Data Communication

Lecture #1

Fundamentals of Data Communications

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Agenda

Course Objectives

Course Information

Fundamentals of data communications

Intro. to Layered Communication protocols
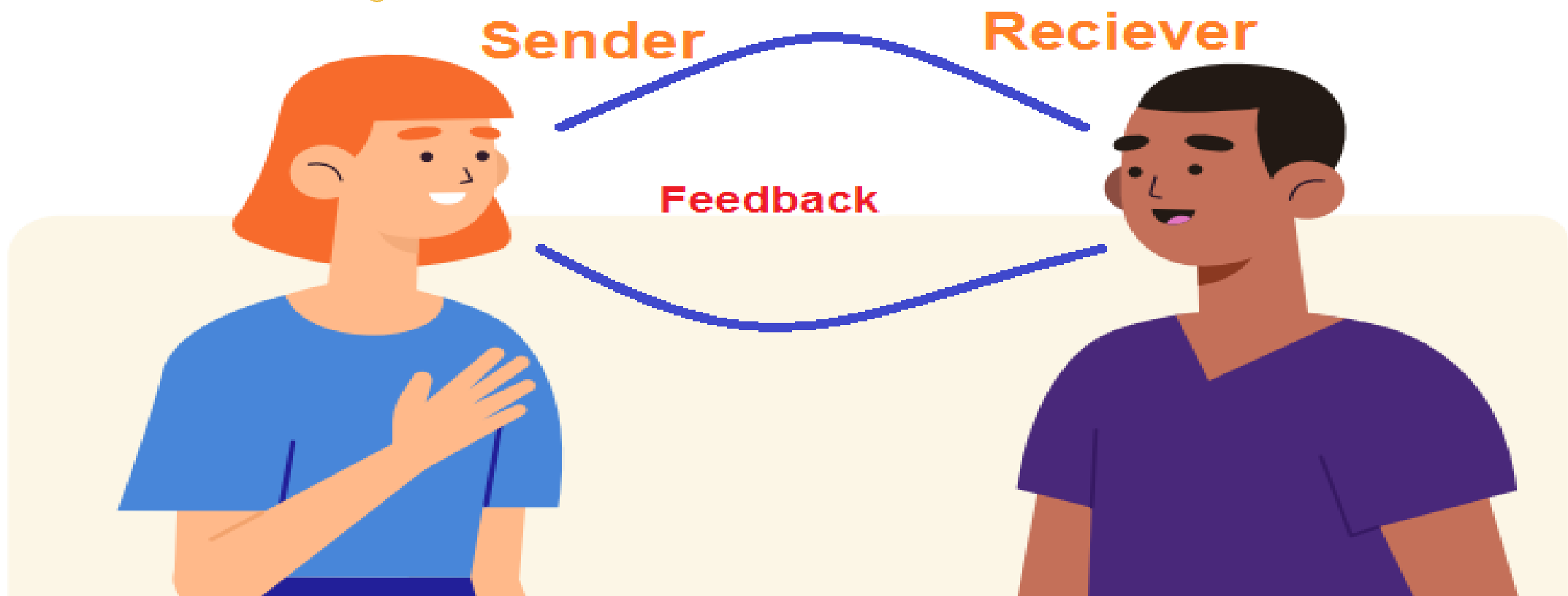
Course Aim & Outcomes

➤ *Course Aim:*

- ▪ *Give the learners the knowledge and skills needed to understand data communication.*

➤ *Course Outcomes:*

- ▪ *Determine and analyze the fundamentals of communications.*

- ▪ *Determine and analyze the principles of selecting and installing telecommunications systems.*

Data & Communication meanings

- Data, refers to a collection of numbers, characters and is a relative term.

- Data is collected and analyzed to create information suitable for making decisions.

- Communication is the activity of exchanging information and meaning across space and time using various technical or natural means, whichever is available or preferred.

- Communication requires a sender, a message, a medium and a recipient.

