



ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS INSTITUTION

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DEPARTMENT OF BIOMEDICAL ENGINEERING

VII Semester

OBT357 BIOTECHNOLOGY IN HEALTH CARE

UNIT- 5 BASICS OF IMAGING MODALITIES

5.7. Different types of Biotelemetry Systems

- ❖ Biotelemetry systems are categorized by the type of physiological signal measured, the transmission method, and the number of channels.
- ❖ Common types include radio telemetry for wireless transmission and wired telemetry for connected systems. Systems can be single-channel for one physiological parameter or multichannel to monitor several simultaneously.
- ❖ Signals themselves are often grouped as bioelectrical (like ECG, EEG) or physio-electrical (like blood pressure, temperature, which require transducers).

What is Biotelemetry?

- ❖ Biotelemetry refers to the remote monitoring and transmission of biological data, such as physiological signals (e.g., heart rate, ECG, respiration), from a subject to a receiver over a distance. It is widely used in medical, veterinary, and wildlife applications to enable real-time or near-real-time analysis without physical constraints.

Classifications of Biotelemetry Systems:

Biotelemetry systems can be classified in several ways, including based on the transmission method, number of channels, Physiological parameters monitored, application domain, Communication link, modulation techniques and Power supply. Below is a summary of the main types.

1. Based on Transmission Mode

- ❖ **Wired Biotelemetry Systems** – Signals are transmitted via physical cables (less common in mobile patients).
- ❖ **Wireless Biotelemetry Systems** – Data transmitted via RF, Bluetooth, Wi-Fi, or satellite.

2. Based on Number of Channels:

- ❖ **Single Channel Telemetry System** - Transmits one biosignal at a time using a simple radio transmitter connected to electrodes. Signal is amplified, modulated (e.g., FM), and broadcast in the RF range (kHz to MHz)
- ❖ **Multi-Channel Telemetry Systems** - Handles multiple bio signals simultaneously via multiplexing techniques like Frequency Division Multiplexing (FDM) or Time Division Multiplexing (TDM).

3. Based on Physiological Parameters Monitored:

- ❖ **Cardiac Telemetry Systems** – For ECG, heart rate, arrhythmia detection.
- ❖ **Respiratory Telemetry Systems** – For respiration rate, airflow, oxygen saturation.
- ❖ **Neurological Telemetry Systems** – For EEG, EMG, neural activity monitoring.
- ❖ **Temperature Telemetry Systems** – For core or skin temperature.
- ❖ **Multi-parameter Telemetry Systems** – For combined ECG, BP, SpO₂, temperature, etc.

4. Based on Application Area:

- ❖ **Clinical / Hospital Biotelemetry** – Continuous patient monitoring in ICUs, post-operative wards.
- ❖ **Ambulatory / Home Biotelemetry** – Portable devices for remote patient monitoring.
- ❖ **Sports & Fitness Telemetry** – Wearables for heart rate, activity, fatigue.
- ❖ **Veterinary / Animal Biotelemetry** – Used in animal research or wildlife tracking.
- ❖ **Space & Aviation Telemetry** – Monitoring astronauts' or pilots' vital signs.

5. Based on Communication Link

- ❖ **Radiofrequency (RF) Telemetry** – Short to medium range (hospital wards, wearable devices).
- ❖ **Infrared Telemetry** – Short-range, line-of-sight communication.
- ❖ **Telephone/Internet Telemetry** – Data transmitted via phone lines, cellular, or internet.
- ❖ **Satellite Telemetry** – Long-distance applications (remote regions, space medicine).

6. Based on Modulation Technique:

- ❖ **DC Telemetry** - Direct voltage or current transmission without modulation
- ❖ **AC Telemetry** - Amplitude Modulation (AM) or Frequency Modulation (FM)
- ❖ **Pulse Telemetry** - Pulse Amplitude (PAM), Width (PWM), Phase (PPM), Frequency (PFM), or Code (PCM) Modulation.

7. Based on Power Supply:

- ❖ **Battery-powered Telemetry Systems** – Portable, patient-worn.
- ❖ **Inductively powered Telemetry Systems** – Power transferred wirelessly (implants).
- ❖ **Energy-harvesting Telemetry Systems** – Use body heat or movement as energy source.

