WESTERN POWER DISTRIBUTION

OPEN LV

OPENING UP THE SMART GRID

PROJECT PROGRESS REPORT
REPORTING PERIOD:
JUNE 2017 – NOVEMBER 2017

ea technology

RIIO NIC NETWORK INNOVATION COMPETITION

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Contents

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Glossary

Term	Definition
Background IPR	Intellectual Property Rights owned by or licensed to a Project Participant at the start of a Project.
Customer Engagement Plan	The plan that the Network Licensee must submit to Ofgem setting out how it or any of its Project Partners, will engage with, or impact upon, Relevant Customers as part of the Project.
Distribution Network Operator (DNO)	Any Electricity Distributor in whose Electricity Distribution Licence the requirements of Section B of the standard conditions of that licence have effect (whether in whole or in part).
Expert Panel	A panel of independent experts who together provide knowledge and expertise under the following headings: energy network industries, environmental policy, technical and engineering, economics and financial and consumer interests. The panel is appointed by Ofgem to advise the Authority's decision making process on the selection of Projects for funding.
Foreground IPR	All Intellectual Property Rights created by or on behalf of any of the Project Participants, their sub-Licensees, agents and sub-contractors as part of, or pursuant to, the Project, including all that subsisting in the outputs of the Project.
Full Submission Pro-forma	A pro-forma which Network Licensees must complete and submit to Ofgem in order to apply for funding under the NIC.
Funding Licensee	The Network Licensee named in the Full Submission as the Funding Licensee, which receives the Approved Amount and is responsible for ensuring the Project complies with this Governance Document and the terms of the Project Direction.
Intellectual Property Rights (IPR)	All industrial and intellectual property rights including patents, utility models, rights in inventions, registered designs, rights in design, trademarks, copyrights and neighbouring rights, database rights, moral rights, trade secrets and rights in confidential information and know-how (all whether registered or unregistered and including any renewals and extensions thereof) and all rights or forms of protection having equivalent or similar effect to any of these which may subsist anywhere in the world and the right to apply for registrations of any of the foregoing.
ITT	Invitation to Tender
LV	Low Voltage
LV-CAP™	Low Voltage Common Application Platform.
NIC	Network Innovation Competition.

Project	The Development or Demonstration being proposed or undertaken.
Project Bank Account	A separate bank account opened and used solely for the purpose of all financial transactions associated with a NIC Project.
Project Direction	A direction issued by the Authority pursuant to the NIC Governance Document setting out the terms to be followed in relation to the Eligible NIC Project as a condition of its being funded pursuant to NIC Funding Mechanism.
Project Participant	A party who is involved in a Project. A participant will be one of the following: Network Licensee, Project Partner, External Funder, Project Supplier or Project Supporter.
Project Partners	Any Network Licensee or any other Non-Network Licensee that makes a contractual commitment to contribute equity to the Project (e.g. in the form of funding, personnel, equipment etc.) the return on which is related to the success of the Network Licensee's Project.
Project Supplier	A party that makes a contractual commitment to supply a product or service to the Project according to standard commercial terms that are not related to the success of the Project.
Relevant Background IPR	Any Background IPR that is required in order to undertake the Project.
Relevant Foreground IPR	Any Foreground IPR that is required in order to undertake the Project.
Successful Delivery Reward Criteria (SDRC)	The Project specific criteria set out in the Project Direction against which the Project will be judged for the Successful Delivery Reward.
WPD	Western Power Distribution

1   Executive Summary

The OpenLV Project "the Project" is funded through Ofgem's Network Innovation Competition (NIC) funding mechanism. The Project commenced in December 2016 and is scheduled to complete in April 2020.

The Project has three phases: 1) Mobilise & Procure, 2) Design & Build and 3) Trial, Consolidate & Share. This Report details the progress of the Project, finalising the first phase "Mobilise & Procure" and progress made in the "Design & Build" phase. This is the second Project Progress Report (PPR) for the Project and details progress on the last six months, June 2017 to November 2017.

1.1   Overall Project Progress

The key achievements in the reporting period are as follows:

- The final commercial agreements were put in place with Project Suppliers;
- The background infrastructure required for the overall OpenLV Solution was put in place;
- The first OpenLV platforms were built and tested;
- The overall OpenLV Solution successfully passed Factory Acceptance Testing (FAT);
- The Project website went live on 31st August 2017;
- The Project was formally launched at WPD's Balancing Act Conference on 5th October in London;
- The first major milestone Successful Delivery Reward Criteria (SDRC) report, SDRC-1: Specification, Design and Factory Testing of the overall OpenLV solution was delivered ahead of schedule on 25th October 2017;
- A Cyber Security assessment of the OpenLV Solution has been completed ahead of equipment being installed;
- WPD's network has been assessed to identify potential locations for the installation of the OpenLV Platforms to support trials under Method 1: Network Capacity Uplift;
- An assessment of the market potential for Community Engagement (Method 2) and OpenLV Extensibility (Method 3) has been completed;
- The Community Engagement Plan has been drafted; and
- Site Surveys have been completed to identify the site for the first 4 test installations ahead of wide scale deployment.

1.2   Business Case

At the time of writing, there have been no changes to the anticipated benefits to be gained by the Project.

1.3   Project Learning and Dissemination

Project lessons learned and what worked well are captured throughout the project lifecycle. These are captured through a series of on-going reviews with stakeholders and project team members.   These are reported in Section 8 of this report.

Key dissemination activity within the reporting period are as follows

- An overview of the OpenLV Project was presented to the National Infrastructure Forum in June 2017 and to 170 attendees at the WPD Balancing Act event where the Project was formally launched in October 2017.
- The Project website (https://openlv.net) went live on 31st August 2017. The following material is available from the website:
    - A leaflet that provides an overview of the Project;
    - The OpenLV Bid document and Project Direction;
    - The OpenLV Customer Engagement Plan;
    - The OpenLV Data Protection Strategy;
    - The OpenLV Public Application Programming Interface (API) document;
    - The OpenLV Measurement Points document;
    - SDRC 1: Specification, Design & Testing of the Overall OpenLV Solution; and
    - The first 6-month Project Progress Report covering December 2016 to May 2017.
- A slide introducing the OpenLV Project has been presented at 11 WPD community energy events organised by Regen on behalf of WPD.
- In terms of overall media coverage, as of 19th October 2017, the OpenLV Project appeared in 40 news items. Approximately 10 of these media items relate to the OpenLV Project team, however, the other 30 are a result of wider media coverage.

1.4   Risks

The OpenLV risk register is a live document and is updated regularly. A total of 45 risks have been raised, 14 of which have been closed, leaving a total of 31 live risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. Of the 31 live risks none are ranked as severe or major, 3 are ranked as moderate and 28 are ranked as minor.

2   Project Manager's Report

2.1   Project Background

The OpenLV Project "the Project" is funded through Ofgem's Network Innovation Competition (NIC) funding mechanism. The Project commenced in December 2016 and is scheduled to complete in April 2020.

The Project Partners are as follows: 1) Western Power Distribution (WPD): The Lead/Funding DNO (licensee); and 2) EA Technology: The 3rd Party Lead Supplier who is responsible for the overall delivery of the Project.