- Although the receiver does not have to be present or aware of the sender's intent to communicate at the time of communication.

- Thus, communication can occur across vast distances in time and space.

Ref: Wiki

Simplified Communications Model
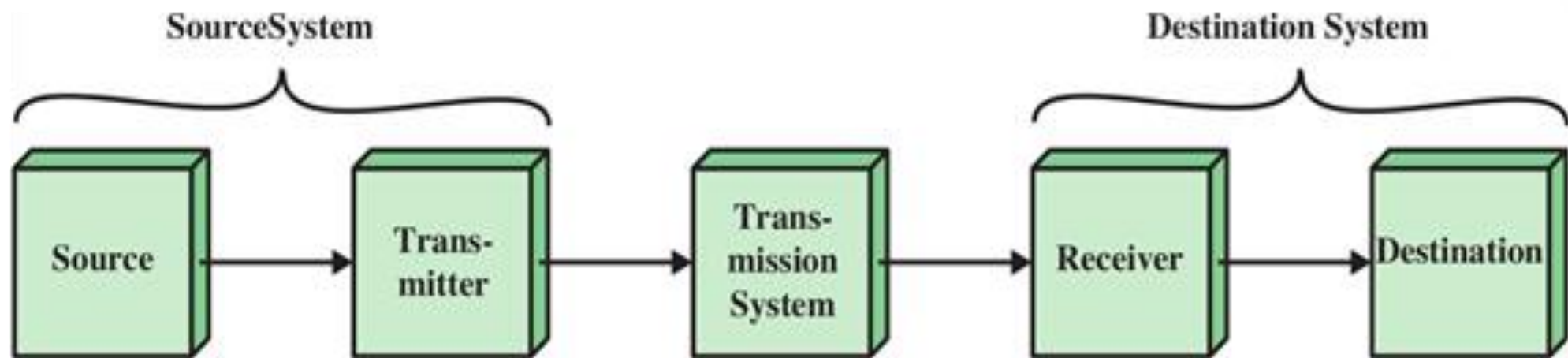
Source:Device that generates data to be transmitted

Transmitter:Converts data from source into transmittable signals

Transmission system:Carries data from source to destination

Receiver:Converts received signal into data

Destination:Takes and uses incoming data

Simplified Communications Model

An Example

Simplified communications model makes it look easy ...but there are many tasks to be performed in a data communications system
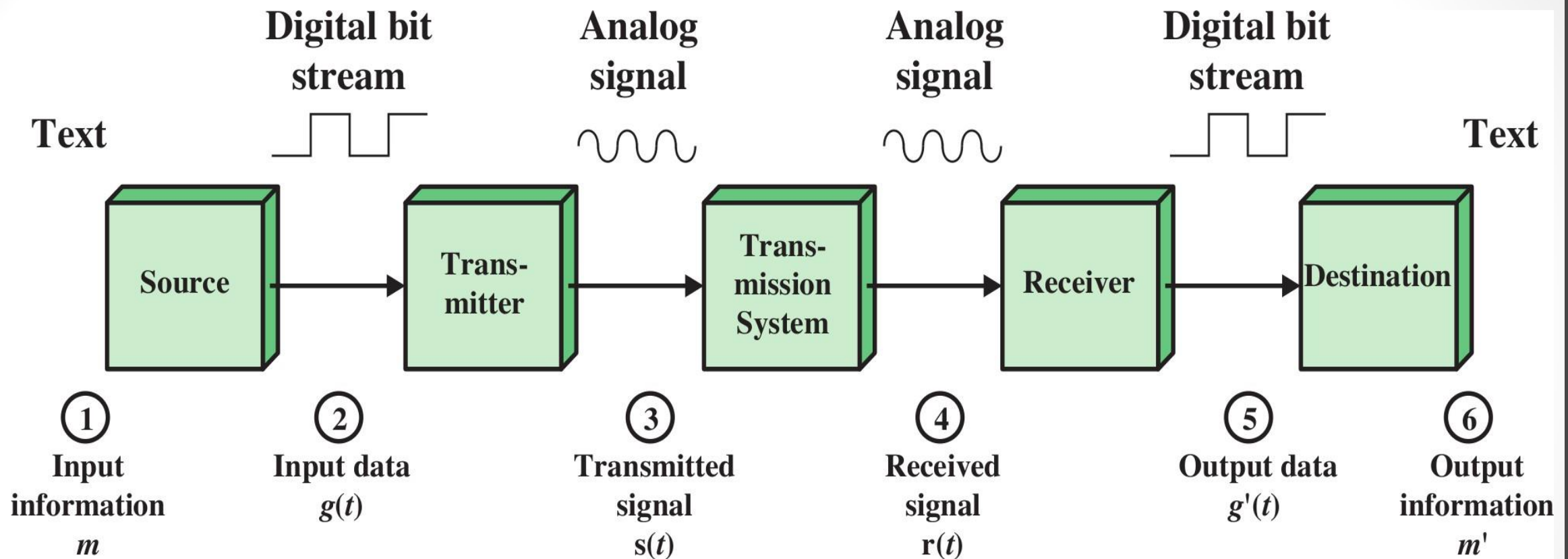
Transmission system utilization	Addressing
Interfacing	Routing
Signal generation	Recovery
Synchronization	Message formatting
Exchange management	Security
Error detection and correction	Network management
Flow control	

