SunSpec Alliance Backgrounder

May 2010

Accelerating the Growth of the Renewable Energy Industry

Ready, Fire, Aim

Federal stimulus funding and state Renewable Portfolio Standards are driving adoption of the Smart Grid and renewable sources of energy. Unfortunately, these driving forces are occurring in advance of full standardization in many areas. Traditionally risk-averse utilities are naturally reluctant to make significant investments that could incur additional integration costs owing to this lack of standards. And when the necessary standards eventually do emerge, existing assets could be incompatible, requiring costly upgrades or replacement.

The industry fully recognizes both the problem and the sense of urgency involved. Numerous organizations, therefore, are working aggressively to identify existing applicable standards and develop any new ones that are needed. This enormous undertaking is being led by the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) in cooperation with the Federal Energy Regulatory Commission (FERC).

In its *Report to NIST on the Smart Grid Interoperability Standards Roadmap*, the non-profit Electric Power Research Institute (EPRI) identified more than 70 standardization gaps and issues. With an exclusive focus on the Smart Grid, however, the Report ignores standardization gaps and issues in distributed energy resources, in general, and photovoltaic power generation, in particular. For this reason, the effort offers no relief for those in the solar industry who have found just how challenging and costly it is currently to implement solar power generation on a distributed and/or large-scale basis.

With no standardization there can be no interoperability. All systems available today for monitoring and managing photovoltaic power generation are, therefore, proprietary. The complexity involved in integrating different proprietary systems from multiple vendors dramatically increases implementation costs. To minimize this problem, project developers and integrators may choose to limit the number of vendors to one or two, which precludes the ability to implement a best-of-breed solution. Proprietary systems also undermine future flexibility by making it equally difficult (and expensive) to integrate new, improved technologies from other vendors, each with its own proprietary system.

Solar Tower of Babel

The dominant communications protocol for solar photovoltaic (PV) power generation systems today is Modbus. And Modbus remains the preferred choice of the PV industry based on the protocol's simplicity, versatility, stability and free availability, including a wealth of open source reference implementations and applications available from the Modbus Organization and others. Modbus shares a similar pedigree to the popular Ethernet protocol (see sidebar on *A Tale of Two Protocols*), but serves a much narrower purpose in the areas of industrial manufacturing, energy meters, solar inverters, environmental equipment and building HVAC equipment. Despite its more narrow purpose, however, Modbus remains the most widely used network protocol in these areas having been implemented by hundreds of vendors in tens of thousands of different applications with a current (and still growing) installed base of over 7 million nodes in North America and Europe alone.

The problem with Modbus is that its very versatility has allowed every vendor of PV balance-of-system (BoS) equipment to utilize different and proprietary methods for monitoring and control applications with different data sets being collected and presented in different formats. Consider the Public Switched Telephone Network (PSTN) as an analogy to this situation. The internationally standardized PSTN permits everyone to call anyone else anywhere in the world, whether on a landline or on a mobile phone. But if someone who speaks only English calls someone who speaks only Chinese, they will be unable to communicate without also having a translator on the call.

For project developers and integrators installing photovoltaic power generation on a pilot or limited basis, the incompatibility problem is manageable with customized applications capable of "translating" the proprietary data sets and formats. But for

A Tale of Two Protocols

Both Modbus and Ethernet trace their roots to the 1970's when each became a de facto standard networking protocol. Modbus was created by Modicon in 1979 as an open protocol for communications among programmable logic controllers (PLCs). In that same year Ethernet's inventor, Robert Metcalfe, left Xerox PARC (the Palo Alto Research Center) to found 3Com, the first vendor of local area networks (LANs). While Modbus was sufficiently robust for its intended purpose at the time, Ethernet needed some enhancements to become a full-fledged LAN protocol. So Metcalfe convinced Digital Equipment Corporation (DEC), Intel and Xerox to form a multi-vendor consortium to advance Ethernet's capabilities. The resulting "DIX standard" (DEC/Intel/Xerox) led to creation of the now well-known IEEE 802.3 standard by the Institute of Electrical and Electronics Engineers.

