



Packet Switching, Layer Models and Protocol Suites

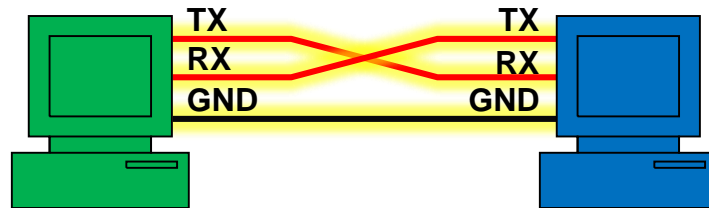


Outline

- Circuit vs. packet switching
- Layered tasks
- Internet protocol suites
- ISO's OSI model

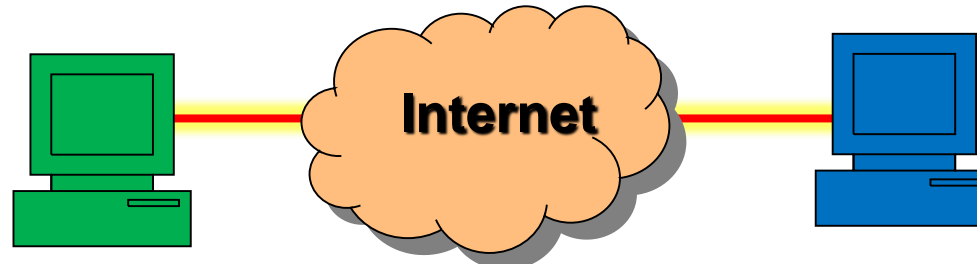
End-to-End Communication

- Direct communication
 - Most basic form of communication



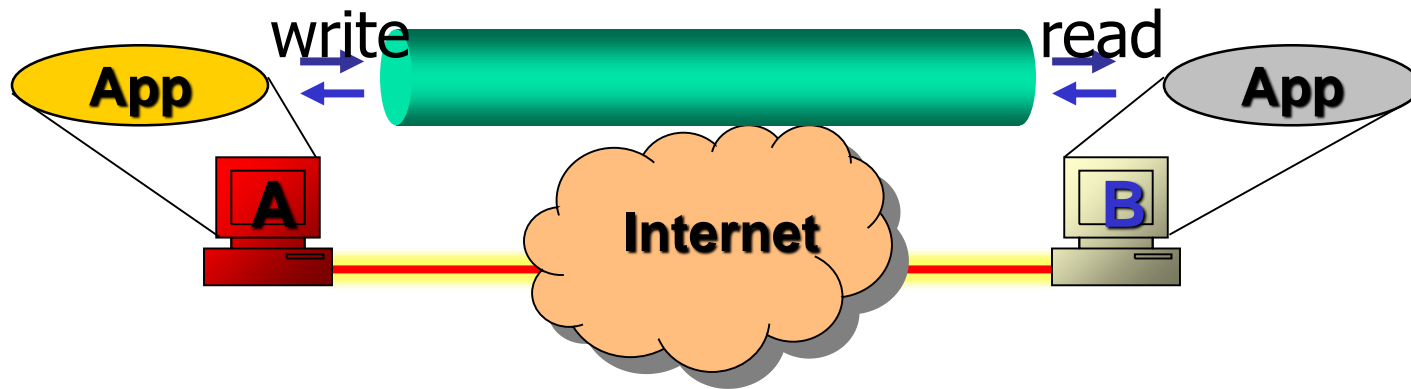
Serial Port

- Internet communication
 - Communication is performed over the Internet



Internet Comm. - *App's Viewpoint*

- Two network applications should interact as if they were directly connected



- But what's going on underneath?
 - What is inside the "cloud"?

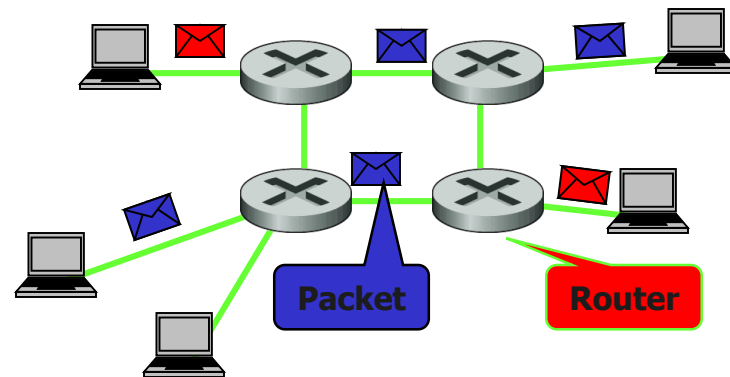
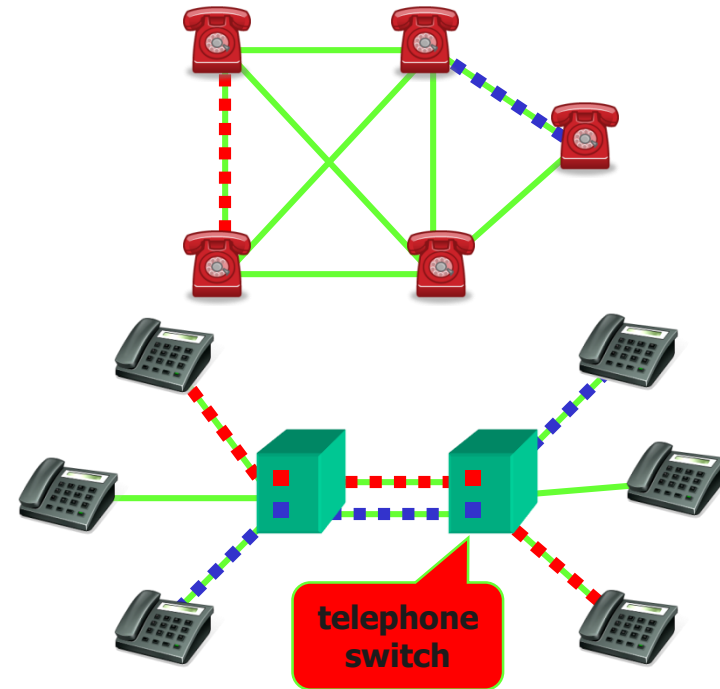


Circuit vs. Packet Switching

- Early communication networks
 - Dedicated circuit
- Electronic switches are used
 - Circuit switching
- In 1960s, packet switching concept revolutionized data communications
 - Provides the basis for the modern Internet
 - Allows multiple users to share a network
 - Divides data into small blocks, called packets
 - Includes an identification of the intended recipient in each packet

Circuit vs. Packet Switching

- Dedicated circuits
- Circuit switching
 - Telephone switches establish circuits for communication
- Packet switching
 - Data are put into packets
 - Each stamped with **source** and **destination** addresses
 - **Routers** know where to forward packets





Layered Tasks

- Computer networks are complex systems
 - Tasks involve varieties of hardware and software components, and protocols
- Networking task is divided into several subtasks, or layers

