# Computer Networks

**Lecture 7**

OSI model, TCP/IP model

# Protocols and references

- There are two basic types of networking models: protocol models and reference models.

- A protocol model provides a model that closely matches the structure of a particular protocol suite. The hierarchical set of related protocols in a suite typically represents all the functionality required to interface the human network with the data network. The TCP/IP model is a protocol model because it describes the functions that occur at each layer of protocols within the TCP/IP suite.

# Protocols and references

- A reference model provides a common reference for maintaining consistency within all types of network protocols and services. A reference model is not intended to be an implementation specification or to provide a sufficient level of detail to define precisely the services of the network architecture. The primary purpose of a reference model is to aid in clearer understanding of the functions and process involved.

- The Open Systems Interconnection (OSI) model is the most widely known internetwork reference model. It is used for data network design, operation specifications, and troubleshooting.

# TCP/IP model

- The first layered protocol model for internetwork communications was created in the early 1970s and is referred to as the Internet model. It defines four categories of functions that must occur for communications to be successful. The architecture of the TCP/IP protocol suite follows the structure of this model. Because of this, the Internet model is commonly referred to as the TCP/IP model.

- Most protocol models describe a vendor-specific protocol stack. However, since the TCP/IP model is an open standard, one company does not control the definition of the model. The definitions of the standard and the TCP/IP protocols are discussed in a public forum and defined in a publicly-available set of documents. These documents are called Requests for Comments (RFCs). They contain both the formal specification of data communications protocols and resources that describe the use of the protocols.

# Communication process

A complete communication process includes these steps:

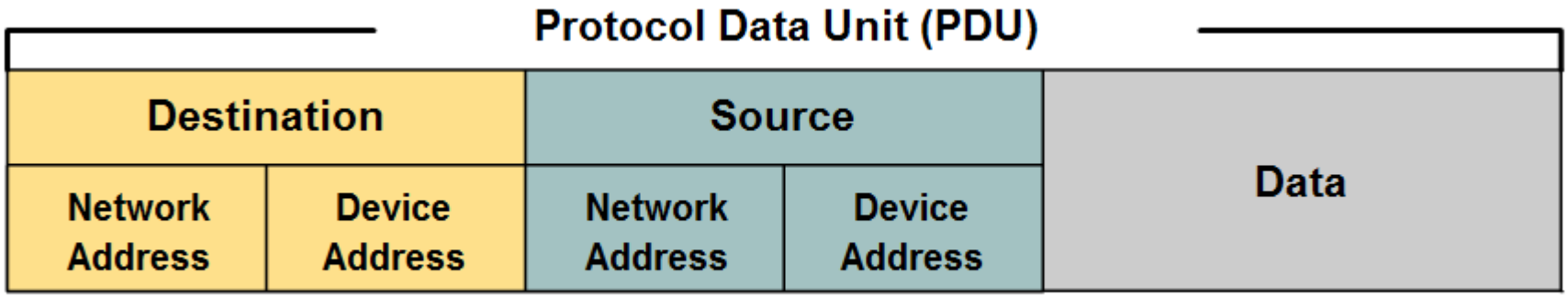
1. Creation of data at the application layer of the originating source end device
2. Segmentation and encapsulation of data as it passes down the protocol stack in the source end device
3. Generation of the data onto the media at the network access layer of the stack
4. Transportation of the data through the internetwork, which consists of media and any intermediary devices
5. Reception of the data at the network access layer of the destination end device
6. Decapsulation and reassembly of the data as it passes up the stack in the destination device
7. Passing this data to the destination application at the Application layer of the destination end device

# Protocol Data Unit

As application data is passed down the protocol stack on its way to be transmitted across the network media, various protocols add information to it at each level. This is commonly known as the encapsulation process.

The form that a piece of data takes at any layer is called a Protocol Data Unit (PDU). During encapsulation, each succeeding layer encapsulates the PDU that it receives from the layer above in accordance with the protocol being used. At each stage of the process, a PDU has a different name to reflect its new appearance

