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Open Vehicle-Grid Integration Platform

General Overview

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ABSTRACT

This public release document provides an overview of the Open Vehicle-Grid Integration Platform (OVGIP), which is a software application that connects various nodes involved in providing and managing energy to Plug-in Electric Vehicles (PEVs). It enables PEV and charging infrastructure management in a grid-friendly manner, and also provides benefits to PEV owners by allowing them to take advantage of utility incentives, while also enabling ratepayer benefits through improved grid capacity utilization. This Platform has been a joint utility industry and automotive industry initiative that has been led by the Electric Power Research Institute (EPRI) since its incepetion in late 2012, and is in its second phase of implementation. The document provides a brief description of the OVGIP deployment roadmap, its scope, cost considerations to develop and deliver it, current State of the technology, and the anticipated benefits from its implementation at scale.

Keywords
Open vehicle-grid integration platform (OVGIP)
Plug-in electric vehicles (PEV)
Charging infrastructure
Application programming interface (API)
IEEE2030.5
OpenADR2.0b

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1
BACKGROUND

The Open Vehicle Grid Integration Platform (OVGIP) represents one of many options utilities, automakers and EVSPs are evaluating in determining the method for large-scale load management of electric vehicles. Specifically, the OVGIP is an intelligent communications development activity designed to prove the value and necessity of a common interface platform between utilities and numerous OEMs' EVs for demand response purposes; and in turn will integrate with EVSPs, aggregators, and other third party platforms for PEV load management. The key benefit of the OVGIP is that it allows for utility-side uniformity while also supporting OEM and EV Infrastructure flexibility.

OVGIP uniformity enables streamlined utility-side program implementations that will address potentially the entire base of PEVs in the utility's service territory. The flexibility on the PEV infrastructure side is the assimilation of technology and market dynamics that will provide cost-effective, customer-centric solutions by enabling a diversity of business models and relationships among the key market actors: OEMs, EVSPs, Energy Management Service (EMS) providers, third-party aggregators and utilities.

The design intent is to provide an adaptable and extensible platform that will enable the development of dynamically evolving PEV grid integrated energy services, programs, and technologies. The ultimate goal being to integrate PEVs as an economically viable Distributed Energy Resource (DER) that supports gird reliability, and is beneficial to both ratepayers and PEV customers. Later sections in this document describe deployment roadmap, scope, cost considerations, current state of the technology and the anticipated benefits from its implementation at scale..

2
DEPLOYMENT ROADMAP

The deployment plan for the OVGIP is envisioned to be a four phase process as depicted in Figure 1. The deployment process is, from the perspective of the OEMs, with the understanding that within each phase specific PEV grid services are to be developed, tested, and verified. Part of the process is to work with utilities, CPUC, CAISO, ESPs (Energy Services Providers), and other stakeholders to determine the value and business case for each of the PEV grid services. This will require appropriate level of funding through rate cases or otherwise as appropriate in different jurisdictions to address non-technical barriers toward making the use of PEVs as a grid resource economically viable.

