2. Requirement, Constraints, And Standard

2.1. Requirement & Constraints

We have developed our requirements into two sections: Functional and Resources Requirements.

Functional Requirements:

The wireless mesh network for pesticide spray monitoring and mapping will have to store the measurement of resistance across the interdigitated electrodes (IDEs). These IDEs will be placed at three levels of the crop canopy with ESP32 microcontrollers which will transmit the data (resistances) to the master node. The wireless mesh network will be implemented using ESP32 microcontrollers (MCU). The transmitted data will be stored in a user-friendly format, such as a .txt file, for future analysis. The network supports real-time data monitoring, allowing users to check measurements' consistency. The whole system will have a low power consumption and long-term deployment in the field. The mesh network will have a minimum of 6-12 nodes.

Resources Requirements:

In our resources, we have separated all the resources we will use into different sections: sensor, master node, and mesh network.

Sensor:

The sensor (IDEs) will be placed on three levels of corn canopies and will each be connected to an ESP32 microcontroller. Each level will have a minimum of 3 IDEs, so each pole will consist of nine IDE’s and three ESP32 microcontrollers, and the sensor's accuracy will be ±1% of actual resistance with minimal noise. The sensor will be operated for 3 hours on battery power and will send voltages to the microcontrollers that are connected which will communicate and send information to the master node.

Master Node:

We must have a master node and a centralized device to communicate to all the nodes and receive data from them, this device will be another ESP32 microcontroller. This master node will collect all the data being received and organize it in a user friendly format that can be accessed at any time. The master node will have a sleep/wake command for the nodes to verify that the nodes are functioning.

Mesh Networking:

Each ESP32 will act as a node in the mesh networking system. The ESP32 will have the capabilities of long-term and reliable communication and communicate directly to the master node. The transmitted data should not be lost and will be communicated with a minimum of 9

sensor nodes. Each of the nodes will have a distance of 200 feet from other nodes, this way the nodes are still able to communicate to one another. The master node will periodically send commands to wake the ESP32 nodes to get the data and the operational status. This networking system will support real-time data transmission, which allows users to receive data from the master node.

2.2. Engineering Standards

IEEE 802.11s

This standard defines protocols for creating a wireless mesh network using Wi-Fi and supports broadcast/multicast and unicast data delivery. This will apply to our transmission on the data line. Multiple data able to transmit to the master node and read from the master node.

IEEE 1588

This standard defines synchronizing time across distributed systems using Precision Time Protocol (PTP) and ensuring high accuracy timing. This is important to our project because we are going to be receiving multiple values from the sensors and will be transmitted to the master node. Our system requires consistent and accurate timing which will provide the user with accurate and reliable real-time data analysis.

IEEE 802.15.1

This covers Bluetooth BR/EDR (Basic Rate/ Enhanced Data Rate). This standard is designed for the wireless networks and the low power wireless communication between devices. In our project, Bluetooth LE is designed and will be used for low energy and periodic communication.

IEEE 1588

This standard is designed for power management and low power in integrated circuits (IC). Our circuit contains integrated circuits which help with the power efficiency with our circuit as a whole.