CSE 311: Computer Networks

Layered Task, TCP/IP Protocol Suite, OSI Model

Lecture 2

Protocol Layering

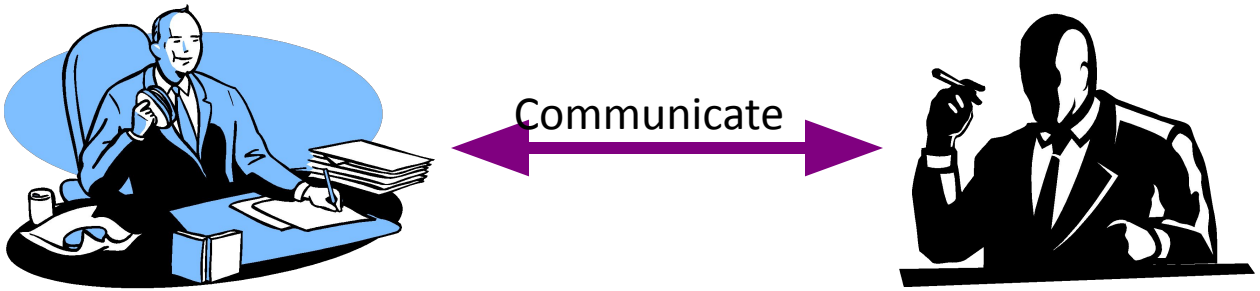
- Protocol: The rules that the sender, receiver and all intermediate devices follow to communicate effectively
- Simple communication Simple protocol
- Complex communication Protocol layering

- Computer networks are complex systems
  - Tasks involve varieties of hardware and software components, and protocols

- Networking task is divided into several subtasks, or layers

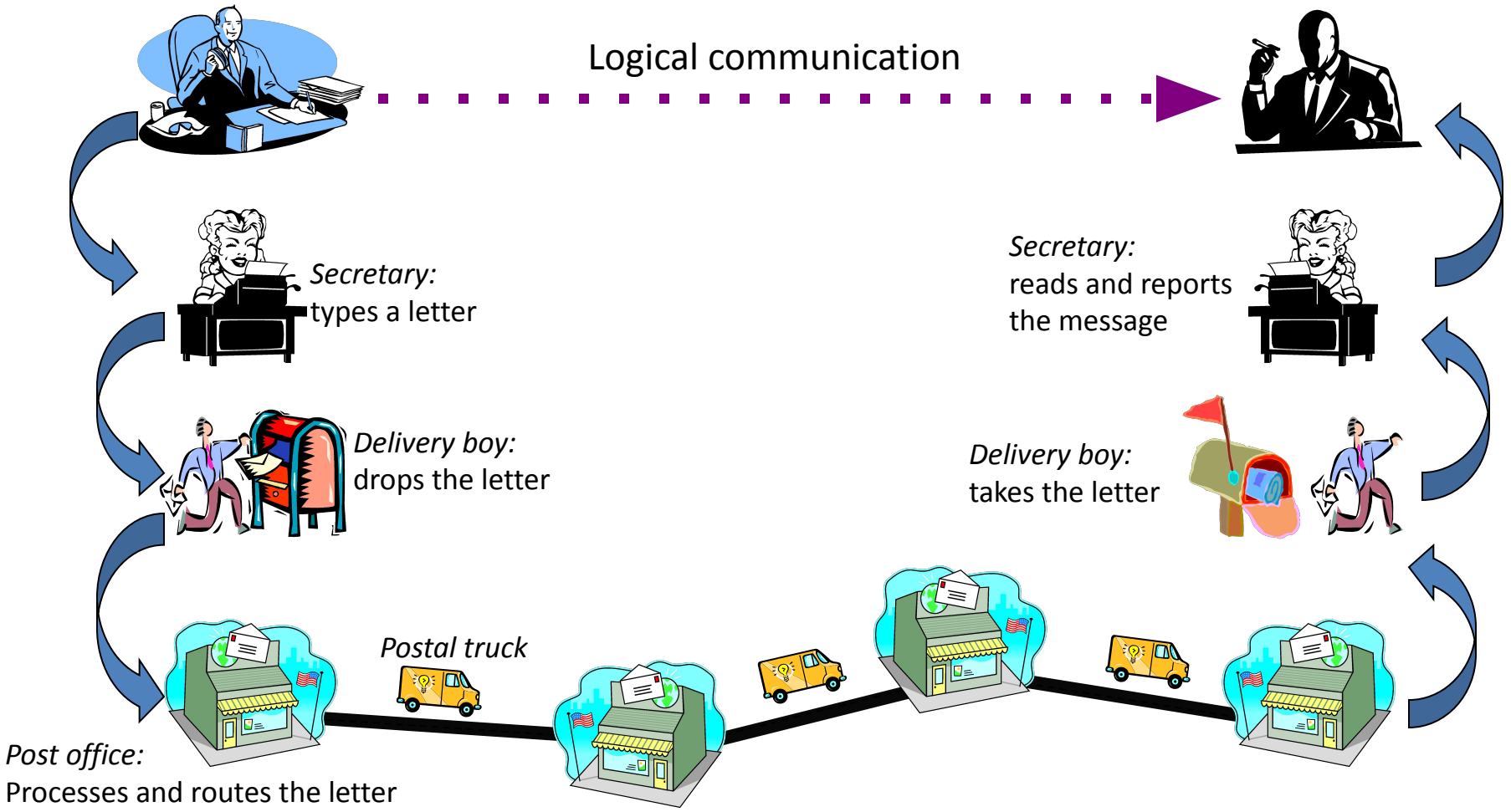
Real World Example

- Communication between managers of two companies



What Actually happens

- Communication takes place thru many layers



Sender, Receiver, and Carrier

At the Sender Site

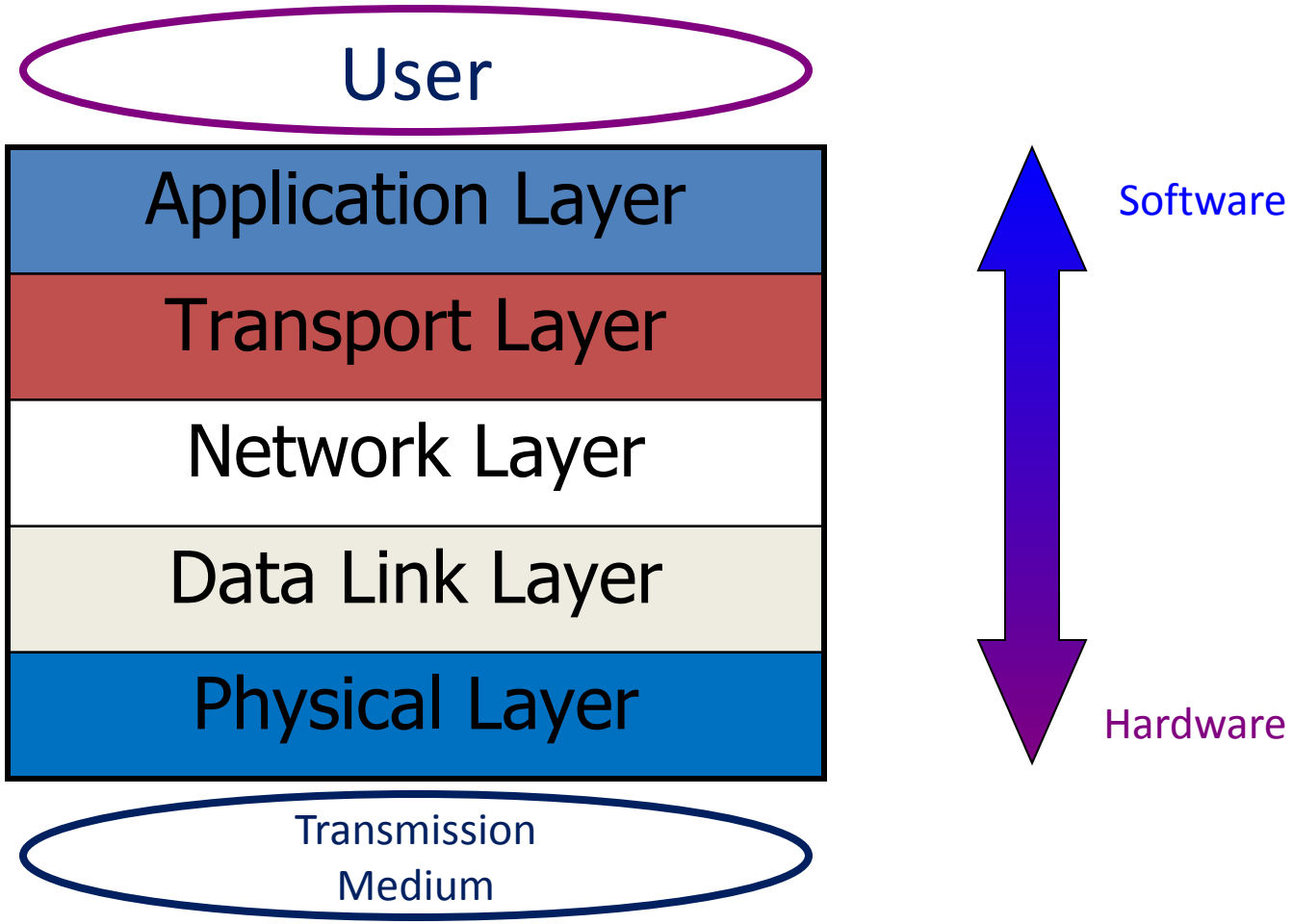
- Higher Layer
- Middle Layer
- Low Layer

