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INTEROPERABILITY MATURITY ROADMAP

IEEE Std 2030.5

Authored by
IEEE 2030.5 Ecosystem Steering Committee (ESC)

IEEE

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Interoperability Maturity
Roadmap

IEEE Std 2030.5

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Executive Summary

Interoperability in the context of this document is a quality of information and communications technology interfaces that enables two or more devices or systems to connect and successfully interact. Achieving interoperability in an environment of mass deployments, by various purchasers and solution providers is a multi-faceted, complex topic that requires the alignment of all stakeholders involved in the development, integration, and operation of the related technologies. These stakeholders form an ecosystem, or community, of organizations with the desire to codify agreements on the things necessary to make integration of the devices and systems simple and reliable.

The IEEE 2030.5 Ecosystem Steering Committee (ESC) was formed to review the state of interoperability for the application of IEEE Std 2030.5 and determine a path forward (a roadmap) for enhancing interoperability for the ecosystem emerging around the standard. As interoperability involves agreements, processes, and supporting material in many areas, the ESC roadmap development process was facilitated by United States Department of Energy (DOE) national laboratory staff who used an interoperability maturity model tool and roadmap methodology developed under the DOE's Grid Modernization Initiative. The roadmap development process was conducted in a series of meetings that spanned roughly a year. Those meetings identified gaps and challenges confronting the IEEE 2030.5 ecosystem in several areas, but particularly in the coordination of efforts that span various implementation areas of IEEE Std 2030.5. That includes testing and certification, education, branding and marketing of interoperable technology, a management framework for cryptographic keys to support secure communications, and templates for creating implementation profiles, among several other items.

The process of developing the roadmap revealed the complex nature of the organizations using IEEE Std 2030.5 and how the landscape changes depending upon the electricity responsive resources being integrated. For example, significant attention has been given to integrating smart inverters for photovoltaic distributed generation in California. In this case, organizations have come together to put in place an implementation profile that specifies requirements that can be tested and certified for supporting interoperable deployments. The maturity level exemplified in this situation is quite different from the emerging applications of IEEE Std 2030.5 for electric vehicle service equipment, where a different implementation profile is being developed. It is different again from new activities evolving in the coordination of demand responsive resources.

The IEEE 2030.5 ESC acknowledges the various technology types that can be integrated with IEEE Std 2030.5 and desires to reflect in the roadmap a vision where there is commonality of approach and supporting processes and material to advance interoperability based on this technical standard across the many types of implementations. While the group recognizes that IEEE Std 2030.5 is also applicable to gas, water, and other types of infrastructure, for the purposes of this roadmap, the scope of activities was focused on the integration of electric system responsive resources.

Lastly, the ESC realizes that this is a roadmap that relies on the goodwill of ecosystem members to consider and take up the cause of the documented actions. As progress is made and the landscape shifts with time, the high-level plans represented here deserve to be revisited and shaped accordingly.

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Introduction

The development of operationally flexible electricity resources at the grid edge and associated communication technologies is transforming power system operations. This transformation challenges the current operation as diverse types of responsive electric equipment need to function together in a safe, effective, and reliable manner. This IEEE 2030.5 Ecosystem Steering Committee (ESC) document proposes a roadmap about the integration of responsive distributed generation, energy storage, and loads (responsive resources) using IEEE Std 2030.5 and supporting material.

This document uses the terms interoperability and integration ecosystem (or community) as defined in the Interoperability Strategic Vision whitepaper.[1] Interoperability is "the ability of two or more systems or components to exchange information and to use the information that has been exchanged."[2] For the purposes of this document, the term refers to the process to achieve interoperability and is focused on the integration experience required to make two or more systems connect and interoperate. Integration ecosystems refers to, "A community of participating organizations collaborating to address one or more business or social objectives that concern interoperability and ease the deployment of specific technologies. The participants in such communities represent many types of organizations that are needed to support integration objectives. These include asset managers/owners/users, technology suppliers, service providers, distribution system operators, regulatory and government agencies, consortia and trade associations, and testing and certification bodies. They have an established convening body with champions who drive the group toward alignment in achieving their shared objectives."

The responsive resources involved in this roadmap, named assets, are classified based on their nature and capabilities. To effectively advance simple and reliable integration of those assets, the stakeholders need to agree on technical standards envisioning the ease of integration and interaction. To describe the scope of the roadmap effort, this document identifies the different actors involved in the coordination of the operation of the assets. Some of these actors are directly participating in the interaction of the assets, while others significantly influence the ability for these interactions to take place.

Interoperability is addressed not only by the definition of a standard but by the development of Implementation profiles and guides, the interconnection requirements, and procedures for testing and certification. Those elements are considered critical for the success of an ecosystem encouraging a business, economic, and regulatory policy environment that aligns technology solutions with viable business value propositions to drive the need to simplify interoperability and advance future standardization.

The IEEE 2030.5 ESC interoperability roadmap outlines activities to advance the interoperability dimensions related to responsive resource integration starting with the present state of IEEE Std 2030.5, supporting material, and related efforts. While the image of a plug and play standard is attractive, the roadmap acknowledges the complex responsive resource integration landscape and aims to describe practical steps that can lead to a simple, streamlined, and largely automated process.

[1] "Interoperability Strategic Vision," GMLC 1.2.2 White Paper, PNNL-27320, March 2018. Accessed November 2018 at https://gridmod.labworks.org/sites/default/files/resources/InteropStrategicVisionPaper2018-03-29.pdf

[2] Defintion taken from ISO/IEC/IEEE 24765.

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1. Roadmap Scope

IEEE Std 2030.5 is designed to support many different application domains. Arguably the greatest area of application interest emerging in technology deployments using IEEE Std 2030.5 is in the distributed energy resource area, specifically in distributed solar and wind systems using smart inverters. Government policies are being enacted in states such as California and Hawaii that require coordination of these responsive resource systems in order to address system operational concerns in regions with high penetrations of these resources.

Attention to these issues encourages stakeholders to come together to seek alignment on standards, guides, and policies that address interoperability and the ease of integrating these systems. Close behind this immediate driver is community interest to address the coordinated operation of storage systems, electric vehicle charging, and demand response. While this attention should not diminish the application of IEEE Std 2030.5 to other integration scenarios, a set of priority responsive resource assets brings focus and substance to the scope of the roadmap effort. In addition, interactions between transmission level operations and distribution system operations has great influence on how customer-oriented assets are engaged in operation. This effort recognizes the importance that aggregated distribution level resources has with the transmission level interactions.

While IEEE Std 2030.5 may be applied to other utility services such as water and gas, the scope of this roadmap focuses on electric system interactions. The following sections summarize the priority assets of attention, the actors involved in the integration and operation scenarios related to these assets, and a conceptualization of the points of integration and interfaces for communication between the actors that help bound the scope of this roadmap.

1.1 Assets

Assets are the communicating energy resources that are being integrated for coordination with electric system operations.

- PV/Wind: The energy generated by these assets are integrated into the electric system using power electronic inverters. Automated control and communications capabilities installed with the inverters provide mechanisms for coordinated operations with the power system.
- Battery: These energy storage devices (whether electrochemical, electromechanical, or thermal) are presumed to reside in a stationary location. They can run in both charge and discharge mode and may be able to regulate the rate of charging and discharging. They use power electronic inverter technology with automated control and communications capabilities to provide a mechanism for coordinated operations with the power system.
- EVSE (electric vehicle supply equipment): These charging systems for electric vehicles (EVs) also use power electronics to regulate the charging current of vehicle batteries. They can also regulate discharge back into the power system. They may use power electronic inverter technology with automated control and communications capabilities to provide mechanisms for coordinated operations with the power system as an alternative path of communication with the EV. The mobile nature of the resource and transportation objectives make these assets different from stationary batteries.
- Responsive load: These assets use electricity to perform work or services, and are automated to regulate their operation, usually within some operational constraints These resources may be associated with industrial, commercial, and residential facilities (as opposed to large

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manufacturing and processing plants). Homes tend to have unitary devices; however, in large, commercial buildings and small industrial plants, the equipment's operation may be part of an interrelated set of processes that use a facility management system. Such facilities may also include other assets, including PV/Wind, batteries, and EVs. The facility management system may coordinate the operation of the devices within the premises to shape the overall facility load and make it responsive for interaction with the electric system. Alternatively, each unitary device within a facility may have its own interface and metering to the electric system for coordinating operations.

- Meter (measurement metrology): This asset class refers to the measurement parts of an electric meter and its communications interface and is not an energy resource per se. The capabilities within a meter enclosure may preform many different functions beyond the basics of power and energy metrology, including device and facility management functions. Where these additional functions are designed and located are a matter of packaging. To clarify the concepts in the scope of concerns, the meter asset in this document refers strictly to the metrology of the meter and its communications interface.

1.2 Actors

The actors are the responsible parties or their agents that are interacting to coordinate the operation of responsive resources with electric system operations.

- Regulator: Regulators are responsible for establishing and monitoring the policies or rules of engagement for responsive resource interactions with the electric system within their jurisdictional authority. They do not participate directly in the interactions, but their policies and decisions guide the nature and performance requirements of the interactions. This may include protocol selection.
- Transmission System Operator (TSO): This class of actors include independent system operators and regional transmission authorities (ISO/RTOs), wholesale market operators, and the parts of utilities that have similar responsibilities for coordinating operations of the bulk electric power system and its associated markets. The way this level of the system is organized and managed as well as the terms used is varied. To focus the scope of this roadmap, this class of actors do not participate directly in the interactions with responsive resources but depend upon distribution system operators and service providers to interact with responsive resource assets and present an aggregated set of responsive resources at the transmission system level. The polices and interaction rules of engagement they put in place with the distribution system operator and service provider guide the nature and performance requirements of the interactions with the responsive resource assets.
- Distribution System Operator (DSO): This actor is responsible for the safe, effective, reliable, and efficient operation of the distribution system infrastructure. It represents the distribution system operations parts of utilities. It may interact with a Service Provider who aggregates the responsive behavior of responsive resources to ensure safe and reliable operations. It may also interact directly with a Responsive Resource Facility Operator who supervises a set of responsive resource assets within the facility or it may interact directly with the local intelligence.
- Service Provider (Aggregator): The Service Provider is an aggregator of responsive resource assets for coordination with a DSO and potentially with a TSO. For the sake of this roadmap, the Service Provider may use IEEE Std 2030.5 and associated material to interact with the DSO. It also interacts directly with a Responsive Resource Facility Operator who supervises a set of responsive resource assets within the facility or it may interact directly with the local intelligence.

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- Responsive Resource Facility Operator: This actor represents the customer who is using electricity in a facility or the customer's agent who is responsible for operating the facility. The facility may include something as large as the premises of a building or compound, in which case it will likely have a management function that supervises the operation of several responsive resource assets each with its own local device manager. It may also be as small as an intelligent responsive resource asset itself with its local device manager. The Facility Operator interacts with the Service Provider in its role to aggregate the behavior of responsive resources and it may interact with the DSO for safe and reliable operation of the distribution system. The Facility Operator may be the customer or a third-party operator (local or remote) who is acting on the customer's behalf.
- Responsive Resource Asset Manager: Each responsive asset has intelligence to manage its operation. The Responsive Resource Asset Manager has direct control of the asset and interacts with the facility's management function to coordinate its operation within the facility. It might also interact directly with other Responsive Resource Asset Managers in the facility or with the DSO and/or the Service Provider. Examples of a Responsive Resource Asset Manager include a smart thermostat for heating and cooling systems, a building management system, a smart inverter controller, or a microgrid controller.

