Lecture 1-2

Introduction to Computer Networks:
Protocol Stacks

Why OSI?

- In the past, only computers computers from the same manufacturer can communicate
  - e.g. a complete DECnet solution or an IBM solution
- In the late 1970s, the *Open Systems Interconnection* (OSI) reference model was created to break this barrier
  - by the *International Organization for Standardization* (ISO)

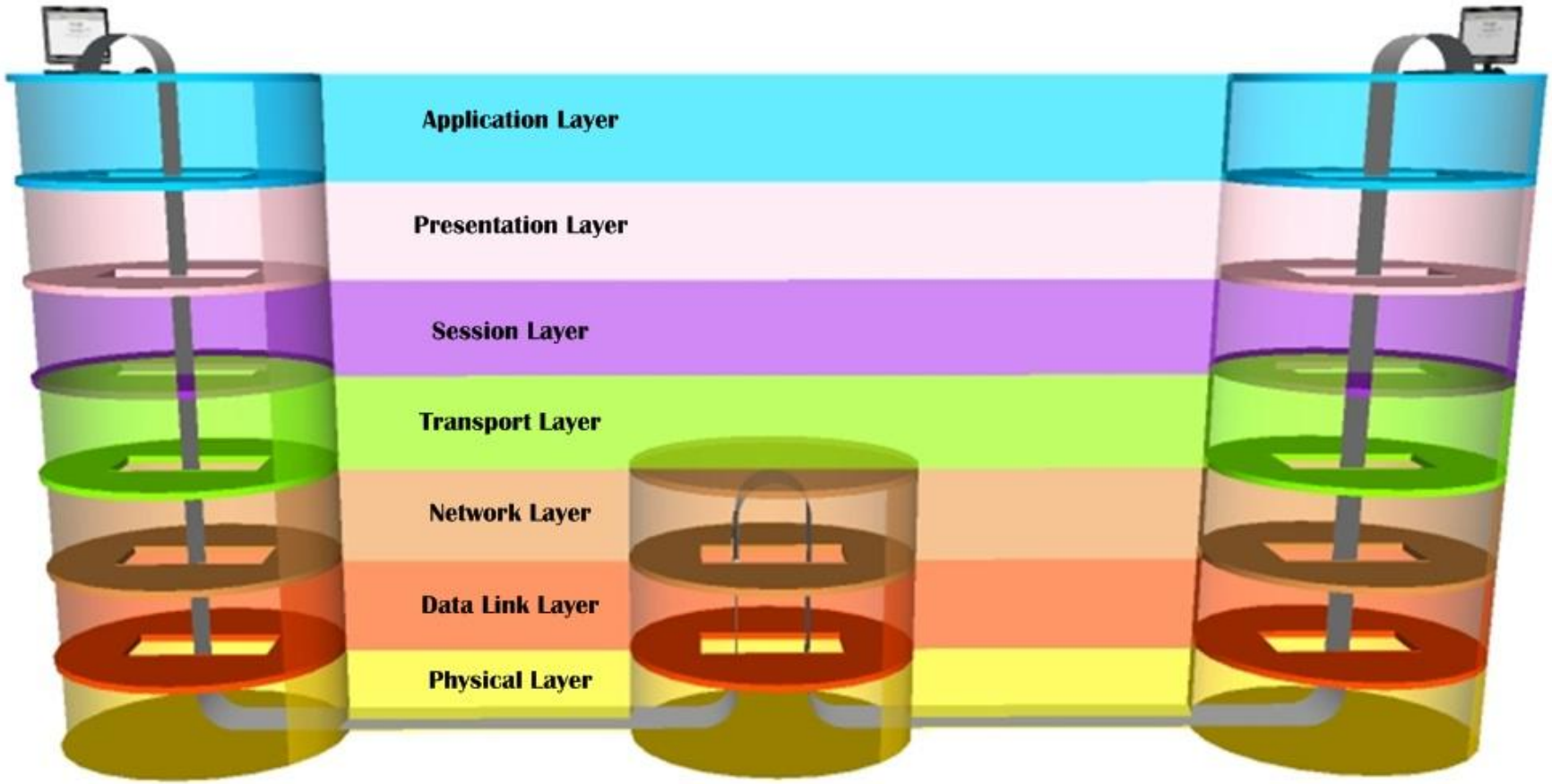
What is OSI?

