Chapter 1

(Week 1)

Introduction

ANDREW S. TANENBAUM
COMPUTER NETWORKS
FOURTH EDITION
PP. 1-37

Short History

18th century – the great mechanical systems

19th century – the steam engine

20th century – information gathering, processing, and distribution

(worldwide telephone networks, the invention of radio and television, the birth and unprecedented growth of the computer industry, the launching of communication satellites)

The Subjects of This Course

- The old model of a single computer serving all of the organization's computational needs has been replaced by one in which a large number of separate but interconnected computers do the job.

- These systems are called computer networks.

- The design and organization of these networks are the subjects of this course.

Computer Network (1)

- Computer network is interconnected collection of autonomous computers

- Two computers are said to be interconnected if they are able to exchange information.

- For connection it may be used not only copper wire, but also fiber optics, microwaves, and communication satellites.

Computer Network (2)

- By requiring the computers to be autonomous, we wish to exclude from our definition system in which there is a clear master/slave relation.

- If one computer can forcibly start, stop, or control another one, the computers are not autonomous.

- A system with one control unit and many slaves is not a network.

Computer Network and Distributed System (1)

- The key distinction between a computer network and distributed system is that in a distributed system, the existence of multiple autonomous computers is transparent (i.e. not visible) to the user.

- He/she can type a command to run a program, and it runs.

- It is up to the operating system to select the best processor, find and transport all the input files to that processor, and put the results in the appropriate place

Computer Network and Distributed System (2)

- With a network, users must explicitly log onto one machine, explicitly submit jobs remotely, explicitly move files around and generally handle all the network management personally.

- With a distributed system, nothing has to be done explicitly; it is all automatically done by the system without the users' knowledge.

Computer Network and Distributed System (3)

- In effect, a distributed system is a software system built on top of a network.

- The software gives it a high degree of cohesiveness and transparency.

- Thus the distinction between a network and distributed system lies with the software (especially the operating system), rather than with the hardware.

Computer Network and Distributed System (4)

- Nevertheless, there is considerable overlap between two subjects.

- For example, both distributed systems and computer networks need to move files around.

- The difference lies in who invokes the movement, the system or the user.

Why Computer Networks?

- Why people are interested in computer networks and what they can be used for?

- Resource sharing

- High reliability

- Saving money (instead of mainframes the client-server model)

- Scalability (the ability to increase system performance gradually)

- Communication medium (human-to-human communication)

- Etc.