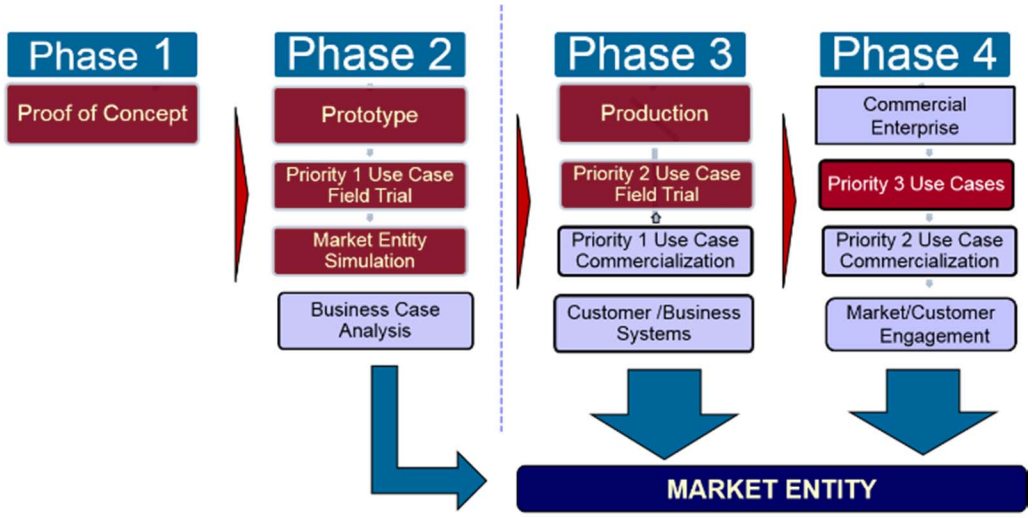

Figure 2-1
OVGIP 4 Phase Market Deployment Roadmap

The OVGIP technology may find market acceptance based on both technology successfully meeting its promise and then provide value to the utilities, end customers and energy markets. One of the key attributes of the OVGIP development program is the inclusion of the California IOUs, multiple other utilities, the CAISO, as well as multiple OEMs which provide a representative forum for conducting the assessments to determine the value, cost benefit, and customer engagement criteria for integrated PEV grid services. The OVGIP development and demonstration program will provide empirical test and demonstration data on the viability and value of specified PEV grid integration use cases that will assist the CPUC and the CAISO in identifying the basis of revenues streams for business cases supporting the commercial deployment of the OVGIP.

A consideration for the OVGIP market entry strategy is likely to be the determination of the organizational and ownership structure required to develop and facilitate business relationships, and implementation of business models and processes between the market actors. The utilities, ISOs, EVSPs, and 3rd party aggregators will require the OVGIP to be able to act as an independent point of contact and intermediary for collaboration, coordination, and establishment

of PEV grid service programs between them, the OEMs, and the customers. In this regard the OVGIP will need to be an entity that is positioned and structured with autonomous authority to establish and manage the business relationships, and ensure open access for all viable PEV grid service programs and participants.

3
PROJECT SCOPE

The OVGIP Phase 2 development and implementation collaborative program is being managed by the Electric Power Research Institute (EPRI) and includes a broad cross-section of utility (Southern California Edison, Pacific Gas & Electric, San Diego Gas & Electric, Southern Company, Hawaiian Electric and Consolidated Edison) and OEMs (BMW, Ford, General Motors, Honda, Mercedes Benz, Toyota) project partners.

There are two primary objectives for the OVGIP Phase 2 Development:

- Provide utilities, energy service providers (ESP), 3rd party aggregators, electric vehicle service providers (EVSP), ISOs, and RTOs the capability to interface and communicate with the entire base of OEM Plug-In Electric Vehicles through a single unified standards based interface platform.

