THE DEVELOPMENT & IMPLEMENTATION OF A COMMON APPLICATION PLATFORM TO SUPPORT LOCAL ENERGY COMMUNITIES

Richard Potter
EA Technology
richard.potter@eatechnology.com

Rachel Coxcoon
Centre for Sustainable Energy
rachel.coxcoon@cse.org.uk

Mark Dale
Western Power Distribution
mdale@westernpower.co.uk

Richard Ash
EA Technology
richard.ash@eatechnology.com

Poppy Maltby
Regen
pmaltby@regensw.co.uk

Dan Hollingworth
EA Technology
Daniel.Hollingworth@eatechnology.com

ABSTRACT

The way we generate electricity is changing from a centralised system with a handful of large power stations, to a distributed network of over one million smaller renewable energy generators. Demand for electricity could double by 2050, and the way we are using it will be different, for example the amount of battery storage is set to increase, and more of us will be using electric vehicles [1].

All this creates challenges for Transmission Network Operators (TSOs) and Distribution Network Operators (DNOs) who have to balance supply and demand to make sure the lights stay on. Currently the network in some areas is constrained because it wasn't designed for two way flows of electricity. We have two options, upgrade the whole network now at an extremely high cost, or to introduce smart solutions to optimise the existing network, allowing us to upgrade the network only when and where needed. Smart solutions can be used to balance the supply of electricity and our increasing demand [1].

In GB it is estimated the latter option could save between £3-8billion by 2030. The scale of change is vast, and this presents exciting opportunities for communities to get involved in finding smart solutions and innovative ways of using the network we have more effectively.

This paper outlines how a new Operating System (OS) call the Low Voltage Common Application Platform (LV-CAP™) can 1) Provide local energy communities with access to electricity network data and 2) How it can be used by communities to implement local energy community schemes.

INTRODUCTION

It is well established that the traditional electricity distribution network is facing an unprecedented challenge. Exposed directly to changes in customer behaviour, the low voltage distribution network is at the frontier of this challenge [2]. At over 400,000km in length, the UK low-voltage network is larger than the combined high-voltage and transmission networks.

Yet this huge asset base remains largely passive; lacking in communication or monitoring, it is invisible to control systems and almost entirely manually operated.

Many attempts have been made to bring monitoring, communication and control technology to low voltage networks, but these have not yet achieved widespread adoption. In order to achieve widespread adoption, it is essential that a single platform delivers a multidimensional business case providing tangible benefits not only to the network operator, but also to the end customer.

We are also in a state of flux. In GB, DNOs are making the transition to Distribution System Operators (DSOs), having to move away from an engineering world focussed on keeping the lights on, to getting involved with customers at the front line, helping them reduce demand and use electricity in ways that keep the networks secure. On the flip side, consumers are becoming 'prosumers' (producing and consuming electricity), as well as needing to become more engaged in how electricity is used, to make savings and avoid escalating bills in the future. These fundamental changes are challenging and exciting [1].

There is a niche revolution of community energy taking place, among people who want to find ways of retaining economic benefit locally, from the electricity we are all paying for. There is also a huge proportion of the population who have no idea what a DNO is, or why they should care about changing a system that on the surface seems to be working fine. There is very little awareness among customers of how and who pays for our network.

This paper presents an overview of how a new piece of software, the Low Voltage Common Application Platform (LV-CAP™) can be used to provide a multi-dimensional business case to deliver benefits to both DNOs and local energy communities. This paper utilises learning from trialling the LV-CAP™ Operating System (OS) with local energy communities as part of the OpenLV project delivered in partnership by EA Technology & Western Power Distribution (WPD) [2].

The learning from the OpenLV project shows how DNOs and community groups can work proactively together to share information and technical expertise to provide mutual benefits. If DNOs work collaboratively with communities on projects, mutual benefit can be realised and shared as current innovation trials are demonstrating.

THE LOW VOLTAGE COMMON APPLICATION PLATFORM (LV-CAP™)

The LV-CAP™ OS: 1) Is designed from the outset to be low cost, 2) Is designed from the outset to benefit network operators, customers and other service providers, 3) Is a software platform, to be implemented on suitable hardware by any vendor or integrator; and 4) Is a flexible platform that can adapt and evolve as requirements change.

