

Introduction to Telecommunications- Basic Concepts



Introduction to communication systems

What is communication?

Communication is the act of exchanging information, as by speech, signals, writing, or behavior.

Communication is the transmission of information from one point to another using:

- Signs
- Signals
- Messages
- Words
- Writings
- Images
- Sounds



What is information?

Communication is the act of exchanging **information**, as by speech, signals, writing, or behavior.

Information is knowledge about the state of some system. Information is always about something (size of a parameter, occurrence of an event ...).

Information is not “1010110” or “words”. That is how we express it, but the information is the concept, value behind the words. The aim of a communication system is to transfer information efficiently and reliably.



What is information?

Communication is the act of exchanging **information**, as by speech, signals, writing, or behavior.

The amount of “information” in a message can be quantified.

The measure of information is a bit – the smallest unit allowing you to choose between 2 equally probable alternatives:

- yes/no
- left/right
- up/down...

Information

To exchange information, you need:

- A means of interacting with another person/object.
- A method of expressing information through that means.
- A method of deciphering information from that means.
- A mutual understanding of the rules for expressing that information.

Definition: A **communication system** is any system whose purpose is to move information between physical locations.

Some Communication System Examples



Boiling Kettle



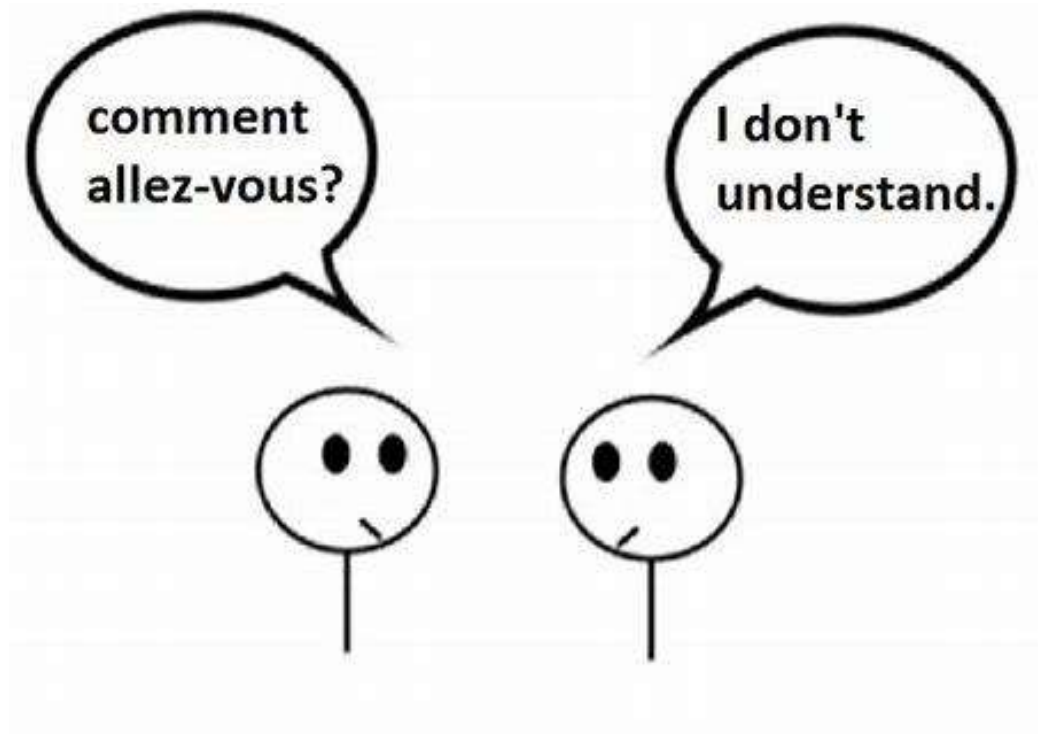
Petrol Fuel Meter



1920x1080@60Hz HD TV

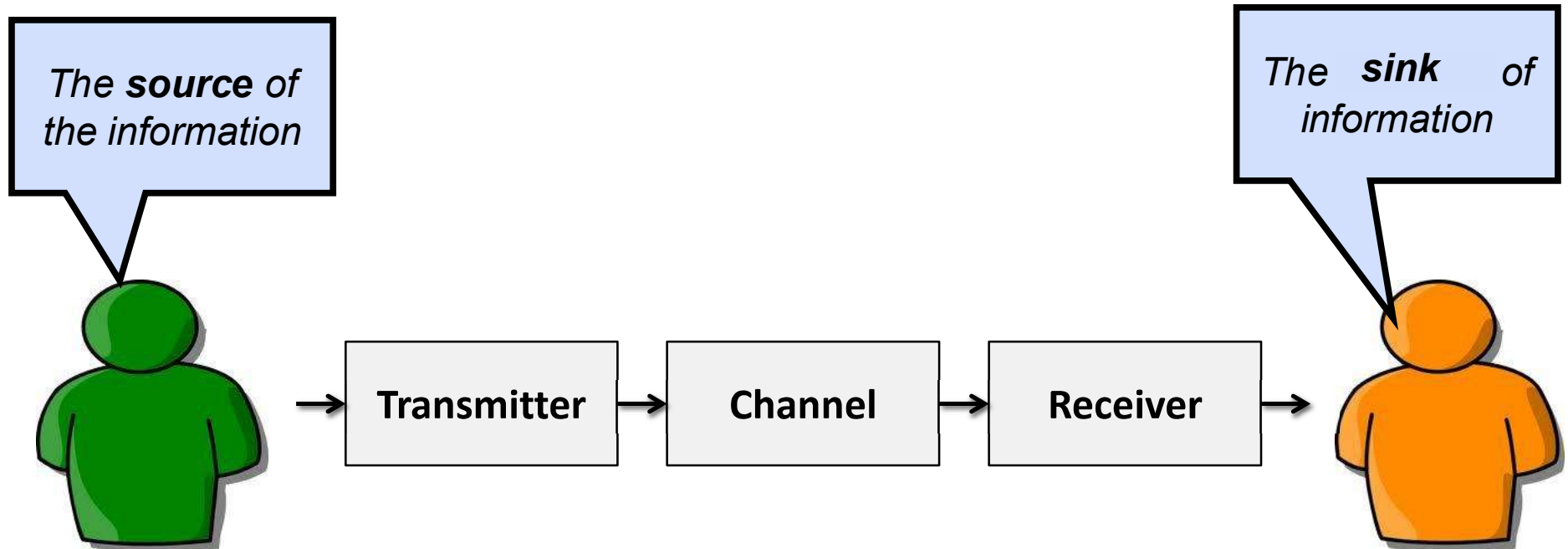
Some Communication System

For a communication to be successful, the sender and the receiver must understand a **common language**.

