

Study Material

INTEGRATED B.ED – M.ED

Cluster University of Jammu

UNIT: THIRD (NETWORKING)



ICT IN EDUCATION

COMPUTER NETWORK

A computer network or data network is a telecommunications network that allows computers to exchange data. In computer networks, networked computing devices pass data to each other along data connections. The connections (network links) between nodes are established using either cable media or wireless media. The best-known computer network is the Internet.

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices are said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

Computer networks support applications such as access to the World Wide Web, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications. Computer networks differ in the physical media used to transmit their signals, the communications protocols to organize network traffic, the network's size, topology and organizational intent.

Definition - What does Computer Network mean?

A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users. Networks are commonly categorized based on their characteristics. One of the earliest examples of a computer network was a network of communicating computers that functioned as part of the U.S. military's Semi-Automatic Ground Environment (SAGE) radar system. In 1969, the University of California at Los Angeles, the Stanford Research Institute, the University of California at Santa Barbara and the University of Utah were connected as part of the Advanced Research Projects Agency Network (ARPANET) project. It is this network that evolved to become what we now call the Internet.

Networks are used to:

- Facilitate communication via email, video conferencing, instant messaging, etc.
- Enable multiple users to share a single hardware device like a printer or scanner.
- Enable file sharing across the network.
- Allow for the sharing of software or operating programs on remote systems.
- Make information easier to access and maintain among network users.



IMPORTANCE OF COMPUTER NETWORK IN SCHOOLS

Speed.

Networks provide a very rapid method for sharing and transferring files. Without a network, files are shared by copying them to floppy disks, then carrying or sending the disks from one computer to another. This method of transferring files in this manner is very time-consuming.

Cost.

The network version of most software programs are available at considerable savings when compared to buying individually licensed copies. Besides monetary savings, sharing a program on a network allows for easier upgrading of the program. The changes have to be done only once, on the file server, instead of on all the individual workstations.

Centralized Software Management.

One of the greatest benefits of installing a network at a school is the fact that all of the software can be loaded on one computer (the file server). This eliminates that need to spend time and energy installing updates and tracking files on independent computers throughout the building.

Resource Sharing. Sharing resources is another area in which a network exceeds stand-alone computers. Most students cannot afford enough laser printers, fax machines, modems, scanners, and CD-ROM players for each computer. However, if these or similar peripherals are added to a network, they can be shared by many users.

Flexible Access.

School networks allow students to access their files from computers throughout the school. Students can begin an assignment in their classroom, save part of it on a public access area of the network, then go to the media center after school to finish their work. Students can also work cooperatively through the network.

Security.

Files and programs on a network can be designated as "copy inhibit," so that you do not have to worry about illegal copying of programs. Also, passwords can be established for specific directories to restrict access to authorized users.

Main challenges of installing a School Network

Costs :- Although a network will generally save money over time, the initial costs can be substantial, and the installation may require the services of a technician.

Requires Administrative Time:- Proper maintenance of a network requires considerable time and expertise. Many students have installed a network, only to find that they did not budget for the necessary administrative support.

File Server May Fail.- Although a file server is no more susceptible to failure than any other computer, when the files server "goes down," the entire network may come to a halt. When this happens, the entire school may lose access to necessary programs and files.

CLASSIFICATION OF NETWORK AS PER GEOGRAPHICAL LOCATIONS

Computer networks are classified in Different types of Networks as per Geographical location is given below:-

- **Local Area Networks. (LAN)**
- **Wide Area Networks. (WAN)**
- **Metropolitan Area Networks. (MAN)**
- **Personal Area Networks. (PAN)**
- **Home Area Networks. (HAN)**
- **Backbone Networks. (BBN)**
- **Global Area Networks. (GAN)**



LOCAL AREA NETWORK (LAN)

LAN Stands for "Local Area Network" and is pronounced "lan." A LAN is a network of connected devices that exist within a specific location. LANs may be found in homes, offices, educational institution, or other areas.