As part of the OpenLV Project the LV-CAP™ OS has been installed on a hardware platform deployed in LV substations. The high-level architecture of the OpenLV solution is shown in Figure 1.

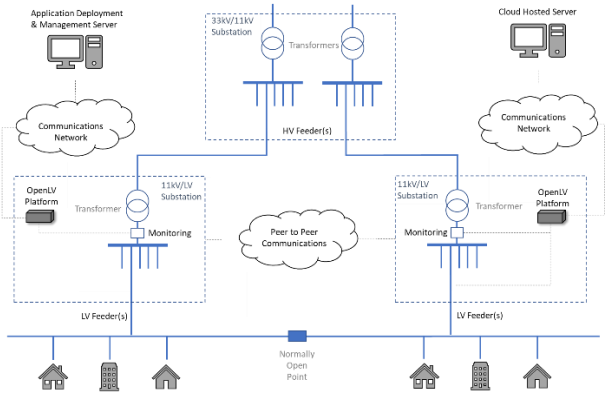

Figure 1: Systems architecture to support local energy community trials

The key components of the solution are as follows:

- **LV Monitoring Equipment:** This monitoring equipment utilises sensors to take electrical measurements from the LV busbar, the transformer and the outgoing feeder(s). In addition, temperature measurements are also taken from the transformer, and inside and outside substation(s). The monitoring equipment provides this LV monitoring data to the OpenLV Platform.

- **OpenLV Platform:** Consists of a ruggedised PC with a Linux based operating system running the Low Voltage-Common Application Platform (LV-CAP™). This platform receives, stores and processes data from external LV monitoring equipment. These devices have sufficient computational power to store and run multiple apps and can provide relevant information out via a communications link to centralised server(s).

- **Application Deployment & Management Server:** Enables management of the OpenLV Platform(s) that will be installed as part of the project. This includes the deployment of app(s) to devices in the field. It will also be utilised to store relevant data to enable the OpenLV trials to be assessed.

- **Cloud Hosted Server:** Enables LV monitoring data to be collected, stored, shared and visualised to provide benefits to communities and the wider industry.

Software applications deployed and running with the LV-CAP™ operating system are shown in Figure 2.

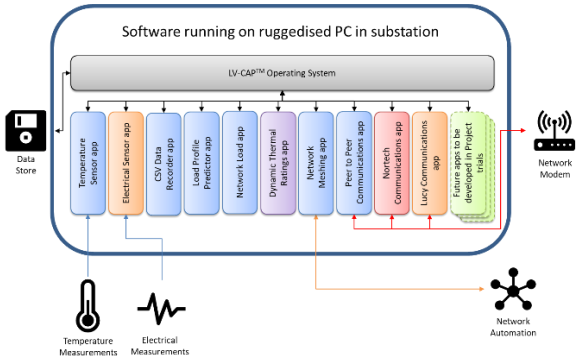

Figure 2: LV-CAP™ OS & software applications

Each of the coloured boxes below the LV-CAP™ OS represent a software application. The blue boxes represent software applications developed by EA Technology, the orange boxes represent software applications developed by Lucy Electric GridKey, the red box represents a software application developed by Nortech and the purple box represents a software application developed by the University of Manchester. This shows 10 applications developed by 4 different organisations in three different programming languages (C++, Java and Go). The green boxes represent multiple software applications that are being developed by community groups and wider industry.

The LV-CAP™ OS runs on an Advantech ruggedised PC as shown in Figure 3. Software applications developed by local energy communities also run on the ruggedised PC.

