INTRODUCTION TO COMMUNICATION SYSTEMS

EEEN 462- ANALOGUE COMMUNICATION SYSTEMS

Friday, 05 September 2025

THE EEEN 462 SYLLABUS

- **Signal Analysis:** Signal representation in time and frequency domain. Generalized expansion in complete orthonormal sets. Interpretation of signals as vectors in signal space. Fourier series.
- **Fourier and Laplace Transforms**. Signal spectra and their properties. Rayleigh theorem. Sampling theorem for baseband and passband signals.
- **Power and spectral energy densities:** The DFT. the FFT. The Hilbert Transform.
- **Deterministic signals** through linear systems.
- **Analog Modulation:** Need for modulation. Linear Modulation: AM, DSB, VSB, SSB.
  - **Angle modulation FM & PM.**
  - **Demodulators for AM and FM signals**.
  - **Effects of noise in AM and FM systems.**
- **Frequency division multiplexing**. Noise in analog modulation:
- **Demodulator performance in the presence of noise**. Pre-emphasis and de-emphasis filtering threshold in FM system.
- **Comparison of system performance in noise (AM & FM).**

INTRUCTION METHODS & ASSESSMENT

Instruction method

- Lectures: 2 hours; Tutorial: 1 hours per week
- Laboratory Exercises: At least **Three Four experiments per semester** with each practical session 3 hours long

Assessment

- Regular Examination at end of Semester: 70 %
- Continuous Assessment: 30 %
  - 10 % shall be continuous assessment tests
  - 5 % shall be assignments
  - 15 % shall be labs

TEXTBOOK & REFERENCE BOOKS

1. Principles of Electronics Communication by Louis Frenzel, 4th Edition
2. Signals and Systems Using MATLAB by Chaparro
3. Introduction to Statistical Signal Processing, by Robert Gray & Lee Davisson

TEACHING SCHEDULE /01

PERIOD	MAIN TOPIC	SUB-TOPICS
WEEK 1	Introduction to Communication Systems	• History Of Electronic Communication • Introduction To Communications • Definition and Importance of Communications.
WEEK 2	Elements of communication systems:	• Basic Block Diagram; • Sources, Transmitter, • Channels, Receiver; • Destination • Noise.
WEEK 3	Types of electronic communications:	• Simplex; amplitude modulation (AM) and Frequency modulation (FM) broadcasting, cable TV, paging, telemetry, surveillance. • Duplex: telephones, data communication.
WEEK 4	Electromagnetic spectrum from audio frequencies to cosmic rays:	• Radio Frequency (RF), • Visible Spectrum • MicroWave Ranges, • Bandwidth • Frequency Management.

TEACHING SCHEDULE /02

PERIOD	MAIN TOPIC	SUB-TOPICS
WEEK 5	• Analogue carrier modulation and demodulation Schemes:	• Amplitude modulation (AM) • Frequency modulation (FM)
WEEK 6	• Analogue carrier modulation and demodulation Schemes:	• Phase modulation and demodulation schemes. • Pulse Amplitude modulation (PAM) • Sampling theorems.
WEEK 7	• Analogue carrier modulation and demodulation Schemes:	• Pulse Width Modulation (PWM) • Pulse Position Modulation (PPM) • PWM And PPM Reception Principles.
WEEK 8	• AM and FM transmitters and receivers:	• Modulator And Demodulator Circuits • Pre – Emphasis and De- Emphasis.

TEACHING SCHEDULE /03

PERIOD	MAIN TOPIC	SUB-TOPICS
WEEK 9	Classification of noises and types in communication systems:	• Noise Performance In Various Modulation Schemes • Noise Figures And Signal – To – Noise Ratios.
WEEK 10	Spectral Density	• Signal energy; Energy spectral density and power spectral density.
WEEK 11	Numerical computation and analysis	• Variety of examples given from MATLAB

DEFINITION OF COMMUNICATION

- **Communication** (from Latin commūnicāre, meaning "to share") is the activity of conveying information through the exchange of thoughts, messages, or information, as by speech, visuals, signals, written, or behaviour.