A LAN may be wired, wireless, or a combination of the two. A standard wired LAN uses Ethernet to connect devices together. Wireless LANs are typically created using a Wi-Fi signal. If a router supports both Ethernet and Wi-Fi connections, it can be used to create a LAN with both wired and wireless devices.

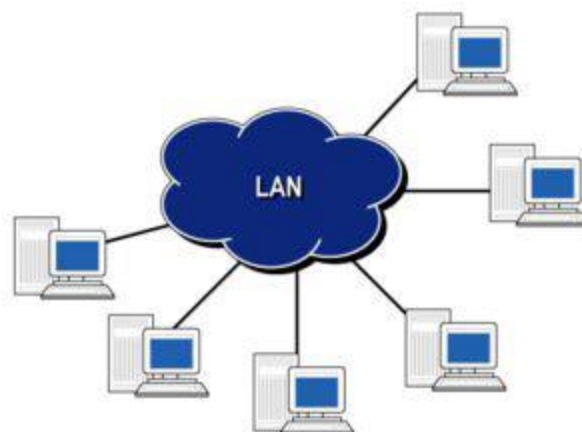
Types of LANs

Most residential LANs use a single router to create the network and manage all the connected devices. The router acts as the central connection point and enables devices, such as computers, tablets, and smartphones to communicate with each other. Typically, the router is connected to a cable or DSL modem, which provides Internet access to connected devices.

A computer may also be the central access point of a LAN. In this setup, the computer acts as a server, providing connected machines with access to files and programs located on the server. It also includes LAN software used to manage the network and connected devices. LAN servers are more common in business and educational networks, since the extra capabilities are not required by most home users. In a server-based LAN, devices may connect directly to the server or indirectly via a router or switch.

The following characteristics differentiate one LAN from another:

- **Topology:** The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.
- **Protocols:** The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.
- **Media:** Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.



ADVANTAGES OF LAN (LOCAL AREA NETWORK)

1. Resource Sharing

Computer resources like printers, modems, DVD-Rom drives and hard disks can be shared with the help of local area networks. This will reduce cost of hardware purchases.

2. Software Applications Sharing

It is cheaper to use same software over network instead of purchasing separate licensed software for each client in a network.

3. Easy and Cheap Communication

Data and messages can easily be transferred over networked computers.

4. Centralized Data

The data of all network users can be saved on hard disk of the server computer. This will help users to use any workstation in a network to access their data. Because data is not stored on workstations locally.

5. Data Security

Since, data is stored on server computer centrally, it will be easy to manage data at only one place and the data will be more secure too.

6. Internet Sharing

Local Area Network provides the facility to share a single internet connection among all the LAN users. In Net Cafes, single internet connection sharing system keeps the internet expenses cheaper.

Disadvantages of LAN (Local Area Network)

1. High Setup Cost

Although the LAN will save cost over time due to shared computer resources but the initial setup costs of installing Local Area Networks is high.

2. Privacy Violations

The LAN administrator has the rights to check personal data files of each and every LAN user. Moreover he can check the internet history and computer use history of the LAN users.

3. Data Security Threat

Unauthorized users can access important data of an organization if centralized data repository is not secured properly by the LAN administrator.

4. LAN Maintenance Job

Local Area Network requires a LAN Administrator. Because, there are problems of software installations or hardware failures or cable disturbances in Local Area Network. A LAN Administrator is needed at this full time job.

5. Covers Limited Area

Local Area Network covers a small area like one office, one building or a group of nearby buildings.

WAN (Wide Area Network)

The term Wide Area Network (WAN) usually refers to a network which covers a large geographical area, and use communications circuits to connect the intermediate nodes. A major factor impacting WAN design and performance is a requirement that they lease communications circuits from telephone companies or other communications carriers. Transmission rates are typically 2 Mbps, 34 Mbps, 45 Mbps, 155 Mbps, 625 Mbps (or sometimes considerably more).

