



# **SNS COLLEGE OF ENGINEERING**

Kurumbapalayam (Po), Coimbatore - 641 107

**An Autonomous Institution**

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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**COURSE CODE & NAME : 19CS621 WIRELESS SENSOR NETWORK**

**III YEAR / VI SEMESTER**

**UNIT I - Overview of WSN**

**TOPIC - Introduction, Sensor network applications**

**19CS621 WIRELESS SENSOR NETWORK / Ms.DRISHYA P/CSE/SNSCE**



# SYLLABUS



<b>UNIT I</b>	<b>Overview of WSN</b>	<b>9</b>
<p>Overview of WSN: Introduction, Sensor network applications – Habitat Monitoring –Tracking chemical plumes -</p> <p>Smart transportation. Constraints and Challenges, Emerging technologies for wireless sensor networks – Advantages of sensor networks.</p>		



# Wireless Sensor Networks - Introduction



- Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location.

## Wireless Sensor Network Architecture

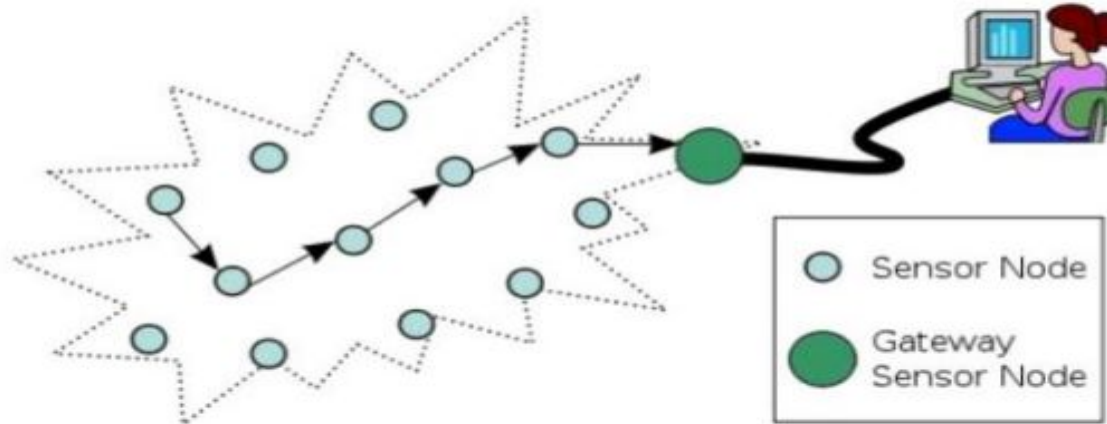


Figure 1: WSN Architecture



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- A Wireless Sensor Network is a self-configuring network of small sensor nodes communicating among themselves using radio signals, and deployed in quantity to sense, monitor and understand the physical world.
- Wireless Sensor nodes are called motes Provide a bridge between the real physical and virtual worlds .
- Have a wide range of potential applications to industry, science, transportation, civil infrastructure, and security



# Applications of Wireless Sensor Networks



- Habitat and Ecosystem Monitoring
- Seismic Monitoring
- Civil Structural Health Monitoring
- Monitoring Groundwater Contamination
- Rapid Emergency Response



# Applications of Wireless Sensor Networks



- Industrial Process Monitoring
- Perimeter Security and Surveillance
- Automated Building Climate Control
- Habitat Monitoring on Great Duck Island



# Habitat Monitoring



## *Preserving Ecosystems with Technology*

- **Definition:** Continuous monitoring of natural habitats using sensors, drones, and satellites.
- **Applications:**
  - Tracking wildlife migration patterns.
  - Monitoring vegetation health and deforestation.
  - Assessing the impact of climate change.
- **Technologies:**
  1. IoT-enabled environmental sensors.
  2. Remote sensing (satellites and drones).
  3. AI for predictive analytics





# Tracking Chemical Plumes



## *Ensuring Environmental Safety*

- **Definition:** Detecting and monitoring the dispersion of chemical substances in air, water, or soil.
- **Applications:**
  - Detecting air pollution and greenhouse gases.
  - Managing industrial accidents (e.g., chemical spills).
  - Protecting public health in urban areas.
- **Technologies:**
  - Chemical sensors and IoT.
  - Computational fluid dynamics (CFD) for modeling.
  - Autonomous vehicles/drones for real-time data collection.



