SERVO INNOVATION PROJECT CLOSE-OUT REPORT

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PROJECT START DATE: (Q1, 2019)
PROJECT END DATE: (Q3, 2020)
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1. PROJECT SCOPE AND DESCRIPTION

The SERVO Project (System-wide Energy Resource and Voltage Optimisation) was established with two primary objectives:

- The development of a data lake for the structured storage of data, generated by ESB Networks' research projects. This data lake could then support the development of dashboards to aid reporting by these research projects; and
- To provide a software platform for the delivery of business use-cases based upon ESB Networks data.

SERVO has been developed in three modules:

1. SERVO Modeller – the central database containing all historic time series data collected by ESB Network Operations and Large Customer metering data, designed with the capability to also store Operations Management System (OMS) data and network topology data from the Geographical Information System (GIS);
2. SERVO Live – the ICT infrastructure to collect and store IOT data from network sensors and Distributed Energy Resources (DER), so as to enable near real time analysis of the impact of increased electrification (Solar PV, Heat Pumps and Electric Vehicle charging) on the LV network as part of innovation trials;
3. SERVO Flex – A secure Application Programming Interface (API) to enable broadcast of network state information to third-party applications.

A separate report on the SERVO Modeller module is available here on the ESB Networks website.

Delivery of the SERVO Live & Flex project, covering modules 2 and 3, was managed as a sub-project within the overall Dingle Electrification Project. This report provides summary level information on SERVO Live & Flex and the work completed as part of that project.

Dingle Electrification Project and the role of SERVO Live & Flex

The high-level objectives of the Dingle Electrification Project focus on understanding the impact of renewable and clean energy enabling technologies on the electricity distribution network, the optimisation and control of these technologies to provide supporting services to the network and the trial of devices on the electricity network to enhance its reliability. The Dingle Electrification Project also seeks to understand the effectiveness of approaches to diffusing active energy citizen behaviours across society.

The aim of the SERVO Live & Flex project, in support of the Dingle Electrification Project was two-fold:

- To develop the technical infrastructure to enable secure collection, storage and reporting (in ESB Network's Microsoft Azure Cloud Environment) of data collected from IOT devices deployed on the electricity network; and
- To develop a secure application programme interface (API) to securely enable access to this IOT data set held within the MS Azure Cloud database.

The SERVO Live & Flex project, which delivered this core ICT infrastructure to support the Dingle Electrification Project, was delivered in collaboration with the Telecommunications Software and Systems Group (TSSG) at Waterford Institute of Technology (WIT).

Background Information on LV Monitoring

To support assessment of the impact of low carbon technologies such as Solar PV and Heat Pumps on the low voltage electricity network, ESB Networks had previously established the Intelligent Secondary Substation Monitoring (Winterpeak) Project. A key element of that project was the assessment of LV monitoring devices and the data which these devices were capable of providing. The project closedown report for the Winterpeak Project is available here.

Overlapping with the Winterpeak Project, ESB Networks participated in a number of Horizon 2020 funded projects (RESERVE and SOGNO) where data collected from LV monitoring units (IOT sensors), deployed at transformers, substations and other assets on the electricity network was collected and stored in 3rd party ICT cloud environments. These storage solutions presented challenges to ESB Networks when it came to subsequent data analysis stages on each of these projects, both in terms of access to this data and query performance, however, as the number of sensors deployed for each of these projects was small, development of a more robust IOT data collection and storage solution was not merited in either of those cases.

As mentioned earlier in this report, a number of the objectives of the Dingle Electrification Project focused on understanding the impact of renewable and clean energy enabling technologies on the electricity distribution network and the potential for the optimisation and control of these technologies to provide supporting services to the network. To this extent, LV monitoring devices were installed at those pole mounted transformer and ground mounted substations that were feeding the electricity supplies to participants on the various project trials. These participants had been provided with various combinations of electric vehicle chargers, vehicle to grid chargers, electric vehicles, Solar PV panels, air source heat pumps and batteries and the project trials were designed to inform ESB Networks of the potential impacts on the network of these technologies under different operating conditions, so that those insights and learnings might help inform the design of the electricity network to support an increasingly low-carbon society over time.

As the scale of LV monitoring device roll-out and associated data collection was significantly greater than that undertaken as part of previous Horizon 2020 project trials, and recognising the necessity to store that data securely for subsequent analysis and presentation to business users, the SERVO Live & Flex architecture was developed to support these objectives.

2. CHANGES TO PROJECT

The SERVO Live & Flex infrastructure was initially intended to include a network model and congestion management engine whose output would feed the digital platform supporting the Dingle Flexibility Trials. The original intention for the digital platform was to simulate the capability of a distributed energy resource management system (DERMS) whereby it would generate and issue set-point control signals to distributed energy resources (DER) deployed at trial participant premises on the Dingle peninsula.

