Introduction to Networking

COMP90007 Internet Technologies

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Outline

- Computer Networks
- Different types of computer networks
- Protocols, Layers and Services

Computer Networks

- **Network**:
  - An intricately connected system of things or people
  - An interconnected or intersecting configuration or system of components

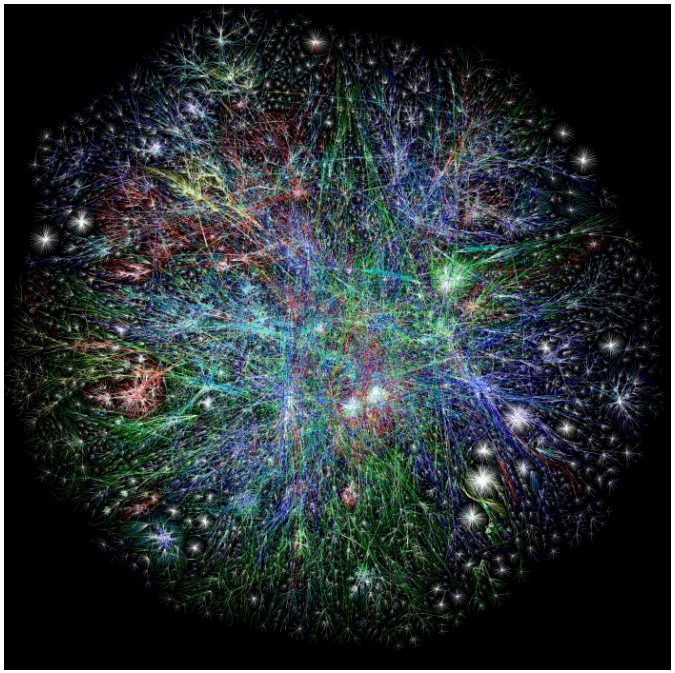
- **Computer Network**:
  - A collection of autonomous computers interconnected by a single technology

Terminologies

- **Network device**: e.g. PC, Phone, Router, Switch.
- **Server**: Provider of a service. Accept requests from clients.
- **Client**: A network device connecting to a server and requesting a service.
- **Packet**: A message sent between two network devices.
- **IP address**: A unique number identifying a network device.

Internet vs. World Wide Web

- Is the Internet or WWW a computer network?
  - The **Internet** is not a single network but a **network of networks**!
  - The **WWW** is a distributed system that **runs on top of the Internet**



