Lecture 5
OSI model

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- Open Systems Interconnection (OSI) is a set of internationally recognized, non-proprietary standards for networking and for operating system involved in networking functions.

History

- The layered model that dominated data communications and networking literature before 1990 was the Open Systems Interconnection (OSI) model.
- Everyone believed that the OSI model would become the ultimate standard for data communications, but this did not happen.
- The TCP/IP protocol suite became the dominant commercial architecture because it was used and tested extensively in the Internet; the OSI model was never fully implemented.

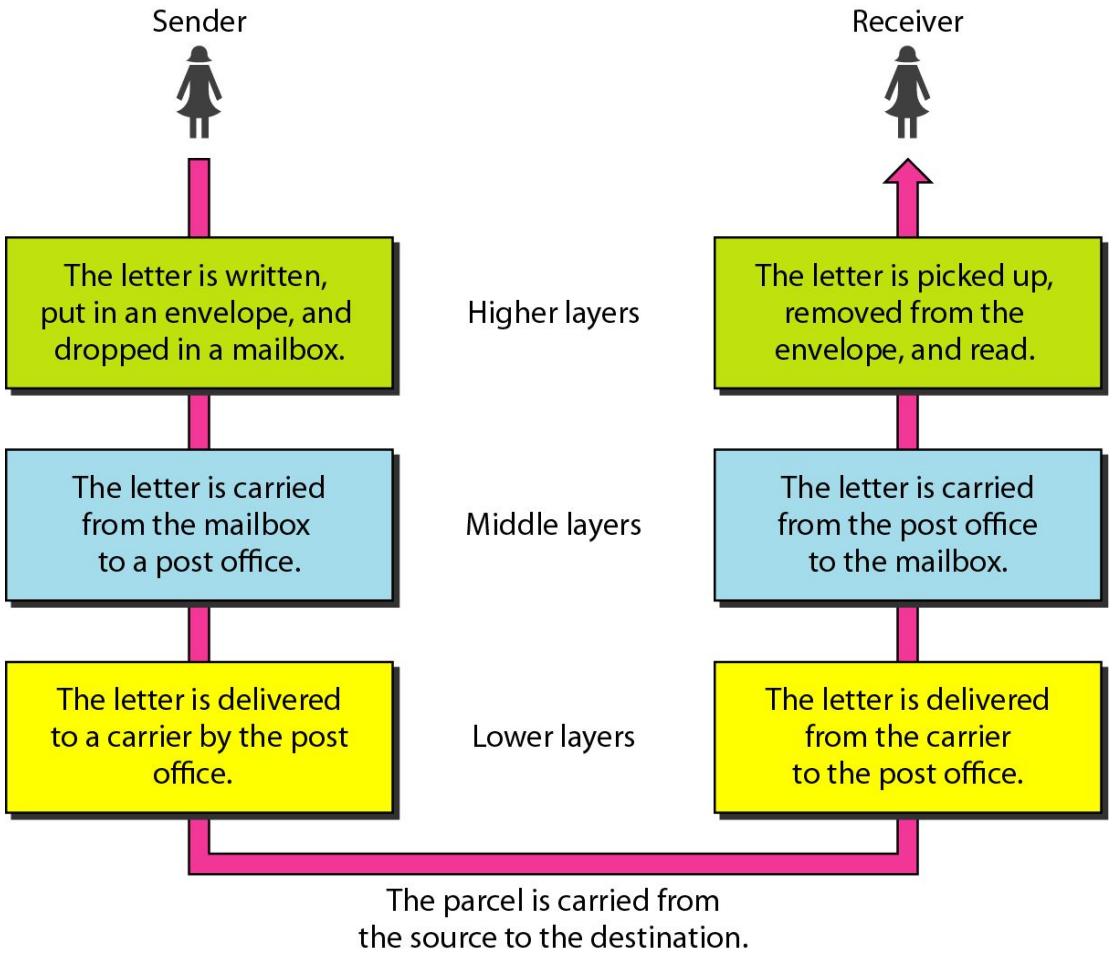
- Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards.
- An ISO standard that covers all aspects of network communications is the Open Systems Interconnection model.
- It was first introduced in the late 1970s.
- It is an open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.

7 Layers

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

All
People
Seem
To
Need
Data
Processing

Tasks involved in sending letter



At the Sender Site

- Higher layer. The sender writes the letter, inserts the letter in an envelope, writes the sender and receiver addresses, and drops the letter in a mailbox.
- Middle layer. The letter is picked up by a letter carrier and delivered to the post office.
- Lower layer. The letter is sorted at the post office; a carrier transports the letter.

