

Lecture 2

Introduction to Data Communication

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Terminology

- The *throughput* or *bandwidth* of a channel is the number of bits it can transfer per second
- The *latency* or *delay* of a channel is the time that elapses between sending information and the earliest possible reception of it

Network topologies

Topology defines the way hosts are connected to the network

Network topology issues

a goal of any topology

1. **high throughput** (bandwidth)
2. **low latency**

Bandwidth and Latency

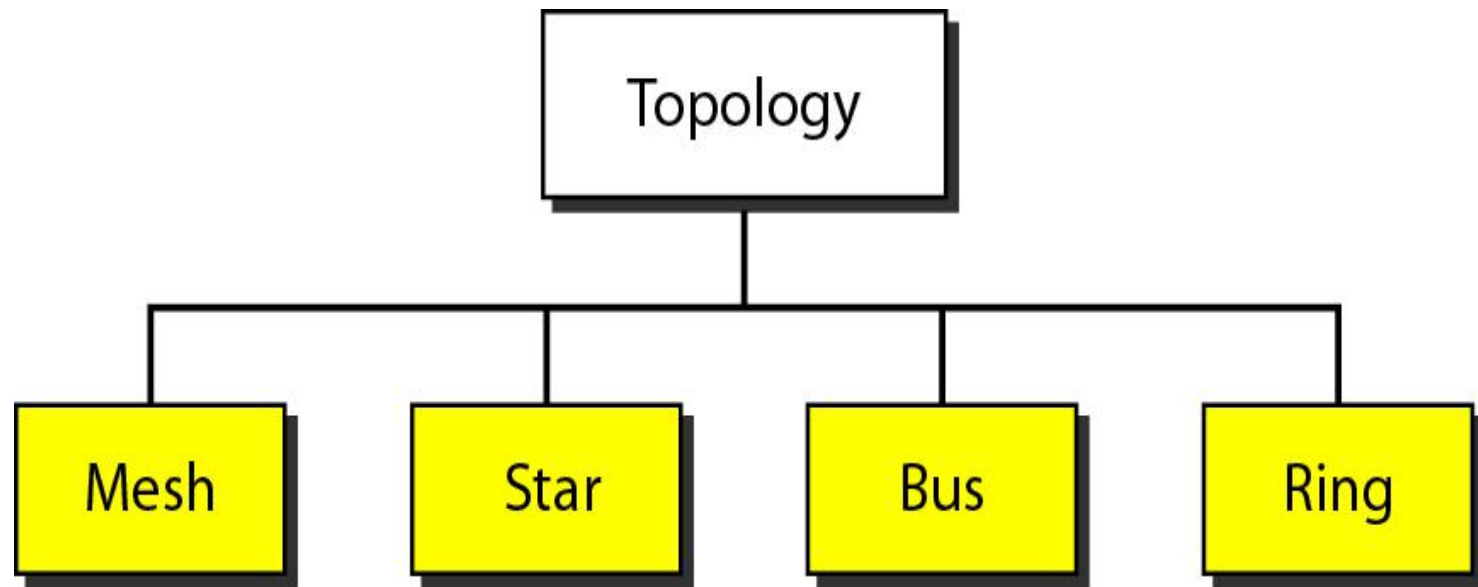
Bandwidth

1. **telecommunications**: **range of radio frequencies**: a range of radio frequencies used in radio or telecommunications transmission and reception
2. **computing**: **communications capacity**: the capacity of a communications channel, for example, a connection to the Internet, often measured in bits per second
3. a data **transmission rate**; the maximum amount of information (bits/second) that can be transmitted along a channel

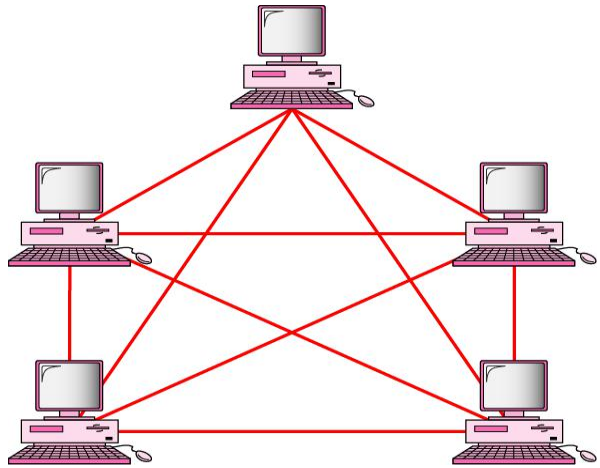
Latency

A synonym for *delay*, is an expression of how much time it takes for transmission from one designated point to another

