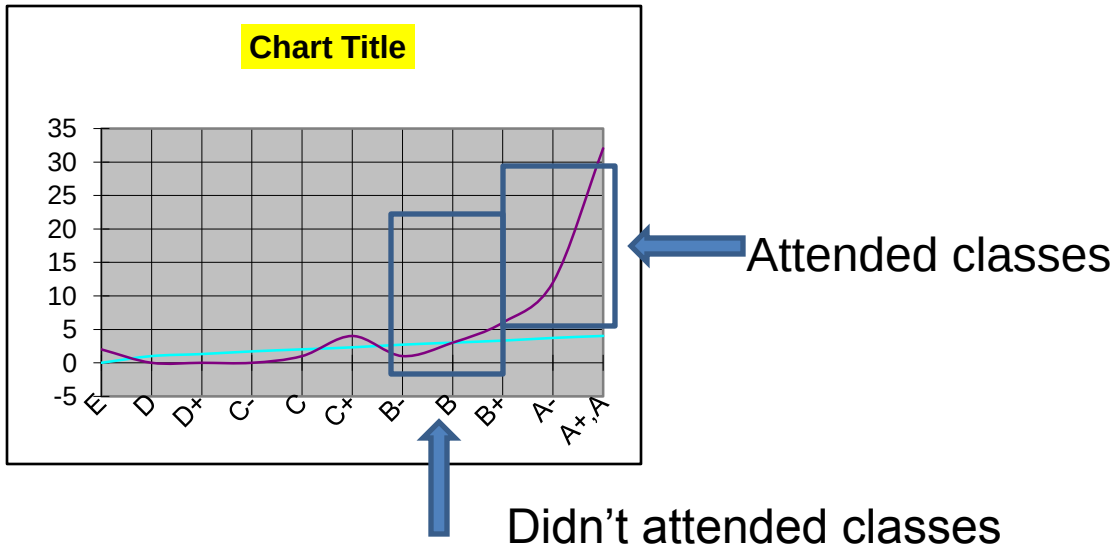
Overview of Communication Networks

Suneth Namal Karunarathna

PhD,MEng.,MSc, BSc(Eng)

Communication Networks II

- Grades 2017



Network applications

Computer network applications are **network software applications** that utilize the Internet or other network hardware infrastructure to perform useful functions for example file transfers within a network.

- **There are 2 types of network applications:-**

❑ **Pure network applications**

❑ **Standalone network application**

Pure Network Applications

- These are applications created to be used in networks; using pure network applications on a single computer doesn't make sense. They help us to transfer data and communicate within a network. Such applications have a separate and distinct user interface that users must learn for instance:

- **Email programs**
- **File transfer protocol (FTP)**
- **Terminal Emulation (TELNET)**
- **Groupware**
  - **Video Conferencing**
  - **Chatting**

Stand Alone Applications

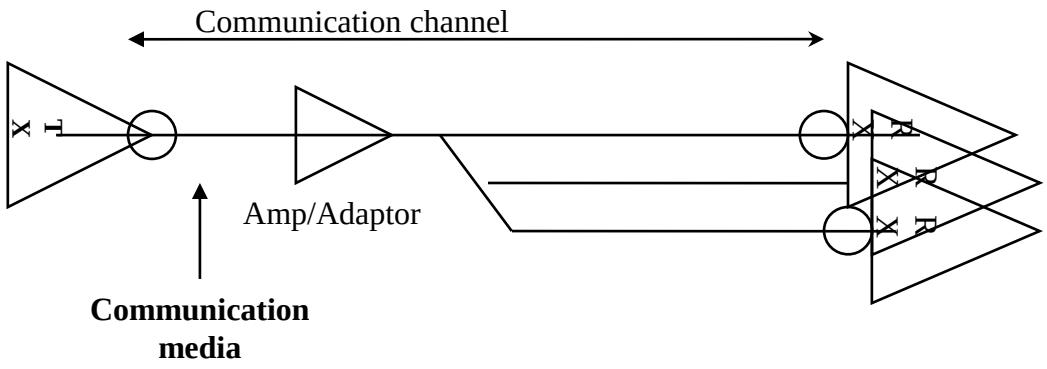
- These are applications that run on **stand alone computers** (computers not connected to any other). In order to extend their activity, they are rebuild to run on network environments e.g. word processors, spreadsheets, database management systems, presentations graphics, project management etc.

Communications and Networks

- **Data Communications**
  - Transmission of signals
    - Encoding, interfacing, signal integrity, multiplexing etc.
- **Networking**
  - Topology & architecture used to interconnect devices

Communication Systems

- Process describing **transfer** of information, data, instructions between one or more systems through some media
  - Examples
    - people, computers, cell phones, etc.
    - Computer communication systems
- Signals passing through the communication channel can be **Digital**, or **analog**
  - Analog signals: continuous electrical waves
  - Digital signals: individual electrical pulses (bits)
- Receivers and transmitters: desktop computers, mainframe computers, etc.



