Computer Network (I)

Objective of Lesson 2:

On Completion of this lesson, the students will be able to:

Define the Internet and its applications.

Explain in brief historical glance.

Describe the architecture of Internet.

Explain Accessing the Internet.

Discuss Internet Administration.

Understanding the Protocol and its heretical.

Describe the design Issues for the layers.

Distinguish between Design Issues for the layers.

The Internet:

The Internet is the global system of interconnected computer networks that use the Internet protocol suite (TCP/IP) to link devices worldwide. [wikipedia.org] Computers from different manufacturers were unable to communicate with one another. The Advanced Research Projects Agency (*ARPA*) in the Department of Defense (*DoD*) was interested in finding a way to connect computers so that the researchers could share their findings, thereby reducing costs and eliminating duplication of effort.

Internet History

There were some communication networks, such as telegraph and telephone networks, before 1960.

The theory of packet switching for bursty traffic was first presented 1961.

In 1967, ARPA presented its ideas for ARPANET, a small network of connected computers.

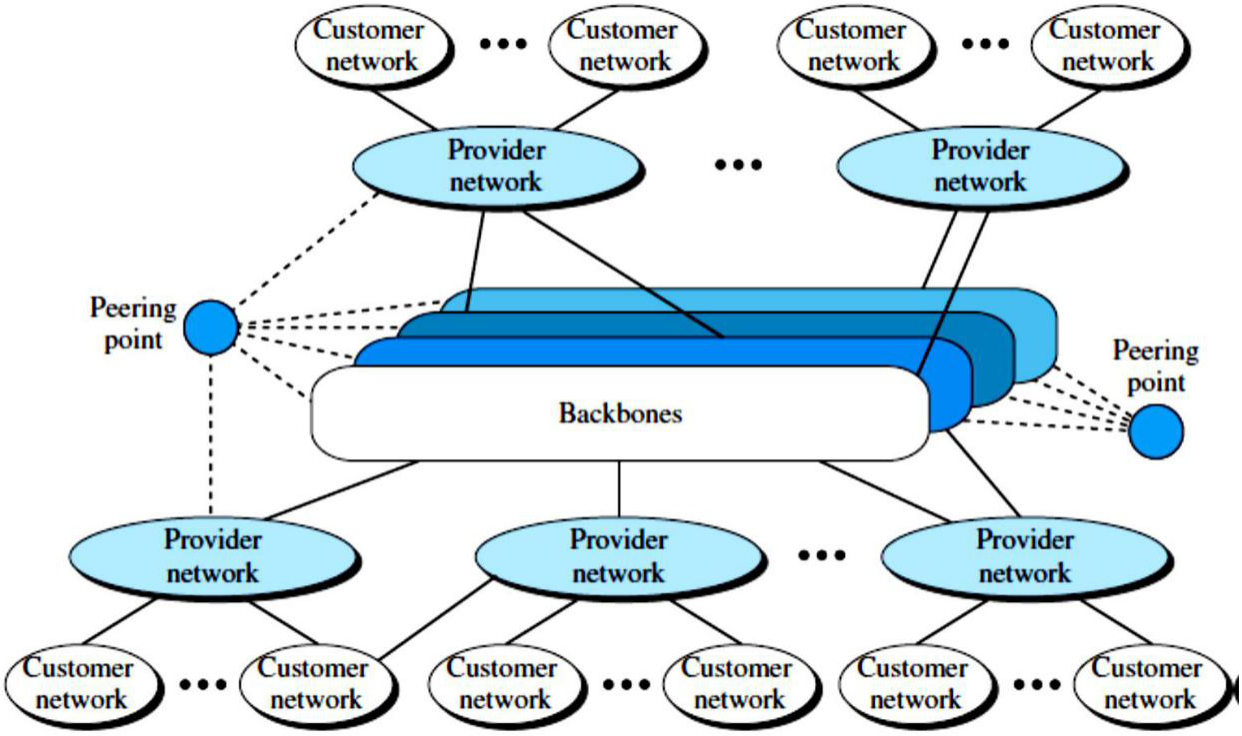
Between 1971 and 1983 TCP/IP has been developed and upgraded.

MILNET: In 1983, ARPANET split into two networks: Military Network (MILNET) for military users and ARPANET for nonmilitary users.

