



SNS COLLEGE OF ENGINEERING



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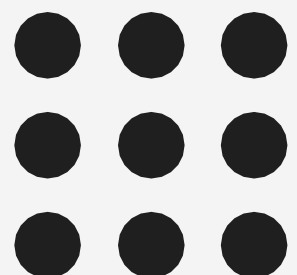
Department of Information Technology

Course Name – 19IT503 Internet of Things

III Year / V Semester

**Unit 2 – FUNDAMENTAL MECHANISMS & KEY
TECHNOLOGIES**

**Topic 4- Key IoT Technologies – Device Power, Sensor
Technology**



Key IoT Technologies – Device Power

M2M / IoT applications are almost invariably constrained by the following factors

- Devices have ultra-low-power capabilities,
- devices must be of low cost, and
- devices generally must have small physical size and be light

A number of devices operate with a small battery, while other devices use a self-energizing energy source, for example a small solar cell array.

Wireless technologies require significant amounts of power; hence, the need for low energy (LE) wireless technologies.

The so-called “coin batteries,” also known as “button batteries,” are typical in many IoT applications.

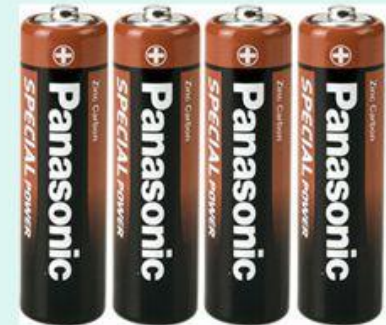



Key IoT Technologies – Device Power

Battery Type

Batteries can be classified into

- Primary and
- Secondary systems.
- Primary batteries are disposable batteries, that is, batteries that cannot be recharged, and their conversion of chemical energy into electrical energy is irreversible.
- Secondary batteries can be recharged, and the electrode material is reconstituted using an electric charge.

Type of Cell	Description	Examples
Primary Cell	A cell that can be used only once.	Zinc-carbon cells 
Secondary Cell	A cell that can be recharged.	Nickel-metal hydride cells 

