Introduction to Computer Networks

Lecture 3:

OSI Model

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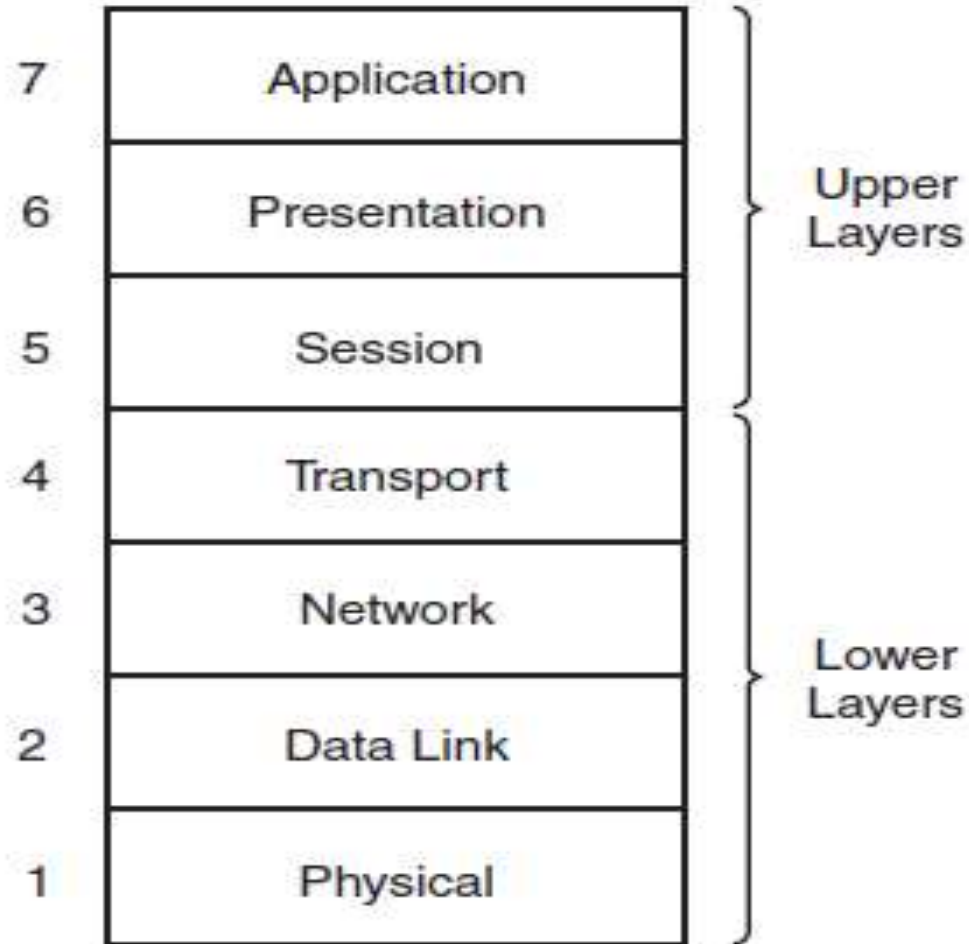
OSI Model

- What is OSI model???

To understand what is the OSI model and why it use, first we will take the following example:

➢ imagine that you are in Baghdad and you want to send an e-mail to your friend in Lebanon . Successfully sending and receiving e-mail involves doing many things, including the following:

■ You must type the message in your e-mail application.

■ You must address the message in your e-mail application.

■ You must click the **Send** button in your e-mail application to start sending the message.

■ You must use the correct type of connections and wires to connect your PC to your local network.

■ Your PC must put the data on the wire.

■ Your PC must be able to connect to the Internet, and you must provide any necessary login information.

