DER Interface Standards 2020 Survey Results:

Lots of Confusion and Opportunity

**DATE:** February 22, 2021

**REVISION NUMBER:** V0.8

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# Revision History

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| --- | --- | --- | --- |
|  Version | Date | Description | Name |
| Revision 0.8 | 02/22/2021 | Initial Draft | James Mater |
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# The Need for DER Protocols Information

The electrical grid transformation that is in process is, if anything, increasing in speed, with innovation and DER deployments increasing in number, diversity and geographic breadth. One of the most critical factors in this transformation is solving the interoperability challenge that is historically part of the industry DNA.

The incorporation of grid edge components – e.g., generation devices and loads, DERs – leaves the industry no choice but to solve the interoperability problem because of the size and scale of the interoperability challenge. The industry is stepping up to the problem in a typically chaotic and point solution way. The efforts consist of different interest groups (utilities, vendors, regulator is, researchers, etc), solving different aspects of DER interoperability in an uncoordinated way while some Regulators and Governments attempt to standardize the effort.

During the months of March and April, 2020, QualityLogic conducted a market survey to assess:

* Interest in the DER Protocols information
* Understand the most important information that industry participants require, and
* Understand the prioritization of the specific standards

68 people from our mailing list of about 1500 responded and the responses to our questions suggest that:

1. There is definite interest in being able to more easily find information on standard communication protocols for DER integration into grid operations.
2. The source of information for most people is vendors, followed by EPRI, Standards Alliances and consultants. But no dominant source was identified.
3. The protocols of most interest include IEEE 2030.5, OpenADR, IEC 61850, IEEE 1547 (also UL 1741), SunSpec Modbus and DNP3.
4. Respondents wanted information on the protocols (descriptions), adoption, status, education and training and other attributes of a standard and its eco-system.

# Current Information on Standards

The information on DER standards available to those who need it comes in varying forms and accuracy.

The most useful is directly from an Interoperability Test and Certification Authority (ITCA) such as the UCAiug (IEC 61850, OpenFMB), the DNP3 User’s Group, the OpenADR Alliance, etc. Each provides information on the standard itself, the testing and certification programs, certified products and future plans. But the form of the information and it’s timeliness, etc., vary from ITCA to ITCA. And most importantly, the information typically does NOT include an objective comparison to other standards or evaluation of the quality of the testing and certification program it operates. Finding insights on potential implementation pitfalls is particularly difficult.

For a utility, regulator, vendor or researcher to gain a potentially useful overview of the currently available standards for DER communications, the sources he/she would need to consult include:

* **Standards Development Organizations (SDOs)** such as IEEE, ISO, IEC, SunSpec, UL, etc. SDO’s may or may not operate an ITCA for a specific standard and typically do not.
* **ITCAs** for specific standards such as the UCAiug (IEC 61850, OpenFMB), the DNP3 User’s Group, the OpenADR Alliance, etc. The information could be conflicting. For instance, SunSpec, OpenADR and UCA all operate certification programs for DER messaging protocols with differing use cases, architectural models and quality.
* **EPRI** publishes for members a [*DER Protocol Reference Guide—4th Edition*(3002018544)](https://www.epri.com/research/products/000000003002018544) that provides a concise digest of communications protocols for DER/demand response (DR)—from maturity to the current state to potential applications. It was updated in December of 2020 but is available free only to specific funding members of the project. For others, the price is $25,000.
* **Vendors and Consultants** are only too eager to explain how to address a DER application with varying degrees of expertise and interests. Vendors can provide proprietary solutions while consultants can do the work of evaluating the application and applicable standards and recommending an approach. In both cases, the user either accepts the recommendations or must invest effort to validate them. In most cases, utility and regulator staff are ill equipped to find, evaluate and second guess vendors and consultants.
* **Smart Electric Power Alliance (SEPA)** [Catalogue of Standards](http://www.gridstandardsmap.com/). The CoS contains hundreds of standards for all the conceptual domains as described in the [NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 4.0](https://www.nist.gov/publications/nist-framework-and-roadmap-smart-grid-interoperability-standards-release-40). It is comprehensive – e.g., it lists over 20 standards for EVs with links to appropriate web sites describing the standards. However, the user must analyze the list of 24 standards to identify ones relevant to a use case. Further, the CoS may not cover certain standards of relevance – e.g., SAE J3072 is not included but is critical for V2G applications.
* [**Smart Electric Power Alliance and NIST Catalogue of Test Programs**](https://sepapower.org/knowledge/catalog-of-test-programs/)is another useful information source for protocols. The database is online and easily navigated with information on each of the identified test and certification programs for all of the smart grid standards and domains it covers. The COTP is broader than DER protocols and heavily weighted currently to IEC standards. Key DER protocols such as IEEE 2030.5 and OpenADR are not included as yet.
* [**NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 4.0**](https://www.nist.gov/system/files/documents/smartgrid/NIST-SP-1108r3.pdf)**,** Identified List of SG Standards. This document was published in 2014 and Version 4.0 was just released. It catalogues 244 standards as well as an in depth discussion of testing and certification of smart grid standards. The standards are listed in a table with some comments and a link to appropriate web sites for more information. This source is closely related to the SEPA CoS and is a handy guide for identifying standards for a specific application. But the user is left with the task of digging further and evaluating them for the application.
* [**DSO Priorities for Smart Grid Standardization**](https://www.edsoforsmartgrids.eu/wp-content/uploads/public/DSO-Priorities-Smart-Gird-Standardisation.pdf), published by Euroelectric and EDSO (undated but probably published in 2014). While this document is useful and does contain analysis and recommendations, it is very European and IEC centric and references only 19 standards, 15 of which are IEC specific standards. For North America this is marginally useful as it is dated and does not contain any IEC, SAE, IEEE or other key standards used in this continent.

