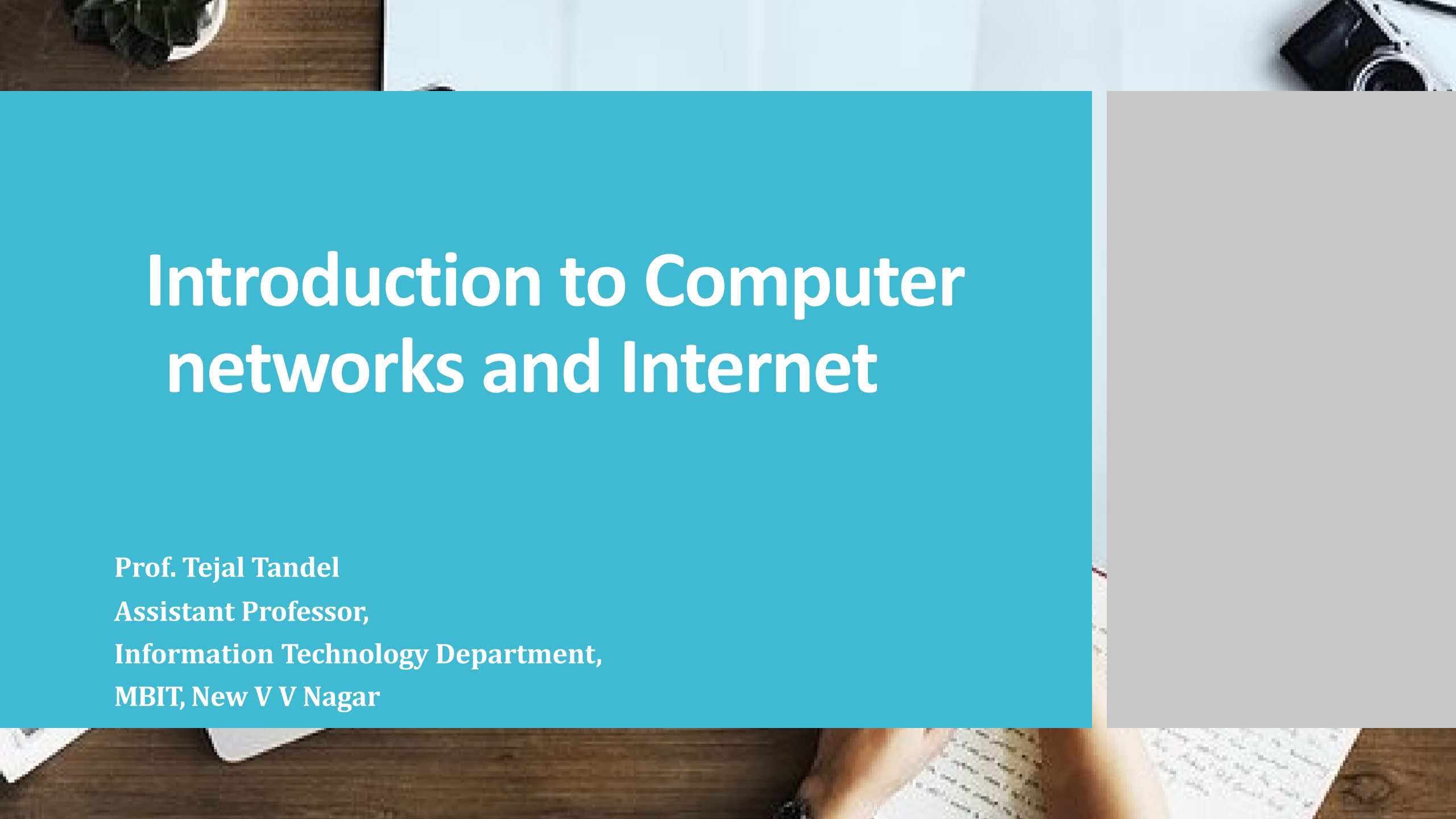

Introduction to Computer networks and Internet

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Protocol Layers

Protocols

- A Protocol is a set of rules that govern data communications.
- A protocol defines
  - what is communicated,
  - how it is communicated, and
  - when it is communicated.
- The kev elements of a protocol are syntax, semantics, and timing.

human protocols:

… specific msgs sent

… specific actions taken when msgs received, or other events

A human protocol Vs. A computer network protocol:

- *protocols define format, order of messages sent and received among network entities, and actions taken on message transmission, receipt*

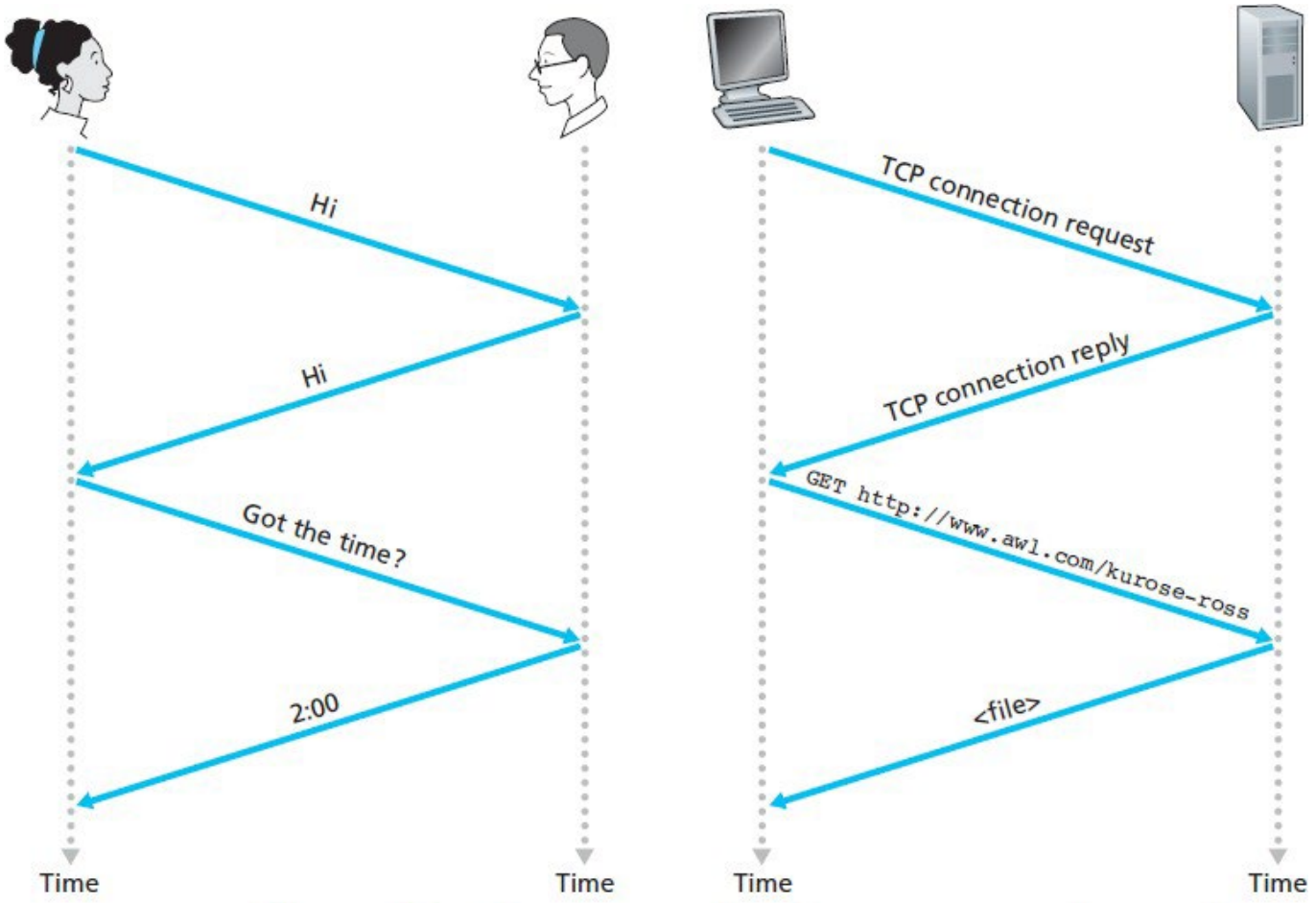


Figure 1.2 ♦ A human protocol and a computer network protocol

Protocol Layers and Their Service Models

- Internet is an *extremely complicated* system.
  - We have seen that there are many pieces to the Internet:
    - **numerous applications and protocols,**
    - **various types of end systems,**
    - **packet switches, and**
    - **various types of link-level media.**

Networks are complex, with many "pieces":