The Project has three phases and four work packages as shown in Figure 1. This Report details the progress of the Project, focussing on the last six months, June 2017 to November 2017. The reporting period is depicted on Figure 1 by the grey shaded box.
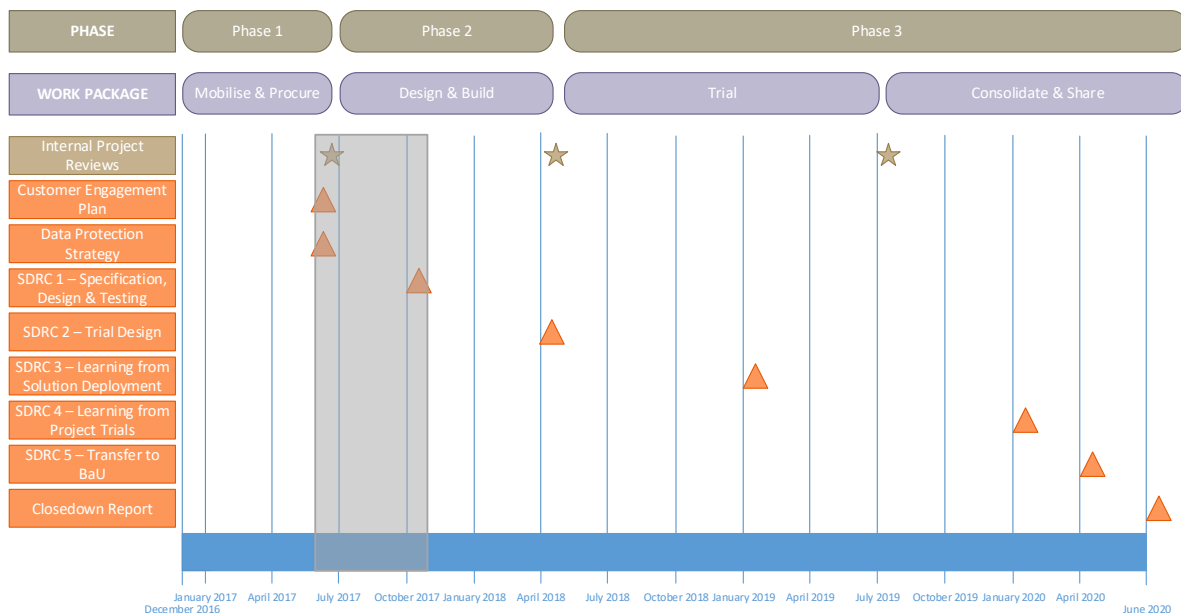
Figure 1: OpenLV Timeline[1]

2.2   Project Progress

2.2.1   Overall Progress

During this reporting period, the final actions to close off the Mobilise & Procure phase were completed and made significant progress in the Design & Build phase. The key achievements in the reporting period are as follows:

- The final commercial agreements were put in place with Project Suppliers;
- The background infrastructure required for the overall OpenLV Solution was put in place;
- The first OpenLV platforms were built and tested;

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[1] The Customer Engagement Plan and Data Protection Strategy were delivered in the previous reporting period.

- The overall OpenLV Solution successfully passed Factory Acceptance Testing (FAT);
- The Project website went live on 31st August 2017;
- The Project was formally launched at WPD's Balancing Act Conference on 5th October in London;
- The first major milestone Successful Delivery Reward Criteria (SDRC) report, SDRC-1: Specification, Design and Factory Testing of the overall OpenLV solution was delivered ahead of schedule on 25th October 2017;
- A Cyber Security assessment of the OpenLV Solution has been completed ahead of equipment being installed;
- WPD's network has been assessed to identify potential location for the installation of the OpenLV Platforms to support trials under Method 1: Network Capacity Uplift;
- An assessment of the market potential for Community Engagement (Method 2) and OpenLV Extensibility (Method 3) has been completed;
- The Community Engagement Plan has been drafted; and
- Site Surveys have been completed to identify the site for the first 4 test installations ahead of wide scale deployment.

2.2.2   Procurement

The final commercial agreements were put in place with Project Suppliers during the reporting period. The agreements were as follows:

- **Cyber Security:** NCC Group was awarded this role. The Sub-Contract and supporting Task Order was agreed with NCC Group on 25th September 2017; and
- **WeatherSense^{TM} Transformer Thermal Ratings app:** A licensing agreement with the University of Manchester was agreed on 25th October 2017. This licensing agreement enables the use of the Real Time Thermal Ratings (RTTR) algorithm developed by the University of Manchester on the OpenLV Project.

All the required commercial agreements for the Project are in place.

2.2.3   Design and Build

This phase of the Project includes setting up the overall OpenLV Solution as defined in the FSP [Ref. 1] and underpins the ability of the Project to test each of the proposed Methods. This phase will provide the overall OpenLV Solution to be trialled for each of the three Project Methods: 1) Network Capacity Uplift, 2) Community Engagement and 3) OpenLV Extensibility.

For reporting purposes, the progress under the Design & Build phase has been split into the following categories:

1) **Enabling Works:** Provides an overview of the work completed on the overall OpenLV Solution that will support the three Project Methods.
2) **Network Capacity Uplift:** Provides an overview of the work completed to support the Project trials under Method 1.
3) **Community Engagement:** Provides an overview of the work completed to support the Project trials under Method 2.
4) **OpenLV Extensibility:** Provides an overview of the work completed to support the Project trials under Method 3.

It is confirmed that the following progress, under the **enabling works** category has been made within the reporting period:

- The Application Deployment & Management Server, from Nortech Management Ltd, has been installed, set up and tested;
- The Cloud Hosted Server, from Lucy Electric GridKey, has been set up and tested;
- The first OpenLV Platforms have been built and tested;
- NCC Group has completed an initial cyber security assessment of the overall OpenLV Solution;
- The following information has been delivered in SDRC-1 Specification, Design and Factory Testing of the overall OpenLV solution:
  - Detailed Systems Architecture for the overall OpenLV Solution;
  - Requirements Specification for the overall OpenLV Solution;
  - The approach for testing the overall Solution ahead of deployment;
  - The results from successful Factory Acceptance Tests (FATs); and
  - Proposed Site Acceptance Tests (SATs).
- The first draft of the installation documentation for the OpenLV Platform has been completed;
- Work is underway to complete assembly of the 83 OpenLV platforms in preparation for widescale deployment in 2018;
- The Project website went live on 31st August 2017; and
- The Project was formally launched at WPD's Balancing Act Conference on 5th October in London.

The high-level architecture of the OpenLV solution is shown in Figure 2.
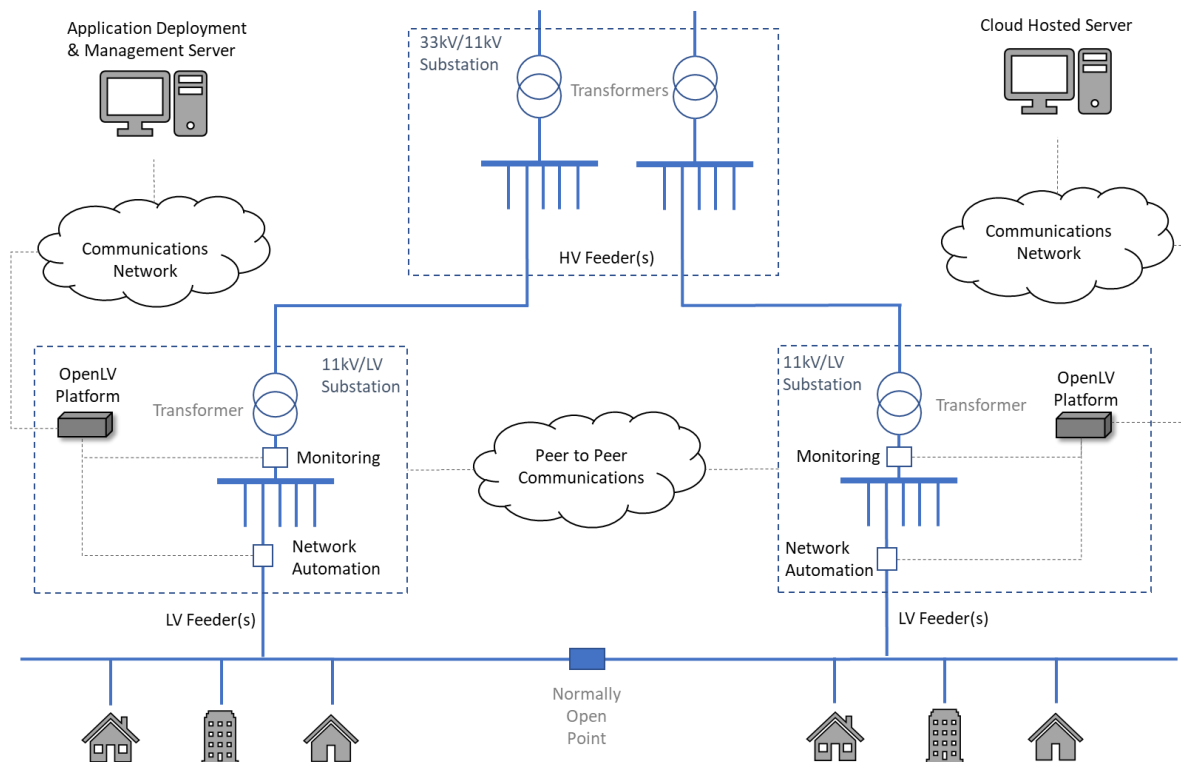