■ Network devices must find the best path through the Internet so that the e-mail is received by the right person.
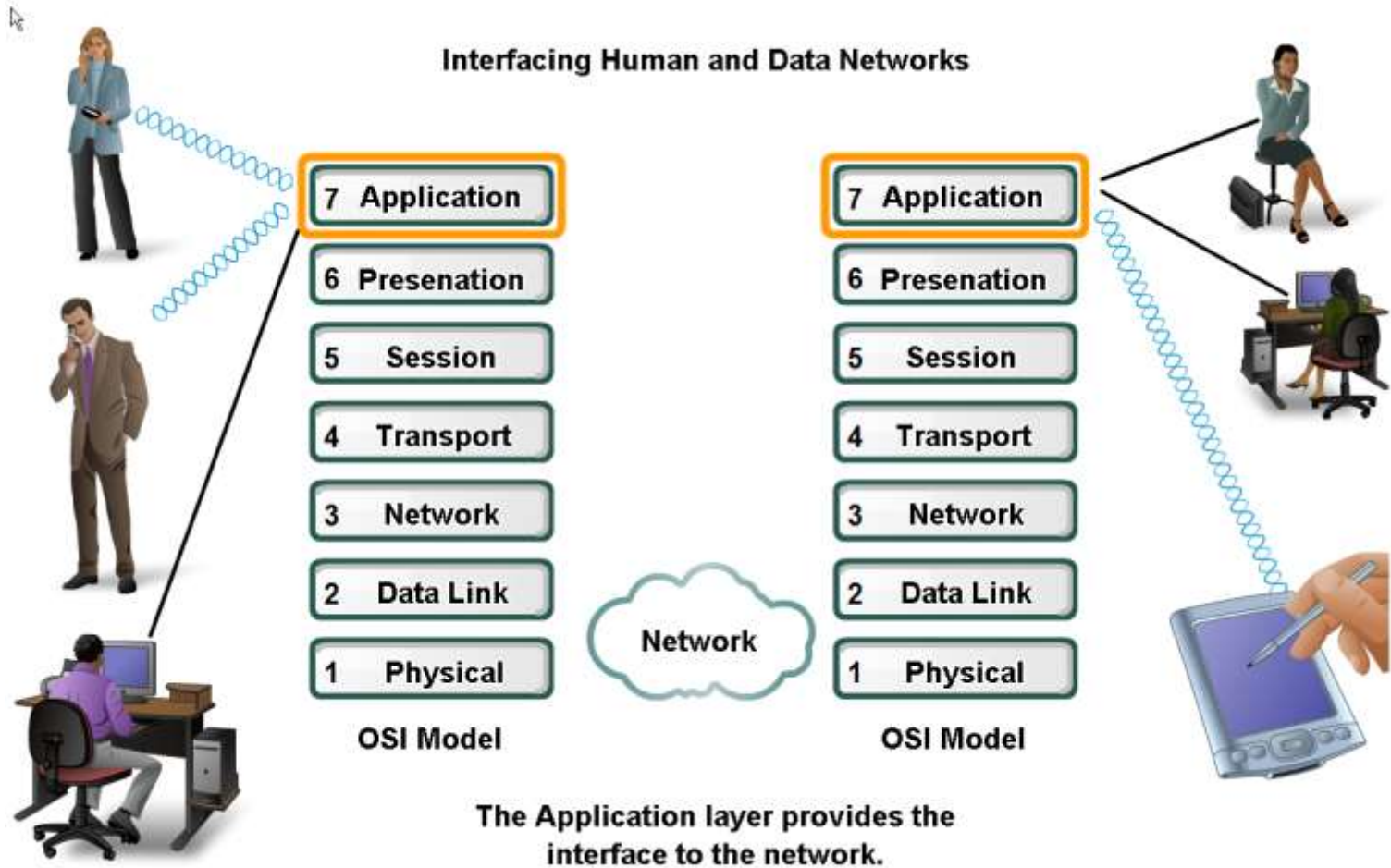
OSI Model

- OSI is stand for (**Open System Interconnection**) Reference Model.

- The International Standards Organizations (ISO) committee created a list of all the network functions required for sending data and divided them into seven categories. This model is the *OSI seven layer* model. The OSI seven-layer model was released in 1984.

