CASE STUDY | Mapping Low Voltage Networks Using AMI Data

Lead author:

Dr Reza Razzaghi

Co-author: Dr Lachlan Andrew

The electricity industry is transitioning from traditional, large-scale, centralised generation to generation distributed energy resources (DER) throughout the grid. Low voltage (LV) distribution networks in particular, are facing significant changes to how their assets are managed. This is primarily because sub 66kVA lines and electricity assets are where much of localised generation, such as rooftop solar, electric vehicle charging, and other battery storage, occurs.

Historically, LV networks were not designed for such capability, and the detailed understanding of their capacity was not required to provide safe, reliable, and stable power supplies. Switching from one way flow of electricity to the bidirectional flows required from multiple distributed energy points, necessitates a more detailed understanding of the capacity of assets at the LV level.

C4NET, in partnership with Australian distribution networks United Energy and AusNet Services, approached researchers at Monash University and The University of Melbourne, to help them map the low voltage network with greater accuracy. The outcomes of this research will enable better investment decisions to facilitate greater uptake of DER for Victorians.

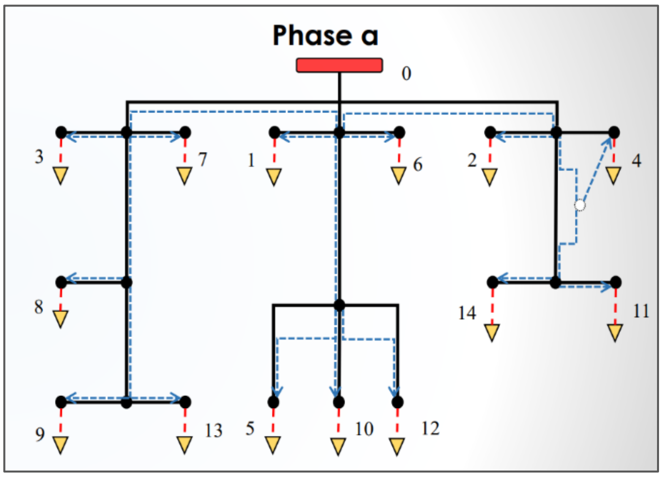
In 2021 Victorian network distribution companies United Energy and AusNet Services, identified four areas where mapping LV data may help inform investment decisions and network operations.

- Assignment of customers to phases might not be accurate.
- Aging and incomplete records of the topology of the network
- Location of customers on the relevant LV distribution circuit is not accurate.
- The electrical parameters and attributes of the distribution cables are not fully populated in geographic information system mapping.

With almost 100% penetration of smart meters in Victoria, data from these devices was used to classify costumers' phases, develop the topology of LV distribution network and the associated electrical parameters.

Current understanding of existing network topology, represented by the black lines in Figure 1, is largely legacy driven and can often exclude changes in the field, upgrades, augmentation, and/or repairs and new connections that occur over time. Full visibility (the location of meters, how they are connected to each other, how far the meters are from the LV transformer, etc.) of LV networks is one of the most challenging aspect of monitoring LV networks.

FIGURE 1: Customer Phase Allocations



Building a model of a LV network through field inspections is impractical, both costly and time consuming. By using algorithmic analysis of smart meter data, researchers were able to map, blue dotted lines, the actual line impedance and distance from customer nodes, noted in yellow triangles. The distance to and from nodes, impedance, and number of customers connected to assets resulted in a greater than 90% accuracy of the LV networks in the United Energy and AusNet Service areas surveyed. In several cases, new customers, denoted in white circles, were identified as connected to assets which were previously unknown.

Having this information will enable and support future technology implementations needed by network distribution companies for accurate demand and generation forecasting, fault detection and location, DER impact and assessment and power quality management.

For more information on this project or to learn how C4NET can facilitate access to data for your research or commercial needs, please visit our website www.c4net.com.au.