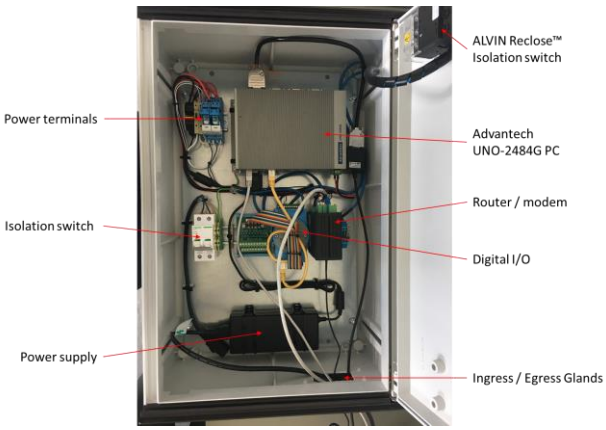

Figure 3: Local energy community trial hardware

LV monitoring hardware provides electrical measurements to the ruggedised PC every 60 seconds. These measurements include RMS voltage at the LV busbar and the following for the transformer and outgoing feeder(s): 1) RMS current in each phase, 2) power factor for each phase, 3) Real (Active) and Reactive power flow in each phase and 4) Real (Active) and Reactive energy in each phase.

METHODOLOGY

Local Energy Community Engagement

The methodology for engaging with local energy communities to test the LV-CAP™ OS is as follows:

- Establish the market potential for local energy communities to exploit the LV monitoring data provided and/or develop software applications to be deployed as part of the OpenLV Solution;
- Develop a community engagement plan to detail the approach to achieve planned outcomes from engaging with local energy communities;
- Work with local energy communities to identify how the OpenLV project could help the community to gain a better understanding of their electricity use and generation;
- Help local energy communities to develop proposal(s) that identify how the community would utilise the data provided by the OpenLV project and/or what software application would need to be developed specifically for each community;
- Provide support to local energy communities who participate in the OpenLV project trials to ensure their idea(s) for utilising LV network data and/or deploying software application(s) can be developed and deployed; and
- Extract learning from local energy communities who participate in the OpenLV project trials to ensure this information can be shared with other local energy communities and the wider industry.

Local Energy Community Trials

The approach for the local energy community trials is summarised below. Overall the approach has been to:

1) Engage with local energy communities to understand how they could benefit from participating in the OpenLV project trials;
2) Help local energy communities to identify how they could fund or resource their involvement in the OpenLV project trials; and
3) Make 10 OpenLV platforms available to local energy communities.

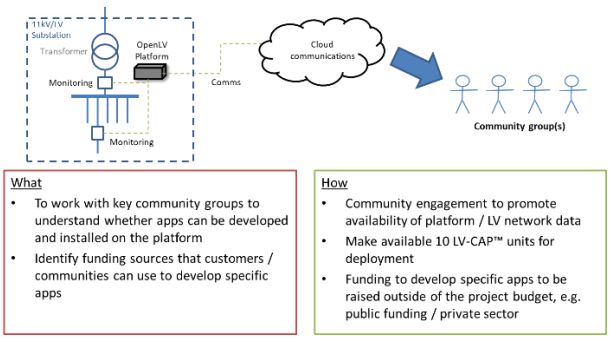

Figure 4: Local energy community trials

FINDINGS

Testing the market

A total of 51 community groups responded to a community engagement survey that was open for 28 days. Respondents were asked to indicate their interest in six app concepts. Respondents could select 'very interested', neutral' or 'not interested' for each of these software application concepts. The results from respondents are shown in Table 1.

Table 1: Summary of results from the community engagement survey

	Very interested	Neutral	Not interested	Total
Understanding community electricity demand	92% (44)	6% (3)	2% (1)	48
Connecting low carbon technologies to the LV grid	91% (43)	9% (4)	0% (0)	47
Community alerts to request reduction or increase in electricity usage	72% (34)	19% (9)	9% (4)	47
Community information alerts	66% (29)	34% (15)	0% (0)	44
Demand side response for managed electric vehicle charging	63% (30)	31% (15)	6% (3)	48
Automated electricity storage control	56% (27)	38% (18)	6% (3)	48

The number of responses to the community engagement survey showed there was considerable interest in LV substation data. There was strong support for the software application concepts suggested in the survey and an additional 45 ideas were suggested by the community groups that responded to the survey.