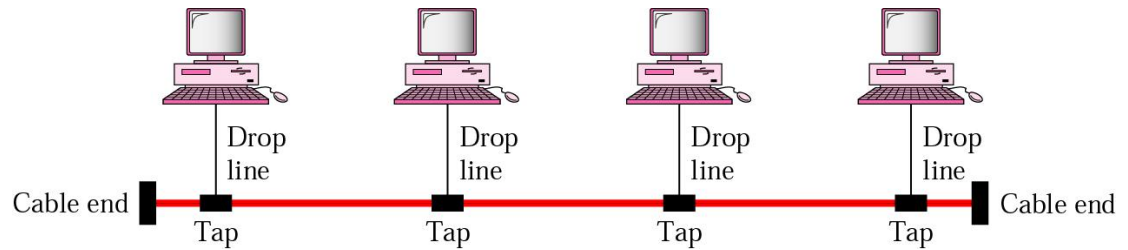
Categories of Topology



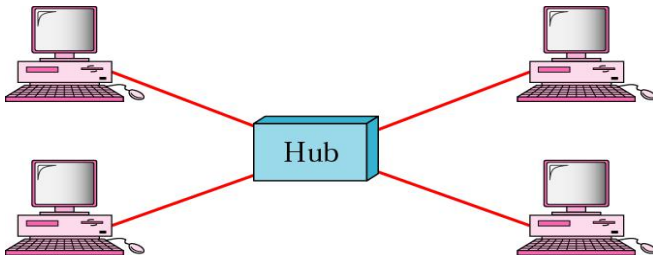
Mostly used network topologies



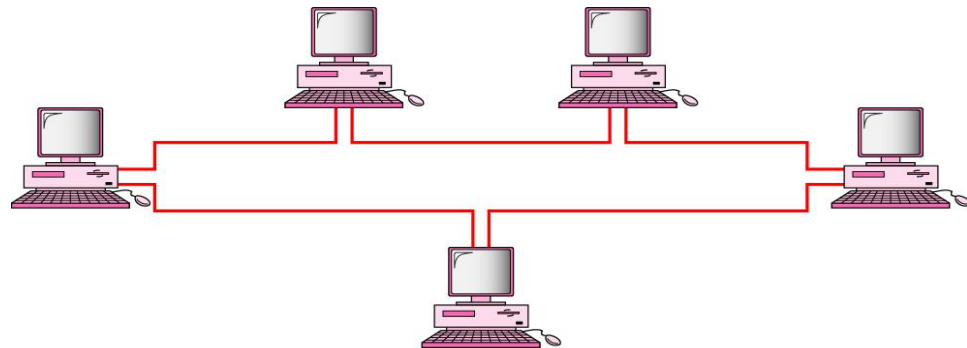
mesh



bus

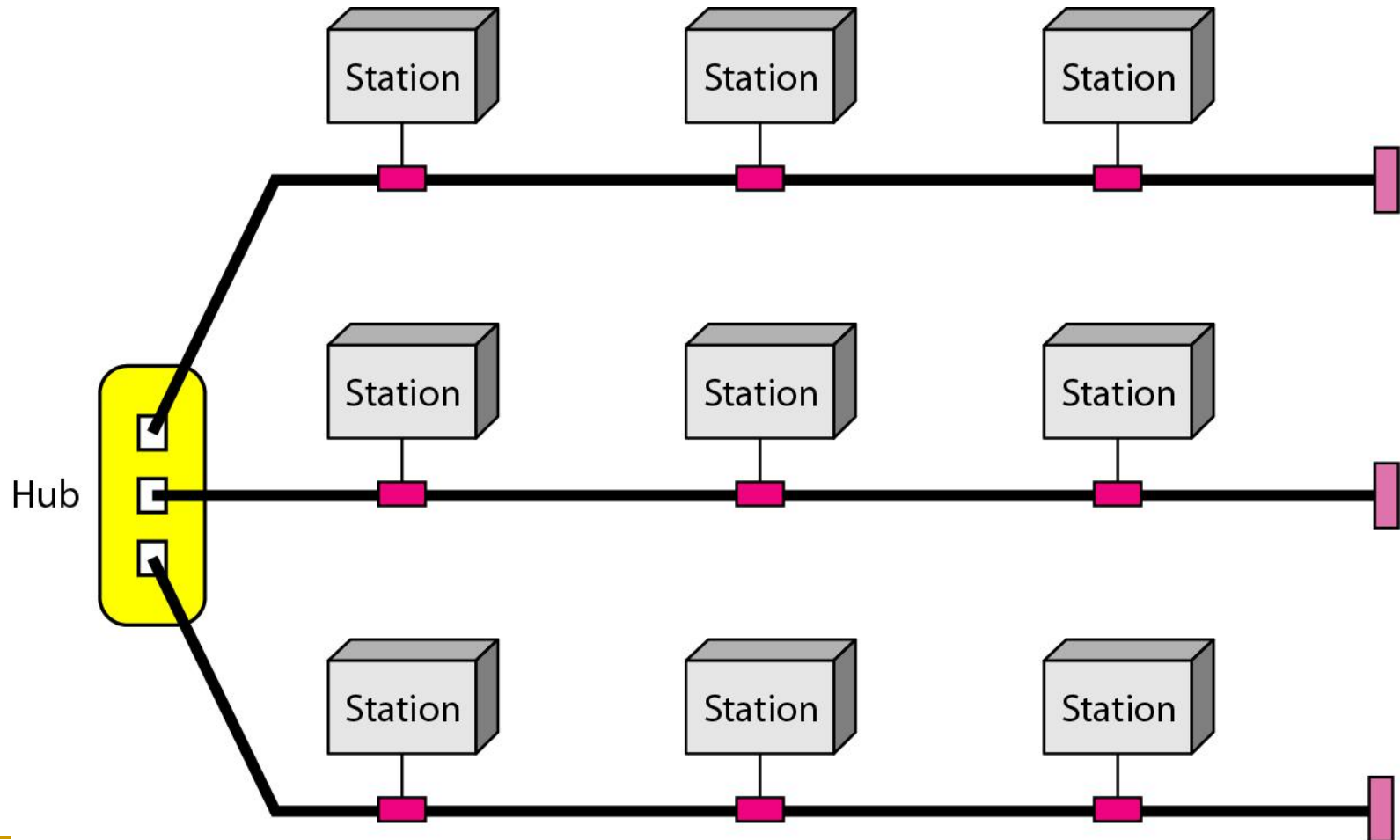


star

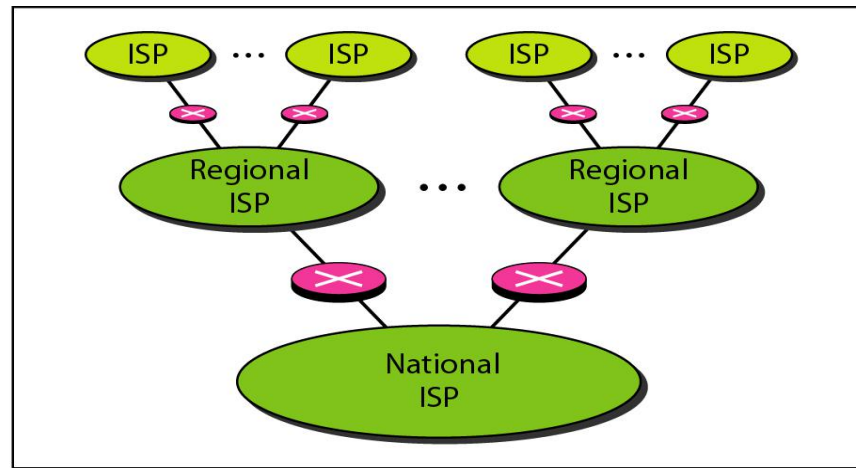


ring

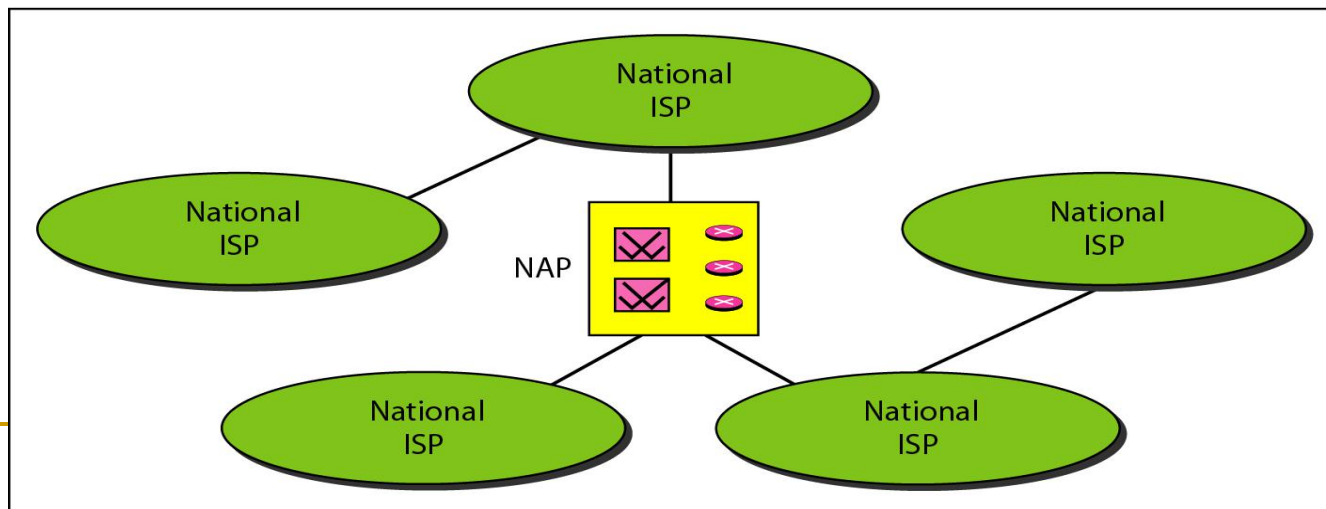
A hybrid topology: a star backbone with three bus networks