Both protocols also benefit from the support of multi-vendor alliances with similar missions. The Modbus Organization (www.modbus.org) formed in 2002; its current mission is to "… drive the adoption of the Modbus communication protocol…" and to "… also provide the infrastructure to obtain and share information about the protocols, their application and certification to simplify implementation by users resulting in reduced costs." The Ethernet Alliance (www.ethernetalliance.org) formed in 2005 with a mission to "… assist with the on-going incubation, development, interoperability testing and support of technologies based or dependent upon Ethernet standards."

widely distributed and/or large-scale PV power generation with different BoS equipment from different vendors, the problem becomes profound. Returning to the PSTN analogy, the situation is similar to attempting a multinational conference call among only native language speakers.

In effect, what is needed is a common language—a consistent set of "nouns" and "verbs"—for Modbus that is specific to the solar electric power industry. Then and only then will the industry be able to integrate distributed PV power generation cost-effectively on a large-scale basis. Unfortunately, this need is being ignored (for now) by the standards bodies. This is a fairly serious omission, albeit an understandable one considering the enormous scope of the Smart Grid and its role in distributed energy resources. Indeed, of the 70 standardization gaps and issues identified by EPRI, only 15 are included as Priority Action Plans (PAPs) in the *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*. And none of these PAPs directly addresses the issue of distributed generation, in general, or PV power, in particular.

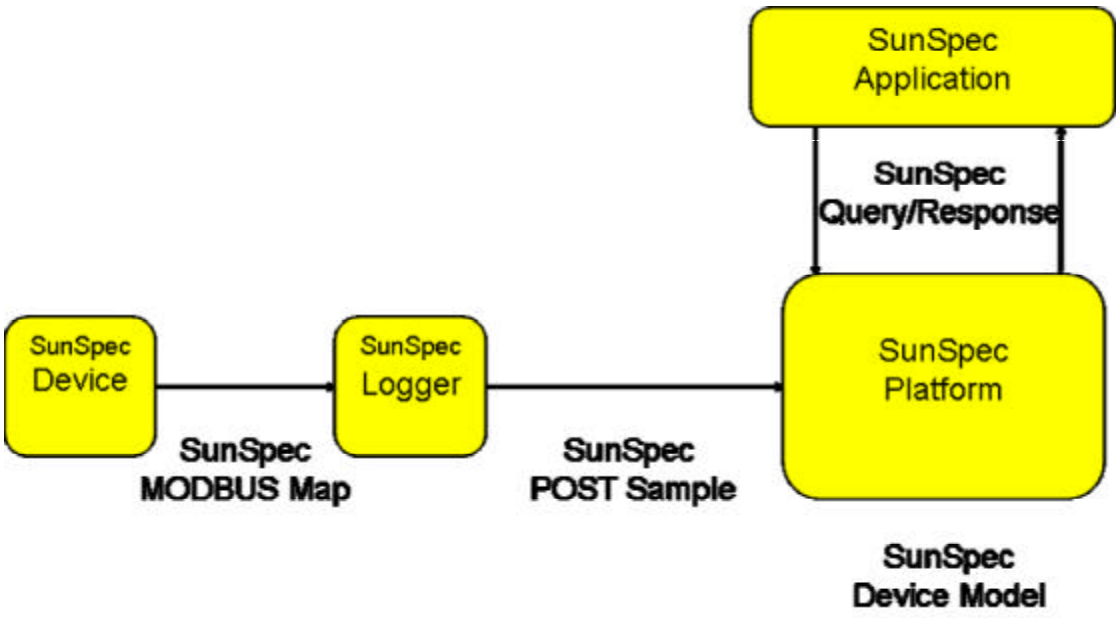
Three existing standards and one new initiative also offer no relief at this time, as all three currently focus on protocols other than Modbus. The standards include the IEC 61850 series for *Communication Networks and Systems in Substations* from the International Electrotechnical Commission (IEC) and the *Distributed Network Protocol* (DNP3) based on other IEC standards, along with the IEEE's 1547 *Standard for Interconnecting Distributed Resources with Electric Power Systems*. The new initiative is EPRI's Program 174 for *Enabling Integration of Distributed Renewables*.

This omission of such a widely-used protocol is both unfortunate for and unsatisfactory to those utilities, integrators and vendors currently attempting to implement distributed PV power generation on a large scale. A multi-member consortium has proven to be an open and effective way to address such needs in the past, so the SunSpec Alliance was formed to take on this role.

