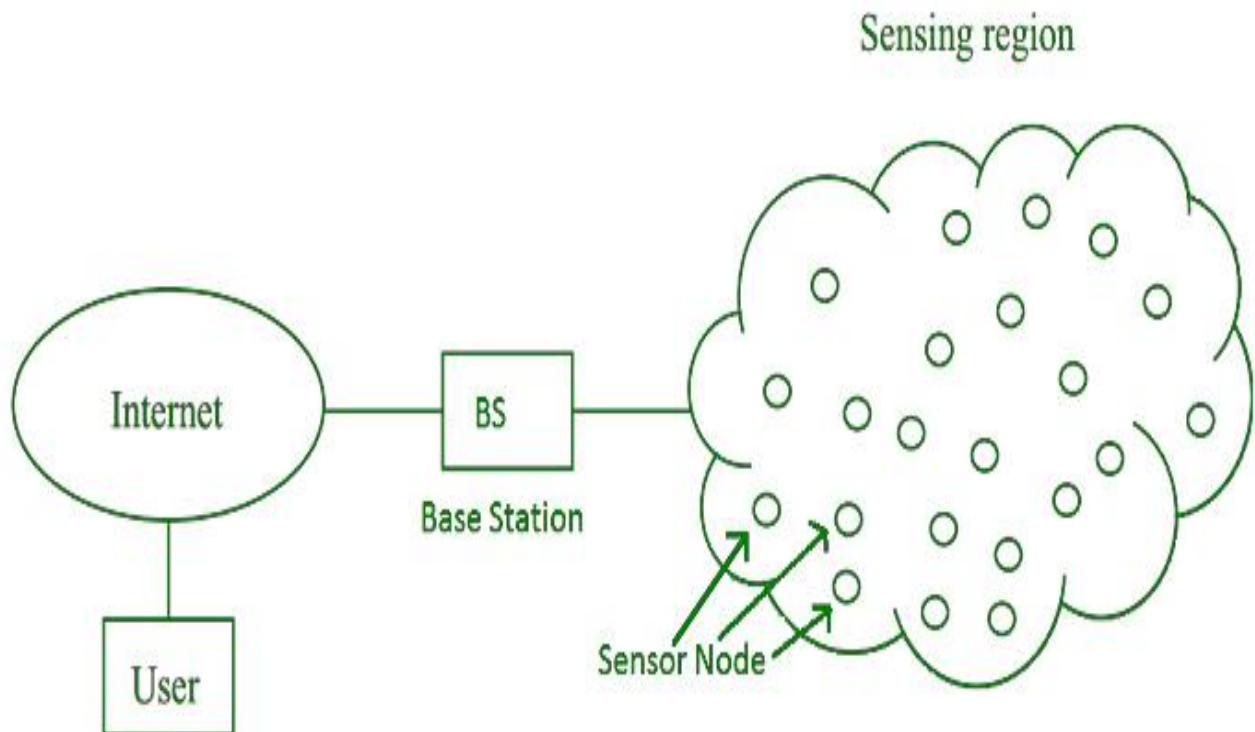


WIRELESS SENSOR NETWORK (WSN)

What is WSN?

- Wireless Sensor Network (WSN) is a network of sensors deployed wirelessly to monitor physical or environmental conditions, such as temperature, humidity, or pressure.
- Sensor Nodes are responsible for monitoring and collecting data. They connect to a Base Station that processes and shares the data over the internet.



WSN Architecture

- **Physical Layer:** Connects sensor nodes to the base station using technologies like radio waves, infrared, or Bluetooth.
- **Data Link Layer:** Ensures reliable communication between nodes and the base station.
- **Application Layer:** Facilitates data communication and defines the format for transmitting data (e.g., ZigBee).

WSN Network Topologies

- **Bus Topology:** Nodes connected along a single line; simple but limited.
- **Star Topology:** A central node connects to multiple other nodes; efficient for centralized control.
- **Tree Topology:** Nodes are arranged hierarchically, like a tree, for larger coverage.
- **Mesh Topology:** Nodes interconnect with each other to provide robust coverage and redundancy.

Types of WSN

1. **Terrestrial WSN:** For efficient communication on the surface; uses solar power for energy efficiency.
2. **Underground WSN:** Monitors underground conditions; faces high costs and limited battery life.
3. **Underwater WSN:** Deployed underwater; faces challenges like slow data transmission and limited power.
4. **Multimedia WSN:** Monitors multimedia events (audio, video); requires high power and bandwidth.
5. **Mobile WSN:** Composed of mobile nodes that can move and adapt to the environment.

Applications of WSN

- **IoT:** Interconnects devices and sensors for smart applications.
- **Security & Surveillance:** Monitors for threats and activities.

- **Environmental Monitoring:** Tracks temperature, humidity, air pressure, etc.
- **Medical:** Monitors patient health.
- **Agriculture:** Tracks soil conditions, crops, etc.
- **Landslide Detection:** Identifies environmental threats.

Challenges in WSN

- **Energy Efficiency:** Limited battery life in sensor nodes.
- **Security:** Vulnerable to attacks like eavesdropping or tampering.
- **Network Throughput & Performance:** Handling large amounts of data efficiently.
- **Scalability:** Managing a large number of nodes.
- **Node Failure:** Ensuring reliability when nodes fail.

WSN Components

1. **Sensors:** Capture environmental data.

2. **Radio Nodes:** Transmit data from sensors to the base station.
3. **WLAN Access Point:** Receives data wirelessly via the internet.
4. **Evaluation Software:** Processes data for analysis and reporting.

Advantages

- **Low Cost:** Affordable and easy to deploy.
- **Wireless Communication:** Flexible and eliminates wiring costs.
- **Energy Efficiency:** Operates for long periods without frequent battery changes.
- **Scalability:** Can add or remove sensors based on needs.
- **Real-Time Monitoring:** Provides immediate data for decision-making.

Disadvantages

- **Limited Range:** Restricted communication range.
- **Limited Processing Power:** Sensor nodes may struggle with complex tasks.
- **Security Risks:** Vulnerable to cyberattacks.
- **Interference:** Susceptible to interference from other wireless signals.
- **Deployment Challenges:** Requires careful sensor placement and network setup.

