COMPUTER NETWORKS

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Unit – 5 Link Layer and LAN Roadmap

- Introduction
- Error detection, correction
- Multiple access protocols
- LANs
  - Addressing, ARP
  - Ethernet
  - Switches
- A day in the life of a web request

- Physical layer
  - Purpose, Signals to Packets
  - Analog Vs Digital Signals
  - Transmission Media
- Wireless LANs: IEEE 802.11

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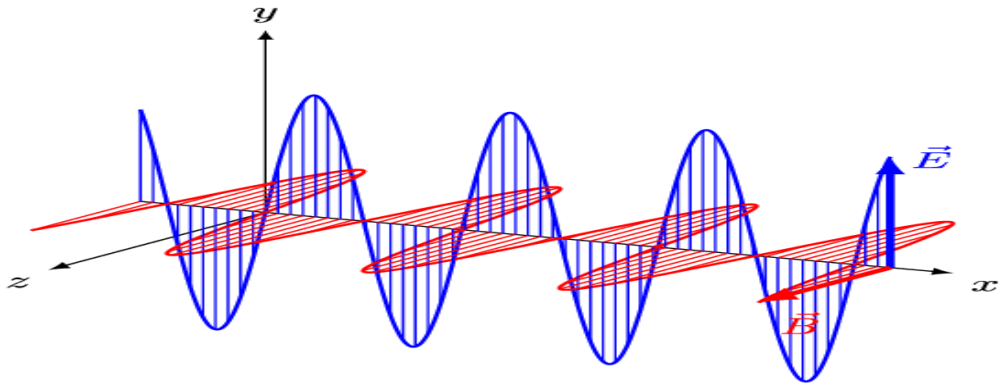
Class 54 : Physical layer : Learning Objectives

- Analog Vs Digital Signals
- Transmission Media

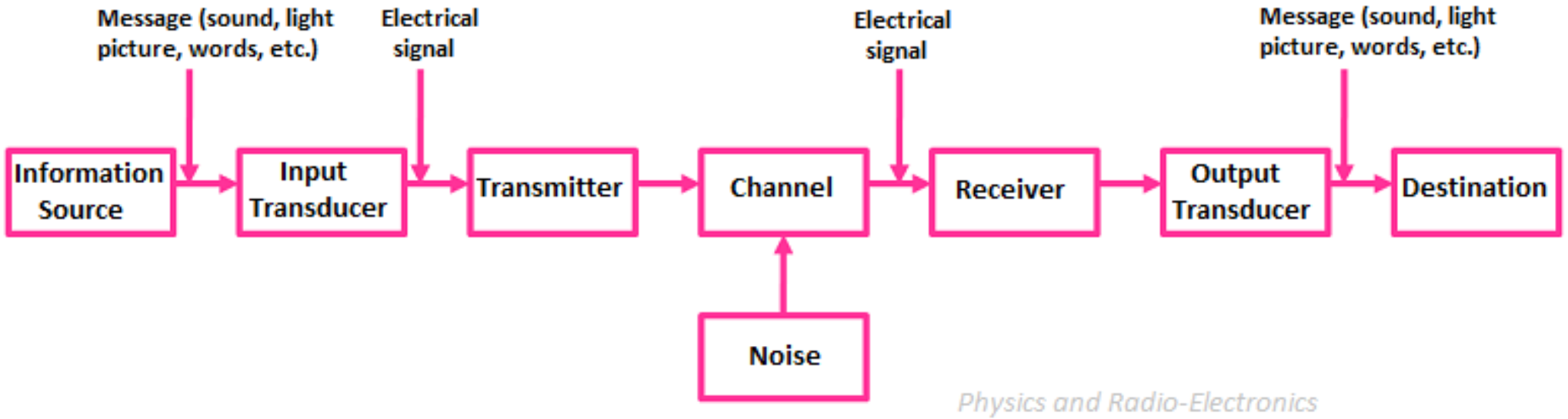
Signal

Signal

- function that conveys information
- electromagnetic or electrical current that carries data from one system or network to another.
- Signal may be Analog or Digital



Analog Communication System



- Any information may be conveyed by an analog signal;
- measured response to changes in a physical variable, such as sound, light, temperature, position, or pressure.
- physical variable is converted to an analog signal by a transducer

Analog Vs Digital Signals

- If data is to be transmitted, then it must be transformed to electromagnetic signals.
  - Analog signals - infinite number of values in a range;
  - Digital signals can have only a limited number of values.
- Data can be analog or digital.
  - Analog data - information that is continuous;
    - Analog data example: voice temperature captured by analog sensor
  - Digital data - information that has discrete states.

