Energy Networks Innovation Process

Project Closedown Report Document

Date of Submission: 28th July 2022

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Notes on Completion: Please refer to the NIA Governance Document to assist in the completion of this form. Please use the default font (Calibri font size 10) in your submission. Please ensure all content is contained within the boundaries of the text areas.

Project Title (*This cannot be changed once registered*)
Technical Interfaces to Scale as a DSO

Project Reference
NIA_SSEN_0040

Funding Licensee(s)
Scottish Hydro Electric Power Distribution

Project Start Date
September 2019

Project Duration
25 months

Year
2022

Nominated Project Contact(s)
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1. Scope

The project is reviewing international interfaces however the output is focused on solutions which are applicable to the GB. To inform this work, all investigated interfaces must be broad enough to cover a representative spread of currently deployed solutions as well as trialled future options. A subset of these interfaces and a number of their combinations, are then trialled to create a detailed specification that covers the hardware, software, communication and cyber security requirements of such an interface.

2. Objective(s)

This project will deliver:
1. A review of interfaces and end-point devices from international trials and deployments
2. A review of cyber security risks and impacts
3. A functional specification document in phase 1 to inform trial in phase 2
4. A trial at the PNDC to garner practical experience with the most promising interfaces
5. A detailed specification document for DSO interfaces built up from all the learning trials

3. Success Criteria

A thorough investigation of interfaces that have been trialled and deployed to understand their applicability to networks in the GB, in order to produce a shortlist of interfaces to trial.
Understand the cyber security implications of these interfaces.
A practical trial of the selected interfaces to understand the detailed implications of using them.
Creation of a specification for DSO interfaces for use in future use in BAU scenarios.

4. Performance compared to the original project aims, objectives and success criteria

Details of how the Project is investigating/solving the issue described in the NIA Project Registration Pro-forma. Details of how the Project is performing/performed relative to its aims, objectives and success criteria.

Project Background

This project aims to understand the requirements to safely and securely communicate with customer end point devices, such as domestic solar panels which can connect to and communicate with the network to increase or decrease their power input, enabling customers to benefit from local energy flexibility markets. This will enable more sources of energy at a localised level to offer their energy via flexible connections and flexibility services, thus enabling traditional energy customers to trade energy i.e. supply energy & / or alter demand. This will be at a small scale and a low cost due to the project utilising products that are off-the-shelf, i.e. logic boards rather than typical full-sized Remote Terminal Unit (RTU) cabinets.

Project Progress

All project deliverable reports mentioned below can be made available upon request by contacting: future.networks@sse.com

The following progress has been made against the deliverables:

1. **A review of interfaces and end-point devices from international trials and deployments**
   This has been completed through an investigation by Wipro who produced a report outlining possible communications protocols and architectures which could be used to securely communicate with customer end point devices. This was reviewed and used to inform the trials that were carried out by Smarter Grid Solutions (SGS) and the Power Networks Demonstration Centre (PNDC).

   Based upon the Wipro report several communication protocols were further assessed and analysed, focusing on their cyber security strength. The following protocols were subsequently trialled:
   OpenFMB Standard: Secure, open, scalable and interoperable protocol already in use by utilities and can be used via the public internet as well.
   OpenADR: One of the front running demand response standards for use via the public internet or through a VPN.
   DNP3: Other utility protocols are available, but DNP3 has been selected as the most expedient method to connect SGS's STRATA platform to the PNDC's instance of General Electric's PowerOn.

   The customer end point devices selected for trial were representative of similar small, low-cost, community supported development platforms available on the market. The devices selected were the "BeagleBone Black" (£40) and the "ONLOGIC CL210G-10" (£245).

2. **A review of cyber security risks and impacts**
   This was accounted for in a series of tests looking at the End Devices, SGS's 'Strata Grid' platform user interface and back-end tests. SGS's Strata platform is a DERMS (Distributed Energy Resource Management System) which is being used as our test environment to simulate DER (Distributed Energy Resource) connections & communications to the test devices in the trials. The testing has been informed by following the NIST (US National Institute of Standards and Technology) Cybersecurity Framework, which is one of the preferred international frameworks. A NIST Cybersecurity Risk Assessment was carried out by SSE IT staff to inform the trials.

   Due to the impact of Covid-19 the security model adopted by SSE has been restricted to considering threats and risks related to a proof of concept (PoC) capability with no opportunity for testing or validating of security controls. This involved the following activities:
   - Identifying a threat model reflective of a PoC environment to inform the supplier on the attack vectors relevant to the interfaces being built;
   - Identifying security risks relevant to the PoC environment based on NIST800-53 to determine applicable security controls;
   - Review of the security controls employed by SGS in delivering the PoC capability.

   A limited number of user access tests were carried out to demonstrate typical tests that are required on a production deployment. These included Access Control Tests, Two Factor Authentication Tests and User Interface Logout Tests.

3. **A functional specification document in phase 1 to inform trial in phase 2**
   This has been completed through an investigation by Wipro which produced a report outlining possible communications protocols and architectures. The report was reviewed and used to inform the trials that will be carried out by SGS and the PNDC. SGS & PNDC created their own trial design and trial specification documents to create tangible action plans that could be reviewed by the wider stakeholders.

4. **A trial at the PNDC to garner practical experience with the most promising interfaces**
   The trial was carried out as planned at the PNDC. The results from the trials are detailed in Section 7 'The Outcomes of the Project.'

