

Reference Models: OSI

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BLM 305 I Veri İletişimi (*Data Communication*)

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References:

- *Computer Networks*, Andrew Tanenbaum, Pearson, 5th Edition, 2010.
- *Computer Networking, A Top-Down Approach Featuring the Internet*, James F.Kurose, Keith W.Ross, Pearson-Addison Wesley, 6th Edition, 2012.
- **BLG 337 Slides** from İTÜ prepared by Assoc. Prof.Dr. Berk CANBERK

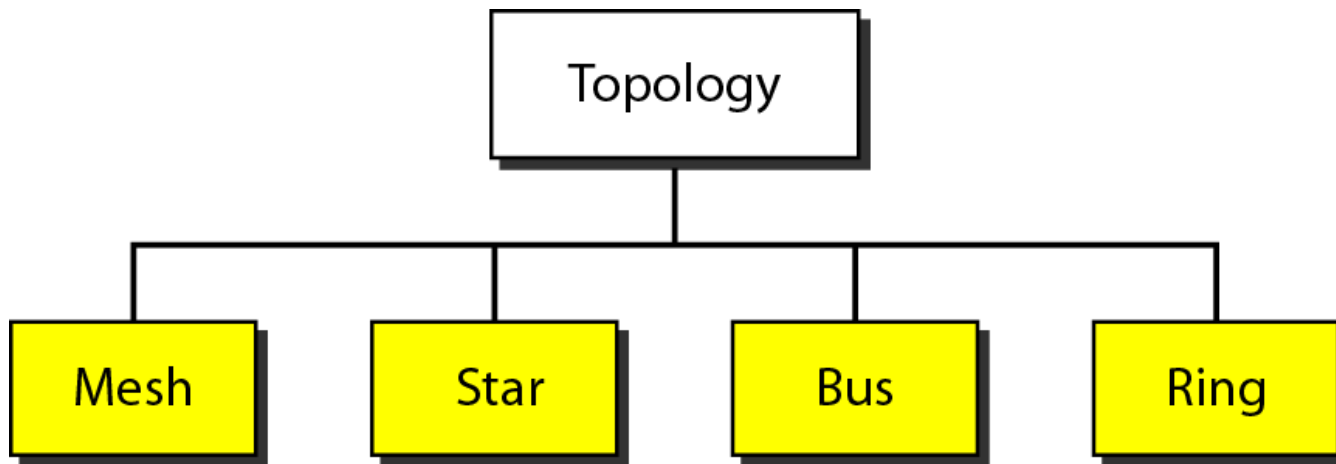
Solution to the huge amount of connections...

- ✓ If one point to point connection is planned to be set for each communication;
 - there would be $N*N$ connections...

- ✓ The solution is Communication Network...