It was originally envisaged that fine tuning the algorithms managing the operation of these technologies would offer a dynamic mechanism to provide flexibility services to the local network.

Overtime, as the distributed nature of the roll-out of "behind the meter" technology on the peninsula became evident, the benefit of dynamically refining the set-point controls versus using use-case aligned set-point schedules, became less obvious. In addition, resource and time constraints combined, which resulted in the scaling back of the original infrastructure scope and the development of a minimum viable product (MVP) for SERVO Live & Flex, with focus on enabling the collection, storage, visualisation and provision of near real-time electricity network data (e.g. voltage, current and power) at particular points on the network.

This MVP dataset was considered critical in supporting analysis of the impact of this DER on the network under the flexibility use-cases to be trialled as part of the project, while also offering future potential for integration into any future congestion management engine development or as a feed into any future DERMS.

3. PROJECT ACTIVITY & RESULTS

ESB Networks and TSSG collaborated on the development of the 3 modules within the overall SERVO platform. This collaboration was a success and enabled the phased development and implementation of each, with SERVO Modeller preceding SERVO Live & Flex.

TSSG developed and tested each of the software components in its own Microsoft Azure environment and deployed them onto the test environment in the ESB cloud environment, from where internal ESB Networks teams subsequently implemented the software in ESB Network's pre-production and production environments in line with cyber security requirements and policies.

The project successfully delivered all elements of the SERVO Live & Flex MVP including:

- Configuration of an IOT Hub, to act as a secure gateway and endpoint for connection of devices and sensors on the electrical network, to ESB Network's Microsoft Azure cloud platform;
- Successfully connected LV Monitoring device sensors (updated with ESB security certs) to the IOT Hub gateway;
- Deployment and configuration of a time series database to receive and store message data from device sensors on the electricity network;
- Design, build, testing and deployment of Microsoft Azure functions to route, transform and store LV vision device and MQTT modem payload message format data, received through the IOT Hub Gateway, in the time series database;
- Development of real-time dashboards in Grafana to enable visualisation of data stored in the time series database;
- Configuration of the SERVO Flex API software and successful trialling of this through the API Gateway;

LV Monitoring Device Locations

Figure 1 below shows the location of LV monitors / sensors deployed on the Dingle Peninsula.