As noted, a user attempting to understand and select one of more grid-edge interface standards is faced with a daunting task of either wading through the available data, paying a consultant to do so or simply accepting vendor claims that they can successfully handle the application (most likely with proprietary interfaces).

Most people are focused on a few key open protocols that are being mandated or attaining traction for DER communications.

To the extent that building codes, the National Electrical Code and other codes and standards have impact on the selection and implementation of grid-edge communication standards, this adds additional complexity to finding the relevant information on the standards. For instance, the 2019 CA Title 24 Building Code requires residential buildings with interconnected energy storage systems to support both OpenADR signaling for Demand Response and CA Rule 21 interconnection requirements for IEEE 2030.5.

## DER Protocols Platform Survey Responses

The survey results reinforced our hypothesis that the information people get comes from a variety of sources. There is no single dominant source so users must assemble their own picture and conclusions based on discussions and research with multiple sources.

60% of respondents pointed to vendors as their source of information on standards. This is very problematic given the natural bias of vendors for their own proprietary protocols to lock in utility programs and customers.



# Key DER Interface Standards

Our definition of the DER domains, and a potential organizing model for DER protocol information is:

* Traditional and advanced demand management (DR)
* Behind-the-meter – i.e., customer owned - solar and battery storage systems
* Behind-the-meter Plug-in Electric Vehicles both in V1G and V2G applications
* Behind-the-meter combinations of DERs
* Microgrids
* Utility-scale and utility-owned and managed DER resources

From an interoperability perspective, the DER interfaces need to be paired with some sort of functional device or system requirements. Without a clear specification of the functions that devices are expected to perform, along with specific performance requirements, the goal of interface standardization is difficult, if not impossible to achieve. If each DER system behaves differently with different nomenclature for its functions, then a standard protocol for communications makes no sense.

For instance, smart inverters in CA will soon be required to meet the functional requirements specified in IEEE 1547-2018. Not only does this enable a standardized management of these assets by the grid operator, it enables the standardization of the communications. All smart inverters interconnected in the CA IOU territories will be required to support the functions specified in IEEE 1547-2018 such as Volt-Var, Frequency-Watt, Nameplate ratings, etc., as well as a specified communications protocols for interacting with grid operators. In theory, this means that a single message sent in a specified protocol to different inverters will result in identical behaviors with respect to grid support and safety operations.

An example of the lack of such a specification is the EV charging stations (EVSE). There is a UL safety standard but no single standard for communicating with the EVSEs about managed charging or V2G applications. CA is working on this issue and the protocols under consideration will be included in our newsletter.

At this point in time, the relevant protocols by domain are:

## Demand Response

* OpenADR and IEC 62746-10-1 ED1
* IEEE 2030.5 as implemented for DR in some jurisdictions

## Behind-the-meter Solar and Storage

* IEEE 2030.5 as mandated in CA Rule 21
* OpenADR as mandated in CA Title 24
* MESA-DER storage control standard
* DNP3 AN 2019 as intended to used by some utilities
* IEC 61850 parts focused on DER communications
* SunSpec solar and storage control standard (Modbus and IP-based)
* UL 1741 SA and IEEE 1547-2018 defines grid-connected inverter functional and communications requirements today and in the future