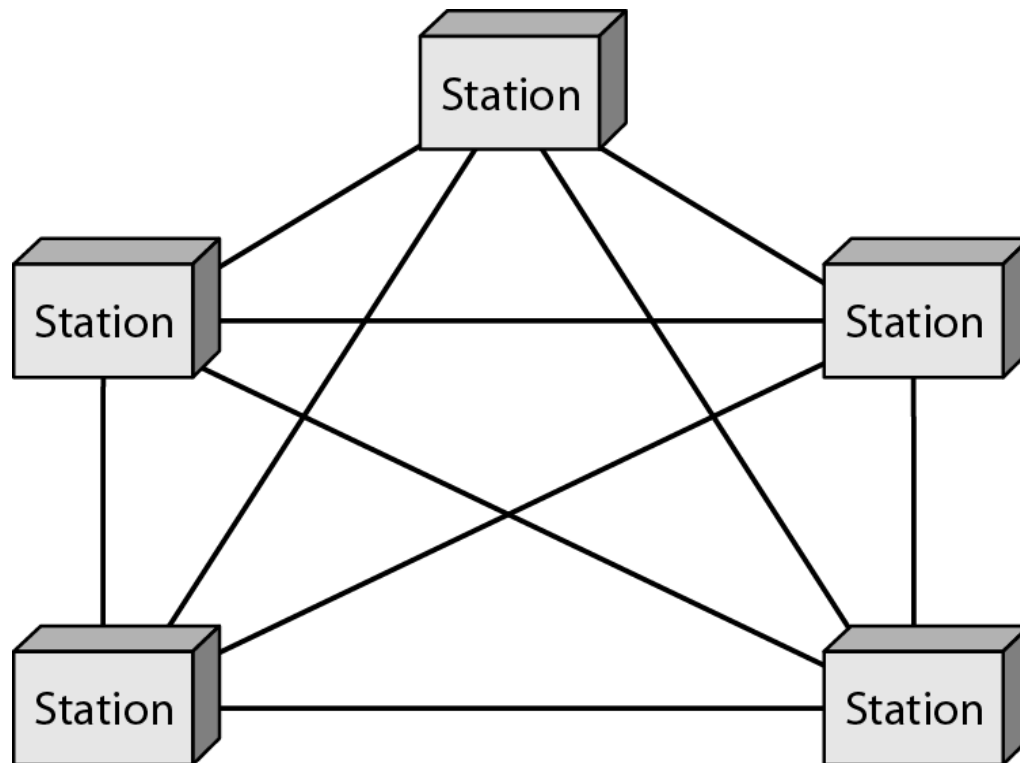
Network Topologies

Categories of network topology



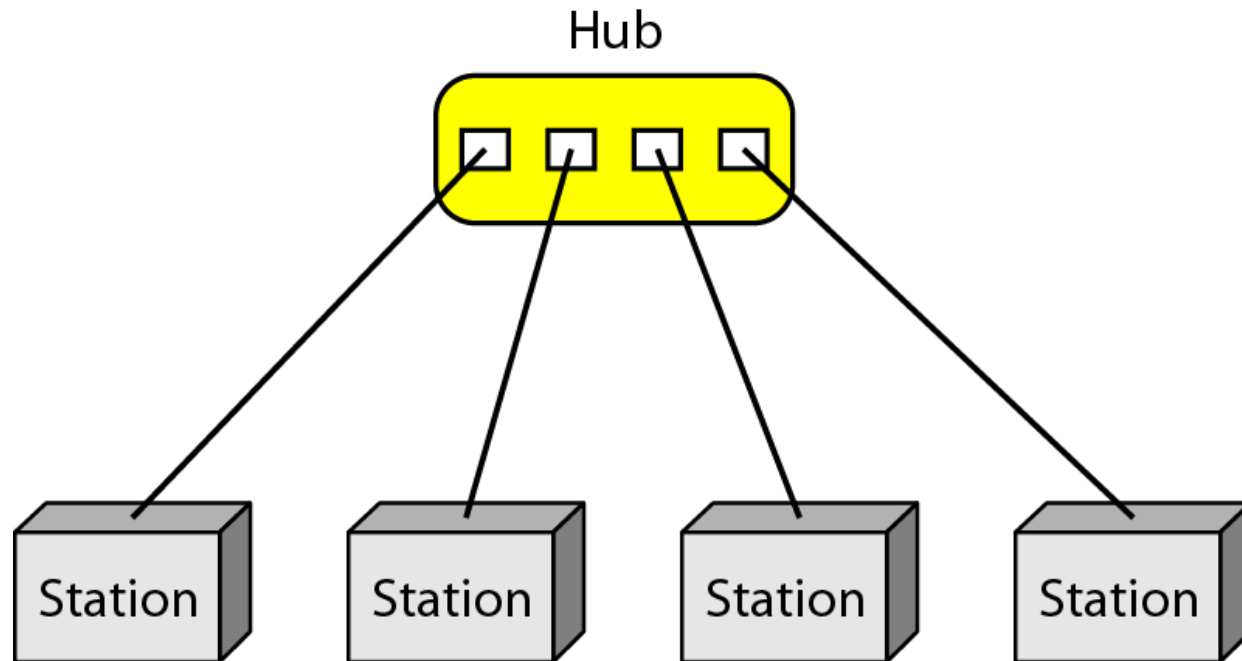
Network Topologies

- ✓ ***A fully connected mesh topology (five devices)***



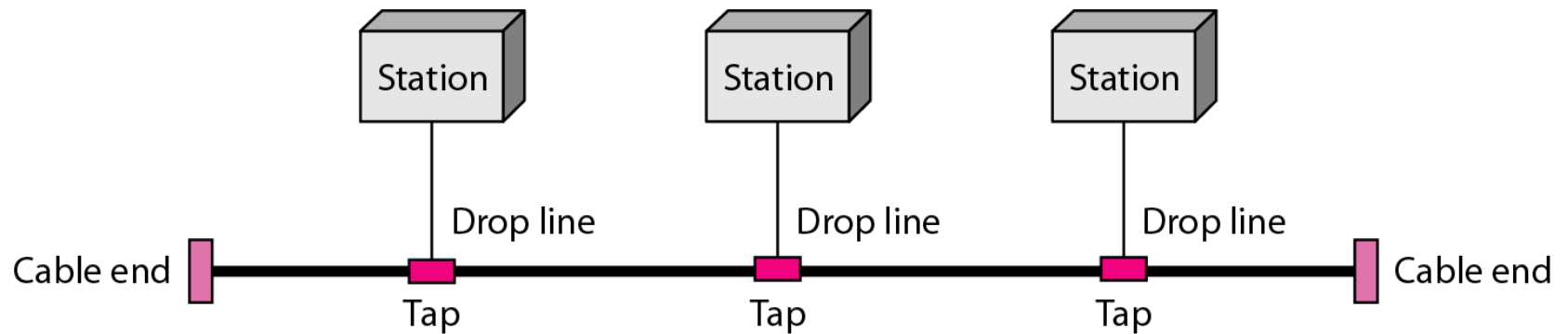
Network Topologies

- ✓ ***A star topology connecting four stations***



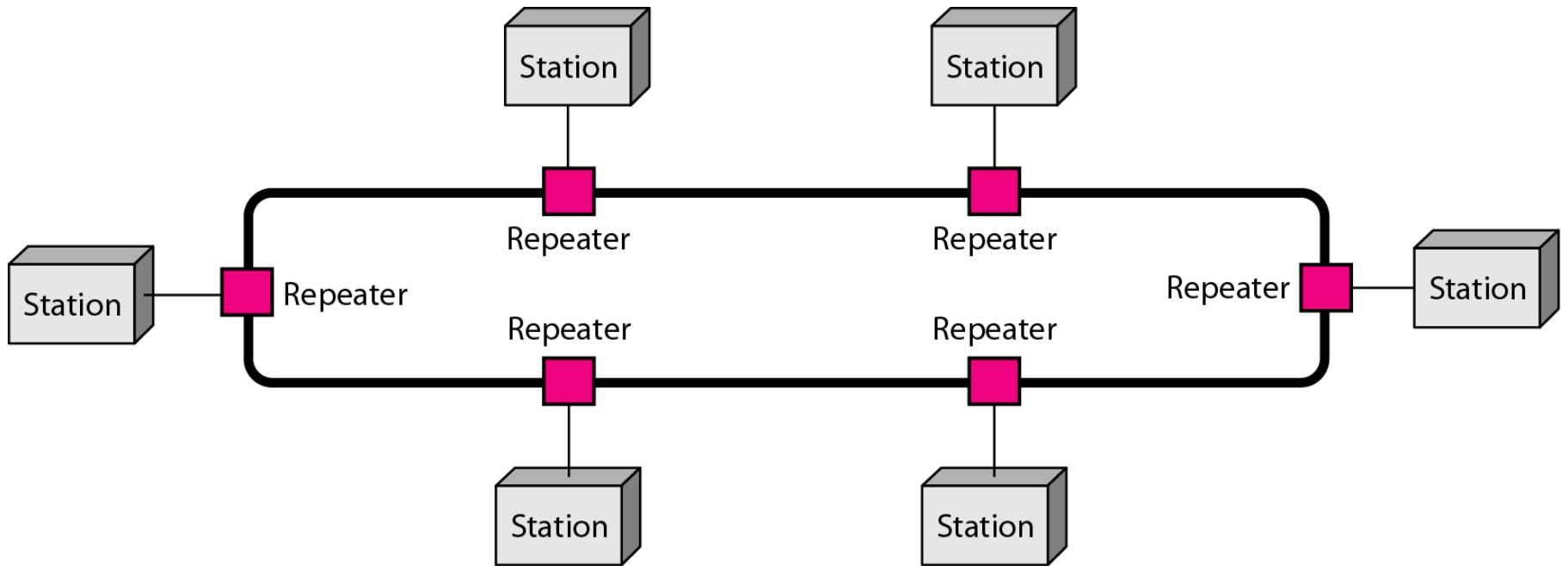
Network Topologies

- ✓ ***A bus topology connecting three stations***



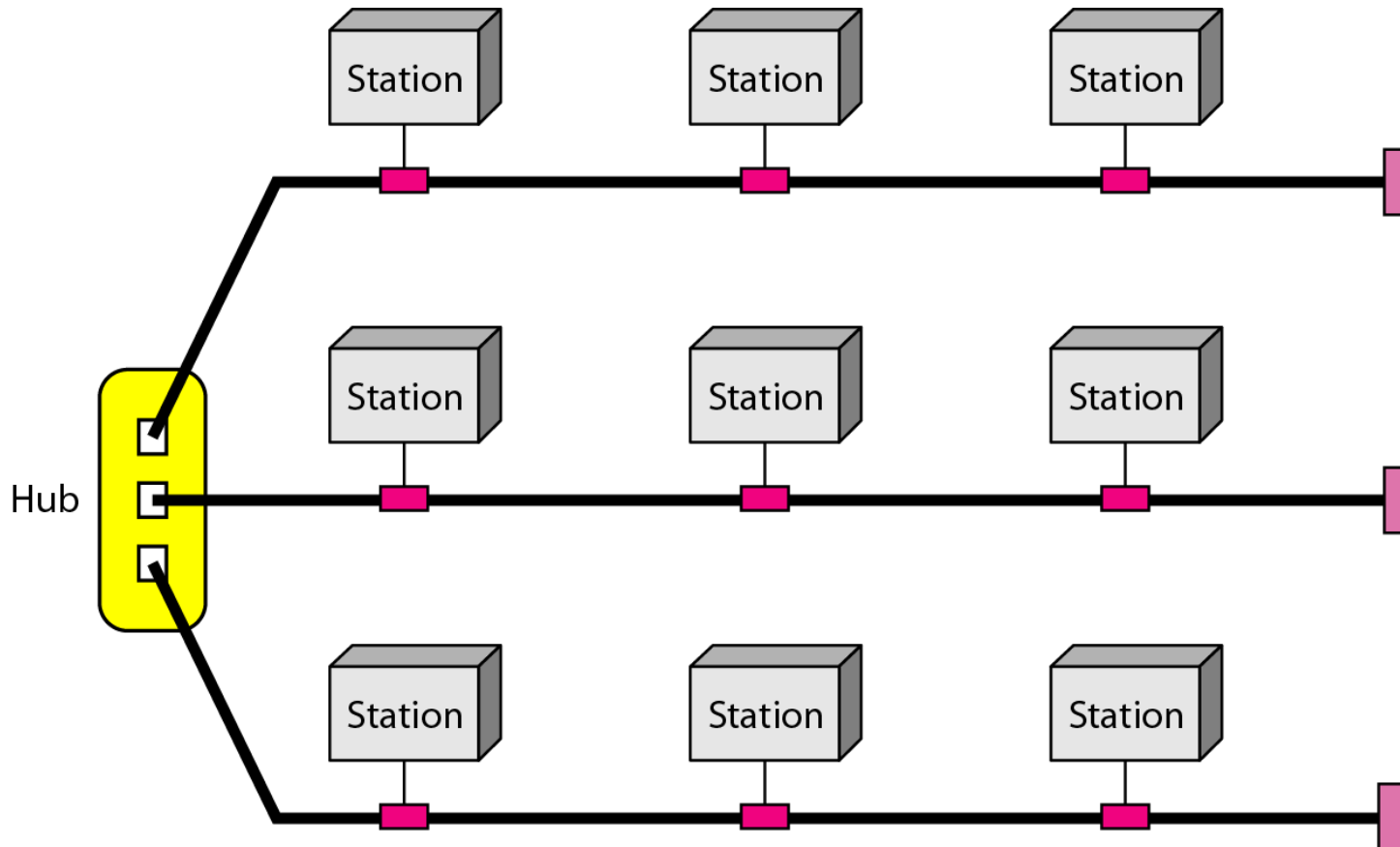
Network Topologies

✓ *A ring topology connecting six stations*



Network Topologies

- ✓ ***A hybrid topology: a star backbone with three bus networks***



Classification of Networks

✓ On the basis of

- Applications
- Model
- Size of Geographical Area covered (Scale)

✓ Such As:

- Local Area Networks
- Metropolitan Area Networks
- Wide Area Networks
- Internetworks

Classification of Broadcast Networks

- ✓ Classification of interconnected processors by scale.

Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	
100 m	Building	
1 km	Campus	Local area network
10 km	City	
100 km	Country	Metropolitan area network
1000 km	Continent	
10,000 km	Planet	Wide area network
		The Internet

Uses of Computer Networks

- ✓ **Business Applications:** Some forms of e-commerce

Tag	Full name	Example
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on-line
P2P	Peer-to-peer	File sharing

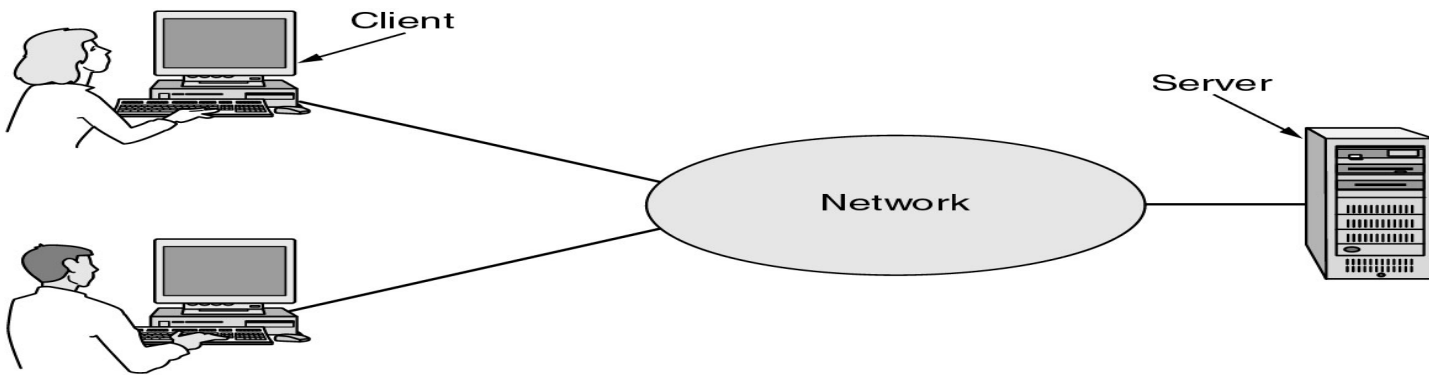
- ✓ **Home Applications**

- Access to remote information(WWW etc)
- Person-to-person communication(Email, Instant Messaging etc, Phone)
- Interactive entertainment(Remote operated or online Games)
- Electronic commerce

