Plug & Play DER Challenge Call for Concepts

The Grid Modernization Laboratory Consortium (GMLC) is challenging the smart grid community to demonstrate *visionary interoperability capabilities* for how facilities with Distributed Energy Resources (DER[1]) integrate and interact with the utility grid. This challenge is being organized and administered by Lawrence Berkeley National Laboratory (LBNL) for the Department of Energy's GMLC (gridmod.labworks.org), as part of an initiative to improve Interoperability[2] (gridmod.labworks.org/projects/1.2.2), in collaboration with the Smart Electric Power Alliance (SEPA), National Institute of Standards and Technology (NIST), and Electric Power Research Institute (EPRI).

The conclusion of the challenge will be a live hardware/software demonstration of DER being integrated with a utility grid entity (real or simulated), at a public event targeted for the first half of 2019. The first phase of the challenge is a call for concept papers where, participants will present their proposed solutions at the Solar Power International trade show. Concept submissions will be evaluated using the criteria below and those demonstrating the highest degree of visionary interoperability capabilities will be selected and recognized to participate in the following demonstration phase of the challenge.

Timeline (subject to change)

Now	Create a team, register your intent, devise an interface specification that supports DER integration (see below), and propose how to demonstrate the DER integration process with hardware and software
September 7	Submit presentation and draft concept proposal for consideration to be presented at Solar Power International/North America Smart Energy Week in Anaheim, CA;
September 14	Qualifying presentation submissions are announced with an invitation to participate at Solar Power International/North America Smart Energy Week in Anaheim, CA
September 24-27	Phase 1 event: Solar Power International/North America Smart Energy Week, Anaheim, CA; Qualifying submitters present their DER integration interface concepts
October 31	Opportunity for concept submitters to interact, form new teams, and optionally submit a revised proposal for the demonstration phase
Fall 2018 / Spring 2019	The demonstration phase of the challenge is expected to start soon after the concept presentations. Successful concept submitters should anticipate an opportunity to interact, form new teams and submit a revised proposal. Details of a call for demonstrations are still being discussed.
After	At the conclusion of the demonstration challenge, concepts from leading submissions are expected to impact future standards, policies, products, and utility programs

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[1] DER includes distributed generation, storage, and load flexibility.

[2] The GMLC 1.2.2 project is being conducted and administered by Pacific Northwest National Laboratory (PNNL), Lawrence Berkeley National Laboratory (LBNL), the National Renewable Energy Laboratory (NREL), and Argonne National Laboratory (ANL).

This document explains the background for conducting the challenge, the context that the technology demonstrated needs to conform with, and criteria that will be applied in judging the concept submissions. A separate announcement will be made for for the second, demonstration phase of the challenge.

Context

The core of this challenge is an interest in improving Interoperability as it eases technology integration. To the degree that our technologies and systems lack good Interoperability, it drives up costs, reduces system performance and capabilities and creates vulnerabilities. Particularly, in the case of DER, interoperability-related problems make it more difficult to integrate high amounts of renewable energy sources and energy storage. The GMLC Interoperability project has outlined a strategic vision[3] of interoperability for our electric system which this challenge aims to demonstrate in reality.

The **Interoperability Maturity Model**[4] (IMM) measures the level of maturity of capabilities that ensure interoperability and simplify technology integration. The IMM criteria are the foundation for evaluating challenge submissions, with emphasis on novel ideas that showcase advanced interoperability capability.