Hierarchical organization of the Internet



a. Structure of a national ISP

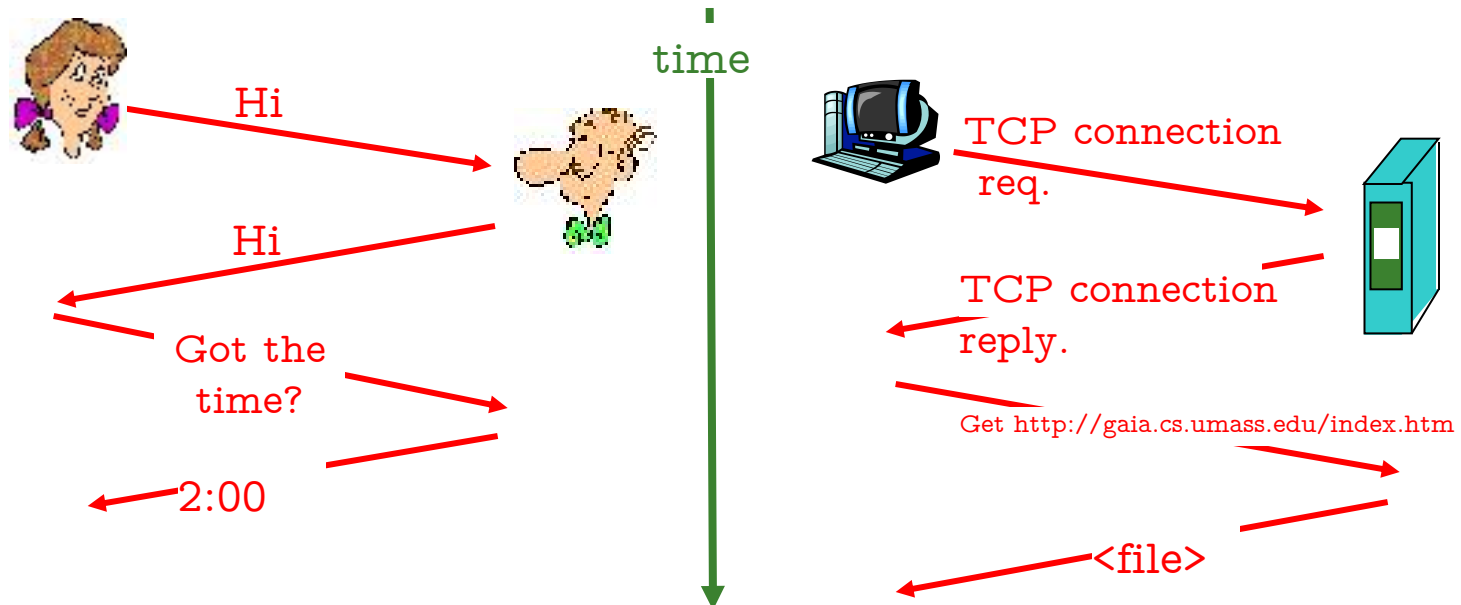


b. Interconnection of national ISPs

Layering & Protocol Stacks

Protocol

- protocols define **format**, **order of msgs** sent and received among network entities, and **actions** taken on msg transmission, receipt
a human protocol and a computer network protocol:

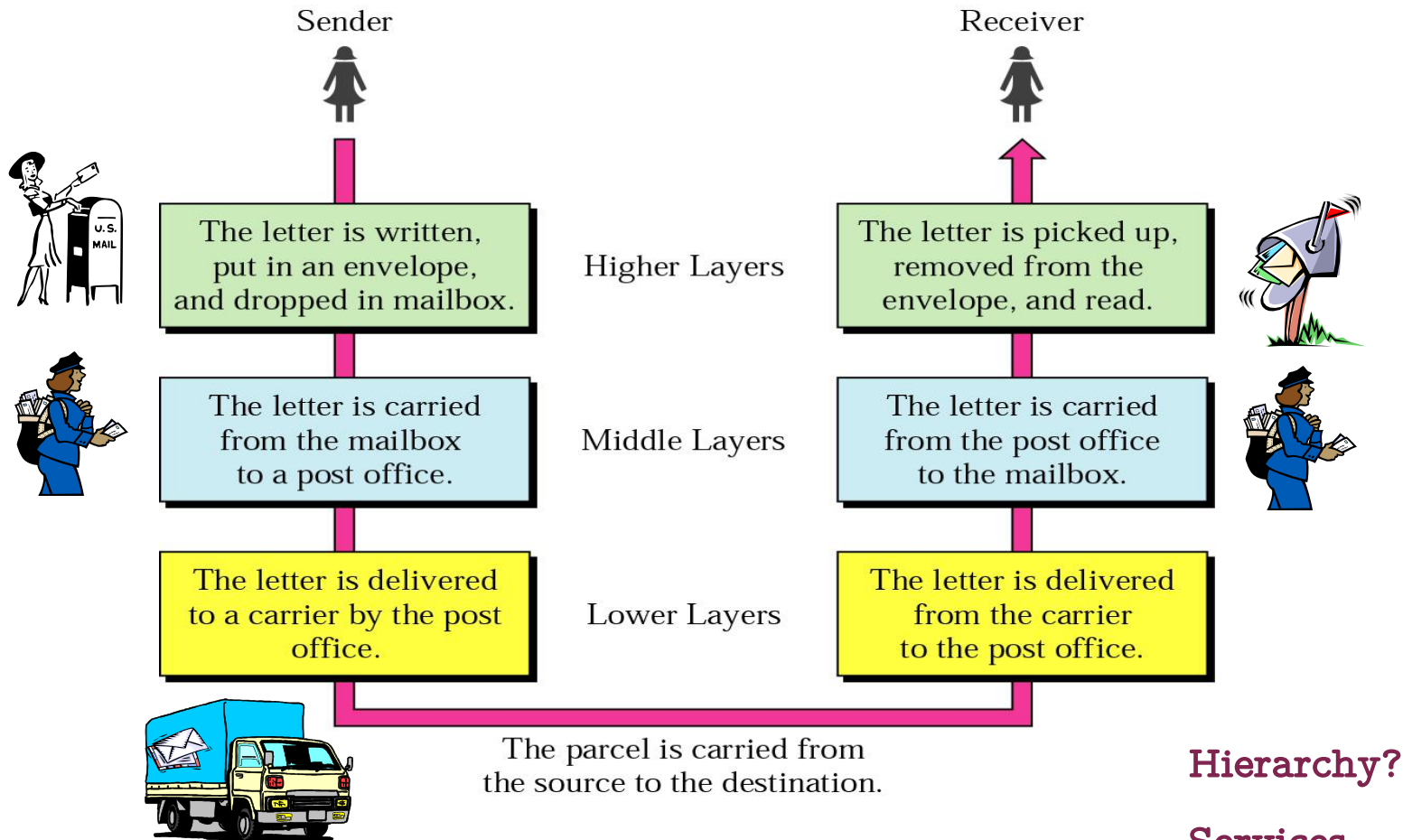


Standard

- Essential in creating and maintaining an open and competitive market for equipment manufacturers
- Guaranteeing national & international **interoperability of data** & telecommunication technology & process.

Layered Tasks

An example from the everyday life



Why layered communication?

- To reduce **complexity** of communication task by splitting it into several layered small tasks
- Functionality of the layers can be changed as long as the service provided to the layer above stays unchanged
 - **makes easier maintenance & updating**
- Each layer has its own **task**
- Each layer has its own **protocol**