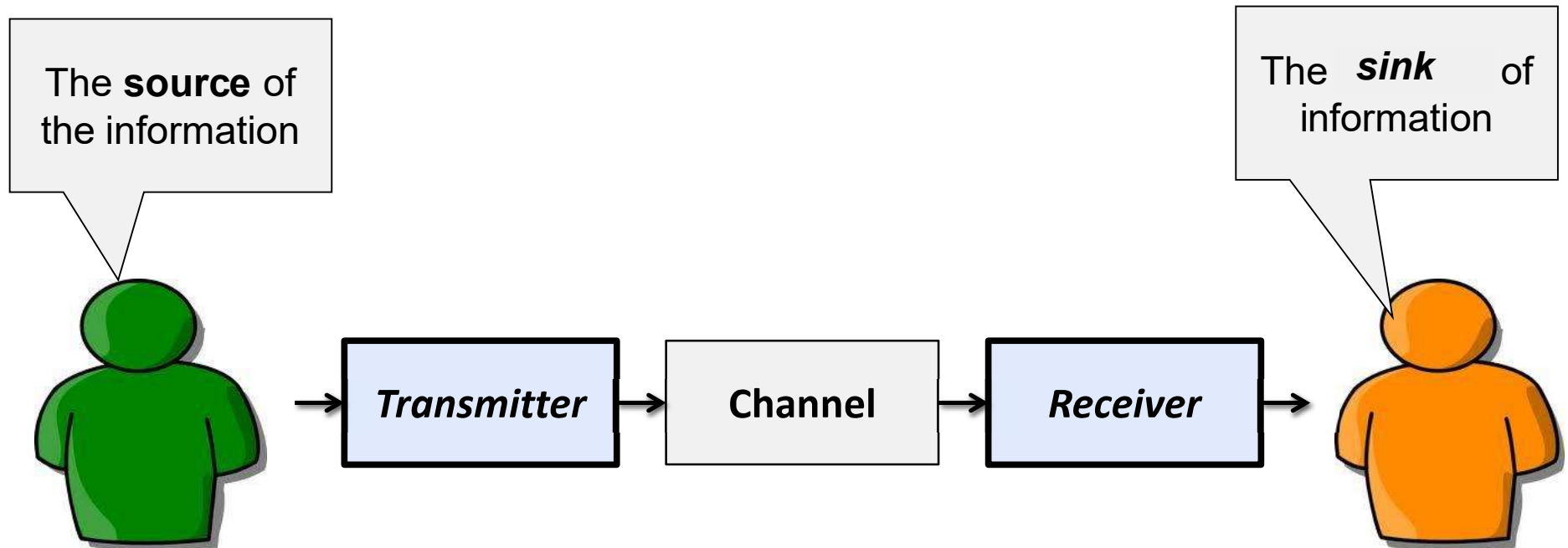


Communications system model overview

Block Diagram of Communication System



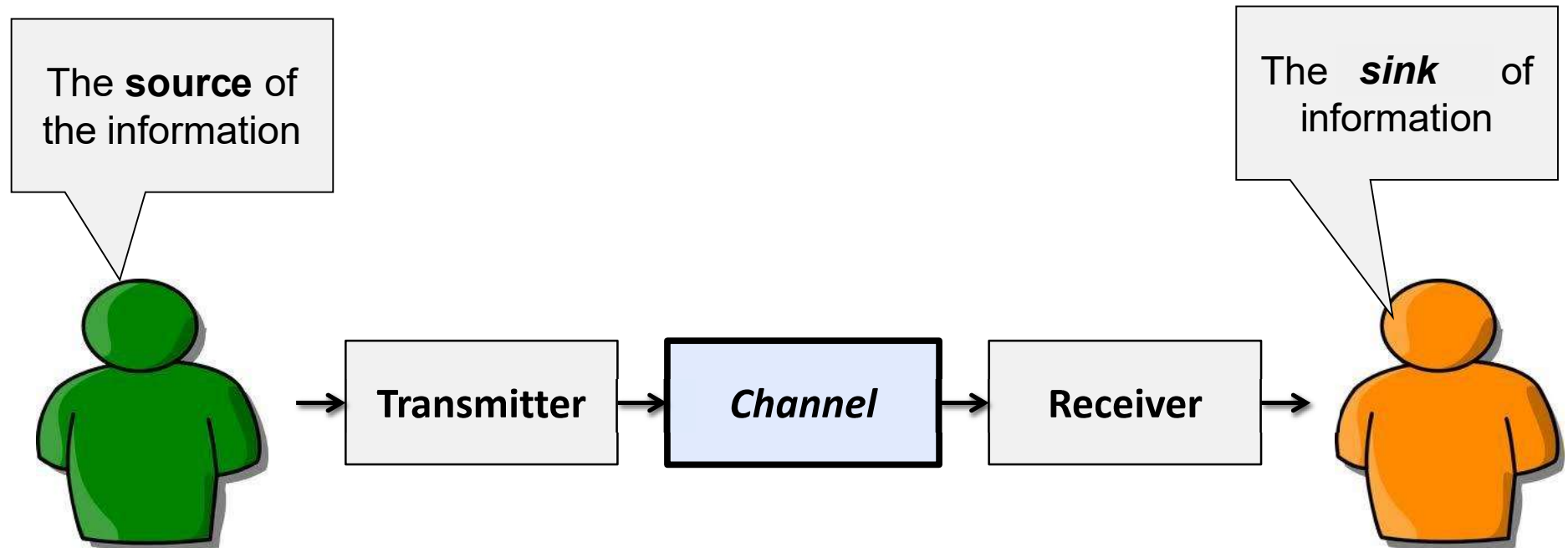
Block Diagram of Communication System



Transmitter: Encodes information into a suitable signal for transmission.

Receiver: Extracts (or decodes) the information from the received signal.

