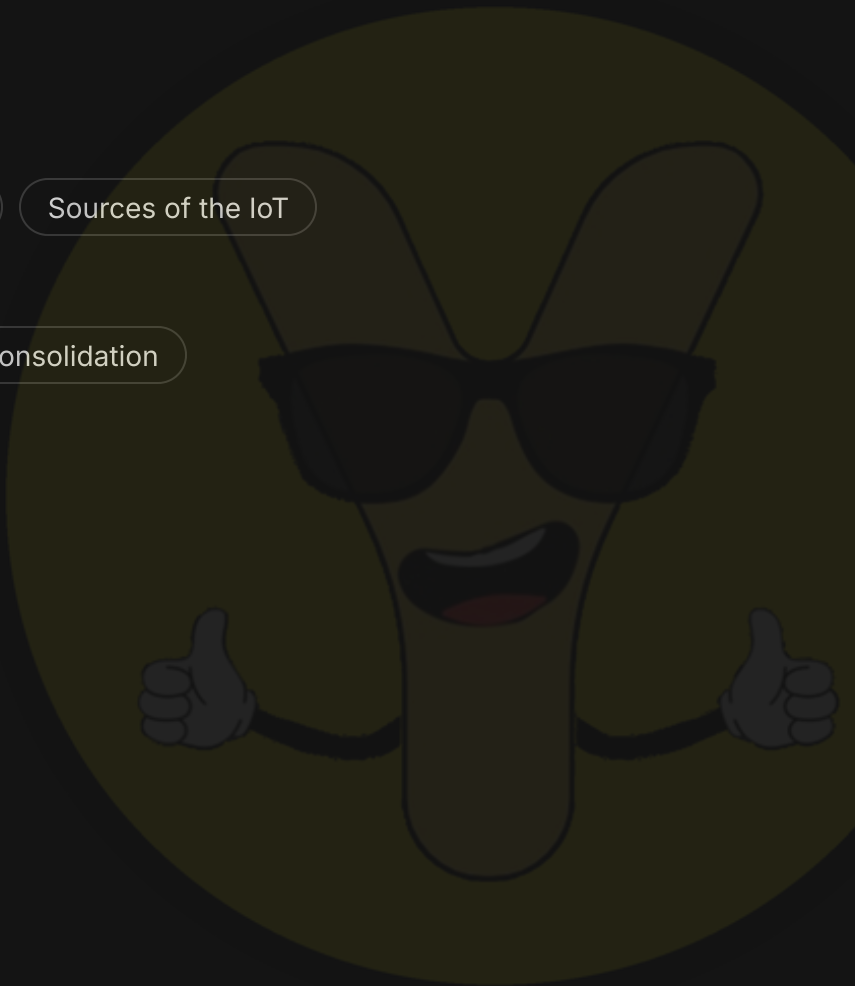
AKTU · 4TH YEAR · SEMESTER 7 · BCS070

Internet of Things

Unit 1 — Introduction to IoT

- Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view
- Technology behind IoT
- Sources of the IoT
- M2M Communication
- IoT Examples
- Design Principles for Connected Devices
- IoT/M2M systems layers and design standardization
- Communication technologies
- Data enrichment and consolidation
- Ease of designing and affordability