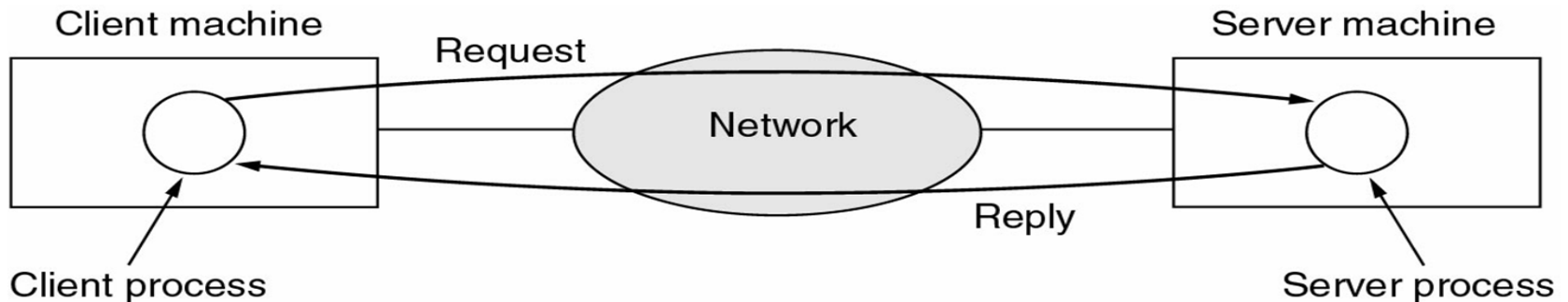
- ✓ **Mobile Users:** Combinations of wireless networks and mobile computing

Wireless	Mobile	Applications
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

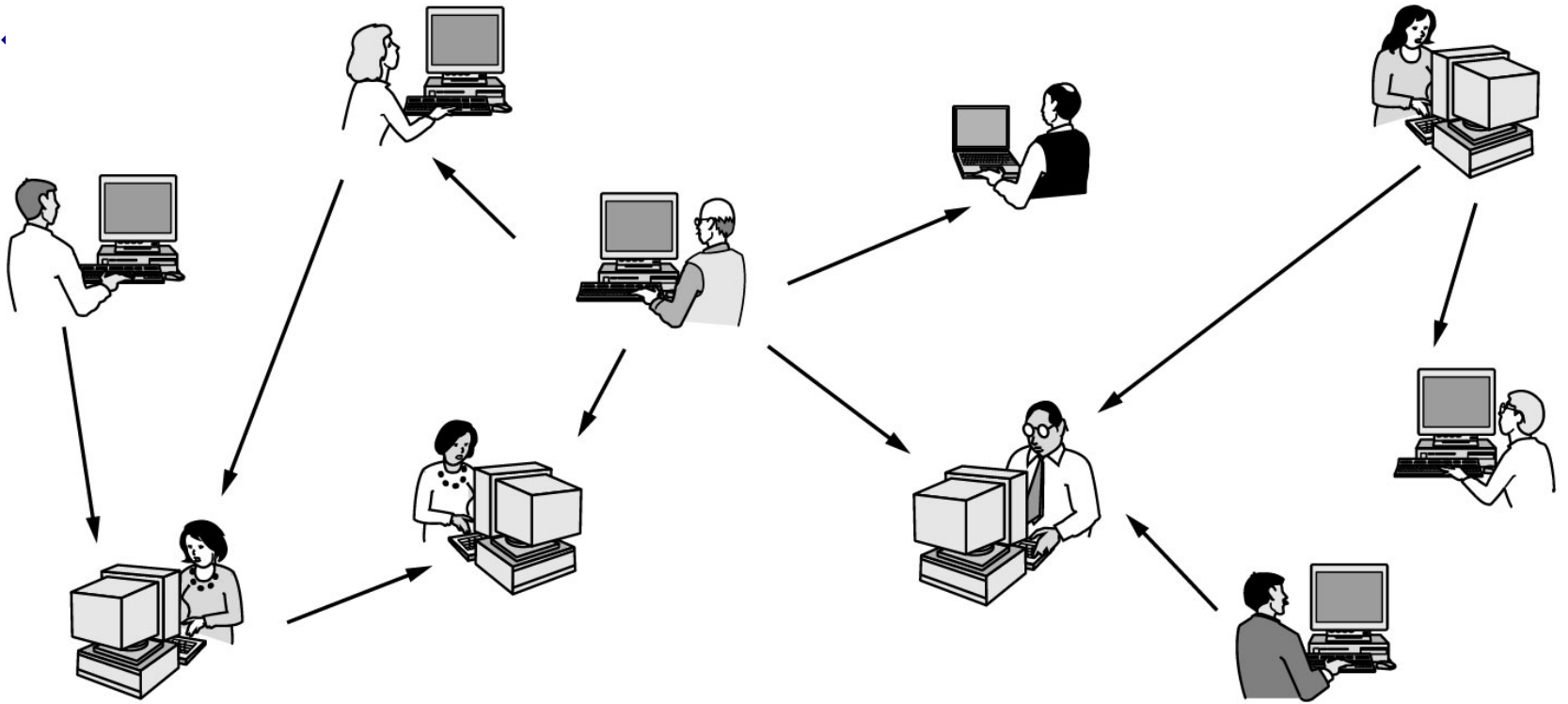
Business Applications of Networks



- ✓ Client Server Model : A network with two clients and one server: Employees accessing company's Information System

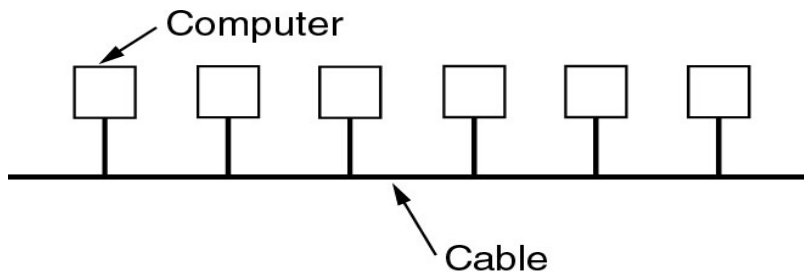


Peer-to-Peer Model of Communication

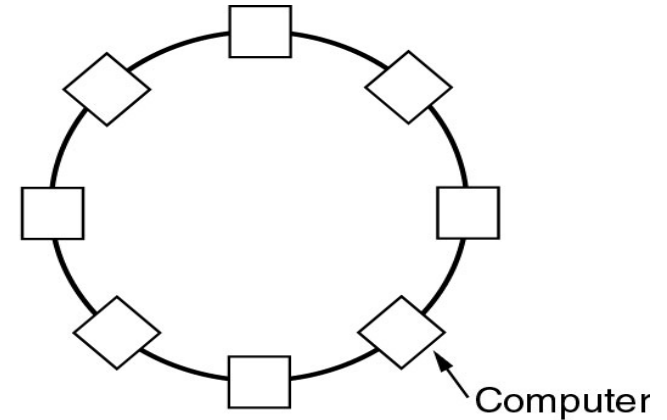


- ✓ In peer-to-peer system there are no fixed clients and servers.