Digital signal

A digital signal

- is a sequence of voltage pulses that may be transmitted over a copper wire medium;
- for example, a constant positive voltage level may represent binary 0 and
- a constant negative voltage level may represent binary 1.

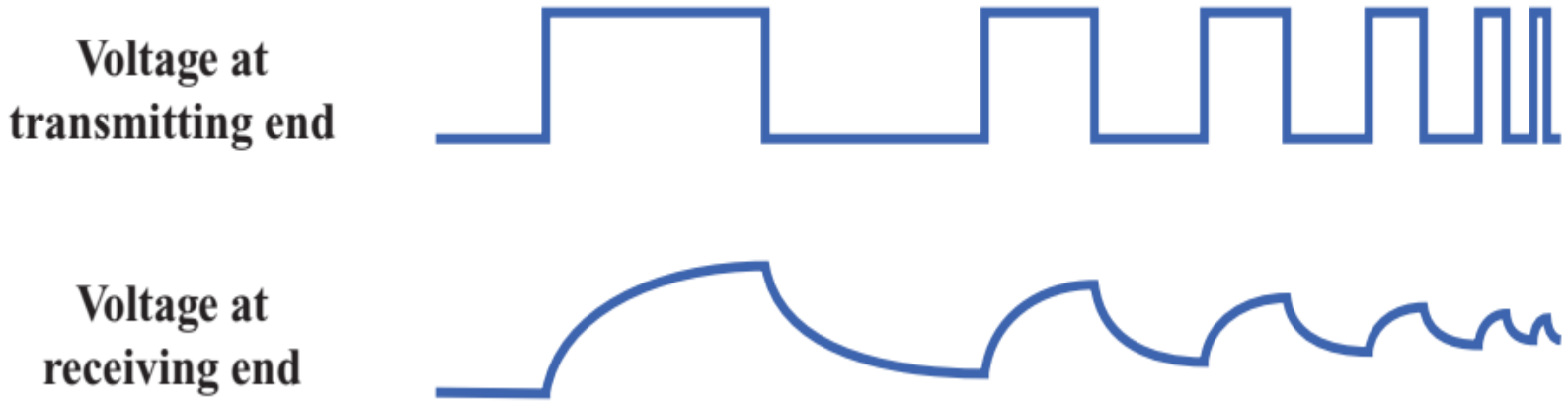
Analog and Digital signaling

The principal advantages of digital signaling

- generally cheaper
- less susceptible to noise interference.

The principal disadvantage is that digital signals

- suffer more from attenuation than do analog signals.



Analog and Digital Data

Analog data

take on continuous values in some interval.

Example:

voice and video are continuously varying patterns of intensity,

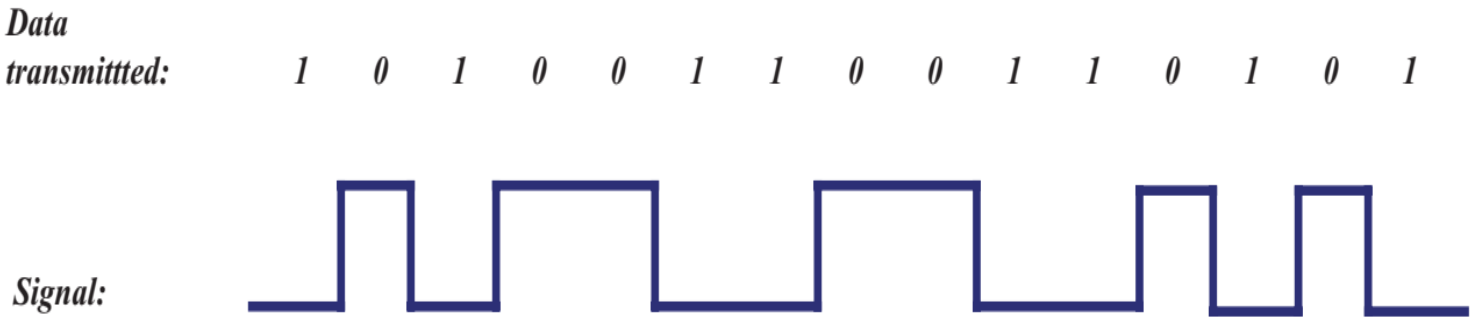
Most data collected by sensors, such as temperature and pressure

Digital data take on discrete values

Examples : text and integers.