- OSI: Open System Interconnection
- Describes how data and network information are communicated
  - From an application on one computer
  - Through the network media
  - To an application on another computer.

Advantages of Reference Models

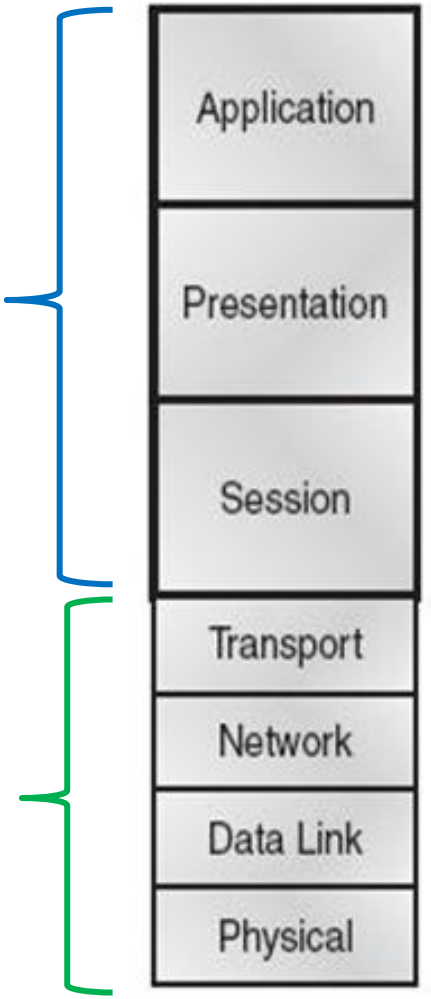
- Divides the network communication process into smaller and simpler components
  - Defining what functions occur at each layer of the model
  - Aiding component development, design, and troubleshooting
  - Preventing changes in one layer from affecting other layers
- Standardization of network components
  - Allows multiple-vendor development
  - Components from different vendors can communicate

The OSI Reference Model

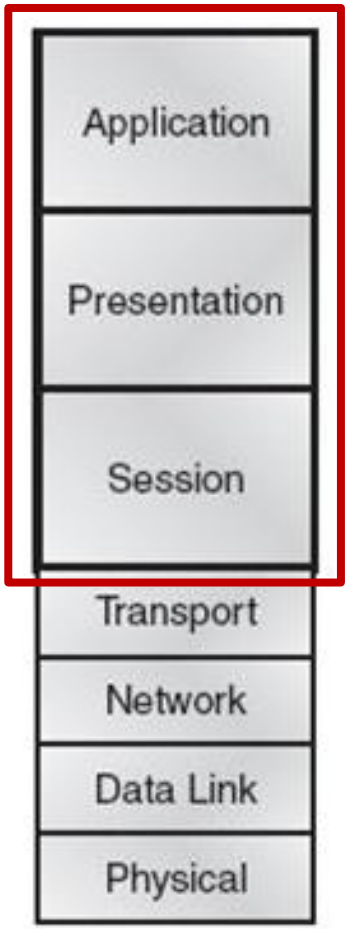


OSI: 7 Layers, 2 Groups

- The top three layers
  - Define how the applications within the end stations will communicate with each other and with users
- The bottom four layers
  - Define how data is transmitted end-to-end



7 OSI Layers



- Provides a user interface

- Presents data
- Handles processing such as encryption

- Keeps different applications' data separate

- Provides reliable or unreliable delivery
- Performs error correction before retransmit

- Provides logical addressing, which routers use for path determination

- Combines packets into bytes and bytes into frames
- Provides access to media using MAC address
- Performs error detection not correction

- Moves bits between devices
- Specifies voltage, wire speed, and pin-out of cables

The Application Layer

- Marks the spot where users actually communicate to the computer
  - Applications
  - Network UI
- Example, using IE
  - You could uninstall every trace of networking components from a system, such as TCP/IP, NIC card, and so on, and you could still use IE to view a local HTML document—no problem
  - But things would definitely get messy if you tried to do something like view an HTML document that must be retrieved using HTTP or nab a file with FTP or TFTP.