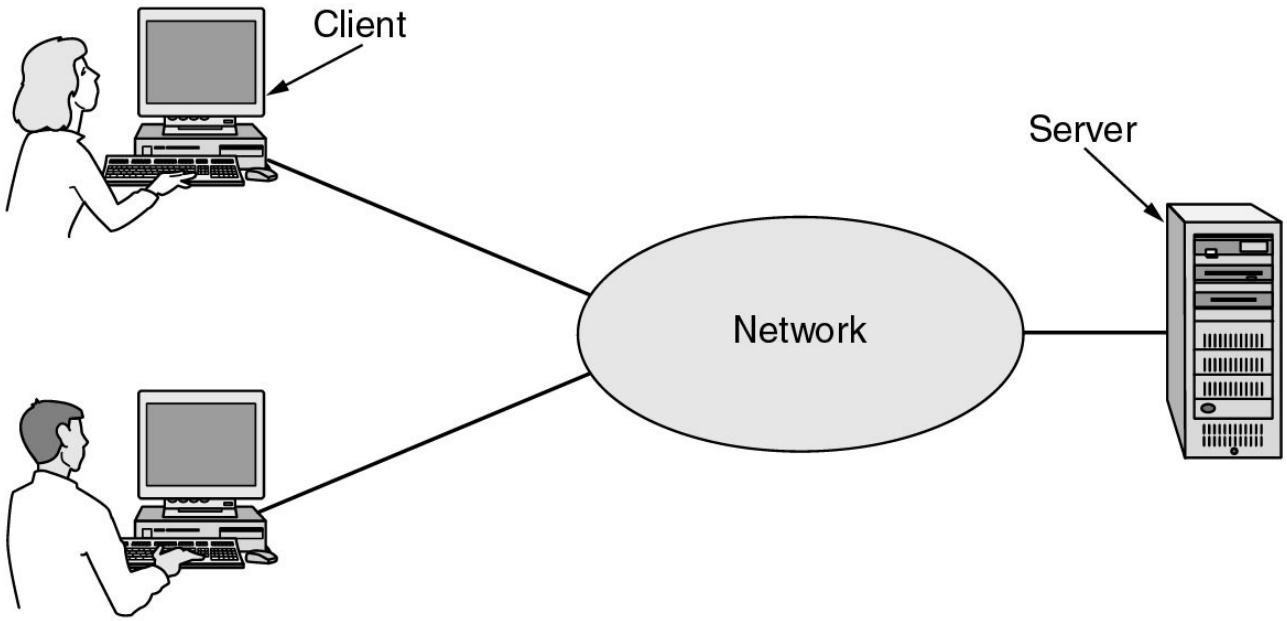
https://mountpeaks.wordpress.com/

Uses of Computer Networks

- Business and Personal Applications
  - Resource sharing (e.g., printer, scanner, files)
  - Access to information
  - Interactive entertainment
  - E-commerce
  - Social Interactions
- Internet-of-Things
  - parking, smart-meter, vending machines

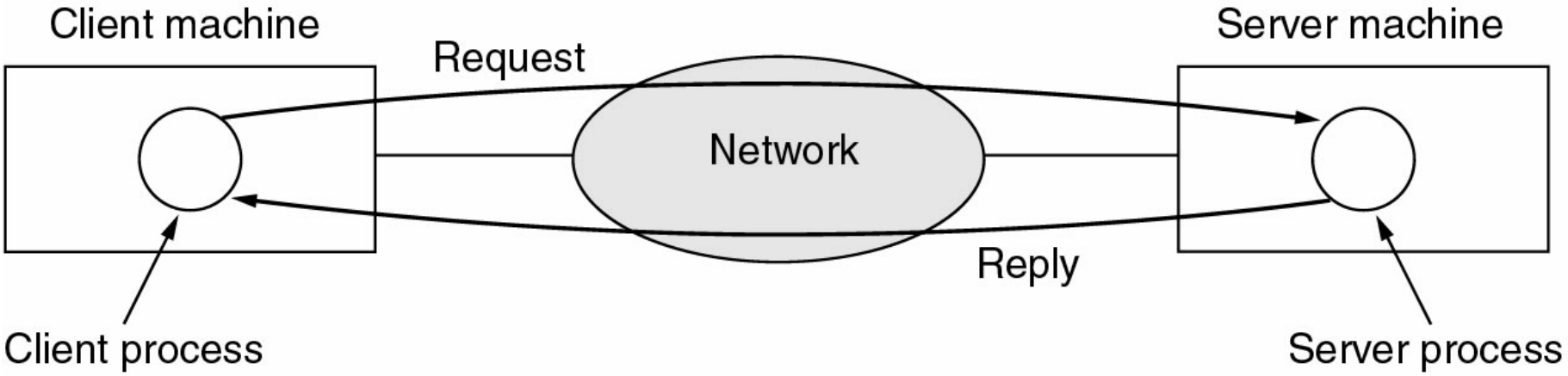
Simple Client-Server Network

- A network with two clients and one server



Simple Client-Server Network

- The client-server model involves requests and replies



Differentiating Factors of Networks

- Types of transmission technology
  - Broadcast links
    - Broadcast networks have a single communication channel shared by all machines on a network.
    - Packets sent by any machine are received by all others. Intended recipients process the packet contents, others simply ignore it.