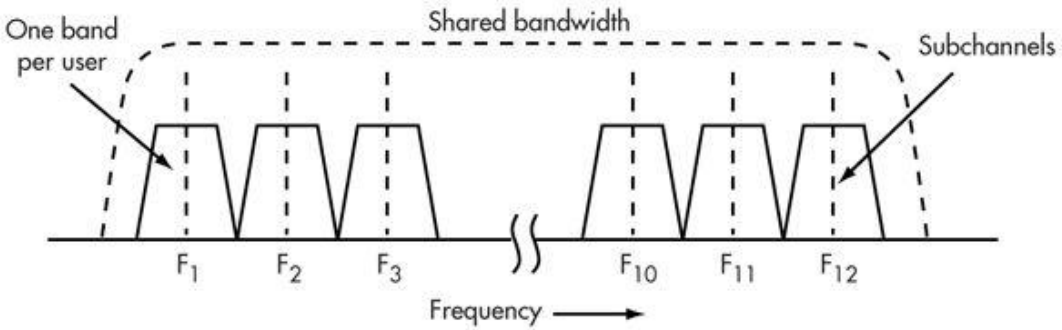
Analog signals: typically 150 MHz and up

1G

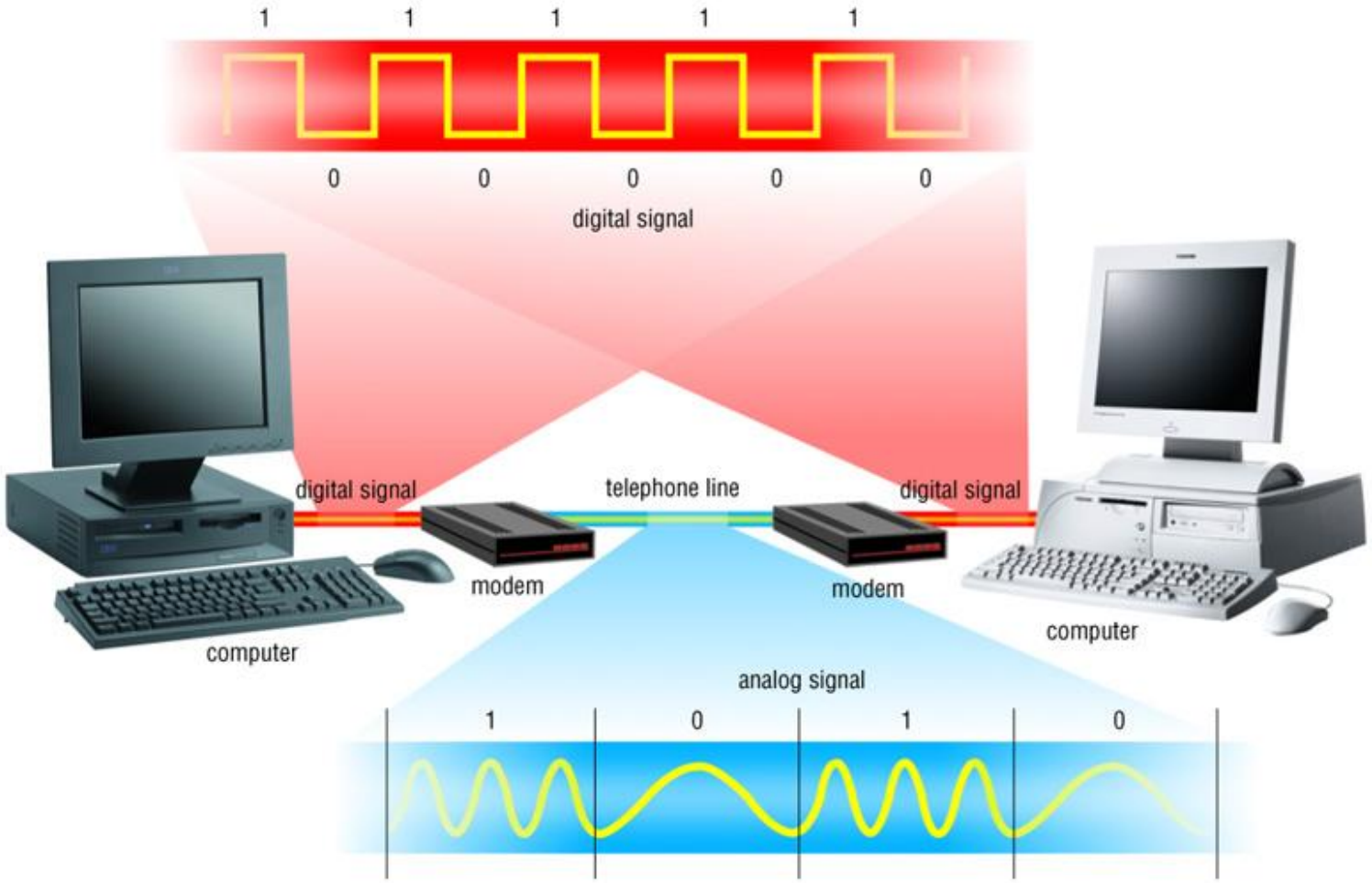
- 1G as the name indicates is the first generation of the mobile telephone technology.
- Developed in 1980's, 1G uses analog signals for its transmission.
- The technique used for handling the traffic in 1G is Frequency-Division Multiple Access (FDMA).