At the Receiver Site

- Low Layer
- Middle Layer
- Higher Layer

Internet Layer Model: TCP/IP Protocol Suite

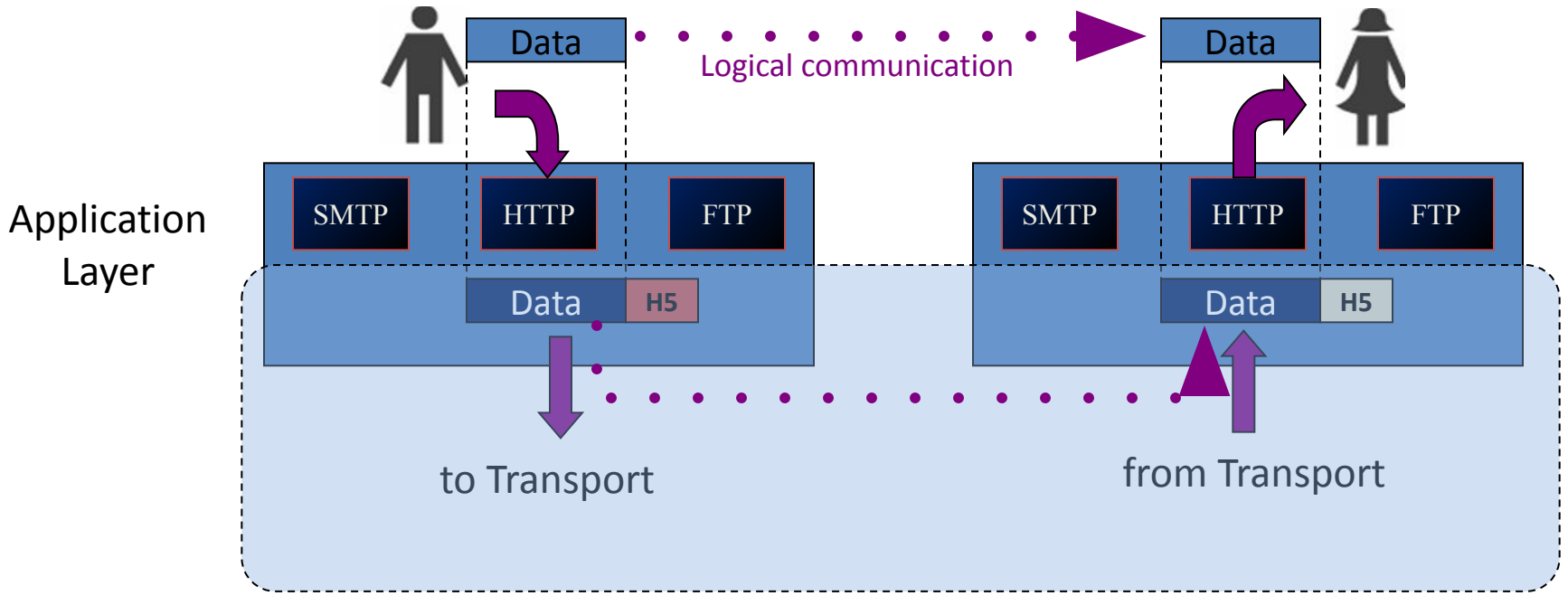
- The Internet Protocol Stack



Application Layer

Responsible for providing services to the user

- The only layer to interact with user

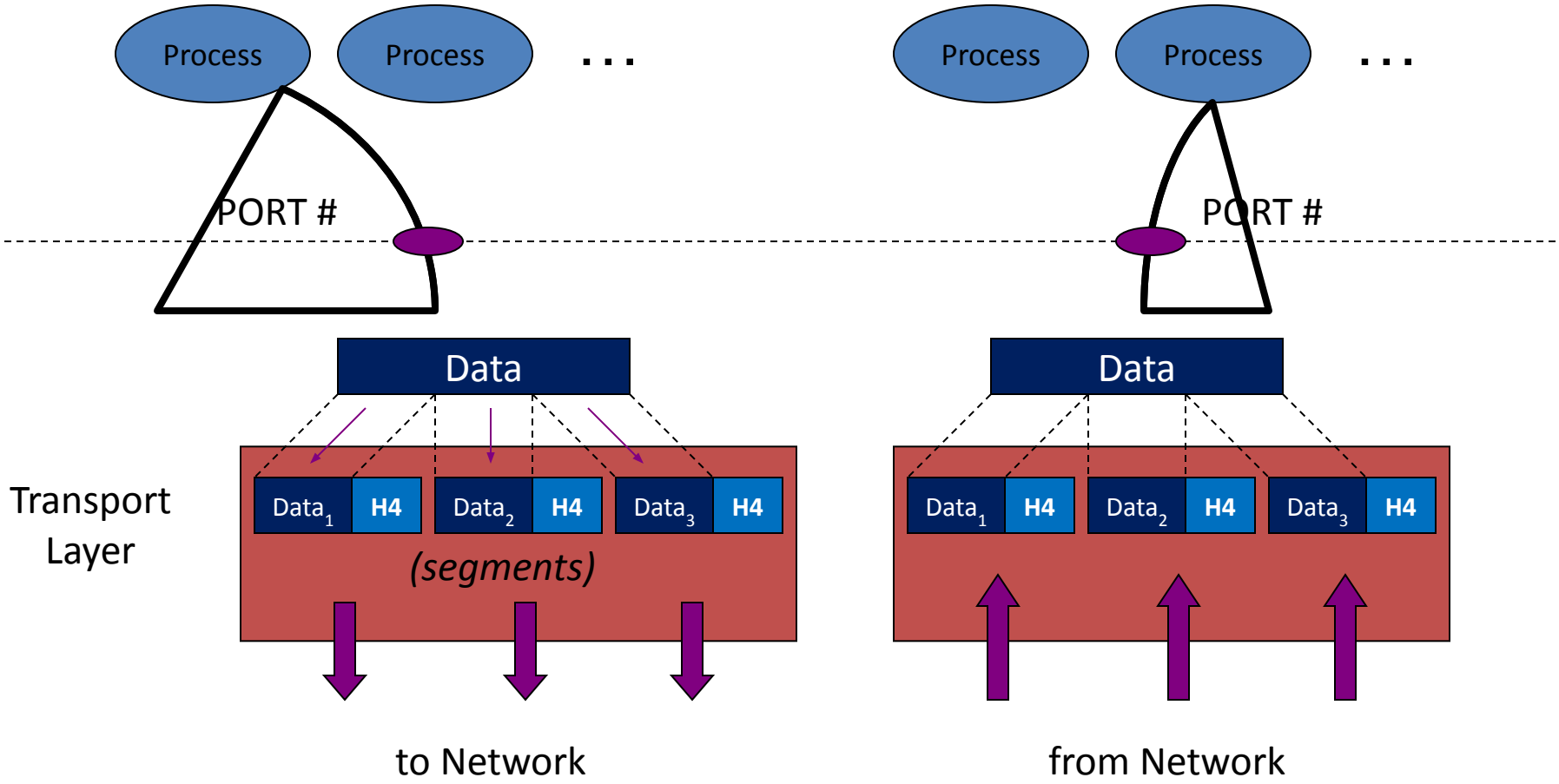


Transport Layer

Responsible for delivery of a message from one process to another

- Duties/services
  - Port addressing
  - Segmentation and reassembly
  - Connection control
  - Flow control (end-to-end)
  - Error control (end-to-end)