DECODED BY

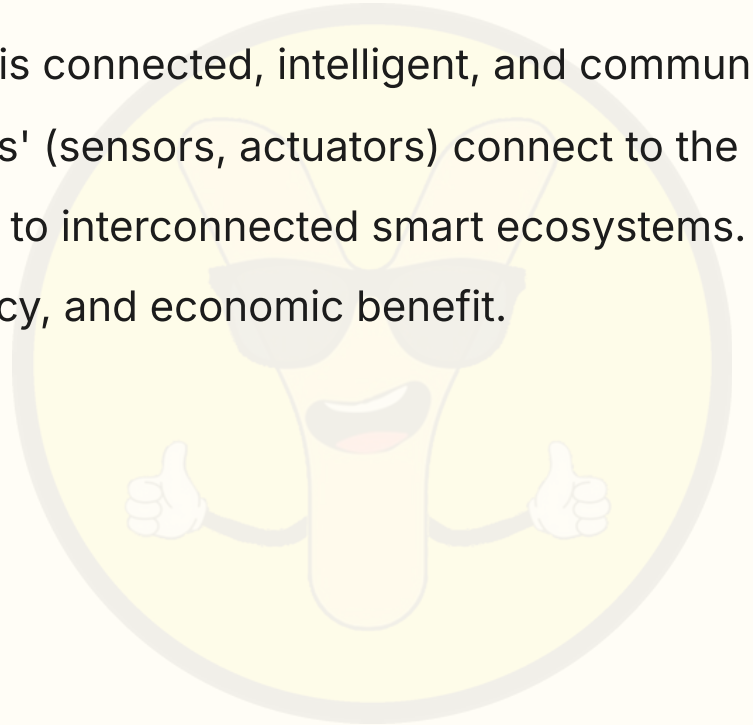
Chirag Jain

Founder, Ycotes · Gold Medalist in Artificial Intelligence, IIT Madras · taught 10,000+ students

Introduction to Internet of Things (IoT)

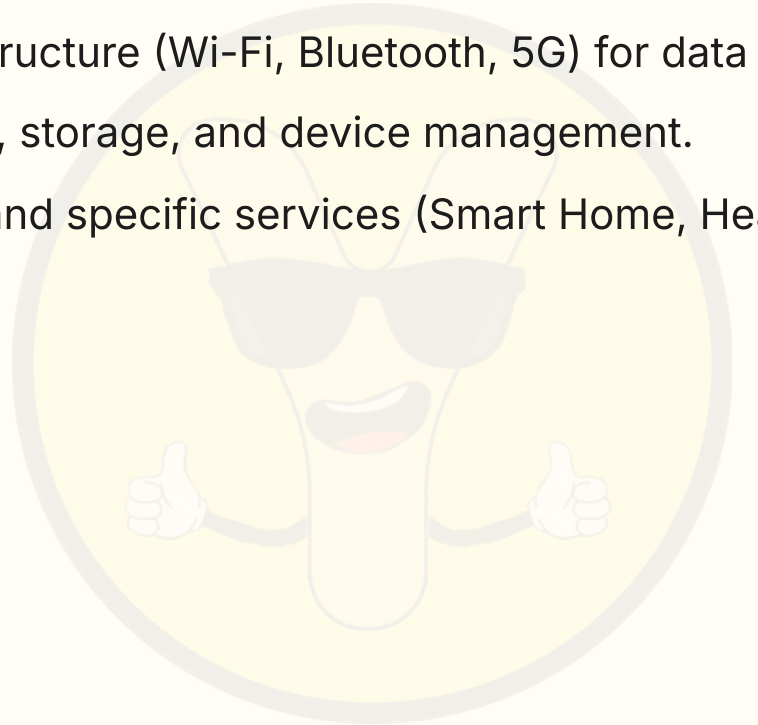
IoT is the network of physical objects embedded with sensors and software for connectivity.

- Vision: A world where every object is connected, intelligent, and communicates autonomously.
- Definition: A paradigm where 'things' (sensors, actuators) connect to the Internet to exchange data.
- Evolution: From standalone devices to interconnected smart ecosystems.
- Goal: To improve efficiency, accuracy, and economic benefit.

