TE Challenge Phase II Team Collaboration on Challenge Scenario

Meeting #2

May 16, 2017
Meeting Agenda

1. Review of Challenge Scenario and goals
2. Discussion of feedback from first meeting.
3. Rethink on Challenge Scenario and update on grid.
4. Common metrics discussion
5. Next meeting(s) and homework
Important Collaboration Points

• TE Challenge Phase II [Launch webinar] intro
• [Slides from May 9] first collaboration meeting
• [Abstract Component Model] on github

• What is the Challenge Scenario?
  – Goal—we want to enable comparison of transactive methods across different platforms by implementing a common event narrative on a common grid, with results reported with common metrics.
  – The narrative (clouds passing over distribution feeder)
  – The R1-12.47-1 grid
  – Common metrics for reporting (minimum set that all use, plus additional potentially)
  – Implementation steps:
    1. Baseline event day, no weather, no market
    2. Add weather and dynamic electricity price (homes are price-takers—no TE bids)
    3. Add your TE market
Challenge Scenario

• How does it help us?
  – Advances interoperability among tools through common metrics, common interfaces, and shared understandings.
  – We hope that through this process we connect co-simulation platform developers together with a larger user base.
  – Provides a common baseline to allow comparison of transactive methods

• Goals for each team
  – Use of common platform model
  – Participate in the Challenge Scenario implementation (3 steps)
Discussion from first meeting

- How are the houses defined, what loads can be controlled and which ones are fixed?
  - HVAC and water heater loads are controllable and participate in TE market
  - Fixed load profiles—need to be pulled out for teams to use
  - We discussed EVs or possible other loads and decided to keep it simple for now
- Are the elementary school loads controllable or fixed?
  - We agreed we don’t need the extra complexity of the school and its EnergyPlus model, so either remove this, or replace with fixed load on grid.
- What fraction of the houses (or loads) are participating in the transactive market?
  - This was not yet fixed. Something like 30% of homes had PV and 1/3 of those have batteries. But this was going to be adjusted to allow for over-generation and backflow at peak sun.
- What is the weather file format? Location?
  - TMY3. Location is TBD. Looking at Tucson or LA.
• Tom (PNNL) noted that 70% of homes have water heaters (DHW), and PV% is still not decided. HVAC and DHW are the only controllable loads so far. PNNL will test the grid to make sure that we have over-voltage conditions, and that we can reduce that using available load reductions and battery charging.

• We discussed use of commercial building loads that they will be added as needed to create an interesting grid. The presence of voltage regulators and switches also need to be looked at. Each team should discuss with PNNL any special needs such that the PNNL grid can serve that team’s purposes.
Follow-up question

• What is the overall objective and how should we weight multiple objectives? For example, if the goals are both to shed load to support the wholesale market and to respond to voltage changes with the cloud, how do we weight the two goals?
  – One team might make energy consumption decisions (and battery charge / discharge) purely based on prices. This might result in increased backflow to substation and reduced substation equipment life if prices do not account for this.
  – Another team might treat branches off the feeder as “neighborhood microgrids” each with its own market, and use this market price to provide voltage support via incentivizing load increase/decrease.
  – A TE method might include multi-lateral trades between neighborhood microgrids. Who runs the market and what are the goals? Where is the money?
  – Can we have a feeder design where we intentionally have strong non-homogeneity of load/DER distribution and thus emphasize these trade-offs?
Notes from May 16 Meeting #2 discussion

• We had a discussion about team objectives that ties to metrics.
• Each team needs to write down and share with other teams the objectives for what kind of TE market they plan to implement. What metrics matter for that? Who are the stakeholders in that market implementation? Then the teams can discuss together how much commonality we can have in objectives and actors in the simulations.
• Bulk market simulation is not included now, but teams could simulate this for their TE market. Currently there is canned bulk market LMP player that can roughly match the distribution grid conditions.
Electric feeder with high penetration of PV. At mid-day on sunny day, the feeder has reverse power flows and over-voltage conditions. At noon, a storm front overspreads the feeder and PV power production drops from full sun to 10% sun in a period of 10 min. This is followed by a ramp back up to full sun from 1:30 - 2:00 pm. Transactive methods are used to incentivize load, generation or storage response as needed throughout the day, and the transactive signals are localized to the feeder level to respond to voltage levels.

Focus on distribution grid and challenge of DER integration (PV, batteries)
Based on Scenario #3 in SGIP TE Application Landscape Scenario white paper
Question: Can this scenario work for your team (you can study the impact of some TE method on the grid or customer resources)? What changes would make this more useful for your team?
R1-12.47-1b grid

- Semi-rural radial feeder.
- Published in the PNNL GitHub TESP directory as SGIP1b.glm
- Currently in Gridlab-d format (need sub-team to work with PNNL to enable duplicating this feeder in other platforms)
- Includes 1500+ homes (with variation in size, load)
- Some homes have PV, and some of those have batteries
- Also some unresponsive commercial loads
- And an elementary school modeled in EnergyPlus.
Implementation steps

• Steps
  1. Baseline event day, no weather, no market
  2. Add weather and dynamic electricity price (homes are price-takers—no TE bids)
  3. Add your TE market

• Rationale
  – Step one allows us to get the basic indication that we have similar results (using common metrics) for the same grid.
  – Step 2 lets us work out weather and price inputs, where we can check common PV response to clouds, house load response to temps, and control algorithm response to price.
  – Step 3 then allows us to see how different TE methodologies perform relative to the common baseline scenario.