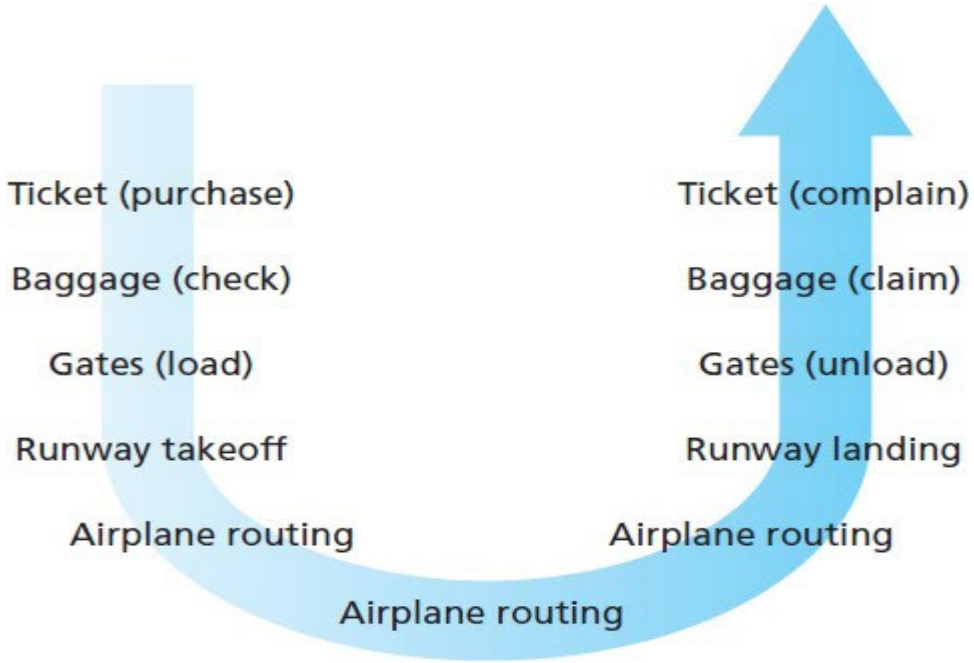
hosts
routers
links of various media
applications
protocols
hardware,
software

Layered Architecture

- let's look for a human analogy.
- Actually, we deal with complex systems all the time in our everyday life.
- ***Imagine if someone asked you to describe, for example, the airline system.***
- How would you find the structure to describe this complex system that has ticketing agents, baggage checkers, gate personnel, pilots, airplanes, air traffic control, and a worldwide system for routing airplanes?
- ***One way to describe this system might be to describe the series of actions you take*** (or others take for you) when you fly on an airline. You purchase your ticket, check your bags, go to the gate, and eventually get loaded onto the plane. The plane takes off and is routed to its destination. After your plane lands, you deplane at the gate and claim your bags. If the trip was bad, you complain about the flight to the ticket agent (getting nothing for your effort).

Layered Architecture

- we can see some analogies here with computer networking:
  - You are being shipped from source to destination by the airline;
  - a packet is shipped from source host to destination host in the Internet.
  - But this is not quite the analogy we are after.
  - We are looking for some *structure.*



Taking an airplane trip: actions

- A layered architecture allows us to discuss a well-defined, specific part of a large and complex system.

Layered Architecture

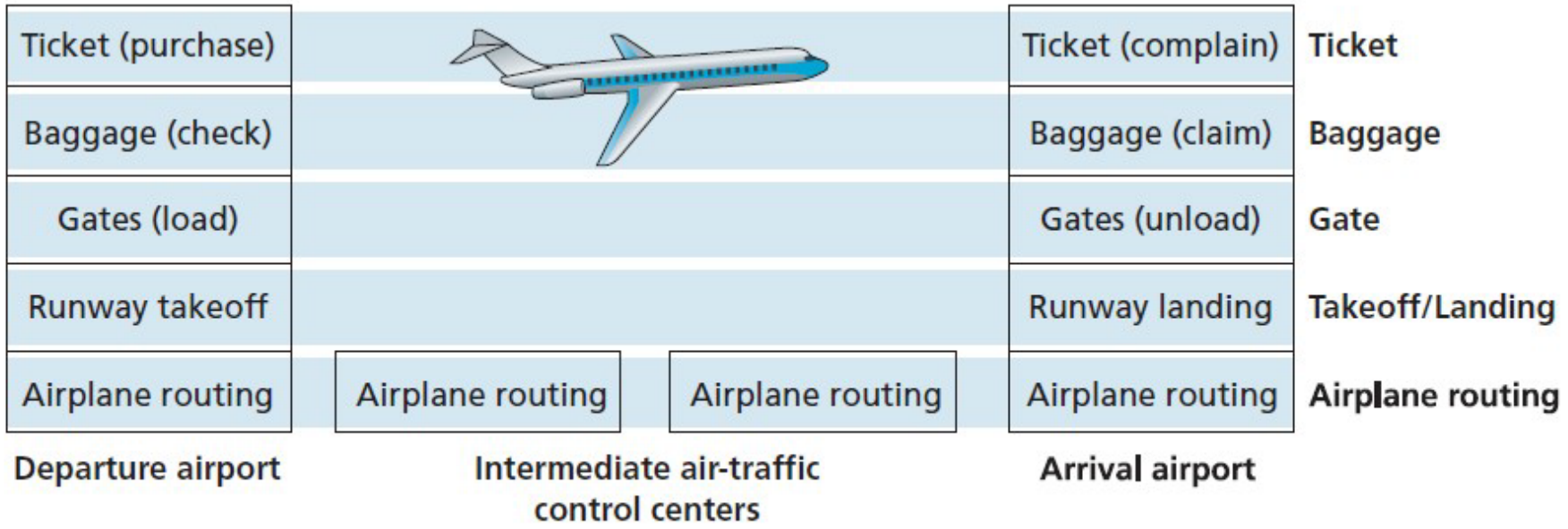
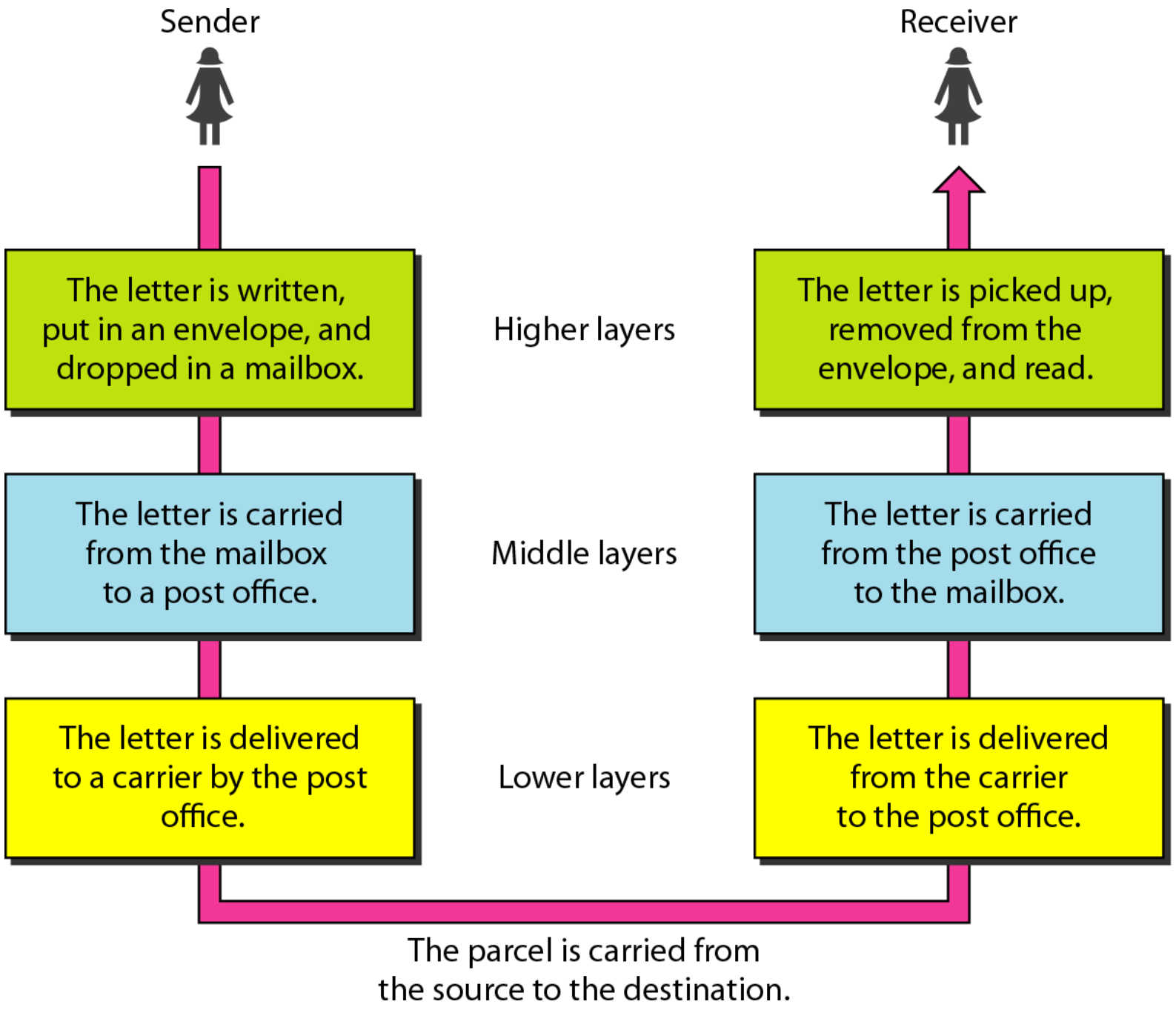