# Protocol Data Unit

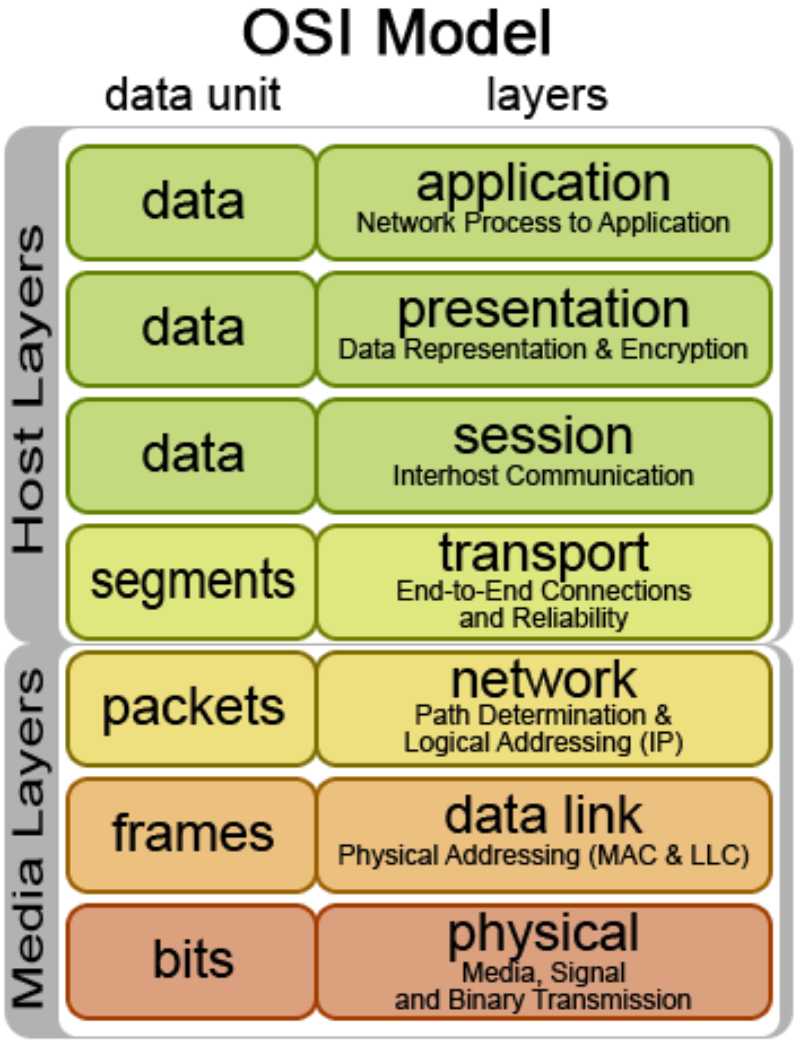


# OSI model

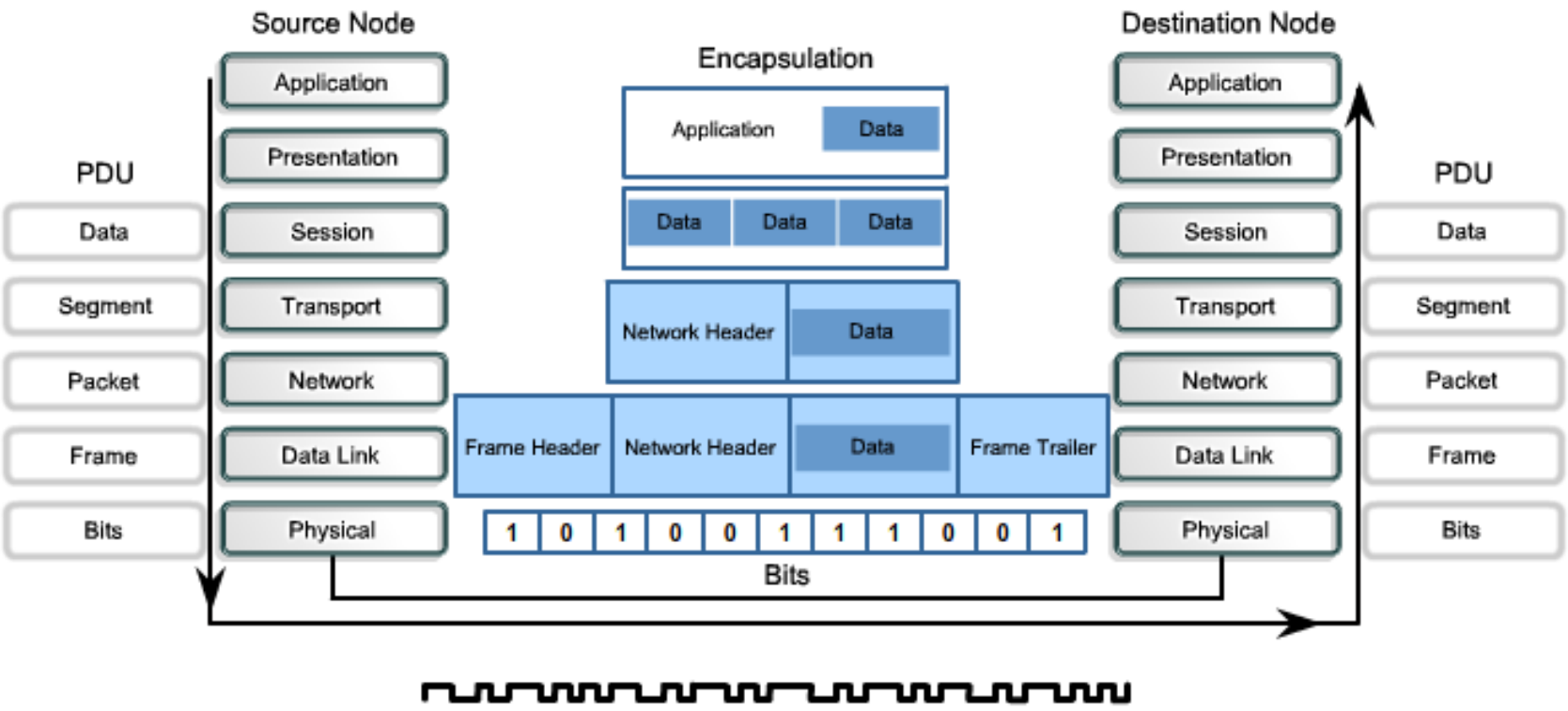
Initially the OSI model was designed by the International Organization for Standardization (ISO) to provide a framework on which to build a suite of open systems protocols.Unfortunately, the speed at which the TCP/IP based Internet was adopted, and the rate at which it expanded, caused the OSI Protocol Suite development and acceptance to lag behind.

