1.1 What is Internet?

The Internet is a global network connecting millions of computing devices throughout the world. Example of these computing devices is traditional desktop PCs, Unix-based workstations, laptops, servers. These devices are called hosts or end systems and the internet applications such as the Web and e-mail are network application programs that run on such end systems.

Unlike online services, which are centrally controlled, the Internet is decentralized by design. Each *host*, is independent. Its operators can choose which Internet services to use and which local services to make available to the global Internet community. ISPs choose what forms of access to provide customers, ranging from traditional modem dial-up to DSL and cable modem to T1/T3 lines. Internet access can be granted through a commercial ISP.

Internet is highly intertwined structure with all the network entities (end systems, routers, and bridges) using a common set of protocols to communicate with each other. The bottom-to-top hierarchy of internet consists of end systems (PCs, workstations, and so on) connected to local Internet service providers (ISPs). The local ISPs are in turn connected to regional ISPs which are in turn connected to the national and international ISPs. The national and international ISPs belong to the highest tier in the hierarchy.

An ISP (Internet service provider) is a company that provides individuals and companies access to the Internet and other related services such as Web site building and virtual hosting. An ISP has the equipment and the telecommunication line access required to have a point-of-presence on the Internet for the geographic area served. The larger ISPs have their own high-speed leased lines so that they are less dependent on the telecommunication providers and can provide better service to their customers. Among the largest national and regional ISPs are AT&T WorldNet, IBM Global Network, MCI, Netcom, UUNet, and PSINet.

An ISP provides its customers with several service levels including the following:

- Digital Subscriber Line (DSL): a telephone technology for delivering high-speed access through ordinary telephone lines found in homes and businesses.

- Cable Modem: a cable television technology that piggybacks digital access to the Internet on top of the analog video cable providing television signals to a home.
- T1: an international telephone standard for digital communication that offers guaranteed delivery at 1.54 Mbps
- T3: an international telephone standard for digital communication that offers guaranteed delivery at 43 Mbps

Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/Internet Protocol). TCP and IP are two of the most important protocols in the Internet and are collectively known as TCP/IP. Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol.
Intranet is a TCP/IP network located within a single organization for purposes of communications and information processing. Extranet is formed when firms permit outsiders to access their internal TCP/IP networks.

The most widely used part of the Internet is the World Wide Web (often abbreviated "WWW" or called "the Web"). Uniform resource locator (URL) is the address used by a Web browser to identify the location of content on the Web. *The Internet* is not synonymous with *World Wide Web*. Using the Web, you have access to millions of pages of information. Web browsing is done with a Web browser, the most popular of which are Microsoft Internet Explorer and Netscape Navigator.

As mentioned earlier, the Internet connects millions of computers (hosts) worldwide. The underlying protocol with which these systems communicate is called TCP/IP. Any computer system directly connected to the network has a domain name and an IP (numeric) address. The domain names are typically of the form "system.site.domain"; e.g., nrl.navy.mil. The most common domain types are:

- .com: for commercial organization
- .edu: for educational organization

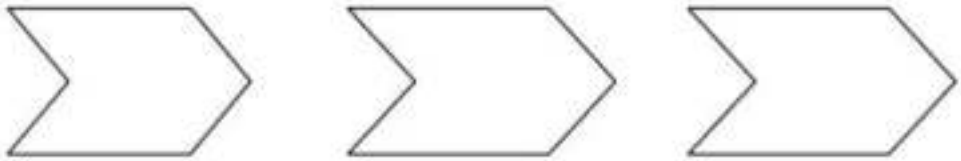
- .gov: for government organization
- .mil: for military (DoD) organization
- .net: for network organization
- .org: for non profit organization
- .au, .uk, etc: country codes for countries other than the USA

The basic communication language or protocol of the Internet TCP/IP provides two types of services: Connection-Oriented Service and Connectionless Service.

The connection-oriented service is a network service that establishes logical connections between end users before transferring information. This logical connection is also called handshaking process in which client and server send control packets to each other before sending real data. Once the handshaking procedure is finished, a connection is established between the two end systems. The Internet's connection-oriented service comes bundled with several other services, including reliable data transfer, flow control, and congestion control. TCP (Transmission Control Protocol) is the Internet's connection-oriented service.

