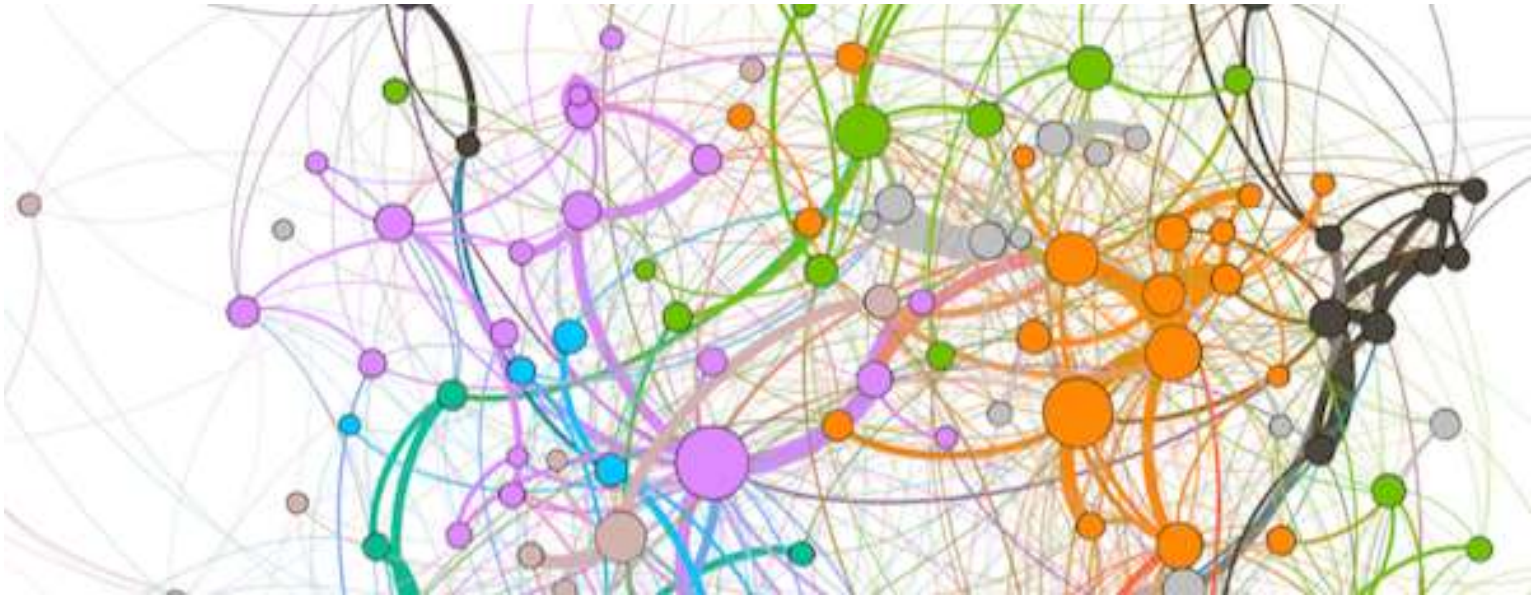
Chapter 2
Network Models



Objective

- the concept of protocol layering and principles.
- the five layers of the TCP/IP protocol suite ; physical, data-link, network, transport, and application; addressing mechanism used in each layer.
- discussion of the OSI model (this model was never implemented in practice); comparison with the TCP/IP protocol suite may be useful to better understand the TCP/IP protocol suite.

PROTOCOL LAYERING

- A word we hear all the time when we talk about the **Internet is protocol**. A protocol defines the rules that both the sender and receiver and all intermediate devices need to follow to be able to communicate effectively.

- When communication is simple, we may need only one simple protocol; when the communication is complex, we need a protocol at each layer, or protocol layering.