Key IoT Technologies - Device Power

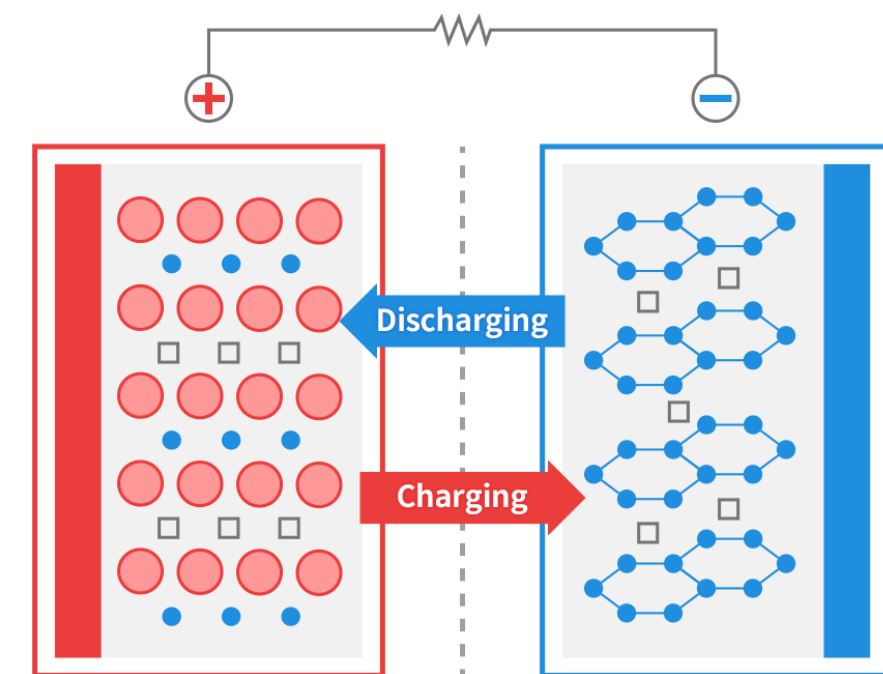
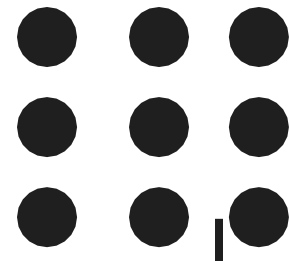
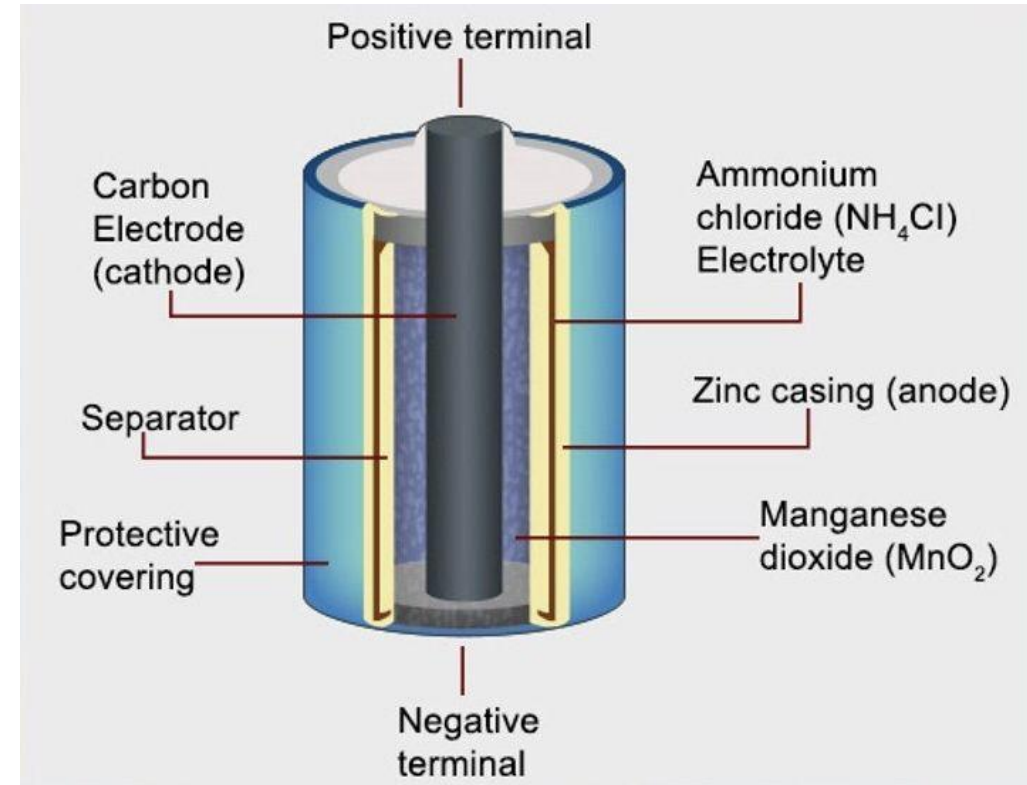
Example

Primary Battery

Alkaline, Lithium, and Metal/air batteries

Secondary Battery

Lead acid,
Nickel/cadmium (NiCd),
Nickel/metal hybrid (NiMH), and
Lithium-ion (Liion)/ Lithium-polymer (Li-polymer)



Cathode

A lithium-ion source that determines the battery capacity and average voltage

Anode

Allows electrical currents to flow through the external circuit, by storing and releasing lithium-ion



Key IoT Technologies – Device Power

- Rechargeable Li-ion batteries have an anode comprising carbon (e.g., graphite), a metal oxide cathode, and an electrolyte containing lithium salt. It is relatively easy to peel ions from lithium metal.
- These are popular batteries because they are lightweight, have a high energy density, hold their charge better than other batteries.
- Materials such as silicon and others are being studied as possible replacement of the graphite anodes in Li-ion batteries.
- Some evolving technologies use small solar panels embedded in the screen of a smartphone or object; other systems may use kinetic devices that translate movement of objects into an electric current.
- Solar cells are an example of an energy harvester, but they are for low efficiency when converting ambient light into useful electrical energy.