Block Diagram of Communication System



Channels are the physical medium through which we communicate. They come in many different forms: piece of wire, wireless/radio, optical fibre, etc.

There are many channels, in the next few slides we'll briefly discuss some channels that are commonly used today.

A Communication System: Terms

Not definitions, just working explanations for common terms

Source: the producer of the information.

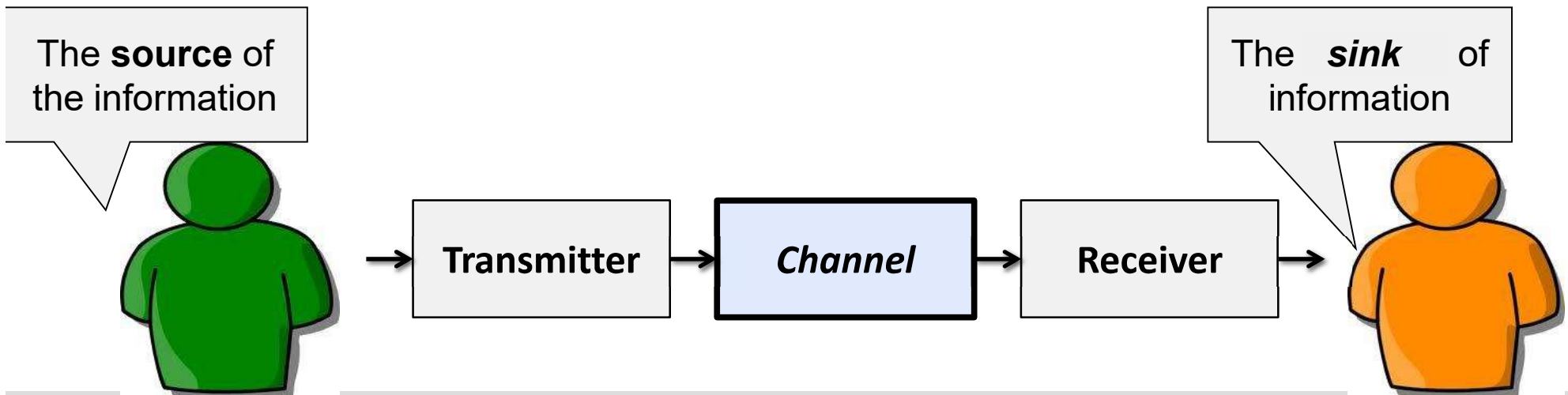
Sink: the consumer of information.

Channel: the physical medium that is used to send the signal from the transmitter to the receiver, e.g. sound, light.

Transmitter: the process or device that converts information to a means suitable for transmission over the channel.

Receiver: the process or device that receives the signal from the channel and extracts the information.

Noise: Unwanted variations introduced by the channel that can result in incorrect extraction of information.



Examples of Channel Media

Channels are the physical way we can transmit information.

We do this by modifying some physical characteristic... so real-world examples:

Visual: Traffic lights

Visual: Flags (naval ships)

Visual: Smoke signals



Electromagnetic Waves: Radio, Light

Electrical Signals (voltage, charge, current): Telephone

A channel must have some physical attribute that can be modified, such that those modifications can be detected.

Channels

Channels are the physical medium in which we communicate. They come in two forms:

1. Guided Transmission

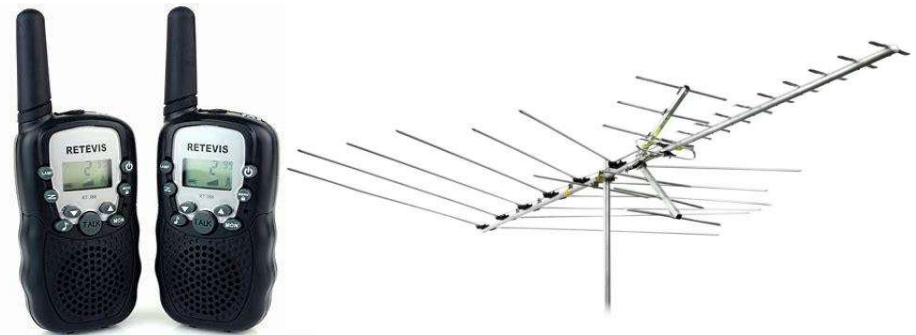
(bounded by the physical nature of the guide)