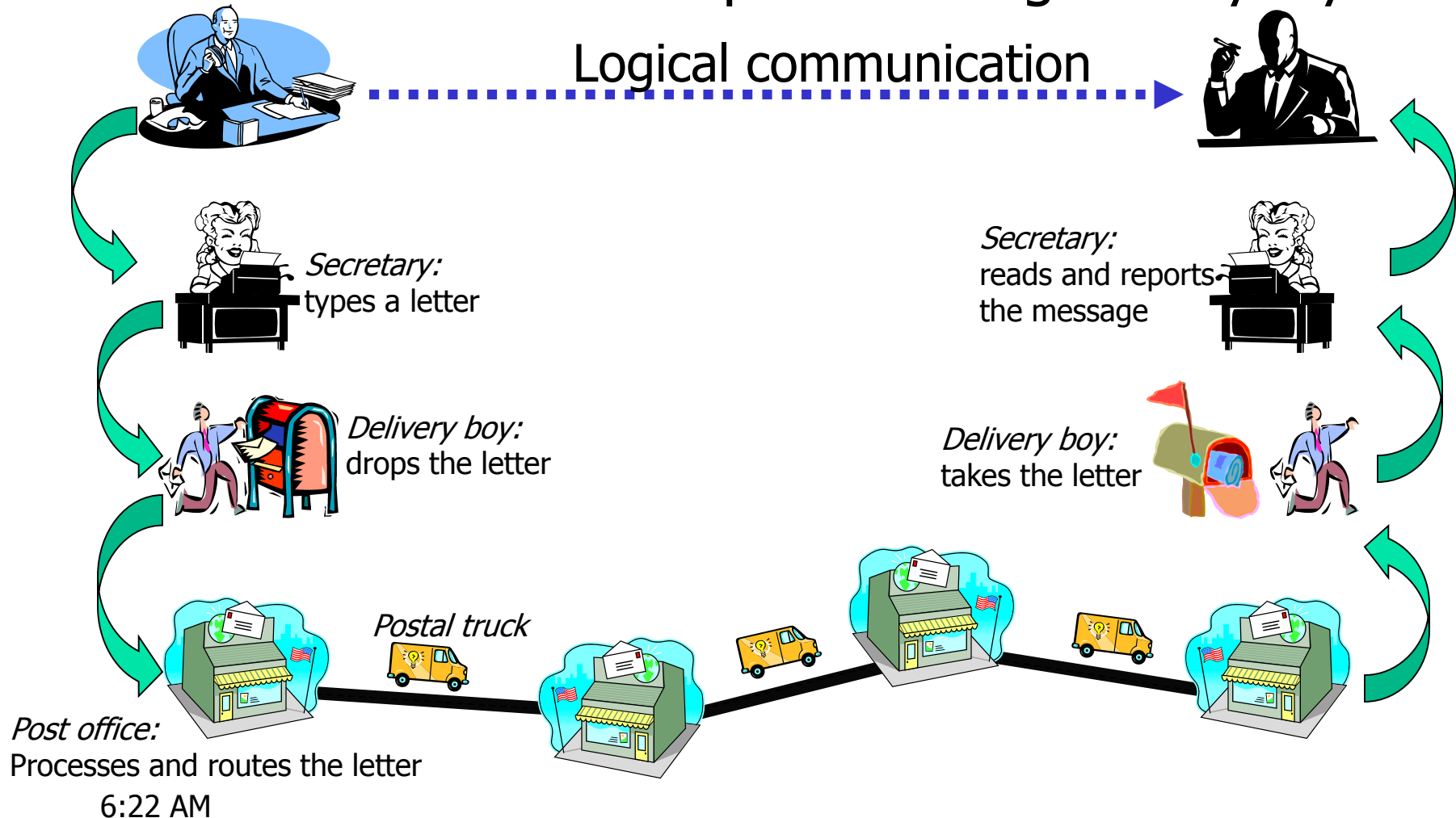
Real World Example

- Communication between managers of two companies



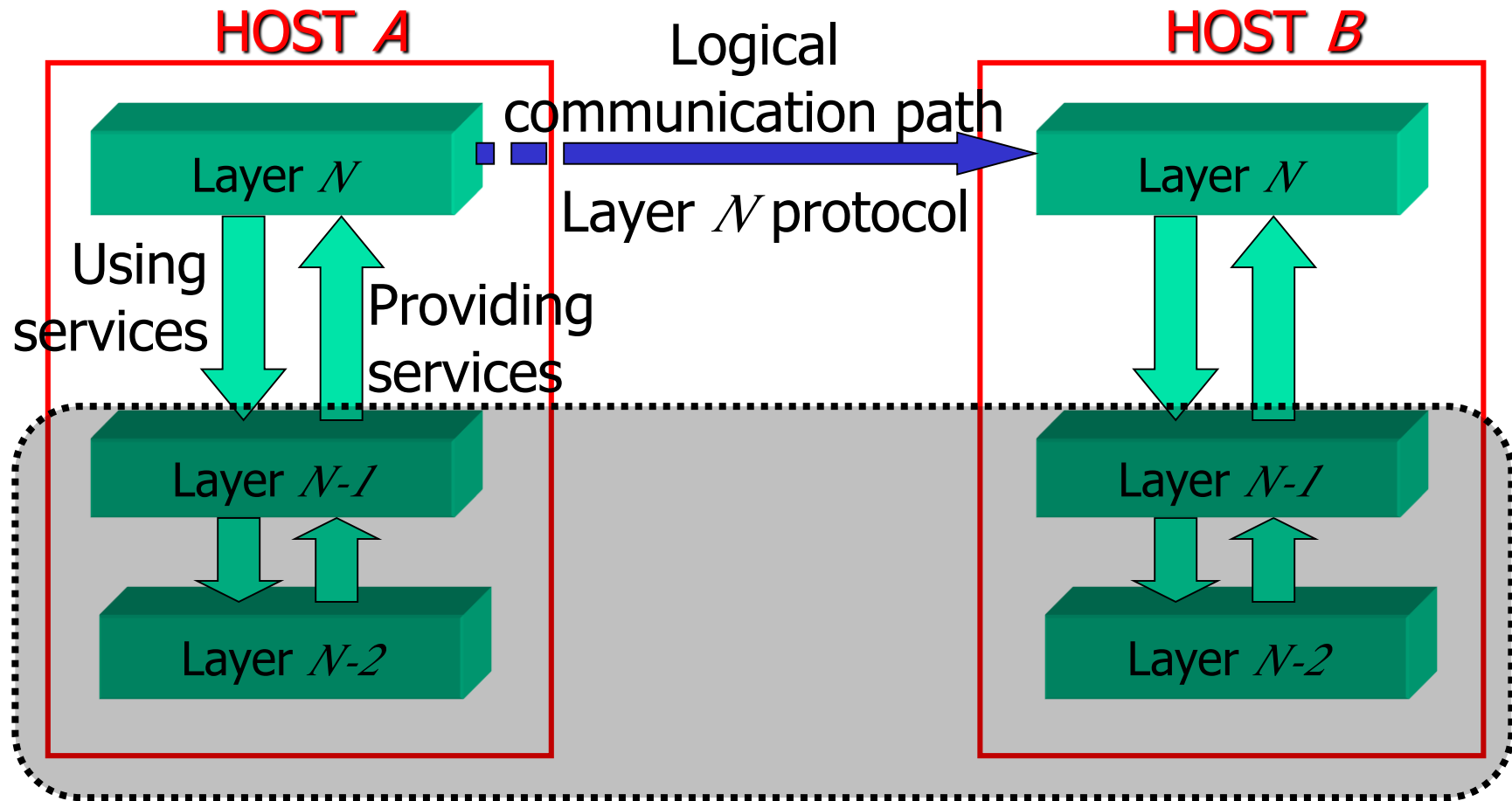
What Actually Happens

- Communication takes place through many layers



Layer Model

- Layer N uses services provided by Layer $N-1$



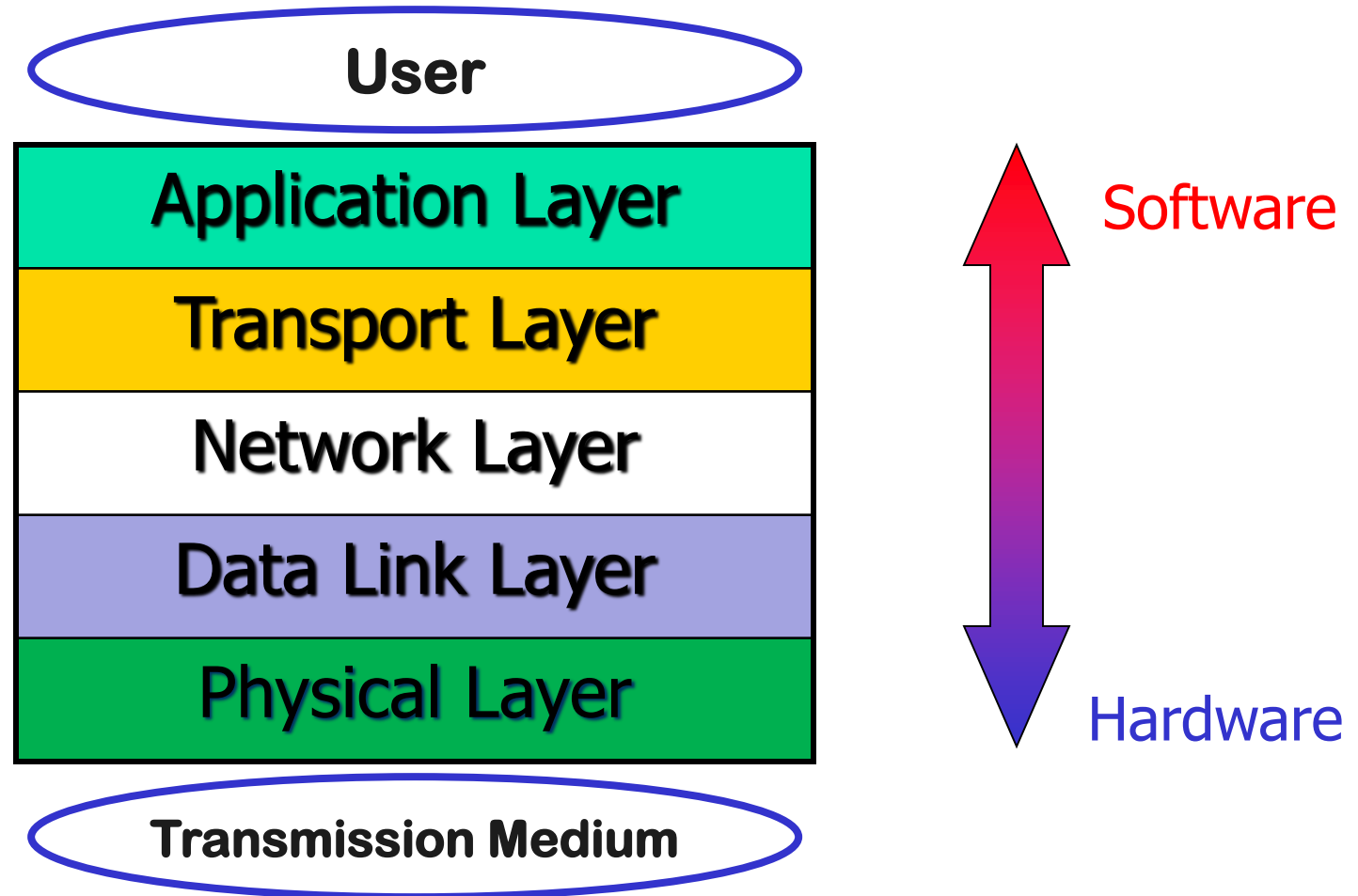


Why Layers?

- Guidelines for protocol developments
 - Reference model
- Modularity
 - Eases maintenance and updating of systems
 - A change in one layer is transparent to the rest
- Is layering always the best thing to do?
 - Maybe not \Rightarrow cross-layer optimization