Figure 1.22 ♦ Horizontal layering of airline functionality

layers: each layer implements a service

- via its own internal-layer actions
- relying on services provided by layer below

Tasks involved in sending a letter



Why layering?

dealing with complex systems:

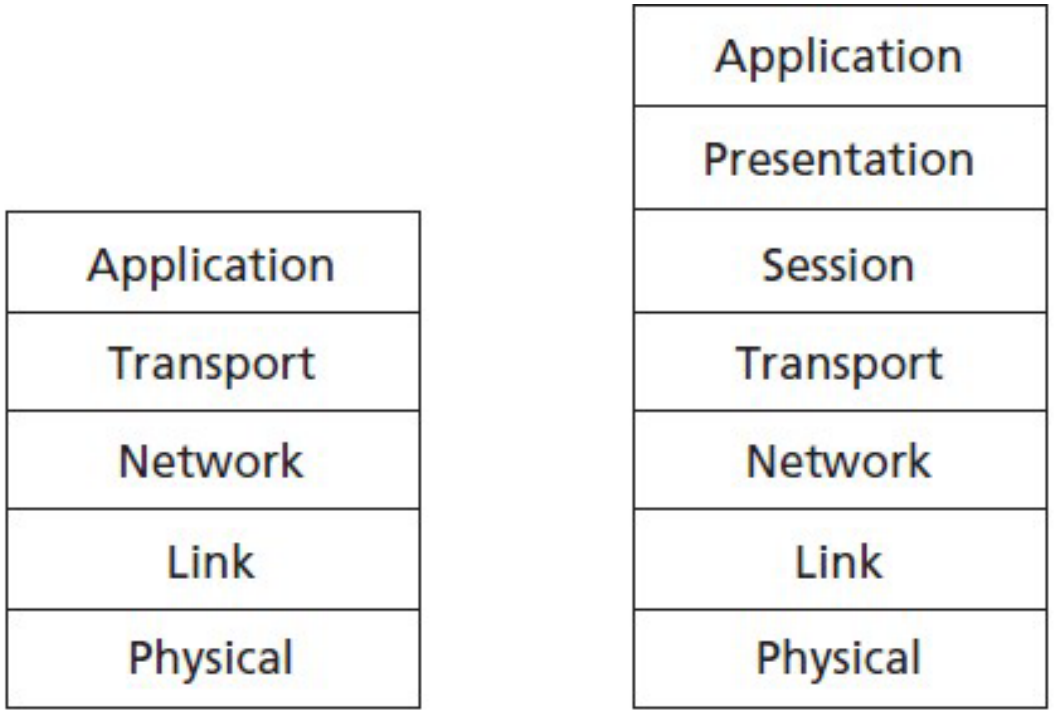
- explicit structure allows identification, relationship of complex system’ s pieces
  - layered *reference model* for discussion
- modularization eases maintenance, updating of system
  - change of implementation of layer’ s service transparent to rest of system
  - e.g. change in gate procedure doesn't’ t affect rest of system
- layering considered harmful?

The OSI Model

- A protocol layer can be implemented in software, in hardware, or in a combination of the two.
- 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 (OSI) model.
- It was first introduced in the late 1970s.

Note

ISO is the organization.
OSI is the model.