1.3 Interfaces

Figure 1 depicts a simplified view of the actors, assets, and interfaces of interest that link the actors. This landscape helps focus the scope of discussion for the roadmap. It shows the regulator and the TSO as important players that influence the specification of the interfaces shown in red, but the direct interacting actors are the DSO, Service Provider, Responsive Resource Facility Operator, and the Responsive Resource Asset Managers. The role of the Management Function in the figure is to represent three types of IEEE Std 2030.5 use cases for integration.

1. The first represents the IEEE 2030.5 interface of an individual responsive resource asset communicating directly with the DSO and/or Service Provider plus the meter. In this case, the Management Function box degenerates into a direct connection to the local asset manager.
2. The second case represents the Management Function as a coordinator of one or more responsive resource assets within a facility. In this case, the DSO and Service provider plus the meter use IEEE Std 2030.5 to interact with something like a building or home management system, which internally interacts with the responsive resource assets and hides the details of the internal interactions from the external parties.
3. The third case represents the use of IEEE Std 2030.5 for interacting between the Management Function with one or more responsive resource assets inside the facility.

Each of these actors might have an interface to the Meter to access the measurement of electricity use. This is also included in the scope of IEEE Std 2030.5 and the roadmap.

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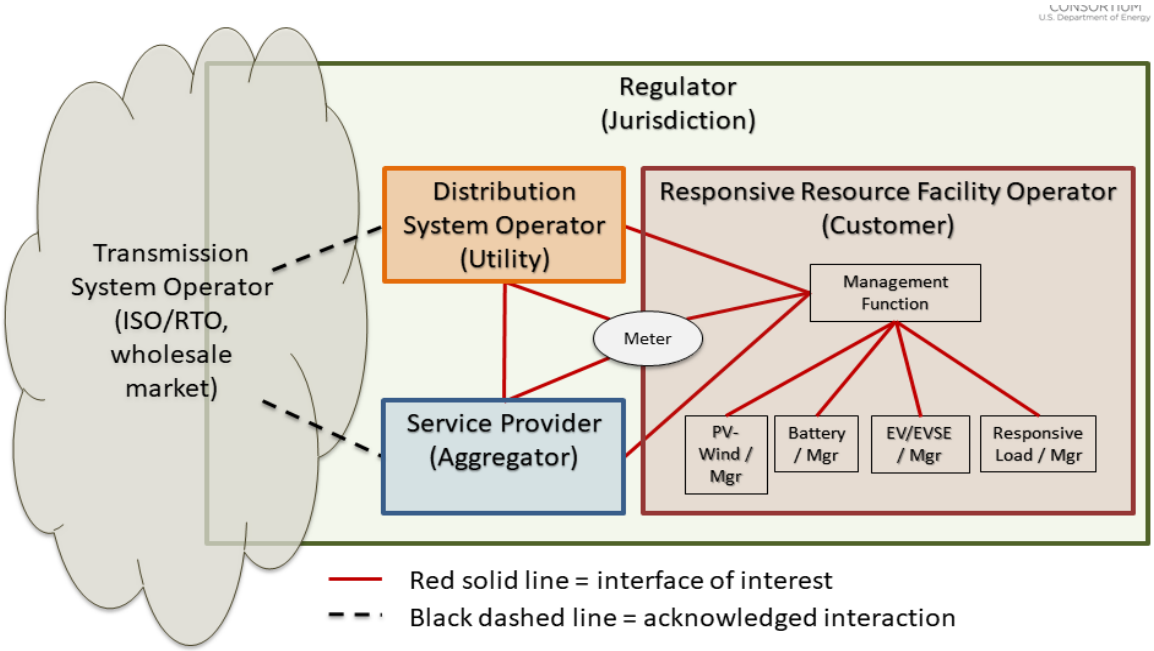

Figure 1—Interfaces of interest conceptual diagram

1.4 Time Horizon

The general period considered in developing the roadmap is from the present to 5 years out. This allows for the description of near-term actions within the roadmap while also considering some steps that may take somewhat longer to implement but help move the ecosystem toward the visionary goals in a reasonable time period.

1.5 Marketplace Business Drivers

A major business objective that has driven the adoption of IEEE Std 2030.5 and helped spawn a community of stakeholders to put in place supporting documents and practices is the integration of PV systems with smart inverters in California and Hawaii. Besides these regional marketplaces, many states of the United States and Ontario, Canada are discussing responsive resource integration and the use of IEEE Std 2030.5. In addition, Korea is participating in IEEE 2030.5 standards efforts and deployments.

These areas represent the main contributors to the IEEE 2030.5 interoperability roadmap effort; however, interest is also being shown in other parts of the world. For example, Africa is looking at using IEEE Std 2030.5, but from a different use case direction. Their implementations consider microgrid or small community electric systems where they would like to have common interface specifications so that these small electric systems can be integrated into a larger, national system as the infrastructure matures.

While the roadmap needs to acknowledge the initial marketplaces influencing this work, it also should consider how other, emerging marketplaces can be informed of roadmap efforts that advance interoperability using IEEE Std 2030.5 and associated material so that the ecosystem grows and becomes even more valuable. The roadmap needs to reflect a vision that supports a common technical standard with rules and best practices for specializing support of different applications (i.e., responsive resource technologies being integrated and their coordination frameworks).

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2. Acronyms and Abbreviations

CSIP	common smart inverter profile
DER	distributed energy resources
DR	demand response
ESC	IEEE 2030.4 interoperability ecosystem steering committee
EV	electric vehicle
EVSE	electric vehicle supply equipment
GMLC	Grid Modernization Lab Consortium
IEEE	Institute of Electrical and Electronics Engineers
OpenADR	Open Automated Demand Response
PICS	profile implementation conformance statements
PKI	Public Key Infrastructure
PV	photovoltaics
SAE	Society of Automotive Engineers

3. Roadmap Vision

The following sections summarize a vision for interoperability that IEEE Std 2030.5 will enable in the future. The vision intends to align stakeholders on a direction from which action steps can be derived. Discussing the vision requires an understanding of the tangible elements that capture the agreements necessary to advance interoperability.

3.1 Elements of Agreement for Interoperability

The roadmap references a few enabling elements that are critical for the sustained success of the ecosystem. These elements are as follows:

1. IEEE Std 2030.5—Containing the technical requirements for interoperability and curated by a committed group of industry experts to ensure its currency, applicability, usability, and relevance.
2. Implementation Profiles—Containing the specific parameters required to meet particular application deployments (e.g., CSIP – Common Smart Inverter Profile that was developed for PV smart inverter deployments). These implementation profiles may be created by collaborative stakeholders or mandated by authorities and will specify which sections of IEEE Std 2030.5 are required to be supported to achieve interoperability for the specified application. California's Rule 21 policy references the CSIP for the California investor owned utilities.
3. Interconnection Requirements—Containing the regulatory and technical requirements (grid codes) for interconnection of responsive resources to the electric power system (e.g., IEEE Std 1547, CA Rule 21, HI 14H).

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4. Testing and Certification Procedures—Containing the test specification (consistent with the standard and implementation profile), and test and certification process and requirements with an aim to drive transparency, consistency, reproducibility and repeatability between testing and certification bodies.

3.2 Vision Statements

IEEE Std 2030.5 Vision

IEEE Std 2030.5 will be the leading technical standard for responsive resource asset integration. As the top technical standard, IEEE Std 2030.5 will be the first choice of producers, users, regulators and other stakeholders when identifying the technical requirements for interoperability of responsive resource assets. The standard applies to all known responsive resource assets, though some assets may reflect a higher priority of attention due to real-life scenarios (e.g., inverter-based responsive resources in California). The standard will also be maintained to proactively address new responsive resource applications and technologies as needed, to stay current with the evolution of the ecosystem.

The standard will be maintained in a clear, concise manner, reducing ambiguity and interpretation, and enabling the ecosystem to drive toward a plug-and-play future that maximizes commonality for all responsive resource assets, while maintaining necessary differences between different types of responsive resource assets. The standard will also facilitate the development of implementation profiles where needed but will preferably evolve to eliminate or reduce the need for implementation specialization.

In this regard, IEEE Std 2030.5 is a critical element of reducing the effort for integration of responsive resource assets.

IEEE 2030.5 Implementation Profile Vision

IEEE Std 2030.5 will be maintained in a manner to reduce the need for specialization via implementation profiles. However, there will be stakeholders who want to define implementation profiles based on IEEE Std 2030.5 for specific deployment applications. Such documents describe deployment specifics, such as security encryption key management or regulatory requirements that may be outside the scope of IEEE Std 2030.5. To facilitate this process, the ecosystem will maintain a proven template for the creation of new profiles and curate an openly accessible community library for refactoring existing implementation profiles to new implementations where applicable. Stakeholders will use a common feedback mechanism to propose revisions to IEEE Std 2030.5 to reduce or eliminate the need to develop new implementation profiles, and commit to implementing implementation profiles that do not create new or different requirements than those specified in IEEE Std 2030.5, but rather to only specify the application of the requirements (e.g., make an optional feature mandatory).

In this regard, implementation profiles are a critical element of reducing the effort for integration of responsive resource assets.

Interconnection Requirements Vision

The regulatory and technical requirements for interconnecting responsive resource assets to the electric power system will clearly specify the functionality that an implementation profile of IEEE Std 2030.5 must support, and that the responsive resource assets must include to achieve interoperability. These requirements will apply to the integration of all responsive assets, but we acknowledge that most

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jurisdictions (and associated ecosystem stakeholders) will define these in a priority order as dictated by real-life scenarios. We encourage and will facilitate the adoption of common elements across different jurisdictions to reduce the amount of specialization and specification development effort.

In this regard, Interconnection Requirements are a critical element of reducing the effort for integration of responsive resource assets.

Test and Certification Procedures Vision

The widespread integration of responsive resource assets is founded on trust. Trust from producers, users, regulators and all other stakeholders that the assets will work as intended and expected once deployed and integrated into system operation. Testing and certification procedures are a critical element in establishing this trust. Their development requires clarity of specification in IEEE Std 2030.5, and the appropriate implementation profile and interconnection requirements. Testing and certification procedures will be documented, publicly available and consistent with the other critical elements. All ecosystem stakeholders recognize the certification brand and trust certified products and services will integrate easily and reliably. Many IEEE Std 2030.5-based products and services will be available and certified to work based on regional jurisdictions, and there will be ready access to publicly available lists of certified products for the ecosystem stakeholders to reference. As experience grows testing should scale and become more comprehensive, efficient and cost-effective. Also, differences in implementation profiles and interconnection requirements in different jurisdictions should reduce overtime, the commonality between the corresponding test procedures should also be enhanced.

In this regard, Test and Certification Procedures are a critical element of reducing the effort for integration of responsive resource assets.

4. Roadmap Development

The methodology used to develop this roadmap concentrated on the process to develop high-level, strategically oriented steps to advancing interoperability in a specific technology integration area. It was designed with a heavy emphasis on understanding the ecosystem of businesses and related stakeholders and the key drivers that make interoperability a worthwhile topic to invest their time and effort. Such motivation is necessary to garner participation in developing a roadmap, and more importantly, in taking ownership to make progress.