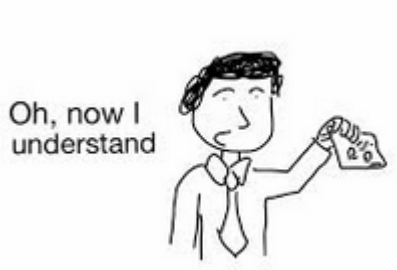
- **Communication** is the meaningful exchange of information between two or more living creatures.

STEPS IN COMMUNICATING

Communicating with others involves three primary steps:

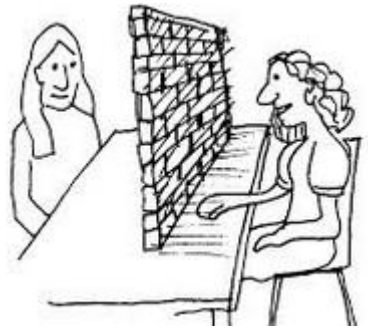
1. **Thought:** First, information exists in the mind of the sender. This can be a concept, idea, information, or feeling.
2. **Encoding:** Next, a message is sent to a receiver in words or other symbols.
3. **Transmission:** The message is conveyed to the receiver through some media. Common media are: air (sound), wires (LAN and Telephone), space (radio and telephone).
4. **Decoding:** Lastly, the receiver translates the received signals into a concept or information that a person can understand.

SENSOR (Replacing Human thought)



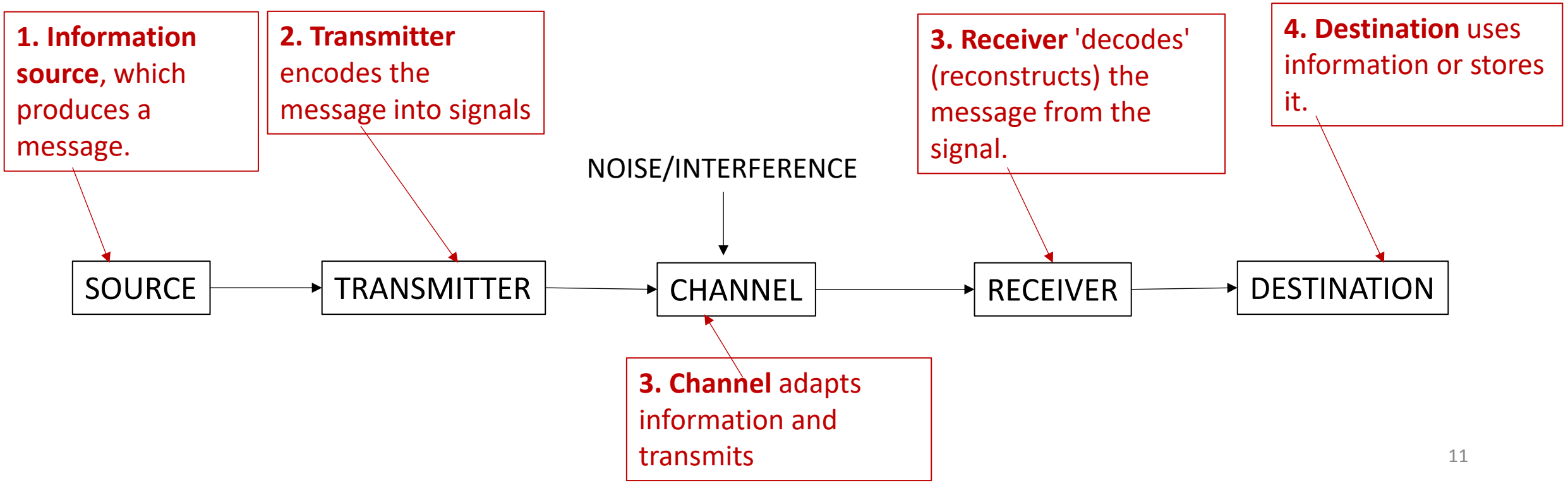
BARRIERS TO HUMAN COMMUNICATION

1. **Physical barriers:** Barriers due to environment e.g staff being located at in different buildings or sites but could also include other environmental factors e.g. weather and noise which interfere with effective communication.
2. **System design barriers:** Barriers due to communication structures or systems in place in an organization. Examples include lack of proper line command, training, lack of clarity in roles and uncertainty of what is expected from the receiver.
3. **Attitudinal barriers:** Barriers due to human attitudes and includes such factors as personal attitudes, poor lack of consultation, personality conflicts and lack of motivation.
4. **Ambiguity of words/phrases:** Misconception of words sounding the same but having different meaning.
5. **Linguistic barriers:** A part from speaking different languages, this also includes use of jargon, difficult or inappropriate words in communication can prevent the recipients from understanding the message.
6. **Physiological barriers:** Barriers resulting from individuals' personal discomfort, caused—for example—by ill health, poor eyesight or hearing difficulties.



