

Digital

Communications II

Third Year, 2^{ed} Semester

Lecture No.1

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Content of Lectures

1. **Introduction and Review of Digital Communications System.**
2. **Evolution of Digital Communications System.**
 - Wireless digital Communications.
 - GSM
3. **Fading Channel.**
4. **Multipath Wireless Communications Channels.**
5. **Channels Models.**
 - SISO
 - MISO
 - SIMO
 - MIMO
6. **Multiple Access Techniques.**
7. **Capacity of Wireless Channels.**

Introduction and Review of Digital Communications System

Wireless communications are growing rapidly with the ability to provide a high-speed exchange of information between mobile devices around the world. It has been the topic of study since the 1960s. In the last 10 years, the world has experienced a technology revolution with access to mobile connections and connected devices. There is an ever-increasing demand in the mobile networks for higher capacity, increased coverage, and everything is expected to a reduced cost. The applications offered by this technology include multimedia mobile phones supporting the Internet, homes and smart devices and teleconferencing, distance learning.

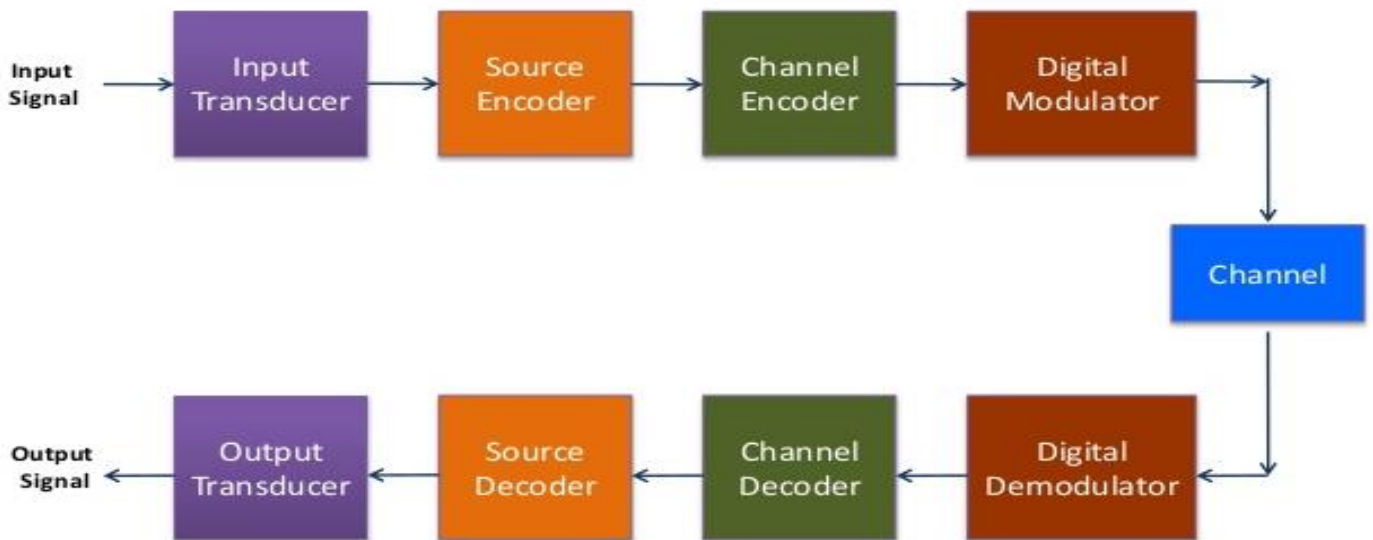
However, there are two important technical challenges in supporting these applications:

First is the fade phenomenon: the temporal variation of the channel due to the small effect of multipath latitude, as well as the widespread effect such as loss of pass distance, attenuation, and shading due to obstacles.

Second, because the transmitter and the radio receiver need to communicate through the air, there is a great overlap between them.

In general, the challenges are mostly due to the limited availability of the free radio spectrum and a complex, time-varying wireless environment (**fading and multiple paths**).

- **Digital communication** is a mode of communication where the information or the thought is encoded digitally as discrete signals and electronically transferred to the recipients.
- **Digital communication** is one of the most commonly used modes of communication nowadays.