Linked closely with the roadmap methodology is the Interoperability Maturity Model (IMM) tool. The IMM provided a structured way to explore the state of interoperability, which has many complex dimensions. It also served to identify gaps and helped those participating in the roadmap process to define their desired goals and prioritize the areas that need attention to achieve them.

"SIMPLY WRITING A ROADMAP IS NOT ENOUGH — THE TRUE MEASURE OF SUCCESS IS WHETHER OR NOT THE ROADMAP IS IMPLEMENTED AND ACHIEVES THE ORGANISATION'S DESIRED OUTCOME."

IEA *Energy Technology Roadmaps: A Guide to Development and Implementation*

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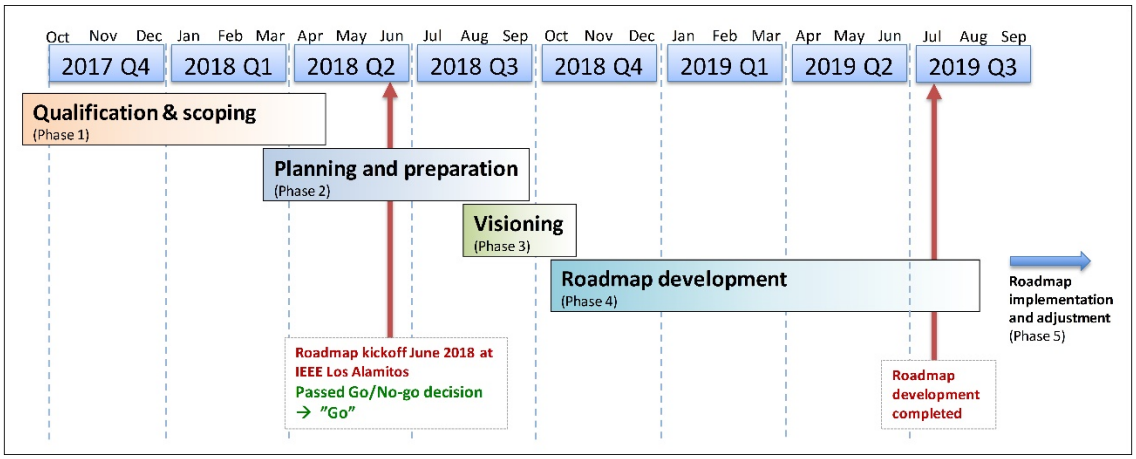

Figure 2—Roadmap Development Process Timeline

In this way, the roadmap combined process-related concerns as well as evaluation of the criteria associated with achieving interoperability.

The core roadmap development process was completed over a twelve-month period (additional detail is shown in Figure 2). In creating the initial interoperability roadmap methodology, the project team reviewed several technology roadmap processes and found one that fit well with the objectives of the overall interoperability effort. The IEA's *Energy Technology Roadmaps: A Guide to Development and Implementation*[3] document offered a process for creating roadmaps that fit well with the needs for building consensus among the various parties with interest in technology integration and enabling field deployments through standardized agreements. The approach was adapted to the specific needs of electric power system interoperability and then further modified to apply to IEEE Std 2030.5.

[3] IEA–International Energy Agency. 2014. Energy Technology Roadmaps: A Guide to Development and Implementation. Accessed February 2017 at https://www.iea.org/publications/freepublications/publication/TechnologyRoadmapAguidetodevelopmentandimplementation.pdf.

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5. Interoperability Maturity Assessment

A key factor in encouraging the adoption of any interface is the ease of which two systems or components can be integrated to usefully exchange information. The Interoperability Maturity Model (IMM) consists of 33 criteria that are used to elicit details that will indicate the maturity of an ecosystem that is dependent upon interfaces and the exchange of data. The interoperability maturity assessment of the IEEE 2030.5 ecosystem was performed by first reviewing the IMM criteria as they related to the IEEE 2030.5 ecosystem.

The criteria were first broadly discussed to determine the priority of each criterion and then, in order of priority were discussed in greater detail. These discussions (documented in Appendix B) were held at biweekly meetings over several months. The assessment consisted of polling prior to the meeting so that the ESC members could indicate what they thought the current maturity level was, on a scale from 1 to 5. This would help to motivate a conversation as to why the members voted this way. The meeting participants would then come to some sort consensus as to where the thought the level was currently and should be in the future. At times, the various facets of the ecosystem such as profiles for electric vehicles or smart inverters, were at different levels of maturity. During the conversations several gaps in the maturity of the ecosystem were brought to light, at times not even relating to the criteria being discussed. After the "baselining" process, further conversations indicated there were several categories, or themes, into which these gaps could fit. The gaps are summarized below according to the theme. The labels associated with each gap indicate the criteria followed by the gap number. For example, C7.2 is the second gap associated with Criterion 7.

5.1 Interoperability Maturity Gaps

1. Coordination across the IEEE 2030.5 ecosystem is needed

- Ecosystem consists of: (standards WG (working group), implementation groups, testing and certification groups)
- Global certificate authority *(C7.1, C7.2)*
- Manage common process for implementation profiles to enhance consistency of the way the standard is applied *(C13.1, C25.3)*
- Coordination of time order dependency, sequencing between standard and implementation profiles *(C15.1, C15.2)*
- Process where plans for future refinements and extensions are coordinated across the greater ecosystem *(C20.1, C28.1)*
- Broad conformance test, interop test, and certification process, authority across greater ecosystem *(C26.1. C26.2)*
- Sharing lessons learned across implementation groups *(C27.3)*
- Drive and oversight for education and marketing *(C33)*

2. Implementation guidance and best practices are needed

- Version upgrades guidance *(C2.2)*
- Scaling guidance *(C5.1, C5.3)*
- Group management *(C5.4)*
- Security and privacy policies *(C10.1, C11.1, C11.2, C29.1)*

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- Failure mode policies *(C12.1)*
- Performance and reliability in implementation profiles guidance *(C13.1)*
- Maturity of defining business goals, processes and procedures *(C17.2)*
- Guidance on integrating IEEE Std 2030.5 information with back office systems *(C17.3, C20.2)*
- Lessons learned and application of the standard in CA Rule 21 group, but not in other areas *(C25.1, C25.2, C27.1, C27.2)*

3. Implementation experience is needed

- Upgrades between versions of the standard (not needed today) *(C2.1)*
- Experience in scaling large deployments *(C5.1, C5.2)*
- Overall system operation undisturbed by actors entering or leaving *(C6.1)*
- Implementation experience strong in PVs but lacking in applications such as demand response and possibly EVs *(C24.2)*

4. Education and marketing for IEEE Std 2030.5 and related products is needed

- Implementation success stories *(C33.1)*
- Curator for existing libraries of implementation experiences *(C33.3)*
- Description of target applications areas where IEEE 2030.5 is appropriate (and where inappropriate) *(C33.4)*

5. Clarification of market rules

- Coordination of business conducted within or across business jurisdictions *(C3.1, C18.1)*
- Incentives for developing compatible business processes (CA Rule 21 and elsewhere) *(C17.1)*
- Management of certificates (roots) and potential implications for mapping to information models *(C21.2)*

6. Miscellaneous gaps

- Profile updates: Opt out *(C4.1)*
- Formal coordination of information models referenced in other standards groups *(C21.1)*
- Harmonization with existing standard information models may vary across IEEE 2030.5 supported function sets *(C24.1)*
- Mechanism to collect functionality proposals for the standard *(C33.5)*

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6. Action Plan

The following action plan depicted in Figure 3 is intended to provide guidance to the IEEE 2030.5 ecosystem. The ESC will need to perform some actions to gain support for the formation of an IEEE 2030.5 coordinating body, sometimes referred to as an alliance. Some ESC members have generously offered to take on some of the tasks discussed during the meetings prior to the formation of the alliance. Once the alliance is formed, the members may decide to update or curate the work and documents produced by the ESC. Some of the actions of the ESC are not priority actions but may be easier to complete and can be managed prior to the formation of the alliance. The formation of the alliance should be initiated as soon as possible and in parallel with the work of the ESC. This will likely require some member(s) of the ESC to take the lead in both identifying key stakeholder members and actively marketing IEEE Std 2030.5. All of the following actions should be discussed amongst the ESC to determine if an existing entity (actor) may be willing to take ownership of the action prior to the formation of the alliance in order to further the roadmap efforts of the ESC.

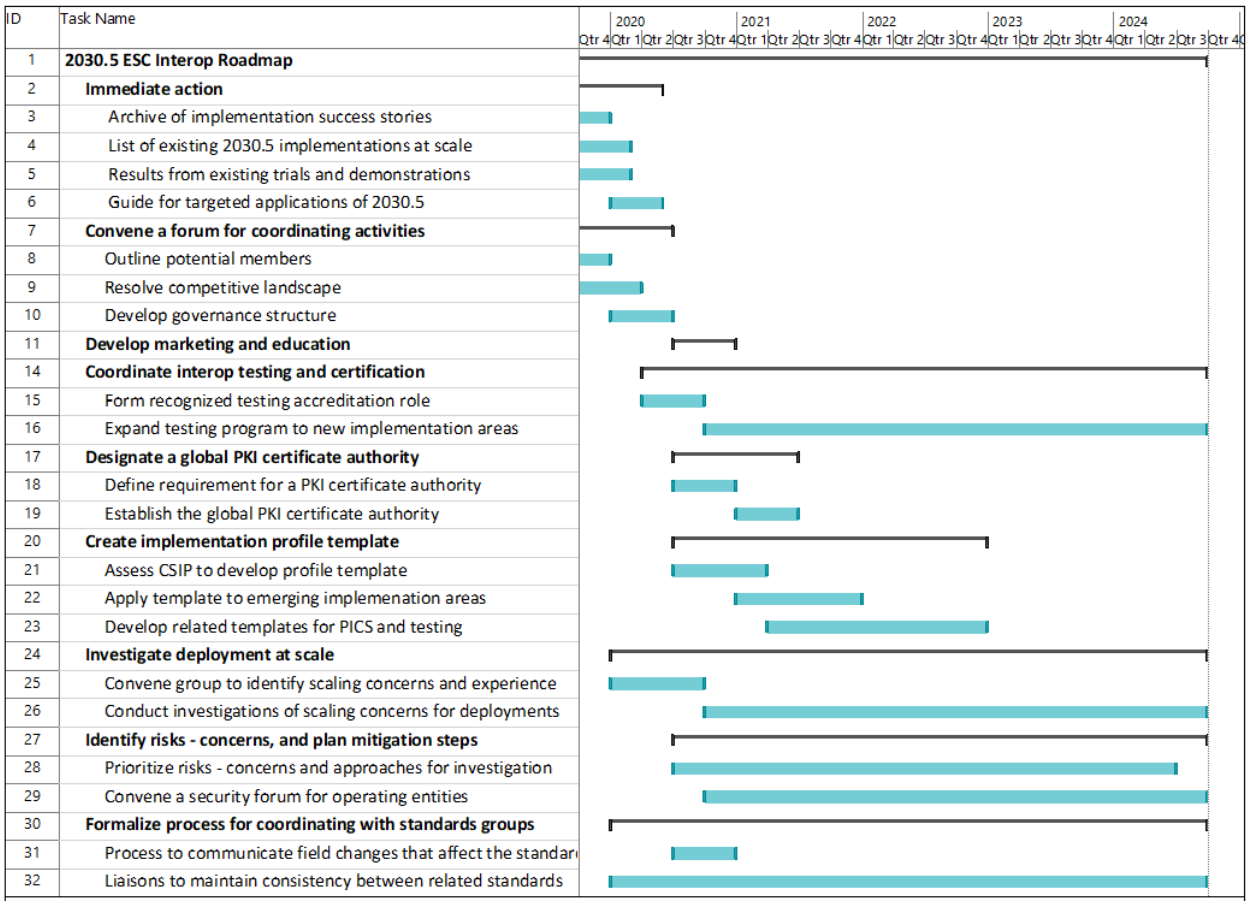

Figure 3—Roadmap of Actions Summary

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6.1 Immediate action

A need to increase awareness of the capabilities and further the adoption of IEEE Std 2030.5 was identified early in the maturity assessment process. The activities in this category will help to accomplish this goal. Potential responsible parties have been identified within the membership of the ESC. After the formation of the coordinating body or alliance, the ownership of these activities and documents will be transferred to that organization. See Figure 4.