The connectionless service is a network service that transfers information between end users without establishing a logical connection or virtual circuit between those specific users. This means there is no handshaking with the Internet's connectionless service. In this the data is delivered faster. But there are no acknowledgements either, so a source never knows for sure which packets have reached the destination. Moreover the service makes no provision for flow control or congestion control compared to the connection-oriented services. UDP (User Datagram Protocol) provides the Internet's connectionless service.

Various applications like Telnet (remote login), SMTP (for electronic mail), FTP (for file transfer) and HTTP (for web) use TCP connection. UDP is used in application such as Internet phone, audio-on-demand, and video conferencing.
The Internet was conceived by the Advanced Research Projects Agency (ARPA) of the U.S. government in 1969 and was first known as the ARPANET. The original aim was to create a network that would allow users of a research computer at one university to be able to "talk to" research computers at other universities. A side benefit of ARPANet's design was that, because messages could be routed or rerouted in more than one direction, the network could continue to function even if parts of it were destroyed in the event of a military attack or other disaster. Today, the Internet is a public, cooperative, and self-sustaining facility accessible to hundreds of millions of people worldwide.
Figure 1.1 illustrates the different stages of the development of the Internet.



Innovation
1961-1974

Institutionalization
1975-1995

Commercialization
1995 - present

Figure 1.1 ♦ Stages in the Development of the Internet

The Internet is governed by the following groups:

- Internet Architecture Board (IAB)
- Internet Corporation for Assigned Names and Numbers (ICANN)
- Internet Engineering Steering Group (IESG)
- Internet Engineering Task Force (IETF)
- Internet Society (ISOC)
- World Wide Web Consortium (W3C)

1.2 Network Protocols

All communications between devices require an agreement among the communicating devices on the format of the data and how the data is going to be sent. The set of rules defining the agreement between the communicating devices is called a *protocol*. Protocols are defined as the rules and encoding specifications for sending data. In computer networks, they are an agreed-upon format for transmitting data between two devices. A protocol includes formatting rules that specify how data is packaged into messages. It also may include conventions like message acknowledgement or data compression to support reliable and/or high-performance communication.
In addition, protocols can include sophisticated techniques for detecting and recovering from transmission errors and for encoding and decoding data.

At the very least, a communications protocol must define the following:

- rate of transmission
- whether transmission is to be *synchronous* or *asynchronous*
- whether data is to be transmitted in *half-duplex* or *full-duplex* mode
- the type of error checking to be used
- data compression method, if any
- how the sending device will indicate that it has finished sending a message
- how the receiving device will indicate that it has received a message

Many protocols exist in computer networking ranging from high level such as the Simple Object Access Protocol (SOAP), to low level such as the Address Resolution Protocol (ARP). The Internet Protocol family includes IP and all higher-level network protocols built on top of it, such as TCP, UDP, HTTP, and FTP. Modern operating systems include services or daemons that implement support for specific protocols. Some protocols, like TCP/IP, have also been implemented in silicon hardware for optimized performance. In the next sections, a quick overview is provided about some of the commonly used network protocols.

1.2.1 Examples of Network Protocols

Many Internet users are familiar with the even higher layer application protocols that use TCP/IP to get to the Internet. These include the World Wide Web's Hypertext Transfer Protocol (HTTP), the File Transfer Protocol (FTP), Telnet (Telnet) which lets you logon to remote computers, and the Simple Mail Transfer Protocol (SMTP). These and other protocols are often packaged together with TCP/IP as a "suite."

- **HTTP**

HTTP is the set of rules for exchanging files of all types (including multimedia) on the World Wide Web. Web browsers are HTTP clients working with the TCP/IP guidelines for the effective exchange of files, and are used to surf the Web.

- **FTP**

This venerable protocol has been around since the early days of the Internet and is used to send and receive files on established Internet collections. FTP supports anonymous and authorized log-ins and transfers of all types of files. One of the most common uses of FTP is adding and removing web pages on a web site.