Transport Layer

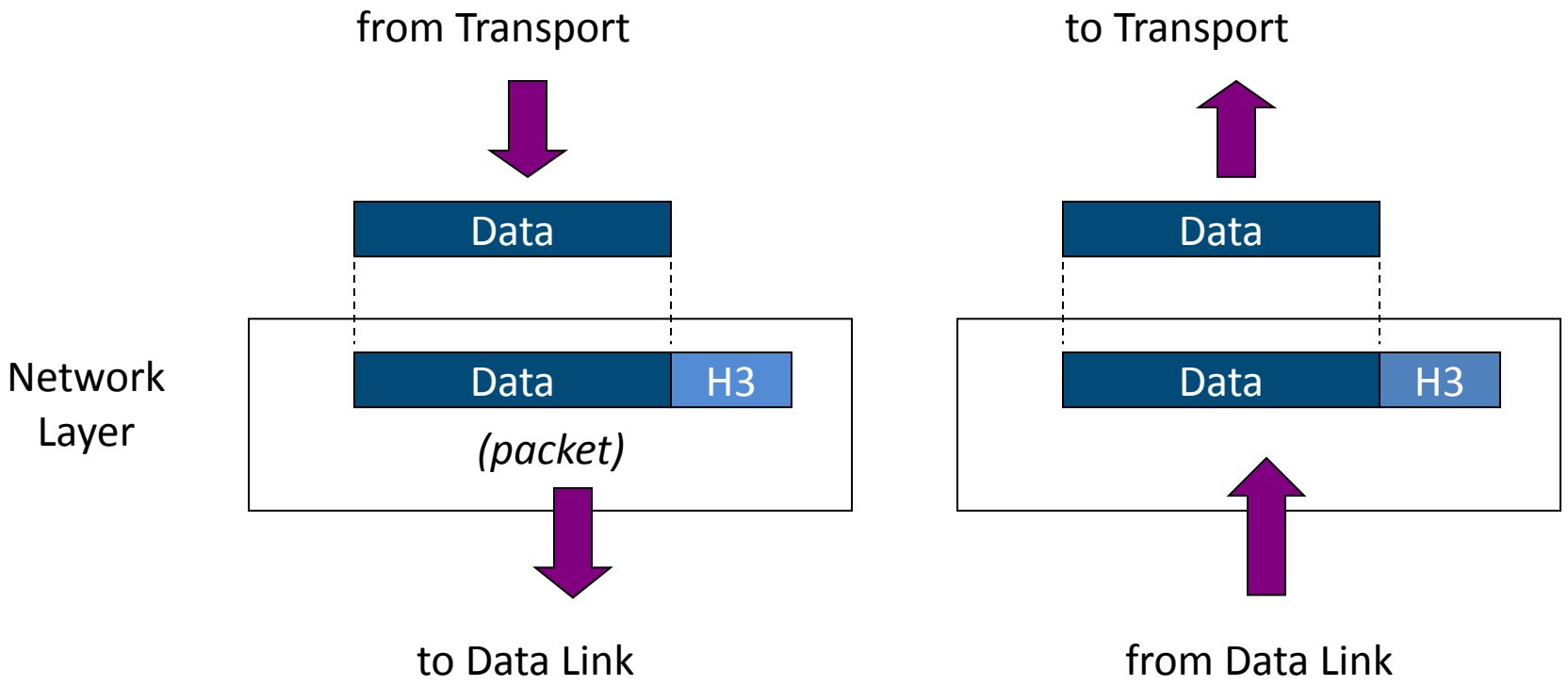


Network Layer

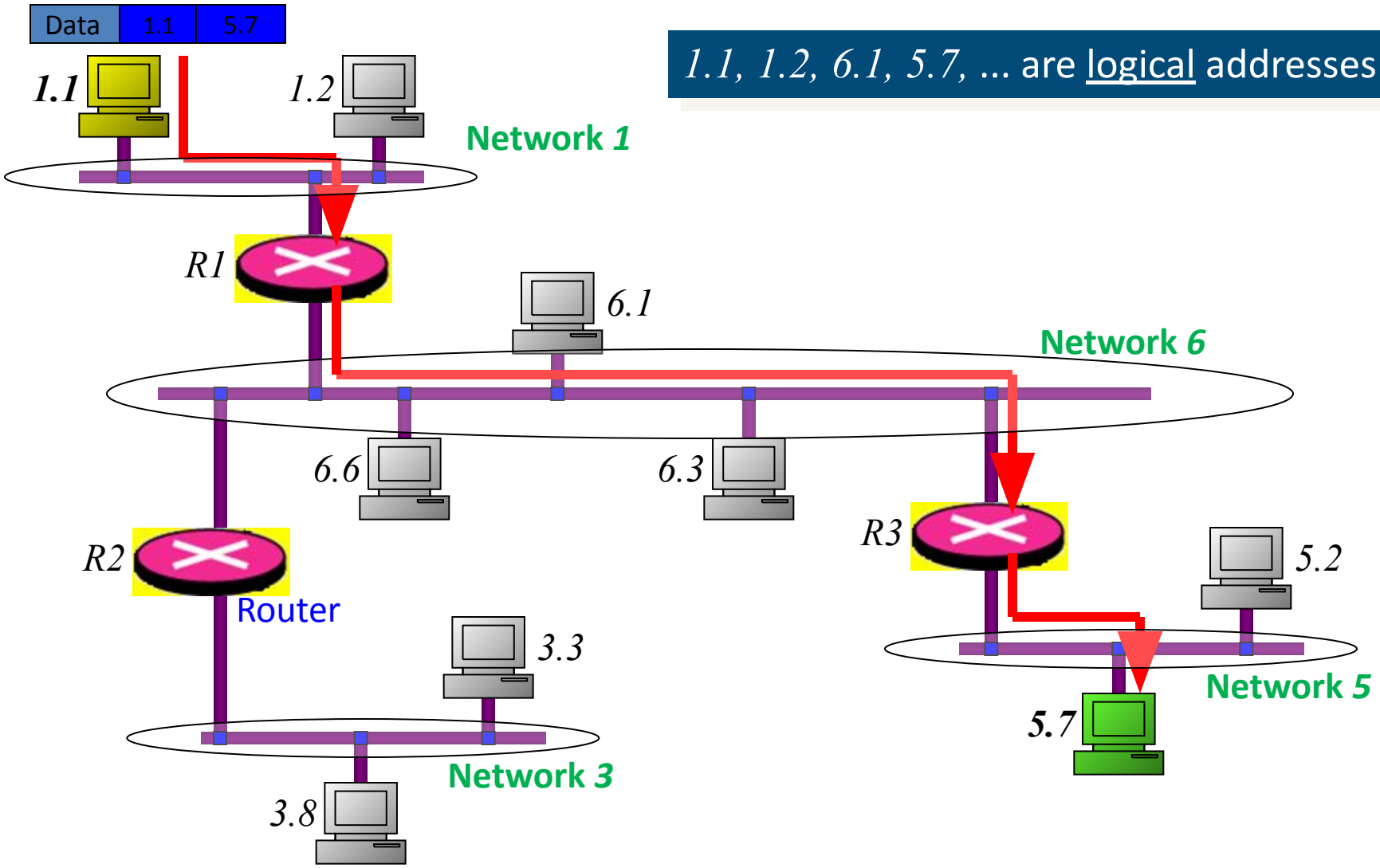
Responsible for the delivery of packets from the original source to the destination