Figure 2: High Level Architecture

An overview of the inside of the OpenLV Platform is shown in Figure 3.
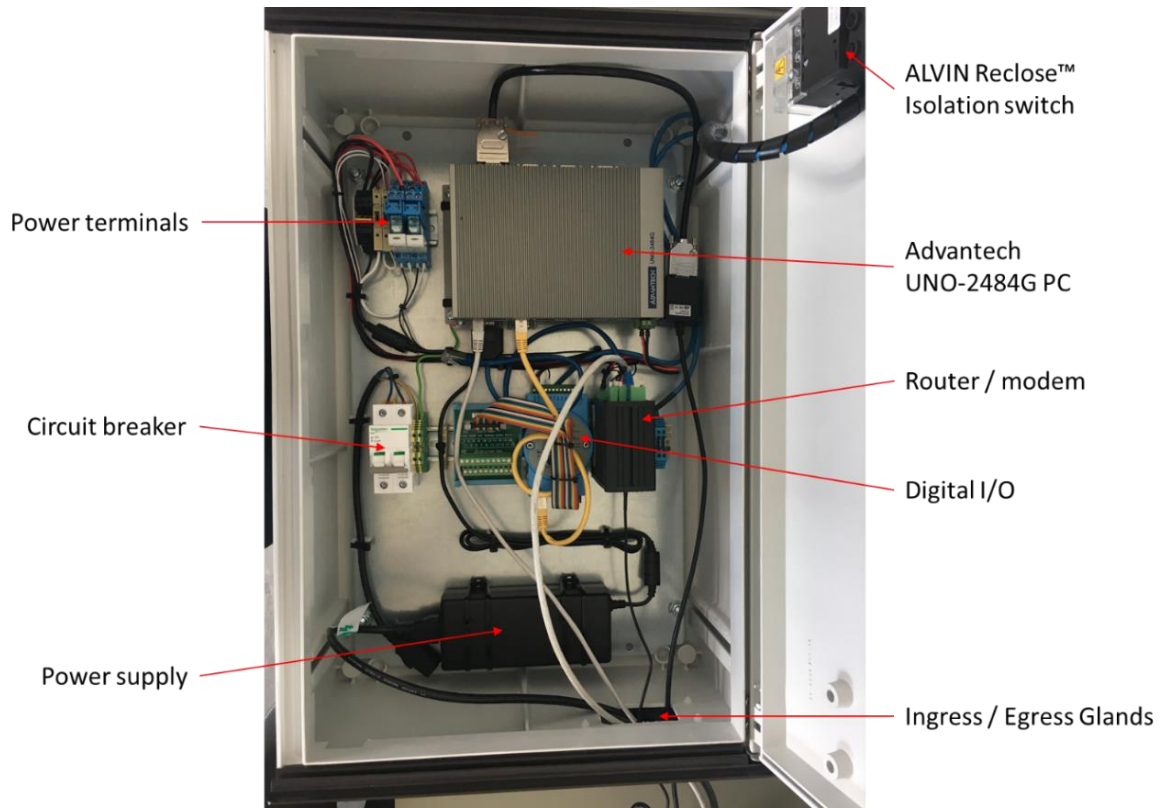

Figure 3: OpenLV Platform (inside)

An overview of the outside of the OpenLV Platform is shown in and Figure 4.
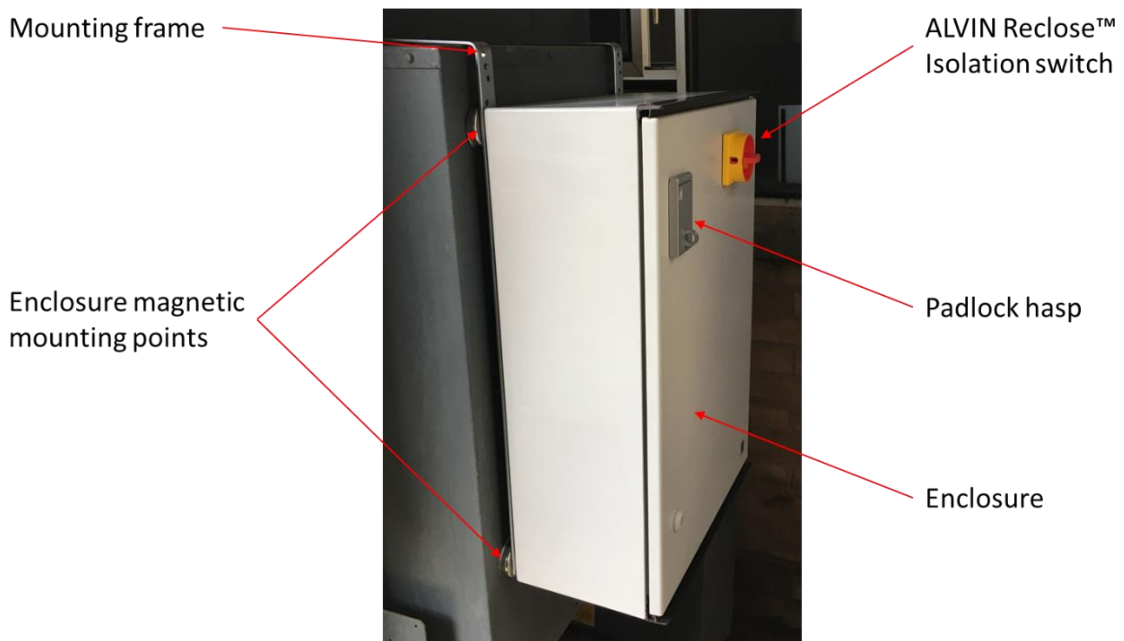

Figure 4: OpenLV Platform (outside)