Another milestone in Internet history was the creation of CSNET in 1981. Computer Science Network (CSNET) was a network sponsored by the National Science Foundation (NSF).

NSFNET: With the success of CSNET, the NSF in 1986 sponsored the National Science Foundation Network (NSFNET), a backbone that connected five supercomputer centers located throughout the United States.

Today most end users who want Internet connection use the services of Internet service providers (ISPs). There are international service providers, national service providers, regional service providers, and local service providers. The next figure shows a conceptual view of the Internet.



The figure shows the Internet as several backbones, provider networks, and customer networks.

International Internet Service Providers: At the top of the hierarchy are the international service providers that connect nations together.

National Internet Service Providers: The national Internet service providers are backbone networks created and maintained by specialized companies.

Regional Internet Service Providers: Regional internet service providers or regional ISPs are smaller ISPs that are connected to one or more national ISPs.

Local Internet Service Providers: Local Internet service providers provide direct service to the end users. The local ISPs can be connected to regional ISPs or directly to national ISPs.

Accessing the Internet:

The Internet today is an internetwork that allows any user to become part of it. The user, however, needs to be physically connected to an ISP. The physical connection is normally done through a point-to-point WAN.

Using Telephone Networks: Today most residences and small businesses have telephone service, which means they are connected to a telephone network. Since most telephone networks have already connected themselves to the Internet, one option for residences and small businesses to connect to the Internet is to change the voice line between the residence or business and the telephone center to a point-to-point WAN. This can be done in two ways.

Dial-up service. The first solution is to add to the telephone line a modem that converts data to voice.

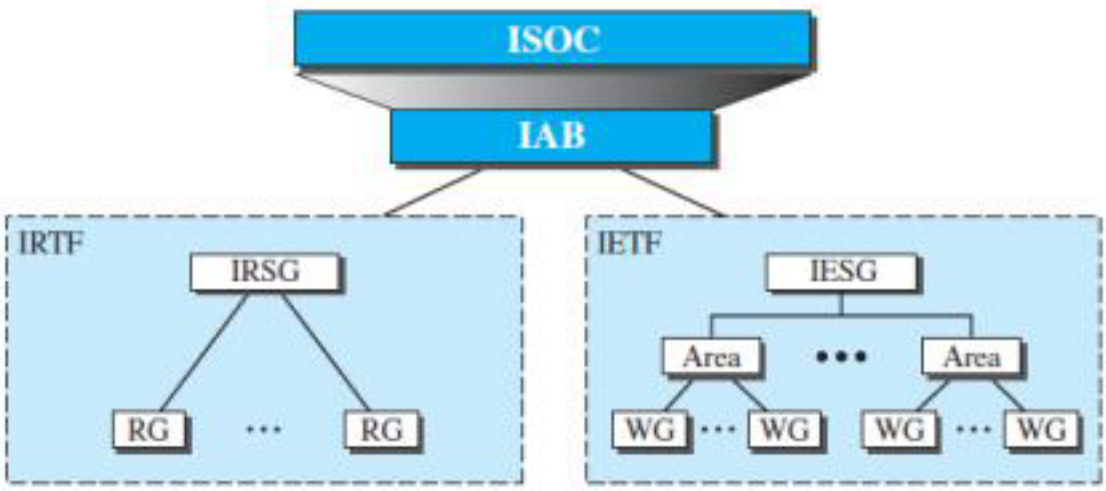
DSL Service: The DSL service also allows the line to be used concurrently for voice and data communication.

Using Cable Networks: More and more residents over the last two decades have begun using cable TV services instead of antennas to receive TV broadcasting. The cable companies have been upgrading their cable networks and connecting to the Internet.

Using Wireless Networks: Wireless connectivity has recently become increasingly popular. A household or a small business can use a combination of wireless and wired connections to access the Internet. With the growing wireless WAN access, a household or a small business can be connected to the Internet through a wireless WAN.

Internet Administration:

The following figure shows the general organization of Internet administration.



ISOC:

The **Internet Society (ISOC)** is an international, nonprofit organization formed in 1992 to provide support for the Internet standards process. ISOC accomplishes this through maintaining and supporting other Internet administrative bodies such as IAB (**Internet Architecture Board**), IETF

(Internet Engineering Task Force), IRTF (Internet Research Task Force), and IANA (Internet Assigned Numbers Authority).

