



GMLC Project Communications Summary

Date: 28 February 2020

Project Title: Interoperability

Project Number: 1.2.2

Principal Investigator: Steve Widergren

Person Completing this Document: Steve Widergren

1. What problem is the project solving or what opportunity is it addressing?
The number of smart devices and systems that communicate and interact throughout the electric power system is growing exponentially and taking more time and effort to integrate. This project provides general interoperability requirements, methodologies, and tools to make integrating these new technologies go more easily and reliably.
2. Who collaborated on this project? (e.g. labs, universities, utilities, vendors, others)
The project's lab partners were PNNL, NREL, LBNL, and ANL. The major collaborators included SEPA, NIST, IEEE, and EPRI. Additional industry advisors included representatives of GWAC, NEMA, ASHRAE, LonMark, GSA, Army Corps of Engineers, EnergyStar, IEC, and the Industrial Internet Consortium. Technical meetings incorporated input from a wide variety of utilities, technology solutions providers, standards development organizations, and testing companies.
3. What is the solution or outcome that the project delivered?
 - A) Established an interoperability strategic vision for the electric power sector.
 - B) described the state, challenges, and path forward to advance interoperability.
 - C) Articulated general interoperability requirements, and offered tools and methodology to facilitate gap analysis, develop roadmaps, and demonstrate vision concepts.

4. How does the solution/outcome break new ground or how is it differentiated from other R&D projects?

To advance interoperability, the project emphasized industry, government, and consortia (standards, professional societies, and collectives) interaction. This is the first project known to create an “Ecosystem Steering Committee” populated by industry experts and stakeholder representatives, which developed an interoperability roadmap for the technical and business community emerging with the use of IEEE std 2030.5.

The project also attracted industry input on new ideas to simplify the integration of distributed energy resources. This resulted in documented specifications and working demonstrations of approaches that can be universally applied to any collection of responsive resources wishing to interact with the electric system.

5. How is the deliverable or outcome of the project being used?

The work attracted industry stakeholder attention and incentivized involvement to make interoperability advancement an enduring aspect of grid modernization technology deployment:

A) Brought attention to the importance of addressing interoperability concerns for grid modernization and educated various communities on these concepts (e.g., NARUC, IEEE, SEPA, and DOE itself).

B) Inspired an on-going effort in SEPA (the ESI Task Force) for developing a universal specification for distributed energy resource information and communications technology integration to improve interoperability of these resources with electric system operation.

C) Launched an interoperability ecosystem group for integration of DER based on the IEEE 2030.5 standard roadmap that continues in IEEE and SunSpec organizations.

D) Provided reference language for adaption and use in requests for information or proposals that encourage interoperability requirements in technology procurements. American Electric Power is looking into incorporating such language in smart technology procurement opportunities.

6. Impact metrics – has project impacted grid modernization in any quantifiable way? (E.g. reliability, resiliency, efficiency, DER integration, event response, etc.) SunSpec and IEEE are using the interoperability maturity roadmap developed around the IEEE Std 2030.5 ecosystem. Working groups within SunSpec are being set up to address some of the steps identified in the roadmap document. See, <https://sunspec.org/sunspec-ieee-2030-5-conformance-profiles-work-group/> In addition, the ESI concept and focus on grid services has inspired the successful creation of the GMLC 2.5.2 Grid Services and ESI project.

7. What IP and/or industry recognition or adoption has the project resulted in?

- Patents: not applicable
- Licensing: not applicable
- Open Source Adoption: 3 Energy Service Interfaces specifications were developed as a result of the Plug & Play DER Challenge. These are open specifications and aspects are being considered in standardization discussions in SEPA and the OpenADR Alliance
- Journal and Publication Articles:
 - a. Public whitepapers
 - i. November 2016, Declaration of Interoperability, <https://gmlc.doe.gov/sites/default/files/resources/InteropDeclarationV3.pdf>
 - ii. March 2018, Interoperability Strategic Vision, <https://gmlc.doe.gov/sites/default/files/resources/InteropStrategicVisionPaper2018-03-29.pdf>
 - iii. July 2018, Plug & Play Challenge Call for Concepts, <http://www.plugandplayder.com/>
 - iv. October 2019, Interoperability Maturity Roadmap – IEEE Std 2030.5, published by IEEE <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8894220>
 - b. Final reports

- i. January 2020, Interoperability Maturity Model – A Qualitative and Quantitative Approach for Measuring Interoperability, PNNL-29683
 - ii. January 2020, Interoperability Maturity Roadmap Methodology, V1.3, PNNL-2749 1.3
 - iii. January 2020, Reference Interoperability Procurement Language, PNNL-28666 Final
 - iv. January 2020, Launching Plug and Play Distributed Energy Resources into the Future, <http://www.plugandplayder.com/>
- c. Articles
 - i. April 2017, Blurring Lines Between Technical and Cognitive Interoperability, Public Utilities Fortnightly, <https://www.fortnightly.com/fortnightly/2017/04/blurring-lines-between-technical-and-cognitive-interoperability>
 - ii. June 2018, Enabling an Interactive Grid: A Strategic Vision for Interoperability, Smart Grid Newsletter, https://resourcecenter.smartgrid.ieee.org/publications/newsletters/S_GNL0255.html
 - iii. Sep/Oct 2019, The Plug-and-Play Electricity Era, IEEE Power & Energy Magazine, pp 47-58, <https://ieeexplore.ieee.org/document/8802361>
 - iv. September 2019, Sowing the Seeds of Grid Interoperability: “Plug-and-Play DER Challenge” Seeks Industry Solutions to Address Technology Silos, Christine Stearn (SEPA) and Tim Wolf (PNNL) <http://www.plugandplayder.com/>
- Conference Presentations
 - i. 2016, 2017, 2018 GMLC Peer Review presentations
 - ii. November 2016, SGIP Grid Modernization Summit
 - iii. November 2016 GridWise Architecture Council presentation
 - iv. April 2017, IEEE ISGT conference presentation
 - v. July 2017, DOE Interoperability briefing
 - vi. July 2017, SEPA Grid Evolution Summit presentation
 - vii. January 2018, AHR Expo panel presentation
 - viii. February 2018, IEEE ISGT conference presentation
 - ix. June 2018, Transactive Energy Systems conference presentation
 - x. July 2018, SEPA Grid Evolution Summit, 2 presentations
 - xi. August 2018, IEEE PES GM presentation

- xii. September 2018, Solar Power International (NASEW) presentation
- xiii. January 2019, AHR Expo presentation
- xiv. January 2019, DOE Innovation XLab presentation
- xv. July 2019, IEEE Transactive Energy Systems conference presentation
- xvi. August 2019, Grid Evolution Summit presentation
- xvii. August 2019, IEEE PES GM presentation
- xviii. September 2019, NCEP training for NARUC presentation
- xix. September 2019, North America Smart Energy Week presentation

8. If you look ahead 5-10 years, how do you see the work of this project impacting grid planning and operations in the U.S.?

Interoperability issues will become ever more important as the incorporation intelligent systems into power system operations continues to grow. The work of this project will inspire collaboration among the stakeholders impacted by creating easy to integrate technology solutions. The strategic direction provided by the Energy Services Interface (ESI) concept will influence discussions within industry and government about the roles and responsibilities among smart devices that are respectful of owner/operator needs such as security and privacy, reliability, and resilience. The formalization of ecosystems (communities of people and organizations with a stake in specific technology integration scenarios) will form the basis for advancing interoperability not just for developing technical standards, but include companion implementation profiles, testing and certification, and branding and marketing initiatives.