What is FDMA ??

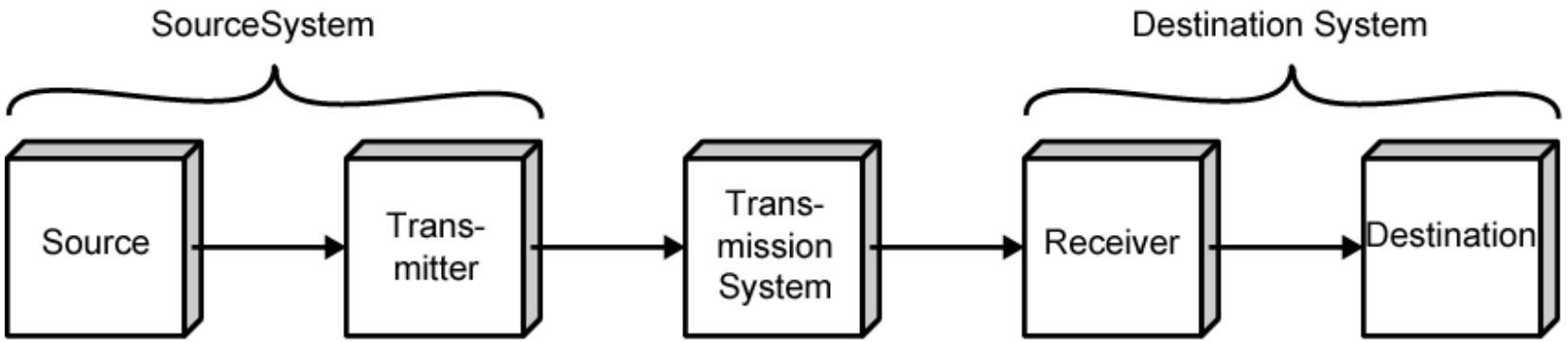
- Frequency Division Multiple Access involves division of the whole allotted bandwidth into different frequency bands and allocating each band to a particular user.



