IxD Theory 2: Telecomunicazioni

IUAV University of Venice

Visual and Multimedia Communication Design graduate programme

Telecommunications (a)

‘Telecommunication’: definitions

Etymology:
‘Sending and receiving information [communication] between distant places [tele]’.

But usually today:
‘Communication by means of electrical or electro-magnetic energy between distant places’.

Communication theory

Communication requires 3 components:

Sender > Information > Receiver

Telecommunication technology

A telecommunication system requires 3 components:

Transmitter > Transmission medium > Receiver

A telecommunication system: definitions

Transmitter:

A device which converts information (input) into a 'signal' (output).

Transmission medium:

The medium through which the signal travels.

Receiver:

A device which converts the signal (input) into comprehensible information (output).

Transmitters

Definition:

A device which converts information (input) into a 'signal' (output).

Device examples:

TV camera, TV remote *(telecommando)*, phone keyboard, microphone.

Information examples:

Light images, sound patterns, symbols, pressure.

Transmission medium

Definition:

The medium through which the signal travels.

Medium types:

Guided (conducted)
e.g. through wires or optic fibres

or

Unguided (usually radiated)
e.g. light, sound, radio waves.

Receiver

Definition:

A device which converts the signal (input) into comprehensible information (output).

Examples:

Screen, loudspeaker, mechanical actuator (e.g. *citofono* lock-switch).

Transmitters and receivers are **transducers**: they convert one kind of energy into another kind of energy.

Short history of telecommunications

In **pre-electric** cultures:

The fastest telecommunication means were:

Sound: drum codes, horns, bells

or

Light: smoke signals, fire beacons, mirror-reflected light, flag codes.

Short history of telecommunications

In **pre-radio** cultures:

Telecommunication innovation was along wires (guided):

- 1790s: First telegraphy experiments
- 1830s: First commercial electrical telegraph (Morse-like code, not voice)
- 1870s: Britain can communicate through undersea telegraph wires to much of its empire, including India
- 1870s: Commercial telephone (voice) services in Britain and the USA.

Short history of telecommunications

In **radio** cultures:

Telecommunication innovation was mostly through radio waves:

- 1901: First transatlantic radio message (Marconi)
- 1929: First experimental TV broadcasts (BBC)
- 1973: First mobile (cell) phone message (Motorola)

Short history of telecommunications

But recent innovation returned, initially, to telephone wires:

1969: communication between networked computers (eventually becomes the Internet).

Transmission medium examples

Guided transmission:

In a ‘string telephone’, sound travels as mechanical impulses along the string.

In a telegraph or landline phone, electrical impulses travel along metal (e.g. copper) wires.

Unguided transmission:

In sound radio and TV, radio waves are ‘broadcast’.

Phone and radio as paradigms

Traditional radios and TVs were only **receivers**: one-way (impersonal), 'one-to-many'.

By contrast, traditional phones were **transceivers**: two-way (interpersonal), one-to-one (democratic).

But traditional phones, connected by wire to their networks, were trapped in a place (e.g. family home) and typically shared, not individual.

Phone and radio as paradigms

Connecting phones wirelessly (by radio) has made them mobile and individual.

The new paradigm:
'**mobile telephony**'.

Telephone: How it works

Sender:

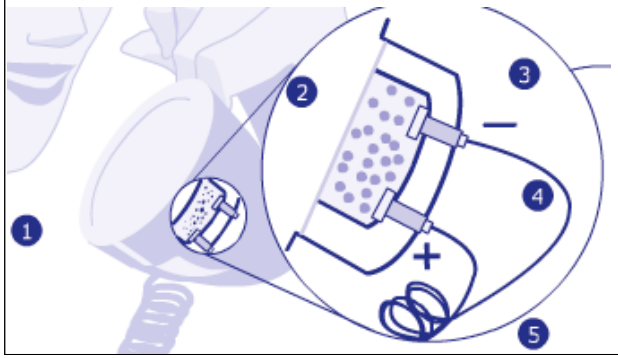
1 Sender speaks into microphone

2 Voice causes diaphragm to vibrate

3 Diaphragm presses carbon particles

4 Weak electric current enters particle chamber. If particles are compressed, current is conducted and exits as an electrical pattern which matches the voice.

This electrical pattern is conducted by wire to the receiver.



