NIST TE Challenge Phase II

Team: Massachusetts Institute of Technology
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Members: MIT-LL, Eaton, ARPA-E, NETSS, CMU, HARPS-Japan, IWR – Germany, UPRM – Puerto Rico
Project name: Scalable Electric Power System Simulator(SEPSS)
Simulation tool set: SGRS, CAMPS, DAMPS, NETSS, MATPOWER

Project Summary:

MIT is developing a modeling and HLA-compatible simulation platform called SEPSS. This platform builds on an earlier TCP/IP based multi-layered interactive computer platform named Smart Grid in a Room Simulator (SGRS) developed in collaboration with NIST. Each user can define its own system architecture comprising modules that have uniform functional characterization such that the interactions can happen across multiple spatial and temporal layers simultaneously. Given this, SEPSS can emulate hybrid system dynamics driven by different inputs (weather, consumer preferences) and market decisions. Both Centralized and Distributed Automated Modeling of Power Systems (CAMPS, DAMPS) are possible. DAMPS is particularly well-suited for simulating utility scale systems and markets.

Based on our development up-to-date, we first demonstrate the basic Transactive Energy Market (TEM) concepts on truncated IEEE-8500 test system and some missing market signals. We then show potential benefits on MIT-LL microgrid test systems from having more detailed market signals such as voltage and power ramp rates. We invite collaboration with others working on similar TEM design issues.

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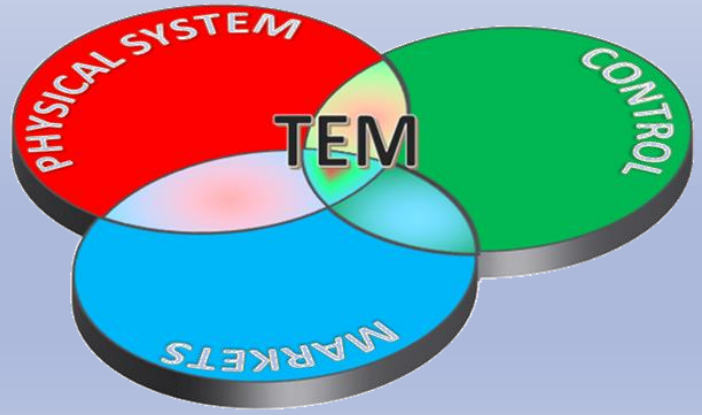

Simulation Platform

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MIT is developing a home-grown physics based multi-layered modeling for representing dynamic interactions between physical and market systems. This approach serves as the basis for an HLA compatible simulation platform called SEPSS. This platform builds on an earlier TCP/IP based multi-layered interactive computer platform named Smart Grid in a Room Simulator (SGRS) developed in collaboration with NIST. Each user can define its own system architectures comprising modules that have uniform functional characterization such that the interactions can happen across multiple spatial and temporal layers simultaneously. Given this, SEPSS can emulate hybrid system dynamics driven by different inputs (weather, consumer preferences) and market decisions. Both Centralized and Distributed Automated Modeling of Power Systems (CAMPS, DAMPS) are possible. DAMPS is particularly well suited for utility scale systems and markets.

Potential uses of SEPSS for TE Challenge

- Over the past five years, SEPSS has been used to simulate both stochastic and deterministic Adaptive Load management (ALM).
- Most recently, SGRS enabled SEPSS is being used in collaboration with MIT-LL and UPRM to simulate microgrids and their participation in transactive energy markets (TEM).
- Recent particular use of SEPSS has been in collaboration with Eaton under ARPA-E project on synthetic reserves by DERs. This can be thought of as an example of TEM supporting ancillary services provision.
- We have also shown fundamental need for voltage dispatch market signals to ensure reliable operation.
- We have shown in collaboration with MIT-LL potential benefits from advanced power inverter control for enabling reliable integration of PVs and EVs. Effects of other TEM participants are implementable by the SEPSS.

The most unique feature of our framework is its fundamental architecture modeled as complex interactive dynamical system.