# Layered Architecture and Network Protocols

## EE450: Introduction to Computer Networks

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# Protocols

**Human Protocols:**

- what's the time?
- I have a question
- Introductions

… specific msgs sent

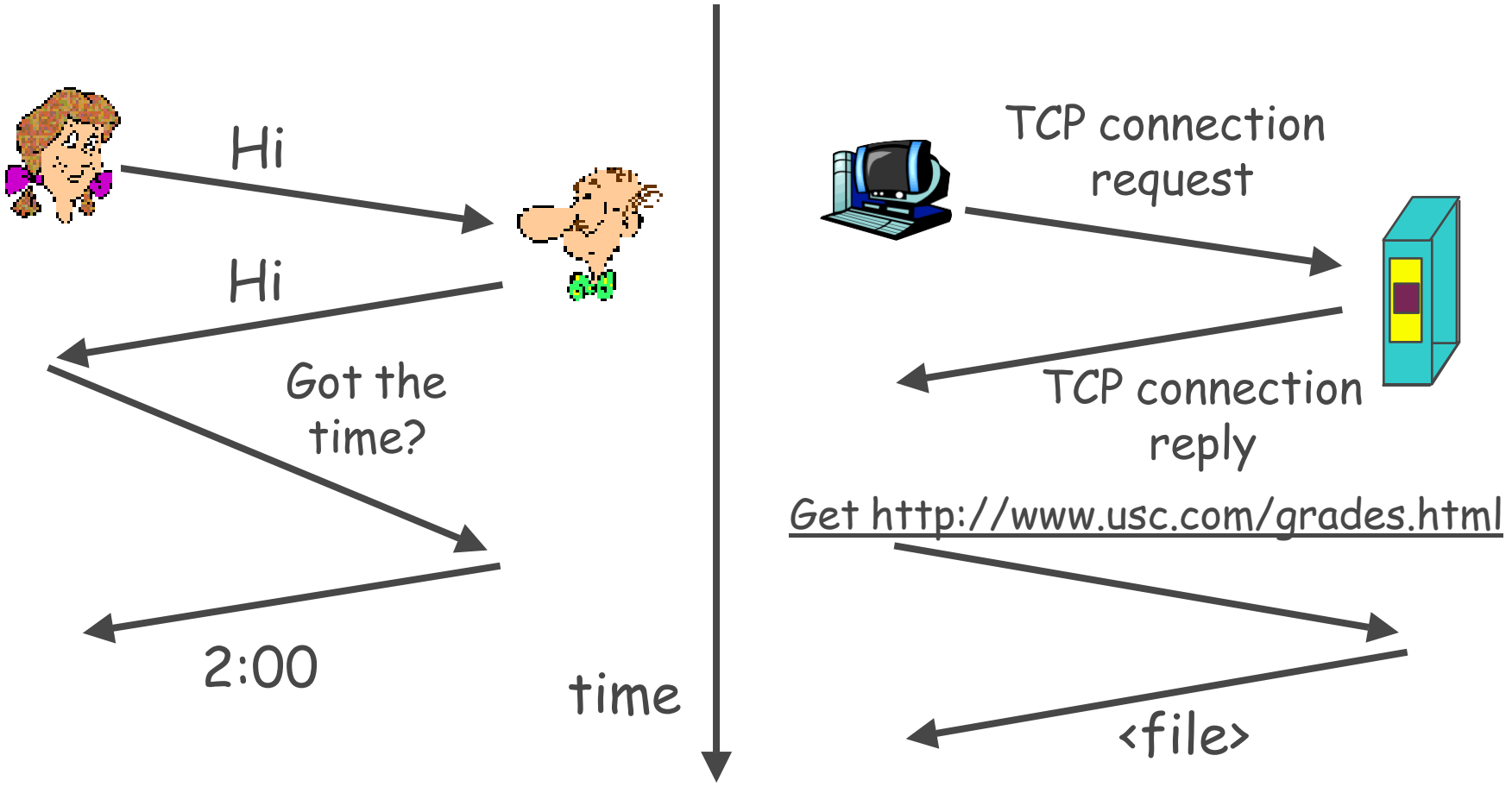
… specific actions taken when msgs received, or other events

**Network Protocols:**

- Machines rather than humans
- All communication activity in Internet governed by protocols