Actions

1) Start assembling an archive of implementation success stories including EPIC and PG&E.

   Potential responsible parties: SunSpec, Quality Logic, including ESC members or public

   Timeline - Start | Duration: immediate | 40 hours

   Open items/gaps: location to host results (may entail additional resources and effort)

2) Develop a list of existing investigations of IEEE Std 2030.5 implementation at scale, and curate the implementation investigations document.

   Potential responsible parties: SunSpec, Quality Logic, including ESC members or public

   Timeline - Start | Duration: immediate | 40 hours

   Open items/gaps: none

3) Collect the results from trials and demonstrations that have occurred to date and put together an easily accessible, public location. Once formed, the alliance could maintain this. This would aggregate research data from IEEE Std 2030.5 communication and control studies as well as network related comms issues research.

   a) Sandia is already performing research. Solicit other labs for studies.
   b) The EASE project (SCE, CEC, and DOE) is looking at 1 feeder with 100 inverters in the field, 10 k in simulation.
   c) Research large-scale EV/EVSE implementation in simulations, etc.

   Potential responsible parties: SunSpec, Quality Logic, including ESC members or public

   Timeline - Start | Duration: immediate | 40 hours

   Open items/gaps: location to host results (may entail additional resources and effort)

4) Develop a white paper explaining where IEEE Std 2030.5 is best applied. This white paper should address use cases where IEEE Std 2030.5 is known to be an effective solution and suggest new implementations where it may be an effective solution, without saying that it is inappropriate for use in other areas.

   Potential responsible parties: ESC members, IEEE Std 2030.5 WG (Robby Simpson), SunSpec, Quality Logic, Southern California Edison, or other subject matter experts (SMEs)

   Timeline – Start | Duration: immediate | 80 hours

   Open items/gaps: location to host results (consider the IEEE Std 2030.5 WG iMeetCentral website)

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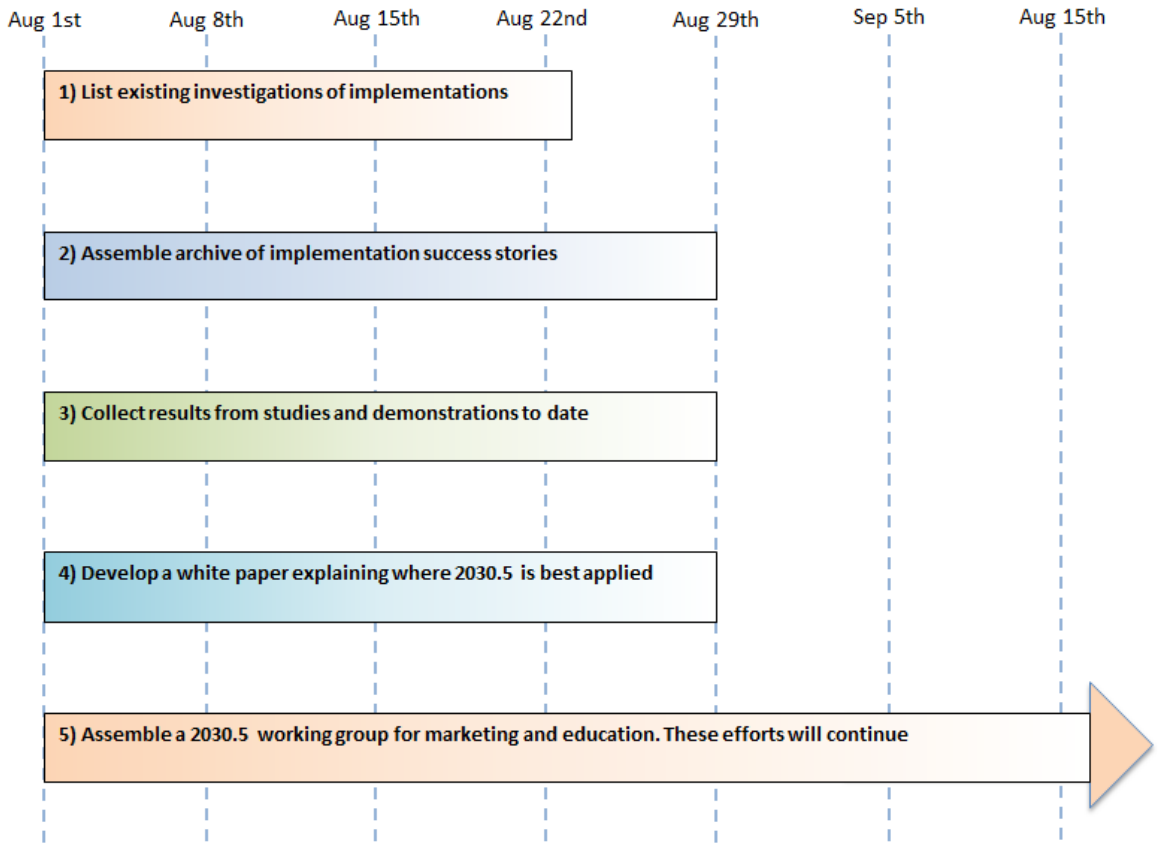

Figure 4—Timeline for Activities with Potential for Immediate Action

6.2 Convene a forum for coordinating activities

This action convenes a forum for coordinating activities across the IEEE 2030.5 ecosystem and could be acted in parallel with the immediate actions above. During roadmap development, ESC members often referred to this forum as an "Alliance" and used the Wi-Fi Alliance as an example of a successful alliance. The desired characteristics include broad representation of the stakeholders, active participation, a well-defined mission encompassing interoperability, and appropriate financial support. The scope, responsibilities, and a prioritized list of what the Alliance must do are summarized below.

Prioritized List of what an Alliance Must Do

1. Furnish staff to provide support for activities such as marketing, conferences, training, and various profile type meetings
2. Outline potential organization members including participants in subgroups
   2.1. Key stakeholders (such as utilities) need to be on board—these include vendor community, user community, profile communities, independent system transmission operator, utilities, labs (research), RTOs, testing organizations.
   2.2. Management and organizational support: SunSpec, SAE, AEE?

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3. Resolve IEEE, ICAP, and SunSpec negotiations and get any competitors on board with the formation of the overall alliance.
4. Build a governance structure and charter that describes the requirements of the alliance.
    4.1. This should be a discussion with potential members where line items of "ingredients" for an overall alliance are determined.
    4.2. Consider included policy or forum groups (security forum for example)
    4.3. Committee working groups identified
5. Develop education and marketing (e.g., develop IEEE 2030.5 brand). There are three primary areas we want to promote (inverter based, EV, demand response).
    5.1. Build strong and appropriate membership, e.g., utilities who will provide funding, key functions of the alliance.
    5.2. Curate archives of education and marketing materials
    5.3. Develop guidance and best practices across implementations
    5.4. Policy forums: security, privacy, cross-jurisdictional business processes
    5.5. Coordination of new (and existing) implementation profiles across greater ecosystem
        5.5.1. Develop a template to be used for new profiles
        5.5.2. Coordinate implementations across jurisdictions/regions
6. Coordinate Implementation Profiles
    6.1. Develop a template for defining implementation profiles
    6.2. Coordinate, monitor and maintain implementation profiles for the various implementation communities based on IEEE Std 2030.5
7. Coordinate testing (conformance and interoperability) and certification across greater ecosystem.[4]
    7.1. Coordinate testing and certification requirements
    7.2. Documented tests and procedures are organized and maintained consistent with the implementation profiles
    7.3. Consumers recognize the certification brand and trust certified products and services will integrate easily and reliably
    7.4. Testing maturity grows over time to be more comprehensive, efficient, and cost effective
8. Take on role of global certificate authority across greater ecosystem.
    8.1. Coordinate the issuance of PKI certificates for all implementation areas of IEEE Std 2030.5
        8.1.1. Since SunSpec has developed a PKI certificate management program, they may be interested in becoming the global authority for all IEEE Std 2030.5 implementations.
        8.1.2. It was noted that there may be outliers in isolated systems such as the military.
    8.2. Certificate management for CA Rule 21 implementation group
    8.3. Certificate management plans for other IEEE Std 2030.5 implementations
9. Conduct and/or disseminate research for large scale deployment experience.
    9.1. Scaling, actors entering/leaving, group management, etc.
    9.2. Eventually upgrade paths between versions or for migrating non-IEEE-2030.5 equipment interfaces

[4] ICAP activity starting; SunSpec already ongoing.

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10. Develop formal processes for coordinating with standards WG
    10.1. Agreements with referenced standards groups where sensible
    10.2. Agreements with existing and emerging implementation groups

Actions

1) Outline potential members
    a) Consider stakeholder types and balance of representation
2) Resolve competitive landscape
    a) Identify other groups being formed around the use of IEEE Std 2030.5
    b) Discuss collaboration and alignment
3) Develop governance structure
4) Create the legal entity

6.3 Develop marketing and education

This action is a continuation of the effort which will be initiated before the formation of the alliance in order to promote adoption of IEEE Std 2030.5 and the emerging ecosystem. Once the alliance is formed, appropriate working groups are expected to be formed to encourage the adoption and use of IEEE Std 2030.5 and supporting material in future implementation areas.

Actions

1) The effort starts with convening a working group for marketing and education for IEEE 2030.5 in general. Demand response, smart inverters, and EV should be the focus of marketing efforts until other areas have the necessary implementation drivers.
    a) This team will need to speak to both management and technical audiences. Target audiences should include utilities outside of CA and those using other technologies in order to educate them on the capabilities of IEEE Std 2030.5. Regulators should be next. Vendors are easier to gain interest from once the utilities are on board.
2) Develop a marketing plan.
3) Develop an education curriculum.
    a) Consider using (C33) SunSpec's "Secure Communication for Distributed Energy Resources" (see Reference section) course which is available for IEEE Std 2030.5 smart inverters. This could be enhanced to include and other implementation areas.
    b) Determine the top (10) organizations (such as utilities) to educate first. It is may be helpful to identify a problem and offer IEEE Std 2030.5 as a solution.
    c) Provide examples of organizations using IEEE Std 2030.5 and how it is being implemented.
    d) Enhance existing IEEE Std 2030.5 course material (such as the SunSpec UC San Diego course). Also add courses for other implementation areas.

    Potential responsible parties: IEEE 2030.5 Alliance membership, ESC members, SunSpec (Bob Fox, Tom Tansy), IEEE Std 2030.5 WG leaders and SMEs

    Timeline - Start | Duration: immediate | 4 to 12 months

    Open items/gaps: contractual arrangements, Archival and curation of the resulting material.