An overview of the OpenLV software stack is shown in Figure 5. This shows that LV-CAP™ is a hardware agnostic operating system that enables cost effective deployment of smart grid products from multiple suppliers on a single set of hardware. Apps can be developed by multiple manufacturers and generate bespoke datasets and/or control various unrelated network assets without any application being influenced or affected by another. The apps that are being deployed have been coded in C++, Go and Java. It is also expected that Python will also be utilised for further apps.
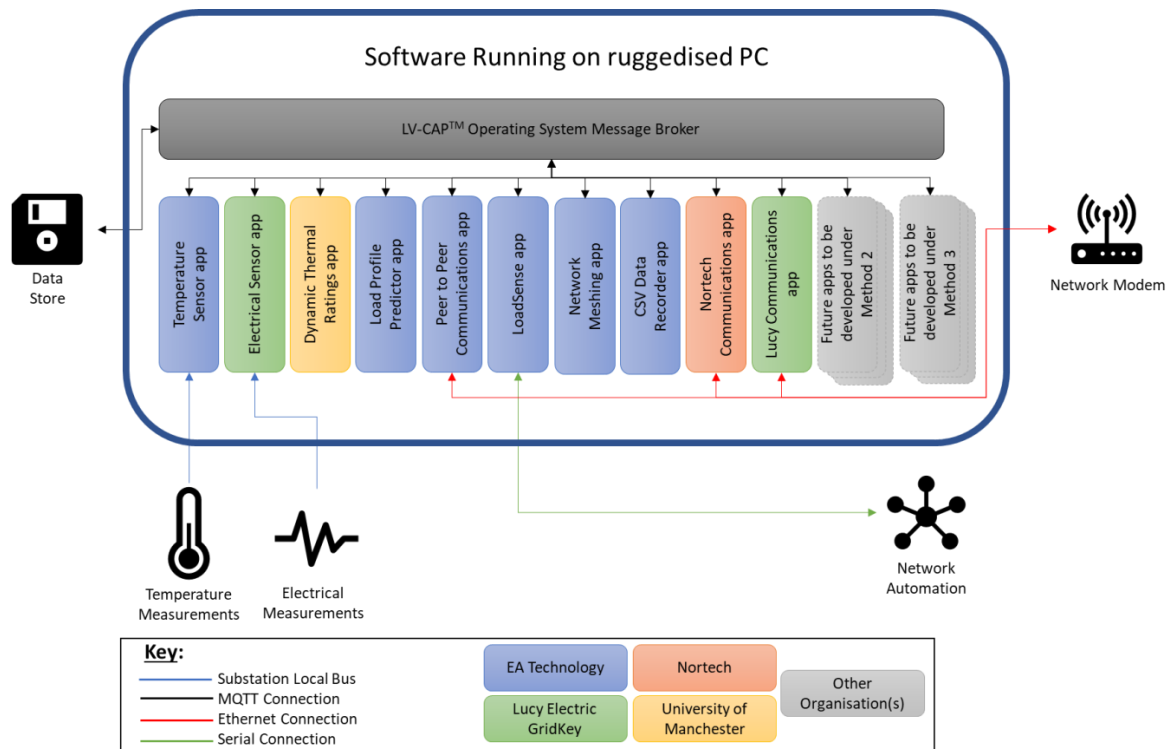
Figure 5: OpenLV Software Stack

It is confirmed that the following progress, under the **network capacity uplift** category has been made within the reporting period:

- A report detailing LV network requirements for the Method 1: Network Capacity Uplift sites has been issued;
- WPD's network has been assessed to identify potential location for the installation of the OpenLV Platforms to support trials under Method 1: Network Capacity Uplift. A total of 224 potential sites have been identified;
- The operational logic for the network meshing app, LoadSense™, that will be deployed for Method 1: Network Capacity Uplift has been agreed with WPD and the development of this app is underway; and
- The WeatherSense™ Transformer Thermal Ratings app is essentially exists from a previous InnovateUK project. This app incorporates the RTTR algorithm, developed by the University of Manchester and will need to be tested to ensure it works as part of the overall OpenLV solution. This app will be utilised as part of the Method 1: Network Capacity Uplift trials.

It is confirmed that the following progress, under the **community engagement** category has been made within the reporting period:

- CSE has completed an assessment of the market potential for the community engagement trials. This has confirmed initial interest from a total of 51 potential community groups;
- CSE has delivered the first draft of the Community Engagement Plan. This document outlines the plan for recruiting community groups for the OpenLV Project trials; and
- Regen has reviewed the assessment of the market potential completed by CSE. This is the first stage in Regen's work to ensure that the learning from Method 2 is maximised.

It is confirmed that the following progress, under the **OpenLV Extensibility** category has been made within the reporting period:

- EA Technology has identified the stakeholder groups to target; and
- EA Technology has completed an assessment of the market potential for the OpenLV extensibility trials. This has confirmed initial interest from a total of 51 potential trial participants.

2.2.4   Key Issues

The following key issues were encountered and managed within the reporting period:

- **Commercial:** Finalising the sub-contract and task order with NCC Group has taken much longer than planned. This was mainly due to the non-standard terms and conditions associated with NIC Projects. In this case the timescales for some deliverables have been re-scheduled but this has not had a significant impact on the overall Project plan;
- **Commercial:** Finalising the licence agreement for the RTTR algorithm with the University of Manchester has taken much longer than planned. This was due to a number of reasons: 1) The University needed to formally register the IP generated from the InnovateUK Project, which took longer than expected and 2) It took longer than expected to agree the terms for licensing the RTTR algorithm; and
- **Delivery:** It took longer than expected to build the Lucy Electric GridKey communications and electrical sensor apps, as a result, multiple FATs were completed. The SAT date has been re-scheduled to account for this. It is not expected that this will have an impact of the start date for Project trials. However, the time that the initial four OpenLV Platforms are installed in the field ahead of full roll out will be reduced; and
- **Delivery:** There has been a one-month delay in the delivery of core LV monitoring components. The LV monitoring components were scheduled to be delivered by November 2017 to enable the full build of all the OpenLV Platforms to be completed in December 2017. The LV Monitoring components will now be delivered in December 2017 which means the OpenLV Platforms will not be built until January 2018. This means that the full installation of the 60 units under Method 1 will be later than originally planned.

However, the project team is planning to resource installation works accordingly to enable the Method 1 trials to commence in March 2018.

2.2.5   Deliverables

The following key deliverable was completed in this reporting period: SDRC-1: Specification, Design and Factory Testing of the overall OpenLV solution. This document was delivered ahead of schedule on 25th October 2017.

2.3   Outlook to the Next Reporting Period

During the next reporting period the Project will continue to complete key tasks within the Design & Build phase. The project team will be focussed on the following activities:

- Installing the first four OpenLV Platforms in the field;
- Site Acceptance Testing (SAT) of the overall OpenLV Solution;
- Building and testing the OpenLV Platforms to ensure they are available for installation for all Methods;
- Delivery of SDRC 2.1: Community Engagement Plan & Assess markets for Methods 2 & 3;
- Delivery of SDRC 2.2: Detailed Trial Design for all Methods;
- Site selection and installation of the 60 OpenLV Platforms for Method 1: Network Capacity Uplift;
- End-to-end cyber-security assessment of the overall OpenLV Solution;
- Promoting the Project to attract potential trial participants for Methods 2 and 3, community engagement and OpenLV Extensibility;
- Selecting trial participants for Methods 2 and 3, community engagement and OpenLV Extensibility; and
- If applicable start developing apps for Methods 2 and 3, community engagement and OpenLV Extensibility.

3   Business Case Update

At the time of writing, there have been no changes to the anticipated benefits to be gained by the Project.

4   Progress Against Plan

4.1   This Reporting Period

Table 1 summarises the progress in this reporting period against the project plan. Key issues encountered during the reporting period are provided in Section 2.2.4.

Table 1: Progress Against Plan

Item	Milestone Description	Status	Due Date	Actual Completion Date	Revised Due Date
1	Method 1 Initial report issued - detailing LV network requirements	Complete	30/06/17	16/08/17	N/A
2	Report - Following assessment of status of LV-Cap™ from InnovateUK	Complete	30/06/17	17/08/17	N/A
3	Formal licencing agreement with the University of Manchester for WeatherSense™ Transformer RTTR (DTR App)	Complete	30/06/17	25/10/17	N/A
4	Agree Contract & Task Order with Cyber Security Specialist	Complete	30/06/17	25/09/17	N/A
5	Develop & agree installation documentation with Western Power Distribution	Complete	31/07/17	06/12/17	N/A
6	Factory Acceptance Testing (FAT) of the overall OpenLV Solution	Complete	31/07/17	16/08/17 & 21/09/17	N/A
7	Method 3 - Finalise report outlining the market potential	Complete	24/08/17	17/11/17	N/A
8	Design & Implement Project Website	Complete	13/09/17	31/08/17	N/A
9	Site Acceptance Testing (SAT) of the overall OpenLV Solution	Not Started	20/09/17	N/A	Dec-17
10	High-level threat model creation and cyber-risk assessment	Complete	18/10/17	06/12/17	N/A
11	SDRC 1: Specification, Design & Testing of the Overall OpenLV Solution	Complete	27/10/17	25/10/17	N/A
12	Method 1 - Target networks and sites identified	Complete	15/11/17	26/10/17	N/A

There is one item that was scheduled to be completed within this reporting period that has not been completed. The installation of the first OpenLV Platforms is scheduled to take place on 11th and 12th December, SAT will be completed following installation. At the current time, the later than planned completion, of this task has no impact on the key SDRC milestone delivery dates.

