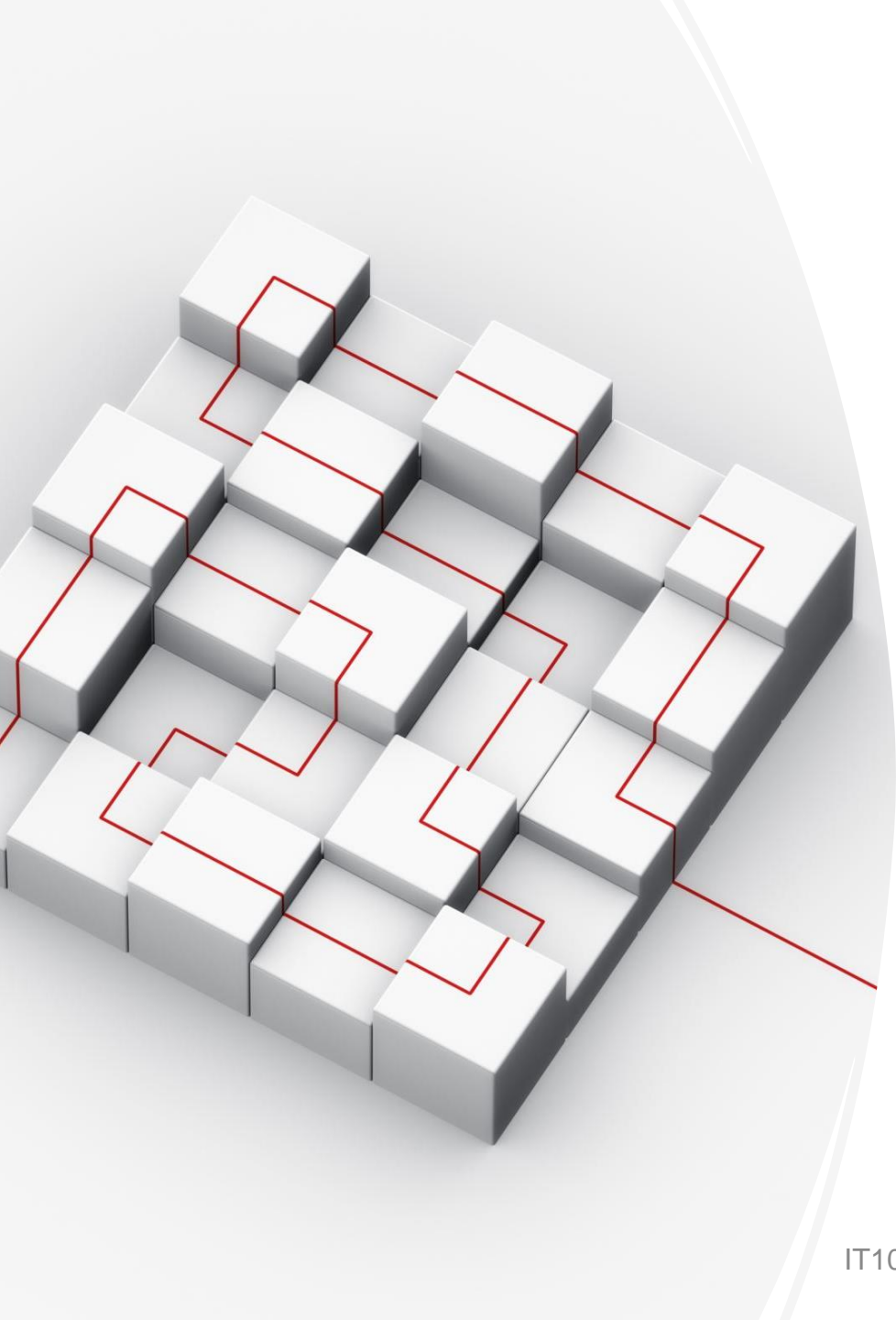# Introduction to Computer Systems

Computer networks

Lecture 09

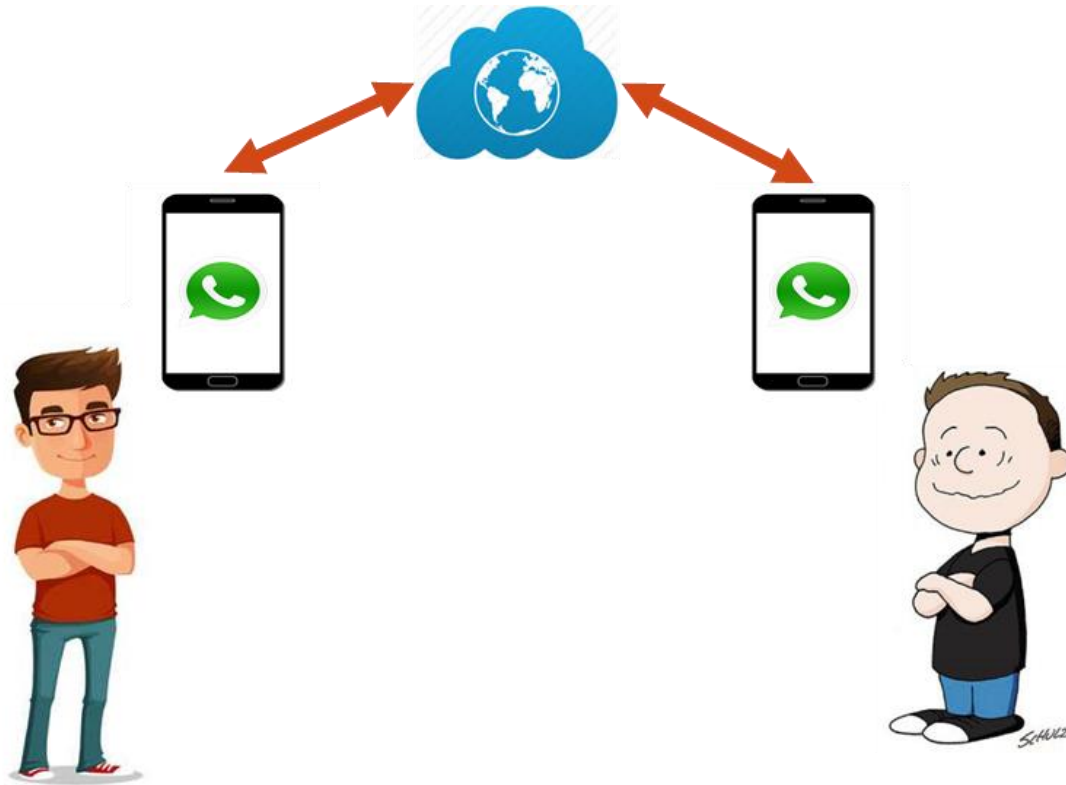# ISO – OSI Reference Model

Lecture Outline

Network Protocols

Layered Architecture
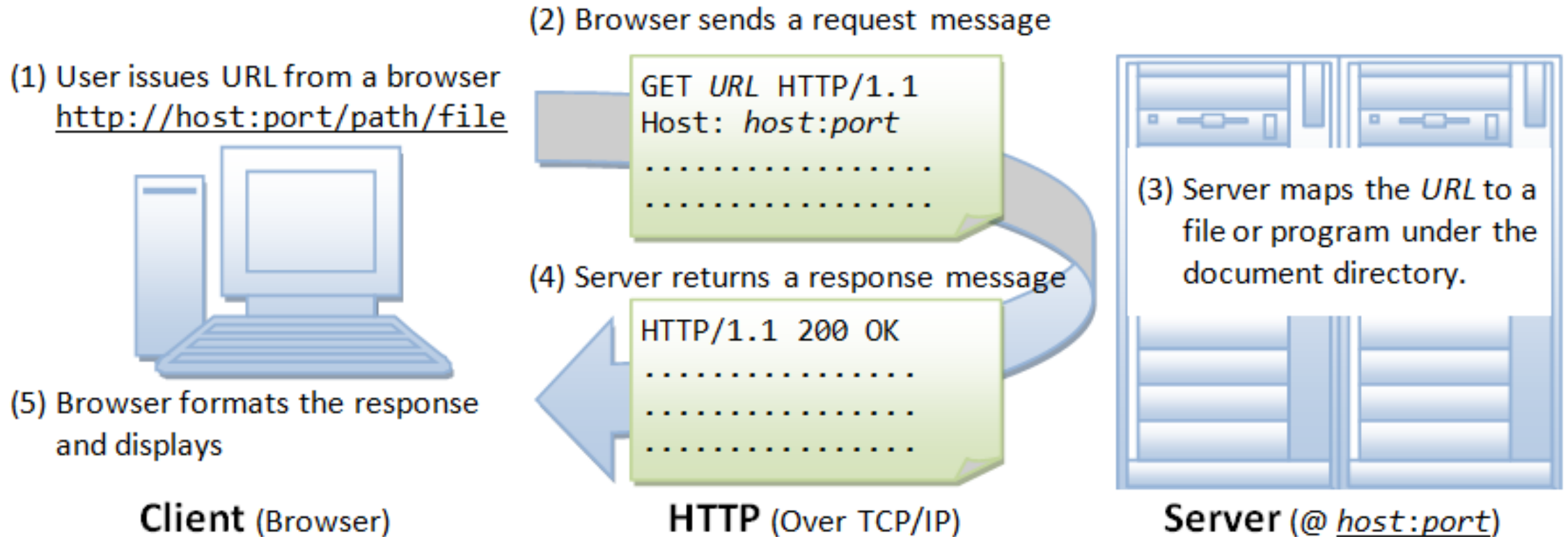
IOS – OSI Model

TCP / IP Model

Rules of Communication

- ✓ Identified sender and receiver
- ✓ Communication language and grammar
- ✓ Speed and timing of delivery
- ✓ Confirmation or acknowledgment requirements

NETWORK PROTOCOLS

- Networking protocols define **a common format** and a **set of rules** for exchanging messages between devices

(1) User issues URL from a browser
http://host:port/path/file

(2) Browser sends a request message

```
GET URL HTTP/1.1
Host: host:port
...................
...................
```

(3) Server maps the URL to a file or program under the document directory.

