1885 SMI UNIVERSITY

Computer Network

Lecturer: Syed Ahsan Raza

Week-1 and Week-2

Introduction to Data Communication Components, Network Criteria, and Topologies

Introduction to Network Models: OSI TCP/IP

Things you need to know …

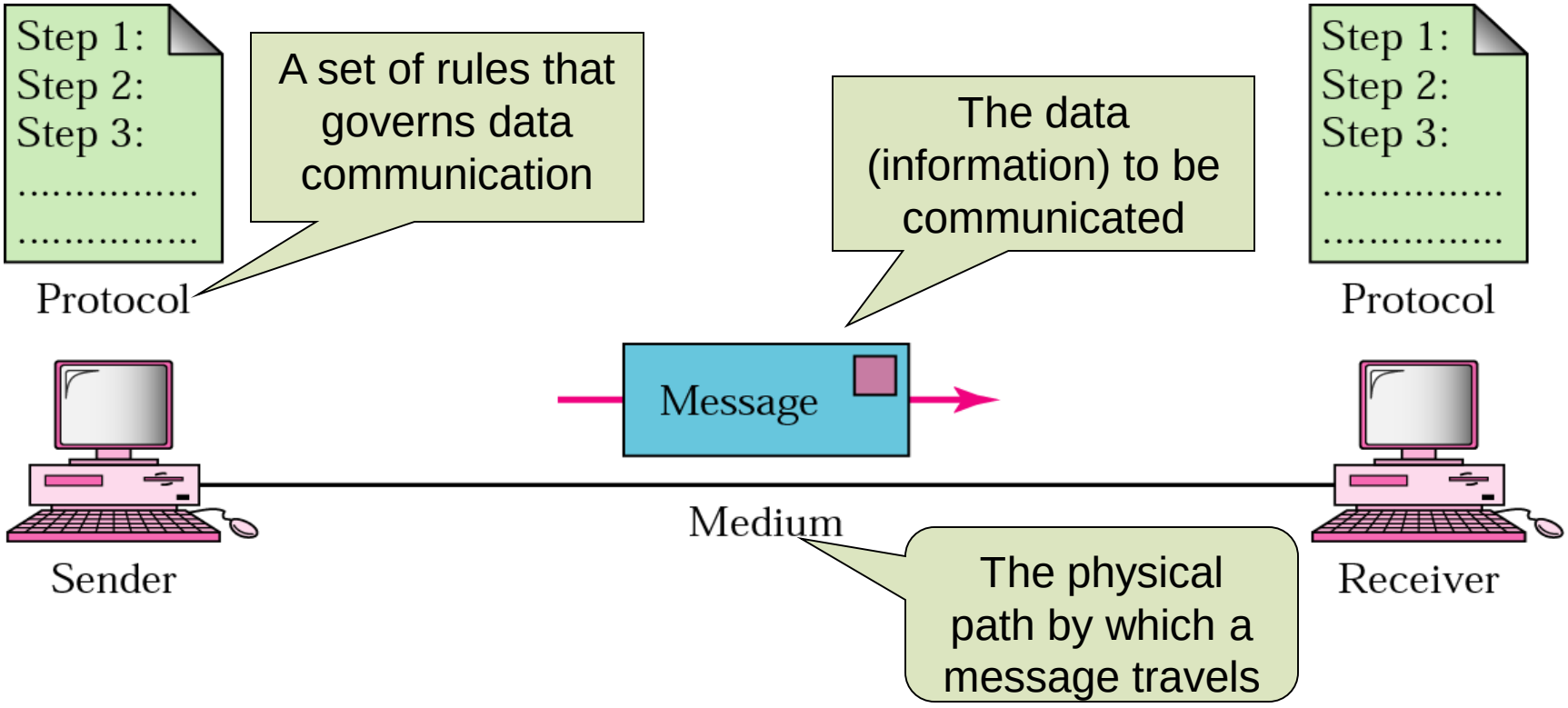
- Instructor:
  - Syed Ahsan Raza
- Textbook:
  - Data Communications and Networking
    - Behrouz A. Forouzan
- Reference Books:
  - Computer Networks - Andrew S. Tanenbaum.
  - Data and Computer Communications - W. Stallings
- Email:
  - Ahsan.raza@indus.edu.pk

What is … ?

- **Communication**
  - Information transfer, according to agreed conventions using hand signals, language, Morse code, smoke signals etc.
- **Telecommunication**
  - Communication at a distance, includes telephony, telegraphy, television etc.
- **Data Communication**
  - Transfer of data from one or more sources to one or more destinations.
- **Computer Network**
  - A network of data processing nodes that are interconnected for the purpose of data communication.

Components of data communication system

Sender, Receiver, Message , Medium, Protocol



Data communication system

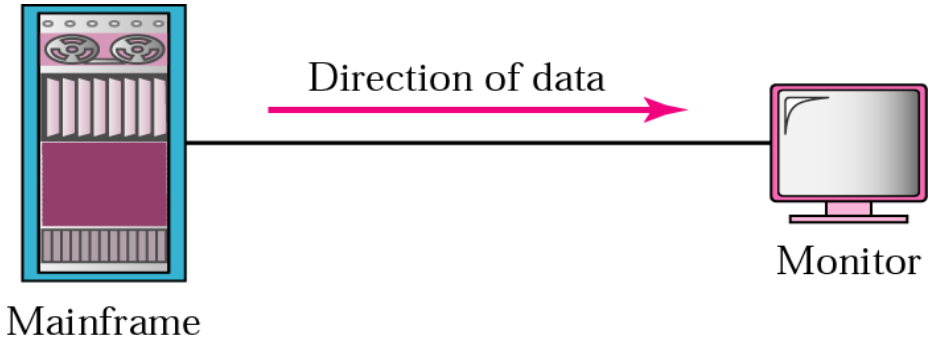
- Its effectiveness depends upon three characteristics …
  - Delivery
    - To deliver data to correct destination
  - Accuracy
    - To deliver data accurately
  - Timeliness
    - To deliver data in a timely manner

Data representation

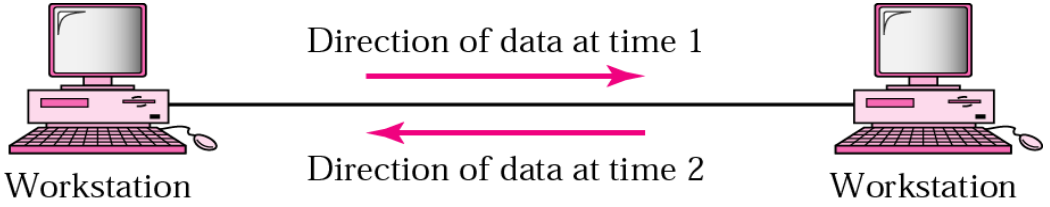
- Text
  - ASCII
  - Extended ASCII
  - Unicode
  - ISO
- Numbers
- Images
- Audio
- Video

Direction of data flow

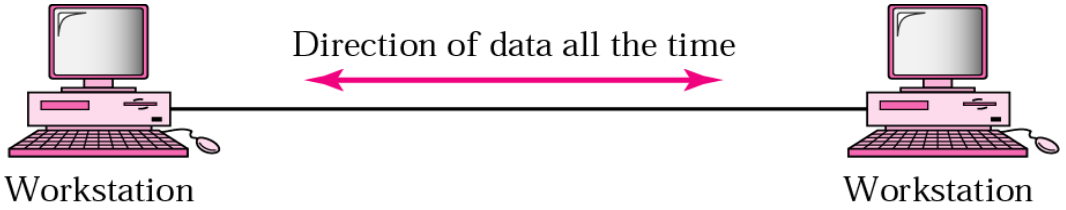
- Simplex



- Half-duplex

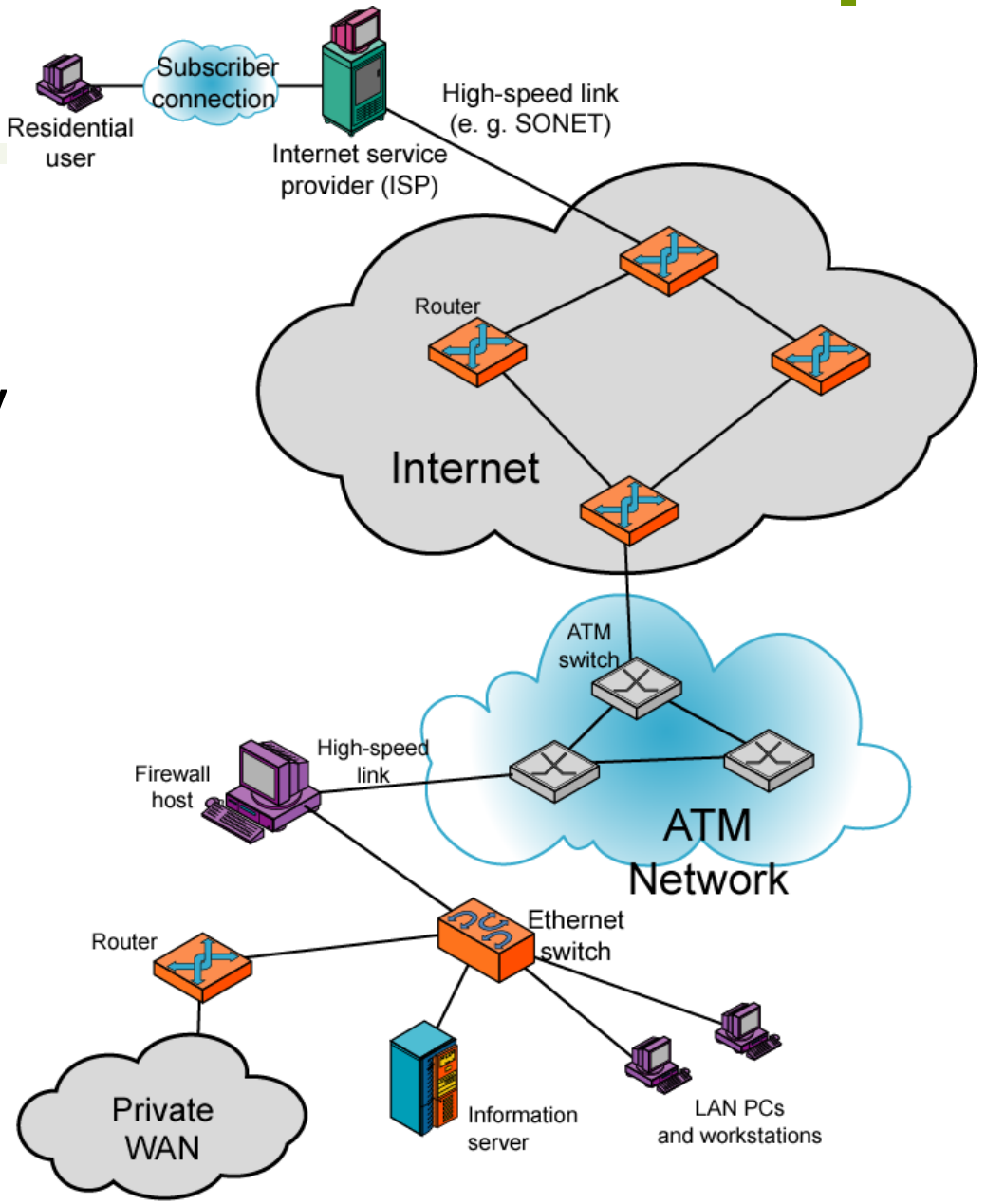


- Full-duplex



What is a network?

- It is a set of devices (nodes) connected by communication links.
- A node can be a computer or printer etc.



Why make a network?

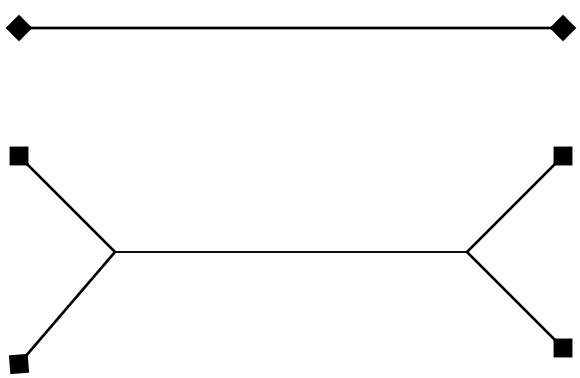
- Because of networks we can …
  - Share resources (Peripherals, files, internet connection etc.)
  - Communicate and collaborate
  - Save data

Network criteria

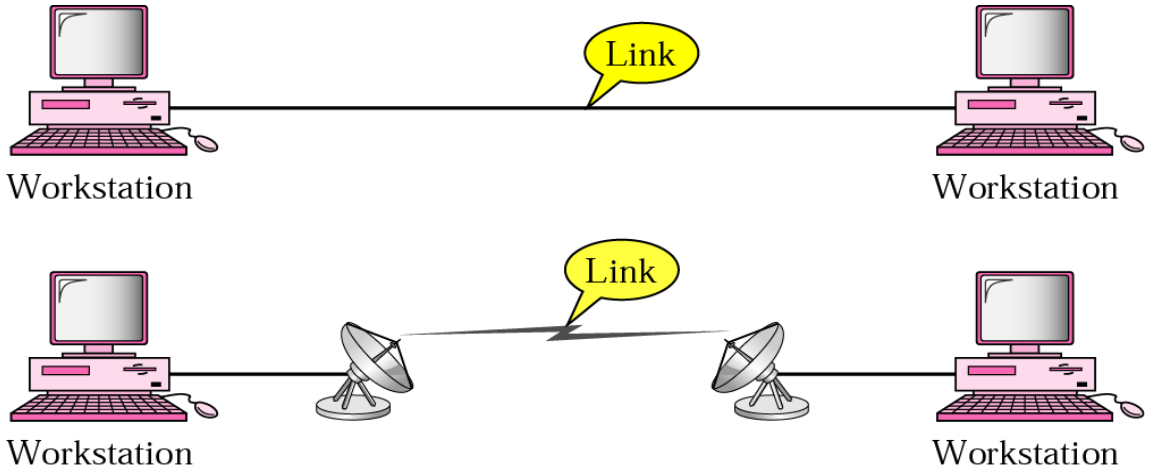
- Three most important criteria for evaluating a network are …
  - Performance
  - Reliability
  - Security

Types of Connection

- Point-to-point
- Multipoint

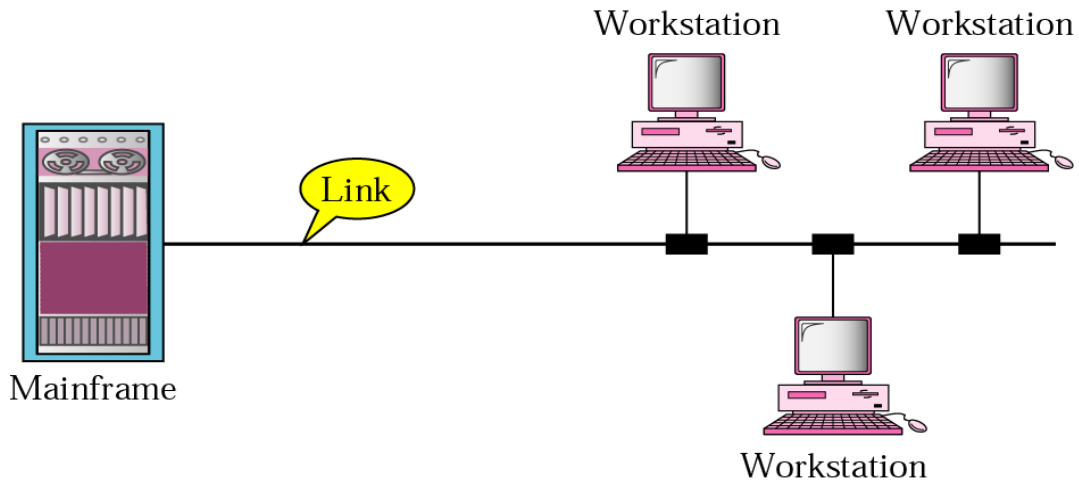


Point-to-point connection



- Provides a dedicated link between devices.
- Entire capacity of the link is reserved for the two devices.

