

Data Communications and Networking Overview

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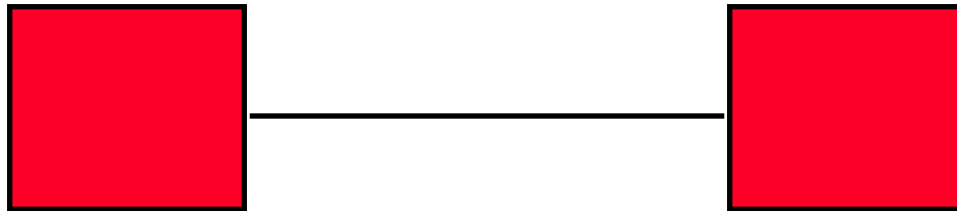
These slides are available on-line at:
<http://www.cse.wustl.edu/~jain/cse473-05/>



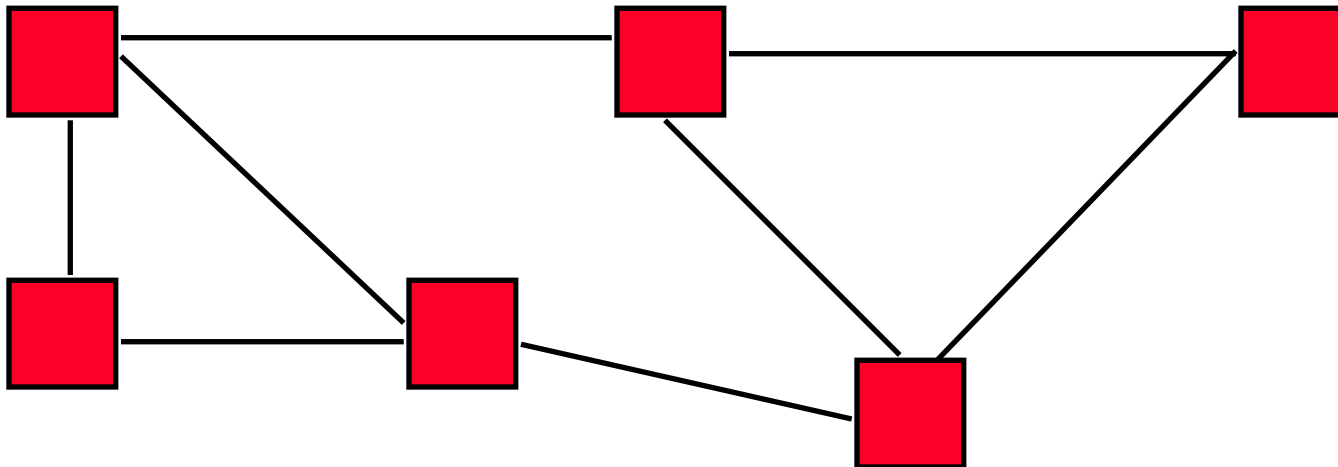
- ❑ Data Comm vs Networking vs Distributed Systems
- ❑ Communications Tasks
- ❑ Types of Networks
- ❑ Protocol Layers
- ❑ ISO/OSI Reference Model
- ❑ TCP/IP Reference Model

Data Communication vs Networking

- Communication: Two Nodes. Mostly EE issues.

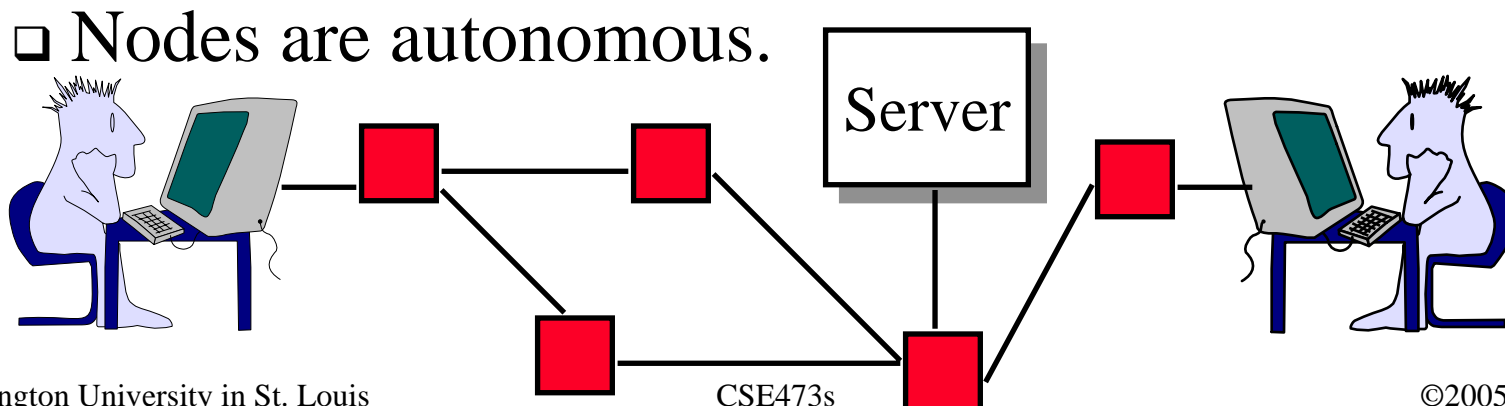


- Networking: Two or more nodes. More issues, e.g., routing

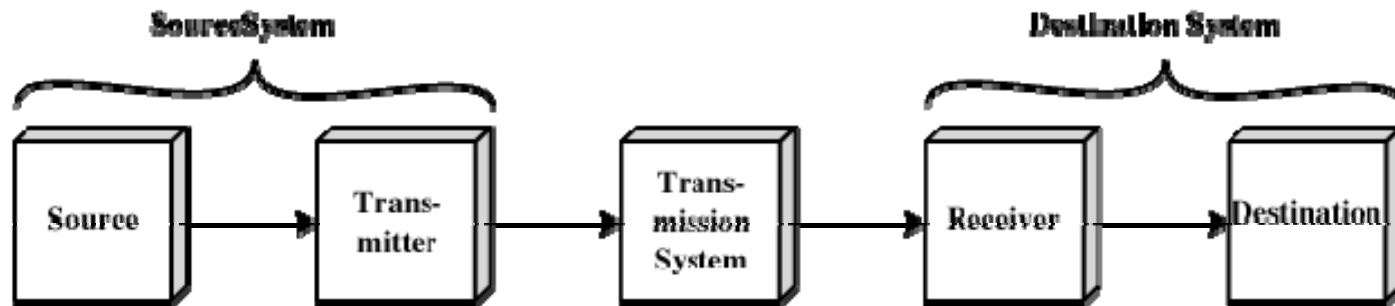


Distributed Systems vs Networks

- ❑ Distributed Systems:
 - ❑ Users are unaware of underlying structure.
E.g., trn instead of \n\bone\0\trn
 - ❑ Mostly operating systems issues.
 - ❑ Nodes are generally under one organization's control.
- ❑ Networks: Users specify the location of resources.
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Simplified Communications Model