Analog and Digital Data

- Data is defined as entities that convey meaning, or information.
- Signals are electric or electromagnetic representations of data.
- Transmission is the communication of data by the propagation and processing of signals.



Transmission Media

- Transmission medium-the physical path between transmitter and receiver.
- Repeaters or amplifiers may be used to extend the length of the medium.
- Communication of electromagnetic waves is *guided* or *unguided.*
  - *Guided media* : waves are guided along a physical path (e.g, twisted pair, coaxial cable and optical fiber).
  - *Unguided media*: means for transmitting but not guiding electromagnetic waves (e.g., the atmosphere and outer space).

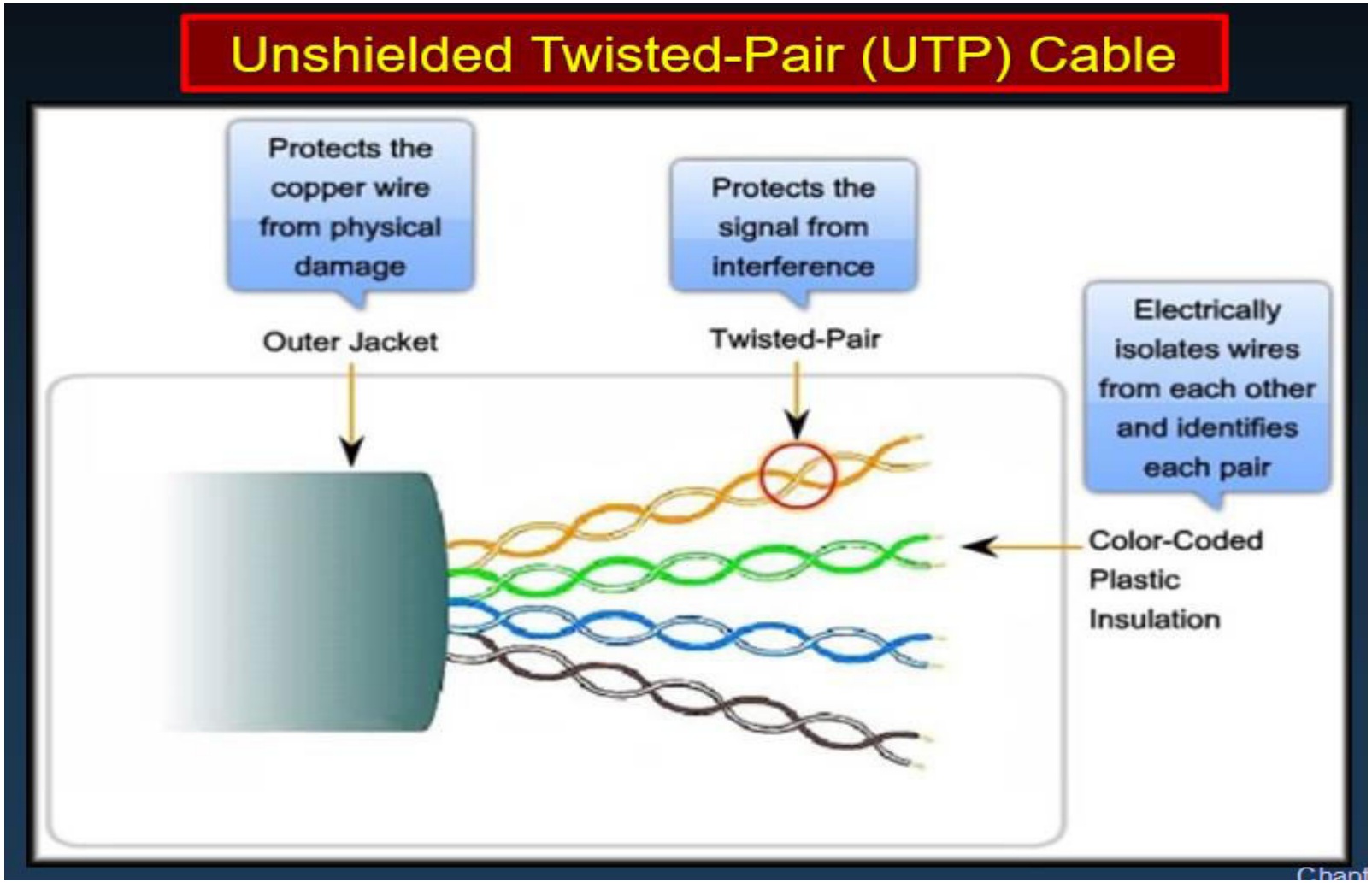
Types of Physical Transmission Media

- Twisted pair
- Coaxial cable
- Optical fiber
- Wireless communications

Types of Physical Transmission Media

Specification	Media	Maximum Segment Length	Connector
10BASE-T	CAT 3,4 or 5 UTP (4 pair)	100m	RJ-45
100BASE-TX	CAT 5 UTP (2 pair)	100m	RJ-45
100BASE-FX	62.5/125 multimode fiber	2km	
1000BASE-CX	STP	25m	RJ-45
1000BASE-T	CAT 5 UTP (4 pair)	100m	RJ-45
1000BASE-SX	62.5/50 multimode fiber	62.5 – 275m 50 – 550m	
1000BASE-LX	62.5/50 multimode 9-micron single-mode fiber	62.5/50 – 550m 9 –10 km	
1000BASE-ZX	9-micron single-mode fiber	70km	
10GBASE-ZR	9-micron single-mode fiber	80km	

Copper Media



Copper Media

- The colored pairs identify the wires for proper connection at the terminals.
- There are several categories of UTP cable. Each category indicates a level of bandwidth performance as defined by the IEEE.
- Category 3 (Cat 3) to Category 5 (Cat 5), 100-megabit transmissions.
- In 1999, Cat 5e, full-duplex Fast Ethernet gigabit
- In 2002, Category 6 (Cat 6). Allow higher performance and less crosstalk.