It is similar to a Local Area Network (LAN), but it's a lot bigger. Unlike LANs, WANs are not limited to a single location. Many wide area networks span long distances via telephone lines, fiber optic cables, or satellite links. They can also be composed of smaller LANs that are interconnected. The Internet could be described as the biggest WAN in the world. You could even call the Internet a Super WAN BAM if you wanted to. Or maybe not.

A WAN connects more than one LAN and is used for larger geographical areas. WANs are similar to a banking system, where hundreds of branches in different cities are connected with each other in order to share their official data.

A WAN works in a similar fashion to a LAN, just on a larger scale. Typically, TCP/IP is the protocol used for a WAN in combination with devices such as routers, switches, firewalls and modems.



Advantages of WANS

If your company has branches in several locations, a wide area network is a viable option to boost productivity and increase internal communications. Below are some of the more critical business advantages to establishing a WAN:

- **Centralizes IT infrastructure** — Many consider this WAN's top advantage. A WAN eliminates the need to buy email or file servers for each office. Instead, you only have to set up one at your head office's data center. Setting up a WAN also simplifies server management, since you won't have to support, back-up, host, or physically protect several units. Also, setting up a WAN provides significant economies of scale by providing a central pool of IT resources the whole company can tap into.
- **Boosts your privacy** — Setting up a WAN allows you to share sensitive data with all your sites without having to send the information over the Internet. Having your WAN encrypt your data before you send it adds an extra layer of protection for any confidential material you may be transferring. With so many hackers out there just dying to steal sensitive corporate data, a business needs all the protection it can get from network intrusions.
- **Increases bandwidth** — Corporate WANS often use leased lines instead of broadband connections to form the backbone of their networks. Using leased lines offers several pluses for a company, including higher upload speeds than your typical broadband connections. Corporate WANS also generally offer unlimited monthly data transfer limits, so you can use these links as much as you like without boosting costs. Improved communications not only increase efficiency but also boost productivity.
- **Eliminates Need for ISDN** — WANS can cut costs by eliminating the need to rent expensive ISDN circuits for phone calls. Instead, you can have your WAN carry them. If your WAN provider "prioritizes voice traffic," you probably won't see any drop off in voice quality, either. You may also benefit from much cheaper call rates when compared to calls made using ISDN circuits. Some companies use a hybrid approach. They have inbound calls come over ISDN and outbound calls go over the WAN. This approach won't save you as much money, but it will still lower your bill.
- **Guaranteed uptime** — Many WAN providers offer business-class support. That means you get a specific amount of uptime monthly, quarterly, or yearly as part of your SLA. They may also offer you round the clock support. Guaranteed uptime is a big plus no matter what your industry. Let's face it. No company can afford to be down for any length of time in today's business environment given the stringent demands of modern customers.
- **Cuts costs, increase profits** — In addition to eliminating the need for ISDN, WANS can help you cut costs and increase profits in a wide variety of other ways. For example, WANS eliminate or significantly reduce the costs of gathering teams from different offices in one location. Your marketing team in the United States can work closely with your manufacturing team in Germany using video conferencing and email. Saving on the travel costs alone could make investing in a WAN a viable option for you.

WANS also provide some key technical advantages as well. In addition to providing support for a wide variety of applications and a large number of terminals, WANS allow companies to expand their networks through plug-in connections over locations and boost interconnectivity by using gateways, bridges, and routers. Plus, by centralizing network management and monitoring of use and performance, WANS ensure maximum availability and reliability.