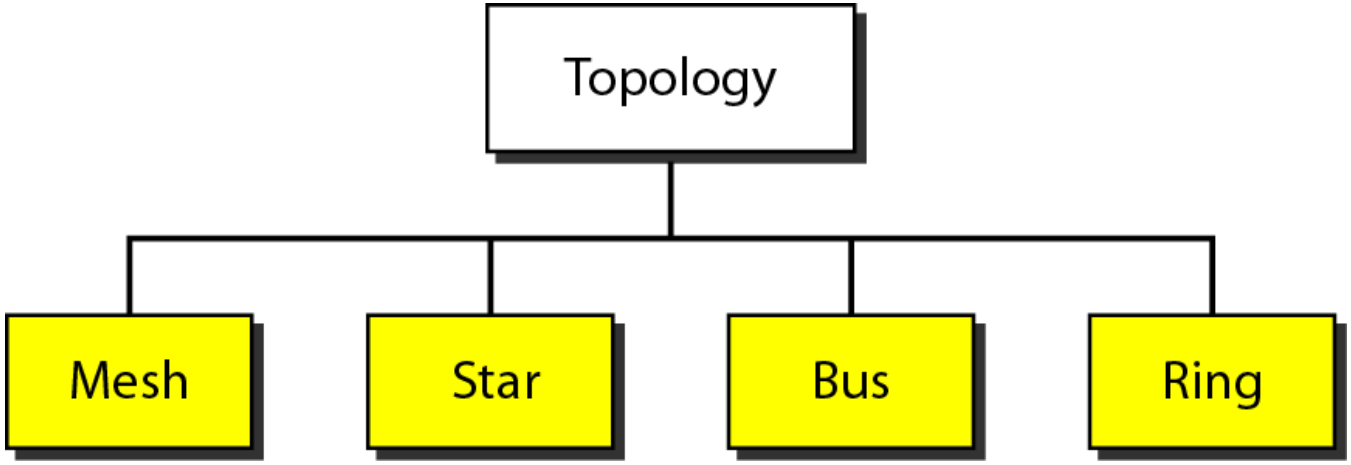
Multipoint connection



- More than two specific devices share a single link.
- The capacity of the channel is shared.

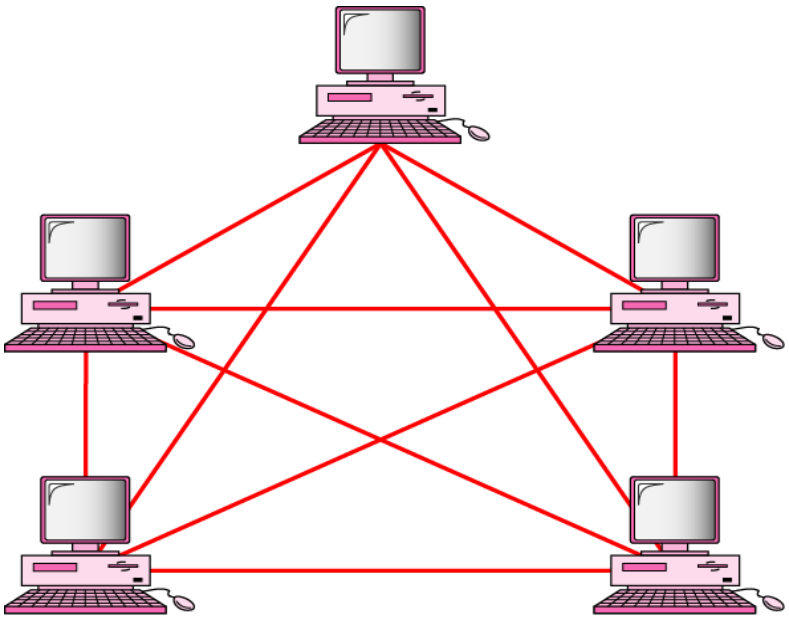
Network Topology

- It refers to the way in which a network is laid out physically.
- It is a geometric representation of the relationship of all the links and linking devices to one another.



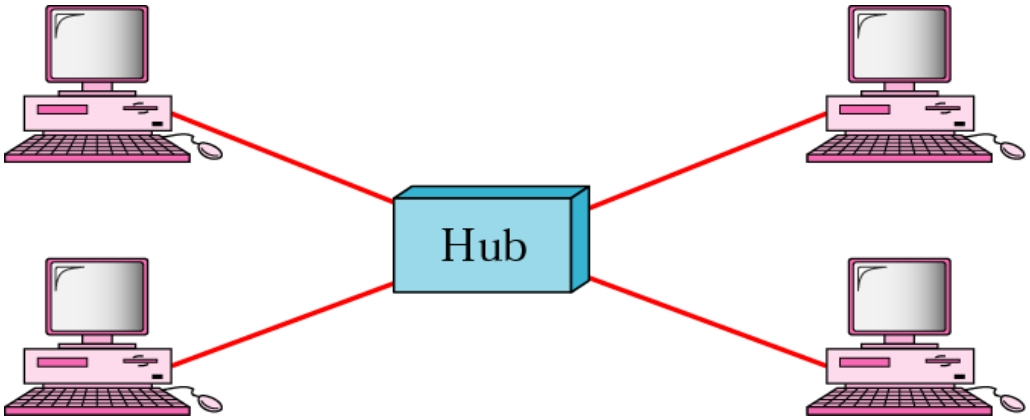
Mesh topology

- Every device has a dedicated point-to-point link to every other device.
- A fully connected mesh network has *n(n-1)/2* physical channels to connect *n* devices with each device having *n-1* I/O ports.



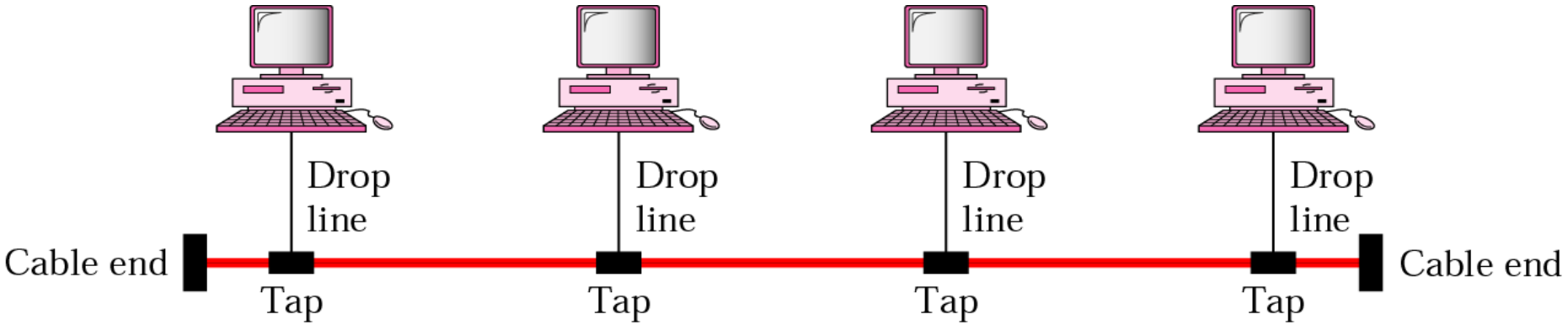
Star topology

- Each device has a dedicated point-to-point link to a central controller (usually a hub).
- Less expensive than mesh.



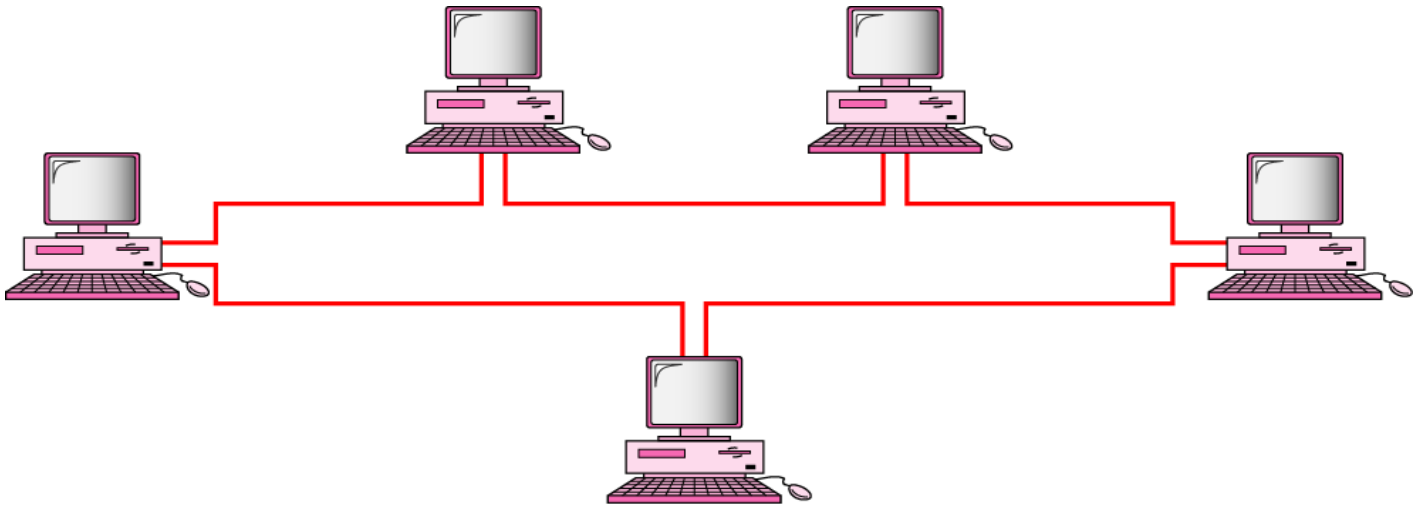
Bus topology

- One long cable acts as a backbone to link all devices.
- Multipoint connection (shared link)



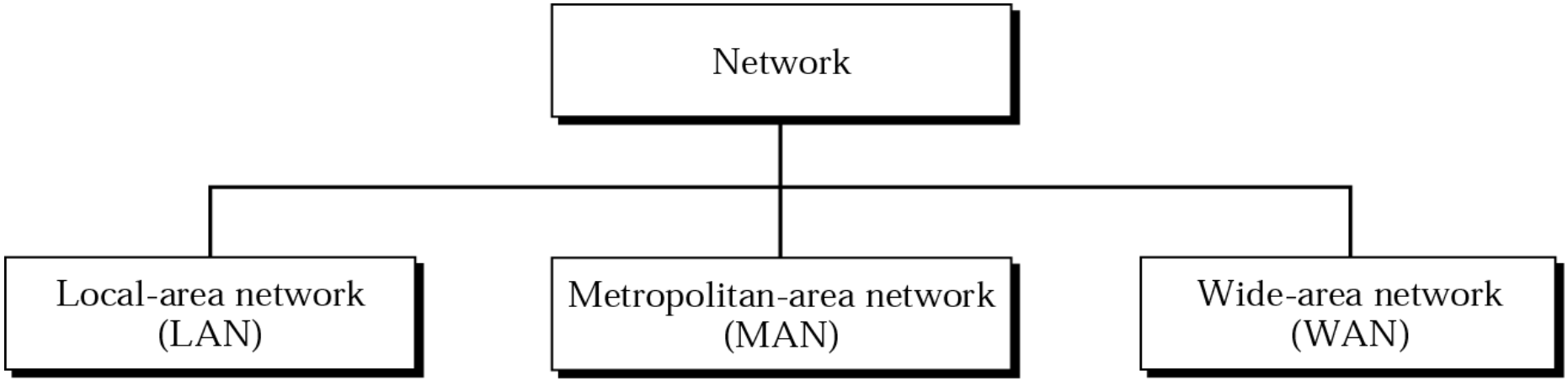
Ring topology

- Each device has a dedicated point-to-point connection only with two other devices.
- A signal is passed along the ring in one direction.



Categories of networks

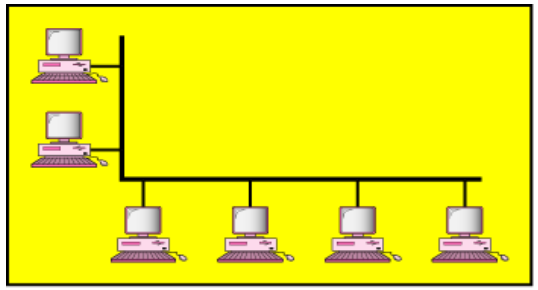
- A Network is categorized with respect to its size, its ownership, the distance it covers and its physical architecture.