CLAUDE SHANNON AND WARREN WEAVER COMMUNICATION MODEL - 1949

1. In 1949, Shannon and Weaver developed a social model of communication which is still widely used.
2. The Model consisted of five elements as follows:

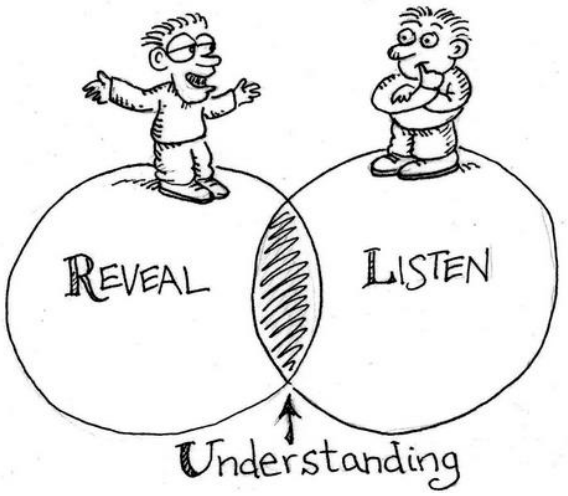


PROBLEMS WITH THE BASIC COMMUNICATION MODEL

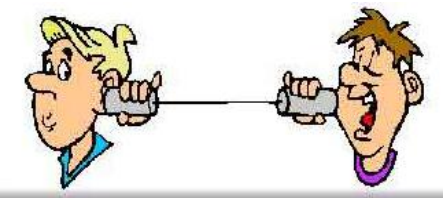
Shannon and Weaver argued that there three problems in the communication model, i.e.

1. **The technical problem:** how accurately can the message be transmitted?
2. **The semantic problem:** how precisely is the meaning 'conveyed'?
3. **The effectiveness problem:** how effectively does the received meaning affect behaviour?

