



Computer Science



Project Consultants
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Student Learning Outcomes

- To explain client/server networking.
- To identify the benefits of network.
- To discuss the structure of networks.
- To describe topology, transmission medium and communication devices.

Networking is the practice of linking two or more computing devices together, mainly for the purpose of sharing data. It also allows to share devices like printers and game consoles and other computers in your home or office. Networks allow many users to access shared data and programs simultaneously. When data and programs are stored on a network and shared, individual users do not need to keep copies of the data and programs on their own computers thus reducing data duplication.

**Client/ Server Networking**

Client/server describes the relationship between two computer programs in which the client program makes a service request to the server program. For example, a web browser is a client program at the user computer that may access information from any web server in the world. To check your bank account from your computer, a web browser client program in your computer forwards your request to a web server program at the bank. That program may in turn forward the request to its own database client program that sends a request to a database server at another bank computer to retrieve your account balance. The balance is returned to the bank database client, which in turn serves it back to the web browser client in your personal computer, which displays the information for you.

The client/server model can be used on the Internet as well as Local Area Networks (LANs).

Benefits of a Network

A network provides many benefits. Three of the most important benefits include the following:

- It allows many users to access programs and data at the same time.
- It allows users to share peripheral devices such as printers and scanners.
- It makes communication easier.

How are Networks Structured?

If you want to understand the different types of networks and how they operate, you need to know how networks are structured. There are three main types of networks.

Local Area Network (LAN)

LAN (Local Area Network) is a network that connects computers and resources together in the same room or two rooms of the same floor or two floors of the same building or buildings that are nearby. This is the most widely used network in organizations. LAN normally operates within a compact area such as an office building or a campus and is owned by the using organizations. A LAN can consist of just two PCs connected together to share resources or it can include hundreds of computers of different kinds. In a large company, for example, two departments may have their own separate LAN but if the departments need to share data, then they can create a link between the two LANs.



Wide Area Network (WAN)

WAN (Wide Area Network) is a network in which two or more LANs are connected together. For example, a company may have its corporate headquarters and manufacturing plant in one city and its marketing office in another city. Each site needs resources, data and programs locally, but it also needs to share data with the other site. To accomplish this feat of data communication, the company can create a WAN. It covers an unlimited distance by using telephone lines, microwave or communication satellite links. This is used by large organizations and government agencies.



Metropolitan Area Network (MAN)

MAN (Metropolitan Area Network) is a very large-scale network that connects multiple corporate LANs together. MANs are not usually owned by a single organization; their communication devices and equipment are usually maintained by a group or single network provider which sells its networking services to corporate customers. MAN often takes the role of a high-speed network that allows for the sharing of regional resources.

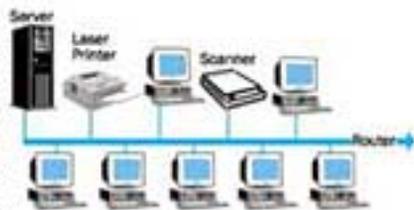


What is Topology?

The word *topology* is derived from the Greek word "Topos" which means "Place". In communication networks, a *topology* is a method of the arrangement of a network, including its nodes i.e. computers and other devices and connecting lines. There are different topologies, as described below:

1. Bus Topology

Bus topology is the most simple, popular and inexpensive of all the topologies. In the bus topology, the server is at one end and the client PCs (devices) are connected at different points or positions. All signals pass through all of the devices. The data transfer rate is between 1 to 50 Mbps (Megabits Per Second) depending on the channel used with certain limitations. If there is a problem with the cable, the entire network goes down.

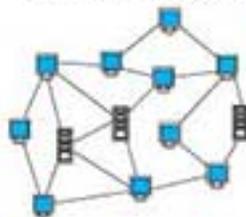
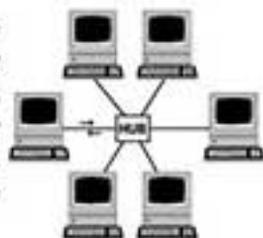


2. Ring Topology

This topology has a simple design and consists of a single cable that forms the main data path in the shape of a ring. Each device is connected to a closed loop of cable. Signals travel in one direction from one node to all other nodes around the loop. The failure of a single node can cause the entire network to fail.

3. Star Topology

This is a form of LAN architecture in which nodes on a network are connected to a common central hub or switch and this is done by the use of dedicated links. It is easier to maintain and troubleshoot large networks. One can easily move a workstation in a star topology by changing the connection to the hub at the central wiring closet. If one connection fails, the rest of the network is unaffected. Use of massive cabling makes this topology expensive to install.

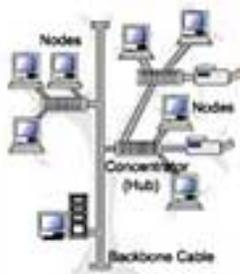


4. Mesh Topology

Mesh topology is a variation of the bus, in which all devices are connected to one another in a daisy-chain fashion as opposed to connecting in sequence to a single network cable. Each node is capable of transmitting, receiving and routing data.

5. Tree Topology

Tree topology is essentially a hybrid of the bus and star layouts. The basic topology is similar to that of a bus, with nodes connected in sequence to a linear central cable. But tree networks may have "branches" that contain multiple workstations that are connected point-to-point in a star-like pattern. Signals from a transmitting node travel the length of the medium and are received by all other nodes.



