A DOE Research Laboratories View on Time Synchronization Needs and Challenges

Achievement: Characterize and quantify barriers and gaps related to time synchronization and its application to the nation's power grid.

Significance and Impact: This work enhances our ability to effectively diagnose and operate the nation's power grid in times of normal operation as well as during natural or man-made induced interruptions.

Research Details:

- Document problems of current Position/Navigation/Timing (PNT) solutions
- Identify specific, near-term solutions and mitigations that can address multiple failure causes
- Develop and share how-to information for these solutions
- Recommendations for longer-term research needs (timing problem detection, equipment interoperability, standards updates, etc.) within grid sector and beyond

The Power Grid (top) is becoming more complex with new requirements for bi-directional flow stemming from power generation at the residential and neighborhood levels. The new capabilities are bringing about increased requirements for dynamic sensor equipment.

Sponsor/Facility: Work was performed ORNL / sponsored by DOE EERE.

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Overview:

Sensors distributed physically throughout the nation are an important aspect to the monitoring and operation of the power grid. These sensors, including the common Phasor Measurement Units (PMUs), do high-speed grid monitoring with time stamps dependent on time-synchronized to UTC with microsecond accuracy. Timing errors from the time source can cause incorrect synchrophasor data. Such errors can create false analytical conclusions and in the future could drive undesirable and possibly dangerous automated grid operations with synchrophasor-based controls. The power sector seeks to protect future grid operations with better timing tools and practices to improve robustness and resilience. PNT should be assumed unreliable at both source and receiving points, and new measures to assure accurate, reliable time stamps against multiple failure modes are needed.

Through research and outreach, ORNL is helping the power grid community to implement consistent, reliable time across a substation and synchronized across a power system. Power system owners and operators use primarily GPS as the source for navigation, position and timing. If we lose GPS today, it will complicate (higher cost, longer duration, lower efficiency), but not kill, grid operations. However, GPS and alternate time sources (and the ways we deliver and use them) need to become more reliable for time-synchronized applications to become mission-critical in the future. ORNL's efforts seek to help our user community implement consistent, reliable time across a substation and synchronized across a power system.