At the Receiver Site

- Lower layer. The carrier transports the letter to the post office.
- Middle layer. The letter is sorted and delivered to the recipient's mailbox.
- Higher layer. The receiver picks up the letter, opens the envelope, and reads it.

Layer 7 – Application layer

- This is the closest layer to the end user. It provides the interface between the applications we use and the underlying layers. But notice that the programs you are using (like a web browser – IE, Firefox or Opera…) do not belong to Application layer. Telnet, FTP, email client (SMTP), HyperText Transfer Protocol (HTTP) are examples of Application layer.

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- The top layer of the OSI model
- Provides a set of interfaces for sending and receiving applications to gain access to and use network services, such as: networked file transfer, message handling and database query processing

- The application layer is responsible for providing services to the user.

Some specific services provided by the application layer

- File transfer, access, and management:

  This application allows a user to access files in a remote host (to make changes or read data), to retrieve files from a remote computer for use in the local computer, and to manage or control files in a remote computer locally.

- Mail services:
  - This application provides the basis for e-mail forwarding and storage.
- Directory services:

  This application provides distributed database sources and access for global information about various objects and services.

Layer 6 – Presentation layer

- This layer ensures the presentation of data, that the communications passing through are in the appropriate form for the recipient. In general, it acts as a translator of the network. For example, you want to send an email and the Presentation will format your data into email format. Or you want to send photos to your friend, the Presentation layer will format your data into GIF, JPG or PNG… format.

Cont..

- Manages data-format information for networked communications (the network's translator)
- For outgoing messages, it converts data into a generic format for network transmission; for incoming messages, it converts data from the generic network format to a format that the receiving application can understand
- This layer is also responsible for certain protocol conversions, data encryption/decryption, or data compression/decompression
- A special software facility called a "*redirector*" operates at this layer to determine if a request is network related or not and forward network-related requests to an appropriate network resource

- The presentation layer is responsible for translation, compression, and encryption.

Layer 5 – Session layer

- Layer 5 establishes, maintains and ends communication with the receiving device.

Cont..

- Enables two networked resources to hold ongoing communications (called a session) across a network
- Applications on either end of the session are able to exchange data for the duration of the session

This layer is:

- Responsible for initiating, maintaining and terminating sessions
- Responsible for security and access control to session information (via session participant identification)
- Responsible for synchronization services, and for checkpoint services

- The session layer is responsible for dialog control and synchronization.

Layer 4 – Transport layer

- This layer maintains flow control of data and provides for error checking and recovery of data between the devices. The most common example of Transport layer is Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).

Cont..

- Manages the transmission of data across a network
- Manages the flow of data between parties by segmenting long data streams into smaller data chunks (based on allowed "packet" size for a given transmission medium)
- Reassembles chunks into their original sequence at the receiving end
- Provides acknowledgements of successful transmissions and requests resends for packets which arrive with errors

- The transport layer is responsible for the delivery of a message from one process to another.

Layer 3 – Network layer

- This layer provides logical addresses which routers will use to determine the path to the destination. In most cases, the logic addresses here means the IP addresses (including source & destination IP addresses).

Cont..

- Handles addressing messages for delivery, as well as translating logical network addresses and names into their physical counterparts
- Responsible for deciding how to route transmissions between computers
- This layer also handles the decisions needed to get data from one point to the next point along a network path
- This layer also handles packet switching and network congestion control

- The network layer is responsible for the delivery of individual packets from the source host to the destination host.

Cont..

- Handles special data frames (packets) between the Network layer and the Physical layer
- At the receiving end, this layer packages raw data from the physical layer into data frames for delivery to the Network layer.
- At the sending end this layer handles conversion of data into raw formats that can be handled by the Physical Layer

Layer 2 – Data Link Layer

- The Data Link layer formats the message into a *data frame*, and adds a header containing the hardware destination and source address to it. This header is responsible for finding the next destination device on a local network.

- The data link layer is responsible for moving frames from one hop (node) to the next.

Cont..

- Notice that layer 3 is responsible for finding the path to the last destination (network) but it doesn’t care about who will be the next receiver. It is the Layer 2 that helps data to reach the next destination.

Cont..

- This layer is subdivide into 2 sub-layers: logical link control (LLC) and media access control (MAC).
- The LLC functions include:
  + Managing frames to upper and lower layers
  + Error Control
  + Flow control
- The MAC sub layer carries the physical address of each device on the network. This address is more commonly called a device's MAC address. MAC address is a 48 bits address which is burned into the NIC card on the device by its manufacturer.

