Chapter 02 :   Information Networks

2.0   Overview

Q   :   02-00-01   :   What are Information / Computer Networks ?
Q   :   02-00-01   :   Define Information / Computer Networks ?

Answer :
Information networks (computer networks), are at the convergence of two important technologies : computing and telecommunications. This convergence has resulted in local area networks (LANs), metropolitan networks (MANs), wide-area networks (WANs), and the Internet.
A network is a large circulatory system, through which information continuously flows.

2.1   Workgroup Computing

Q   :   02-01-01   :   Define or Describe Workgroup Computing ?

Answer :
Workgroup computing is highly important aspect of modern World computing in today's business, academic, technological, and research oriented atmosphere. It is also known as collaborative computing and it enables the individuals and teams of certain projects to use computer networks for the purpose cooperation, consultation, and information sharing.

2.2   E-mail and Its Benefits

Q   :   02-02-01   :   Define E-mail and Describe its Benefits ?
Q   :   02-02-01   :   What are Benefits of E-mail ?

Answer :
E-mail : **Electronic mail, is the process of sending messages directly from one computer to another (linked through wired or wireless connections).**
Benefits of E-mail :
    Distance : We can communicate with anyone, anywhere. Distance or size of email does not matter. E-mail usually reaches its destination in a matter of minutes or seconds.
    The Cost of Message : It is cost-effective way to communicate with friends, colleagues, or business associates regardless of where they are physically located.
    The Content : We can send letters, notes, files, data, or reports all using the same techniques.
    No Interruption To Recipient : The recipient, working on the computer, is not interrupted by the arrival of the e-mail. It is put in his mail box (on the server) and can be seen and worked upon later, using the e-mail program.
    The User's Computers May Be Off : when the mails arrive (all will stay in the server) and can be read anytime (later).
    E-mails Are Not Anonymous : They always carry an address of the originator. Therefore, we are always sure about where it is coming from and where it is going to.

2.3   Internet

Q   :   02-03-01   :   Define Internet and Describe its History ?
Q   :   02-03-01   :   How and where was Internet Born ?

Answer :

Internet : [**The Internet is a huge network of connected computers that provide us a facility of exchanging data, messages, and files with other computers that are connected to the Internet**]. Internet has brought the world nations to the realization of a **"Global Village",** in which we feel, everyone as close as our neighbor.

History or The Birth of Internet :

During late l960s, it was designed as **ARPANET** (**Advanced Research Project Agency NETwork**) by the US Department of Defense - DARPA, in collaboration with other universities and research organizations. In the beginning, ARPANET was used mainly for communication technology research and development, with scientists at various sites connected through a network, to share the information.

Later, throughout l970s and 1980s, ARPANET evolved into several other networks dedicated mostly to military use. In 1989, all the previous networks, created for military use, were abandoned and replaced by **National Science Foundation's NSFNET**. The Internet has grown rapidly since 1990. According to the Internet Society (the monitoring organization), the number of computer networks in the Internet is more than Two Million and the number of computers that connect to these networks is more than Hundred Million.

Q   :   02-03-02   :   Define or Describe or Explain Components of Internet ?

Answer :

Components of Internet : World Wide Web is popular but actually, the Internet has many more components :

World Wide Web (www) : www is a collection of millions of uploading web pages / web sites. It organizes the Internet-related resources so that we can easily access the information available on the Internet.

Electronic mail (e-mail) : It is the process of sending and receiving messages and files among the Internet users.

Telnet : It is the software tool that allows one computer to connect to another computer and make use of the other computer's information.

File Transfer Protocol (FTP) : It is also an Internet software tool for transferring files from one computer to another. The process of transferring a file from a remote computer to our local computer is called **downloading**. The process of transferring a file from our own computer to the remote computer (on the Internet) is called **uploading**.

Gopher : It is an access and retrieval system covering a wide range of information, from reference materials to magazine articles to government documents and speeches.

Chat Groups : The Internet users with similar interests, form up their forums, to have online real-time discussions over the Internet.