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6.4 Coordinate interoperability testing and certification

This action would stand up an entity for coordination of testing and certification of IEEE Std 2030.5 conformance and interoperability across the greater ecosystem. The entity will be responsible for documented tests and procedures that are organized and maintained consistent with the implementation profiles. Customers will recognize this certification brand and trust that the certified products and services will integrate easily and reliably. The entity should continuously mature the testing and certification process over time to be more comprehensive, efficient, and cost effective. Consideration should be given to the model used in California's smart inverter testing for developing test and certification methods in other implementation areas. The ESC identified several questions to address prior to the formation of the coordinating body. This includes a clearer definition and understanding of what is expected of the testing and certification authority. There is also a need for clarification of the roles and responsibilities of existing groups such as ICAP. The following are some of the questions asked during the maturity assessment process.

- What is the scope of responsibilities of a coordinator?
- What are the actions needed to create such a coordinator?
- What are the priorities and sequence of the actions?
- How does this align with the ICAP's mission and goals and SunSpec's testing and certification role?
- What is the ICAP roadmap and can it be harmonized within a greater alliance?

In order to form the testing and certification authority several steps were identified. This section of the roadmap document will need to be revisited frequently and modified as the roles of the entity are further defined and as the ecosystem evolves to include a broader range of implementation areas.

Actions

1) Form a recognized test and certification authority role in the alliance
   a) Consolidate, converge, and coordinate test and certification activity amongst the ecosystem participants
   b) SunSpec, ICAP, and SAE develop a plan to converge on coordinating authorization of testing and certification across IEEE Std 2030.5 implementation areas. Identify any ad hoc groups and coordinate convergence.
2) Expand test and certification coordination to maturing implementation areas such as electric vehicle charging and demand response.

Potential responsible parties: IEEE 2030.5 Alliance, SunSpec, Quality Logic, IEEE ICAP, Testing Agencies (Labs, RTLs)

Timeline - Start | Duration: immediate | 6 to 18 months (3-6 months for each new profile, post profile development)

Open items/gaps: ICAP and SunSpec coordination

6.5 Designate a global PKI certificate authority

The management of security keys is an important part of every implementation using IEEE Std 2030.5 for DER integration. While IEEE Std 2030.5 provides for multiple PKI encryption key authorities, the potential for confusion, conflicts, and mismanagement of the keys is greatly increased without careful coordination.

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The designation of a global PKI certificate authority across the greater ecosystem would address this issue. A process for managing root certificate issuance should be developed. A single certificate management authority should be encouraged to oversee a single certificate root for the greater public ecosystem with an understanding that exceptions may be needed for closed user groups such as the military.

Actions

1) Define the requirements for a PKI certification authority across IEEE Std 2030.5 implementation areas.
   a) Consider expanding the model used for the CA Rule 21 implementation group.
2) Establish a PKI certificate authority
   a) Define priorities and sequence of the actions
   b) Identify governance and responsible parties
      i) SunSpec currently manages this for CA Rule 21 and may provide guidance. They could potentially take on this role if desired by the greater alliance.
3) Develop scenarios for how the certificate authority will work, including special use cases such as military uses.
      i) Use cases for manufacturers of devices: Define how security keys will be issued and managed.
      ii) Use cases for issuance and management of security keys for utilities, aggregators, and other organizations.

Potential responsible parties: IEEE 2030.5 Alliance, SunSpec

Timeline - Start | Duration: immediate | 3 to 12 months?

Open items/gaps: contractual arrangements? Other?

6.6 Create an implementation profile template

This action would result in an implementation profile template for all implementation areas of IEEE Std 2030.5 to follow. The use of a template will result in more consistent use of the features and implementation options in IEEE Std 2030.5. Through experience, best practices can be developed and reflected in improved versions of such a template. Once such a template is created, the effort needed to develop new implementation profiles should be significantly be reduced (perhaps taking from 3 to 6 months). This can also result in the definition of a common set of Protocol Implementation Conformance Statements (PICS) that can define a common subset of testing and certification requirements appropriate for any IEEE Std 2030.5 implementation area.

Actions

1) Develop an implementation profile template that can be used for existing and future implementation groups across the IEEE 2030.5 ecosystem.

   a) The CSIP could be used as an example in developing the template and opportunities for improvement may be identified in the process.

   b) The template should consider areas that are expected to be common for all implementation profiles and areas where implementation area specialization may likely occur.

   c) Existing standards, such as SAE J2931-1, J2836-1, J2847-1, and ISO 15118 (used in Europe) for EV/EVSE, should be reviewed and considered for developing a template for specific implementation groups.

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d) Jurisdictional aspects of implementation profiles also need to be considered in developing a template (e.g., CSIP is the common smart inverter profile, but a jurisdiction may specialize in that profile for their specific implementation region).

2) Review implementation areas (e.g., photovoltaic smart inverters, batteries, electric vehicle charging, demand response) and identify a common set of PICS (Protocol Implementation Conformance Statements), and then address implementation area specifics for each implementation profile.

   a) Evaluate EV/EVSE PICS from SAE work.

   b) Look at demand response implementation profile next

   c) Other priorities will depend upon the drivers for developing the vertical implementation profiles.

3) Develop a migration plan for any separate implementation groups that exist or are emerging around IEEE Std 2030.5 to apply the implementation profile template as managed by the overall alliance of stakeholders across IEEE Std 2030.5 implementation areas

4) Apply the same requirements to all implementation areas (profiles, function sets). This includes test procedures and standard testing plans.

   a) Develop consistent implementation profile and testing documentation across the overall IEEE 2030.5 ecosystem.

Potential responsible parties: IEEE 2030.5 Alliance membership, ESC members, SunSpec, IEEE Std 2030.5 WG leadership and implement area champions (e.g., SAE in the electric vehicle charging area)

Timeline - Start | Duration: immediate | (3−6 months for each new profile, post profile development)

Open items/gaps: contractual arrangements? Document sharing (NDA?) Other?

6.7 Investigate deployment at scale

Several concerns arose in the course of discussing interoperability gaps related to the lack of experience in using the IEEE Std 2030.5 in large scale deployments. These concerns included performance and stability of actors continually entering or leaving a system and group management of a large number of responsive resources throughout a region. In order to help both new and existing ecosystem participants develop best practices and more quickly resolve potential issues, an archive of lessons learned from existing experiences implementing IEEE Std 2030.5 should be assembled. The ecosystem of organizations should also monitor and sanction investigations into potential issues associated with scaling. This may involve simulations of large-scale implementations, extrapolations from testing of a smaller mocked up system, and combined simulation with hardware in the loop studies. As the IEEE Std 2030.5 matures with new revisions, this activity area should consider investigating upgrade paths between versions and migrating non-IEEE Std 2030.5 equipment interfaces to the IEEE Std 2030.5.

The following is a list of some of the items discussed during the maturity and gap assessment regarding actions that could be taken to reduce technical risks prior to full scale deployments.

- Performance in large-scale deployments
- Smooth overall system operation undisturbed by actors entering or leaving the system
- Implementation experience growing in smart inverters associated with PVs, but other implementation areas, such as EV deployments and demand response are just emerging and will need attention
- Once new versions of IEEE Std 2030.5 become available, upgrades between versions of the standard will become important to investigate. This will need to involve capabilities such as rolling upgrades so

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that a system implementation can operate with multiple versions of IEEE Std 2030.5 operating in the field at the same time.

As experience is gained through current and future implementations an archive should be maintained. The ESC should address how to host this archive and how to transfer ownership to the alliance once it is formed. These activities should be managed by the alliance.

Actions

1) Convene a group of stakeholders with implementation experience and others who may be facing large-scale implementation concerns who articulate and prioritize issues for investigation.

2) Identify the needs to investigate large scale deployment concerns in various implementation areas (e.g., smart inverters for PVs and batteries, EVs, and demand response), and propose investigation projects.
    a) Concerned parties: utilities (e.g., SCE, PG&E, Sempra, Hawaii Electric), aggregators, technology solution providers
    b) Supporting parties: laboratories with experience technical investigations (e.g., EPRI, national laboratories, academic institutions).
3) Conduct investigations of scaling concerns and disseminate findings to Alliance members
    a) The existing EASE project (SCE, CEC, and US DOE) was mentioned as potentially offering insight.

Potential responsible parties: IEEE 2030.5 Alliance membership, ESC members, SunSpec, IEEE Std 2030.5 WG leaders and SMEs

Timeline - Start | Duration: immediate | 6 to 12 months to report with feedback but ongoing

Open items/gaps: contractual arrangements? Other?

6.8 Identify risks/concerns, and plan mitigation steps

There is great concern regarding how systems that use IEEE Std 2030.5 will perform as the penetration of renewables increases along with integration of other systems, actors, and components such as EVs and aggregators. Some concerns include networking, security, privacy, and coordination. The following are some areas of interest to the ESC.

Actions

1) Identify and prioritize the important risks and concerns with responsive resource integration using IEEE Std 2030.5.
    a) Communications concerns such as overloading and failure scenarios
    b) Consider the magnitude of inverters required to support the 100% renewables goals of states like Hawaii and California.
2) Consider approaches for investigating the important risks and concerns.
    a) Use of modeling and simulation to investigate concerns such as system interactions of vast numbers of inverters or other integrated equipment.

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3) Specifically, convene a security forum with representatives from operating entities to review experiences, lessons learned, and best practices about security policies and issues.
    a) The forum for meeting needs to respect the sensitivity of the information exchanged, which will affect those who can attend and protect the information shared.
    b) This group should publish risk assessment criteria.
    c) Consider partnering with government initiatives with a mission for secure critical infrastructure. This may be an opportunity for help from government and other research groups.

Potential responsible parties: Organizations that fund investigations including CEC, utilities (SCE), DOE, EPRI (who is working with SAE on other EV research), and other research labs, IEEE 2030.5 Alliance membership, ESC members, IEEE Std 2030.5 WG leaders and SMEs, research entities, consultants?

Timeline - Start | Duration: immediate |

3 to 12 months to report with feedback but ongoing action item

Open items/gaps:

6.9 Formalize process for coordinating with standards groups

The maturity assessment revealed that it can take considerable time to change the standard when an issue is found through implementation experience. The IEEE standards organization has a proven, mature process that by its nature requires time. Groups involved in actual implementation (e.g., the CA Rule 21 smart inverter integration) may be driven to change things in an implementation profile and resulting PICS so that implementations may proceed as quickly as possible. Such changes may have impacts on the IEEE Std 2030.5 and need to be communicated to the standards working group so that appropriate revisions can be considered in future versions of the standard. Developing formal liaisons and processes to communicate the changes and the driving issues between implementation groups and the standards working group will be very beneficial.

In addition, formal coordination liaison agreements can help ensure consistency with other related, standards groups. The following questions were raised by the ESC.

- What are the standards groups to target for more formal liaison?
    - IEC 61970, IEC 61968, IEC 61850, IEC OpenADR, NAESB, Green Button, ASHRAE, SAE
- What actions could be taken to formalize relationship?

Actions

1) Establish a coordinated process for requesting changes to IEEE Std 2030.5 based on issues that are identified through implementation experiences or captured in implementation profiles and their updates.
    a) The IEEE Project Authorization Request, better known as PAR, process exists and already addresses the way to interact with the WG for changes to the standard, but these should be coordinated across the implementation areas.
2) Develop a best practices document for coordinating with the standard and profile working groups.
3) Maintain the information model mapping done between standards used in IEEE Std 2030.5 and presently documented. This is seen as a low priority.

