CHAPtER- 2

- communication channels(transmission media)
  - OPEN COPPER WIRE-twisted pair cable- COAXIAL CABLE- OPTICAL FIBER-wireless communication-
  - evaluation criteria

part-1

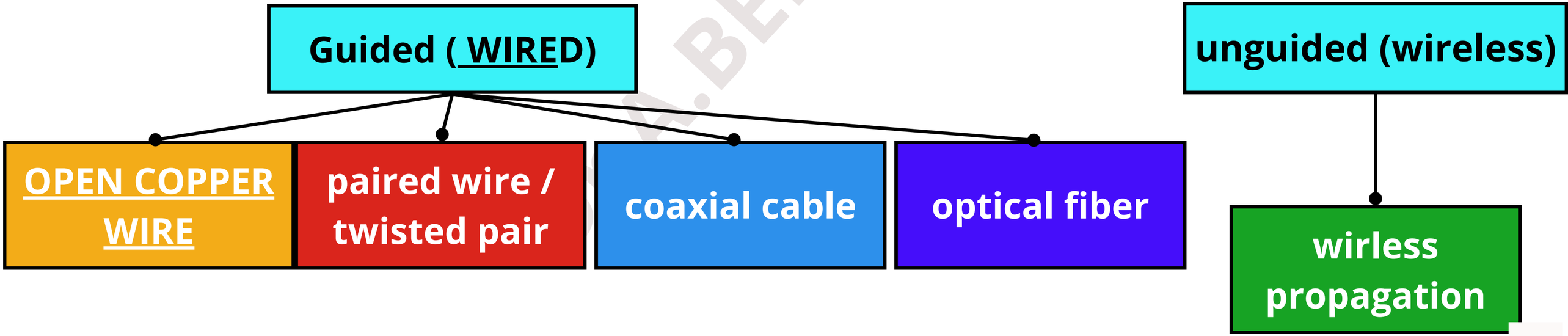
CHAP- 2

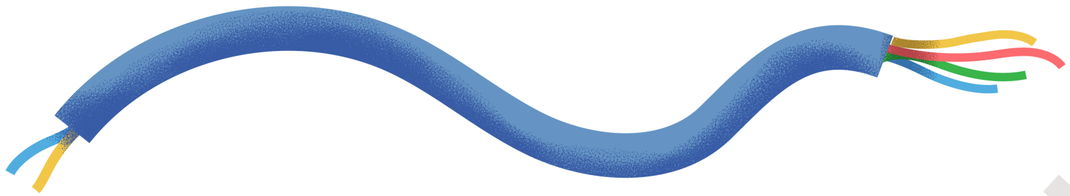
communication channels/transmission media

the aspect of telephony that deals with the various media and technologies for conveying signals be they speech, data, or video signals from one place to another is called transmission

a variety of different transmission media are used to transmit and convey signals. sometimes these media carry only a single signal, while other times they cary many signals combined together, or multiplexed

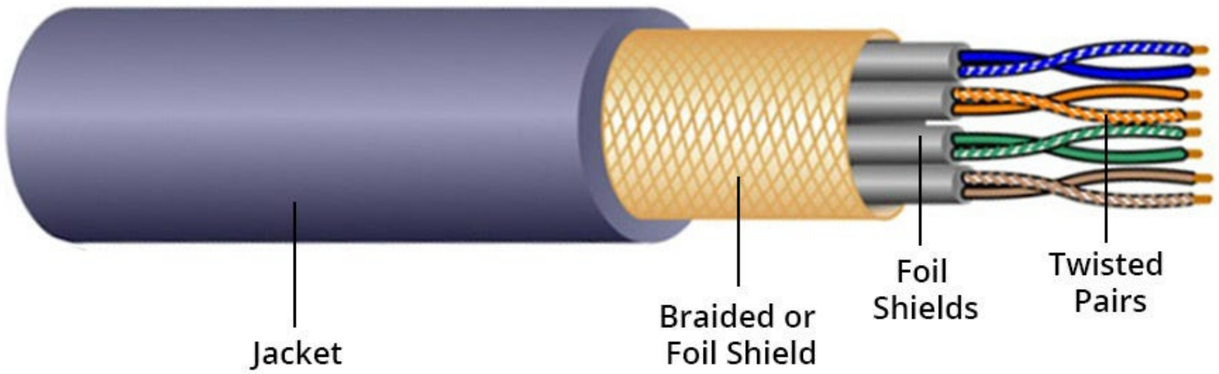
- in telephone transmission many forms of transmission media are used to convey speech:





OPEN COPPER WIRE

open wire consists of uninsulated, bare copper wires that are strung on poles. the two wires that form the pair needed for transmission of electric signals.open wire is thick and therefore has a low loss, typically about 0.03 dB per mile.it was used during the early days of telephony until physical congrestion became a serious problem.open wire is still found, though very rarely, in rural areas.



paired wire = twisted pair cable

is a pair of individually insulated copper wire twisted together with a full twist about every 2 to 6 inches. the insulation is usually plastic, but wood pulp has been used in the past. the diameter of the cooper wires varies from 0.016 inch to 0.036 inch. paired cable can be strung on poles, buried underground, or installed in a conduit.