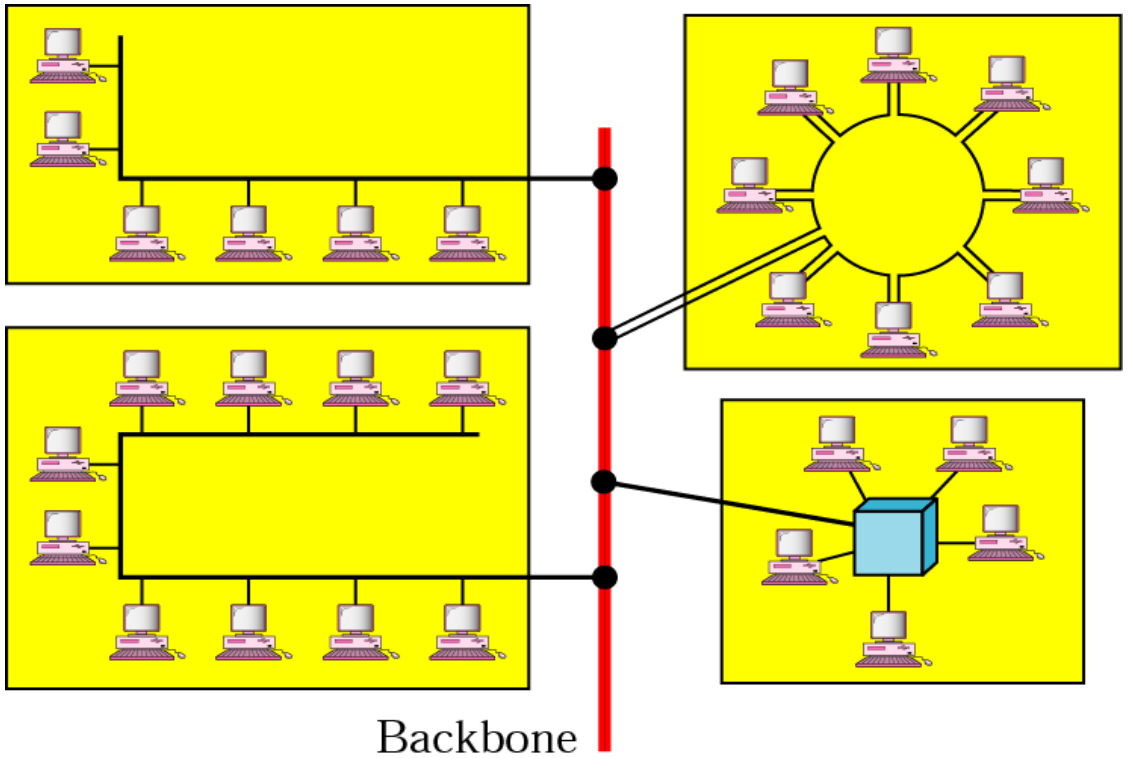
Local Area Network (LAN)

- Smaller scope
  - Building or small campus
- Usually owned by same organization as attached devices
- Data rates much higher
- Usually broadcast systems

LAN



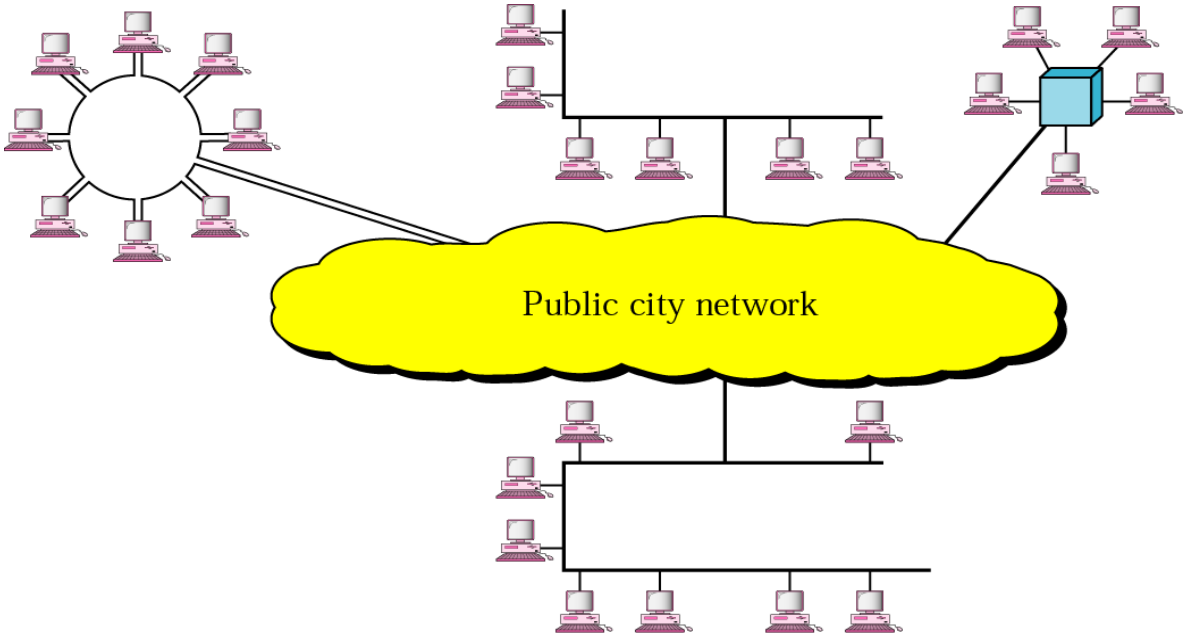
a. Single-building LAN



b. Multiple-building LAN

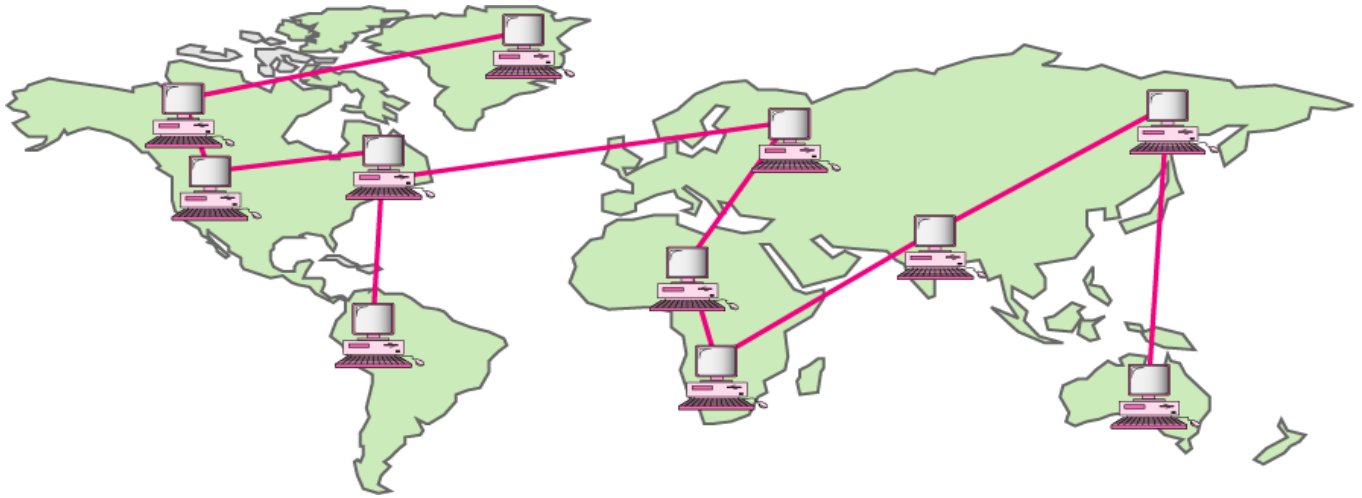
Metropolitan Area Network (MAN)

- Middle ground between LAN and WAN
- May be owned by Private company or a service provided by a public company
- Large area

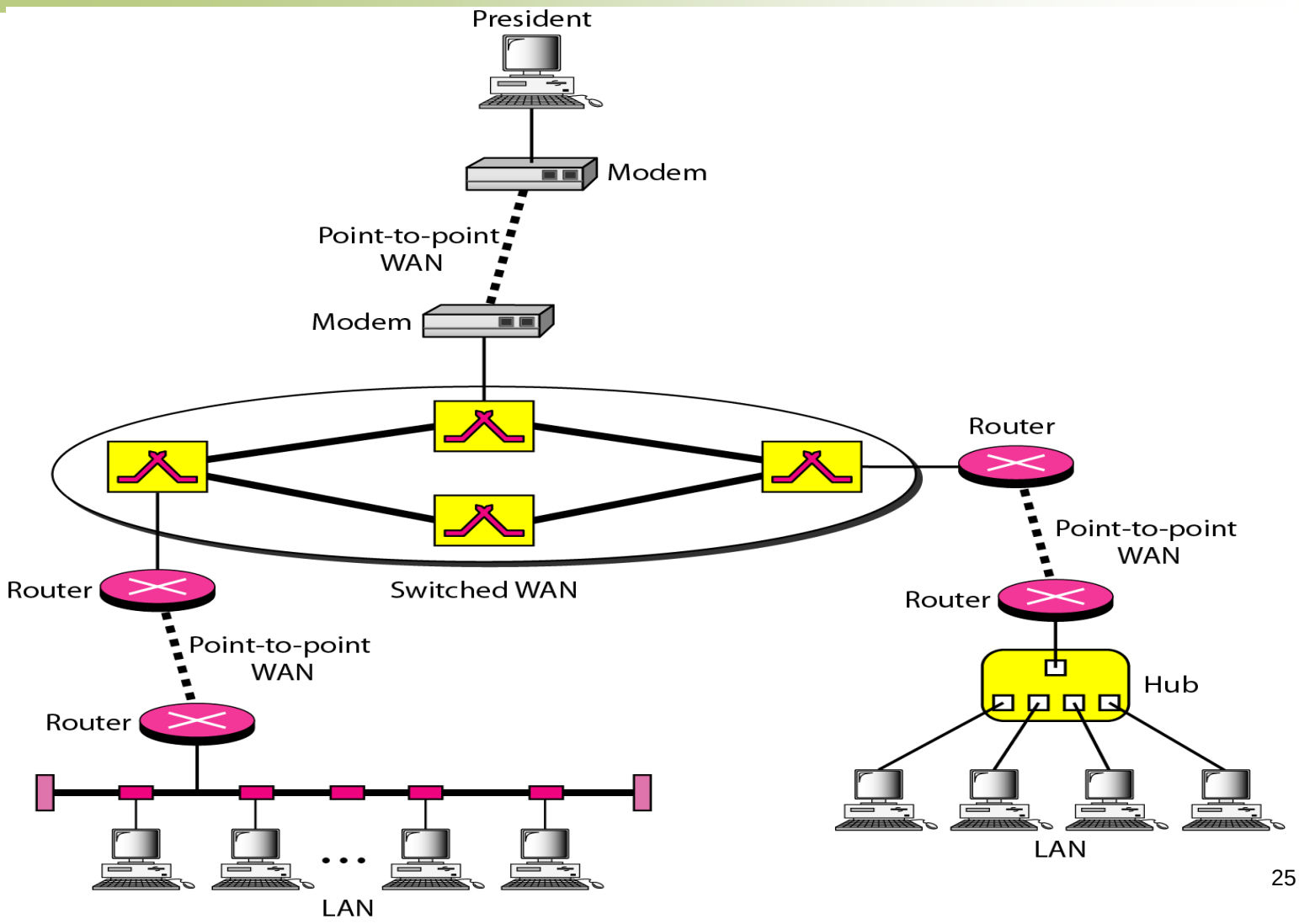


Wide Area Network (WAN)

- Large geographical area
- Crossing public rights of way
- Rely in part on common carrier circuits

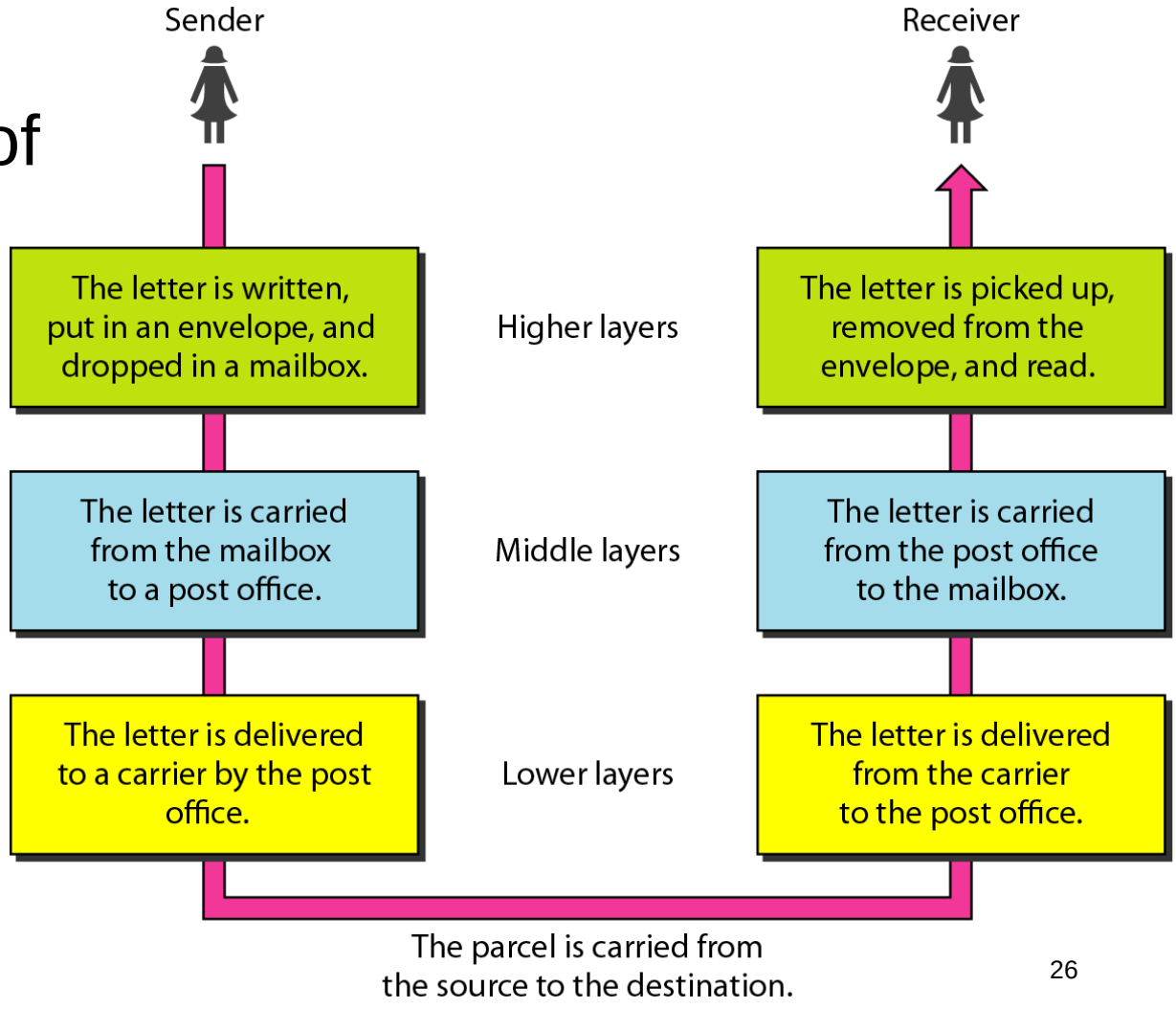


Interconnection of Networks: Internetwork



Layered Tasks

- The concept of layered tasks is common in our daily life, e.g. postal mail.



What is a protocol?

