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Technology Panel, Presentation

Additional submitted attachment is included below.

California Vehicle Grid Integration (VGI) Roadmap Update

Technology Panel

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Workshop on California Vehicle-Grid Integration Roadmap Update
10/30/2018

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EPRI EV/Grid Integration Projects Portfolio: 2016-2021

Open Vehicle-Grid Integration Platform Phase 2

- Collaboration with OEMs/Utilities for aggregated EV DR services; 6 major OEMs /15 utilities participating; 'All of the above' standards approach

Vehicle to Grid (V2G) Integration (CEC 14-086)

- AC On-vehicle V2G implementation/demonstration (SAE/IEEE Standards)
- Development of Transformer and Facility-oriented V2G Management Control System; EPRI/E3 V2G Valuation Study

DER/V2G Integration (DoE EE 0007792)

- DC Off-vehicle V2G implementation/demonstration (SAE/IEEE Standards); Development of Smart Power Integrated Node (SPIN) DC V2G/DER System; Unified V2G/PV/Stationary Storage integrated power electronics and software; Battery degradation analysis

V2G Integration with Microgrid and Building Energy Controls Systems (CEC 16-054)

- V2G/DER communications/control software integration – V2G as a dispatchable DER asset

PEVs as a part of Broader Ecosystem (CEC 15-075)

- Open Demand Side Resource Integration Platform: residential, commercial flex loads, EVs as a resource; Open-Source Platform

EVs in the Virtual Wide-Area Microgrid Setting (CEC 17-052)

- V2G, Managed Charging, Portable Storage, Commercial and Shared EVs, DC and AC infrastructure with microgrids, DERs and commercial buildings – 2 IOUs, 3 locations, 5 microgrids, coordinated DERMS

EV Infrastructure Cybersecurity (DOE DE 0008852)

- EV Ecosystem Cybersecurity: Requirements, Design, Assessment, Mainstreaming at component, subsystem, system level including XFC

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Learnings for VGI

Hierarchy of control

- Customer preferences are paramount
- Localized VGI interface and control
  - VGI will become part of local energy management systems
    - Microgrid Control Systems, Facility EMS, Home EMS
  - Home Owner and Site/Facility Owner have autonomy to determine charging load management requirements
    - EMS developers providing PV and storage (DER) integration solutions to support EV charging
  - Challenge is Site Host EMS meeting EV driver needs, utility needs within the site load management constraints.

There are different VGI Communications pathways

- Through direct communications (utility to vehicle), indirect communications (utility to 3rd party to vehicle) and EVSP provider communications (EVSE Network, eMobility Operators, Mobility Service Operators)
- Options versus charging environment and technologies need to be evaluated for cost effectiveness

V1G and V2G communications and controls are dynamically different

- V1G is about managing time of charge within utility pricing and load/capacity constraints
- V2G is the dynamic orchestration of EV power / energy to provide dispatchability to the grid and to other loads
- V2G is about 2x-4x more valuable to the grid (per preliminary EPRI/E3 estimates)

Standards necessary but not sufficient for integrated system operation

- Interoperability matters, as do control algorithms and use cases

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New Technologies to Improve Cybersecurity

Apply the NIST Catalogue of Smart Grid Standards for Cybersecurity

- NIST Principle of Cybersecurity is end to end authentication and encryption
  - End to End premise for VGI is Utility to EV
- Cybersecurity cannot just be added to EV and Equipment
  - Middleman penetration/attack risks and protection of customer PII data
  - Must be part of the end to end architecture embedded cybersecurity solution

CEC can Significantly Impact the Direction through Active Emphasis

- Defer to comprehensive effort of the DOE to address cybersecurity
- Join nationwide DoE-led collaboration of experts from multiple industries to coordinate accelerated deployment – NIST, EPRI, Sandia, INL, ABB, Siemens, Virginia Tech, DoT
- CEC: consider joining forces and instituting industry expert(s) to represent CEC and participate in the EPRI-led DoE EV Infrastructure Cybersecurity Working Group