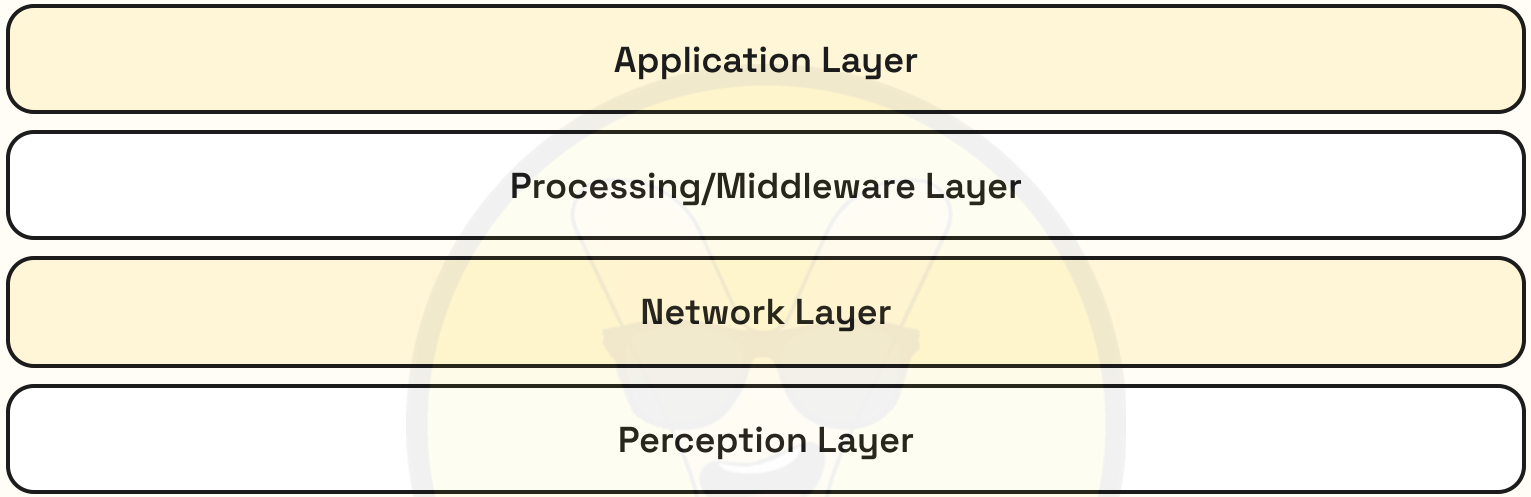


Conceptual Framework of IoT

- Perception Layer: Physical devices and sensors collecting environmental data.
- Network Layer: Connectivity infrastructure (Wi-Fi, Bluetooth, 5G) for data transmission.
- Middleware Layer: Data processing, storage, and device management.
- Application Layer: User interfaces and specific services (Smart Home, Healthcare).



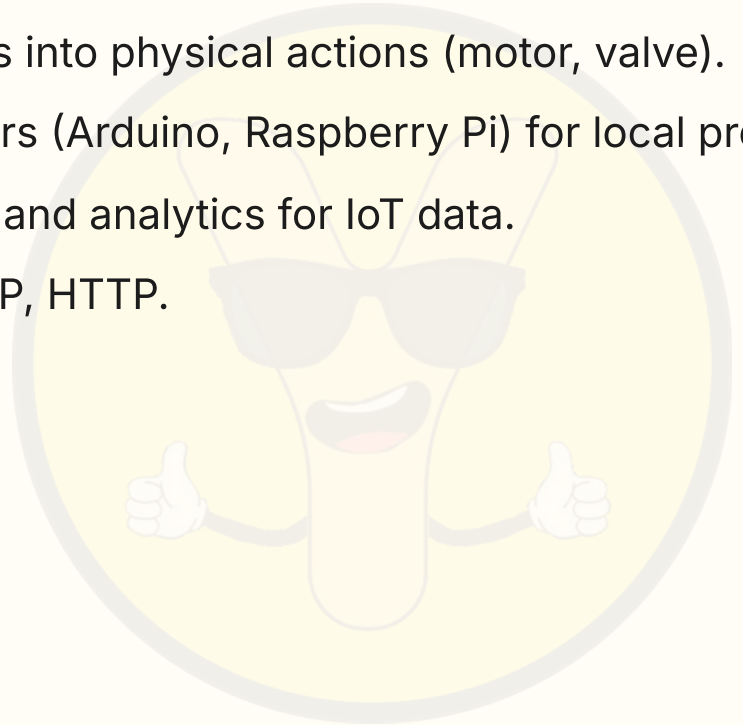
Architectural View of IoT



The four-layer architecture representing the flow from physical sensing to user application.