Key IoT Technologies – Device Power

There are a number of factors that must be considered in selecting the most suitable battery for a particular application; key considerations include

- Operating voltage level
- Load current and profile
- Duty cycle—continuous or intermittent
- Service life
- Safety and reliability
- Shelf life
- Maintenance and replacement
- Environmental impact and recycling capability
- Cost

Physical requirement

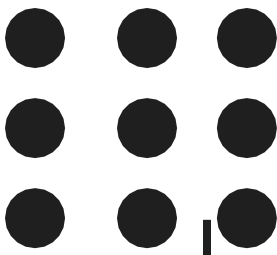
- Size
- Shape
- Weight

Environmental conditions

- Temperature
- Pressure
- Humidity
- Vibration
- Shock
- Pressure



Key IoT Technologies - Sensor Technology



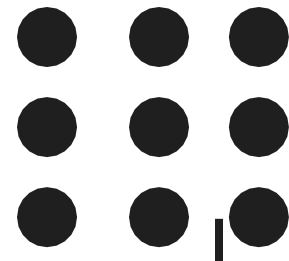
A sensor network is an infrastructure comprising sensing (measuring), computing, and communication elements that gives the administrator the ability to instrument, observe, and react to events and phenomena in a specified environment.

There are four basic components in a sensor network:

- (i) an assembly of distributed or localized sensors;
- (ii) an interconnecting network (usually, but not always, wirelessbased);
- (iii) a central point of information clustering; and
- (iv) a set of computing resources at the central point (or beyond) to handle data correlation, event trending, querying, and data mining.

Sensors, the things or objects, are active devices that measure some variable of the natural or man-made environment.