Local Area Networks topologies



(a)

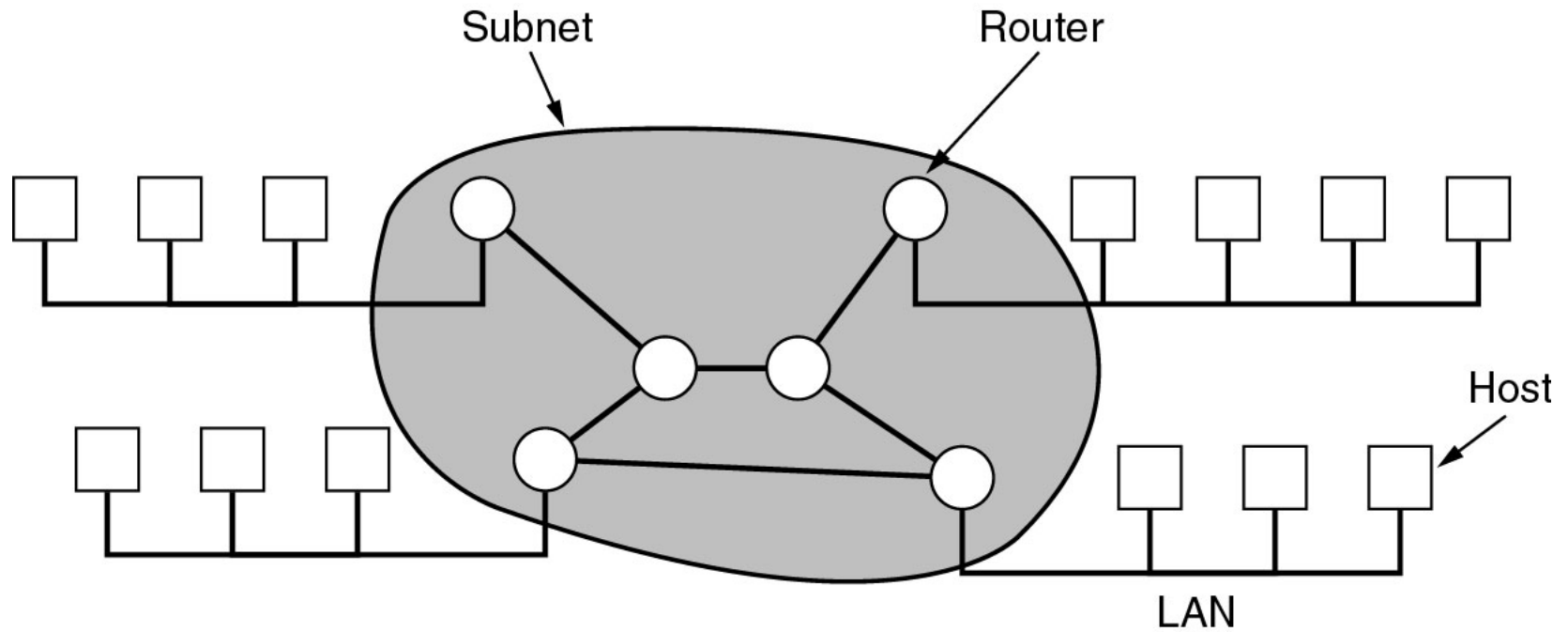


(b)

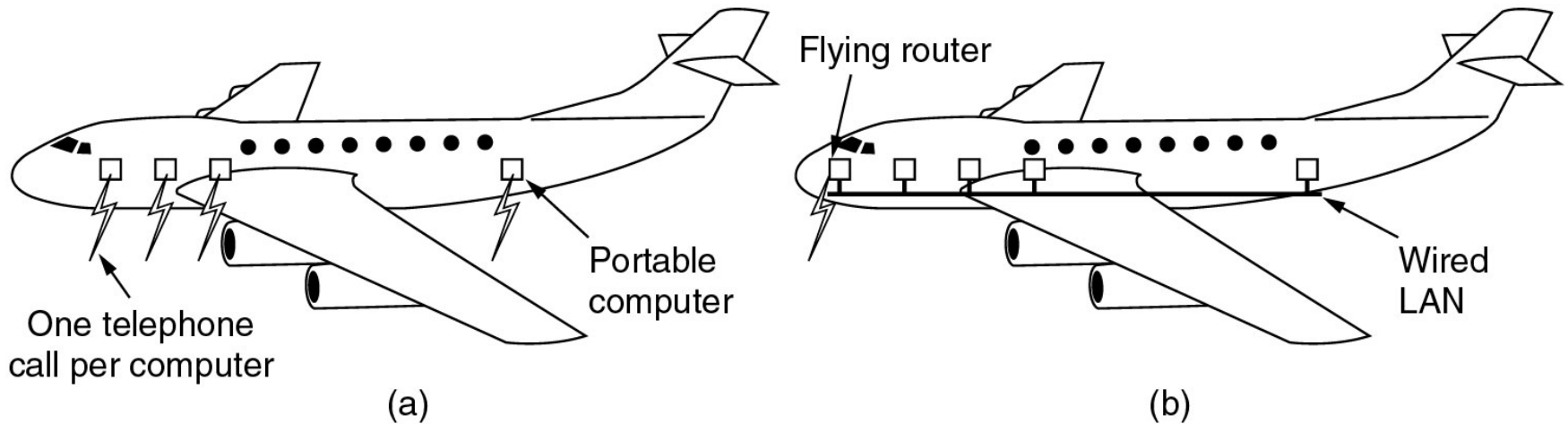
- ✓ Two topologies for broadcast networks
 - (a) Bus
 - (b) Ring

Wide Area Networks

- ✓ Relation between hosts on LANs and the subnet.



Wireless Networks



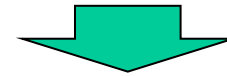
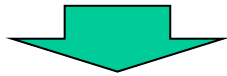
- ✓ (a) Individual mobile computers
- ✓ (b) A flying LAN

Network Software

- ✓ Protocol Hierarchies
- ✓ Design Issues for the Layers
- ✓ Connection-Oriented and Connectionless Services
- ✓ Service Primitives
- ✓ The Relationship of Services to Protocols

Protocol Means...

- ✓ *Set of rules that define format, order of sent and received messages among network entities, and actions taken on messages transmission, receipt*



human protocols:

- “what’s your name?”
- “Can I ask a question”
- introductions

network protocols:

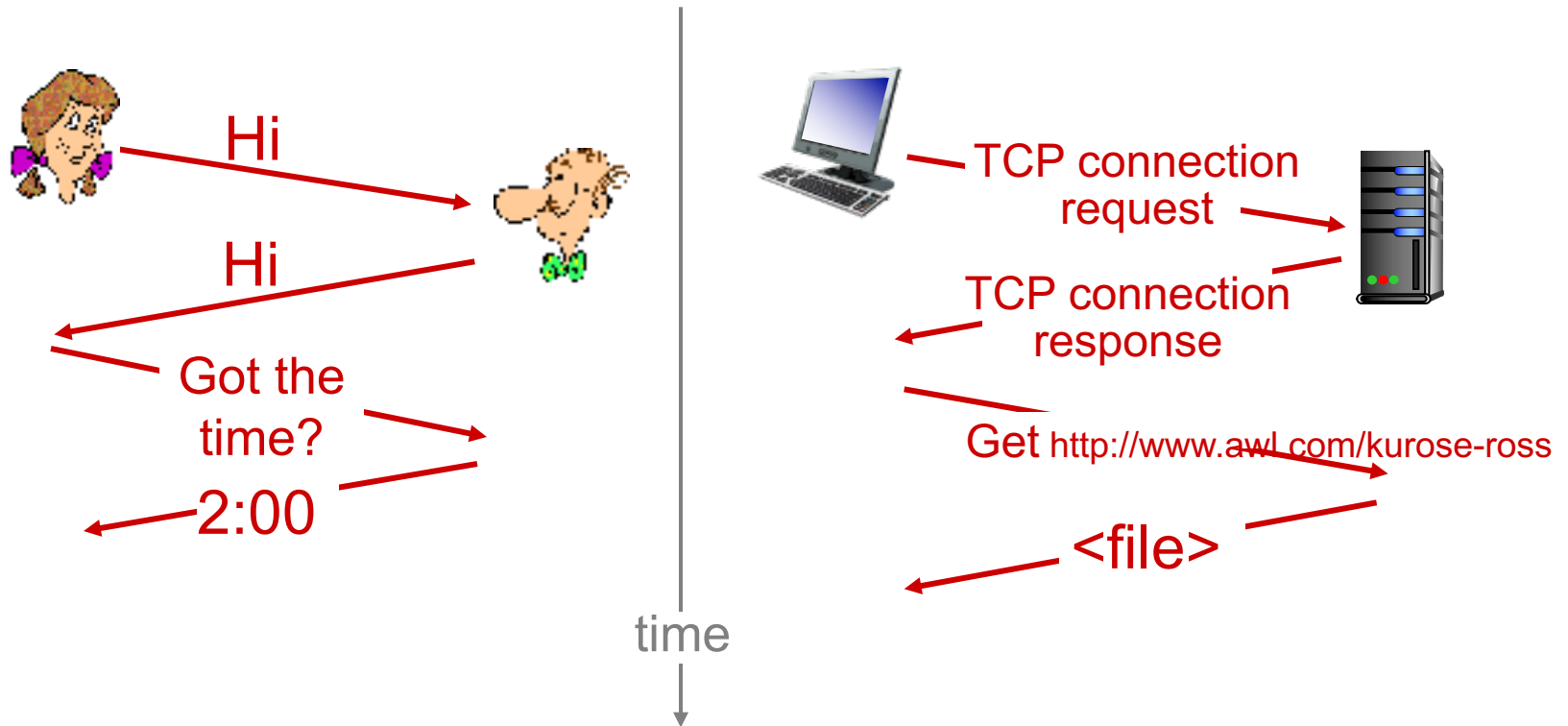
- machines rather than humans
- all communication activity in Internet governed by protocols

... specific messages sent

... specific actions taken when messages received, or other events

Protocol Means...