Disadvantages of WANS

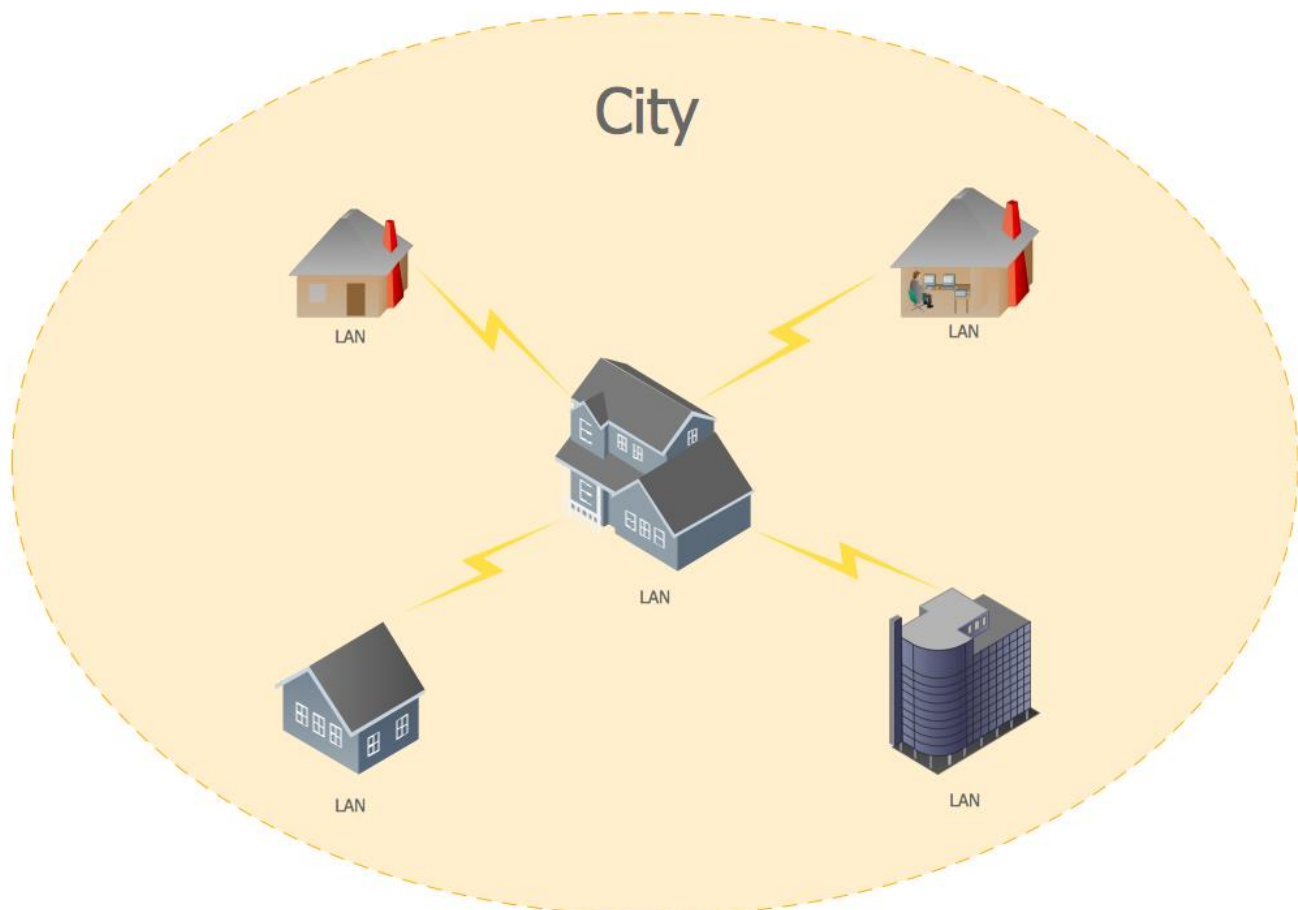
While WANS provide numerous advantages, they have their share of disadvantages. As with any technology, you need to be aware of these downsides to make an informed decision about WANS. The three most critical downsides are high setup costs, security concerns, and maintenance issues.