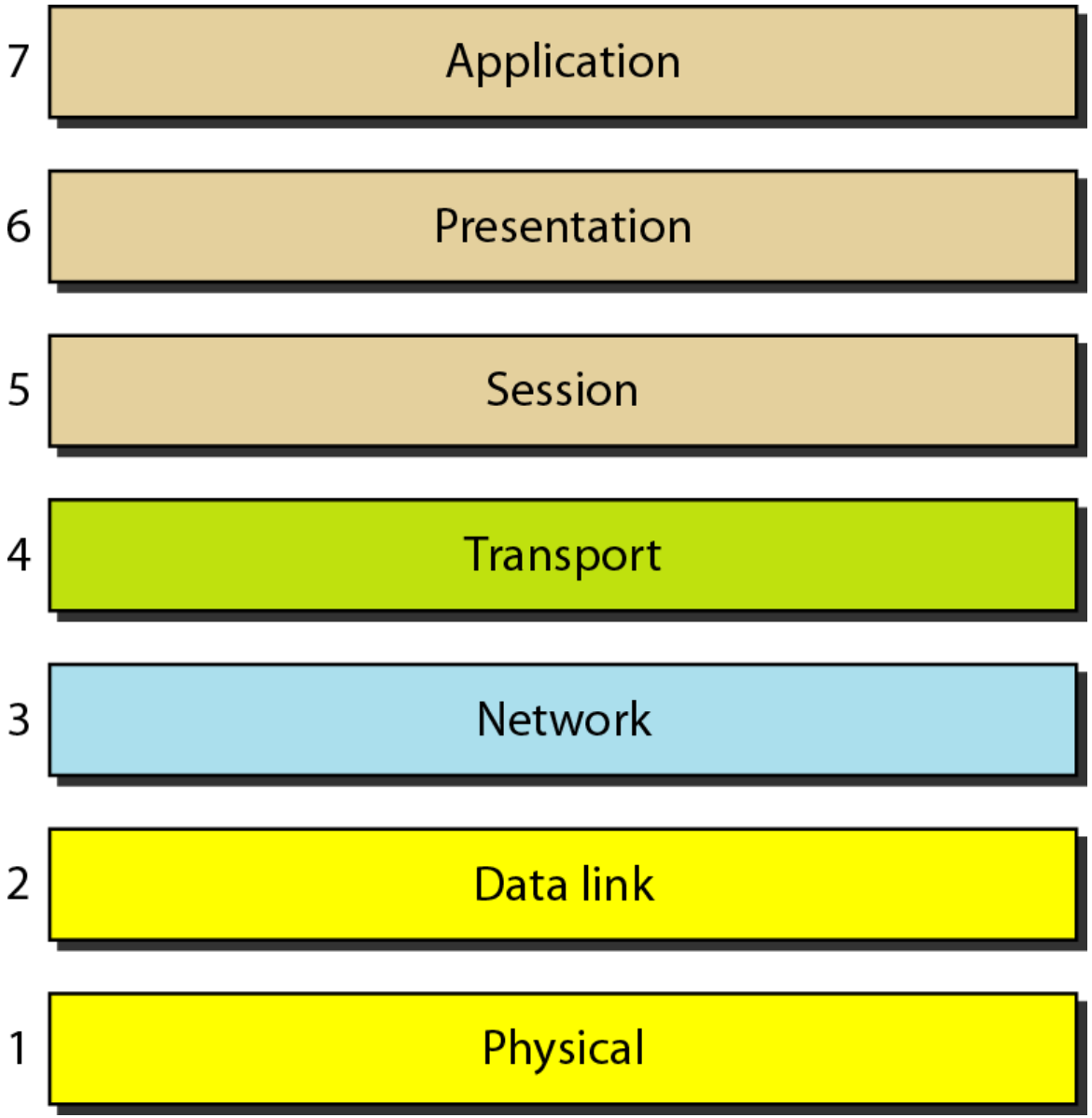


a. Five-layer Internet protocol stack

b. Seven-layer ISO OSI reference model

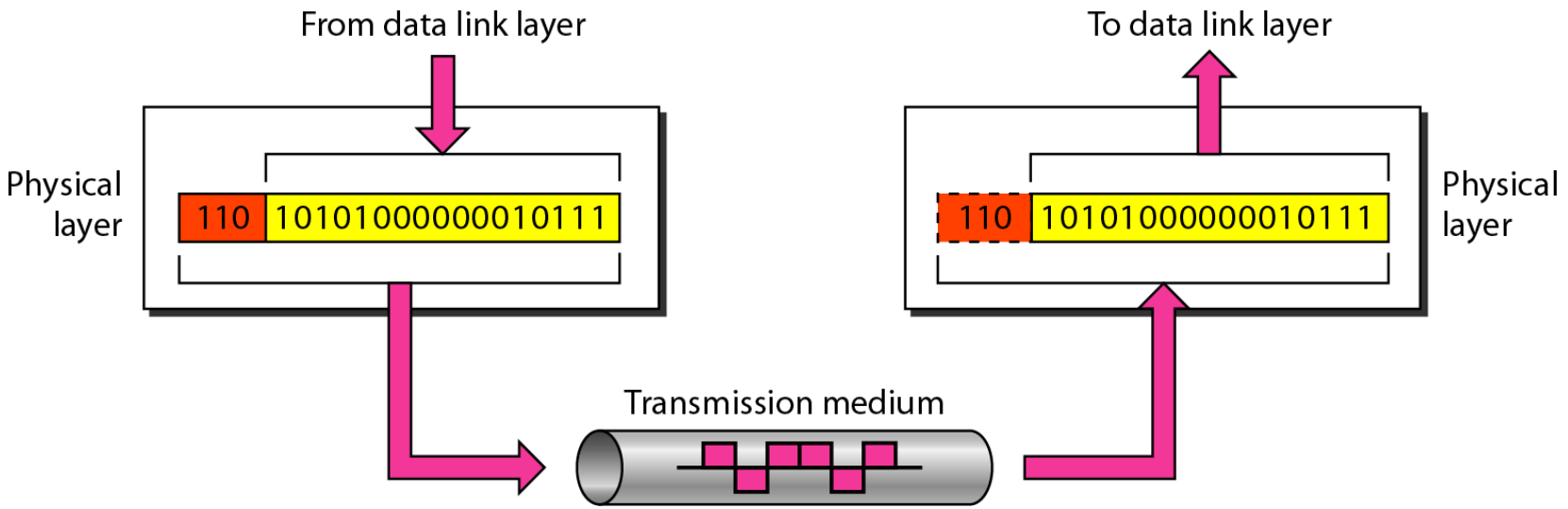
- The Internet protocol stack (a) and OSI reference model (b)

Seven layers of the OSI model



Physical Layer

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



Note

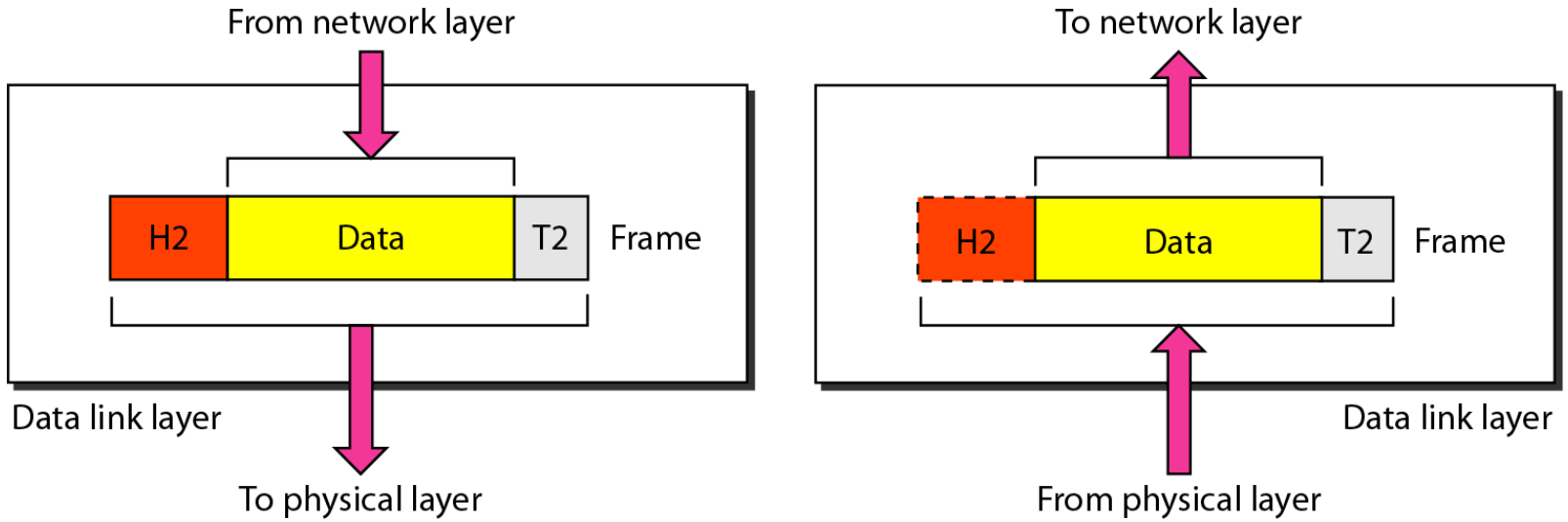
The physical layer is responsible for movements of individual bits from one hop (node) to the next.

Physical Layer

- Carries the bit stream over a physical media.
- Physical Layer is concerned with:
  - Interface and Medium like guided cables
  - Representation of bits
  - Data rate
  - Synchronization of bits
  - Line configuration
  - Physical topology
  - Transmission mode