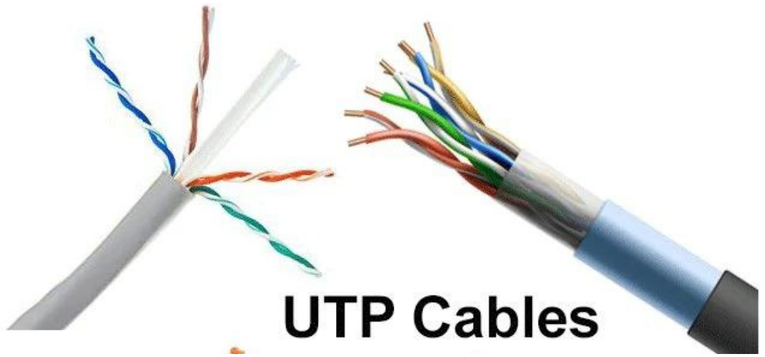
the thinner wire used in paired cable has a higher loss than open wire.the heaviest gauge wire has a loss of about 1.1 db per mile at 1 Hz.
the higher the loss, the smaller the signal that finaly emerges after travelling through the wire. popular paired cables contain 2700 pairs of 26 gauge wire- 1800 pairs of 24 gauge wire and 110 pairs of 22 gauge wire .

the primary applications of twisted pair are in premises distribution systems, telephony, private branch exchanges (PBXs) between the telephone sets and the switching cabinets, LANSs, and local loops

a problem with many wire pairs all running parallel to each other with close spacing in a cable is that the electric signal on one pair can leak to another pair. this effect is called crosstalk

in cases of high subscriber density and of very long loops, subscriber loop carries systems are available, using either frequency-division multiplexing via amplitude modulation AM or time-division multiplixing via digital technique.

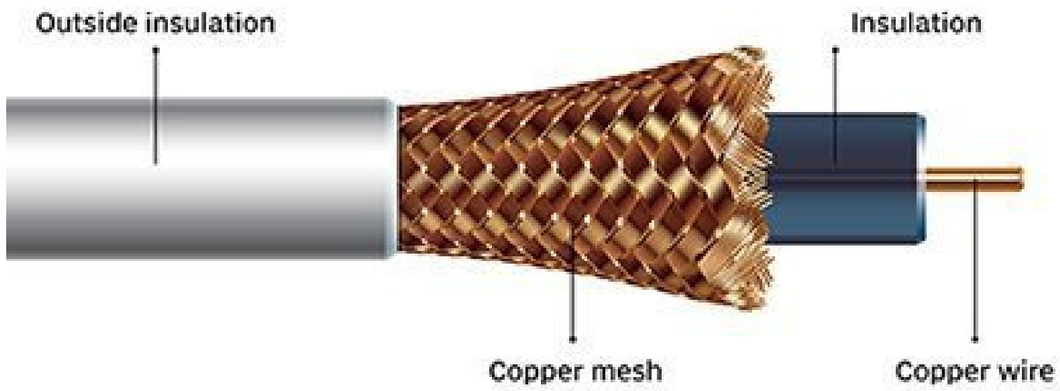
STP Cables



UTP Cables

communication channels/transmission media

COAXIAL CABLE

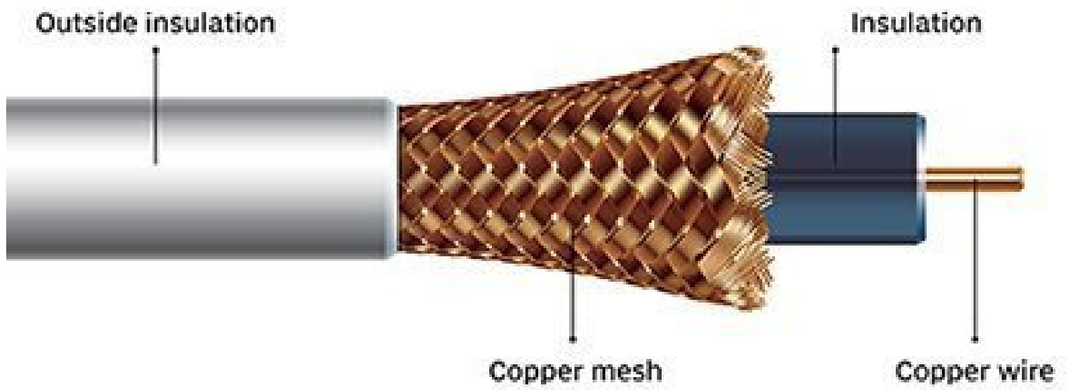


in the centre of a coaxial cable is a cooper wire that acts as the conductor, where the information travels

the cooper wire in coaxial cable is thicker than that in twisted pair,and it's also unaffected by surrounding wires that contribute to EM . so it can provide a heigher transmission rate than twisted pair:the center conductor is surrounded by plastic insulation is covered by the return path, wich is usually braided-cooper shielding or aluminum foil-type covering