Although few of the protocols developed using the OSI specifications are in widespread use today, the seven-layer OSI model has made major contributions to the development of other protocols and products for all types of new networks.

# OSI model


OSI Model
data unit
layers
Host Layers
data
application
Network Process to Application
data
presentation
Data Representation & Encryption
data
session
Interhost Communication
segments
transport
End-to-End Connections and Reliability
Media Layers
packets
network
Path Determination & Logical Addressing (IP)
frames
data link
Physical Addressing (MAC & LLC)
bits
physical
Media, Signal and Binary Transmission

# OSI model


Source Node
Encapsulation
Destination Node
PDU
Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Segment
Packet
Frame
Bits
Application
Data
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Network Header
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Frame Header
Network Header
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Frame Trailer
1 0 1 0 0 1 1 1 0 0 1
Bits
PDU
Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Segment
Packet
Frame
Bits

# OSI model

The OSI model describes the processes of encoding, formatting, segmenting, and encapsulating data for transmission over the network.

A data stream that is sent from a source to a destination can be divided into pieces and interleaved with messages traveling from other hosts to other destinations. Billions of these pieces of information are traveling over a network at any given time. It is critical for each piece of data to contain enough identifying information to get it to the correct destination.

# Application layer

The most widely-known TCP/IP Application layer protocols are those that provide for the exchange of user information. These protocols specify the format and control information necessary for many of the common Internet communication functions. Among these TCP/IP protocols are:

- Domain Name Service Protocol (DNS)
- Hypertext Transfer Protocol (HTTP)
- Simple Mail Transfer Protocol (SMTP).
- File Transfer Protocol (FTP) is used for interactive file transfer between systems.

# Presentation layer

The Presentation layer has three primary functions:

- Coding and conversion of Application layer data to ensure that data from the source device can be interpreted by the appropriate application on the destination device.
- Compression of the data in a manner that can be decompressed by the destination device.
- Encryption of the data for transmission and the decryption of data upon receipt by the destination.

Presentation layer implementations are not typically associated with a particular protocol stack. The standards for video and graphics are examples. Some well-known standards for video include QuickTime and Motion Picture Experts Group (MPEG). QuickTime is an Apple Computer specification for video and audio, and MPEG is a standard for video compression and coding.

# Session layer

- Session layer implies, functions at this layer create and maintain dialogs between source and destination applications. The Session layer handles the exchange of information to initiate dialogs, keep them active, and to restart sessions that are disrupted or idle for a long period of time.

- Most applications, like web browsers or e-mail clients, incorporate functionality of the OSI layers 5, 6 and 7.