The Presentation Layer

- Presents data to the Application layer
- Responsible for data translation and code formatting
  - Data compression and decompression
  - Encryption and decryption
- Some Presentation layer standards are involved in multimedia operations too

The Session Layer

- Sets up, manages, and then tears down sessions between presentation layer entities
- Coordinates communication between systems and serves to organize their communication
  - Offers three different modes
    - *simplex*
    - *half duplex*
    - *full duplex*

The Transport Layer

- Segments and reassembles data into a data stream
  - from upper-layer applications
  - unite it into the same data stream
- End-to-end data transport services
- Can establish a logical connection between the sending host and destination host on an internetwork
  - Ex. TCP and UDP (will be discussed later)

The Network layer

- Manages device addressing
- Determines the best way to move data
- Device: mainly routers
  - Provide the routing services within an internetwork

What happens in Layer 3?

- A packet is received on a router interface
- A router checks the destination IP address
- Forward if the packet isn't destined for that particular router
  - It will look up the destination network address in the routing table
  - Choose an exit interface to that destination
- The packet will be sent to that interface to be framed and sent out
- If the router can't find an entry for the packet's destination network
  - The router drops the packet

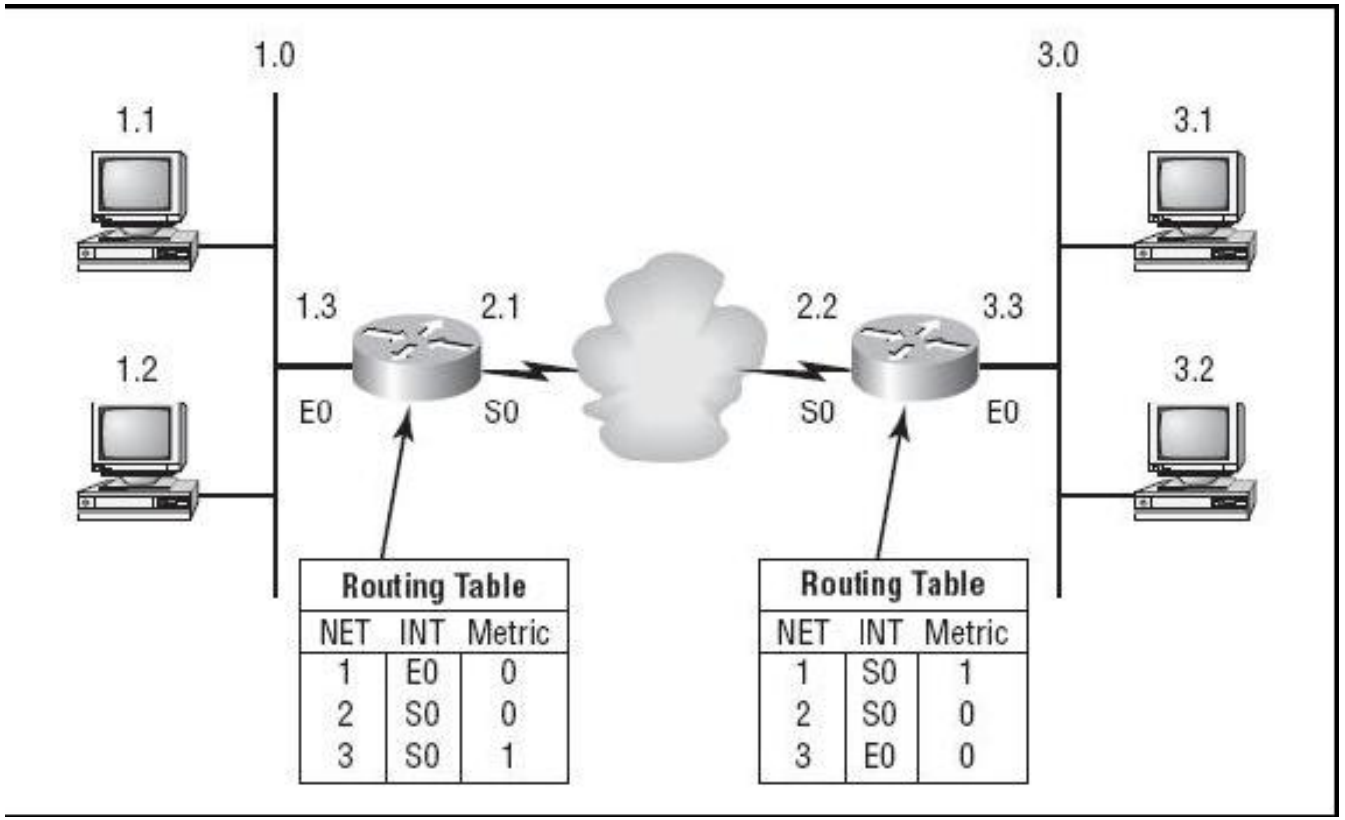
Network Layer's Packet Types

- **Data packets**
  - Used to transport user data through the internetwork
  - Protocols used to support data traffic are called routed protocols
    - IP4 and IPv6
- **Route update packets**
  - Used to update neighboring routers about the networks connected to all routers within the internetwork
  - Protocols that send route update packets are called routing protocols
    - RIP, RIPv2, EIGRP, OSPF

What are these?

- **Network addresse**
- **Network interface**
- **Routing table**

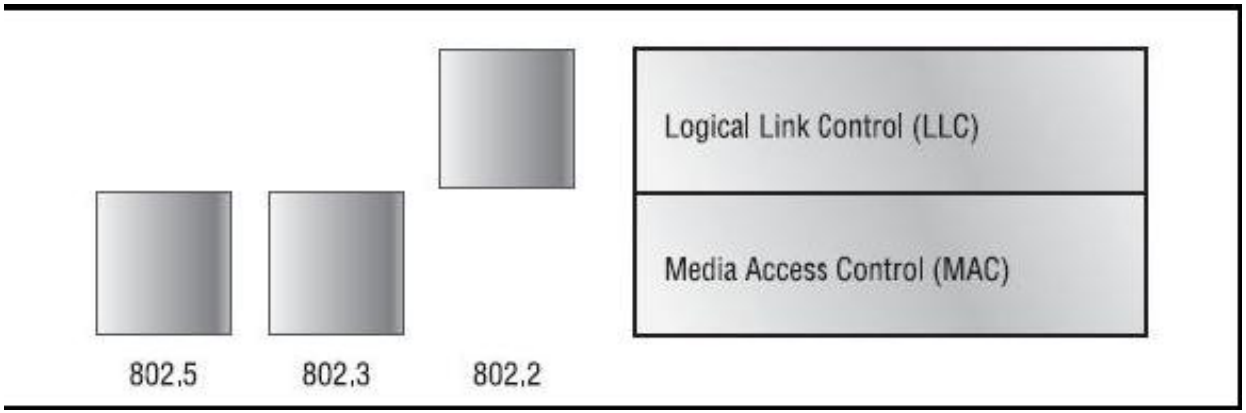
Layer 3 in a Picture



Data Link layer

- The Data Link layer provides the physical transmission of the data and handles error notification, network topology, and flow control.
- The Data Link layer formats the message into pieces, each called a data frame, and adds a customized header containing the hardware destination and source address.
- The IEEE Ethernet Data Link layer has two sublayers:
  - **Media Access Control (MAC) 802.3** Defines how packets are placed on the media. Line discipline, error notification (not correction), ordered delivery of frames, and optional flow control can also be used at this sublayer.