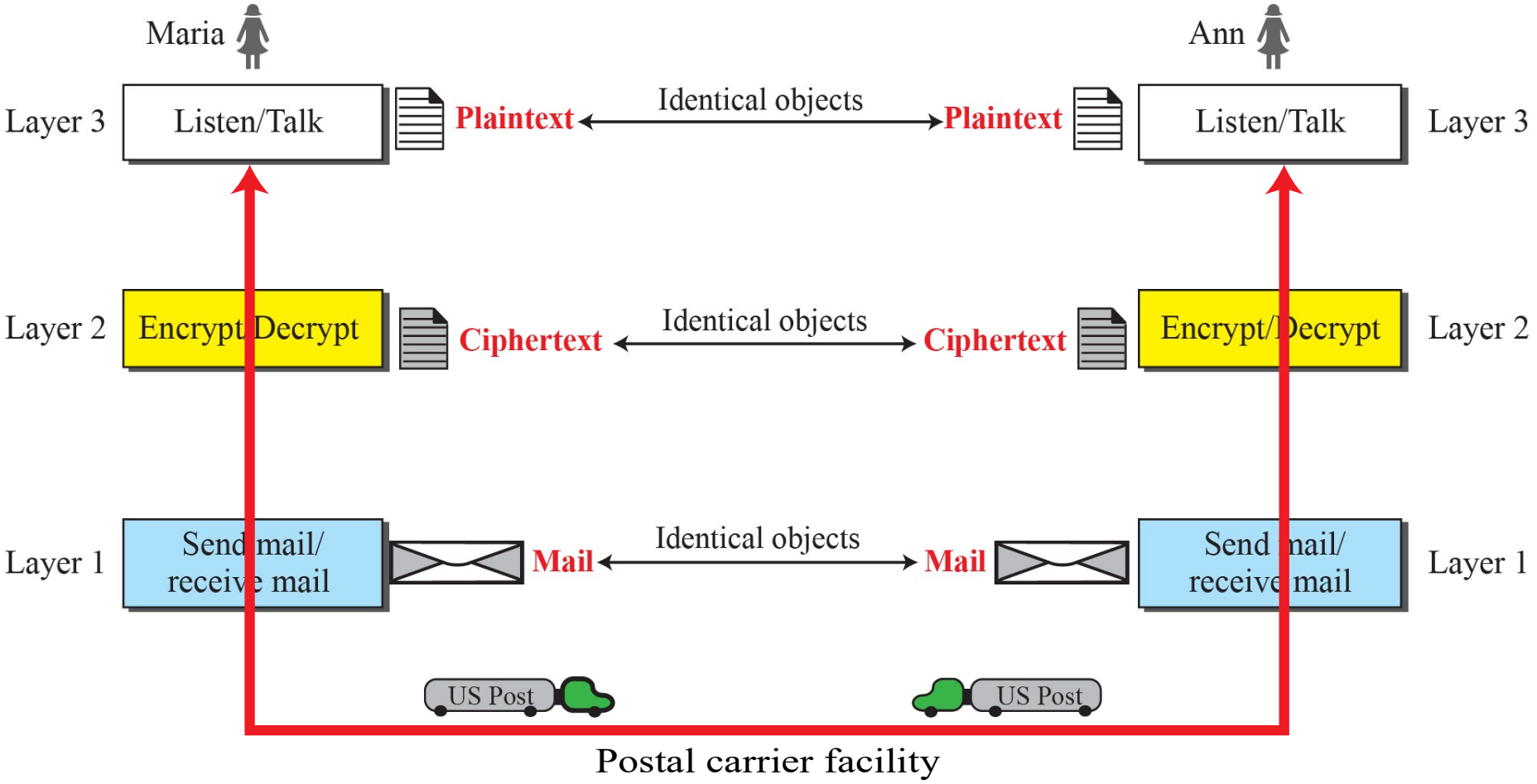
Scenarios

- Let us develop two simple scenarios to better understand the need for protocol layering.

- In the first scenario, communication is so simple that it can occur in only one layer.

A single-layer protocol

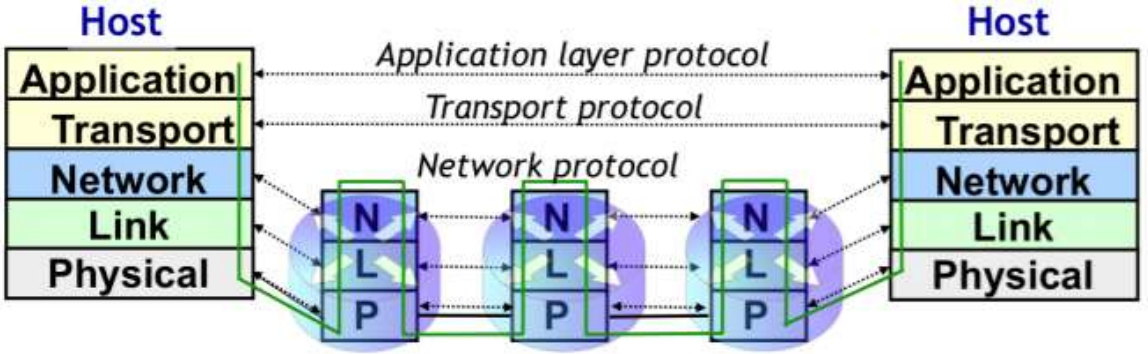
- In the second, the communication between Maria and Ann takes place in three layers.



A three-layer protocol

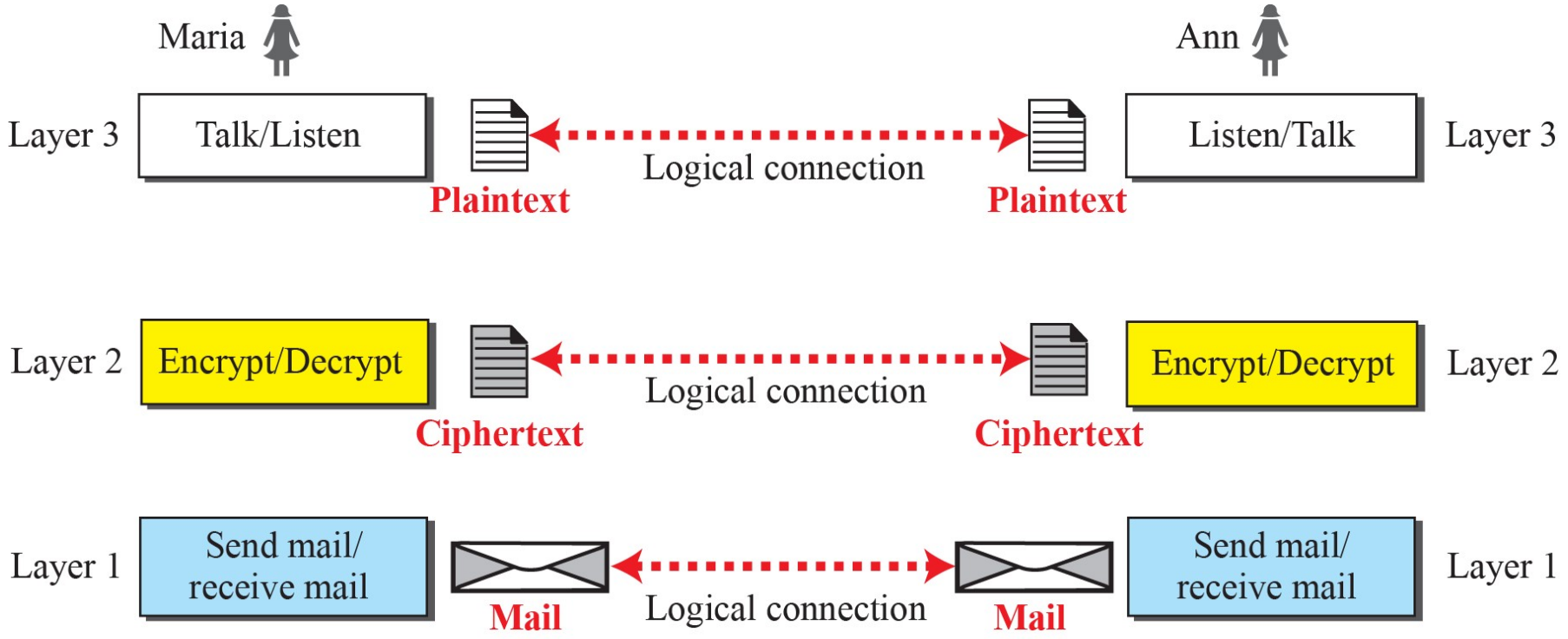
Principles of Protocol Layering

- Let us discuss two principles of protocol layering.
- The first principle dictates that if we want bidirectional communication, we need to make each layer so that it is able to perform two opposite tasks, one in each direction.
- The second principle that we need to follow in protocol layering is that the two objects under each layer at both sites should be identical.