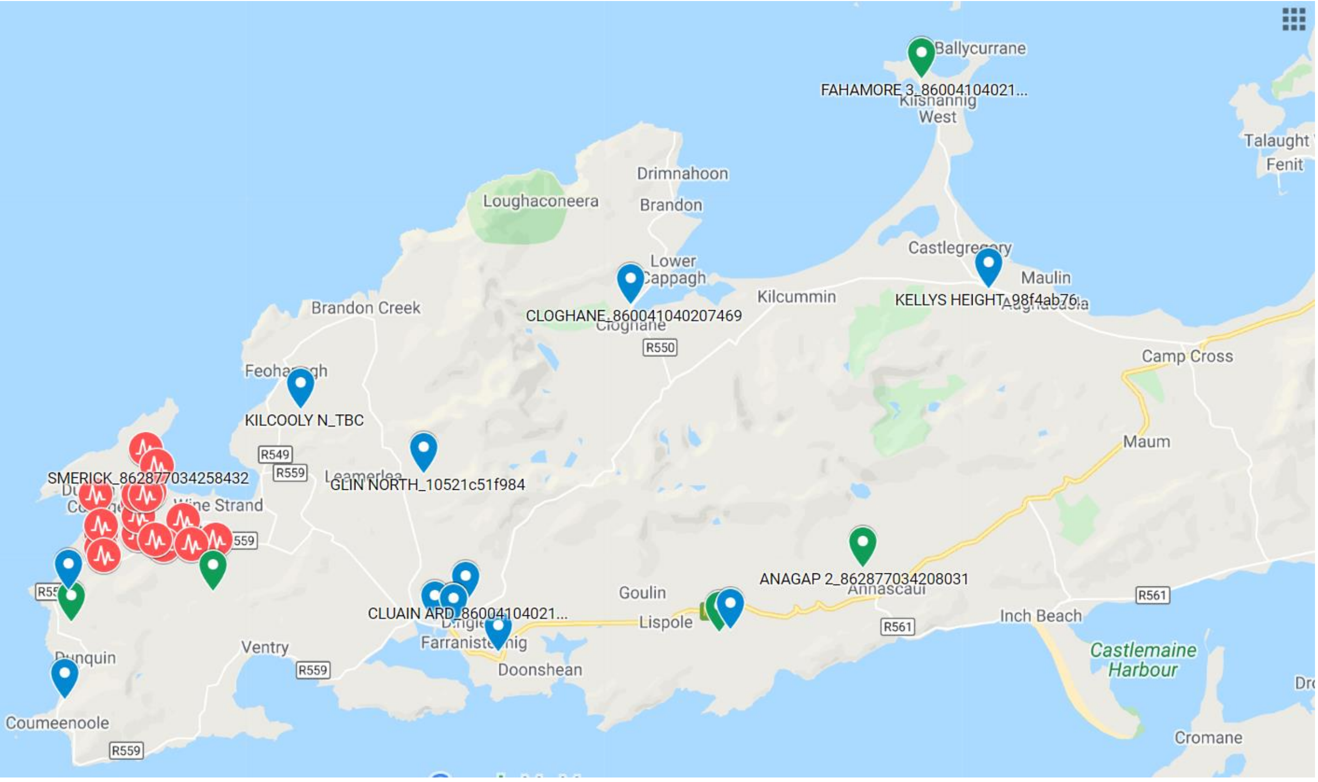

Figure 1 - Map highlighting locations of LV monitoring devices / sensors on Dingle Peninsula

The monitors installed as part of the StoreNet residential battery Virtual Power Plant project are shown in red. The monitors installed at LV/MV transformers feeding the Dingle Project Ambassador premises are highlighted in green. The LV monitoring devices deployed at the locations indicated by blue markers are deployed to monitor the transformers feeding the Solar PV and EV trial participants.

Role of LV Monitoring Devices

Figure 2 below shows a typical Pole Mounted MV/LV transformer location (circled in red) where a device has been installed to monitor the impact of distributed energy resources installed "behind the meter" at trial participant properties.

These electrical loads will, at times throughout the Dingle Electrification Project's Flexibility Trial, be controlled and their operation optimised by their accepting set-point signals issued from a third-party aggregator-type platform. The flexibility trials will seek to understand whether optimising the operation of these technologies, including EV chargers, ASHP's and batteries, can at times minimise their impact on, or provide supporting services to the local electricity network.

The LV Monitoring devices will capture network data before, during and after various flexibility scenario tests, so that their impact on the network can be subsequently analysed and visualised using the reporting dashboards enabled within SERVO Live.

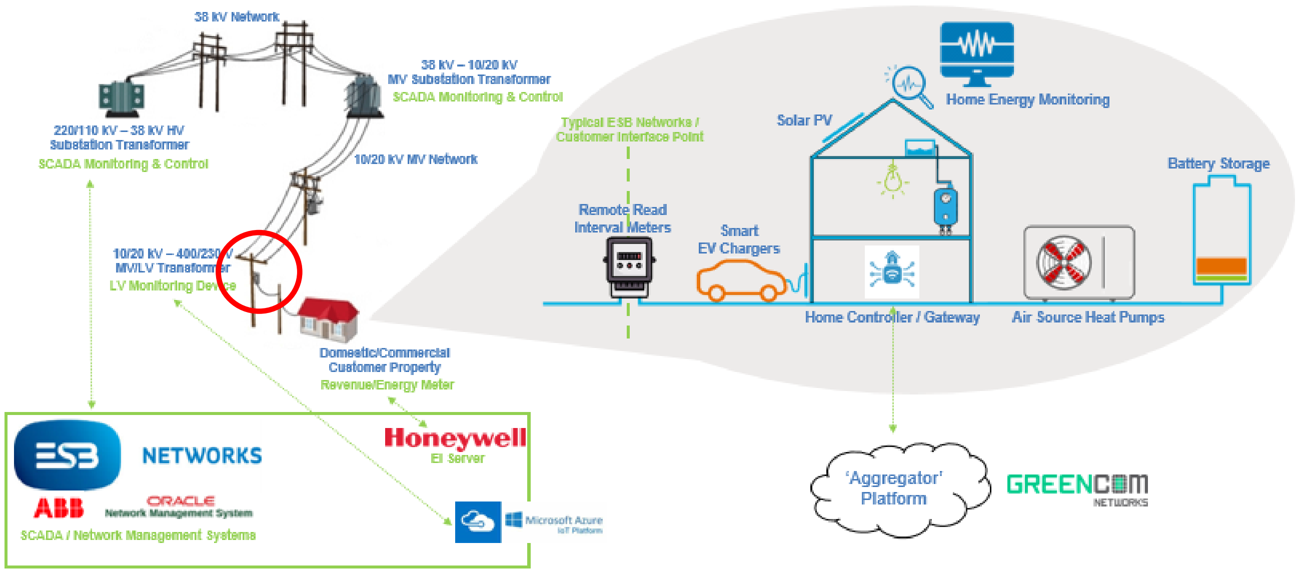

FIGURE 2 – LOCATION OF LV VISION DEVICES

SERVO Live & Flex Dataflows

Figure 3 below shows the flow of data from network devices / sensors through the IOT Hub and into the SERVO Live database. Elements of the toolset used to provide visualisation services are highlighted. The SERVO Flex API enables validated requests for data from outside the SERVO Live environment to return data to the requesting application, in a secure manner.