The Role of the SunSpec Alliance

The SunSpec Alliance (www.sunspec.org), formed in July 2009, consists of a "who's who" among industry-leading companies. SunSpec membership consists of broad representation from among a global and diverse set of project developers, monitoring system providers and equipment manufacturers. The Alliance's mission is to: Accelerate the growth of the renewable energy industry by standardizing data interfaces of energy system components and by promoting the adoption of SunSpec Alliance recommendations and the SunSpec brand. The Alliance is organized in a traditional fashion with an Executive Director reporting to a governing Board of Directors, and both Technical and Marketing Steering Committees, each with focused Working Groups.

The initial effort for the SunSpec Alliance is the specification of the urgently-needed PV-specific Common Data Model for Modbus. The highest priority devices include inverters, meters and environmental sensors. The specification's Common Device Model is being made extensible so that other balance-of-system (BoS) components can be added in the future, and the Alliance is currently working on specifications for PV panels, string combiners and solar trackers. The current set of specifications is available on the Web at www.sunspec.org/specification/.



The SunSpec Alliance Architecture, which includes both specifications and Reference Implementations, creates a Common Data Model for applications to communicate with multiple devices via existing networking protocols. Initially offered for inverters, meters and environmental sensors communicating via Modbus, the Common Data Model is extensible to other devices and network protocols.

In addition to the Common Data Model specification, the SunSpec Alliance will also produce Reference Implementations for various devices and data loggers, and conduct Conformance Testing and Certification once these elements are available. Over time, the Conformance Testing and Certification are expected to become an increasingly important part of the Alliance's efforts to ensure compatibility and interoperability among the members' various and manifold systems. Of course, the Alliance will also promote adoption of the Common Data Model industry-wide, including among non-member organizations.

Because the Alliance is fully committed to open standards and interoperability, the organization will also leverage existing standards to the maximum extent possible, and cooperate with other standards bodies and organizations. Such cooperation includes elected representation by the Alliance's Executive Director on the Governing Board of NIST's Smart Grid Interoperability Panel (SGIP), and coordination with IEC 61850, DNP3, IEEE 1547 and EPRI Program 174 activities. The Alliance will also monitor the renewable energy industry for the emergence of other standards initiatives that are complementary to its mission.

Membership in the SunSpec Alliance is open to the full spectrum of industry stakeholders, including project developers, system integrators, PV and BoS equipment manufacturers, networking vendors, software companies, monitoring service providers, energy producers and consumers, utilities, other non-profit organizations, and individuals. Stakeholders are able to join at various levels ranging from Sponsor and Contributing membership, which permits participation in any Working Groups, to Supporting and Individual membership for those desiring a less active role. The Alliance's Internet-style open collaboration and other operating principles have been established to fully conform to NIST's own guidelines for setting standards.

The SunSpec Alliance may pursue other initiatives in the future, as determined by its voting members, to accelerate the growth of the renewable energy industry through standardization of monitoring and management interfaces for renewable energy system components. These may include, for example, the extension of the Common Data Model to new devices, support for other networking protocols, such as DNP3, and the addition of control capability, potentially for Supervisory Control And Data Acquisition (SCADA) applications. One possible project, for example, would be a Reference Implementation that performs a gateway function to interface Modbus with DNP3.

By enabling manufacturers to embed more intelligence into system components in an interoperable infrastructure, thereby enabling the integration and management of PV power systems to be greatly streamlined, the work of the SunSpec Alliance is driving down costs and creating new business opportunities for the industry. And by lowering the Levelized Cost of Energy for PV, the Alliance and its members will ultimately accelerate the adoption of renewable sources of energy.

Conclusion

Renewable Portfolio Standards and government incentives are driving the adoption of photovoltaic power generation to unprecedented levels. And the increasing scale and distributed nature of PV power are driving the need for additional standards. The problem is: The enormous scope of the Smart Grid makes it impossible for the industry to address every such need immediately, and NIST has, therefore, been forced to establish priorities that initially ignore distributed generation. But that leaves the industry with some difficult challenges when attempting to integrate distributed PV power on a large (and growing) scale.

The SunSpec Alliance was formed to help fill this void. The Alliance must also establish priorities and has decided to focus initially on the most serious standardization gap: the lack of a Common Data Model for Modbus, the de facto communications protocol for PV power today. But there is much more that needs to be done to promote interoperability among the various systems used in solar electric power generation. With more members, of course, the Alliance will be able to do more to fulfill its mission of accelerating the growth of the renewable energy industry by standardizing data interfaces of energy system components. So the Alliance is actively recruiting new members to this important cause. Interested parties can learn more about the opportunities and options for participation by visiting the SunSpec Alliance on the Web at www.sunspec.org.

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