- **High setup costs** — WANS are complicated and complex, so they are rather expensive to set up. Obviously, the bigger the WAN, the costlier it is to set up. One reason that the setup costs are high is the need to connect far-flung remote areas. However, by using public networks, you can set up a WAN using just software (SD-WAN), which reduces setup costs. Keep in mind also that the price/performance ratio of WANS is better now than a decade or so ago.
- **Security Concerns** — WANS open the way for certain types of internal security breaches, such as unauthorized use, information theft, and malicious damage to files. While many companies have some security in place when it comes to the branches, they deploy the bulk of their security at their data centers to control and manage information sent to their locations. This strategy reduces management costs but limits the company's ability to deal directly with security breaches at their locations. Some companies also have a hard time compressing and accelerating SSL traffic without significantly increasing security vulnerabilities and creating new management challenges.
- **Maintenance Issues** — Maintaining a WAN is a challenge, no doubt about it. Guaranteeing that your data center will be up and operating 24/7 is the biggest maintenance challenge of all. Data center managers must be able to detect failures before they occur and reduce data center downtime as much as possible, regardless of the reasons. Downtime is costly, in fact, a [study](#) done by

METROPOLITAN AREA NETWORKS (MAN).

A Metropolitan Area Network (MAN) is a large computer network on the large geographical area that include several buildings or even the entire city (metropolis). The geographical area of the MAN is larger than LAN, but smaller than WAN. MAN includes many communicating devices and provides the Internet connectivity for the LANs in the metropolitan area.

MAN is used to combine into a network group located in different buildings into a single network. The diameter of such a network can range from 5 to 50 kilometers. As a rule, MAN does not belong to any particular organization, in most cases, a group of users or a provider who takes charge for the service own its connecting elements and other equipment. Level of service is agreed in advance and some warranties are discussed. MAN often acts as a high-speed network to allow sharing regional resources (like a big LAN). It is also often used to provide public available connection to other networks using a WAN connection. There are many ways of classifying networks. The main criterion for classification is considering the administration method. That is, depending on how the network is organized and how it is controlled, it can be attributed to local or distributed, metropolitan or WAN. or her A network administrator manages a network or it's segment. Administration team activities are logged, and their rights and responsibilities are strictly divided if the network is complex. Computers can be connected using a variety of media access controllers: a twisted pair, optical conductors (optical cables) and via radio (wireless technology). Wired optical connections are usually established via Ethernet, wireless - through Wi-Fi, Bluetooth, GPRS and other protocols. Private LAN may be linked to other local area networks through gateways, as well as being part of a global computer network (eg, the Internet), or have a connection to it.



PERSONAL AREA NETWORK

A personal area network (PAN) is a computer network used for data transmission among devices such as computers, telephones and personal digital assistants. PANs can be used for communication among the personal devices themselves (intrapersonal communication), or for connecting to a higher level network and the Internet (an uplink).

HOME NETWORK

A home network or home area network (HAN) is a type of local area network that develops from the need to facilitate communication and interoperability among digital devices present inside or within the close vicinity of a home. Devices capable of participating in this network—smart devices such as network printers and handheld mobile computers—often gain enhanced emergent capabilities through their ability to interact. These additional capabilities can then be used to increase the quality of life inside the home in a variety of ways, such as automation of repetitious tasks, increased personal productivity, enhanced home security, and easier access to entertainment.

BACKBONE NETWORK

A backbone network or network backbone is a part of computer network infrastructure that interconnects various pieces of network, providing a path for the exchange of information between different LANs or sub networks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than the networks connected to it.

BROADBAND GLOBAL AREA NETWORK

The Broadband Global Area Network (BGAN) is a global satellite internet network with telephony using portable terminals. The terminals are normally used to connect a laptop computer to broadband Internet in remote locations, although as long as line-of sight to the satellite exists, the terminal can be used anywhere. The value of BGAN terminals is that unlike other satellite Internet services which require bulky and heavy satellite dishes to connect, a BGAN terminal is about the size of a laptop and thus can be carried easily. The network is provided by Inmarsat and uses three geostationary satellites called I-4 to provide almost global coverage.

COMPONENTS OF NETWORKING

Basic computer network components

Computer networks share common devices, functions, and features including servers, clients, transmission media, shared data, shared printers and other hardware and software resources, network interface card(NIC), local operating system(LOS), and the network operating system (NOS).

Servers - Servers are computers that hold shared files, programs, and the network operating system. Servers provide access to network resources to all the users of the network. There are many different kinds of servers, and one server can provide several functions. For example, there are file servers, print servers, mail servers, communication servers, database servers, fax servers and web servers, to name a few.