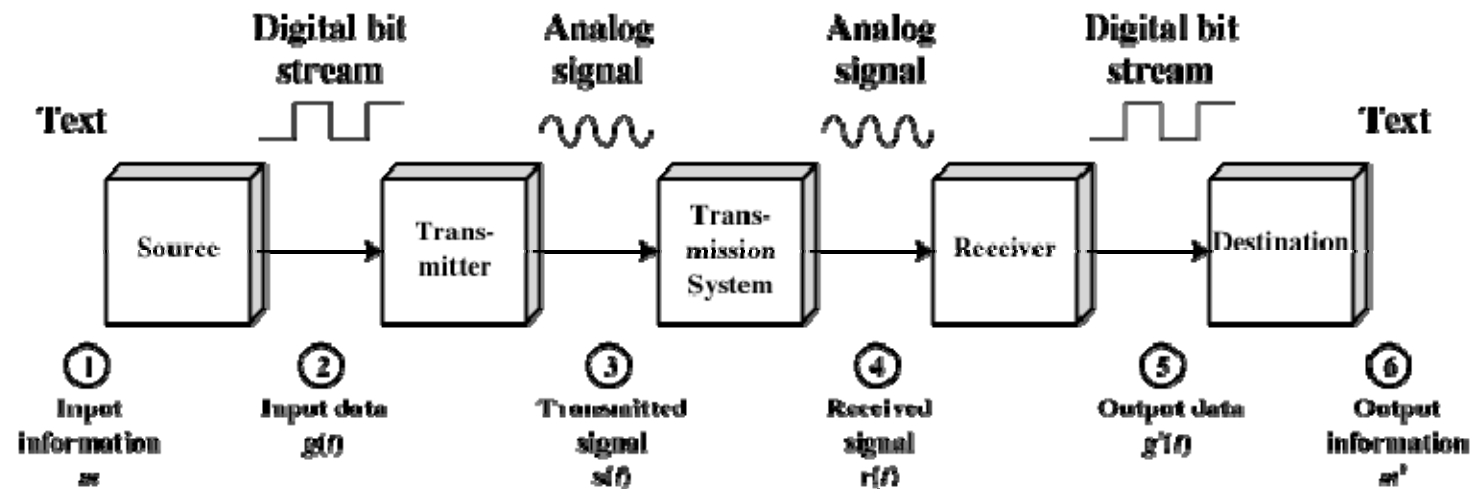
(a) General block diagram



(b) Example

- ❑ Transmitter: encodes the information

Data Communications: Example



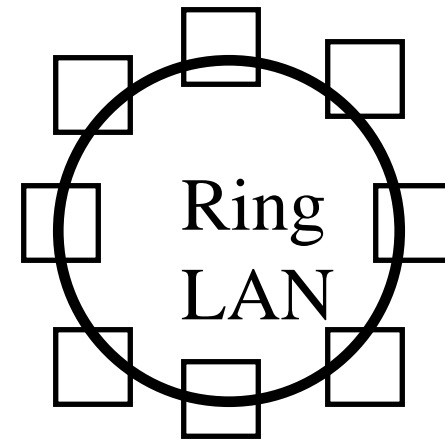
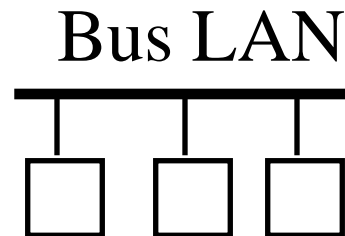
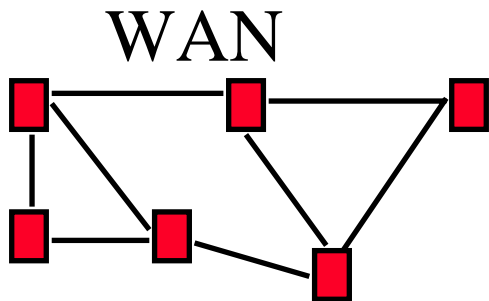
- ❑ Modem is used to transmit/receive digital information over analog phone system

Communications Tasks

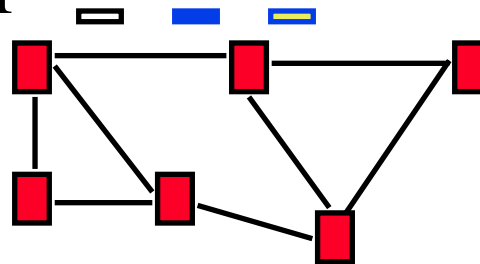
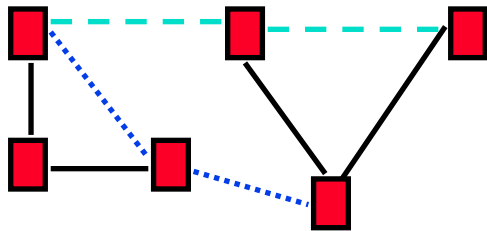
- ❑ Transmission System Utilization (Multiplexing)
- ❑ Interfacing
- ❑ Signal generation (Coding)
- ❑ Synchronization between transmitter and receiver
- ❑ Exchange management (Connection Management)
- ❑ Error detection and correction
- ❑ Flow control
- ❑ Addressing
- ❑ Routing
- ❑ Recovery
- ❑ Message formatting
- ❑ Security
- ❑ Network Management