Protocols define format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt

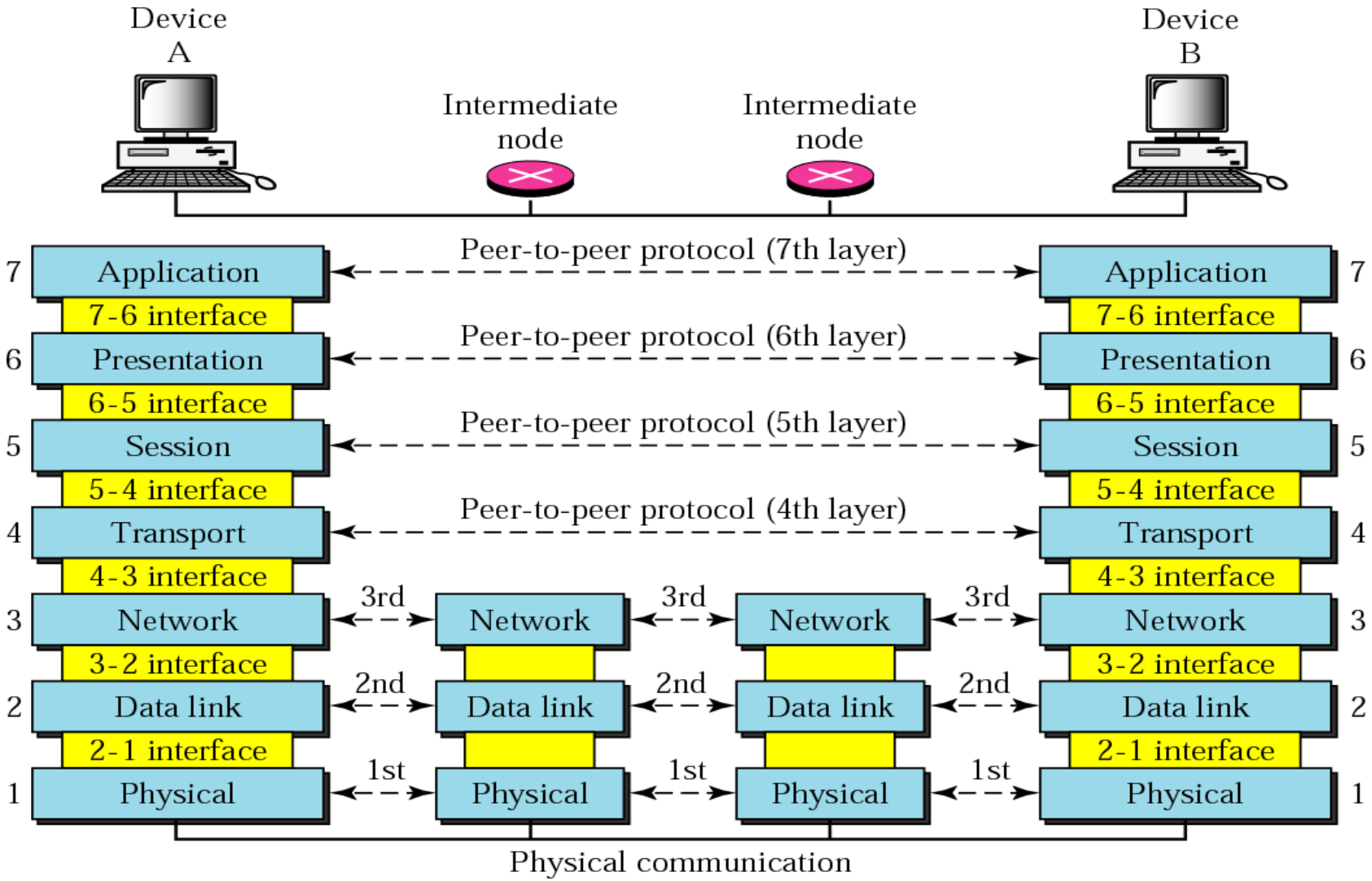
# Human vs. Network Protocols



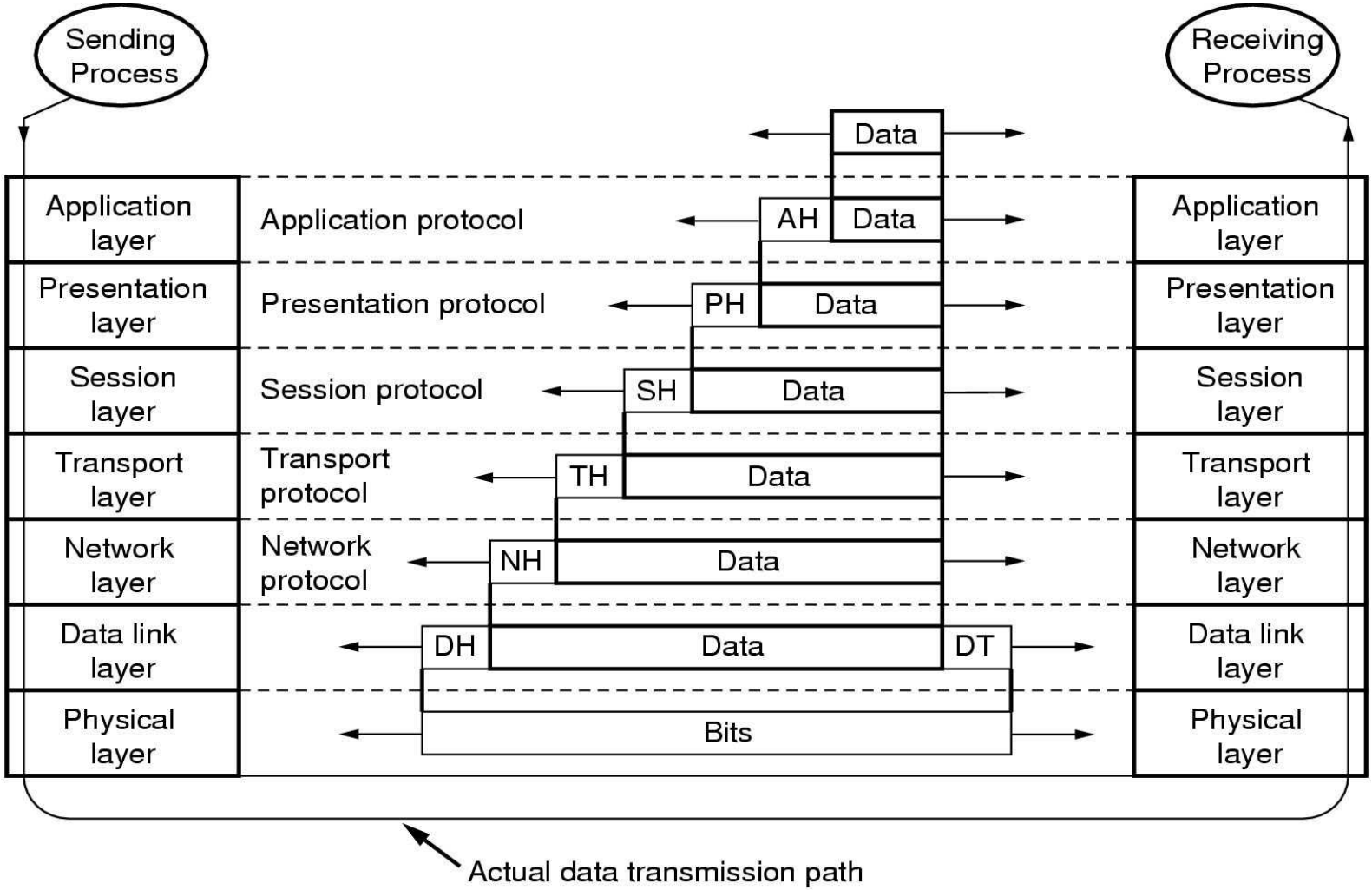
# Key Elements of a Protocol

- Syntax
  - Data formats, compression, encryption, etc..
  - Signal levels
- Semantics
  - Control information such as flow & congestion
  - Error detection and control mechanisms
- Timing
  - Speed matching
  - Sequencing
- Fairness