Intranet : It is a privately owned, secure, business network based on Internet technology, although not necessarily connected to the Internet.

Extranet : An "extranet" is two or more intranets connected in such a way that they enable collaboration among the companies that own the separate intranets.

2.4   Components of Network

Q   :   02-04-01   :   Define or Describe Components of Network ?

Answer :

Components of Network : LANs do not use the telephone network. Its networks are constructed with standard set of components :

Local Area Network (LAN)
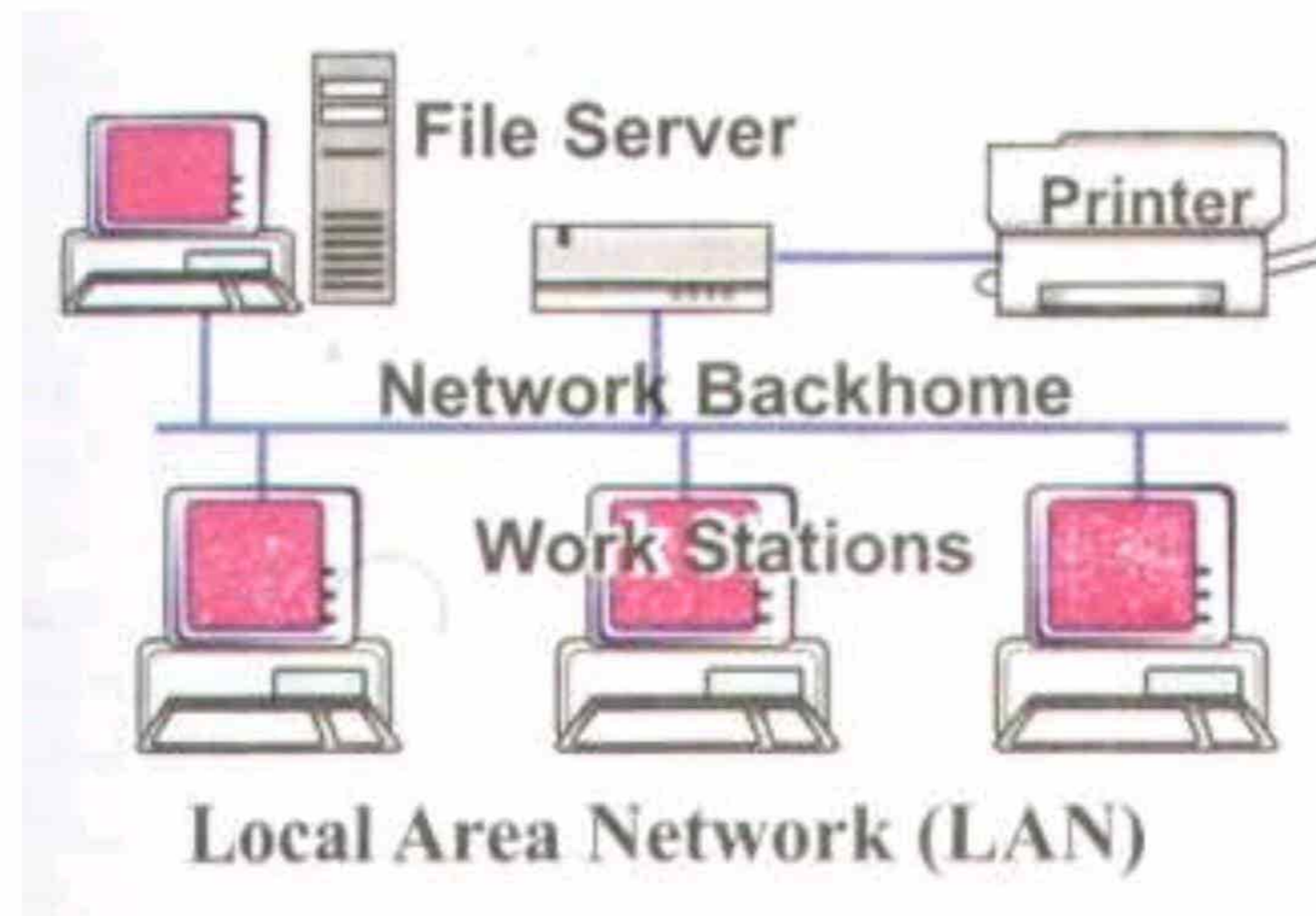
Connection Cables : Low-cost LANs are connected with twisted wire pairs, but many LANs use coaxial cable or fiber optic cable, which are both more expensive and faster. Some LANs are wireless, using infrared or radio wave transmissions instead of cables.