- *Each of the Seven Layers of the OSI Model Represents Functions Required for Communication.*
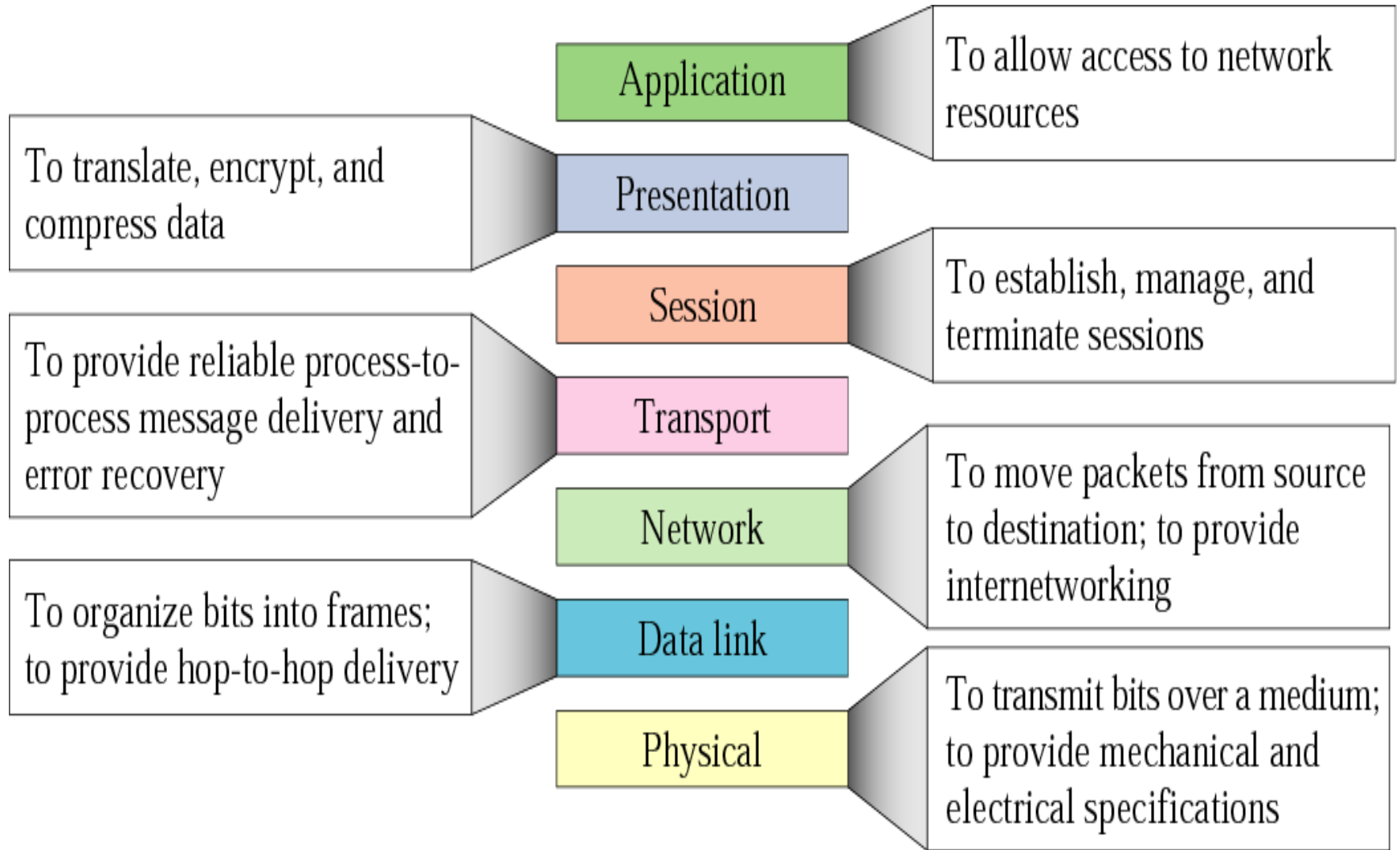
OSI Model