Clients - Clients are computers that access and use the network and shared network resources. Client computers are basically the customers(users) of the network, as they request and receive services from the servers.

Transmission Media - Transmission media are the facilities used to interconnect computers in a network, such as twisted-pair wire, coaxial cable, and optical fiber cable. Transmission media are sometimes called channels, links or lines.

Shared data - Shared data are data that file servers provide to clients such as data files, printer access programs and e-mail.

Shared printers and other peripherals - Shared printers and peripherals are hardware resources provided to the users of the network by servers. Resources provided include data files, printers, software, or any other items used by clients on the network.

Network Interface Card - Each computer in a network has a special expansion card called a network interface card (NIC). The NIC prepares(formats) and sends data, receives data, and controls data flow between the computer and the network. On the transmit side, the NIC passes frames of data on to the physical layer, which transmits the data to the physical link. On the receiver's side, the NIC processes bits received from the physical layer and processes the message based on its contents.

Local Operating System - A local operating system allows personal computers to access files, print to a local printer, and have and use one or more disk and CD drives that are located on the computer. Examples are MS-DOS, Unix, Linux, Windows 2000, Windows 98, Windows XP etc.

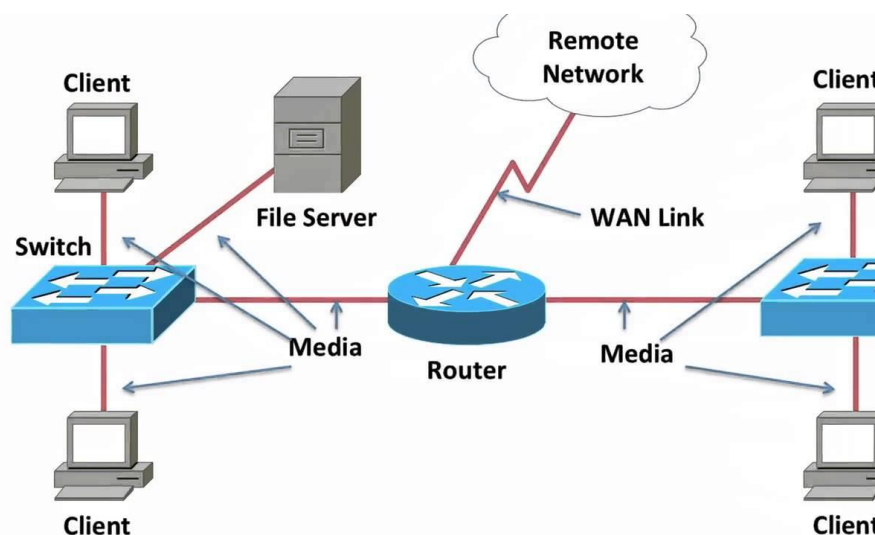
Network Operating System - The network operating system is a program that runs on computers and servers, and allows the computers to communicate over the network.

Hub - Hub is a device that splits a network connection into multiple computers. It is like a distribution center. When a computer requests information from a network or a specific computer, it sends the request to the hub through a cable. The hub will receive the request and transmit it to the entire network. Each computer in the network should then figure out whether the broadcast data is for them or not.

Switch - Switch is a telecommunication device grouped as one of computer network components. Switch is like a Hub but built in with advanced features. It uses physical device addresses in each incoming messages so that it can deliver the message to the right destination or port.

Like a hub, switch doesn't broadcast the received message to entire network, rather before sending it checks to which system or port should the message be sent. In other words, switch connects the source and destination directly which increases the speed of the network. Both switch and hub have common features: Multiple RJ-45 ports, power supply and connection lights.

Router - When we talk about computer network components, the other device that used to connect a LAN with an internet connection is called Router. When you have two distinct networks (LANs) or want to share a single internet connection to multiple computers, we use a Router. In most cases, recent routers also include a switch which in other words can be used as a switch. You don't need to buy both switch and router, particularly if you are installing small business and home networks. There are two types of Router: wired and wireless. The choice depends on your physical office/home setting, speed and cost.