- **IPX**

IPX is associated with Novell's NetWare networking software. IPX networks have their own addressing schemes, but very much resemble TCP/IP

- **PPP**

When connecting to the Internet with a modem, the Point to Point protocol is used. User names and passwords are part of the underlying UNIX structure used to support these connections. When PPP is used and an authorized connection is established, your PC actually becomes a node on the Internet capable of communicating as fast as the modems involved will allow. When an AOL account (or similar) is started, the setup software configures not only the interface screens and file structures, but establishes proper PPP settings as well.

- **WAP**

The Wireless Access Protocol (WAP) has been the enabling force behind cellular and wireless phones (along with PDA devices) to be able to receive and exchange Internet content.

- **SSL**

The Secure Socket Layer (SSL) is a protocol that provides secure communications between the client and the server

- **SMTP**

The Simple Mail Transfer Protocol (SMTP) is the Internet protocol used to send mail to a server

- **POP**

The Post Office Protocol (POP) is a protocol used by the client to retrieve mail from an Internet server

- **IMAP**

The Internet Mail Access Protocol (IMAP) is a more current e-mail protocol that allows users to search, organize, and filter their mail prior to downloading it from the server

- **Telnet**

Telnet is a terminal emulation program that runs in TCP/IP

- **Finger**

Finger is a utility program supported by UNIX computers that tells who is logged in, how long they have been attached, and their user name

- **Ping**

Ping is a program that allows you to check the connection between your client and the server

1.3 Network Types

Networks can be classified into several types based on the area covered. Several network types have been defined which include the following: local area networks, wide area networks, metropolitan area networks, etc.
In the following section, all network types will be covered in more details.

1.3.1 LAN (Local-Area Network):

A Local Area Network (LAN) is a computer network that spans a relatively small area. It is generally limited to a geographic area such as a writing lab, school, or building. Rarely are LAN computers more than a mile apart. Most LANs are confined to a single building (Figure 1.2) or group of buildings (Figure 1.3). However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a *wide-area network (WAN).*

Most LANs connect workstations and personal computers. Each *node* (individual computer) in a LAN has its own CPU with which it executes programs, but it also is able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

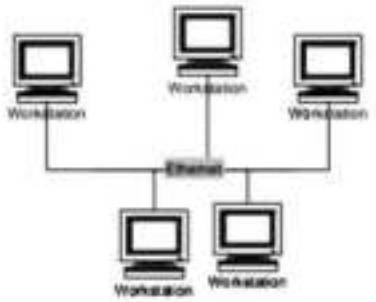


Figure 1.2 ♦ Single Building LAN

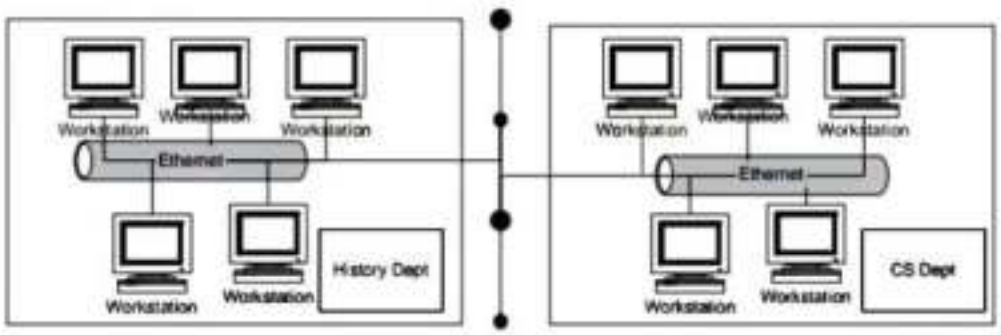


Figure 1.3 ♦ Multiple Building LAN

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distances are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

There are many different types of LANs, *Ethernets* being the most common for PCs.