Differentiating Factors of Networks

- Types of transmission technology
  - Point-to-point links
    - Data from sender machine is not seen and processed by other machines.
    - Point-to-point networks consist of many connections between individual pairs of machines.
    - Unicasting is the term used where point-to-point networks with a single sender and receiver pair can exchange data.
  - Multicasting
    - Transmission to a subset of the machines.

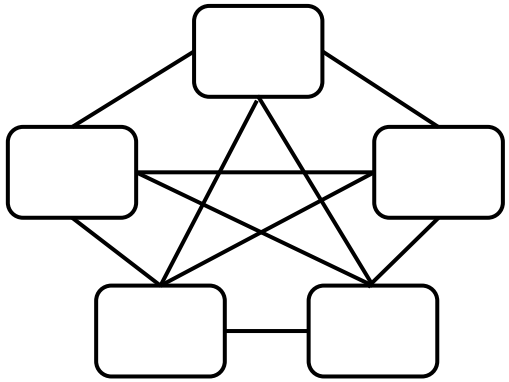
Differentiating Factors of Networks

- By Scale

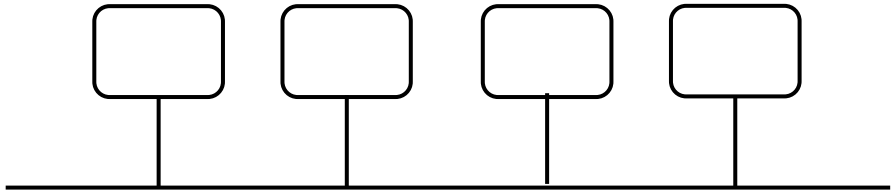
Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

Differentiating Factors of Networks

- By Topology
  - Mesh
    - Fully mesh: each device has a dedicated point-to-point link to every other device.
  - Bus
    - All devices are attached to a shared medium.
    - Only a single device on the network can transmit at any point in time. Requires a negotiation mechanism to resolve transmission conflicts.
    - e.g. Ethernet is the most common bus network.



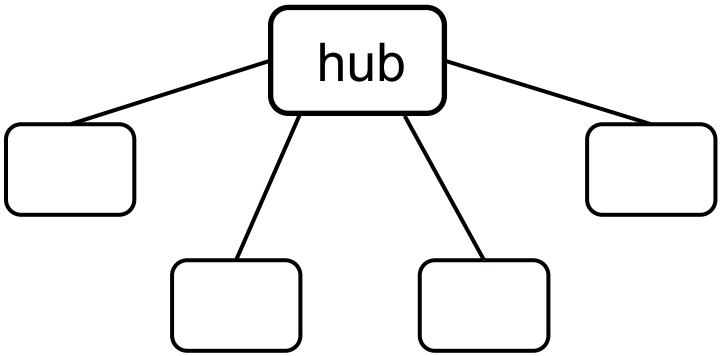
(a) fully mesh



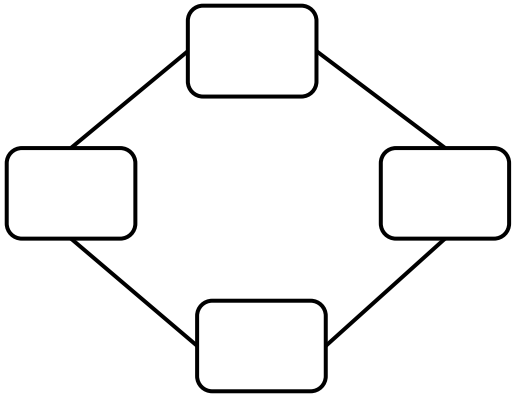
(b) bus

Differentiating Factors of Networks

- By Topology
  - Star
    - All devices are attached to a central device.
  - Ring
    - Each device on the ring receives the data from the previous device and forwards it to the next device.
    - Requires access control to resolve propagation queuing.
    - e.g., Token ring.