Uses of Computer Networks

- Business Applications

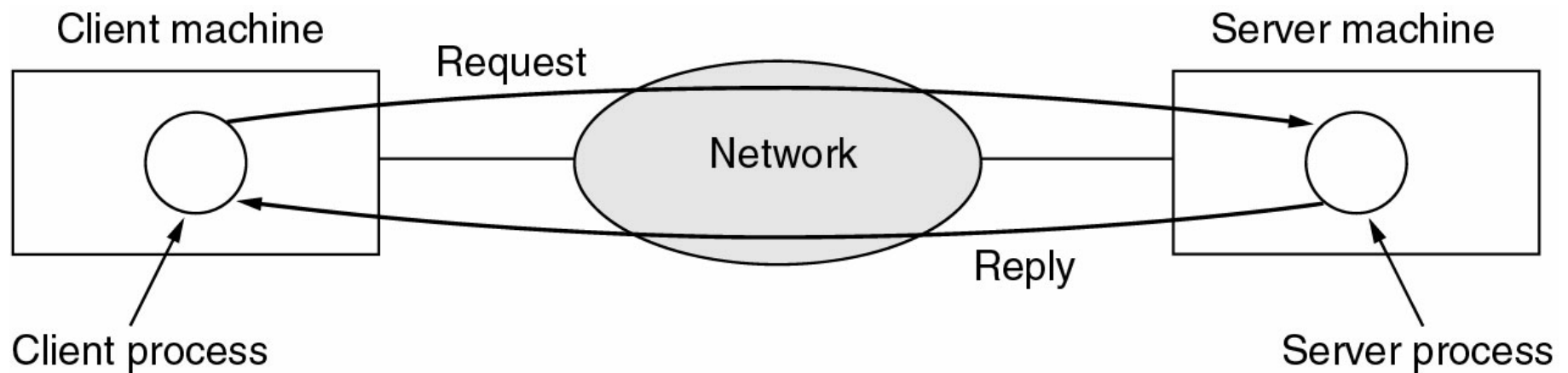- Home Applications

- Mobile Users

- Social Issues

Business Applications of Networks

THE ISSUE HERE IS RESOURCE SHARING, AND THE GOAL IS TO
MAKE ALL PROGRAMS, EQUIPMENT, AND ESPECIALLY DATA
AVAILABLE TO ANYONE ON THE NETWORK WITHOUT REGARD
TO THE PHYSICAL LOCATION OF THE RESOURCE AND THE USER.
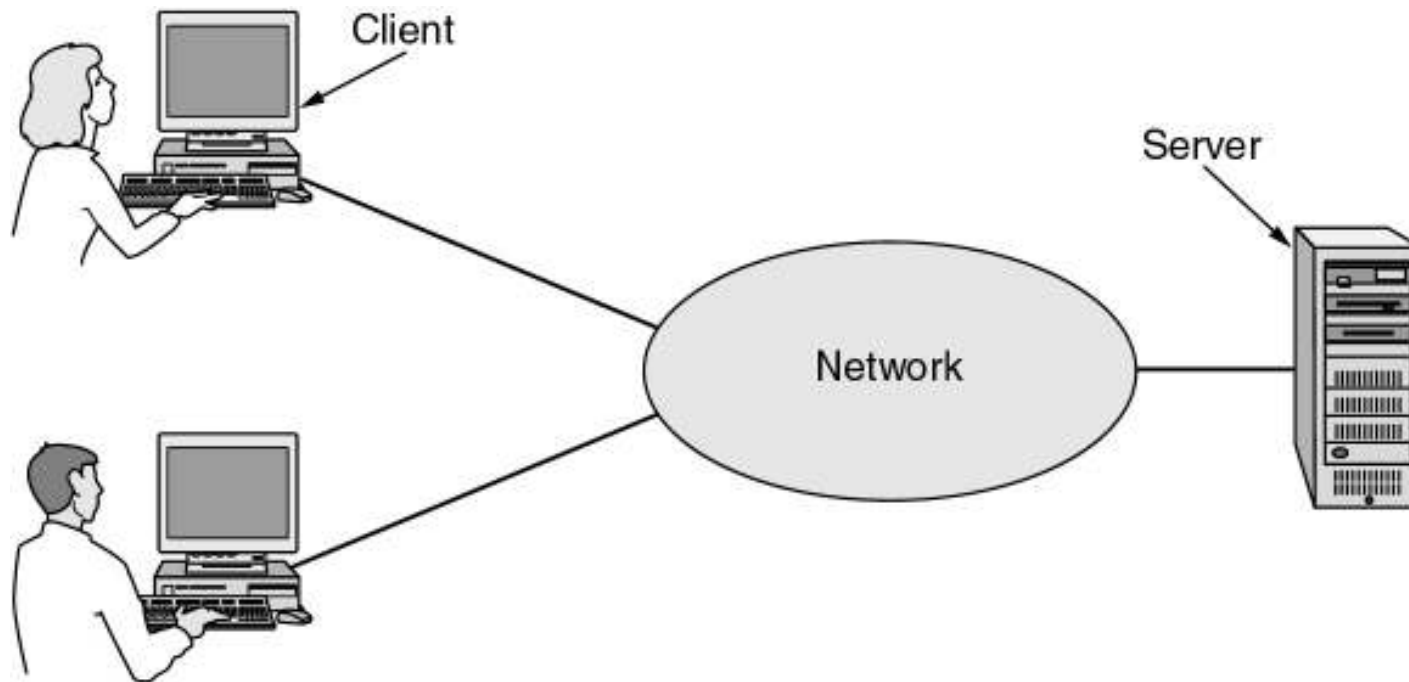
A network with two clients and one server.
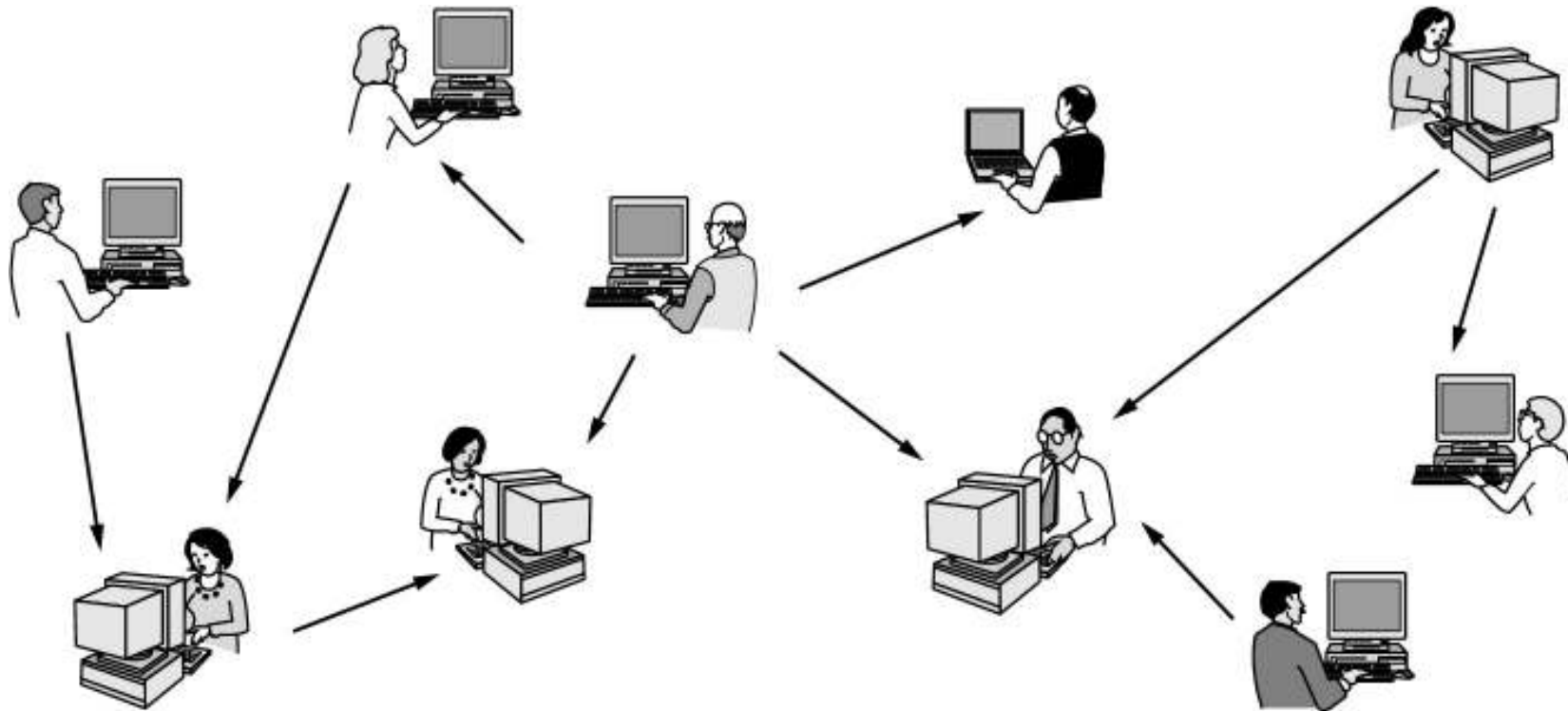
Business Applications of Networks (2)

The client-server model involves requests and replies.

Home Network Applications

- Access to remote information

- Person-to-person communication

- Interactive entertainment

- Electronic commerce

Home Network Applications (2)

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

Home Network Applications (3)

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

Some forms of e-commerce.