- Copper wire
- Coaxial cable
- Optical fibre

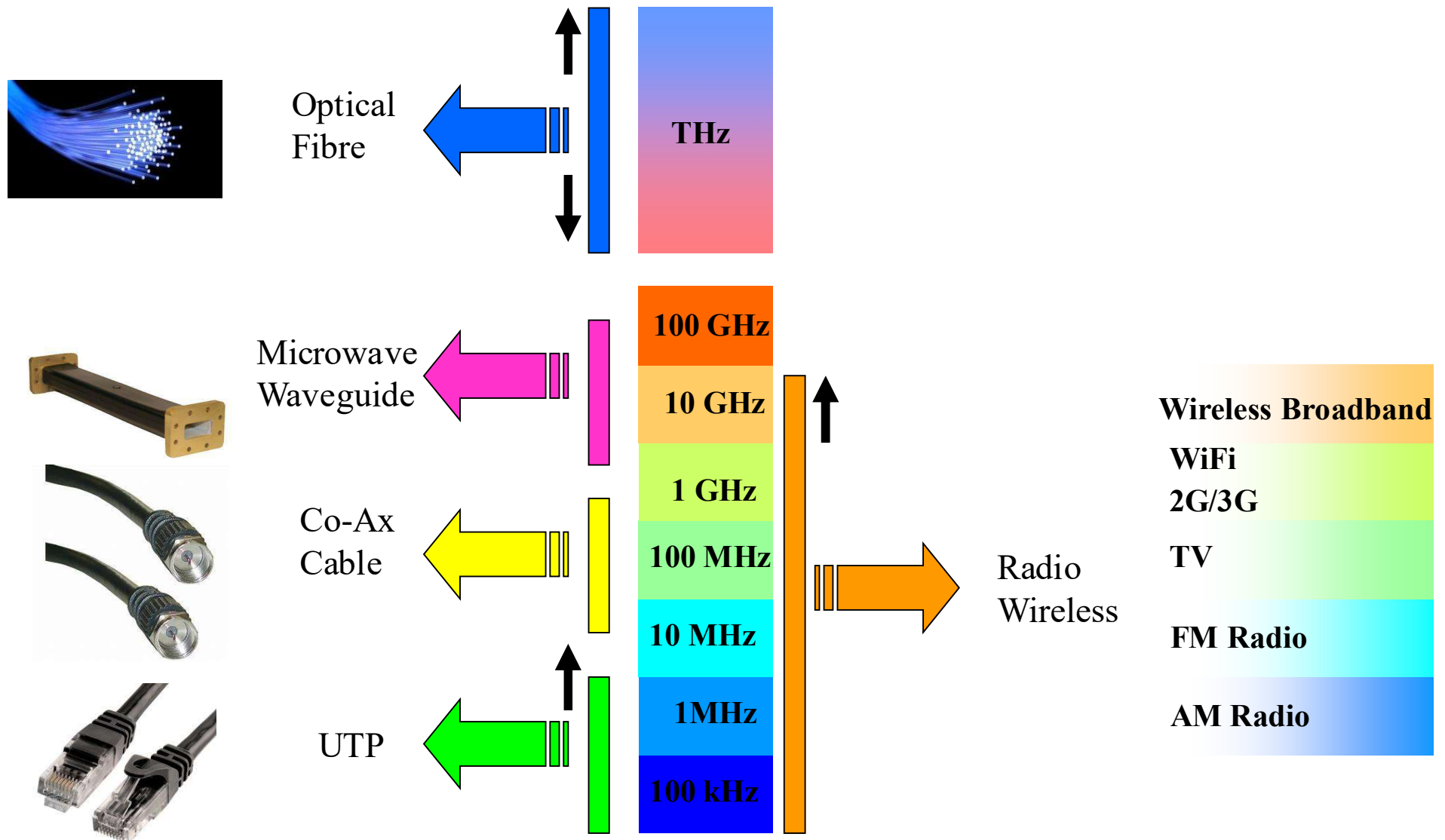


2. Unguided Transmission (unbounded)

- Radio and microwave
- Audio



Frequencies and Channels