- It is a set of rules that governs data communication

Standardized Protocol Architectures

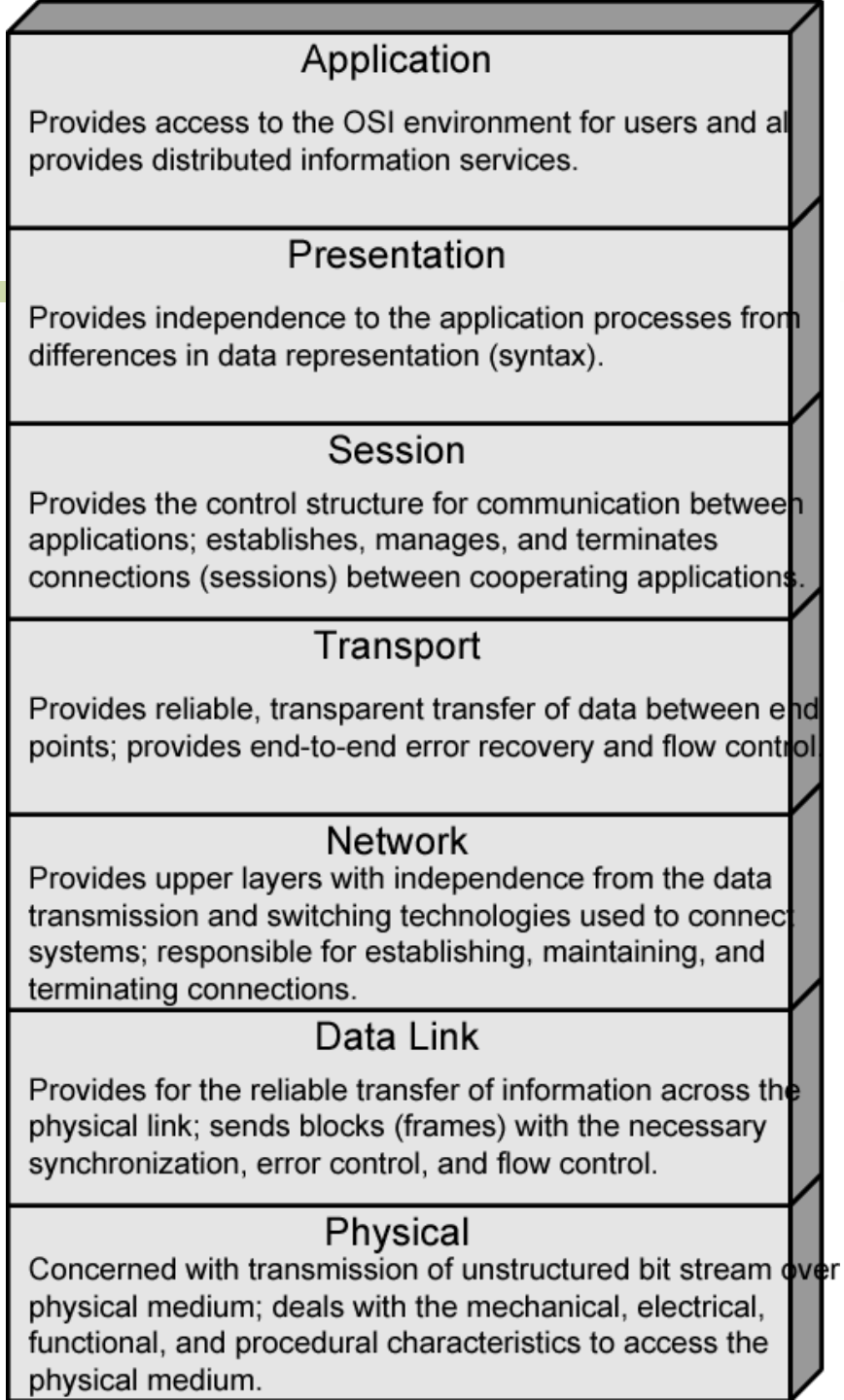
- Required for devices to communicate
- Vendors have more marketable products
- Customers can insist on standards based equipment
- Two standards:
  - OSI Reference model
    - Never lived up to early promises
  - TCP/IP protocol suite
    - Most widely used
- Also: IBM Systems Network Architecture (SNA)

The OSI Model

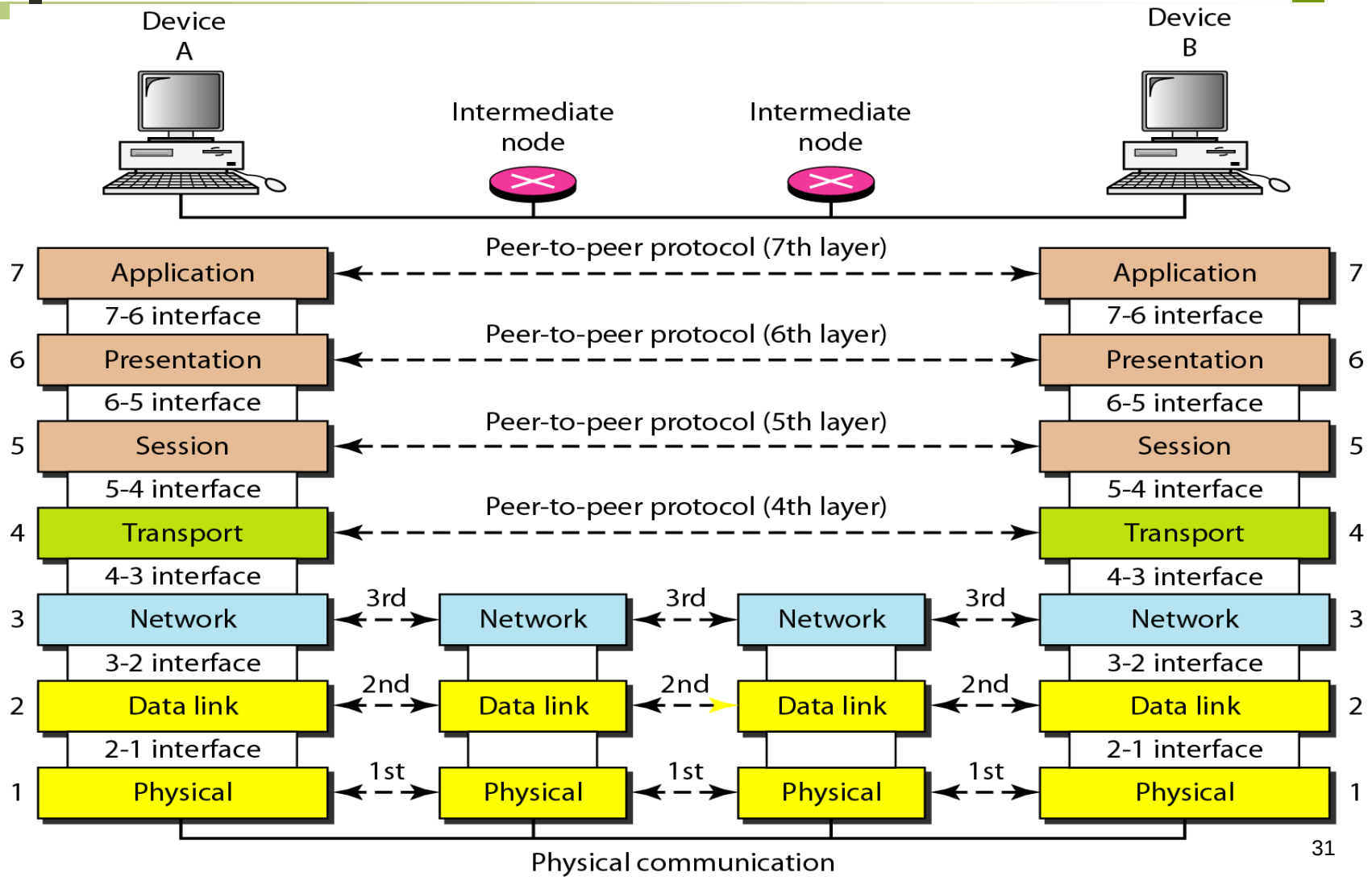
- International Standards Organization (ISO)
  - An organization dedicated to worldwide agreement on international standards.
- Open Systems Interconnection (OSI)
  - An ISO standard/model that covers all aspects of network communications.

OSI Model

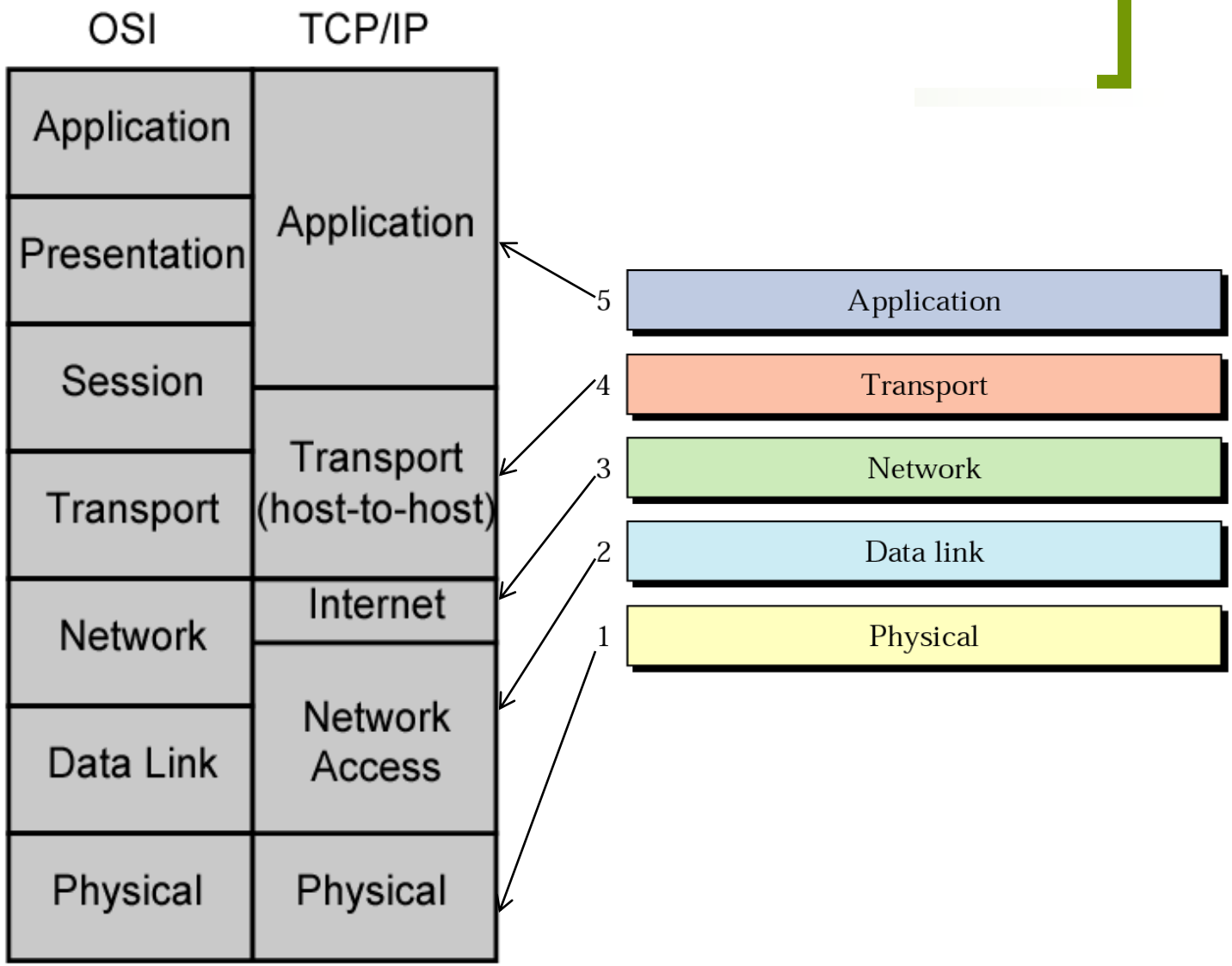
- All
- People
- Seems
- To
- Need
- Data
- Processing



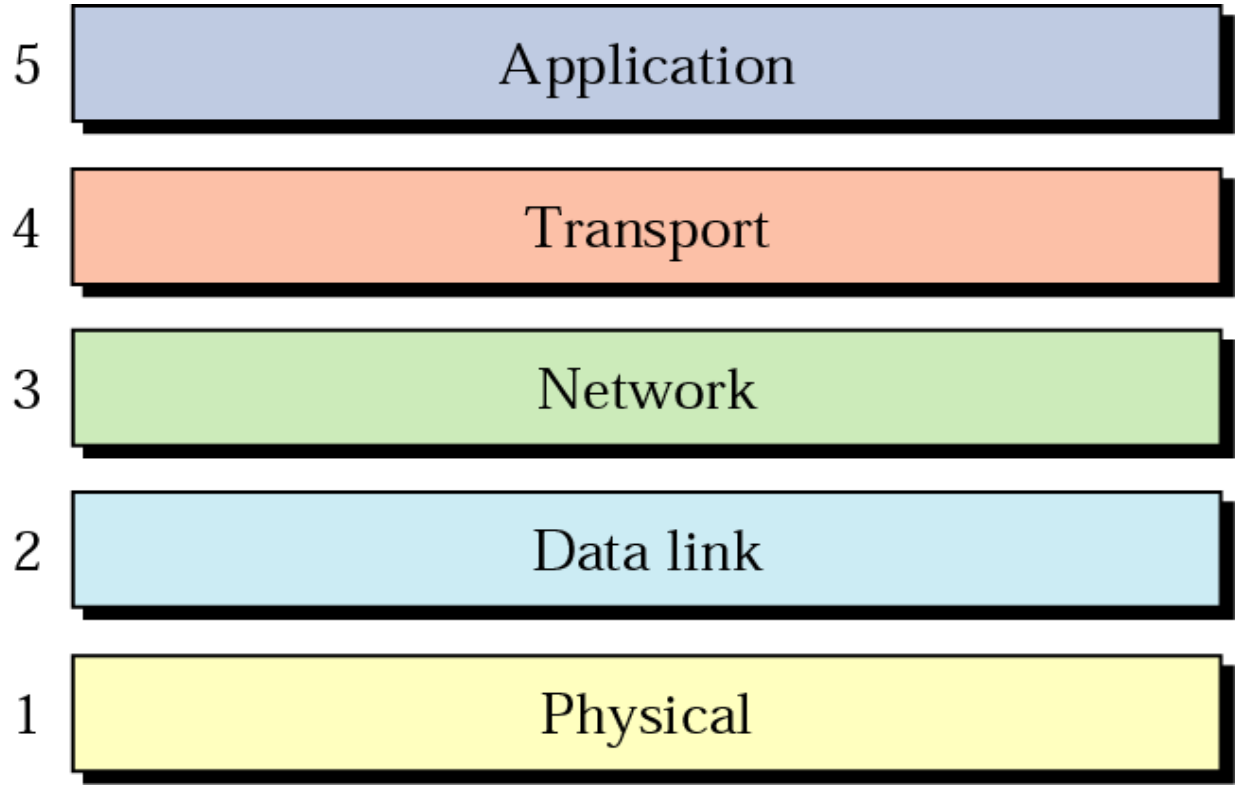
The OSI model



OSI vs. TCP/IP

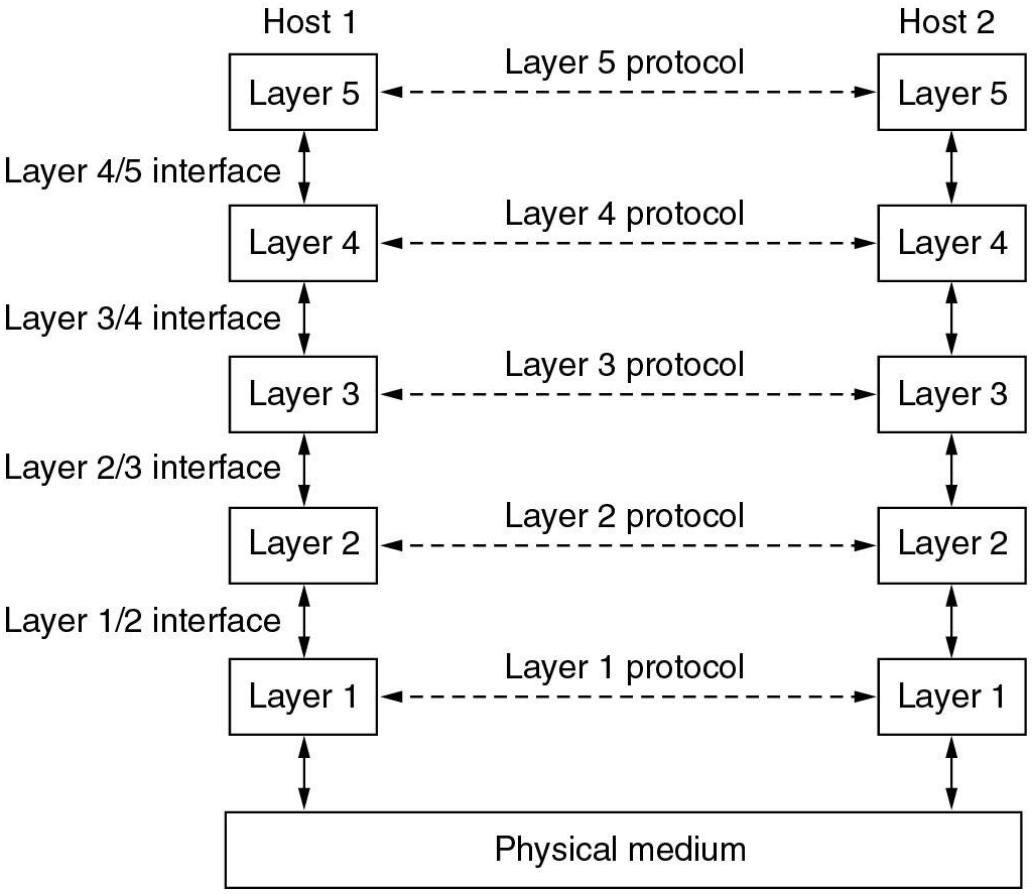

OSI
TCP/IP
Application
Presentation
Session
Transport
Network
Data Link
Physical
Application
Transport (host-to-host)
Internet
Network Access
Physical
5
4
3
2
1
Application
Transport
Network
Data link
Physical