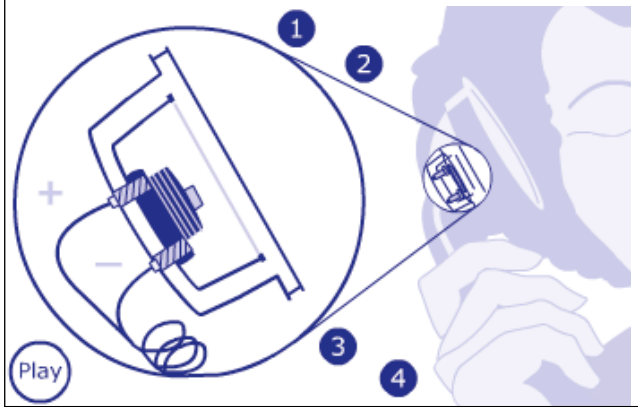
Telephone: How it works

Receiver:

1 Electrical pattern enters loudspeaker and causes magnetic impulses.

2 These impulses cause a membrane to vibrate.

3 The receiver hears these vibrations as the sender's voice.



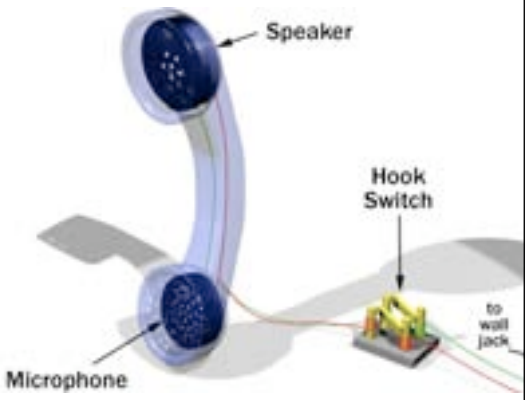
Telephone: How it works

The most important characteristics of the phone are:

1 Its communication is **2-way**: it is a transceiver (= both a transmitter and a receiver).

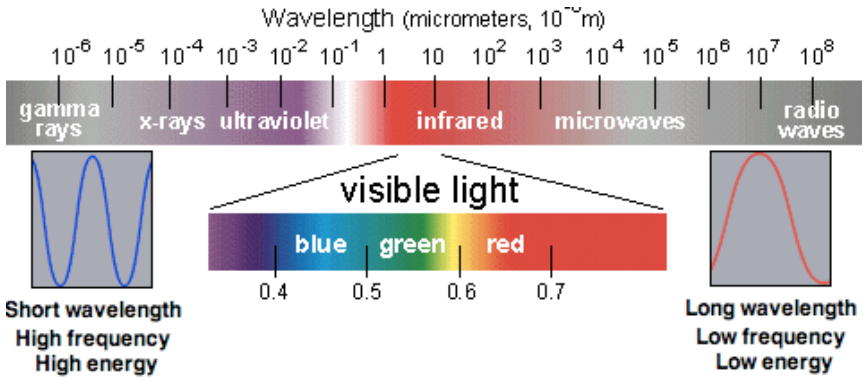
2 It is a **networked device**: between the sending phone and the hearing phone is usually a complex 'routing network'.

3 If wired, its communications are **robust** – but **not mobile**. Mobility needs radio.



Radio: How it works

The electromagnetic spectrum:



Electromagnetic energy is radiated as waves.

Different wavelengths produce different kinds of radiation.

The human eye can detect a small part of this spectrum: that of visible light.

Longer wavelengths (= lower frequencies) than visible light include: infrared light, microwaves, and radio waves.

Radio: How it works

Every wireless technology has its own place in the spectrum, e.g (frequencies shown are approximate):

AM radio (535 Khz–1.7 Mhz)

CB radio (27 Mhz)

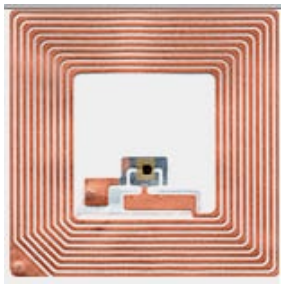
Garage door openers (40 Mhz)

Baby monitors (49 Mhz)

TV (54–88, 174–220 Mhz)

Radio: How it works

Radio-controlled model airplanes (72 Mhz)



Radio-controlled model cars (75 Mhz)

FM radio (88–108 Mhz)