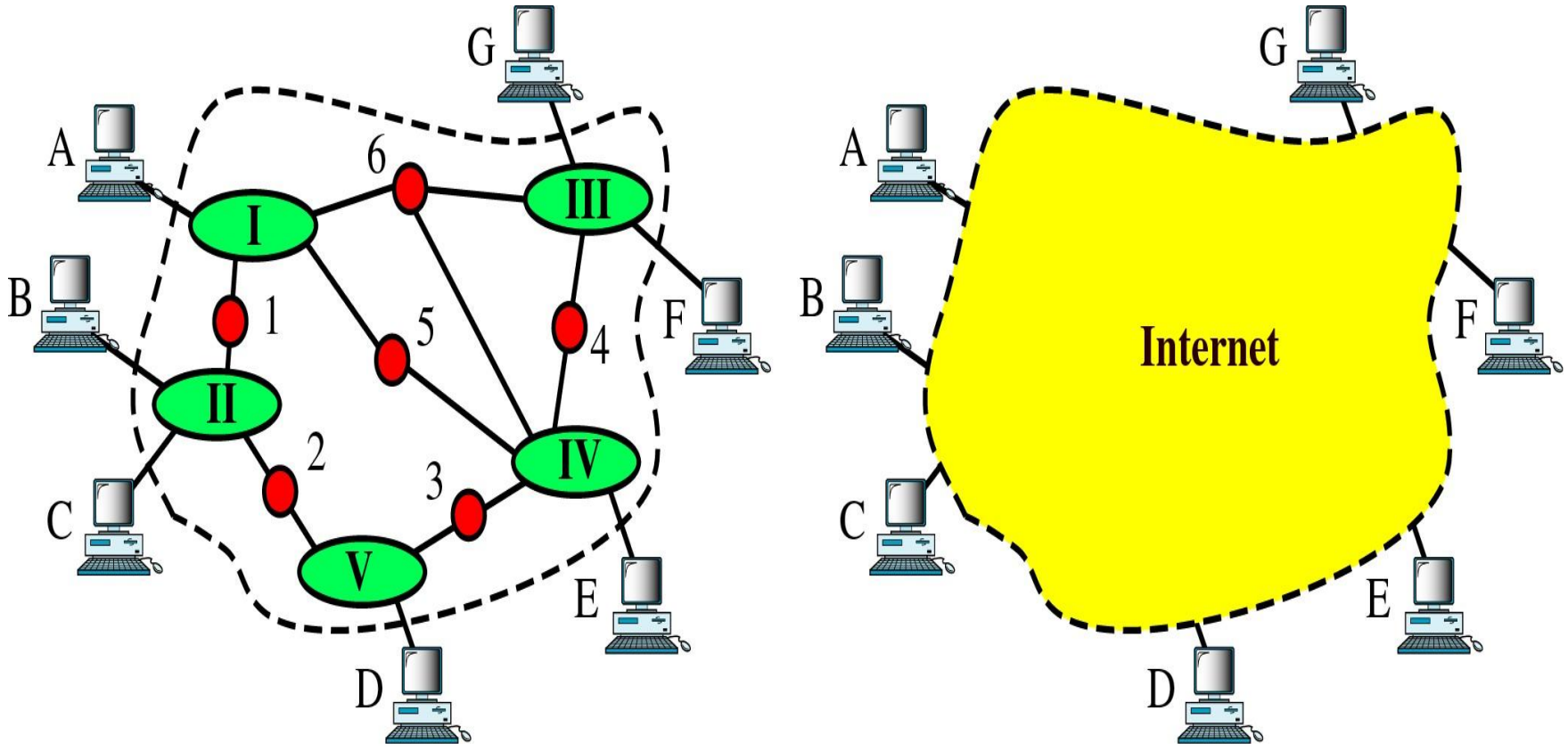
# OSI Reference Model



# Data Transfer in OSI



# The Internet and TCP/IP

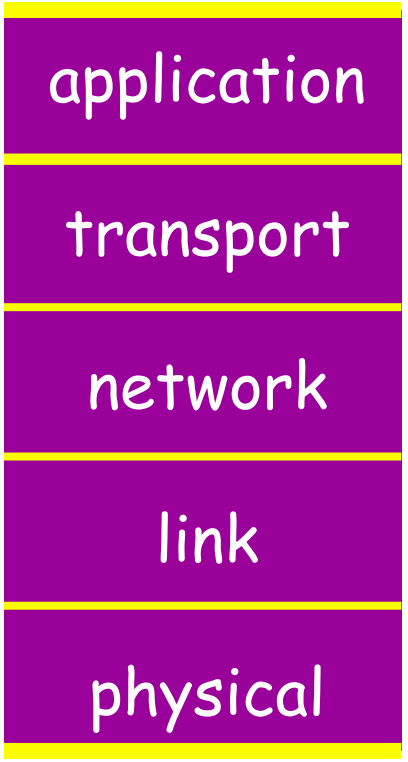



a. An actual internet

b. An internet seen by TCP/IP

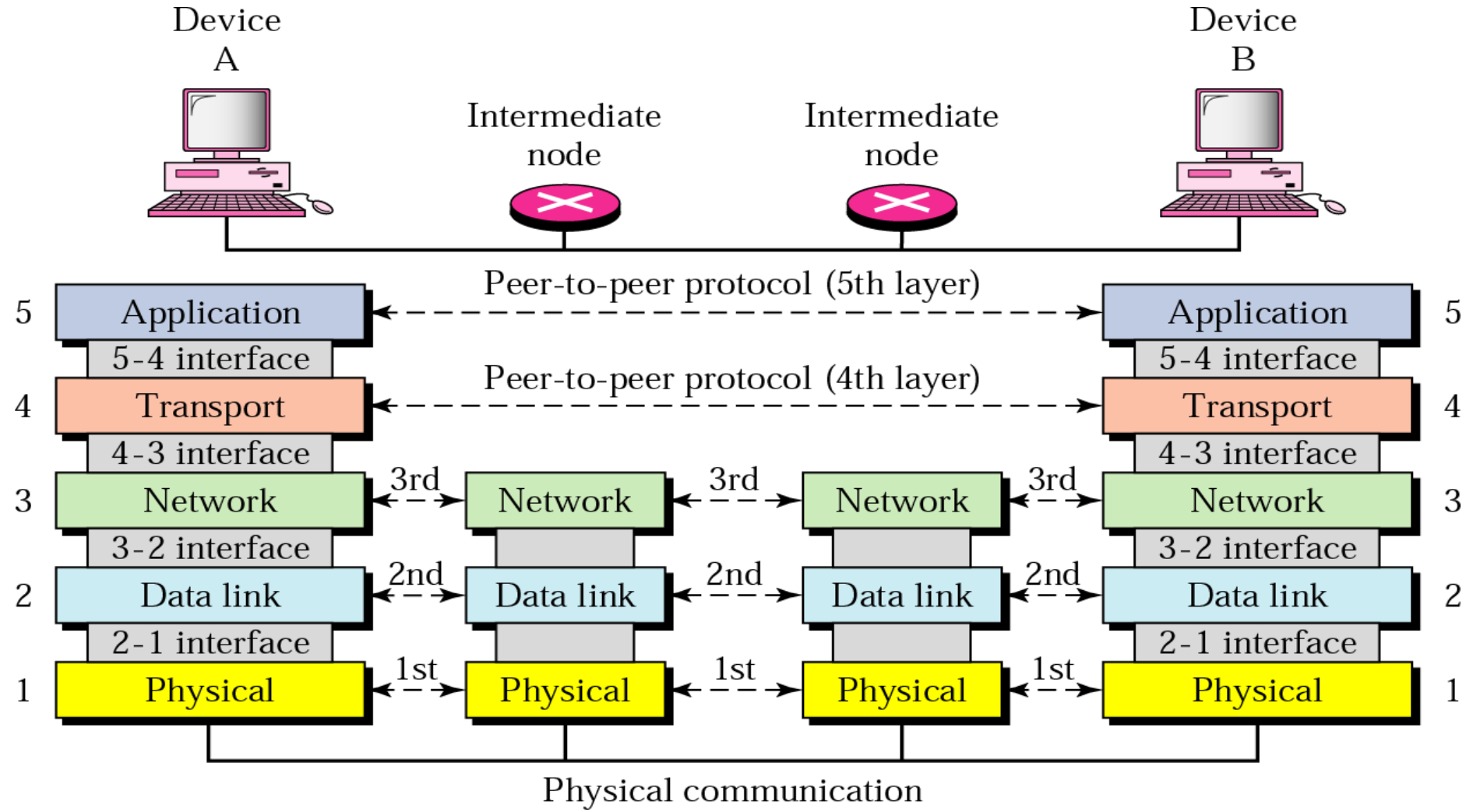
# Internet Protocol Stack

- Application: supporting network applications
  - FTP, SMTP, HTTP
- Transport: process-process data transfer