Types of Networks

- Point to point vs Broadcast



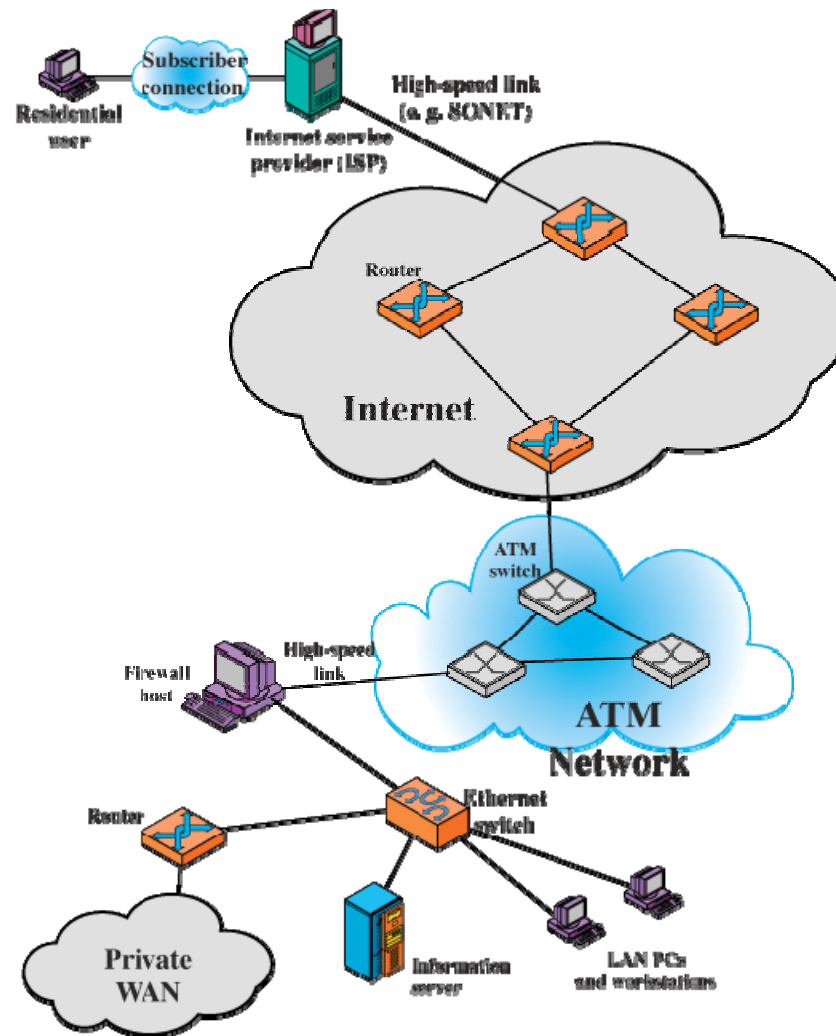
- Circuit switched vs packet switched



Types of Networks (Cont)

- ❑ Enterprise vs Telecom Networks
 - Ethernet is the most common interface in Enterprise
 - Frame relay and ATM are common in Telecom Networks
- ❑ Local Area Networks (LAN) 0-2 km, Single Ownership
- Metropolitan Area Networks (MAN) 2-50 km,
- Wide Area Networks (WAN) 50+ km
- ❑ Telecom Networks:
 - ❑ Access: Between subscriber and the service provider
 - ❑ Metro: Covering a city
 - ❑ Core: Between cities

An Example Configuration

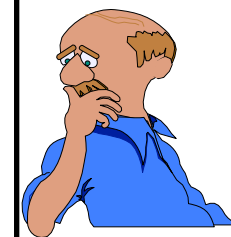


Protocol Layers

- ❑ Problem: Philosophers in different countries speak different languages. The Telex system works only with English.

I believe there is a God!