Categorizing Communication Technologies

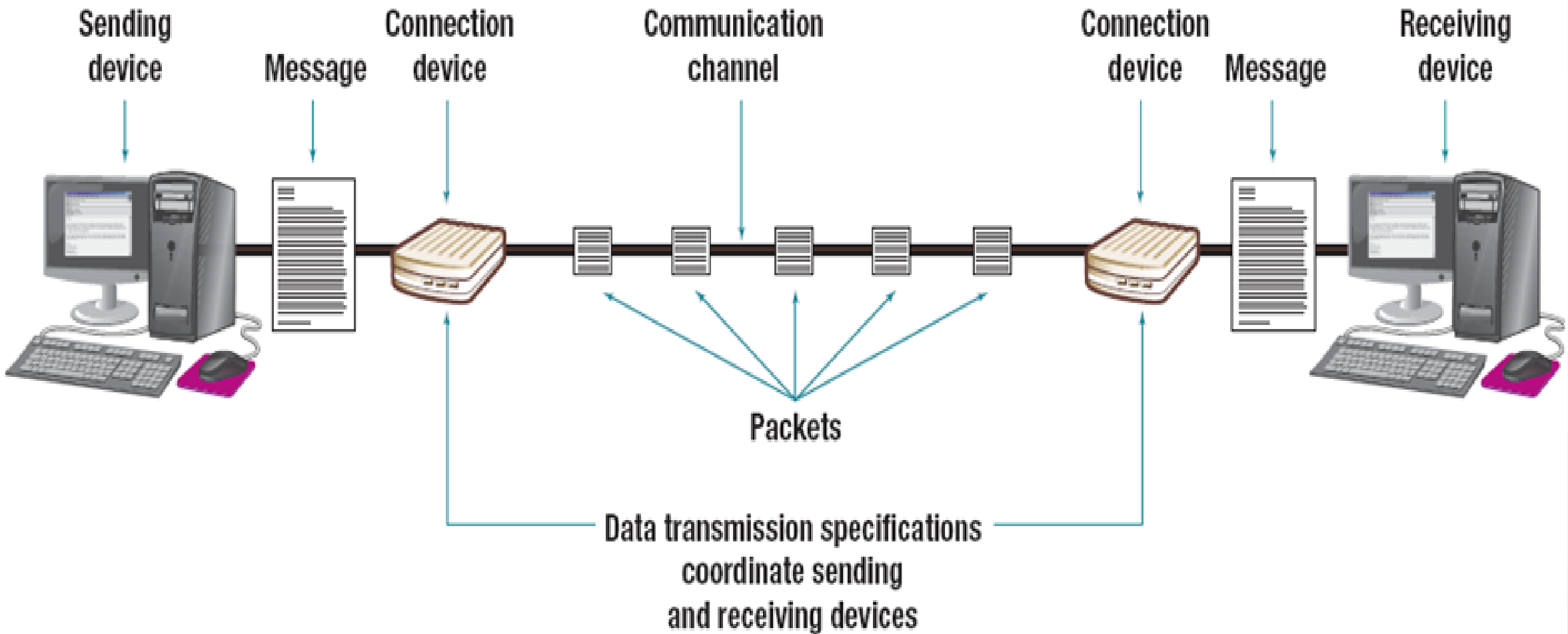Data Communications: transmitting signals in reliable and efficient manner; focusses on individual links