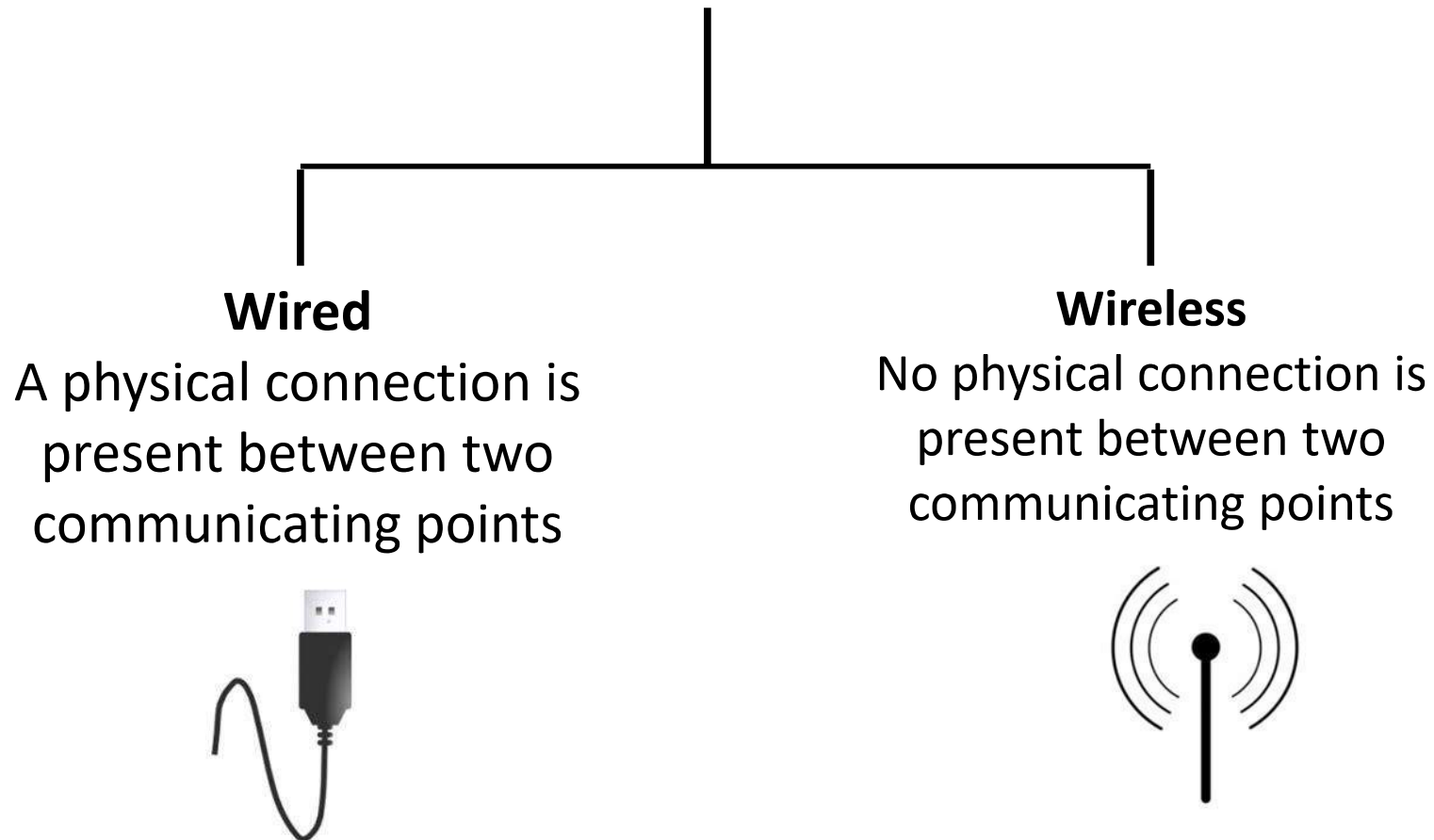


Types of communication systems

Types of Communications

Information can be transmitted over physical medium or open air/free space.

