Network Software:-

The first computer N.W were designed with the hardware as the main concern and the software as an after through. This strategy no longer works. Network software is now highly structured.

PROTOCOLS AND STANDARDS

In this section, we define two widely used terms: protocols and standards. First, we define protocol, which is synonymous with rule. Then we discuss standards, which are agreed-upon rules.

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 it 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.

Standards

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.

Protocol Hierarchies:-

To reduce their design complexity, most N.Ws are organized as a stack of layers or levels, each one built upon one below it. The purpose of each layer is to:-

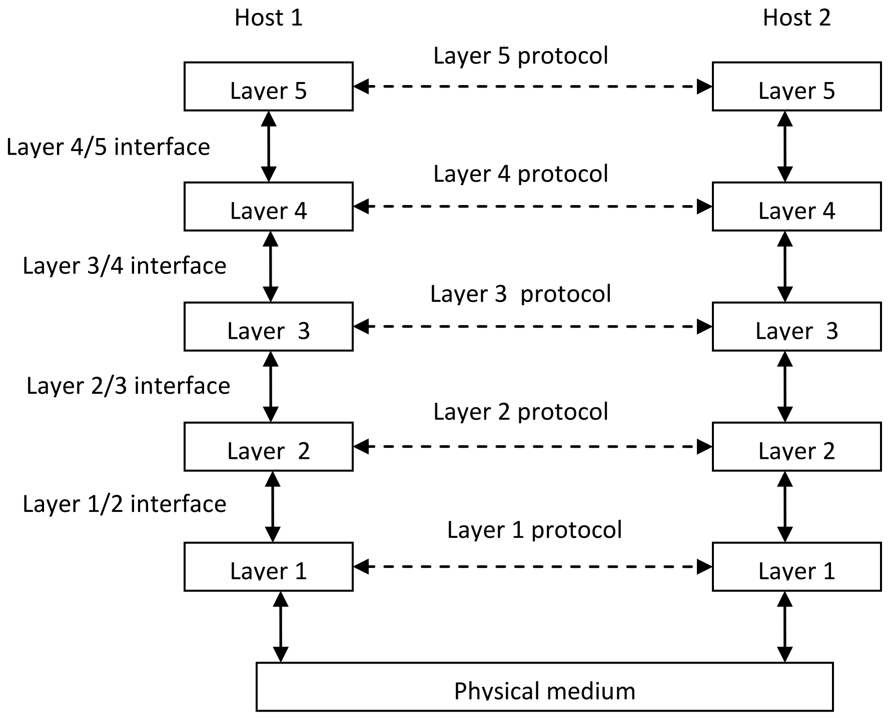
1- Offer certain services to the higher layers.
2- Shielding those layers from the details of how the offered services are actually implemented.

In a sense, each layer is a kind of virtual machine offering certain services to the layer above it.

The fundamental idea is that a particular piece of software (or hardware) provides a service to its user but keeps the details of it's internal state and algorithms hidden from them.

Layer n on one machine carries on a conversation with a layer n on another machine. The rules and conventions used in this conversation are collectively known as the layer n protocol.

Figure below show five – layers networks and layers and protocols and interfaces of these N.W.



The entities comprising the corresponding layers on different machines are called peers. The peers may be processes, hardware, devices, or even human being. In the words, it is the peers that communicate by using the protocol.

In reality, no data are directly transferred from layer n on one machine to layer n on another machine, Instead, each layer passes data and control the lowest layer is reached. Below layer 1 is the physical medium through which actual communications occurs.

Between each pair of adjacent layers is an interface. The interface defines which primitive operations and services the lower layers makes available to the upper one. Network designer must define clear interface between the layers, Doing this requires that each layer performer a specific collection of well – understood functions. In addition to minimizing the amount of information that must be passed between layers. Clear – cut interface make it simpler to replace the implementation of one layer with a completely different implementation (e.g.:- all the telephone lines are replaces by satellite channels).

