Report to NIST on the Smart Grid Interoperability Standards Roadmap:

Priority Action Plans – Illustrative Versions

This document contains material gathered and refined by the Electric Power Research Institute using its technical expertise. It has been submitted as a deliverable to the National Institute of Standards and Technology under the terms of Contract No. SB1341-09-CN-0031.

Version 1.0a

July 30, 2009

Table of Contents

0 Overview

On the basis of stakeholder input received at two public workshops as well as its reviews of research reports and other relevant literature, the National Institute of Standards and Technology (NIST) is proposing a set of priorities for developing standards necessary to build an interoperable Smart Grid. Among the criteria for inclusion on this initial list were immediacy of need, relevance to high-priority Smart Grid functionalities,[1] availability of existing standards to respond to the need, state of the deployment of affected technologies, and estimated time frame to achieve an effective solution.

To facilitate timely and effective responses to these needs, NIST has drafted a preliminary Priority Action Plan (PAP) for each need. The PAPs are intended to scope out problem areas and to begin clarifying the steps required for achieving solutions.

The President's recently issued *Cyberspace Policy Review* recognizes that "as the United States deploys new Smart Grid technology, the Federal government must ensure that security standards are developed and adopted to avoid creating unexpected opportunities for adversaries to penetrate these systems or conduct large-scale attacks." As part of efforts coordinated by the National Institute of Standards and Technology to achieve Smart Grid interoperability, NIST has established a Cyber Security Coordination Task Group. Cyber security is being addressed in a complementary and integral process that will result in a comprehensive set of cyber security requirements. These requirements will be developed using a high-level risk assessment process that is defined in the cyber security strategy for the Smart Grid. All of the documents produced from the risk assessment process, and the cyber security requirements will be included in a separate document that will be published by NIST. Therefore, cyber security is not the explicit focus of a particular priority application plan in this document. However, its importance is recognized as implicit in all.

The plans are preliminary; they are not prescriptive. However, some PAPs focus on standards developed under the auspices of specific organizations. In such instances, these organizations are identified in the plan--but not to the exclusion of other organizations, nor with the intention to dismiss alternative responses to particular standards needs. For the purpose of stimulating discussion and expediting action and depending on the maturity of the requirements addressed in the PAP, several plans also list options for responding. These do not preclude other actions.

In short, the PAPs are intended to facilitate progress, which includes more detailed definition of needs and identifying the appropriate actions and actors for accomplishing modifications or enhancements to standards as well as the harmonization required. These are key objectives of August 3-4, 2009, workshop convened by NIST, with assistance from the Electric Power Research Institute.

Establishing an initial set of standards-related priorities for building the Smart Grid infrastructure is an important first step. However, the PAPs listed in the table below are just the beginning of what will be a sustained standardization effort spanning a number of years. The list does not encompass the entire scope of standardization efforts that will be required as the nation pursues the vision of a fully interoperable Smart Grid.

---

[1] NIST's initial framework and roadmap for Smart Grid interoperability standards is focusing on six Smart Grid functionalities: wide-area situational awareness; demand response; electric storage; electric transportation; advanced metering infrastructure; and distribution grid management.

0.1 Priority Action Plan (PAP) Scopes May Use Similar Standards

It should be noted that the PAP scopes are not orthogonal with respect to the standards that may be applied in the Smart Grid. Advanced "field equipment" communications, for example, are involved in several PAPs that ultimately may converge on standards targeted for field equipment and real-time operations in transmission and distribution (T&D) environments. Similarly, some customer equipment integration communications may also integrate with T&D operation standards as well as standards relevant to market operation and e-commerce. Some PAPs may use standards developed for back-office systems or information- technology environments. In some cases more than one standard addresses the applications or domain suggested by the PAP. Discussions may also note where there is a need to integrate or harmonize across environments. Integration and/or "harmonization" of key standards are topics that are likely to come up in several of the PAP discussions. These action plans can help to identify current and planned work that can be directly applied to the PAP as well as that needed to address future systems. Discussions are encouraged to identify synergies with existing and ongoing standards work.

0.2 Next Steps

As noted, key aims of the August 3-4 workshop are to further distill and define problems, determine follow-up actions, and develop the necessary processes to achieve effective solutions in a timely manner. Workshop discussions may lead to identification of additional priorities and action plans. Others may be added as the PAPs undergo refinement and improvement following the workshop. All interested stakeholders are encouraged to review and comment on the PAPs, which are posted on the Smart Grid Interim Roadmap TWIKI (http://collaborate.nist.gov/twiki-sggrid/bin/view/_SmartGridInterimRoadmap/PriorityActionPlans). Each PAP page has a form at the bottom, where reviewers can comment and make recommendations.

The following table lists the initial PAPs and the technical leaders for each. Where applicable, the PAPs reference relevant sections in the Report to NIST on the Smart Grid Interoperability Standards Roadmap (http://www.nist.gov/smartgrid/InterimSmartGridRoadmapNISTRestructure.pdf)

Table 1: Priority Action Plans

#	*Priority Action Plan*	*NIST Lead*	*EPRI Lead*
1	IP for the Smart Grid	David Su	Joe Hughes
2	Wireless Communications for the Smart Grid	David Su	Joe Hughes
3	Common Pricing Model	David Holmberg	Toby Considine
4	Common Scheduling Mechanism	David Holmberg	Toby Considine
5	Standard Meter Data Profiles	Tom Nelson	Aaron Snyder
6	Common Semantic Model for Meter Data Tables	Tom Nelson	Erich Gunther
7	Electric Storage Interconnection Guidelines	Al Hefner	Frances Cleveland
8	CIM for Distribution Grid Management	Jerry FitzPatrick	Grant Gilchrist
9	Standard DR Signals	David Holmberg	Bill Cox

#	*Priority Action Plan*	*NIST Lead*	*EPRI Lead*
10	Standard Energy Usage Information	David Wollman, Tom Nelson	Marty Burns
11	Common Object Models for Electric Transportation	Eric Simmon	Stuart McCafferty
12	IEC 61850 Objects/DNP3 Mapping	Jerry FitzPatrick	Grant Gilchrist
13	Time Synchronization, IEC 61850 Objects/IEEE C37.118 Harmonization	Jerry FitzPatrick	Christoph Brunner
14	Transmission and Distribution Power Systems Model Mapping	Jerry FitzPatrick	Christoph Brunner

Note that this document is a composite of fourteen plans that are "works-in-progress". All the acronyms and standards referenced are defined and described in the Interim Roadmap document on which these were based. Please refer to the referenced report for these definitions.

0.3 Priority Action Plan Template

The plans in this draft follow a template, as follows:

What: [Title: Name of standard/need/gap (with, where applicable, to parenthetical reference to discussion of this topic in the *Report to NIST on the Smart Grid Interoperability Standards Roadmap,* which can be downloaded from: http://www.nist.gov/smartgrid/InterimSmartGridRoadmapNISTRestructure.pdf)]

Abstract: [One- or two-sentence summary.]

Description: [Distillation of key elements.]

Objectives: [High level objectives / requirements for the goals of the plan.]

Why: [Why is it important? What does it enable? What are the consequences of not developing this standard/filling this gap? Which stakeholder group is most affected? . . .]

Where: [Where does it fit in the framework or architecture? Interfaces with what layers, domains, uses, etc.? . . .]

How: [How to get the job done (e.g., level of effort, stakeholder groups to engage, and other important procedural considerations)? What harmonization is needed?]

Who: [Suggestions on project planning team.]

When: [Timeline for deliverables.]

1 What: Role of Internet Protocol (IP) in the Smart Grid (6.1.4)

1.1 Abstract:

For interoperable networks it is important to study the suitability of Internet networking technologies for smart grid applications. This work area investigates the capabilities of protocols and technologies in the Internet Protocol Suite by working with key SDO committees to determine the characteristics of each protocol for smart grid application areas and types.

1.2 Description:

The Internet technologies consist of a set of protocols to network and transport data messages using IP packets, as well as a set of protocols to manage and control the network, such as routing, mapping of IP addresses, device management, etc. This protocol suite enables distributed applications to run over a set of interconnected networks. It also includes session- and transaction-oriented security mechanisms to provide security services.

1.3 Objectives:

- Review the communications networks and domains identified in the Smart Grid conceptual model and determine whether they are presented in fine-enough granularity to discuss the application of the IP suite.
- Define the approach for fully defining the network and systems management requirements for Smart Grid networking infrastructures.
- Define a set of standards profiles required for Smart Grid networks,
- Identify key networking profiles issues including issues surrounding IPv4 vs. IPv6.
- Determine the key remaining issues surrounding adoption of standardized networking profiles.
- Determine appropriate Smart Grid network architectures and technologies appropriate for basic transport and security requirements (e.g., shared IP networks, virtual private networks, MPLS switching, traffic engineering and resource control mechanisms).
- Determine which transport layer security protocol(s) (e.g., TLS, DTLS, SCTP, and IPsec) are most appropriate for securing Smart Grid applications.
- Identify higher layer security mechanisms (e.g., XML, S/MIME) to secure transactions.
- Develop an action plan for development of necessary usage guides, profiles and remaining work.

1.4 Why:

The Smart Grid will need a comprehensive mapping of application requirements to the capabilities of protocols and technologies in a well defined set of IP Suite(s) or Profiles. This should be defined by experts well versed in the applications and protocols, including management and security. A set of well defined networking profiles can be tested for consistency and interoperability to help ensure systems integration as appropriate across the Smart Grid. A set of consistent and testable protocol profiles is also necessary to ensure that the combination of technologies can meet not only today's requirements but meet future application needs as well.

The networking profiles defined by this work will define a significant portion of the interfaces to Smart Grid equipment and systems. Most notably the interfaces that integrate systems over wide-area networks and large geographical areas will need to be defined in part by these profiles. The networking profiles will define networking functions, such as addressing and the integration of concepts, including multihoming and other key functions necessary for the Smart Grid.

1.5 Where:

The Smart Grid will use a variety of different networking environments across domains and sub-domains, as identified in the applications and conceptual models. The suitability of the proposed protocol suites or profiles in specific application contexts should be analyzed against the requirements emerging for Smart Grid applications and the proposed scale and scope of Smart Grid networks. The analysis should identify which protocols are clearly applicable in specific application contexts (e.g. use of TCP/IP, UDP, TLS/SSL, IPsec, IPV4/IPV6, MPLS) and protocols for network control, management and security, in addition to identifying any existing gaps.

1.6 How:

This task will require the development of a combination of networking standards into well defined sets known as profiles. Working from existing and proposed Smart Grid applications and use cases, the approach will require the distillation of Smart Grid applications and requirements into sets of networking profiles. These profiles will need to be developed into designs and implementations that can then be tested against the requirements. The communities that need to be involved include those within the Internet Engineering Task Force as well as other research communities that are working on networking technology.

1.6.1 Task Descriptions

Develop along with project team.

1.6.2 Deliverables

Develop along with project team.

1.7 Who:

Project Team
NIST Lead: David Su
EPRI Leads: Joe Hughes jhughes@epri.com , Erich Gunther,
SDO Leads: IETF (Ralph Droms, JP Vassseur, David Oran, Henning Schulzrinne, Russ Housley, Sean Turner, Leslie Daigle, Richard Shockey,)

Project Team
Other SDOs: IEEE, TIA, ATIS
Users Groups: UCA International Users Group
Technical Team:

1.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

2 What: Wireless Communications for the Smart Grid (6.1.5)

2.1 Abstract:

This work area investigates the strengths, weaknesses, capabilities, and constraints of existing and emerging standards-based physical media for wireless communications. The approach is to work with the appropriate standard development organizations (SDOs) to determine the characteristics of each technology for Smart Grid application areas and types. Results are used to assess the appropriateness of wireless communications technologies for meeting Smart Grid applications.