EFFECTIVE COMMUNICATION



148 YEARS OF TELEPHONY



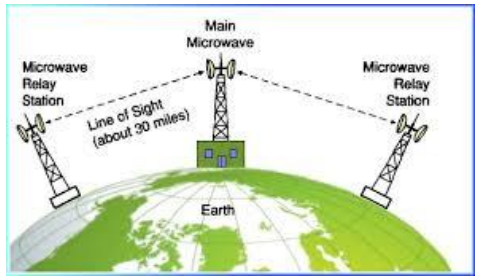
Child Play and Imagination

1876: Alexander Bell Graham invents the telephone

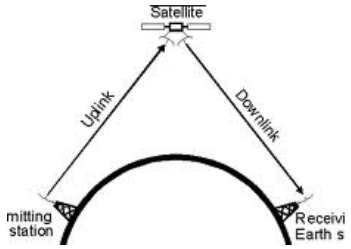
Open Wire Communication between Cities

1894: Guglielmo Marconi invents the first Wireless Telegraph

1906: Reginald Fessenden invents the AM radio



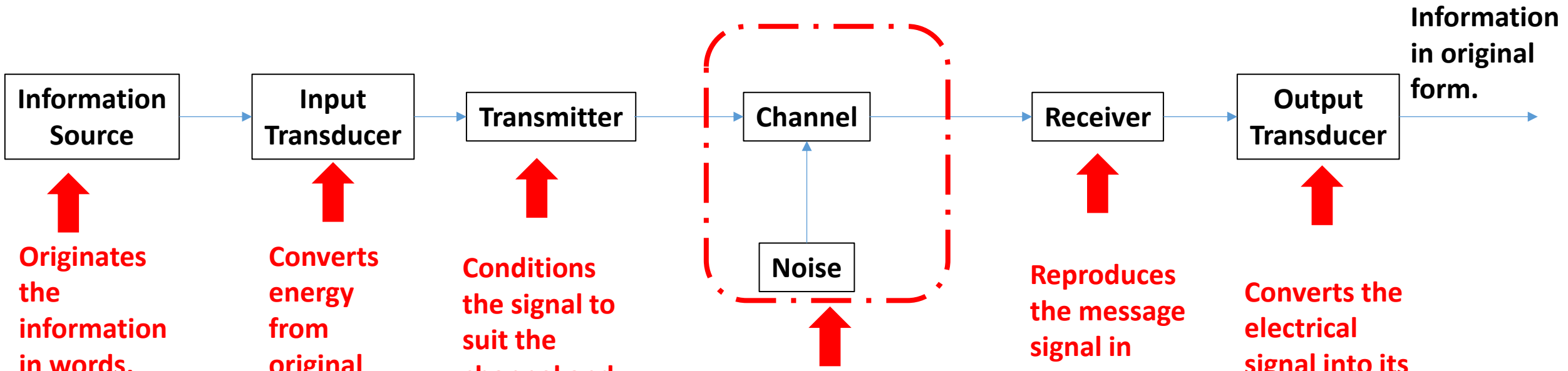
1945: Terrestrial Microwave radio systems



1965: Commercial Satellite Communication Systems

1992- The Mobile Revolution

BLOCK DIAGRAM OF AN ELECTRICAL COMMUNICATION SYSTEM



Originates the information in words, code, symbol, etc

Converts energy from original form to electricity

Conditions the signal to suit the channel and transmits the signal

A medium which carries the signal from the transmitter to the receiver, e.g. Fibre optic cable, Space or guided electromagnetic waves.

Reproduces the message signal in electrical form through detection and demodulation

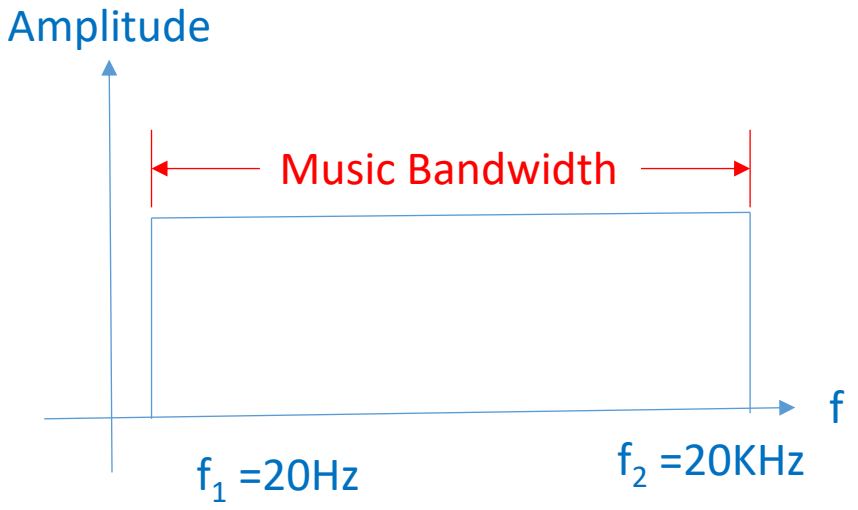
Converts the electrical signal into its original form

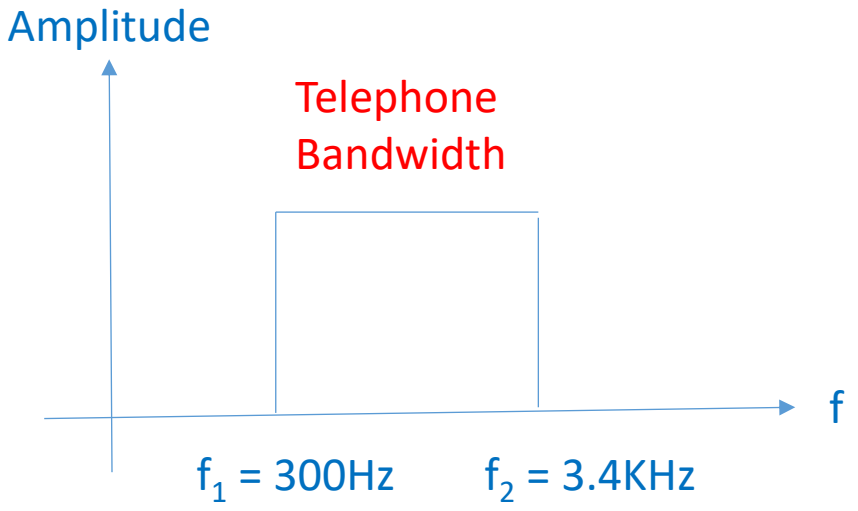
CONCEPT OF BANDWIDTH

Definitions:

1. **Bandwidth** is the portion of the electromagnetic spectrum occupied by a signal.

