D2.2: Approved List of Sensor Devices to Match the Data Requirements under the SRI and Enable Smart Building Monitoring across the Living Lab including through DIY Kits

SMARTLAB | Work Package 2, Task 2.4

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Table of Contents

List of Acronyms

SRI	Smart Readiness Indicator
IoT	Internet of Things
LPWAN	Low Power Wide Area Networks
LoRaWAN	A LPWAN protocol in the 868MHZ spectrum
NB-IoT	A LPWAN protocol operated by licenced mobile operators under 3GPP standards

Executive Summary

This report identifies the sensor devices selected by SMARTLAB to deploy throughout the project area. The sensor devices have been selected against criteria established by the requirements of the SRI to develop the potential for increased smartness in Irish buildings.

Deliverable WP3-D1: Review of the SRI and other appropriate systems for measuring the 'smartness' of a building and requirements for data monitoring and DIY toolkits as a result describes the requirements of the SRI and how it would be implemented in an ideal context in Ireland for maximal results. This report will not cover that ground, instead we took those findings and attempted to develop a sensor-based toolset that would allow us to bring buildings from a zero SRI rating to a minimum basic level of SRI performance.

Deliverable WP3-D1 notes that the optimal results for SRI evaluations and performance come when buildings are connected to the cloud for both reporting and control. However, to achieve a basic level of smart readiness reporting is sufficient.

The sensor requirements laid down in Deliverable WP3-D1 are for monitoring of energy use at the main incoming meter and monitoring of environmental conditions within the building to report comfort and other relevant data for taking action and offering services.

The outcome of the process of evaluation and tendering was a decision to adopt the Vutility Hotdrop sensor to meter electricity usage and report via LoRaWAN and to adopt the Milesight AM307 sensor to report on environmental conditions.

1 Introduction

The Living Lab project is assessing methods for implementing the Smart Readiness Indicator (SRI) within existing building stock in the project catchment area. The SRI standard is intended to support efforts to improve efficiency, comfort and performance of buildings and contribute to targeted reductions in carbon emissions across society. The vision for this project is mapping a process where ordinarily 'non-smart' buildings can be brought up to a basic level of 'smart readiness'.

The SMARTLAB project will rely on technology enabled by IoT sensors to develop processes and recommendations for implementing the SRI and mapping out the way to an improved building stock. As noted in Deliverable WP2-D1 Review of Available LPWAN Networks and Distribution Models, collection of building data is ultimately a physical endeavour and depends on a link between the data point within the building e.g. a meter and the internet of services that are supported.

The projected has evaluated network solutions (WP2-D1) and adopted LoRaWAN as the preferred communication protocol for sensor equipment. The process then moved to choosing sensors to adopt which would enable an SRI rating for the existing buildings.

This Deliverable describes the criteria adopted for sensors and examines the options available to the project to achieve this flow of data. It concludes with the specific sensor units chosen for deployment to the living lab.

2 Methodology

Based on the review of the SRI conducted in Deliverable WP3-D1, we developed criteria for sensors that can be deployed to increase the SRI values of local buildings within the project area.

The criteria reflect the project's need to implement sensor solutions simply and quickly and to provide a nationally relevant roadmap for implementing SRI services. Thus the criteria for evaluation along with their justification are:

- Wireless (LoRaWAN): This was covered in Deliverable WP2-D1 but sensors need to communicate via LoRaWAN.
- Report relevant SRI data: Based on the evaluation in Deliverable WP3-D1 sensors need to report the minimum viable data to improve the rating of the buildings' smart readiness.
- Long battery life: Long life should be available from the devices without needing battery changes over the course of the project.
- Minimal installation works: Sensors should avoid requiring major works (electrical or mechanical) to install and be suitable for deployment at scale by building occupants.
- Support visualisation and feedback: sensors should have the capacity to integrate to the software visualisation developed within SMARTLAB by partners and to provide feedback to tenants visually within their environment.

One consideration that had to be accounted for during the project was that tendering and procurement rules were respected. Therefore the process followed an order of establishing the baseline specification, identifying possible solutions on the market and where multiple solutions were available in the market running a tender process for a device.

3 Device Specification and Selection

The conclusion of Deliverable WP3-D1 stated that it was unfeasible to attempt to report and control heating systems within the SMARTLAB project remit, despite the overall high impact it would have on SRI ratings. This is largely due to cost and complexity of deployment. The project's ambition remains to have devices that can be deployed at a local level by owners, tenants, and occupants to provide a foundation level of smartness within a building.

This left two areas of focus for sensor deployment within SMARTLAB. These are energy and local condition/comfort. The collection of this data must be scalable with few 'workarounds' or exceptions.

3.1 Smart Energy Meters

Deliverable WP3-D1 outlined that energy sensors should "be capable of real-time energy readings to avoid costly energy behaviour and inform the building owners when to reduce consumption, particularly during peak times (demand side management)" (15).

In addition to this requirement, the project aimed to select a device capable of tenant installation. By definition, this meant we could not accept electrical works as a condition of deployment. The latter restricted the volume of devices that fit our criteria outlined in Section 2 and met the basic standard of reliable data reporting of real time energy consumption to the cloud to enable demand-side feedback.

After a survey of the marketplace, it was agreed that there was a dearth of sensor devices that met our requirement. We considered a series of 'in-line' energy meters (examples include Eastron SDM230 LORA) which all required electrical works to be installed. These were not in keeping with the 'DIY' ambition of the project and seen as a longer-term barrier to scaling up smartness in buildings due to the extra costs.