Data link layer

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

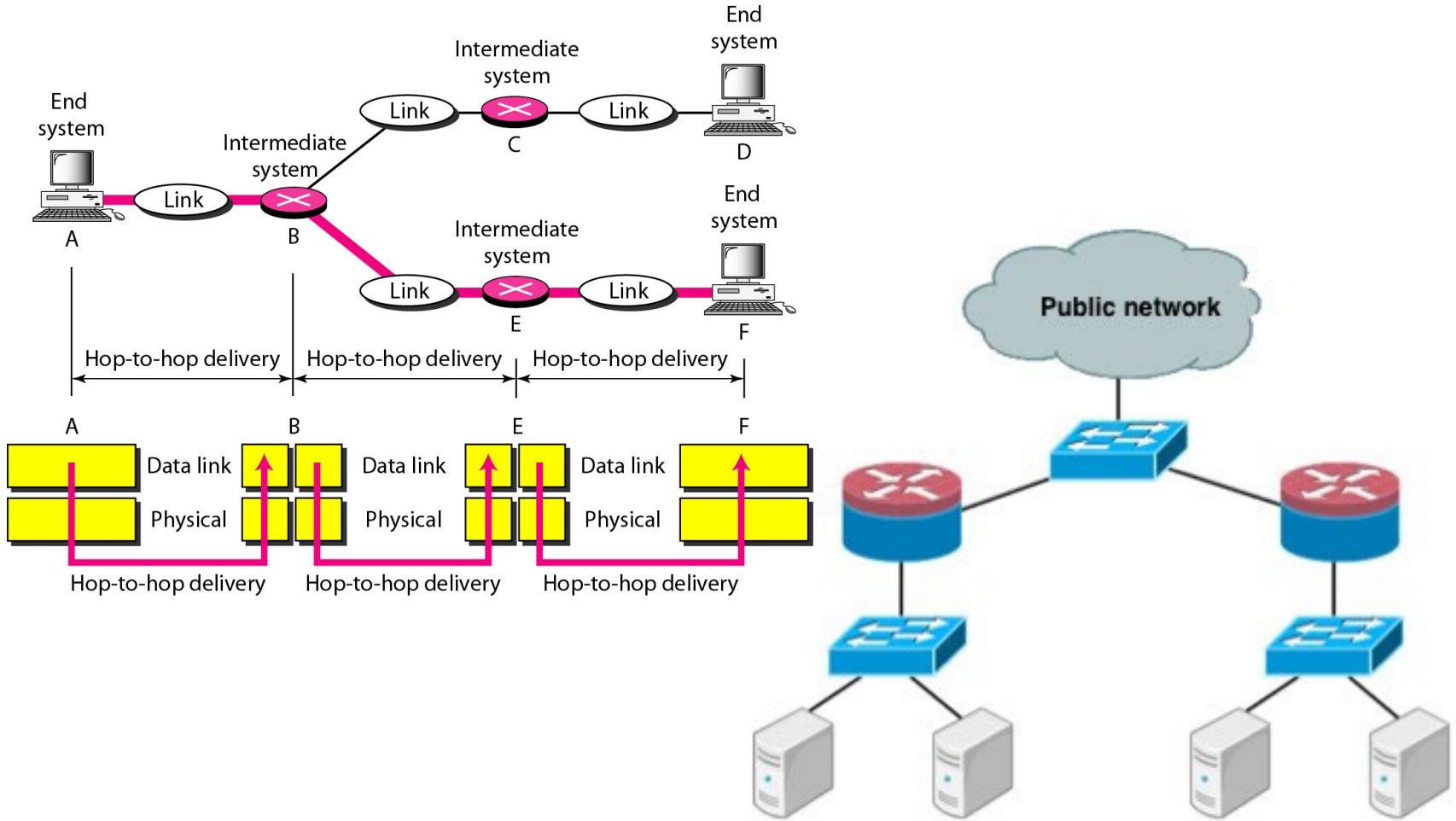


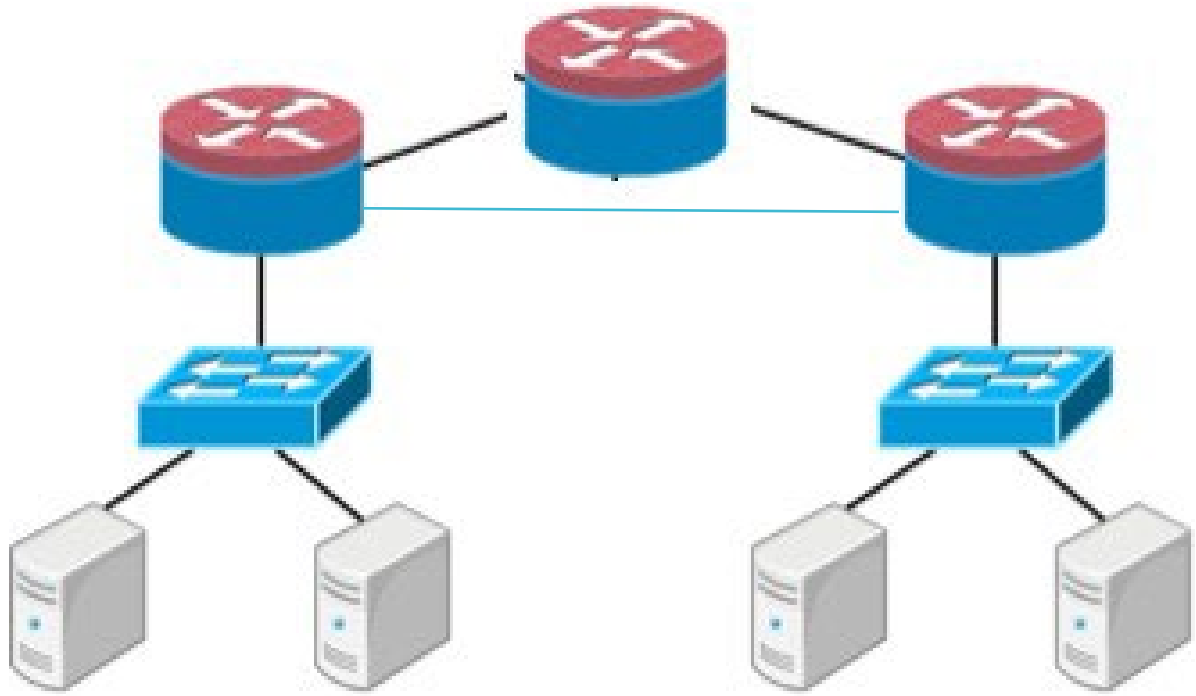
Note

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

Data link layer

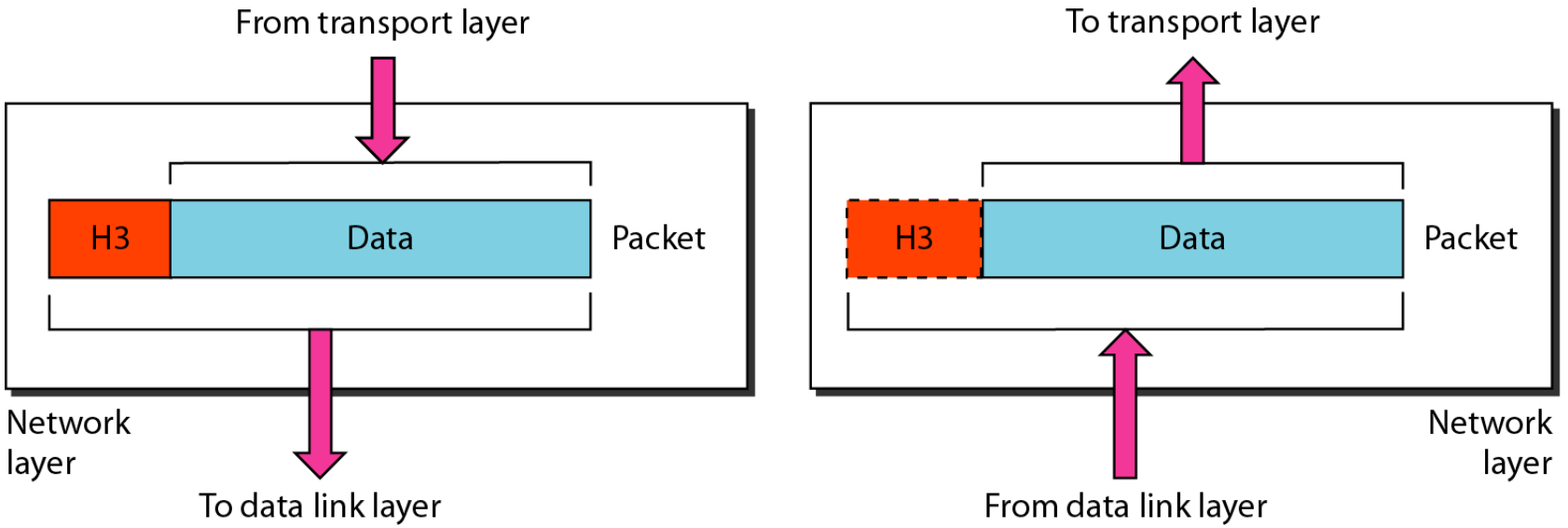
- Data link layer is concerned with:
  - Framing – divide bits stream into data unit (frame)
  - Physical addressing
  - Flow control – avoid over overwhelming
  - Error control – bit loses, retransmission
  - Access control