2.2 Description:

Review existing documentation and ongoing work to assess the capabilities and weaknesses of wireless technologies operating in both licensed and unlicensed bands and to develop guidelines on their use for different Smart Grid application requirements.

2.3 Objectives:

- Identify requirements for use of wireless technologies for the Smart Grid.
- Identify guidelines for effectively, safely, and securely employing wireless technologies for the Smart Grid.
- Identify approaches to define the strengths and weaknesses of candidate wireless technologies to assist Smart Grid design decisions.
- Analyze co-channel interference issues and develop coexistence guidelines for operation in unlicensed bands.
- Identify key issues to be addressed in wireless assessments and development for the Smart Grid.

2.4 Why:

Wireless technologies are one of many types of media that could meet many Smart Grid requirements by enabling access where other media are too costly or otherwise not workable. However, different types of wireless technologies also have different availability, time-sensitivity, and security characteristics that may constrain what applications they are suitable for. Therefore, different wireless technologies must be used with knowledge of their varying capabilities and weaknesses in all plausible conditions of operation. This work provides objective information on the appropriateness of use.

2.5 Where:

Wireless can be used in field environments across the Smart Grid including generation plants, transmission systems, substations, distribution systems, and customer premises communications. The choice of wireless or non-wireless, as well as type of wireless must be made with knowledge of the appropriate use of the technology.

2.6 How:

2.6.1 Task Descriptions

Develop along with project team.

2.6.2 Deliverables

Develop along with project team.

2.7 Who:

Project Team
NIST Lead: David Su
EPRI Leads: Joe Hughes jhughes@epri.com , Frances Cleveland fcleve@xanthus-consulting.com
SDO Leads: ISA SP100: Wayne Manges IEEE Phil Beecher, Mark Klerer, Roger Marks, Steve Shellhammer, Bob Heile ZigBee Alliance Skip Ashton WiFi: Greg Ennis IETF: Geoffrey Mulligan TIA: Grant Seiffert
Other SDOs: ATIS,
Users Groups: Utility Telecom Council (UTC)
Technical Team:

2.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd

3 What: Common Pricing Model (6.1.1)

3.1 Abstract:

Price is more than a number. Price is a number associated with product characteristics. Already identified product characteristics include delivery schedule, quality, environmental characteristics, and regulatory characteristics. A common specification for price is a precursor to new market developments, to demand response, to distributed energy resources, to understanding meter information, and to every other hand-off between domains.

3.2 Description:

Shared responsibility for balancing energy production and consumption requires shared access to information about energy markets and actual use. Price is a common abstraction for market conditions, including abundance, scarcity, and quality. Energy quality may include reliability, power quality, and source. Energy source may be as important as energy price to influencing consumption decisions in some scenarios.

A common price model will define how to exchange energy characteristics, availability, and schedules to support free and effective exchange of information in any market. In financial markets, this type of description is called product definition. Although today's energy markets are almost exclusively wholesale, the product definition will be usable in other scenarios including retail markets and "prices to devices" scenarios. The completed price model will be used in demand response (DR) communications, in usage sharing between the meter and the premises energy srvice interface, and in potential market operations

Today's large-scale trading systems are built using the FIX (Financial Information) Protocol. The FIX product attribute dictionary already includes many elements used in today's wholesale energy markets; this plan's work can be completed more quickly if it re-uses this work. A common product profile compatible with FIX is a secondary deliverable of this plan.

Energy prices and energy products are closely tied to schedules and intervals. Building systems and enterprise activities must share an understanding of those schedules for effective collaborative energy. Product definitions must include schedule information.

3.3 Objectives:

- Develop a summary of product characteristics of interest to energy consumers.
- Develop summary of power reliability and quality characteristics that affect price and availability (supply side) and desirability (demand side).
- Develop and implement a plan to expedite harmonized standards development and adoption within the associated standards bodies.

3.4 Why:

Coordination of energy supply and demand requires a common understanding of supply and demand. Future energy markets will see greater variability than today. Consumer interests in green power, parallel markets for energy, and carbon regulations may create increased interest in energy sources. Distributed energy resources introduce new market focuses and new market sources.

Better communication of actionable energy prices will help enable and expand efficient markets (including forward or futures markets) that satisfy growing demand for lower-carbon, lower-energy buildings, net zero-energy systems, and supply-demand integration that take advantage of dynamic pricing. Local generation and local storage require that the consumer (in today's situation) makes investments in technology and infrastructure including electric charging and thermal storage systems. Businesses, homes, electric vehicles and the power grid will benefit from automated and timely communication of energy pricing, characteristics, quantities, and related information.

A consistent model for market information exchange can be applied, with elaboration or use of defined subsets, to allow essentially the same information communication for homes, individual appliances, electric vehicles, small businesses, commercial buildings, office parks, neighborhood grids, and industrial facilities, simplifying communication flow and improving the quality of actions taken across the broad range of energy providers, distributors, and consumers. A consistent information model will reduce costs for implementation.

Price and characteristics of energy are not necessarily simple. Retail markets typically have simple actionable information, in large measure because the retail markets combined with distribution are defined with clear and specific prices; wholesale markets are more complex, with transactions subject to later adjustments, e.g. for balancing costs, as well as the complexities of tariff market definitions. This work does not intend to address those complexities, rather to define a means for effective information exchange that permits immediate decisions—wholesale market participants must independently understand the complexities of the markets in which they operate. But a simple quotation of price, quantity, and characteristics in a consistent way across markets has significant value, even though the participants must understand and anticipate later adjustments.

Without transparency and common formats, energy markets, as with other markets, are prone to manipulation and gaming. Pricing and product definition are the key to transparent market accounting. Commonly agreed upon schedule and interval information is essential to developing forward markets.

3.5 Where:

Price and product definition are common components of information exchange across almost every domain. In the evolving transactive power grid market communications will involve energy consumers, producers, transmission and distribution systems. The definitions must enable aggregation for both consumption and curtailment resources. Market makers, such as Independent System Operators (ISOs), Regional Transmission Operators (RTOs), utilities, and other evolving mechanisms need to deliver actionable information in consistent formats as the Smart Grid evolves. With information in consistent formats, building and facility agents can make decisions on energy sale, purchase, and use that fit the goals and requirements of their home, business, or industrial facility.

Price and product definition are critical to open market operations. Machine understandable product definitions will be included in any retail forward markets. Wherever a decision to use or not use energy is made, energy product definition and price are potential decision points.

Common price and product definitions are critical across the GWAC stack. Product definition is the core of Semantic Understanding (level 4) and setting Business Context (level 5). As price is an abstraction for scarcity and value, reliance on price reduces the complexity required to achieve syntactic interoperability (3). Price is the primary means for sharing objectives between businesses (7). Today, prices are determined largely by regulatory policy (8); because product definitions enable multiple clearing markets over the same wired, future economic and regulatory policies will be affected by these definitions.

3.6 How:

- Engage today's market makers in energy (ISO/RTOs) to better support today's markets.
- Select common models and delivery format for specifications to support 1-n relationships among domains.
- Develop semantic mapping between scheduling in energy and in other domains and within energy between supply and demand.
- Use interval and schedule formats from other domains, especially the WS-Calendar (PAP 04) specifications.
- Develop cross-reference between market terms in energy and in financial markets.
- Engage FIX Protocol organization to supply those attributes and definitions already in use in commodity and energy markets. Extend FIX attributes as needed.
- Engage NAESB to formulate market rules for FIX profiles.
- Engage Regulatory entities to determine model product representations of existing tariff products.

3.6.1 Task Descriptions

(These task descriptions are a starting point for discussion within the workshop process on August 3 & 4, 2009)

- Develop plan and identify funding for interoperability and conformance, to be done in parallel with specification development
- Define attributes and features needed for product description, including environmental and regulatory attributes.
- Integrate product description with schedule and interval specifications, to be developed separately (PAP04)
- Define profiles for packaging product definitions and prices into automatable trading platforms, e.g., FIX profiles.
- Identify business process attributes from non-energy trading operations and markets useful for energy space. These might include blended products (Energy with Carbon Credits) or Sequences of Operations (Storage Management), et al.

3.6.2 Deliverables

Develop along with project team.

3.7 Who:

Project Team
NIST Lead: Dave Holmberg david.holmberg@nist.gov
EPRI Lead: Toby Considine Toby.Considine@gmail.com William Cox wtcox@coxsoftwarearchitects.com
SDO Lead: OASIS Laurent Liscia laurent.liscia@oasis-open.org
Other SDOs: FIX Protocol, Ryan Pierce,FIX Protocol,ryan.pierce@fixprotocol.org FIX Protocol, Jim Northey, FIX Protocol,jimn@lasalletech.com NAESB,Jonathan Booe,NAESB,jbooe@naesb.org NAESB,Joelle Ogg ,,Ogg@bc-law.net IEC,Jim Waight,Siemens,jim.waight@siemens.com ISO,Tim Schoeckle,ISO,schoechl@colorado.edu ISO/IEC,Ron Ambrosio,(GWAC) IBM,rfa@us.ibm.com ISO/IEC,Kenneth Wacks,(GWAC) GridPlex. Inc,kenn@alum.mit.edu PNL,Ron Melton,Pacific Northwest National Laboratories, ron.melton@pnl.gov
Users Group Lead: OSCRE Andy Fuhrman, Andy.Fuhrman@oscre.org AHAM, Charles R Smith,Appliance Manufacturer GE,CHARLESR.SMITH@ge.com AHAM, Matthew Williams,AHAM,mwilliams@aham.org ASHRAE, Jim Butler,Cimetrics,JimButler@cimetrics.com ASHRAE, Jim Lee,Cimetrics,JimLee@cimetrics.com CABA, Ron Zimmer,CABA,zimmer@caba.org FIATECH, Rick Jackson,FIATECH,jackson@fiatech.org GWAC,Lynne Kiesling,Northwestern University,lynne@knowledgeproblem.com GWAC,Terry Mohn,BAE,terry.mohn@bae systems.com GWAC,David Hardin,Invensys,david.hardin@ips.invensys.com GWAC,Nora Mead Brownell,,norabrownell@verizon.net User, Cazalet,Cazalet Group,ed@cazalet.com Multispeak,Bob Saint,(GWAC) NRECA, robert.saint@nreca.coop OSCRE, Andy Fuhrman,OSCRE,Andy.fuhrman@oscre.org UCAIug, Wayne Longcore,Consumers Energy,wrlongcore@cmsenergy.com BOMA, Henry Chamberlain,BOMA,Hchamberlain@boma.org User, Dr. Ralph Martinez,BAE Systems,ralph.martinez@baesystems.com LONMark, User,Jeremy Roberts,LONMark International,jeremy@lonmark.org [RTO/ISO trade association] *The event organizers below run purpose-driven organizations in the areas of standards-based building systems and grid communications (building system suppliers & integrators) and IT-based facility operations (owner-operators). Each can be very helpful in building participation and consensus)* Jim Young, RealComm jyoung@realcomm.com Anto Budiardjo, Clasma, antob@clasma.com
Technical Team: Richard Brooks, New England ISO rbrooks@iso-ne.com . FIX, ISO20022, Derek LaSalle, derek.n.lasalle@jpmorgan.com OASIS, Ed Koch,(OpenADR) Akuacom,ed@akuacom.com OASIS, Toby Nixon,Microsoft,Toby.Nixon@microsoft.com <u>Others</u>, TBD

3.8 When:

Task Description	Completion Date
Task 1:	Tbd
Task 2:	Tbd
…	

4 What: Common Scheduling Mechanism (6.1.3.2)

4.1 Abstract:

The coordination of supply and demand is already of critical importance on the grid; tomorrow, with the increase of distributed energy resources, this coordination becomes more critical. The coordination must involve more than electromechanical coordination; it also involves enterprise activities, home operations and family schedules, and market operations. A common specification, developed for other domains as well as in smart grid, would better support interactions with those other domains and get broader adoption.