Internet Layer Model

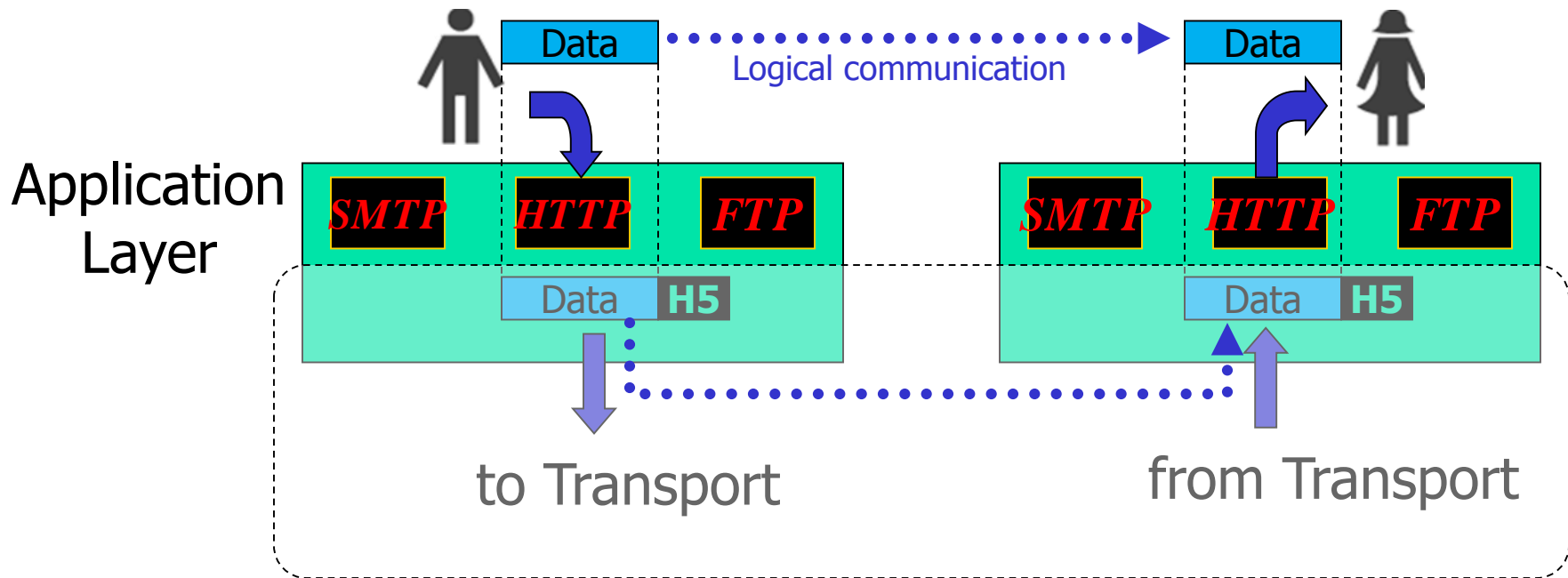
- The Internet Protocol Stack



Application Layer

Responsible for providing services to the user

- The only layer to interact with user



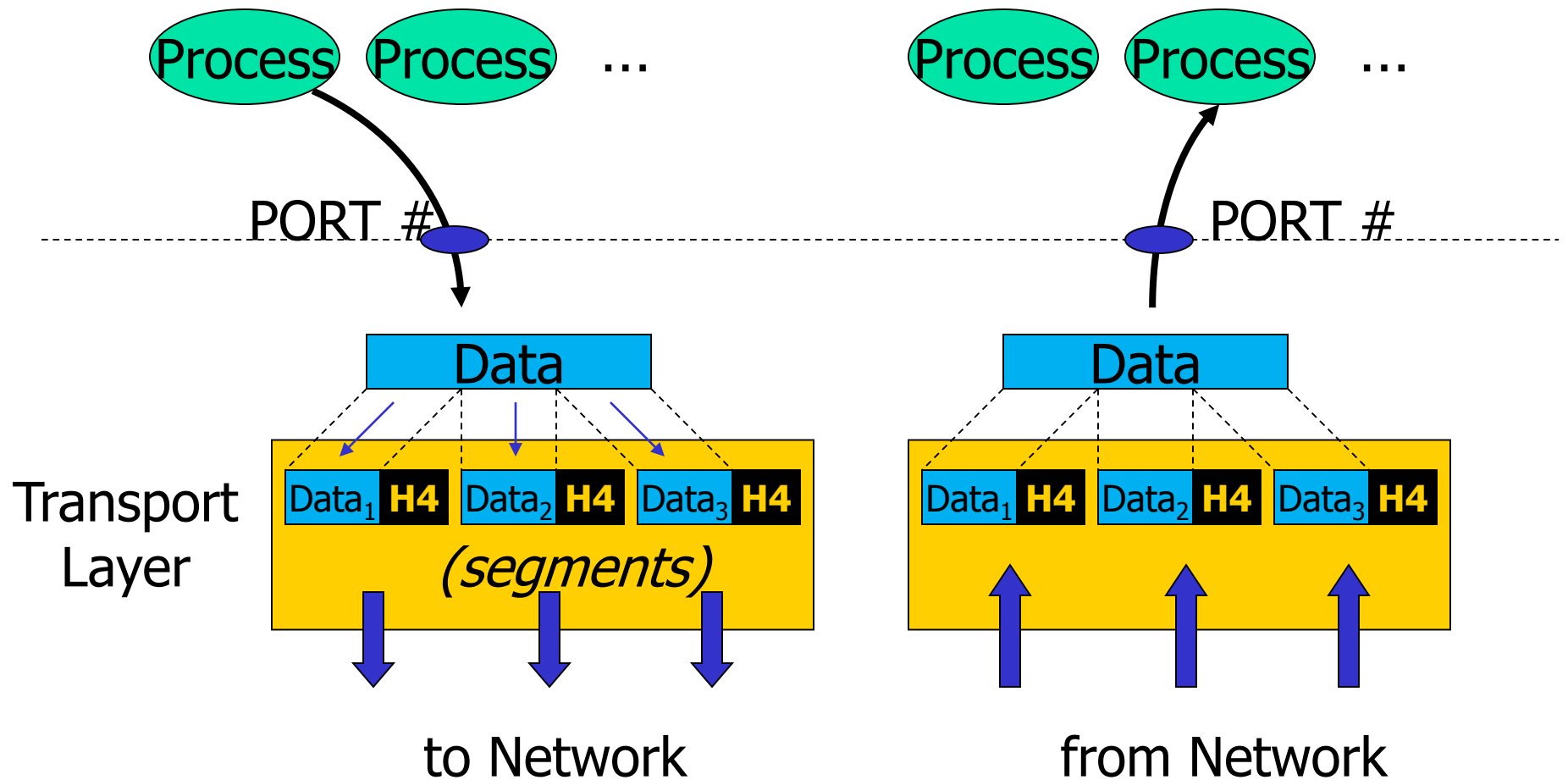