(4) Server returns a response message

```
HTTP/1.1 200 OK
.................
.................
.................
```

(5) Browser formats the response and displays

Client (Browser)

HTTP (Over TCP/IP)

Server (@ host:port)

REFERENCE MODEL FOR NETWORK COMMUNICATION

- Defines how applications can communicate over a network: the full process

- Guide vendors and developers, so the digital communication products and software programs they create will interoperate

- A layered reference model divides the full process into specific related groups of actions at each layer
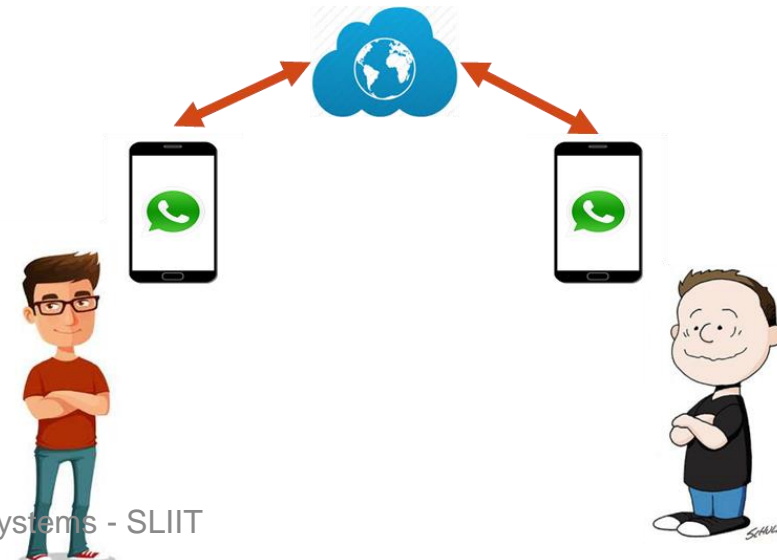
Layered Tasks

Sender

Receiver

Higher layers

Middle layers

Lower layers

THE METHOD YOU ALL KNOW

OLD SCHOOL METHOD

Benefits of Using a Layered Model

- Provides a common language

- Create a competition between vendors

- Changes in one layer do not affect other layers

- Assists in protocol design

ISO – OSI Reference Model

- ISO – International Organization for Standardization
- OSI – Open Systems Interconnection

- The International Organization for Standardization (ISO)
  is a multinational body dedicated to worldwide agreement on international standards

- An ISO standard that covers all aspects of network communications
  is the Open Systems Interconnection (OSI) model
- It was first introduced in the late 1970s

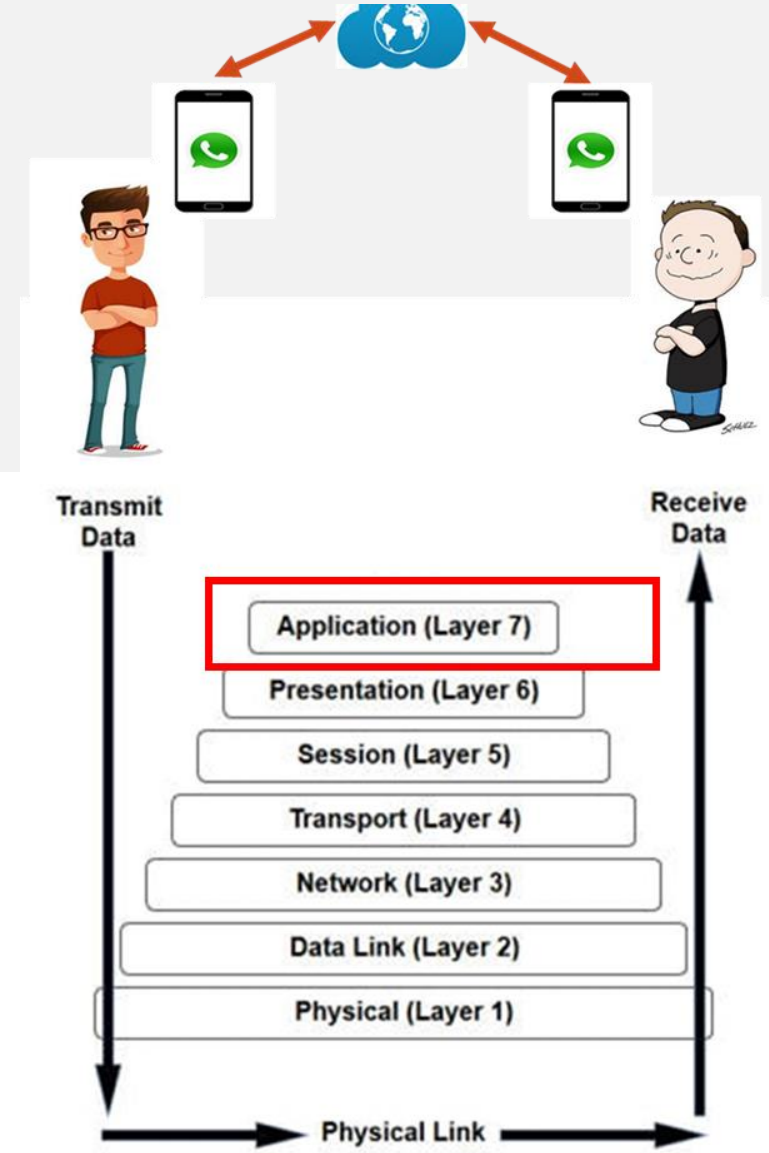- ✓ Note: ISO is the organization, OSI is the model

ISO – OSI Reference cont.

ISO – OSI Reference cont.