We then evaluated devices that collected pulses emitted by some models of electricity meters. These can be wired or optical and are an industry standard. These devices (examples include NKE Watteco Flash'O) are ideal for the requirement of 'DIY' installation and are battery powered with long lifetime. However, the existing building stock is largely equipped with meter models that pre-date pulse outputs. As such until completion of the 'smart meter' upgrade is complete we could not expect more than 20% of applicants to have meters that would support pulse outputs.

Finally, this left us requiring a CT clamp device that was LoRAWAN capable and logged 'real-time' data rather than point information every 10 minutes. A survey of the market yielded only one device that fit all the criteria, the Vutility Hotdrop. This device has the added advantage of being self-powered inductively from the electrical cable it is measuring providing indefinite performance.

3.2 Environmental Sensors

Environmental sensors are capable of providing a foundation for smartness. Per Deliverable 3.2 these sensors enhance the user's ability to monitor environmental conditions towards optimal health and comfort, in turn achieving a majority of occupant health and wellbeing criteria toward the monitoring functionality of the SRI calculation.

To significantly advance the SRI rating they need to be connected with a control system however this is out of scope for the SMARTLAB participants. Therefore in addition to the base criteria in section 2, specific criteria for environmental sensors was decided upon as follows:

- Integrated sensors for temperature (-40˚C to 85˚C; resolution 0.1˚C), humidity (0% to 100%RH; Accuracy ± 3%; resolution 0.5% RH), light, CO2 concentration (400 to 5000ppm; accuracy 3%; resolution 1PPM), TVOC (0 to 500 (IAQIndex)), barometric pressure (300 to 1100hPa), and PIR range 5m.
- Provide feedback to tenants and occupants directly via e-ink screens with legible readouts. This supports interim user behaviour changes in the absence of a fully connected control system.
- Provide feedback aurally was well as visually.
- Support a mobile app to streamline tenant DIY installation and enable remote trouble shooting.

There is a larger selection of such devices on the market (from vendors such as mClimate, Elsys and Milesight) and due to multiple units potentially matching our criteria a tender process had to be undertaken with evaluation against technical criteria and price taken into account.

The outcome of the process was the selection of the Milesight AM307 as the preferred device for deployment due to its combination of technical specifications and pricing.

3.3 DIY Sensors

WP1-D1 Plan for Stakeholder Engagement describes how a DIY approach is integrated into project delivery. This document outlines how project Objectives with relevance for DIY sensors and toolkits can be reached through Living Lab activities. In relation to Objectives including the empowerment of smart energy citizens and the deployment of smart infrastructure, the project will carry out activities around demystifying sensor technology and developing a DIY approach for interested project participants.

Although fabricated DIY sensors will not be installed as the default option in SMARTLAB participant buildings, due to ease of calibration of the factory made devices and the need for a CE mark on the devices used, a core communication function of the project is to build and share DIY toolkits which are easy to use and understand by non-technical stakeholders (WP2, WP4). This is to support capacity building amongst stakeholders on the potential and accessibility of smart building technologies. The project purchased a number of Arduino kits which can collect data critical to SRI evaluation and ongoing smart building services. There is potential for DIY sensors to contribute to an improved SRI rating in any building assessment, as it is the functionality of the technology which is measured, and DIY sensors can potentially be more easily adapted to include control add-ons than proprietary technology. The availability of DIY kits will address several technical and financial barriers to the uptake of smart technologies already identified within project research, in particular WP1-D3 Barriers to Improving the Smartness of Buildings. DIY toolkits will also be used as part of the project's Living Lab approach, to ensure that citizens remain at the centre of the work, as outlined in WP1-D1 Plan for Stakeholder Engagement. A full workshop has been developed and designed as part of this activity and is recorded in supplemental Deliverable WP2-D2.1 DIY Sensor Workshop. Work in this area, carried out in Fab Lab Limerick and in the Citizen Innovation Lab, has been published on GitHub for further refinement by online communities: SMARTLAB Limerick on GitHub.

4 Conclusion

For SMARTLAB to achieve its ambition of fostering smarter buildings within the framework of the European SRI it is necessary to identify and deploy smart sensors which begin the process of reporting and controlling buildings via a network. The process for identifying which sensors are necessary is informed by WP1 and WP3 taking into consideration the age of the housing stock and the actions we can take to improve a building's smart readiness.

Following a review of the necessary data collection and identifying energy metering and environmental reporting as the most effective starting points, an evaluation was conducted on sensor equipment which would meet the require data specification. This evaluation took into consideration ease of installation, veracity of data and the cost implications to the project.

In order to proceed with SMARTLAB at the scale we are aiming for it was decided not to embark on a solution to monitor and control heating within buildings. This is primarily because the budget required to satisfy an SRI rank improvement would render SMARTLAB unfeasible.

The sensor selection process yielded a smart energy meter based on a LORAWAN network, the Vutility Hotdrop. This device is simple to install and requires no access to power or electrical works to install. It is ideal for data collection in this context and will transmit data independently of the tenants' own internet provision.

Environmental sensors were evaluated against a matrix of requirements and a tender process. The final selection yielded the Milesight AM307 as the environmental sensor of choice. It will provide in-building feedback via large e-ink screen as well as granular data to the digital twin model being developed within other work packages.

It is anticipated that some users or the general public will wish to adopt a DIY approach to sensor deployment and the project has developed a full guide to building and deploying DIY sensors. This is available as a GITHUB and promoted as part of the project's communication strategy.

Once sensors are deployed, the SMARTLAB project will demonstrate how improving building SRI can enable both energy and non-energy services, and the results of this demonstration will be made available in WP4-D2 Report on the Outcomes of Service Provision Enabled by Smart Building Data (M24).

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