Logical Connections

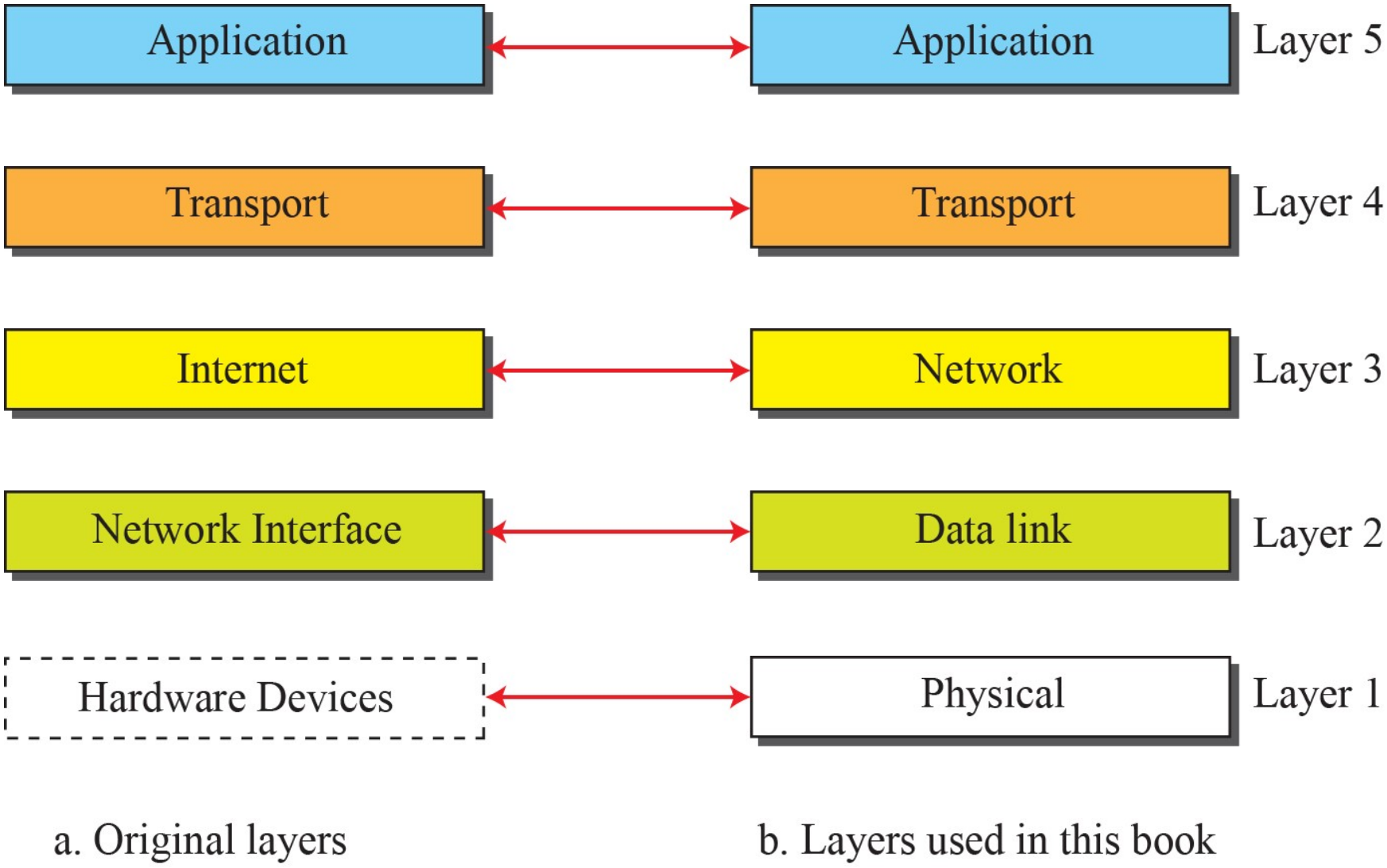
- After following the above two principles, we can think about logical connection between each layer



Logical connection between peer layers

Logical Connections

- After following the above two principles, we can think about **logical connection** between each layer
- This means that we have layer-to-layer communication. Maria and Ann can think that there is a logical (imaginary) connection at each layer through which they can send the object created from that layer.
- We will see that the concept of logical connection will help us better understand the task of layering we encounter in data communication and networking.