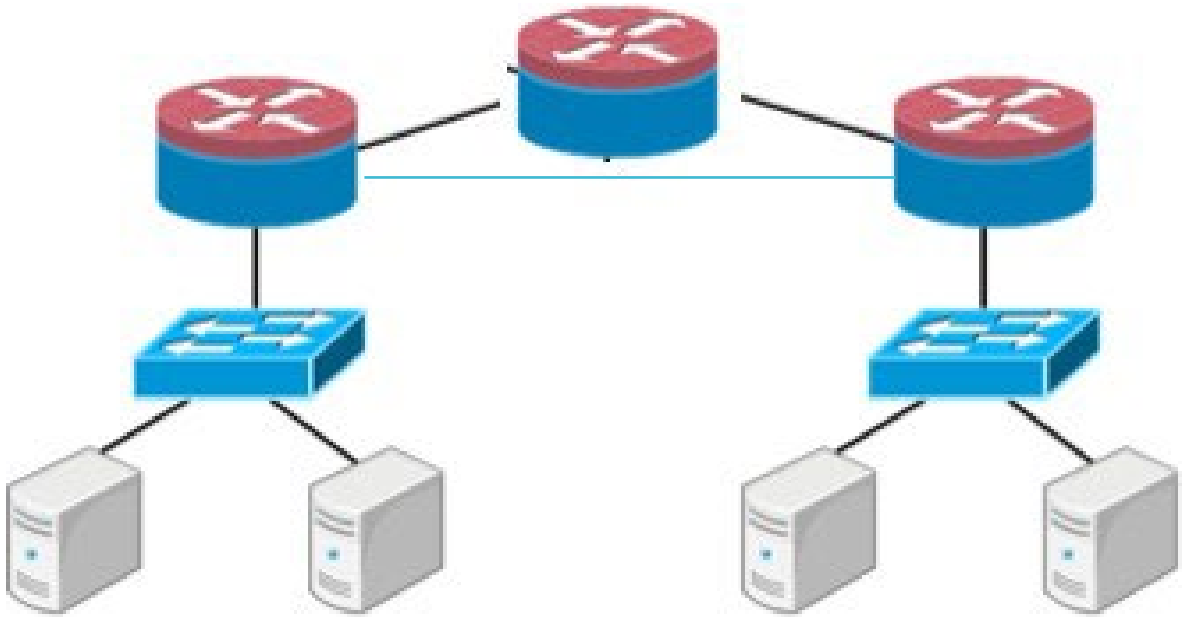
Network Layer

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



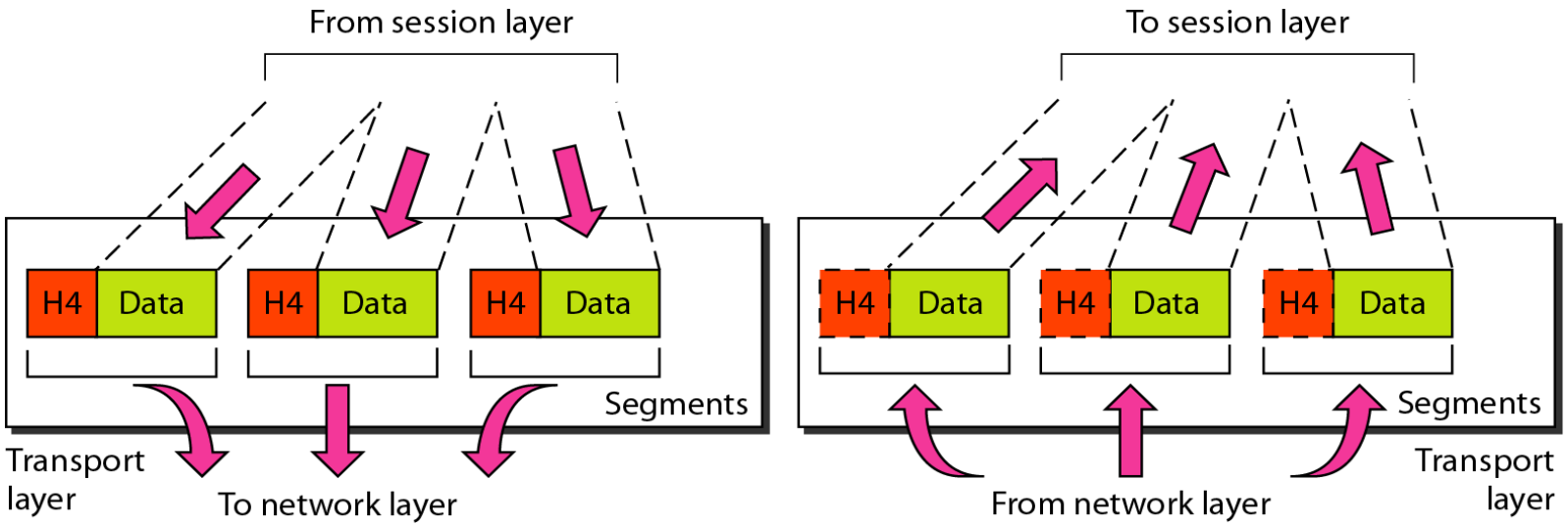
Network Layer

- In this layer, packet is combined with header and data.
- In case of data link layer, packet delivers on the same network.
- If two different networks are connected then packet is concern with network layer.
- Network layer is concerned with:
  - Logical addressing e.g. 192.168.1.1 (IP Address)
  - Routing



Transport Layer

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

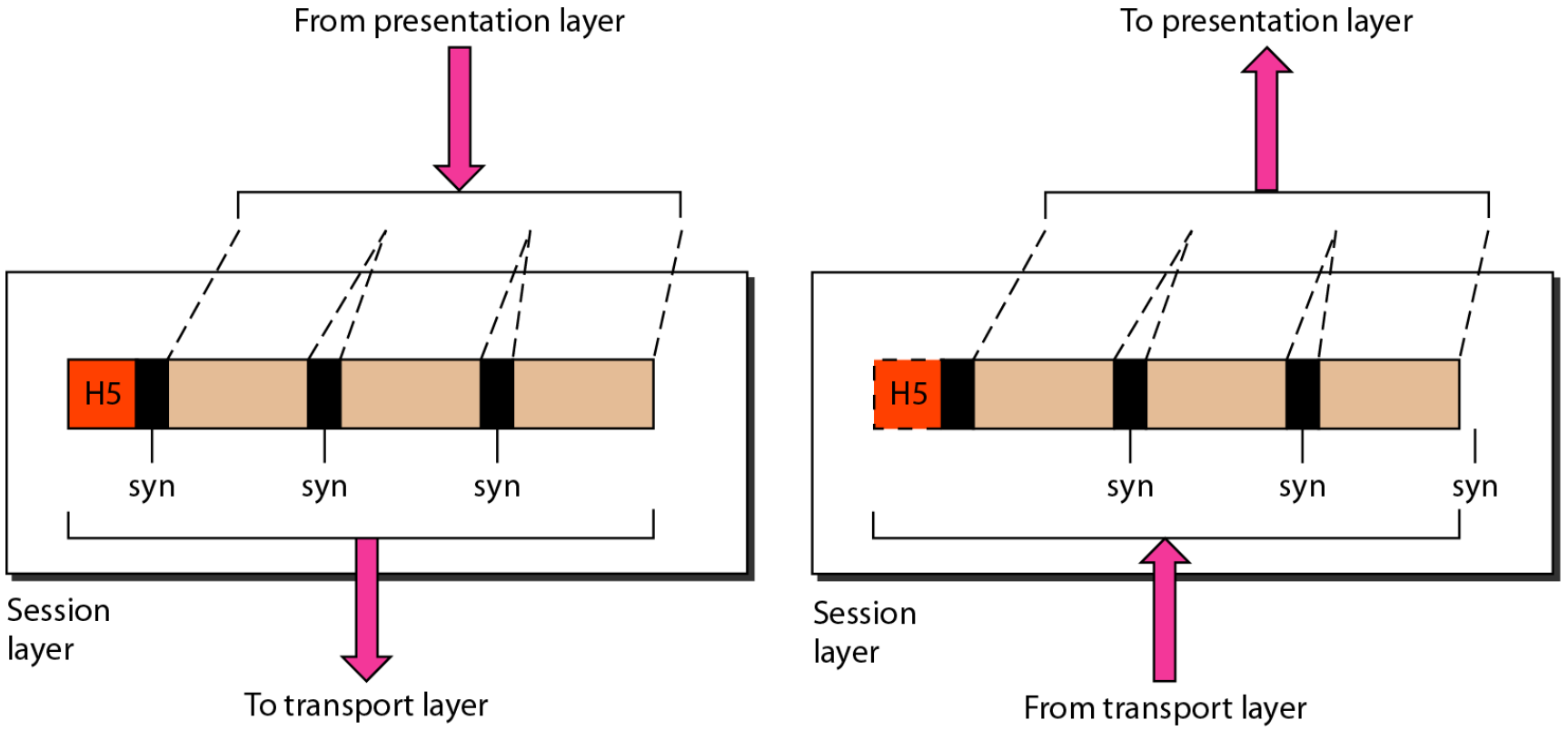


Transport Layer

- This layer ensures that the whole message arrives intact and in order.
- Transport layer is concerned with:
  - Service-point addressing (port address)
  - Segmentation and reassembly
  - Connection control
  - Flow and error control

Session Layer

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

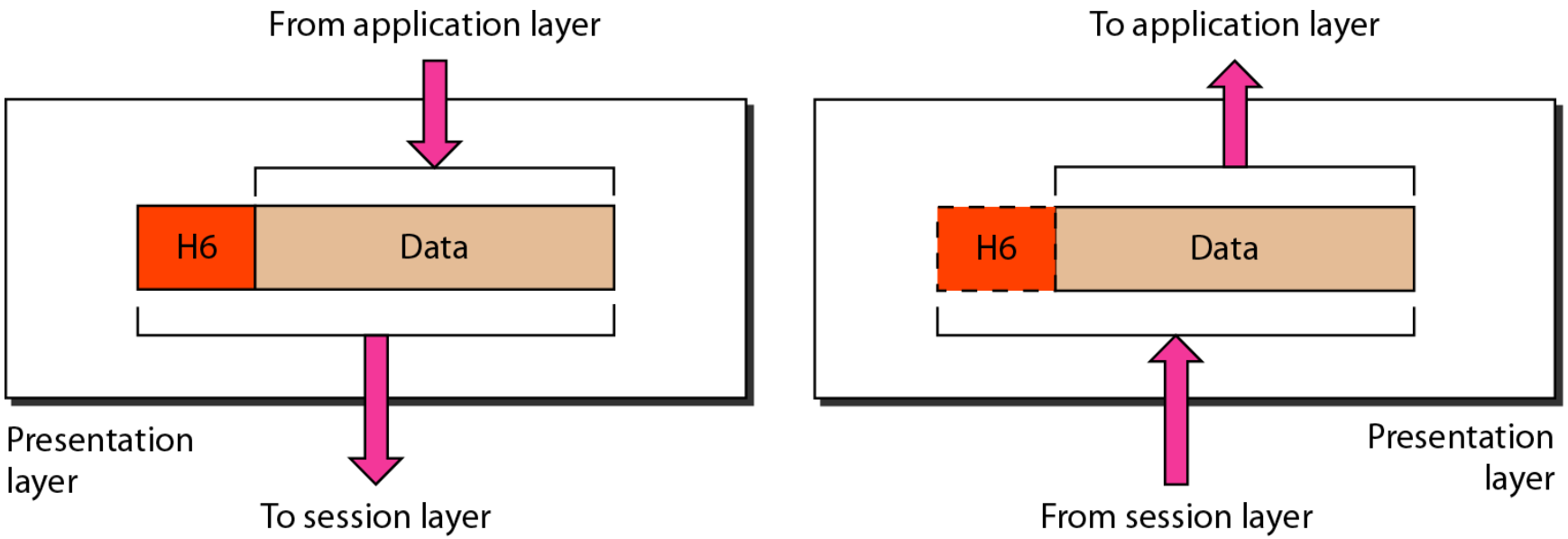


Session Layer

- This layer is network dialog controller – establishes, maintains, synchronizes the interaction among computers.
- Session layer is concerned with:
  - Dialog control
  - Synchronization