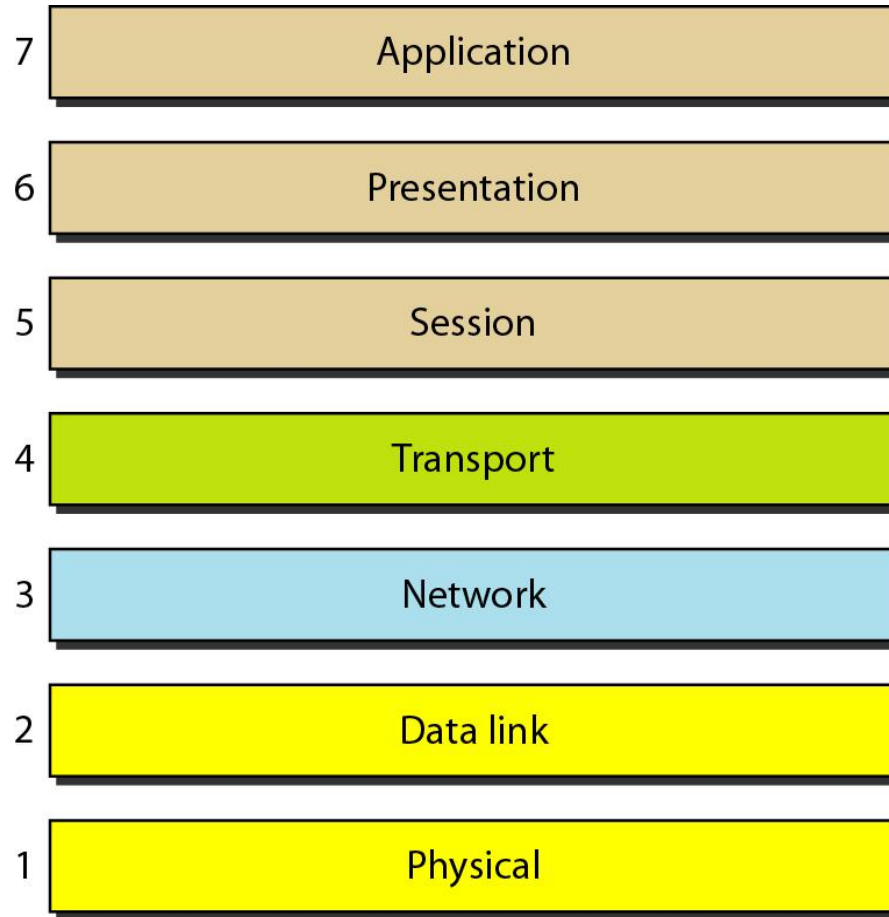
Reference Models

- OSI reference model
- TCP/IP

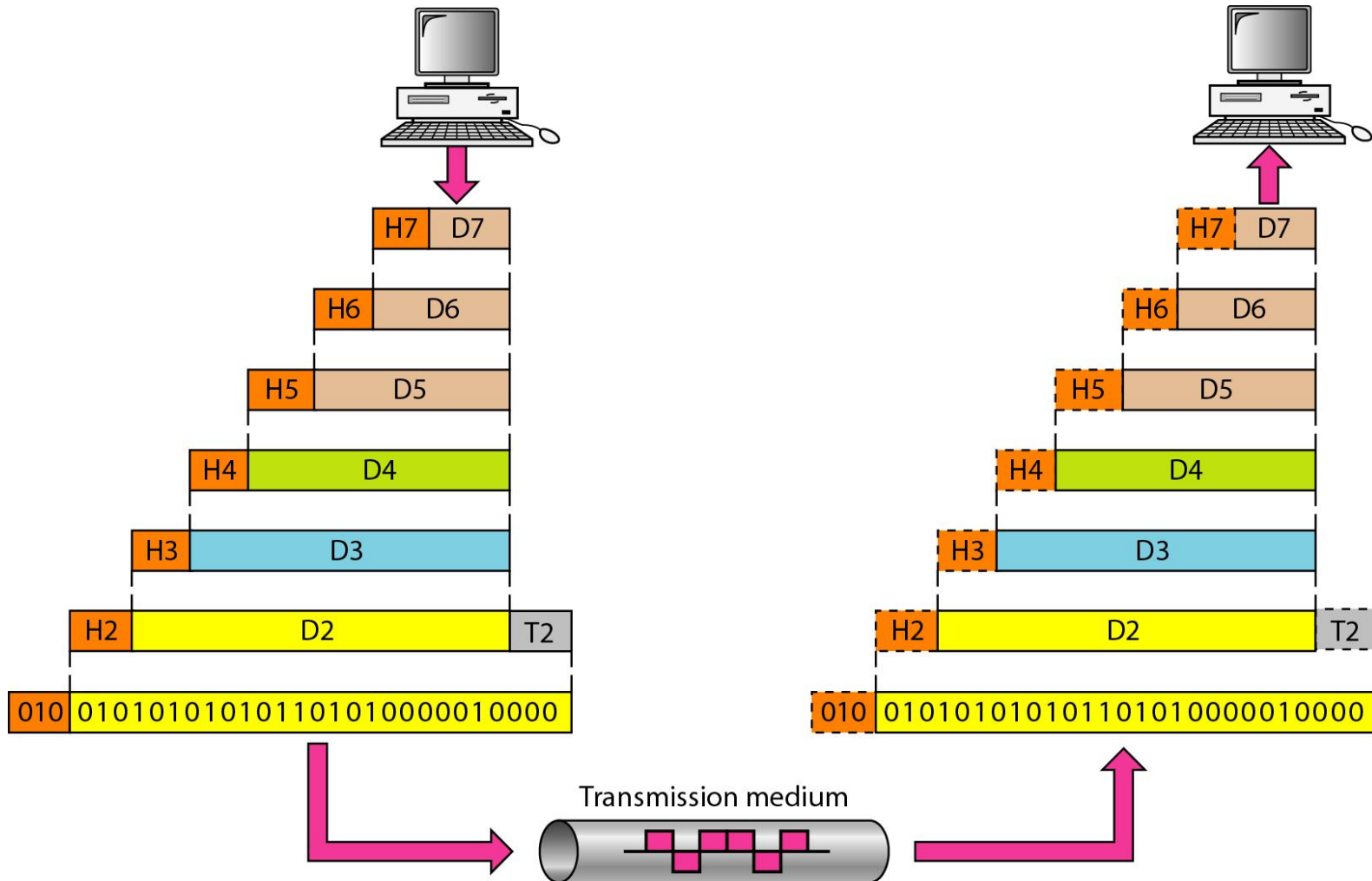
OSI Reference model

- Open System Interconnection
 - 7 layers
1. Create a layer when different **abstraction** is needed
 2. Each layer performs a well define **function**
 3. Functions of the layers chosen taking **internationally standardized** protocols
 4. Number of layers – large enough to avoid **complexity**