Communication Systems

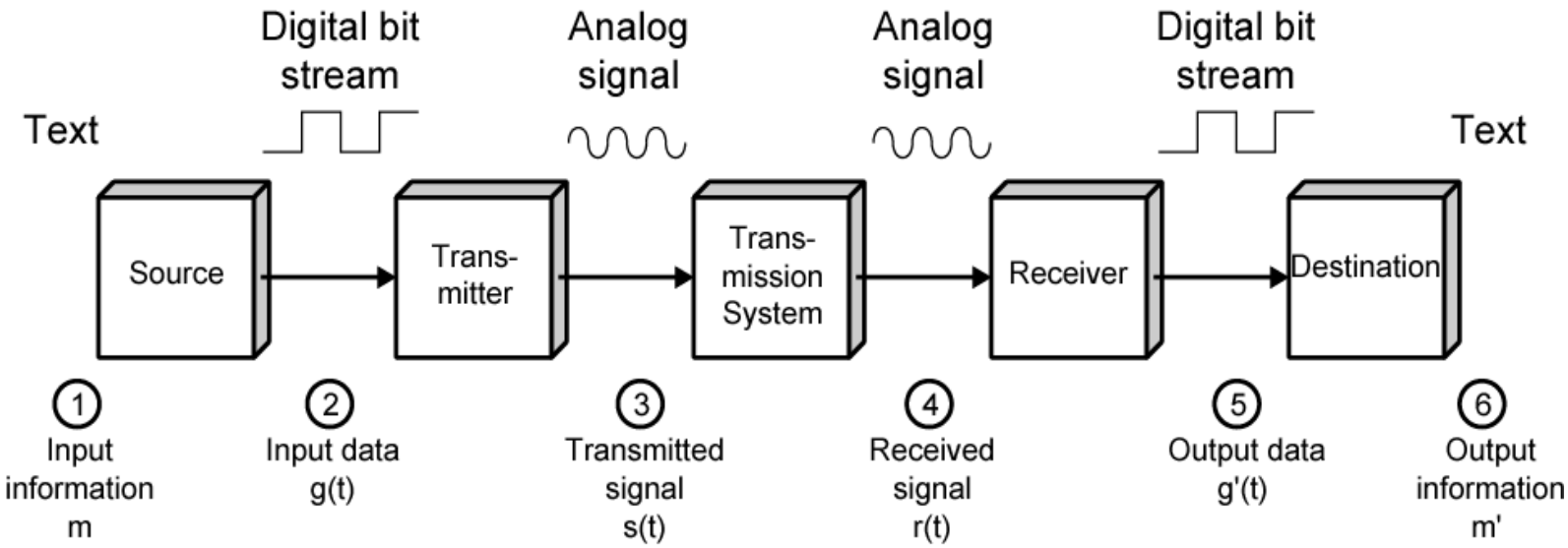


A Communications Model

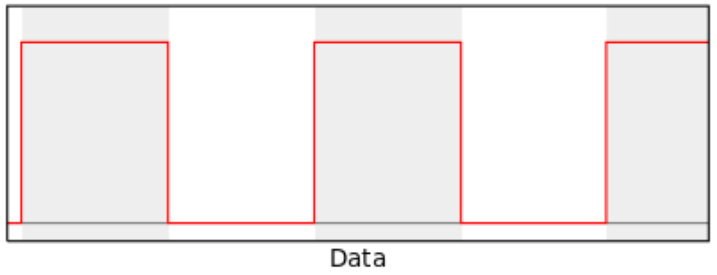


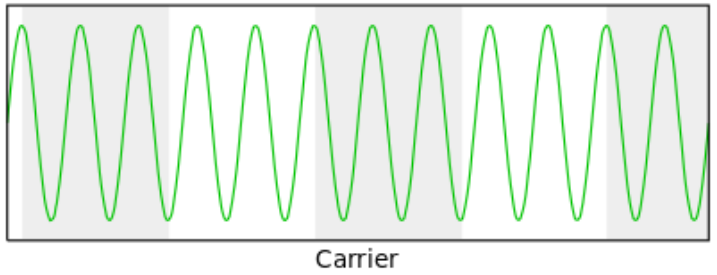
(a) General block diagram

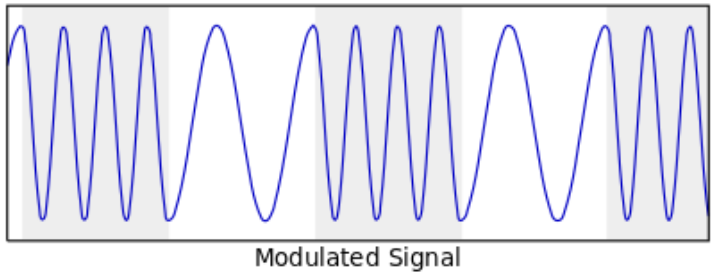