7	Application	Upper Layers
6	Presentation	
5	Session	
4	Transport	Lower Layers
3	Network	
2	Data Link	
1	Physical	

OSI Model

Interfacing Human and Data Networks

OSI Model		OSI Model
7 Application		7 Application
6 Presenation		6 Presenation
5 Session		5 Session
4 Transport	Network	4 Transport
3 Network		3 Network
2 Data Link		2 Data Link
1 Physical		1 Physical

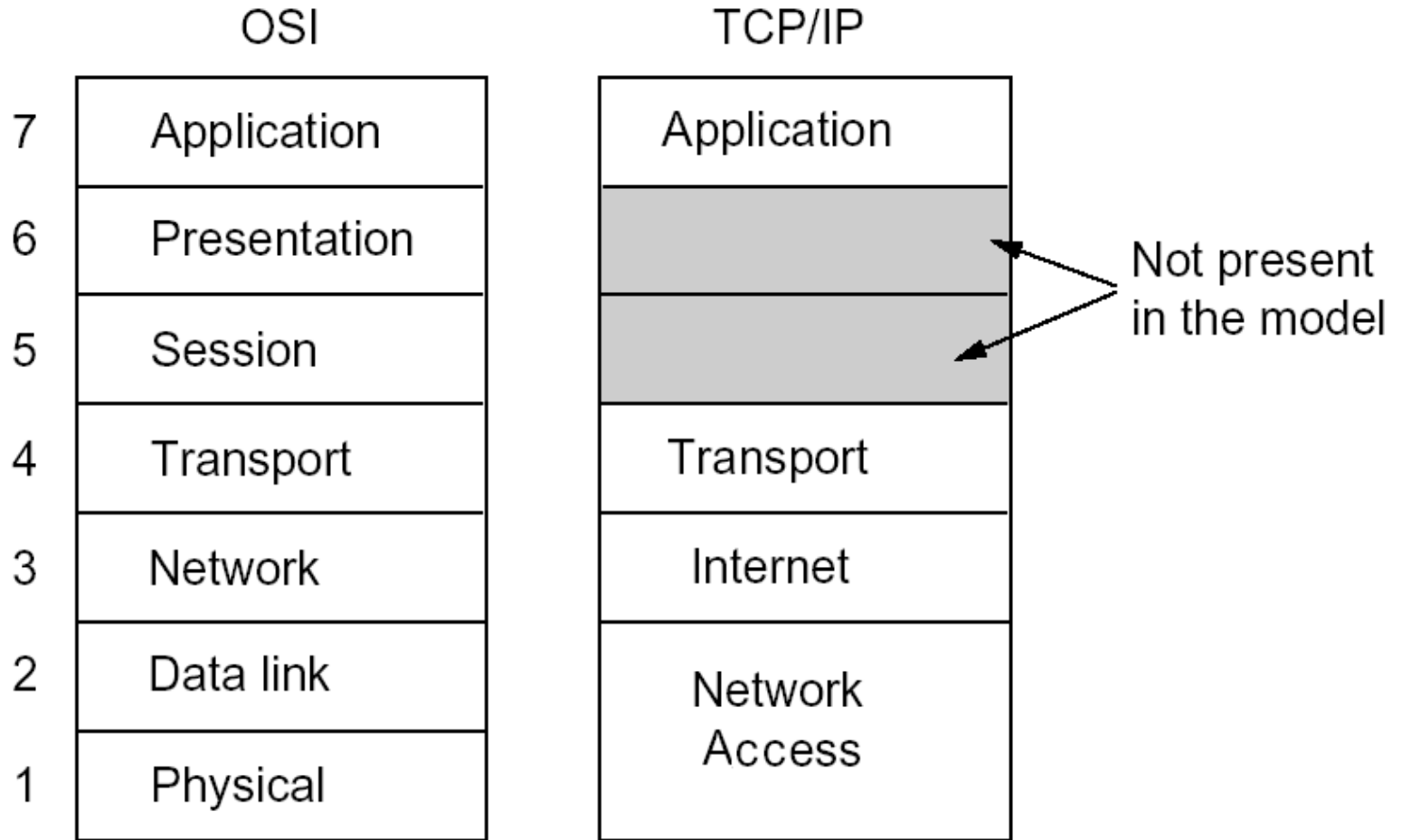The Application layer provides the interface to the network.