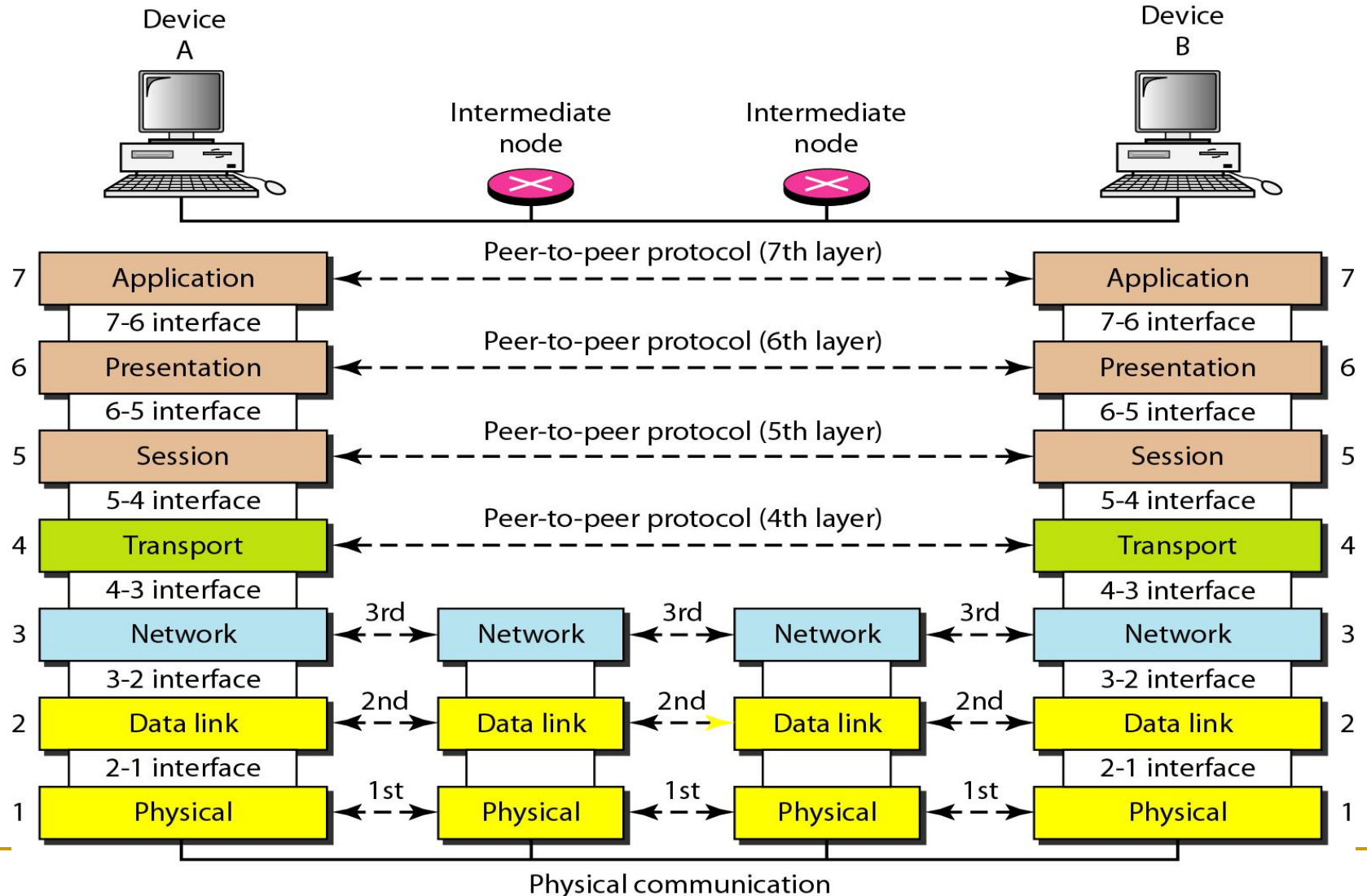
Seven layers of the OSI model



Exchange using OSI Model



The interaction between layers in the OSI model

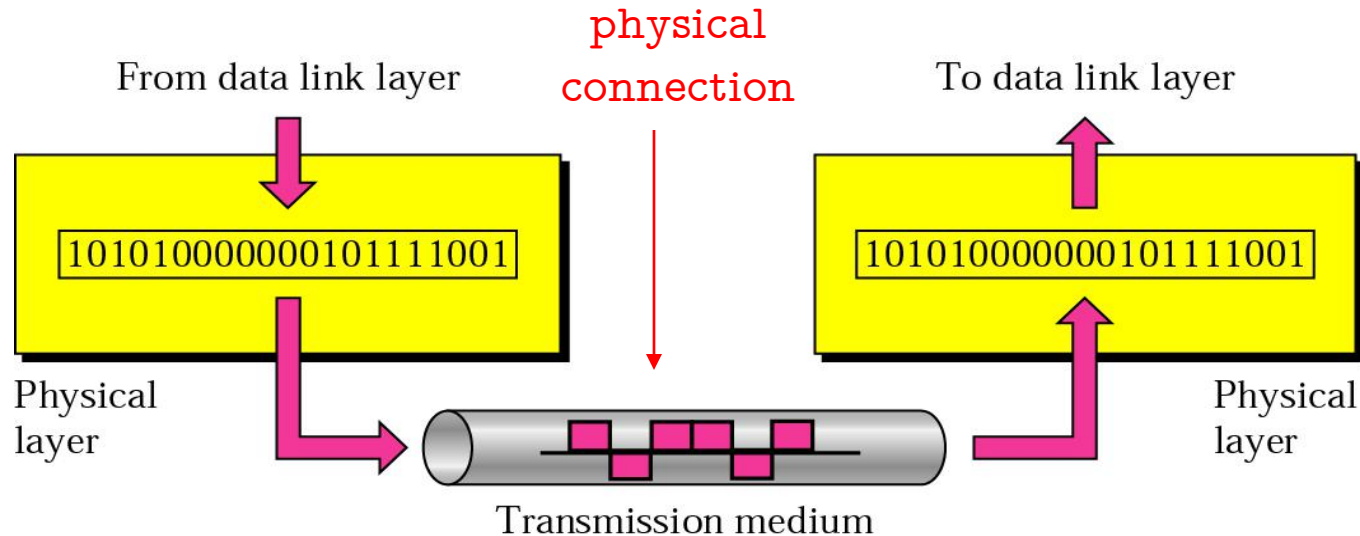


Issues, to be resolved by the layers

- Larger bandwidth at lower cost
- Error correction
- Flow control
- Addressing
- Multiplexing
