1.4 Reference Model

In the next two sections we will discuss two important network architectures, the OSI reference model and the TCP/IP reference model. Although the protocols associated with the OSI model are rarely used any more, the model itself is actually quite general and still valid, and the features discussed at each layer are still very important. The TCP/IP model has the opposite properties: the model itself is not of much use but the protocols are widely used. For this reason we will look at both of them in detail.

1.4.1 The OSI reference model

The OSI (Open System Interconnections) which shown in Fig (1-24). This model was developed on the basis of proposal by the International Standard Organization (ISO) to provide a framework on which to build a suite of open systems protocols. The vision was that this set of protocols would be used to develop an international network that would not be dependent on proprietary systems.

The OSI model has seven layers, the principles that were applied to arrive at the seven layers are

1. A layer should be created where different level of abstraction is needed.
2. Each layer should perform a well defined function.
3. The function of each layer should be chosen with an eye twoard defining internationally standardized protocols.
4. The layer boundaries should be chosen to minimize the information flow across the interfaces.
5. The number of layers should be large enough that distinct functions needs not be thrown together in the same layer and small enough that the architecture does not become unwieldy.

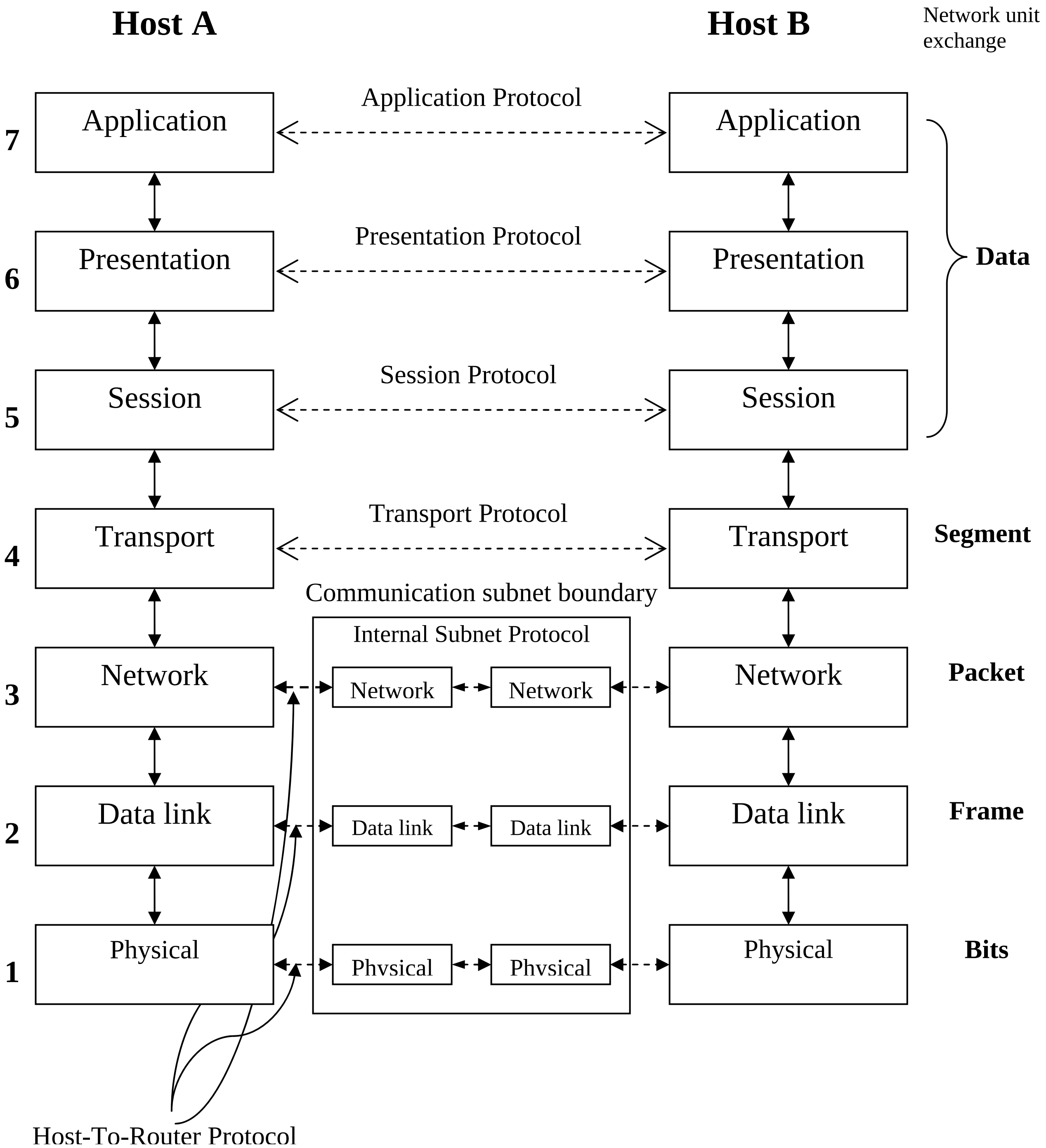

Fig (1-24) OSI reference Model

Layer 1 - Physical Layer

The "physical layer" is concerned with transmitting raw bits over a communication channel. The design issues have to making sure that when one side sends "1" bit, it is received by other side as "1" bit not as "0" bit.