The **Energy Services Interface** (ESI) is a concept for how DER facilities interact with the electric grid (including possible third parties) based on a service-oriented paradigm. At present, utilities are unsure of what set of grid services they should seek from DER facilities, how they can or should coordinate with them, and what level of control or visibility they have into individual DER. Vendors of individual DER are unsure of what technologies or grid services to support in their products. Vendors of hardware and software systems that coordinate DER at a facility level (that is, that create systems that support an ESI) are thus unsure of what to do. In this situation, general integration mechanisms that span DER technologies are needed and the ESI concept is a way to bring commonality to interfacing with these different technologies. And critically, will reduce the burden of the integration experience.
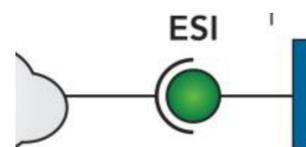
The ESI topic involves issues of system architecture, boundaries of responsibilities, business relationships, and coordination that drive the provision of grid services, so all submissions necessarily must describe assumptions about all of these.

The GMLC interoperability project recognizes the importance of the ESI concept in the Strategic Vision document. To the extent that the ESI can modularize the complexities of the grid from that in DER facilities, it simplifies integration and enables greater interoperability in those domains as well.

The demonstrations should clearly show advanced interoperability capability through ease of integration.
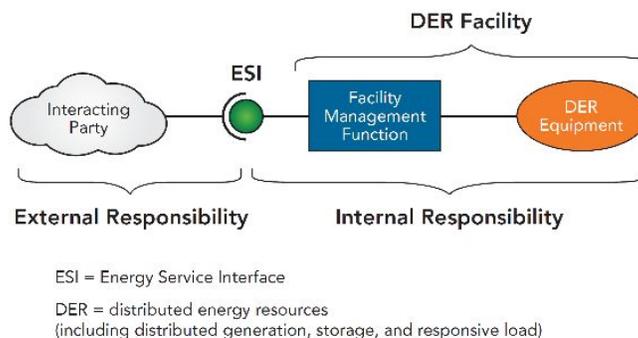

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[3] Interoperability Strategic Vision: A GMLC White Paper, March 2018
https://gridmod.labworks.org/sites/default/files/resources/InteropStrategicVisionPaper2018-03-29.pdf
[4] https://www.gridwiseac.org/about/imm.aspx

Scope of the Challenge

The Interoperability Strategic Vision outlines a set of assumptions about how the ESI relates to the utility grid and DER within the facility. These are listed below.

ESI = Energy Service Interface

DER = distributed energy resources
(including distributed generation, storage, and responsive load)

Figure 1. Components of DER and Grid Integration

- "An ESI is a bi-directional, [*service-oriented*], logical interface that supports the secure communication of information between entities inside and entities outside of a customer boundary to facilitate various energy interactions between electrical loads, storage, and generation within customer facilities and external entities[5]." Figure 1 shows this in graphic form.
- The ESI concept means that the grid interacting parties do not directly control individual DER within the DER facility, but invoke agreed upon services.
- The challenge addresses the business, information and communications interactions, but does not address utility electrical interconnection issues with DER facilities. It does recognize that interconnection and interoperability issues need to be part of DER deployments.
- The grid services represented in an ESI specification should not be defined for specific DER types, but be based on ability to perform the service.
- DER equipment either communicate and coordinate their operation as a unit (taking in grid signals directly) or are directly controlled by a separate management system (via a functional control command).

Grid Services in Scope[6]:

    a. <u>Peak capacity management</u> – reduce net load over a specified period of time related to system or local peaks. This could be using price based incentive techniques or other approaches.

    b. <u>Energy market price response</u> – reduce net load when prices are high or increase net load taking place when prices are low.

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[5] Hardin D. *Customer Energy Services Interface White Paper*. Grid-Interop Forum 2011. Accessed February 2018 at http://www.gridwiseac.org/pdfs/forum_papers11/hardin_paper_gi11.pdf. Note that the words "service-oriented" are added to the definition here.