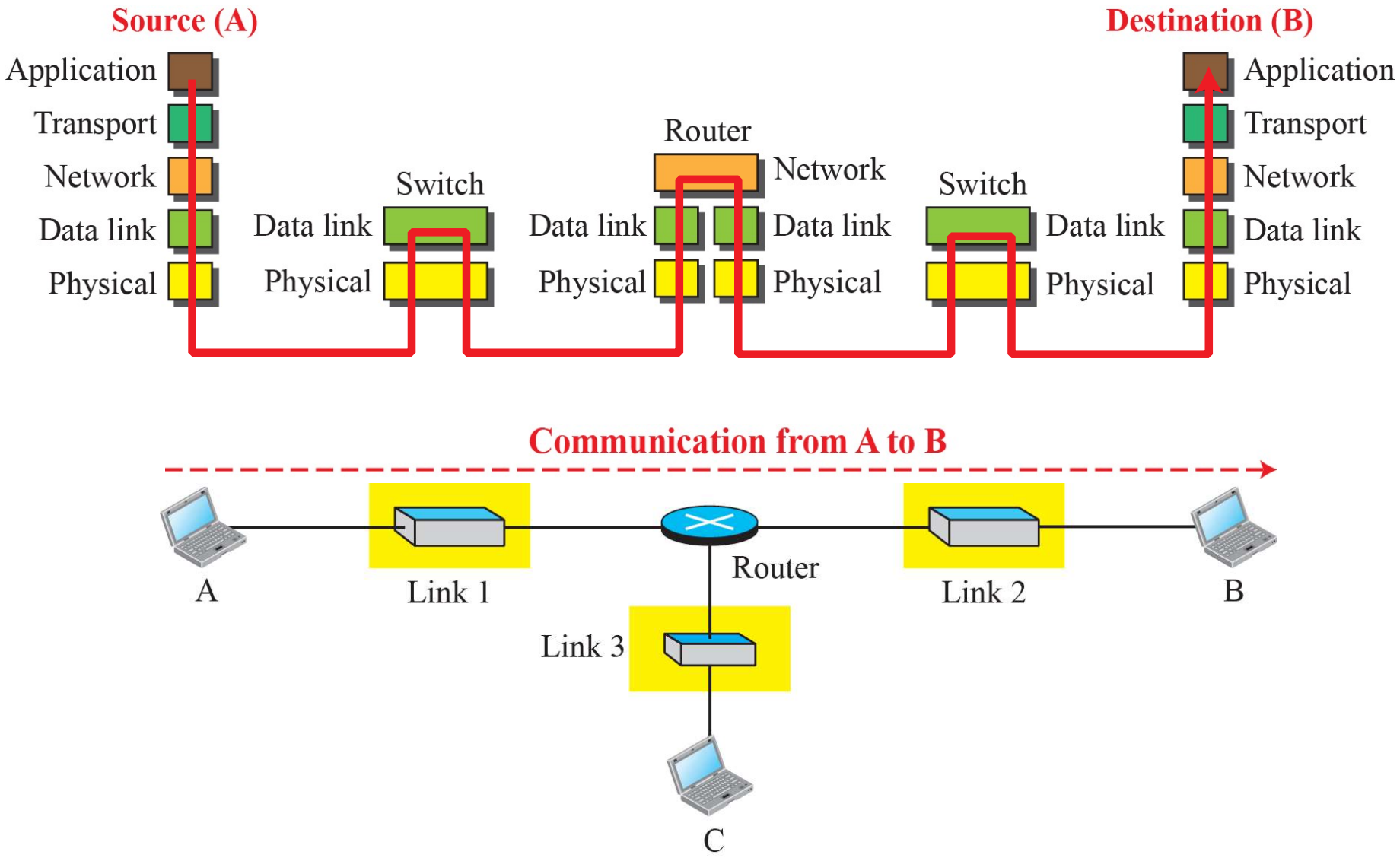


Layers in the TCP/IP protocol suite

Layered Architecture

- To show how the layers in the TCP/IP protocol suite are involved in communication between two hosts, we assume that we want to use the suite in a small internet made up of three LANs (links), each with a link-layer switch.

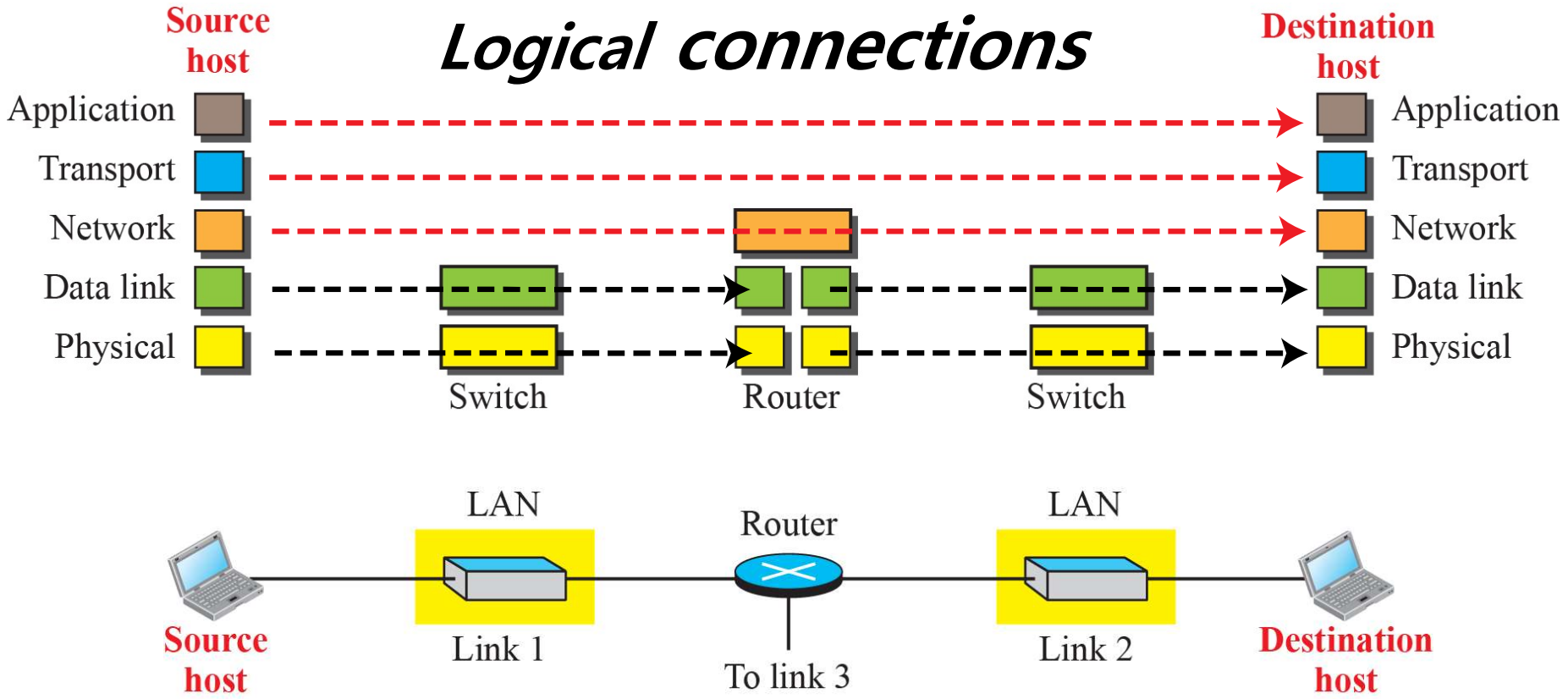
- We also assume that the links are connected by one router.