Typical considerations are

1. How many volts should be used to represent 1 and how many for 0.
2. How many microseconds a bit delay.
3. How the initial connection is established and how its turn down after finishing.
4. How many pins the network connection has and what each pin used for.

In general, the design issues here largely deals with mechanical, electrical interfaces, and physical transmission medium.

Layer 2 - Data Link Layer

The main task of the "data link layer" is to take a row of transmission bits and transform it in to a line that appears free of undetected transmission errors to the "network".

It accomplished that task by breaking the input data up into "data frames". (Few hundreds of bytes or few thousand bytes), transmit the frames sequentially and process the "acknowledgement frames" sent back by receiver to sender.

The data link layers create and recognize frame boundaries by attaching a special bit patterns to begin and end of frame.

Another issues of data link layer is how to keep a fast transmitter from drowning a slow receiver in data. Thus, some traffic regulation mechanism must be employed.

Broadcast network has additional issues in the data link layer that is how to control access to the shared channel. A special sub layer of data link layer "medium access sub layer" deals with this problem. The Data link layer encapsulates data as frames which is the PDU name of this layer.

Layer 3 - Network Layer

The network layer defines the functions necessary to support data communication between indirectly-connected entities. It provides the capability of forwarding messages from one Layer 3 entity to another until the final destination is reached.

The network layer introduces another layer of abstraction to the data communications model. It moves messages called packets communicating Layer 3 Devices (routers and end devices for example). Network layer functions include route determination or routing and forwarding of packets to their final destinations.

In order to forward a packet to its destination host, routing information must be provided to the intermediate systems (mainly the routers) responsible for forwarding packets to their respective destinations. This routing information includes the address of the destination, which is contained in each packet. The next hop to be traversed by the packet is determined primarily by this destination address.

Design issues that are included in this layer are:

1. Determining how packets are routed from source to destination. Routes can be based on static tables or can be made dynamically according to the current network load.
2. If too many packets are present in the subnet at the same time, they will get in each others ways. The control of such congestion also belongs to the network layer.
3. The network layer has to over come all problems due to interconnecting heterogeneous networks.

In broadcast networks, the routing problems are simple, so the network layer is often thin or even not existent.

Layer 4 - Transport Layer

The basic function of the "transport layer" is to accept data from session layer, split it up into smaller units called Segments, pass these to the network layer. This must be done efficiently and in away that isolates the upper layer from the changes in hardware technology.

The perspective of Layer 4 is of end-to-end communications rather than the hop-by-hop perspective of Layer 3. Layer 4 assumes that packets can be moved from network entity to network entity, eventually getting to the final destination host. How this is accomplished is of no concern to Layer 4 functionality.

In the lower layers, the protocols are between each machine and its immediate neighbors. The difference between layers 1-3 which are chained, and layers 4-7 which are end-to-end is illustrated in fig (1-24).

Layer 5 - Session Layer

The Session Layer controls the dialogues/connections (sessions) between computers. It establishes, manages and terminates the connections between the local and remote application. It provides for full-duplex, half-duplex, or simplex operation. The Session layer defines how data conversations are started, controlled and finished. It some times manage authorizations. Some session services are:

1. Session layer service is to mange dialogue control.
2. Synchronization by providing a way to insert checkpoints into the data stream.
3. Tokens management by providing tokens that can be exchanged , and only the side holding the token may perform the critical operation.

Layer 6 - Presentation Layer

The presentation layer presents the data into a uniform format and masks the difference of data format between two dissimilar systems. It also translates the data from application to the network format. Presentation layer is also responsible for the protocol conversion, encryption, decryption and data compression. Presentation layer is a best layer for cryptography.

The Presentation Layer establishes a context between Application Layer entities, in which the higher-layer entities can use different syntax and semantics, as long as the Presentation Service understands both and the mapping between them

For example, in order make it possible for different computers with different representation to communicate, the data structure that must be exchanged could be defined in an abstract way with standard encoding to be used in the network. The presentation layer manages these abstract data structures and converts from the representation used inside the computer to network standard representation and back.

Layer 7 - Application Layer

The application layer is the OSI layer closest to the end user, which means that both the OSI application layer and the user interact directly with the software application. This layer interacts with software applications that implement a communicating component. Such application programs fall outside the scope of the OSI model.

This layer contains variety of protocols that are commonly needed by user, Some examples of application layer implementations include Remote access (Telnet), File Transfer Protocol (FTP), Web browsing using Hyper Text Transfer Protocol (HTTP) and Electronic mails using Simple Mail Transfer Protocol (SMTP).