SENDING

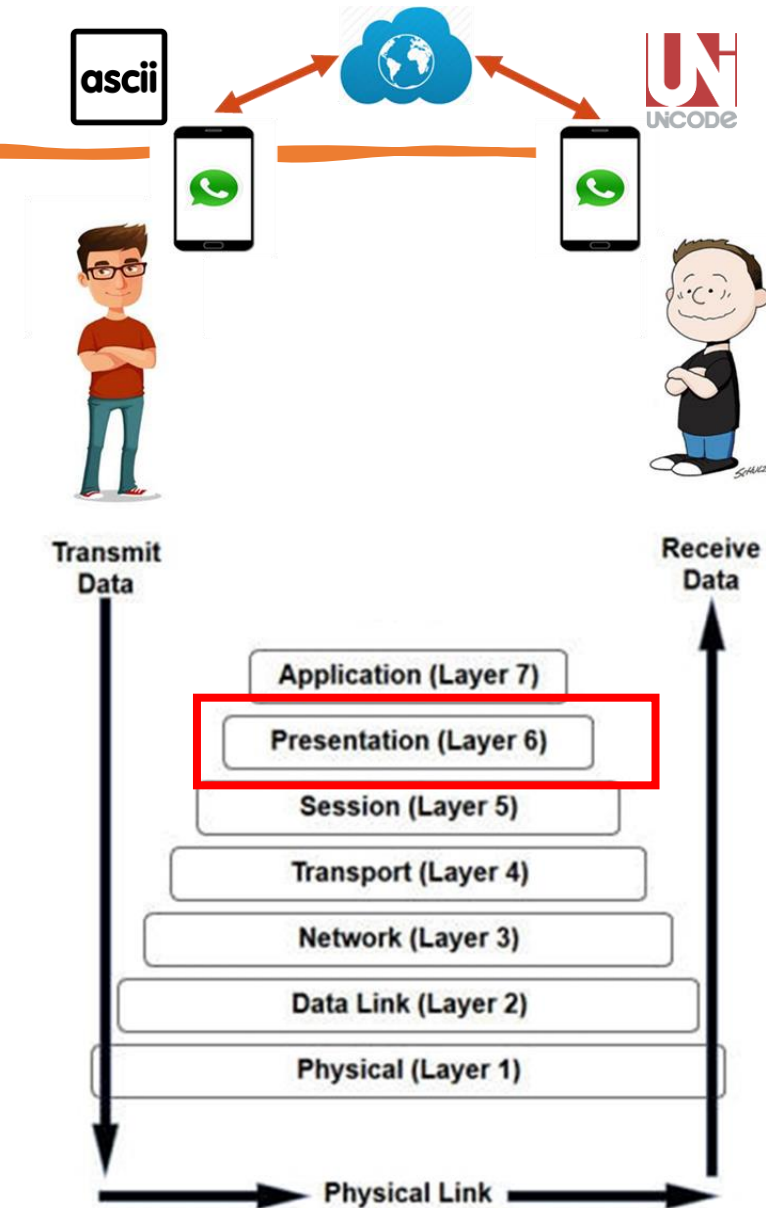RECIEVING
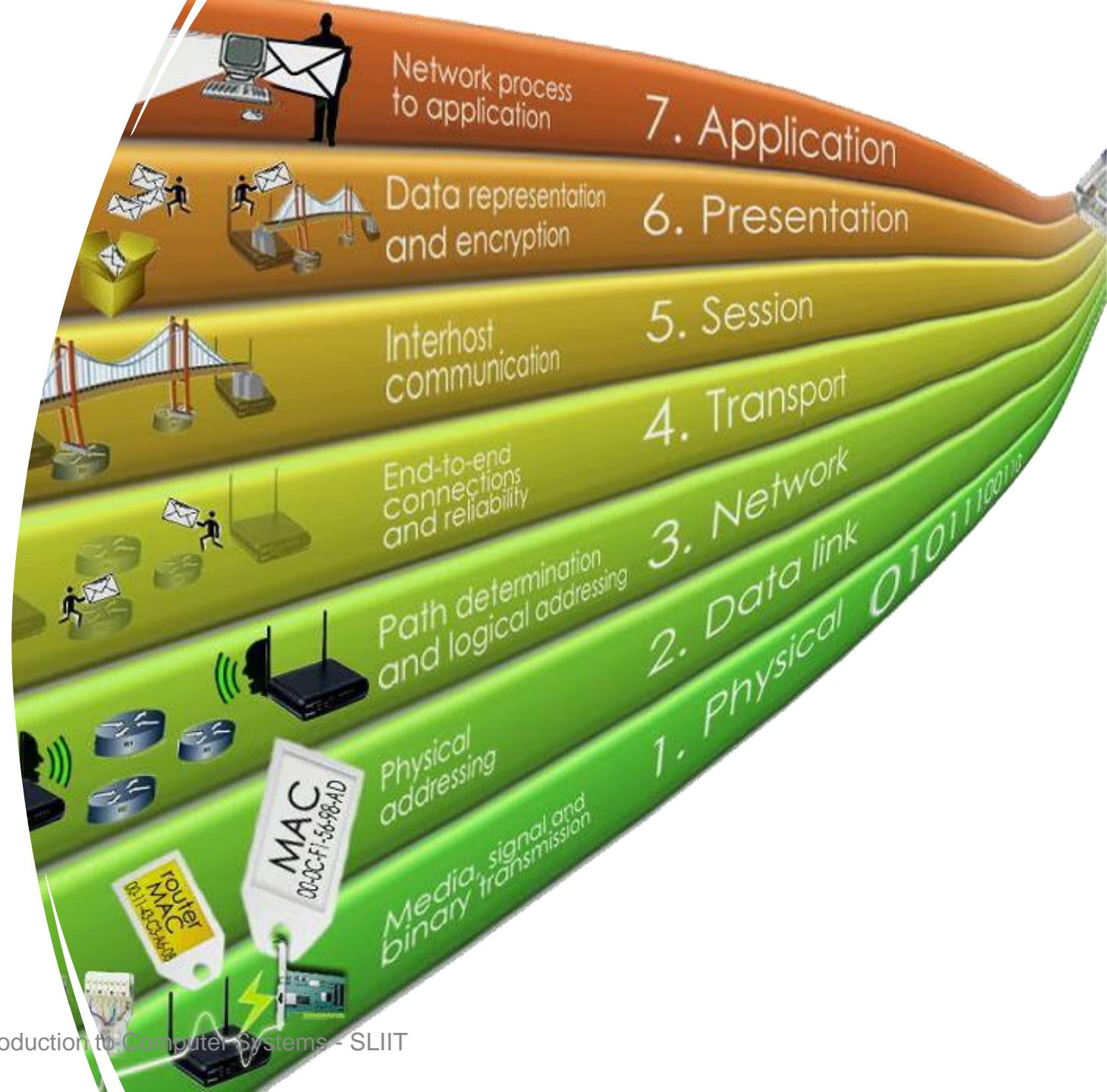
Application Layer

- Application layer is **our (i.e. users) interface** to the network

- Application layer provides many useful applications to facilitate our day-to-day tasks,
  - ✓ Email services
  - ✓ File transferring
  - ✓ Remote terminals
  - ✓ Web services

Transmit Data

Receive Data

Application (Layer 7)

Presentation (Layer 6)

Session (Layer 5)

Transport (Layer 4)

Network (Layer 3)

Data Link (Layer 2)

Physical (Layer 1)

Physical Link

Presentation Layer

There are **three major functions** performed by the Presentation Layer,

1. **Translation**

2. **Encryption**

3. **Compression**

Transmit Data

Receive Data

Application (Layer 7)

Presentation (Layer 6)

Session (Layer 5)

Transport (Layer 4)

Network (Layer 3)

Data Link (Layer 2)

Physical (Layer 1)

Physical Link

Presentation Layer cont.

There are three major functions performed by the Presentation Layer,

Translation

- Sender and Receiver may be using two different formats to represent data (e.g. ASCII vs. UNICODE).
- Translation is the process of converting data,
  - ➢ From **sender-dependent** format **to a common** format **at the sender**
  - ➢ From **common format** to the **receiver-dependent** format **at the receiver**.

Presentation Layer cont.

Encryption
- Translate the data into an not recognizable format
- To prevent unauthorized people from viewing the data
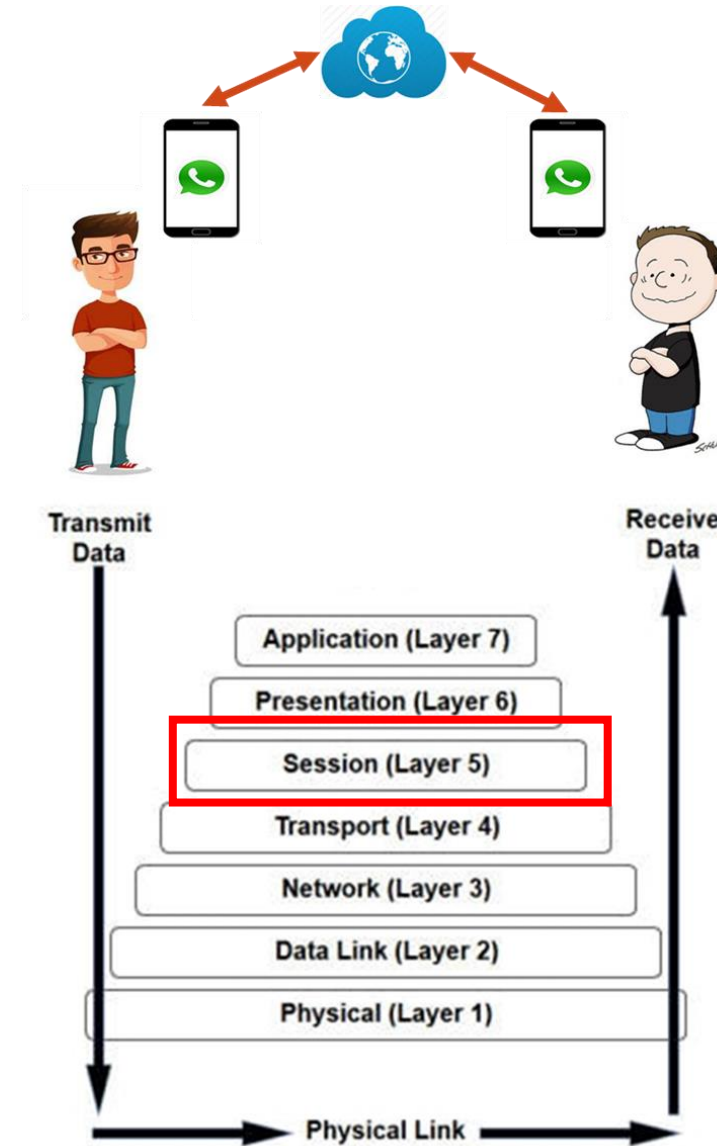
Compression
- To reduce the number of bits to be transmitted (e.g., reduce the size)
- Important when sending multimedia content such as audio and video

Session Layer

There are **two major functions** performed by the Session Layer,
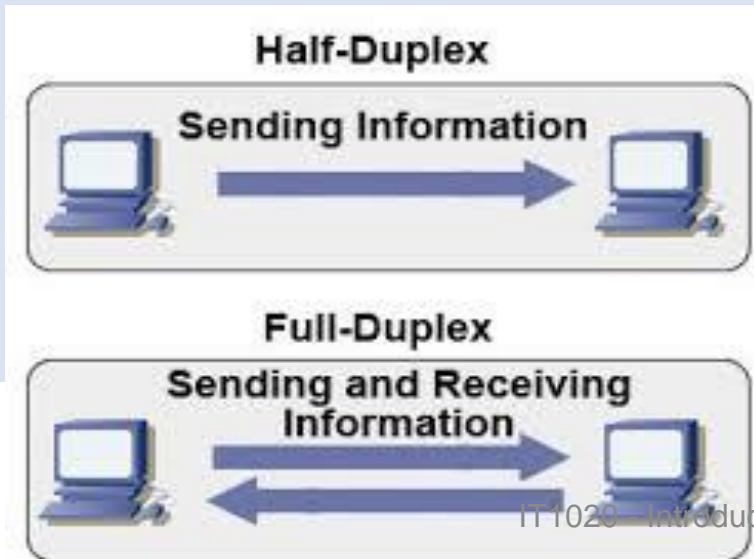
1. **Dialog Control**
2. **Synchronization**

Session Layer cont.