Philosopher



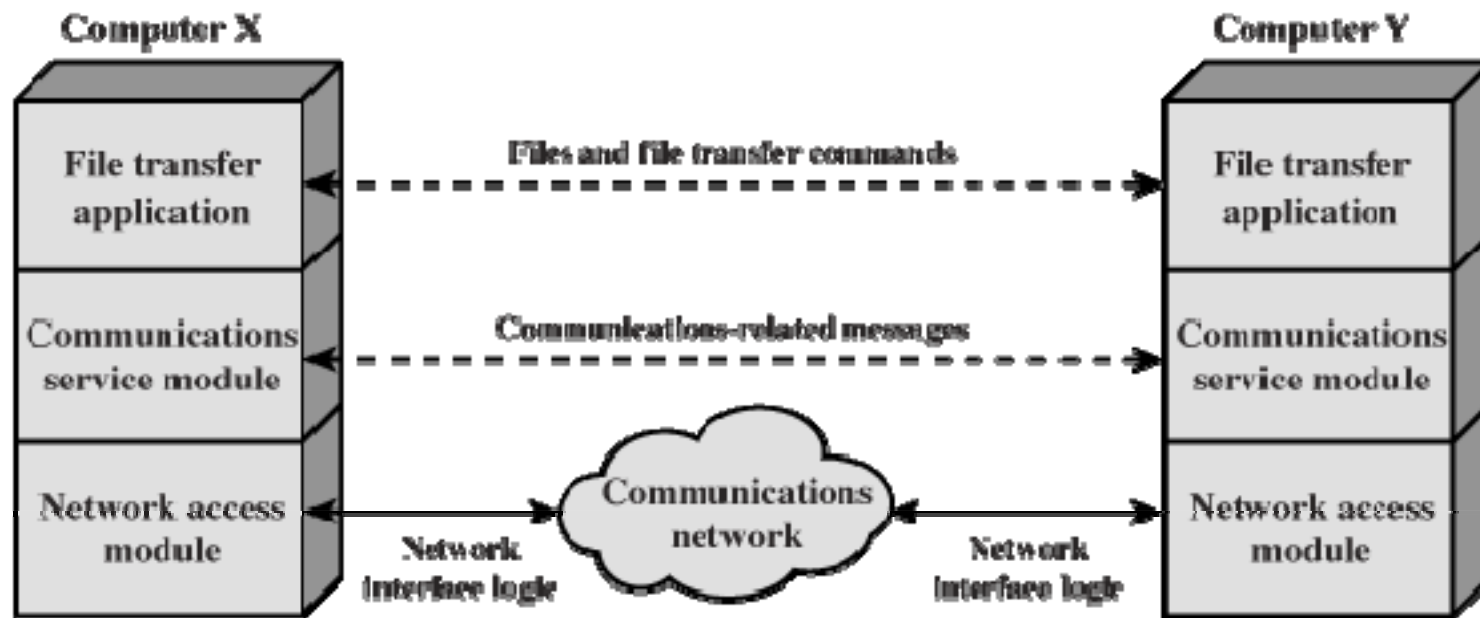
Translator



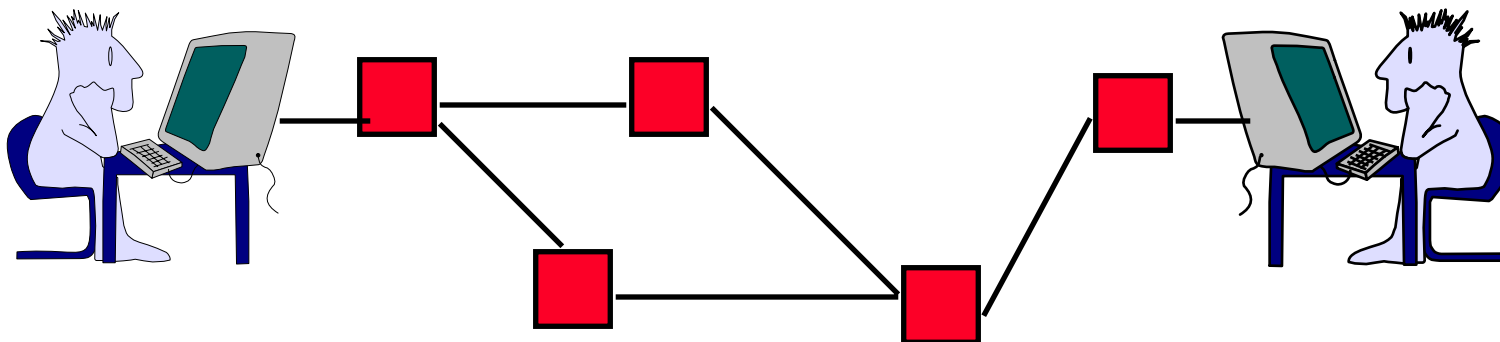
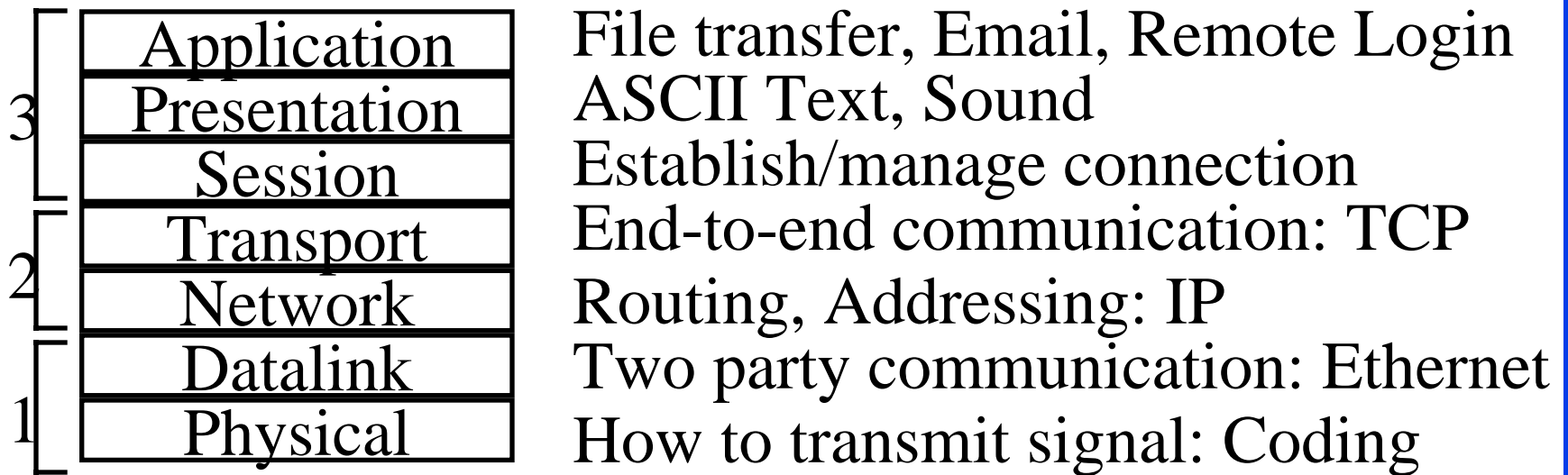
Secretary