Copper Media

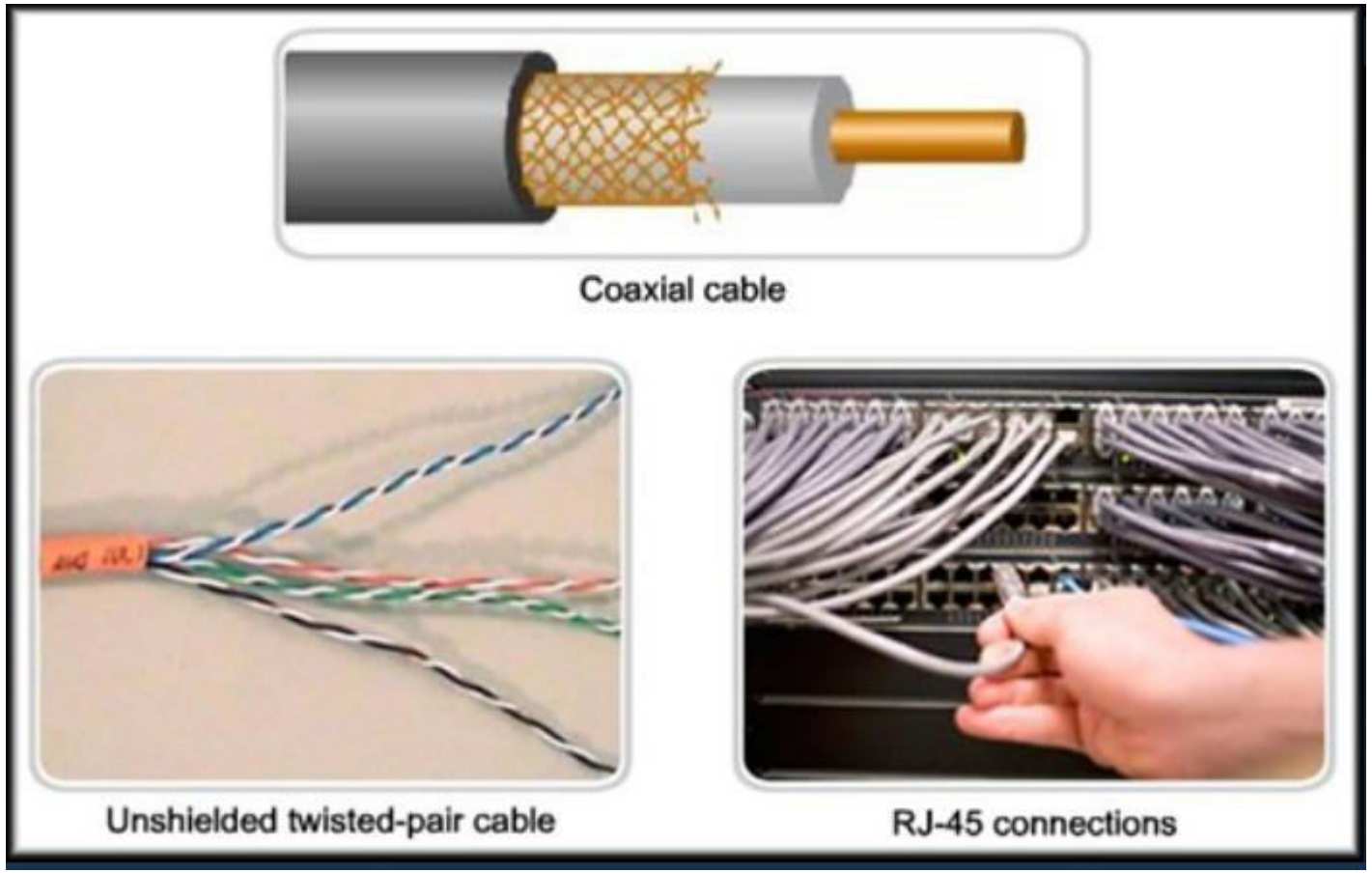
