Department of Biomedical Engineering

VI Semester

CBM 370 - Wearable Devices

Unit- 3 WIRELESS HEALTH SYSTEMS

3.2 Definition of Body Area Networks

A **body area network** (**BAN**), also referred to as a **wireless body area network** (**WBAN**), a **body sensor network** (**BSN**) or a **medical body area network** (**MBAN**), is a wireless network of wearable computing devices. BAN devices may be embedded inside the body as implants or pills, may be surface-mounted on the body in a fixed position, or may be accompanied devices which humans can carry in different positions, such as in clothes pockets, by hand, or in various bags. Devices are becoming smaller, especially in body area networks. These networks include multiple small body sensor units (BSUs) and a single central unit (BCU).

Despite this trend, decimeter (tab and pad) sized smart devices still play an important role. They act as data hubs or gateways and provide a user interface for viewing and managing BAN applications on the spot. The development of WBAN technology started around 1995 around the idea of using wireless personal area network (WPAN) technologies to implement communications on, near, and around the human body. About six years later, the term "BAN" came to refer to systems where communication is entirely within, on, and in the immediate proximity of a human body. A WBAN system can use WPAN wireless technologies as gateways to reach longer ranges. Through gateway devices, it is possible to connect the wearable devices on the human body to the internet. This way, medical professionals can access patient data online using the internet independent of the patient location.

- A **Body Area Network (BAN)**, also known as a **Wireless Body Area Network (WBAN)**, is a system of wearable or implanted sensors and devices that communicate wirelessly to monitor and transmit physiological data. These networks are commonly used in healthcare, fitness, and medical applications to track vital signs such as heart rate, blood pressure, temperature, and movement.
- It may also be referred to as a wireless body area network (WBAN), a body sensor network (BSN), or a medical body area network (MBAN). BANs are primarily used for medical monitoring and healthcare delivery, facilitating wireless communication between sensors and computing devices attached to the human body.
- BANs involve wearable computing devices that are either implanted or surface-mounted on the body. The sensors and actuators in a WBAN connect through a wireless communication channel, typically arranged in a star or multihop topology, expanding over the entire human body.
- BANs consist of two types of computing units:
  (1) sensor nodes, which have a low processing capability; and
  (2) the base station, which is a high-end computing device such as a cell-phone or a PDA.

  In a BAN the computing units communicate with each other through a wireless channel, since wires running between sensors in a BAN would make it obtrusive. The sensor communication is assumed to be reliable, and each sensor is time synchronized, using several schemes that are based on packet-arrival time.