Network-Interface-Card (NIC) : Connects each computer to the wiring in the network. NIC is a circuit board that fits in one of the computer's internal expansion slots (on the mother board). Some computers have built in NIC (on board).

Bridge : Similar networks can be connected by a bridge, which recognizes the messages on a network and passes on those to addressed nodes in the other network.

Gateway : Gateway is a collection of hardware and software resources that lets a node communicate with a computer on another different network.

Router : Router is a device that connects two or more networks, it consist of combination of hardware and software. The hardware can be a network server, a separate computer, or a special black box device. The hardware includes the physical interfaces to the various networks in the internet.

Q   :   02-04-02   :   Define or Describe LAN's Protocol? List commonly used Protocols?

Answer :

LAN's Protocol : Networks have certain rules, called Protocols, to send and receive data, and it is defined in the network software. The most common are :

Ethernet

Token Ring

ARCNet

TCP/IP (Transmission Control Protocol / Internet Protocol)

ISDN (Integrated Series Digital Network) and DSL (Digital Subscriber Line)

Q   :   02-04-03   :   Explain Commonly used Protocols for LAN ?

Answer :

LAN's Protocol : Networks have certain rules, called Protocols, to send and receive data, and it is defined in the network software. The most common are :

Ethernet : Currently, it is the most commonly used protocol. It uses high-speed network cable and bus topology, so it is relatively simple and cheaper. Since all the nodes (computers) use the same cable to send and receive data, they must follow a set of rules about when to communicate otherwise, two or more computers could transmit at the same time causing lost messages. Before transmitting the data, a node listens" to find out if the cable is in use. If so, the node must wait. When the cable is

free from other transmission, the node can begin transmitting immediately This process is also known as **CSMA/CD (Carrier Sense Multiple Access with Collision Detection)**.

If two nodes transmit data at the same time, the messages collide. When a collision occurs, a special message, lasting a fraction of second, is sent out over the network to indicate that it is jammed. Each node stops transmitting, waits a random period of time, and then transmits again. Since the wait period for each node is random, it is unlikely that they will begin transmitting at the same time again.

Token Ring : It is closely associated with IBM, works on the concept of a ring network topology and a token (a kind of electronic signal). The method of controlling access to the shared network cable is called token passing. Only one token is available on the network. When a node on the network wishes to transmit, it first captures the token, only then it can transmit data. When the node has sent its message, it releases the token back to the network. Since only one token is circulating around the network, only one device is able to access the network at a time. Thus no collision occurs but the only disadvantage is its **slow data transfer rate**.

ARCNet : The ARCnet (**Attached Resource Computer network**) has both a topology and networking technology all its own. It uses either twisted-pair wire or coaxial cable, and the star topology is informed with hubs attached to the network. The original ARCnet protocol was very slow, but it became popular because it was inexpensive, reliable, and easy to set up or expand. Fast ARCnet increased the transmission rate to **100 Mbits Per Second** and includes the capability to use fiber optic cable.

TCP/IP (Transmission Control Protocol / Internet Protocol) : [**TCP/IP (Transmission Control Protocol / Internet Protocol): TCP/IP is the protocol used by every computer on the Internet. A protocol is a set of rules and procedures that defines how computer receive and transmit data over the network**]. Every computer on the Internet must have TCP/IP configured. TCP/IP ensures a reliable connection between the computers communicating over the Internet. It also defines a mechanism through which every computer on the Internet is identified separately. TCP/IP software differs for different computers but it always presents the same interface to the network. It does not matter if the system on the other end is a supercomputer, a mainframe, mini computer or a microcomputer; as long as it is using TCP/IP, it can send and receive data through the Internet.