5. **A detailed specification document for DSO interfaces built up from all the learning trials.**
   Due to mixed results from the trials, which left gaps in the learning required to create a specification, the specification was not created, and this objective was not met.

5. Required modifications to the planned approach during the course of the project

The Network Licensee should state any changes to its planned methodology and describe why the planned approach proved to be inappropriate. Please confirm if no changes were required

A change request was submitted in August 2020 to increase the project budget by £70,000. This was because tendering for suppliers to carry out the project work, cyber security resources, and facilities capable of hosting the trials had resulted in higher project costs than originally expected. Extra work was also required to make the project outputs suitable for review and future acceptance by industry standards organisation(s). This extra work included time and resources to engage a second, much larger, group of stakeholders and incorporate their feedback. It also included secondary reviews to remove commercially sensitive information in preparation for this more public forum. Further issues arose due to Covid-19, mainly around time delays. During the tender negotiations the project scope and payment schedules were altered to include a stage gate at the end of the desktop work (prior to the live trials) to assess how to safely continue.

6. Lessons learnt for future projects

Describe how the project (methodology, stakeholder engagement etc.) changed, or provided opportunities, from your expectation at the start of the project and therefore could be useful for a future project. In addition, please discuss the effectiveness of the research development or demonstration undertaken.

- IT access through the various organisations added complications to the testing and several extra steps in the trial process due to site access restrictions imposed due to the COVID19 pandemic. Staff had to access their respective organisation's IT real estate from home and then try to access the trial systems, which were connected to systems at the other organisation (whose engineers were likewise accessing it from home). Physical devices also had to be configured and transported between people's homes, rather than worked on jointly at a central lab/workspace. Future projects should pre-agree how work will continue if staff are required to work from home, with particular attention given to communications and IT requirements.
- Learning for DNOs carrying out similar IT/OT projects is that you need to commit significant internal resource to review and monitor the contractors carrying out the work to ensure they are aligning with our organisations', and the industry's, expectations and roadmaps. This is a large topic area that overlaps with a lot of other IT/OT topic areas, many of which aren't solely focussed on Network Operators (e.g., the British Standards Institute 'Energy Smart Appliances' work).

7. The outcomes of the project

When available, comprehensive details of the Project's outcomes are to be reported. Where quantitative data is available to describe these outcomes it should be included in the report. Wherever possible, the performance improvement attributable to the Project should be described. If the TRL of the Method has changed as a result of the Project this should be reported. The Network Licensee should highlight any opportunities for future Projects to develop learning further.

Key Learnings from the project:

1. For OpenADR and OpenFMB communication protocols, for the parts of the framework tested the test results show no major impediments to using any of the communication media/technologies in use today.
2. Each of the frameworks tested benefit from standardization and built-in cyber security. The testing showed that the frameworks would be able to cope with standard Distribution Network Operator (DNO) operations within a range of typical internal network deployments.
3. The project has highlighted a number of requirements for end-point devices and makes some recommendations on specifications..
4. For interfaces at scale, standardization of APIs (Application Programming Interfaces) and importantly authentication mechanisms are critical. Learning in this report details these requirements and extends into additional testing, which would be required for a large-scale deployment.

Significant work is still required at low TRL before this project topic can go above "demonstrator" to "live trials".

8. Data Access & Quality Details

A description of how any network or consumption data (anonymised where necessary) gathered in the course of the Project can be requested by interested parties. Please include a link to the publicly available data policy.

For information on how to request data gathered as part of this project see Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://ssen-innovation.co.uk/innovation-strategy/

9. Foreground IPR

A description of any foreground IPR that have been developed by the project and how this will be owned.

N/A

10. Planned implementation, recommendations or next steps

Please describe the next steps to implement this innovation project. What policies and standards need to be updated or created as part of this implementation.

Challenges still to be addressed in future projects:

1. **Scalability**: Investigate how systems using these protocols/frameworks would scale.
2. **Hardware Requirements:** Compare different hardware architectures for the customer end point devices to obtain a better understanding of their limitations.
3. **Computational Resources:** Investigating the required system resources on customer end point devices utilising light weight programming language (including cost of deployment).
4. **Security Architecture:** Explore use of a zero-trust architecture.

Related work, ongoing projects and market offerings in this area that could inform follow up projects:

1. **Customer participations via In Home Displays.** These initiatives use cost effective Internet of Things (IoT) technologies via home broadband connections to enable customer participation. The Core4Grid project in the UK with the companies Geo and UKPN serves as an example.
2. **IEC104 Security Proxy from PSI GridConnect** – This project's gateway exploits properties of the protocol to allow data to be passed out of SCADA networks to third parties.
3. **CLUE (Concepts, Planning, Demonstration and Replication of Local User-friendly Energy Communities) –** The project aims to implement a web of cell architecture for Distributed Energy Resource (DER) management and control. A key challenge in the project was to create an architecture that would meet the cybersecurity requirements of the different parties.
4. **PNDC projects (TCS-009 & 010) –** These projects are developing OpenFMB adaptors and hosting OpenFMB and OPC-UA cloudlets investigations along with a comparison between MQ Telemetry Transport (MQTT) and SparkPlug B messaging protocols to improve the overall latency and bandwidth requirements for the energy utilities.

11. Other comments

N/A

12. Standards Documents

Identify any industry standards that may require updating due to the outcomes or understanding developed from this innovation project. If no standards will need to be updated, please state - not applicable

N/A