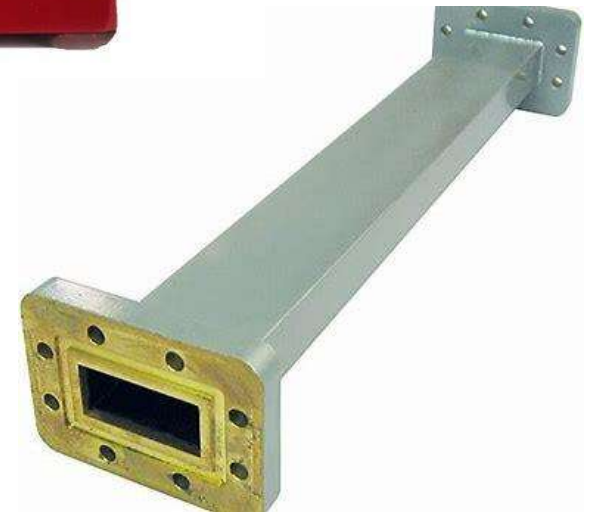
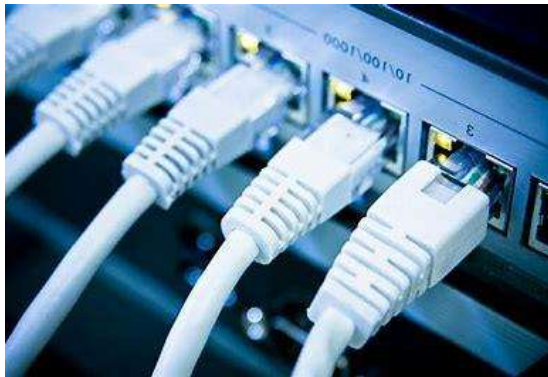
Broadly can be of two types based on the medium of information transfer.



Wired Communication

There are different types of **Wired Communication** technologies :

- Telephone Networks
- Cable Television
- Broadband Internet
- Fibre-optic Communications
- Waveguides



Wired Communication

Advantages

- Reliable, not affected by other wireless signals
- Low in price
- High life expectancy
- High speed
- High Quality of Service

Disadvantages

- Affected by moisture and other weather conditions
- Affected by noise (such as by machinery noise)

Wireless Communication

There are different types of **Wireless Communication** technologies:

- Satellite
- Broadcast Radio
- Wifi or Wi-Fi or WiFi
- Mobile / Cell Phone
- Bluetooth



Wireless Communication

Advantages

- Maintenance and installation cost is less for these networks
- The internet can be accessed from anywhere wirelessly
- Doctors working in remote areas as they can be in touch with medical centers

Disadvantages

- Low speed, low data-rate
- Signals can be easily intercepted
- Limited RF spectrum and bandwidth is expensive

Evolution of Wireless Technology

Wireless systems have gone through several evolutionary stages over the past few decades.

Each new generation of wireless network delivers faster speeds and more functionality.



Classification of Wireless Systems

The wireless systems can be classified according to the:

- placement and nature of the users
- directionality of communications
- location of the system
- operating frequency range

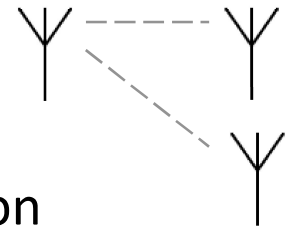
Classification of Wireless Systems

According to the placement and nature of the users

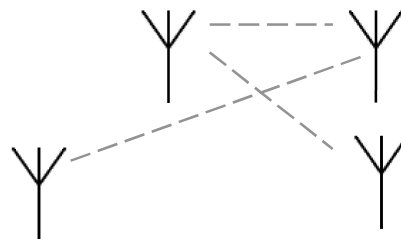
- **Point to point:** single transmitter and single receiver



- **Point to multipoint systems:** central station and large number of possible receivers



- **Multipoint to multipoint system:** allow simultaneous communication between individual users who may not be in fixed location