Mobile Network Users

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

Combinations of wireless networks and mobile computing.

Network Hardware

- Local Area Networks

- Metropolitan Area Networks

- Wide Area Networks

- Wireless Networks

- Home Networks

- Internetworks

Broadcast Networks (1)

Types of transmission technology

- Broadcast links

- Point-to-point links

Broadcast Networks (2)

- BROADCAST NETWORKS
have a single communication channel that is shared by all the machines on the network

- POINT-TO-POINT NETWORKS
consists of many connections between individual pairs of machines.

Broadcast Networks (3)

- AS A GENERAL RULE, SMALLER, GEOGRAPHICALLY LOCALIZED NETWORKS TEND TO USE BROADCASTING, WHEREAS LARGER NETWORKS USUALLY ARE POINT-TO-POINT.

Broadcast Networks (4)

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

Classification of interconnected processors by scale.

Local Area Networks
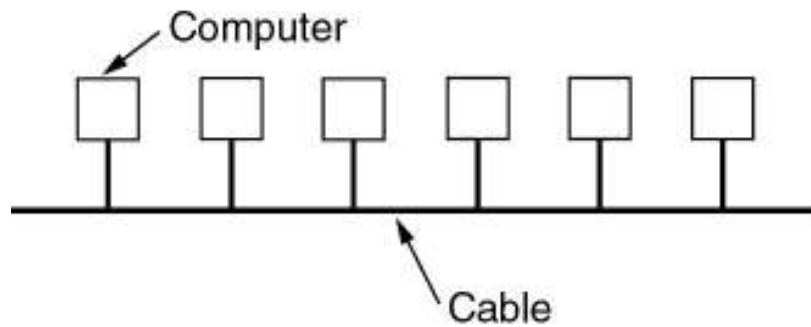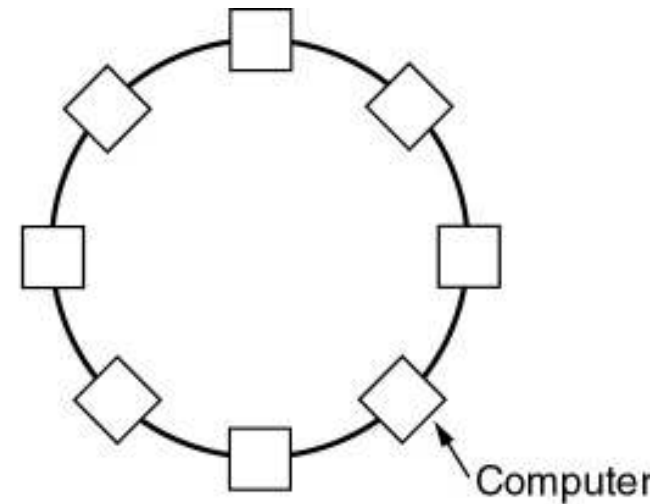
Two broadcast networks
(a) Bus
(b) Ring