The term *Ethernet* refers to the family of local-area network (LAN) products covered by the IEEE 802.3 standard that defines what is commonly known as the CSMA/CD protocol. 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. Three data rates are currently defined for operation over optical fiber and twisted-pair cables:

- 10 Mbps—10Base-T Ethernet
- 100 Mbps—Fast Ethernet
- 1000 Mbps—Gigabit Ethernet

10-Gigabit Ethernet is under development and will likely be published as the IEEE 802.3ae supplement to the IEEE 802.3 base standard in late 2001 or early 2002.

Another popular LAN protocol for PCs is the *IBM token-ring network*. LANs cane be physically interconnected into several topologies including the following: bus topology, star topology, ring topology, and tree topology. Those types of Network topologies will be discussed in more details in the upcoming sections

1.3.2 WAN (Wide-Area Networks):

WAN network is a computer network that spans a relatively large geographical area(Figure 1.4). Typically, a WAN consists of two or more local-area networks (LANs). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest and the most popular WAN in existence is the Internet. Many smaller portions of the Internet, such as extranets, are also WANs.

A WAN spans a large geographic area, such as a state, province or country. WANs often connect multiple smaller networks, such as LANs or MANs. WANs generally utilize different and much more expensive networking equipment than do LANs. Technologies sometimes found in WANs include SONET, frame relay, and ATM.

The term WAN distinguishes a broader telecommunication structure from a local area network. A wide area network may be privately owned or rented, but the term usually

connotes the inclusion of public (shared user) networks. An intermediate form of network in terms of geography is a metropolitan area network (MAN).

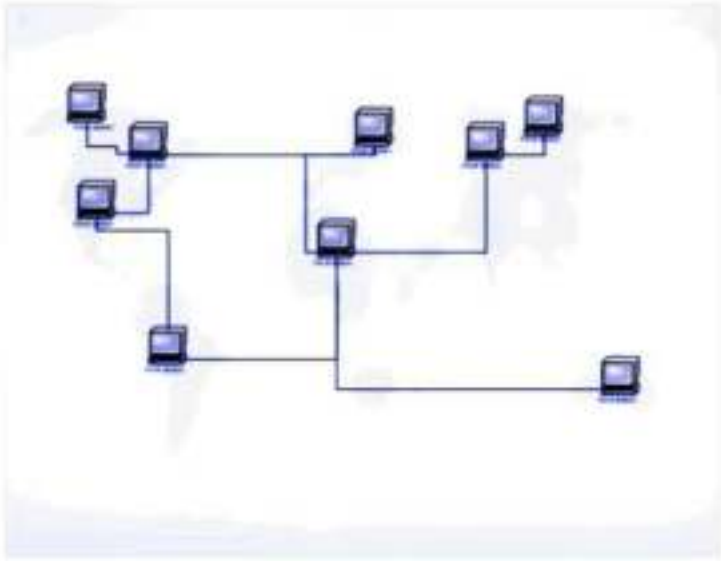


Figure 1.4 ♦ WAN

1.3.3 1.1.3 MAN (Metropolitan-Area Network):

A MAN network (Figure 1.5) is a relatively new class of network, it serves a role similar to an ISP, but for corporate users with large LANs. A MAN (metropolitan area network) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). We could say that a MAN is designed to extend over an entire city. The term is applied to the interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network). It is also used to mean the interconnection of several local area networks by bridging them with backbone lines. The latter usage is also sometimes referred to as a *campus network*. There are three important features which discriminate MANs from LANs or WANs:

1. The network size falls intermediate between LANs and WANs. A MAN typically covers an area of between 5 and 50 km diameter. Many MANs cover an area the size of a city, although in some cases MANs may be as small as a group of buildings or as large as the North of Scotland.
2. A MAN (like a WAN) is not generally owned by a single organization. The MAN, its communications links and equipment are generally owned by either a

consortium of users or by a single network provider who sells the service to the users. This level of service provided to each user must therefore be negotiated with the MAN operator, and some performance guarantees are normally specified.

3. A MAN often acts as a high speed network to allow sharing of regional resources (similar to a large LAN). It is also frequently used to provide a shared connection to other networks using a link to a WAN.