(c) star

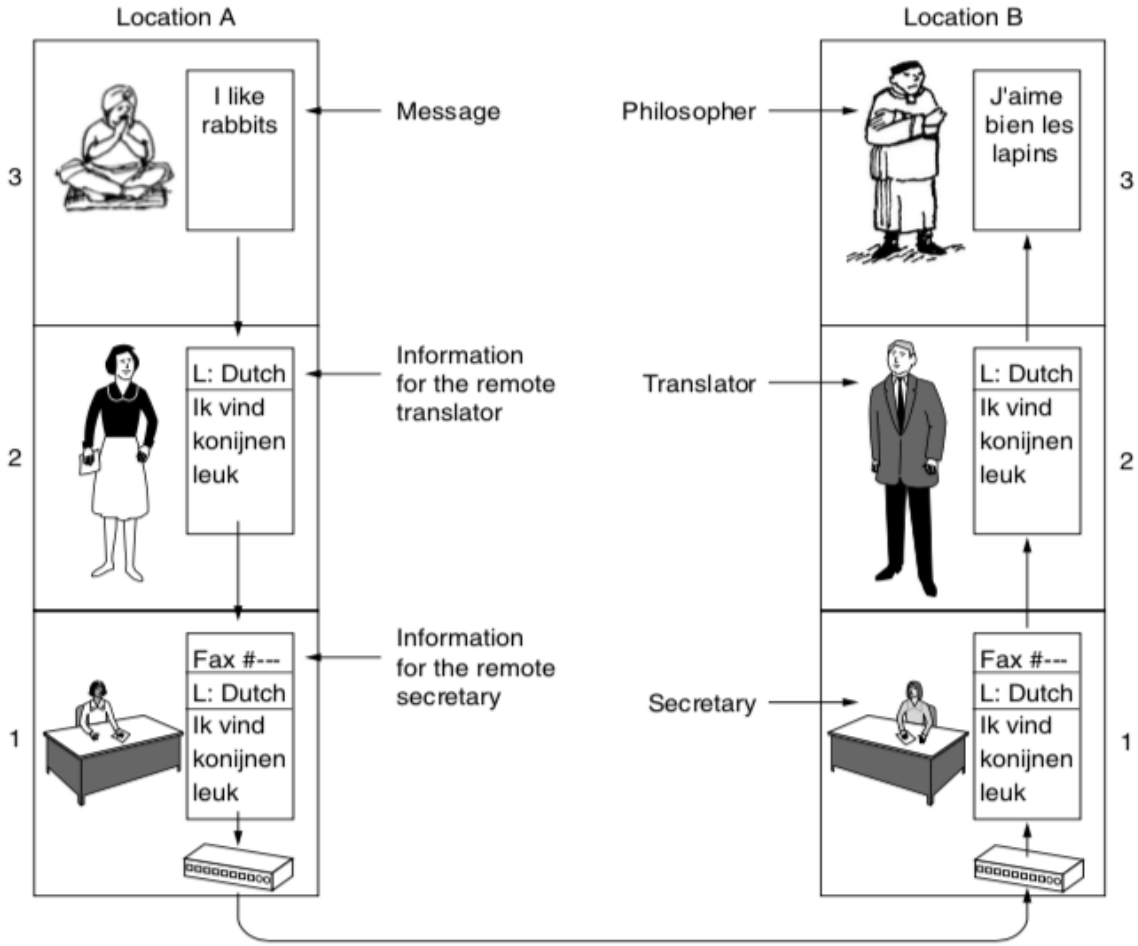


(d) ring

What Makes the Internet Work

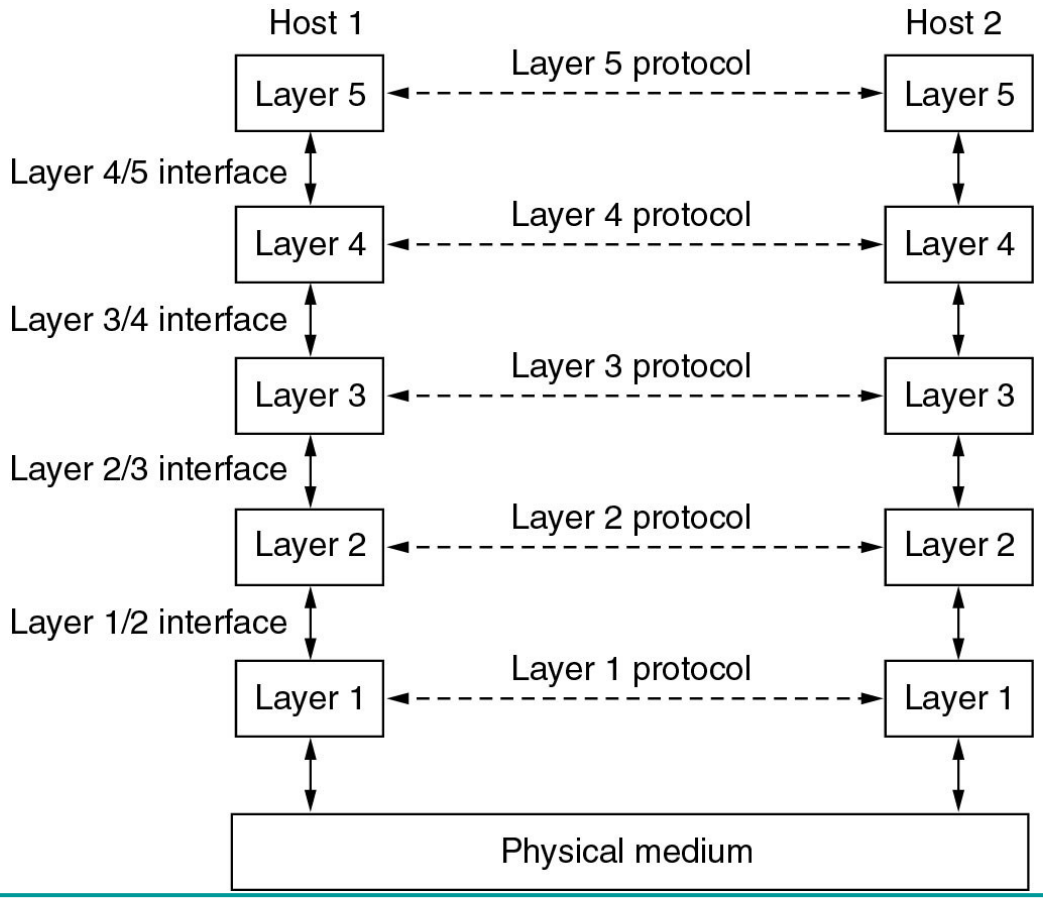
- Protocols, Layers and Services
  - Protocol Hierarchies
  - Design of Layer Models
  - Connection-Oriented and Connectionless Services
  - Services Primitives
  - Services and Protocols
- Network Reference Models
  - Open Systems Interconnect
  - TCP/IP

Philosopher-Translator-Secretary Architecture



Network Software: Protocol Hierarchies (1)