4.2   Next Reporting Period

Table 2 summarises the key planned activities for the next reporting period. Description(s) of key planned activities for the next reporting period are provided in Section 2.3. Items 1 and 2 were scheduled to be completed within this reporting time period but have been re-scheduled. It is confirmed that re-scheduling these items has had no impact on key deliverables.

Table 2: Progress Against Plan

Item	Milestone Description	Status	Due Date	Revised Due Date
1	Site Acceptance Testing (SAT) of the overall OpenLV Solution	In Progress	20/09/17	Dec-17
2	Detailed Trial Design for all Methods	Not Started	13/12/17	09/02/18
3	All LV network hardware available for installation	In Progress	13/12/17	31/01/18
4	SDRC 2.1: Community Engagement Plan & Assess markets for Methods 2 & 3	In Progress	31/12/17	N/A
5	All Equipment for Method 1 Installed	Not Started	15/02/18	30/03/18
6	Network Capacity Uplift Trials (start)	Not Started	16/03/18	02/04/18
7	End-to-end cyber-security assessment of complete functioning system	In Progress	12/04/18	N/A
8	SDRC 2.2: Detailed Trial Design for all Methods	In Progress	30/05/18	N/A

5   Progress Against Budget

Table 3 shows the baseline budget as outlined in the FSP.

Table 3: Progress Against Budget

Cost Category	Total Budget £k	Expected Spend to Date Nov-17	Actual Spend to date Nov-17	Variance £	Variance %
Labour	267.3	99.4	33.8	65.5	66%
Equipment	853.6	567.0	645.4	-78.4	-14%
Contractors	3775.1	1720.8	1167.9	552.9	32%
IT	2.5	0.2	1.5	-1.3	-656%
IPR Costs	0	0	0	0	0%
Travel & Expenses	29.7	11.0	3.8	7.3	66%
Payments to Users	0	0	0	0	0%
Contingency	451.5	451.5	0	451.5	100%
Decommissioning	66.0	0	0	0	0%
Other	0	0	0	0	0%
TOTAL	5445.7	2849.9	1857.5	992.4	

In terms of the variances shown two line items are in excess of the 5% threshold and require explanation. The explanations are as follows:

- **Equipment:** Orders for equipment have been placed earlier than scheduled in order to reduce the risk of late delivery of individual components and to progress work within the Design & Build phase as soon as possible; and
- **IT:** The FSP spread the IT costs across 3 financial years: 1) 2017/218 included a £290 budget, 2) 2018/2019 included a £1,760 budget and 3) 2019/2020 included a £440 budget. Following Project award, the IT costs have hit earlier in the Project than originally planned at bid stage.

6 Bank Account

The bank account statement for the project, for the reporting period is provided in a separate confidential Appendix.

7   Successful Delivery Reward Criteria (SDRC)

Table 4 details the status of each SDRC outlined in the Project Direction [Ref. 2]. SDRC 1: Specification, Design and Factory Testing of the overall OpenLV Solution was delivered within the reporting period. SDRC 2.1: Community Engagement Plan & Interim Results of Assessing Market Potential (Methods 2 & 3) is currently being drafted and is on schedule to be delivered by 31st December 2017.

Please note that all SDRCs that are currently flagged as 'Not Started' were not planned on being underway at this point in the Project and so should be considered as on-schedule.

Table 4: SDRCs to be completed

SDRC	Description	Due Date	Status
SDRC 1	Specification, Design and Factory Testing of the overall OpenLV Solution	27/10/17	Delivered
SDRC 2.1	Community Engagement Plan & Interim Results of Assessing Market Potential (Methods 2 & 3)	31/12/17	In Progress
SDRC 2.2	Identification of Target Networks (Method 1), Update of Assessing the Market Potential (Methods 2 & 3) and Detailed Trial Design for all Methods	30/05/18	Not Started
SDRC 3	Learning from Deployment of the Overall OpenLV Solution & Standard Guidelines for Application Development	01/02/19	Not Started
SDRC 4	Learning Generated from the OpenLV Project Trials for All Methods	31/01/20	Not Started
SDRC 5	Knowledge Capture, Dissemination & Transferring the OpenLV Solution to Business as Usual	30/04/20	Not Started

8 Learning Outcomes

8.1 Learning Outcomes

The high-level learning outcomes recorded within the reporting period have been categorised under the following headings:

- Commercial & Project Management;
- Enabling Works; and
- The Project Methods, 1) Network Capacity Uplift, 2) Community Engagement and 3) OpenLV Extensibility.

8.1.1 Commercial & Project Management

The commercial and project management learning points recorded within the reporting period are as follows:

➤ **Commercial:** The commercial agreements with NCC Group and the University of Manchester (UoM) took longer to put in place than scheduled. This shows the importance of really pushing to get the agreements signed. The longer it takes to get agreement the higher the likelihood is that there will be a negative impact on the project plan/deliverables.

➤ **Project Management:** Having a Project set up meeting with all project suppliers, following the award of tenders, is extremely valuable for the overall project. It ensures that all Suppliers have a common understanding of the key project objectives, understand the scope of works for each individual supplier and gives Suppliers a chance to meet face to face. This in turn helps to establish a cohesive project team.

➤ **Project Management:** It is important to ensure that you engage with the right people, both at bid stage and post award, within the DNO/DSO organisation to ensure the long-term success of the project and enable personnel within the business to challenge the proposed innovation. In the case of OpenLV this includes: 1) Installation, 2) Policy and 3) IT security personnel.

➤ **Project Management:** Getting a commercial agreement in place with the University of Manchester took much longer than expected. Direct engagement between the Project Manager and the Supplier has led to a potential resolution. Direct communication via telephone rather than relying on email has been key. This along with understanding the relationships/responsibilities between departments within the University has helped to resolve outstanding issues.

➤ **Project Management:** Supplier management – Using agreed escalation routes in the right way, for example, one to one email communication to ensure the issues are recorded in writing along with telephone calls between key staff is key. This helps to ensure you get what is required to successfully deliver the project and help continue a productive on-going relationship for the duration of the project.

➤ **Project Management:** A flexible approach is required to managing the programme, particularly when scheduling deliverables from multiple Suppliers with dependencies between them. The need for change reflects the fact the original delivery plan was developed at bid stage well before any commercial agreements were put in place.

8.1.2   Enabling Works

The learning points recorded within the reporting period as part of the enabling works for the overall OpenLV Solution are listed below. The learning points have been recorded under the following titles: Specification, Design, Build and Test.