2. **Bandwidth** is the frequency range over which the information is transmitted.





COMMUNICATION FREQUENCY BANDS (1)

BAND NAME	ABBREVIATION	FREQUENCY AND WAVELENGTH IN AIR	APPLICATIONS
Tremendously Low Frequency	TLF	**< 3 Hz** > 100,000 km	Natural and artificial electromagnetic noise
Extremely Low Frequency	ELF	**3–30 Hz** 100,000 km – 10,000 km	Communication with submarines
Super Low Frequency	SLF	**30–300 Hz** 10,000 km – 1000 km	Communication with submarines (Audible)
Ultra Low Frequency	ULF	**300–3000 Hz** 1000 km – 100 km	Submarine communication, Communication within mines (Audible)
Very Low Frequency	VLF	**3–30 kHz** 100km – 10km	Navigation, time signals, submarine communication, wireless heart rate monitors, geophysics (Audible <20kHz)

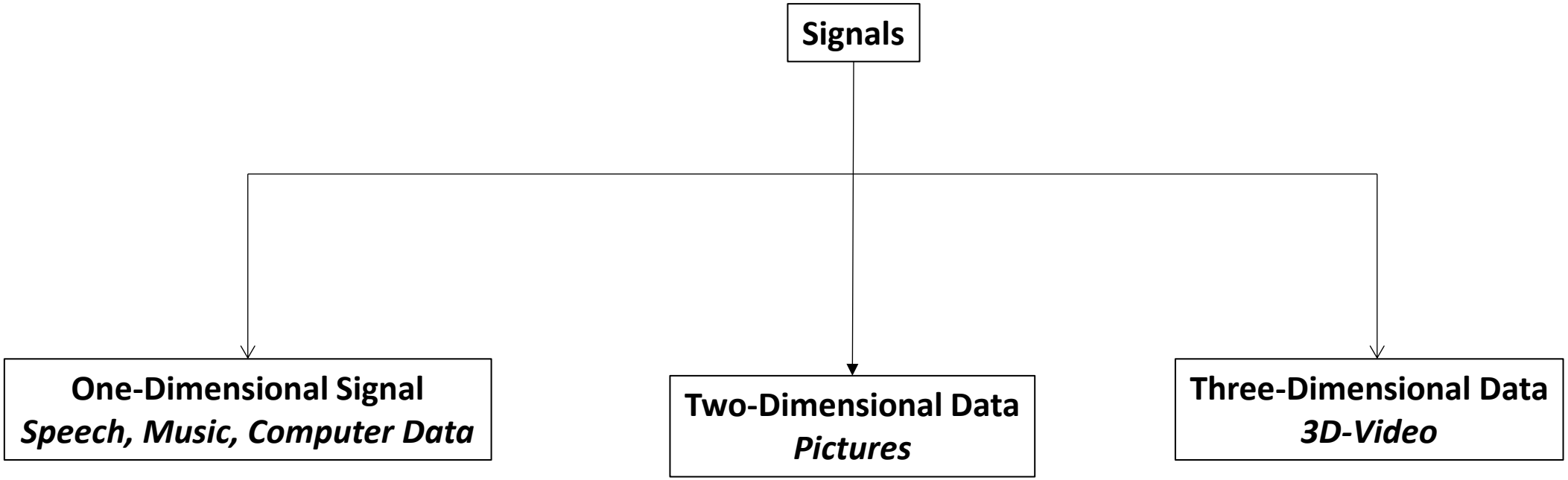
COMMUNICATION FREQUENCY BANDS (2)