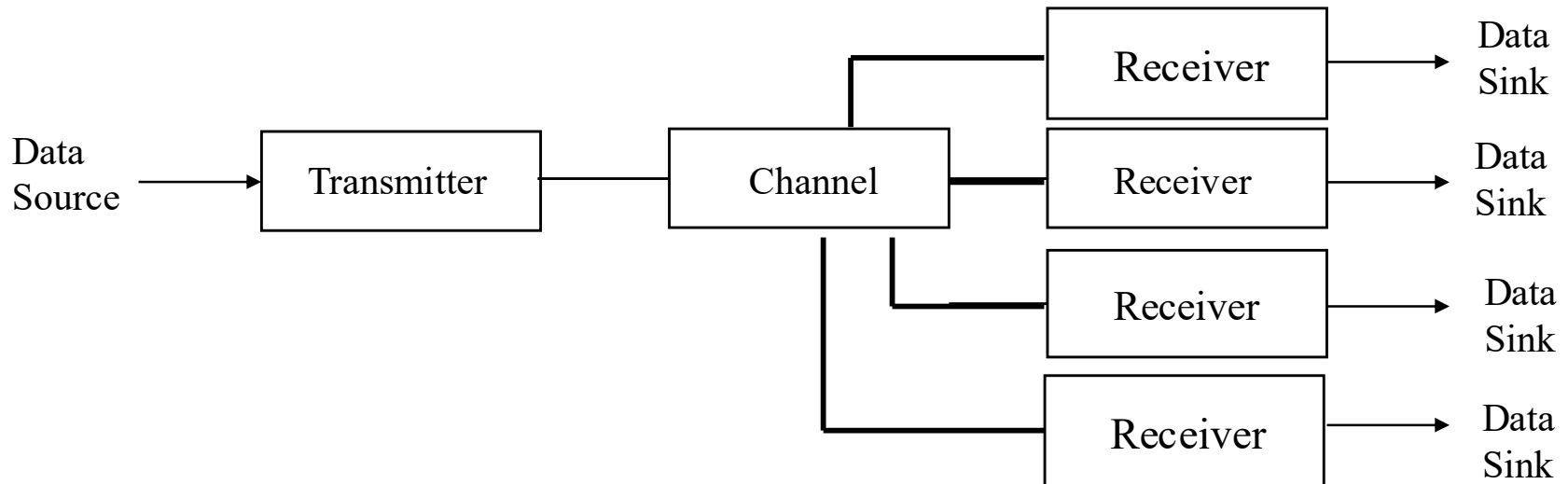


A Communication System: Terms

One to one (1:1)



One to Many (1:N)



Classification of Wireless Systems

According to the directionality of communications

- **Simplex system:** communications occur only in one direction – from transmitter to receiver
- **Half duplex system:** communications occurs in two directions, but not simultaneously
- **Full duplex system:** allows simultaneous two-way transmission and reception.

Classification of Wireless Systems

According to the location of the system

Ground system: most of the contemporary systems

Satellite system: large number of users and wide area

- **Geosynchronous earth orbit (GEO):** 36.000 km, fixed position
- **Low earth orbit (LEO):** 500 km- 2000 km, visible for short time for a given point on the ground, good coverage needs many satellites

Classification of Wireless Systems

***According to the
operating frequency range***

Wireless System (Country)	Frequency
Advanced Mobile Phone System (AMPS, United States; obsolete)	U: 824–849 MHz D: 869–894 MHz
GSM 850 (Americas)	U: 824–849 MHz D: 869–894 MHz
GSM 900 (worldwide)	U: 890–915 MHz D: 935–960 MHz
GSM 1800 (worldwide)	U: 1710–1785 MHz D: 1805–1880 MHz
GSM 1900 (Americas)	U: 1850–1910 MHz D: 1930–1990 MHz
Universal Mobile Telecommunications System (UMTS), band 1 (most countries)	U: 1920–1980 MHz D: 2110–2170 MHz
UMTS, band 2 (most countries)	U: 1850–1910 MHz D: 1930–1990 MHz
UMTS, band 8 (most countries)	U: 880–916 MHz D: 925–960 MHz
Wireless local area networks (WiFi)	902–928 MHz 2.400–2.484 GHz 5.725–5.850 GHz
Global Positioning System (GPS)	L1: 1575.42 MHz L2: 1227.60 MHz
Direct Broadcast Satellite (DBS) (Europe, Russia) (Americas) (Asia, Australia)	10.7–12.75 GHz 12.2–12.7 GHz 11.7–12.2 GHz
Industrial, medical, and scientific bands (most countries)	902–928 MHz 2.400–2.484 GHz 5.725–5.850 GHz

U, uplink (mobile-to-base); D, downlink (base-to-mobile).