DOCKETED

Docket Number:	16-TRAN-01
Project Title:	SB 350 Transportation Electrification (Publicly Owned Utilities)
TN #:	214650
Document Title:	Presentation - Vehicle-Grid Integration To Enable Customer-Centric Innovation with Speed, Scale and Flexibility
Description:	By Sunil M. Chhaya, Ph.D., 12/7/16
Filer:	Tami Haas
Organization:	Electric Power Research Institute
Submitter Role:	Public
Submission Date:	12/7/2016 8:27:14 AM
Docketed Date:	12/7/2016

Vehicle-Grid Integration

To Enable Customer-Centric Innovation with Speed, Scale and Flexibility

Sunil M. Chhaya, Ph.D.
Principal Technical Leader, Electric Transportation

CEC VGI Communications Standards Workshop
12/7/2016

ACR Issued in 09/2016 Has Sufficient Room to Enable Innovative VGI Approaches to Emerge… EPRI Proposes a Process to Get There

ACR 09/2016 has Expertly Catalyzed Goal-Oriented Activity

- Proposes several holistic principles as criteria for creating SB350 funded VGI infrastructure technical requirements, while suggesting IEC/ISO15118 as one approach
- Invites IOUs to propose alternative approaches that can achieve compliance to holistic principles that meet overall goals

EPRI Proposes VGI Workgroup Patterned After Rule 21 SIWG

- Translate principles into implementable technical requirements
- Recommend qualified standards and solutions
- 8-12 Month Process; Directly linked to OEM commercialization roadmap
  - *2-4 Months: Formalize evaluation criteria for VGI service providers*
  - *2-4 Months: Develop Technical Requirements and Implementation Guide*
  - *2-3 Months: Create Reference Implementation and Certification Body*
- Process will inform all related VGI policy and regulatory rulings and proceedings

Participation

- All-inclusive of key stakeholders and standards bodies

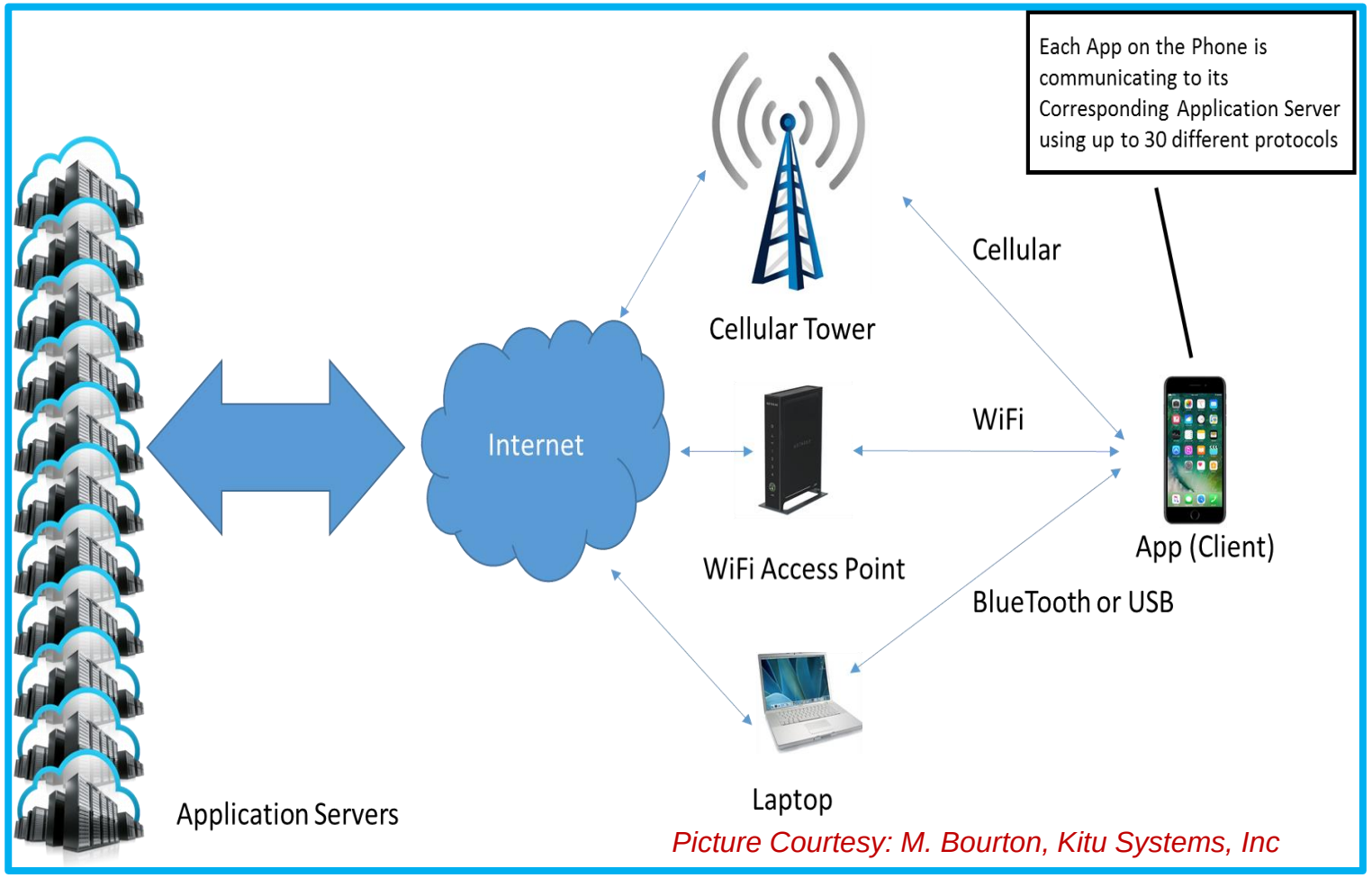
ACR 09/2016 Appendix B Lists Holistic Evaluation Principles for VGI Standards