- Duties/services
  - Logical addressing
  - Routing

Network Layer



Network Layer

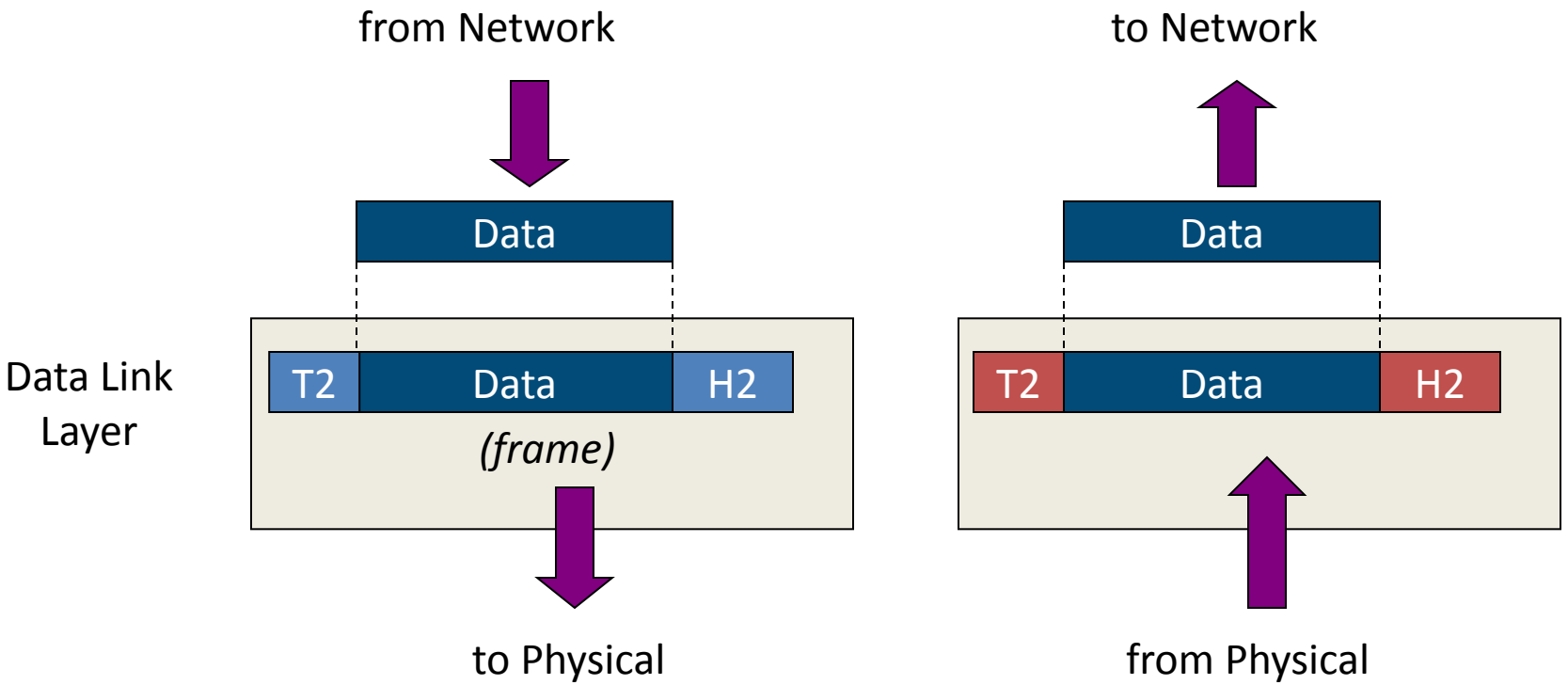


Data Link Layer

Responsible for transmitting frames from one node to the next

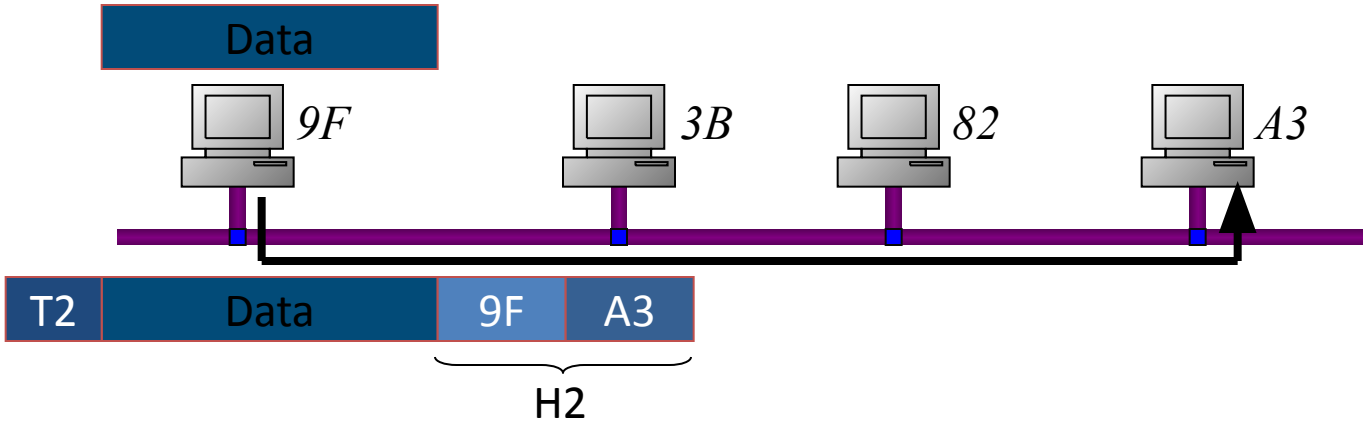
- Duties/services
  - Framing
  - Physical addressing
  - Flow control (hop-to-hop)
  - Error control (hop-to-hop)
  - Access control

