Location Matters

The key to leveraging smart meters as grid sensors is knowing exactly where they are connected to the distribution system

After a powerful storm strikes, utility crews from other states come to help with repair and restoration through a mutual assistance agreement, quickly rebuilding the distribution system but in a slightly different configuration than before. How do you update connectivity information after power is restored?

Similarly, a utility may try to update its meter locations and their assumed connectivity based on visual inspections when they install smart meters, but the quality of that data is far from ideal and it degrades again over time. Keeping that data updated with current methods is a labor-intensive, imprecise and never-ending process.

Based on research Itron has done with its utility customers, the accuracy of connectivity data can vary greatly, with many utilities lacking accurate and updated connectivity data for 10, 20 or even 50 percent of their meters in some cases. Or they may be relying solely on dated "as-built" engineering drawings from decades ago or imprecise GIS data to make educated guesses on connectivity.

As the evolution to a more distributed grid accelerates with more intelligence and decision making being pushed to the edge of the network, the inability of smart meters to know exactly where they are connected to the distribution network is perhaps the greatest obstacle to leveraging smart meter data and communication capability to support grid operations on the lower voltage network. We're talking about use cases that involve the control of loads and distributed energy resources, intelligent switching of equipment, phase balancing and decisions that impact reliability and service to customers.

Now, for the first time, smart meters can be continuously aware of where they are in relation to other grid assets. This awareness does not require a GIS component, nor is it dependent on the topology of the communications network. Rather it's enabled by continuous monitoring and real-time algorithmic analysis of electrical characteristics (voltage and other data) relative to various grid devices within the network. This capability, which we call "Location Awareness," is a vital breakthrough in OpenWay Riva and the Active Grid, and it opens up an entirely new frontier of smart grid use cases and applications that were not achievable without reliable connectivity data.

The Value of Active Grid Location Awareness

- One second data resolution provides higher accuracy than previously possible
- Requires significantly less back office infrastructure and data science expertise
- Device self-awareness of electrical location greatly improves many application outcomes
- Always accurate to within 24 hours
- PLC connectivity delivers very accurate and rapid phase detection and transformer connectivity
- Adds $2.3 million per year in added business case value to utility with 1 million customers

Itron's patented Location Awareness analytic, available with the OpenWay Riva solution, identifies each meter's electrical location on the distribution network, (transformer, phase, feeder) and updates that location continually, providing operators with a highly accurate connectivity model of smart meters to distribution assets.

This unprecedented visibility into connectivity enables Itron to unlock new value in distribution operations by greatly increasing the effectiveness of applications such as outage and theft detection, transformer load management and demand response, while also enabling entirely new applications including the detection of potentially unsafe grid conditions such as high-impedance connections (HIC) and downed conductors. The value of OpenWay Riva's Location Awareness analytic is that it enables operators to execute localized grid operations use cases with much more confidence and precision than ever before possible.

Here's how it works: Voltage fluctuations are taking place continually throughout the lower voltage network. These fluctuations can be caused by switching power on and off at a customer premise, particularly from electricity-hungry appliances such as ovens, air conditioners, water heaters, or commercial equipment, etc. When these events take place, those voltage changes "echo" at premises that are served by the same transformer. Voltage fluctuations are also caused by switching events on the primary side of the transformer, such as a recloser operation or capacitor bank switching. With their ability to process and analyze high-resolution 1-second data in real time at the edge of the network, OpenWay Riva meters "see" these voltage events immediately and in great detail, and by using their computing power to correlate voltage change on one meter to voltage change on another meter, they can confirm (or refute) connectivity with an extremely high degree of accuracy.

This distributed analytic process requires three key capabilities that only OpenWay Riva provides: the ability to access high-resolution 1 second data from the meter; the distributed computing power to analyze that data at the edge in real time; and the line sensing capabilities that come with the advanced powerline communications component of the OpenWay Riva's Adaptive Communications Technology.

Compare that to current generation smart metering systems collecting and then analyzing preprocessed hourly or 15-minute data in the utility back office, which is a comparative eternity in grid operations time, and deriving accurate connectivity data is not only impractical but usually too late to manage rapidly changing grid conditions.

OpenWay Riva's Location Awareness application uses an algorithm to correlate voltage data between any two meters, gauging "affinity" between the two. If the affinity falls within a certain range, it's a virtual certainty they're connected to the same transformer; if affinity falls outside a determined range, it's clear that they are connected to different transformers.

Again, the ability to do this analysis using highly detailed data delivers the accuracy and confidence, and by running resident as an application on the smart meters, the connectivity model is continually updated for accuracy.

So what is the business value of having a highly accurate connectivity model? In a nutshell, precision and accuracy in executing Active Grid operations on the lower voltage network. Phase balancing, transformer load management, demand response, outage detection and diversion detection are just some of the use cases that take on an entirely new level of precision and efficacy when devices know where they are in the context of the distribution network.

For transformer load management or demand response, specific loads and distributed generation assets can be controlled to flatten peak loads and manage the grid in a targeted and coordinated manner. The accuracy and timeliness of outage and diversion detection is greatly increased.

Location Awareness is a fundamental capability of the OpenWay Riva solution and the Active Grid, where intelligent devices analyze data at the edge, then communicate and collaborate with each other and make decisions in real time. With meters and edge devices knowing exactly where they are on the lower voltage network and what they're connected to, grid operators can manage rapidly changing conditions, solve problems or create opportunities that were never before possible.

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