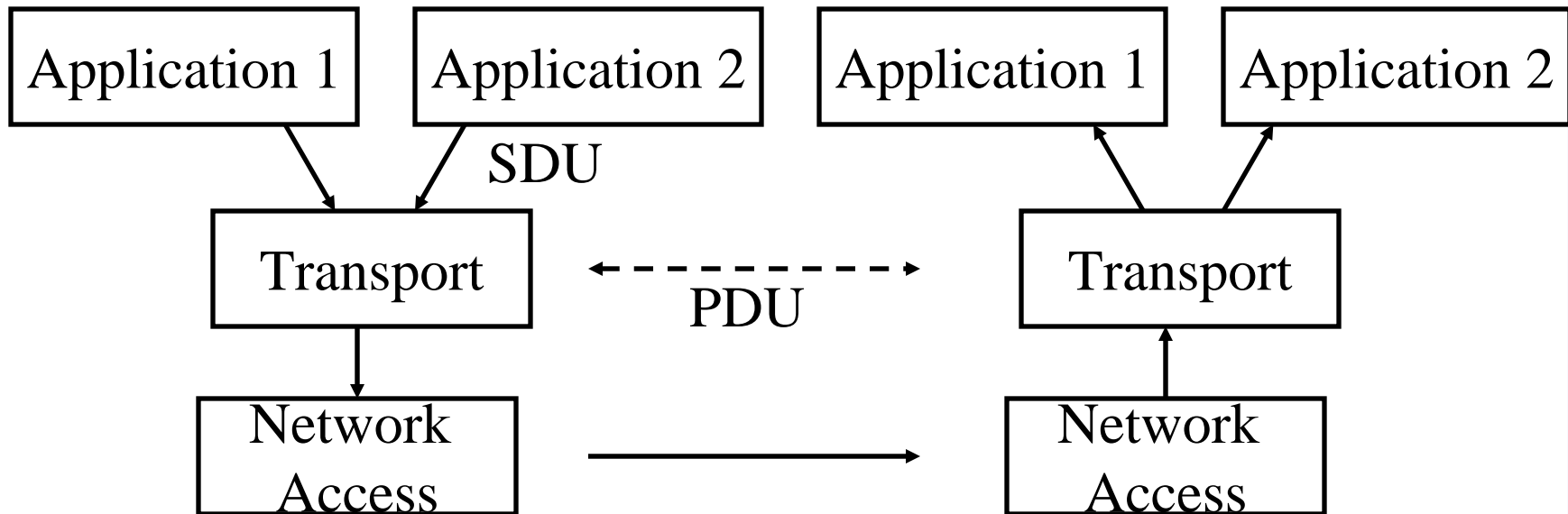
A Sample Protocol Architecture



ISO/OSI Reference Model

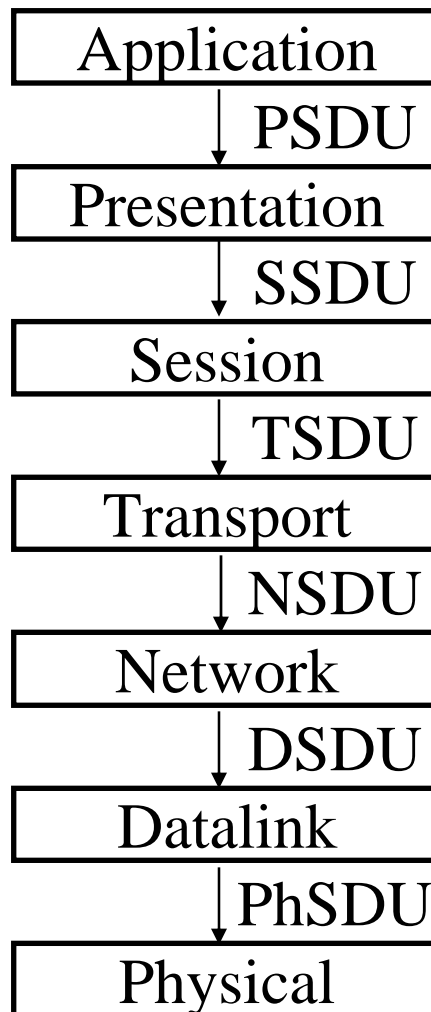


Service and Protocol Data Units

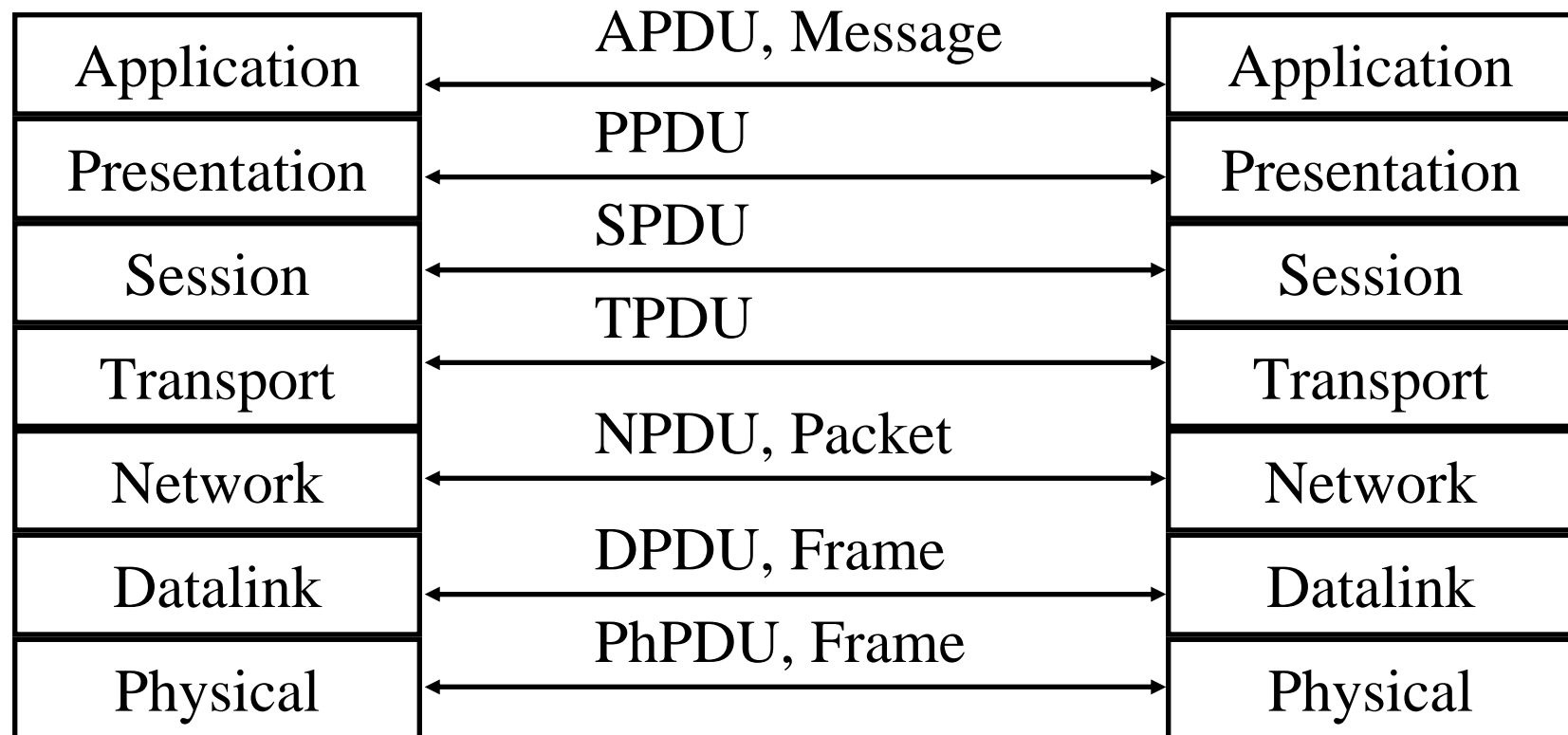


- ❑ Service Access Points (SAPs)
- ❑ Service Data Units (SDUs)
- ❑ Protocol Data Units (PDUs)