  - TCP, UDP
- Network: routing of datagrams from source to destination
  - IP, routing protocols
- Link: data transfer between neighboring network elements
  - PPP, Ethernet
- Physical: bits "on the wire"

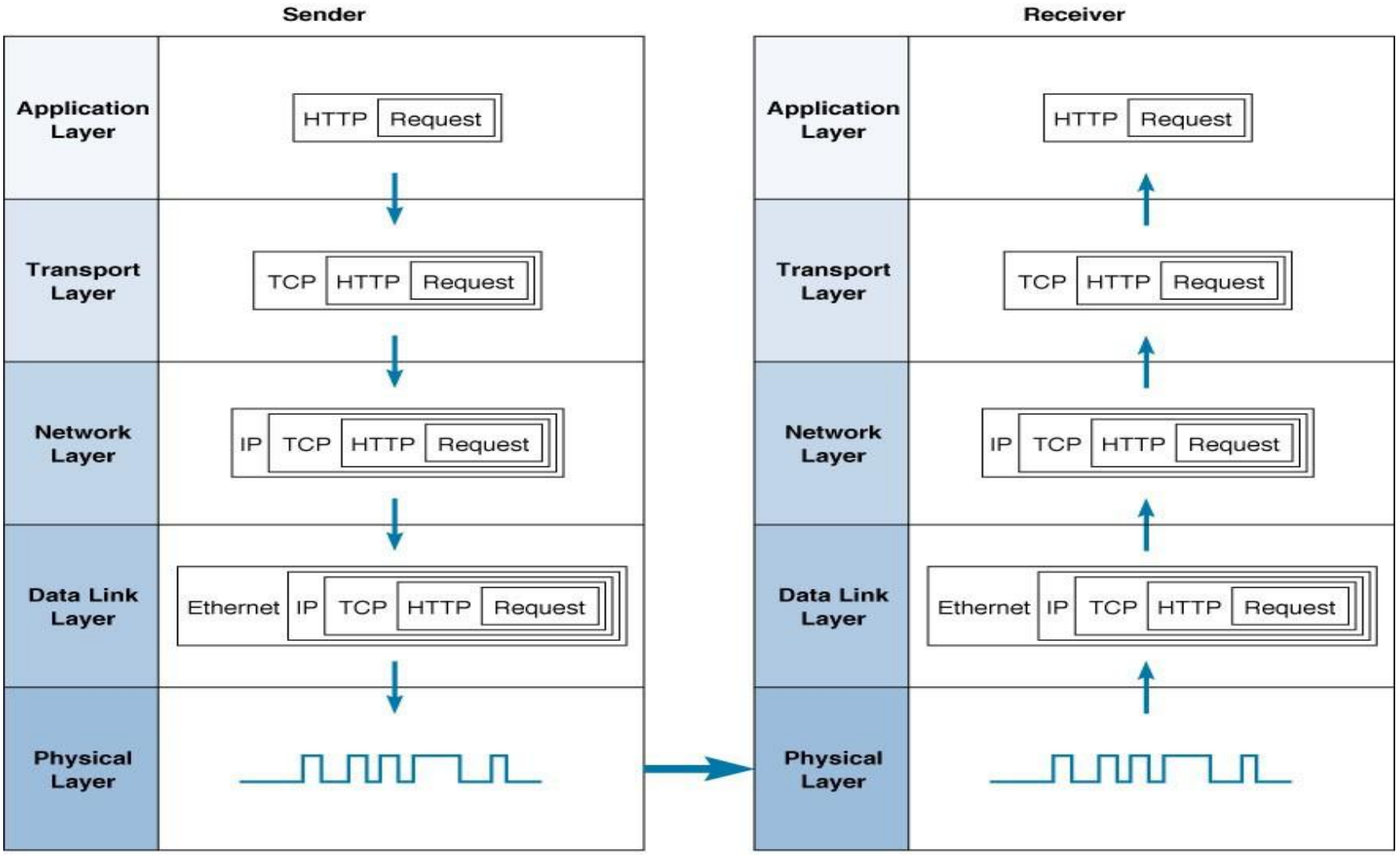



Developed by the US Defence Advanced Research Project Agency (DARPA) for its packet switched network (ARPANET)