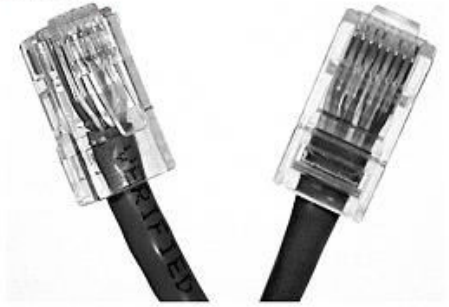
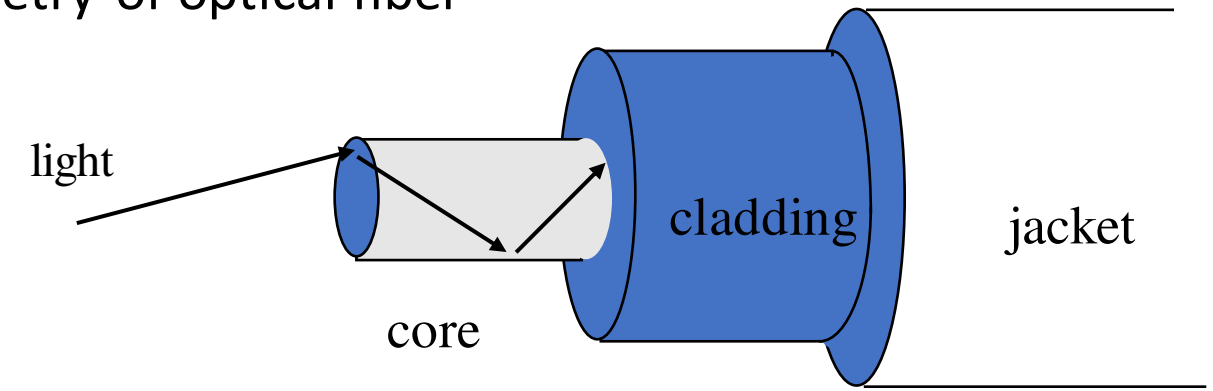