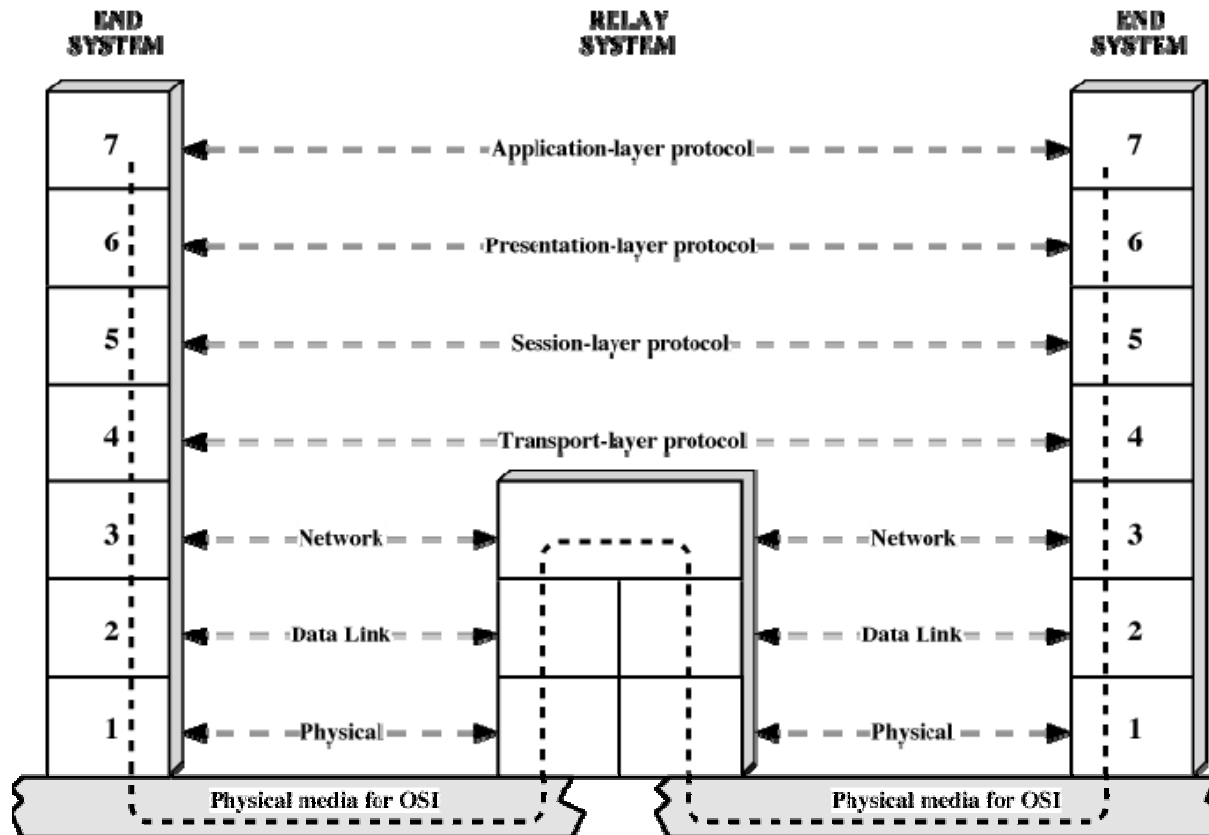
Service Data Unit (SDU)



Protocol Data Unit (PDU)

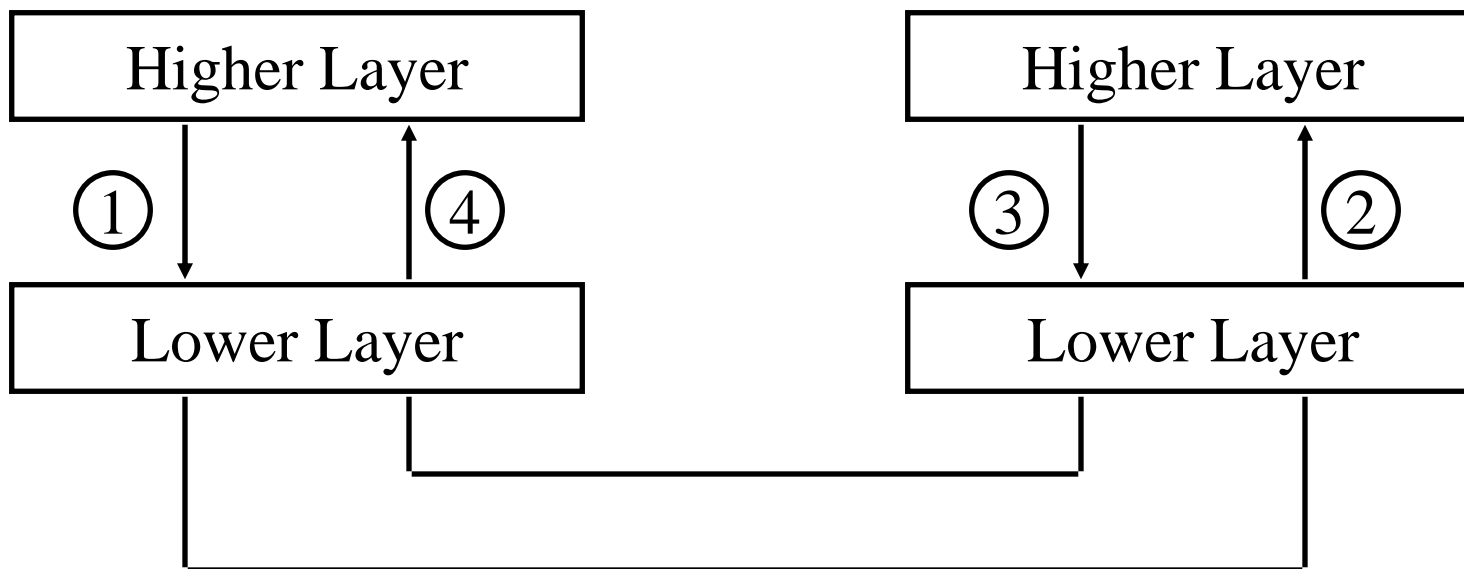


Use of a Relay



Service Primitives

- Indication = Interrupt



1. Request

2. Indication

3. Response

4. Confirm

Unconfirmed service: No confirmation or response

TCP/IP Reference Model

- ❑ TCP = Transport Control Protocol
- ❑ IP = Internet Protocol (Routing)

TCP/IP Ref Model TCP/IP Protocols

Application	FTP	Telnet	HTTP
Transport	TCP		UDP
Internetwork	IP		
Host to Network	Ethernet	Point-to-Point	Packet Radio
Physical	Coax	Fiber	Wireless