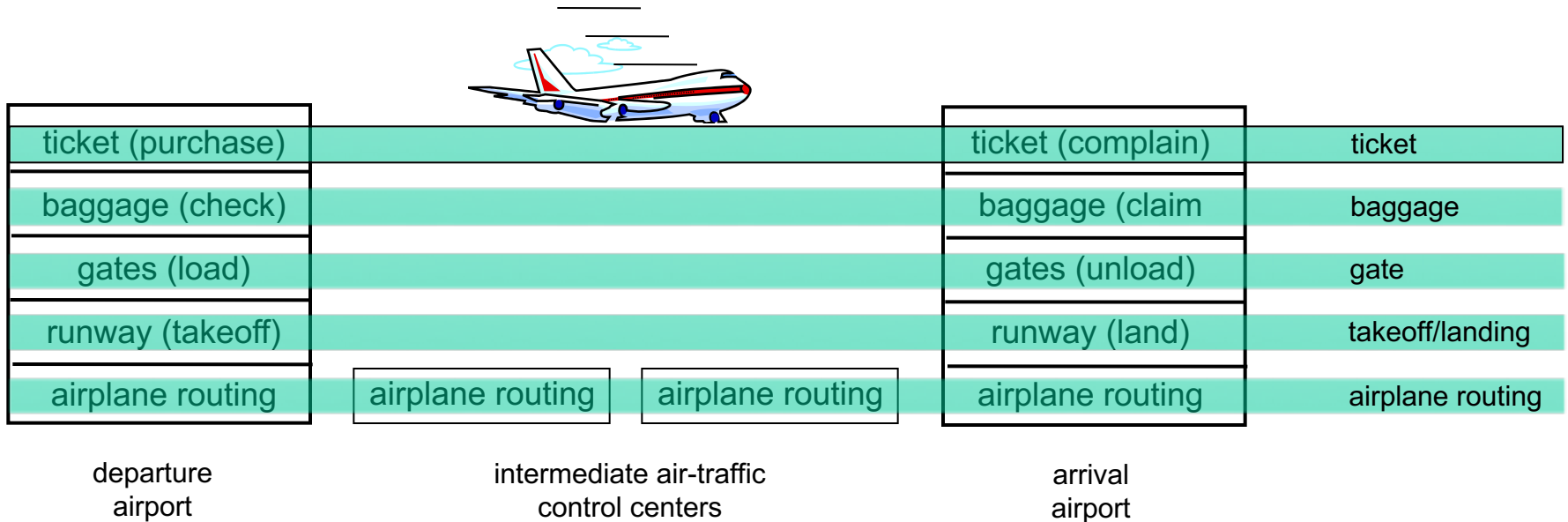
- ✓ a human protocol and a computer network protocol:



Organization of Networks : “Layers”

- ✓ Networks have many separate groups of parts;
 - hosts
 - routers
 - links of various media
 - applications
 - protocols
 - hardware, software
- ✓ The solution of the organization and management of all these staff: **“Layers”**

Example implementation of Layering: "Air Travel"



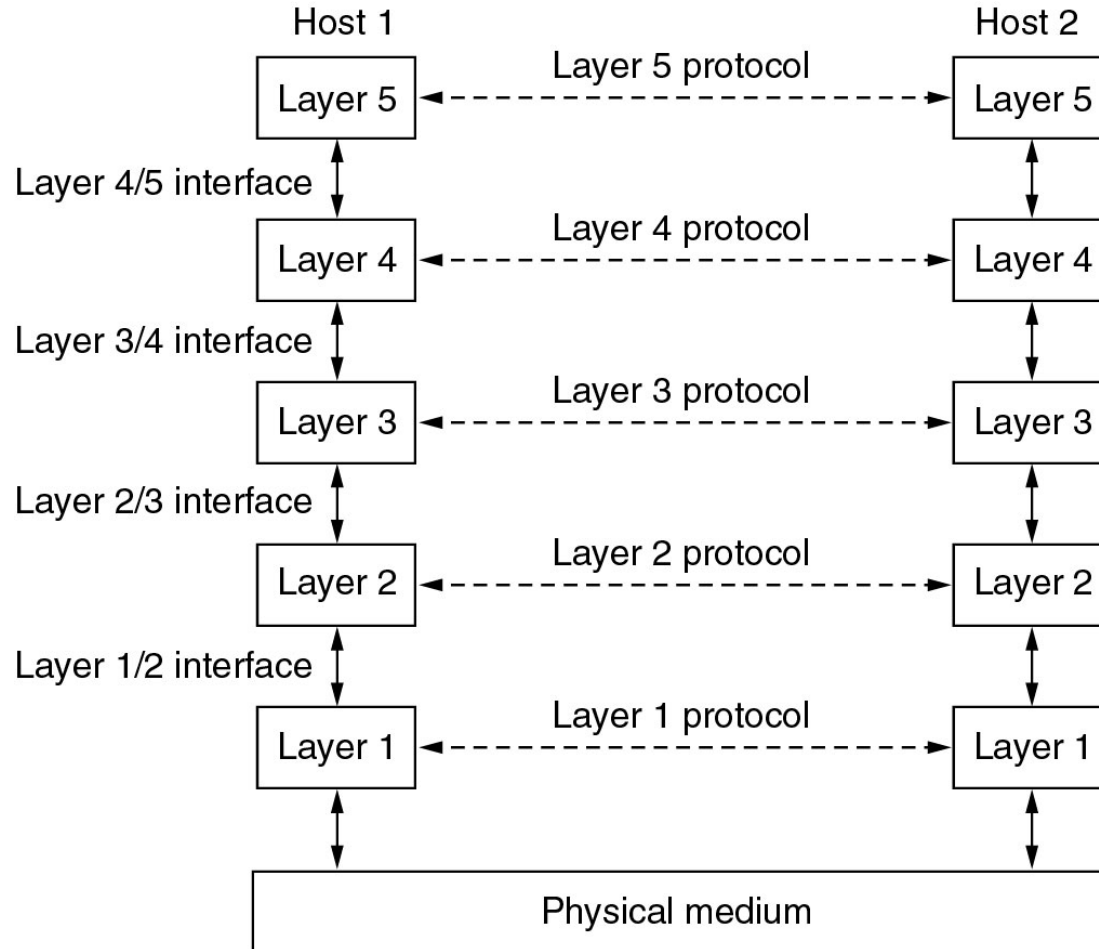
✓ Each layer ;

- Implement its own service
- Takes the responsibility of its own actions
- Depends on services provided by layer below

Layering is essential because..

- ✓ Offers solution to the complexity of the network system
 - The system pieces and their relationships are organized by the layers defined by the “reference model”
 - Organization of the system helps maintenance, updating of system
 - change of implementation of layer's service transparent to rest of system
 - e.g., change in gate procedure doesn't affect rest of system

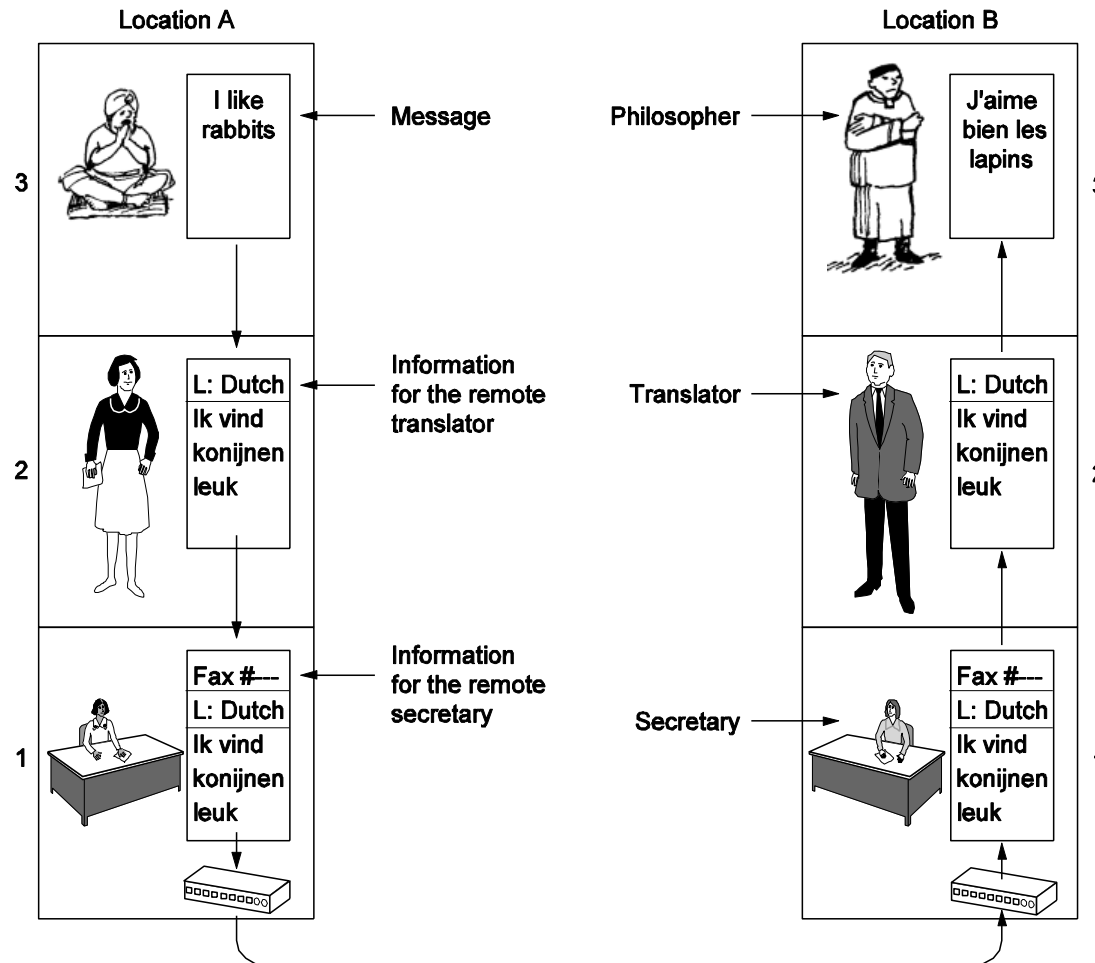
Protocol Hierarchies



- ✓ Layers, protocols, and interfaces.