## Behind-the-meter Plug-in Electric Vehicles both in V1G and V2G applications

* IEEE 2030.5 as mandated in CA Rule 21 and SAE J3072
* OpenADR as used by numerous utilities for managed charging
* OCPP 1.5/1.6/2.0
* ISO 15118-2:2014
* SAE J3072 and related SAE standards
* UL 9741 EVSE safety standard
* UL 1741 SA and IEEE 1547-2018 defines grid-connected inverter functional and communications requirements today and in the future
* IEC 61850-90-8 Object model for Electric Mobility

## Microgrids

* IEEE 2030.7-2017 Standard for Specification of Microgrid Controllers
* IEEE 2030.8-2018 Standard for Testing of Microgrid Controllers
* IEEE 1547.1-2018 DER Interconnection Requirements
* UL 3001
* DNP3 AN 2019 as intended to used by some utilities
* IEC 61850 parts focused on DER communications
* IEEE 2030.5 as mandated in CA Rule 21
* OpenADR as used by numerous utilities for DR

We would expect to add additional standards as they gain momentum for one of the above applications.

## DER Protocols Platform Survey Responses

The survey offered a subset of protocols for ratings on importance. The only additions offered by respondents were cybersecurity and the Facility Smart Grid Information Model (FSGM – ISO 17800).

The results reflect a mix of respondents focused on SCADA and substation communications versus those focused on behind-the-meter DER and DR assets. It is not surprising that the IEEE 2030.5 and OpenADR were deemed highest priority for two reasons: in the behind-the-meter DER domain, these are the two leading protocols and secondly, our database is biased towards these protocols since we are directly engaged in both.

The priority for DER standards information in our survey were:

* IEEE 2030.5
* OpenADR
* IEC 61850
* UL 1741/IEEE 1547-2018
* DNP3
* SunSpec

# Standards Information of Most Interest

One question we were interested in answering is: what information is most important to people looking for DER protocol’s information? ***Description*** was the highest priority. That makes sense in the context that most people have only a vague idea what a particular standard is designed for and capable of.

The next area of interest is ***adoption***, both in terms of who is adopting and implementing, and which vendors are supporting a standard and how so. It is natural for anyone considering using an open standard to want to know where it is mandated and how big (and growing) the eco-system is using it.

We think the interest in ***current status*** is driven by a desire to understand a standard’s stability. Is an update in process? Does a certification program exist and how effective is it? And for some people, understanding the history is useful in placing a standard in context. For instance, understanding that OpenADR is a subset of the Oasis Energy Interop standard opens the potential for adding transactive functionality to OpenADR.

Where to get ***education and training*** are next in priority but probably highest for those actually working on an implementation based on a standard. There is both high-level education on the standard and its eco-system and in-depth technical training for those doing actual development work.

Finally, we asked people to rate interest in ***commentary***, ***advocacy,*** and ***calendar of events*** for standards. These were lowest on the ratings but still of interest.

# A DER Protocols Platform

We were so impressed with the number of people who responded to our survey (68 out of 1500 invited which is good) that we decided to create [GridEdge Intelligence](https://www.gridedgeintelligence.com/) to address the gap in DER protocol specific information. Besides a focus on individual protocols, we included a whole section on interoperability that we call Interop Essentials. This is aimed at helping people understand how a truly interoperable, standard-based eco-system can be created along with background information on the protocol world itself – e.g., the [SEPA Catalog of Standards](https://sepapower.org/knowledge/catalog-of-standards/#:~:text=SEPA%20produces%20the%20Catalog%20of%20Standards%20(CoS)%20as,of%20a%20robust,%20interoperable,%20and%20secure%20Modern/Smart%20Grid.) and the new [NIST Framework and Roadmap for Smart Grid Interoperability](https://www.nist.gov/publications/nist-framework-and-roadmap-smart-grid-interoperability-standards-release-40).

One of the biggest gaps in the DER standards landscape, in our view, is the twin issue of understanding comparisons between standards and the inter-standard communications that some applications require. For instance, in the V1G and V2G domains, the standards are not agreed upon and a typical scenario may involve communications using 2-3 different open standards (see our blog on this issue [here](https://www.qualitylogic.com/2021/02/03/the-challenge-of-inter-protocol-interoperability-for-grid-operators-and-the-ev-world/)). This is another topic we plan to address in GridEdge Intelligence.

As the global power industry moves towards a more distributed, carbon-free power system, the standardization of the communications for information exchange and grid management operations is only going to become more important. Hopefully, it will not become more complex and expensive. At QualityLogic , we are committed to reducing the costs of DER integration through standardizing the communications required to achieve the end-goal.