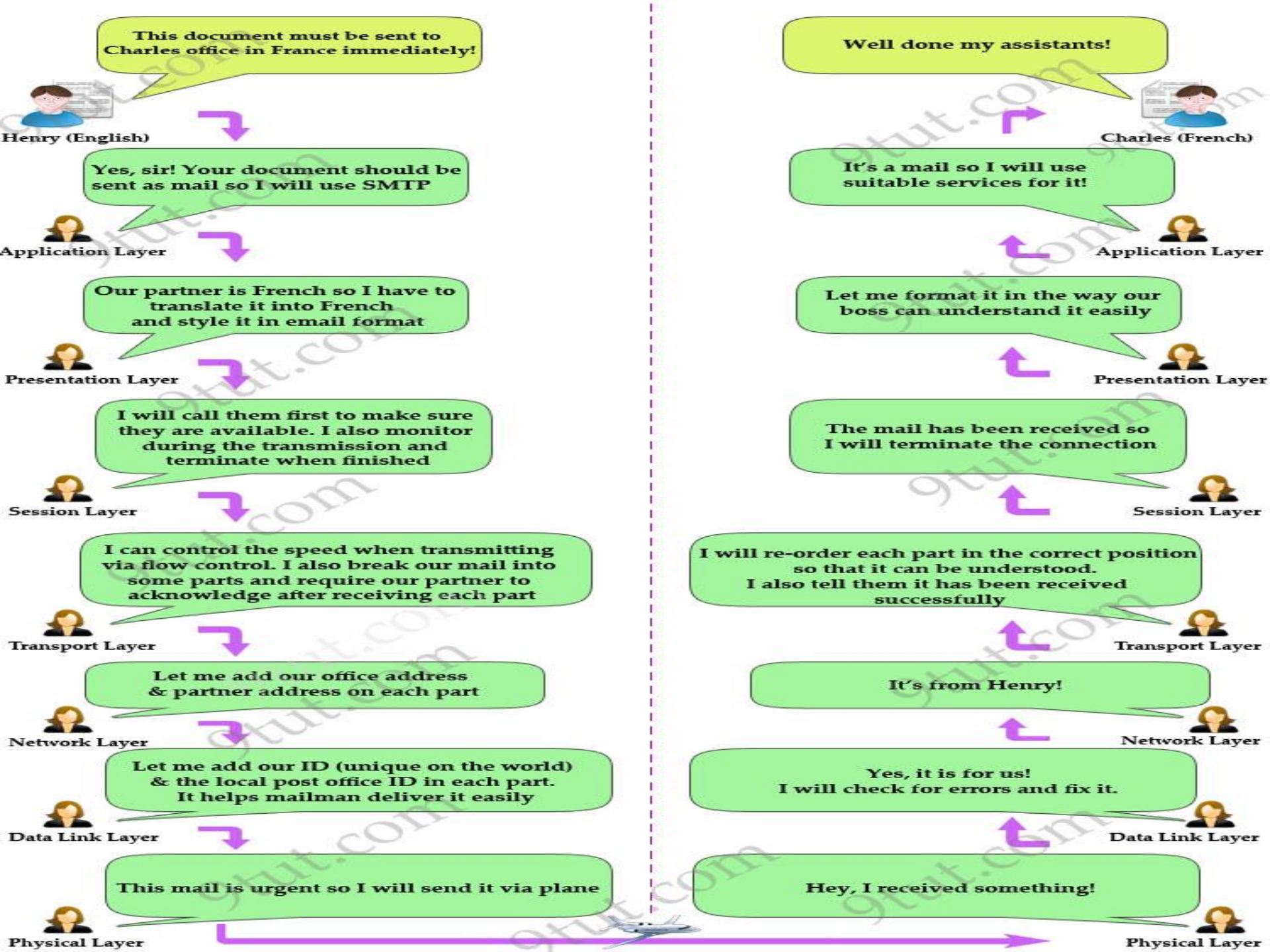
Layer 1 – Physical layer

- The Physical Layer defines the physical characteristics of the network such as connections, voltage levels and timing.