- **Specification:** It is better to over specify core components, for example the ruggedised PC, when trialling new systems to ensure you have sufficient computational processing power and storage space to support Project trials.
- **Specification:** It is important to ensure the hardware specified fully supports the software you want to implement. In the case of LV-CAP™ operating system it is possible to run the software utilising an ARM chipset rather than an Intel chipset. However, the LV-CAP™ environment relies upon Docker, which is not yet fully supported on the (cheaper) ARM hardware. As a result, an Intel chipset was specified to reduce technical risks for implementation.
- **Specification:** What is seen as a single, simple, requirement from an end user perspective may require more than one Application to deliver it, and so trigger numerous technical requirements which must be cross-referenced.
- **Specification:** It is important to utilise known, existing, tried and tested techniques to capture software requirements. For OpenLV we utilised the MoSCoW approach.
- **Specification:** The sensors specified and the time intervals at which they are sampled will affect what applications it is possible to run on the system. It may be desirable to over-specify sensors to provide for future Application requirements.
- **Design:** It is important to ensure that the systems deployed for innovation trials are sufficiently secure. In the case of OpenLV, NCC Group were awarded this role and part of their scope of works is to ensure that the cyber security elements of the proposed trial solution are fit for purpose, both within the context of the trials and eventually business-as-usual deployment (BaU)of an LV-CAP™ type platform..
- **Design:** It is important to ensure that the hardware is designed to enable it to be installed in a number of different ways. The space available for hardware and the mounting requirements for the OpenLV Platform and associated LV monitoring hardware will vary on a site by site basis. As a result, the OpenLV Platform has been designed to be mounted in a number of different ways (magnetic, floor and wall mount).
- **Design:** To reduce technical risks, off the shelf hardware has been used where possible. For example, the ruggedised PC is an off the shelf piece of hardware that is available from multiple suppliers. In addition, the LV monitoring hardware has already been deployed by WPD in a BaU scenario as have the ALVIN Reclose™ devices.
- **Design:** Safety of on-site maintenance personnel is key and needs to be considered when designing new hardware to trial on innovation projects; with this in mind the OpenLV Platform enclosure has been designed to include an isolation switch for the ALVIN Reclose™ devices. This ensures that on site personnel can isolate these devices locally when working on site.
- **Design:** The decision to utilise a dedicated private APN for the OpenLV Project trials was taken, rather than using a shared private APN. This improves the security of the overall solution.

➢ **Build:** The approach to building the overall OpenLV solution was to focus on building the core functionality first and then adding additional functionality later. This is reflected in the approach to testing and implementation. This enabled the Project team to focus on delivering core functionality, testing it and then building on this foundation. This approach gets a core system built earlier allowing testing to start earlier in the programme, reducing the technical risks of deployment.

➢ **Build:** The LV-CAP™ operating system is based on a Docker systems architecture. This enables flexibility when building the overall solution. This architecture means that software, or in the case of OpenLV, Apps, from multiple vendors can be packaged into separate 'containers'. The core advantage of this is that the containers are designed to run on a shared operating system.

➢ **Build:** The LV-CAP™ environment enables developers to write apps in any programming language. This has enabled the overall platform to be built up quickly and easily utilising apps developed by multiple vendors using various programming languages (C++, Java and Go).

➢ **Build:** Although LV-CAP™ allows the use of a wide range of programming languages, it still imposes restrictions on the memory usage, processor usage and storage space available to Applications. These restrictions must be clearly communicated to developers at an early stage.

➢ **Build:** The main limit on the storage size of Applications is the reliability and cost of deploying them to all required sites over mobile data networks.

➢ **Build:** Prior to the deployment of any trial system of this nature it is critical to complete a cyber security review of the proposed solution prior to installation. In the case of OpenLV, NCC Group has completed an assessment of the proposed solution and has confirmed that the OpenLV Platform can be deployed for field trials.

➢ **Test:** A dedicated test rig was built to enable testing of two development OpenLV Platforms. This test rig includes relevant sensors (temperature, voltage and current) to provide data inputs to the test system. This test rig was built as early as possible within the programme to enable both software and hardware components to be soak tested for as long as possible prior to installation.

➢ **Test:** Having a controlled test rig in a laboratory environment allows defined inputs (currents, voltages and temperatures in this case) to be applied and the outputs verified. Where necessary scaling and unit issues can be resolved under laboratory conditions. This would be very difficult to achieve in a field situation on a live network.

➢ **Test:** Formally defining the requirements for the overall solution is key to ensure that the FAT and SAT documents test each of the individual Project requirements. Both the FAT and SAT documents refer back to the specific requirements to ensure relevant tests are completed at each stage.

8.1.3 The Project Methods

The learning points recorded within the reporting period as part of the project methods are outlined below. The learning points have been recorded under the following titles: Network Capacity Uplift (Method 1), Community Engagement (Method 2) and OpenLV Extensibility (Method 3).

Network Capacity Uplift (Method 1)

➢ **Substation Construction** Substations in given areas tend to be constructed in the same way, through being designed and manufactured at the same time or within a close time period. A predominance of ground mounted package substations in some areas precludes them from use in the trials as space is likely to be highly limited for the LV-CAP™ enclosure. It is also highly unlikely that ALVIN Reclose™ devices could be installed.

Community Engagement (Method 2)

➢ **Community groups engagement:** Community groups have required a tailored engagement approach in terms of imagery and style of communications. This has been critical to engagement success in terms of understanding the appetite from community groups to take part in the project;

➢ **Marketing:** The scope of the marketing materials' requirement under Method 2 has been reviewed in light of the need that has emerged for more direct engagement via telephone and one-to-one contact in the next stage of engagement, post initial survey, rather than the originally perceived need for bespoke leaflets for the community groups;

➢ **App ideas:** Community groups proposing potential app ideas under the banner of "policy, planning and retrofit programmes" has been a surprise. This is not an area that was covered in the initial list of six potential app ideas when the survey was sent out. A total of five app ideas have been received under this title (11% of the total). An example includes, using the data to input to neighbourhood development planning. These ideas will be considered as part of the project going forward;

➢ **Wider stakeholder engagement:** There were a number of stakeholder groups that were not targeted in the first round of engagement, such as local authorities and Housing Associations. These 'additional' stakeholder groups will be contacted to encourage a wider range of responses as a result of this learning;

➢ **Assessment criteria:** Engagement with community groups going forward should follow development of clear assessment criteria for reviewing app ideas that take into account the barriers, issues and risks set out in the Regen market potential assessment report; and

➢ **Identification of beneficiaries and specific value streams:** Asking community groups to identify beneficiaries and specific value streams to form the basis of their business case in their response to the Expression of Interest will support extrapolation of learning going forward; the learning here is that this was too complex to be included in the initial survey going out to community groups. This may require some guidance and support from CSE.

OpenLV Extensibility (Method 3)

- **Intellectual Property:** A number of organisation expressed concerns about giving up their ideas for potential apps. As a result, a Non-Disclosure Agreement (NDA) has been utilised where applicable;
- **Internal resourcing:** Seven organisations outlined that they may not be able to commit the resource to developing an app for the project due to internal resource constraints. However, a number of organisations stated that should an internal investment case be identified, then the resource issues may be resolved;
- **Internal Investment Case:** Six organisations outlined that the business case for committing resource to developing an app to the project needed to be fully assessed before resources could be committed;
- **Further information required:** Two organisations outlined that they would like to gather more information on the project before making a commitment to develop an app;
- **Insufficient internal skill set:** Two organisations thought their internal skill set would limit their ability to develop apps; and
- **What are WPD's plans for roll out?** Two organisations wanted to gain further information on the potential scale of the roll out for the OpenLV Platform before making a commitment to developing an app.

8.2   Learning Dissemination

The following dissemination activities have been completed within the reporting period:

- WPD are presented an overview of the OpenLV Project at the National Infrastructure Forum on 13th June 2017 in London.
- The Project website (https://openlv.net) went live on 31st August 2017 and includes a short video providing an overview of the OpenLV Project.
- The Project website also hosts two other videos one previously developed by WPD which provides an overview of Smart Grids and a link to a video developed by Ofgem providing an overview of the energy network. Both these videos provide relevant context for the OpenLV Project.
- The following documents have been published on the OpenLV Website:
    - A leaflet that provides an overview of the Project;
    - The OpenLV Bid document and Project Direction;
    - The OpenLV Customer Engagement Plan;
    - The OpenLV Data Protection Strategy;
    - The OpenLV Public Application Programming Interface (API) document;
    - The OpenLV Measurement Points document;
    - SDRC 1: Specification, Design & Testing of the Overall OpenLV Solution; and
    - The first 6-month Project Progress Report covering December 2016 to May 2017.