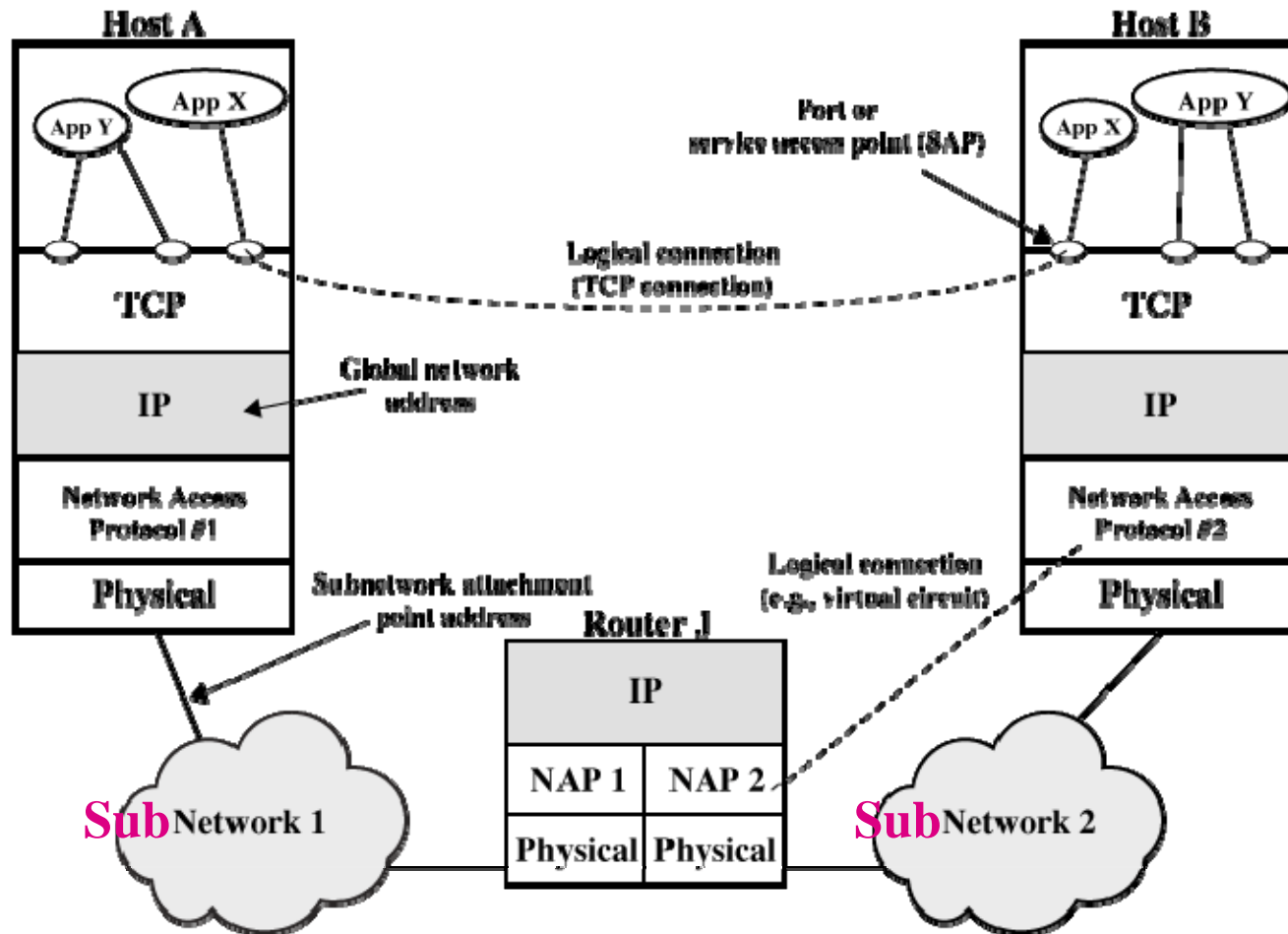
OSI vs TCP/IP

OSI	TCP/IP
Application	Application
Presentation	
Session	
Transport	Transport (host-to-host)
Network	Internet
Data Link	Network Access
Physical	Physical

OSI vs TCP Reference Models

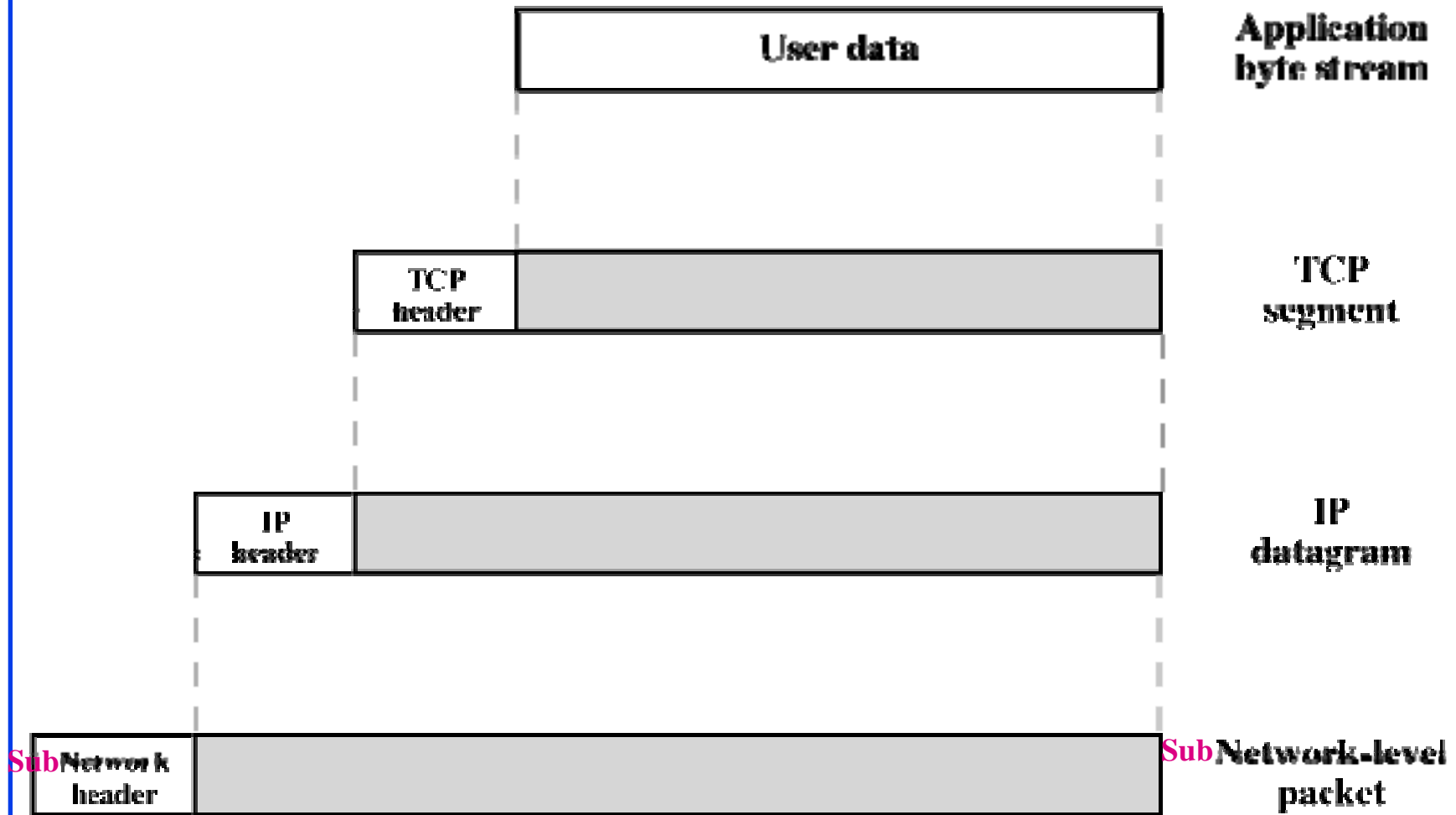
- ❑ OSI introduced concept of services, interface, protocols. These were force-fitted to TCP later
⇒ It is not easy to replace protocols in TCP.
- ❑ In OSI, reference model was done before protocols.
In TCP, protocols were done before the model
- ❑ OSI: Standardize first, build later
TCP: Build first, standardize later
- ❑ OSI took too long to standardize.
TCP/IP was already in wide use by the time.
- ❑ OSI became too complex.
- ❑ TCP/IP is not general. Ad hoc.