(b) Example



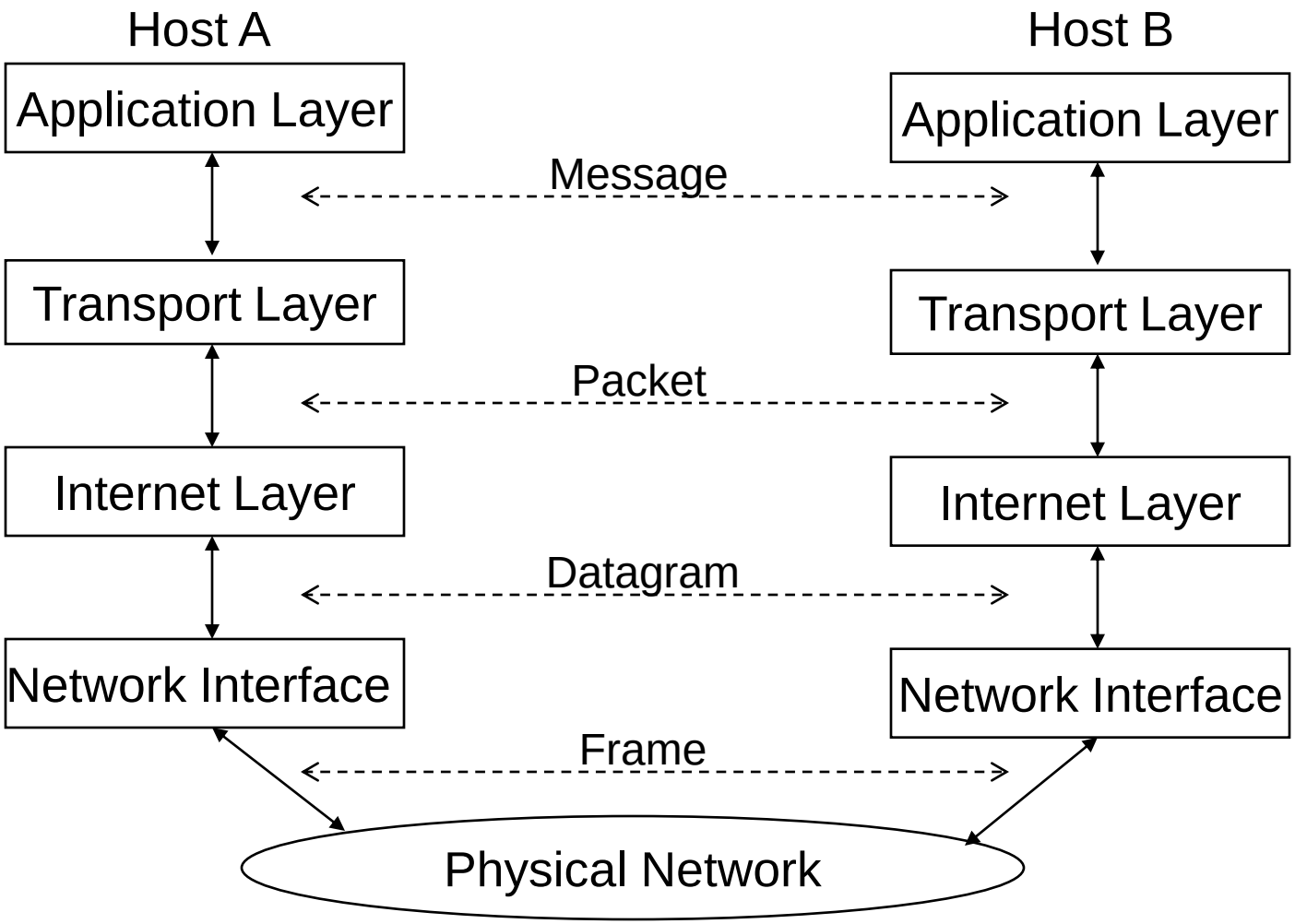
Data Communications Model



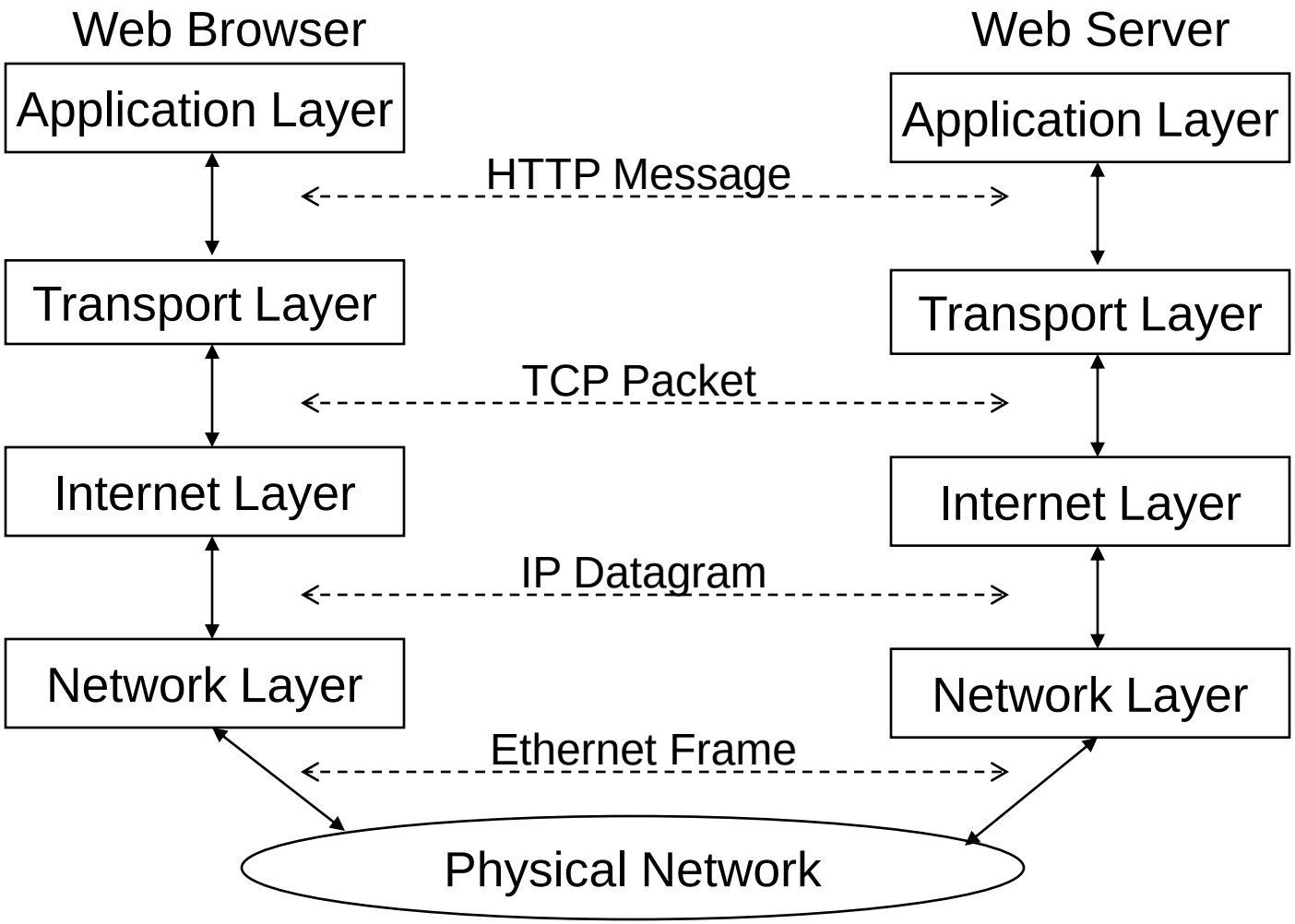




Protocol Layering



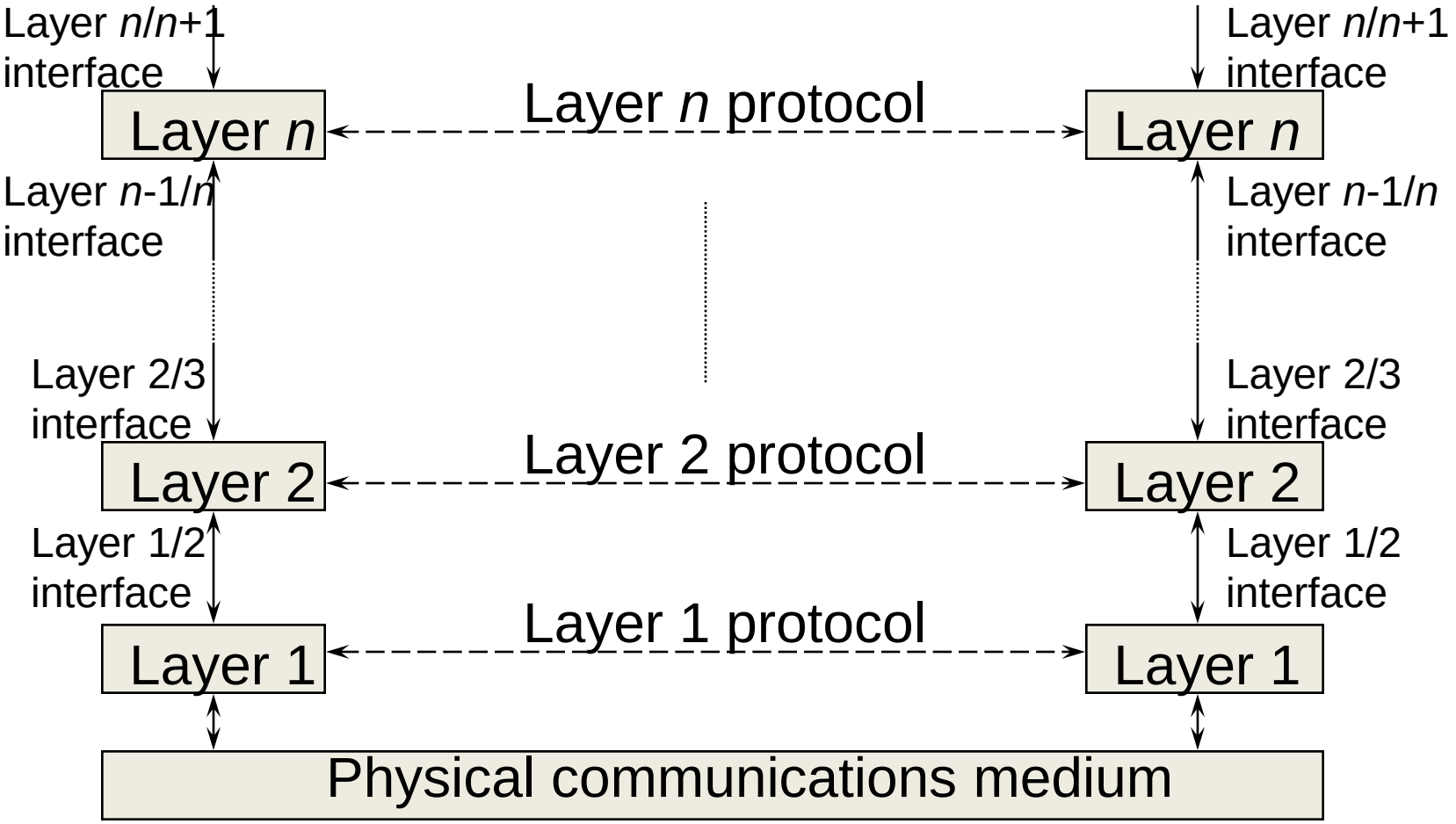
Protocol Layering



Protocol Hierarchies

- Protocols are stacked vertically as series of ‘layers’.
- Each layer offers *services* to layer above, shielding implementation details.
- Layer n on one machine communicates with layer n on another machine (they are *peer processes/entities*) using Layer n Protocol.