Internet (TCP/IP) Model

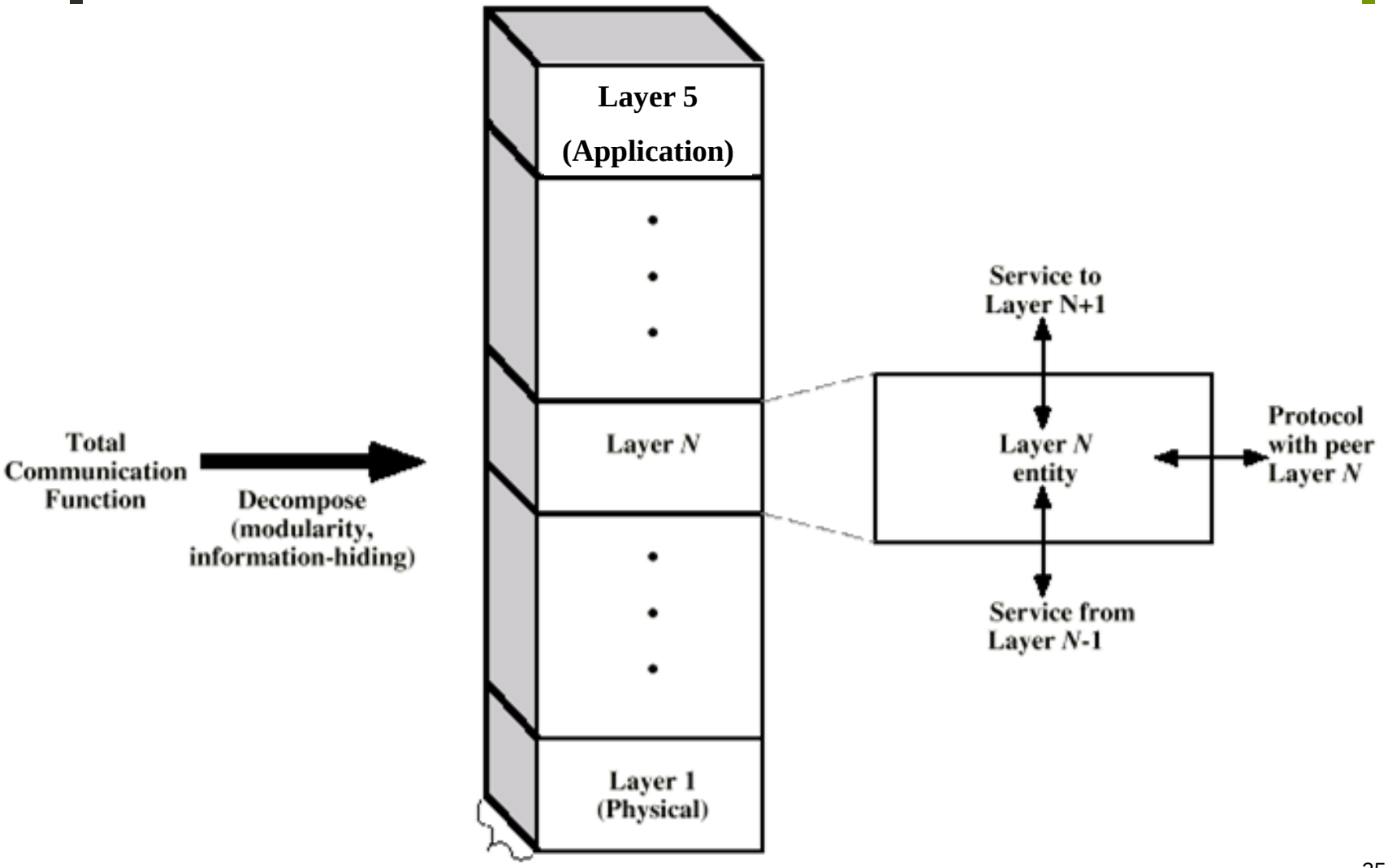


Protocol Hierarchies

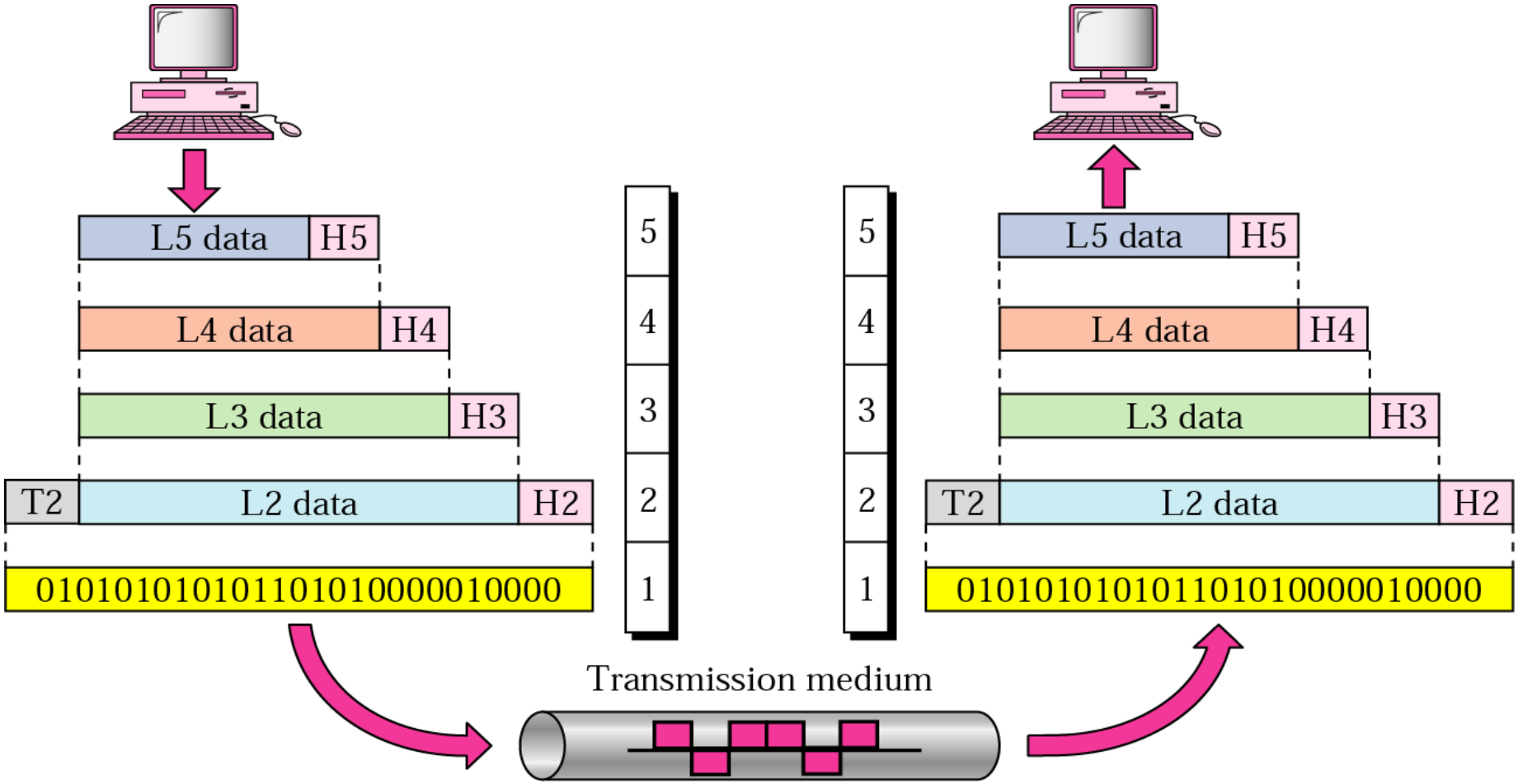
- The entities comprising the corresponding layers on different machines are called peers.