Block diagram of the Digital communications system

1. The Source and Output Signal



The **source** can be an analog signal. Example: A **Sound** signal Input Transducer This is a transducer that takes a physical input and converts it to an electrical signal (Example: **microphone**).

This is the **output** that is produced after the whole process. Example – The sound signal received.

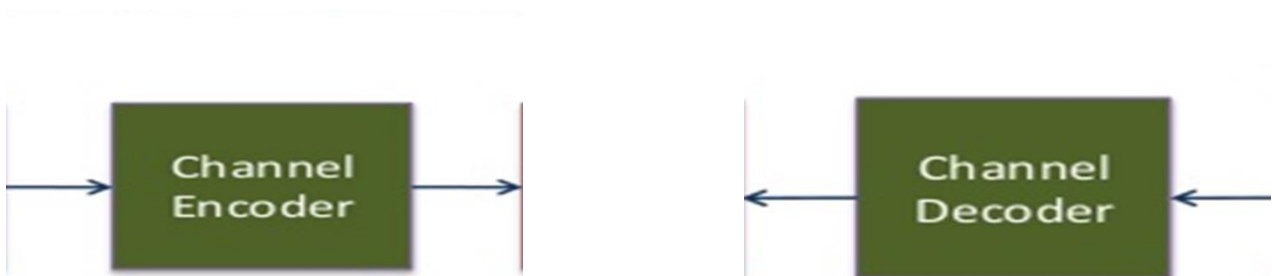
2. Source Encoder and Decoder



The **source encoder** compresses the data into the minimum number of bits. This process helps in the effective utilization of the bandwidth. It removes the redundant.

The resultant signal is once again digitized by sampling and quantizing so that the pure digital output is obtained without the loss of information. The source decoder recreates the source output.

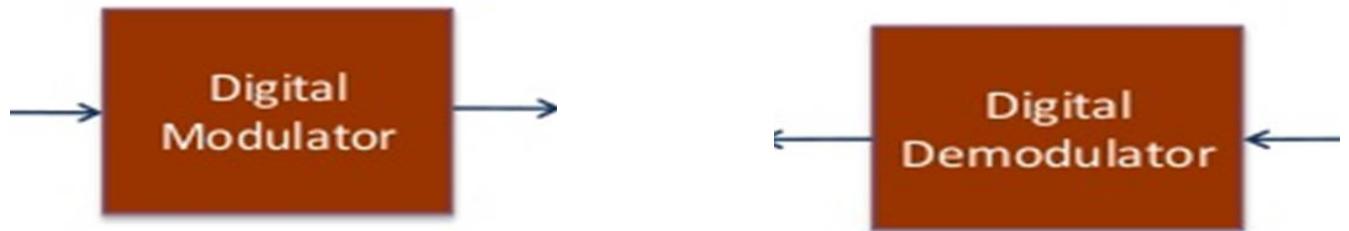
3. Channel Encoder and Decoder



The **channel encoder** does the coding for error correction. During the transmission of the signal, due to the noise in the channel, the signal may get altered, and hence to avoid this, the channel encoder adds some redundant bits to the transmitted data. These are the error-correcting bits.

The **channel decoder**, after detecting the sequence, does some error corrections. The distortions which might occur during the transmission, are corrected by adding some redundant bits. This addition of bits helps in the complete recovery of the original signal.

4. Digital Modulator and Demodulator



The signal to be transmitted is modulated here by a carrier. The signal is also converted to analog from the digital sequence, to make it travel through the channel or medium.

This is the first step at the receiver end. The received signal is demodulated as well as converted again from analog to digital. The signal gets reconstructed here.

- **Amplitude shift keying [ASK]**
- **Frequency shift keying [FSK]**
- **Phase shift keying [PSK]**

5. The Channel



The communication channel is the physical medium that is used for transmitting signals from transmitter to receiver.

The modulation and coding used in a digital communication system depend on the characteristics of the channel. The two main characteristics of the channel are **BANDWIDTH** and **POWER**. In addition, the other characteristics are whether the channel is linear or nonlinear, and how free the channel is free from external interference.

- Five channels are considered in digital communication, namely:
 - Telephone channels
 - Coaxial cables
 - Optical fibers
 - Microwave radio, and satellite channels.