[6] These services from the Strategic Vision, there taken from GMLC 1.4.2 on Definitions Standards and Test Procedures for Grid Services - https://gridmod.labworks.org/projects/1.4.02. Additional grid services include capacity, frequency regulation, ramping and artificial inertia.

c. <u>Spinning reserve</u> – able to rapidly reduce net load and sustain the reduction (typically 15 to 30 minutes).

d. <u>Distribution voltage management</u> – able to self-sense when the distribution voltage drops rapidly, and act instantly and autonomously by rapidly adjusting net load in the form of its reactive and/or real power components (~1 second, less is preferred). Fast response – in response to rapid changes in net demand. Slow response – coordinating reactive power output with distribution voltage management systems, either on command or autonomously based on self-sensed voltage fluctuations.

Process

Intent to Submit. Those intending to create a submission for this call for concepts are encouraged to share their intent to submit by August 13, 2018 to https://goo.gl/forms/G9XeElQFazItCqao2 with their contact information, tentative title of their submission, and brief (~300 words) description. The organizers will review these and advise submitters of any concern about the content.

Concept Submissions (Phase 1). A presentation & draft written concept will be submitted by September 7th and then the best qualifying submissions will be presented at the Solar Power International event in Anaheim, CA in September (24-27). The submissions must fully cover the material below; the Challenge organizers will evaluate submissions for how they are responsive to the process and reserve the right to disqualify submissions that insufficiently do so. Qualifying submissions will be posted on the project website.

At the Solar Power International conference, submitters will verbally present their submission followed by a question and answer session. The submissions will also include the content in a poster. The organizers reserve the right to limit the number of submissions that deserve verbal presentation should there be too many or if any do not meet a quality threshold.

During the Phase I process, the organizers will provide feedback to the submitters to guide them in directions deemed most beneficial to the challenge, and pose questions about the concept paper that submitters mayaddress in a transition to the demonstration phase to the challenge (see below). This feedback is to be private to the submitters.

Demonstration Submission (Phase 2). The results of the Phase 1 will set the stage for Phase 2, the demonstration phase of the challenge. Detailed arrangements for a call for demonstrations are in progress. An industry event will be identified that can showcase the work of the submitters to a large group of interested people. In order to provide adequate time to prepare for the demonstrations, the identified event is expected to be sometime in the second quarter of 2019. i The submitters should bringing all necessary hardware and software to support their demonstration. The submissions should cover the components of Figure 1, and emphasize the integration with an electric system grid entity (e.g., aggregator or distribution system operator) using the ESI concept to integrate and then interact with a DER facility management function. Within the DER facility, interactions between the facility management function and one or more DER should be included using a hardware device that is a DER or simulates a DER.

Submitters qualifying for the Phase 1 concepts presentations will have an opportunity to consider the Phase 1 feedback, discuss potential teaming arrangements with other submitters, and submit a Phase 2 demonstration proposal with updated teams and/or content. This may result in some submitters combining efforts, adding new people, or incorporating ideas from other submissions or comments from the organizers and Phase 1 event attendees.

Submission Content
There is no page limit on submissions but brevity is appreciated so long as all necessary content is included. Reference to web resources with additional detail are encouraged.
1. **Submission Title:** contact information for all participants (name, organization, email, phone).
2. **Narrative about the ESI Functionality:** Submissions must follow the definition of the ESI concept in the Interoperability Strategic Vision whitepaper.
3. **Assumptions about Grid/DER Facility Relationship(s):** Submissions must detail their assumed system architecture with regards to the nature of the relationship between the grid and the DER facility as well as the facility management function and the DER. It must also describe how grid services are verified and settlement (financial or otherwise) occurs.
4. **Needed Hardware/Software for Demo**: Since the ESI is a logical construct, it needs to be supported by a host device in the DER facility that can house and implement its logical capabilities.Similarly, a corresponding host device or system for the grid entity is required. This section describes the nature and design of these hosting components that will be used to demonstrate the integration process.
5. **Narrative of Integrator Experience**[7]: Since the goal of the project is to demonstrate visionary interoperability capability as a way to reduce integration time and cost, it is necessary to capture the integrator experience in each submission. The following points should be covered:
    o An integrator: The entity/person commissioning the system
    o Other actors who support the integrator by accomplishing some specific task required for integration - Ideally nobody.
    o The point of integration – the physical locations for connection using the ESI
    o The interface to be integrated - ESI. This includes a description of the systems or components on either side of the integration.
    o Example Scenario: Price-responsive thermostat, facility management function and DER aggregator
        · Integrator: homeowner
        · Others: Electrician
        · Point(s) of Integration: homeowner's internet connection to thermostat and simulated DER aggregator internet connection
        · Components: thermostat, DER aggregator, and internet routers