APPLICATIONS OF NETWORKING

Applications of Computer Networks

A network is a collection or set of computing devices connected to one another to establish communication and also share available resources. A network will comprise of software and hardware devices. You can have a network even if you are not connected to the internet. Computer networks make it possible for people to transfer files from one place to another and to communicate taking the shortest time possible.

Computer network applications are network software applications that utilize the Internet or other network hardware infrastructure to perform useful functions for example file transfers within a network. They help us to transfer data from one point to another within the network.

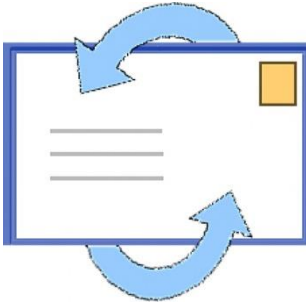
There are 2 types of network applications:-

1. Pure network applications
2. Standalone network application

(A) Pure Network Applications

These are applications created to be used in networks; using pure network applications on a single computer doesn't make sense. They help us to transfer data and communicate within a network. Such applications have a separate and distinct user interface that users must learn for instance:-

Outlook Express



Outlook Express, an email program | Source

1. Email programs

They allow users to type messages at their local nodes and then send to someone on the network. It is a fast and easy way of transferring mail from one computer to another. Examples of electronic mail programs (Clients) are:-

- Pegasus mail
- Outlook express
- Eudora Windows mail
- Fox mail
- Opera
- Poco mail
- Mozilla Thunderbird
- Windows mail

2. File transfer protocol (FTP)

This application facilitates transfer of files from one computer to another e.g. from a client to a server. There are 2 common processes involved in FTP

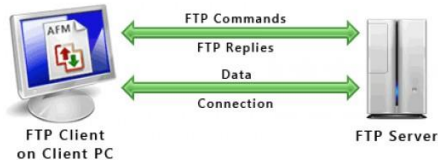
Downloading: - This is the process of obtaining files from a server to a workstation or a client (for example when you download programs and music from a server).

Uploading:- This is obtaining of files from a workstation to a server (for instance when you attach documents and upload them to a server, a good example being when you upload photos to Facebook).

Examples of FTP programs are:-

- **FTP in Unix**
- **FTP in Linux or**
- **FTP in Windows**

File Transfer Protocol Process



File transfer protocol process

3. Terminal Emulation (TELNET)

It allows a workstation to access the server for an application program. This enables you to control the server and communicate with other servers on the network. The workstation appears as a dumb terminal that is directly attached to the server. The user feels like he/she is using the server directly. **TELNET** enables PCs and workstations to function as dumb terminals in sessions with hosts on inter-networks.

4. Groupware

These applications are used to automate the administration functions of a modern office for instance **video conferencing** and **chatting**. They facilitate the work of groups and improve on their productivity; they can be used to communicate, co-operate, coordinate, solve problems, compete, negotiate among others.

(i) Video Conferencing

This is the process of conducting a **conference** between two or more participants at different sites by using computer networks to transmit audio and video data. For example, a *point-to-point* (two-person) video conferencing system works much like a video telephone.

Each participant has a video camera, microphone, and speakers mounted on his or her computer. As the two participants speak to one another, their voices are carried over the network and delivered to the others speakers, and whatever images appear in front of the video camera appear in a window on the other participant's monitor.

(ii) Chatting

It is a real-time communication between two users via computer. Once a chat has been initiated, either user can enter text by typing on the keyboard and the entered text will appear on the other user's monitor. The two must be online for a chat to be initiated. Most networks, cybers and online services offer a chat feature which enables computer users to chat as they go on with their work.

(B) Stand Alone Applications

These are applications that run on **stand alone computers** (computers not connected to any other). In order to extend their activity, they are rebuilt to run on network environments e.g. word processors, spreadsheets, database management systems, presentations graphics, project management etc. They function even when the computer is offline.