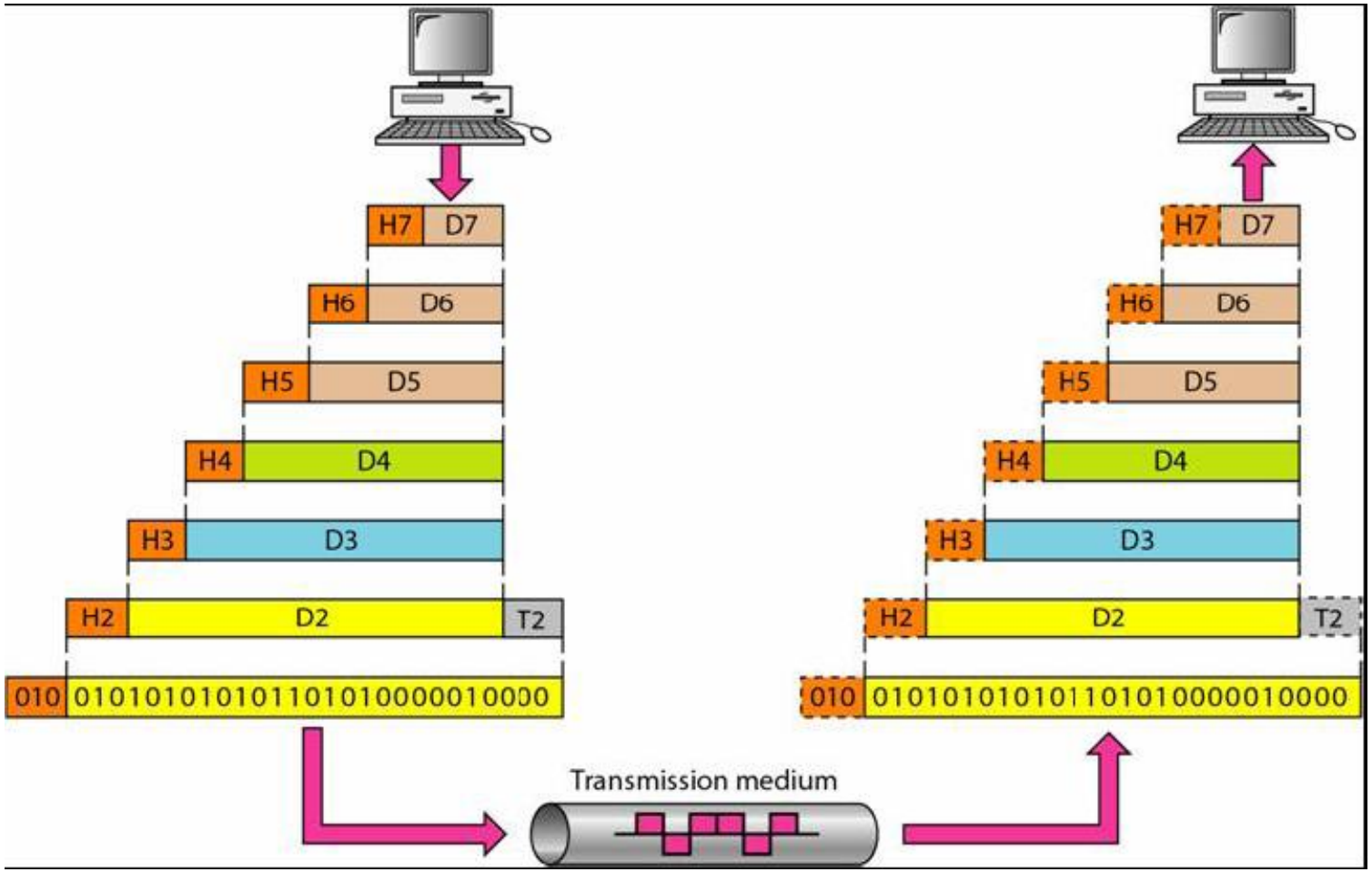
- **Logical Link Control (LLC)** **802.2** Responsible for identifying Network layer protocols and then encapsulating them. An LLC header tells the Data Link layer what to do with a packet once a frame is received.



The Physical layer

- The *Physical layer* does **two** things: It sends bits and receives bits.
- The Physical layer specifies the electrical, mechanical, procedural, and functional requirements for activating, maintaining, and deactivating a physical link between end systems.

An exchange using the OSI model



TCP/IP Protocol Architecture I

- Practical Used
- TCP/IP is generally viewed as being composed of fewer layers than the seven used in the OSI model.
- The original TCP/IP protocol suite was defined as having four layers: *host-to-network*, *internet*, *transport*,and *application*.
- However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: *physical*, *data link*, *network*, *transport*, and *application*.

TCP/IP and OSI model