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[7] *This will be demonstrated live at the event.*

6. **ESI Implementation:** The ESI Interface Specification. The following breakdown of interface elements are derived from the Gridwise Architecture Council's Interoperability Context-Setting Framework[8]

- o Organizational characteristics
  - · Assumptions about the economic and regulatory environment that support the interface
  - · Assumptions about the business objectives of the interacting parties.
  - · The business process conducted, including the grid services supported.
    - ● Each submission and demonstration can cover a subset of grid services; while a single grid service is acceptable, more may be more compelling.
    - ● This section will detail the types of grid services the ESI is capable of supporting even if all the capabilities are not showcased during the demonstration.
    - ● This section describes (diagrams) the interactions (message flows) across the interface including the message definitions and allowable sequencing of messages. This can include processes such as registration, configuration, operational interactions, measurement and validation, and settlement and reconciliation.
- o Informational characteristics
  - · The information model(s) used that describe the semantic content in the message definitions, and if derived from a general information model, the subset of information (business context) that applies to the messages.
- o Technical characteristics
  - · The layers of communications networking needed to support the interface interactions, including the basic connectivity standards, the networking standards, and the protocol standard or specification
- o Cross-cutting issues: the specification or reference to standards implemented that support the following areas
  - · Resource identification
  - · Discovery and configuration
  - · System evolution and scalability
  - · Time synchronization and sequencing
  - · Transition and state management
  - · Quality of service
  - · Security and privacy
  - · Logging and auditing
  - · System preservation (e.g., operation under loss of communications)

7. **DER Device to DER-Facility Management Function Communication**
- o Protocol(s) used

8. **Criteria Coverage:** How the submission addresses each of the criteria described in Criteria for Evaluation below.

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[8] See GridWise® Interoperability Context-Setting Framework, March 2008, for more detail
https://www.gridwiseac.org/pdfs/interopframework_v1_1.pdf

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Criteria for Evaluation

The **Interoperability Maturity Model**[9] (IMM) proposes a way to measure the level of maturity in several dimensions associated with capabilities that ensure interoperability and simplify the technology integration experience. The model has roughly 30 criteria for measuring interoperability maturity and these criteria are designed to be applied to the ecosystems of technology suppliers, purchasers, industry consortia, standards organizations, and other stakeholders to gauge and advance interoperability. These criteria will be the foundation for the way that challenge submissions will be evaluated, with emphasis on a subset of criteria where demonstration of novel ideas are most desired to showcase advanced interoperability capability.

The following are derived from the IMM.

The evaluation of concept submissions will emphasize how the proposed interface specifications address the following criteria.

Configuration & Evolution
- What configuration methods exist in the interface to negotiate options or modes of operation (including support for user overrides if applicable)?
- How it supports the ability to revise and extend interface capabilities over time (versioning), while accommodating connections to previous versions of the interface?
- How it accomplishes unambiguous resource identification and management?
- How it implements resource discovery methods?

Safety & Security
- What features of the interface address concerns for privacy and security, including how policies are defined, maintained, and aligned?
- How are failure modes dealt with, including operational policies and how they support the safety and health of individuals and the overall system?

Operations & Performance
- How are time order dependency and sequencing of interactions addressed?
- What time synchronization requirements exist and how are they managed?
- What are the interface agreements for manage transactions and device state?

Informational
- What information models (i.e., semantic ontologies) are used that describe the message content in the information exchange?