Transport Layer

*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



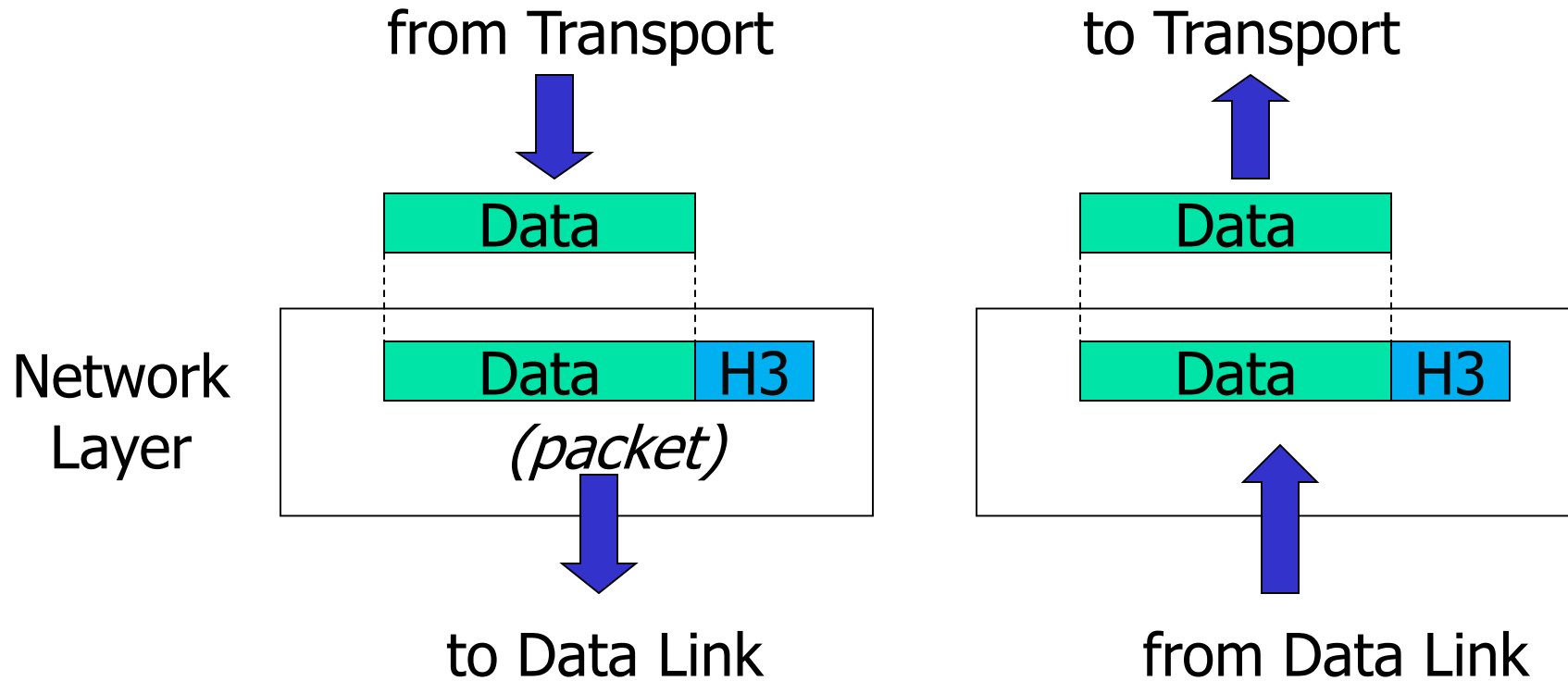


Network Layer

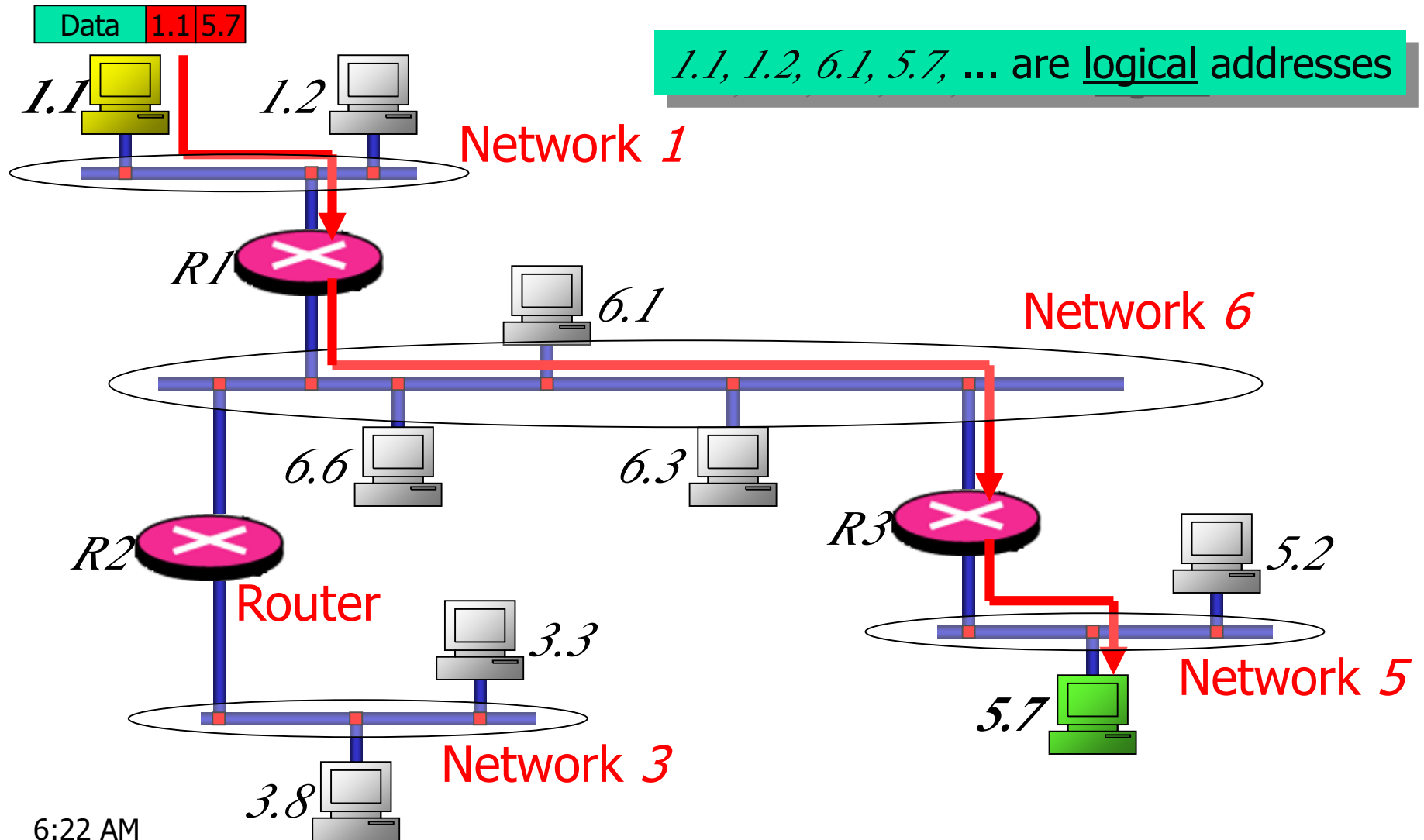
*Responsible for the delivery of packets
from the original source to the destination*