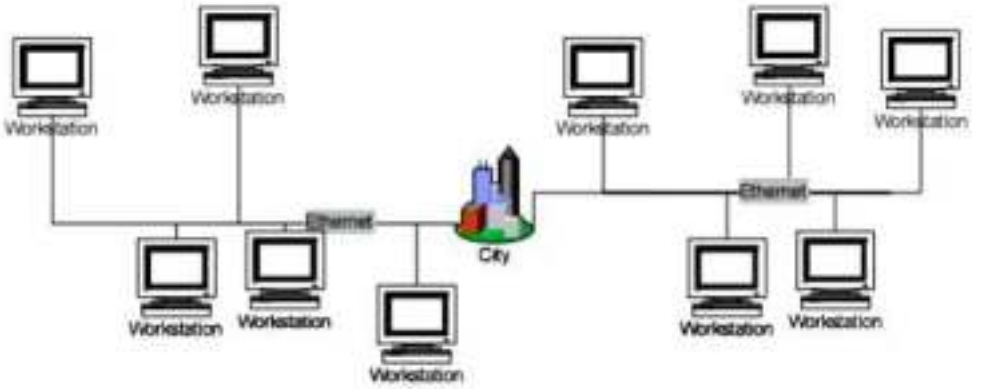


Figure 1.5 ♦ MAN network

1.3.4 Wireless Networks

A wireless network is an infrastructure for communication "through the air", in other words, no cables are needed to connect from one point to another. These connections can be used for speech, e-mail, surfing on the Web and transmission of audio and video. The most widespread use is mobile telephones. Wireless networks are also used for communication between computers. Figure 1.6 illustrates the basic architecture of a wireless network.

Figure 1.6: wireless network environment

Wireless networks can be used for voice services, video/audio services, data services, E-learning, E-trade, E-mail, Internet browsing, remote signaling, remote control,

Wireless networks have some strengths as well as weaknesses. The strengths include the easiness of installing such network, low price, high capacity, no cables need to be destroyed, no transmission costs such as leased lines, etc. As for the weaknesses, they include the following: sensitive equipments, line of sight, lower capacity lower compared to that provided by fiber cables, etc.

When designing a wireless network, several factors have to be taken into consideration. Those factors include the following: the mobility of network nodes, scalability of the network size, limited communication resources, efficient handoff when moving from one cell to another, call blocking, co-interference, traffic engineering, etc.

Transmission Media:

On any network, the various entities must communicate through some form of media. Just as humans can communicate through telephone wires or sound waves in the air, computers can communicate through cables, light, and radio waves. Transmission media enable computers to send and receive messages but do not guarantee that the messages will be understood.

Most common network transmission media are coaxial cable, shielded twisted-pair cable, and unshielded twisted-pair cable, fiber-optic cable and wireless communications.

Select the appropriate media for various situations. Media choices include the following:

- Twisted-pair cable
- Coaxial cable
- Fiber-optic cable
- Wireless communications

Situational elements include the following:

- Cost
- Distance limitations
- Number of nodes

Types of transmission media

There are two categories of transmission media used in computer communications.

Bounded media/Guided media

Unbounded media/Unguided media

Bounded media:

Bounded media are the physical links through which signals are confined to narrow path. These are also called guide media. Bounded media are made up of a external conductor (Usually Copper) bounded by jacket material. Bounded media are great for LABS because they offer high speed, good security and low cast. However, some time they cannot be used due distance communication. Three common types of bounded media are used of the data transmission. These are

- Coaxial Cable
- Twisted Pairs Cable
- Fiber Optics Cable

Coaxial cable

Coaxial cable gets its name because it contains two conductors that are parallel to each other. The center conductor in the cable is usually copper. The copper can be either a solid wire or stranded martial.
Outside this central Conductor is a non-conductive material. It is usually white, plastic material used to separate the inner Conductor form the outer Conductor. The other Conductor is a fine mesh made from Copper. It is used to help shield the cable form EMI.