Data Link Layer

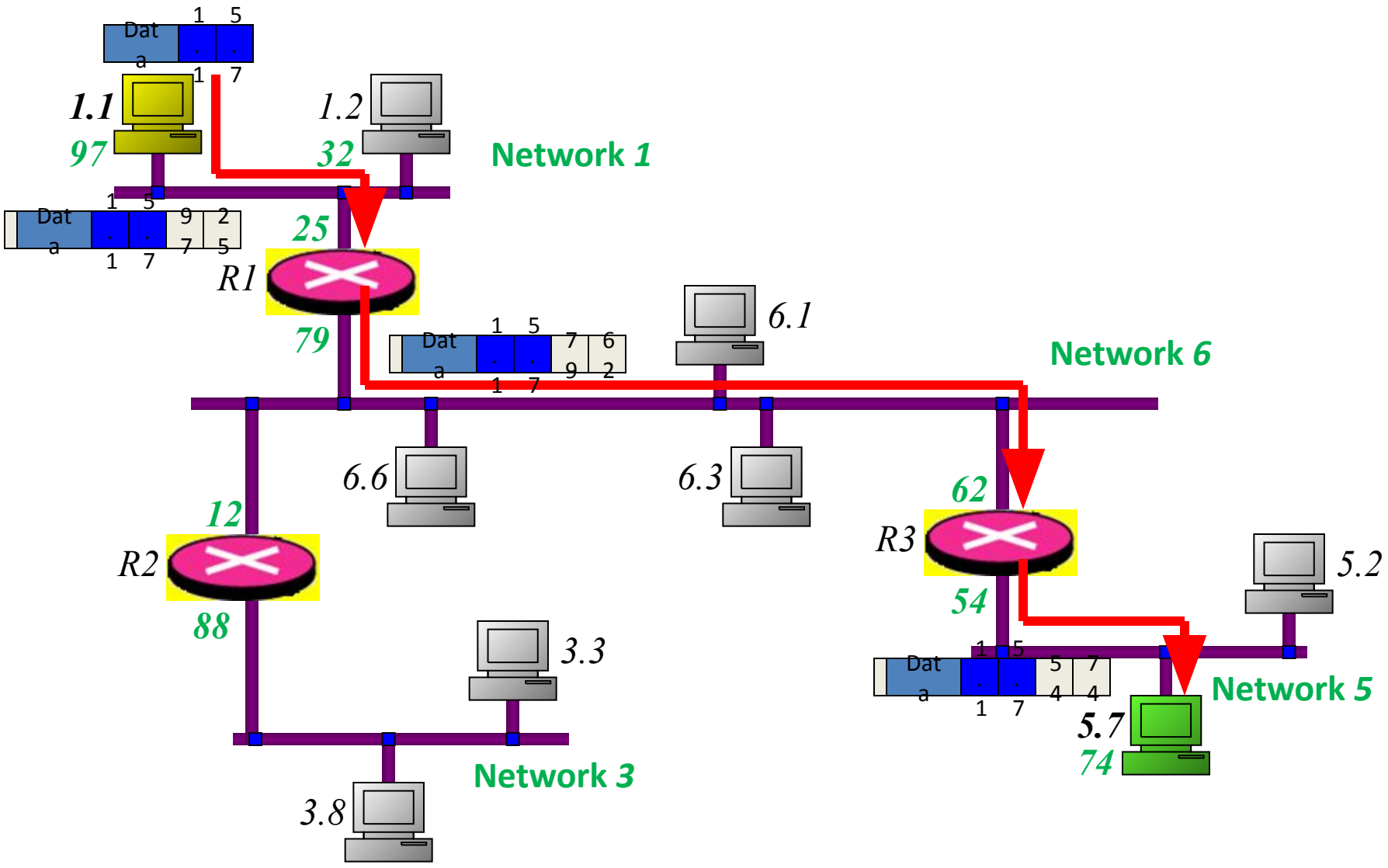


Data Link Layer

A3, 3B, 82, 9F, ... are physical addresses



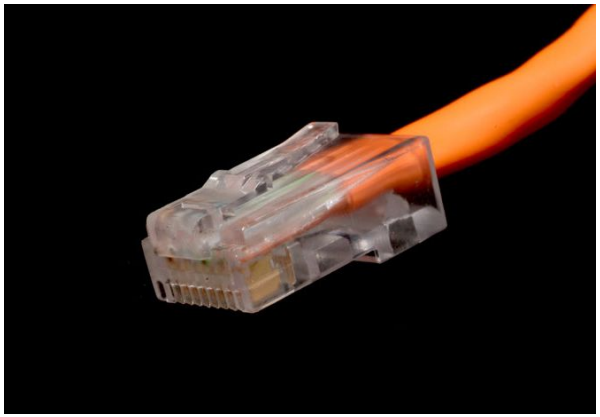
Data Link Layer



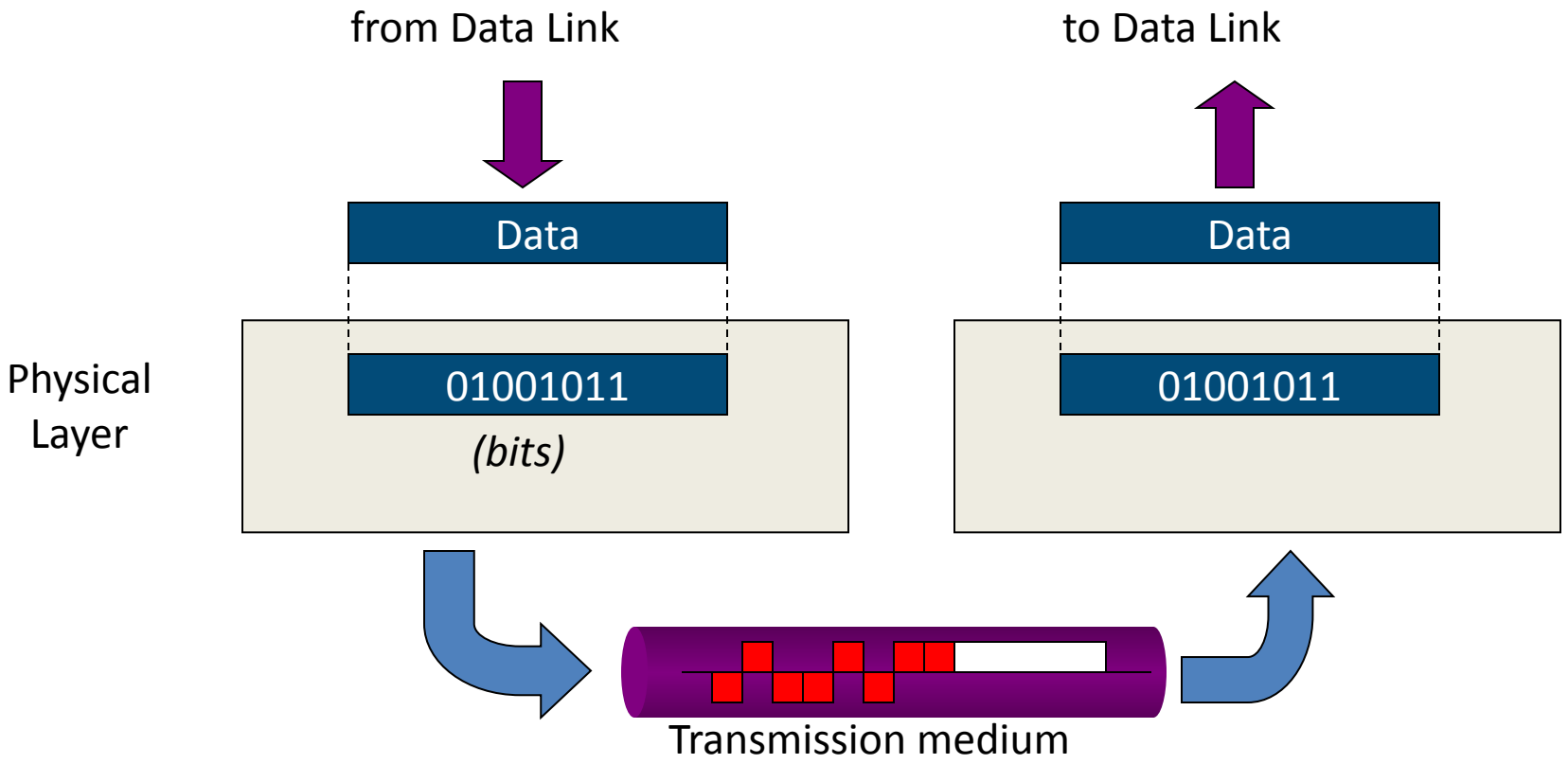
Physical Layer

Responsible for transmitting individual bits from one node to the next

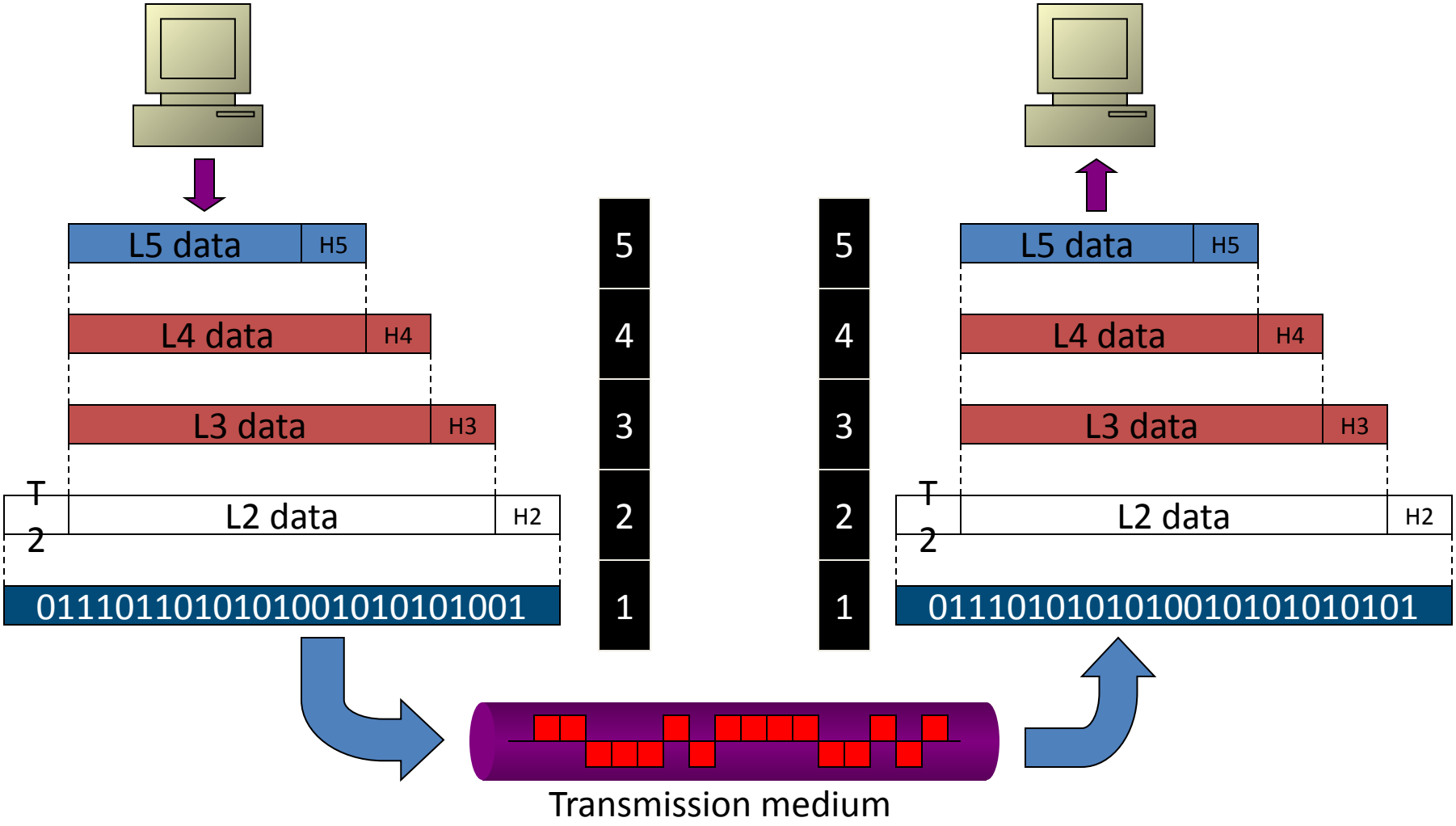
- Duties/services
  - Physical characteristics of interfaces and media
  - Representation of bits
  - Data rate (transmission rate)
  - Synchronization of bits