Transmission Medium

The term transmission medium refers to the material on which signals are carried. In a network, a cable is referred to as a transmission medium. Here are the different types of cables used for transmission:

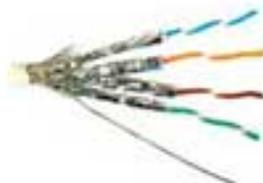
Coaxial Cable

This cable consists of an electrically conductive wire surrounded by an outer layer of insulating material, usually plastic or rubber. The purpose of the shielding layer is to reduce external electrical interference. Coaxial cables are used for transmission of high-frequency audio, video, computer network and other signals.



Twisted Pair Cable

It is the ordinary copper wire cable that connects home and many business computers to the telephone company. To reduce crosstalk or electromagnetic induction between pairs of wires, two insulated copper wires are twisted around each other. Each connection on the twisted pair requires both wires. Since some telephone sets or desktop locations require multiple connections, the twisted pair is sometimes installed in two or more pairs, all within a single cable. For some business locations, the twisted pair is enclosed in a shield that functions as a ground. This is known as Shielded Twisted Pair (STP). Ordinary wire to the home is Unshielded Twisted Pair (UTP).



Optical Fiber or Fiber Optic

This cable is made-up of super-thin filaments of glass or other transparent materials that can carry beams of light. Because a fiber-optic cable is light-based, data can be sent through it at the speed of light. The receiving end of the transmission translates the light signals back into data which can be read by a computer.



Student Learning Outcomes

- To describe robots, their uses, advantages and disadvantages.
- To describe cellular communications, its working and advantages.
- To describe Bluetooth, its working, devices using it and advantages.

Cutting edge is the position of greatest advancement while technology is the process by which humans modify nature to meet their requirements. Thus cutting-edge technology means the most up-to-date, most advanced and latest technology, which has an important impact on our lives.

Robots

A robot is a machine designed to execute one or more tasks repeatedly with speed and precision. There are as many different types of robots as there are tasks for them to perform. A robot can be controlled by a human operator, sometimes from a great distance. But most robots are controlled by computers. People must write instructions for the computer and this is called "programming". Then, the computer tells the robot what to do. Messages are sent from the computer to motors in the robot's parts. For example, a message is sent to the robot's legs, telling it to move in a certain direction and the robot walks. Another message can be sent to the robot's arms and the robot moves its arms. Robots can even walk up and down stairs! Once a robot is correctly programmed, it can perform tasks on its own. However, the robot must always be programmed by a person, as it is never totally independent.

Where is the word "Robot" derived from?

The word robot was introduced for the first time by a Czech writer Karel Čapek in his play R.U.R (an abbreviation of Rossum's Universal Robots) in 1920 and it was translated into English and presented in London and New York in 1923. The term "Robot" is derived from the Czech word "robota" which means "forced labour". In the play, the robots overthrew their human creators.



Karel Čapek

Properties of a Robot

A typical robot has several, though not necessarily all of the following properties:

- It is artificially created.
- It can sense its environment and manipulate or interact with things in it.
- It has some ability to make choices based on the environment, often using automatic control or a preprogrammed sequence.

- ◆ It is programmable.
- ◆ It moves with one or more axis of rotation or translation.
- ◆ It makes dexterous co-ordinated movements.
- ◆ It moves without direct human intervention.
- ◆ It appears to have intent.

Uses of Robots

There are many jobs which a human can perform better than a robot, but in some situations the human either does not want to do or cannot do it because it is dangerous or inaccessible; so robots are used. Such robots are controlled from a distance by a human operator. They are used in many fields because they can use tools, pick things up, carry heavy things, squeeze things together and work without resting or eating. They can work where it is too hot or too cold for humans. Severe cold never bothers robots, so they can even work at the North Pole! Here are some examples of robots used in different fields.

At Home

Robots are increasingly being used in the home where they are taking on simple but unwanted jobs, such as vacuum cleaning, floor cleaning and lawn mowing.



A robot lawn mower



A submarine robot

In the Sea

The depth of the sea is an area where humans find it difficult to go physically so robots are the solutions. They can map the sea floor, explore the ocean depths for scientists and locate shipwrecks for archaeologists. They are extending the reach of the energy industry as they pursue oil into ever-more-difficult environments. They are essential in the development of offshore oil and gas reserves 3,000 to 4,000 meters deep in the oceans.

In Space

The objective of space robots is to perform those jobs that astronauts cannot do in space, such as positioning an instrument to take a measurement, collecting a sample for examination, assembling a structure, etc. The most conventional robot used in space missions is the rover. This vehicle can move around the surface of a planet transporting scientific instruments. Another robot, the NASA Remote Manipulator System (RMS) robot arm has performed a number of tasks on many space missions, serving as a grapple, a remote assembly device and also as a positioning and anchoring device for astronauts working in space.



Dexter the space robot

About the Consultants

Sadaf Yousuf holds a Master's degree in Computer Science and has an experience of more than 18 years as an instructor, trainer and coordinator at various reputable schools. She is currently working as a subject coordinator at a prestigious O Level school in Karachi. She has also worked as a Deputy Academic Coordinator and conducted academic audit of various schools, colleges and institutes in Karachi as well as other cities.

She has also participated in workshops related to teaching and management and has worked as a teachers' trainer to impart IT training to teachers and executives. Her services have been acknowledged by the organizations she has worked for by presenting her with the 'Best employee of the year' award on a number of occasions.

Khazima Anwar has a B.E. Computer Systems degree and has done her MBA in Educational Management. She has worked in different educational institutes as a Computer Science teacher as well as an Academic and Administration Coordinator. She is currently working in a highly reputable system of schools and colleges. Her areas of interest include Educational Leadership, ICT integration and Curriculum Development.



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