Layers, Protocols & Interfaces



Layer/Interface Design

- Important objective is ‘clean’ interfaces, having minimal set of well-defined services.
- Clean-cut interfaces enable:
  - minimisation of inter-layer communications
  - easy replacement of individual layers
- Set of layers and protocols is the Network Architecture.

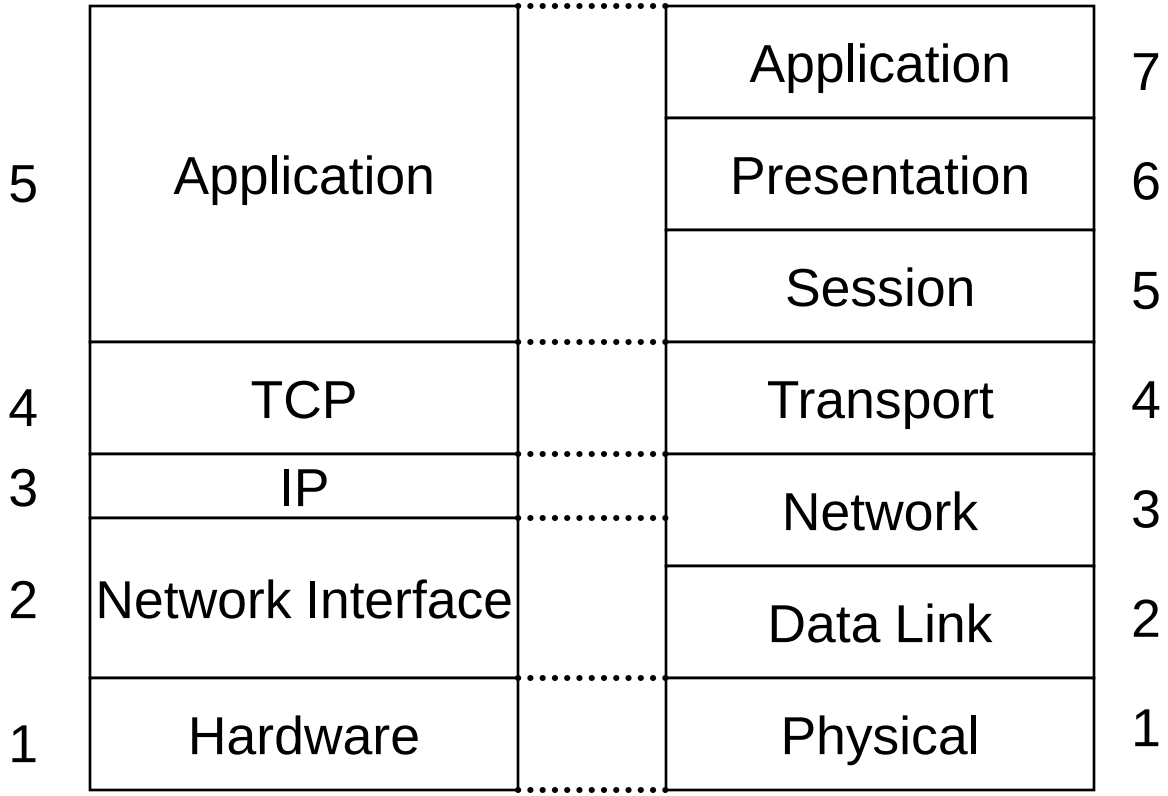
Virtual & Actual Communications

- Important to understand difference between:
  - virtual and actual communications,
  - protocols and interfaces.
- Peer processes ‘think’ of communications as being ‘horizontal’ using protocol.
- Actual communications is via interfaces (and the physical communications medium).
- Peer process idea is key to network design.

The OSI Reference Model

- OSI Reference Model – an internationally standardised network architecture.
- An abstract representation of an ideal network protocol stack; not used in real networks.
- OSI = Open Systems Interconnection.
- Specified in ISO 7498-1.
- Model has 7 layers.

Internet Protocols vs OSI



Layer 7: Application Layer

- Home to wide variety of protocols for specific user needs, e.g.:
  - virtual terminal service,
  - file transfer,
  - electronic mail,
  - directory services.

Layer 6: Presentation Layer

- Concerned with representation of transmitted data.
- Deals with different data representations.
  - ASCII or EBCDIC,
  - one's complement or two's complement,
  - byte ordering conventions,
  - floating point conventions (IEEE or proprietary).
- Also deals with data compression.

Layer 5: Session Layer

- Allows establishment of sessions between machines, e.g. to
  - allow remote logins
  - provide file transfer service.
- Responsible for:
  - dialogue control
    - which entity sends when with half-duplex communications.
  - token management
    - E.g. control which entity can perform an operation on shared data.
  - synchronisation
    - E.g. insertion of checkpoints in large data transfers.