4.2 Description:

For human interactions and human scheduling, the well-known ICalendar format is used. There is no equivalent standard for web services. As an increasing number of physical processes are managed by web services, the lack of a similar standard for calendaring of services becomes critical.

The goal of this action plan is to survey the existing specifications for calendaring and develop a standard for how schedule and event information is passed between and within services. The standard should support all of the functionality currently supported by ICalendar for application to the completion of a web service contract.

The scheduling specification will be a micro-specification, and then a micro-standard. A calendar event without associated contract is of little use. The micro-specification can then be incorporated into other specifications through composition, bringing a common scheduling operation to diverse contracts in different domains.

4.3 Objectives:

- Survey work to date and determine short-list precursors.
- Determine plan to expedite development of specifications to standards.
- Develop a plan for cross-referencing schedules and other documents/contracts in a message.

4.4 Why:

One of the most fundamental components of negotiating services is agreeing when something should occur. Short-running services have traditionally been handled as if they were instantaneous, and thereby dodged this requirement through just-in-time requests. Longer-running processes may require significant lead times. When multiple long-running services participate in the same business process, it may be more important to negotiate a common completion time than a common start time. Central coordination of such services reduces interoperability as it requires the coordinating agent to know the lead time of each service. As we reach out to multiple processes with the span of the grid, coordination must take into account local time zones as well.

A growing number of specifications envision synchronization of processes through broadcast scheduling. The Smart Grid relies on coordinating processes in homes, offices, and industry with projected and actual power availability, including different prices at different times. Weather reports including time are becoming increasingly important to projecting energy availability. Emergency management coordinators wish to inform geographic regions of future events, such as a projected tornado touchdown. These efforts would benefit from a common standard for transmitting calendaring.

Web services are meeting increased acceptance to interact with the low-level [control] systems world. Business systems can interact with building systems using web services specifications, such as oBIX, BACnet/WS, and a number of proprietary specifications including LON-WS, TAC-WS, and others. Energy use in buildings can be reduced while improving performance if building system operation is coordinated with the schedules of the buildings occupants.

Coordination of energy supply and demand requires a common understanding of supply and demand. Future energy markets will see greater variability than today. Consumer interests in green power, parallel markets for energy, and carbon regulations may create increased interest in energy sources. Distributed energy resources introduce new market focuses and new market sources. A scheduling component within energy market operations coordinates both short-lead and long-lead-time activities. This will promote the development of autonomous agents to drive performance while reducing costs for implementation.

4.5 Where:

Coordination is a common component of information exchange across almost every domain. In the evolving transactive power grid market communications will involve energy consumers, producers, transmission and distribution systems, and must enable aggregation for both consumption and curtailment resources. Market makers, such as Independent System Operators (ISOs), Regional Transmission Operators (RTOs), utilities, and other energy services providers. With information in consistent formats, building and facility agents can make decisions on energy production, sale, purchase, and use that fit the goals and requirements of their home, business, or industrial facility.

4.6 How:

- Identify pre-existing work from enterprise domains. The Calendar Consortium(www.calconnect.org) and the ISO20022 financial schedule elements are likely candidates..
- Seek agreement from those who have existing work as to completion, submission as a standard, IP assertions, etc.
- Expedite completion to deliver as component of developing specifications for DR (Energy Interoperation), Market Information (EMIX) and other specifications
- Explore how existing standards for scheduling sequences in BPEL and other well known standards can interact with calendar-oriented standards to solve other problems on the grid.

4.6.1 Task Descriptions

Develop along with project team.

4.6.2 Deliverables

Develop along with project team.

4.7 Who:

Project Team
NIST Lead: Dave Holmberg david.holmberg@nist.gov
EPRI Lead: Toby Considine Toby.Considine@gmail.com William Cox wtcox@coxsoftwarearchitects.com
SDO Lead: OASIS Laurent Liscia laurent.liscia@oasis-open.org
Other SDOs: CALCONNECT, Mike Douglass , RPI, douglm@rpi.edu ISO, SIIA, Derek Lasalle, JPMorgan, ISO20022, derek.n.lasalle@jpmorgan.com CALCONNECT, Dave Thewlis, CALCONNECT, dave.thewlis@calconnect.org GWAC, Ron Ambrosio, IBM, rfa@us.ibm.com PNL, Ron Melton, PNL, ron.melton@pnl.gov OASIS, Toby Nixon, Toby.Nixon@microsoft.com
Users Group Lead: Ed Cazalet, ed@cazalet.com Terry Mohn, BAE Systems, terry.mohn@baesystems.com FIATECH, Bob Wible, wible@fiatech.org FIATECH, Rik Jackson, jackson@fiatech.org SIIA, Derek Lasalle, JP Morgan, derek.n.lasalle@jpmorgan.com Gridwise Architectural Council, Ron Ambrosio, IBM, rfa@us.ibm.com Gridwise Architectural Council, Lynne Kiesling, lynne@knowledgeproblem.com Gridwise Architectural Council, Dave Hardin, Invensys, david.hardin@ips.invensys.com BACNET, Jim Butler, Cimetrics, JimButler@cimetrics.com CABA, David Katz, dkatz@sustainable.on.ca BOMA, Harry Chamberlain, Hchamberlain@boma.org OSCRE, Andy Furhman Andy.fuhrman@oscre.org PNL, Ron Melton, ron.melton@pnl.gov, OSCRE Alan Edgar, aredgar@comcast.net
Technical Team: CALCONNECT, Gary Schwartz, RPI, schwag@rpi.edu CALCONNECT, Cyrus Daboo, Apple, cyrus@daboo.name CALCONNECT, Bernard Desruisseaux , Oracle, bernard.desruisseaux@oracle.com   CALCONNECT, Stephen Lees, Microsoft, steven.lees@microsoft.com

4.8 When:

Task Description	Completion Date
Task 1:	Tbd
Task 2:	Tbd
…	

5 What: Standard Meter Data Profiles (6.2.5)

5.1 Abstract:

NIST should work with NEMA to utilize EDL to represent one or more meter profiles with distinct information locations and formats to simplify client access to commonly shared information (**6.2.5**).

5.2 Description:

ANSI C12.19-2008 contains four default profiles, known in its nomenclature as "DEFAULT_SET_USED" in Section 9.1.1, Table 00:

> **DEFAULT_SET_USED** Indicates which, if any, default sets are used.
> See Annex C, "Default Sets for Decade Tables", for the default set definitions.

0	Default sets are not used. See Section 4.1, "Standard Tables", Figure 4.1, conditions C through H for more detail.
1	Default set #1, Simple Meter Register, in use.
2	Default set #2, Simple Demand Meter, in use.
3	Default set #3, Simple TOU Meter, in use.
4	Default set #4, Simple Profile Recorder, in use.
5..255	Reserved.

The values for the "default sets" are contained in the referenced Annex C.

Despite these definitions, there may be misconceptions about the "default sets" as well as a misalignment of those sets with utility requirements. Since it would be possible to extend the number of default sets by about 250, there is ample space within the published standard (with an amendment) to allow the definition and publication of new defaults sets.

5.3 Objectives

- Develop strong stakeholder team to define utility requirements.
- Express requirements in Standard Table language and publish "EDL Form" default sets.
- Prepare and deliver to ANSI C12 SC17 WG2 an amendment to ANSI C12.19-2008 containing requested changes in Standard Form in a "contribution".
- Socialize existence and application of existing default sets.
- Socialize extension method for definining new default sets.

5.4 Why:

The Smart Grid recognizes that several clients may require local access to meter data and these may be on the same order of complexity as the meter itself. Such potential clients might range from thermostats to building automation systems. Other potential clients will exist inside and outside of the customer premises.

5.5 Where:

Meter interface with: Metering System (28 – Operations Domain), Customer EMS (32 – Customer), Submeter (37 – Customer), Workforce Tool (39 – Distribution), Field Devices (41 – Distribution); Semantics layer

5.6 How:

1. Formulate team
2. Find an entity willing to provide the four default set definitions in EDL form and publish
3. Create and publish a "how to develop" guide with respect to this topic.
4. Develop a strategy to publish and maintain EDL default sets via an SDO and/or user's groups.
5. Identify sets of meter attributes that should be able to be acquired simply based on known meter profile adoption, i.e. new "default set" definitions.
6. Implement the description in EDL Form the "default sets".
7. Investigate potential integration challenges (e.g., with MultiSpeak and IEC 61968-9) and create roadmap to minimize or eliminate those challenges.
8. Produce descriptions and example messaging scenarios to illustrate how meters can be read by simple clients to obtain commonly requested information.
9. Identify and Socialize a "recipe" for getting a candidate set of meter information that is not part of a default set.

5.6.1 Task Descriptions

Develop along with project team.

5.6.2 Deliverables

Develop along with project team.

5.7 Who:

Project Team
NIST Lead: Tom Nelson thomas.nelson@nist.gov
EPRI Lead: Aaron Snyder aaron@enernex.com Ben Rankin ben@enernex.com
Action Plan SDO Leads: AEIC: Larry Barto labarto@southernco.com AEIC: Terry Penn @southernco.com AEIC: Jim West jbwest@ameren.com AEIC: David Bernaudo david.bernaudo@sce.com ANSI C12 SC12.1: Scott Weikel scott.j.weikel@us.elster.com ANSI C12 SC17: Larry Kotewa larryk@cntenergy.org ANSI C12 SC17 WG1: Ed Beroset edward.j.beroset@us.elster.com ANSI C12 SC17 WG2: Avy Moise avy@fdos.ca

ANSI C12 SC17 WG3: Ginger Zinkowski ginger.zinkowski@ge.com ANSI C12 SC17 WG4: Aaron Snyder IEC TC13: Thomas Schaub thomas.schaub@landisgyr.com IEC TC57 Smart Grid TF: Scott Neumann sneumann@uisol.com IEEE SCC31: Larry Kotewa IEEE SCC31 End Devices SC: Richard Tucker richardaet@aol.com MultiSpeak: Gary McNaughton gmcnaughton@corniceengineering.com NEMA: John Caskey joh_caskey@nema.org NEMA: Paul Orr pau_orr@nema.org UCAIug AMI-NET TF: Matt Gillmore mkgillmore@cmsenergy.com
Other SDOs: Measurement Canada: Vuong Nguyen nguyen.vuongt@ic.gc.ca
Stakeholder Leads:David Haynes – Technical Expert, ANSI/IEC/MultiSpeak →Software Vendor (Customer EMS)?? →Software Vendor (MDMS) – representative from AMI-MDM?