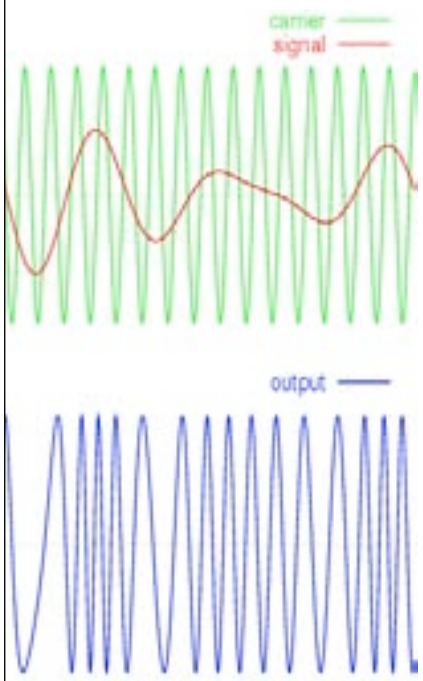
RFID (125 Mhz–5,3 Ghz)

Mobile phones (824–49 Mhz)

Air traffic control radar (960–1.215 Mhz)

GPS (1.227–1.575 Mhz)

Radio: How it works



Example: **FM** (Frequency Modulation)

Sound (or light) patterns are **transduced** into electrical patterns (the signal).

(Radio waves are **radiated** at a constant carrier frequency.)

This signal is **superimposed** on the carrier frequency.

The resulting 'modulated' output is **transmitted**.

The receiver **translates** the output back into the signal.

Telephony and telematics

'**Telephony**':
Mostly person-to-person telecommunications.

'**Telematics**':
A combination of telecommunications and informatics. It includes:

person/person communications

person/device communications

device/device communications.

Person/person telecommunications

Mobile telephony: more later

Person/device and device/device telecommunications

Wireless (radio) connection has made it easier for **people** to communicate with **devices**, and ...

... for **devices** to communicate with **other devices**:

NFC (Near Field Communication)
e.g: Bluetooth, RFID

FFC (Far Field Communication)
e.g: GPS (Global Positioning System)

Telephones increasingly communicate **non-voice** information: they are more 'tele', less 'phone'.

NFC (Near Field Communications)

Wi-Fi ('Wireless-Fidelity'):
an open technology for wireless communications between near devices.

Sometimes called 'wireless Ethernet' because it organizes communication between large groups, and sophisticated 'handshaking protocols' to ensure that communications are wanted and private.

Typical distance:
Max. 100m.

Common uses:
Device-coordinating 'hubs' in houses, office-wide networks, Internet hot-spots in cafés.

NFC (Near Field Communications)

Bluetooth:
An open technology for wireless communications between near devices.

A transceiver chip in a device transmits a low-power radio signal in all directions. It receives signals through walls etc., depending on their density.

Unlike Wi-Fi, Bluetooth uses no sophisticated protection protocols.

Distance:
Max. 10m (100m if amplified).

Common uses:
Wireless mobile phone headsets, laptops, video game controllers.

NFC (Near Field Communications)

RFID ('Radio Frequency Identification')

Like bar-codes, RFID is used for tracking inventory.

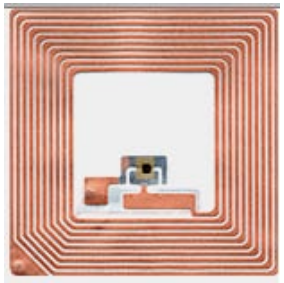
An RFID **system** has 3 components:

1 A '**tag**', usually attached to an object

2 A '**reader**'

3 A '**host**', usually a computer, which interprets the readings.

RFID



An RFID tag is a chip and a ‘transponder’ (radio transmitter-responder).

The chip holds information: always a unique identifier (like a bar-code, but with a unique ID for, theoretically, anything in the world).

In addition, some tags can be programmed to hold more information than the identifier.

RFID

An RFID tag can be almost microscopic or as large as a cigarette packet, but most are about the size of a postage stamp. They take many shapes, e.g:

Small tags are '**passive**': they have no battery. When they receive energy from a reader, they use it to send ('backscatter') their unique information back to the reader.

RFID

Passive tags hold max. 64KB of information.

They can be printed, like printed circuits.

They are cheap: a few cents each.

Distance from reader:
Max. 1.5m (e.g. shop security doorway). Very small tags must touch, or almost touch, the reader (e.g. ski-lift passes).

RFID

Larger tags are '**active**': they have a **battery**. When they receive a signal from a reader, they use the battery to send their unique information back.

Active tags hold max. 8MB of information.

Not cheap: $10–100 each.

Distance from reader:
Max. 100m, and more with powerful batteries.

Batteries last 3–5 years

Some have GPS and mobile phone capability.

RFID

Tag **implantation** in animals was one of RFID's first uses: to identify farm animals and protect pets against theft.

So far, tag implantation in humans is rare. Uses include: 'human artworks', staff identification in high-security laboratories, night club credit cards.

http://www.kevinwarwick.org/Cyborg1.htm