- Duties/services
 - Logical addressing
 - Routing

Network Layer



Network Layer



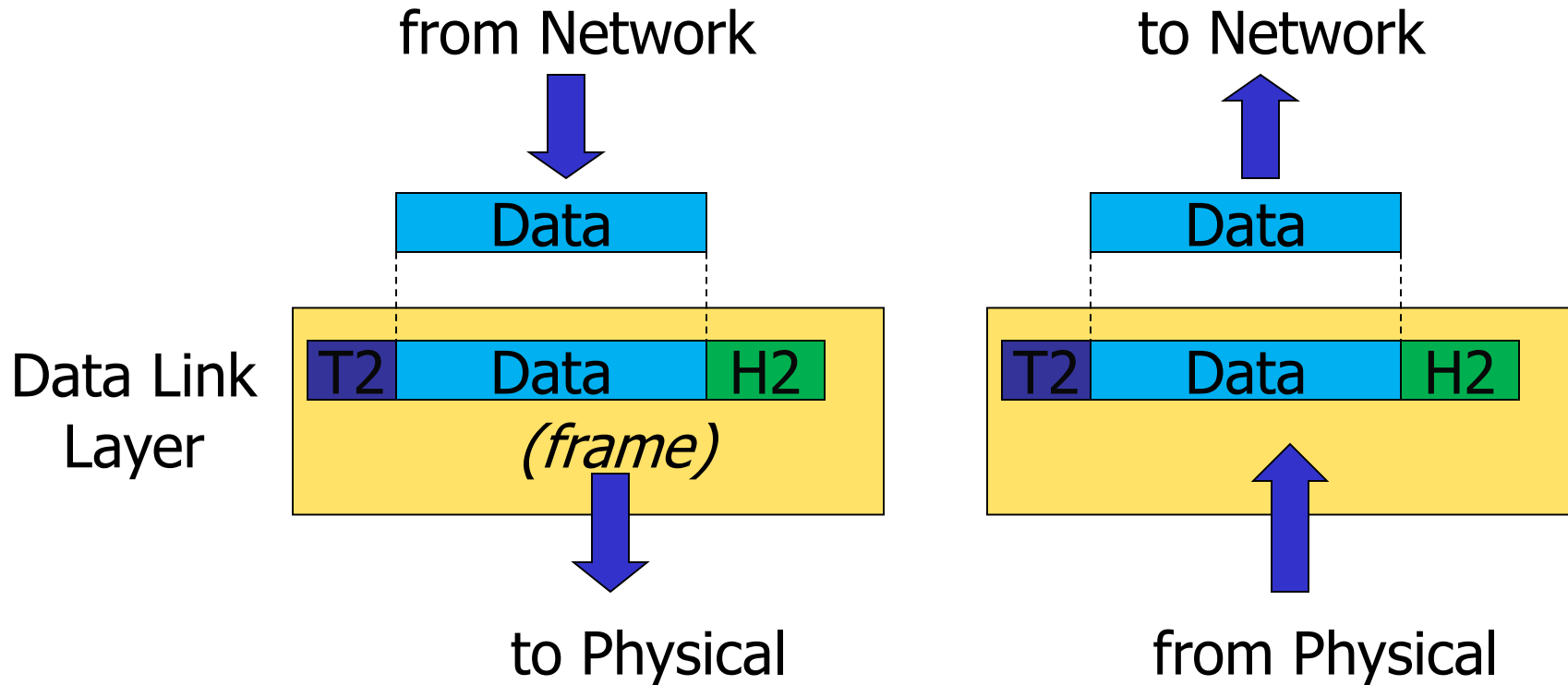


Data Link Layer

*Responsible for transmitting frames
from one node to the next*

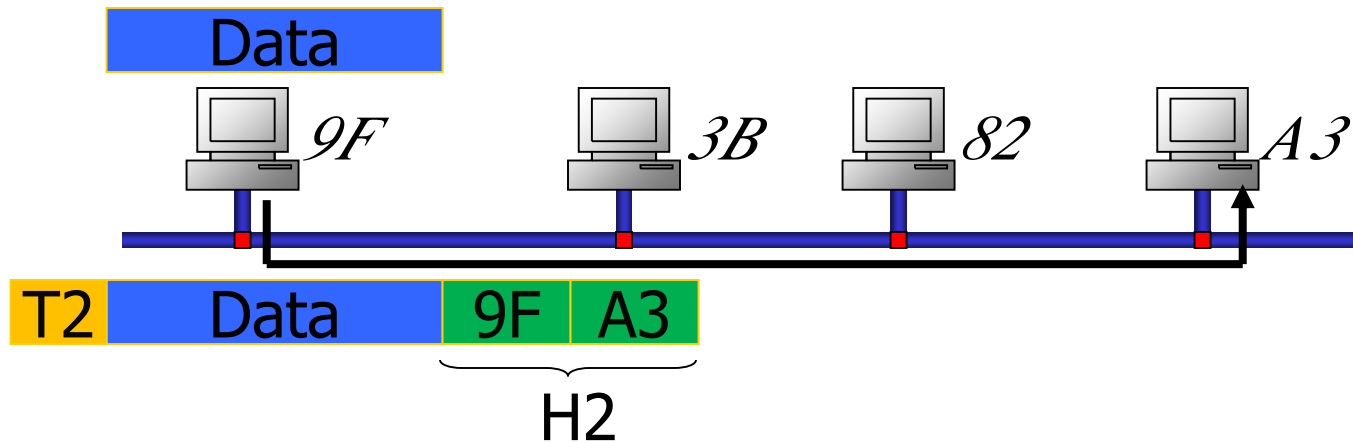
- Duties/services
 - Framing
 - Physical addressing
 - Flow control (hop-to-hop)
 - Error control (hop-to-hop)
 - Access control