- **Dialog Control**

  ✓ Allows the **two** communicating **processes** to **enter into a dialog** (i.e. a two way communication)

 ✓ This dialog can be either half duplex or full duplex

- **Synchronization**

  ✓ Session layer **adds checkpoints in between the long data** stream passed by the layer above (i.e. presentation layer)

 ✓ Adds an additional level of verification to the receiver
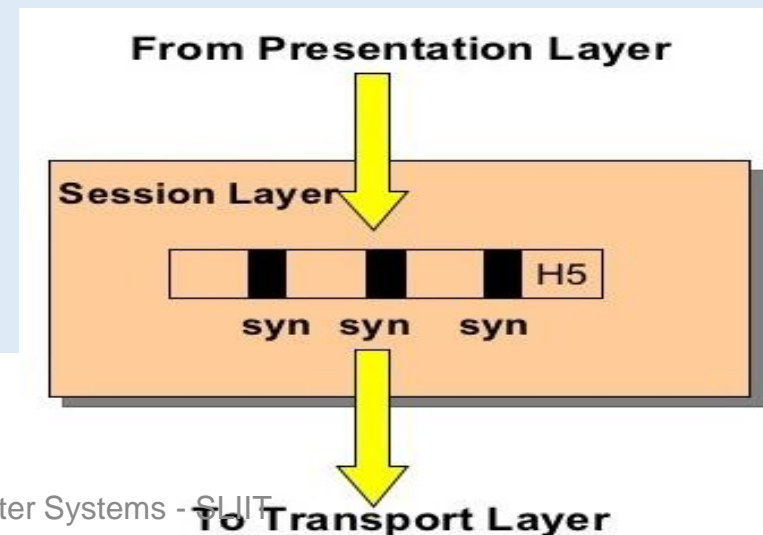
Transport Layer

- Several very important functionalities,
  - ✓ **PORT Numbers**: an address to each application
  - ✓ **Segmentation** and reassembly
  - ✓ **Connection** control
  - ✓ **Flow** control
  - ✓ **Error** control
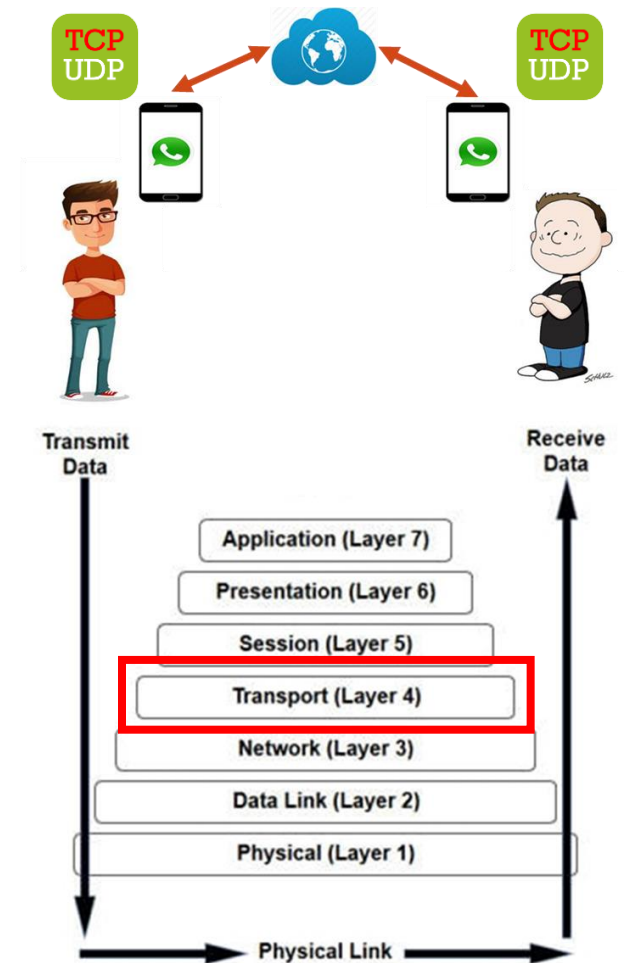
TRANSPORT LAYER CONT.
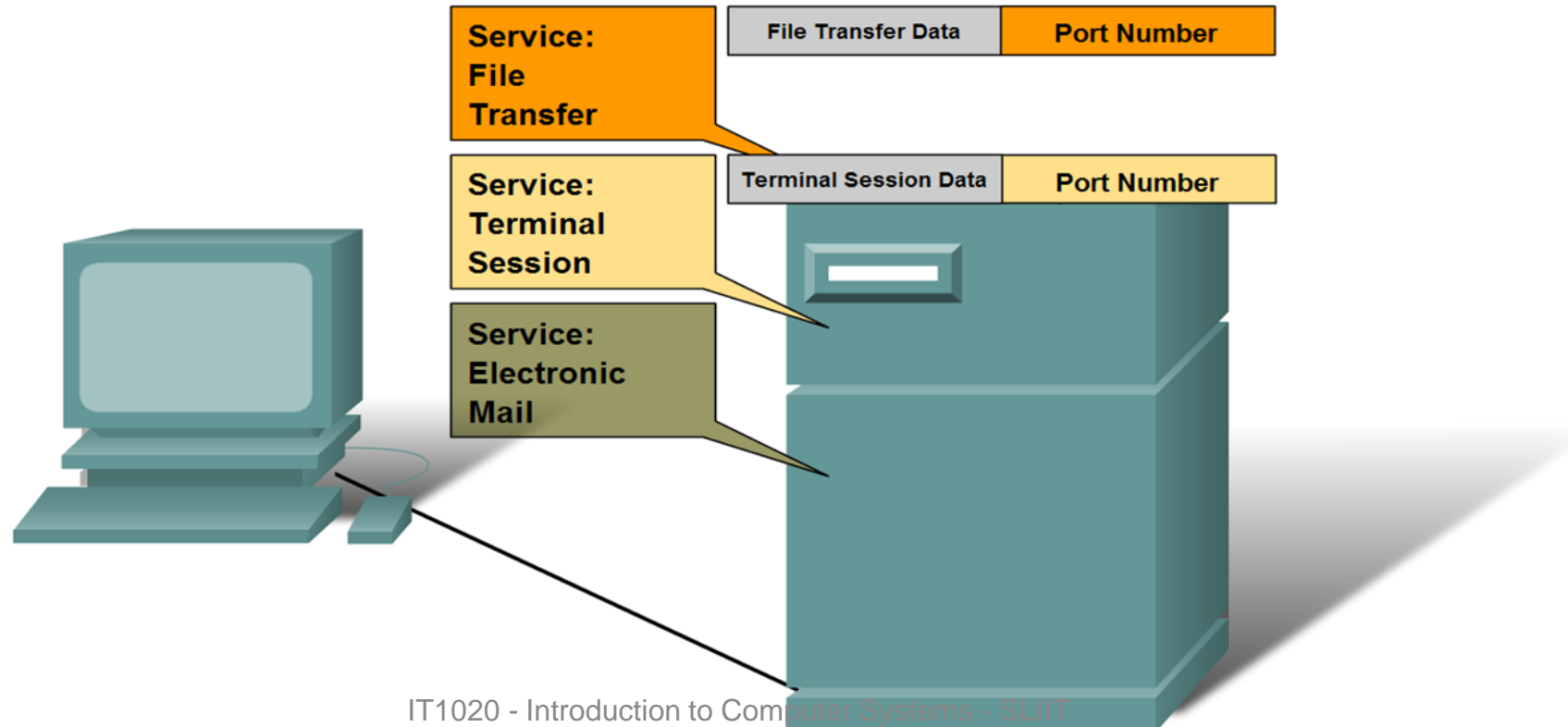
Transport Layer: Process to Process Delivery