communication channels/transmission media

COAXIAL CABLE

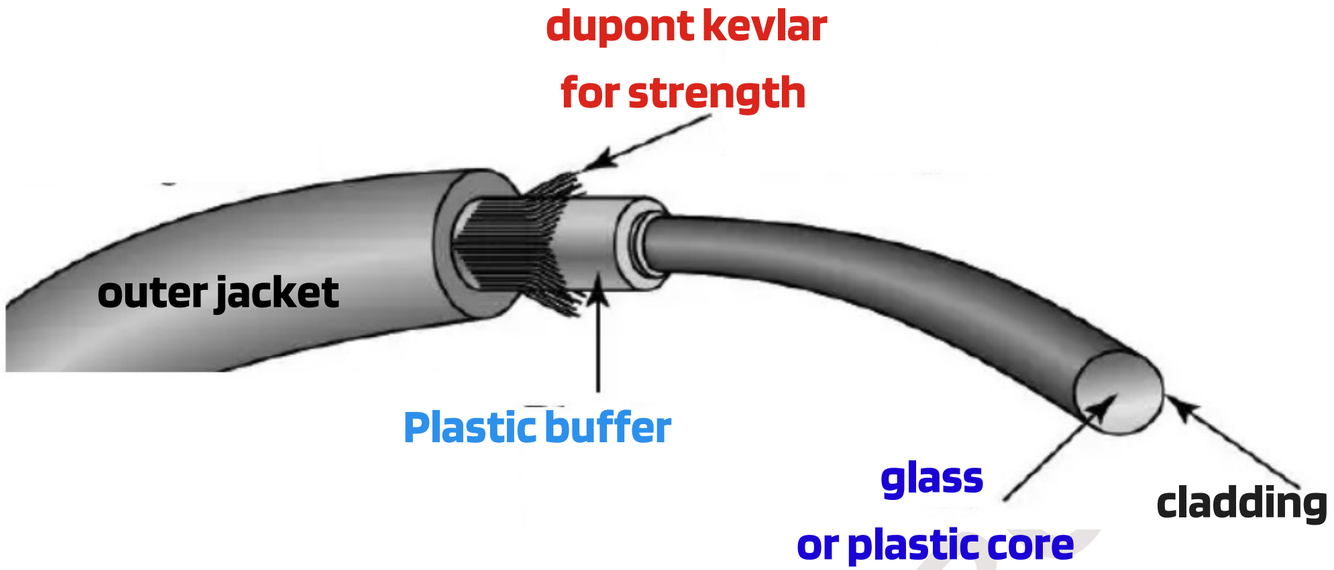


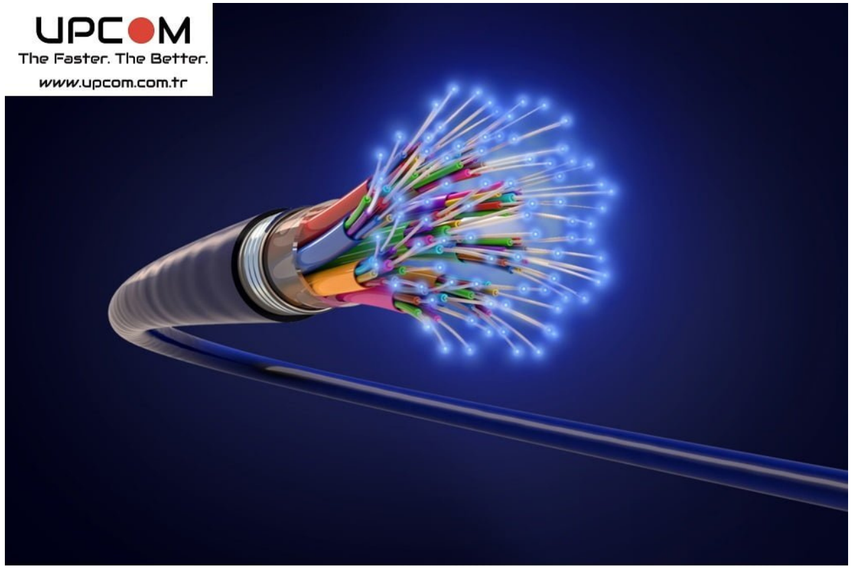
coaxial cable are categorized by their Radio Government (RG) ratings, each RG number denotes a unique set of physical specifications; including wire gauge of the inner conductor; the thickness and type of the inner insulator; the construction of the shield, and the size and type of the outer casing, each cable defined by RG rating is adapted for a specialised function