Presentation Layer

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

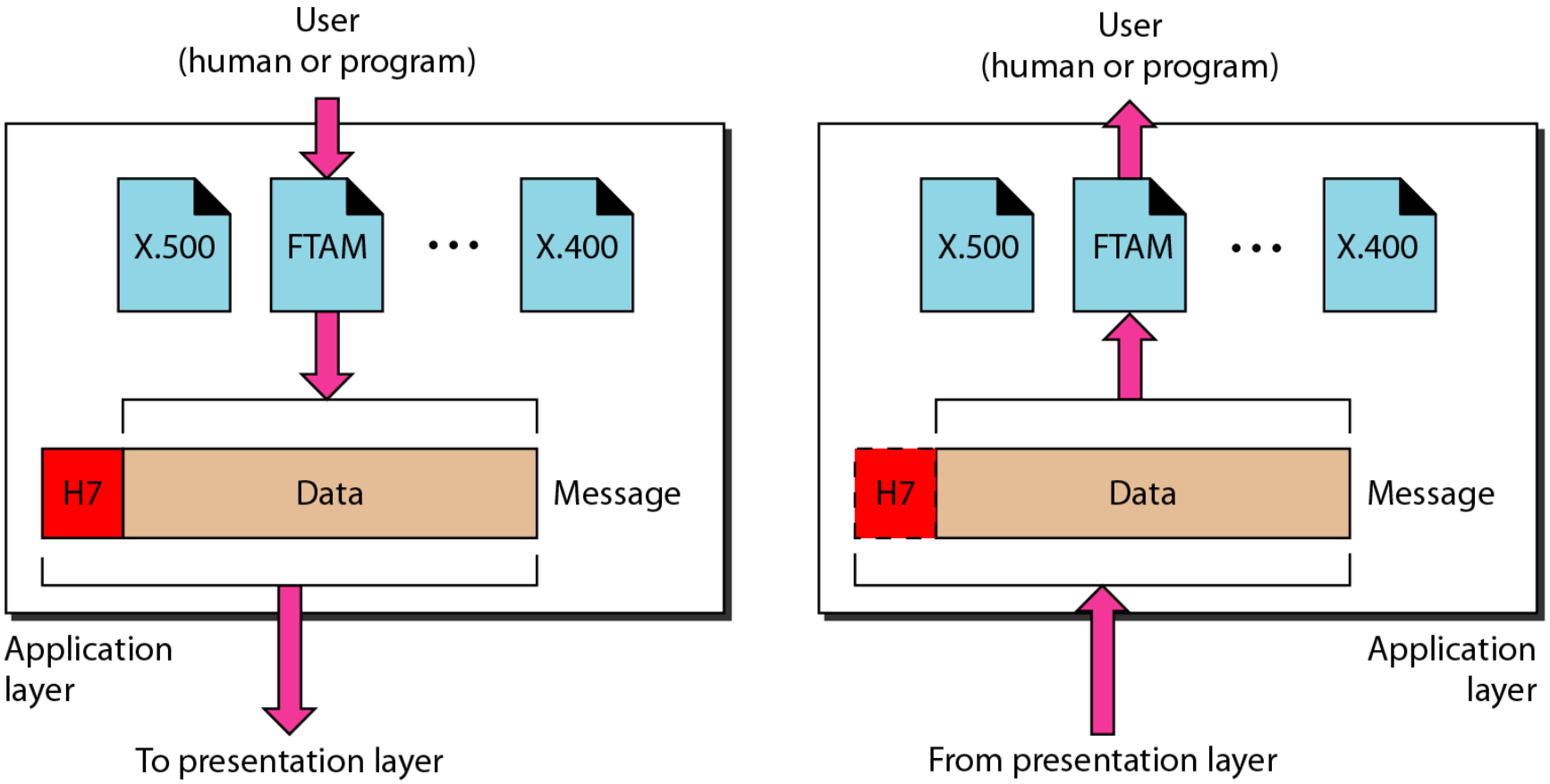


Presentation Layer

- This layer is concerned with the syntax which refers to order in which data is presented and semantics helps in interpreting a particular pattern.
- Presentation layer is responsible for:
  - Translation
  - Encryption
  - Compression

Application Layer

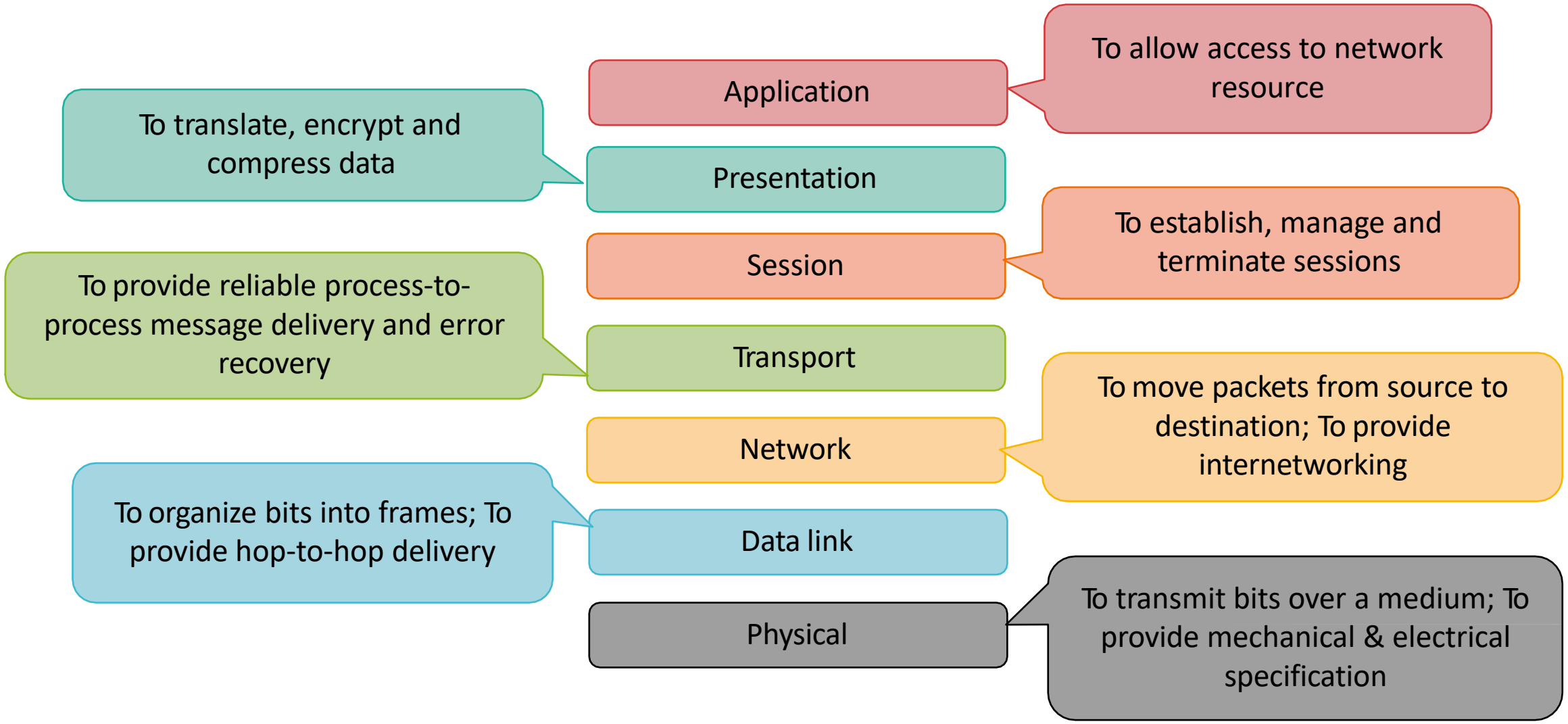
- The application layer is responsible for providing services to the user.