I. Single channel ECG telemetry system:

The figure below shows the block diagram of a single channel telemetry system suitable for the transmission of an electrocardiogram:

System Components:

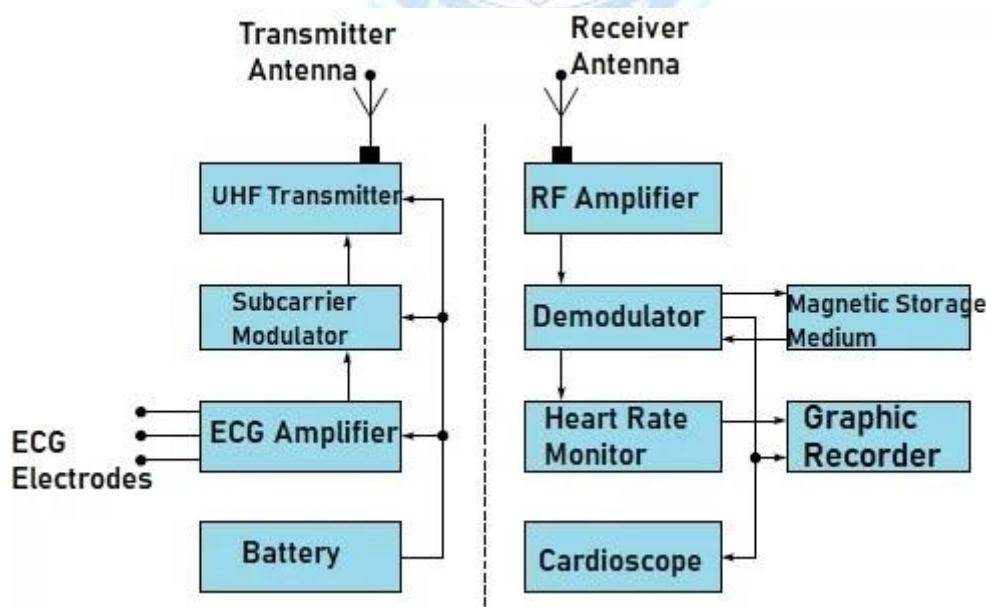
Transmitter Section (Patient side)

1. **ECG Electrodes** – Detect electrical activity of the heart.
2. **ECG Amplifier** – Amplifies the tiny ECG signals (microvolt range) to a usable level.

3. **Subcarrier Modulator** – Converts the ECG signal into a modulated form suitable for transmission.
4. **UHF Transmitter + Transmitter Antenna** – Sends the modulated ECG signal wirelessly at Ultra High Frequency (UHF).
5. **Battery** – Provides power to the transmitter and amplifier.

Receiver Section (Monitoring side)

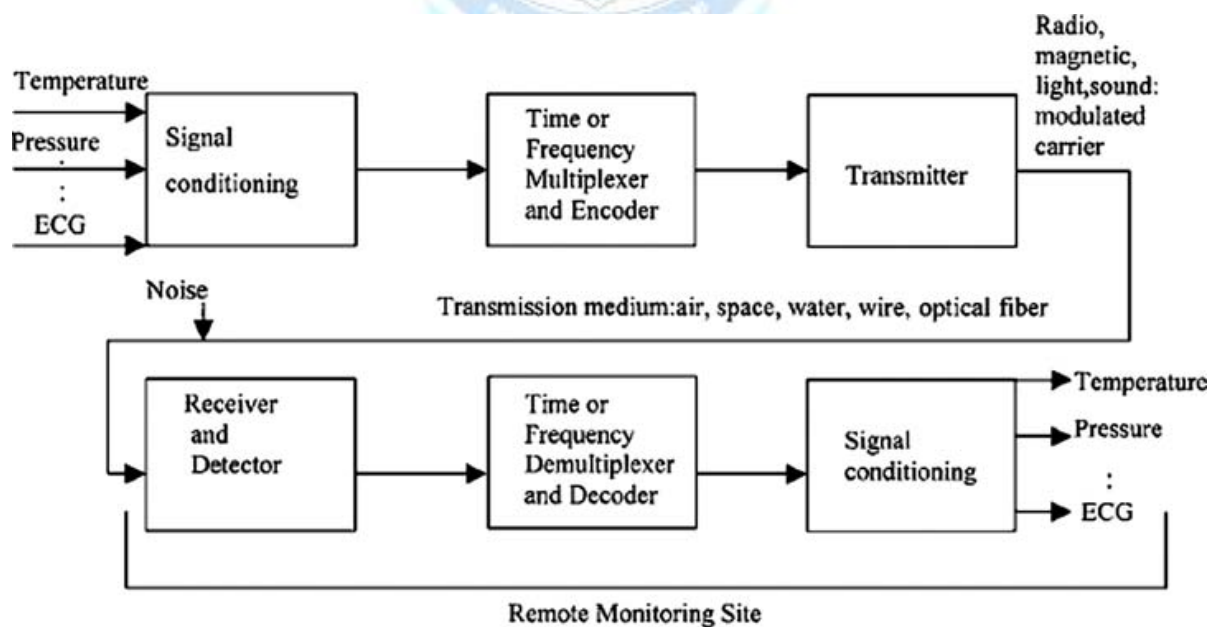
1. **Receiver Antenna** – Captures the transmitted UHF signal.
2. **RF Amplifier** – Strengthens the received weak RF signal.
3. **Demodulator** – Extracts the original ECG signal from the modulated carrier wave.
4. **Heart Rate Monitor** – Calculates and displays heart rate from ECG.
5. **Cardioscope** – Real-time display of ECG waveform on a monitor.
6. **Graphic Recorder** – Provides a hard copy (paper recording) of ECG.
7. **Magnetic Storage Medium** – Stores ECG data for future analysis.