Networks: communications across set of links; Wide Area Networks, Local Are Networks, The Internet

A Data Communications Model

Text	Digital bit stream	Analog signal	Analog signal	Digital bit stream	Text
Source	Trans-mitter	Trans-mission System	Receiver	Destination	

①	②	③	④	⑤	⑥
Input information m	Input data $g(t)$	Transmitted signal $s(t)$	Received signal $r(t)$	Output data $g'(t)$	Output information m'

- user keys in message m comprising bits g buffered in source PC memory

- input data is transferred to I/O device (transmitter) as sequence of bits g(t) using voltage shifts

- transmitter converts these into a signal s(t) suitable for transmission media being used

- while transiting media signal may be impaired so received signal r(t) may differ from s(t)

- receiver decodes signal recovering g'(t) as estimate of original g(t)

- which is buffered in destination PC memory as bits g' being the received message m'

A Data Communications Model

Sending device | Message | Connection device | Communication channel | Connection device | Message | Receiving device

Packets

Data transmission specifications coordinate sending and receiving devices

Data Communications Aspects

- The Transmission of Information:
    - Transmission media: twisted-pair, coaxial cables, fiber optic, wireless,..
    - Antennas: dipole, yagi-uda, dish (parabolic) , microstrip,..
    - …
- Communication Techniques:
    - Encoding : source, channel
    - Modulation: Analog, Digital
    - ..
- Transmission efficiency:
    - Capacity issue: Multiplexing, compression,..
   - Data rate
    - …

Networks

► Demand for any user to communicate with any other machine/user

► Require:
  › Communication software
  › Communication network technologies: WANs and LANs

- LAN - Local Area Network
  - single building or cluster of buildings
  - ethernet, token ring, star, wireless
- WAN - Wide Area Network
  - city-to-city, country-to-country
  - telephone, ISDN, ATM, etc.
- Wireless Network
  - radio, microwave, satellite