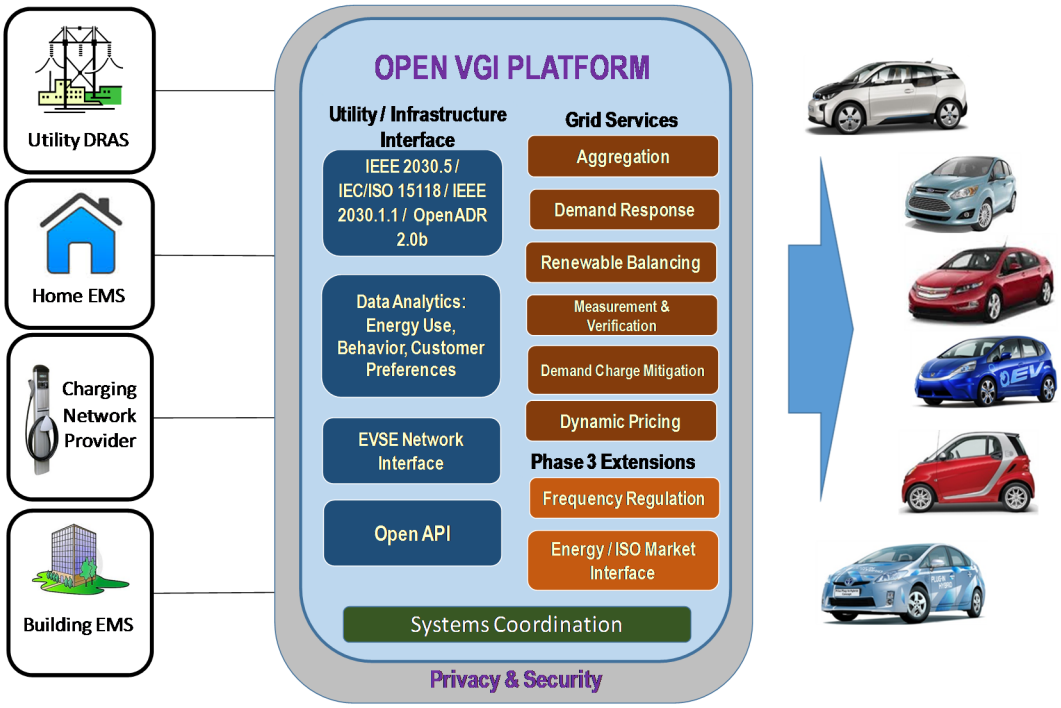

Figure 3-1
Open Vehicle-Grid Integration Platform Scope

- Allow the OEMs the flexibility to use diverse on-vehicle communications technologies (i.e. IEEE2030.5, ISO/IEC 15118, and Telematics) that are compatible and interoperable, through the OVGIP, with Utility standard interface protocols (OpenADR2.0b, IEEE 2030.5) and EV Service Providers' application program interfaces (ISO/IEC 15118, OCPP, and industry applied standard and proprietary APIs).

The OVGIP Phase 2 Development Program (Figure 2) is to define and implement the interface and functional use cases, in collaboration with the utilities, that provide an integrated suite of automated PEV charge management control strategies including time-of-use (TOU) pricing, peak load reduction, demand charge mitigation, load balancing for intermittent solar/wind generation, Real Time Pricing (RTP), aggregated Demand Response (DR), and scheduling dispatch for ancillary services. The development and implementation of the use cases are to be prioritized according to the utility specified PEV integration demonstration requirements. The platform's automation, integration, and interface strategy is to provide the ability for PEV customers to control charging, reduce costs, and participate in energy savings incentive programs.

Security and data privacy are priority design elements for the Phase 2 development of the OVGIP. Reliability, scalability, and extensibility of the platform are also critical elements to ensure the long term sustainability of the value streams from PEV supported grid services. The Phase 2 platform is to provide the foundation for implementing, testing, and evaluating the value of the use cases for evolving energy services beyond Phase 2.

4
COST CONSIDERATIONS

One way to look at the deployment and scale-up costs is to look at the manner in which the Platform approach is intended to design out cost of delivery of services through the platform. These include leveraging information and communication capabilities wherever they exist and ultimately designing in these capabilities in the PEVs themselves, so they can respond to grid-state automatically by receiving the signals from the grid directly. This obviates the need for costly intermediaries, infrastructure upgrades and perpetual subscription fees that the end customers are saddled with, while providing a customer-centric approach to grid services

The OVGIP development program is in its second phase and 4th year of development. For successfully completed Phase 1, which was essentially the proof of concept phase, the costs were borne by each participant from their internal budgets either in terms of material support or through in-kind resources. For Phase 2 work, the technology development cost will be borne by the OEMs and the IT Platform Developer, whereas EPRI and the utilities participating intend to contribute toward the field demonstration s well as setting the requirements that enable the platform to maximize value within their jurisdiction.

The costs for production system deployment of the OVGIP are to be determined at an appropriate time and state of maturity of the Open VGI Platform. Expectation is the determination of the costs for business enterprise development and system maintenance will be predicated on the outcomes from the Phase 2 PEV grid service Use Case demonstrations as applied based on which possess the most viable economic potential per the resulting valuation assessments.

5
CURRENT STATE OF THE TECHNOLOGY

Clearly, undertaking a task that is as complex in its technological aspects as it will be possibly in its business and implementation aspects involving multiple stakeholders requires up front understanding of roles, responsibilities and expectations. In that regard, the OVGIP negotiations among the key actors (OEMs and IT Solutions Provider) are still underway with the expectation the OEMs and the IT Solutions Provider will complete the contractual agreement by end April 2016. Presently are engaged with the utility participants in the coordination and review of the Use Cases by their application to the individual utility OVGIP pilot demonstration requirements. There is expressed emphasis on the Use Cases for PEV Aggregation for DR and Critical Peak Pricing, Dynamic Pricing, Optimized Load Management (ISO/IEC 15118), Customer Enrollment, and Measurement & Verification.