Network Layer
Host-to-host Communication

Transport Layer
Process-to-Process Communication
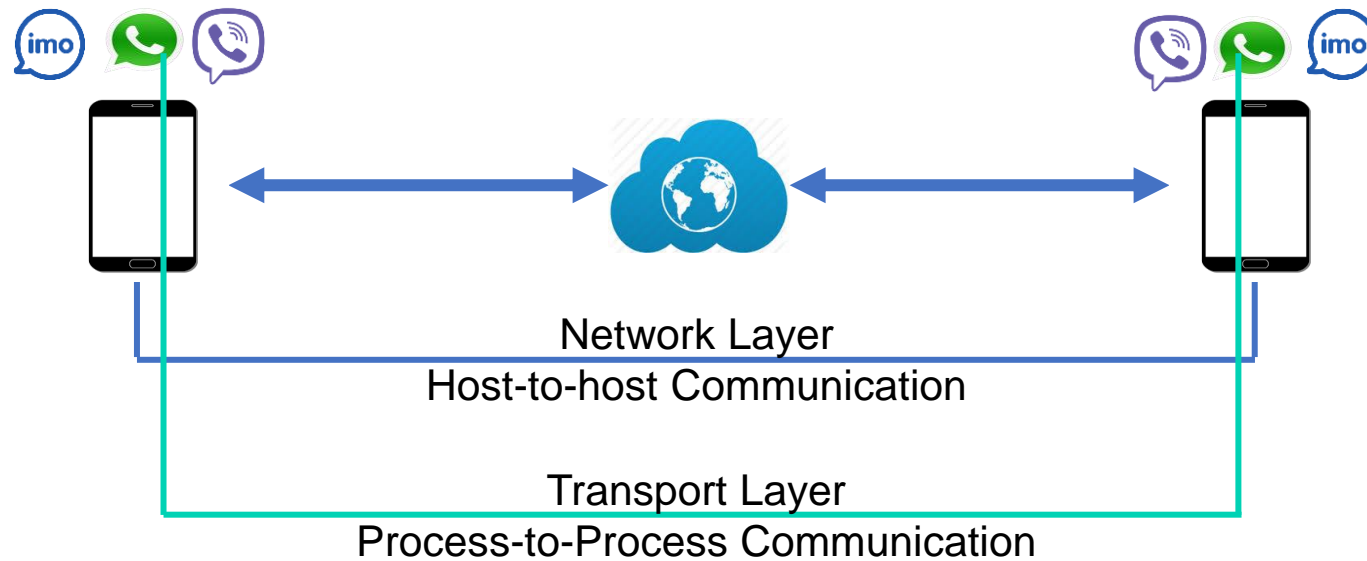
TRANSPORT LAYER CONT.

**TRANSPORT LAYER ADDRESS: PORT ADDRESS**

- Uses to **identify** the **source and destination processes** for communication

At the end device, the service port number directs the data to the correct conversation.

| Service: File Transfer | File Transfer Data | Port Number |

| Service: Terminal Session | Terminal Session Data | Port Number |

| Service: Electronic Mail |

Network Layer

- Network layer is responsible for two major functionalities:
1. **Routing**
2. **Logical addressing (IP address)**
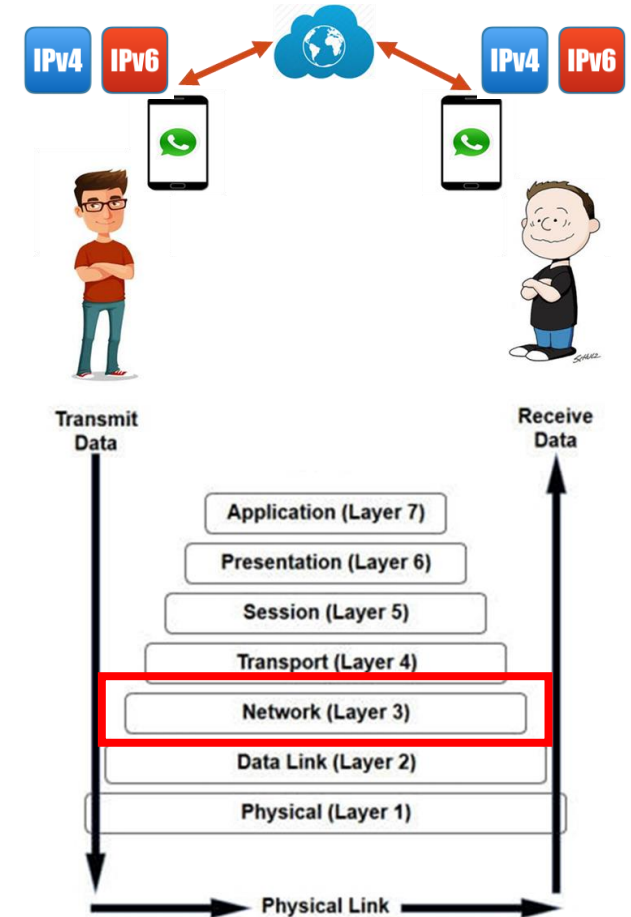
Logical addressing (IP address)

- Each **device** should **have** a address

- Network layer issues addresses to the devices called the **logical addresses: IP addresses**
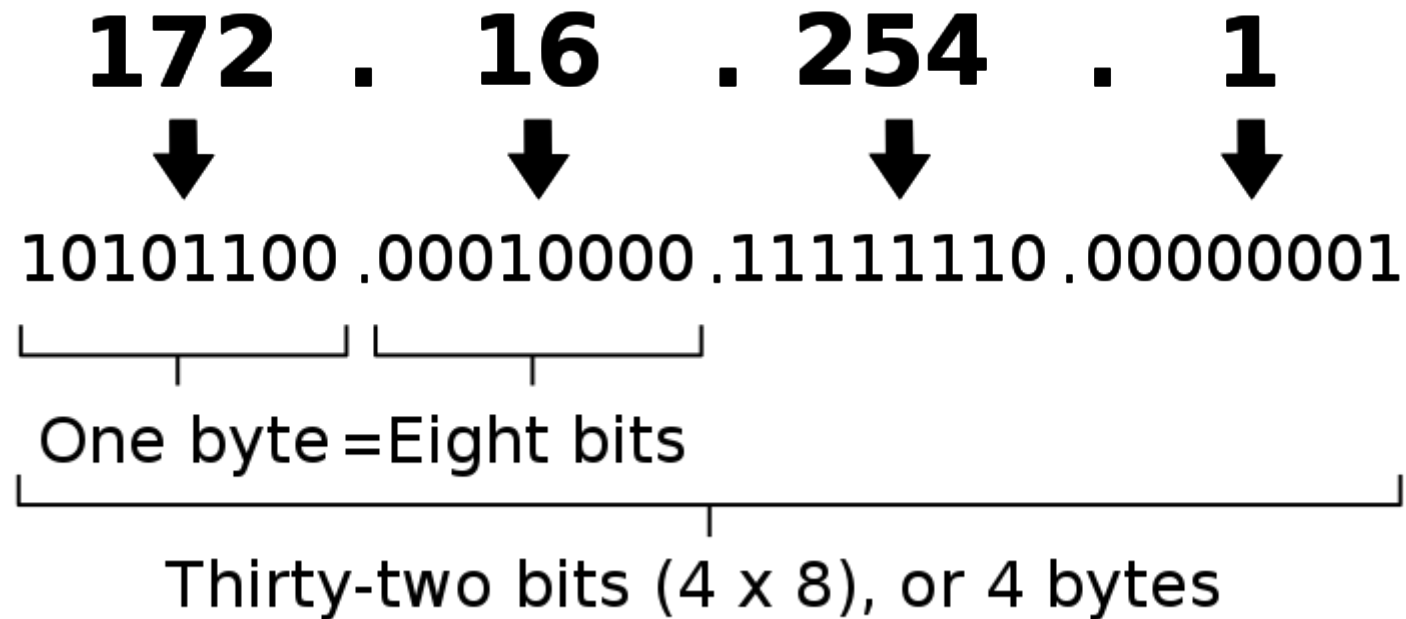
Routing

- **Applications** are in **different devices**

- Different devices are **connected** to **same/different networks**

- So there should be a mechanism to **travers** the **data** between the devices **through the networks**

- That mechanism is known as routing

Network Layer cont.

Network Layer cont.

NETWORK LAYER ADDRESS: IP ADDRESS

172 . 16 . 254 . 1

10101100 . 00010000 . 11111110 . 00000001

One byte = Eight bits

Thirty-two bits (4 x 8), or 4 bytes

Network Layer cont.