Figure 8-12 RJ-45 Connector

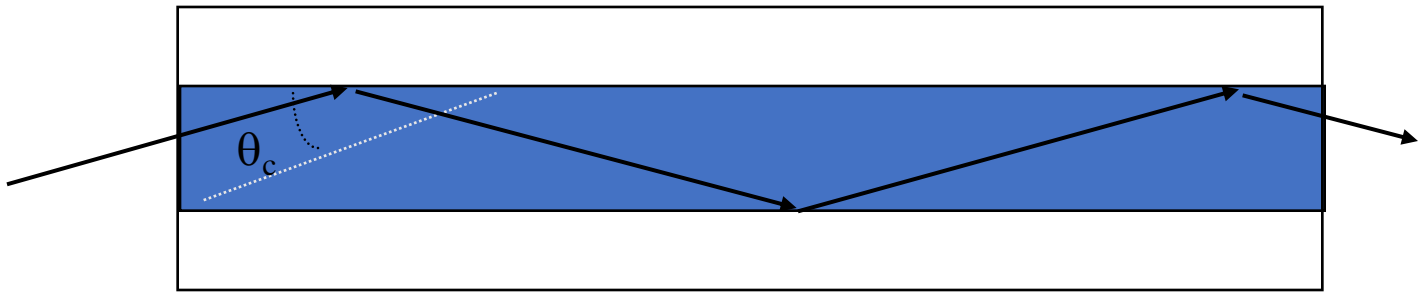


Optical fiber

(a) Geometry of optical fiber

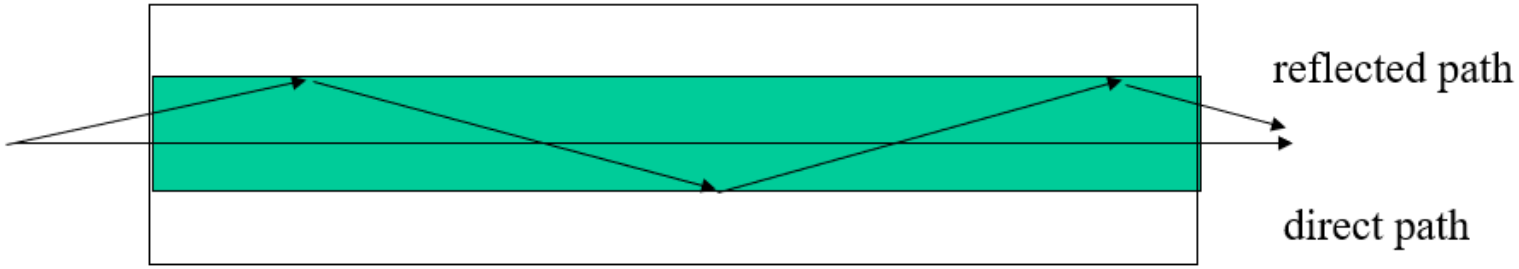


(b) Reflection in optical fiber

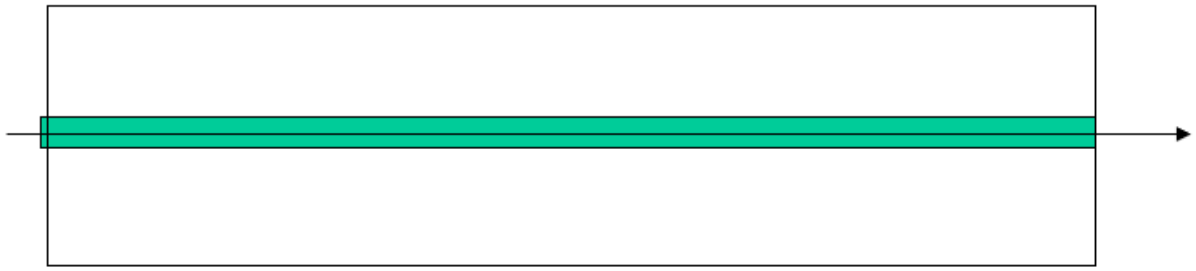


Optical fiber

(a) Multimode fiber: multiple rays follow different paths



(b) Single mode: only direct path propagates in fiber



Optical fiber

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Three techniques

1. Multimode step-index
   - light propagates in the shape of a zigzag along the fiber/core axis according to the principle of total reflection.
   - Light entering the fiber at different angles of incidence will go through different paths.
   - Distance: few kms
2. Multimode graded-index
   - light travels forward in the form of sinusoidal oscillation.
   - Like step-index multimode fibers, different lights in a graded-index multimode fiber travel along different paths
   - Distance: 10-12 kms
   - Better performance

Optical fiber

3. Single-mode step-index
    - propagation of only one traverse electromagnetic **mode**
    - core diameter must be of the order of 2 µm to 10µm.
    - high information carrying capacity.

- Presence of multiple paths ➔ differences in delay ➔ optical rays *interfere* with each other.
- A narrow core can create a single direct path which yields higher speeds.
- WDM (Wavelength Division Multiplexing) yields more available capacity.