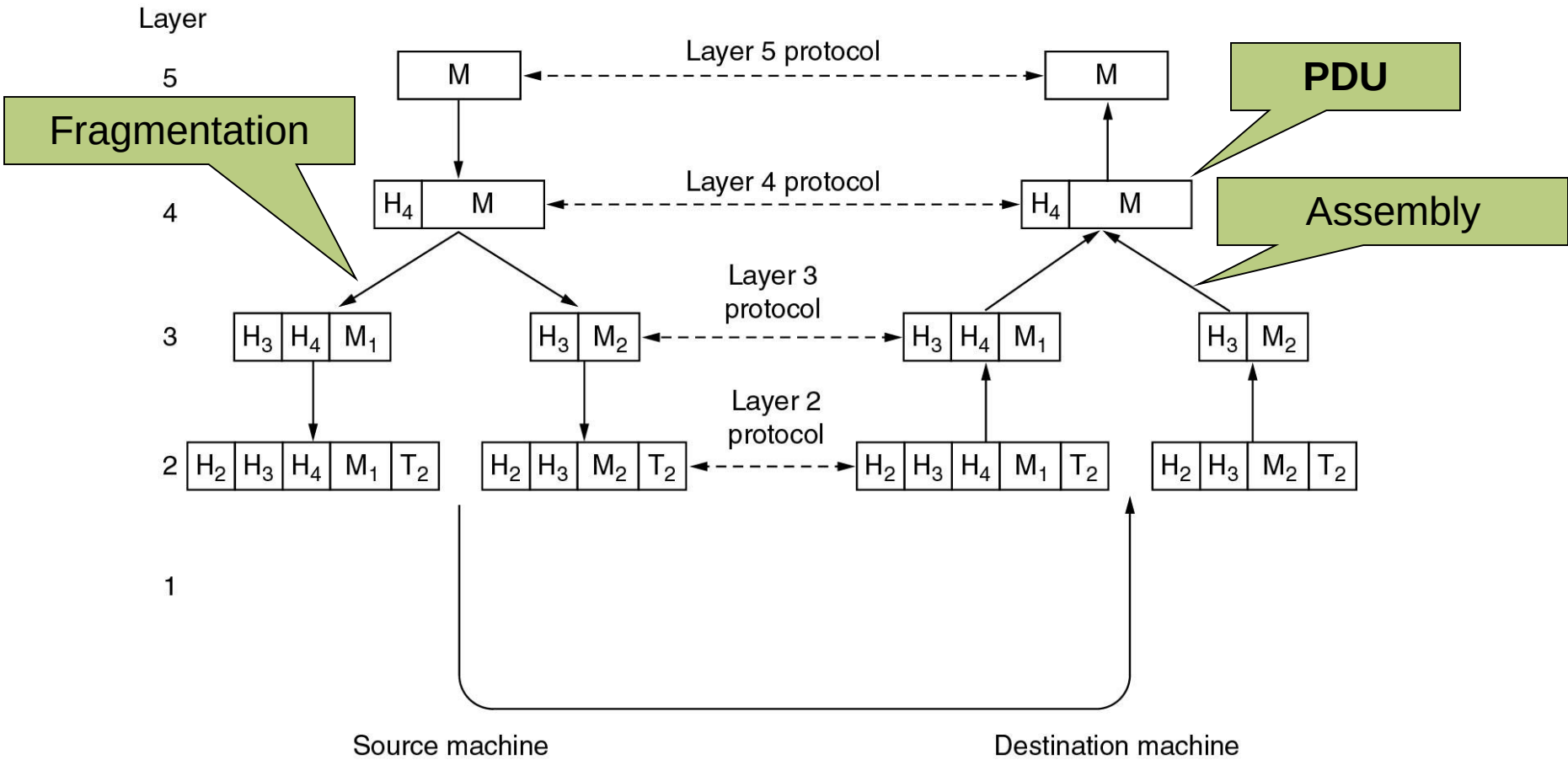
Protocol Hierarchies



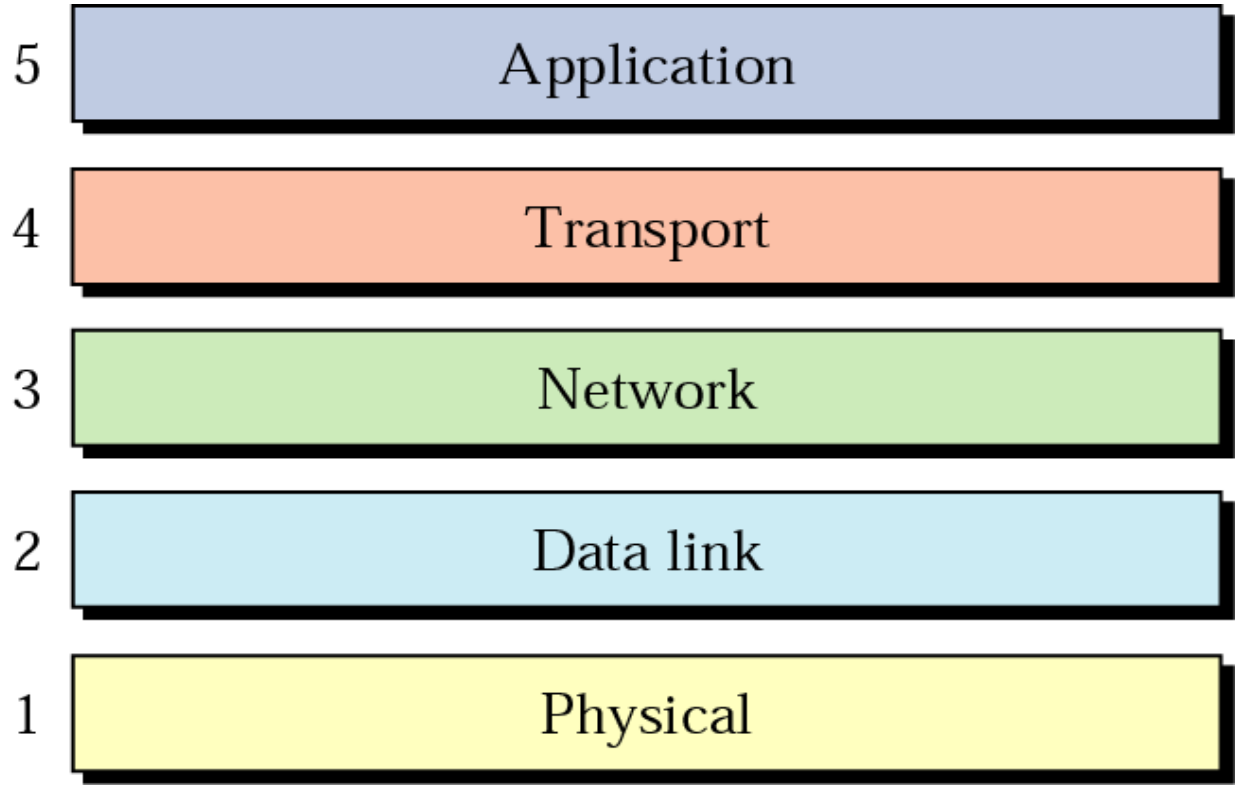
Protocol Hierarchies



Protocol Hierarchies

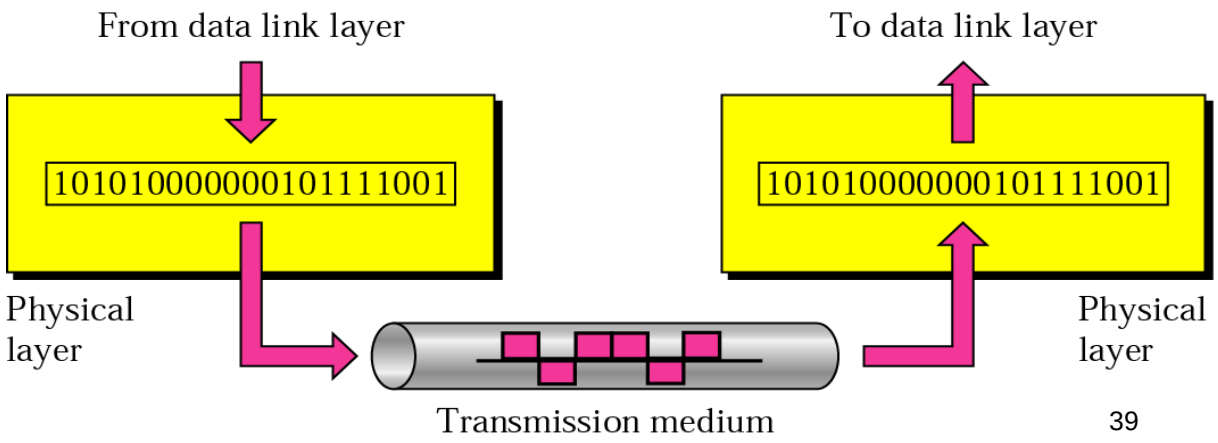


Internet Layers



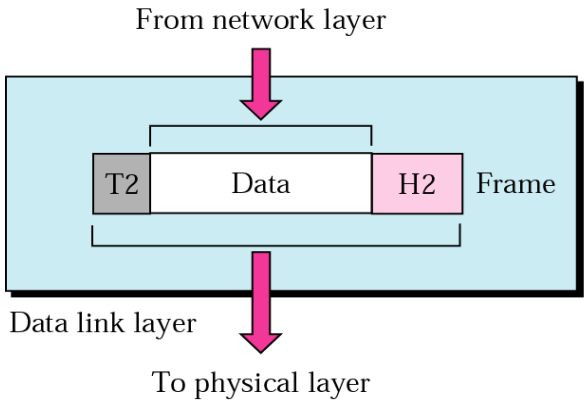
Physical Layer

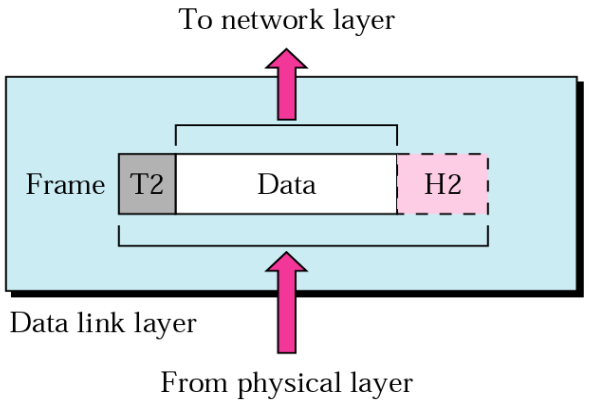
- It is responsible for transmitting individual bits from one node to the next.
- It is mainly concerned with …
  - Characteristics of transmission medium
  - Signal levels
  - Data rates



Data Link Layer

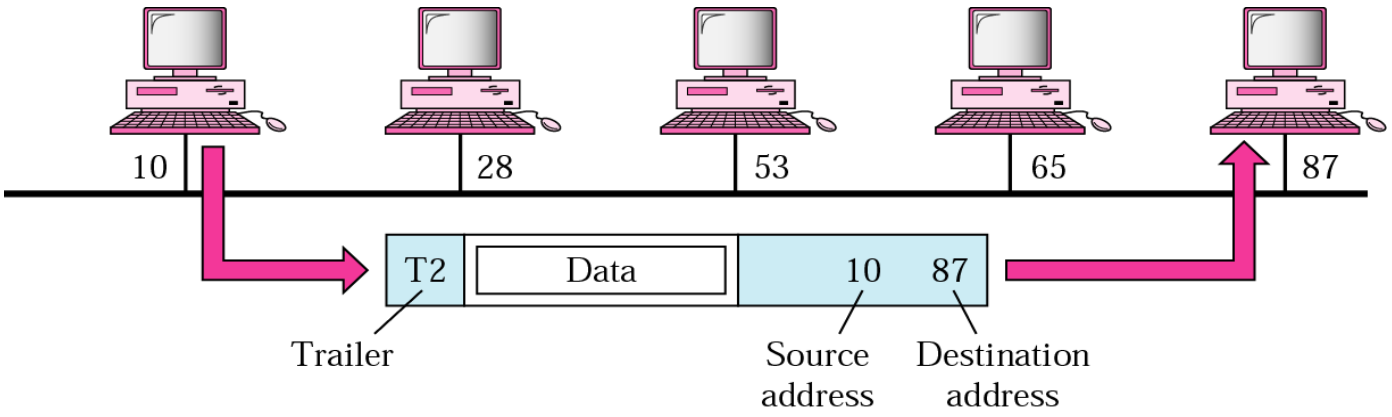
- It is responsible for transmitting frames from one node to the next.
- Its major duties are …
  - Framing
  - Physical Addressing
  - Flow Control
  - Error Control
  - Access Control



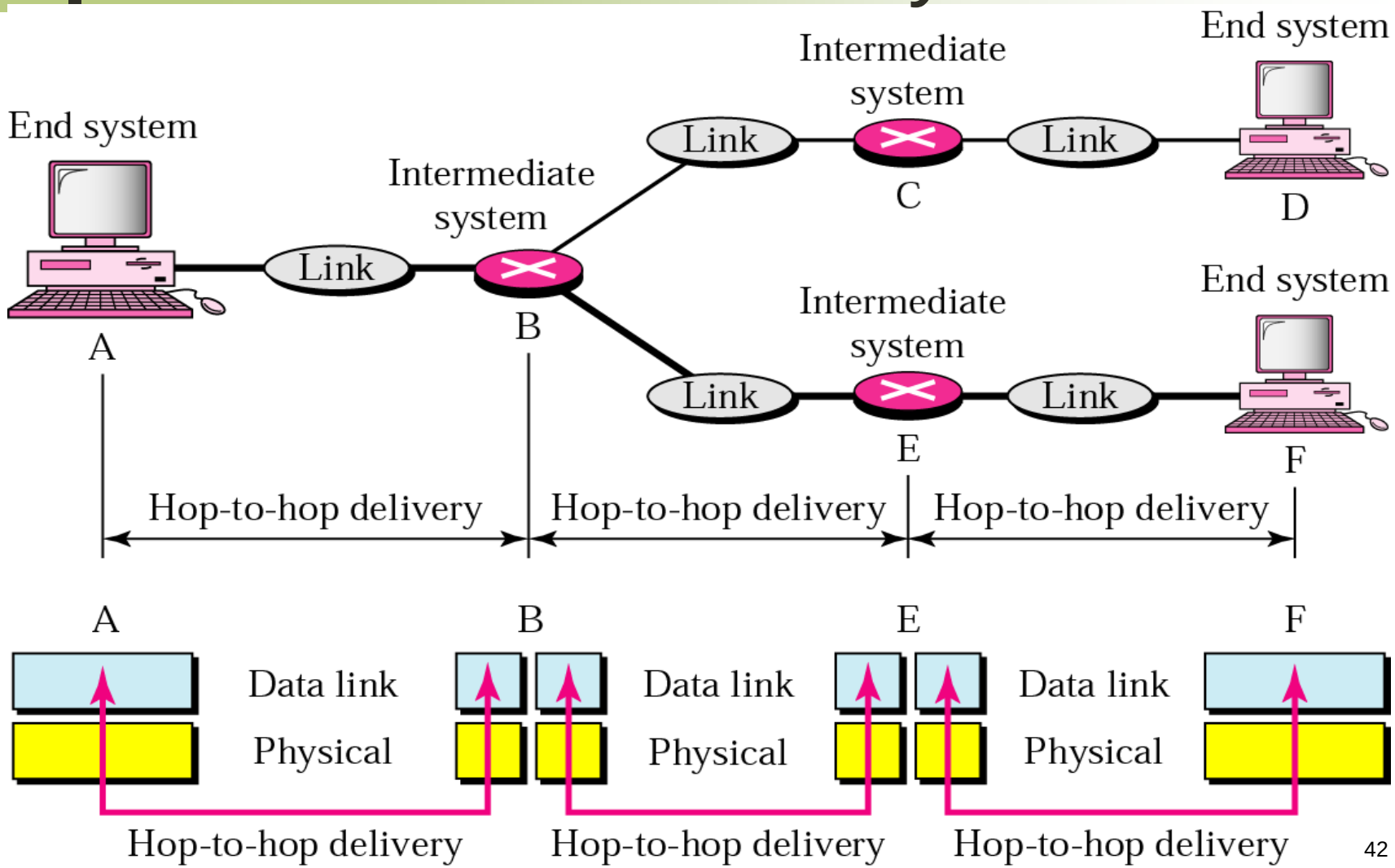


Node to node delivery

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

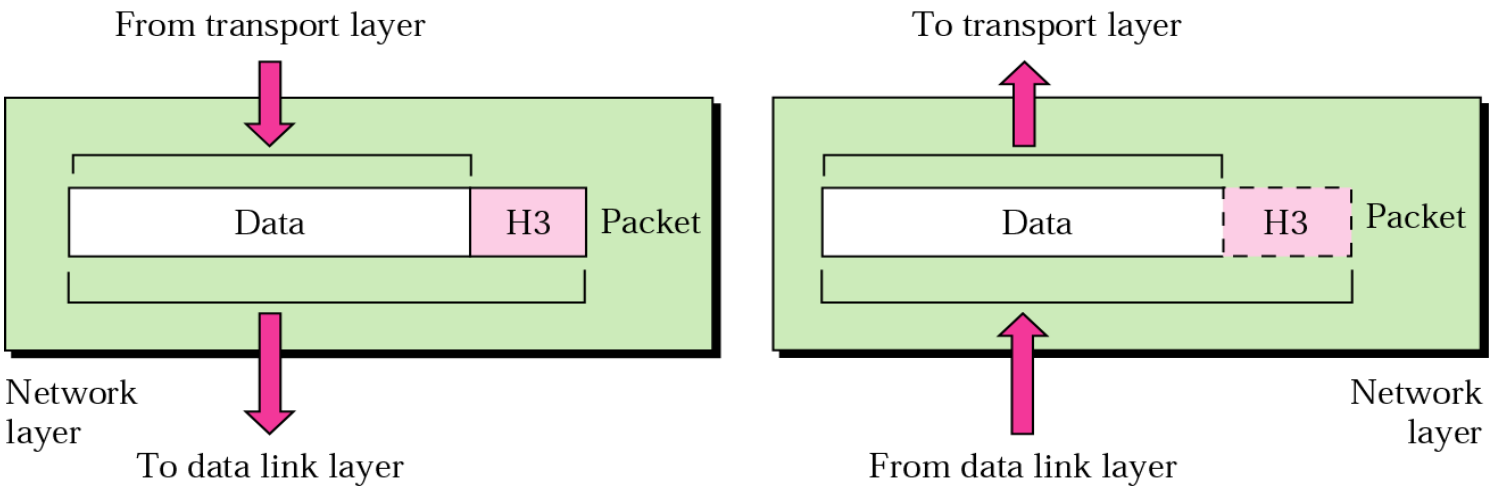


Node to node delivery

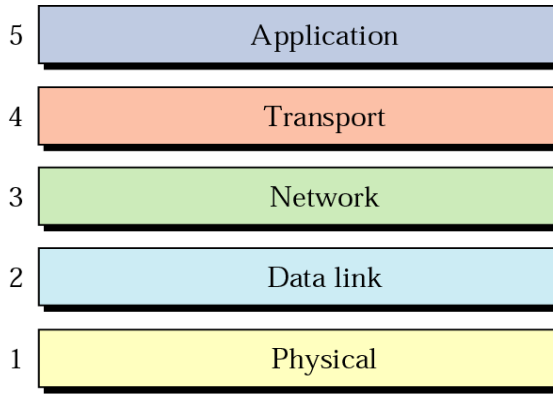


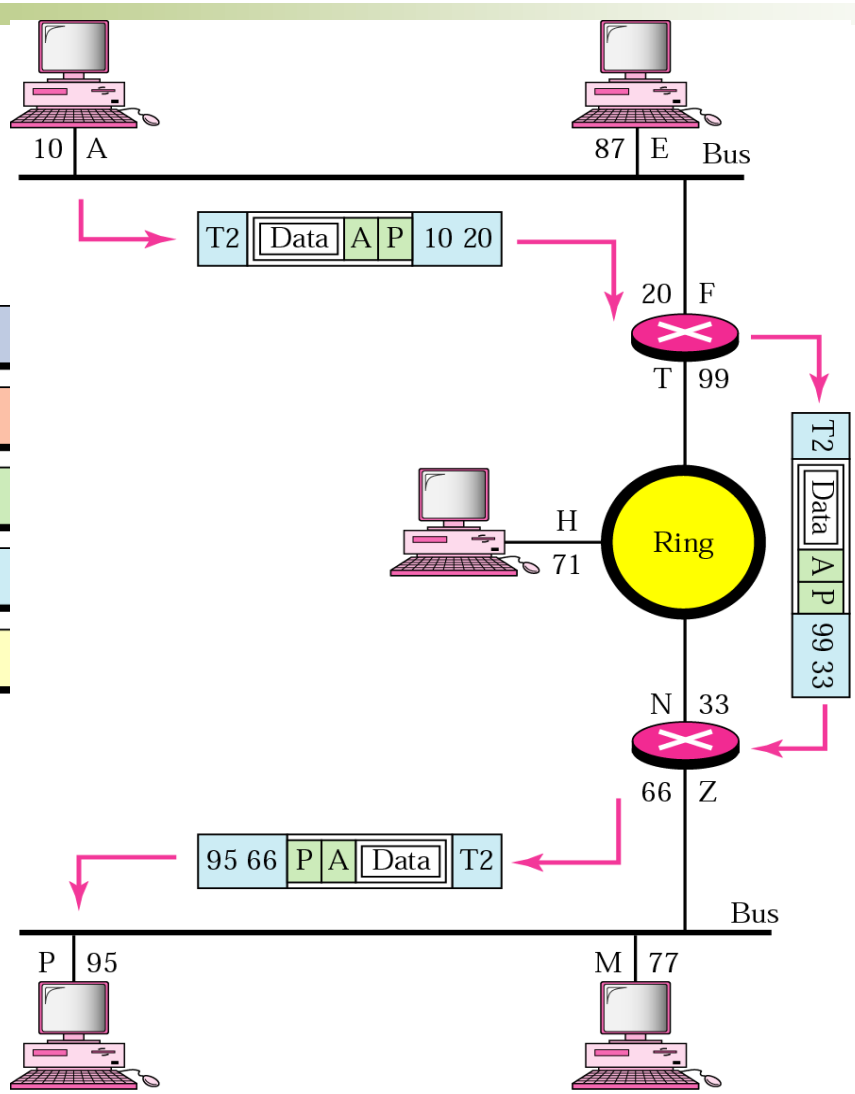
Network Layer

- Responsible for the delivery of packets from the original source to the final destination.
- Performs routing functions across multiple networks
- Implemented in end systems and routers