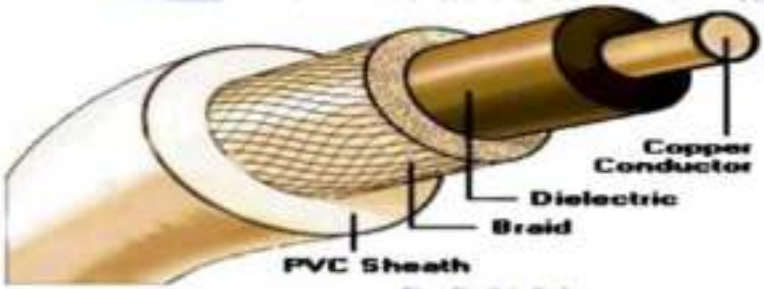


Fig 1.Coaxial cable

Twisted Pair Cable

The most popular network cabling is Twisted pair. It is light weight, easy to install, inexpensive and support many different types of network. Twisted pair cabling is made of pairs of solid or stranded copper twisted along each other. The twists are done to reduce vulnerably to EMI and cross talk. The number of pairs in the cable depends on the type. There are two types of twisted pair cables:

1. Unshielded twisted pair (UTP)

It is the most common type of telecommunication when compared with Shielded Twisted Pair Cable which consists of two conductors usually copper, each with its own colour plastic insulator. Identification is the reason behind coloured plastic insulation.

UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use **RJ-11** connector and 4 pair cable use**RJ-45** connector

Shielded Twisted Pair Cable

This cable has a metal foil or braided-mesh covering which encases each pair of insulated conductors. Electromagnetic noise penetration is prevented by metal casing. Shielding also eliminates crosstalk .It has same attenuation as unshielded twisted pair. It is faster the unshielded and coaxial cable. It is more expensive than coaxial and unshielded twisted pair.

Fiber Optic Cable

These are similar to coaxial cable. It uses electric signals to transmit data. At the centre is the glass core through which light propagates.

In multimode fibres, the core is 50microns, and In single mode fibres, the thickness is 8 to 10 microns.The core in fiber optic cable is surrounded by glass cladding with lower index of refraction as compared to core to keep all the light in core.

This is covered with a thin plastic jacket to protect the cladding. The fibers are grouped together in bundles protected by an outer shield.

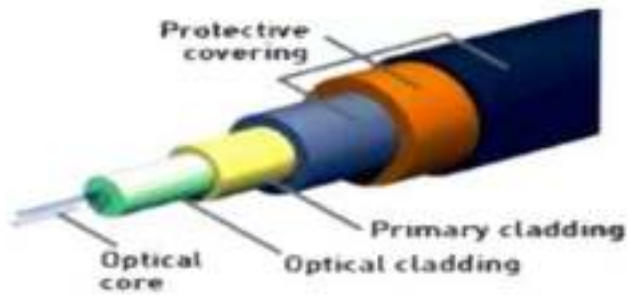


Fig.2.Fiber optic cable

Web Browser

web Browser is an application software that allows us to view and explore information on the web. User can request for any web page by just entering a URL into address bar.

Web browser can show text, audio, video, animation and more. It is the responsibility of a web browser to interpret text and commands contained in the web page.

Earlier the web browsers were text-based while now a days graphical-based or voice-based web browsers are also available. Following are the most common web browser available today:

Browser	Vendor
Internet Explorer	Microsoft
Google Chrome	Google
Mozilla Firefox	Mozilla
Netscape Navigator	Netscape Communications Corp.
Opera	Opera Software
Safari	Apple
Sea Monkey	Mozilla Foundation
K-meleon	K-meleon

Architecture

There are a lot of web browser available in the market. All of them interpret and display information on the screen however their capabilities and structure varies depending upon implementation. But the most basic component that all web browser must exhibit are listed below:

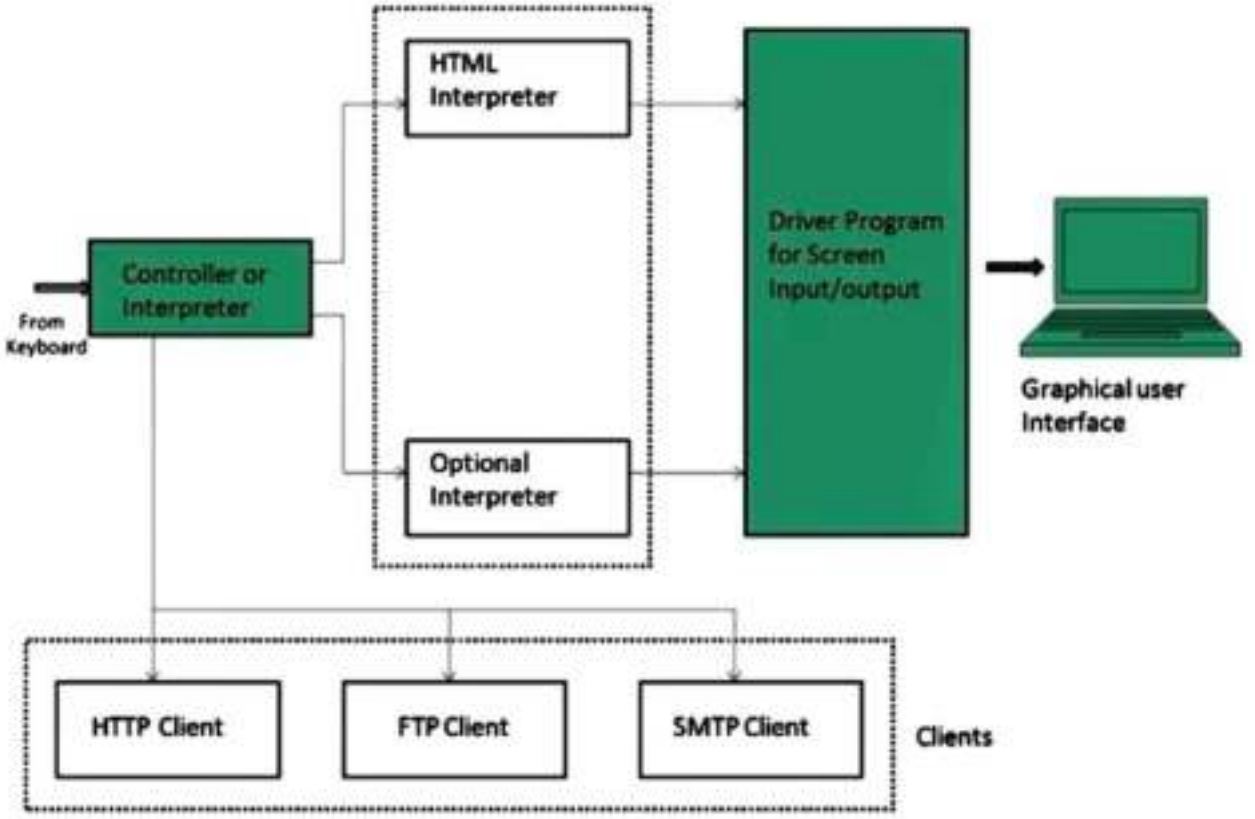
- Controller/Dispatcher
- Interpreter
- Client Programs

Controller works as a control unit in CPU. It takes input from the keyboard or mouse, interpret it and make other services to work on the basis of input it receives.

Interpreter receives the information from the controller and execute the instruction line by line. Some interpreter are mandatory while some are optional For example, HTML interpreter program is mandatory and java interpreter is optional.

Client Program describes the specific protocol that will be used to access a particular service. Following are the client programs tat are commonly used:

- HTTP
- SMTP
- FTP
- NNTP
- POP



Starting Internet Explorer

Internet explorer is a web browser developed by Microsoft. It is installed by default with the windows operating system howerver, it can be downloaded and be upgraded.