NETWORK LAYER ADDRESS: IP ADDRESS

- IP address has two parts: the network prefix and the host part

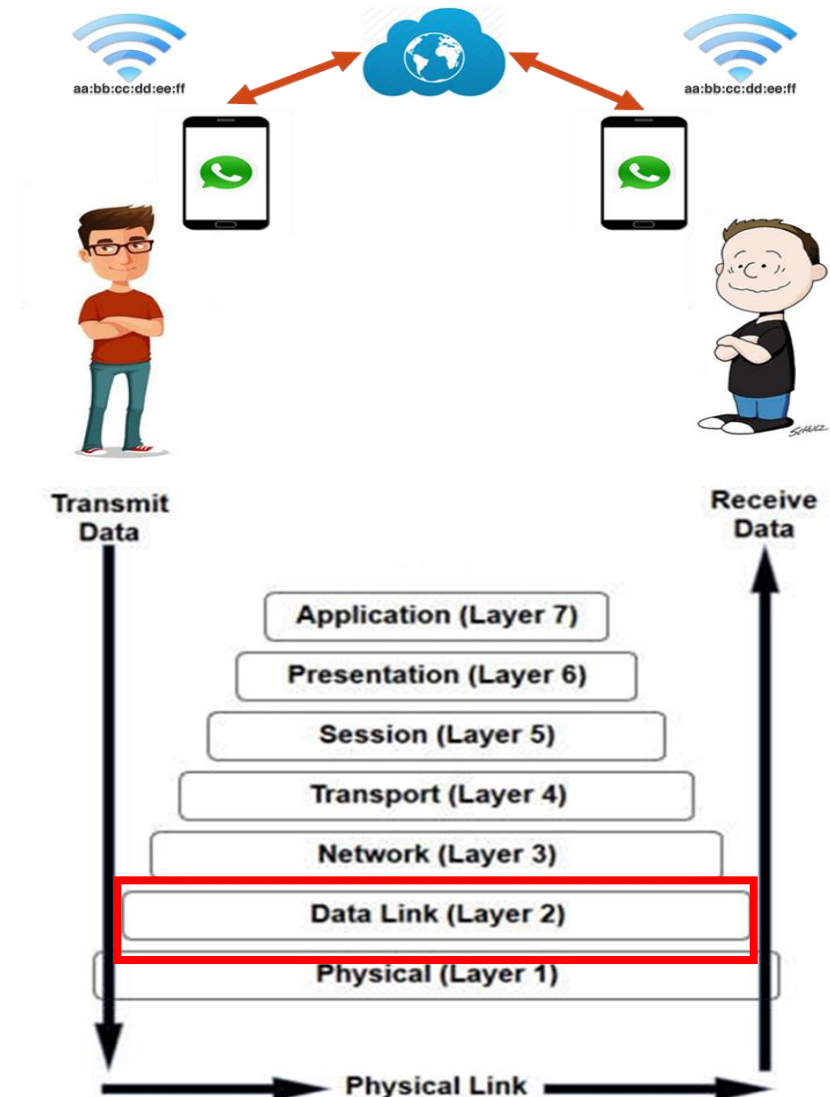| 192	.	168	.	10	.	1
11000000		10101000		00001010		00000001

The computer using this IP address is on network 192.168.10.0.
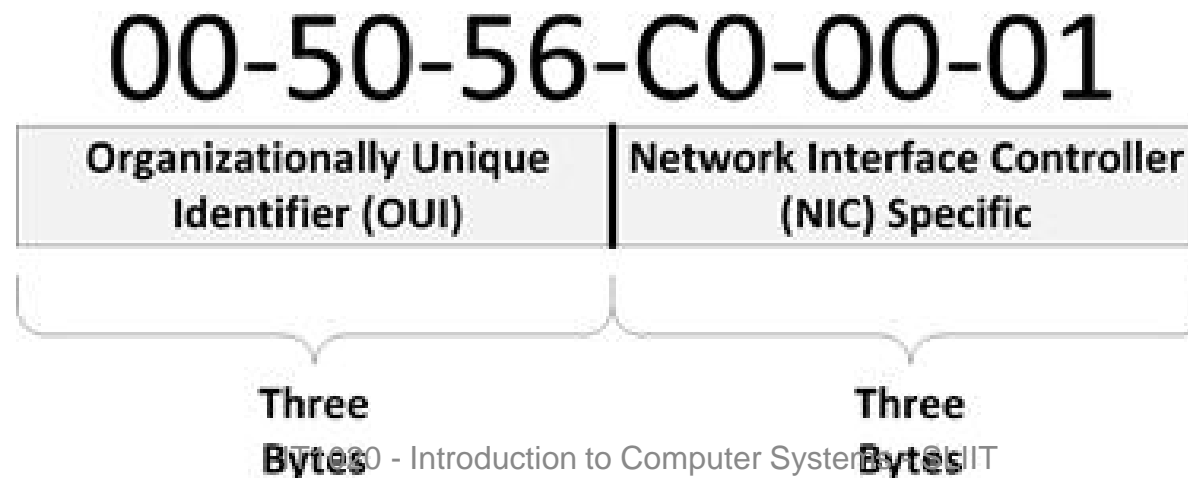
Data Link Layer

- Responsible to guarantee the successful transmission of frames from one hop to the next
    1. Framing – Ethernet frame
    2. Physical addressing (MAC address)
    3. Flow control
    4. Error control
    5. Access control

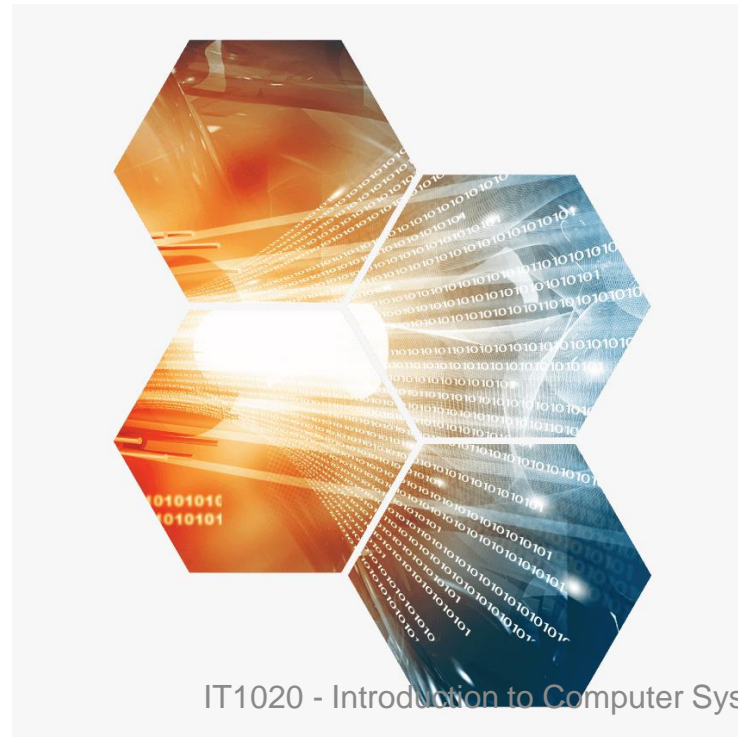aa:bb:cc:dd:ee:ff   aa:bb:cc:dd:ee:ff

Transmit Data   **Receive Data**

Application (Layer 7)

Presentation (Layer 6)

Session (Layer 5)

Transport (Layer 4)

Network (Layer 3)

Data Link (Layer 2)

Physical (Layer 1)

Physical Link

Data Link Layer Cont.

DATA LINK LAYER ADDRESS: MAC ADDRESS

- Physical address
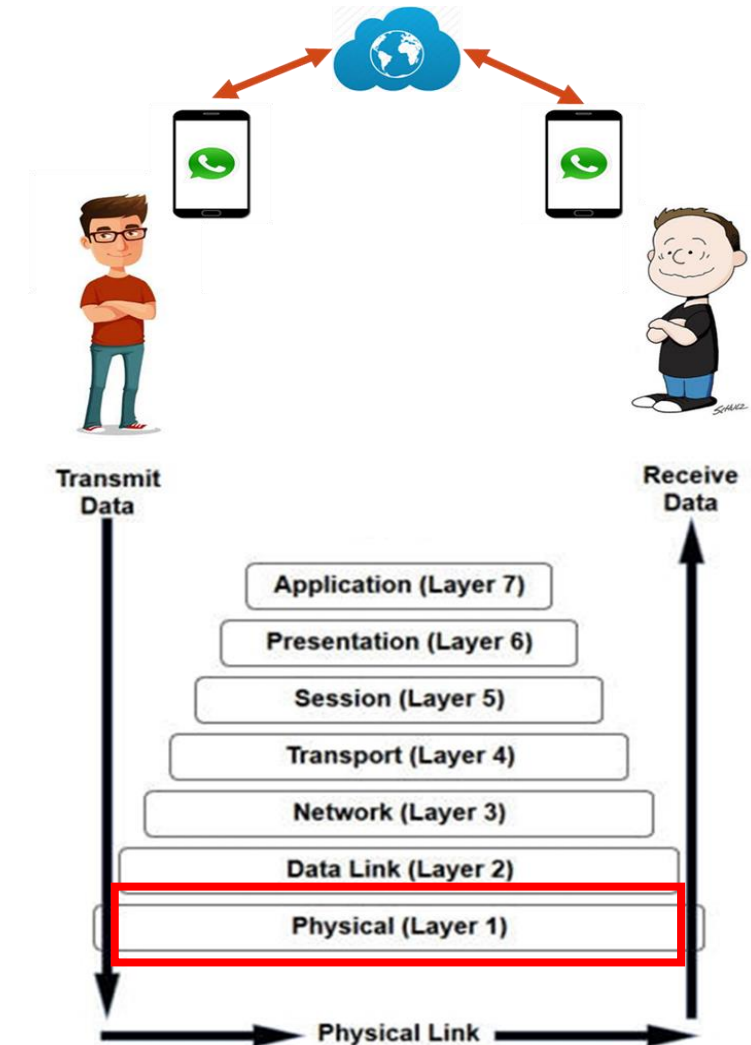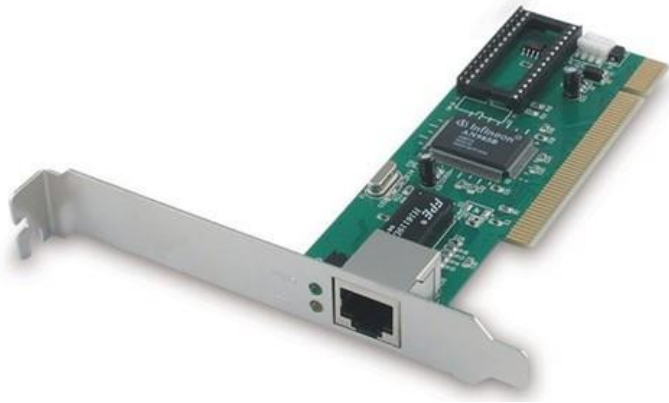
- Universally Unique address