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a) The IEEE 2030.5 Working Group should formalize information model mapping and its maintenance into the future between OpenADR, DNP3, SunSpec Modbus, and IEEE Std 2030.5. This may be an action that can be taken prior to the formation of the alliance.

Potential responsible parties: 2030.5 Alliance, ESC members, IEEE Std 2030.5 WG leaders/sponsor chair and SMEs

Timeline - Start | Duration: immediate | 3 to 12 months

Open items/gaps: contractual arrangements

7. On-going maintenance of the roadmap

In order to maintain the roadmap beyond the scope of the IEEE 2030.5 ESC project to develop it, a group will need to regularly follow up on the progress and support the evolution of the document. This group or organization will likely include members of the ESC; however, the formation of an IEEE 2030.5 alliance would create a natural forum to take on the responsibility for upkeep of the roadmap. In the interim, the ESC will discuss the possibility to continue functioning as a coordination body or look for another forum for reviewing progress on roadmap actions and potential revisions.

In the future, there may be a need to extend the scope of the function sets covered by the roadmap to include technology ecosystems that were not well-represented on the ESC in the initial roadmap effort. During the discussions with the IEEE 2030.5 ESC members, EV and devices such as water heaters and pool pumps were often mentioned. Progress on the use of the standard in these areas will likely create reasons for updating the roadmap. In addition, the IEEE Std 2030.5 was developed to be broadly applicable to incorporate any number of function sets. That means that the application of this standard may eventually expand beyond connections with the electrical power grid to include smart technology interactions with infrastructure such gas and water. If this were to occur, the aforementioned alliance organization should share lessons learned or enhance its membership to include representation from the expanded ecosystem.

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Appendix A: References

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[5] The IEEE standards or products referred to in this appendix are trademarks owned by the Institute of Electrical and Electronics Engineers, Incorporated.

[6] IEEE publications are available from the Institute of Electrical and Electronics Engineers (http://standards.ieee.org/).

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Appendix B: Interoperability Maturity Baseline Assessment

B.1 Configuration and Evolution

These criteria address topics related to vocabularies, concepts, and definitions across multiple communities and companies. This means that all resources need to be unambiguously defined to avoid clashes between identification systems. This is important over time as new automation components enter and leave the system because resource identification is essential for discovery and configuration. This also provides the ability to upgrade (evolve) over time and to scale without affecting interoperability.

Criterion 01
The ability of the interface to accommodate the integration with legacy components and systems is described along with an upgrade migration path.

Discussion:
This gap is by design. The WG decided against IEEE Std 2030.5 (2018) being backwards compatible (2013). The new version will have more support for devices running older schema.

> **Gaps:**
> *1.1) Implementation profiles shall be expanded to include guidance for how to use an upgrade of specification between versions if required. (This gap has been moved in Criterion 2, versioning) (Lack of adequate implementation guidance)*

Criterion 02

Interface capabilities can be revised over time (versioning) while accommodating connections to previous versions of the interface and without disrupting overall system operation (such as supporting a rolling upgrade process).

Discussion:

This will be dependent on the next revision of IEEE Std 2030.5. There is already an action in IEEE Std 2030.5 to include this capability. IEEE Std 2030.5 now can support field device remote update and multiple server capability at the function set level; however, manufacturers have not yet chosen to use these features. The features were added for situations such as utilities upgrading firmware in gas meters and being able to have the devices point to a separate manufacture's server.

The ESC noted that to date, utilities have not needed to use this feature across different devices/manufacturers.

> **Gaps:**
> 2.1) Not currently a gap. *There is a mechanism in IEEE Std 2030.5 for performing a software update with the capability for roll-out to devices. These capabilities have not been used actively because most responsive resources are customer-owned. More experience is needed to see if this feature has been adequately specified. It may be that this feature is never be implemented. A gap may be the communication and marketing to the implementation community of the remote upgrade feature and its adoption. The question is whether the marketplace feels it is of value to have a common upgrade mechanism or to continue to use vendor-specific mechanisms. (Need for implementation experience) :*
> **Priority Level: Low Priority**

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2.2) There is a need for guidance on how to use an upgraded specification between versions. (This gap was moved from Criterion 1) (*Need for adequate implementation guidance and best practices)*
Priority Level: High Priority

Roadmap actions:

2.2) Implementation profiles should be expanded to include guidance for how to use an upgrade of specification between versions if required.) There is also a need to better define "backwards compatibility". If taking the CSIP as a "template" implementation guide, it may be informative to conduct a baseline maturity on the CSIP itself, to determine if it provides the necessary guidance on the full range of interoperability criteria.

Potential responsible parties: ESC Members

Criterion 03

The way regional and jurisdictional differences are supported is described.

Discussion:

The way to manage regional and jurisdictional differences is defined in the CSIP.
The standard defines the options but does not manage them; the SunSpec Alliance manages them on an ad hoc basis.

Gaps:

3.1) Standard supports the options to configure the interaction, but an alliance of stakeholders should facilitate the management of regional or jurisdictional differences. (*Market rules ambiguous*)
Priority Level: Medium Priority

Roadmap Actions:

3.1) The ecosystem needs a single, central collectively recognized entity for implementation across jurisdictions and regions. The alliance may manage the discussion of the differences between regions and jurisdictions. There needs to be discussion as to what sort of organization this "Alliance" would be and its scope.

3.2) ESC noted the potential for misalignment of security policy when implementing across applications, jurisdictions or entities. (This gap was moved to Criterion 11) (Lack of adequate implementation guidance)

Criterion 04

Configuration methods to negotiate options or modes of operation including the support for user overrides are described.

Discussion:

CSIP: For CA Rule 21, there may be system design requirements in the CSIP that evolve over time with experience. There should be a mechanism to see that changes in requirements from field experiences are reviewed for potential changes to IEEE Std 2030.5.

Gaps:

4.1) CSIP: In IEEE Std 2030.5 a message allows user to opt out. The CSIP states this message is not to be used. (*Possible need to update profile requirements*)
Priority Level: Low Priority

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Roadmap Actions:

4.1) There is no profile for demand response. This capability should exist in that demand response profile. Maybe a profile working group would help? (Profile working group came up during Criterion 13 and Criterion 15 discussions as well.)

4.2) This is not a gap. Provided in the standard but not used in the profile. Additional messages such as a reason why user "opt out" was used would be nice. (Possible need to update standard)

Criterion 05

The capability to scale the integration of many components or systems over time without disrupting overall system operation is supported.

Discussion:

ESC noted that scaling is built into the standard and that grouping is done via function set assignment (defined in the CSIP).

Gaps:

5.1) CA Rule 21 is using a hierarchical aggregation method to scale many devices. This should be used to develop best practices that could be used moving forward. (*Need for adequate implementation guidance and best practices, Need for implementation experience)*

Priority Level: High Priority

Roadmap Actions:

5.1a) There is need for large scale deployments for field demonstration of functionality.

5.1b) An alliance activity may be to collect results from studies and demonstrations to date and put in an easily-accessible public location.

5.1c) the alliance could also convene a group that has experience in this who could jointly create a "guide" to scaling.

Potential responsible parties: Mike Bourton (SunSpec), James Mater (QLI), ESC Members

5.2) The ESC noted that studies from CA EPIC program suggest scaling requirements are mostly met however, results from the field are needed to verify this. (*Need for implementation experience*)

Priority Level: Medium Priority

Roadmap Actions:

5.2) need to verify the results – there are no implementations to date on a large-enough scale. Some DERMS work will include IEEE Std 2030.5, which will have adequate scale.

5.3) Currently, there are no universal implementation guides for other types of technology types. (comment came from Criterion 1 discussion). (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

5.3) Need to document what other profiles have for scaling (SAE, demand response). Need coordination among implementation profiles.

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5.4) There is no industry standard for group management. Group management needs to be appropriately defined. Group management is the second step after resource discovery. The standard has one way to do this, while EPRI came up with another way of responsive resources grouping. Utilities also have different ways of using grouping. (This was also addressed in Criterion 8 discussion) The EPRI/IEC group management IEC 61968-5 – this may be difficult to adopt for IEEE Std 2030.5. (*Need for adequate implementation guidance and best practices)*
Priority Level: Medium Priority

Roadmap Actions:
5.4) An alliance could provide guidance of best practices on grouping, which could be helpful.

Criterion 06
The ability of overall system operation and quality of service to continue without disruption as interfacing actors (responsive resources, utilities, aggregators) enter or leave the system is supported.

Discussion:
EPRI may have good references in document for responsive resources and group coordination efforts.

Gaps:
6.1) Implementation experience is lacking and more guidance could be provided in the standard. EV and DR are less mature and working groups are making progress outside the standards. (*Need for implementation experience*)
Priority Level: High Priority

Roadmap Actions:
6.1) Develop Marketing and education tools including best practices documentation.

Criterion 07
Unambiguous resource identification and its management is described.

Gaps:
7.1) PKI Certificate issuance is defined, however, anyone can issue certificate. (*Need for coordination across the IEEE 2030.5 ecosystem landscape)*
Priority Level: High Priority

Roadmap Actions:
7.1) Having an IEEE 2030.5 globally recognized certificate authority would help address this issue. It was noted that Wi-Fi and Bluetooth SIG have such functions.
Potential responsible parties: SunSpec?

Gaps:
7.2) Other implementations may set up a certificate authority for PVs or EVs, or other function set implementations. That could lead to negative consequences if the implementations overlap. (*Need for coordination across the IEEE 2030.5 ecosystem landscape*)
Priority Level: High Priority

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Roadmap Actions:
7.2) Designate a global PKI certificate authority
Potential responsible parties: SunSpec?

Criterion 08
Resource discovery methods for assisting with identification and integration between actors (such as access to information like owner, responsive resource type, location, etc.) is supported.

Discussion:
Discussion/gaps were combined with Criterion 5.
Guidance is needed for how to use and manage the responsive resources group features in the standard. (Comment moved to Criterion 5)

B.2 Summary Discussion of Configuration and Evolution

Safety and Security

These criteria are concerned with aligning security policies and maintaining a balance of the tension between minimizing exposure to threats while supporting performance and usability. This includes the capability to troubleshoot and debug problems that span disparate system boundaries, while placing the integrity and safe operation of the electric power system above the health of any single automation component.

Criterion 09
The requirements and mechanisms for auditing and logging exchanges of information is described.

Gaps: Consensus was reached that this criterion is already at target maturity.

Criterion 10
Privacy policies are defined, maintained, and aligned among the parties of interoperating systems.

Discussion:
The ESC noted that this was a very application-dependent criterion because implementation of the policy is dependent on the protocol. Privacy policies may also be dependent on the jurisdiction or location (examples are laws that may change over time, or jurisdictions that consider data competitive information).

The ESC noted the seven principles of “privacy by design,” which may be useful to evaluate a specific policy.

To what extent are security and privacy linked?

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Gaps:

10.1) There is a need for best practices documentation. (The idea of a "best practices" document also came up in Criterion 29) (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

10.1) A sample privacy policy document could be made. The seven principles of "privacy by design" may be useful in developing a template for other groups using IEEE Std 2030.5.

Potential responsible parties: ESC Members, SunSpec

Criterion 11 (cross-lined to Criteria 3)

Security policies are defined, maintained, and aligned among the parties of interoperating system.