Category	*Impedance*	*Use*
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

categories of coaxial cables

OPTICAL FIBER



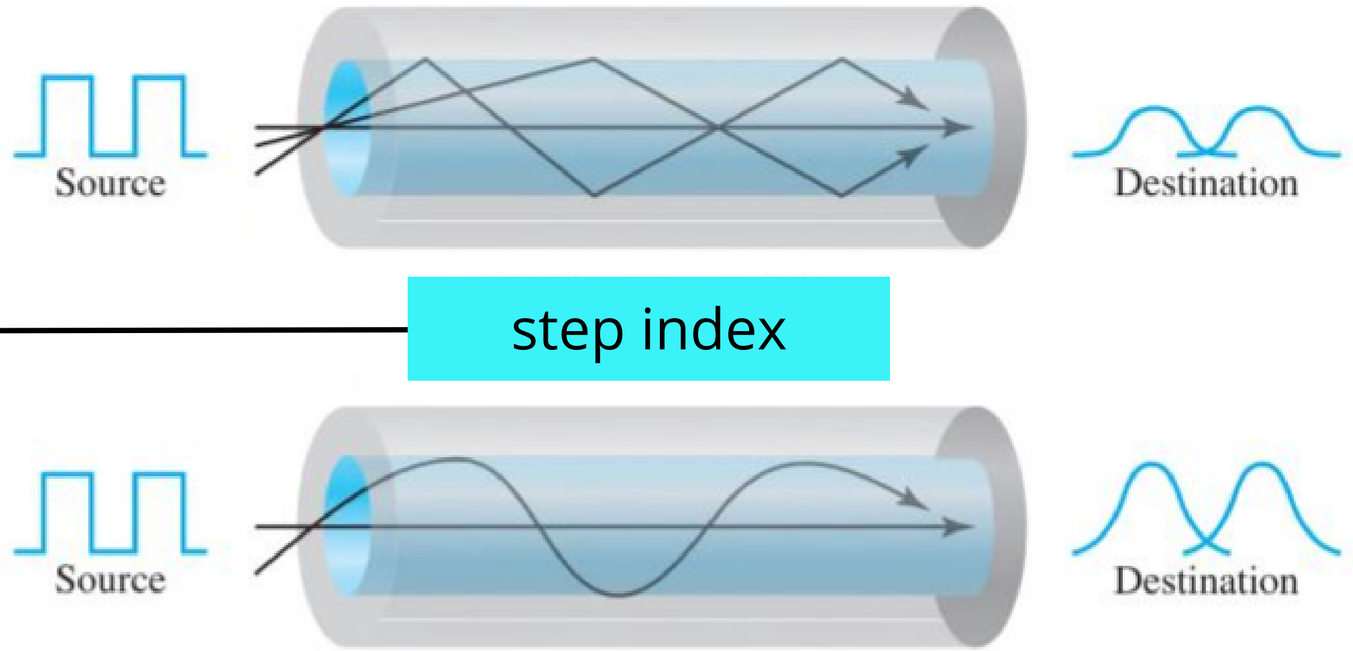


- a fiber optic cable is made of glass or plastic and transmits signals in the form of light
- optical fibers use reflection to guide light through a channel. a glass or plastic core is surrounded by a cladding of less dense glass or plastic. the difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refrqcted into it.
- 2 type of fiber optical cable and

OPTICAL FIBER Modes

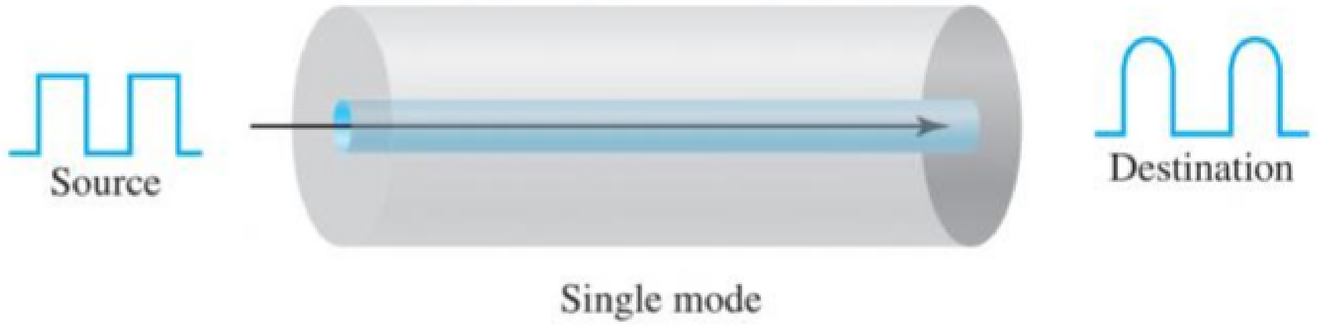
multimode

step index



graded index

single mode



Single mode

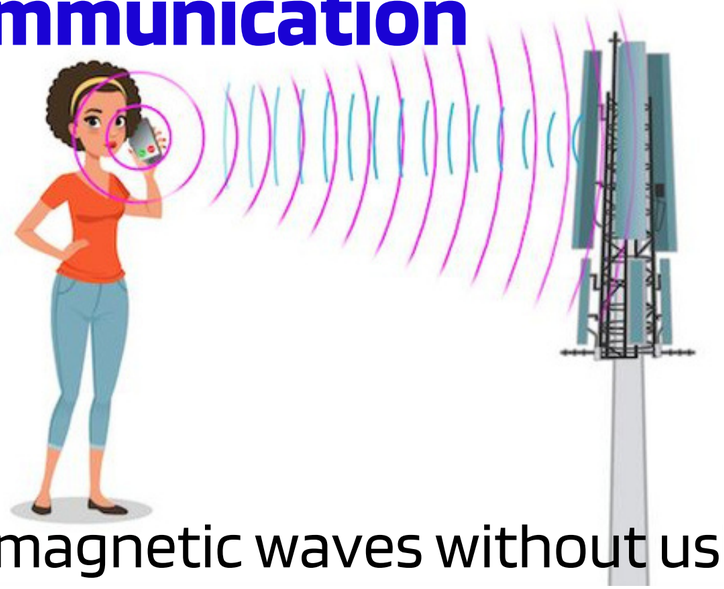
OPTICAL FIBER TYPES

Type	Core	Cladding	Mode
50/125	50	125	Multimode, graded-index
62.5/125	62.5	125	Multimode, graded-index
100/125	100	125	Multimode, graded-index
7/125	7	125	Single-mode

wireless microwave communication

wireless satellite communication

wireless communication



transport electromagnetic waves without using a physical conductor. this type of communication is often referred to as wire less communication.

signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

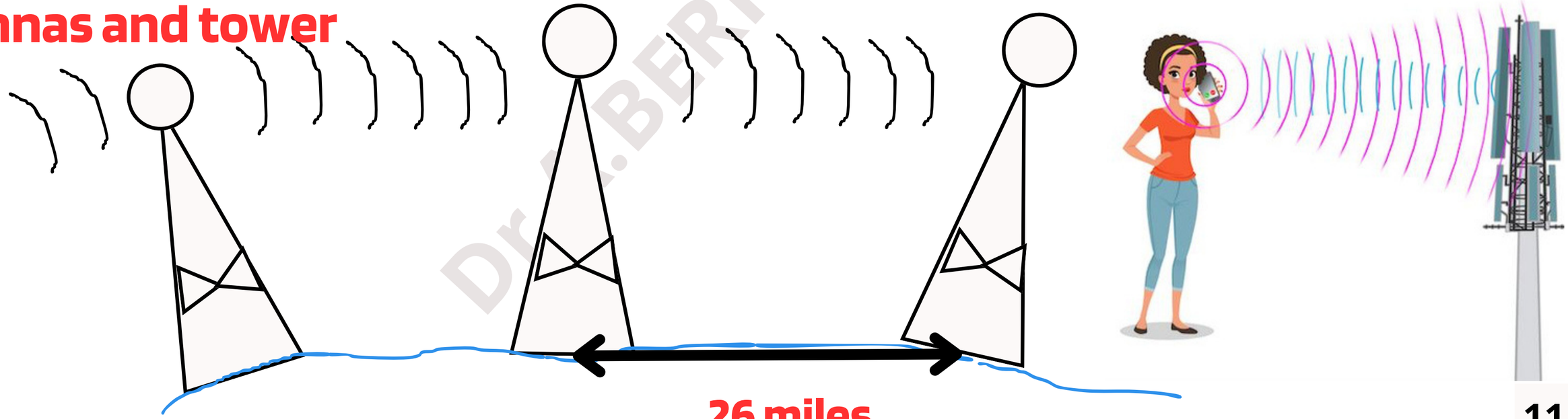
this signals can travel from the source to the destination in several ways: ground propagation, sky propagation and line of sigh propagation

wireless microwave communication

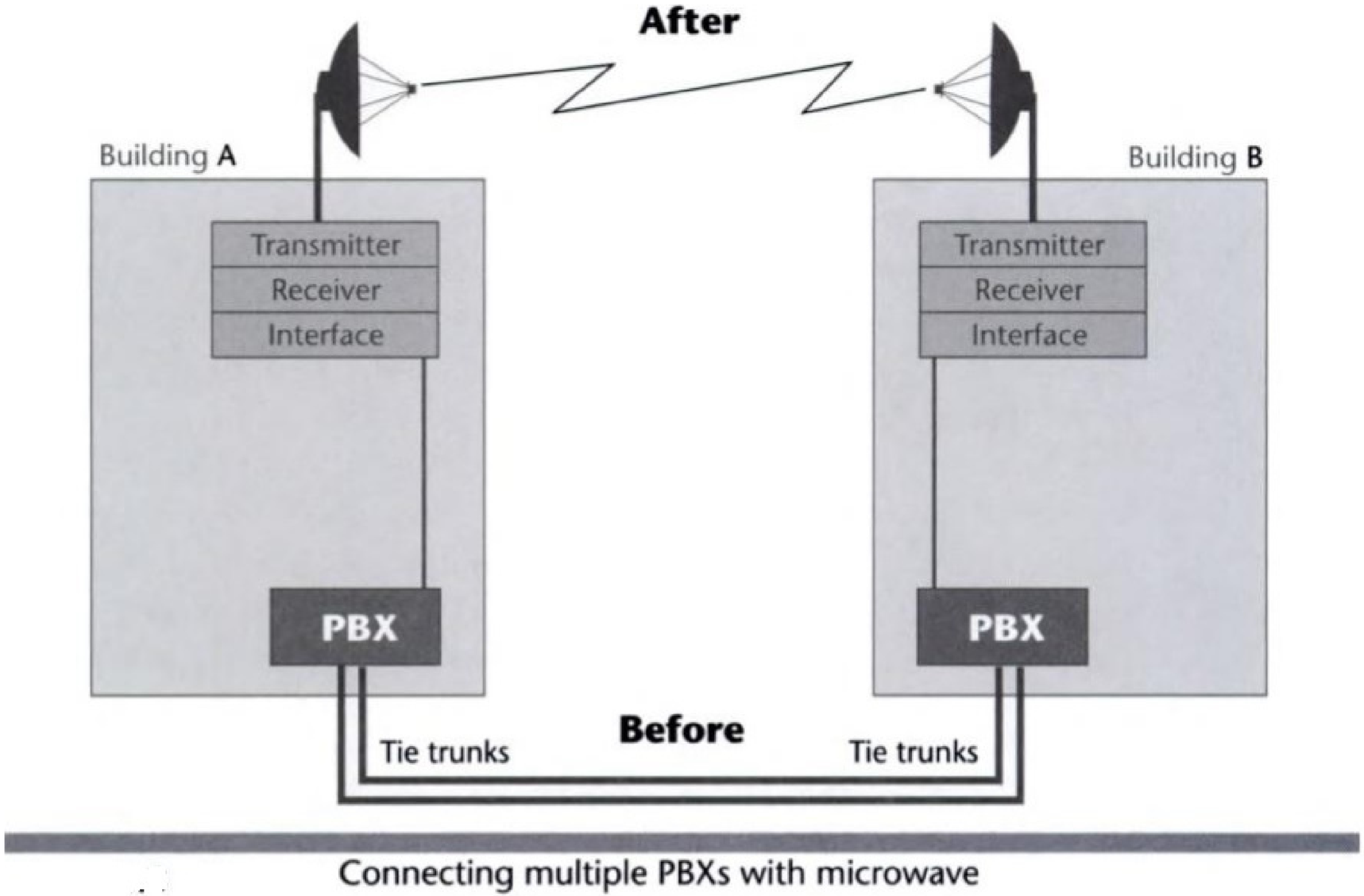
the microwave antenna consists of parabolic dish with a launching unit situated at its focal point, modem microwave transmitters operate in the range 2-23 Ghz and cover distances of 50-60 Km between aerials, at each hop between aerials the incoming signal is tranlated to an intermediate frequency, amplified and then stepped up to the main carrier frequency for onward transmission.