Community engagement plan

In recognition of the fact that 65% of respondents to the community engagement survey were self-defined 'community energy groups', a two-stream recruitment process was used. This was to ensure that a wider range of communities were included in the local energy community trials, widening the possibilities for replication.

In December 2017, an open recruitment process was launched, which was promoted widely via community energy networks. Applications closed in late January 2018, and six shortlisted groups have been interviewed.

Separately, through partnership working with key community and tenant support organisations (Locality, Action with Communities in Rural England (ACRE) and the National Housing Federation), non-energy focused community groups were encouraged to apply, with a supported process closing in February 2018. Two shortlisted groups have been interviewed.

Selected local energy communities for trial

In total ten applications were received to take part in the local community energy trials. A short summary of the ideas proposed by each group are provided below:

- Nine of the ten applicants wish to develop a web-based visualisation of the LV substation data, with functionality to show local residents daily, weekly and monthly use patterns.
- Seven of the ten applicants want to be able to combine data from their own generation assets (either single large installations or collections of domestic scale solar PV), to drive better matching of existing local renewable energy supply with local demand.
- Seven of the ten applicants also want to be able to send alerts via text message or via email to local residents, as a call to action to either reduce or increase demand, linked variously to: data on substation capacity; local renewable energy generation; time of use tariffs and; carbon emissions.
- All of the applicants have an interest in developing business models once they understand the local substation better. In most cases business modelling will relate to demonstrating extra capacity to connect renewable energy assets to the grid, through better demand-side management. In a few cases, this also extends to proving the case for managed rollout of battery storage and EVs in domestic properties in the area.
- One of the applications is distinctly different to the rest, in that it does not revolve around an immediate community engagement process but is instead focused on collecting LV substation data for the whole village over a whole year in the background, which the group then intend to use to develop proposals for a village wide energy strategy, combining plans for a renewable energy local supply model and EV rollout scheme. With the exception of this scheme, all applicants wish to use the substation data to drive behavior change among local residents from the outset.

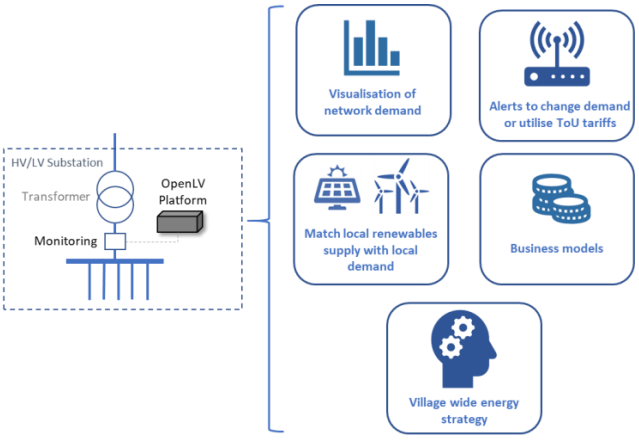

Figure 5: Summary of the software applications to be developed by local energy communities

CONCLUSIONS

This paper presents an overview of how the LV-CAP™ OS is being used within the OpenLV project to enable local energy communities to access LV electricity data and/or to develop software applications to be deployed at their local LV substation. The approach used to engage with local energy communities is also outlined along with the findings from engaging with local energy community groups.

Engagement has shown that there is significant interest from local energy communities as 51 local energy communities responded to the community engagement survey. There was strong support for the software application concepts suggested in the survey and an additional 45 ideas were suggested by the community groups that responded to the survey.

Following the community engagement survey ten local energy communities applied to take part in the project trials. The applications received from local energy communities are currently being assessed. A number of local energy groups will be selected to take part in the trials.

Overall the findings show that there is significant demand from local energy communities to be able to access LV network data and use it in ways that benefit both the community and the network operator.

REFERENCES

[1] Energy Networks Association, Connecting Community Energy, A guide to getting a network connection, June 2016: Click Here.

[2] OpenLV Project Bid Document, 2016: Click Here.

[3] OpenLV, SDRC 1 Specification Design & Testing, October 2017: Click Here.

[4] OpenLV, SDRC 2.1, Community Engagement Plan & Testing the Market, December 2017, Click Here.