Discussion:

The ESC noted the potential for misalignment of security policy when implementing across applications, jurisdictions or entities.

Gaps:

11.1) While the IEEE Std 2030.5 protocol itself seems to have the capability of a robust security policy, within the ecosystem itself, there seems to be a lack of shared understanding and knowledge about the use and implementation of these capabilities among the ecosystem. (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

11.1) This is addressed best by security professionals within each organization that requires interoperability. The "alliance" should have a "security forum" with appropriate controls to maintain adequate "need to know".

11.2) ESC noted the potential for misalignment of security policy when implementing across applications, jurisdictions or entities. (This gap was moved from Criterion 3) (*Lack of adequate implementation guidance*)

Priority Level: High Priority

Roadmap Actions:

11.2) This is addressed best by security professionals within each organization that requires interoperability. The "alliance" should have a "security forum" with appropriate controls to maintain adequate "need to know". (*Need for adequate implementation guidance and best practices)*

Criterion 12

Failure mode policies are described and aligned among the parties of the interoperating systems to support the safety and health of individuals and the overall system.

Discussion:

The standard provides the mechanisms, but the policies should be part of the implementation profile.

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The CSIP states that these default settings are determined by the utility. There are no plans for stating failure mode policies.

Gaps:
12.1) Other implementation profiles may be lower. The EV failure/recovery state is more likely defined by needs of the vehicle. (*Need for adequate implementation guidance and best practices)*
Priority Level: Medium Priority

Roadmap Actions:
12.1) Could the various ecosystems come up with common definitions and a guidance document?

B.3 Summary Discussion of Safety and Security

Operation and Performance

These criteria focus on synchronicity and quality of service, as well as operational concerns. Operational concerns may include concerns such as maintaining integrity and consistency during fault conditions that disrupt normal operations and ensuring that distributed processes can meet expected interaction performance and reliability requirements.

Criterion 13
Performance and reliability requirements of the interface are defined.

Discussion:
The standard does not really specify performance and reliability requirements, but these are nailed down in an implementation profile and are application dependent. These should be specified in the profile and perhaps not the standard. The CSIP does this.

Gaps:
13.1) Performance is relevant for all function set implementations. It would be better if IEEE 2030.5 had a profile working group so that everyone shares knowledge and best practices can be documented and applied. (Profile working group came up during Criterion 4 and Criterion 15 discussions as well.) *(Need for coordination across the IEEE 2030.5 ecosystem landscape, Performance and reliability in implementation profiles guidance, Need for adequate implementation guidance and best practices)*
Priority Level: High Priority

Roadmap Actions:
13.1) Develop marketing and education tools including an archive of successful implementations and best practices.

Criterion 14
The interface definition specifies the handling of errors in exchanged data.

Gaps: Consensus was reached that this criterion is already at target maturity.

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Criterion 15
Time order dependency and sequencing (synchronization) for interactions is specified.

Discussion:
Consideration should be given to advancing a process for coordination between implementation profile updates and base standard revisions. (Profile working group came up during Criterion 4 and Criterion 13 discussions as well.)

Gaps:
15.1) There is a decoupling between IEEE Std 2030.5 and the CSIP. Some things are well defined in CSIP but not IEEE Std 2030.5 and vice versa. It is also easier (faster) to update the CSIP/implementation profile [than the standard itself]. (*Performance and reliability in implementation profiles guidance*)
Priority Level: Medium Priority

Roadmap Actions:
15.1) Develop and codify a formal process for coordinating with standards working group

15.2) Some time-order dependency may need to be removed from standard and included in the implementation profile. This is an application dependent issue. More experience is needed. This may make testing more difficult. (*Performance and reliability in implementation profiles guidance*)
Priority Level: Low Priority

Roadmap Actions:
15.2) Develop an archive of successful implementations and best practices. Develop a profile template with a common set of PICS.

Criterion 16
The interface definition specifies the mechanism for message transaction and state management.

Gaps: Consensus was reached that this criterion is already at target maturity.

B.4 Summary Discussion of Operation and Performance

Organizational

These criteria represent the pragmatic aspects of interoperability. They represent the policy and business drivers for interactions. Interoperability is driven by the need for businesses (or business automation components) to share information and requires agreement on the business process integration that is expected to take place across an interface.

Criterion 17
Compatible business processes and procedures shall exist across interface boundaries.

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Discussion:
This should be addressed at an implementation level and not by the standard.

Gaps:
17.1) There should be a mechanism to incentivize and develop compatible business processes with the Rule 21 ecosystem in a 5-year target. (*Market rules ambiguous*)
Priority Level: Low Priority

Roadmap Actions:
17.1) Coordinate between implementation profiles. Create an implementation profile template with a common set of PICS.

17.2) The ecosystem needs to become more mature in defining business goals, processes and procedures - the standard can then evolve to support the need. (*Need for adequate implementation guidance and best practices)*
Priority Level: Medium priority

Roadmap Actions:
17.2) Develop an archive of successful implementations and best practices. Develop and codify a formal process for coordinating with standards working group.

17.3) Currently, there is no clear guide to integrate IEEE Std 2030.5 with the back office. (Comment came from Criterion 1 and may apply to 17 and/or 20) (*Need for adequate implementation guidance and best practices)*
Priority Level: Medium Priority

Roadmap Actions:
17.3) Develop an archive of successful implementations and best practices. Develop and codify a formal process for coordinating with standards working group.

Criterion 18
Where an interface is used to conduct business within a jurisdiction or across different jurisdictions, it complies with all required technical, economic, and regulatory policies.

Gaps:
18.1) CA has done a good job of defining this but other ecosystems have not. Within CA jurisdiction CSIP is managing this portion of the interface but unknown across jurisdictions. (*Market rules ambiguous*)
Priority Level: Low Priority

Roadmap Actions:
18.1) Develop an archive of successful implementations and best practices. Form an alliance amongst the implementation groups to coordinate across jurisdictions

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B.5 Summary Discussion of Organizational

Informational

These criteria emphasize the semantic aspects of interoperability. They focus on what information is being exchanged and its meaning and they focus on both human and device recognizable information. At this level, it is important to describe how entities are related to each other, including relations to similar entities across domains and any constraints that may exist.

Criterion 19
Information models relevant for data exchanged across the interface are formally defined using standard information modeling languages.

Discussion: Parts of the information model apply to responsive resource technologies that need more implementation experience to contribute plans for refinement.

Gaps: Consensus was reached that this criterion is already at target maturity.

Criterion 20
Data exchange relevant to the business context is derived from the information model

Gaps:
20.1) The process to update or refine the information model through the standards process takes too long and could be improved. The implementation profiles can be faster to update, and these can eventually move into standards updates. (*Performance and reliability in implementation profiles guidance*)
Priority Level: Medium Priority

Roadmap Actions:
20.1) Develop and codify a formal process for coordinating with standards working group.

20.2) Currently, there is no clear guide to integrate IEEE Std 2030.5 with the back office. (Comment came from Criterion 1 and may apply to 17 and/or 20) (*Need for adequate implementation guidance and best practices)*
Priority Level:

Roadmap Actions:
20.2) Develop an archive of successful implementations and best practices. Develop a profile template with a common set of PICS.

Criterion 21
Where the data exchanged derives from multiple information models, the capability to link data from different information models is supported.

Gaps:
21.1) There is no formal agreement in place between the standards organizations.

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Priority Level: Medium Priority

Roadmap Actions:
21.1) Work with other standards organizations to coordinate and develop a template for implementation profiles with a common set of PICS.

21.2) An issue was brought up about certificates (roots) that could need updating and would upset the mapping to the information model. This may be more of a security policy and/or resource identity issue. The problem needs more exploration. (*Market rules ambiguous*)
Priority Level: High Priority

Roadmap Actions:
21.2) Designate a global PKI certificate authority

B.6 Summary Discussion of Informational

Technical

These criteria address the syntax, format, delivery, confirmation/validation, and integrity of the information. They focus on how information is represented within a message exchange and on the communications medium. They focus on the digital exchange of data between systems, encoding, protocols, and ensuring that each interacting party is aligned.

Criterion 22
The structure, format, and management of the communication protocol for all information exchanged shall be specified.

Discussion: The standard says that the application layers set atop TCP/IP and it is well defined for this; probably Level 5. If an implementation requires a different network transport protocol (i.e., mesh network), additional integration efforts are required. If transport protocols other than TCP/IP are desired, then implementation guides or changes to the standard may be needed.

Gaps: Consensus was reached that this criterion is already at target maturity.

Criterion 23
The information exchanged and business process interactions at the interface are cleanly layered (described separately) from the technical (communication networking) layers in the interface specification.

Discussion:
It was noted that running IEEE Std 2030.5 over UDP rather than TCP is more complicated in that the checks to verify packets are not defined in the IEEE Std 2030.5. It was also noted that IEEE Std 2030.5 does refer to HTTP, and HTTP is typically done over TCP.

Gaps:

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23.1) This criterion may be already at the near-term target maturity. This discussion can be included in the "mesh network" conversation. (*Lack of knowledge transfer/codification of best practices*)
Priority Level: Low Priority

Roadmap Actions:
23.1) research area? – running HTTP over UDP rather than TCP?

B.7 Summary Discussion of Technical Community

These criteria are focused more on the culture changes and collaboration activities that are required to help drive interoperability improvements and that reflect stakeholder maturity with respect to interoperability. These criteria reflect the participation of organizations in efforts to improve interoperability in general, not just specific interfaces.

Criterion 24
The ecosystem references openly available standards, specifications, or agreed-upon conventions in interface definitions.

Discussion:
This is somewhat defined for BESS. It is defined by work associated with SAE but not accepted into the CSIP profile for AC (J3072) and will be captured (J2953) for inverter conformance, interoperability, and certifications (Testing and conformance).

Gaps:
24.1) The function sets may be harmonized with existing standards (such as information models) to different degrees.
Priority Level: Low Priority

Roadmap Actions:
24.1) Work with other standards organizations to coordinate and develop a template for implementation profiles with a common set of PICS.

24.2) There are still missing standards and/or implementation profiles for responsive resources other than PV. (*Need for implementation experience*)
Priority Level: Medium Priority

Roadmap Actions:
24.2) Work with other standards organizations to coordinate and develop a template for implementation profiles with a common set of PICS.

Criterion 25
The ecosystem participates in development of interoperability standards efforts consistent with their businesses.

Discussion:
The ESC noted there is an application profile for electric vehicles, but it lacks a testing and certification component.

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Gaps:

25.1) The IEEE 2030.5 ecosystem is mature for smart inverter deployments in California, however this is not the case for other technology domains. (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

25.1) Stand up an entity for coordination of conformance testing and certification. Develop a template for implementation profiles with a common set of PICS.

25.2) There is no ecosystem group for coordinating the application of the standard overall. (This was also mentioned in Criterion 27) (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

25.2) Convene a forum for coordinating activities amongst the ecosystem members.

25.3) ESC noted there could be IEEE Std 2030.5.X for specific implementation profiles to ensure commonality for function sets and testing approaches. (*Performance and reliability in implementation profiles guidance*)

Priority Level: High Priority

Roadmap Actions:

25.3) Stand up an entity for coordination of conformance testing and certification. Develop a template for implementation profiles with a common set of PICS.

Criterion 26

The ecosystem supports interoperability test and certification efforts.