- Layers, protocols and interfaces



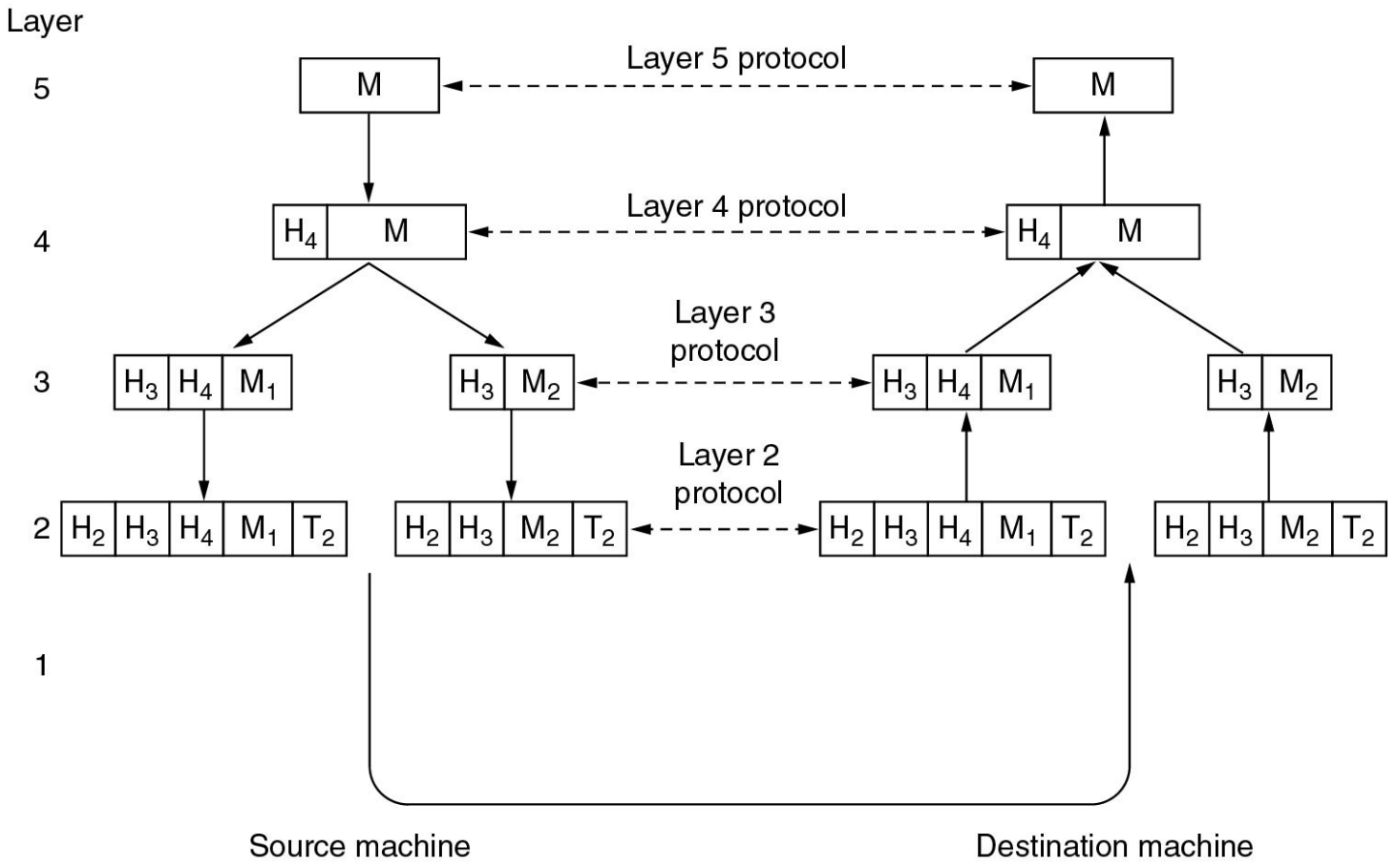
Consider the network as a stack of **layers**

Each layer offers **services** to layers above it through **interface**

Protocol is an agreement between the communicating parties on how communication is to proceed

Network Software: Protocol Hierarchies (2)

- Information flow supporting the virtual communication in layer 5



Services

- Choice of service type has a corresponding impact on the reliability and quality of the service

- Connection-Oriented vs. Connectionless
  - Connection-Oriented: connect, use, disconnect. Negotiation inherent in connection setup.
  - Connectionless: send.