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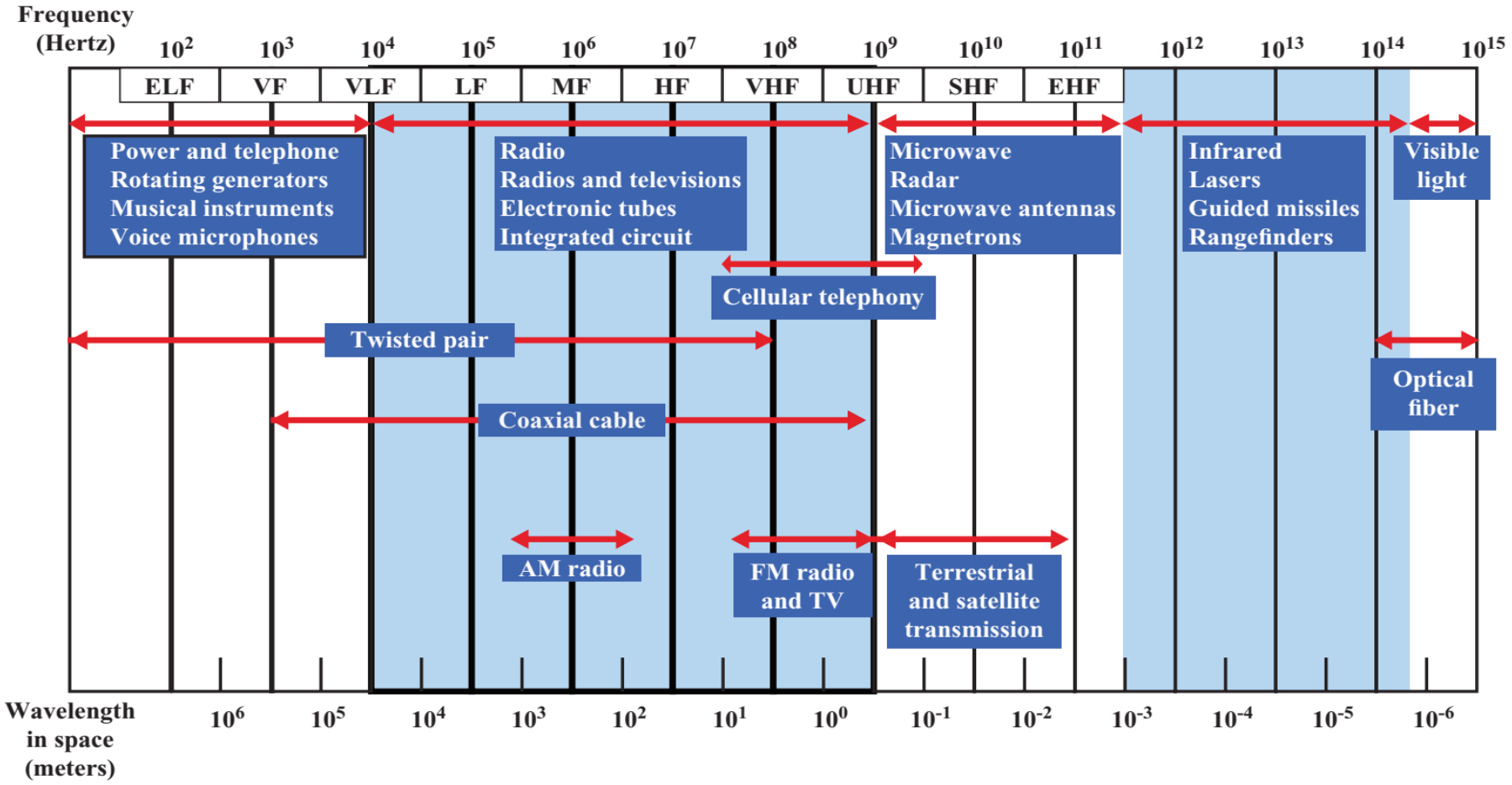
Electromagnetic Spectrum



ELF = Extremely low frequency
VF = Voice frequency
VLF = Very low frequency
LF = Low frequency
MF = Medium frequency
HF = High frequency
VHF = Very high frequency
UHF = Ultrahigh frequency
SHF = Superhigh frequency
EHF = Extremely high frequency

THANK YOU

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