in terrestrial microwave radio systems, radio signals travel from tower to tower, each tower located a line of sigh **26 miles** from the next

antennas and tower



wireless microwave communication



Connecting multiple PBXs with microwave

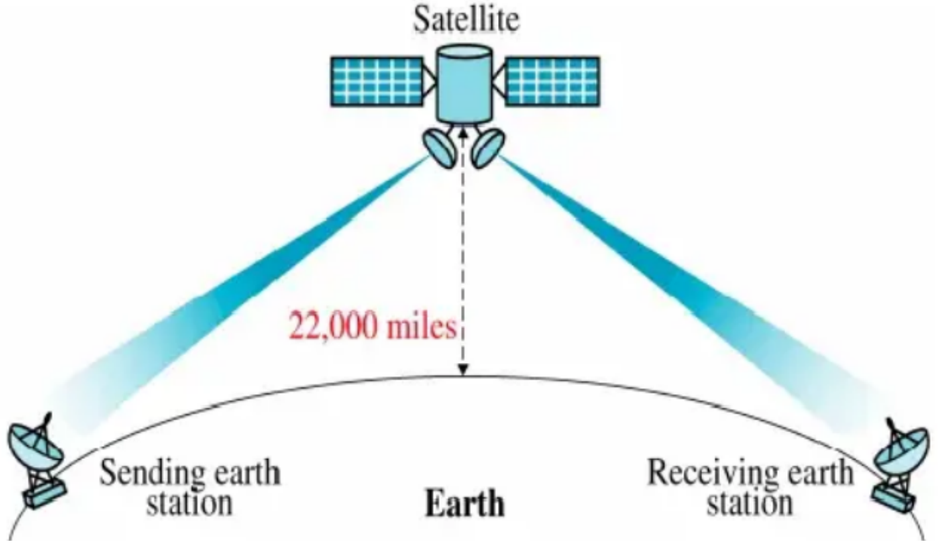
wireless microwave communication

- teressterial microwave radio cannot go every where: a very high-frequency microwaves cannot penetrate walls
- it is very costly to construct a series of microwave towers to reach remote areas with few telephone subsribers
- terrestrial microwave radio cannot cross oceans because radio waves travel along a lone-of-sight path and floating microwave towers are not feasible

a practical solution is the use of an artificial earth satellite for communication purposes. the first communication satellite, Telstar I, was launched on 1962

wireless satellite communication

satellite systems are a particular from wireless microwave system but, due to the very long distances involved, the closest an earth station can ever be to satellite is 22300 miles.with the electromagnetic waves travelling at 300 000 km/s that means that a signal travels from a ground station in the earth take about a quarter of a second to go up to the satellite and then back to another ground station.



- high-frequency microwave transmission is used to send signals up to communication satellites and then back to earth.
- the microwave band of frequencies used to transit from the earth to the satellite is called **uplink.**
- the band of frequencies used to transmit from the satellite back to the earth is caled **downlink**

wireless satellite communication

- satellite can be classified by how far out into orbit each one is:

(**LEO** - **MEO** - **GEO** and **HEO**)

LEO /Low Earth Orbit 100 miles : used for pagers /wireless e-mail / special mobile telephones / spying / videoconferencing.