5.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

6 What: Data Tables Common Semantic Model for Meter Data Tables (6.2.5)

6.1 Abstract:

NIST should work with NEMA to translate the ANSI C12.19 end device (meter) data model into a common form that will allow the semantics of this and end device models in other standards to be more readily harmonized. The objective is to allow the lossless translation from the common form to the various syntactic representations prevalent in each Domain. Details will include the representation of the Decade/Table/Element model, as well as, the Table-independent representation of key measurements of a revenue meter. (**6.2.5**)

6.2 Description:

ANSI C12.19-2008 standard organizes metering (and other end device) data and operating criteria to be conveyed into and out of those devices into defined groupings of information called ”Tables”. A large number of Tables are supported to allow representation of many types of data in numerous formats for "standard" or common data elements as well as manufacturer specific data. A high degree of flexibility in formats for time, integer values, data order, character formats, and data access are provided for. This flexibility has also resulted in some difficulties in determining what elements should be expected to be used-- a minimum set of expected functionality. Individual utilities and organizations, such as the AEIC, have attempted to develop implementation guidelines. A criticism of ANSI C12.19 has been its continued use of Tables to represent information rather than more "modern" methods of representing semantic models and implementation syntax.

6.3 Objectives

- Develop strong stakeholder team to define utility requirements.
- Develop one or two very specific use cases, and use them for clarifying the requirements and testing the results of the work.
- Use XML, XSLT and Substation Configuration Language (SCL) as common languages to provide mappings between the models, since all of the standards use XML for some part of their function.
- Create common definitions of metering measurements that can be used by all models.
- Create multiple “views” of data in each model that permit other technologies to access the data in two ways: either “verbatim” using the concepts common to the data source (e.g. tables), or “translated” using concepts and structures familiar to the viewer (e.g. logical nodes).
- Create rules for mapping data and services that will permit information to be mapped algorithmically at run-time, rather than requiring pre-configuration.
- Prepare and deliver to ANSI C12 SC17 WG2 an amendment to ANSI C12.19-2008 containing requested changes in a “contribution”.

6.4 Why:

This work has the potential to substantially reduce the labor costs of integrating large-scale systems that use metering data. By reducing or eliminating the amount of human intervention required, utilities can focus on products and services that provide benefit to the organization and to the customer, rather than spending extensive effort on simply achieving connectivity between computer systems.

The ability to share the resources represented by metering can greatly enhance the operation of the energy generation and delivery operations as well as opening up new ways to serve customers. This work can enable enterprise level sharing and support a variety of new applications.

6.5 Where:

Meter interface with: Metering System (28 – Operations Domain), Customer EMS (32 – Customer), Submeter (37 – Customer), Workforce Tool (39 – Distribution), Field Devices (41 – Distribution); Semantics layer

6.6 How:

1. Formulate team.
2. Leverage the significant published work that already exists on this topic - specifically EPRI Report 1012651 - *"IntelliGrid Metering Objects Integration for Customer Communications"*.
3. Create and publish a “how to develop” guide with respect to this topic.
4. Develop a strategy to fully capture and embody in the semantic model the more than 20 years of data modeling effort and participation by all major North American meter manufacturers, numerous utilities, and communications companies, that defines what data is produced by customer meters.
5. Implement the description in some form based on XML, XML Schema, and/or UML.
6. Investigate potential integration and harmonization challenges (*e.g.*, with MultiSpeak, IEC 61968-9, IEC 61850, IEC 60256 COSEM, etc.) and create roadmap to minimize or eliminate those challenges.
7. Transfer the results to ANSI and other relevant standards groups

6.6.1 Previous Work:

- EPRI Report 1012651 - *"IntelliGrid Metering Objects Integration for Customer Communications"*. The primary source work for this effort since it has a very similar scope.
- ASHRAE Research Project RP-1011. Was intended to propose use cases and object models for applications dependent on the interaction of the commercial building and utility industry.
- Association of Edison Illuminating Companies Guidelines v1.0 – placed boundaries on implementations of ANSI C12.19-1997 to ensure that features of the standard that encourage interoperability, such as the agreement to use “big-endian” data

representation, were implemented by all who comply. Version 2.0 is under development to match the recently published ANSI C12.19-2008.

- IEC 60256 COSEM object model for ANSI C12 – permits ANSI C12 Tables to be viewed through specific objects defined in the COSEM standard.

6.6.2 Task Descriptions

Develop along with project team.

6.6.3 Deliverables

Develop along with project team.

6.7 Who:

Project Team
NIST Lead: Tom Nelson thomas.nelson@nist.gov
EPRI Leads: Erich Gunther erich@enernex.com Aaron Snyder aaron@enernex.com
Action Plan SDO Leads: AEIC: Larry Barto labarto@southernco.com AEIC: Terry Penn @southernco.com ANSI C12 SC17: Larry Kotewa larryk@cntenergy.org ANSI C12 SC17 WG1: Ed Beroset edward.j.beroset@us.elster.com ANSI C12 SC17 WG2: Avy Moise avy@fdos.ca ANSI C12 SC17 WG3: Ginger Zinkowski ginger.zinkowski@ge.com ANSI C12 SC17 WG4: Aaron Snyder IEC TC13: Thomas Schaub thomas.schaub@landisgyr.com IEC TC57 Smart Grid TF: Scott Neumann sneumann@uisol.com IEEE SCC31: Larry Kotewa IEEE SCC31 End Devices SC: Richard Tucker richardaet@aol.com MultiSpeak: Gary McNaughton gmcnaughton@corniceengineering.com NEMA: John Caskey joh_caskey@nema.org NEMA: Paul Orr pau_orr@nema.org UCAIug AMI-NET TF: Matt Gillmore mkgillmore@cmsenergy.com
Stakeholder Leads: AEIC: Jim West jbwest@ameren.com AEIC: David Bernaudo david.bernaudo@sce.com ANSI C12 SC12.1: Scott Weikel scott.j.weikel@us.elster.com Marty Burns - Co-lead from EPRI meter objects harmonization effort Grant Gilchrist - Co-lead from EPRI meter objects harmonization effort David Haynes – Technical Expert, ANSI/IEC/MultiSpeak → Someone from ASHRAE BACnet (Marty Burns??)

6.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

7 What: Electric Storage Interconnection Guidelines (6.2.3)

7.1 Abstract:

NIST should issue a request to IEEE SCC 21 that the IEEE 1547 working groups recruit industry experts in energy storage devices, electrical power systems (EPS), and hybrid generation-storage systems to update or augment the 1547 standards series as appropriate to accommodate Smart Grid requirements. Coordination with UL, SAE and NEC-NFPA70 may be required for electric vehicle based storage systems. In addition, coordination will be required with IEC TC8 and TC57 WG17 for developing the object models for exchanging information with electric storage devices.

7.2 Description:

Energy storage and hybrid generation-storage systems will be increasingly connected to the grid. Electrical interconnection guidelines for electric storage need to be developed to ensure continued safe and reliable operation of the grid, along with the object models.

7.3 Objectives:

- IEEE SCC 21 P1547 working groups should recruit industry experts in energy storage devices, electrical power systems, and hybrid generation-storage systems, and update or augment the IEEE 1547 standards series as appropriate to accommodate energy storage system specific requirements, coordinating with FERC and/or NERC on regulatory and reliability requirements. As appropriate, this may entail increasing the IEEE 1547 family to include aggregated systems greater than 10 MVA, and further address end-use operational support, applications and regulatory technical needs.

- IEC TC57 WG17 should work with domain experts in energy storage devices to develop additional object models for energy storage devices and hybrid generation-storage systems.

7.4 Why:

Energy Storage is a new and emerging technology that has been identified by FERC as a key functionality of the smart grid, and standards related to storage should be treated as a key priority by the Institute and industry in the interoperability standards development process, subject to certain reservations. Coupled with inverter-based technology, these systems can be used to improve EPS performance. Due to the infancy of the use of storage and inverter technologies as a grid-integrated operational asset there are few standards that exist to capture how it could or should be utilized on the legacy grid and Smart Grid. For example, to date there exist no guidance or standards to address grid-specific aspects of aggregating large or small mobile storage, such as Plug-in Hybrid Electric Vehicles (PHEVs). Energy Storage is treated as a distributed energy resource in some standards, but there may be distinctions between electric storage and connected generation. In particular, storage-based systems may function as a load more than 50% of the time.

At the same time, we are moving towards large penetration of renewables into the Grid, which could be destabilizing, but should, in the context of the Smart Grid, allow these renewables to be true utility assets. The potential for instability is twofold; first, due to the intermittent nature of renewables and therefore their unsuitability to be dispatchable resources, and second, due to the interconnection regulations themselves can lead the electronic interconnection interface (the inverter) to trip off in response to minor variations in grid voltage or frequency. As low frequency is the result of insufficient generation, tripping a high level of inverter based systems would contribute to the problem and cause possible stability issues in response to a relatively minor disturbance. Appropriate interconnection standards, smart grid devices, and storage are all key elements of the solution.

In addition, hybrid generation-storage systems based on photovoltaic, wind, and other renewable, intermittent sources of energy are also exploring the use of storage to help smooth their intermittency, augment their ability to respond to distribution power grid management requirements, such as avoiding back-flow on networked power grids, and enhance commercial output by shifting when the energy is delivered. Eventually electric storage will play a larger role in islanded systems by helping to stabilize generation and load variations. Island system applications do provide some early examples of the stabilizing support needed when renewable are added to islanded (weak electrical) systems.

Various types of storage technology and hybrid generation-storage systems are emerging. Each type will have different ranges of abilities to respond to power grid management requests, and will use different system parameters and technology specific constraints for forecasting their availability. Furthermore, the storage needs (power, energy, duty cycle, and functionality) will also depend on the grid domain where the storage is used (e.g., transmission, distribution, consumer, etc.). These considerations should be included in the storage and hybrid generation-storage connectivity and information model standards.

Examples of the different storage requirements for grid services include:

- Ancillary Services – including load following, operational reserve, frequency regulation, and 15 minutes fast response.
- Managing diurnal cycles for wind: Large energy capacity
- Relieving congestion and constraints with renewable: short-duration (power application, stability) and long-duration (energy application, relieve thermal loading) .

Examples of storage technologies being considered include:

- Pumped Hydro
- Compressed Air Energy Storage (CAES)
- Flywheels
- Batteries
- Super-Capacitors (SuperCaps)
- Superconducting Magnetics
- Thermal Storage
- Fuel Cells (reversible)
- Hydrogen Storage

Currently, IEEE 1547 defines the interconnection of distributed energy resources (DER) rated 10 MVA and less with the electric power system.[2] This standard defines DER as a small-scale electric generator located in and connected to the local electric power system (e.g., the customer facility), near the loads being served with an electric grid interconnection. The standard does not specify a distinction between energy storage devices and generators within the DER portfolio. However, there is no standardization for functioning during islanding (P1547.4 is still a draft), there are no ramp rate specifications that would enable hybrid generation-storage to mitigate intermittency of renewables, the trip point specifications do not enable renewables or storage to avoid tripling under moderate grid transients, there are no voltage support specifications, and there are inconsistencies between the anti-islanding requirements of IEEE 1547 and the ride through requirements defined by FERC's Large Generator Interconnection Procedure (LGIP), depending on interpretation and application. In particular, the standards that cover the period between event onset and when a resource must stay on, or must disconnect from the grid can have conflicting time requirements, and the FERC LGIP ride through requirements extend beyond the 1547 default values for DR ceasing to energize the point of common coupling with the grid.

FERC Order 719 currently prohibits generation of power within islanding. Distribution systems are beyond the purview of FERC and regulation does not exist for authorizing the application and dispatch of storage. ISOs and regulatory bodies today have a tendency to treat storage as a generation device and struggle with seeing transmission or distribution entities owning storage. Revision or augmentation of IEEE 1547 will need to be closely coordinated with FERC. FERC has requested that the individual specification of IEEE 1547 be itemized (e.g., 1547.8.1) so that they can be adopted individually as FERC requirements.

