NETWORK ARCHITECTURE

INTRODUCTION

- Computer networks are designed in a highly structured way to reduce their design complexity. Most networks are organised as a series of *layers* or levels.
- Each layer clearly defines various data communication functions and logical operations. Each level is functionally independent of the others but builds on its predecessor.
- In order to function, higher levels depend on correct operation of the lower levels.

INTRODUCTION CONT...

- The set of rules and conventions that encompasses electrical, mechanical and functional characteristics of a data link, as well as the control procedures for such communication is called the *layer n protocol*.
- The communication between two layers at the same level of two different computers is called *virtual communication*.
- Here, each layer passes data and control information to the layer immediately below it, until the lowest layer (layer 1).

INTRODUCTION CONT...

- At layer 1, information from one computer is physically transferred to layer 1 of the other *(physical communication)*.
- The *interface* between each pair of adjacent layers defines which operations and services the lower layer offers to the upper one.
- The *network architecture* thus can be defined as the set of layers and protocols.

OSI MODEL

Open System Interconnection,

- An ISO standard for worldwide communications that defines a networking framework for implementing protocols in seven layers.
- Open Systems Interconnection (OSI) model is developed by ISO (International organization for standardization) in 1984.

OSI MODEL

Open System Interconnection

- OSI reference model is a logical framework for standards for the network communication.
- OSI reference model is now considered as a primary standard for internetworking and inter computing.
- Today many network communication protocols are based on the standards of OSI model.
- In the OSI model the network/data communication is defined into seven layers.

OSI MODEL/OSI STACK

The OSI model is comprised of seven layers:

Layer 7

Layer 6

Layer 5

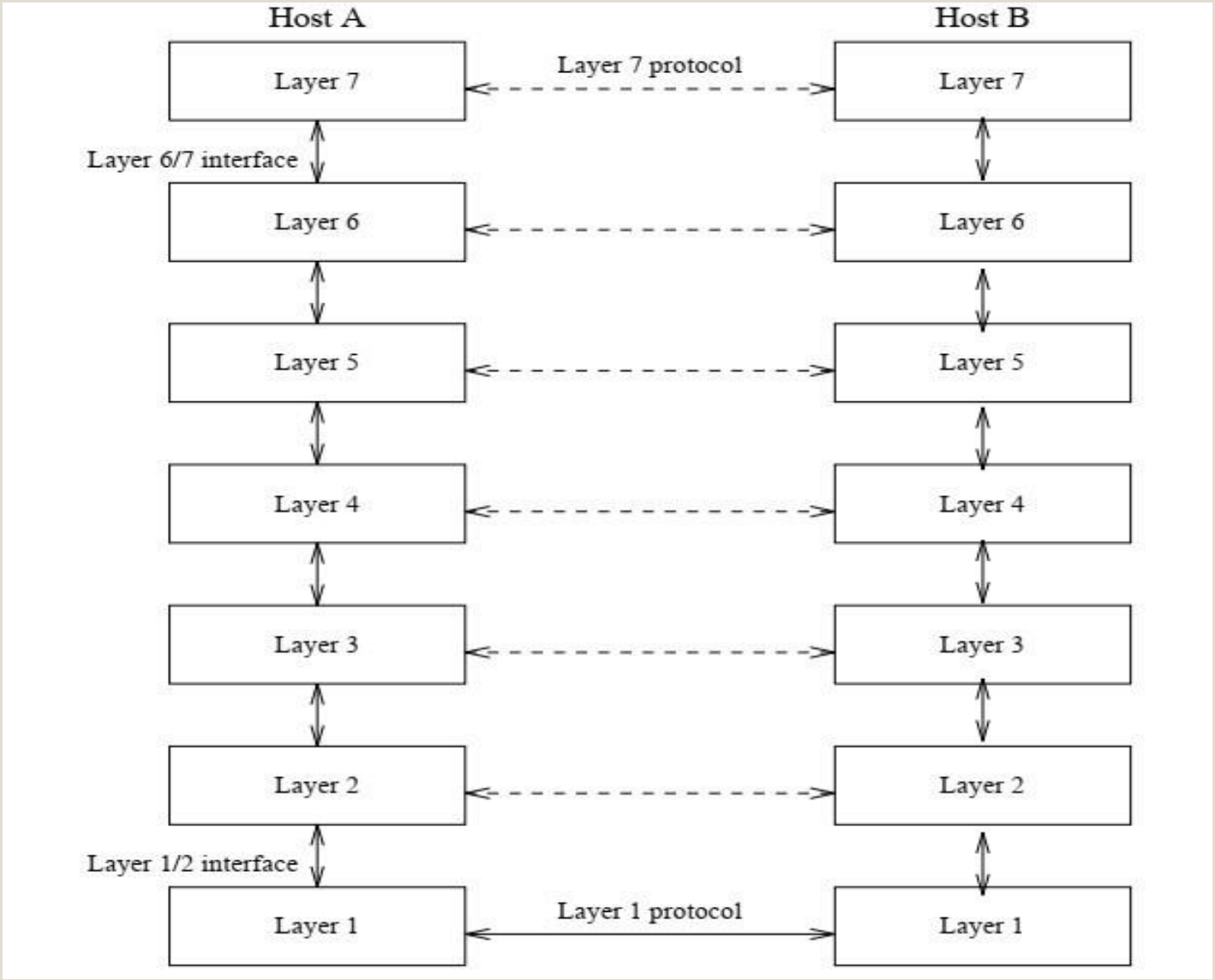
Layer 4

Layer 3

Layer 2

Layer 1

LAYERS, PROTOCOLS AND INTERFACES



LAYER 1: THE PHYSICAL LAYER

The physical layer, is concerned with the transmission of data on the network.
It is only in this layer where there is physical communication between communicating devices

The physical layer defines:

a)How bits are represented on the medium:

b) Wiring Standards for connectors and Jacks

c) Physical topology

d) Bandwidth Usage (broadband or baseband)

LAYER 2: THE DATA LINK LAYER

- The data link layer transforms the physical layer to a reliable link. It makes the physical layer appear error-free to the upper layer (network layer).

- The data link layer, is concerned with packaging data into frames and transmitting those frames on the network, performing error detection/ correction, uniquely identifying network devices with an address, and handling flow control.
- It performs ***physical addressing***
- These processes are collectively referred to as *data link control (DLC)*. It has two sublayers MAC and LLC.

LAYER 3: THE NETWORK LAYER

The network layer is primarily concerned with forwarding data/ packets based on logical addresses.

Network layer tasks:

- **Logical addressing:** using IP addressing
- **Switching:** Making a decision about how data should be forwarded. E.g Packet switching and message switching
- **Route discovery and selection**
- **Connection services:** for flow control and error control

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LAYER 4: THE TRANSPORT LAYER

- Whereas the network layer oversees source to-destination delivery of individual packets, it does not recognize any relationship between those packets.
- It treats each one independently, as though each piece belonged to a separate message, whether or not it does.
- The transport layer, on the other hand, ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source to-destination level.

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LAYER 5: THE SESSION LAYER

The session layer, is responsible for setting up, maintaining, and tearing down sessions.

Setting up a session: Examples of the procedures involved in setting up a session include:

- Checking user credentials (for example, username and password)
- Assigning numbers to a session's communications flows to uniquely identify each flow
- Negotiating services required during the session
- Negotiating which device begins sending data

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LAYER 6: THE PRESENTATION LAYER

The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems

The presentation layer is responsible for the formatting of data being exchanged and securing that data with encryption.

LAYER 7: THE APPLICATION LAYER

The application layer supports services used by end-user applications.

The application layer enables the user, whether human or software, to access the network.

It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services.

THE APPLICATION LAYER CONT...

Functions of the application layer

- **Application services:** Examples of the application services residing at the application layer include file sharing and e-mail.
- **Service advertisement:** Some applications' services (for example, some networked printers) periodically send out advertisements, making the availability of their service known to other devices on the network.