Technical
- What is the structure and format of the communication transport used and its management?
- How are the informational and organizational categories in the interface specification independent from the technical categories?

Criteria of intermediate emphasis follow:

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[9] The IMM is described in GMLC Interoperability project document, "A Qualitative and Quantitative Approach for Measuring Interoperability," April 2017.
https://gridmod.labworks.org/sites/default/files/resources/InteropIMMTool2017-04-22.pdf

Configuration & Evolution
- The accommodation and migration path for integration between legacy and new components and systems shall be described.
- How are regional and organizational differences supported?
- How does the interface support the ability for parties to enter or leave the system without disrupting overall system operation and quality of service?

Safety & Security
- The requirements and mechanisms for auditing and for logging exchanges of information shall be described.
- Performance and reliability requirements shall be defined.

Operations & Performance
- How are errors in handled in the interaction across the interface?

Organizational
- Describe the assumptions that indicate that the business conducted across the interface is aligned with jurisdictional, economic and regulatory interoperability policies defined for the community.

Informational
- What standard information modeling language is used to describe the Information models relevant for the interface?

Community
- What existing, mainstream, modern information exchange technologies are specified in the interface specification to maximize the longevity of interface definitions.

Additional Requirements

Submission Details

- The first name listed on the submission will be deemed to be the primary contact.
- No logos from DOE or GMLC should be included. Graphics from the Interoperability Strategic Vision document may be included (with source credit).
- Each submission must be original, the work of the submitter, and must not infringe (to the knowledge of the submitter), misappropriate, or otherwise violate any intellectual property rights, privacy rights, or any other rights of any person or entity.
- It is an express condition of submission and eligibility that each submitter warrants and represents that the submitter's submission is solely owned by the submitter, that the submission is wholly original with the submitter, and that no other party has any ownership rights or ownership interest in the submission.
- Each submitter further represents and warrants to DOE and Administrator (Lawrence Berkeley National Laboratory) that the submission, and any use thereof by DOE or Administrator shall not: (i) be defamatory or libelous in any manner toward any person, (ii) constitute or result in any misappropriation or other violation of any person's publicity rights or right of privacy, or (iii) infringe, misappropriate or otherwise violate any intellectual property rights, privacy rights or any other rights of any person or entity.
- Ideas and videos submitted to the call for concepts (Step 1) must be submitted and released to the public under a Creative Commons Attribution 4.0 International License (see http://creativecommons.org/licenses/by/4.0/).
- In addition to the rights under the Creative Commons Attribution 4.0 International License, by making a submission and consenting to the Official Rules of the challenge, a submitter is granting the following license to DOE, Administrator, and any other third parties supporting DOE and Administrator in the challenge: a royalty-free, non-exclusive, worldwide perpetual license to copy, display publicly, and use the submission for Government purposes. This license includes posting or linking to the Public submission on DOE's, Administrator's, and SEPA's websites and applications, including the challenge Website, DOE websites, and partner websites, and inclusion of the submission in any other media, worldwide. The submission may be viewed by the DOE, Administrator, and Judges for purposes of the challenge, including but not limited to screening and evaluation purposes. The DOE, Administrator, and any third parties acting on their behalf will also have the right to publicize submitter's name and, as applicable, the names of submitter's team members, organization, or large organization which participated in the submission on the challenge website for a period of three years following the conclusion of the challenge.

Copyright

Each submitter represents and warrants that the submitter is the sole author and copyright owner of the submission; that the submission is an original work of the submitter and that the submitter has acquired sufficient rights to use and to authorize others, including DOE and Administrator, to use the submission, as specified throughout the Official Rules, that the

submission does not infringe upon any copyright or upon any other third party rights of which the submitter is aware; and that the submission is free of malware.

