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Framework for Network Co-Simulation: Ready to Meet New Power Grid Challenges

Throughout the nation's power grid, millions of sensors constantly collect and transmit information about grid operations. These devices and the information transmitted could lead to technological advances in the design, development, and operation of the future power grid ecosystem.

To fulfill the promise of an integrated future power grid, utilities and grid operators need to understand the requirements of smart grid applications, and whether new communication networks are needed to fully enable their efficiency and resiliency potential. Yet compared to current resources, smart grid technologies and concepts, such as demand response and advanced metering infrastructure, require relatively intensive data transfer and considerable communication resources. Until now, capable design tools able to simulate power and communication systems in a single environment have not been available.

The **Framework for Network Co-Simulation, or FNCS**—pronounced "phoenix"— integrates power grid and communication network simulators so that grid planners can solve many cross-domain problems. This open-source software framework enables various simulators, such as power distribution, transmission and generation, and building energy use, to link together and co-simulate communications and grid operational requirements. By automatically managing time and date synchronization among any number of simulators, FNCS facilitates the seamless and secure integration of legacy communication systems with new, smart grid communication technologies and protocols.

KEY ADVANTAGES

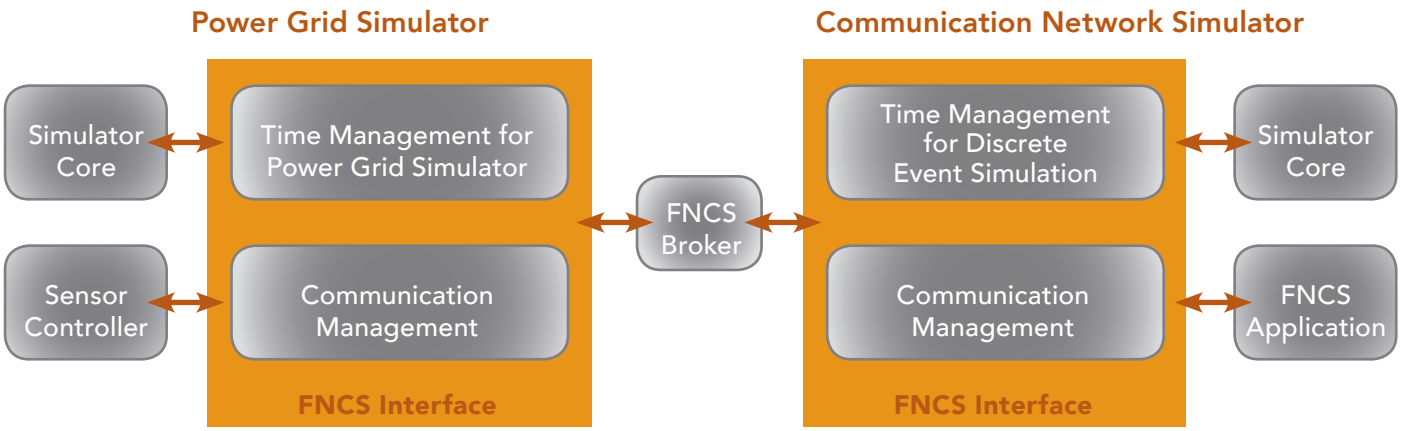
Building upon existing and proven simulation capabilities, FNCS includes:

- **ns-3**—an open source, discrete-event communications network simulator for Internet systems. It is targeted to research and educational use.
- **GridLAB-D™**—a power distribution system simulation and analysis tool.
- **MATPOWER**—an open source simulation tool for solving power flow and optimal power flow challenges.

FNCS leverages these capabilities to offer **two key advantages** for researchers and others who design and run models to create smart grid tools.

First, it takes advantage of today's advanced computing capabilities to link multiple simulation tools and run at larger scales with less effort, while also achieving improved performance.

Second, FNCS synchronizes multiple simulators that run at various timescales. Grid transmission and distribution simulators are continuous, with variable or constant time steps, and coarser timescales. Conversely, communications simulators are discrete event simulators that often use finer timescales. FNCS's unique approach provides the necessary synchronization, helping to ensure rapid, consistent and on-time delivery of messages across simulators.



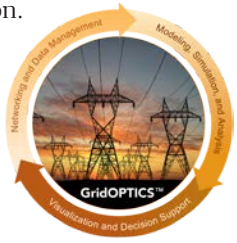
URBAN SCIENCE: BEYOND THE GRID

In today's rapidly changing grid environment, FNCS is a dynamic resource for model developers who need to test their ideas within multiple domains of expertise. The tool is useful for university and laboratory research, and is of value to industry, where there is a need to understand requirements for the deployment of hardware in support of smart grid development and emerging markets.

In addition to its core use, FNCS provides insights into the dynamic interactions of information flow and power systems. It also creates a virtual testbed for evaluating new communication specifications and other information-rich applications.

ABOUT GRIDOPTICS™

FNCS is part of the **PNNL Future Power Grid Initiative-developed Grid Operations and Planning Technology Integrated Capabilities Suite (GridOPTICS™)**. This set of tools facilitates secure data collection in real time, uses data to drive modeling and simulation, and converts large volumes of data to actionable information. The result will be the ability to show and analyze grid performance at an unprecedented speed, scale, and resolution, supporting operational and policy decision-making for the grid of the future.



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FNCS is open source and available at https://github.com/FNCS/fncs

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