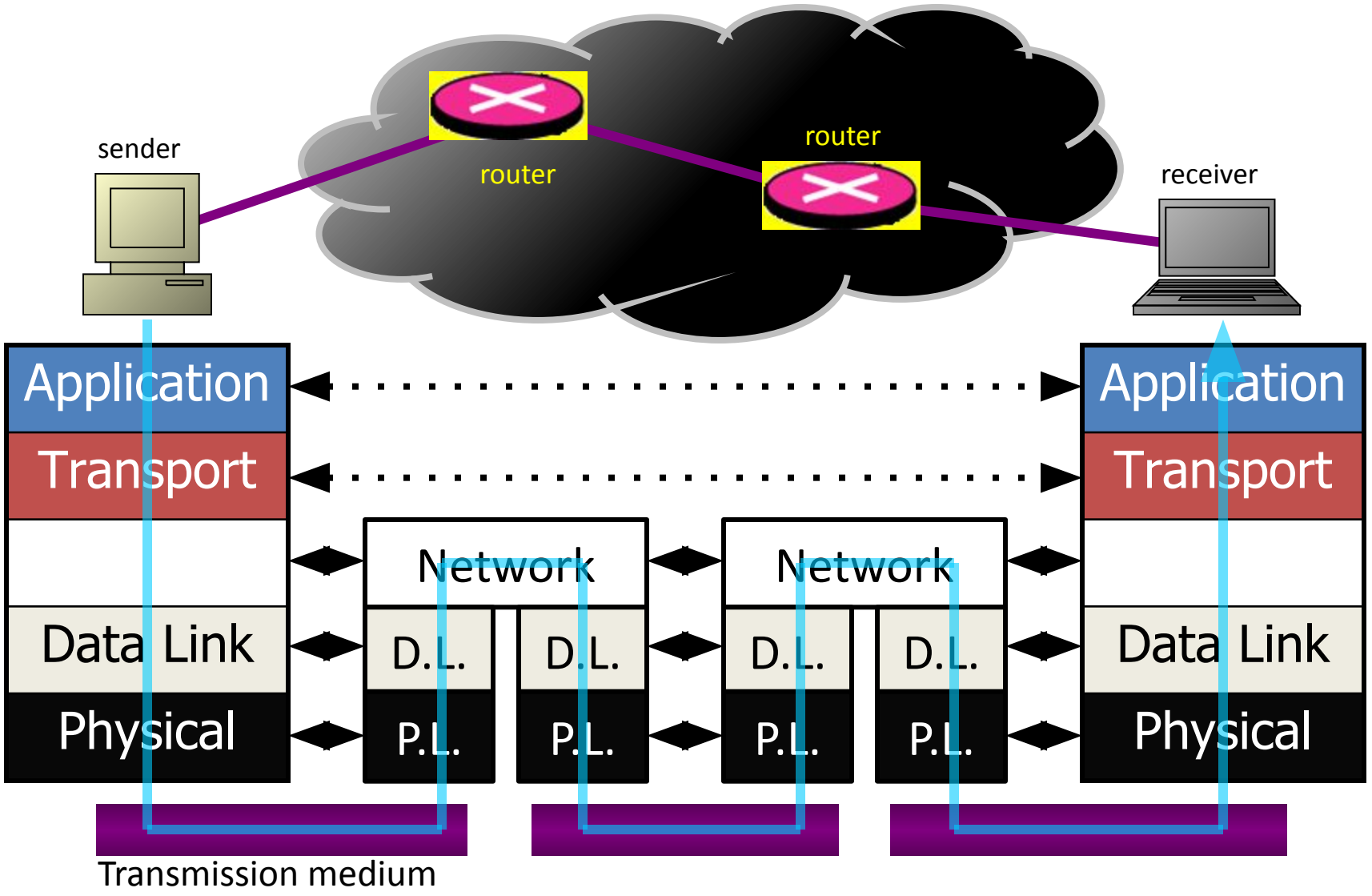
Physical Layer



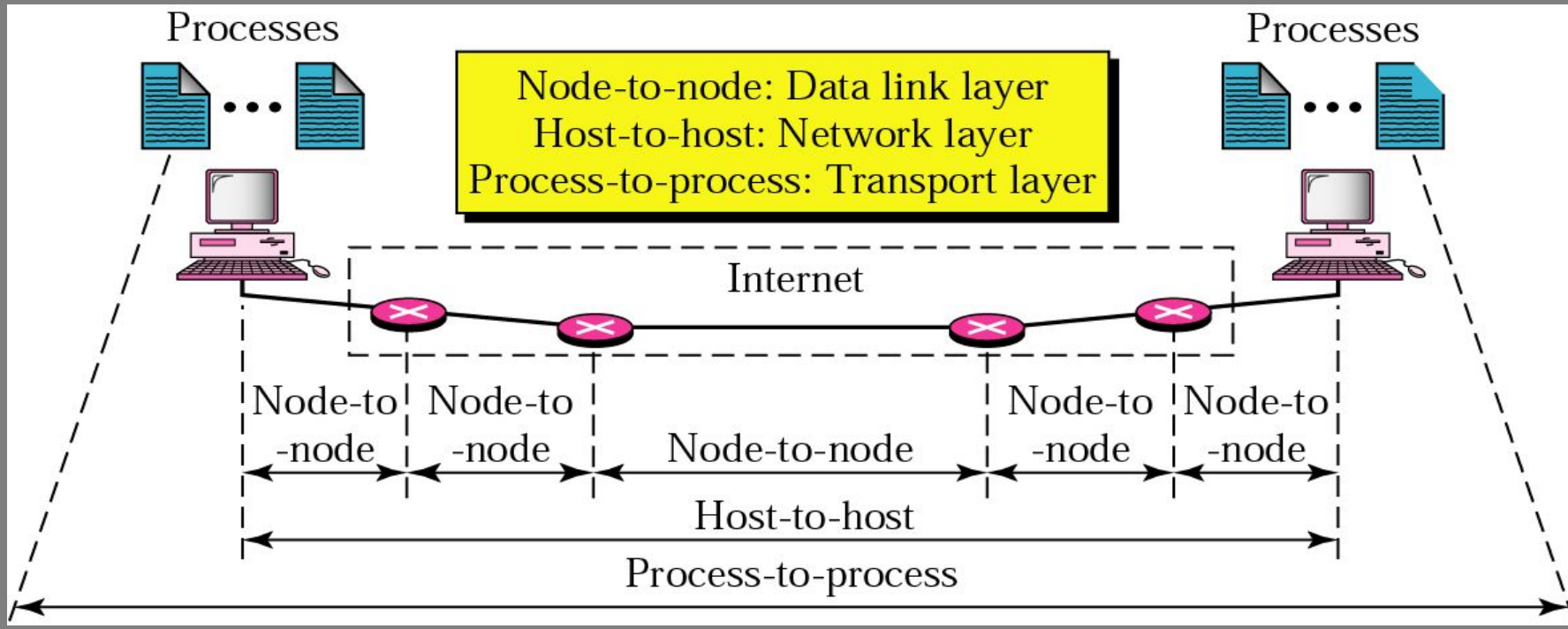
The Big Picture



Internet Model



Internet Model



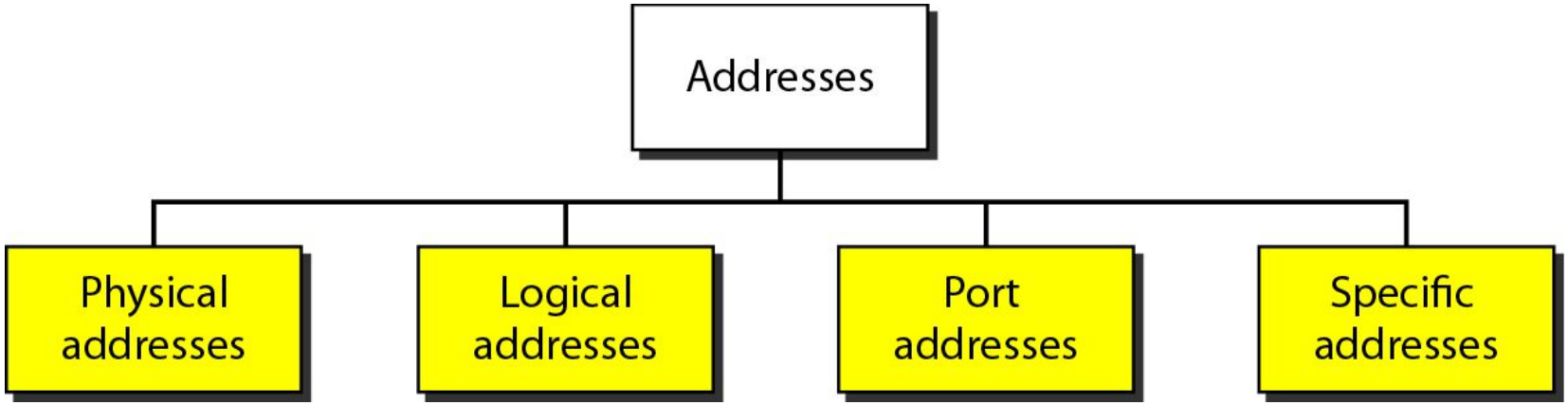
Protocol Suites

- A set of protocols must be constructed
  - to ensure that the resulting communication system is complete and efficient
- Each protocol should handle a part of communication not handled by other protocols
- How can we guarantee that protocols work well together?
  - Instead of creating each protocol in isolation, protocols are designed in complete, cooperative sets called suites or families