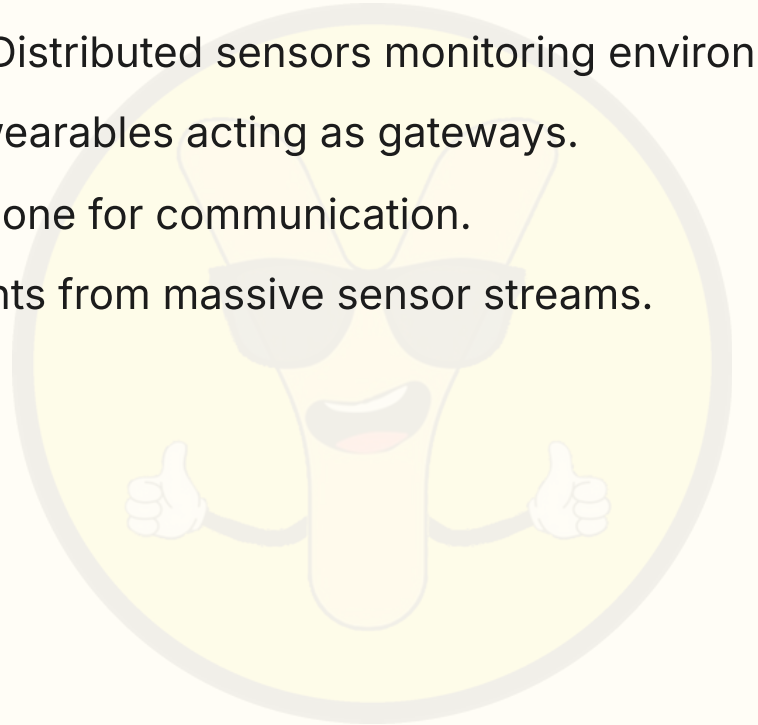
Technology Behind IoT

- Sensors: Convert physical parameters (temperature, pressure) into electrical signals.
- Actuators: Convert electrical signals into physical actions (motor, valve).
- Embedded Systems: Microcontrollers (Arduino, Raspberry Pi) for local processing.
- Cloud Computing: Massive storage and analytics for IoT data.
- Connectivity Protocols: MQTT, CoAP, HTTP.



Sources of the IoT

- RFID (Radio Frequency Identification): Used for tracking and identification.
- Wireless Sensor Networks (WSN): Distributed sensors monitoring environmental conditions.
- Smart Devices: Smartphones and wearables acting as gateways.
- Internet: Providing the global backbone for communication.
- Big Data Analytics: Extracting insights from massive sensor streams.

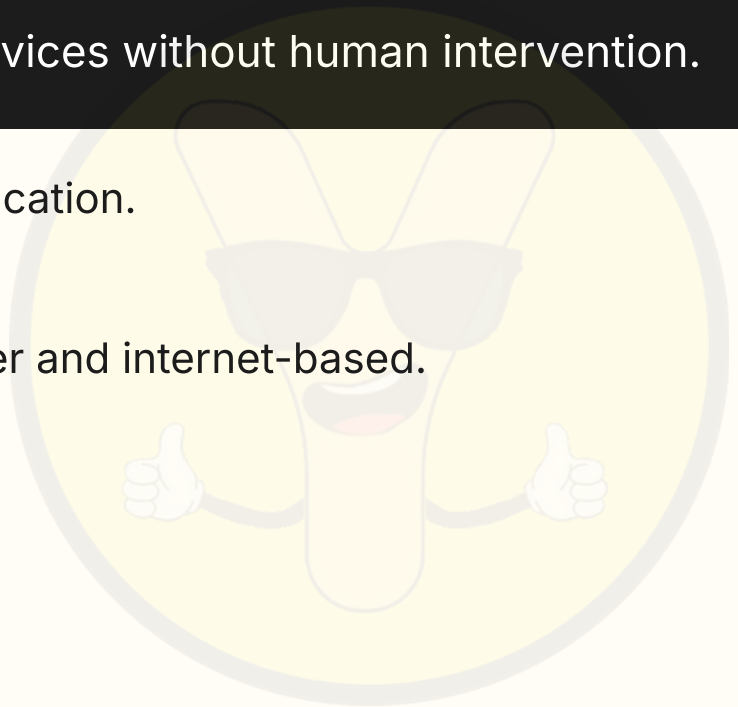


M2M Communication

MACHINE-TO-MACHINE (M2M)