1. A driver's **mobility**, need for **simplicity**, and **privacy** is preeminent.
2. A vehicle's charging behaviors is consistent with the battery management system and mobility requirements are not externally curtailed by an entity without consulting the driver.
3. Functions enabled through the standard's implementation are fully **scalable**: a) In electrical system terms, from an individual vehicle, to an array of EVSE, to facility circuity, to a campus/microgrid, to distribution, and to regional transmission systems, and b) In magnitude to accommodate millions of vehicles of different makes and models.
4. **Reliability and functional requirements** meet those of the California Public Utilities Commission's adoption of Utility Electric Rules, Federal Energy Regulatory Commission as implemented by the CAISO, or the best practices of the ~~National~~ North American Electric Reliability Corporation (NERC).
5. Technologies and equipment deployed through the standard's implementation are **resilient to evolving use cases** in the automotive, electricity, and communications industries including: high-power charging, wireless charging, vehicle-to-grid, autonomous, connected, electric and shared (ACES) vehicles, higher-speed wireless and wire-based communications.
6. Technologies and equipment deployed prior to the standard's implementation can **voluntarily be re-equipped to increase functionality** and compatibility to the adopted standard to the cost-effective extents possible.
7. Transportation **Network-specific use cases** and services will be leveraged and account **for Geospatial Information System (GIS) data** including charging infrastructure utilization, road infrastructure utilization, route navigation, demand sequencing and queueing, traffic flow, and trip dispatch.
8. The standard is **adaptive to automakers' design and manufacturing requirements** which are, ultimately, global in nature. Regulations incorporating standards should strive to recognize existing progress and avoid duplication.
9. Synchronize the **timing of public and private investments in developing vehicle, infrastructure, and network** or data management products with timelines established in California policy and regulations to efficiently meet climate change mitigation and adaptation goals.
10. **Leverage** the technical capability of the State agencies, and the research and interests of the **national labs** of the **U.S. Department of Energy** and independent research institutions and standards making organizations.
11. **Guarantee and hasten** opportunities for the return of ratepayer investments in research and development (R&D).