Layer 4: Transport Layer

- Basic function is to take data from Session Layer, split it up into smaller units, and ensure that the units arrive correctly.
- Concerned with efficient provision of service.
- The Transport Layer also determines the ‘type of service’ to provide to the Session Layer.

Layer 3: Network Layer

- Key responsibility is control of routing in the subnet.
- Routing can be based on:
  - static tables,
  - determined at start of session,
  - highly dynamic (varying for each packet depending on network load).
- Also responsible for congestion control and usage monitoring.

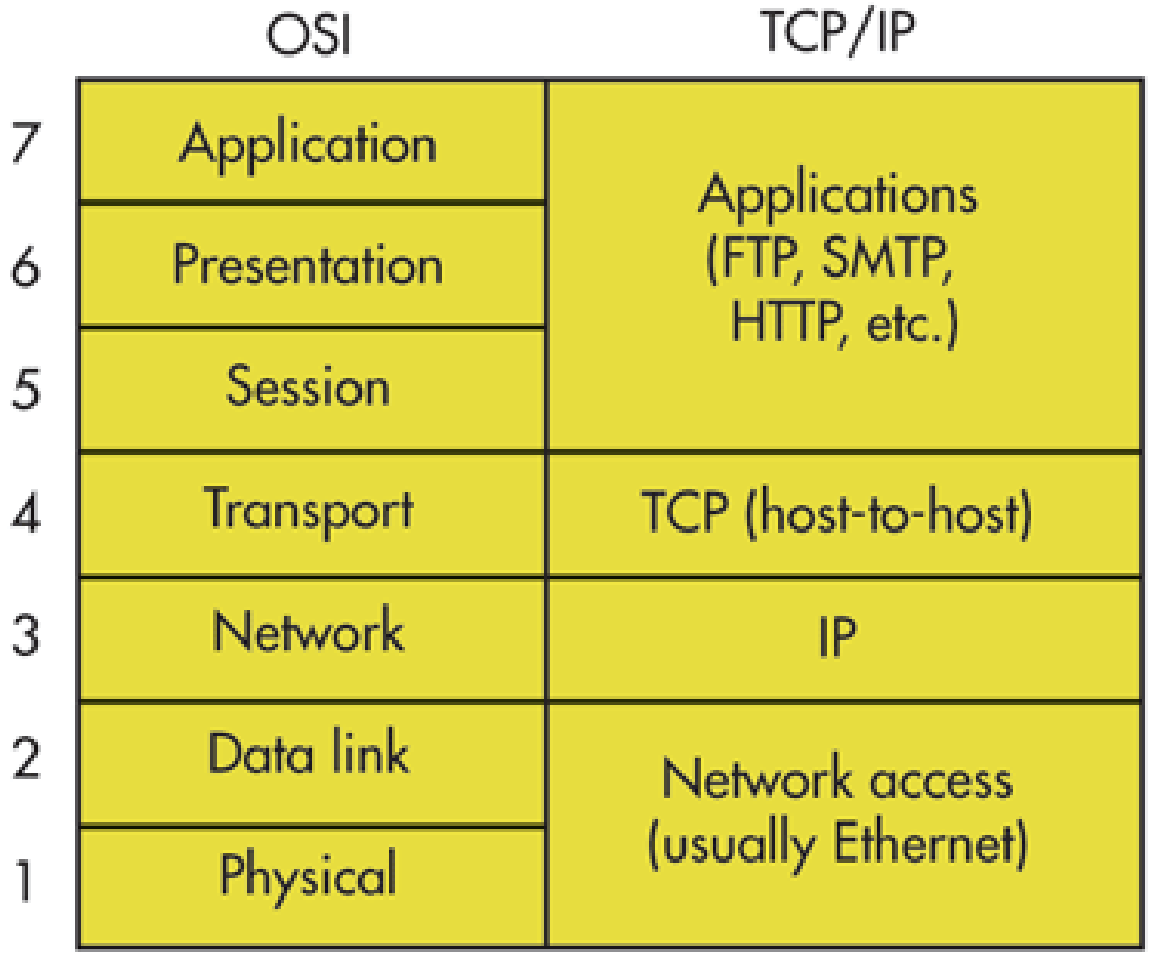
Layer 2: Data Link Layer

- Provides reliable, error-free service on top of raw Layer 1 service.
- Breaks data into frames. Requires creation of frame boundaries.
- Frames used to manage errors via acknowledgements and selective frame retransmission.

Layer 1: Physical Layer

- Concerned with bit transmission over physical channel.
- Issues include:
  - definition of 0/1,
  - whether channel simplex/duplex,
  - connector design.
- Mechanical, electrical, procedural matters.

Comparison


OSI
TCP/IP
7
Application
6
Presentation
5
Session
Applications
(FTP, SMTP,
HTTP, etc.)
4
Transport
TCP (host-to-host)
3
Network
IP
2
Data link
1
Physical
Network access
(usually Ethernet)