TCIPG Testbed Overview

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GOALS

- Span transmission, distribution & metering, distributed generation, and home automation and control, providing true end-to-end capabilities.
- Provide foundational support for TCIPG projects.
- Analyze research across varying fidelities and scales.
- Serve as a national resource for experimental work in research and analysis of trustworthy power grid systems.

FUNDAMENTAL QUESTIONS/CHALLENGES

- How does one provide a scalable and flexible framework that can operate at varying fidelities to facilitate emerging research?
- What is the right mix of simulation, emulation, and real equipment to accomplish the research goals?
- How does one programmatically set up, integrate, control, and interact with this equipment?

RESEARCH PLAN

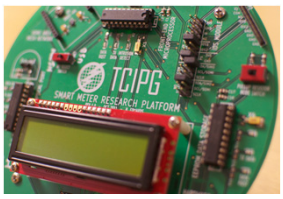
- Develop new modeling and evaluation technologies to enhance evaluation capabilities of the testbed.
- Continue to expand the testbed capabilities, features, and functionality through strategic integration of equipment.
- Provide integration glue that provides unique capabilities in the testbed environment.
- Leverage existing and emerging research from other areas when it can advance the goals of the testbed effort.

HIGHLIGHTED RESEARCH RESULTS

- Virtual Power System Testbed (VPST and RINSE/S3F): large-scale cyber-physical simulation.
- Network Access Policy Tool (NetAPT/NP-View): policy tool to evaluate network access paths and verify compliance with a global policy.
- Tools and analysis of smart grid protocols (AMIlyzer, protocol parsers and test harnesses, and scalable environment).
- Quantum Key Distribution: validation of external quantum computing research through application to smart grid systems.

BROADER IMPACT

- Enabling advanced research for smart grid efforts throughout the world via federation and collaboration.
- Flexible framework leverages tailored operating constraints to use resources efficiently.
- Open for collaborative research, facility-driven use, sponsored research, and technical testing.



CAPABILITIES

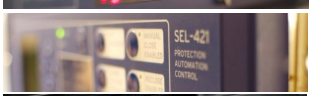
- Full end-to-end smart grid capabilities.
- On-grid testing capabilities via Ameren TAC facility (with fiber optic interconnects to our primary testbed).
- Deployed Advanced Metering Infrastructure (AMI).
- Solar research platforms.
- Real, emulated, and simulated hardware/software for scalability.
- Real data from the grid, industry partners, etc.
- Power simulation, modeling, and optimization of various forms.
- Network simulation, modeling, and visualization of various forms.
- Advanced hardware-in-the-loop cyber-physical simulation.
- WAN/LAN/HAN integration and probes.
- Security and protocol assessment tools (static/dynamic analysis, test harnesses, fuzzing).
- … and more

ASSETS

- RTDS, PowerWorld, PSSE, PSCAD, PSLF, DSAtools, DynRed
- RINSE, tstBench, LabView, OSI PI, OSIi Monarch, SEL suites, PGDA
- Full range of open-source power grid tools (openDNP3, openPDC, openPG, openXDA/openFLE, openHistorian, SIEGate)
- GPSs, substation computers, relays, PMUs, testing equipment, PLCs, security gateways, NI platforms
- Power analysis tools, PDCs, data analytics
- Full AMI deployment, TCIPG Smart Meter Research Platform
- RTUs, F-Nets, inverters, oscilloscopes, firewalls, embedded devices, sensors, spectrum analyzers, SIEMs, IDSs
- Home EMS, energy and environmental monitoring devices, ZigBee, automation
- Display wall, visualization platforms (STI, RTDMS), training platforms
- Mu Dynamics, Fortify, security research tools, IBM Tivoli suite
- DETER integration and cyber-physical extension via federation
- … and more

USE CASES

- Provide a multifaceted approach to security through testbeds, education and training, field testing, and tool creation.
- Facilitate collaboration among researchers and industry to work towards creation of more resilient critical infrastructure.
- Facilitate rapid transition and adoption of research in industry.
- Provide positive real-world impact through engagement.
- Allow for cutting-edge smart grid security research.



FUNDING SUPPORT PROVIDED BY DOE-OE AND DHS S&T