# Transport layer

The Transport layer provides for the segmentation of data and the control necessary to reassemble these pieces into the various communication streams. Its primary responsibilities to accomplish this are:

- Tracking the individual communication between applications on the source and destination hosts
- Segmenting data and managing each piece
- Reassembling the segments into streams of application data
- Identifying the different applications
- Separating Multiple Communications

# Network layer

The Network layer, or OSI Layer 3, provides services to exchange the individual pieces of data over the network between identified end devices. To accomplish this end-to-end transport, Layer 3 uses four basic processes:

- Addressing
- Encapsulation
- Routing
- Decapsulation

# Data Link layer

The Data Link layer provides a means for exchanging data over a common local media.

The Data Link layer performs two basic services:

- Allows the upper layers to access the media using techniques such as framing
- Controls how data is placed onto the media and is received from the media using techniques such as media access control and error detection

# Physical layer

The OSI Physical layer provides the means to transport across the network media the bits that make up a Data Link layer frame. This layer accepts a complete frame from the Data Link layer and encodes it as a series of signals that are transmitted onto the local media. The encoded bits that comprise a frame are received by either an end device or an intermediate device.

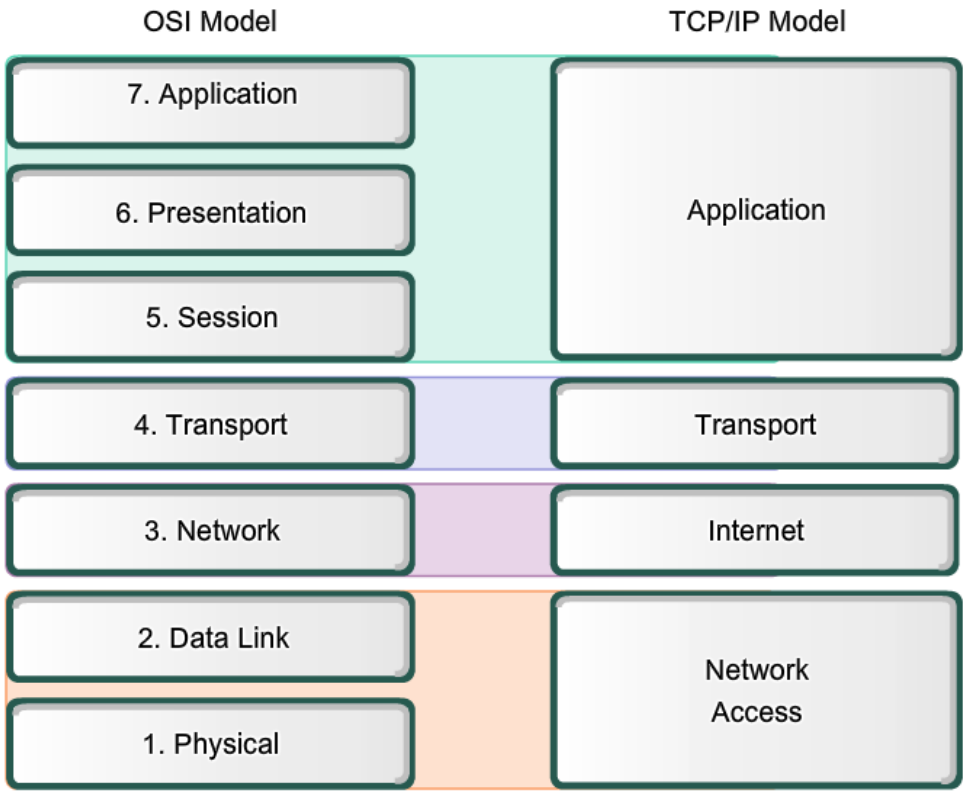
The delivery of frames across the local media requires the following Physical layer elements:

- The physical media and associated connectors
- A representation of bits on the media
- Encoding of data and control information
- Transmitter and receiver circuitry on the network devices

# Physical layer

At this stage of the communication process, the user data has been segmented by the Transport layer, placed into packets by the Network layer, and further encapsulated as frames by the Data Link layer. The purpose of the Physical layer is to create the electrical, optical, or microwave signal that represents the bits in each frame. These signals are then sent on the media one at a time.

# TCP/IP model


OSI Model
TCP/IP Model
7. Application
6. Presentation
5. Session
Application
4. Transport
Transport
3. Network
Internet
2. Data Link
1. Physical
Network Access