ISDN (Integrated Series Digital Network) : ISDN is a set of international communication standards for software control of transmitting voice, video, and data simultaneously as digital signals over twisted-pair telephone lines. ISDN provides better quality than analog connections and more reliable digital connections at higher speeds than those offered by analog connections.

DSL (Digital Subscriber Line) : DSL provides high speed, digital data transmission from homes and businesses over existing telephone lines. The exiting lines are analog and the transmission is digital, so modems are necessary with DSL technology. DSL is a popular alternative to ISDN.

2.5   LAN VS WAN

Q   :   02-05-01   :   Explain LAN, WAN and MAN ?
Answer :
LAN (Local Area Network) : It is a collection of computers, usually micro computers, that share hardware, software, and In simple terms, LAN hook personal computers together through communications media so that each computer can share the resources with others. As the name implies, LANs cover short distances, usually one office or building or a group of buildings that are close to each other.

WAN (Wide Area Network) : A wide area network is a network of geographically distant computer terminals. WAN is two or more LANs connected together across a wide geographical area using the connectivity mentioned above. The Internet is the ultimate WAN that connects thousands of computers and LANs around the world, ultimately making it as www (World Wide Web).

MAN (Metropolitan Area Network) : A metropolitan area network (MAN) is a communications network covering a geographical area the size of a city. MAN bypasses local telephone companies when accessing long distance services. Mobile phones (Cellular) systems are often MANs.

2.6   Networking Concepts

Q   :   02-06-01   :   Explain the Concept of a Network ?

Answer :

Networking Concept : [**It is a way to connect computers together so that they can communicate, exchange information and pool / share their resources amongst each other**]. In business or education, scientific or technological research, institutes or office atmosphere, networks have revolutionized the use of computer technology. A lot of information is virtually on our table, using the smart powers of browsing and surfing the resources Internet.

Q   :   02-06-02   :   Describe Uses of Network ?

Answer :

Uses of Networks : Networks allow users to :
     Simultaneous access to shared programs and data.
     Share peripheral devices, such as printers and hard disks.
     Send e-mail along with big attachments (files etc).
     Communicate by providing tools for teleconferencing and videoconferencing.

Q   :   02-06-03   :   Explain Network Models ?

Answer :

Network Models : Basically two types (models) of Network :
     Client / Server (Dedicated Server Network) : This arrangement involves a **SERVER**, which is a computer that controls the network. A server has the hard disks holding shared files / databases and often shared quality printer which can be used by all nodes. (Resources are controlled by the file server in a client / server network).
     Peer-To-Peer : All computers in a peer-to-peer arrangement have equal status. No one has control over others. With all files and peripheral devices distributed across several computers, users share each other's data devices as needed. The main disadvantages are lack of speed and security. (Resources are shared among equals in a peer-to-peer network).
     Hybrid : Many networks are hybrid i.e. combination of both client / server and peer-to-peer approaches. This approach takes the advantages of both models.

Q   :   02-06-03   :   Explain Network Standards ?

Answer :

Network Standards : [The standards are the precise documents containing technical and physical specifications about the network being designed]. By following worldwide acceptable standards, the networks can be reliable, efficient and trustworthy.

De-Facto Standard : De Facto "By Tradition" or "By Facts". These standards are most commonly used by the organizations worldwide.

De-Jure Standard : De-Jure means "According To Law or Regulation". The networks governing bodies have properly approved these standards.

American National Standard Institute (**ANSI**).

The Institute of Electrical and Electronics Engineers (**IEEE**).

The International Standard Organization (**ISO**).

The International Telecommunications Union-Telecommunication Standards Sector (**ITU-T**, formally **CCITT**) Consulate Committee International on telegraph and telephone.

The Electronic Industries Association (**EIA**).

Telcordia.

Q   :   02-06-04   :   Explain Network Topologies ?