Connection-Oriented and Connectionless

- Six different types of services

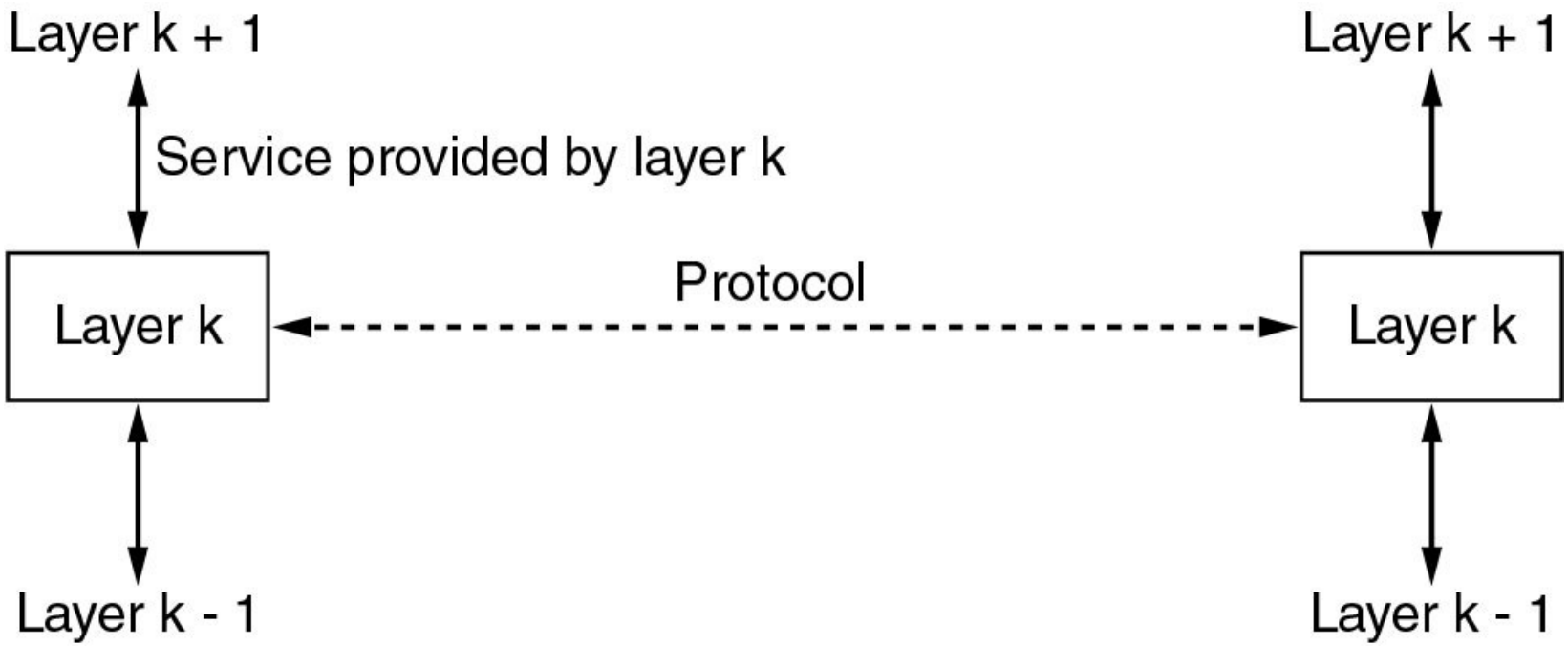
	Service	Example
Connection-oriented	Reliable message stream	Sequence of pages
	Reliable byte stream	Movie download
	Unreliable connection	Voice over IP
Connectionless	Unreliable datagram	Electronic junk mail
	Acknowledged datagram	Text messaging
	Request-reply	Database query

Service Primitives

- Primitives are a formal set of operations for services
- The number and type of primitives depends on the nature of service - in general more complex services require more service primitives
- Six 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
ACCEPT	Accept an incoming connection from a peer
RECEIVE	Block waiting for an incoming message
SEND	Send a message to the peer
DISCONNECT	Terminate a connection

