running many different applications and managing resources other than data. For example, imagine an office building in which each of a company’s departments runs its own LAN and all the LANs are connected. This network may contain many servers, hundreds of workstations, and several shared CD-ROM devices, printers, plotters, and fax machines. Figure 1-3 roughly depicts this type of network (in reality, the network would probably contain many more clients).
Networks may extend beyond the boundaries of a building. A network that is larger than a LAN and connects clients and servers from multiple buildings is known as a metropolitan area network (MAN). Because of the distance it covers, a MAN may use different transmission technology and media than a LAN. A network that connects two or more geographically distinct LANs or MANs is called a wide area network (WAN). Because they carry data over longer distances than LANs, WANs require slightly different transmission methods and media and often use a greater variety of technologies than LANs. WANs commonly connect separate offices in the same organization, whether they are across town or across the world from each other. WANs are also used to connect LANs that belong to different organizations. For example, all the public universities within a state might combine and share their resources via a WAN. The largest and most varied WAN in the world is the Internet. Figure 1-4 depicts a simple WAN.

![Simple WAN](image)

**Simple Physical Topologies**
A physical topology is the physical layout, or pattern, of the nodes on a network. It depicts a network in broad scope; that is, it does not specify device types, connectivity methods, or addressing schemes for the network.

Computer network topologies can be categorized in the following categories.

- **bus**
- **star**
- **ring**
- **mesh**
- **Tree.**

Hybrid networks are the complex networks, which can be built of two or more above mentioned topologies.

**Bus**

Bus topology is a multipoint, one long cable acts as a backbone to link all the devices in the network.

**Advantages of a Linear Bus Topology**

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

**Disadvantages of a Linear Bus Topology**

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building.

\[ \text{Star} \]

A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub or concentrator (See fig. 2). Data on a star network passes through the hub or concentrator before continuing to its destination. The hub or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow. This configuration is common with twisted pair cable; however, it can also be used with coaxial cable or fiber optic cable.

Advantages of a Star Topology

- Easy to install and wire.
- No disruptions to the network then connecting or removing devices.
- Easy to detect faults and to remove parts.

Disadvantages of a Star Topology

- Requires more cable length than a bus topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the concentrators.
**Ring**

In ring Network, every computer or devices has two adjacent neighbors for communication. In a ring network, all the communication messages travel in the same directory whether clockwise or anti clockwise. Any damage of the cable of any cable or device can result in the breakdown of the whole network. Ring topology now has become almost obsolete.

**Mesh**

This type of network topology boasts the highest fault tolerance of all of the network topologies, it is also usually the most expensive.

In a mesh topology each device/PC is connected to every other device/PC in the network by its own cable (see fig 1.2 below), which means vast amounts of cables for any sizeable network.

The Mesh topology provides fault tolerance by having separate cables for each connection, allowing any one cable to break without interfering with the rest of the network.

Unfortunately because each connection needs its own cable a Mesh topology can get very expensive. Every time you add a client to a mesh network you have to run cables to each of the other devices.

The amount of cables you will need for a mesh network can be calculated by: \( CN = \frac{D \times (D-1)}{2} \)

(where \(CN\) is Cables Needed, and \(D\) is the amount of devices on the network)
**Tree**

It is a star but in wide area, we use tree topology when we have a huge no. of pcs or we plan to exceed the no. of pcs.