PROJECT FACTSHEET

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LORSAT

Integration of Internet of Things (IoT) and Satellite Communication (SATCOM) for smart agriculture applications.

INSPIRATION

Internet of Things (IoT) applications are bringing fundamental changes to our lives, and in all sectors of activity. It also represents an engine for innovation, economic growth, and social progress. In the last decade, a large variety of IoT communication technologies have gradually emerged, reflecting a large diversity of application domains and communication requirements. Among them, Low Power Wide Area Network (LPWAN) technology came out as a better choice for enabling longer-range connections, at greater cost-saving and power efficiencies.

LPWAN technologies such as LoRa, whose interest for continues to grow, has led to the creation of the LoRa Alliance. It aims to both promote LoRa communications and define a MAC layer able to manage LoRa Wide Area Networks (LoRaWAN), which contributes to the ongoing standardisation process. LPWANs allow low power devices interacting directly with some gateways through long-range transmissions, making them suitable for scenarios such as precision agriculture (e.g. soil moisture and crop growth), and environmental monitoring applications that require low data-rate, and are tolerant to packet loss, and transmission delay.

However, some of these may be located in remote, sparsely populated areas that do not have mobile terrestrial coverage, or other forms of connectivity. In this context, satellite technology comes into play, as a key enabler to transform IoT connectivity across industries and geographical borders and allow global IoT coverage. There is a need to design technical solutions allowing the smooth integration and interoperability of satellite and LPWAN terrestrial networks.

INNOVATION

LORSAT focuses on the integration of LPWAN LoRaWAN networks with satellites backhaul in the service of an application scenario: precision agriculture. This use case has already proved to be one of the best fits for the target IoT technology and satellite communication means, requesting long-range coverage (including in not-easily accessible remote area), reliability, and adaptability.

LIST researchers will look at the IoT data collection and transmission over satellite, from the end-devices until the remote network/application server, and the following transmission of actuation commands from the server till the end devices. They will go a step further with current state of art, and design synchronisation and scheduling techniques that ensure successful delivery of (group of) ACK and downlink traffic, taking into account gateway mobility, satellite network conditions, SFs options and duty cycle limitations.

In particular, LIST will investigate how to combine Class B and Class A devices functionalities and use reserved slots to receive ACK (or data) that could not be delivered within the receiving windows. LIST researchers will design LoRaWAN MAC enhancement for communication over a GEO satellite backhaul between multiple gateways and the network server. Finally, with the final aim to improve the QoS of the entire e2e system, LORSAT will propose cross-layer optimisation (from PHY to APP).

Research activities carried out in the LORSAT project will target heterogeneous network integration validation first in laboratory, based on simulation. LORSAT will develop an open-source simulated tool, as an extension of NS3 and SNS3. Second, validation in a real scenario, with the development of a proof-of-concept (PoC), aiming to the successful demonstration of LORSAT capabilities.

IMPACT

The LORSAT e2e system designed by LIST researchers will enable better data extraction, communication exchange and management, with environmental and socio-economic impacts for many players in the IoT agriculture value chain. Amongst other, farmers will benefit from a cost-effective solution allowing them to take prompt action (for irrigating, or spreading fertilisers at the right time), based on the timely exchange of data and commands. IoT and satellite networks providers will be able to provide new services and have access to new markets.

With its IoT and satellite based network infrastructure, LORSAT directly contributes to the achievement of 4 of the 17 Sustainable Development Goals of the 2030 UN Agenda: n°1 – No Poverty, n°2 – No Hunger, n°8 – Economic Growth, n°9 – Innovation and Infrastructure.

Besides the dissemination into the IoT, LPWAN, satellite research community, the LORSAT outcomes, in particular the LoRaWAN scheduling techniques, will be promoted to standardization, in the IETF LPWAN WG.

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Contact

5, avenue des Hauts-Fourneaux
L-4362 Esch-sur-Alzette
phone: +352 275 888 - 1 | LIST.lu

Dr Maria Rita PALATTELLA
(mariarita.palattella@list.lu)

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY | LIST