THE TCP/IP STACK OR DOD MODEL

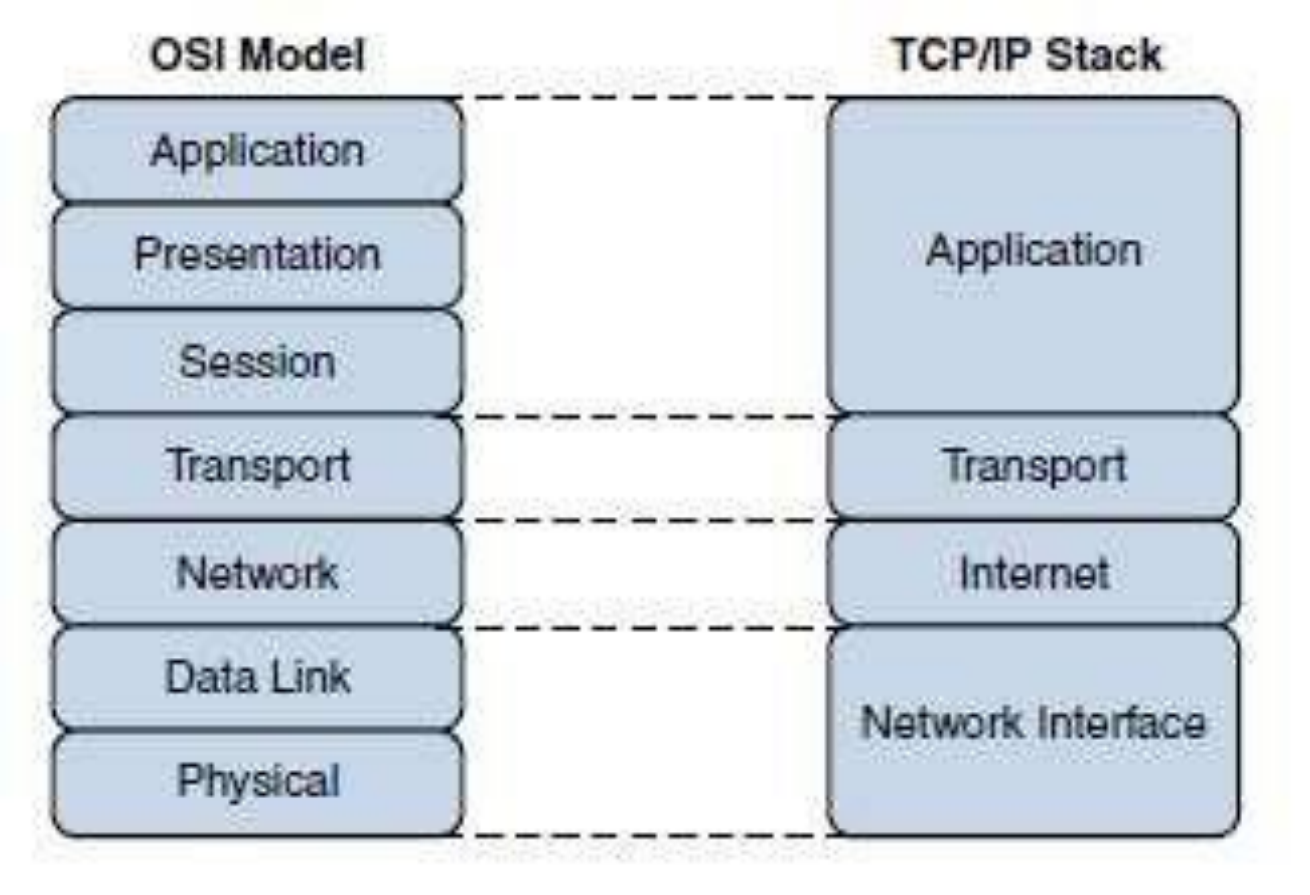
The TCP/IP protocol suite was developed prior to the OSI model. Therefore, the layers in the TCP/IP protocol suite do not exactly match those in the OSI model.

The ISO developed the OSI reference model to be generic, in terms of what protocols and technologies could be categorized by the model.

However, the vast majority of traffic on the Internet (and traffic on corporate networks) is based on the TCP/IP protocol suite.

THE TCP/IP STACK CONT…

- It has only four defined layers, as opposed to the seven layers of the OSI model.



THE TCP/IP STACK CONT...

- **Network interface:** The TCP/IP stack's network interface layer encompasses the technologies addressed by Layers 1 and 2 (physical and data link layers) of the OSI model.
- **Internet:** The Internet layer of the TCP/IP stack maps to Layer 3 (the network layer) of the OSI model. The Internet layer of the TCP/IP stack focuses on IP as the protocol to be routed through a network.
- **Transport:** The transport layer of the TCP/IP stack maps to Layer 4 (the transport layer) of the OSI model. The two primary protocols found at the TCP/IP stack's transport layer are TCP and UDP.

THE TCP/IP STACK CONT…

- **Application:** The biggest difference between the TCP/IP stack and the OSI model is found at the TCP/IP stack's application layer. This layer addresses concepts described by Layers 5, 6, and 7 (the session, presentation, and application layers) of the OSI model.
- Application layer protocols in the TCP/IP stack are identifiable by unique *port numbers* .
- It supports the functionalities supported by all the OSI layers that it maps to

COMPARISON OF THE OSI AND TCP/IP REFERENCE MODELS:

- Both are based on the concept of a stack of independent protocols.
- In both models the layers up through and including the transport layer are there to provide an end-to-end, network-independent transport service to processes wishing to communicate.
- In both models, the layers above transport are application-oriented users of the transport service.
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COMPARISON OF THE OSI AND TCP/IP CONT…

- The OSI model supports both connectionless and connection-oriented communication in the network layer, but only connection-oriented communication in the transport layer
- The TCP/IP model has only one mode in the network layer (connectionless) but supports both modes in the transport layer
- The protocols in the OSI model are better hidden than in the TCP/IP model and can be replaced relatively easily as the technology changes.
- The OSI model has 7 layers while TCP/IP has four layers

END