TCP/IP Concepts

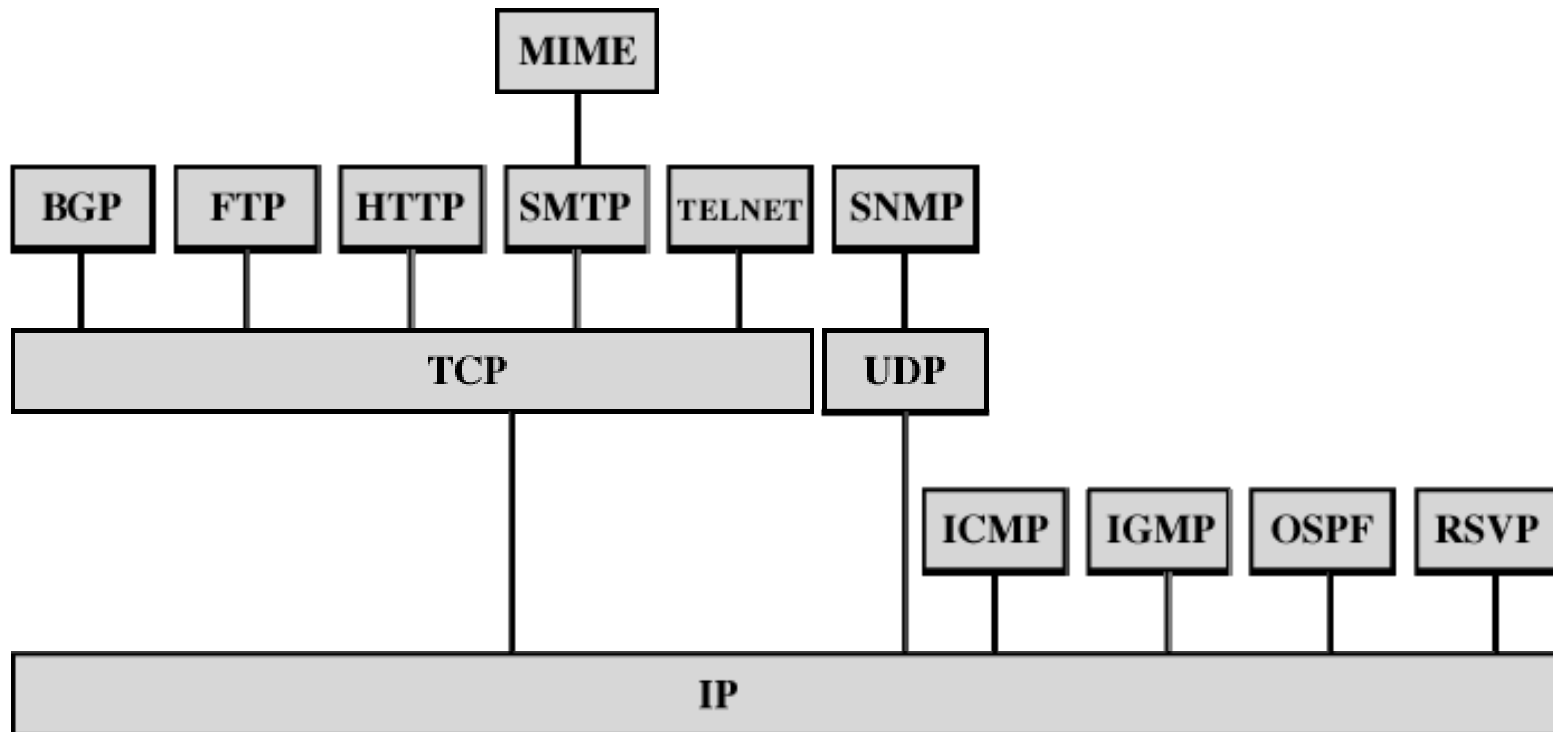


□ Network Attachment Point (NAP)

PDU in TCP/IP Architecture



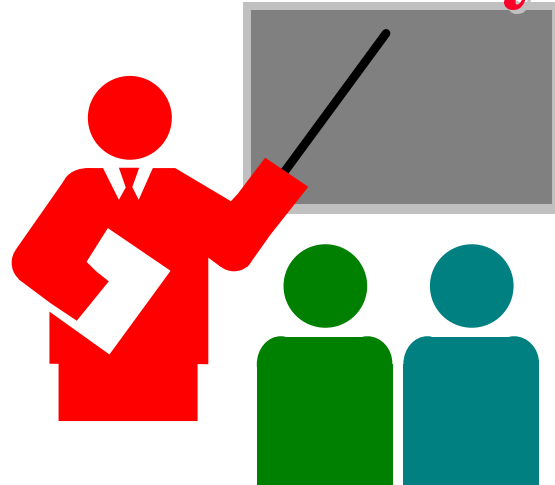
TCP/IP Applications



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

Summary



- ❑ Communication, Networks, and Distributed systems
- ❑ ISO/OSI's 7-layer reference model
- ❑ TCP/IP has a 5-layer model
- ❑ PDU, SDU, SAP
- ❑ Request, Indication, Response, Confirmation

Reading Assignment

- ❑ Read Chapters 0, 1, and 2 of Stallings 7th Edition
Appendix 2A can be skipped at this time
- ❑ 0.2 Internet and Web Resources
- ❑ 0.3 Standards
- ❑ Visit some of the web sites mentioned in 0.2 and 0.3

Homework

- ❑ Visit www.ietf.org and find the titles of RFC 1 and RFC 780
- ❑ Submit answers to Problems 2.2 and 2.7 of Stallings 7th Edition
 - ❑ Problem 2.2: Communications between France and China
 - ❑ Problem 2.7: Segmentation and Blocking