6. Protocols and Standards

A network is a combination of hardware and software that sends data from one location to another. The hardware consists of the physical equipment that carries signals from one point of the network to another. The software consists of instruction sets that make possible the services that we expect from a network. The main idea in this course is to understand something about the widely used computer network software.

6.1. Protocols

In computer networks, communication occurs between entities in different systems. An entity is anything capable of sending or receiving information. However, two entities cannot simply send bit streams to each other and expect to be understood. For communication to occur, the entities must agree on a protocol. A protocol is a set of rules that govern data communications. A protocol defines what is communicated, how is communicated, and when it is communicated. The key elements of a protocol are syntax, semantics, and timing.

Syntax: The term syntax refers to the **structure** or format of the data, meaning the order in which they are presented. For example, a simple protocol might expect the first 8 bits of data to be the address of the sender, the second 8 bits to be the address of the receiver, and the rest of the stream to be the message itself.

Semantics: The word semantics refers to the **meaning** of each section of bits. How is a particular pattern to be interpreted, and what action is to be

taken based on that interpretation? For example, does an address identify the route to be taken or the final destination of the message?

Timing: The term timing refers to two characteristics: when data should be sent and **how fast they can be sent**. For example, if a sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps, the transmission will overload the receiver and some data will be lost.

6.2. Standards and Organizations:

Standards are essential in creating and maintaining an open and competitive market for equipment manufacturers and in guaranteeing national and international interoperability of data and telecommunications technology and processes. Standards provide guidelines to manufacturers, vendors, government agencies, and other service providers to ensure the kind of interconnectivity necessary in today's marketplace and in international communications. Network architectures define the standards and techniques for designing and building communication systems for computers and other devices. In the past, vendors developed their own architectures and required that other vendors conform to this architecture if they wanted to develop compatible hardware and software. Therefore it was necessary to make reference models or standers. Standards are developed through the cooperation of standards creation committees, forums, and government regulatory agencies.

International Organization for Standardization (ISO).

International Telecommunication Union Telecommunication Standards Sector (ITEl-T).

American National Standards Institute (ANSI).

Institute of Electrical and Electronics Engineers (IEEE).

Electronic Industries Association (EIA).

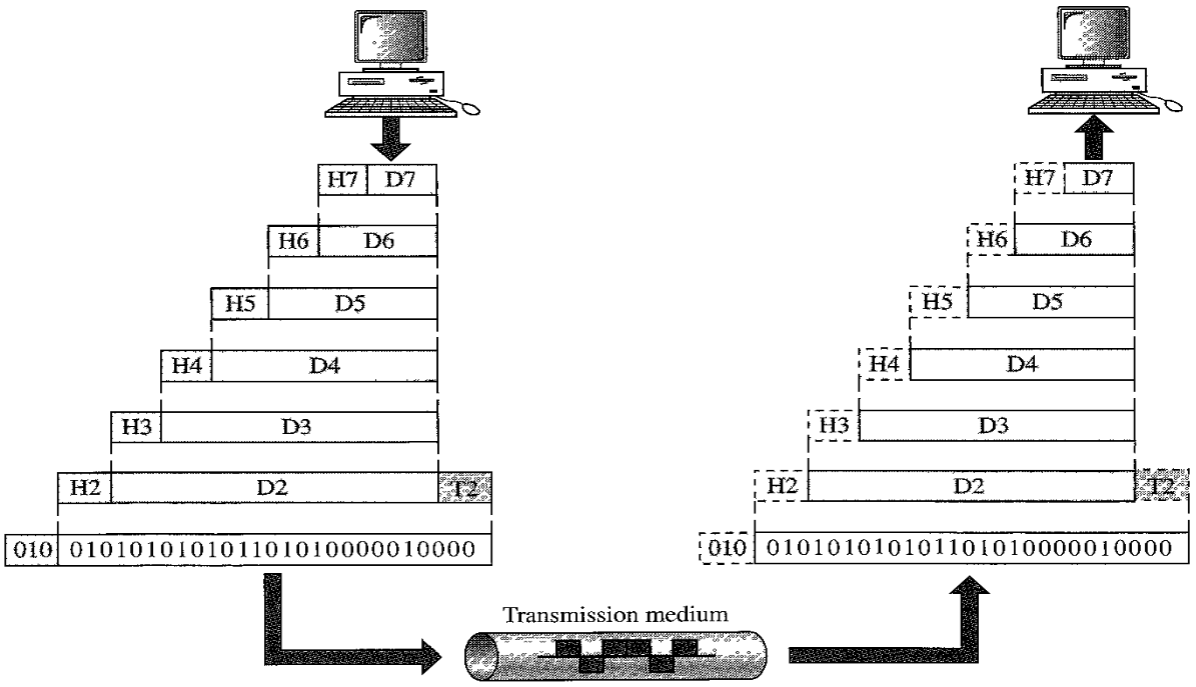
Protocol Hierarchies:

To reduce the design complexity, most of the networks are organized as a series of **layers** or **levels**, each one build upon one below it. The basic idea of a layered architecture is to divide the design into small pieces. Each layer adds to the services provided by the lower layers in such a manner that the highest layer is provided a full set of services to manage communications and run the applications. The benefits of the layered models are:

- To make the design process easy by breaking tasks into several smaller and manageable tasks (by divide-and-conquer approach).
- Ensure independence of layers, so that implementation of each layer can be changed or modified without affecting other layers.
- Each layer can be analyzed and tested independently of all other layers.

A set of layers and protocols is known as **network architecture.** The basic elements of a layered model are **services**, **protocols** and **interfaces**. A *service* is a set of actions that a layer offers to another (higher) layer. *Protocol* is a set of rules that a layer uses to exchange information with a peer entity. These rules concern both the contents and the order of the messages used. A list of protocols used by a certain system, one protocol per layer, is called **protocol stack**. Between the layers service interfaces are defined. The messages from one layer to another are sent through those interfaces. It defines which primitives operations and services the lower layer offers to the upper layer adjacent to it.

Now consider a more technical example: how to provide communication to the top layer of the seven-layer network as shown in the following figure:



Design Issues for the layers:

There are some of the key design issues that should be considered during the layer designing and some of them are:

Addressing issue: due to many senders and receivers are in the network so that there should be mechanism to identify senders and receivers. There are four types of addresses: physical address, logical address, port address, and specific address.

Connection Control: there are two types of connection: connectionless and connection-oriented. There are some features for each type.

Error control: it is an important issue because physical communication circuits are not perfect. Many error-detecting and error-correcting codes are known, but both ends of the connection must agree on which one is being used. In addition, the receiver must have some way of telling the sender which messages have been correctly received and which have not.

Segmentation and reassembling: the segmentation is performed at the sender and it means dividing the message into several segments that can be sent via one path or several paths. While the reassembling is performed at the receiver site. It means collection of the segments of same message with consideration of the sequences of these segments. There are many reasons for segmentation and some of them are:

- The communications network may only accept blocks of data up to a certain size.
- Error control may be more efficient with a smaller PDU size.
- More equitable access to shared transmission facilities, with shorter delay.
- Allocating smaller buffers at the receiver site.

Flow control: sometimes the receiving processing is slower than sending processing and as a result the receiver will discard many packets. Therefore the flow control is necessary. The flow control is a function performed by a receiving entity to limit the amount or rate of data that is sent by a transmitting entity.

Routing issue: When there are multiple paths between source and destination, a route must be chosen. The selection of the appropriate path depends on some factors.

Access media (multiplexing): as we know there are serval senders that can use the same channel then there is necessary to mechanism that is used to manage how to access to the shared channel.

Connection-Oriented and Connectionless Services

Layers can offer two different types of service to the layers above them: connection-oriented and connectionless.

Connection-Oriented:

In the connection-oriented network service, the service user first establishes connection, uses the connection, and then releases the connection just like the steps of setting up call from one telephone to another.

The service can be performed over two ways: firstly, without **virtual** circuits in which several packets are sent through different paths such as TCP over Internet. It is useful if the network most likely to be congested however it requires flow control. It is not useful for real-time applications (why?). Secondly, with virtual circuits in which all the sent packets are sent and routed through one path between the sender and receiver. This type of connection is useful for real-time applications.

Connectionless:

In this type of the connection, there is no connection established.

There is no need for synchronization between the sender and receiver.

Each message is divided into several packets and each packet is sent separately.

There is no need for flow control, congestion control, and quality of service.