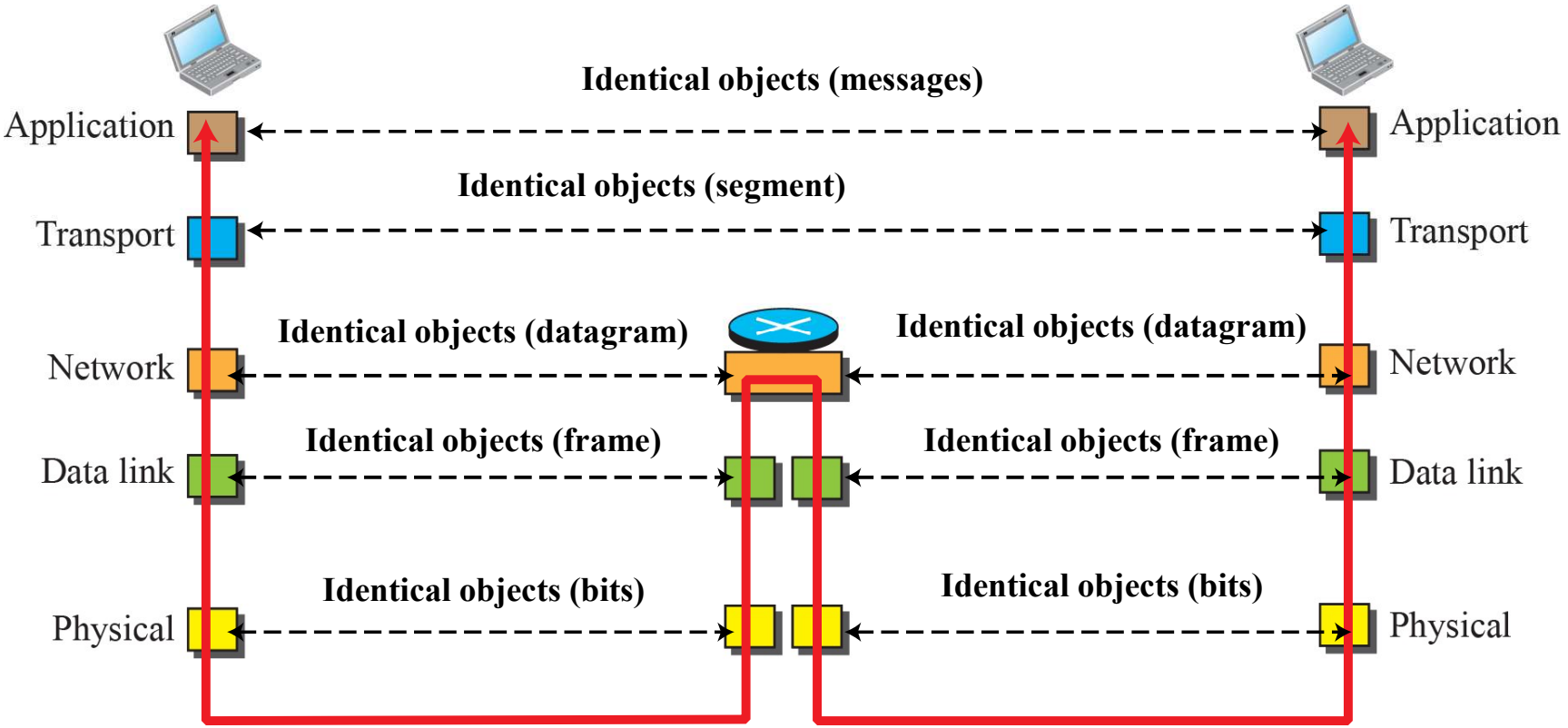
Communication through an internet

Layers in the TCP/IP Protocol Suite

- After the above introduction, we briefly discuss the **functions and duties** of layers in the TCP/IP protocol suite.
- Each layer is discussed in detail in the next. To better understand the duties of each layer, we need to think about the logical connections between layers.
- Next figure shows logical connections in our simple internet.



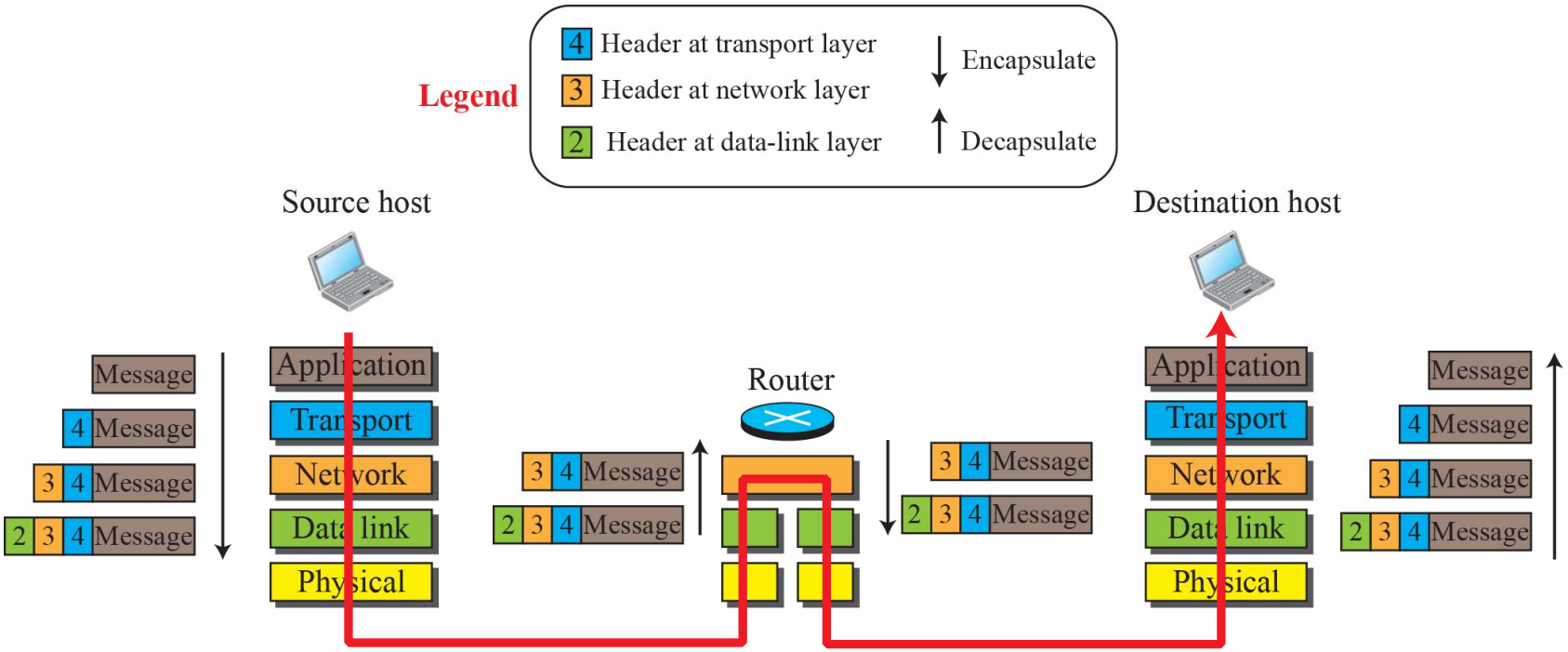
Logical connections between layers in TCP/IP