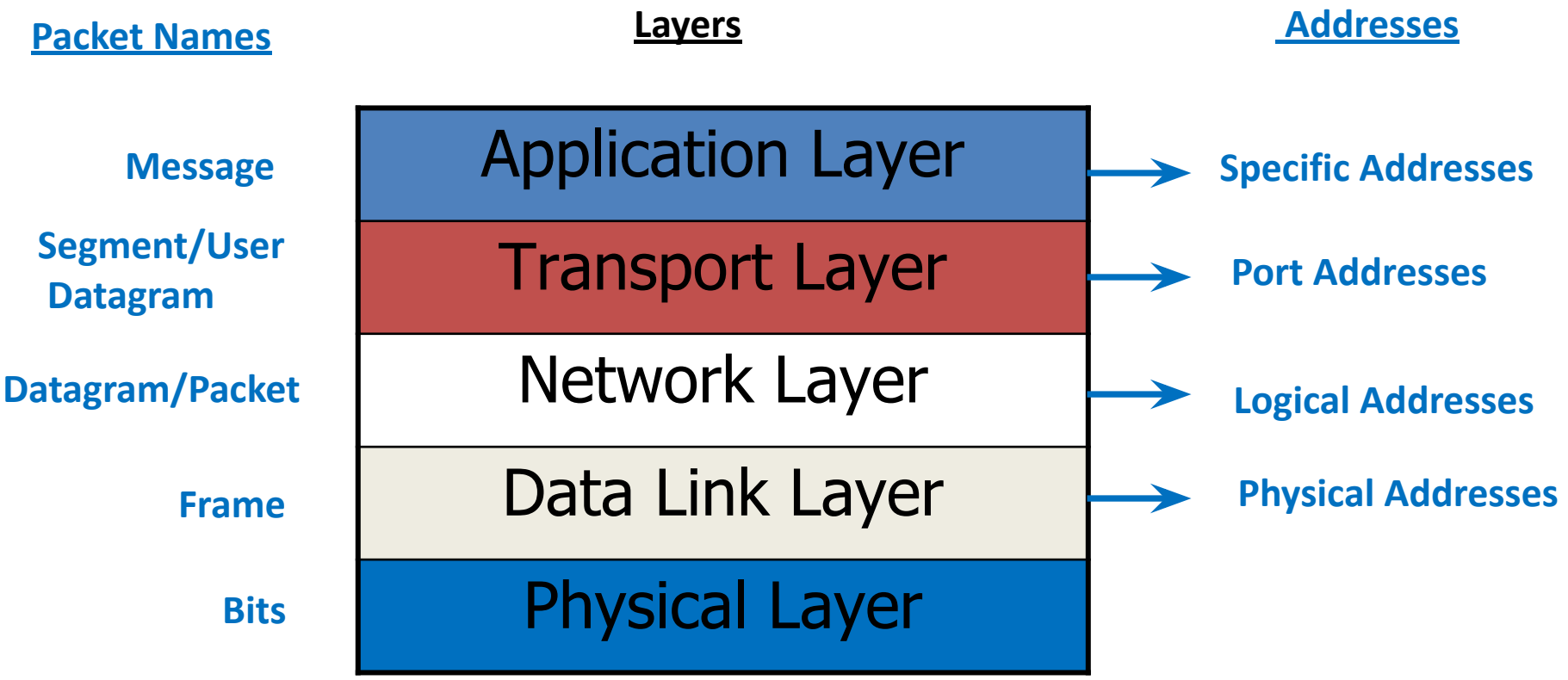
Internet Protocol Suite

Layer	Protocols
Application	HTTP, FTP, Telnet, SSH, SMTP, DNS, SNMP, IGMP, …
Transport	TCP, UDP, SCTP, ...
Network	IP (IPv4), IPv6, ICMP, IGMP, ARP, RARP, ...
Data Link	Ethernet, Wi-Fi, PPP, ...
Physical	RS-232, DSL, 10Base-T, ...