- Naming
- Congestion control
- Mobility
- Routing
- Fragmentation
- Security

OSI Layers

Physical layer

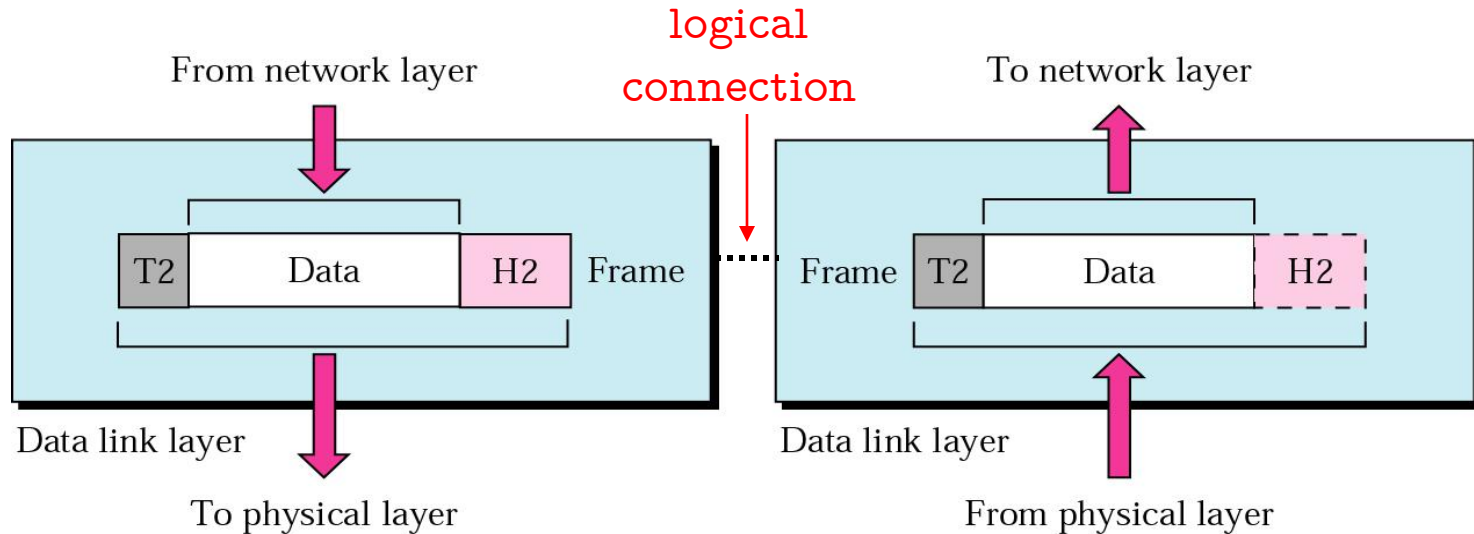


Transporting bits from one end node to the next

- bit representation (voltage levels of logical values)
- data rate (speed)
- synchronization of bits (time synchronization)