A set of layers and protocols is called a network architecture.

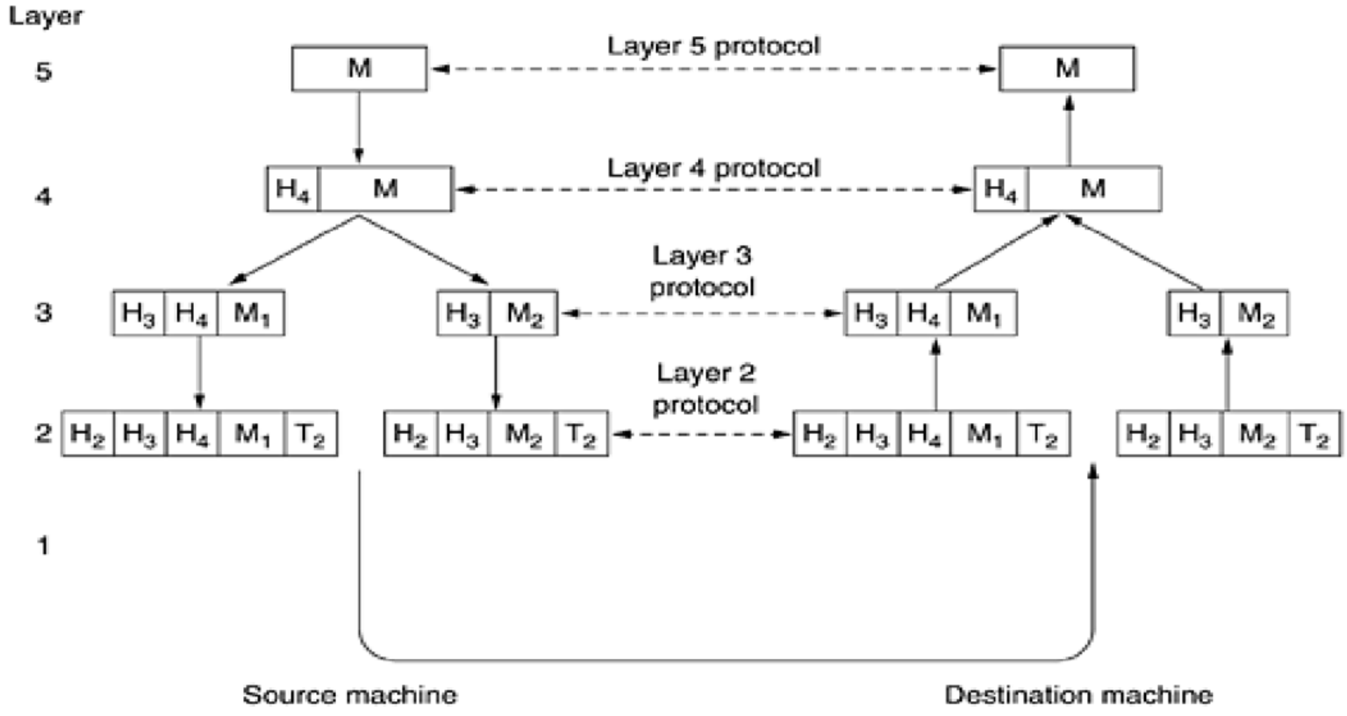
Now consider following technical example:-

How to provide communication on the top layer of the five – layer network. ?

A message M, is produced by an application process running in layer 5 and given to layer 4 for transmission.

Layer 4 puts header in front of the message to identify the message and passes the result to layer 3. The header include control information, such as sequence numbers, to allow layer 4 on the destination machine to deliver messages in the right order if the lower layers don’t maintain sequence.

In some layers, headers can also contain size, times, and other control informational fields.



Always there is limit to the size of messages transmitted by layer 3, so layer 3 must break incoming messages into smaller units, packets, prep ending a layer 3 header to each packet. At the receiving machine the messages moves upward from layer to layer with headers being stripped off as it progresses. None of the headers for layers below n are passed up to layer n.