OSI Model

- The OSI model represents everything that must happen to send data. The important thing to remember is that the OSI model does not specify *how* these things are to be done, just *what* needs to be done. Different protocols can implement these functions differently. For example, the open-standard Internet Protocol (IP) and Novell's Internetwork Packet Exchange (IPX) protocol are different implementations of the network layer.

OSI Model

	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

OSI and TCP/IP

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

Not present in the model

Physical Layer

- Layer 1, Physical layer defines specifications such as the electrical and mechanical conditions necessary for activating, maintaining, and deactivating the physical link between devices.

• Specifications include voltage levels, maximum cable lengths, connector types, and maximum data rates.

• The physical layer is concerned with the binary transmission of data. This binary data is represented as *bits* (which is short for *binary digits*). A bit has a single binary value, either 0 or 1.
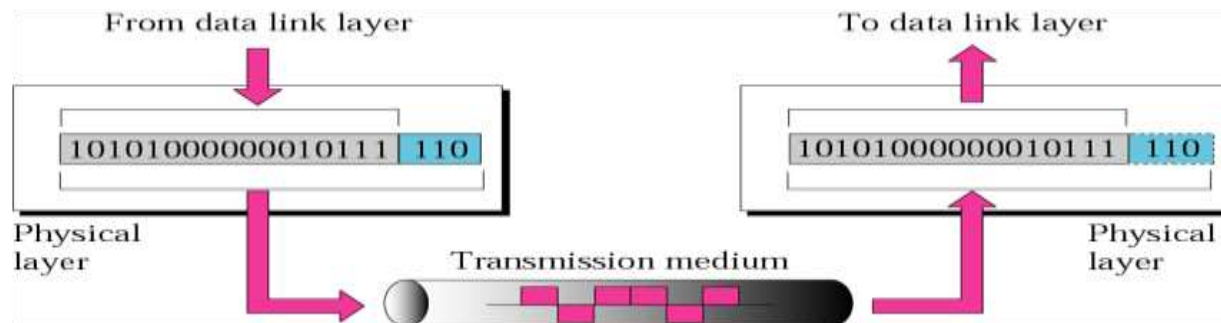
Data Link Layer

- Layer 2, defines the format of data that is to be transmitted across the physical network. It indicates how the physical medium is accessed, including physical addressing, error handling, and flow control.

- The data link layer sends **frames** of data.

- A *frame* is a defined set of data that includes addressing and control information and is transmitted between network devices. A frame can contain a header field (in front of the data) and a trailer field (after the data); these two fields are said to "frame" the data.

  - Has two sub-layers:
    - Logical Link Control (LLC):
      - ✓ Allows multiple network layer protocols to communicate .
      - ✓ Monitoring and controlling the connection.
    - Media Access Control (MAC): uniquely physical address identify device on network.

- The MAC sublayer specifies the *physical* MAC address that uniquely identifies a device on a network. Each frame that is sent specifies a destination MAC address; only the device with that MAC address should receive and process the frame. Each frame also includes the MAC address of the frame's source.

Network Layer

- Layer 3, Network layer is responsible for routing, which allows data to be properly forwarded across a logical internetwork (consisting of multiple physical networks).

- The Network layer sends datagram (**Packets)** of data

•Internet Protocol (IP) addresses (*Logical* network addresses) as opposed to physical MAC addresses are specified at Layer 2.

•Layer 3 protocols include routed and routing protocols. The routing protocols determine the best path that should be used to forward the routed data through the internetwork to its destination.

Network Layer (Cont.)