BAND NAME	ABBREVIATION	FREQUENCY AND WAVELENGTH IN AIR	APPLICATIONS
Low frequency	LF	**30–300 kHz** 10 km – 1 km	Navigation, time signals, AM longwave broadcasting
Medium frequency	MF	**300–3000 kHz** 1 km – 100 m	AM (medium-wave) broadcasts, amateur radio
High frequency	HF	**3–30 MHz** 100 m – 10 m	Shortwave broadcasts, citizens' band radio, amateur radio
Very high frequency	VHF	**30–300 MHz** 10 m – 1 m	FM, television broadcasts and line-of-sight ground-to-aircraft and aircraft-to-aircraft communications
Ultra High frequency	UHF	300–3000 MHz 1 m – 100 mm	Television broadcasts, 2G, 3G and 4G Mobile, wireless LAN, Bluetooth, GPS

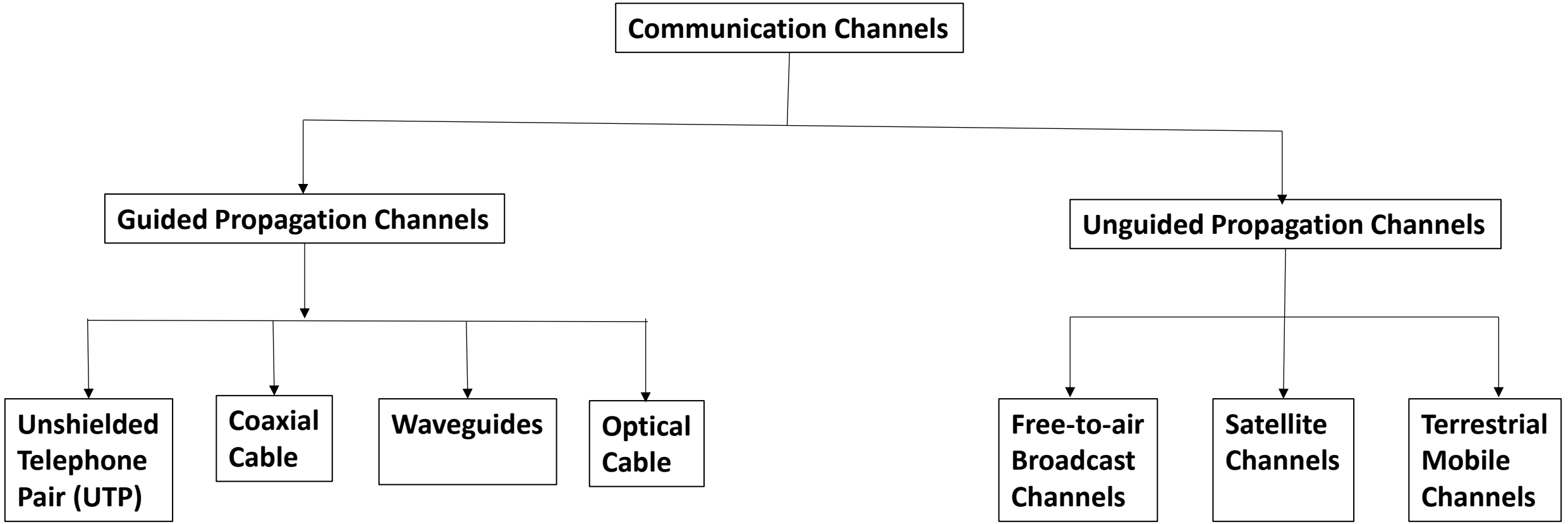
COMMUNICATION FREQUENCY BANDS (3)

BAND NAME	ABBREVIATION	FREQUENCY AND WAVELENGTH IN AIR	APPLICATIONS
Super high frequency	SHF	3–30 GHz 100 mm – 10 mm	Radio astronomy, Radars, Communications satellites, 5G Mobile
Extremely high frequency	EHF	30–300 GHz 10 mm – 1 mm	Radio astronomy, high-frequency microwave radio relay, remote sensing, 5G Mobile
Terahertz or Tremendously high frequency	THz or THF	300–3,000 GHz 1 mm – 100 µm	Terahertz imaging – a potential replacement for X-rays in some medical applications

REVIEW – CLASSIFICATION OF SIGNALS



COMMUNICATION CHANNELS



COURSE WEBSITE

WWW.EEEN462.ELIMU.COM