Connection – oriented and Connectionless Services:-

Layers can offer two different types of services to the layers above them:-

Connection – oriented services:- is modeled after the telephone system. To talk to someone, you pick up the phone, dial the number, talk and then hang up. Similarly, to use a connection – oriented services, the service user first establishes a connection, uses the connection, and then releases the connection. The essential aspect of a connection is that it acts like a tube: the sender pushes object (bits) in at one end, and the receiver takes them out at the other end. In most cases the order is preserved so that the bits arrive in the order they were sent.

Connectionless Services:- is modeled after postal system. Each message (letter) carries the full destination address, and each one is routed through the system independent of all the others.

Each service can be characterized by a quality is Service. Some services are reliable in the sense that they never lose data. Usually a reliable services is implemented by having the receiver acknowledge the receipt of each message so the sender is sure that it arrived. The acknowledgment process introduces overhead and delays. A typical situation in which reliable connection – oriented service is appropriate is file transfer.

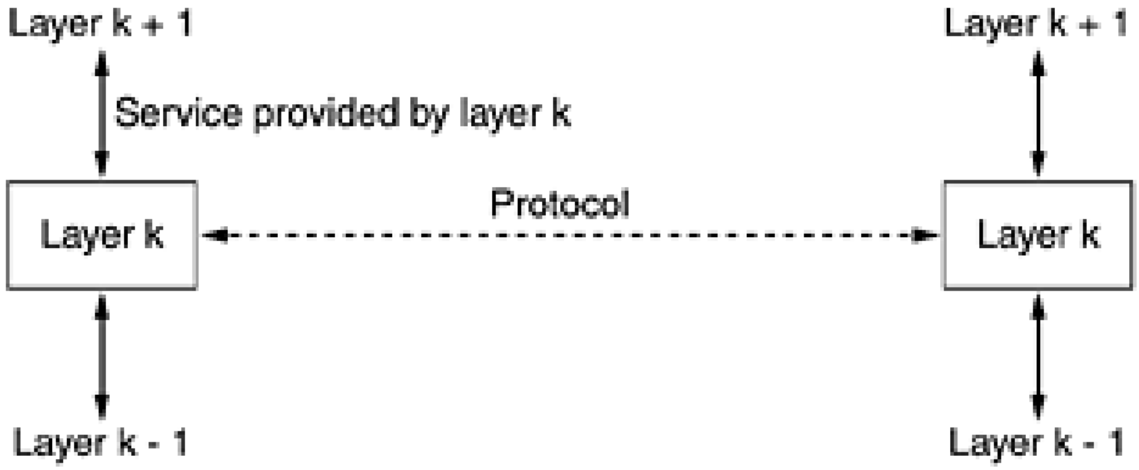
For some application, the delays by an acknowledgment are unacceptable. One such application is digitized voice traffic. Similarly video conference.

The Relationship of Services to Protocols

Services and protocols are distinct concepts, although they are frequently confused. This distinction is so important, however, that we emphasize it again here. A service is a set of primitives (operations) that a layer provides to the layer above it. The service defines what operations the layer is prepared to perform on behalf of its users, but it says nothing at all about how these operations are implemented. A service relates to an interface between two layers, with the lower layer being the service provider and the upper layer being the service user.

A protocol, in contrast, is a set of rules governing the format and meaning of the packets, or messages that are exchanged by the peer entities within a layer. Entities use protocols to implement their service definitions. They are free to change their protocols at will, provided they do not change the service visible to their users. In this way, the service and the protocol are completely decoupled.

In other words, services relate to the interfaces between layers, as illustrated in figure below. In contrast, protocols relate to the packets sent between peer entities on different machines, it is important not to confuse the two concepts.



An analogy with programming languages is worth making. A service is like an abstract data type or an object in an object-oriented language. It defines operations that can be performed on an object but does not specify how these operations are implemented. A protocol relates to the implementation of the service and as such is not visible to the user of the service.