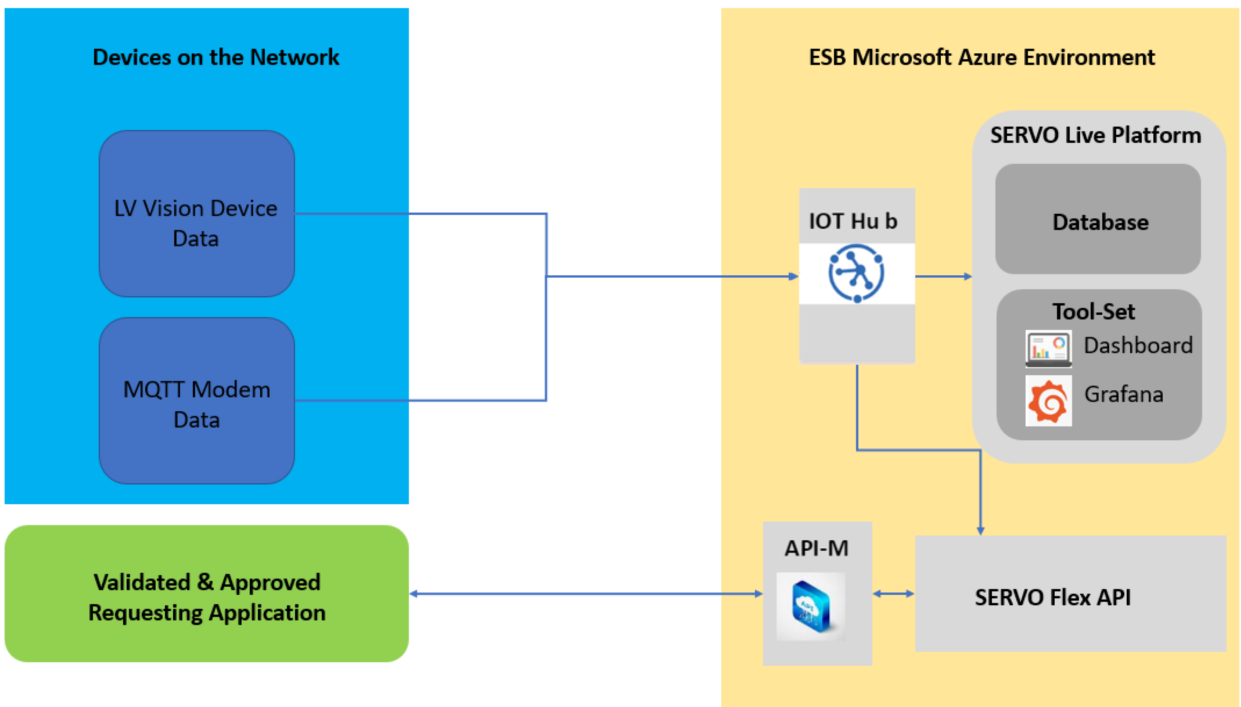

FIGURE 3 – SERVO LIVE & FLEX DATAFLOWS

Data Visualisation

To maximise the value of the SERVO Live data set, TSSG and ESB Networks collaborated on the development of a number of dashboards to present key data to the user in an understandable format. Visualisation of SERVO Live data is enabled through bespoke dashboards created using the Grafana data visualisation tool.

Figure 4 below shows a sample prototype dashboard, displaying various time series data points.

FIGURE 4 – SAMPLE GRAFANA DASHBOARD

4. LEARNINGS AND RECOMMENDATIONS

Technical learnings, relating to time series database deployment in the Microsoft Cloud environment, have been shared across the relevant ICT teams across the business.

The technical architecture designed for the Dingle Project has been recommended by ESB Networks' IT team as appropriate to support other IOT data collection and storage projects for ESB Networks. Specific Microsoft Azure functions can be developed to recognise payload data from other devices deployed on the network.

Open source toolsets, like Grafana, provide a simple technology solution to prototype visualisation dashboards. However, for future enduring, production standard business systems, the value of a more integrated database and visualisation solution should also be considered. This would greatly aid in the alignment and analysis of multiple data sets.

5. FINAL TIMELINES AND COSTS

SERVO Live & Flex project completed in Q3 2020. There were no CAPEX costs incurred as part of the project. The costs incurred for delivering the SERVO Live & Flex solution were time and expenses for ESB Networks' staff and consultants.

6. PROJECT TRANSITION

The project learnings and recommendations outlined in section 4 have been successfully shared and disseminated to the relevant business units in ESB Networks through several internal workshops. The SERVO Live and Flex systems have been successfully deployed onto ESB Networks Microsoft Azure cloud along with the management and maintenance of the system.

If you would like further information/data from this project, please contact us at innovationfeedback@esbnetworks.ie