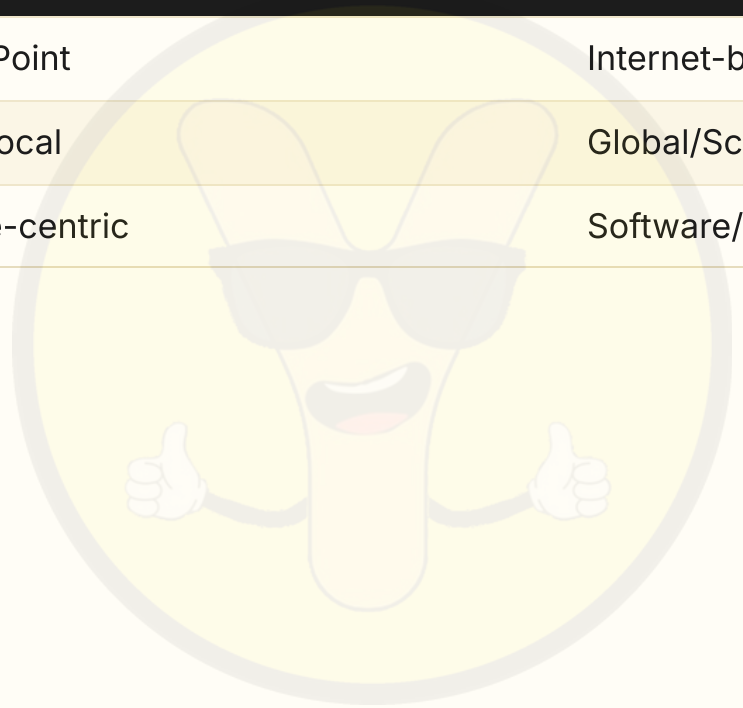
Direct communication between devices without human intervention.

- Focuses on point-to-point communication.
- Uses proprietary protocols often.
- Foundation for IoT, but IoT is broader and internet-based.



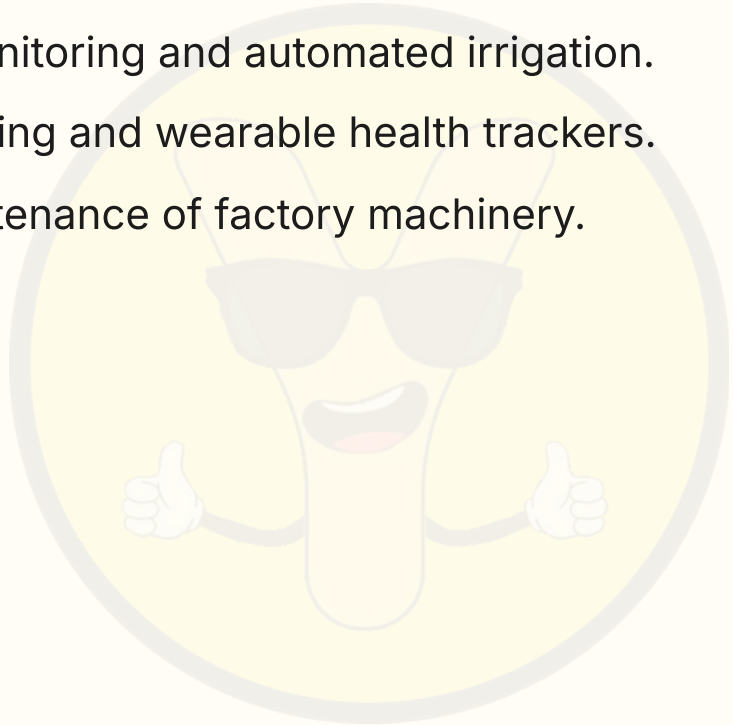
IoT vs M2M

Feature	M2M	IoT
Connectivity	Point-to-Point	Internet-based
Scope	Limited/Local	Global/Scalable
Integration	Hardware-centric	Software/Cloud-centric