Identical objects in the TCP/IP protocol suite

Encapsulation and Decapsulation

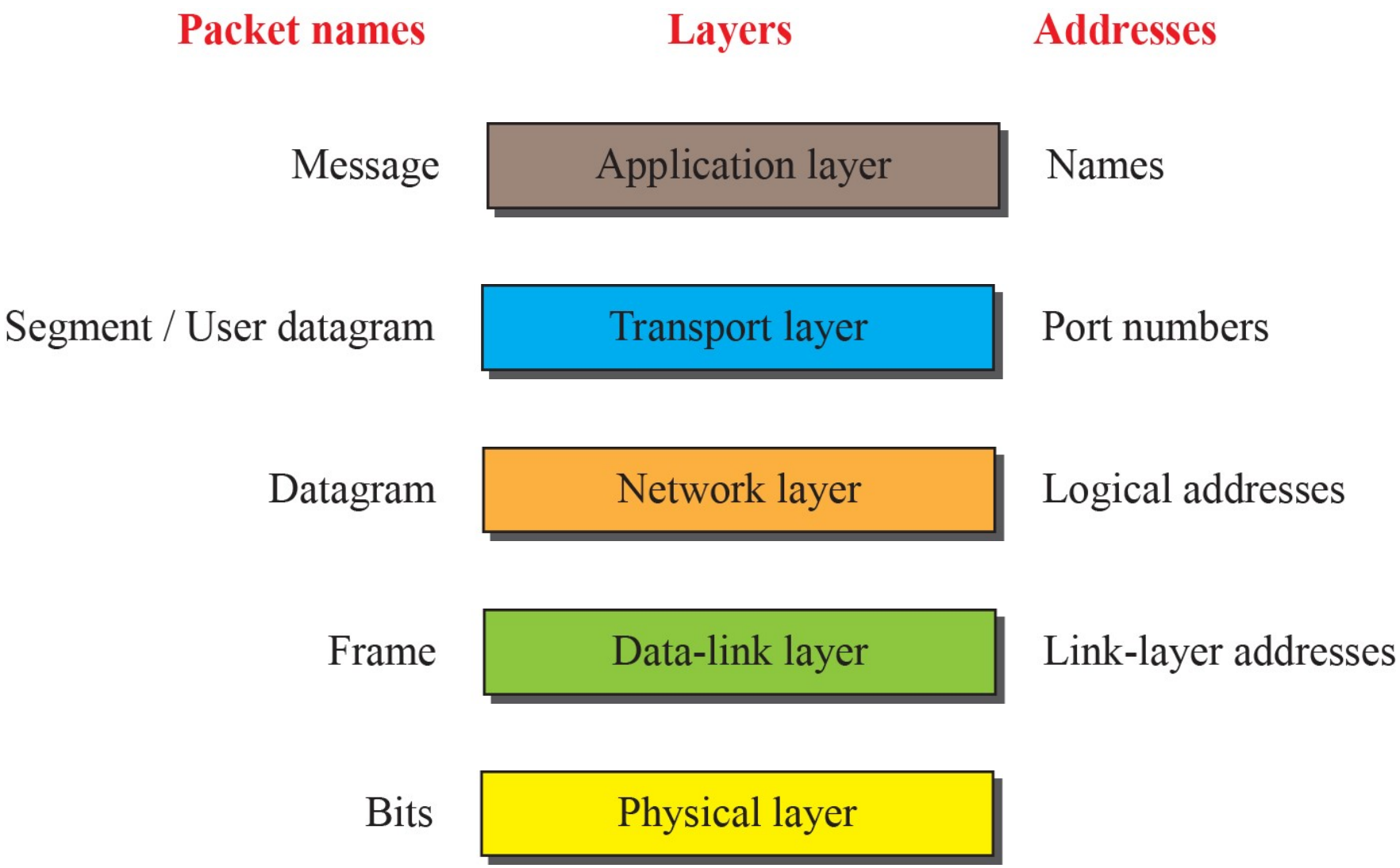
- One of the important concepts in protocol layering in the Internet is **encapsulation/ decapsulation**.



Encapsulation / Decapsulation

Addressing

- It is worth mentioning another concept related to protocol layering in the Internet, addressing.
- We have logical communication between pairs of layers in this model. Any communication that involves two parties needs two addresses: source address and destination address.
- Although it looks as if we need five pairs of addresses, one pair per layer, we normally have only four because the physical layer does not need addresses; the unit of data exchange at the physical layer is a bit, which definitely cannot have an address.