Discussion:

To date, the ecosystem is confident of conformance testing for inverter-based resources under CSIP and other standards. The function sets for these devices have been well tested and certified.

The ESC noted conformance to the standard and implementation profile requirements as the first step towards interoperability and that there is a difference between interoperability and conformance. Testing for interoperability is much more complicated and costly than testing for conformance.

We need to note that conformance testing is not same as interoperability. This may be a gap in our criteria. We should clarify the difference between these. (*Potential improvement to the IMM*)

Gaps:

26.1) Interoperability testing and certification to date has been done by utilities on a project-by-project basis, based on the utility's own certification standards. There is currently no broad certification for interoperability. (*Performance and reliability in implementation profiles guidance*)

Priority Level: High Priority

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Roadmap Actions:

26.1) Stand up an entity for coordination of conformance testing and certification. Develop a template for implementation profiles with a common set of PICS.

26.2) There is a lack of visibility across technology domains, so it is unclear whether function sets for other devices are well used or certified. (*Performance and reliability in implementation profiles guidance*)

Priority Level: High Priority

Roadmap Actions:

26.2) Develop marketing and education to promote IEEE Std 2030.5 and best practices. Stand up an entity for coordination of conformance testing and certification. Develop a template for implementation profiles with a common set of PICS.

Criterion 27

The ecosystem actively identifies, and shares lessons learned and best practices resulting from implementation experience and interoperability improvements.

Discussion:

The ESC noted the lack of an overall ecosystem group for IEEE 2030.5. (This was also mentioned in Criterion 25)

Gaps:

27.1) To date, SunSpec and the Smart Inverter Working Group have implemented efforts that address the intent of this criteria, however, this is specific to a single jurisdiction and a specific technology—inverter-based resources ("application" in IEEE Std 2030.5 language). (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

27.1) Convene a forum for coordinating activities amongst the ecosystem members. Develop a template for implementation profiles with a common set of PICS. Develop an archive of successful implementations and best practices.

27.2) There is currently no common approach for sharing lessons learned. (*Need for adequate implementation guidance and best practices)*

Priority Level: High Priority

Roadmap Actions:

27.2) Develop an archive of successful implementations and best practices.

27.3) There is also a need to share lessons learned across ecosystems in different technology domains. Specific examples include electric vehicles, energy storage, demand response. (*Performance and reliability in implementation profiles guidance*

Priority Level: Medium Priority

Roadmap Actions:

27.3) Develop an archive of successful implementations and best practices.

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Criterion 28
The ecosystem (standards development and implementation group contexts) periodically reviews refinements and extensions to interface definitions.

Gaps:
28.1) IEEE Std 802.1 was given as an example of being at Level 5, where plans for future refinements are in place and the ecosystem looks at continually improving its processes to manage the interface specifications. IEEE 2030.5 does not have this level of maturity yet. (*Performance and reliability in implementation profiles guidance*)
Priority Level: Medium Priority

Roadmap Actions:
28.1) Develop and codify a formal process for coordinating with standards working group

Criterion 29
Security and privacy requirements are specified in a manner to support integration and interoperation.

Discussion: It was determined that this criterion was more closely aligned with the "Safety and Security" category.

Capability for managing security and privacy are well defined in the standard itself.

Requirements for managing security and privacy are specified in other documents developed and promulgated by entities such as regulators and utilities. These requirements may be either more or less stringent than the standard itself.

Gaps:
29.1) The standard itself has a lot of guidance statements, but there could be a separate "best practices" document. (The idea of a "best practices" document also came up in Criterion 10) (*Need for adequate implementation guidance and best practices)*
Priority Level: High Priority

Roadmap Actions:
29.1) ESC ecosystem should consider developing a pro forma "policy application guide" with best practices, which could be updated faster than the standard.

Criterion 30
The ecosystem shall coordinate information exchange transparency and privacy agreements across the interface.

Comment: It was determined that this criterion fell under the umbrella of Criterion 11 (Privacy policies are defined, maintained, and aligned among the parties of interoperating systems.)

Criterion 31
Stakeholders coordinate usability and security in interface definitions.

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Comment: It was determined that this criterion fell under the umbrella of Criterion 11. (Security policies are defined, maintained, and aligned among the parties of interoperating system.)

Criterion 32
Purchasers of technology that is expected to support the interface specify interoperability performance language in their procurement documents.

Gaps: Consensus was reached that this criterion is already at target maturity.

Criterion 33
Education and marketing initiatives about the ecosystem and its interoperability elements (including standards, implementation profiles, testing, and certification) are supported.

Gaps:
33.1) ESC noted usefulness of providing education on cases where IEEE Std 2030.5 has been implemented successfully. The ecosystem needs to decide whether the ecosystem should provide some guidance on what is a "good" role of IEEE Std 2030.5—and what is not a "good" role for IEEE 2030.5, however, this may need to be left to the market. (comment came from criterion 35) (*Need for education and marketing about the IEEE Std 2030.5 and ecosystem products*)
Priority Level: High Priority

Roadmap Actions:
33.1) Convene a forum for coordinating activities amongst the ecosystem members. Develop an archive of successful implementations and best practices.

33.2) The ESC noted that other protocols have collectively supported creation of an "alliance" to help accomplish the intent of this criteria (Wi-Fi Alliance example, see criterion 7 and criterion 3). (*Performance and reliability in implementation profiles guidance*)
Priority Level: High Priority

Roadmap Actions:
33.2) Convene a forum for coordinating activities amongst the ecosystem members.

33.3) The ecosystem could do more to become educated on existing libraries for implementing the standard (ESC noted EPRI libraries). This may be something that an ecosystem alliance could take on, or, as an interim step, specific ecosystems could decide on a common method to document and disseminate libraries built in separate ecosystems. (comment came from criterion 34, ESC suggested moving to criterion 33) (*Need for education and marketing about the IEEE Std 2030.5 and ecosystem products*)
Priority Level: Medium Priority

Roadmap Actions:
33.3) Develop marketing and education tools. Create an archive of successful implementations and best practices.

33.4) The ESC consensus is that the IEEE 2030.5 ecosystem (not the standard) needs to more clearly educate its members and the broader community on the potential (and appropriate) roles for IEEE

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Std 2030.5. To date, it has been up to each implementation to provide that guidance (example given of OpenADR in contrast). (comment came from criterion 35) (*Need for education and marketing about the IEEE Std 2030.5 and ecosystem products*)

Priority Level: High Priority

Roadmap Actions:

33.4) Develop marketing and education tools. Create an archive of successful implementations and best practices.

33.5) ESC noted the need for education on potential desired functionality that may not be present in IEEE Std 2030.5 but may exist in other standards (such as IEC 61850). (comment came from criterion

Priority Level: Medium Priority

Roadmap Actions:

33.5) Develop marketing and education tools. Create an archive of successful implementations and best practices.

Criterion 34

The ecosystem adopts or aligns with existing, mainstream, modern information exchange approaches and standards that address the business objectives and maximize the longevity of its specifications.

Discussion:

We did not see a gap here. The standard itself can be considered very mature and modern.

The ecosystem is currently focused on the specific implementation of inverter-based resources in California.

Lack of knowledge transfer/codification of best practices: The ecosystem could do more to become educated on existing libraries for implementing the standard (ESC noted EPRI libraries). This may be something that an ecosystem alliance could take on, or, as an interim step, specific ecosystems could decide on a common method to document and disseminate libraries built in separate ecosystems. (comment moved to criterion 33)

Gaps: Consensus was reached that this criterion is already at target maturity.

Criterion 35

The ecosystem does not create new interface standards where suitable standards already exist.

Discussion:

ESC noted usefulness of providing education on cases where IEEE Std 2030.5 has been implemented successfully. The ecosystem needs to decide whether the ecosystem should provide some guidance on what is a "good" role of IEEE Std 2030.5—and what is not a good role for IEEE Std 2030.5; however, this may need to be left to the market. (comment moved to criterion 33) (Lack of knowledge transfer/codification of best practices)

Gaps:

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35.1) ESC consensus is that the IEEE 2030.5 ecosystem (not the standard) needs to more clearly educate its members and the broader community on the potential (and appropriate) roles for IEEE Std 2030.5. To date, it has been up to each implementation to provide that guidance (example given of OpenADR in contrast). (comment moved to criterion 33) (Lack of knowledge transfer/codification of best practices)

35.2) ESC noted the need for education on potential desired functionality that may not be present in IEEE Std 2030.5 but may exist in other standards (such as IEC 61850). (comment moved to criterion 33)

B.8 Summary Table

The IEEE 2030.5 Ecosystem Steering Committee met every other week over several months in order to discuss the various criteria and build a maturity baseline profile. The levels (as specified below the table) were used to spur discussion and identify gaps in interoperability of the systems and devices affected by IEEE Std 2030.5. During the baselining process it was determined that some technologies or jurisdictions were either more or less mature or that the gaps were not necessarily best addressed by the standard but instead should be addressed in the technology profile. Since the CSIP is the most evolved profile, the variance in level from IEEE Std 2030.5 primarily existed in this score. The following table is a summary of the scoring based on the aforementioned meetings.

Criterion	Date Discussed	Current Maturity	5 Year Target	Long-Term Target	Profile Maturity	Profile Target
1	12/14/18	2	3	4		
2	1/18/19	3	4	5		
3	2/15/19	2	3		1	
4	3/1/19	3	4		2	
5	12/14/18	2	3	4		
6	2/15/19	5	5			
7	2/15/19	3	4			
8	2/15/19	2	5			
9	3/15/19	5	5		3	3
10	12/7/18	2	3	4		
11	12/7/18	2	3	4		
12	3/15/19	5	5		2	3
13	3/1/19	2	4		4	
14	3/15/19	5	5			
15	3/1/19	3	3	5		
16	3/15/19	NA	NA			

Summary table continues next page

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Criterion	Date Discussed	Current Maturity	5 Year Target	Long-Term Target	Profile Maturity	Profile Target
17	2/15/19	1	3			
18	3/1/19	1	3		2	
19	2/1/19	3	3			
20	2/1/19	2	3		3	
21	2/1/19	3	4			
22	3/1/19	3	5			
23	1/18/19	3	3	5		
24	1/18/19	2	4	5		
25	12/7/18	2	3	4		
26	12/14/18	2	3			
27	11/9/18	2	4			
28	2/1/19	3	4		2	
29	1/4/19	2	3			
30	1/4/19	2	3			
31	1/4/19	2				
32	1/4/19	3	3			
33	11/9/18	2	3		3	
34	12/14/18	3	3			
35	12/7/18	2	3	4		

Maturity Level Definitions

The definitions for the criteria were derived from those used by capability maturity model for integration and were refined to meet the needs of the ecosystem steering committee. The final levels are specified as follows:

Level 5: Optimized – Continuous improvement of the process itself

Level 4: Planned – The ecosystem has developed plans for future refinements and improvements

Level 3: Defined – The process for review and refinements to extensions is defined

Level 2: Managed – Review of refinements and extensions are performed on a per implementation basis

Level 1: Initial – Ad hoc and chaotic

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Appendix C: Members of the IEEE 2030.5 Ecosystem Steering Committee

Facilitators

Jaime Kolln	Pacific Northwest National Laboratory
Rasel Mahmud	National Renewable Energy Laboratory
David Narang	National Renewable Energy Laboratory
Steve Widergren	Pacific Northwest National Laboratory

Voting Members

Michael Bourton	Kitu
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