- 48 bit long address

00-50-56-C0-00-01

Organizationally Unique Identifier (OUI)	Network Interface Controller (NIC) Specific
Three Bytes	Three Bytes

Physical Layer

- **Physical Interfaces transmit** and **receive** unstructured **raw data** over the **transmission media**

- **Converts** the **digital/analog bits** into **electrical** or **optical** signals

Transmit Data

Receive Data

Application (Layer 7)
Presentation (Layer 6)
Session (Layer 5)
Transport (Layer 4)
Network (Layer 3)
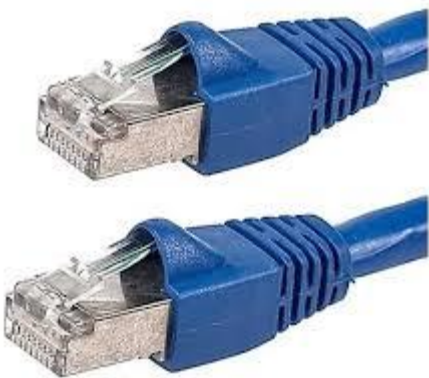Data Link (Layer 2)
Physical (Layer 1)
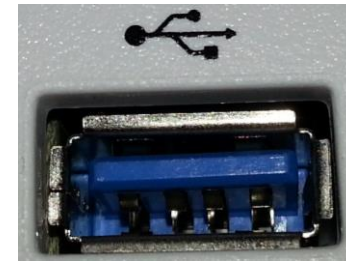
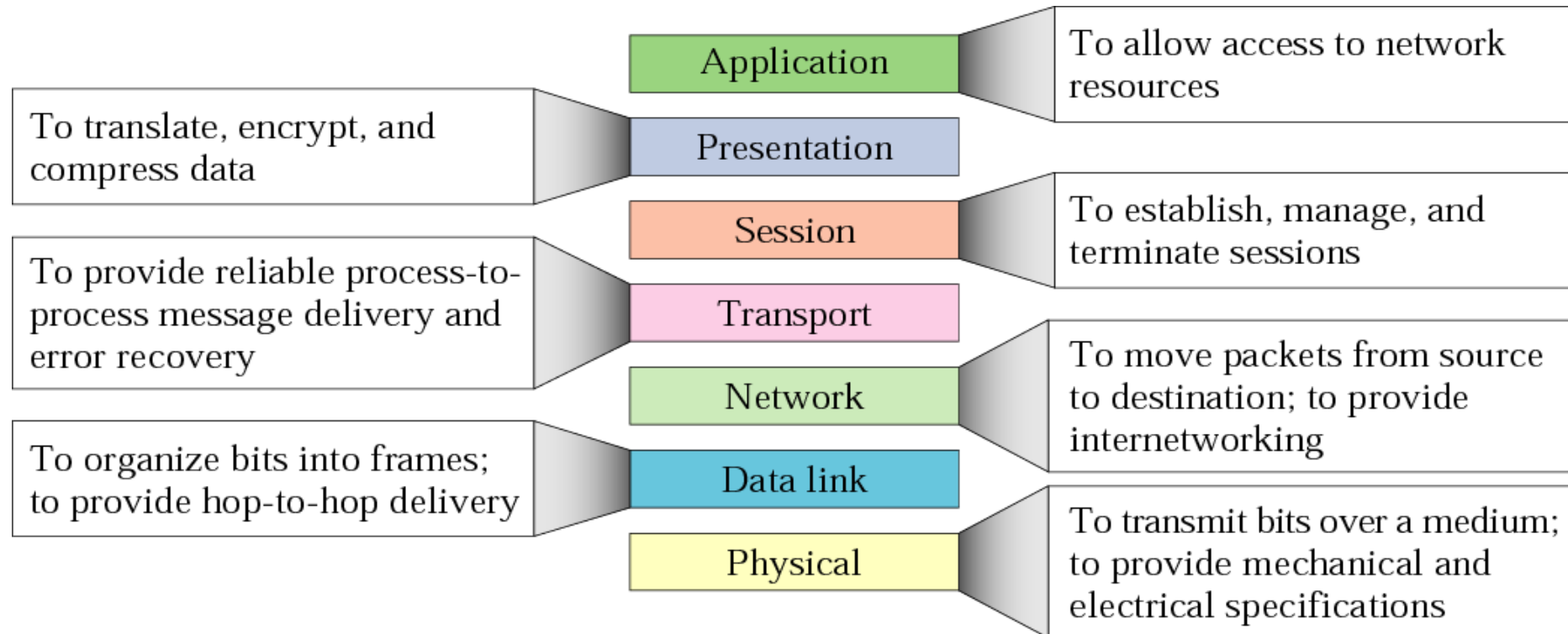Physical Link

Physical Layer cont.

??

??

??

??

??

??

PHYSICAL LAYER CONT.

Standard bodies that define Physical layer specifications
- EIA: Electronic Industries Alliance
- ITU-T: International Telecommunication Union Telecommunication Standardization Sector
- ANSI: American National Standards Institute

