Aim: Configuration of the XBee S2C and LoRa devices in order to create a WSN (Network).

Theory:

A Wireless Sensor Network (WSN) consists of spatially distributed sensor nodes that collect and transmit data wirelessly to a central node or gateway for analysis. Configuring modules like XBee S2C (ZigBee protocol) and LoRa is essential for establishing reliable WSN communication, especially in IoT applications such as agriculture, environmental monitoring, and industrial automation.

This practical focuses on configuring these modules to communicate wirelessly and form a sensor network.

1. XBee S2C Module (ZigBee-based Communication)

The XBee S2C module is a compact and reliable device that supports ZigBee mesh networking using the IEEE 802.15.4 protocol. It enables low-power, low-data-rate communication between multiple nodes over a self-healing mesh network.

Key Features of XBee S2C:

- Operates in the 2.4 GHz ISM band
- Supports mesh, point-to-point, and point-to-multipoint topologies
- UART interface for serial communication
- Low power consumption
- Communication range: up to 1 mile (with high-gain antennas)

Configuration Steps:

- Use XCTU software (provided by Digi) for configuration
- Coordinator: Central node that initiates and manages the network
- Router/End Devices: Nodes that send/receive data
- Set PAN ID, DH (Destination High), DL (Destination Low), and MY (Device Address) values
- Enable or disable API/AT mode depending on use-case
- Test communication by sending data from one XBee module to another

2. LoRa Module (e.g., SX1278 or RFM95)

LoRa is a physical layer protocol used for long-range, low-power communication. It is ideal for large-scale WSNs where devices are deployed far apart, such as in smart agriculture or environmental sensing.

Key Features of LoRa:

- Range: 2–15 km depending on terrain

- Ultra-low power consumption
- Operates in the unlicensed ISM bands (e.g., 433 MHz, 868 MHz, 915 MHz)
- Supports star topology (not mesh like ZigBee)

Configuration Steps:

- Connect LoRa module to microcontroller (e.g., Arduino, ESP32)
- Use libraries like LoRa.h or RadioHead to write communication code
- Set parameters:
    - Frequency (e.g., 433E6 or 915E6)
    - Spreading Factor (SF): Determines range vs. data rate
    - Bandwidth (BW) and Coding Rate (CR)
    - Node ID and Destination ID for identification
- One node acts as a gateway, others as sensor nodes

Conclusion:

To establish a WSN, both XBee S2C and LoRa offer robust wireless communication solutions, each suitable for different environments. XBee is better for short-range, mesh networks, while LoRa is ideal for long-range, low-bandwidth applications. Proper configuration using tools like XCTU for XBee and appropriate libraries for LoRa is crucial for effective communication within the sensor network.