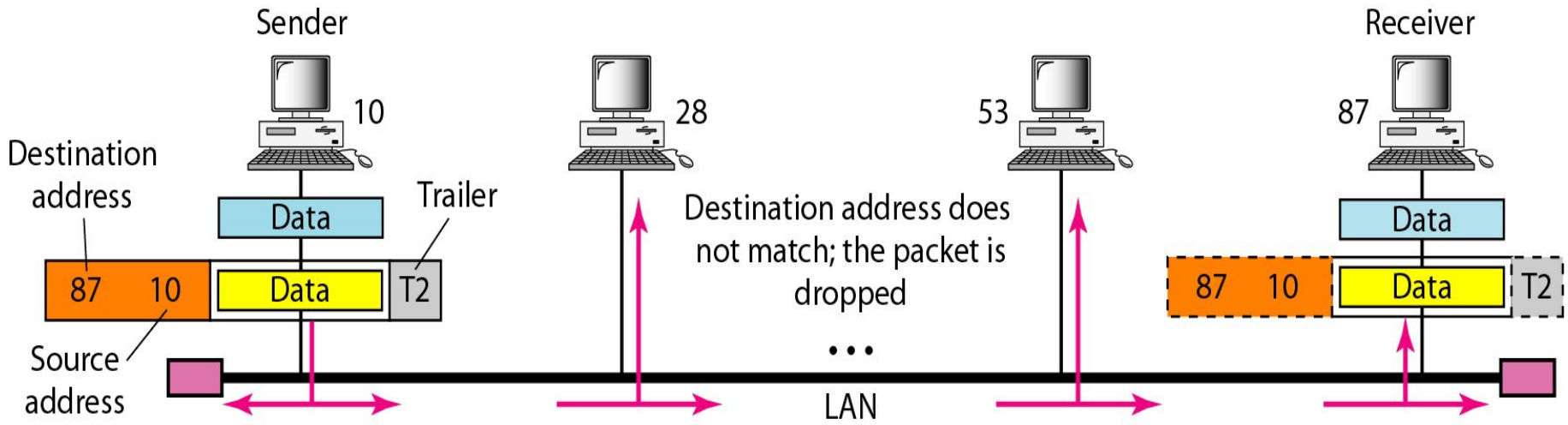
Addresses in TCP/IP



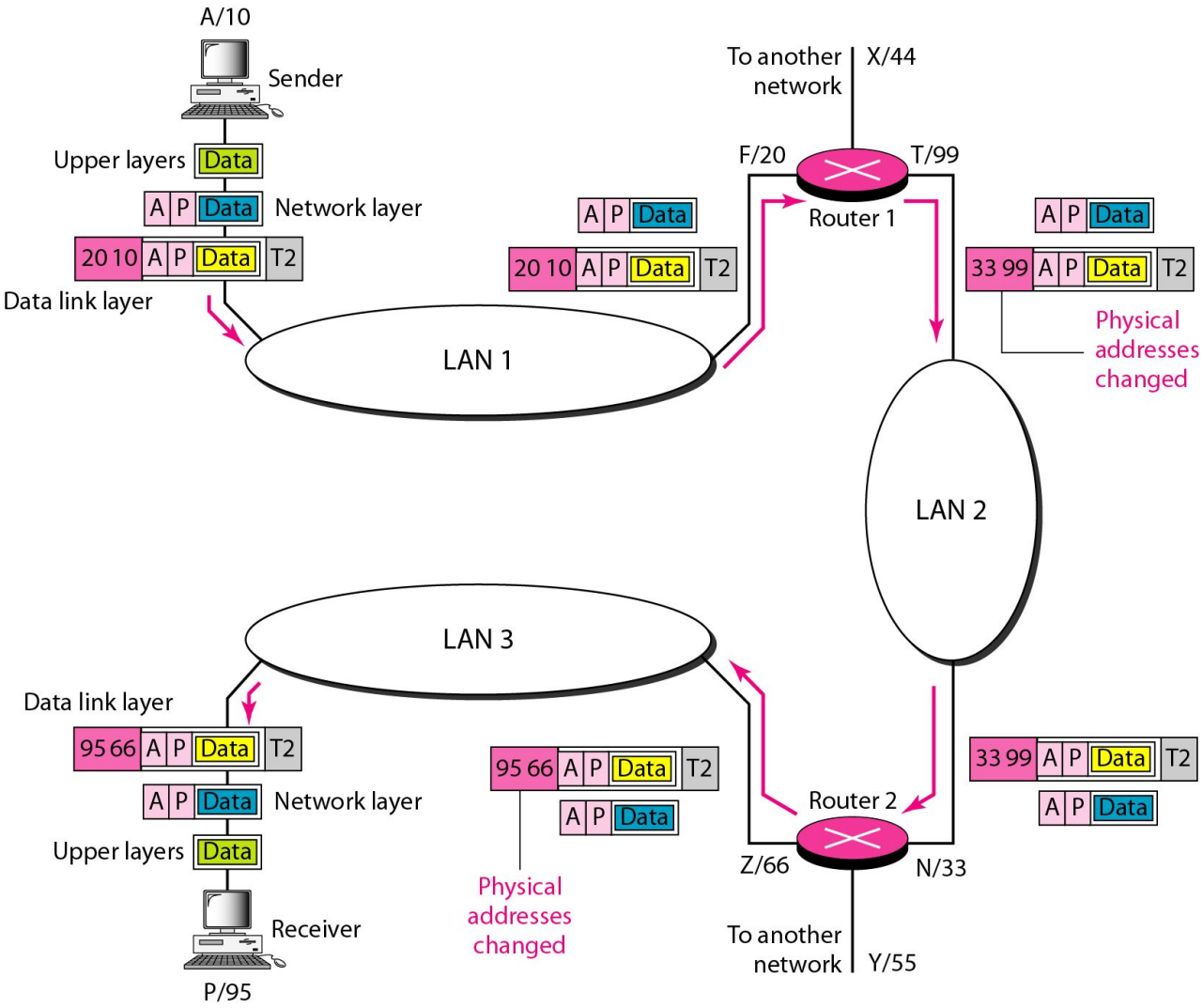
Addressing in TCP/IP



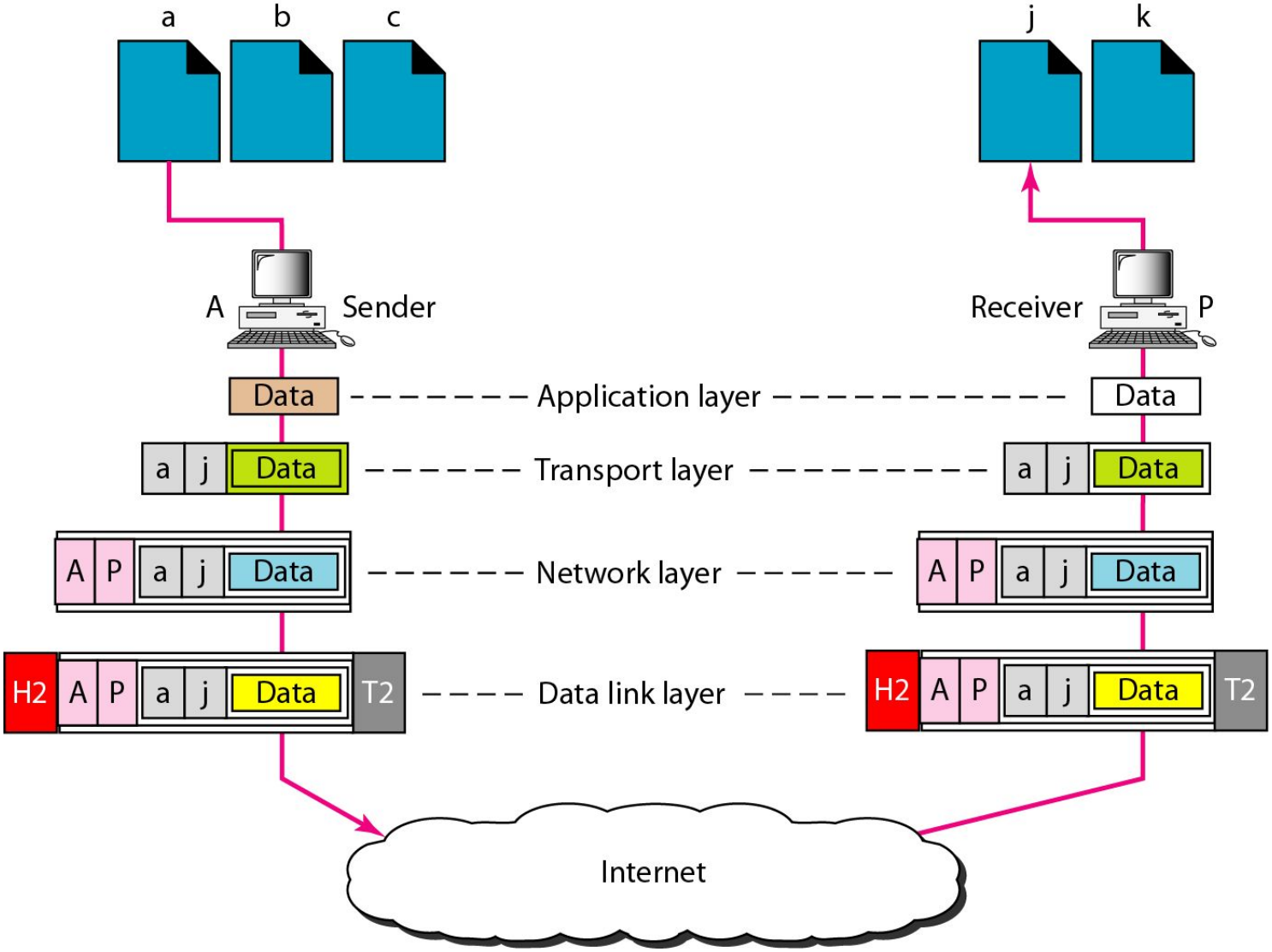
Physical Addresses



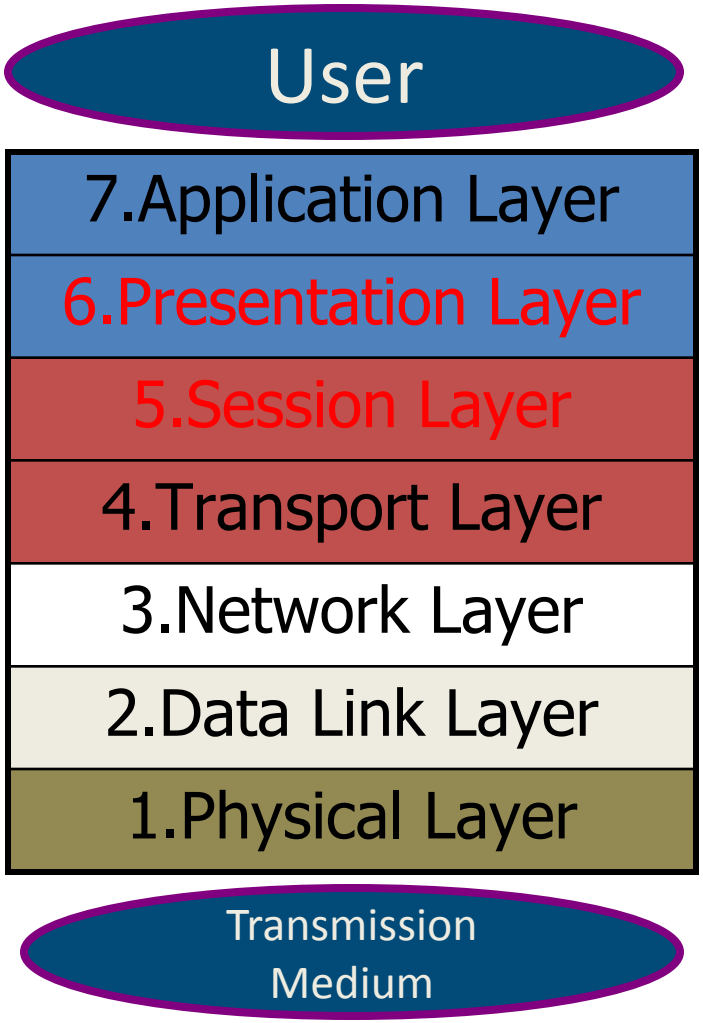
Logical/IP Addresses



Port Addresses



OSI Model



- OSI – ***O****pen* ***S****ystems* ***I****nterconnection*
- Developed by the ***I****nternational* ***S****tandards* ***O****rganizations* (ISO)

- Two additional layers
  - Presentation layer
  - Session layer

Session Layer

Responsible for establishing, managing and terminating connections between applications

- Duties/services
  - Interaction management
    - ⇨ Simplex, half-duplex, full-duplex
  - Session recovery

Presentation Layer

Responsible for handling differences in data representation to applications

- Duties/services
  - Data translation
  - Encryption
  - Decryption
  - Compression

Lack of OSI Model's Success

- Costly
- Some of layers were never fully defined
- Performance