Next Generation Network Simulations for Power System Applications

OBJECTIVE

New smart grid technologies and concepts are expected to require considerable communication resources. To operate the future power grids, these will need to take into account:

» the integration of high-speed, secure connections with legacy communication systems

» adequate system control and security

» communication system latency

» cyber-security

» grid topology.

Limited work has been performed in integrating communications directly into a power domain solver. Simulating a large-scale power and communications network by power system planners is necessary until an understanding of the interactions of the two systems is proven.

APPROACH

PNNL developed the Framework for Network Co-Simulation (FNCS – "phoenix"), a scalable, high-performance cooperative simulation framework for data communication networks to be used for power transmission and distribution power grids. PNNL has:

» integrated the power distribution system simulator GridLAB-D, the communication network simulator ns-3, the transmission system and wholesale market simulator MATPOWER, as well as the building energy simulator EnergyPlus

» developed an initial use case for the integrated tools simulating a real-time, transactive pricing mechanism designed by PNNL and currently being deployed in the AEP gridSMART Demonstration Project
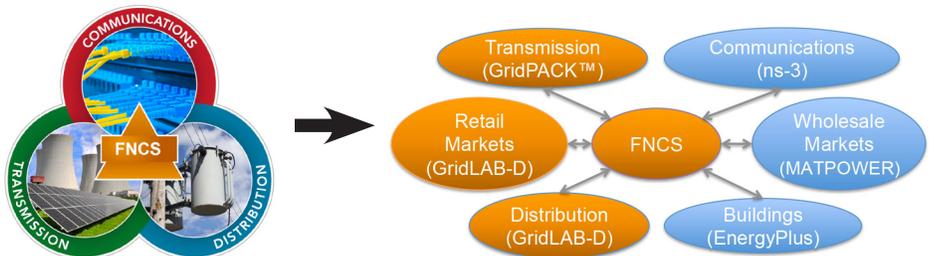
The Framework for Network Co-Simulation synchronizes a cooperative simulation of connected components—each component modeled by its vetted, specialized simulation software—on a cluster.

FOCUS AREA 1 - NETWORK AND DATA MANAGEMENT

» developed a scalable framework for simulating connected components, capable of simulating larger integrated power and communication systems.

We will continue to map and optimize existing simulation engines to state-of-the-art, high-performance computers and integrate additional simulators such as PowerWorld and those developed using GridPACK™, as well as hardware in the loop and real-time simulation capabilities.

IMPACT

The aim of the project is to develop a unique infrastructure that will position PNNL as the leader in modeling and planning power grid data communication networks. External users have already expressed significant interest in using the integrated system, mainly for business case scenarios and testing of communication requirements with smart grid investments.

FOCUS AREA

Focus Area One addresses data networking and management issues, and enables the digital infrastructure for the future grid. This focus area will address the gaps in networking and real-time data management by developing advanced algorithms and software tools and techniques. **Focus Area Lead:** Bora Akyol (bora@pnnl.gov)
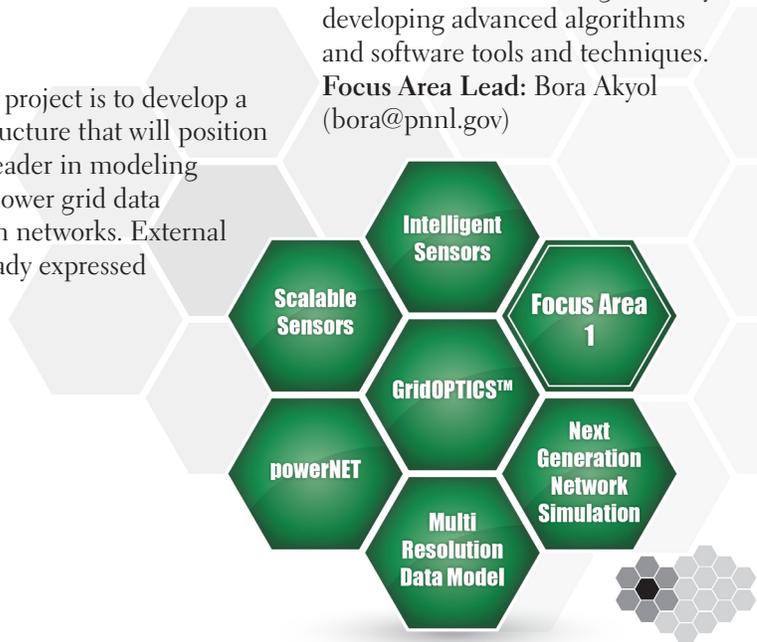
ABOUT FPGI

The Future Power Grid Initiative (FPGI) will deliver next-generation concepts and tools for grid operation and planning and ensure a more secure, efficient and reliable future grid. Building on the Electricity Infrastructure Operations Center (EIOC), the Pacific Northwest National Laboratory's (PNNL) national electric grid research facility, the FPGI will advance the science and develop the technologies necessary for meeting the nation's expectations for a highly reliable and efficient electric grid, reducing carbon emissions and our dependence on foreign oil.

ABOUT PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,300 staff, has an annual budget of nearly $1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

For more information, please visit the FPGI website or contact:

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