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

Data Link layer

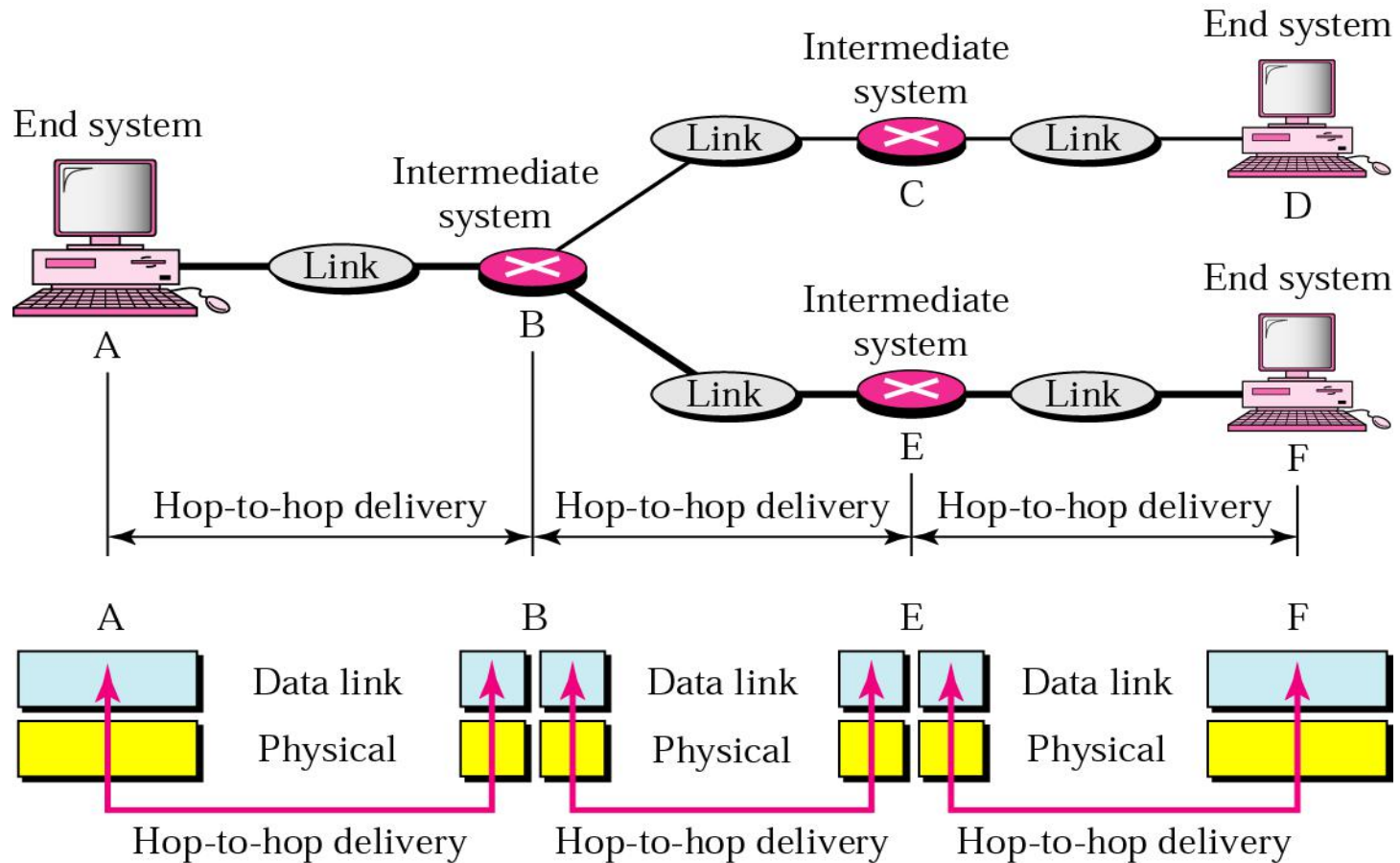


Transporting frames from one end node to the next one

- framing
- physical addressing
- flow control
- error control
- access control

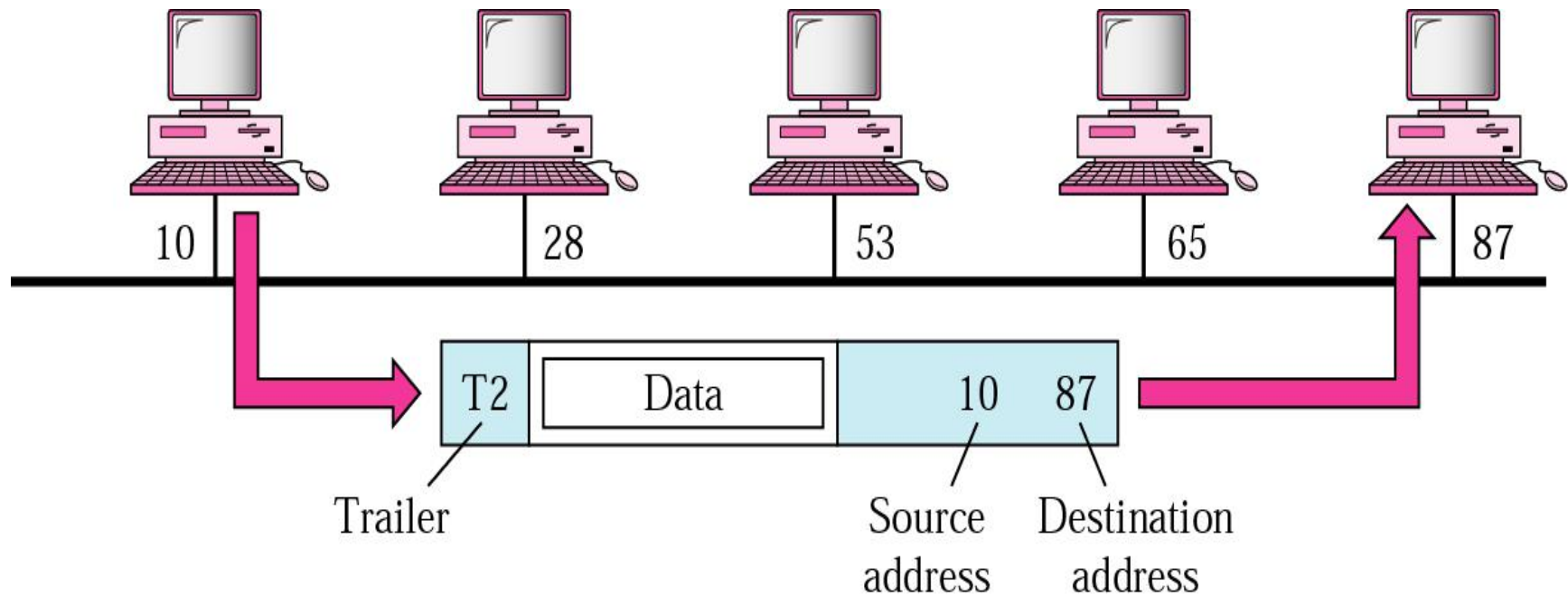
Data Link layer

- hop-to-hop delivery -



Data Link layer

- example -



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

To be Continued...

Question ???