Metropolitan Area Networks
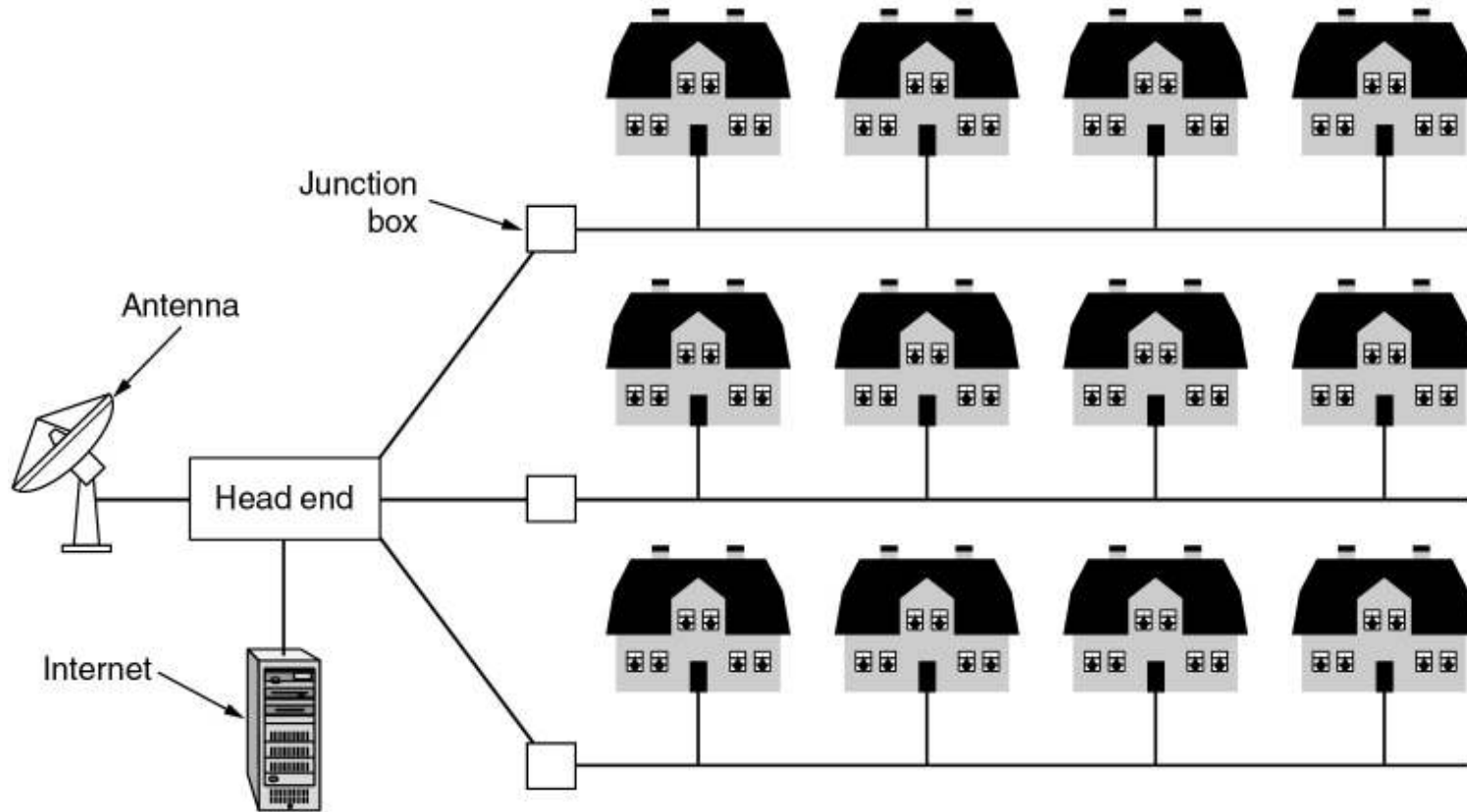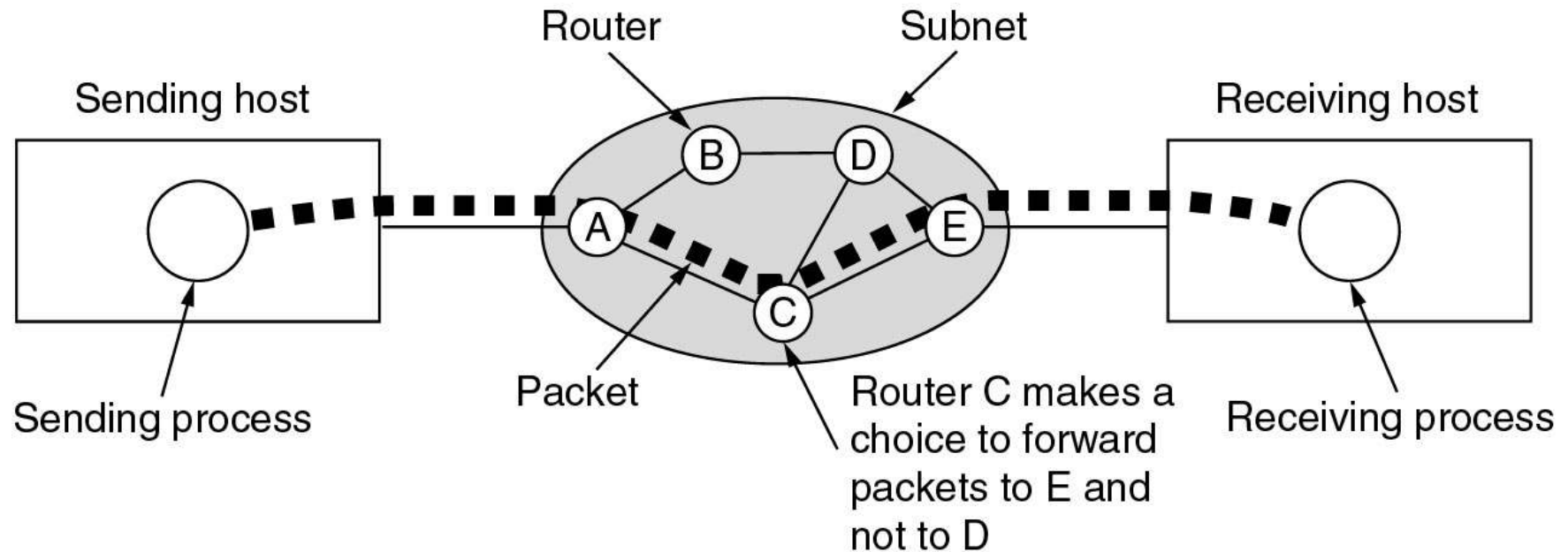

A metropolitan area network based on cable TV.