IEEE 1547 was developed for interconnected systems of limited DER and renewable energy system penetration levels. This proposed new IEEE SCC21 P1547.8.x Standards are needed to enable the grid to accommodate increased renewable penetration levels, systems greater than 10 MVA, and to get value from inverter based systems to improve EPS performance, and further address end-use operational support, applications and regulatory technical needs.

7.5 Where:

The primary requirement is for P1547.8x's to develop appropriate electrical interconnection standards for electric storage and hybrid generation/storage that will enable substantial grid stability and security enhancements and permit a larger penetration of renewable energy resources and PHEVs, and further address end-use operational support, applications and regulatory technical needs.

Additional efforts will include validating and enhancing the IEC 61850-7-420 semantic layer object model standard for storage devices and hybrid generation/storage systems, including covering more storage devices than just batteries. PHEV object modeling will be handled by a different PAP.

IEEE 1679, that is standardizing the characterization of grid storage units, can coordinate efforts to assure object models for storage are consistent with a common basis for characterizing the underlying performance attributes of grid connected storage systems.

7.6 How:

---

[2] Note – DOE uses the term DER, IEEE 1547 refers to DR, but that is confusing due to the increased use of demand response.

The key stakeholder groups are: IEEE SCC21 P1547 WGs, UL, SAE and NEC-NFPA70 for PEV storage issues, IEC TC8, and IEC TC57 WG17 for semantic object models.

7.6.1 Task Descriptions

Develop along with project team.

7.6.2 Deliverables

Develop along with project team.

7.7 Who:

Project Team			
NIST Lead: Al Hefner			
EPRI Leads: Frances Cleveland, Mark McGranaghan			
SDO Leads:			
Dick DeBlasio	NREL	IEEE SCC21	Dick.DeBlasio@nrel.gov
Jean Goulet	IREQ	IEC TC57 WG17	goulet.jean@ireq.ca
Other SDOs and Key Groups:			
Tom Basso	NREL	IEEE	Thomas.Basso@NREL.gov
Joe Koepfinger	Consultant	IEEE	joseph_l_koepfinger@msn.com
Leo Casey	Satcon		Leo.Casey@satcon.com
Bob Reedy	FSEC		reedy@fsec.ucf.edu
Le Tang	ABB		le.tang@us.abb.com
James P. Lyons	Novus Energy		jim.lyons@novusep.com
Andy Furman	OSCRE	OSCRE	Andy.Fuhrman@oscre.org
George D. Bellino	GMATC	SAE	george.bellino@gm.com
Dave Nichols	IEEE	IEEE	david.nichols@ieee.org
Tom Rizy	ORNL		rizydt@ornl.gov
Charlie Vartanian	A123Systems,		cvartanian@a123systems.com
Ward Bower	Sandia,	NEC	wibower@sandia.gov
Peter Smeallie	BuildingSmart		smeallie@verizon.net
Timothy Zgonena	UL	UL	Timothy.P.Zgonena@us.ul.com
Users Group Lead:			
Technical Team: ...			

7.8 When:

The goal of the August 3-4 workshop will be to develop a roadmap, a timeline for the roadmap, and action items for key participants.

Task Description	**Completion Date**
Task 1: Develop (possibly within IEEE SCC21 or IEEE P2030) Use Case scenarios and business processes to define the different requirements for electrical interconnections, focusing on scenarios	December 2009

Task Description	**Completion Date**
involving high penetration of DER, potential microgrid formation, aggregated DER/Storage/PEVs in neighborhoods with no clearly defined Point of Common Coupling (PCC), grid operations with significant market involvement of aggregated DER systems, and adequate responses to frequency and voltage anomalies to avoid power system instabilities. These Use Cases will be recommended to be used as inputs for additions and modifications of the IEEE 1547 series of standard and the IEC object modeling standards. The Use Cases should look at • Systems of different sizes kw-100s MW • Connection at D, t or at the customer • Grid connected, islanded and consumer stand alone operation • Inverter and traditional based generation • Aggregation issues • ES as a load	
Task 2: Complete the development of IEEE 1547-4 for island applications and 1547-6 for distribution secondary grid networks. – ballot ready drafts.	Spring 2010
Task 3: Complete proposal to develop a new SCC21 standard project (e.g., 1547.8 including subtask elements/parts described in tasks 3a through 3e below, i.e., 1547.8.1 through 1547.8.5). The P1547.8 will address the definition of unified methods for interconnection and further address end-use operational support, applications and regulatory technical needs for generic generation systems, storage systems, and hybrid generation-storage systems. This would define dispatchable service types that might be of value for the utility or local EMS; define generic generation/storage system type specification including power capacity for generation, power and energy capacities for storage, grid services capabilities and types of intermittency; and define methods for specifying generic generation/storage status parameters including probabilistic representation of availability (capacity versus time within percent certainty), and cost of providing each service type including impact of equipment wear-out (e.g., impact of battery cycling). Promote accelerated timeframe development and initiate the project concurrent with IEEE approval.	Spring 2010
Task 3a: Complete the proposal to develop new SCC21 standard project (e.g., 1547.8.1 for example) to represent methods for interconnection of generic generation/storage systems (developed in Task 3) as itemized individual requirements for interconnection of specific system types in specific domains (e.g., VAR support specification of storage system within distribution domain) so that they can be referenced as individual requirements by FERC etc.). Promote accelerated timeframe development and initiate the project concurrent with IEEE approval.	Spring 2010

Task Description	Completion Date
Task 3b: Complete the proposal to develop new SCC21 project for itemized requirements for interconnection of STORAGE energy systems (without net generation capability) in specific domains so that they can be referenced as individual requirements by FERC etc. (itemize as 1547.8.2 for example). Promote accelerated timeframe development and initiate the project concurrent with IEEE approval	Spring 2010
Task 3c: Complete the proposal to develop new SCC21 project for itemized requirements for interconnection of PHOTOVOLTAIC energy systems with storage in specific domains so that they can be referenced as individual requirements by FERC etc. (itemize as 1547.8.3 for example). Promote accelerated timeframe development and initiate the project concurrent with IEEE approval	Spring 2010
Task 3d: Complete the proposal to develop itemized requirements for interconnection of WIND energy systems with storage in specific domains so that they can be referenced as individual requirements by FERC etc. (itemize as 1547.8.4 for example). Promote accelerated timeframe development and initiate the project concurrent with IEEE approval	Spring 2010
Task 3e: Complete the proposal to develop new SCC21 project for itemized requirements for interconnection of PHEV energy systems with storage in specific domains so that they can be referenced as individual requirements by FERC etc. (itemize as 1547.8.5 for example). Promote accelerated timeframe development and initiate project concurrent with IEEE approval.	Spring 2010
Task 4: Continue development of object model standards for distributed energy resources (e.g., IEC TC57 WG17 to enhance IEC61850-7-420 and IEC TC57 WG14 to develop DER models in IEC 61968 CIM), including object models for managing generic storage/generation systems. Object models developed under this task should be coordinated with IEEE Std P1679 - Recommended Practice for the Characterization and Evaluation of Emerging Battery Technologies in Stationary Applications.	Developed with continuous information exchange from Task 3. Each subtask completed within 3 months after the completion of the respective subtasks of Task 3. A TC57 WG17 CDV (Committee draft for vote) may meet this schedule.
Task 5: UL, NEC-NFPA70UL and SAE will develop codes and test methods to ensure safe and reliable implementation of Tasks 3 within	Developed with continuous

Task Description	Completion Date
the residential-consumer, and commercial building-consumer domains.	information exchange from Task 3. Each subtask would be completed within 6 months after the completion of the respective subtasks of Task 3.

8 What: CIM for Distribution Grid Management (6.2.6, 11.6.1)

8.1 Abstract:

This work defines strategies for integrating standards for distribution operations across different environments. Strategies call for defining key applications and evaluating the available standards for meeting the applications. Field equipment can supply the raw data for objects and measured parameters used across the enterprise.

8.2 Description:

This work develops an approach for integrating the application level communications from three standards. The IEC 61968 and Multispeak provide the structure and semantics for integrating a variety of back office applications. The IEC 61850 standard provides a basis for field equipment communications and provides semantics for communications with field equipment including both real time operations as well as non-operational data such as condition monitoring. Integrating these standards provides a basis for powerful integration for both real time operations as well as support for a variety of back office applications.

8.3 Objectives:

- Develop strategies to integrate IEC 61968, Multispeak and IEC 61850 for Smart Grid applications
- Evaluate the contents of each standards for a Best fit to meet the requirements of key applications that span the environments of these standards
- Agree on an approach to integrate domain knowledge represented in each standard

8.4 Why:

This work can enable the effective integration of field equipment data and information with that used for enterprise back office systems. This integration can enable many new applications that may not be possible by just operating in one environment.

8.5 Where:

The integration of these standards would take place across the enterprise where field equipment operations need to integrate with back office systems. Several interfaces will be involved through the development of the standards that are targeted for their environment.

8.6 How:

The task will identify and/or develop key requirements and use cases that define the type of integration needed across these standards. This work is followed by analysis of the standards developed to date as well as work items in progress. This analysis should be used to identify synergy with the other standards and propose to build either a mapping or new extensions to existing standards. Preferable pathways are to minimize translation and reach agreement on shared or similar terms.

8.6.1 Task Descriptions

Develop along with project team.

8.6.2 Deliverables

Develop along with project team.

8.7 Who:

Project Team
NIST Lead: Jerry Fitzpatrick
EPRI Lead: Grant Gilchrist, Frances Cleveland
SDO Leads: Greg Robinson, Gary McNaughton, Frank Goodman/Jean Goulet
SDOs: IEC TC57 WG14: Greg Robinson Xtensible Solutions IEC TC 57 WG 17: Frank Goodman SDG&E IEC TC57 WG19: Paul Skare Siemens Paul.Skare@siemens.com IEC TC57 WG15: Frances Cleveland, Xanthus fcleve@xanthus-consulting.com IEEE Power Systems Relay Communications Committee: Alex Apostolov
Users Groups: UCAIug: Mark Adamiak USB: Forrest Small
Technical Team:

8.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

9 What: Standard DR Signals (6.2.1)

9.1 Abstract:

Develop or adopt standard DR and DER signals – NIST shall organize a meeting with IEC TC57, OASIS, NAESB, and AMI-ENT to specify a process for developing a common semantic model for standard DR signals. The effort shall ensure DR signal standards support load control, supply control, and environmental signals.

9.2 Description:

The semantics of Demand Response are generally well understood, but the information that is conveyed varies. Signals range from price, optionally with time of effectiveness, grid integrity, to proposed environmental signals (e.g. air quality).

Defining consistent signals for Demand Response will make the information conveyed more consistent as a signal flows from grid management through aggregators to customers and within premises networks. Some of the standards define business processes, while others define XML or other data models with a variety of delivery mechanisms.

The semantics for Distributed Energy Resources should fit into the same sort of signaling framework. This group will also develop a plan for DER signal definition.

9.3 Objectives:

Define a framework and common terminology for:

- Price communication,
- Grid safety or integrity signals,
- DER support, and
- Other signals and/or an extensibility mechanism.

9.4 Why:

Demand Response has evolved over the years; previous mechanisms included phone calls, pagers, and other messaging to plant managers; current mechanisms support varying levels of automation.