Data Link Layer

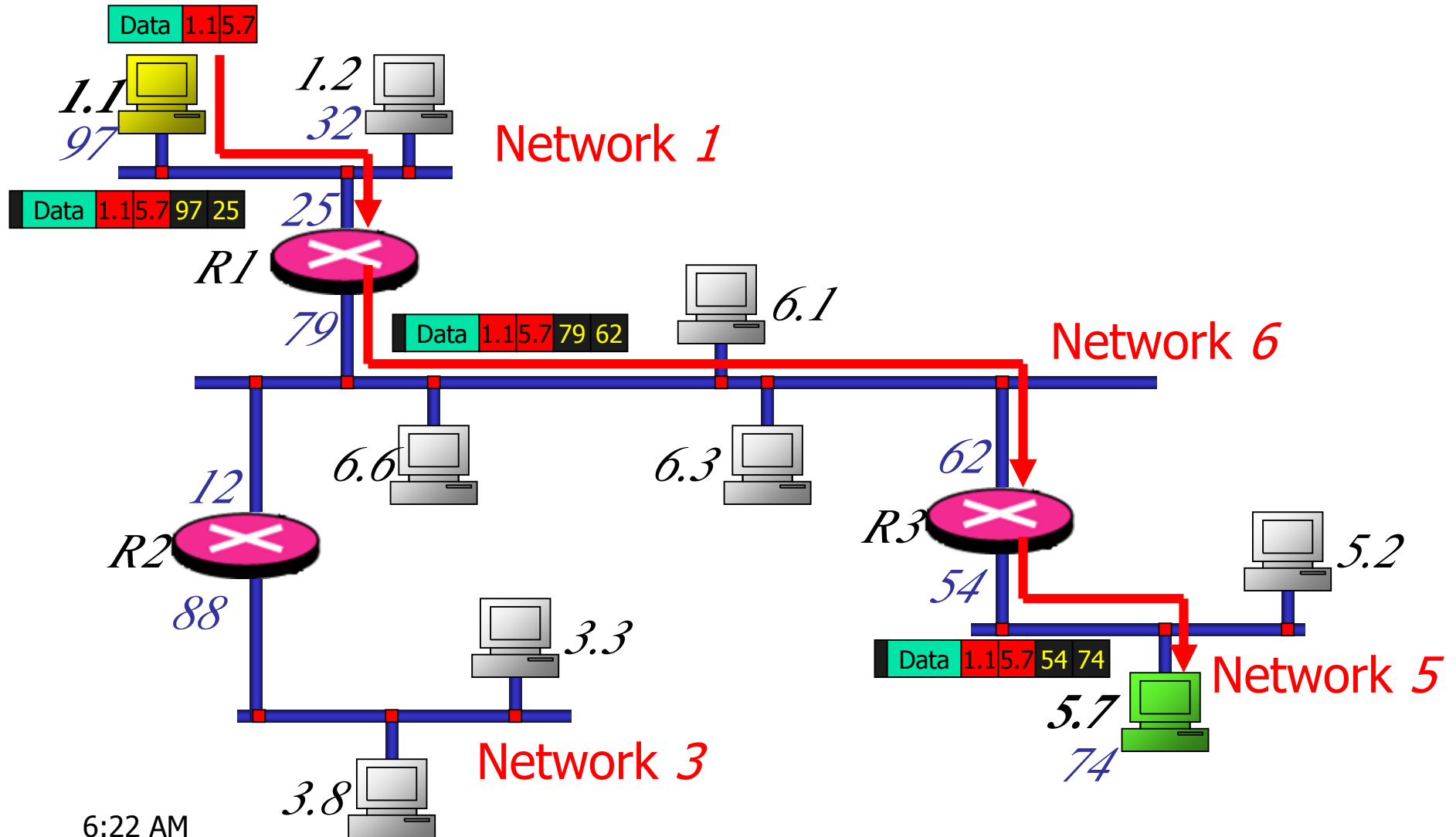


Data Link Layer

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



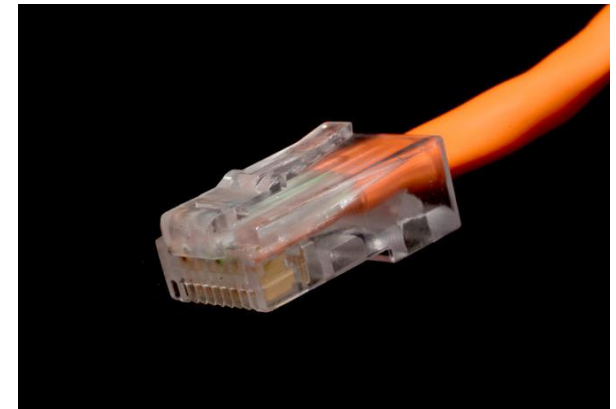
Data Link Layer



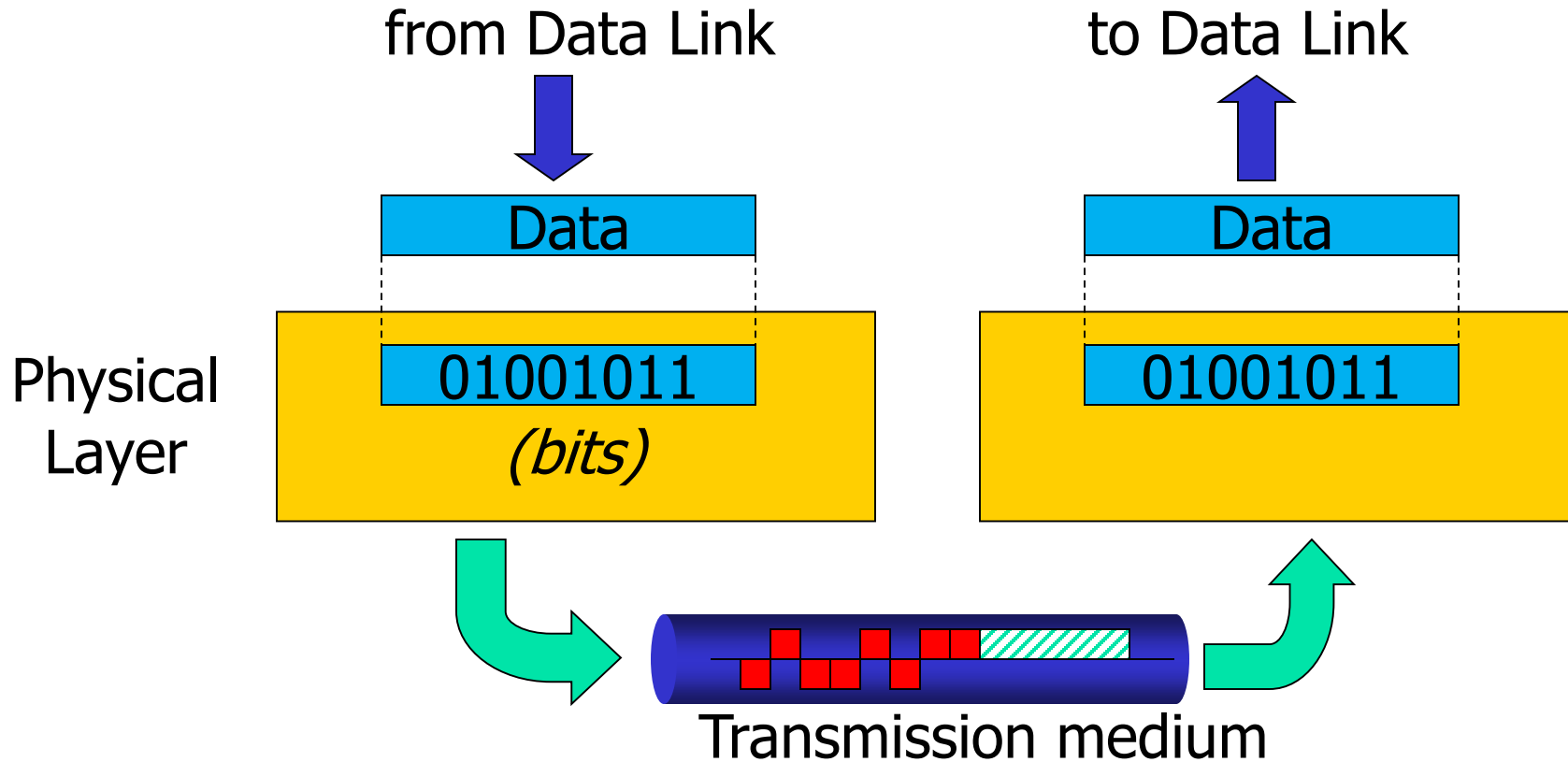
Physical Layer

*Responsible for transmitting individual bits
from one node to the next*

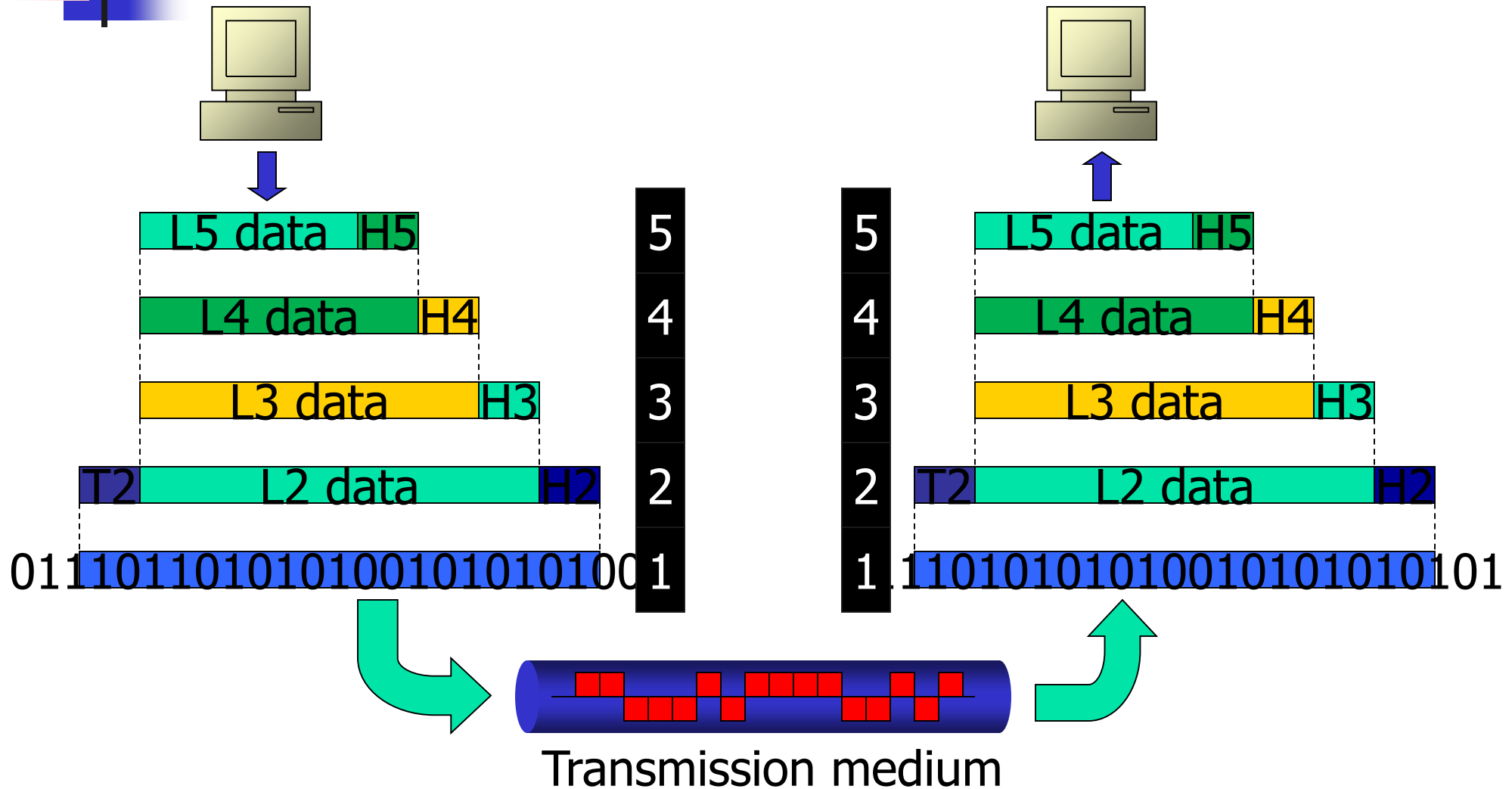
- Duties/services
 - Physical characteristics of interfaces and media
 - Representation of bits
 - Data rate (transmission rate)
 - Synchronization of bits



