What:: Develop and standardize common object models for electric transportation (6.2.4)

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 the charging profiles through price or direct control, the possibility of allowing customers to sell PEV electricity back into the grid, and complexity of providing fair settlement to everyone in the value chain when vehicles charge away from their home base, requires common object models to manage all these aspects of mobile bi-directional charging devices.

Description: As PEVs move from area to area, 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 PEV 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 EVs. Similar approaches to those used for non-mobile loads point to two related gaps: a common model for Demand-Response 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 Demand-Response use 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.

Objectives:

1) Extract interface requirements from enhanced and polished use cases (based on SAE and NIST workshop Use Cases). This includes recognizing the architecture of actors and messaging, settlement mechanism.

a. What is the appropriate mechanism for PEV settlement? 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 process to build a model around?
b. 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.
c. Determine whether vehicle needs to explicitly send charging requirements information to the “grid”.
d. Architectural decisions should be flexible enough to accommodate varying regulatory requirements. E.g. PEVs may require sub-meters for roaming or if tariffs are developed that treat them separately from the rest of customer loads. This would involve policies, regulations, and testing and a decision whether existing standards for metering and retrieving metered data are adequate for PEVs. Note that ANSI C12.19 has a robust metering model.

2) Draft high level information model in UML.
3) 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. ANSI C12.19/22 defines object models for revenue quality metering. ZigBee SEP 2 defines models for HAN environment.
4) 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 then needs to be described via System Configuration Language (SCL) specifications for PEVs.
5) The Regulators should be asked to review the current regulatory electricity resale rules and metering requirements that will be impacted by roaming and ancillary service market support. 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, then this would open a new market. In addition, the current regulations would 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.

6) Similar to the IEEE 1547 electrical interconnection standards for DER, there may be a need for electrical interconnection and safety standards for chargers and discharging, as well as a weights and standards certification and seal for charging/discharging.

Why: One of the key cornerstones of the current administration's energy opinion is to encourage 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 the common object model development are not resolved in short order, the speed of PEV charging infrastructure build out (and therefore PEV adoption) will be reduced as, the ability to drive and charge/discharge across utility boundaries will be complex or impossible, and the ability to incorporate PEVs into the overall distribution management strategy will be speculation. 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 reductions 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 the 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 promoting electricity theft when there are no standard (legal) means for getting it.

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

System interactions:

Demand Response
Operations
Markets

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?*]

Task Descriptions

Develop along with project team.

Deliverables

Develop along with project team.

Who: [*Recommendations on SDOs and division of labor.*]

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Utilities & Energy Services:

When: [*Timeline for deliverables*.]

Task Description	Completion Date
Task 1: Extract interface requirements from enhanced and polished use cases (based on SAE and NIST workshop Use Cases). This includes recognizing the architecture of actors and messaging, settlement mechanism. (12/09) • List all use cases and aggregate in common format. (09/09) • Sort between near term and longer term (09/09) • Polish use cases (09/09) • Complete set of use cases (12/09)	12/09 EPRI (Arindam Maitra)
Task 2: Draft high level harmonized (CIM/61850) information model in UML (2/10) • Base line Object Model (10/09) - Already in process in ZigBee SEP 2 • Evolve robust Object models after use cases and requirements are resolved (2/10) – Dependent on Task 1 completion	02/10 ZigBee SEP (Greg Robinson / Robby Simpson)
Task 3: Overcome collaborative impediments between standards bodies. (8/24/09) - Need to involve stakeholder SDOs in this process affirmatively. Involve Mathew Ulsar (OPUS) / Greg Robinson from WG 14 who is responsible for integrated DER into CIM. Accellerate these existing processes. TC57 WG17 (Jean Goulet). ANSI C12.19 (Ed Beroset). • Get SAE / SEP 2 into a collaboration meeting to plan the CIM / 61850 PEV. (8/24/09) - Need to resolve IP policy issues that currently precludes sharing of information from ZigBee to SAE prior to meeting.	08/24/09 SAE (Jose Salazar)
Task 4: Take the UML model and create a standards specific view of the model for 61968/61850. They will form the basis of the standards documents. (12/10) - Involve Mathew Ulsar (OPUS) / Greg Robinson from WG 14 who is responsible for integrated DER into CIM. Accellerate these existing processes. TC57 WG17 (Jean Goulet). • Produce 61968 and 61850 documents for circulation at IEC (12/10) - May need to assess / refine UML model as needed	12/10 TC57 WG 14,17,19
Task 5: Review the current regulations / use case conflicts to determine areas where they need to be changed. Interface with	TBD NEMA (Ben Biroschak)

regulators to discuss barriers observed. • NIST may need to help facilitate. (George Bellino)	
Task 6: Coordinate standards activities for electrical interconnection and safety standards for chargers and discharging, as well as a weights and standards certification and seal for charging/discharging. - UL, SAE, IEEE, NEC,NEMA	TBD SAE (Efrain Ornelas)

Metrics:

Issues, Comments, or Observations of Note

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