Key IoT Technologies - Sensor Technology



The technology for sensing and control includes

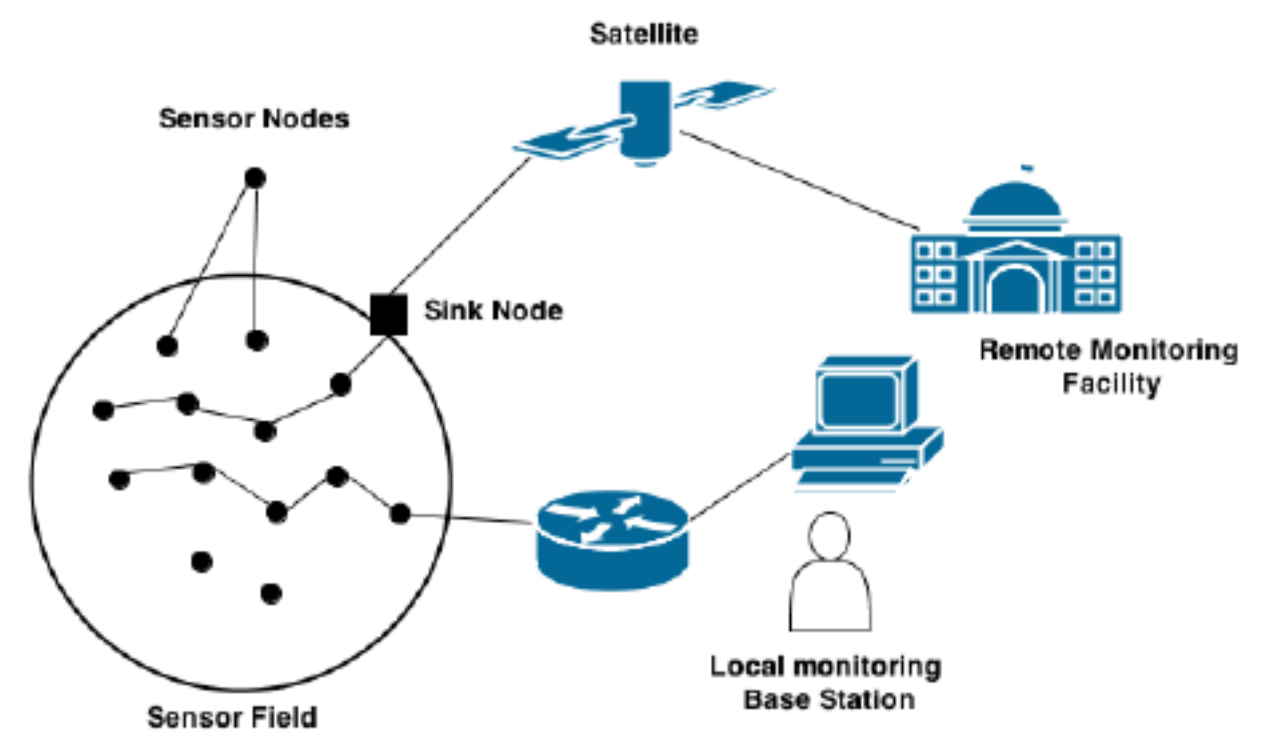
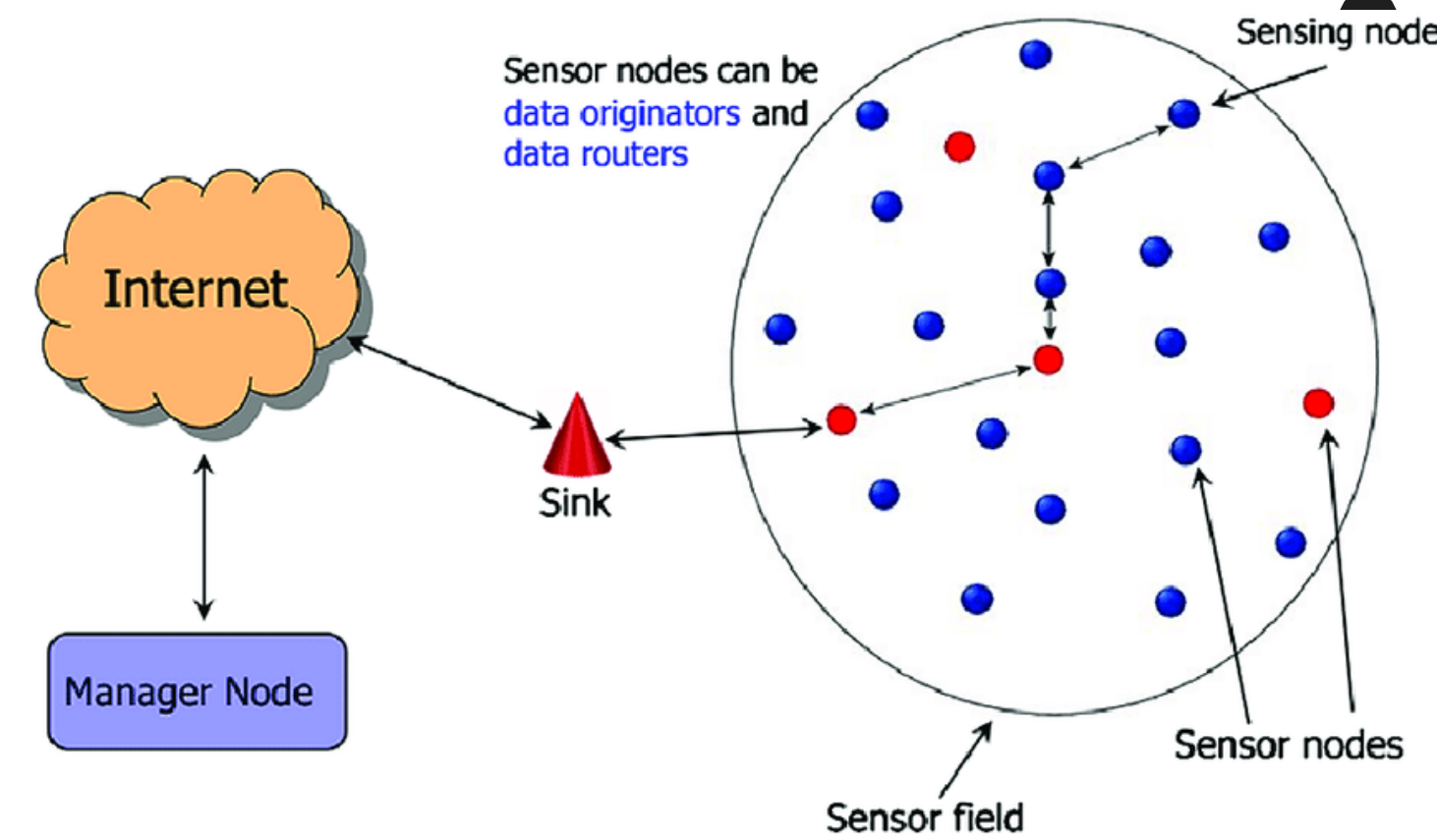
- Electric and magnetic field sensors;
- Radio-wave frequency sensors;
- Optical, electro-optic, and
- Infrared sensors;
- Radars;
- Lasers;
- Location/navigation sensors;
- Seismic and pressure-wave sensors;
- Environmental parameter sensors
(e.g., wind, humidity, heat, and so on); and
- Biochemical Homeland Security-oriented sensors.



Key IoT Technologies – Sensor Technology

What is sensor and how it works ?