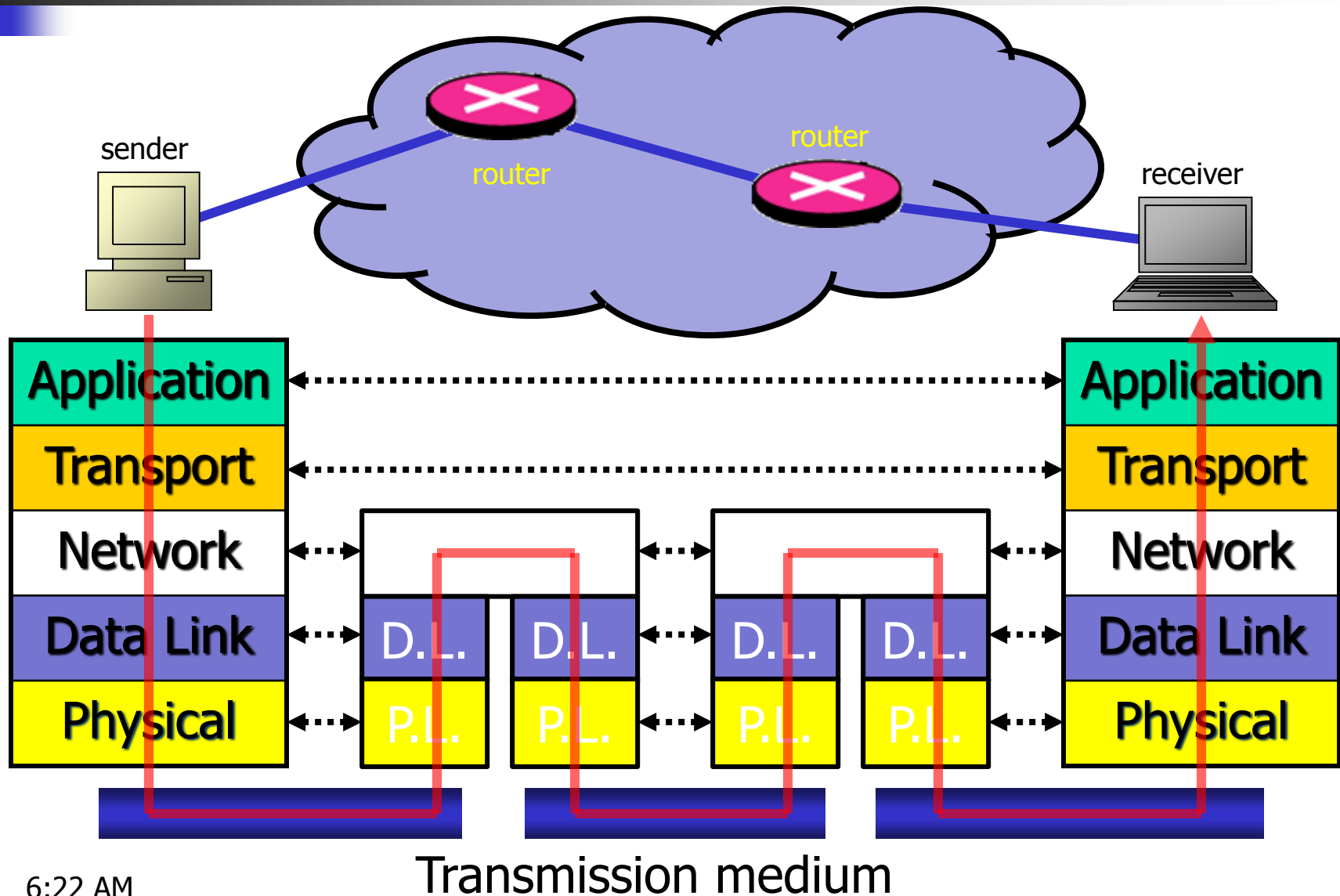
Physical Layer



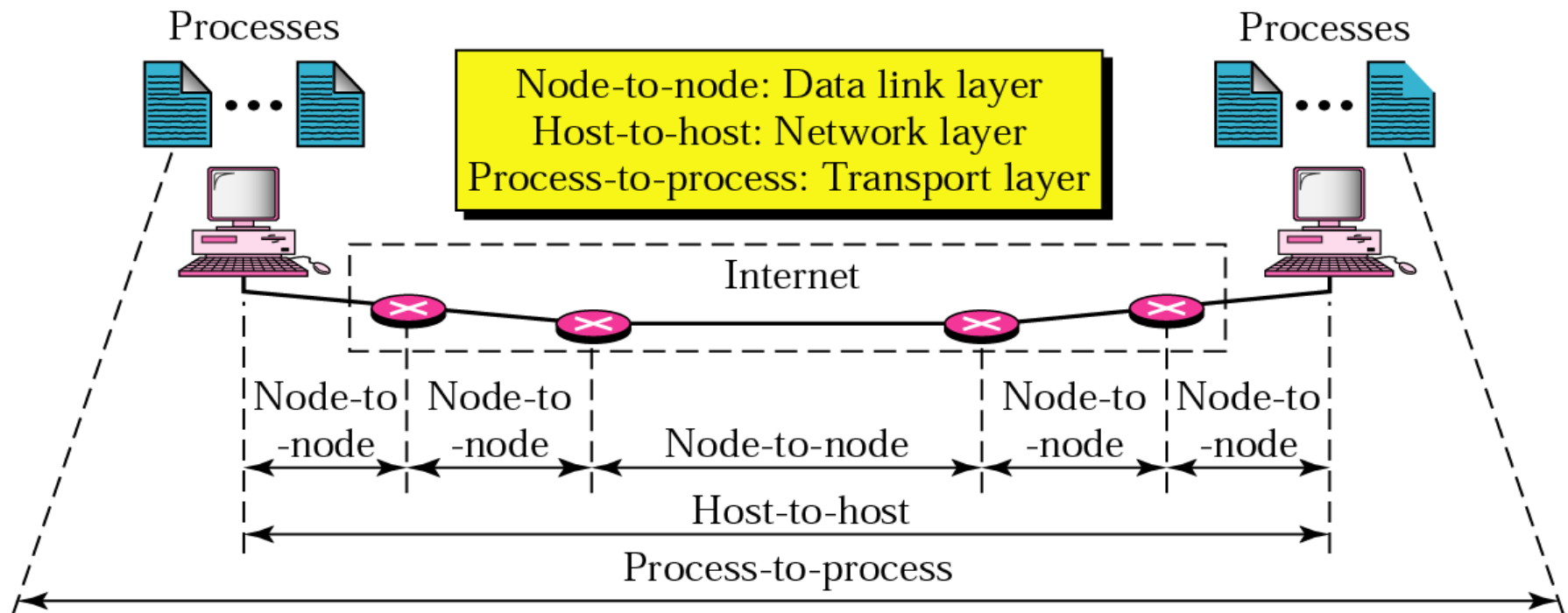
The Big Picture



Internet Model



Internet Model





Protocol Suites

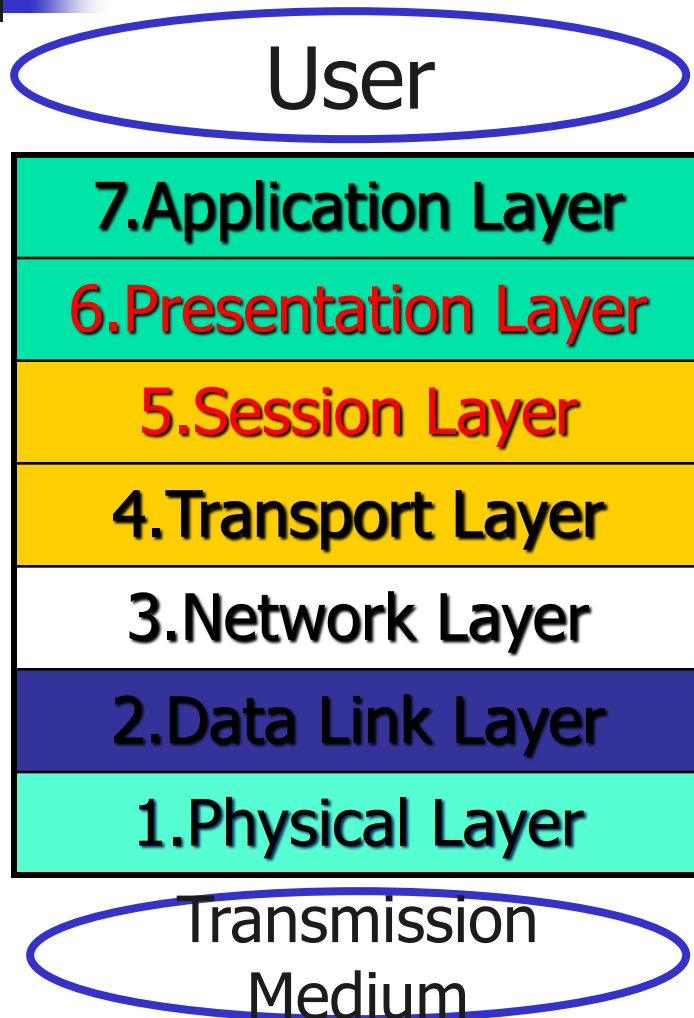
- A set of protocols must be constructed
 - to ensure that the resulting communication system is **complete** and **efficient**
- Each protocol should handle a part of communication **not handled** by other protocols
- How can we guarantee that protocols work well together?