- A *datagram* is a defined set of data that includes addressing and control information and is routed between the data's source and destination.

- If a datagram needs to be sent across a network that can handle only a certain amount of data at a time, the datagram can be fragmented into multiple packets and then reassembled at the destination. Therefore, a *datagram* is a unit of data, whereas a *packet* is what physically goes on the network. If no fragmentation is required, a packet is a datagram; the two terms are often used interchangeably.

Transport Layer

- Layer 4, the transport layer, is concerned with end-to-end connections between the source and the destination.

- The transport layer provides network services to the upper layers.

- The Transport layer sends **Segments** of data

- A *segment* is a defined set of data that includes control information and is sent between the transport layers of the sender and receiver of the data.

Transport Layer(Con.)

- Connection-oriented reliable transport.

- transport establishes a logical connection and uses sequence numbers to ensure that all data is received at the destination.

- Connectionless best-effort transport.

- transport just sends the data and relies on upper-layer error detection mechanisms to report and correct problems.

- Reliable transport has more overhead than best-effort transport

The upper layers

- The three upper layers represent the data that must be transmitted from the source to the destination; the network typically neither knows nor cares about the contents of these layers.

- **The Session layer, Layer 5**, is responsible for establishing, maintaining, and terminating communication sessions between applications running on different hosts.

- **The Presentation layer, Layer 6**, specifies the format, data structure, coding, compression, and other ways of representing the data to ensure that information sent from one host's application layer can be read by the destination host.

- **The Application layer, Layer 7**, is the closest to the end, it provides a means for the *user to access information on the network through an application*. This layer is the ***main interface*** for users to interact with the application and therefore the network.

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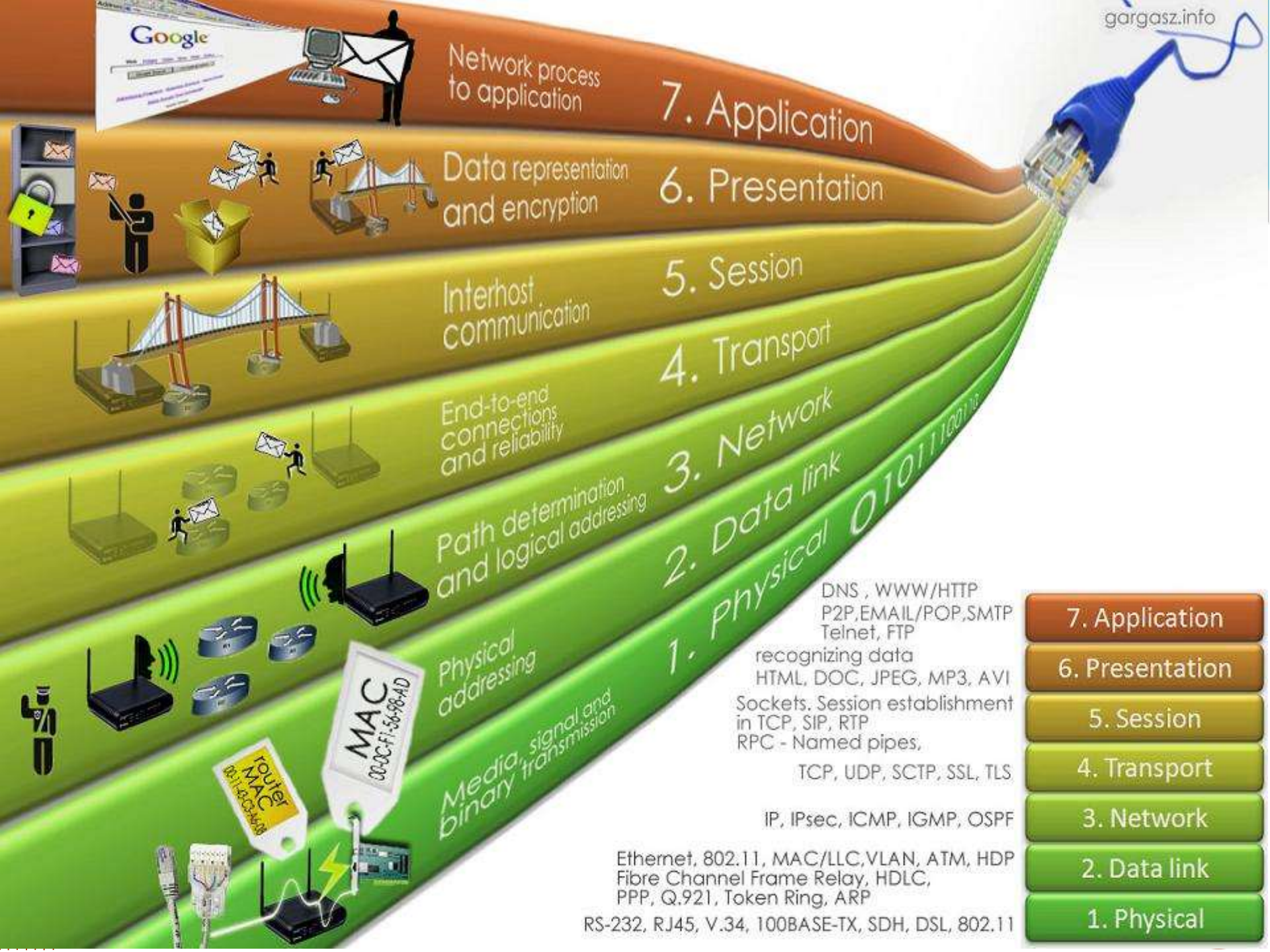
7. Application — Network process to application