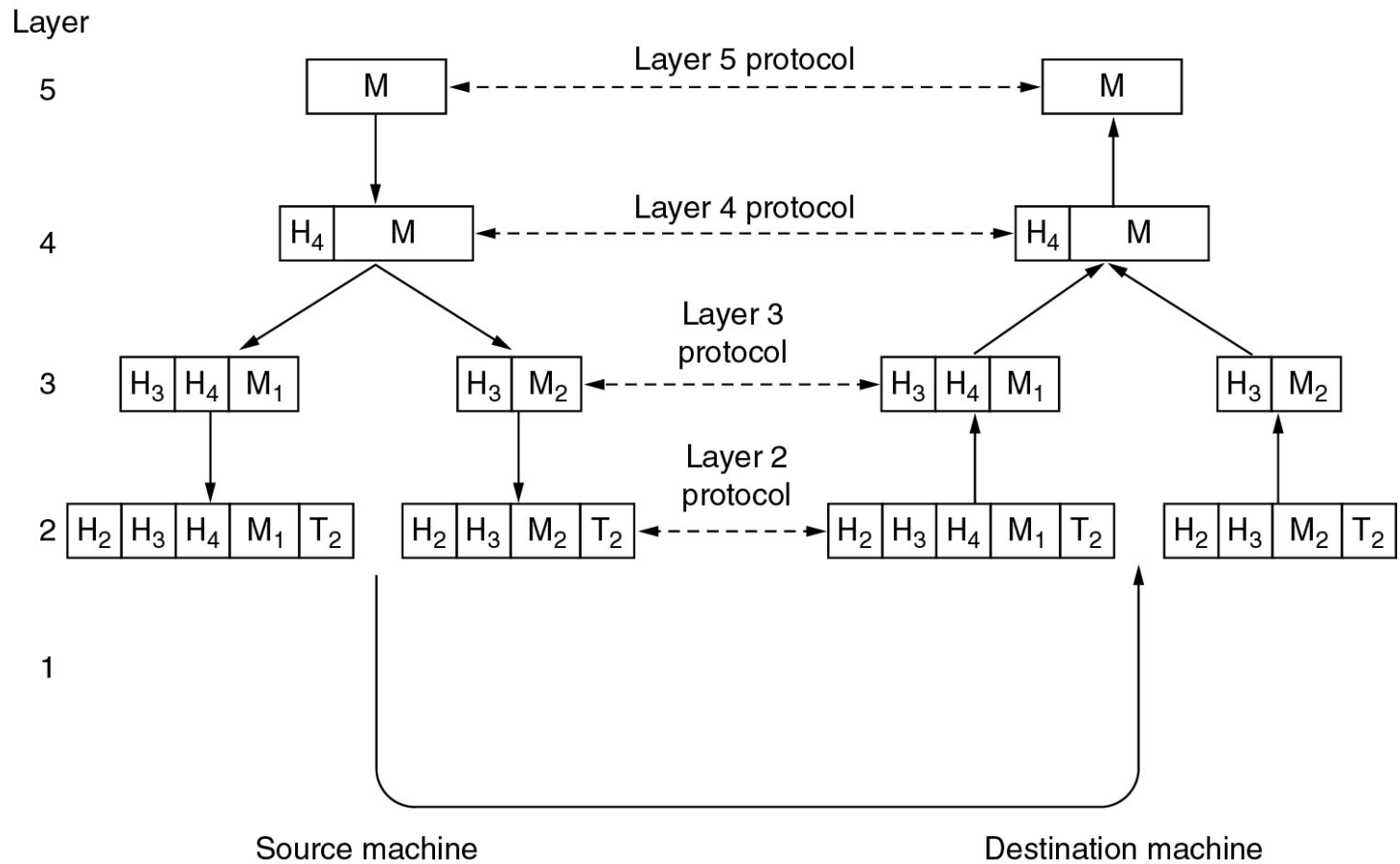
Protocol Hierarchies

- ✓ The philosopher-translator-secretary architecture.



Protocol Hierarchies

- ✓ Example information flow supporting virtual communication in layer 5.



Design Issues for the Layers

- ✓ Addressing
- ✓ Error Control
- ✓ Flow Control
- ✓ Multiplexing
- ✓ Routing

Connection-Oriented and Connectionless Services

- ✓ Six different types of service.

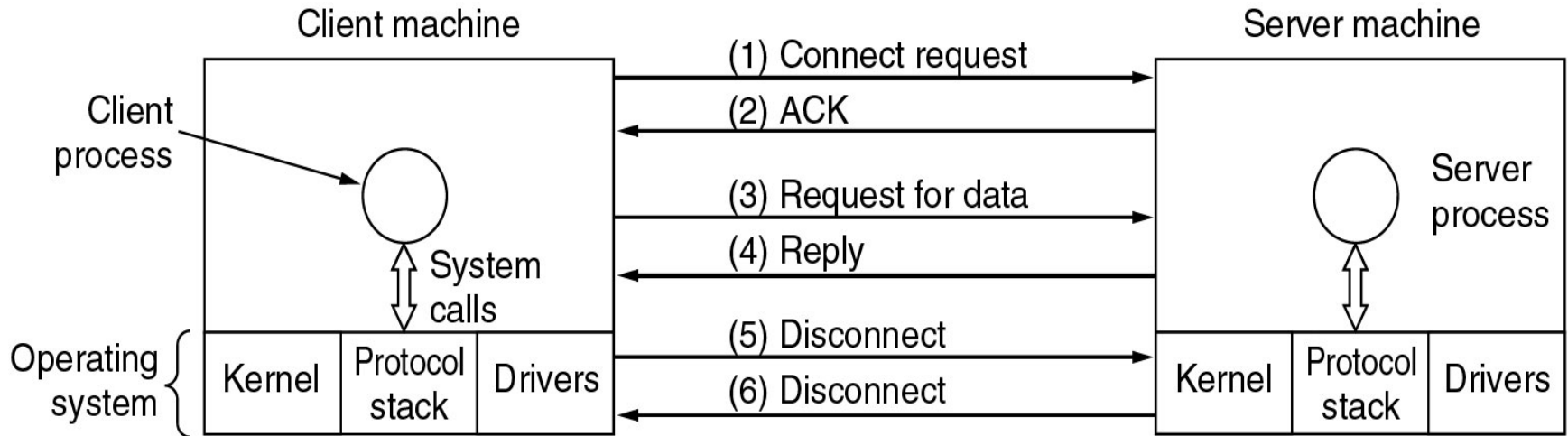
	Service	Example
Connection-oriented	Reliable message stream	Sequence of pages
	Reliable byte stream	Remote login
	Unreliable connection	Digitized voice
Connectionless	Unreliable datagram	Electronic junk mail
	Acknowledged datagram	Registered mail
	Request-reply	Database query

Service Primitives

- ✓ Five service primitives for implementing a simple connection-oriented service.

Primitive	Meaning
LISTEN	Block waiting for an incoming connection
CONNECT	Establish a connection with a waiting peer
RECEIVE	Block waiting for an incoming message
SEND	Send a message to the peer
DISCONNECT	Terminate a connection