Wide Area Networks
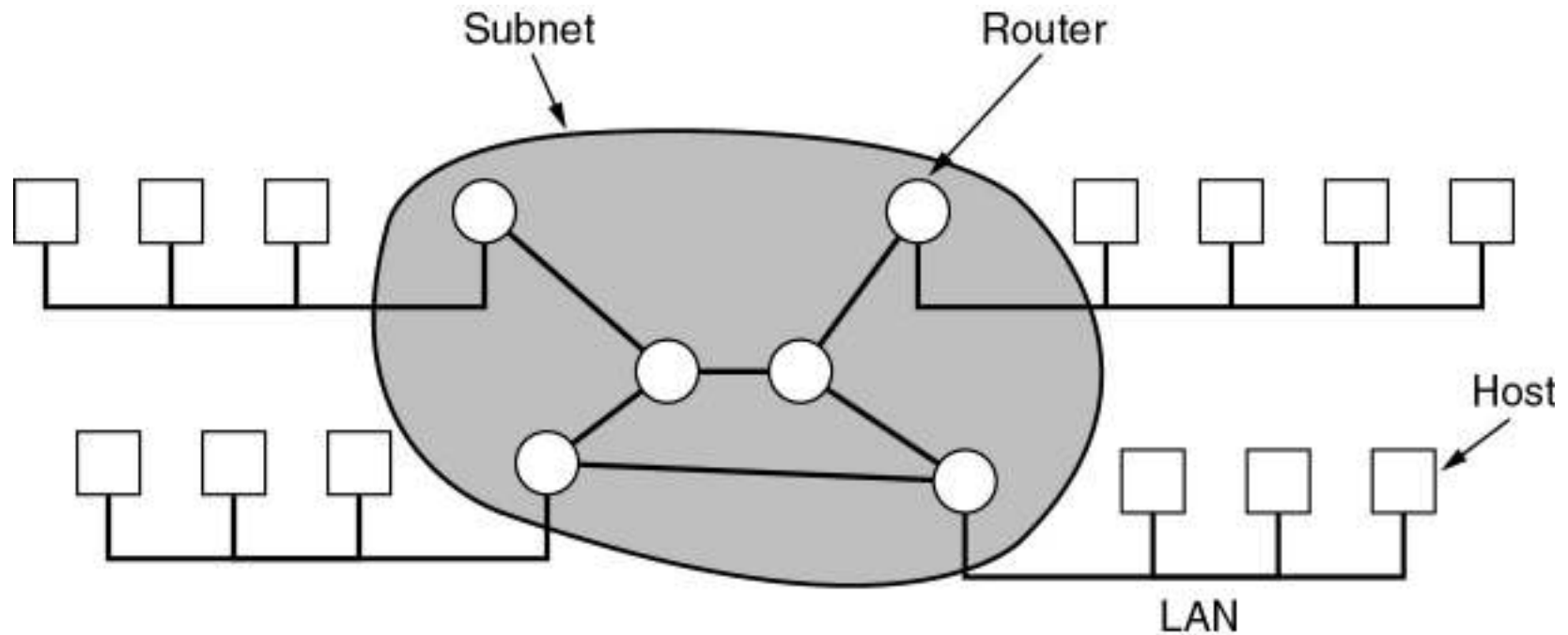
Relation between hosts on LANs and the subnet.
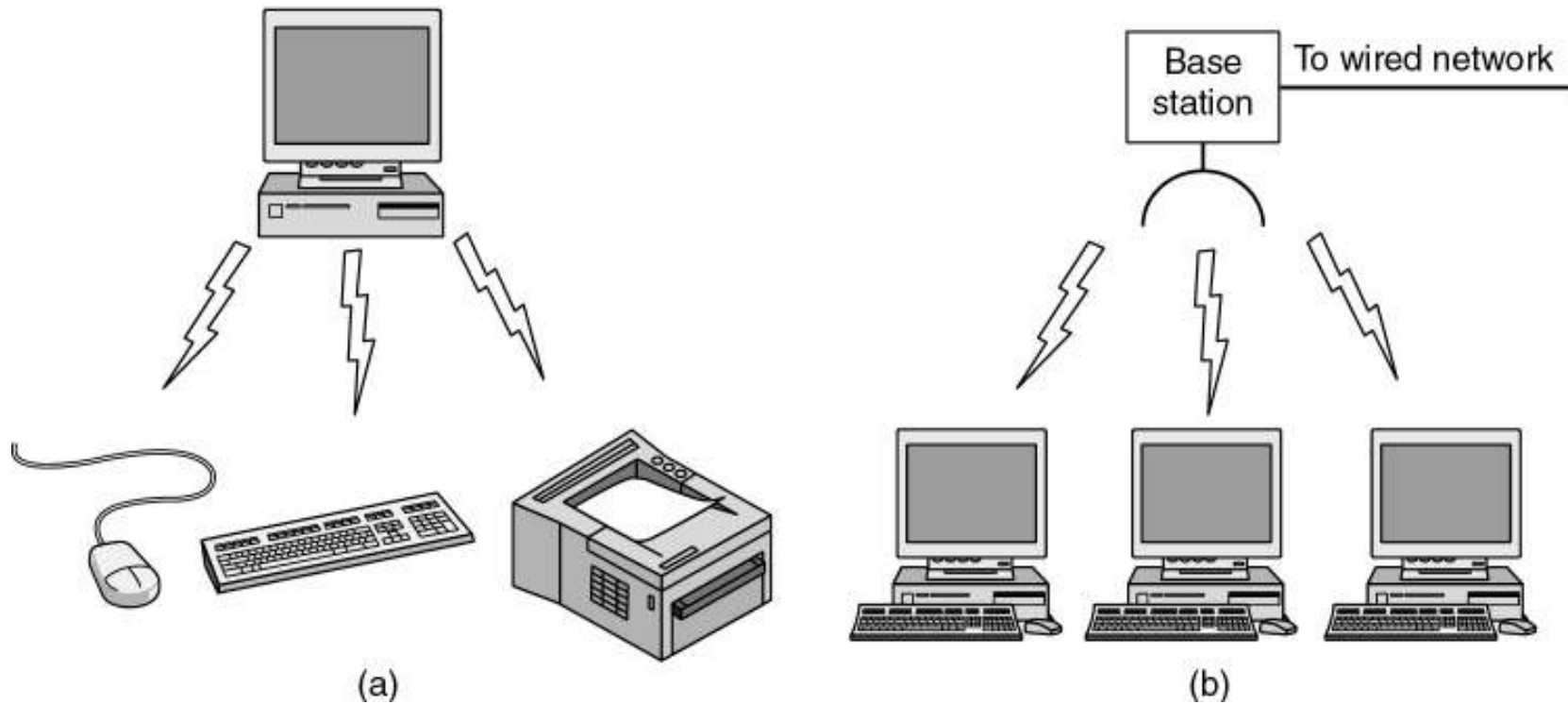
Wide Area Networks (2)

A stream of packets from sender to receiver.

Wireless Networks

Categories of wireless networks:

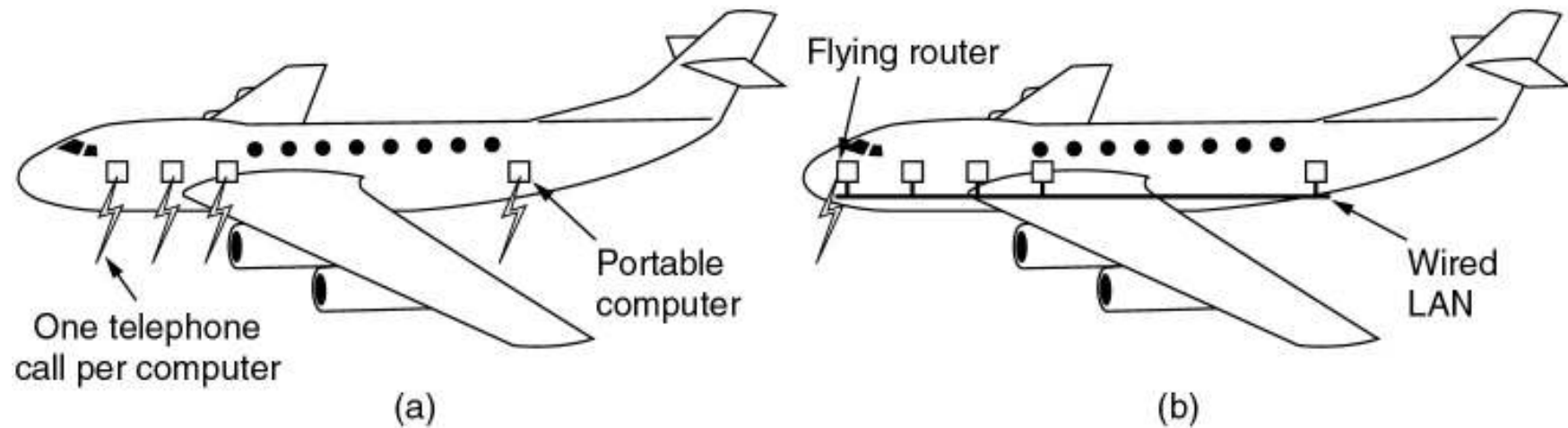- System interconnection

- Wireless LANs

- Wireless WANs

Wireless Networks (2)

(a)

(b)

(a) Bluetooth configuration
(b) Wireless LAN

Wireless Networks (3)

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

Home Network Categories

- Computers (desktop PC, PDA - Personal digital assistant, shared peripherals)

- Entertainment (TV, DVD - Digital Versatile Disc , VCR - Video Cassette Recording , camera, stereo, MP3)

- Telecomm (telephone, cell phone, intercom, fax)

- Appliances (microwave, fridge, clock, furnace, airco, lights)

- Telemetry (utility meter, smoke/burglar alarm, babycam).

Network Software

- Protocol Hierarchies

- Design Issues for the Layers

- Connection-Oriented and Connectionless Services

- Service Primitives
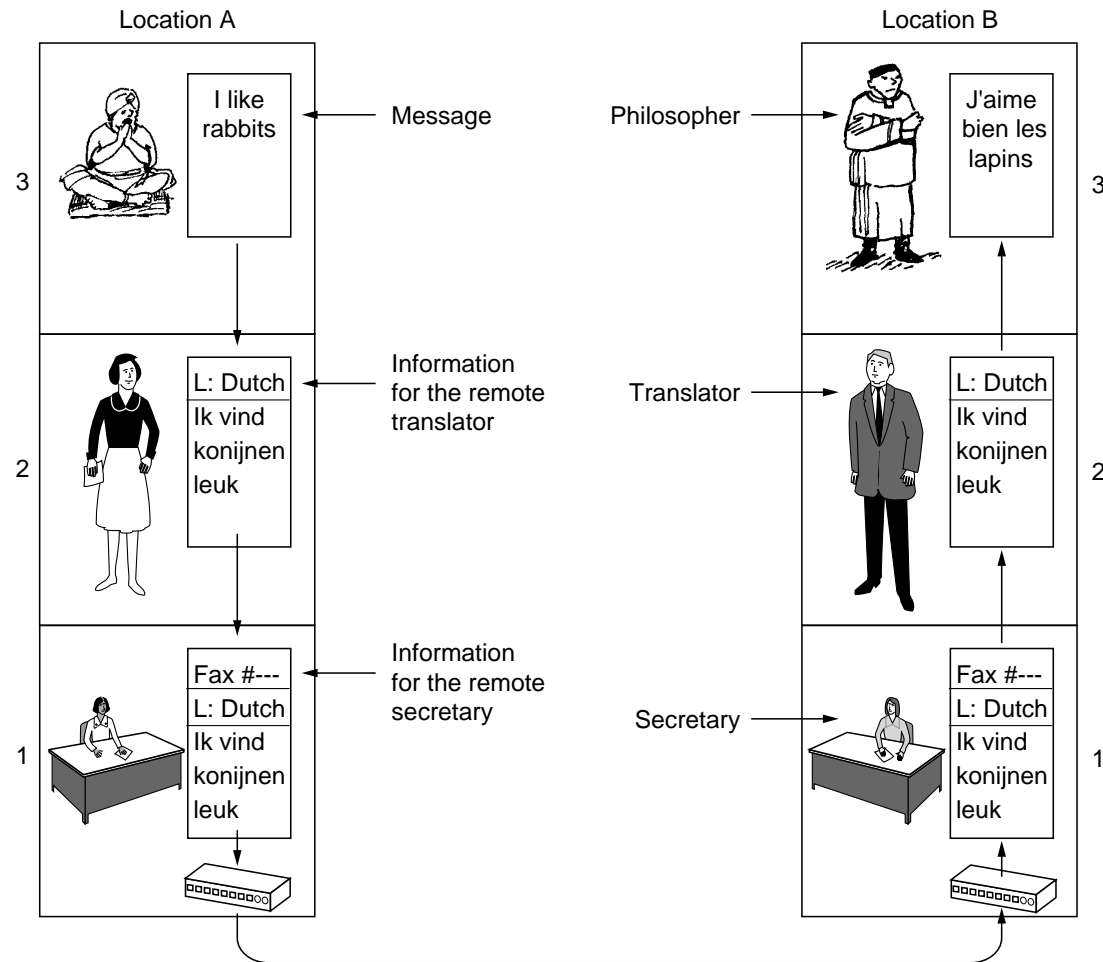
- The Relationship of Services to Protocols