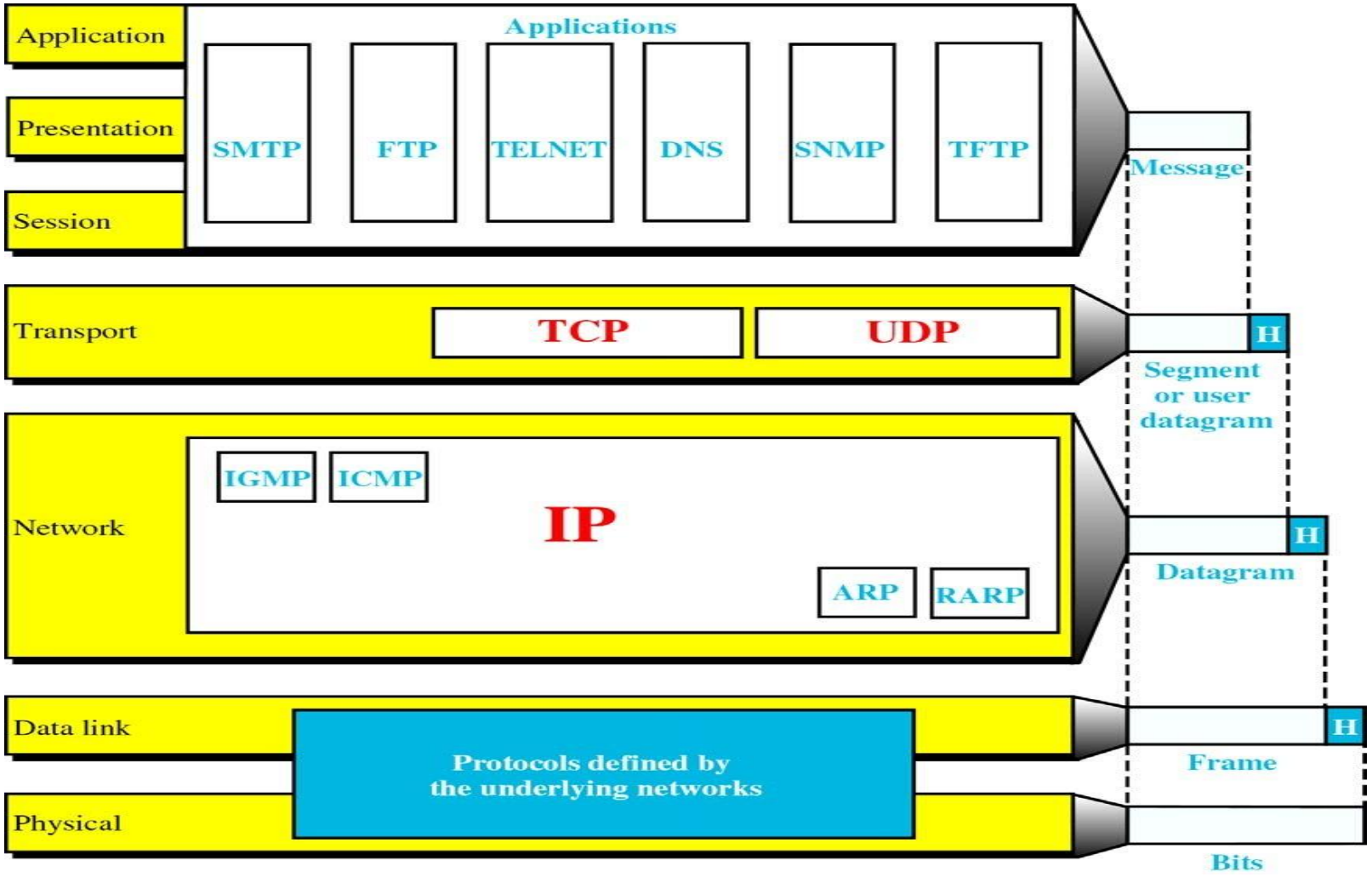
# TCP/IP Model


Device A
Device B
Intermediate node
Intermediate node
Peer-to-peer protocol (5th layer)
Peer-to-peer protocol (4th layer)
5
Application
5-4 interface
4
Transport
4-3 interface
3
Network
3-2 interface
2
Data link
2-1 interface
1
Physical
3rd
2nd
1st
Physical communication