- The Project was formally launched at WPD's Balancing Act Conference on 5th October 2017 in London. The delegate list for this event included 170 attendees from across the industry. The Project Team presented an overview of the OpenLV Project during an hour-long session dedicated to the OpenLV Project.
- WPD has held a number of community events/workshops during the reporting period and a slide introducing the OpenLV Project has been presented at each of the following events organised by Regen:
    - Vulnerable Customers Workshop, Birmingham, 12th September 2017;
    - Vulnerable Customers Workshop, Cardiff, 13th September 2017
    - Peer Power Feast, Dorset, 28th September 2017;
    - Smart Community Energy Systems, Nottingham, 11th October 2017;
    - Smart Community Energy Systems, Cardiff, 18th October 2017;
    - Electricity Network Innovation, London, 1st November 2017;
    - Electricity Network Innovation, Newcastle, 7th November 2017;
    - Peer Power Arts Energy Event, Dorset, 9th November 2017;
    - Taking the power back, an energy jamboree about social justice and making our energy system smarter, Plymouth, 15th November 2017;
    - EWiRE A smart decentralised system, London, 16th November 2017; and
    - Renewable Futures and Green Energy Awards, Bath, 28th November 2017.
- A meeting was held with representatives from the Department for Business, Energy and Industrial Strategy (BEIS) to provide them with an overview of the OpenLV Project, in London, on 15th August 2017.
- EA Technology are undertaking discussions with all GB DNOs regarding LV-CAP™ as a potential long term solution for monitoring on LV networks, the OpenLV project has a key role to play, and the links have been made.
- An overview of the OpenLV Project was presented at the UN Climate Change Conference in Bonn Germany during November 2017.
- In terms of overall media coverage, as of 19th October 2017, the OpenLV Project appeared in 40 news items. Approximately 10 of these media items relate to the wider OpenLV Project team, however, the other 30 are a result of wider media coverage.

9 Intellectual Property Rights

9.1 Overall IP Statement

Table 5 outlines the details of the Background IP that will be brought to the Project and the Foreground IP that either will or could be generated on the Project. One item has been added to the IP Register during this reporting period (IP016).

Table 5: IP Summary

IP No.	Description	Detail of IP	IP Type	IP Created By	IP Assignment
IP001	Core LV-CAP™ system	Comprising the operating system image including Internal API, 3rd Party Developer API (v1.0) and the following containers: MQTT, Data Storage, Sensor Reads, Container Manager	Background	EA Technology & Nortech	EA Technology[2]
IP002	LV-CAP™ Comms. Container (Method 1)	Comprising of the Nortech iHost comms. container	Background	Nortech	Nortech
IP003	iHost (Application Deployment Server Method 1)	Pre-Existing iHost platform	Background	Nortech	Nortech
IP004	Container Management from iHost (Method 1)	Development of iHost capability to manage & deploy container	Background	Nortech	Nortech
IP005	Cloud Based Hosted Platform (Method 2 & 3)	Existing Lucy Electric GridKey platform	Background	Lucy Electric GridKey	Lucy Electric GridKey
IP006	LV-CAP™ Comms. Container (Methods 2 & 3)	Comprising of the Lucy Electric GridKey communication container	Background	Lucy Electric GridKey	Lucy Electric GridKey

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[2] Pre-existing commercial agreement in place between EA Technology and Nortech for this purpose

IP007	WeatherSense^TM Transformer RTTR (DTR App)	EA Technology implementation of University of Manchester algorithm	Background	EA Technology & University of Manchester	TBC
IP008	LoadSense™ the LV Control App for Method 1 (Network Meshing App)	Application developed on the Project to enable automation of LV network meshing	Foreground	Western Power Distribution (via EA Technology)	GB DNOs
IP009	3rd Party App Containers (Methods 2 and 3)	To be defined on the Project	To Be Confirmed	Dependent upon funding mechanism	App developer / funder
IP010	LV-CAP™ API v2.0	A second iteration of the API to allow third party Apps to be created on the LV-CAP™ platform following learning from Methods 2 and 3	Foreground	Western Power Distribution (via EA Technology)	GB DNOs
IP011	Method 1 Communication Container	Development of the iHost communications container and iHost server to enable the wide scale deployment of LV-CAP™ for the OpenLV project.	Relevant Foreground	Nortech	Nortech
IP012	GridKey LV Monitoring Equipment	Use of the Lucy Electric GridKey "substation monitoring equipment" as part of the overall OpenLV solution	Relevant Foreground	Lucy Electric GridKey	Lucy Electric GridKey

IP013	Method 2 & 3 Communication Container	Development of the Application container to enable communication between the LV-CAP™ platform and the Lucy Electric GridKey platform (allowing extraction of data through network monitoring and system updates)	Relevant Foreground	Lucy Electric GridKey	Lucy Electric GridKey
IP014	Alvin Hardware	Use of the EA Technology Alvin platform as part of the overall OpenLV solution	Relevant Background	EA Technology	EA Technology
IP015	Alvin Communication Protocols	Development of the Alvin communication protocols into the LV-CAPTM solution to enable communication links between Alvin devices.	Relevant Foreground	EA Technology	EA Technology
IP016	LV Monitoring Hardware	Use of the GridKey MCU520, as part of the overall OpenLV Solution, to provide monitoring of LV substations.	Relevant Background	Lucy Electric GridKey	Lucy Electric GridKey

9.2   Current Reporting Period

There is no IPR generated or registered during this reporting period.

9.3   Overall IP Statement

It is not expected that we will register any IPR in the next reporting period.

10   Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with WPDs and EA Technology's risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- ✓ Defining the roles, responsibilities and reporting lines within the team for risk management;
- ✓ Including risk management issues when writing reports and considering decisions;
- ✓ Maintaining a risk register;
- ✓ Communicating risks and ensuring suitable training and supervision is provided;
- ✓ Preparing mitigation action plans;
- ✓ Preparing contingency action plans; and
- ✓ Regular monitoring and updating of risks and the risk controls.

10.1   Current Risks

The OpenLV risk register is a live document and is updated regularly. A total of 45 risks have been raised, 14 of which have been closed, leaving a total of 31 live risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible.

Of the 31 live risks none are ranked as severe or major, 3 are ranked as moderate and 28 are ranked as minor. Table 6 details the three moderate risks. For each of these, a mitigation action plan has been identified and the progress of these are tracked and reported.

Table 6: Top current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
There is a risk that funding cannot be secured for the development of 'Community Apps'.	Moderate	Favour groups with clear, demonstrable app development skills or groups that can secure funds from quick turnaround sources.	An initial assessment of the market potential for engaging with community groups has been completed.
There is a risk that funding cannot be secured for the development of 'Apps' for Method 3.	Moderate	Active involvement with 3rd party organisations early in the Project and testing the market.	An initial assessment of the market potential for engaging with 3rd parties has been completed.
There is a risk that the automated switching and meshing of the network leads to safety issues for operational staff.	Moderate	The design of the OpenLV Solution will be independently reviewed by WPD operational staff to ensure it is fit for purpose.	Documentation outlining the methodology for automated switching has been completed and reviewed by WPD.

Table 7: Graphical View of Risk Register

Likelihood = Probability x Proximity		1. Insignificant changes, re-	2. Small Delay, small	3. Delay,	4. Substantial Delay, key	5. Inability to
	Certain/Imminent (21-25)	0	0	0	0	0
	More likely to occur than not/Likely to be near future (16-20)	0	0	0	0	0
	50/50 chance of occuring/Mid to short term (11-15)	0	0	0	0	0
	Less likely to occur/Mid to long term (6-10)	0	2	0	0	0
	Very unlikely to occur/Far in the future (1-5)	10	9	7	3	0
				Impact		

		Minor	Moderate	Major	Severe	
Legend		28	3	0	0	No of instances
Total			31			No of live risks

10.2 Update for risks previously identified

Descriptions of the most significant risks, identified in the previous six-monthly progress report are provided in Table 8 with updates on their current risk status.