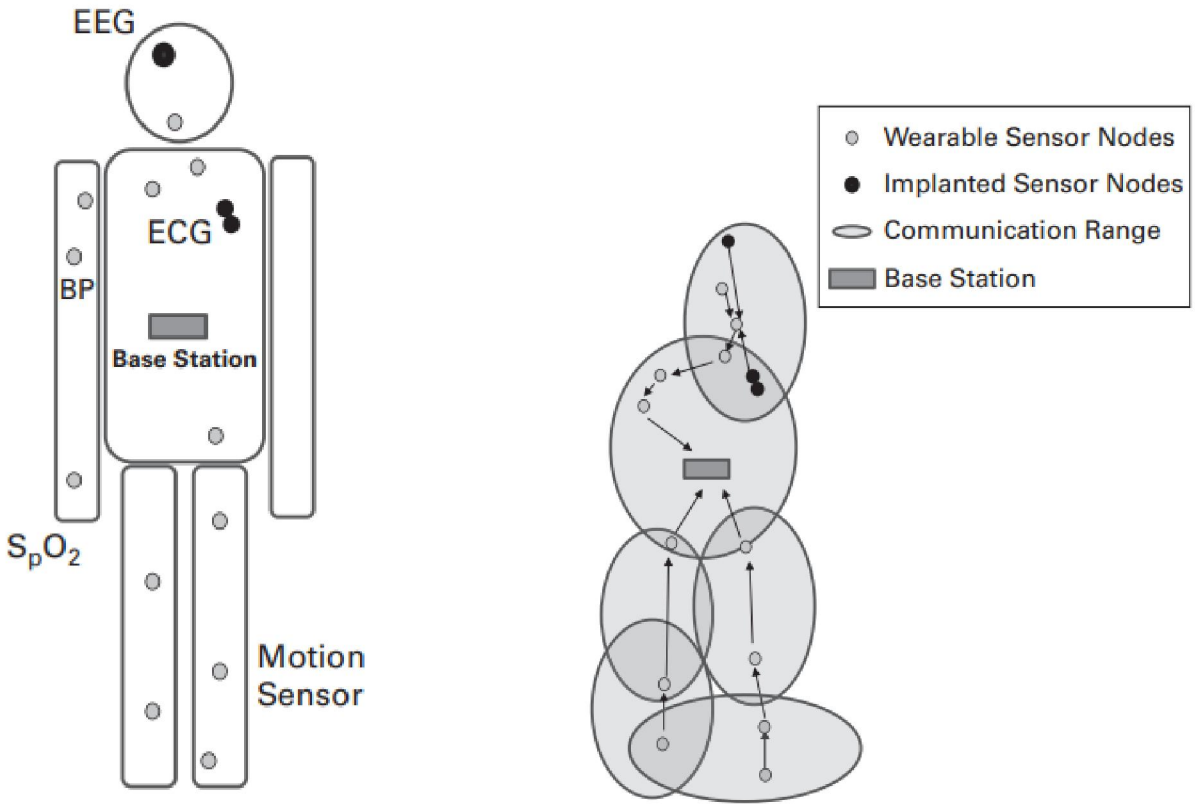

Figure3.1 A body area network.

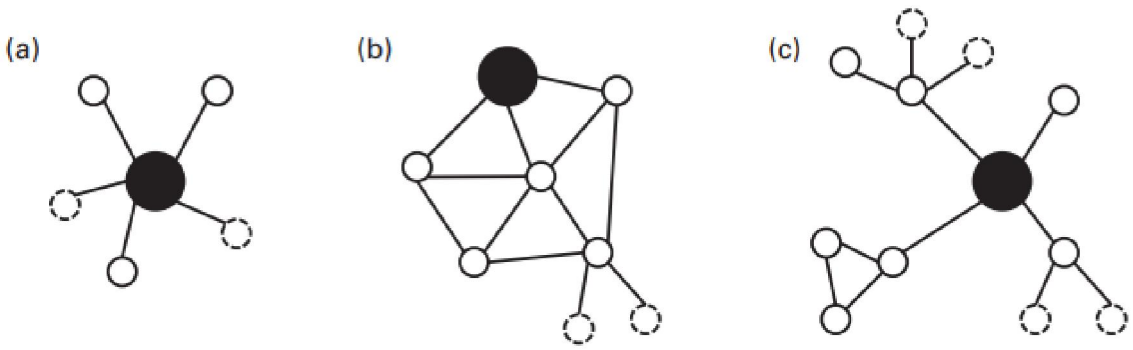

Fig. 3.2 BAN network topologies recommended by IEEE TG6: (a) star topology, (b) mesh topology, and (c) hybrid topology.

❒ Three network topologies have been recommended by IEEE TG6, as shown in Figure 2.2. Figure 3.2(a) shows the star topology, where each node has a one-hop wireless link to the base station.

- Multi-hop routing from the nodes to the base station is also recommended in the mesh topology shown in Figure 3.2(b).
- A combination of single-hop access to the base station for powerful nodes and multi-hop access for weaker nodes is employed, with the base station at the root collecting the data from all the sensor nodes, in the hybrid topology shown in Figure 3.2(c)
- Each BAN has a controlling entity called the base station, which collects and processes data for the BAN. All the sensors in the BAN communicate the data they collect to the base station at regular intervals. BANs can vary in size from a network of a few nodes to a large network with a few hundred.

- **Key Features of a Body Area Network:**

1. **Wireless Connectivity** – Uses technologies like Bluetooth, Zigbee, or Wi-Fi to connect sensors and devices.
2. **Health Monitoring** – Helps in real-time monitoring of patients, athletes, or individuals.
3. **Wearable & Implantable Sensors** – Can be in the form of smartwatches, fitness bands, ECG monitors, or even embedded medical devices.
4. **Low Power Consumption** – Designed to operate with minimal energy consumption for prolonged use.
5. **Data Transmission & Processing** – Sends collected data to smartphones, cloud systems, or medical professionals for further analysis.