TIP 396: SEL Tempus Project - DOE CEDS Initiative*

Context

Time synchronization serves a fundamental role in any network, but it's too often added as an afterthought. However, it can mean the difference between correctly troubleshooting a conflict in minutes and having no idea why the server is figuratively on fire. For financial and scientific institutions, time synchronization must be accurate to a billionth of a second, but even commercial and industrial organizations are starting to push for synchronization accuracy in the sub-millisecond range.

The need for substation time synchronization has evolved from time-stamping basic Sequence of Events and disturbance recording information to more mission-critical needs, such as synchrophasor measurement (IEEE C37.118), sampled measured values (IEC 61850-9-2), and traveling-wave fault location. These new applications demand the same reliability, security, and dependability for precise time synchronization as other equipment designed for critical infrastructure applications, like protective relays in a substation

Description

Precise time synchronization enhances protection, monitoring, and control of electric power systems. Many precise time synchronization systems rely on navigation satellite systems, including the American GPS, (Global Positioning System) and the Russian GLONASS,(GLObal NAvigation Satellite System) which are highly accurate and effective but may not always be available or secure. The focus for Schweitzer Engineering Laboratories (SEL) is to provide a clock that includes more of the timing signals required for substations beyond IRIG (Inter-range instrumentation group codes), NTP (Network Time Protocol) and PTP (Precision Time Protocol). The following is a high-level feature list of the new clock:

- Track and utilize up to 4 GNSS (Global Navigation Satellite System) constellations in the timing solution;
- Monitor and utilize terrestrial timing sources - PTP, SyncE, IRIG and possibly others;
- Provide multiple local oscillator options - allows for longer holdover (loss of external timing sources) performance;
- Time source signal manipulation detection and mitigation;
- Comparison of multiple time source signals
- Provide IRIG, PTP, NTP and other timing signals (pulse, frequency) for downstream devices;
- Event reporting through Syslog, SNMP (Simple Network Management Protocol), and local reports;
- User authentication through local accounts, LDAP (Lightweight Directory Access Protocol), and Radius;
- Modular construction; allows the customer to configure the clock as they require - additional IRIG, Ethernet, or other signal outputs--factory and field options;
- Redundant power supply options;
- Provisions to field upgrade firmware.

Why It Matters

An advanced time synchronization system is critical to the optimal operation of power systems. It can improve the reliability and security of time distribution and mitigate the effects of the following situations:

- Atmospheric interference caused by solar flares
- Multipath errors due to reflected radio signals
- Equipment failure
- Intentional and unintentional jamming
- Equipment maintenance or testing
- Spoofing attacks, in which a satellite system receiver locks to a counterfeit signal

Bonneville Power Administration’s Testing and Evaluation group will provide technical support for the SEL project and host field trials for the device.

Goals and Objectives

The project goal is the development of a next generation clock. The focus for the Department of Energy contract is a clock that can detect and mitigate timing signal interruption and manipulation events and maintain downstream timing through these events.

Deliverables

Project results will include the following:

- Cyber-secure time synchronization platform for critical substation applications, with automatic fail-over to a trusted time source in the event of GPS spoofing
- Identification and logging of the GPS spoofing event and other signal anomalies for post event analysis
- Multi-constellation timing receiver technology

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Project Start Date: November, 2016

Project End Date: September, 2020

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Related Projects

TIP 366-EPRI Precision Timing Security Assessment
TIP 397-ABB Cyber Attack Resilient HVDC Systems-DOE CEDS
TIP 406-SEL Ambassador Project-DOE CEDS
TIP 410-PNNL Method to Quantify Cyber-Risk Reduction-DOE CEDS

Reports, References, Links

Participating Organizations

BPA leverages its research dollars and resources by partnering with the following organizations:

- Schweitzer Engineering Laboratories (SEL)
- US Department of Energy - Cybersecurity for Energy Delivery Systems (DOE-CEDS)

* Cybersecurity for Energy Delivery Systems (CEDS)

CEDS projects are funded through the Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE) research and development (R&D) program, which aims to enhance the reliability and resilience of the nation's energy infrastructure by reducing the risk of energy disruptions due to cyber-attacks.
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http://energy.gov/oe/technology-development/energy-delivery-systems-cybersecurity