- Sensors are “smart” inexpensive devices equipped with multiple on-board sensing elements:
- They are low cost, low power, multifunctional nodes that are logically homed to a central sink node.
- Sensors are typically internetworked via a series of multihop short-distance low power wireless links.
- They typically utilize the Internet or some other network for long-haul delivery of information to a point (or points) of final data aggregation and analysis.
- Wireless sensors typically transmit information to collecting (monitoring) stations that aggregate some or all of the information.





Key IoT Technologies – Sensor Technology



Size of Sensor

- Sensors span several orders of magnitude in physical size;
- They range from nanoscopic-scale devices to mesoscopic-scale devices at one end; and,
- From microscopic-scale devices to macroscopic-scale devices at the other end.
- Nanoscopic refers to objects or devices in the order of 1–100 nm in diameter.
- Mesoscopic scale refers to objects between 100 and 10,000 nm in diameter
- Microscopic scale ranges from 10 to 1000 microns; and
- Macroscopic scale is at the millimeter-to-meter range.

Example - biological sensors, small passive microsensors, identity tags, toll collection devices, controllable weather data collection sensors, radars, and undersea submarine traffic sensors based on sonars

Key IoT Technologies - Sensor Technology

Sensor Applications

- Industrial/building WSNs,
- Appliance control (lighting and heating, ventilation, and air conditioning (HVAC)),
- Automotive sensors and actuators,
- Home automation and networking,
- Automatic meter reading/load management (LM),
- Consumer electronics/entertainment, and asset management

Commercial market segments include the following:

- Industrial monitoring and control
- Commercial building and control
- Process control
- Home automation
- Wireless automated meter reading (AMR)/ LM
- Metropolitan operations (traffic, automatic tolls, fire, and so on)
- Homeland Security applications: chemical, biological, radiological, and nuclear wireless sensors
- Military sensors
- Environmental (land, air, sea)/agricultural wireless sensors



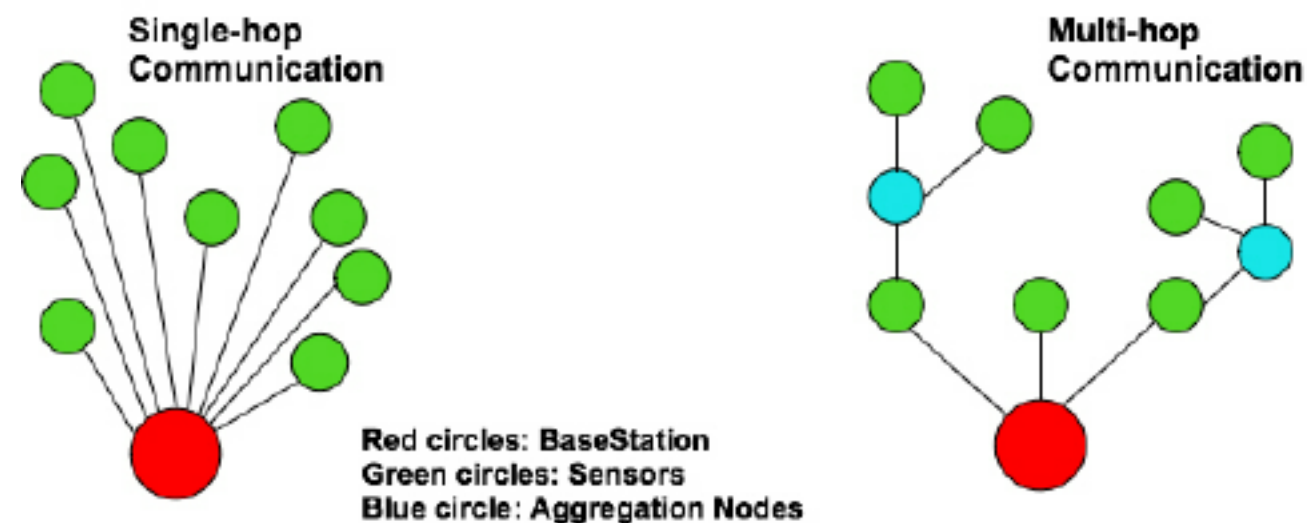
Key IoT Technologies – Sensor Technology

Challenges

- Limited power supply
- Low power consumption for transmission over low bandwidth channels and low power-consumption
- logic to pre-process and/or compress data is required.

Power efficiency in WSNs is generally accomplished in three ways:

- (i) Low duty cycle operation
- (ii) Local/in-network processing to reduce data volume (and, hence, transmission time)
- (iii) Multihop networking





THANK YOU