6. Presentation — Data representation and encryption

5. Session — Interhost communication

4. Transport — End-to-end connections and reliability

3. Network — Path determination and logical addressing

2. Data link — Physical addressing

1. Physical — Media, signal and binary transmission

0101110011 0

MAC 00-0C-F1-56-98-AD

router MAC 00-14-C2-C3-44-08

7. Application
DNS, WWW/HTTP
P2P, EMAIL/POP, SMTP
Telnet, FTP
recognizing data
HTML, DOC, JPEG, MP3, AVI

6. Presentation

5. Session
Sockets. Session establishment
in TCP, SIP, RTP
RPC - Named pipes,

4. Transport
TCP, UDP, SCTP, SSL, TLS

3. Network
IP, IPsec, ICMP, IGMP, OSPF

2. Data link
Ethernet, 802.11, MAC/LLC, VLAN, ATM, HDP
Fibre Channel Frame Relay, HDLC,
PPP, Q.921, Token Ring, ARP

1. Physical
RS-232, RJ45, V.34, 100BASE-TX, SDH, DSL, 802.11

Communication Among OSI Layers

- In OSI model terms, information is exchanged between peer OSI layers— the application layer on your computer is communicating with the application layer on your friend' computer. However, to accomplish this, the e-mail must go through all the other layers on you computer.

- for example, it must have the correct network layer address, be put in the correct frame type, and so on.

- The e-mail must then go over the network, and then go back through all the layers on your friend's computer, until it finally arrives at your friend's e-mail application.