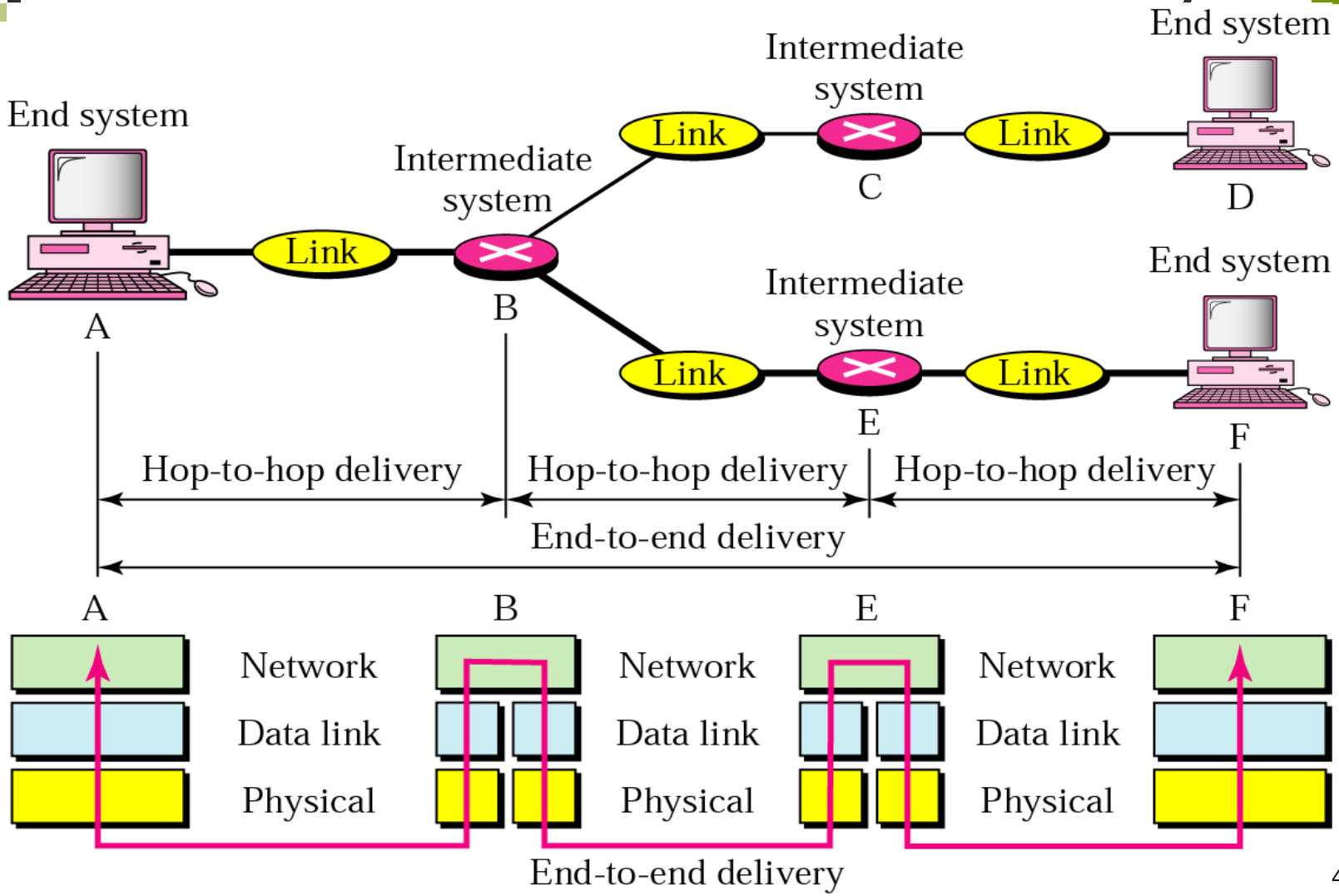


Source to destination delivery



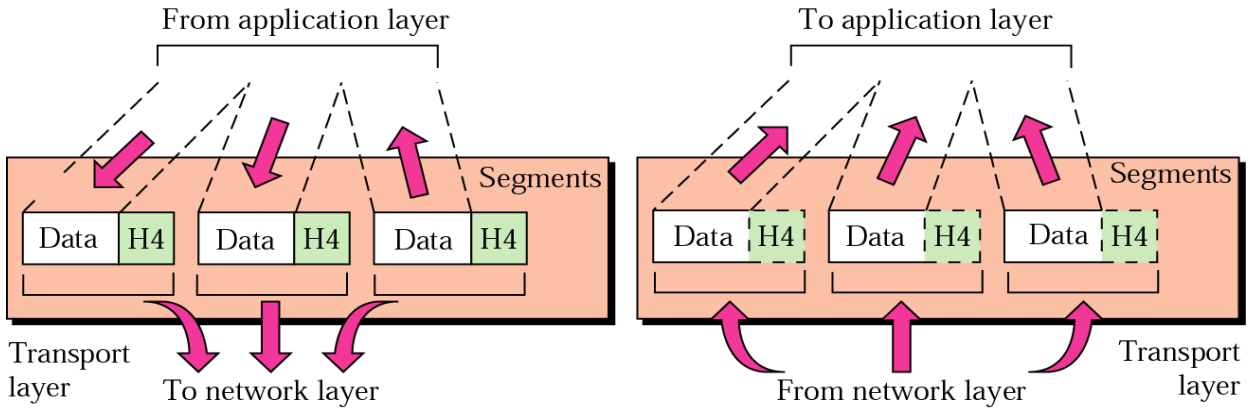


Source to destination delivery

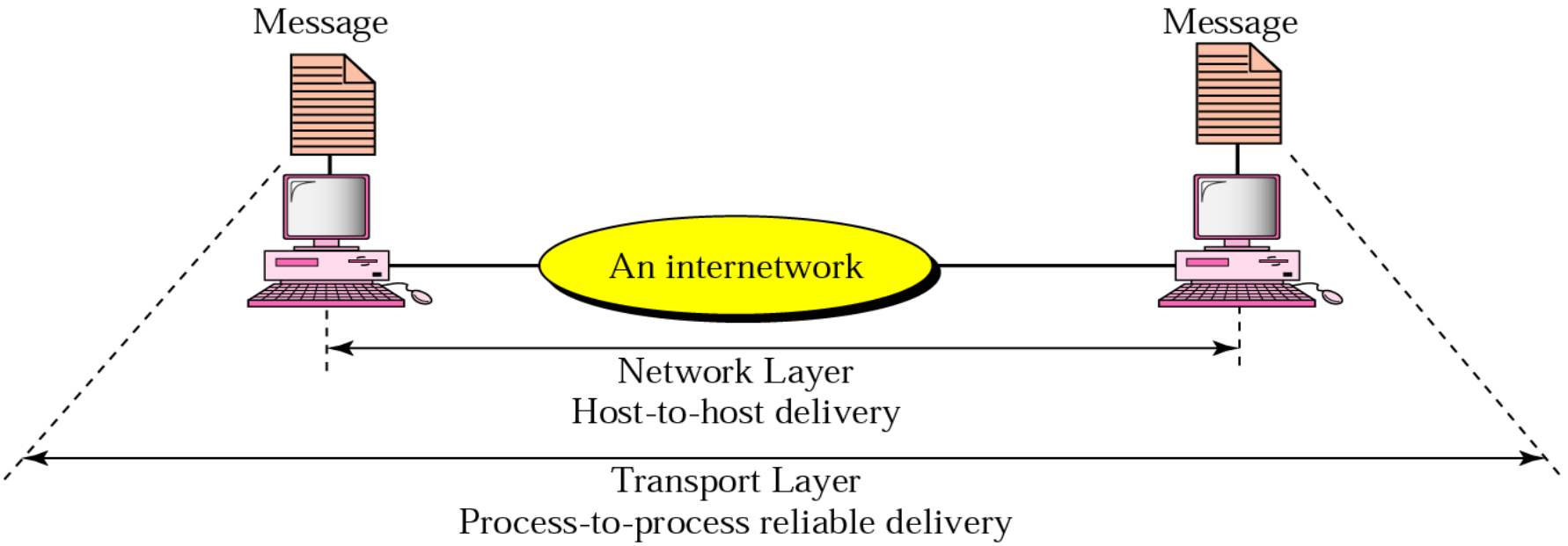


Transport Layer

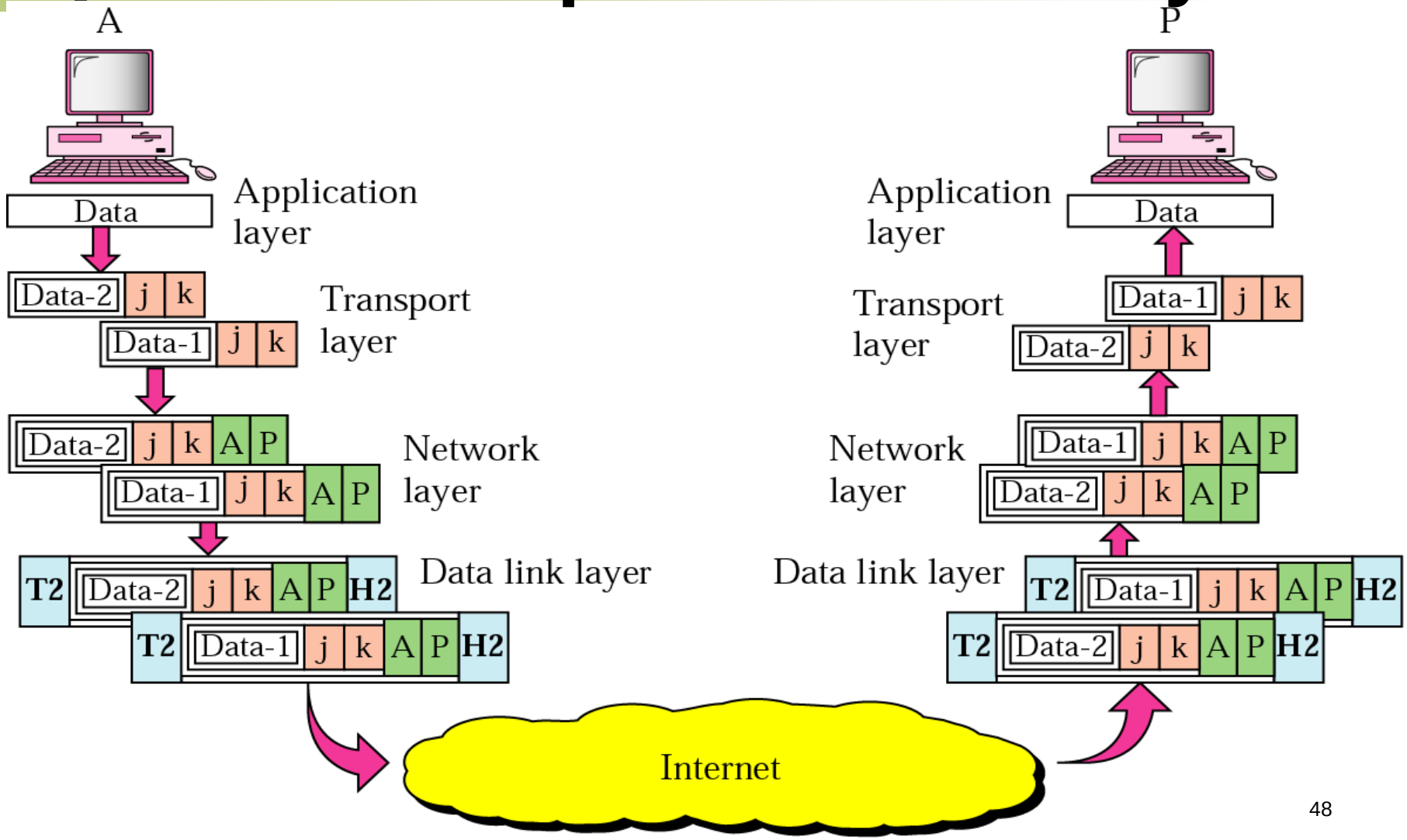
- It is responsible for delivery of a message from one process to another.
- Its major functions are …
  - Port Addressing
  - Connection Control
  - Flow Control
  - Error Control