# Smart Transportation



## *Transforming Urban Mobility:*

- **Definition:** Intelligent and sustainable transport systems powered by technology.
- **Applications:**
  - Reducing traffic congestion using AI and data analytics.
  - Autonomous and connected vehicles.
  - Real-time tracking of public transportation.
- **Technologies:**
  - GPS and IoT sensors for traffic management.
  - AI for route optimization.
  - Electric and hybrid vehicles.
- **Visual:** City roads with connected cars, buses, and smart traffic signals.



# Constraints-WSN



## 1. Limited Energy Resources:

- Sensors are often battery-operated with limited power.
- Frequent replacements in remote or hazardous areas are difficult.
- Example: Habitat monitoring in forests.

## 2. Bandwidth Limitations:

- Communication is constrained by limited bandwidth.
- Data transmission can be delayed, especially with high sensor density.

## 3. Memory and Processing Power:

- Sensors typically have small memory and low computational capabilities.
- Complex algorithms for real-time analysis are challenging.

## 4. Physical Size:

- Sensors need to be small and lightweight, limiting hardware capabilities.



# Challenges



## 1. Scalability:

- Adding more nodes increases network complexity.
- Managing data from thousands of sensors is computationally intensive.

## 2. Network Reliability:

- Node failures due to energy depletion, environmental factors, or physical damage disrupt the network.
- Interference in communication channels can lead to data loss.

## 3. Security Concerns:

- Vulnerable to hacking, eavesdropping, and data tampering.
- Critical in applications like chemical plume tracking near industrial zones.



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#### **4.Environmental Conditions:**

- Sensors in harsh conditions (e.g., extreme temperatures, underwater) face durability issues.
- Example: Smart transportation sensors exposed to rain or snow.

#### **5.Cost of Deployment and Maintenance:**

- Initial setup of a large-scale WSN can be expensive.
- Regular maintenance, especially in inaccessible locations, adds to costs.

#### **6.Data Accuracy and Calibration:**

- Sensor readings can drift over time, requiring re-calibration.
- Noise in data from environmental interference affects decision-making.



# Emerging technologies for wireless sensor networks



1. Internet of Things (IoT) Integration
2. Artificial Intelligence and Machine Learning (AI/ML)
3. 5G and Beyond
4. Edge and Fog Computing
5. Blockchain Technology
6. Energy Harvesting Technologies
7. Low-Power Wide-Area Networks (LPWANs)
8. Advanced Sensing and Materials
9. Software-Defined Networking (SDN)
10. Cybersecurity Enhancements



# Advantages of sensor networks.

- 1. Real-time Monitoring:** Sensor networks provide continuous, real-time data collection and monitoring, enabling timely detection of changes or anomalies in the environment.
- 2. Automation:** They enable automated systems to respond to specific conditions, reducing the need for human intervention. For instance, sensors can automatically control lighting, temperature, or security systems.
- 3. Cost-effective:** By enabling remote monitoring and reducing the need for manual checks, sensor networks save both time and labor costs.
- 4. Scalability:** Sensor networks can be easily scaled to cover larger areas or accommodate additional devices as the need grows.
- 5. Improved Decision-making**  
The data collected by sensor networks can be analyzed to make more informed decisions, improving efficiency in various fields like agriculture, healthcare, and industry.



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## **6. Energy Efficiency**

Many sensor networks are designed to operate with minimal power consumption, making them suitable for long-term applications.

## **7. Flexibility and Adaptability**

Sensor networks can adapt to different applications, such as environmental monitoring, smart cities, healthcare systems, and disaster management.

## **8. Enhanced Security**

In security systems, sensor networks enable intrusion detection, surveillance, and early warnings, increasing safety in sensitive areas.

## **9. Environmental Protection**

They help in monitoring air quality, water pollution, or deforestation, contributing to sustainable practices and environmental conservation.





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