Local Area Networks

Backbone
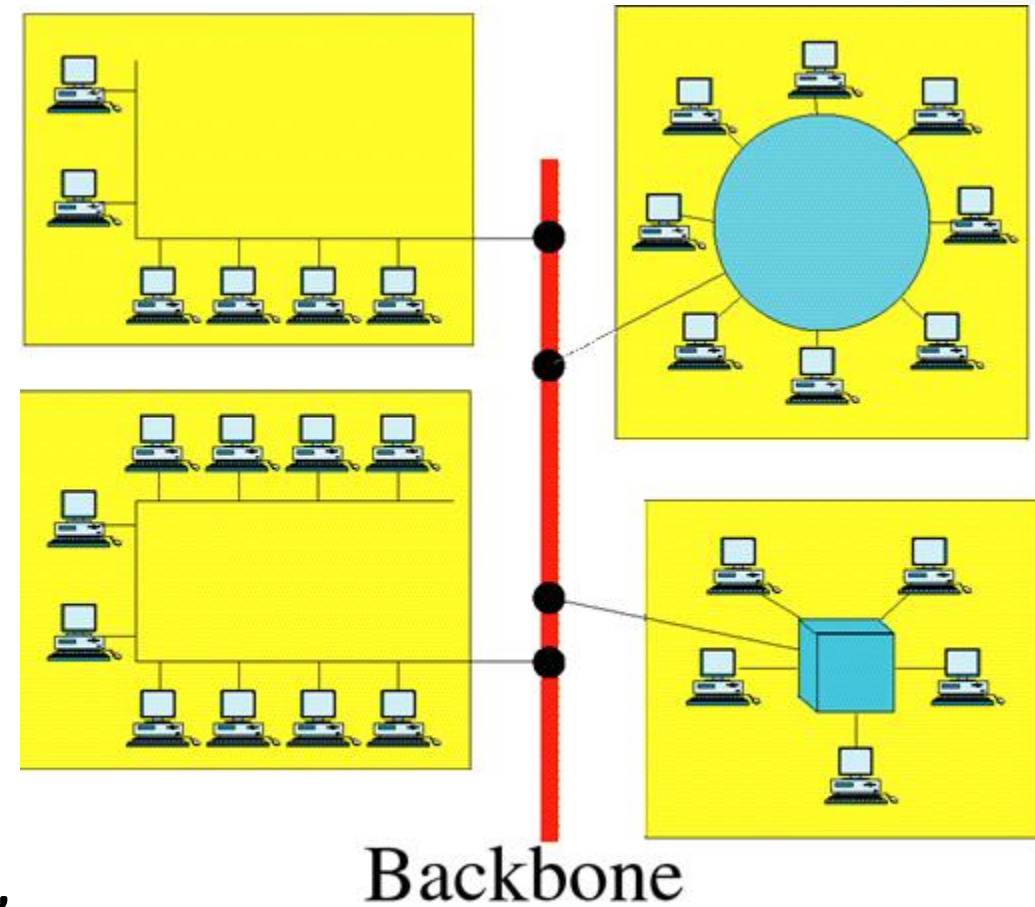
► Small coverage area, e.g. building,

► Owned and operated by organisation owning end-devices

► Higher internal (per user) data rates compared to WANs

► How to arrange nodes in a LAN?

► How to share LAN amongst multiple users?