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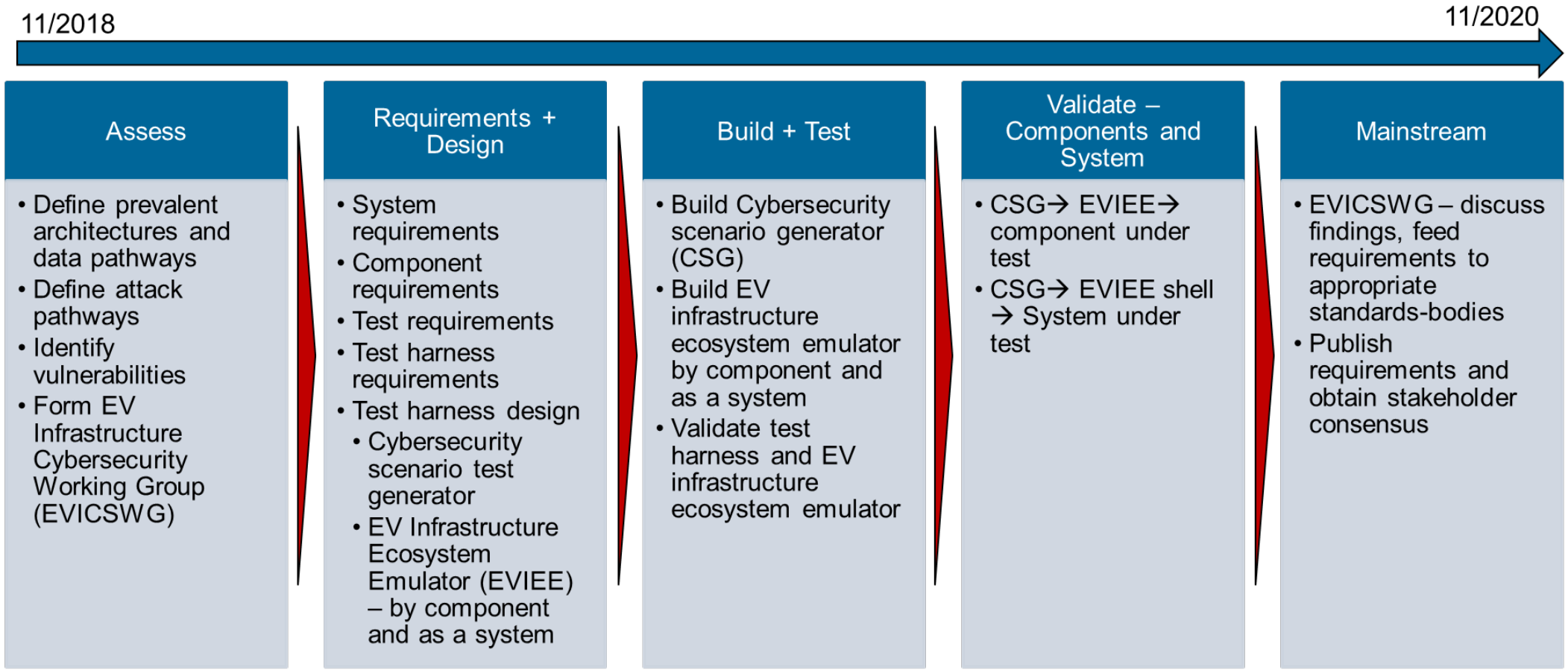
Scope of EPRI-Led DOE EE0008852 Project: EV Infrastructure Cybersecurity Requirements, Design, Assessment, Mainstreaming



This is a flagship project for the broader EPRI-wide Utility Industry Cybersecurity Initiative

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Standards and Methods of Communications to Consider

- Value → Use Cases → Requirements (Technical and Business) → Implementations that meet requirements
- Emphasis on **open** standards based hardware and software that is non-proprietary will prevent vendor lock-in, stranded assets and obsolescence.
- There Is no commercial implementation/development of VGI technologies to date *primarily due to a lack of clearly defined value, markets or programs* (except tariff-based mechanisms now emerging)
- Verification of standards and communications technologies is required to determine
  - Applicability across multiple settings: Residential, Fleet, Workplace, Commercial Public/Private Host Sites, Multiple Dwelling Facilities, Utility Owned, etc.
  - Efficiency and cost effectiveness specific to each setting
  - Interoperability with microgrid and local energy management systems for tighter integrated DER asset management
  - Scalability for evolving functionality across multiple environments
  - Extensibility for application across various EV charging technologies – wired vs. wireless, AC vs DC fast, future-proof
- Point of Reference for VGI implementation per the Roadmap affects determinations
  - Short term versus long term focus
    - V2G (longer term) more dynamic communications requirements than V1G (short term)
    - Compatibility between short term and long term functionality should be considered
    - Requires definition of VGI functional requirements and clear articulation of value for future EV charging technologies and use cases
  - Roadmap should foster innovation and investment in technology and evolve accordingly
- **There is a dire need to enact well-structured TD&D programs that provide comprehensive datasets around customers, use cases, charging technologies, standards and value, leading to well-defined commercialization / rollout**

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Use Cases that Benefit from EVSE Embedded Metering

- Every use case relying on energy flow (uni/bi-directional and pricing) could benefit from EVSE embedded metering
- Electric Vehicle charging will represent largest uncontrolled mobile load (and generation) irrespective of any feature - Utilities require EV load impact and usage data
  - Data for predictive EV load impact analysis becoming more critical – projected circuit hotspots
    - Analogy to solar impact – not important in the beginning – Rule 21 now requires monitoring and functional control communications to monitor, manage, and mitigate the impact from solar
  - Determination of VGI use case measurement and verification
    - Effectiveness and value verification – basis for compensation
- Evaluate feasibility for utilization of vehicle telemetry for EV load impact and generation data
  - Viable broader EV load/generation data source – OEM support needed
  - Feasibility for verification of compensation from EV DR/DER aggregation programs – at aggregator and customer level
  - Define criteria based on accuracy assessments of vehicle telemetry
- NIST handbook 44 is a consumer weights and measure issue and does not apply in residential and free access use cases

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Analytical Models To Link Demand With Grids Operating At High Penetrations Of Renewables

- There are limited analytical tools for projecting and analyzing renewables grid impact and interjecting overlays of EV projected loads
  - Requires some granular detail by segments of the distribution circuit network.
  - Some Analytical Models that may be applied
    - ICA 2.0 - California Integration Capacity Analysis
    - DREAMS – Distributed Resource Energy Analysis and Management System
    - dGEN – Distributed Generation Market Demand
    - SAM – Systems Advisor Model
    - SIND – Solar Integration National Dataset
    - StorageVET or DER-VET – Storage / Distributed Energy Resource Value Estimation Tool
- The analysis could feasibly go beyond to inclusion of costs for VGI versus avoided upgrade investment, and provide a basis for calculating value of EV grid service use cases. . .
- EPRI continues to work with DoE Labs, academia, industry and the utility industry to extend the existing analytics capabilities for grid value and EV integration
- EPRI can propose analysis requirements, evaluate applicability of existing analytical models, and define an analytical framework worthy of consideration for collaborative development and application

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