Table 8: Risks identified in the previous progress report

Details of the Risk	Previous Risk Rating	Current Risk Rating	Progress
There is a risk that the integration of LV-CAP™ with generic hardware and the use of Alvin switching devices is more complex than expected and delays the OpenLV programme.	Major	Minor	Control of Alvin switching devices, from the OpenLV platform, has been proven at FAT.
There is a risk that the development of WeatherSense™ from the InnovateUK project does not provide the OpenLV project with the functionality that is required.	Moderate	Minor	Initial assessment of the algorithm from the University of Manchester has been completed.
Supplier(s) challenge the ITT process causing a delay in awarding packages of works to potential Suppliers.	Moderate	Closed	N/A
There is a risk that the development of LV-CAP™ from the InnovateUK project is delayed.	Moderate	Closed	N/A
There is a risk that the development of LV-CAP™ from the InnovateUK project does not provide the OpenLV project with the functionality that is required.	Moderate	Closed	N/A

Descriptions of the most prominent risks, identified at the project bid phase, are provided in Table 9 with updates on their current risk status.

Table 9: Key Risks Identified at Bid Stage

Details of the Risk	Bid Stage Risk Rating	Current Risk Rating	Comments
There is a risk that funding cannot be secured for the development of 'Community Apps'.	Major	Moderate	See Table 6
There is a risk that the integration of LV-CAP™ with generic hardware and the use of Alvin switching devices is more complex than expected and delays the OpenLV programme.	Major	Minor	See Table 8
There is a risk that the last mile communications between the distributed LV-CAP™ devices and the switches on the LV network is not robust and the devices cannot be switched as expected.	Major	Closed	N/A

11   Accuracy Assurance Statement

This report has been prepared by: 1) the WPD Project Manager (Mark Dale) and 2) the EA Technology Project Manager (Richard Potter), recommended by: 1) the WPD Future Networks Manager (Roger Hey) and 2) the EA Technology Delivery Manager (Dan Hollingworth) and approved by: 1) the WPD Regulatory and Government Affairs Manager (Alison Sleightholm) and 2) the EA Technology Smart Interventions Director (Dave A Roberts). Both WPD and EA Technology confirm that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

12   References

1. OpenLV Full Submission Pro-forma:
   https://www.westernpowerinnovation.co.uk/Document-library/2016/OpenLV/NON-CONFIDENTIAL-OpenLV-NIC-Bid-2016-WPD_EN_NIC_02.aspx
2. OpenLV Project Direction:
   https://www.westernpowerinnovation.co.uk/Document-library/2016/OpenLV/Open-LV-Formal-project-Direction.aspx
3. SDRC 1: Specification, Design & Testing of the Overall OpenLV Solution, Version 1.1, 17th October 2017: https://openlv.net/resources/openlv-sdrc1-specification-design-testing-version-1-1_with-appendices/

Annex 1 – Media Coverage

Number	Company	Link
1	APB	http://www.abpclub.co.uk/bodyshop-news.php?story=OpenLV-project---sharing-electricity-usage-data-about-levels-of-capacity-for-charging-EVs-on-local-electricity-networks-139460
2	Automotive Industry Digest	http://www.automotiveindustrydigest.com/latest-fleet-news/network-capacity-for-charging-electric-vehicles-to-be-further-aided/auto-news
3	Bristol Energy Network	http://bristolenergynetwork.org/centre-for-sustainable-energy-openlv-project/
4	Clean Energy News	https://www.cleanenergynews.co.uk/news/efficiency/open-access-substation-data-being-primed-by-western-power-distribution
5	Community Land Trusts	http://www.communitylandtrusts.org.uk/_filecache/252/f9f/390-open-lv-more-information-23617.pdf
6	CSE	https://www.cse.org.uk/projects/view/1335
7	DriveEV	http://driveev.net/2017/10/09/electric-car-charging-project-help-manage-capacity/#.WejQasaZOL8
8	EA Technology	https://www.eatechnology.com/projects/openlv/
9	EA Technology	https://www.eatechnology.com/blog/2017/10/11/network-capacity-for-charging-electric-vehicles-to-be-further-aided-by-opening-up-data-from-substations/openlv-balancing-act/
10	EcoTopical	http://ecotopical.com/green-car-congress/196331/openlv-project-proposes-opening-up-local-electricity-usage-data-to-improve-ev-charging/
11	Efficient Energy	http://www.efficientenergy.net/nl/2016/dec16.htm
12	Electric Cars Report	http://electriccarsreport.com/2017/10/network-capacity-charging-evs-aided-opening-data-substations/
13	Electrive	http://www.electrive.com/2017/10/11/stockholm-openlv-wales-bengaluru-dubai/
14	Energy Capital	http://www.energycapital.org.uk/2017/07/11/open-lv/
15	EV FleetWorld	http://evfleetworld.co.uk/ev-initiative-to-help-overcome-challenges-with-network-capacity/
16	ENA Smarter Networks	http://www.smarternetworks.org/Project.aspx?ProjectID=2030
17	Enzari	https://enzari.com/network-capacity-for-charging-electric-vehicles-to-be-further-aided/
18	Express & Star	https://www.expressandstar.com/news/motors/2017/10/09/substation-data-to-help-improve-ev-charging-infrastructure/
19	Fleet Magazine	http://fleetmagazine.co.uk/tag/openlv/
20	Fleet News	https://www.fleetnews.co.uk/news/fleet-industry-news/2017/10/10/openlv-project-aims-to-aid-network-capacity-for-charging-electric-vehicles
21	Fleet Point	http://www.fleetpoint.org/fleet-industry-news/news-by-date/openlv-opening-local-electricity-usage-data/
22	Green Car Congress	http://www.greencarcongress.com/2017/10/20171010-openlv.html
23	Greenfleet	http://www.greenfleet.net/news/10102017/openlv-project-open-local-electricity-usage-data
24	Lucy Electric	http://www.lucyelectric.com/en/press-news/company/openlv-gets-funding-green-light-ofgem/
25	Networks	https://networks.online/gphsn/news/1000734/software-platform-access-local-grid
26	New Power	https://www.newpower.info/2017/09/ideas-wanted-wpd-opens-network-data-to-app-developers/
27	OpenLV	https://openlv.net
28	PPL	http://pplweb.mediaroom.com/index.php?s=12270&item=137306
29	Regen	https://www.regensw.co.uk/openlv
30	Renewable Energy Magazine	https://www.renewableenergymagazine.com/energy_saving/openlv-awarded-4-9-million-funding-20161205
31	Shropshire Star	https://www.shropshirestar.com/news/motors/2017/10/09/substation-data-to-help-improve-ev-charging-infrastructure/
32	The Register	https://www.theregister.co.uk/2017/10/11/openlv_substation_electricity_data/
33	Today Eco	https://todayeco.com/transport/pages/103237931-network-capacity-for-charging-evs-to-be-further-aided-by
34	Top Car News	http://www.topcarnews.co.uk/news/article/326/network_capacity_for_charging_electric_vehicles_to_be_further_aided_by_opening_up_data_from_substations
35	Total EV	http://www.totalev.com/need-to-know/112/electric-car-charging-infrastructure-substation-data-improve
36	Utility Week	http://utilityweek.co.uk/news/new-software-platform-gives-open-access-to-local-grid-data/1314152#.WejRXsaZOL8
37	WPD	https://www.westernpower.co.uk/Innovation/Projects/Current-Projects/Open-LV.aspx
38	Yahoo	https://uk.news.yahoo.com/substation-data-help-improve-ev-145854139.html
39	YouTube	https://www.youtube.com/watch?v=bogJNxOAUfI
40	Renewable Energy Magazine	https://www.renewableenergymagazine.com/energy_saving/openlv-awarded-4-9-million-funding-20161205