As technologies, such as Open Automated Demand Response, allow rapid and un-attended automation of curtailment based on price or grid integrity, consistent signals across the entire Demand Response signaling and validation chain have raised in importance. Consistent signals will allow further automation of the Demand Response chain, and improve the responsiveness as well as the value to all stakeholders.

Renewable and other intermittent resource integration increases the need for balancing reserve, spinning reserve, and other techniques for successful integration to take advantage of lower operating cost for renewables. However, the responsiveness of the entire power generation and delivery system needs to improve in correspondence with the extent and degree of intermittency.

Distributed Energy Resource integration raises interoperation issues related to distribution automation, signals and information exchanges, and profiles; some of these (e.g. storage) are being addressed specifically in other action plans.

Markets, Operations, Distribution, distribution-related capital costs, and the Customer domain are the primary areas affected, though all are affected to some extent.

9.5 Where:

This is primarily levels 4 (Semantic Understanding), 5 (Business Context) and 6 (Business Procedures) of the GWAC stack, though it involves most of the cross-cutting issues.

Security and privacy can be composed in; the focus of this activity is consistent semantics that work with business processes of today and those we cannot specify that may develop in the future.

9.6 How:

A broad range of stakeholders need to be involved, broadly from the distribution management and markets area, building automation, industrial automation, home automation and energy management, and vehicles.[3]

There are several formalized or standardized specifications in these areas that need to share common semantics where they overlap; we should aim at a high level rather than details that may not be relevant in cross-domain interactions and interoperation.

Since there are a number of existing bodies of work, a survey of relevant efforts and their overlap and gaps relative to DR/DER signaling would seem to be a good starting point.

Other issues:

- Should requirements analysis—what information needs to be exchanged for which use cases—be done as part of this process?
- When do we need a high-level light interface, versus deep integration?
- What are differences between ISO/RTO Demand Response and Distributed Energy Resource integration and the local utility counterparts?
- Can we incorporate ancillary (fast-DR) services in the signaling approach? Or is fast DR only applicable to deep integration that will support the short time scales?
- Measurement and verification need to be addressed for both curtailment and DER. How should we address in this process?

9.6.1 Task Descriptions

Develop along with project team.

9.6.2 Deliverables

Develop along with project team.

---

[3] Vehicles may interact with DR and DER signals primarily through their charging stations, but the characteristics will likely need to be expressed in profiles that include decision information for the vehicle owner, e.g., amortized cost of battery use to sell energy to the grid or a microgrid.

9.7 Who:

	Project Team	
Role	**Organization**	**Name**
NIST Lead	David Holmberg	David Holmberg David.Holmberg@NIST.gov
EPRI Support	Cox Software Architects	William Cox wtcox@CoxSoftwareArchitects.com
	TC9 Inc	Toby Considine Toby.Considine@gmail.com
SDOs	ASHRAE	Sharon Dingus sdingus@trane.com
	ASHRAE	Steven Bushby steven.bushby@nist.gov
	IEC TC57 WG14 Distr Mgt	Greg Robinson grobinson@xtensible.net
	IEC TC57 WG16 Dereg Mkt C	Jean Goulet goulet.jean@ireq.ca
	ISO/IEC JTC 1 WG15	Tim Schoeckle schoechl@colorado.edu
	LonMark	Ron Bernstein ron@lonmark.org
	NAESB	Rae McQuade rmcquade@naesb.org
	NAESB	Jonathan Booe jbooe@naesb.org
	OASIS	James Bryce Clark jamie.clark@oasis-open.org
	OASIS WS-Device Profile	Toby Nixon Toby.Nixon@microsoft.com
	SAE	Rich Scholer rscholer@ford.com
Other Stakeholders	Users Group Lead	Wayne Longcore wrlongcore@cmsenergy.com
	UCAIug Smart Grid SC	Jeff Gooding Jeff.Gooding@SCE.COM
	UCAIug AMI-ENT TF	Joe Zhou jzhou@xtensible.net
	UCAIug OpenADR TF	Albert Chiu akc6@pge.com
	AHAM	Matt Williams mwilliams@aham.org
	AHAM	Charles Smith CHARLESR.SMITH@ge.com
	EPRI (appliances)	Gale Horst ghorst@epri.com
Additional Invitees	ISO/RTU+GWAC	Robert Burke rburke@iso-ne.com
	GWAC	Ron Ambrosio rfa@us.ibm.com
	GWAC	Lynne Kiesling lynne@knowledgeproblem.com
	LBNL OpenADR	Mary Ann Piette MAPiette@lbl.gov
	LBNL OpenADR	Girish Ghatikar GGhatikar@lbl.gov
	LBNL OpenADR	Ed Koch ed@akuacom.com
	Microsoft Energy	Larry Cochrane larrcoch@microsoft.com
	ZigBee/HomePlug SEP2	Robby Simpson robby.simpson@ge.com
	Other Experts	Ed Cazalet ed@cazalet.com
	I2G, GWAC	Dave Hardin david.hardin@ips.invensys.com
	FIATECH	Robert Wible wible@fiatech.org
	CABA	David Katz dkatz@sustainable.on.ca
	CABA (alt)	Ron Zimmer zimmer@caba.org (alt)
	Building Smart	Deke Smith deke@dksic.net
	Home Automation	Kenneth Wacks kenn@alum.mit.edu
	Emergency Mgt	Michelle Raymond michellearaymond@gmail.com
	ASHRAE BACnet	Jim Lee Jim.Lee@cimetrics.com

9.8 When:

Task Description	Completion Date
Task 1:	TBD
Task 2:	TBD
…	

10 What: Standard Energy Usage Information (11.1.1)

10.1 Abstract:

Customers, through their energy management systems, will benefit from energy usage information that enables them to make better decisions about energy use. In particular, consumers could make better decisions about emerging demand response (DR) incentives, including whether to change DR plans, or to take specific actions now in anticipation of future DR events. Unfortunately, today there is limited provision to share meter information directly with the consumer. Additionally, there are no provisions that would make it possible forconsumers will to delegate access to their meter information to third parties for value-added services. Distributed energy resources (DER), including energy storage, make timely information more important; bidirectional energy flows will make it critical. Energy sales and purchases, including the non-price attributes of that energy, are the basic components of transactional aspects of the Smart Grid. A common, shared understanding of each transaction is essential to realizing he anticipated benefits of the Smart Grid. This information is fundamental to innovation in the use and management of energy in the industrial, commercial building, and residential sectors. This PAP addresses the definition and standardization of this information.

10.2 Description:

Shared responsibility for balancing energy production and consumption requires shared access to information about energy markets and actual use. Price is a common abstraction for market conditions, including abundance, scarcity, and quality. Energy qualities include reliability, power quality, and source (hydro-electric, wind, solar, coal …).

Sharing live information with the energy consumer makes energy use real in a way that after-the-fact billing never can. Customer-focused energy management is hindered by limited access to information and this, in turn, by the lack of information standards. National information standards will create worthwhile markets and automation of energy -use decisions. This automation will be a platform for innovation in energy use.

In the near future, energy source may be as important as energy price in influencing consumption decisions in some scenarios. Consumers may wish to make decisions based upon the energy source or to qualify for carbon credits. As these markets develop, the variability of product availability will increase, the complexity of decision-making will increase, and the value of products that personalize, visualize, and automate responsive energy use will grow.

The official recorder of market transactions is the meter. The meter is also the edge of the distribution management control system[4]. Information about consumption of energy originates at the meter, but is also available at other points in the energy delivery system, such as the utility or aggregating service provider. Well defined information models are essential to establish the basis for services and behaviors based on the content of these models.

It is anticipated that initial uses of this information model will come from the utility service provider via the worldwide web, or public Internet, and other approaches to accessing information from legacy meters. However, as the Smart Grid develops, new opportunities will

---

[4] All communications with the meter must be limited or constrained to preclude any inappropriate interactions or effects on the underlying systems.

leverage real-time information on energy use and energy pricing. A robust model of such information should be invariant to the mechanism and timing of acquisition. Hence, this plan envisions development of such a flexible model as can be exposed via the communications standards in place in the home, business, distribution system, and enterprise.

This effort will overlap with and support information standards for load curtailment, load shaping, and energy market operations.

10.3 Objectives:

- Develop a summary of information needs for various means of customer information access about metering and billing.
- Develop short term plans for near-term customer access to usage data based upon today's installed meters.
- Develop composite information model that can be easily transformed without loss for transport via standards in OASIS, IEC61970/61968, IEC61850, ANSI C12.19/22, AHRAE 135, and ZigBee.
- Development and implement a plan to expedite harmonized standards development and adoption within the associated standards bodies.

10.4 Why:

Attempts at encouraging consumers of electricity to conserve are greatly assisted by providing feedback as to actual energy use. Energy consumers will more accurately respond to curtailment signals if they can track actual energy use while testing scenarios in advance. Consumers may need to observe actual usage at intervals shorter than are maintained within provider billing systems. Premises-based distributed energy resources will require transparent common metrics on both sides of the meter.

Today, curtailment and peak prices are computed and presented a limited number of times each year. As the proportion of alternative energy sources on the grid rises, and as more energy comes from intermittent sources, the desirable frequency and scale of these events will increase. New electric loads, such as electric vehicles, will increase the need for and benefits of coordinating electricity use and introduce new load characteristics and timing.

Shared access to live energy transactions, both usage and price, is an enabler of many aspects of the Smart Grid. A common information exchange model for usage, price, and other energy information would enable consumers, building-based systems, and third parties to collaborate with energy suppliers.

The Smart Grid anticipates new business models that will increase the importance of sharing energy usage information. Premises-based, distributed energy resources may change the net flow of energy from moment to moment. Retail resale of energy may be part of future green leases and plug-in electric vehicle (PEV) support.

There are many competing standards efforts already under way in this area. ANSI C12.19 (2008) has a new "decade"[5] that supports pricing information at the meter. The OASIS Energy

---

[5] ANSI C12.19 groups information available from the meter into "decades" of tables of detail on an individual subject area such as measurements, load profile, pricing, etc…

Interoperability TC looks to build upon the California Energy Commission (CEC) OpenADR specification to create data and communications models for the interoperable exchange of dynamic price, reliability, and emergency signals as well as informationon on market participation and load predictability and generation. IEC 61850-7-420 has pricing and consumption models for use in distributed energy resources (DER). Without coordination, there will be multiple dissimilar standards and limited interoperability. Incompatible data models can result in information loss when translated or mapped between standard representations. Additionally, duplicative complexity will add to costs borne by consumers and providers of energy management services. Limited interoperability will hinder the development of markets impede innovation.

10.5 Where:

The energy transaction is the informational hand-off within and between adjacent domains in the Smart Grid, just as the meter is the hand-off within and between domains. Shared energy-transaction information is essential to interactions between:

- Distribution and the industrial, commercial, and home premise;
- The service provider and industrial, commercial, and home premises;
- Distributed energy resources and all other domains; and
- Plug-in electric vehicles.

10.6 How:

10.6.1 Task Descriptions

Develop along with project team.

10.6.2 Deliverables

Develop along with project team.