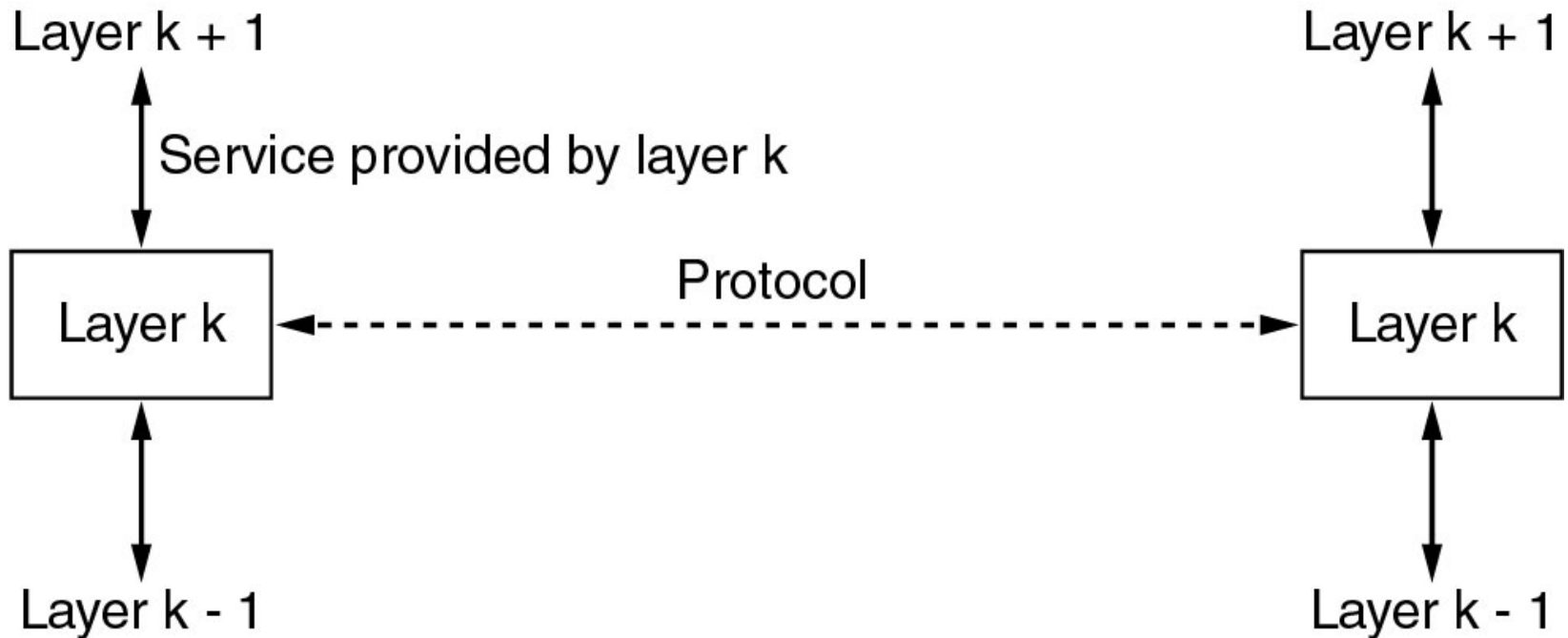
Service Primitives (2)



- ✓ Packets sent in a simple client-server interaction on a connection-oriented network.

Services to Protocols Relationship

- ✓ The relationship between a service and a protocol.

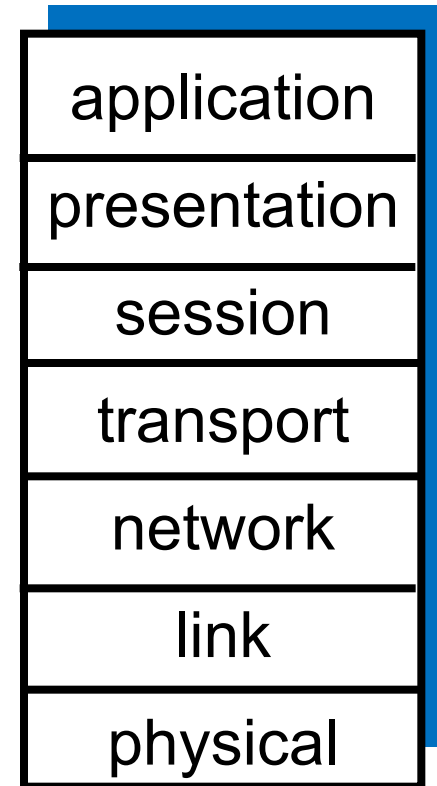


Reference Models

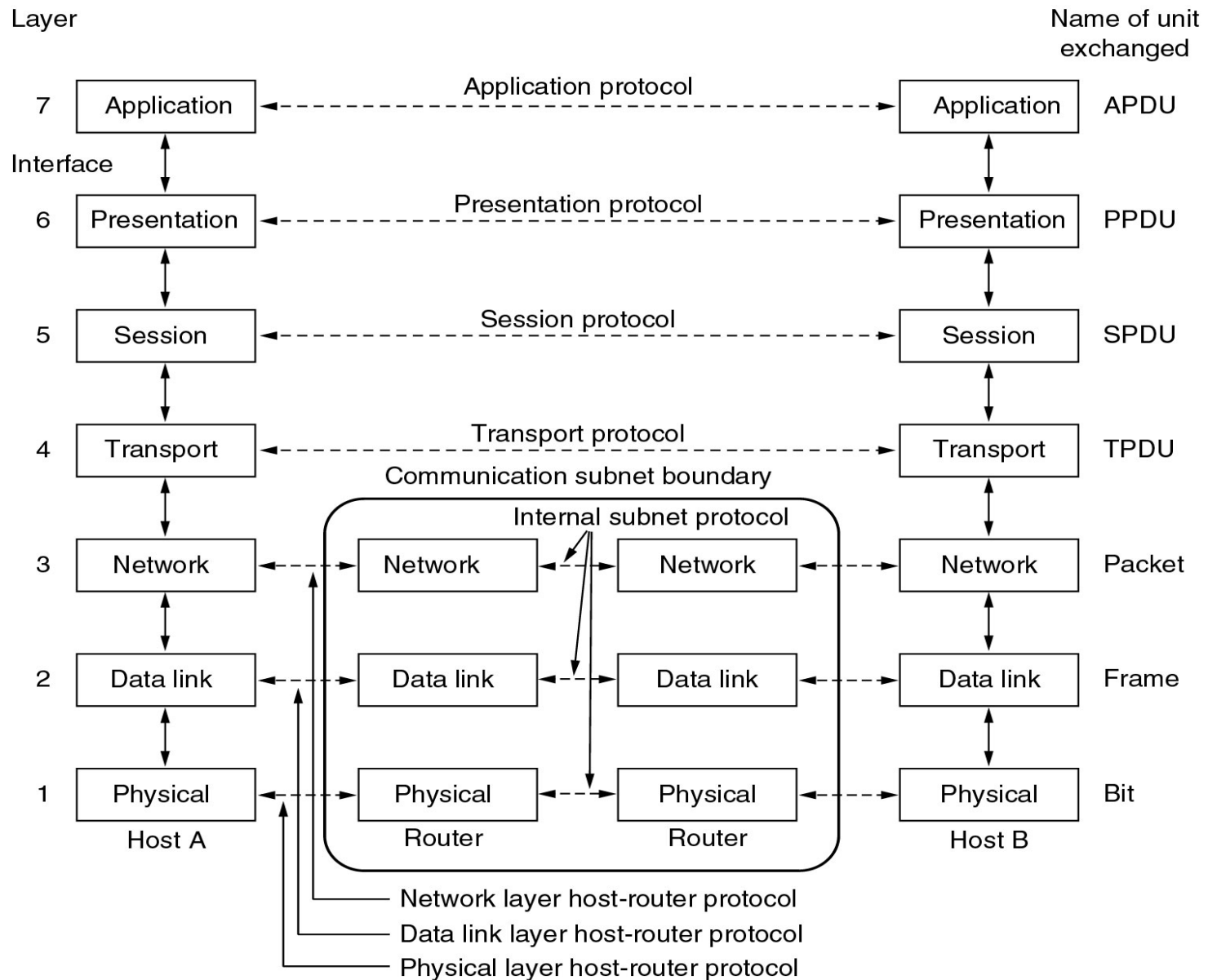
- ✓ The OSI Reference Model
- ✓ The TCP/IP Reference Model
- ✓ A Comparison of OSI and TCP/IP
- ✓ A Critique of the OSI Model and Protocols
- ✓ A Critique of the TCP/IP Reference Model

ISO/OSI reference model

- ✓ *presentation*: allow applications to interpret meaning of data, e.g., encryption, compression, machine-specific conventions
- ✓ *session*: synchronization, checkpointing, recovery of data exchange
- ✓ Internet stack “missing” these layers!
 - these services, *if needed*, must be implemented in application
 - needed?

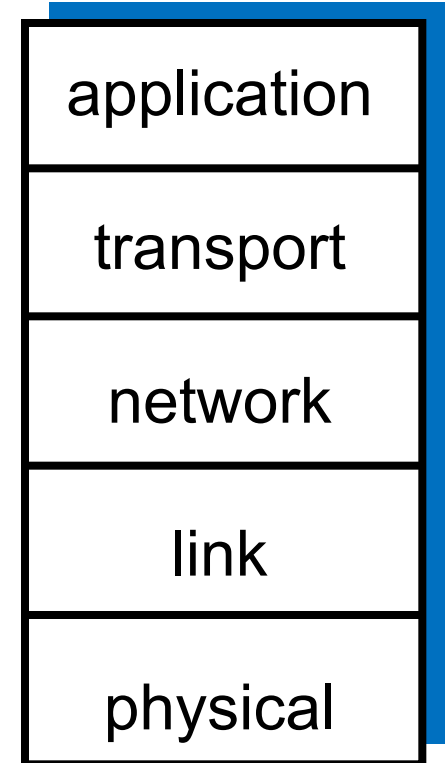


Reference Models: "OSI reference model"