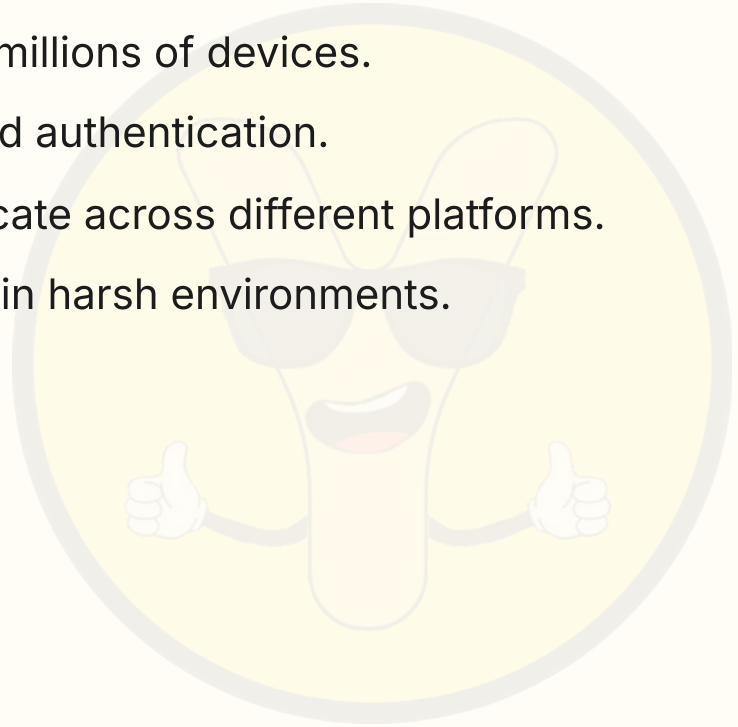
IoT Examples

- Smart Home: Automated lighting, thermostats, and security cameras.
- Smart Agriculture: Soil moisture monitoring and automated irrigation.
- Healthcare: Remote patient monitoring and wearable health trackers.
- Industrial IoT (IIoT): Predictive maintenance of factory machinery.



Design Principles for Connected Devices

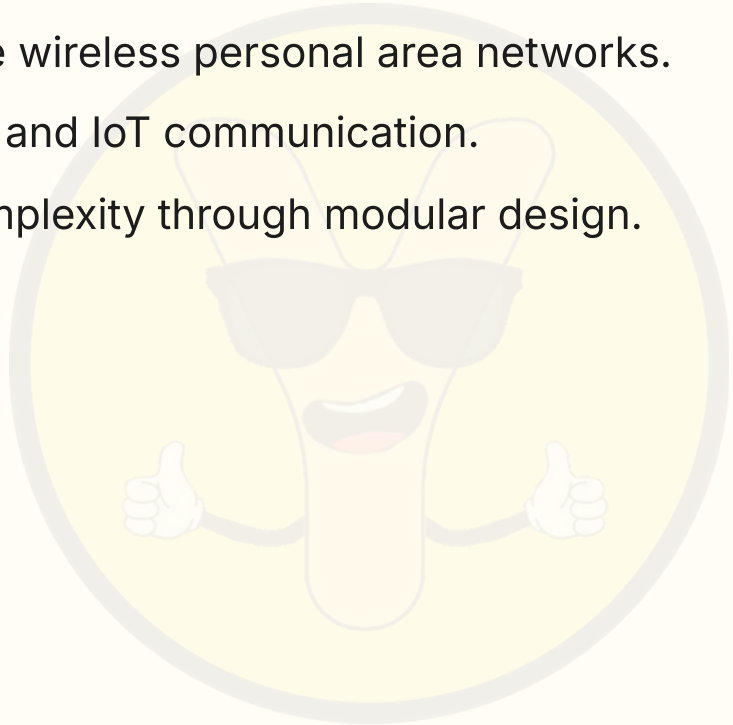
- Power Efficiency: Devices must operate on low power (batteries/energy harvesting).
- Scalability: System should support millions of devices.
- Security: End-to-end encryption and authentication.
- Interoperability: Ability to communicate across different platforms.
- Reliability: Consistent performance in harsh environments.



IoT/M2M Systems Layers

Design Standardization

- Standardization ensures compatibility between diverse manufacturers.
- IEEE 802.15.4: Standard for low-rate wireless personal area networks.
- OneM2M: Global standard for M2M and IoT communication.
- Reduces development cost and complexity through modular design.