EPRI Recommends Consideration of Additional Requirements for Qualifying VGI Standards

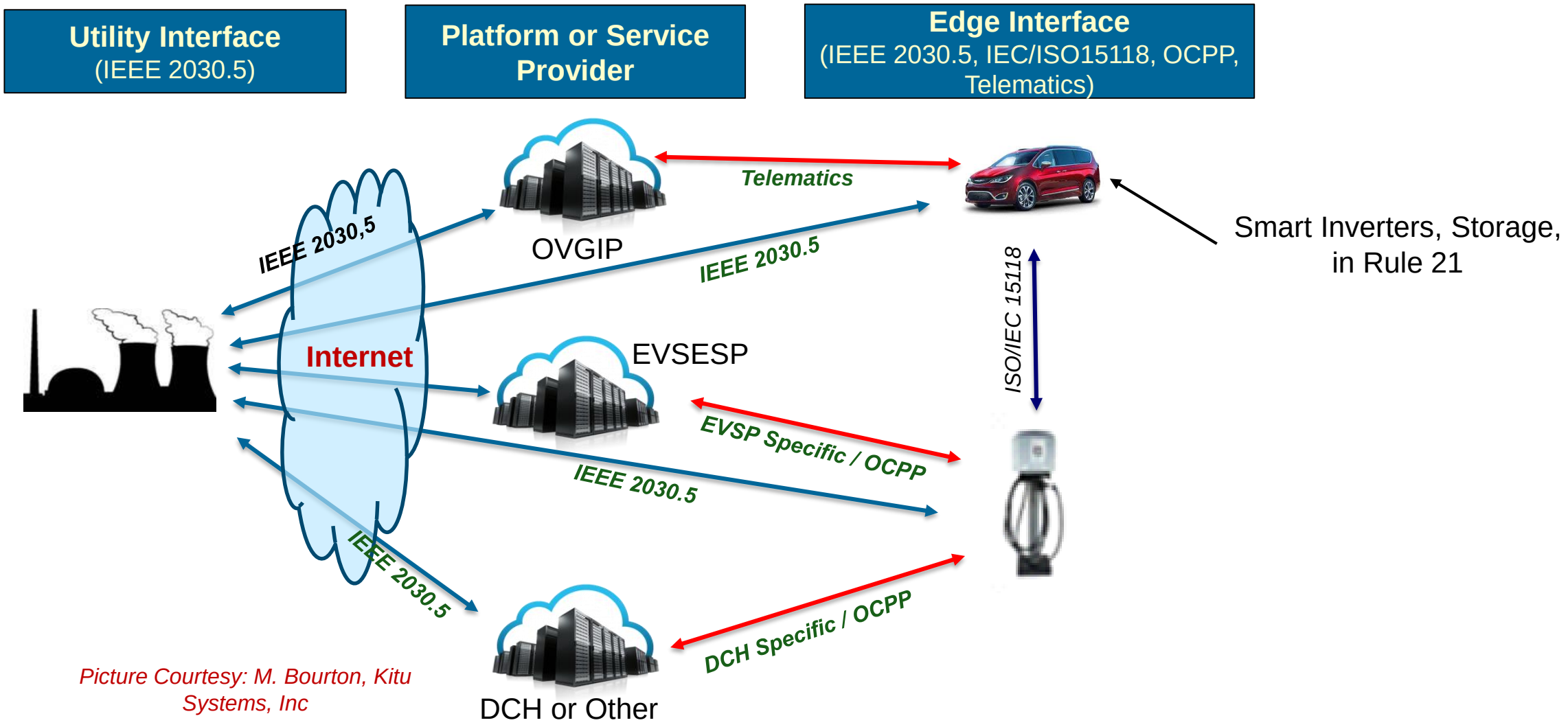
- **Consistency with Rule 21 SIWG** DER Integration Principles, avoiding new silos for PEVs as DERs
  - **IOU-side uniformity** and unanimity with other approaches to **aggregated** & **distribution system level** grid management
  - Functional and Safety Requirements for integrating **EVs as a BTM DER** asset
- Conformance to NISTIR 7628 **Cybersecurity** Guidelines for Smart Grid communications protocols
  - EPRI defining VGI architecture requirements for cyber security implementation and verification
- **Consistency** across Medium and Heavy Duty Vehicle Segments re: High Power Charging
- Resolution of **primacy of control conflicts** and alignment of customer objectives
- Flexibility to address **dynamic data exchange** and functional requirements from multiple stakeholders/actors - Between and amongst primary and secondary actors
- **Extensibility** toward future VGI technologies (i.e. V2G, V2B, V2H, DER, ZNE, Connected Cars), while Safeguarding against **technology obsolescence and stranded assets**
- **Coexistence and interoperability** for variety of services and technologies in the VGI ecosystem
- Ability to foster 3rd party innovation, customer choice and competitive marketplace
- Reduce up front and end use costs to site hosts and end customers as well as ratepayers