Process to process delivery

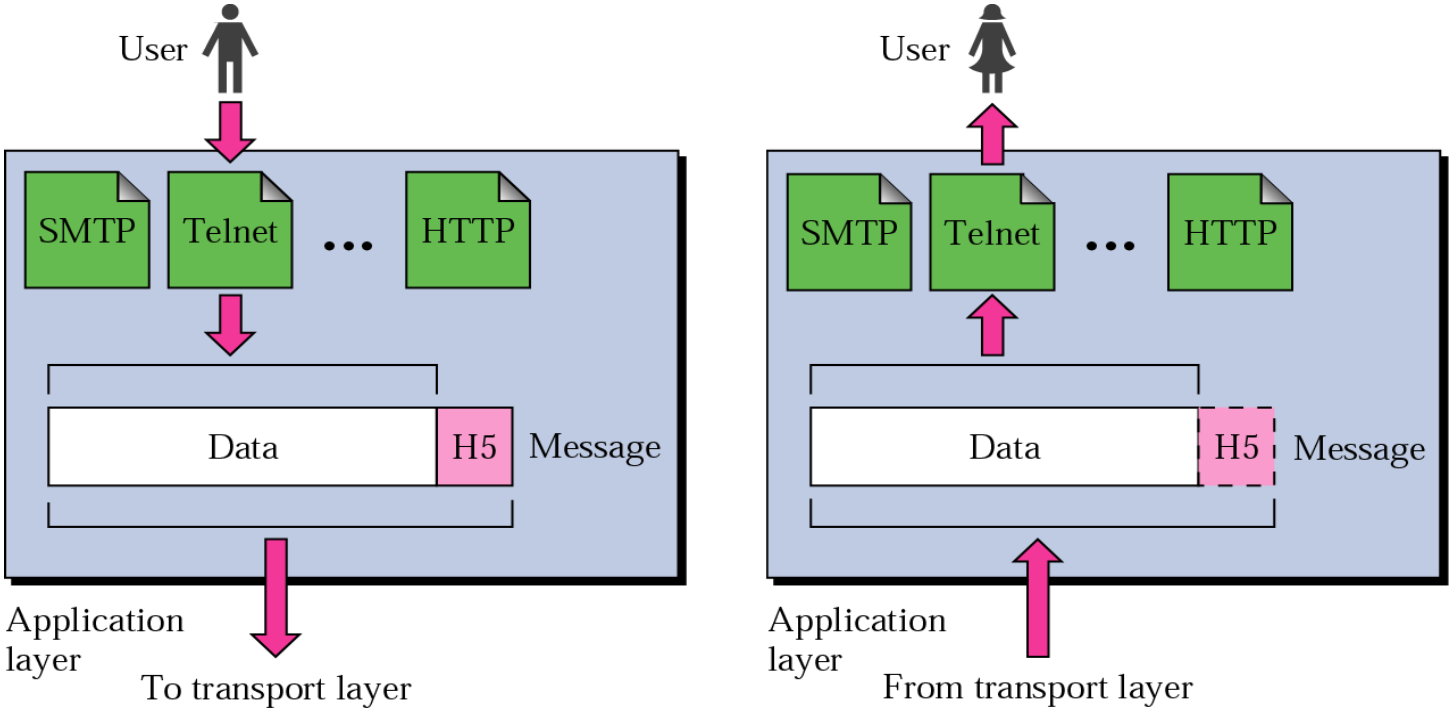


Process to process delivery

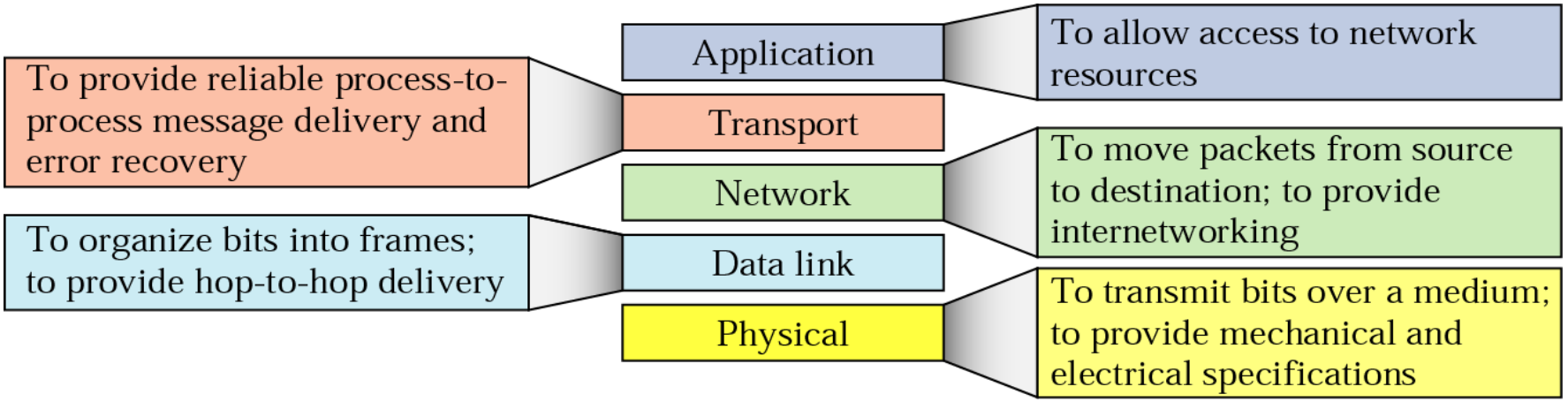


Application Layer

- It is responsible for providing services to the user.

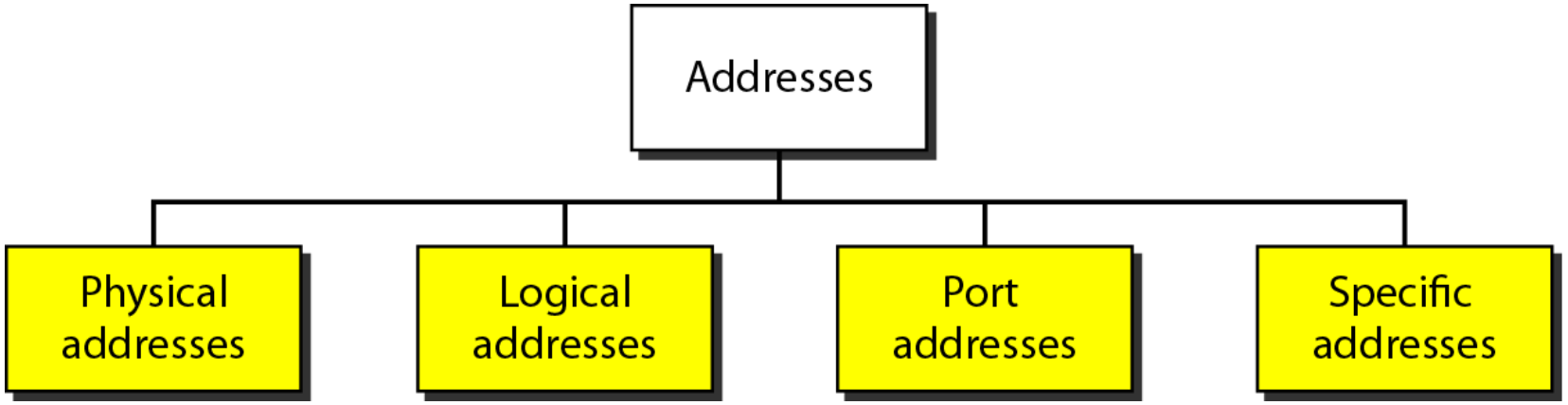


Summary

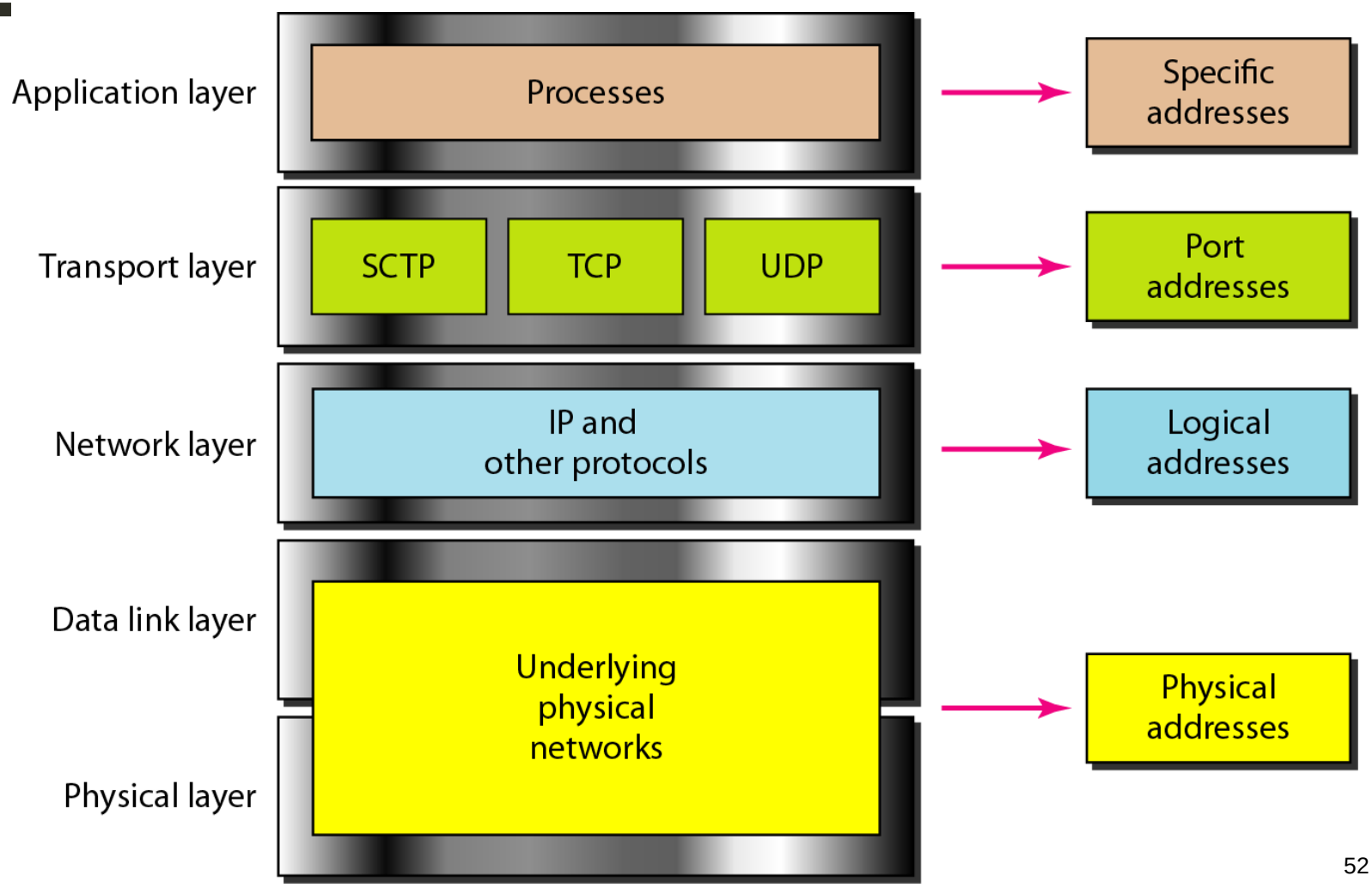

Application
Transport
Network
Data link
Physical
To provide reliable process-to-process message delivery and error recovery
To organize bits into frames; to provide hop-to-hop delivery
To allow access to network resources
To move packets from source to destination; to provide internetworking
To transmit bits over a medium; to provide mechanical and electrical specifications

Addresses

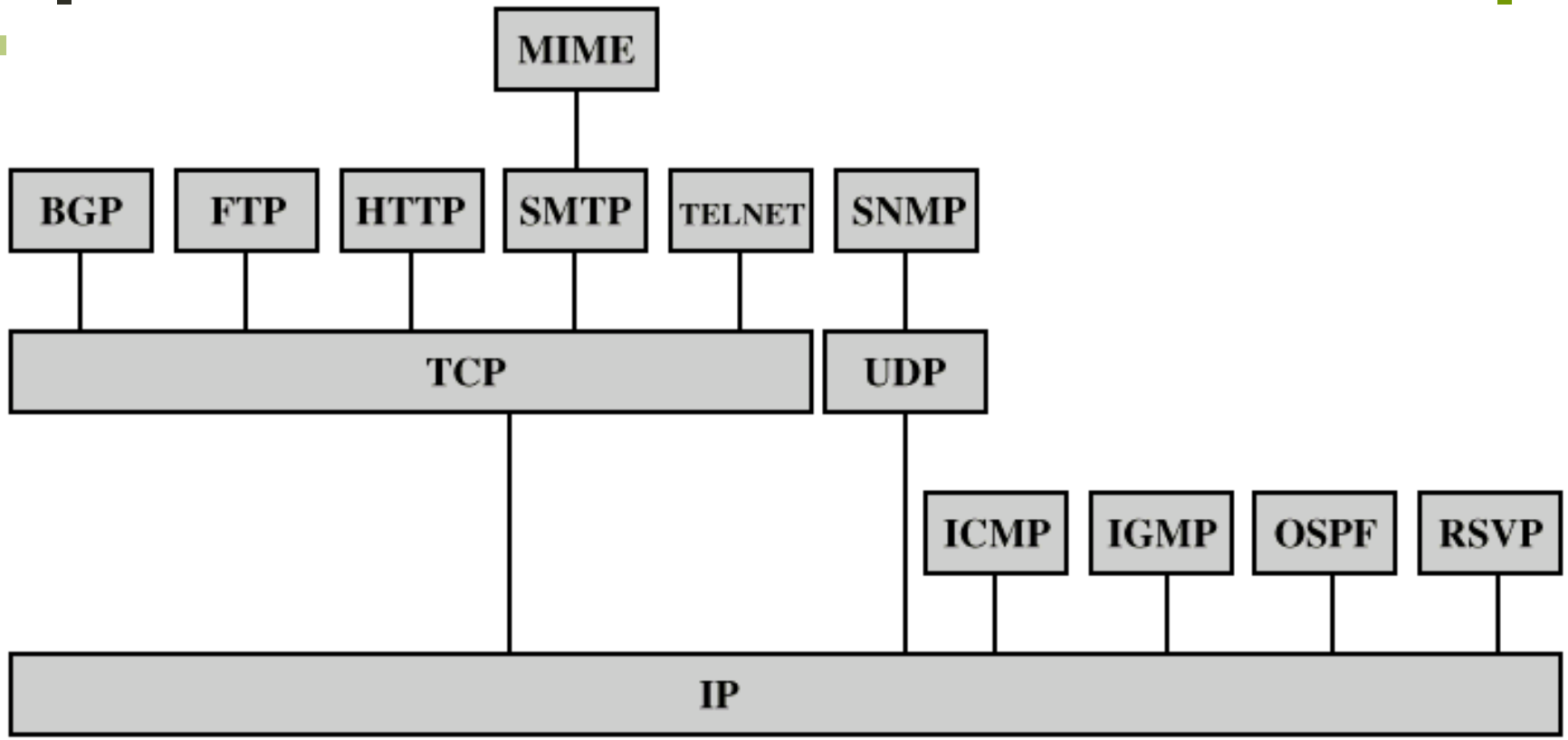
- Four levels of addresses are used in an internet employing the TCP/IP protocols:



Addresses


Application layer
Processes
Specific addresses
Transport layer
SCTP
TCP
UDP
Port addresses
Network layer
IP and other protocols
Logical addresses
Data link layer
Underlying physical networks
Physical addresses
Physical layer

Some Protocols in TCP/IP Suite



BGP = Border Gateway Protocol
FTP = File Transfer Protocol
HTTP = Hypertext Transfer Protocol
ICMP = Internet Control Message Protocol
IGMP = Internet Group Management Protocol
IP = Internet Protocol
MIME = Multi-Purpose Internet Mail Extension

OSPF = Open Shortest Path First
RSVP = Resource ReSerVation Protocol
SMTP = Simple Mail Transfer Protocol
SNMP = Simple Network Management Protocol
TCP = Transmission Control Protocol
UDP = User Datagram Protocol