► Example technologies: Ethernet, Wireless LAN

Wide Area Networks
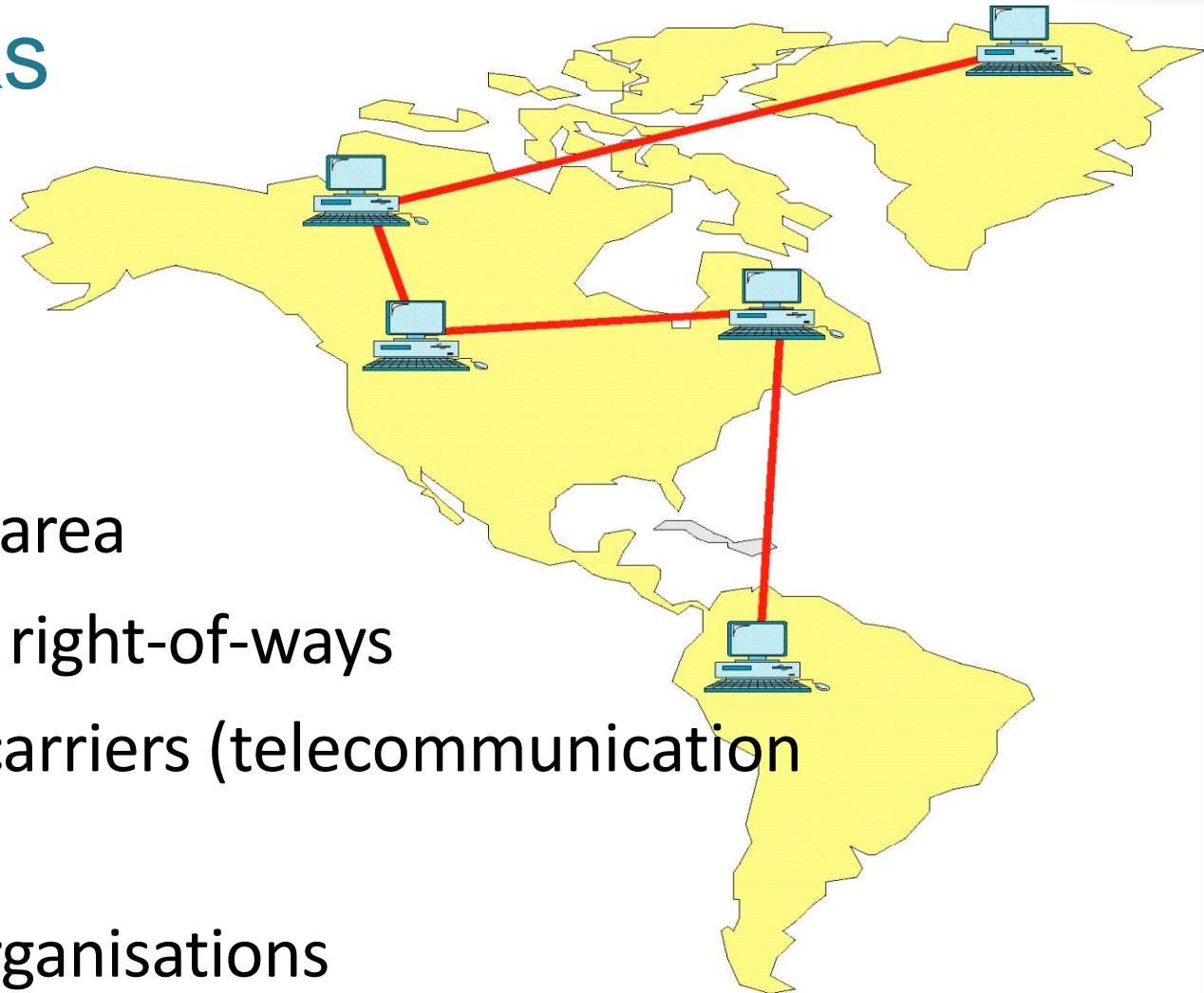
► Span a large geographical area

► Require crossing of public right-of-ways

► Rely on links of common carriers (telecommunication companies)

► Carries data of multiple organisations

► How to find path across a network?

► How to deliver data across the network?