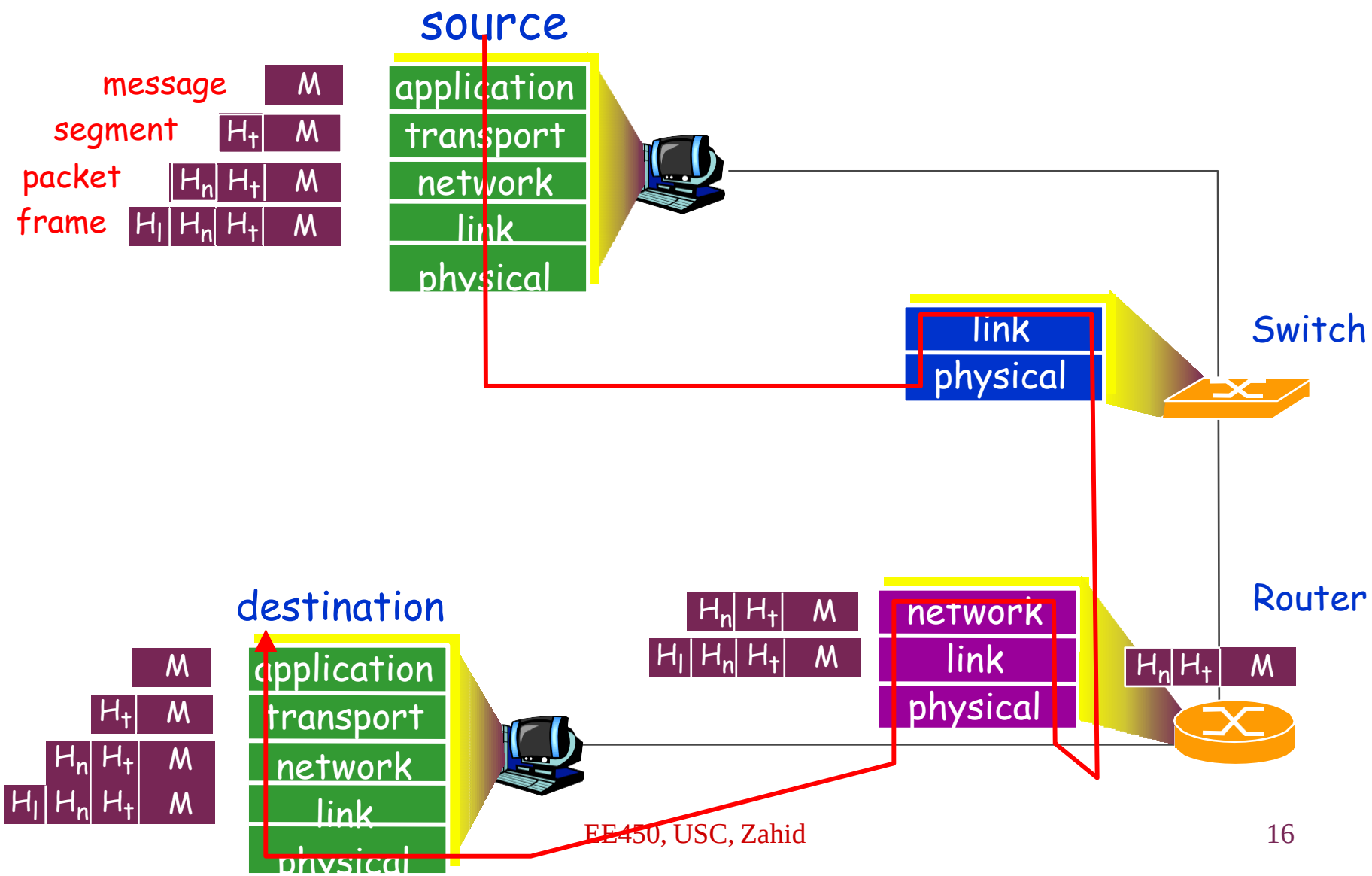
# Message Transmission using TCP/IP



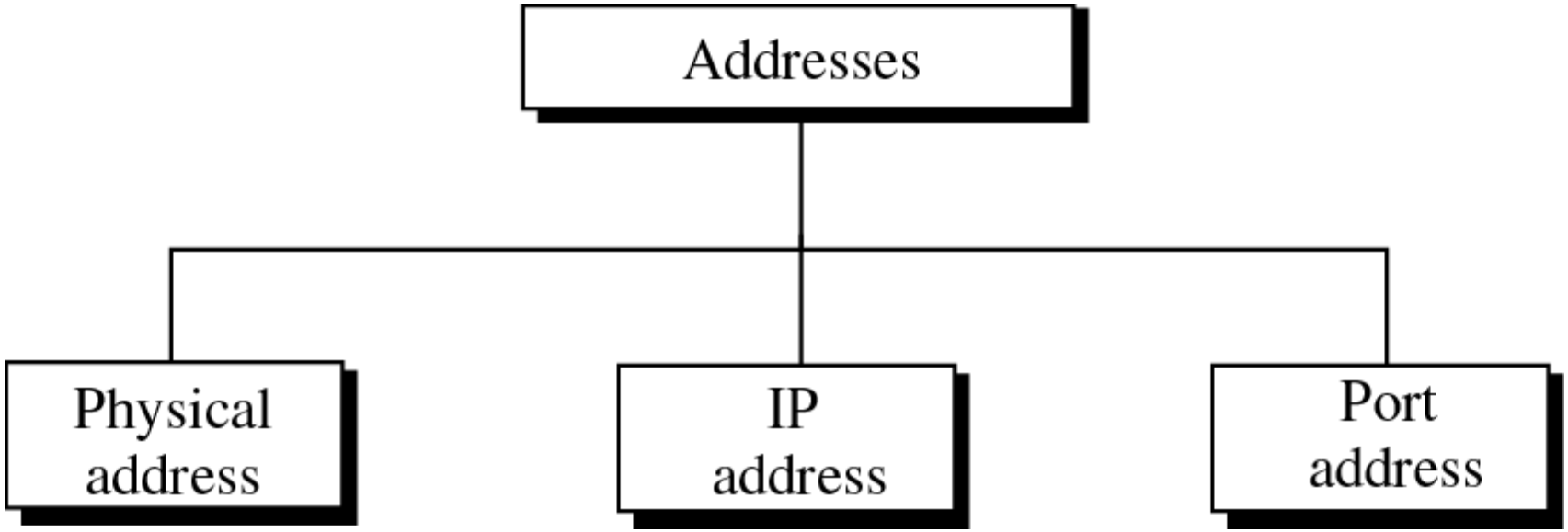
# TCP/IP vs. OSI Models



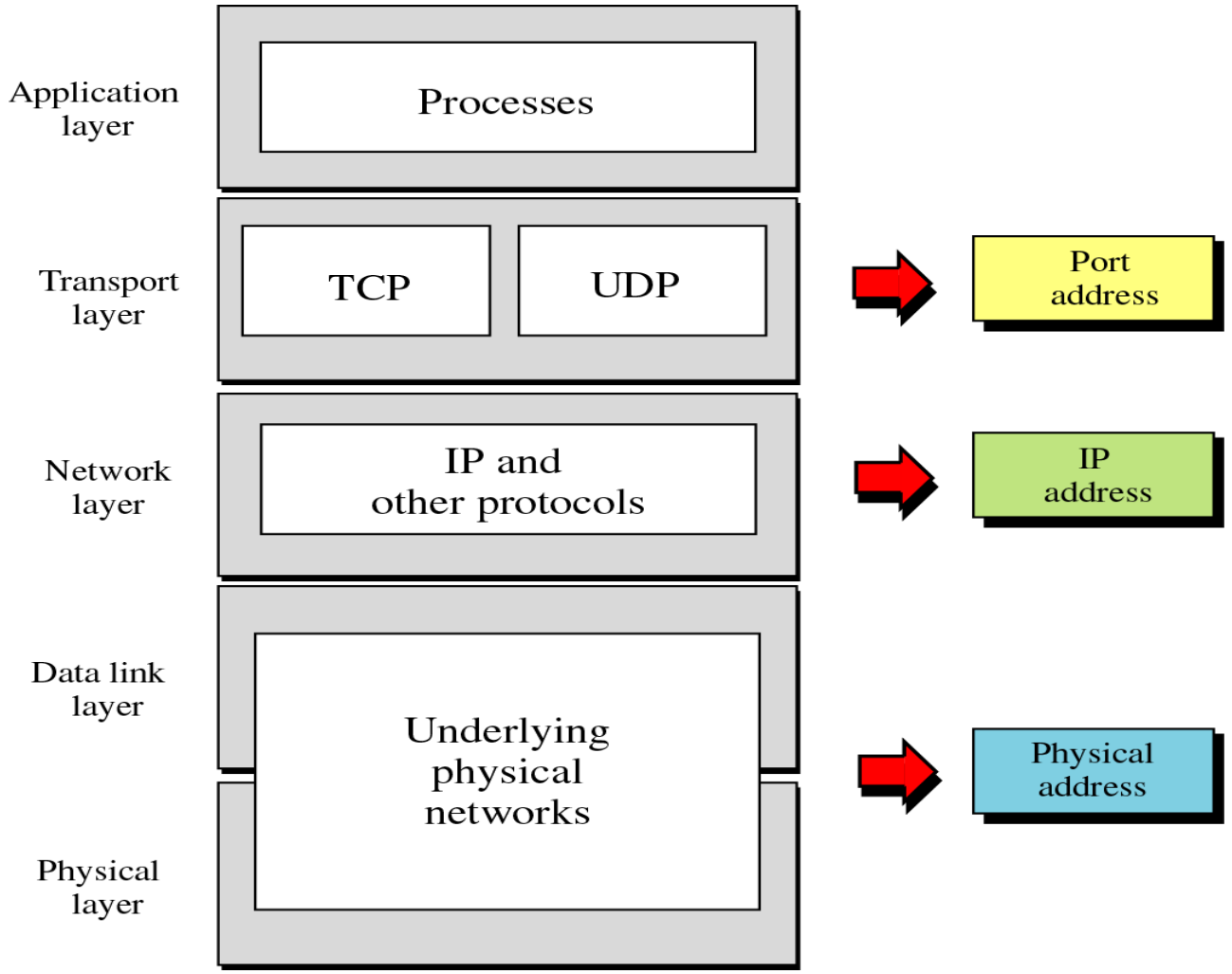
# Encapsulation



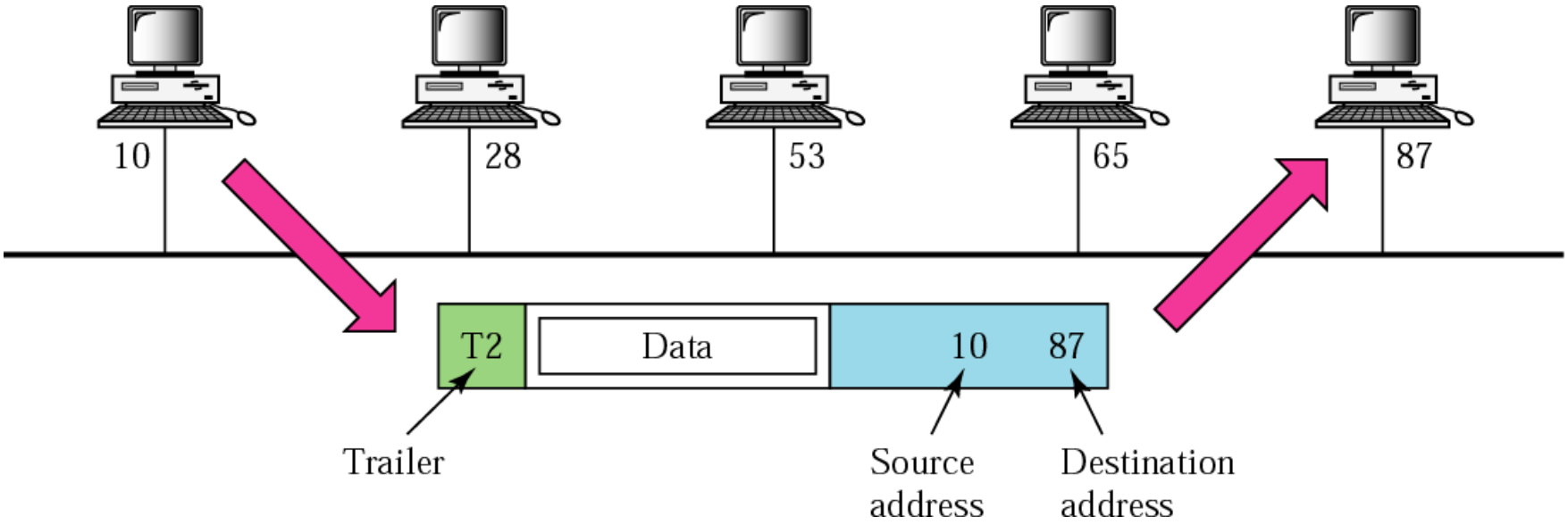
# Addressing in TCP/IP



# TCP/IP Layers and Addresses



# Link Layer (MAC) Addresses

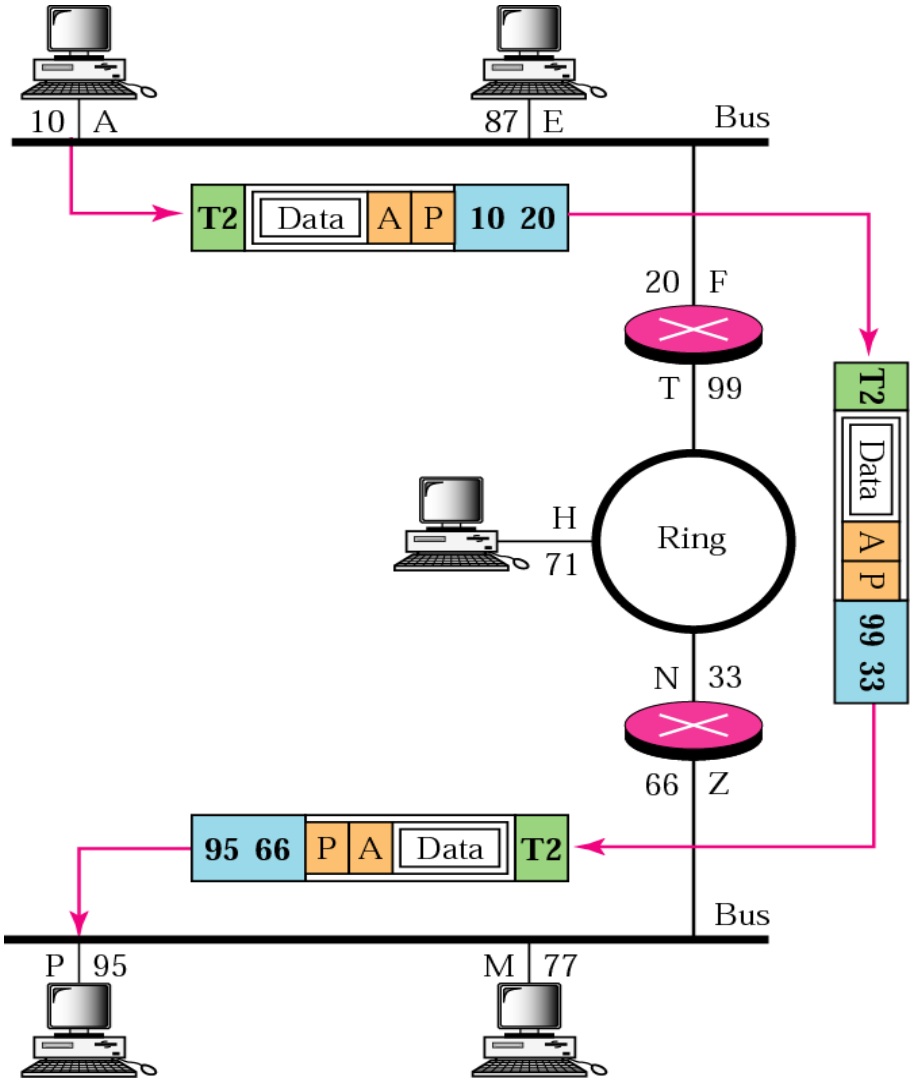



Most local area networks use a 48-bit (6 Bytes) physical address written as 12 hexadecimal digits, with every 2 Bytes separated by a hyphen for example

"07-01-02-01-2C-4B"

a node with MAC address 10 sends a frame to a node with MAC address 87. The two nodes are connected by a link. At the data link level this frame contains MAC addresses in the header. These are the only addresses needed. The header contains other information needed @ this level. The trailer contains extra bits needed for error detection