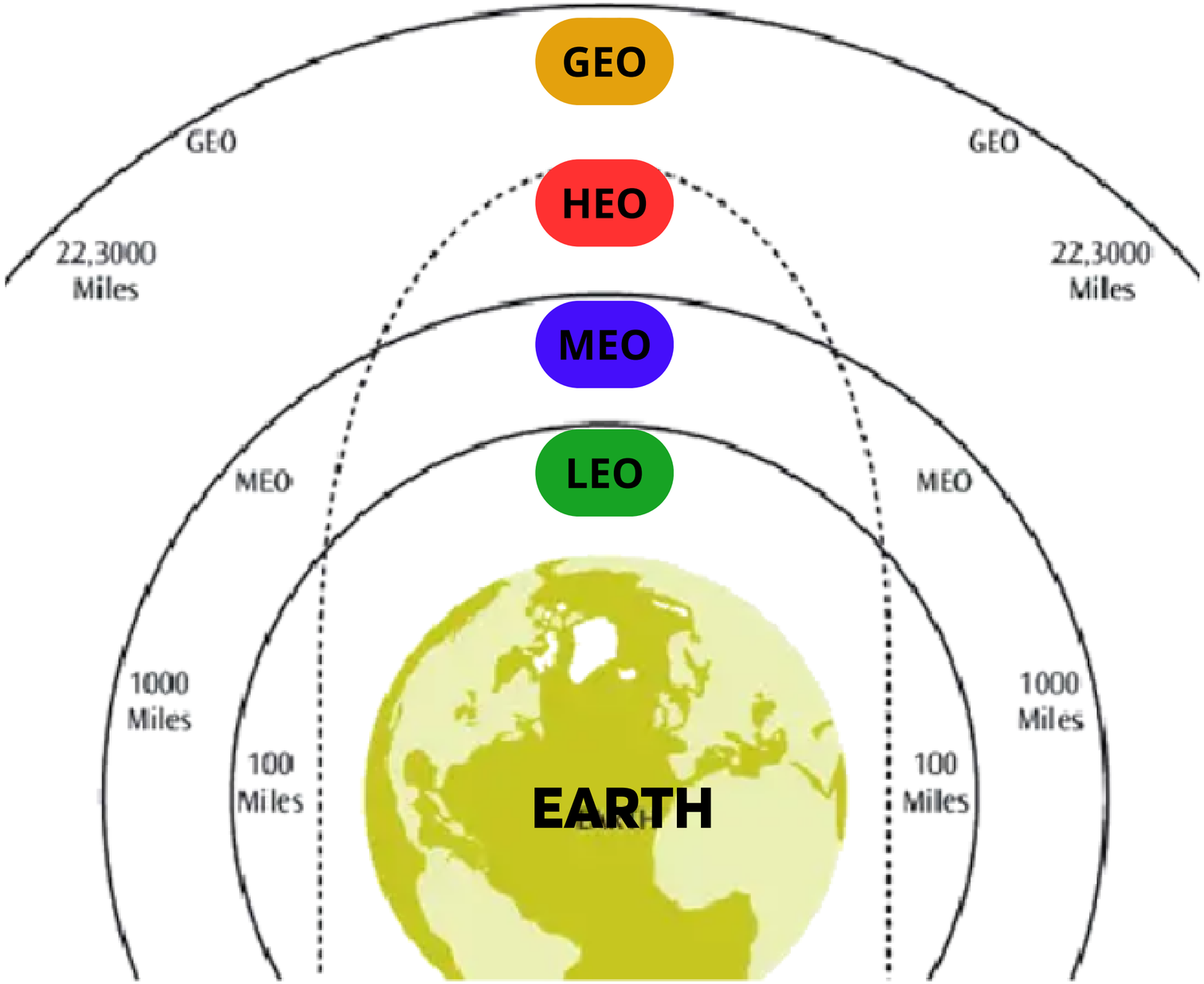
MEO Middle Earth Orbit - 1000 miles : used for GPS and government.

GEO- Geosynchronous Orbit 22,300 miles: used for weather/ television and government operations.

HEO used by the military for spying and by scientific organizations for photographing celestial bodies.

when satellite is far out into space, it takes photos. When satellite is close to earth, it transmits data.

Satellite Orbit



comparison table

Media Type	Frequency Spectrum	Performance Error Rate	Distance Between Repeaters	Security	Cost
Twisted-pair	1MHz	Poor to fair (10^{-5})	Short (1.2 miles/2 km)	Poor	Low
Coaxial	1GHz	Good (10^{-7} to 10^{-9})	Short (1.5 miles/2.5 km)	Good	Moderate
Microwave	100GHz	Good (10^{-9})	Medium (up to 45 miles/72 km)	Poor	Moderate
Satellite	100GHz	Good (10^{-9})	Long (up to 22,3000 miles/36,000 km)	Poor	Moderate to high
Fiber	75THz	Great (10^{-11} to 10^{-13})	Long (up to 4,000 miles/6,400 km)	Good	Moderate to high

evaluation criteria

The basic building block for transmission is the telephone channel or voice channel. voice channel implies spectral occupancy, whether the voice path is over wire, radio, or coaxial cable or over a fiber-optic system.

the quality of transmission can be impaired by a variety of sources. these sources all produce unwanted signals that can be grouped under the general category of noise.

- **attenuation distortion (frequency response)**
- **phase distortion**
- **noise**

evaluation criteria

- **attenuation distortion (frequency response)**

a signal transmitted over a voice channel suffers various forms of distortion. that is, the output signal from the channel is distorted in some manner such that it is not an exact replica of the input. one form of distortion is called attenuation distortion and is the result of imperfect amplitude-frequency response.

evaluation criteria

- **Phase distortion**

a voice channel may be regarded as a band-pass filter. a signal takes a finite time to pass through a telecommunication network. this time is a function of the velocity of propagation, which varies with the media involved. the velocity of propagation also tends to vary with frequency because of the electrical characteristics associated with the network. considerring the voice channel, therefore, the velocity of propagation tends to increase toward band center and decrease taward band edge.