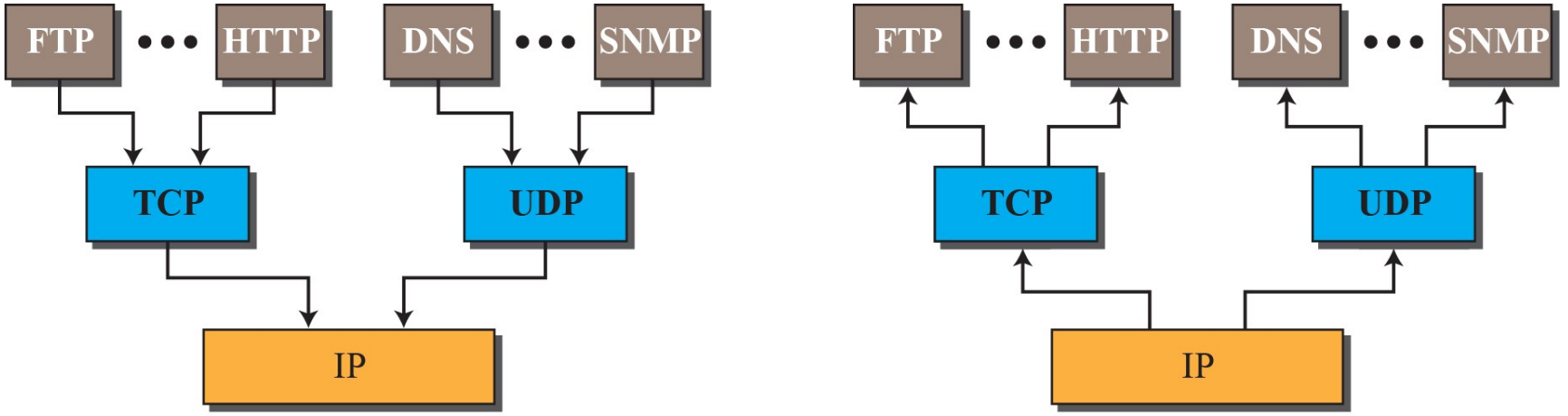
Addressig in the TCP/IP protocol suiten

Multiplexing and Demultiplexing

- Since the TCP/IP protocol suite uses several protocols at some layers, we can say that we have **multiplexing at the source and demultiplexing at the destination.**

- **Multiplexing** in this case means that a protocol at a layer can encapsulate a packet from several next-higher layer protocols (one at a time)

- **Demultiplexing** means that a protocol can decapsulate and deliver a packet to several next-higher layer protocols (one at a time).