Challenge Subject to Applicable Law

All challenges are subject to all applicable state and federal laws and regulations. Participation constitutes each submitter's full and unconditional agreement to these Official Rules and administrative decisions, which are final and binding in all matters related to the challenge. Eligibility for recognition is contingent upon fulfilling all requirements set forth herein. This notice is not an obligation of funds.

Resolution of Disputes

The Administrator (Lawrence Berkeley National Laboratory or "Administrator")is solely responsible for administrative decisions, which are final and binding in all matters related to the challenge.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the submitter. The "authorized account holder" is the natural person or legal entity assigned an email address by an Internet access provider, online service provider or other organization responsible for assigning email addresses for the domain associated with the submitted address. Submitters may be required to show proof of being the authorized account holder.

Publicity

The qualifying submissions will be featured on the Challenge website.

Except where prohibited, participation in the challenge constitutes each submitter's consent to DOE's, Administrator's, and its agents' use of each submitter's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media, worldwide, without further permission, payment or consideration.

Liability and Insurance

Any and all information provided by or obtained from the Federal Government or the Administrator is without any warranty or representation whatsoever, including but not limited to its suitability for any particular purpose. Upon registration, all submitters agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this challenge, development of any application or the use of any application by the participants or any third-party. Upon registration, except in the case of willful misconduct, all submitters agree to and, thereby, do waive and release any and all claims or causes of action against the Federal Government and Administrator and its officers, employees and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential and whether foreseeable or not), arising from their participation in the challenge, whether the claim or cause of action arises under contract or tort. Upon registration, all participants agree to and, thereby, shall indemnify

and hold harmless the Federal Government and Administrator and its officers, employees and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential and whether foreseeable or not), including but not limited to any damage that may result from a virus, malware, etc., to Government or Administrator computer systems or data, or to the systems or data of end-users of the software and/or application(s) which results, in whole or in part, from the fault, negligence, or wrongful act or omission of the submitters or submitter's officers, employees or agents.

Submitters are required to demonstrate financial responsibility by certifying that they have $500 to cover claims in the amount of $500 or less, made by: (A) a third party for death, bodily injury, or property damage, or loss resulting from an activity carried out in connection with participation in the Challenge; and (B) the Federal Government and Administrator for damage or loss to Government property resulting from such an activity.

Records Retention and FOIA

All materials submitted to DOE and Administrator as part of a submission become DOE records and cannot be returned. Any confidential commercial information contained in a submission should be designated at the time of submission. Submitters will be notified of any Freedom of Information Act or other records requests for their submissions in accordance with 29 C.F.R. § 70.26.

508 Compliance

Submitters should keep in mind that the Federal government considers universal accessibility to information a priority for all individuals, including individuals with disabilities. In this regard, the government is strongly committed to meeting its compliance obligations under Section 508 of the Rehabilitation Act of 1973, as amended, to ensure the accessibility of its programs and activities to individuals with disabilities. This obligation includes acquiring accessible electronic and information technology. When evaluating submissions for this challenge, the extent to which a submission complies with the requirements for accessible technology required by Section 508 will be considered.

Privacy

If you choose to provide DOE or Administrator with personal information by registering or filling out the submission form through the challenge website, that information shall be used to respond to you in matters regarding your submission and/or the challenge only - unless you choose to receive updates or notifications about other challenges s from DOE or Administrator on an opt-in basis. Information is not collected for commercial marketing. Please read the SEPA Privacy Policy for complete information.

General Conditions

DOE and Administrator reserve the right to cancel, suspend, and/or modify the challenge, or any part of it, if any fraud, technical failures, or any other factor beyond DOE's or Administrator's reasonable control impairs the integrity or proper functioning of the challenge, as determined by

DOE or Administrator in its sole discretion. DOE and Administrator are not responsible for, nor are required to count, incomplete, late, misdirected, damaged, unlawful, or illicit votes, including those secured through payment or achieved through automated means.

ALL DECISIONS BY DOE AND ADMINISTRATOR ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CHALLENGE.