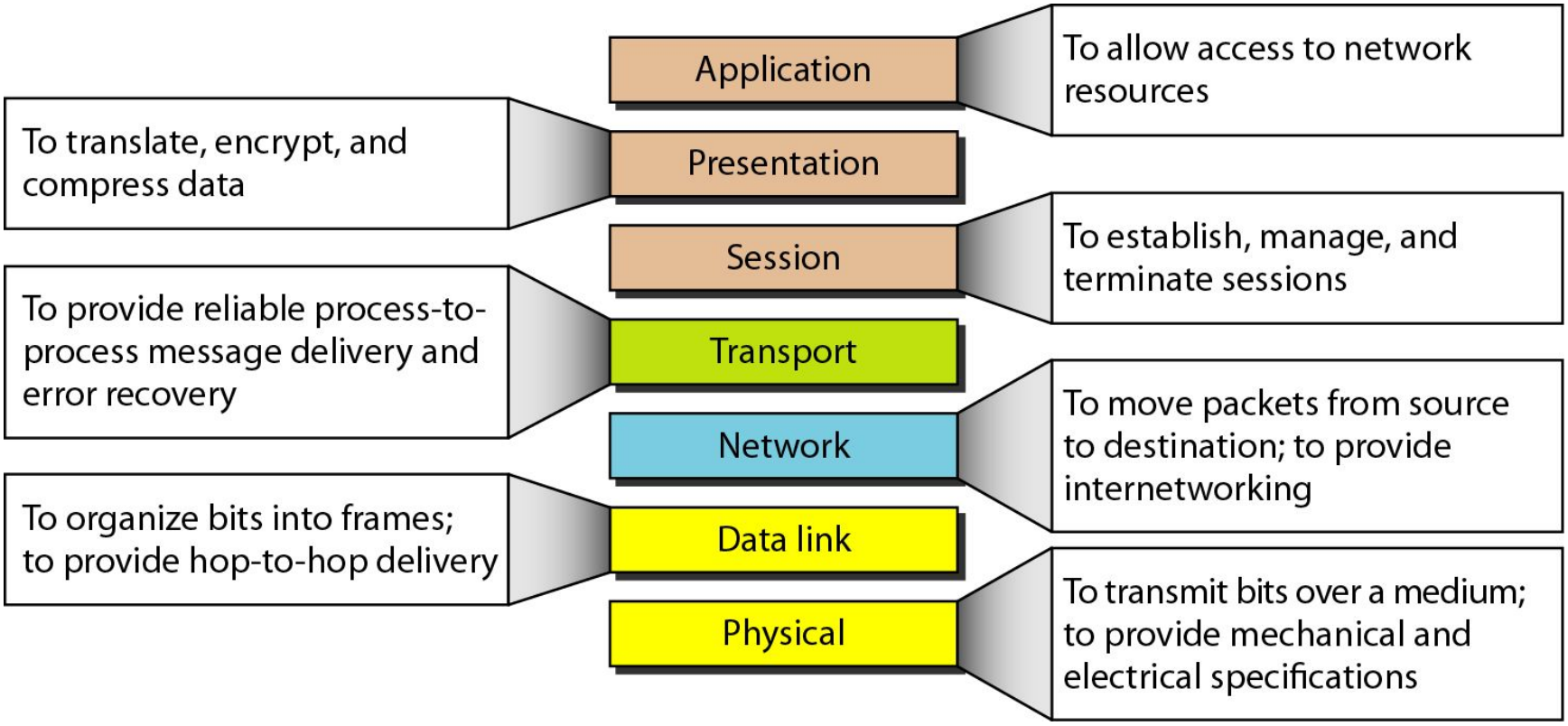
Cont..

- Converts bits into electronic signals for outgoing messages
- Converts electronic signals into bits for incoming messages
- This layer manages the interface between the computer and the network medium (coax, twisted pair, etc.)
- This layer tells the driver software for the MAU (media attachment unit, ex. network interface cards (NICs, modems, etc.) what needs to be sent across the medium
- The bottom layer of the OSI model

- The physical layer is responsible for movements of individual bits from one hop (node) to the next.


This document must be sent to Charles office in France immediately!
Henry (English)
Yes, sir! Your document should be sent as mail so I will use SMTP
Application Layer
Our partner is French so I have to translate it into French and style it in email format
Presentation Layer
I will call them first to make sure they are available. I also monitor during the transmission and terminate when finished
Session Layer
I can control the speed when transmitting via flow control. I also break our mail into some parts and require our partner to acknowledge after receiving each part
Transport Layer
Let me add our office address & partner address on each part
Network Layer
Let me add our ID (unique on the world) & the local post office ID in each part. It helps mailman deliver it easily
Data Link Layer
This mail is urgent so I will send it via plane
Physical Layer
Well done my assistants!
Charles (French)
It's a mail so I will use suitable services for it!
Application Layer
Let me format it in the way our boss can understand it easily
Presentation Layer
The mail has been received so I will terminate the connection
Session Layer
I will re-order each part in the correct position so that it can be understood. I also tell them it has been received successfully
Transport Layer
It's from Henry!
Network Layer
Yes, it is for us! I will check for errors and fix it.
Data Link Layer
Hey, I received something!
Physical Layer

At a glance


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