Summary of the ISO – OSI Layers

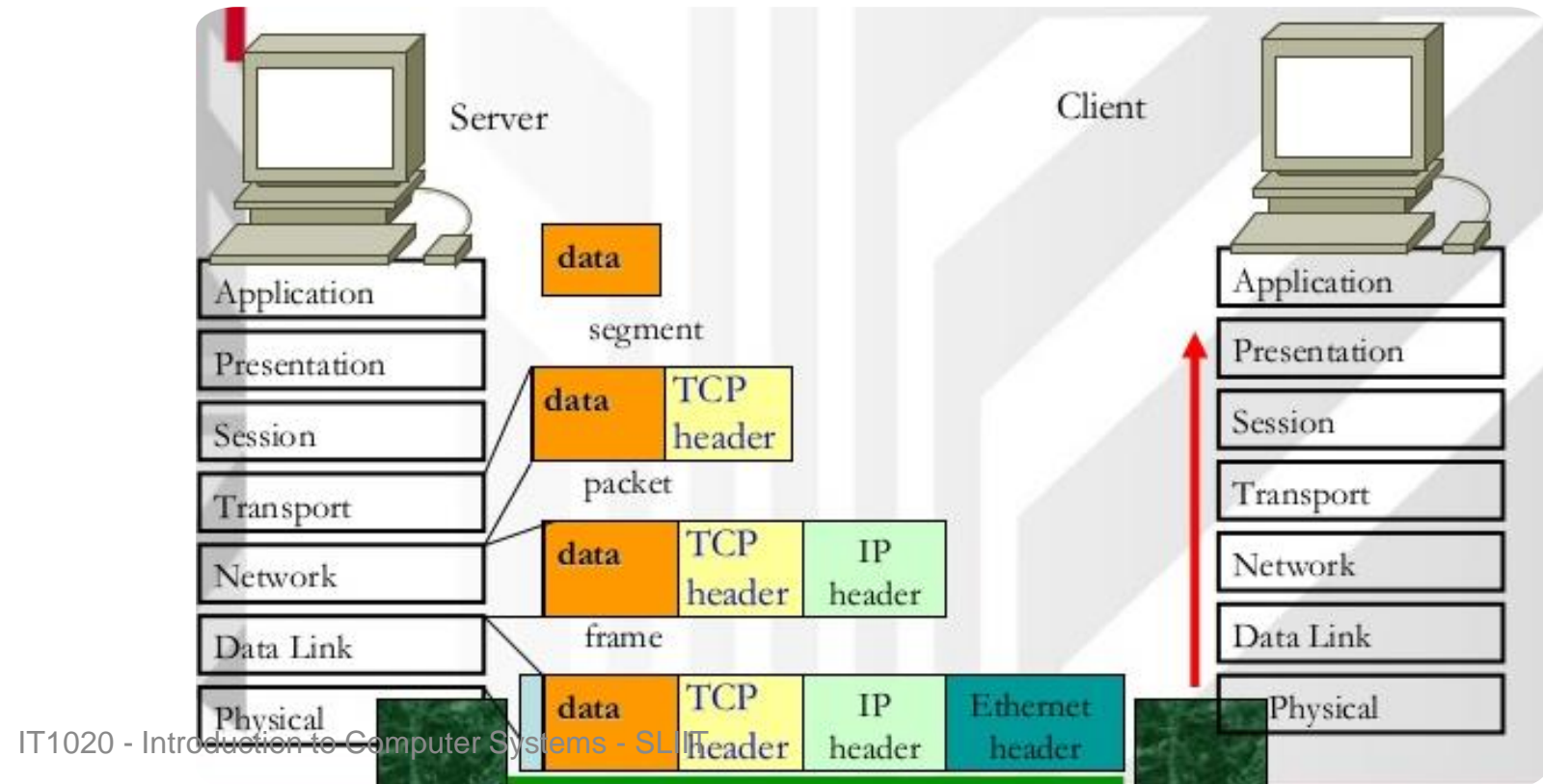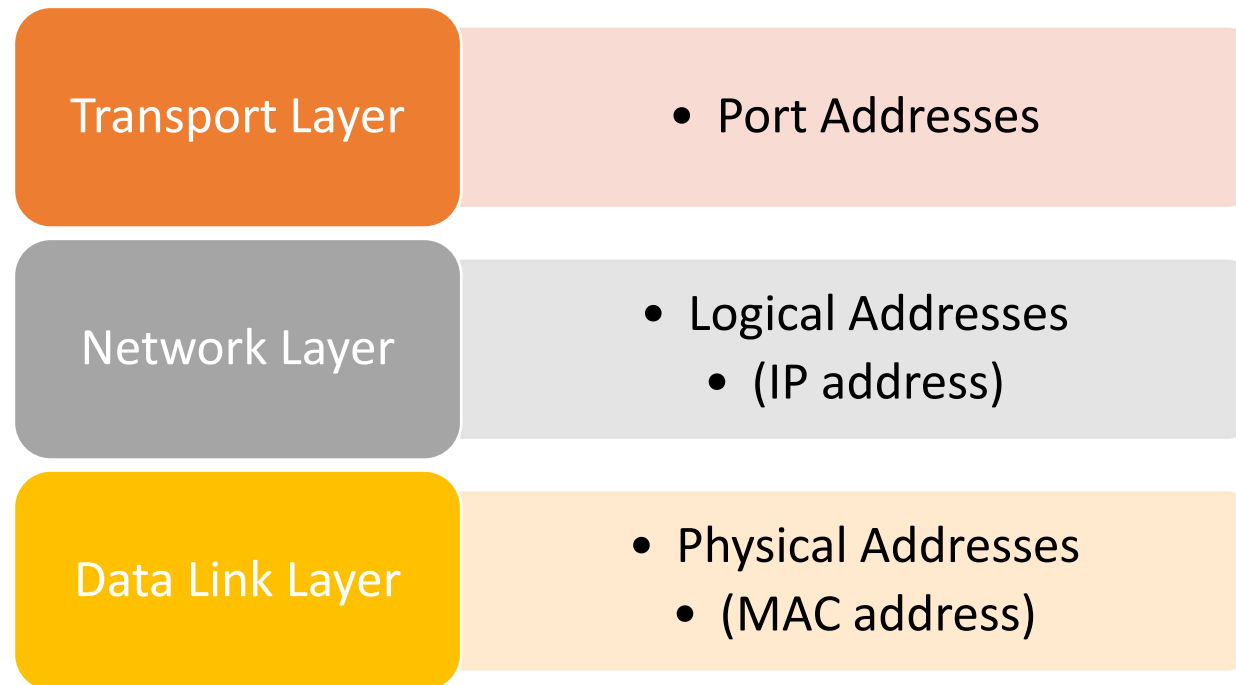|	Layer	
	Application	To allow access to network resources
To translate, encrypt, and compress data	Presentation	
	Session	To establish, manage, and terminate sessions
To provide reliable process-to-process message delivery and error recovery	Transport	
	Network	To move packets from source to destination; to provide internetworking
To organize bits into frames; to provide hop-to-hop delivery	Data link	
	Physical	To transmit bits over a medium; to provide mechanical and electrical specifications

ISO - OSI reference model cont.

- **HEADERS CONCEPT:**

EMBED CONTROL INFORMATION AT EACH LAYER

What are the Addresses used in network communication ?

Transport Layer	• Port Addresses
Network Layer	• Logical Addresses • (IP address)
Data Link Layer	• Physical Addresses • (MAC address)

What are the Connections used at different layers?

Transport Layer	• **Process-to-Process** • i.e. Source Application to Destination Application
Network Layer	• **Host-to-Host** • i.e. Source Computer to Destination Computer
Data Link Layer	• **Hop-to-Hop** • i.e. One hop to the next hop
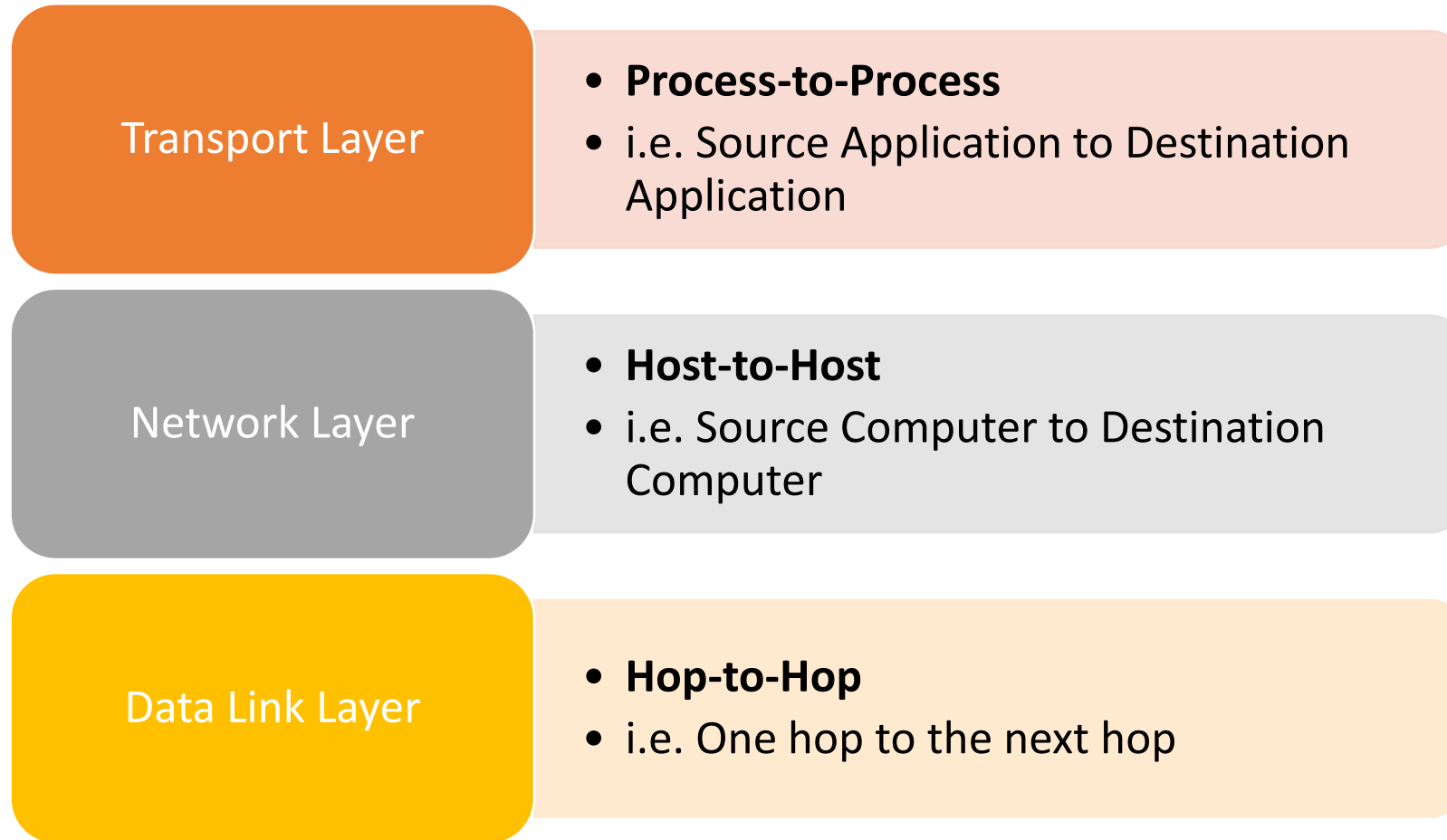
Names used for Data at each layer

Layer	Data Name
Application Layer	• Data
Presentation Layer	• Data
Session Layer	• Data
Transport Layer	• Segments
Network Layer	• Packets
Data Link Layer	• Frames
Physical Layer	• Bits

Protocols Used at Different Layers

Layer	Name	Example protocols
7	Application Layer	HTTP, FTP, DNS, SNMP, Telnet
6	Presentation Layer	SSL, TLS
5	Session Layer	NetBIOS, PPTP
4	Transport Layer	TCP, UDP
3	Network Layer	IP, ARP, ICMP, IPSec
2	Data Link Layer	PPP, ATM, Ethernet
1	Physical Layer	Ethernet, USB, Bluetooth, IEEE802.11

TCP/IP stack

THANK YOU!

ANY QUESTIONS?