Answer :

Network Topology : [Topology refers to the layout of connected devices on network. One can think of a topology as a network's "shape"].

Bus : Bus networks (not to be confused with the system bus of a computer) use a common backbone to connect all devices. A single cable, the backbone functions as a shared communication medium, that devices attach or tap into with an interface connector. Ethernet bus topologies are relatively easy to install and don't require much cabling compared to the alternatives. 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet") were popular Ethernet cabling options. Disadvantage is that, if the backbone cable fails, the entire network becomes unusable.

CSMA/CD (Carrier Sense Multiple Access/Collision Detection) : It is a local area network access method in which contention between two or more stations is resolved by collision detection. When two stations transmit at the same time, they both stop and signal a collision has occurred. Each then tries again after waiting a predetermined time period. To avoid another collision, the stations involved each choose a random time interval to schedule the re-transmission of the collided frame.

CSMA/CS (Carrier Sense Multiple Access/Carrier Sense) : A node listens to the bus for a predetermined amount of time before transmitting and waits until the talking node has completed transmission.

CSMA/CR (Carrier Sense Multiple Access/Collision Resolution) : It allows multiple devices to talk at once, a protocol determines which device receives priority.

Ring : In a ring network, every device has exactly two neighbors for communication purposes. All messages travel through a ring in the same direction (effectively either "Clockwise' or Counter clockwise"). A failure in any cable or device breaks the loop and can take down the entire network. Token passing scheme is used in this topology.

Star : Many home networks use the star topology. A star network features a central connection point called a "hub" that maybe an actual hub or a switch. Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet. Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. If the hub fails, however, the entire network also fails.

Tree : Tree topologies integrate multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus, and each hub functions as the root of a tree of devices. This bus / star hybrid approach supports future expandability of the network much better

than a bus were (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub ports) alone.

Mesh : Mesh topologies involve the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. (Recall that in a ring, although two cable paths exist, messages can only travel in one direction.) Some WANs, like the Internet, employ mesh routing. A mesh offers several advantages over other network topologies.

Fault Tolerance : Mesh network has high fault tolerance due to multiple links.

Under Load : Due to multiple links mesh network can work fine even under severe loads.

Troubleshooting : Troubleshooting of mesh network is easy as compared to other networks. If data is not communicated between any two computers then it means that there is some fault in direct links between them.

Disadvantages : These include the difficulty of installation reconfiguration, as well as the cost of maintaining redundant links.

Q : 02-06-05 : Define Open Systems Interconnection(OSI)Model and Explain it layers ?

Answer :

The Open Systems Interconnection (OSI) : This model was created by **International Organization for Standardization (ISO)** to provide a logical framework for how data communication processes should interact across networks. Standards were created for the computer industry allowing different networks to work together efficiently.

The OSI model has the upper layers and lower layers. The upper layers focus on user applications and how files are represented on the computers prior to transport. It's the lower layers that concentrate on how the communication across a network actual occurs.

Application Layer : Provides network services to user applications. It responsible for exchanging information between programs running on the machine, such as an e-mail program, and other services running on a network such as a print server or another computers' application.

Presentation Layer : Concerned with how data is converted and formatted for data transfer. Examples of format conversions include ASCII text for documents and .gif and JPG for images. This layer performs code conversion, data translation, compression and encryption.

Session Layer : Determines how two devices establish, maintain and manage a connection - how they talk to each other. These connections are called sessions.

Transport Layer : Responsible for breaking the data into segment, establishing an end-to-end logical connection between machines, and providing for error handling.

Network Layer : Responsible for determining addressing on the network determining the routes that information will take on its journey, and managing network traffic congestion. Data at this level is packaged into packets.

Data Link Layer : Provides the link for how data, packaged into frames is communicated through hardware to be transported across a medium. It communicates with network cards, manages physical layer communication between connecting systems and handles error notification.

Physical Layer : Specifies how data is processed into bits physically transferred over medium, such as cables. Its responsible for activating and maintaining the physical link between systems.