Relationship of Services and Protocols

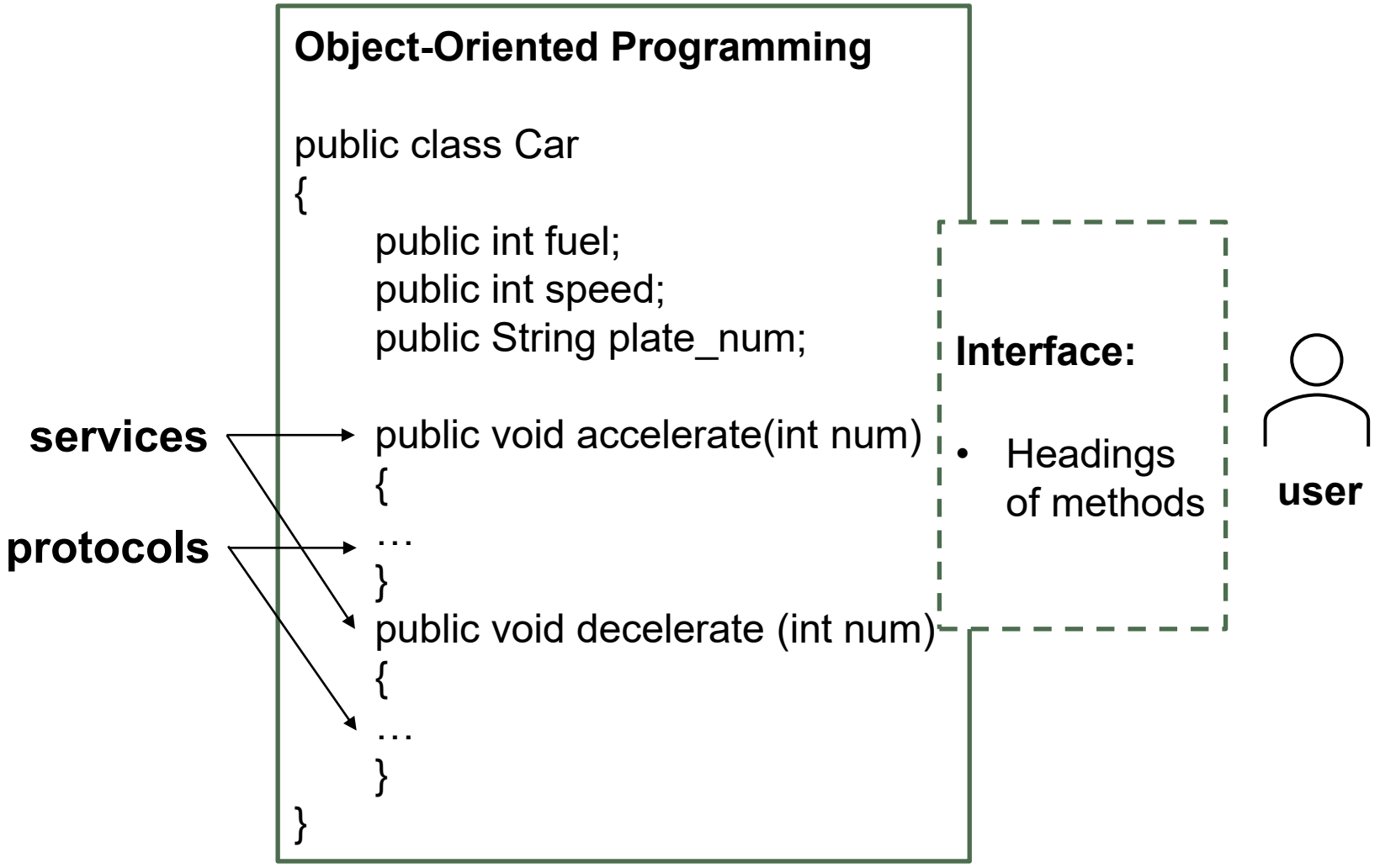


Relationship of Services and Protocols

- **Service = set of primitives that a layer provides to a layer above it**
  - Provided through the interfaces between layers (service provider and service user)
  - Defines what operations the layer is prepared to perform on behalf of its users
  - Abstract: nothing about how these operations are implemented

- **Protocol = a set of rules governing the format and meaning of packets that are exchanged by peers within a layer**
  - Packets sent between peer entities

Relationship of Services and Protocols



Next Topic: 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