 - Instead of creating each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



Internet Protocol Suite

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

OSI Model



- OSI – *Open Systems Interconnection*
- Developed by the *International Standards Organizations* (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

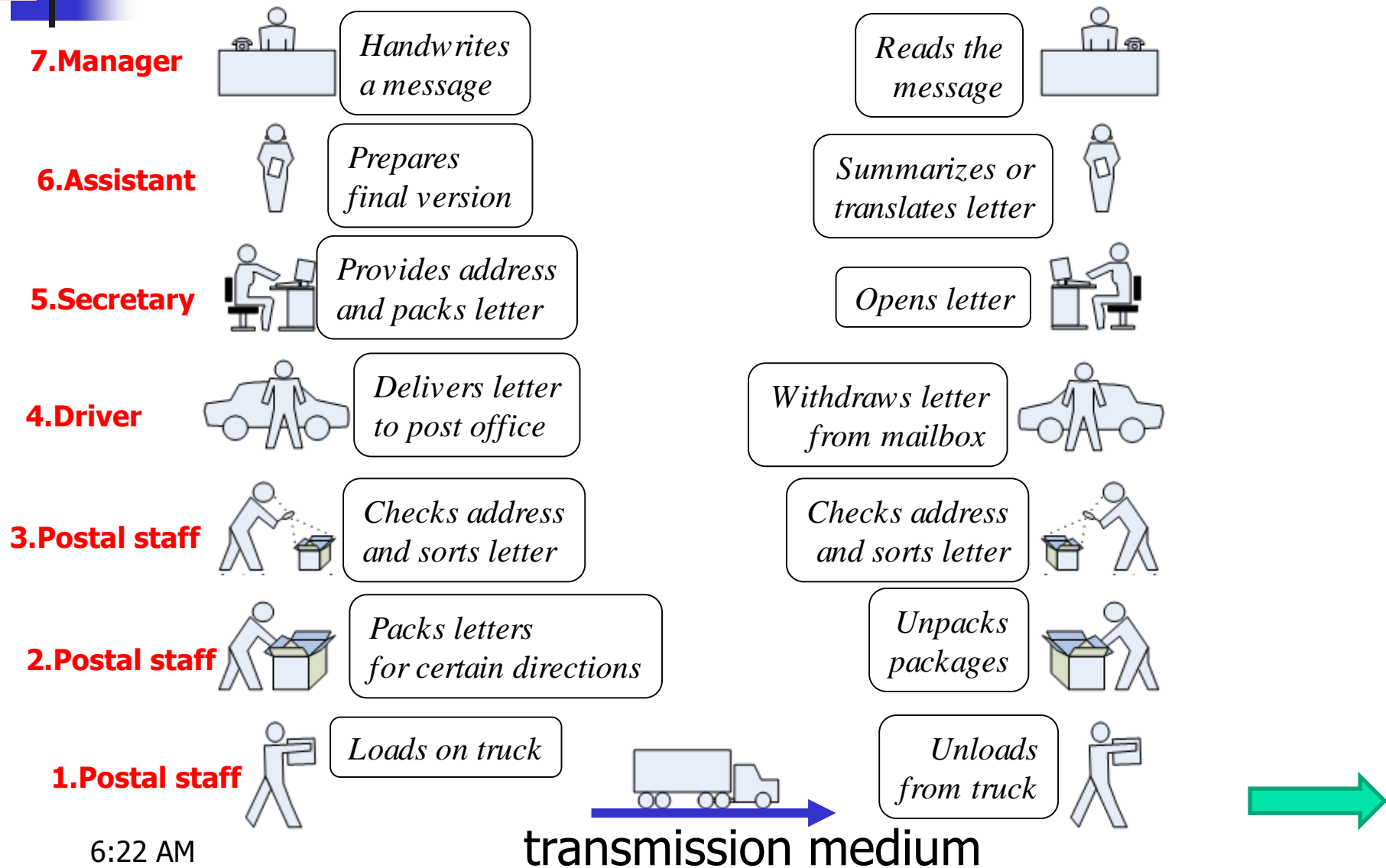


Presentation Layer

Responsible for handling differences in data representation to applications

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

OSI Layers in Real World





Questions