► Example technologies: ATM, Frame Relay, SDH
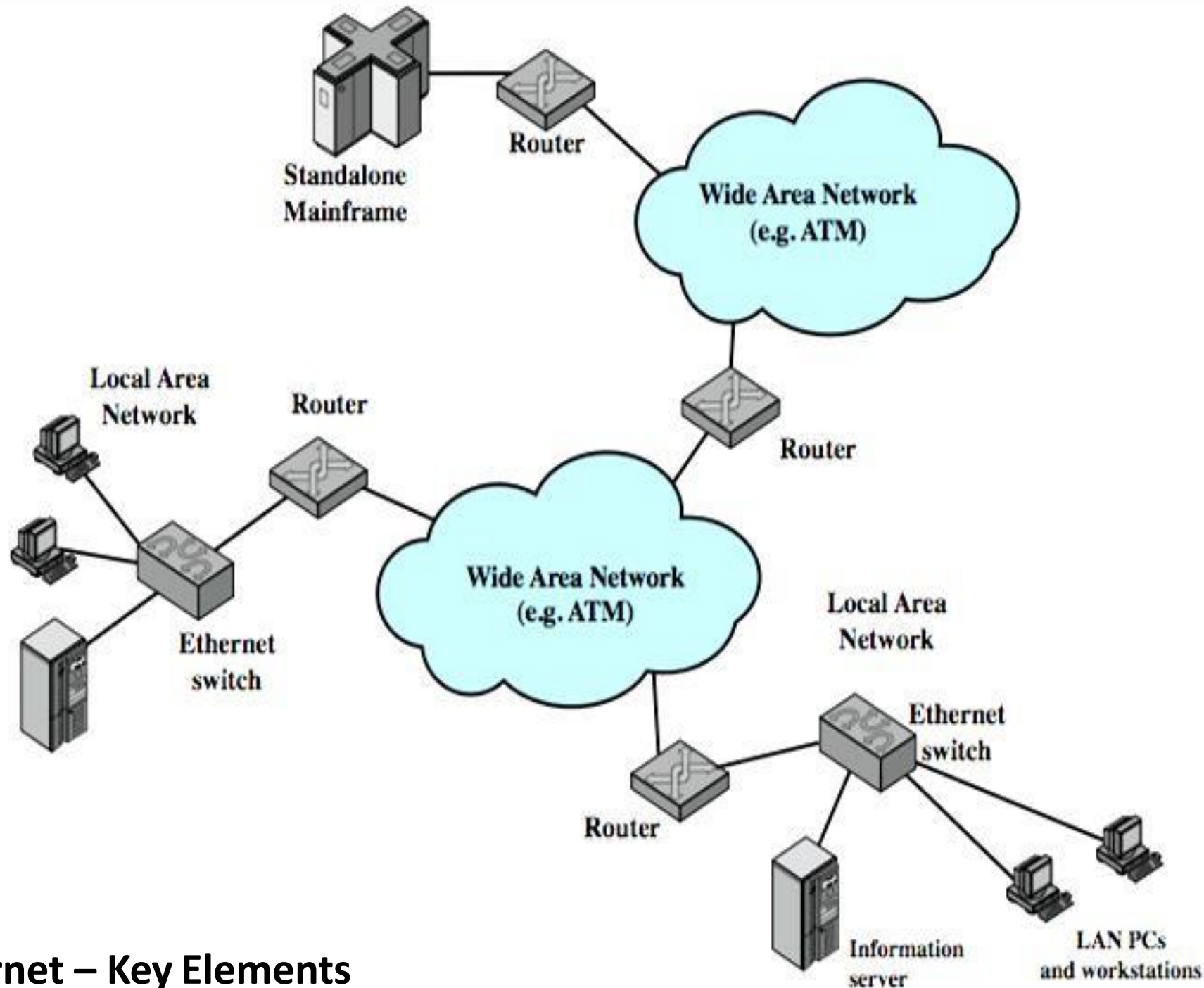
The Internet

Origins

- ▶ Evolved from US Department of Defence research network, ARPANET (developed in 1969)

- ▶ Used packet switching technology (whereas telephone networks used circuit switching)

- ▶ Development and standardization of the Internet suite of protocols: TCP/IP

What is The Internet?

- ▶ Collection of networks connected together using common software: Internet Protocol(IP)

- ▶ Although network technologies differ, any computer can communicate with any other computer (providing they are using IP)