- The direction of moving in the sender device is from top to down while in the destination device is from down to up.
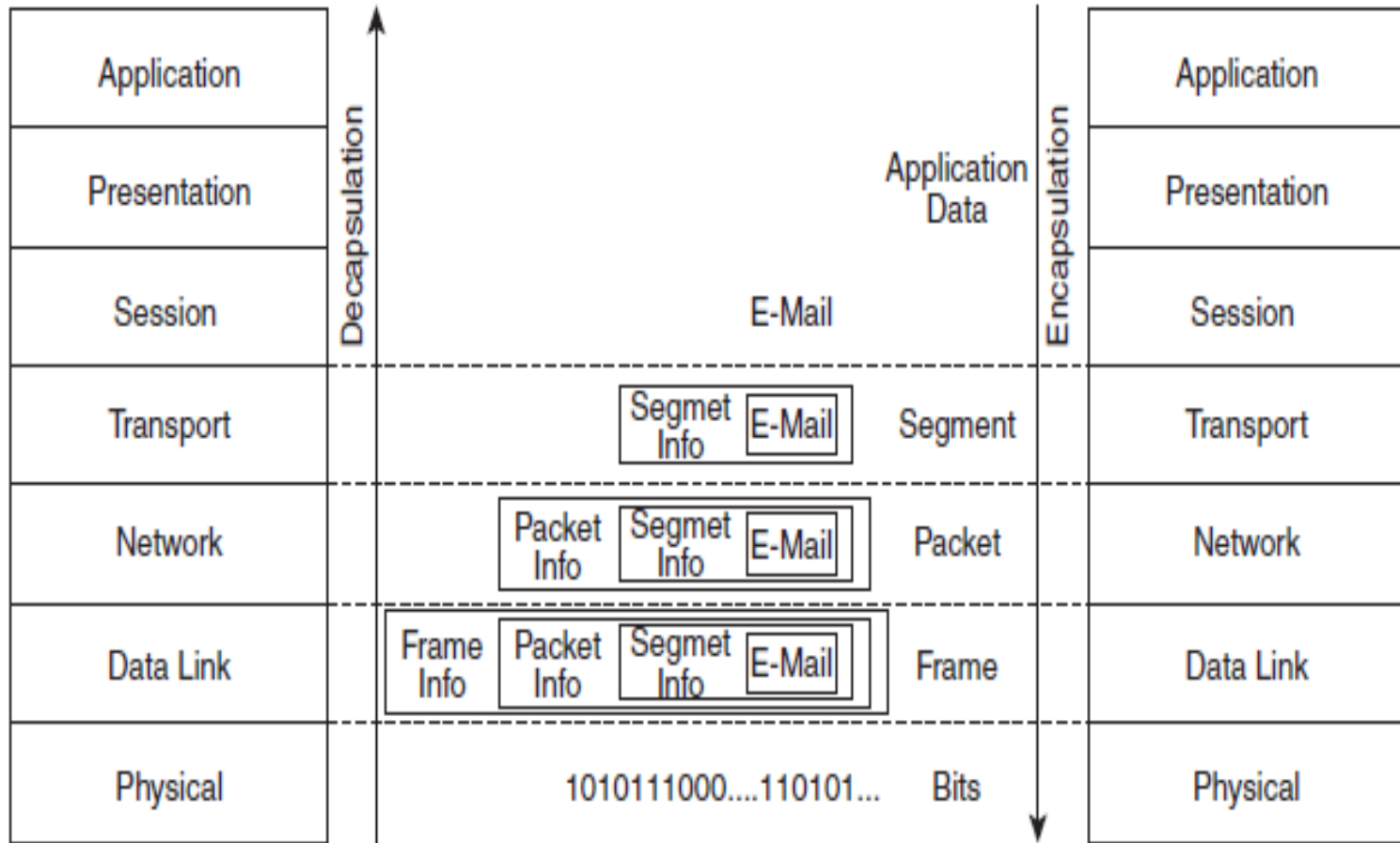
Communication Among OSI Layers(Cont.)

- Control information from each layer is added to the e-mail data before it passes to lower layers; this control information is necessary to allow the data to go through the network properly. Thus, the data at each layer is *encapsulated in* the information appropriate for that layer.
  - At Layer 4, the data is encapsulated in a segment.
  - At Layer 3, this segment is encapsulated in a packet.
  - At Layer 2, this packet is encapsulated in a frame.
  - Finally, at Layer 1, the frame is sent out on the wire (or air, if wireless is used) in bits.

Communication Among OSI Layers(Cont.)

- When data is received at the other end of the network, this additional information is analyzed and then removed as the data is passed to the higher layers toward the application layer. In other words, the data is decapsulation *(unencapsulated)*.

Communication Among OSI Layers(Cont.)

Thank You