Executive Summary

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1. Title of the Project:
Green/Sustainable IoT for Smart Environment

2. Date of Start of the Project:
October 1, 2021

3. Aims and Objectives:
Two aspects are of primary interest: communication/storage resource efficiency and energy sustainability. On energy sustainability, the focus has been on intelligent node-level and network-level strategies for energy-optimized operation and novel strategies for online energy replenishment. The targeted exercise has been divided into 3 core objectives:

a) **Algorithms and technology development on smart IoT sensor nodes** for two target sensing applications: smart power metering and grid monitoring, and fine-grained pollution sensing.

b) **Campus-wide deployment of indigenously developed nodes** for field data collection, for which appropriate network architecture are being considered for the two contexts.

c) **Localization of events, such as pollution sources, for potential real-time actuation/actionability** by using the sensed field data from the IoT nodes, including demonstration of the **online auto-calibration** feature of the IoT nodes.

4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc.)

- **S. De, “Smart sensing technology,” non-exclusive license transferred to i2SAGE Technologies Pvt. Ltd., New Delhi; licensed by Foundation for Innovation and Technology Transfer, IIT Delhi, Jan. 2023.**

- **S. De, “Smart real-time/non-real-time data handling technology,” non-exclusive license transferred to i2SAGE Technologies Pvt. Ltd., New Delhi; licensed by Foundation for Innovation and Technology Transfer, IIT Delhi, Jan. 2023.**

- **Basic DLMS-enabled data-smart meter prototypes have been deployed in 10 places in IIT Delhi campus** for cloud-based smart meter data collection on ‘real time’ (please refer to Fig. 1).
- We have **proposed an inventive learning-aided smart IoT device for non-invasive identification of power supply source and power quality** in a heterogeneous powered (AC power grid, solar power, diesel generator, etc.) appliance/system, such as wireless network base station, by measuring the DC signature at the DC-powered appliance/system input point (please refer to Fig. 2); Indian patent filed.

![Figure 1: Deployed DLMS server (data-smart meter) and DLMS client.](image1)

- In an allied direction of energy sustainability of wireless nodes, our inventive distributed polarization beamforming for optical wireless energy transfer has been filed for Indian patent (please refer to Fig. 3).

![Figure 2: Laboratory set-up for studying the proposed power source identification module.](image2)

![Figure 3: (a) Generalized system model for distributed polarization beamforming; (b) block diagram of proposed transmitted-end polarization offset correction.](image3)
• Our proposed inventive technique for grid connected green cellular network base stations have also been submitted for an US patent.

Key publications:


Patents filed:


5. Concluding remarks

In this translational research direction, we are continuing to explore newer ways to “smart” (learning-enabled) energy-sustainable communication and system performance. Two new patents have been filed, and a previously submitted Indian patent application has also been filed for an US patent. We are working on building industry partnerships for further productization and commercialization of the smart IoT and communication systems prototypes.