Application Layer

- This layer provides various services like:
  - Network virtual terminal
  - File transfer, access and management
  - Mail services
  - Directory services

Summary - OSI Layer

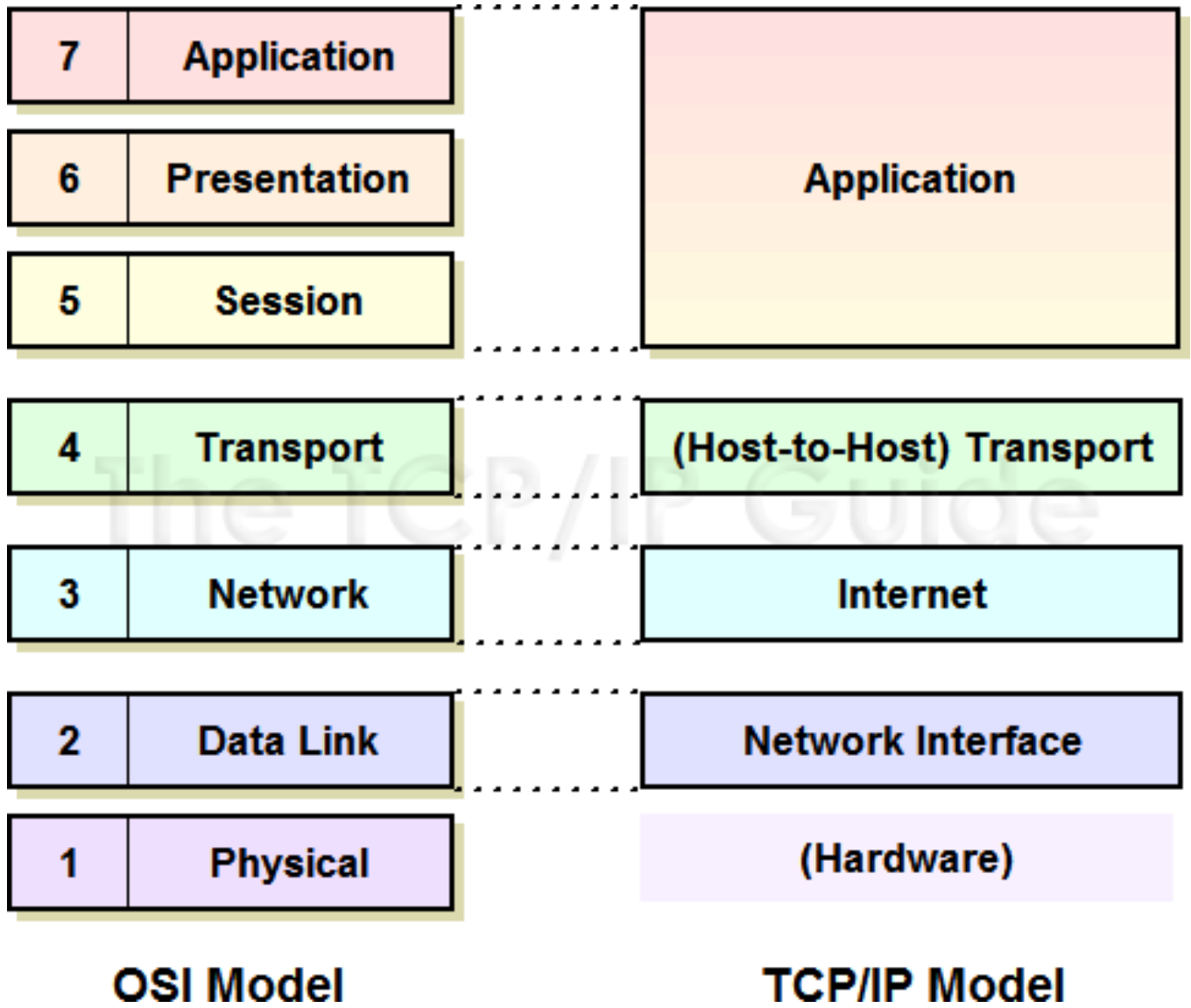


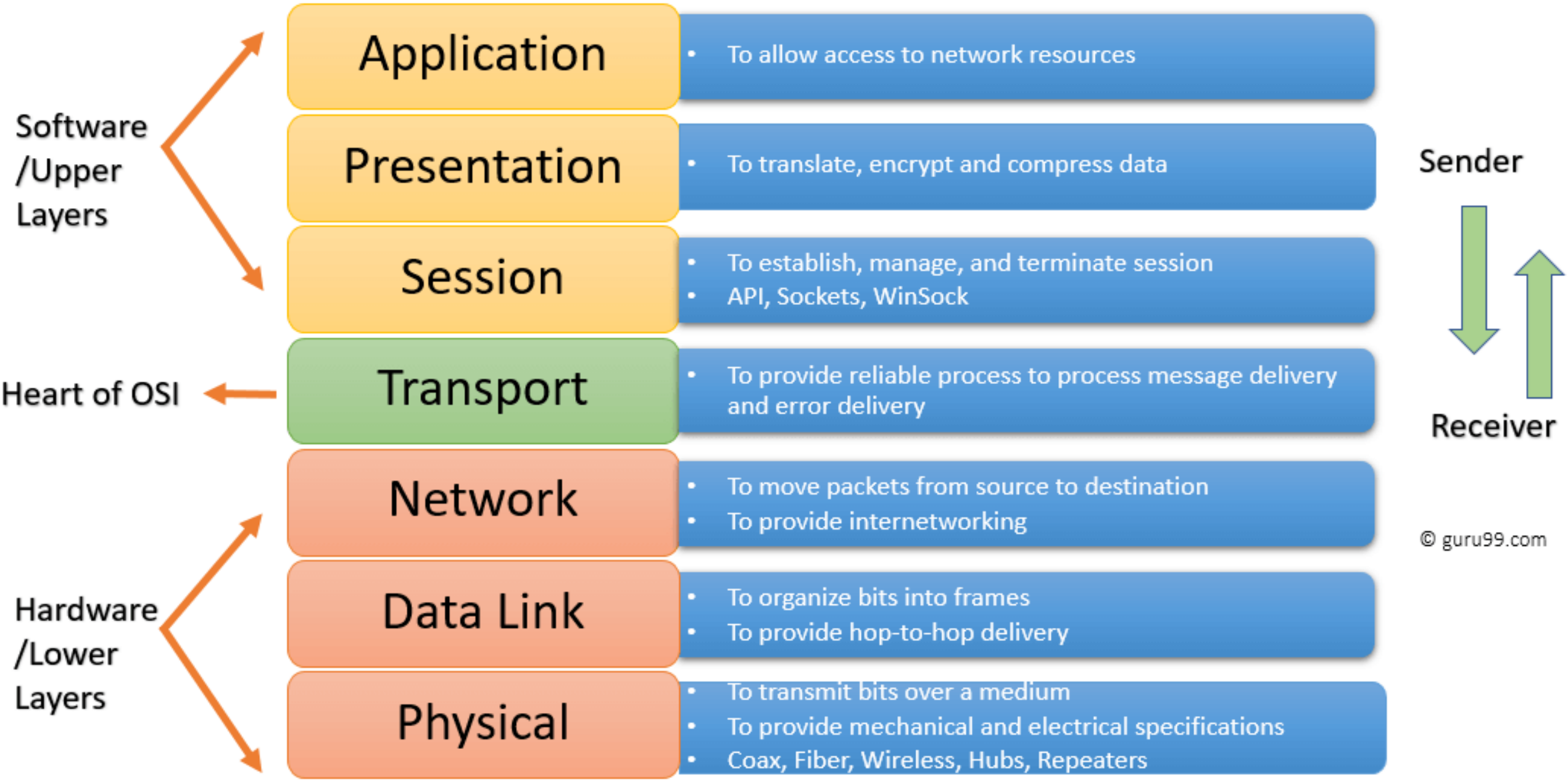
TCP/IP Reference Model

(Transmission Control Protocol/Internet Protocol)

- It was originally defined as having five layers:
- TCP/IP is a set of protocols developed to allow cooperating computers to share resources across the network.
  1. Application Layer
  2. Transport Layer
  3. Network Layer
  4. Data Link Layer
  5. Physical Network

TCP/IP Model Architecture




Application
To allow access to network resources
Presentation
To translate, encrypt and compress data
Session
To establish, manage, and terminate session
API, Sockets, WinSock
Transport
To provide reliable process to process message delivery and error delivery
Network
To move packets from source to destination
To provide internetworking
Data Link
To organize bits into frames
To provide hop-to-hop delivery
Physical
To transmit bits over a medium
To provide mechanical and electrical specifications
Coax, Fiber, Wireless, Hubs, Repeaters
Software /Upper Layers
Heart of OSI
Hardware /Lower Layers
Sender
Receiver
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Thank You!