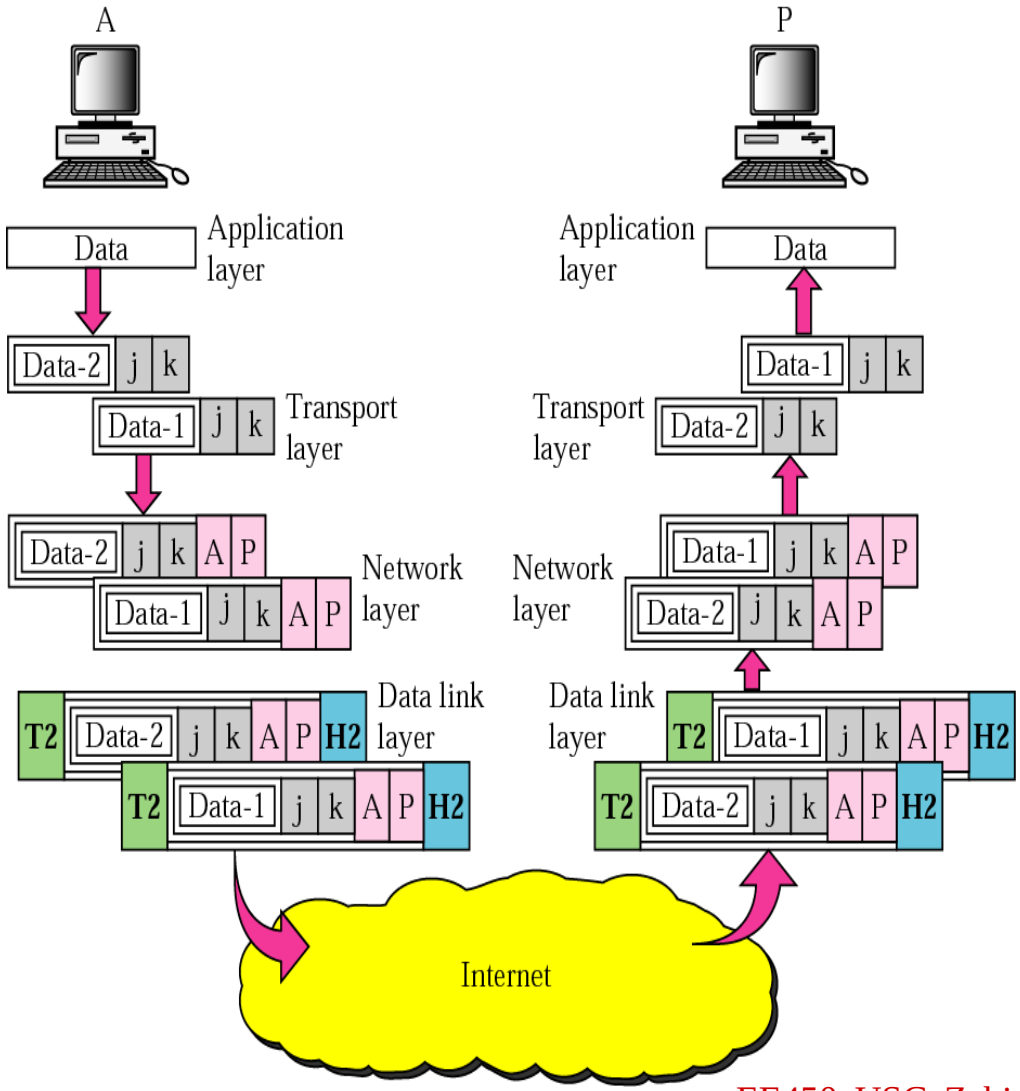
# Internetwork Communications




An Internet address (in IPv4) is 32 bits in length written as four decimal numbers, with each number representing 1 Byte. The numbers are separated by a dot. For example 128.125.75.9

A node with an IP address A and MAC address 10, located on one LAN, to a node with an IP address P and MAC address 95, located on another LAN. Because the two devices are located on different networks, we cannot use MAC addresses only; the MAC addresses only have local significance. What we need here are universal addresses that can pass through the LAN boundaries. The IP address has this characteristic.

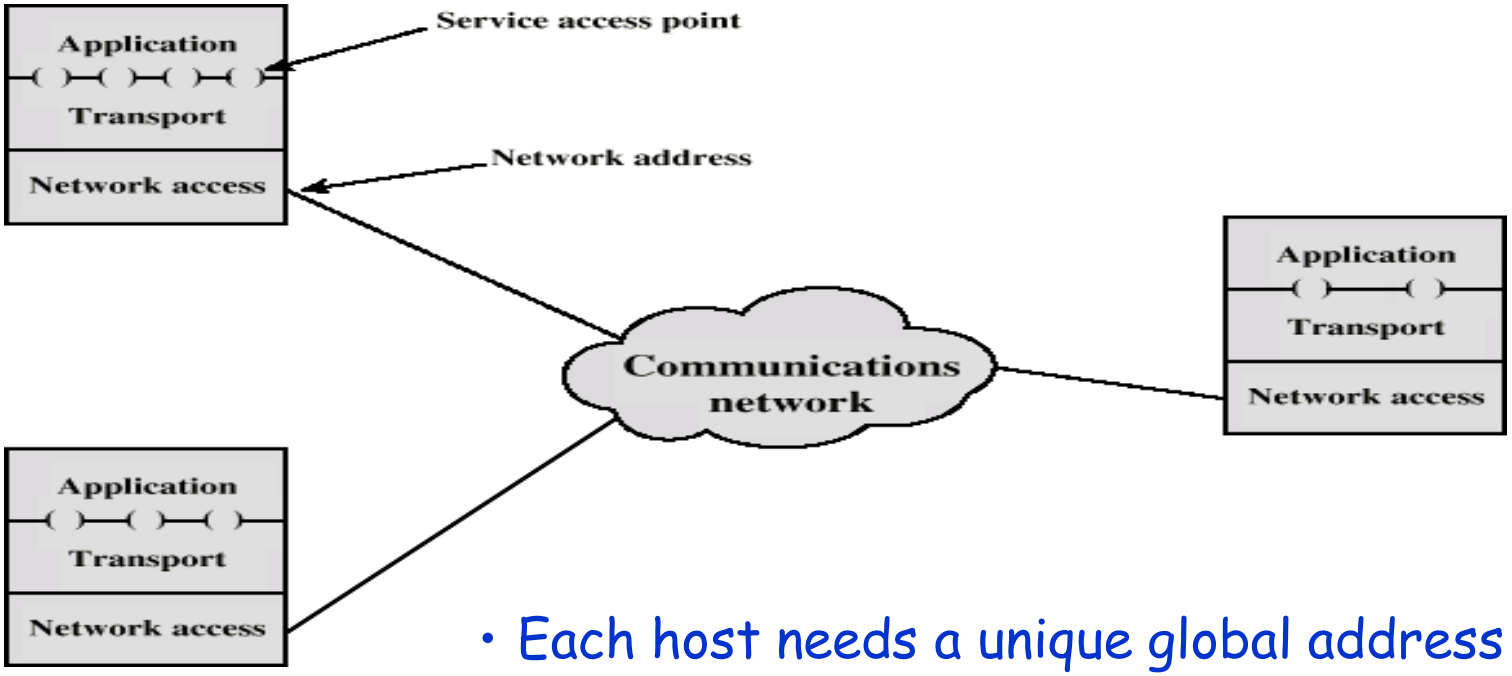
# Port Addresses




A port address is a 16-bit address represented by one decimal number for example 750

Data coming from the upper layers have port addresses j and k (j is the address of the sending process, and k is the address of the receiving process). Data are split into two Packets, each retaining the port addresses (j and k). Then in the network layer, IP addresses (A and P) are added to each packet.

# Layered Architecture and Networks




- Each host needs a unique global address referred to as the IP address
- Each application on a multitasking computer needs a unique address, referred to as the Port number, within the computer