Single Channel- ECG Telemetry System

Working:

- ❖ The working of a biotelemetry system is based on the wireless transmission of physiological signals from a patient to a distant monitoring station.
- ❖ In an ECG telemetry system, **electrodes** placed on the patient's body pick up the heart's electrical activity, which is then **amplified** using an ECG amplifier.
- ❖ The amplified signal is **modulated** by a subcarrier modulator and **transmitted** via a UHF transmitter and antenna, powered by a **battery**. At the receiving end, the **antenna** captures the transmitted signal, which is **amplified** by an RF amplifier and **demodulated** to retrieve the original ECG waveform.
- ❖ The **recovered signal** is then **displayed** on a cardioscope for real-time monitoring, used by a heart rate monitor for **beat calculation**, recorded on a **graphic recorder**, and stored in magnetic storage media for future analysis.
- ❖ This allows **continuous**, wireless monitoring of vital signs without restricting patient movement.

II. Multi Parameter Biotelemetry System:

Components:

The main components of a Biotelemetry System are,

1. Patient Side (Transmitting Unit)

1. **Sensors/Transducers** – Measure physiological parameters (ECG electrodes, temperature probe, pressure sensor, etc.).
2. **Signal Conditioning Unit** – Amplifies, filters, and converts raw signals into a usable form.
3. **Multiplexer & Encoder** – Combines multiple signals (time-division or frequency-division) into a single channel for transmission.
4. **Transmitter** – Modulates the signal onto a suitable carrier (radio, light, magnetic, sound) for transmission.
5. **Transmission Medium** – Channel through which signals travel (air, space, water, wire, or optical fiber).

2. Remote Monitoring Side (Receiving Unit)

1. **Receiver & Detector** – Captures the transmitted signal, amplifies it, and extracts the modulated information.
2. **Demultiplexer & Decoder** – Separates individual signals (e.g., ECG, temperature, pressure) from the combined signal.
3. **Signal Conditioning Unit** – Restores signals to their original form (amplification, filtering, scaling).
4. **Output Devices / Display** – Final stage where signals are displayed, recorded, or analyzed (monitors, recorders, storage).

Working:

- ❖ In a biotelemetry system, physiological signals such as ECG, temperature, and pressure are first picked up by sensors and passed to a **signal conditioning unit**, where they are amplified, filtered, and converted into a suitable form.
- ❖ These conditioned signals are then combined using a **time or frequency multiplexer and encoder**, which allows multiple signals to be transmitted together without interference.

- ❖ The processed signals are fed into a **transmitter**, which modulates them onto a carrier wave (radio, magnetic, light, or sound) and sends them through a suitable **transmission medium** such as air, space, water, wire, or optical fiber.
- ❖ At the remote monitoring site, the signal is received and detected by a **receiver and detector**, where noise is minimized.
- ❖ The signals are then separated by a **time or frequency demultiplexer and decoder** back into individual physiological parameters.
- ❖ Finally, the recovered signals undergo **signal conditioning** again to restore them to their original form, enabling doctors or monitoring systems to analyze parameters like ECG, temperature, and pressure in real time.

❖ **Advantages of Biotelemetry Systems**

- ✓ Remote monitoring
- ✓ Continuous observation
- ✓ Multi-parameter monitoring
- ✓ Early diagnosis
- ✓ Patient comfort and mobility
- ✓ Data storage and analysis
- ✓ Wide applications

❖ **Disadvantages of Biotelemetry Systems**

- ✓ High cost
- ✓ Signal interference
- ✓ Limited range
- ✓ Power requirement (battery dependency)
- ✓ System complexity
- ✓ Security/privacy issues
- ✓ Environmental limitations