Network Software
Protocol Hierarchies
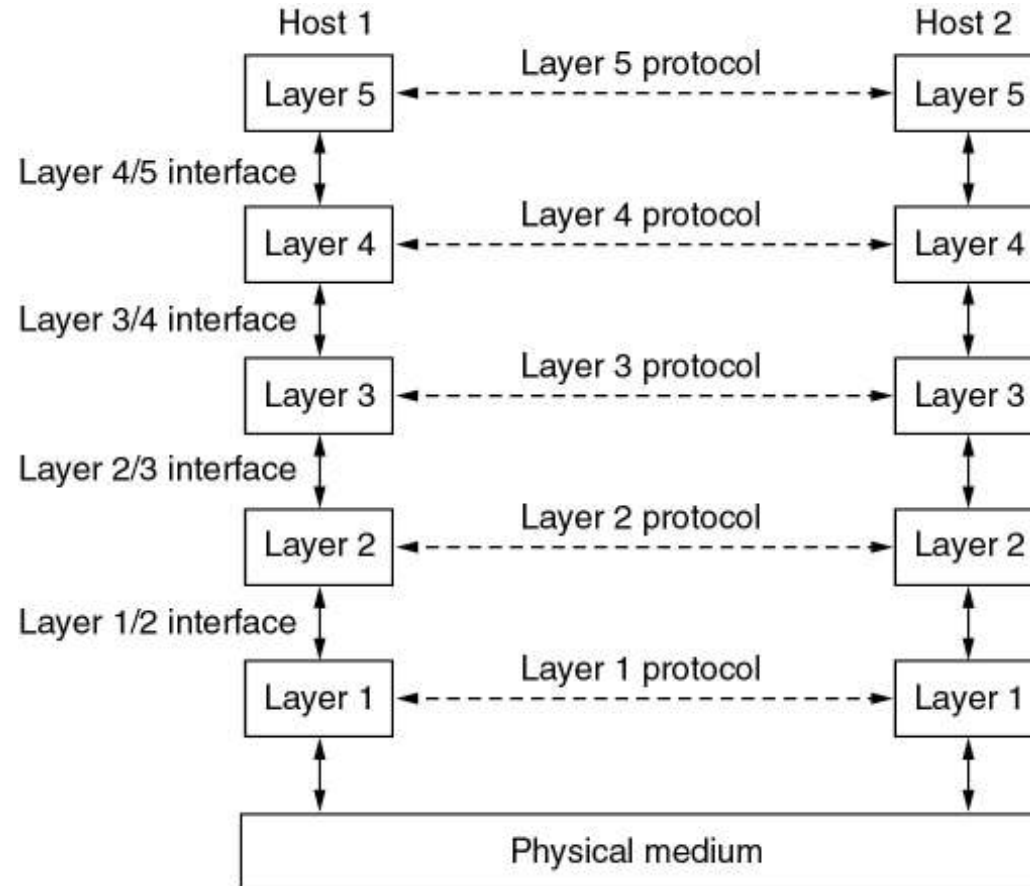
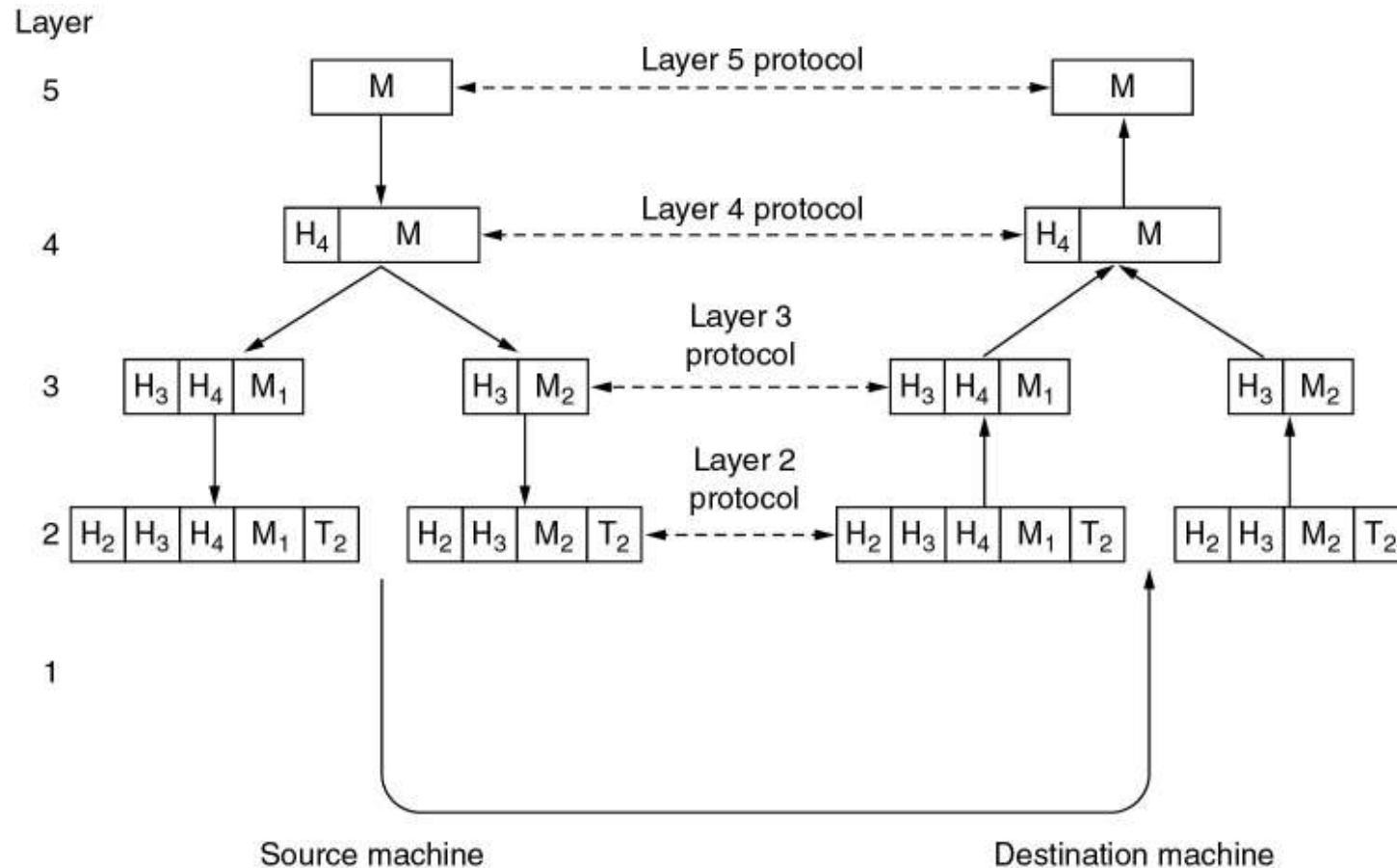Layers, protocols, and interfaces.