10.7 Who:

Project Team Leads
NIST Leads: David Wollman david.wollman@nist.gov Tom Nelson thomas.nelson@nist.gov
EPRI Leads: Marty Burns burnsmarty@aol.com Toby Considine Toby.Considine@gmail.com
Action Plan SDO/User Groups Leads: OASIS: Laurent Liscia laurent.liscia@oasis-open.org IEC TC57 WG14: Greg Robinson Xtensible Solutions grobinson@xtensible.net IEC TC57 WG15: Frances Cleveland, Xanthus fcleve@xanthus-consulting.com ANSI C12.19: Paul Orr, NEMA pau_orr@nema.org ZigBee/HomePlug Alliance – SEP Michael Stuber, ITRON michael.stuber@itron.com ASHRAE BACnet. Dave Robin, Automated Logic drobin@automatedlogic.com UCAIug, OpenADE Committee, Dave Mollerstuen dmollerstuen@tendrilinc.com
Stakeholder Leads

OSTP Representatives:
Nick Wellkamp Nicholas_A._Wellkamp@ostp.eop.gov
Aneesh Chopra Aneesh_Chopra@ostp.eop.gov
Kevin Hurst Kevin_D._Hurst@ostp.eop.gov

Other SDO Representatives:
Craig Gemill, Honeywell/Tridium craig.gemmill@tridium.com
ODVA: Katherine Voss, KVoss@odva.org
IEEE SCC21 P2030: Dick DeBlasio dick_deblasio@nrel.gov
OSCRE Andy Furhman , Andy.Fuhrman@oscre.org (Commercial Real Estate)
Kantara Initiative Brett McDowell brett@kantarainitiative.org

Users Groups:
BOMA: Henry Chamberlain hchamberlain@boma.org
UCAIug Paul De Martini, SCE paul.demartini@sce.com
Service Providers:
Larry Cochrane, Microsoft L.Cochrane@microsoft.com
Michael Jon Miller Michaeljon.Miller@microsoft.com
Todd Graves tgraves@microsoft.com
Charles Spirakis css@google.com
Harry Wingo, Google hwingo@google.com
Control4: Paul Nagel (CEO) pnagel@control4.com
Utilities & Energy Services:
AEP: George Belovek gbjelovuk@aep.com
PG&E: Chris Knudsen CxKq@pge.com
Reliant: Brent Hodges bhodges@reliant.com
Customer Information Systems (CIS):
Oracle: Bradley Williams Bradley.Williams@oracle.com
SAP: Klaus Heimann heimann.k@t-online.de
Alan Johnston MIMOSA (Industrial) atjohn@comcast.net

10.8 When:

Task Description	Completion Date
Task 1:	Tbd
Task 2:	Tbd
…	

11 What: Common Object Models for Electric Transportation (6.2.4)

11.1 Abstract:

The introduction of mobile plug-in electric vehicles (PEVs) to the grid creates some interoperability challenges around exchanging price, demand response (DR), and settlement information. The impact of PEVs on the grid is expected to be significant, and the ability to control charging profiles through price or direct control, the possibility of allowing customers to sell PEV electricity back into the grid, and the complexity of providing fair settlement to everyone in the value chain when vehicles charge away from their home base require common object models to manage all these aspects of mobile bi-directional charging devices.

11.2 Description:

As PEVs move across geographical areas, a common interoperable model for price, DR events, energy characteristics for dynamic pricing across markets, signals for curtailment, and distributed generation resources will allow information supporting these uses to flow through the Smart Grid. In addition, a system is needed to determine how costs and payments for PEVs are settled.

Several critical points are listed below:

1) PEV mobile loads will stress the existing distribution infrastructure. By using PEVs as electric storage during high demand periods, some of this stress can be offset. Models will resemble the existing electric storage models with the addition of parameters related to the mobile nature of PEVs. Similar approaches to those used for non-mobile loads point to two related gaps: a common model for DR signals (grid safety and pricing for demand shaping), and a common model for price, energy characteristics, and time for use. There are alternatives, including very specific demand control mechanisms, but the benefits of applying economic demand shaping appear to be much greater, particularly given the growth of DR use anticipated in other customer areas.

2) PEVs can act as both a load and power source. The impact of PEVs on planning and managing the distribution system and the potential impact of mass numbers of PEVs on system protection must be considered.

3) Models for settlement of PEV energy costs and payments are developing slowly, and there are technical and policy/regulatory barriers. Some proposals support billing the PEV owner’s home utility. Others suggest a simpler model similar to current gasoline stations. Still others suggest a mixture of prepaid and billed services, similar to cellular phone payment models.

11.3 Objectives:

- SAE is developing the PEV information exchange requirements, but will look to other SDOs to develop the object models to reflect these requirements. Therefore, IEC 61850-7-420 for Distributed Energy Resource (DER) equipment should be extended to include PEV object models, as well as other related object models. IEC 61850-7-

420 for DER currently addresses photovoltaic systems, fuel cells, diesel generators, batteries, and combined heat and power (CHP), with wind covered by IEC 61400-25.

- IEC 61968 (Distribution CIM) needs DER and PEV information models, but should be harmonized with the existing DER object models in IEC 61850-7-420, as well as all on-going DER 61850 development. such as with PEV object models. In addition, IEC 61850-7-420 has architectural issues to be addressed and needs to develop System Configuration Language (SCL) specifications for PEVs.
- Distribution Management Systems (DMS) must be able to communicate with PEVs to influence charging profiles and discharging incentives through price signals or direct control signals.
- The appropriate mechanism for PEV settlement must be determined. Is it similar to the clearinghouse concept used by banks and media, where a third party batches orders each evening and divides the transaction values across all the parties involved? Is the transaction tied to the PEV owner or the vehicle? Or, is the traditional gas station model using credit cards a model to be emulated?
- Regulators should be asked to review the current regulatory electricity resale rules. Current regulations do not permit the resale of electricity as it is received in real-time by a customer, but if stored electric energy could be resold later. This would open a new market. In addition, current regulations require that all accounting and cross-utility settlement issues would have to be managed by utilities or energy service providers, thus posing an enormous burden on them to manage these new complex accounting and settlement processes. On the other hand, if regulations were to change, the accounting model could change dramatically, and normal retail methods could be used or outsourced to credit card companies and other retail accounting providers.
- Similar to the IEEE 1547 electrical interconnection standards for DER, there may be a need for electrical interconnection standards for chargers and discharging, as well as a weights and standards certification and seal for charging/discharging.
- PEVs may require sub-meters if tariffs are developed that treat them separately from the rest of customer loads. If utilities do not provide these sub-meters, there may be a need for a submetering standard for non-utilities. This would involve policies, regulations, and testing and a decision whether existing standards for metering and retrieving metered data are adequate for PEVs.

11.4 Why:

A goal of the Smart Grid is to promote PEV manufacturing and use to reduce the degree of dependence on foreign oil. In order for this to occur at the levels being discussed and support DR functions, PEVs need to interoperate with the grid's distribution system and have a mechanism for allowing mobile consumers to pay the appropriate electricity vendors for energy.

If common object model development is not accomplished in short order, the speed of PEV charging infrastructure build-out (and therefore PEV adoption) will be slowed. The ability to drive and charge/discharge across utility boundaries will be complicated, if not impossible, and the ability to incorporate PEVs into the overall distribution management strategy will be impeded.

This affects a broad number of stakeholder groups, including consumers, utilities, regulators, and environmental NGOs,.

If the speed of PEV adoption is stymied, goals for PEV use to reduce foreign oil dependence and greenhouse gas emission may not be met.

If mass numbers of PEVs enter the market due to government pressure on American automakers without proper standards in place, it is hard to predict what effect it will have on the management of distribution activities. At best, it will be difficult to manage charging (and possibly discharging) profiles. At the worst, it could negatively impact grid reliability and consumer prices for electricity. Also, the ability for consumers to purchase electricity for a vehicle when they are outside their utility's jurisdiction could be quite problematic, discouraging consumers from purchasing PEVs and abetting theft of elecric power.

11.5 Where:

System interactions:

- Demand Response
- Operations
- Markets

11.6 How:

11.6.1 Task Descriptions

Develop along with project team.

11.6.2 Deliverables

Develop along with project team.

11.7 Who:

Project Team
Project Team Leads
NIST Leads: Eric Simmon NIST eric.simmon@nist.gov
EPRI Leads: Stuart McCafferty EnerNex stuart@enernex.com Frances Cleveland Xanthus fcleve@ix.netcom.com
Action Plan SDO Leads: SAE 2293: Rich Scholer Ford rscholer@ford.com Arindam Maitra EPRI AMaitra@epri.com IEC TC57 WG14: Greg Robinson Xtensible Solutions grobinson@xtensible.net IEC TC57 WG15/ZigBee/HomePlug Alliance: Robby Simpson GE robby.simpson@ge.com IEC TC57 WG19: Paul Skare Siemens Paul.Skare@siemens.com IEEE 2030: Stefano Galli, NEMA pau_orr@nema.org ASHRAE BACnet. Dave Robin, Automated Logic drobin@automatedlogic.com
Stakeholder Leads

Other SDO Representatives:
Users Groups: UCAIug Wayne Longcore, Consumers Energy wrlongcore@cmsenergy.com Service Providers: Utilities & Energy Services:

11.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

12 What: IEC 61850 Objects/DNP3 Mapping (6.2.2)

12.1 Abstract:

DNP3 is the de facto communication protocol used at the distribution and transmission level. However, DNP3 does not possess all of the desirable attributes for use in the Smart Grid. A means must be found to enable transport of Smart Grid management functions over these legacy DNP3 networks.

12.2 Description:

The DNP3 protocol was designed for low-bandwidth SCADA operations. Data acquisition consists of anonymous instances from three object classes: binary inputs, analog inputs, and counters. Supervisory control consists of commands to instances of the classes of binary points and analog points. Although this protocol allows any type of data to be transported between any two points, the semantic content of the messages depends upon lists of tables, which are not machine readable.

The desire is to ensure that seamless transport of situational semantics can flow between devices, even when the communication is constrained by the DNP3 protocol.

Mapping of objects in each direction presents different challenges.

12.3 Objectives:

- Agree upon a consistent algorithm to map *any* IEC 61850 object to a corresponding DNP3 object. Annex E of IEC 61400-25-4 presents one approach to this mapping.
- Provide a method to map DNP3 objects onto IEC 61850 objects. Because DNP3 uses less-specific semantics than IEC 61850, this is only an approximate mapping. The DNP3 specification (Volume 8 clause 8.4 and its Appendix 1 clause 2) presents the approach recommended by the DNP3 Technical Committee, which uses XML to perform this mapping.

12.4 Why:

Although DNP3 is the dominant SCADA communication protocol in the USA, it lacks some of the features envisioned for the Smart Grid. A mapping between 61850 and DNP3 will allow presently communicated SCADA information to be used in new ways, while also providing the ability to create new applications while using the existing DNP3 infrastructure.

This will enable the addition of new control and monitoring functions to be used with legacy DNP3 equipment while still providing a solid path to a full IEC 61850-based communications system in the future. Furthermore, the integration issues between the two types of systems will be minimized by a consistent mapping solution.

If a mapping between these two protocols is not accomplished, then existing DNP3 systems will need to be modified in an ad-hoc fashion to integrate each new control and monitoring function. If the legacy DNP3 system is ever replaced with a IEC 61850 system, then the entire communication network would need to be replaced at the same time. This would cause enormous additional expense and disruption to any existing applications.

The impact of the mapping will affect all users of data presently sourced by DNP3 devices. System planners and grid operations management would be among the stakeholders most affected.

12.5 Where:

Transmission and distribution domains at the application layer.

12.6 How:

12.6.1 Task Descriptions

Develop along with project team.

12.6.2 Deliverables

Develop along with project team.

