

Using Synchrophasors to Estimate Distribution Energy Resources

Germany | *Deployed on Commercial 4G LTE*

SCENARIO

Communities are installing more distributed energy resources (DERs), from solar panels to electric vehicle (EV) charging stations. Yet today's power distribution infrastructure wasn't designed for such intermittent generation and loads.

In Germany, a nation at the forefront of the energy transition, utilities are investing in cost-effective, minimally disruptive ways to achieve DER visibility and therefore safe, efficient network operations. For one major utility, this investment involved distributed system state estimation (DSSE) by Zaphiro Technologies.

The DSSE solution uses phasor measurement units (PMUs) installed in strategic locations to collect synchrophasors, time-synchronized numbers that represent the magnitude and phase angle of sine waves found in electricity. It creates an accurate digital twin model of the network that estimates the status of network voltage, current, and power flows in real time.

SOLUTION

PMU-based DSSE typically sends synchrophasor measurements to a central software platform via fiber communication. Because fiber was not available for this utility's selected site, the utility used a public 4G LTE network from a local provider.

To bring the solution to life, the utility:

- + Installed seven PMU devices in two medium-voltage feeders to collect synchronized and high-speed measurements of voltage and current synchrophasors
- + Installed a 4G LTE router in every PMU device and established separate virtual private network (VPN) tunnels between each device and the cloud-based software platform. This enabled real-time data communication.
- + Logged measurement and state estimation data in a long-term database for offline analysis

RESULTS

The utility met its accuracy threshold of 1% error for voltage estimations and 10% error for estimating the network's current state. In addition, overall process latency showed that the solution could be used for both real-time operations and offline applications such as grid analytics, root cause analysis, advanced planning, and predictive maintenance.

Overall, the utility found public LTE to be a cost-effective and ready-to-use alternative to traditional fiber network for PMU-based DSSE.

For others pursuing this path, the utility noted that a lack of specific service level agreements (SLAs) with network providers might cause sporadic periods of increased packet losses and latencies.

The utility also noted that private networks have been deployed to offer more robust security controls. Not only does this increase protection and control, it offers utility grids the increased coverage they need in remote areas along with benefits such as increased data capacity, reliability, and resiliency, and lower latency.