To start internet explorer, follow the following steps:

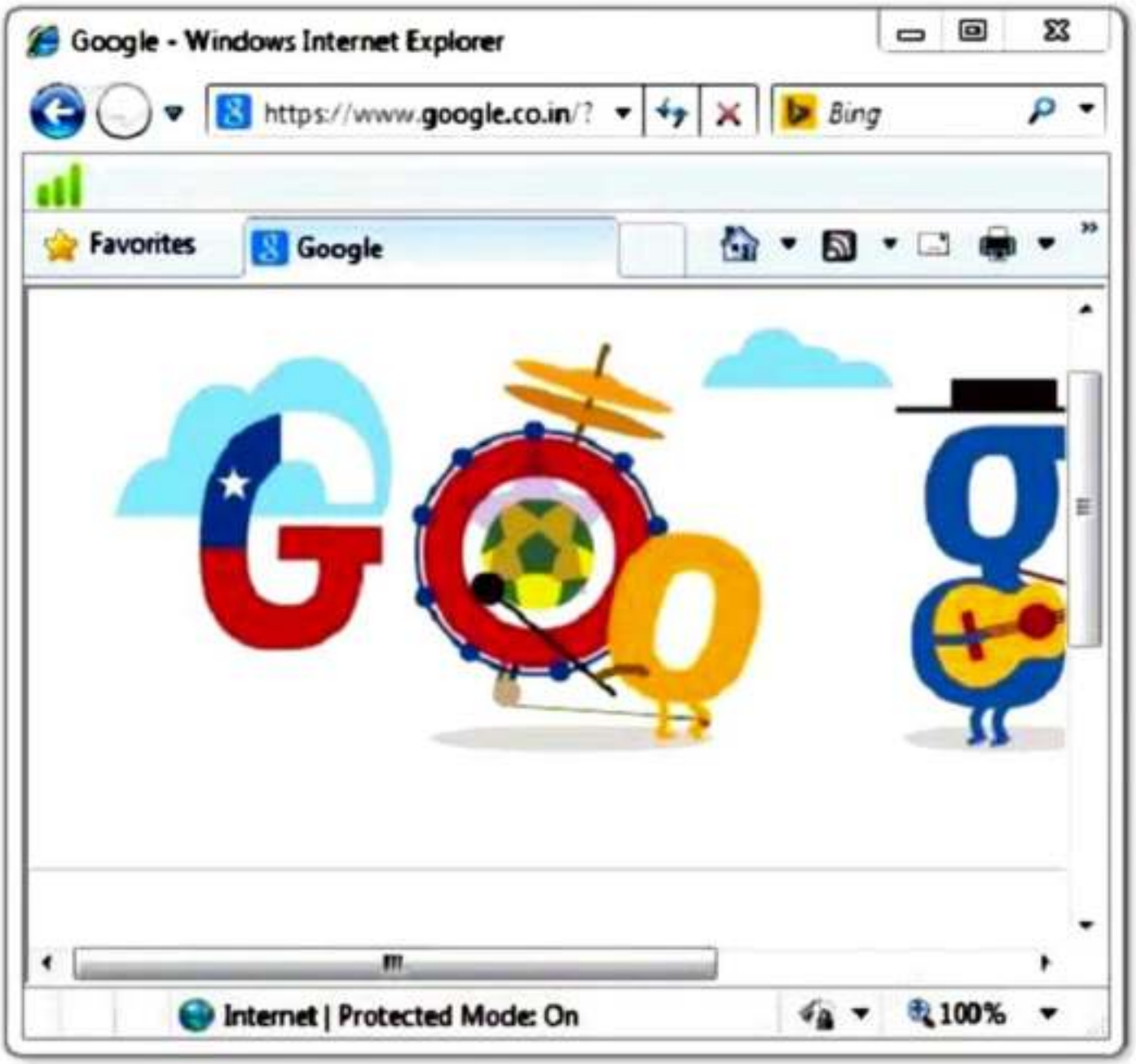
- Go to **Start** button and click **Internet Explorer.**

The **Internet Explorer** window will appear as shown in the following diagram:

internet_technologies_tutorial

Accessing Web Page

Accessing web page is very simple. Just enter the **URL** in the address bar as shown the following diagram:



Navigation

A web page may contain **hyperlinks.** When we click on these links other web page is opened. These hyperlinks can be in form of text or image. When we take the mouse over an hyperlink, pointer change its shape to hand.