12.7 Who:

Project Team Leads
NIST Lead: Jerry FitzPatrick gerald.fitzpatrick@nist.gov Tom Nelson thomas.nelson@nist.gov
EPRI Lead: Bruce Muschlitz bruce@EnerNex.com Christoph Brunner christoph.brunner@utinnovation.com
Action Plan SDO Leads: DNP Technical Committee: Andrew West andrew.west@ieee.org IEC TC57 WG10: Christoph Brunner christoph.brunner@utinnovation.com UCAIug Technical Committee: Kay Clinard Clinardkay@aol.com
Stakeholder Leads
Other SDO Representatives: DNP Technical Committee: Barry Shephard barry.shephard@grontmij.co.uk UCAIug Testing Committee: Bruce Muschlitz bruce@EnerNex.com IEC TC57 WG10 Barry Shephard barry.shephard@grontmij.co.uk IEC TC57 WG03: Wolfgang Brodt wolfgang.brodt@siemens.com
Users Group Leaders: DNP User Group: Jim Coats jcoats@trianglemicroworks.com UCA International Users Group: Kay Clinard Clinardkay@aol.com

12.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

13 What: Time Synchronization, IEC 61850 Objects/IEEE C37.118 Harmonization (6.1.2, 6.2.2)

13.1 Abstract:

IEC 61850 has been substantially developed for substations but is seen as a key standard for all field equipment operating under both real-time and non-real time applications. It shall be possible in the future to use IEC 61850 as well to transmit Phasor Measurement Unit data and information according to IEEE C37.118 standard.

Common time synchronization will be a key for many Smart Grid applications. Guidelines on how to achieve that synchronization and addressing different issues related to that synchronization are required. The IEEE 1588 standard will be a key element to achieve that synchronization.

13.2 Description:

Two Standards are related to communications of phasor measurement unit (PMU) data and information. IEEE C37.118 was published in 2005 for PMUs. IEC 61850 has been substantially developed for substations but is seen as a key standard for all field equipment operating under both real-time and non-real time applications. The use of IEC 61850 for wide-area communication is already discussed in IEC 61850-90-1 (Draft technical report) in the context of communication between substations; it is only a small step to use it as well for transmission of PMU data. The models for PMU data need to be defined in IEC 61850. This work item seeks to assist and accelerate the integration of standards that can impact phasor measurement and applications depending on PMU-based data and information.

With IEEE 1588, a standard is available to achieve highly accurate synchronization over a communication network. Several applications related to Smart Grid require time synchronization. Several aspects need to be considered like loss of synchronization, dealing with synchronization islands and resynchronization. Calendar models are required.

13.3 Objectives:

- Develop contributing technical work to integrate IEEE C37.118 and IEC 61850 under a Dual Logo Standard.
- Participate with SDO working groups to work out technical issues related to the standard integration.
- Support demonstration activities.
- Develop detailed requirements from Smart Grid applications using common time synchronization and time management.
- Develop, in cooperation with SDO working groups, guidelines for application and role-based time synchronization.
- Develop contributing technical work to prepare standard profiles for IEEE 1588.

13.4 Why:

Integrating IEEE C37.118 with IEC 61850 will help to remove overlaps between the standards, which may impede development of interoperable equipment and systems.

IEEE C37.118 is intended to support protection-related applications. IEC 61850 is suitable for such applications that require higher publishing rates.

A standards-based approach for time synchronization that addresses the requirements from all applications will support interoperability and facilitate implementation of new Smart Grid applications.

13.5 Where:

IEC 61850 supporting PMU data based on C37.118 will be used between devices exchanging phasor measurement data. The interfaces are within PMU's, relays, master stations, and other equipment involved in phasor measurement monitoring and/or applications based on PMU measurements.

Time synchronization is required across all applications for a Smart Grid.

13.6 How:

For the integration of PMU data based on IEEE C37.118 into IEC 61850, a new work item has already been issued as a joint work item for IEEE and IEC. The work has been circulated within IEC TC57. It is assumed that within IEC, a task force as part of working group 10 will be created to support that work from the IEC side. In IEEE, the PSRC H11 WG is responsible for C37.118. These will be the key SDOs for that part of the work.

From a procedural viewpoint, the integration of PMU data into IEC 61850 cannot be considered as a independent standard. Integration will affect several parts of the existing IEC 61850 standard. Therefore, it is recommended to develop in a first step a technical report (similar to IEC 61850-90-1) that addresses all the issued related to the problem.

While the final responsibility of the work will be in the joint IEEE/IEC task force, this work can contribute technical work to the SDO, can interact with the stakeholders like NASPI, and can support demonstration activities.

For the time synchronization, the IEEE PSRC WG H7 is already working on developing a profile for accurate time synchronization for power system applications. This work is supported by IEC TC57 WG10, so no harmonization is required here. The current activities in the WG are driven on one side by the requirements from PMU and on the other sides by the requirements fro an accurate synchronization of instrument transformers in a substation that are transmitting sampled values as stream of data towards protection and control applications.

This work shall interact with the IEEE working group by developing the requirements for the different applications of Smart Grid, by contributing technical work and by supporting demonstration activities.

13.6.1 Task Descriptions

Develop along with project team.

13.6.2 Deliverables

Develop along with project team.

13.7 Who:

Project Team
NIST Lead: Jerry Fitzpatrick
EPRI Lead: Joe Hughes jhughes@epri.com
SDO Lead: Christoph Brunner Convenor IEC TC 57 WG 10
Other SDOs: IEEE PSRC H11 Committee Chair Ken Martin kemartin8421@comcast.net. IEEE PSRC H7 Committee Chair Bill Dickerson IEEE Power Systems Relay Committee, Communications Subcommittee: Veselin Skendzic IEC TC57 WG19: Paul Skare Paul.Skare@siemens.com IEC TC57 WG15: Frances Cleveland, Xanthus fcleve@xanthus-consulting.com
Users Groups: UCAIug: Mark Adamiak
Technical Team: NASPI, Performance and Standards Committee, Vahid Madani, VxM6@pge.com NASPI, Alison Silverstein Alex Apostolov (Member IEC TC57, WG10, 19, IEEE PSRC H7) Galina Antinova (Co-Chair IEEE PSRC H7)

13.8 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	

14 What: Transmission and Distribution Power Systems Model Mapping (11.2.1)

14.1 Abstract:

This work defines strategies for integrating standards across different environments to support different real-time and back-office applications. Strategies call for defining key applications and evaluating the available standards for meeting the requirements of such applications. Modeling of the electric power system, multifunctional IEDs, and definition of standard methods for reporting events and exchanging relay settings will meet the requirements for improvements of the efficiency of many protection, control, engineering, commissioning and analysis tasks. Field equipment can supply the raw data for objects and measured parameters used across the enterprise based on the standard models and file formats defined.

14.2 Description:

Advanced protection, automation, and control applications will benefit from a utility-wide communication infrastructure. The information requiorements of these Smart Grid applications must be identified and standardized to the level required to achieve interoperability. Use cases describing the application are the basis for this. Information needs then must be mapped to the existing transmission and distribution power system models. The existing models need to be extended where required.

This work develops an approach for integrating the application-level communications from several standards. The IEC 61850 standard provides a basis for field equipment communications and provides semantics for communications with field equipment, including real- time operations as well as non-operational data, such as condition monitoring. The IEC 61968 and IEC 61970 provide the structure and semantics for integrating a variety of back office applications. The models of the transmission and distribution power system are available in IEC 61970 and IEC 61968-11. Some of the information to be added may be retrieved from devices supporting IEC 61850. Some of the Smart Grid applications that need this information may reside in devices supporting IEC 61850. Therefore, an extension of the IEC 61850 models may be required as well.

An automated verification of the different settings of the components of a power system will be essential in the future to prevent system failures due to misconfiguration that may lead to blackouts. In order to make these applications possible across the power system, standardization of the setting information is required. In addition to setting information of the individual devices, these applications also may require enhanced information about the power network, such asline characteristics or topology. IEEE PES PSRC Working group H5 is in the process of completing the protection settings object models and defining a common data format for exchange between applications.

Other standards to be considered are IEEE PC37.239, whichhat defines a Standard Common Format for Event Data Exchange (COMFEDE) for Power Systems, and IEEE PC37.237, which defines a Recommended Practice for Time Tagging of Power System Protection Events.

14.3 Objectives:

- Develop strategies to integrate IEC 61850, IEC 61968, IEC 61970, IEEE PC37.237, IEEE PC37.239 and the future IEEE Common Settings file format for Smart Grid Applications.
- Develop a summary of information required from the power system for various Smart Grid applications.
- Map that information with the already defined models from IEC 61970, IEC 61968-11, and IEC 61850.
- Coordinate with the SDO to extend the existing models.
- Identify setting information that is required to perform an automatic verification of the power system configuration to prevent failures due to mis configurations. This information shall include both settings in the devices as well as parameters of the power network that need to be available for verification.
- Coordinate with the SDO to extend the existing standards with that information.

14.4 Why:

This work can enable the effective integration of field-equipment data and information with that used for enterprise back-office systems. Many existing applications require manual conversion between different proprietary formats. A standards-based approach for system models, protection settings, and event-reporting data exchange will improve the efficiency of many Smart Grid-related tasks. This integration can enable many new applications that may not be possible by just operating in one environment.

14.5 Where:

The integration of these standards would take place across the enterprise where field equipment operations need to integrate with back-office systems. Models and settings will be implemented in multifunctional IEDs at different levels of the substation and electric power system hierarchy. They will be used also in analysis, testing, commissioning, asset management, automatic analysis, and protection coordination tools. Several interfaces will be involved through the development of the standards that are targeted for their environment.

14.6 How:

The activities related to this task will require coordination with many SDOs. Strategies for integration of the different standards shall be developed in cooperation with the SDOs involved.

This work shall identify and/or develop key requirements and use cases that define the type of integration needed across these standards. Information requirements for the different Smart Grid applications need to be identified. Thist work needs to involve the different stakeholders and domain experts.

The mapping of that information on the existing models as well as the extension needs to be done by the relevant working groups (IEC TC57 WG10, 13, 14 and 19). This work shall contribute technical support to the SDOs.

The completion of the settings data objects in protection logical nodes will be done in working group H5 of the IEEE PSRC (Juergen Holbach, Chairman). Following the completion of this work, the logical nodes in IEC 61850 will be updated. A PAR will then be submitted to define a file format for setting data exchange based on the IEC 61850 substation configuration language. The work based on this action plan shall contribute technical input.

Other SDOs involved are IEEE PSRC WG H3 (IEEE PC37.237) and H16 (IEEE PC37.239).

14.6.1 Task Descriptions

Develop along with project team.

14.6.2 Deliverables

Develop along with project team.

14.7 Who:

Project Team
NIST Lead: Jerry Fitzpatrick
EPRI Lead: Joe Hughes
SDO Lead: Christoph Brunner Convenor IEC TC57, WG10
Other SDOs: IEEE PSRC H3 Committee Chair Bill Dickerson IEEE PSRC H5 Committee Chair Jürgen Holbach IEEE PSRC H16 Committee Chair Mark Adamiak IEEE Power Systems Relay Committee, Communications Subcommittee: Veselin Skendzic IEC WG13 Convenor Terry Saxton IEC WG14 Convenor Greg Robinson
Users Groups: UCAIug Mark Adamiak
Technical Team: Alex Apostolov (Member IEC TC57, WG10, 19, IEEE PSRC H3, H5 and H16)

14.7.1 When:

Task Description	Completion Date
Task 1:	tbd
Task 2:	Tbd
…	