FNCS: Framework for Network Co-Simulation

Jeff Daily, Jason Fuller, Selim Ciraci, Andrew Fisher, Laurentiu Marinovici, Khushbu Agarwal

Challenge

• Integration of communication and information technologies with power system applications promises a more reliable, efficient electrical infrastructure.
• Cost-effective technology development and evaluation in this domain requires an understanding of power and communication system interactions and detailed simulation and analysis capabilities.
• Traditionally, power grid and communication network domains have not resided within a single simulator with relatively equal consideration to the complexity of each.

Technical Solution

The Framework for Network Co-Simulation (FNCS) has been designed to abstract the application layers from the integration framework, allowing specialists to work within their specific domains while distancing users from the high-performance computing co-simulation components. FNCS:

• Automatically manages time synchronization and inter-simulator message exchanges
• Uses optimistic synchronization and speculative multiprocessing to enhance performance
• Provides a conservative synchronization algorithm for simulators sensitive to artificially delayed messages
• Scales across multiple processors and platforms to support large-scale simulations.

Results

FNCS offers a flexible co-simulation framework that provides a federated simulation environment.

• Enables transmission- and distribution-level power grid simulator integration with a telecommunication network simulator, namely GridLAB-D, MATPOWER, and ns-3

Applications

Simulation may provide insight on how communication latency, packet drop, and interference might impact control systems in relation to:

Distribution

• Real-time data collection for outage management, reconfiguration, etc.
• Demand Response and retail markets
• AMI for state or parameter estimation.

Transmission

• Wide Area Control (and Protection)
• Using phasor data in control applications
• Communication pathways and redundancy requirements.

Transmission and Distribution

• Transactive energy ancillary market (with distributed resources)
• Centralized vs. distributed vs. hierarchical control paradigms
• Reconfiguration of networks during communication losses
• Loads as a resource with high-penetration of variable generation.

Acknowledgment

FNCS development has been funded via PNNL’s Future Power Grid Initiative, a PNNL Laboratory Directed Research and Development program activity.

An initial “bootcamp” tutorial for the FNCS software was held in January 2014, with approximately 40 people participating.

For more information, please contact:
Jeff Daily
Pacific Northwest National Laboratory
Jeff.Daily@pnnl.gov

www.pnnl.gov