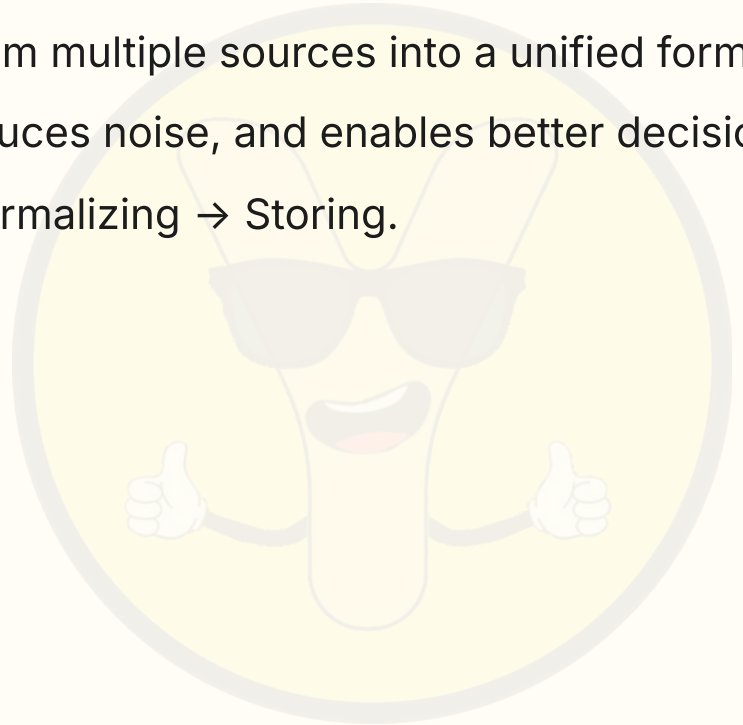
Communication Technologies

- Short Range: Bluetooth Low Energy (BLE), ZigBee, NFC.
- Medium Range: Wi-Fi, Z-Wave.
- Long Range (LPWAN): LoRaWAN, Sigfox, NB-IoT.
- Cellular: 4G LTE, 5G for high bandwidth requirements.



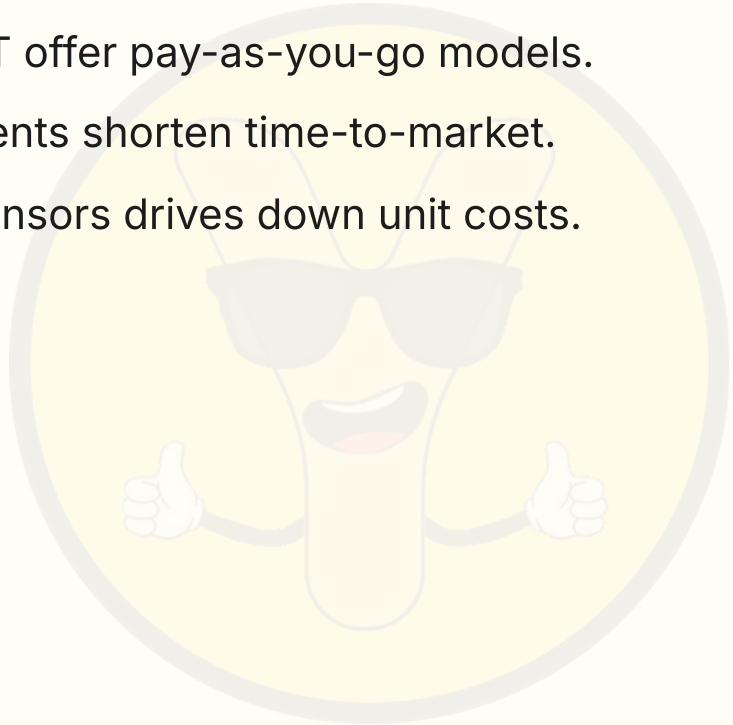
Data Enrichment and Consolidation

- Enrichment: Adding context (time, location, metadata) to raw sensor data.
- Consolidation: Aggregating data from multiple sources into a unified format.
- Benefits: Improves data quality, reduces noise, and enables better decision-making.
- Process: Filtering → Cleaning → Normalizing → Storing.



Ease of Designing and Affordability

- Open Source Hardware: Arduino, Raspberry Pi, ESP32 reduce prototyping costs.
- Cloud Platforms: AWS IoT, Azure IoT offer pay-as-you-go models.
- Modular Design: Reusable components shorten time-to-market.
- Affordability: Mass production of sensors drives down unit costs.



Exam corner

- **Q1** Define IoT and explain its conceptual framework with a neat diagram.
- **Q2** Differentiate between IoT and M2M communication with examples.
- **Q3** Explain the various layers of the IoT architecture in detail.
- **Q4** What are the key design principles for developing connected IoT devices?
- **Q5** Discuss the role of communication technologies in IoT deployment.
- **Q6** Explain the importance of data enrichment and consolidation in IoT systems.
- **Q7** How do open-source hardware and cloud platforms contribute to IoT affordability?

Unit 1 done. You are exam-ready.

Revise the Exam corner once more, then open Unit 2 on theycotes.com. Every AKTU subject, unit by unit, free. Notes by Chirag Jain, Ycotes.