a. Multiplexing at source

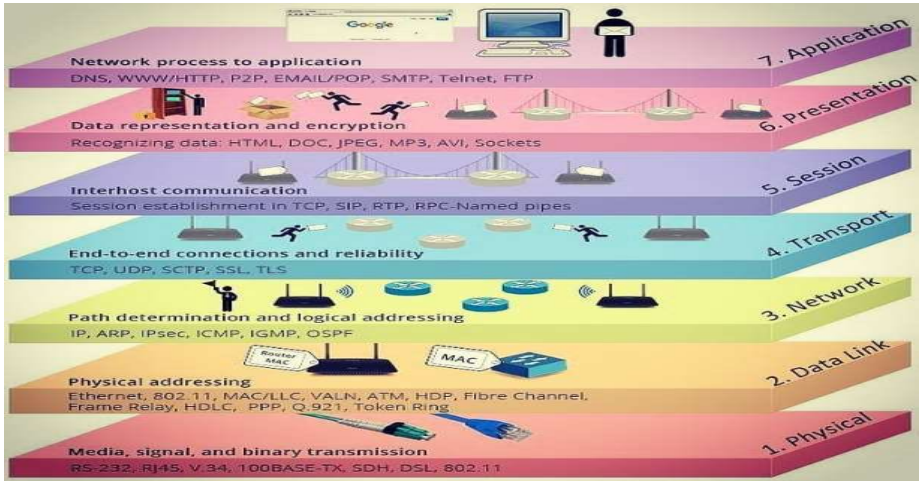
b. Demultiplexing at destination

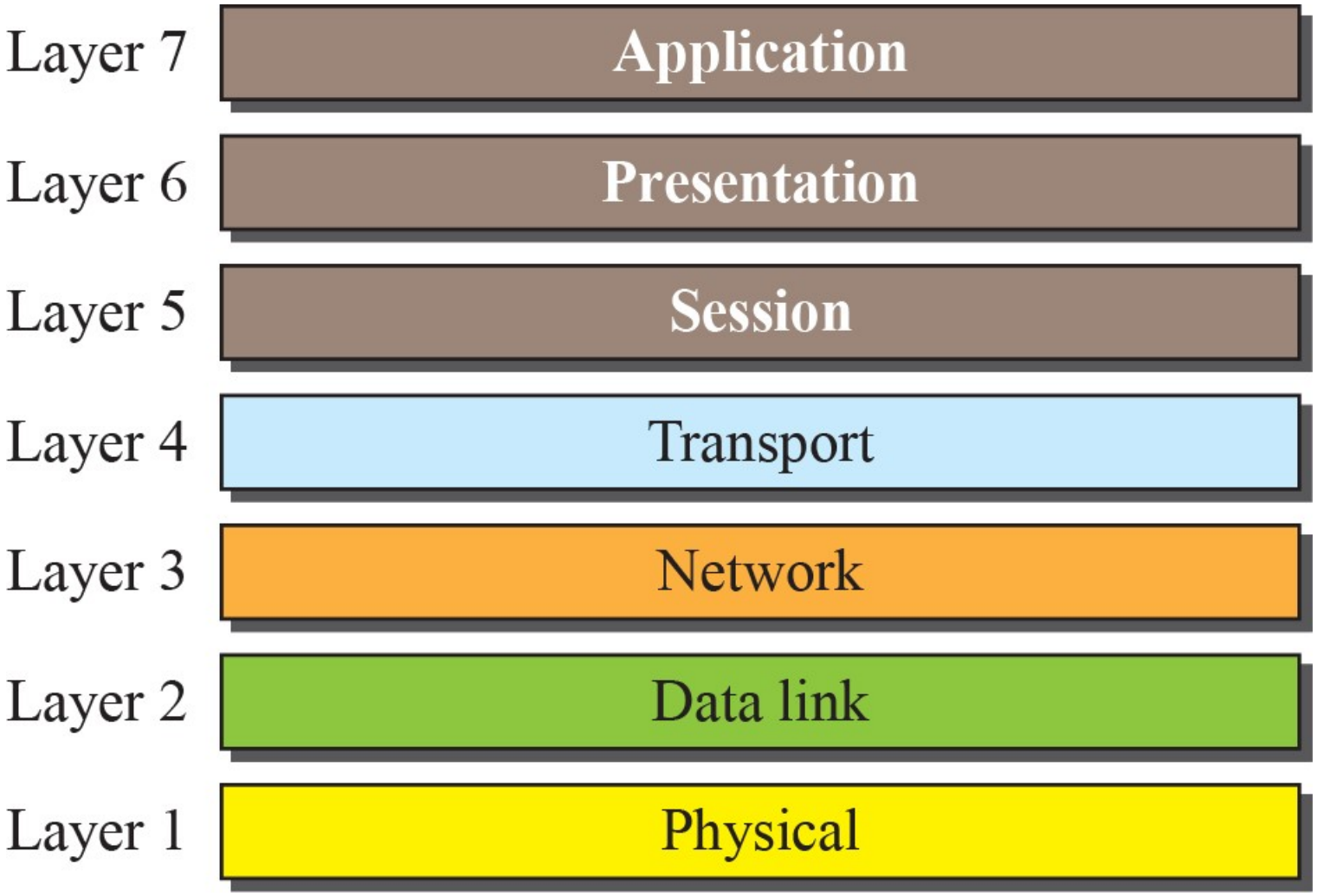
Multiplexing and demultiplexing

OSI MODEL

- The Open Systems Interconnection model (OSI model) is a conceptual model that characterises the communication functions of a computing system without regard to its underlying internal structure and technology.

- Its goal is the interoperability of diverse communication systems with standard communication protocols.

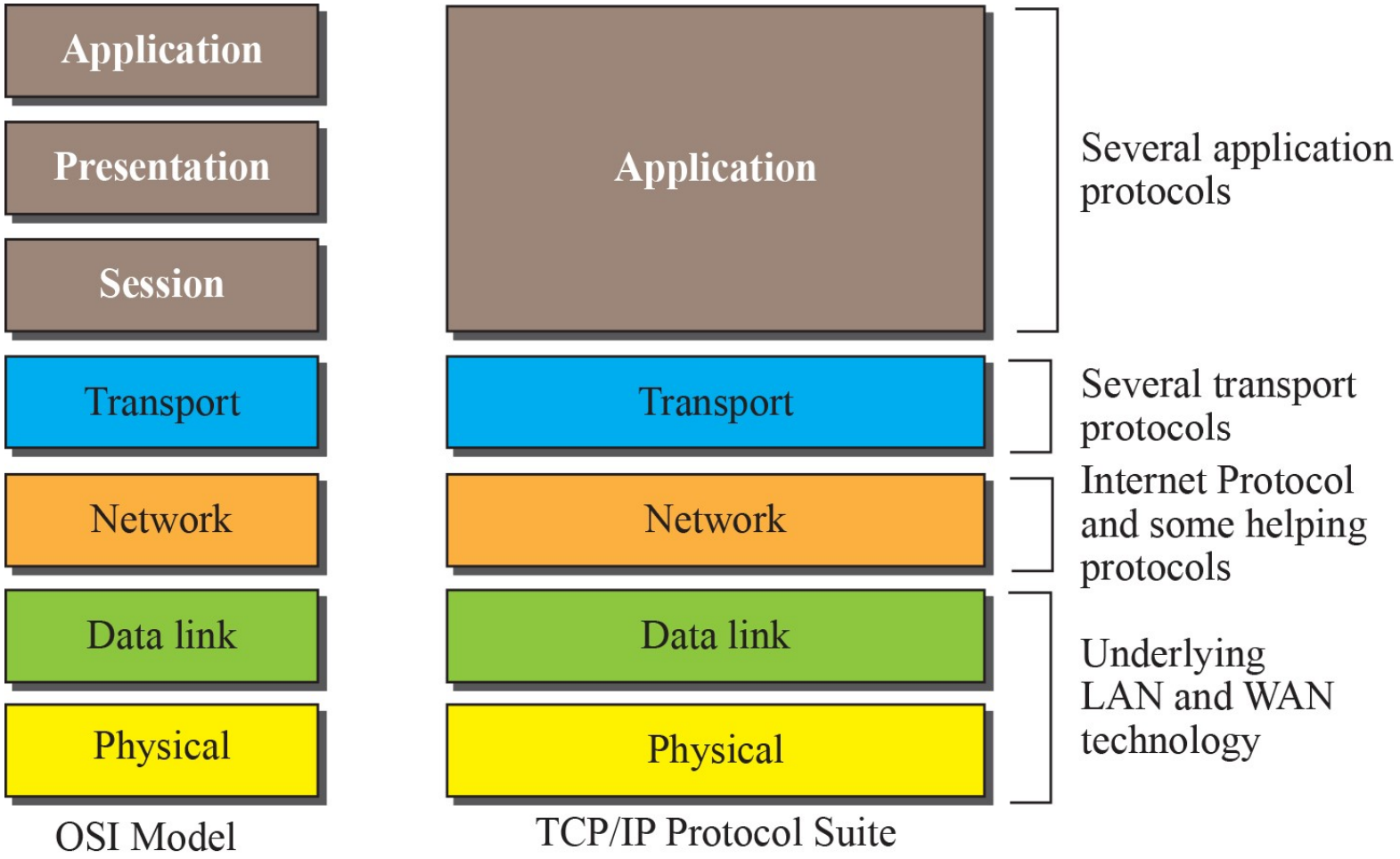




The OSI model

OSI versus TCP/IP

- When we compare the two models, we find that two layers, session and presentation, are missing from the TCP/IP protocol suite.
- These two layers were not added to the TCP/IP protocol suite after the publication of the OSI model.
- The application layer in the suite is usually considered to be the combination of three layers in the OSI model, as shown in next Figure.



TCP/IP and OSI model

Lack of OSI Model's Success

- The OSI model appeared after the TCP/IP protocol suite. Most experts were at first excited and thought that the TCP/IP protocol would be fully replaced by the OSI model.

- This did not happen for several reasons, which are agreed upon by all experts in the field.