Protocol Hierarchies (2)

The philosopher-translator-secretary architecture.

Protocol Hierarchies (3)

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

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

Six different types of service.

Service Primitives

| 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

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

Service Primitives (2)
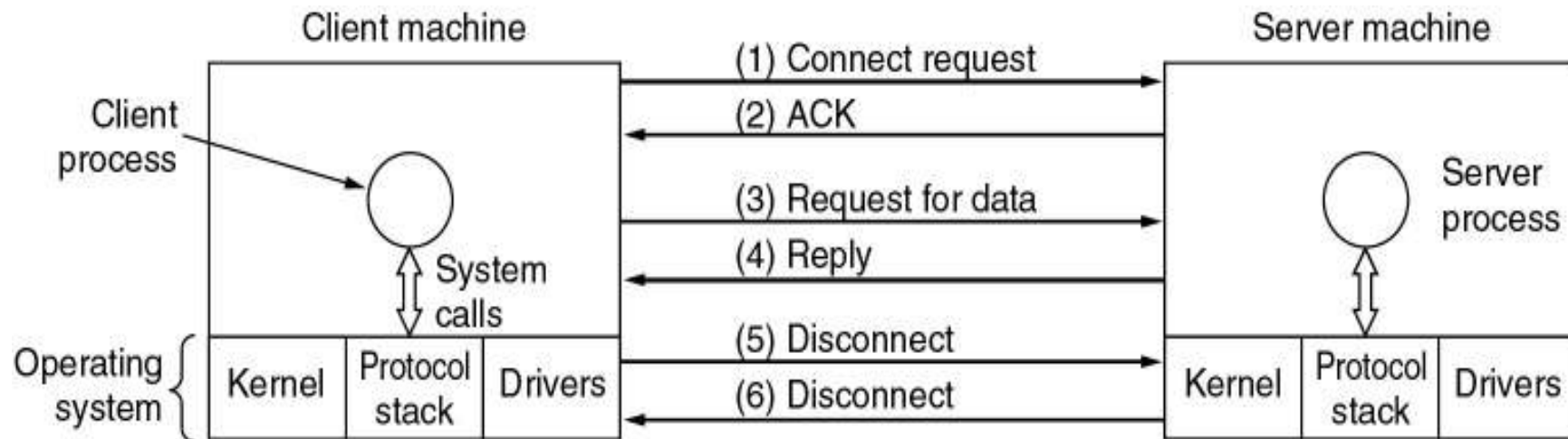
Packets sent in a simple client-server interaction on a connection-oriented network.

Services to Protocols Relationship
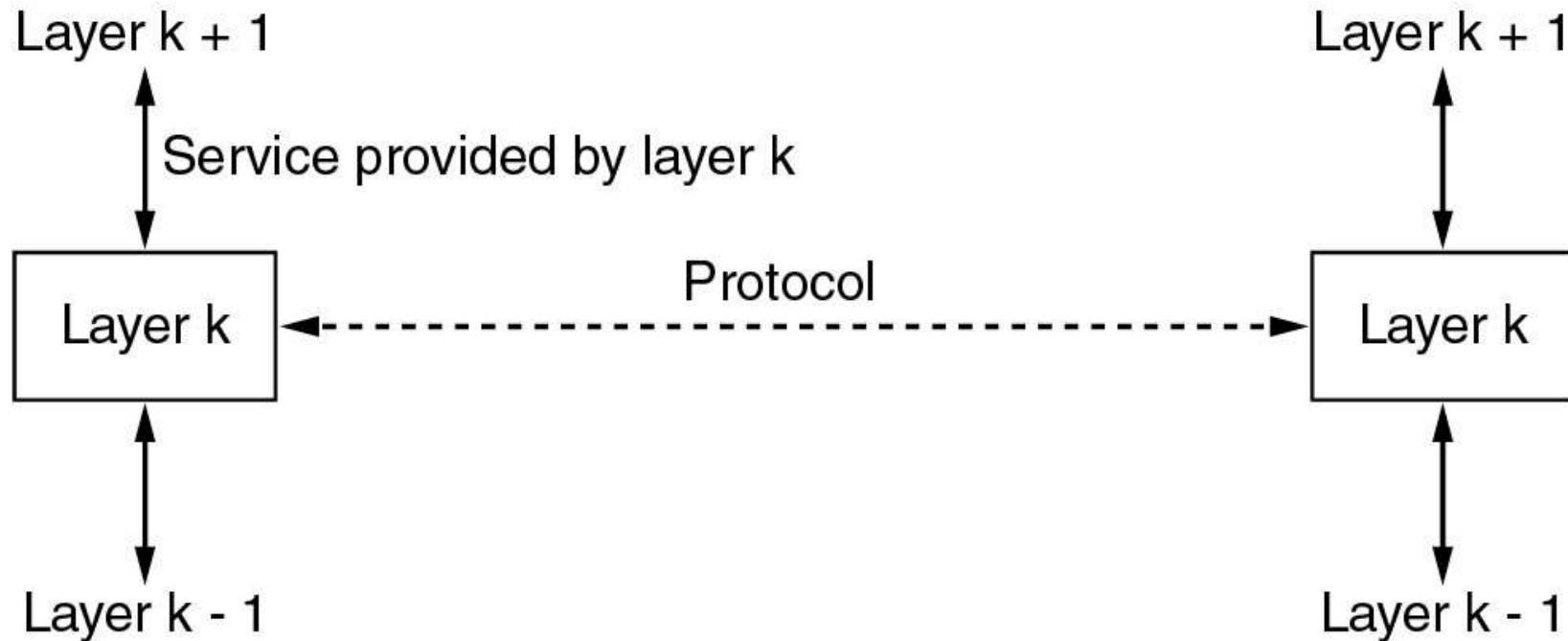
The relationship between a service and a protocol.