For a VGI Ecosystem to Thrive and Grow, Multiple Solutions Need to Coexist to Engage Customers and Still Have Uniform Response Behavior on the Utility side



Picture Courtesy: M. Bourton, Kitu Systems, Inc

Possible Solution Sets for an End to End Implementation



Picture Courtesy: M. Bourton, Kitu Systems, Inc

VGI Roadmap Use Cases and Readiness of Standards Today

VGI Use Cases	OpenADR 2b	OCPP	ISO/IEC 15118	IEEE 2030.5	SAE J2836/2847
STAGE 1: Uni-direction Power Flow – One Resource and Unified Actor Objectives	• Provides the DR event /price / schedule signals/requests to the controlling entity / ESI / EMS.	• DR control at the EVSE through EVSP. • Interoperable with IEEE 2030.5 and OpenADR	• Single resource for com and control from DCH to EVSE to EV • Singular access point to EV	• Point to point com control to individual load devices. • Enables Volt/Var and PFC at EVSE level • Interoperable with OpenADR	• Addresses EV messages for managed charging • Interoperable with OpenADR/IEEE 2030.5
STAGE 2: V1G with Aggregated Resources	• Provides the DR event /price / schedule signals/requests to the controlling entity / ESI / EMS	• Aggregated DR control at the EVSE through EVSP. • Interoperable with IEEE 2030.5 and OpenADR	• DR aggregated resource through com and control from DCH to EVSE to EV	• Provides aggregator resource to simultaneously control multiple load devices	• Addresses EV and customer messages for aggregation • Interoperable with OpenADR/IEEE 2030.5
STAGE 3: V1G with Fragmented Actor Objectives	• Provides the DR event /price / schedule signals/requests to the controlling entity / ESI / EMS	• Not adaptable for local EMS or facility control	• Need separate protocol for DCH to communicate with facility or premise EMS	• Enables customer control at the local EMS level. • Interoperable with OpenADR	• Supports interface with local EMS • Message sets predicated on IEEE 2030.5 Protocol
STAGE 4: Bi-Directional Power Flow (V2G)	• Does not address V2G control features	• Does not facilitate V2G communications and control	• Does not presently address V2G functionality.	• Provides Feature Sets for V2G control functionality	• Supports EV V2G implementation and authorization
STAGE 4+ / Rule 21 / Smart Charging as Storage App: Advanced V2G DER Integration	• Does not address Rule 21 functions	• Does not integrate with DER such as solar and battery energy storage	• Not adaptable for integration with Rule 21 smart inverters and integration with solar and battery energy storage	• Adaptable for integration with Rule 21 smart inverters and integration with solar and battery storage	• Supports Rule 21 DER integration • IEEE 2030.5 DER function set applied

EPRI Recommends Forming VGI Working Group to Accelerate Orderly Rollout of Technologies for PEVs and VGI Infrastructure

Form Vehicle-Grid Integration Working Group

- Patterned on CPUC Rule 21 Smart Inverter Working Group
- Responsible for developing Consensus Technical Requirements, Implementation Guide, Certification Body and Functional Representation
- Focus on End to End Solutions and Standards with Uniform Utility Interface consistent with other segments (SMB, C&I, non-road, medium duty/commercial)
- Expedited Results of the 8-10 month process forming the Technical Foundation of Rulemaking around VGI Infrastructure and Utility Programs

Follow Working Group Process Parallel to SIWG, in an EPRI IWC-Like Open Forum

- Transparent, Consensus-Oriented and Open
- Access and Input from All Stakeholders: OEMs, EVSPs, IOUs, 3rd Party Operators, Standards Bodies, ARB, CEC, PUC and Governor's office
- Leadership from Industry Veterans, Ownership from EPRI