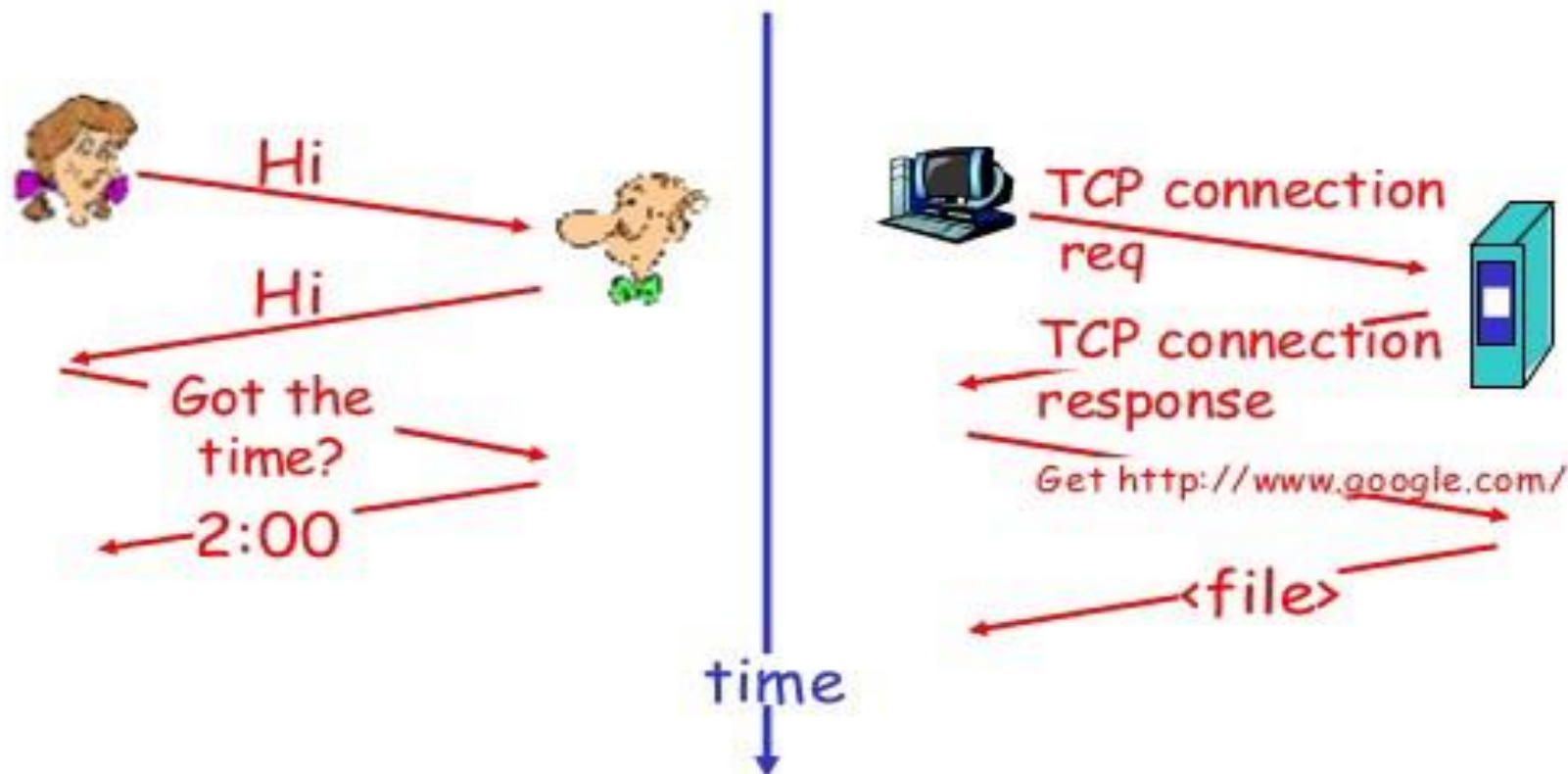# Internet

Hosts, routers and (sub-)networks

Internet – Key Elements

INTRODUCTION TO LAYERED COMMUNICATION PROTOCOLS

The Need for Protocol Architecture

- A protocol is a set of rules or conventions that allow peer layers to communicate.

- To transfer data several tasks are performed

1. The source must activate the communications path or inform network of destination

2. The source must make sure that destination is prepared to receive data

3. The file transfer application on the source must confirm file management program at destination is prepared to accept and store the file

4. A format translation function may need to be performed if the formats on the systems differ

Protocol Architecture Logic

- Logic is divided into subtask modules
    - Implemented separately
- Modules are arranged in a vertical stack
    - Each layer in the stack performs a subset of functions
    - Rely on next layer for more primitive functions
    - Changes in one layer should not require changes in other layers

- The key features of a protocol are:
    - Syntax – format of data blocks
    - Semantics – control information for coordination and error handling
    - Timing – speed matching and sequencing

A simple Protocol Architecture

- Three agents involved
    - Applications (e.g. email, file transfer)
    - Computers
    - Networks
- Application sends data via module(s) to network to another computer which must get it to the intended application