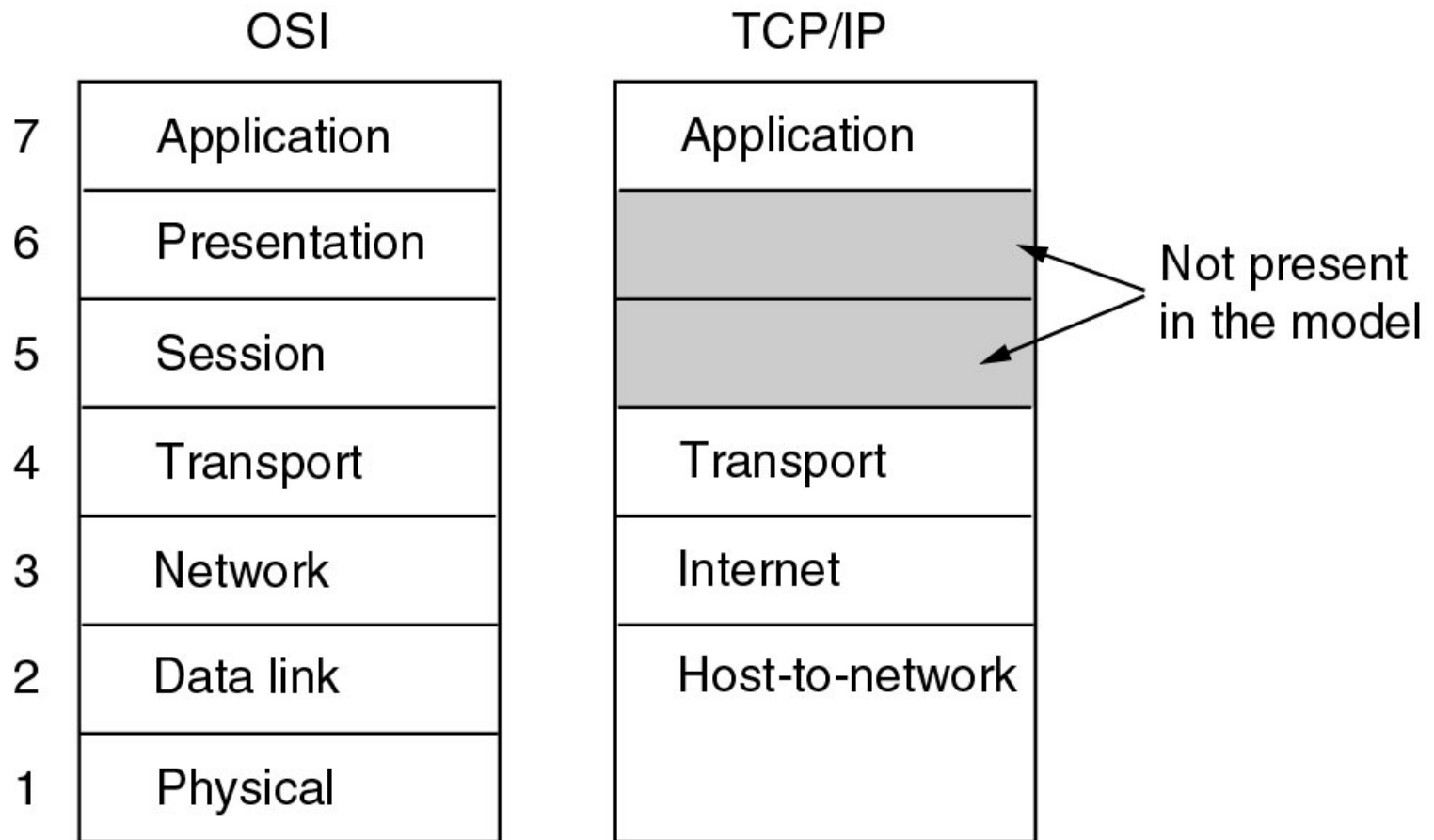
Internet side of Protocol Layers

- ✓ *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
 - Ethernet, 802.111 (WiFi), PPP
- ✓ *physical*: bits “on the wire”



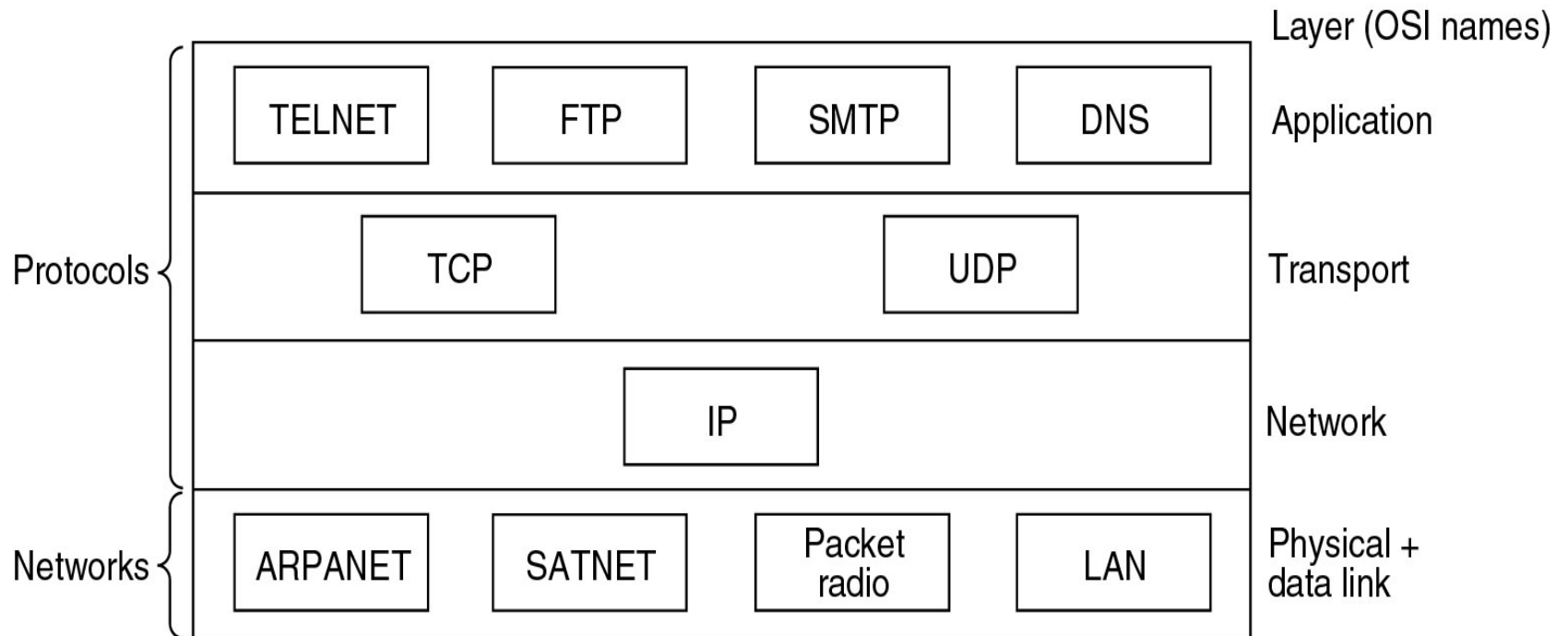
Reference Models

- ✓ The TCP/IP reference model.



Reference Models

- ✓ Protocols and networks in the TCP/IP model initially.



Comparing OSI and TCP/IP Models

✓ Concepts central to the OSI model:

- Services

- Interfaces

- Protocols

A Critique of the OSI Model and Protocols

- ✓ Why OSI did not take over the world
 - Bad timing
 - Bad technology
 - Bad implementations
 - Bad politics

A Critique of the TCP/IP Reference Model

✓ Problems:

- Service, interface, and protocol not distinguished
- Not a general model
- Host-to-network “layer” not really a layer
- No mention of physical and data link layers
- Minor protocols deeply entrenched, hard to replace

Hybrid Model

- ✓ The hybrid reference model.

5	Application layer
4	Transport layer
3	Network layer
2	Data link layer
1	Physical layer

Example Networks

- The Internet
- Connection-Oriented Networks:
X.25, Frame Relay, and ATM
- Ethernet
- Wireless LANs: 802:11

Network Standardization

- ✓ Who's Who in the Telecommunications World
- ✓ Who's Who in the International Standards World
- ✓ Who's Who in the Internet Standards World

ITU(International Telecommunication Union)

✓ Main sectors

- Radiocommunications(allocating Radio Frequencies) :ITU-R
- Telecommunications Standardization(telephone and data communication systems) : ITU-T
- Development: ITU-D

✓ Classes of Members

- National governments(members of United Nations)
- Sector members(Telecom, Computer, Media)
- Associate members(Smaller Organizations interested in a particular Study Group)
- Regulatory agencies(Controlling authorities)

IEEE 802 Standards

Number	Topic
802.1	Overview and architecture of LANs
802.2 ↓	Logical link control
802.3 *	Ethernet
802.4 ↓	Token bus (was briefly used in manufacturing plants)
802.5	Token ring (IBM's entry into the LAN world)
802.6 ↓	Dual queue dual bus (early metropolitan area network)
802.7 ↓	Technical advisory group on broadband technologies
802.8 †	Technical advisory group on fiber optic technologies
802.9 ↓	Isochronous LANs (for real-time applications)
802.10 ↓	Virtual LANs and security
802.11 *	Wireless LANs
802.12 ↓	Demand priority (Hewlett-Packard's AnyLAN)
802.13	Unlucky number. Nobody wanted it
802.14 ↓	Cable modems (defunct: an industry consortium got there first)
802.15 *	Personal area networks (Bluetooth)
802.16 *	Broadband wireless
802.17	Resilient packet ring

- ✓ The 802 working groups. The important ones are marked with *. The ones marked with ↓ are hibernating. The one marked with † gave up.