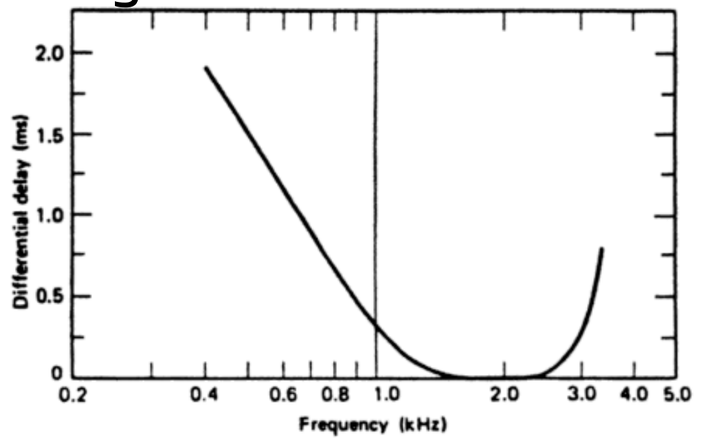


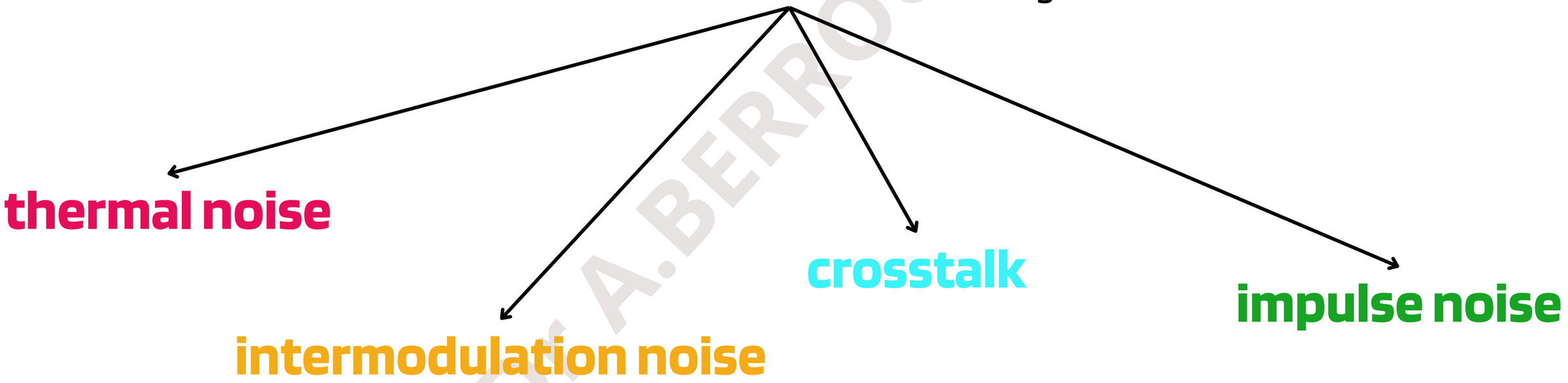
Figure 5.2. Typical differential delay across a voice channel. Frequency-division-multiplex (FDM) equipment back-to-back.

evaluation criteria

- **Noise**

noise in its broadest definition, consists of any undersired signal in a communication circuit. the subject of noise and noise reduction is probably the most important single consideration in analog transmission engineering. it is the major limiting factor in system performance.

noise is broken down into four categories



evaluation criteria

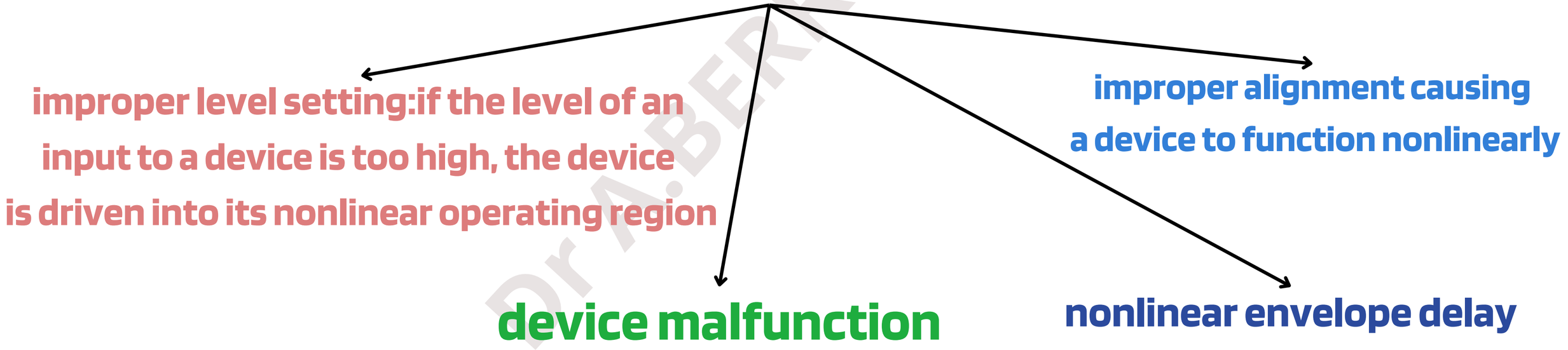
- **thermal noise**

thermal noise occurs in all transmission media and all communication equipment, including passive devices. it arises from random electron motion and is characterized by a uniform distribution of energy over the frequency spectrum with gaussian distribution of levels

evaluation criteria

intermodulation noise

devices passing multiple signals simultaneously, such as multichannel radio equipment, develop intermodulation (IM) products that are so varied that they resemble white noise. intermodulation noise may resule from a number of causes:



evaluation criteria

crosstalk

crosstalk refers to unwanted coupling between signal paths, there are essentially three causes of crosstalk:

1. electrical coupling between transmission media, such as between wire pairs on a voice-frequency cable system VF
2. poor control of frequency response
3. nonlinear performance in analog FDM multiplex systems. Excessive level may exacerbate crosstalk.

There are two types of crosstalk

intelligible

where at least four words are intelligible to the listener from extraneous conversation

unintelligible

crosstalk resulting from any other from of disturbing effects of one channel on another

evaluation criteria

impulse noise

impulse noise is noncontinuous, consisting of irregular pulses or noise "spikes" of short duration, broad spectral density, and relatively high amplitude. these spikes are often called "hits". impulse noise degrades telephony ordinarily only marginally