• “Step 4”—additional research according to your own research goals
  – ideally using the same metrics and demonstrating interoperability, collaboration and lessons learned from the Challenge Scenario.

• Reporting results
  – Results from implementing Challenge Scenario reported in common metrics
  – Results form other scenario or variation that is investigated
  – Any useful lessons learned in the process that can help advance the state of the art.
# Common Metrics

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>gridPower</td>
<td>Power</td>
<td>Power provided by the Grid. Power flows at each grid node.</td>
</tr>
<tr>
<td>loadProfile</td>
<td>Energy</td>
<td>Energy consumed by each load.</td>
</tr>
<tr>
<td>generationProfile</td>
<td>Energy</td>
<td>Generation by generator.</td>
</tr>
<tr>
<td>aggregatedLoadsByHousehold</td>
<td>Energy</td>
<td>Aggregated load by household.</td>
</tr>
<tr>
<td>priceNegotiations</td>
<td>Tender</td>
<td>Sequence of all tenders.</td>
</tr>
<tr>
<td>realizeMarketPricing</td>
<td>Quote</td>
<td>Realized Market price quotes.</td>
</tr>
</tbody>
</table>

- Summer 2016 Tiger Team effort.
- Large collection of [TESP output metrics](#) defined for PNNL’s TE Simulation Platform (e.g., voltage deviations outside of ANSI, line overloads, etc.)
- What metrics do/don’t work for your team?
Notes from May 16 Meeting #2 discussion

• The Tiger Team metrics specify all the data that must be transferred at the common abstract model-defined interfaces. This is the raw data.
• The TESP specifies derived metrics. They provide a good start for teams to analyze.
• Capturing and writing the raw data to file take processing time and also requires significant storage. Not every team may want to do this, but it is an option and it may support comparisons between teams.
• We should review and try to agree on a base set of derived metrics, starting with what PNNL has in the TESP. We may want to add or modify. Others may do some TE market approach that produces additional metrics, which is fine. Some teams may not be able to generate all the metrics, depending on the TE market.
Homework for next meeting

• What concerns/changes do you have for the Challenge Scenario?
• Consider TE market objectives for your team research. What are the best metrics for reporting results? Consider the metrics from TESP—which of these are important to your team, which ones are missing, which ones cause problems?
• How will your team implement the common platform model interfaces/components?
• Each team prepare an implementation plan for the Challenge Scenario with goal to try to run baseline (null case) scenario and storm passing event scenario on grid by end of June, if possible.
  – Prepare a one page summary if possible that can be shared with a team introduction on our collaboration page.
Meeting schedule

• April 20, 2017 TE Simulation Challenge Phase II Launch.
• May 9 Challenge Scenario Development Meeting #1
  • Follow-on meeting schedule (approx. bi-weekly)—see next slides
• June 14, 2017 Face to face meeting and Scenario Workshop at the GWAC TE Systems Conference in Portland, OR.
• January 2018 TE Challenge Capstone Meeting to share simulation results.
• Collaboration site: https://pages.nist.gov/TEChallenge gives access to the latest documents
Meeting #3 May 30 (Tues, 11:30-1:00pm ET)

• At the meeting:
  – Review updated Challenge Scenario and team expectations. Discussion.
  – Review teams and team plans. Coordinate on how to start implementing Challenge Scenario grid on each platform.
  – Review of metrics and feedback.
  – Prep for June 14 workshop at TE Systems Conference Portland, OR. Steps to take and best use of next meeting
June Meetings

• Meeting June 6 (Tues)
  – TBD goals
  – Review of plans for following week meetings at TE Systems Conference in Portland.
  – Homework: prepare slides for presentation in Portland.

• Meeting at TE Systems Conference, June 13-15, Portland, OR
  – TE Challenge Scenario Workshop, Wed, June 14, 5:30-7:00pm.
  – Opportunity to connect face-to-face, present research objectives, build teams, plan for Scenario implementation work and beyond to accomplish team research goals.
Meetings after TE Systems Conference (Portland)

- Meetings June 28 (Wed, 1:00pm ET), July 5 (Wed, 1:00pm ET) and 11 (Tues, 1:00pm ET):
- Perhaps have additional participants joining.
- Discussion of any further updates to Challenge Scenario or implementation based on initial experiences of some teams.
- Presentations by teams on initial simulation efforts (may move to August as appropriate).