INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*EPRI*	**Date Submitted**	*11/18/2022*
Project Title	Research and Testing of Various ISM Communications Data-Control Platforms **(EPRI_ISM)**	**Planned Starting Semester**	*Spring 2023*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical		Electrical	2
Computer	2	Systems	

Company and Project Overview:

The Electric Power Research Institute (EPRI) conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. As an independent, nonprofit organization for the public interest, we focus on electricity generation, delivery, and use in collaboration with the electricity sector, its stakeholders and others to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

EPRI has collaborated with the electricity sector and its stakeholders since 1972 and our membership has grown to represent approximately 90% of the electric utility revenue generated in the United States and extends to participation in more than 35 countries. The worldwide membership that supports our work comprises more than 1,000 organizations. While most members are electric utilities, others are businesses, government agencies, regulators and public or private entities engaged in some aspect of the generation, delivery, or use of electricity.

Through their advisory roles in EPRI, its research sectors and programs, EPRI members help inform the development of EPRI's annual research portfolio, identify critical and emerging electricity industry issues, and support the application and technology transfer of EPRI's research

and development.

This project will be related to technology related to Communications and Controls.

Project Requirements:

Throughout the world, wireless communications for the Industrial Internet of Things (IIoT) and wireless devices are becoming more commonplace. However, not all applications of IIoT and devices require the use of 802.11-type communications protocols – especially those installed in an outdoor environment. Because of this, several other Industrial, Security, and Medical (ISM) communication bands and protocols have been developed of the past couple of year. Some of these include:

- LoRaWAN
- SigFox
- ZigBee
- NB-IoT

Each of these ISM band technologies have their own advertised advantages and tradeoffs. Some of the concerns could be from their available bandwidth, speed, throughput, imbedded security, range, and latency. For some applications and use-cases, these are important factors that could be limiting. As more and more IIoT devices are installed, use cloud technologies, and serve a more critical role in green power generation and low carbon initiatives, these types of ISM communications networks could help greater incorporation into industrial application

Expected Deliverables/Results:

The multi-disciplinary student team should perform the following:
1. Perform a literature review comparative analysis between the four ISM band technologies (as advertised) and others that look similar that should be included, as compared against each technology and the newest standard 802.11ax (Wi-Fi 6E [2.4GHz, 5.0 GHz, 6.0GHz]).
2. Design and build out a physical network for each of the ISM technologies using RaspberryPi microcomputers with various HATs and servo motors to perform a simple task. If gateways, antennas, or other components need to be purchased that are outside of the allocated budget, those can be provided by EPRI and returned at the end of the semesters. EPRI's Charlotte labs can also be used as a testing facility. All ISM applications should make use of open platforms and codebase, avoid private networks and customized protocols.
3. Develop a simple code in Python (or similar) to send commands, receive data, and compare performance of the four ISM band technologies. The student team should also consider and incorporate cyber security (encryption, etc.) into their design. Network and physical testing should include using a consistent, standardized methodology:
a. Battery consumption
b. Effective communications range
c. Communications speed
d. Communications latency
e. Effective throughput
f. Effective bandwidth

4. Provide a summary of the performance of each of the ISM band technologies, recommendations for usage per use-case, and advantages/tradeoffs per technology in a final report or presentation.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Interest in ISM band communication.