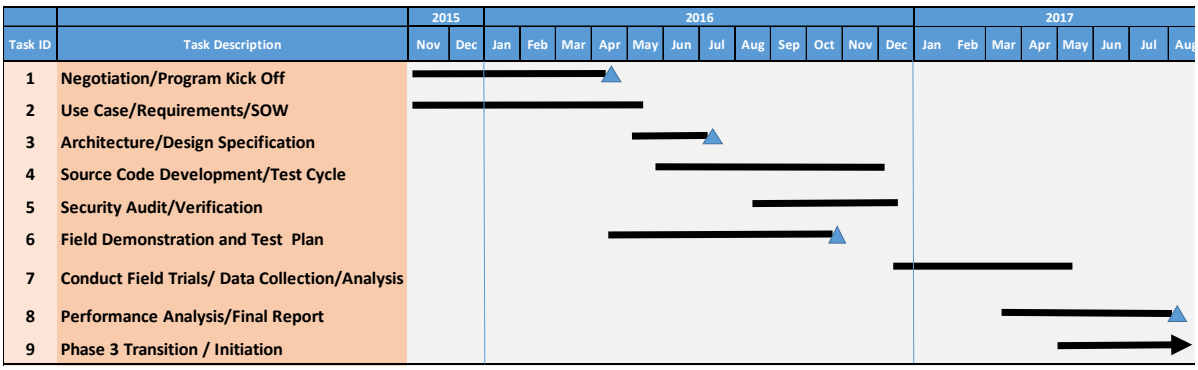

Figure 5-1
Open Vehicle Grid Integration Platform Estimated Development Timeframe

The schedule (Figure 5-1) defines the major task elements over a sixteen-month period. EPRI and the IT Solutions Provider intends to engage with selected stakeholders such as the utilities, EVSPs, EMS vendors, and eMobility Operators to define the application program interface and communications requirements for the pertinent Use Case. Individual OEMs are expected to provide their API interface and interoperability requirements for establishing interconnectivity of their PEVs to the OVGIP. Security best practices and standards are intended to be applied and will be verified through an audit by EPRI cyber security experts.

Field demonstrations are planned to be implemented and conducted with the individual utilities and required secondary actors. Analysis of the system performance in terms of reliability and latency will be measured and reported. A final report will be prepared that summarizes the detailed outcomes of each of the demonstration projects A summary of each project detailing preliminary value assessments, system performance characteristics, and comparison of performance between different protocols and physical transfer methods.

6
ANTICIPATED BENEFITS

The OVGIP is a foundational, driver-centric solution that enables integration of PEVs for use as a resource for grid reliability. It focuses on the integral role of the PEV customers and their value for vehicle grid integration and provides the following benefits to CA ratepayers and utilities:

1. Provides an open technology platform for integrating PEV demand flexibility as a grid resource. An example is It will enable PEV integration and load synchronization with renewable generation, which will accelerate the decarbonized grid vision.
2. Provides access to information exchange with PEVs and the drivers through a centralized secure communications platform. The information will provide visibility and awareness of PEV charging behavior for use by utilities to predict distribution capacity and reliability requirements.
3. Provides basis for convergence of common interoperability standards for more effective integration of electricity market transformation and technology innovation. Provides an ongoing foundation for development and implementation of more dynamic use cases and business models
4. Enables PEVs to be a readily dispatchable resource that will help mitigate generation, transmission and distribution investment costs.
5. Utility investment in PEV infrastructure energy management will be leveraged by OEM and IT Developer investment through the OVGIP.

The OVGIP will enable PEV inclusion in utility energy management and energy efficiency and load management programs that will improve reliability and mitigate utility infrastructure costs. This benefits all customer stakeholder categories including the ratepayers, as well as the utility and customer infrastructure owners and operators.

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