VGI Working Group 2017 Summary Report

DR 17.13

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Emerging Products
Customer Service
Southern California Edison

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Disclaimer

EXECUTIVE SUMMARY

In 2015, the Clean Energy and Pollution Reduction Act, Senate Bill 350, directed the California Public Utilities Commission (CPUC) to require the investor-owned utilities (IOUs) to implement Transportation Electrification (TE) programs. In September of 2016, an Assigned Commissioner Ruling was issued that, besides detailing the types of applications the IOUs should propose, also required the applications to comply with the ISO 15118 protocol between the Electric Vehicle (EV) and Electric Vehicle Supply Equipment (EVSE) or to explain why they could not comply. Following a stakeholder meeting in December of 2016, the CPUC decided to convene a Vehicle Grid Integration Working Group (VGIWG) to allow stakeholders to evaluate if requiring one or more protocols was appropriate.

From April until December 2017, the VGIWG investigated, debated, and derived use cases, requirements, architectures, and protocol mappings. At the end of the process, key deliverables had been abandoned and an outcome was unclear. In the end, it took a compromise among all participants to agree to a proposal for the CPUC. Instead of a protocol, the VGIWG proposed future proofing the EVSEs so that when EV manufacturers finally adopt a protocol in masse, the EVSEs can be upgraded to support. Additionally, further work has been proposed for 2018 and beyond, including conducting large scale pilots, evaluating customer, manufacturer, implementer, environmental, and customer values and benefits that can be derived from the eventual adoption of a protocol, and further VGIWG work to update VGI Roadmaps. The VGIWG proposed EVSE "Future Proofing" requirements are shown in the table below.

TABLE ES. 1 EVSE Future Proofing Requirements

DOMAIN OF COMMUNICATION	HARDWARE FUNCTIONALITY/PHYSICAL LAYER	DESCRIPTION
Power Flow Entity* to EVSE	IEEE 802.11n Compliance	WiFi Connection
	IEEE 802.3 Compliance	Ethernet Connection
	Field Upgradable	Ensures over-the-air Updates are Possible
	Sufficient processor power to perform real-time protocol translation and encryption/decryption, supporting IP stack	
	Interface that provides hardware extensibility	
	Form factor that supports extensibility, via Internet Protocol version 6	Use of IPv6 will allow for third-party management
EVSE to EV	HomePlug Green PHY for conductive EVSE	The physical layers that support the protocols the working group identified

* The Power Flow Entity (PFE) includes Aggregator, Utility, EV Service Provider, Energy Service Company, Alternative Energy Supplier, Building Management System, Energy Portal, and Clearing House.

ABBREVIATIONS AND ACRONYMS

AC	Alternating Current
ACR	Assigned Commissioner Ruling
CAISO	California Independent System Operator
CARB	California Air Resources Board
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CRPP	Charge Ready Pilot Program
DR	Demand Response
ED	Energy Division
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider (EVSE Aggregator)
HB	Handbook
IOU	Investor Owned Utility
ISO	International Organization for Standardization
OEM	Original Equipment Manufacturer
PG&E	Pacific Gas & Electric (IOU)
PWM	Pulse Width Modulation
SAE	Society of Automotive Engineers

SB	Senate Bill
SCE	Southern California Edison (IOU)
SDG&E	San Diego Gas & Electric (IOU)
SOC	State of Charge
TE	Transportation Electrification
VGI	Vehicle Grid Integration
VGIWG	Vehicle Grid Integration Working Group
ZEV	Zero Emission Vehicle

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INTRODUCTION

The state of California is aggressively pursuing the deployment of Transportation Electrification (TE) in order to meet its renewable energy, air quality, and climate change goals. Key among the many transportation-related regulatory and government actions are the Zero Emission Vehicle (ZEV) Action Plan which calls for 1.5 million ZEVs in California by 2025[1], and Senate Bill (SB) 350[2] which requires the California Investor Owned Utilities (IOUs) to invest in and create programs to accelerate TE goals.

Prior to the release of SB 350 in November 2015, the three large IOUs filed TE related infrastructure program proposals with the California Public Utility Commission (CPUC). SCE's Charge Ready Program Pilot (CRPP)[3], approved in January 2016, is deploying up to 1500 Electric Vehicle Supply Equipment (EVSE) charging ports. The CRPP provides SCE owned distribution infrastructure and rebates for EVSEs and their installations at multifamily, workplace and public locations. San Diego Gas & Electric (SDG&E) and Pacific Gas & Electric (PG&E) have similar programs that differ in size and ownership. The CPUC has since approved the first SB 350 compliant TE programs[4]. Table 1 lists the existing TOU applications.

TABLE 1. EXISTING TOU APPLICATIONS

	SDG&E **POWER YOUR DRIVE**	**SCE** **CHARGE READY**	**PG&E** **EV CHARGE NETWORK**
Program Start Date	Expected mid-2017	May 27, 2016	Expected mid-2017
Scope	3,500 Charging Stations	1,500 Charging Stations	7,500 Charging Stations
Budget	$45M	$22M	$130M
Markets	Multifamily, workplace	Multifamily, workplace, public	Multifamily, workplace
Disadvantaged Communities	> 10% charging stations in disadvantaged communities	> 10% charging stations in disadvantaged communities	> 15% charging stations in disadvantaged communities
Charger Ownership	SDG&E	Site Host	Site host, PG&E ownership allowed only in multifamily or

1 http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455828

2 http://www.cpuc.ca.gov/sb350te/

3 https://goo.gl/gLubbh

4 http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455977

			disadvantaged community up to 35%
Cost to Host	Participant Payment	Rebate	Participant Payment or Rebate
Rates	Vehicle-grid integration rate to driver or host	Time-of-use rate to host	Time-of-use rate to driver or host
Regulatory Status	Approved Jan 2016 (CPUC Decision 16-01-045)	Approved Jan 2016 (CPUC Decision 16-01-023)	Approved Jan 2016 (CPUC Decision 16-01-065)

BACKGROUND

In September of 2016, the CPUC issued an Assigned Commissioner's Ruling (ACR)[5] concerning the IOUs TE filings required from Senate Bill 350. Among the requirements, the ACR stated that the IOUs' VGI programs must "conform their specific infrastructure, pricing, or incentive programs and supporting communications, metering, and billing system to the ISO 15118 protocol" or provide justification as to why they are not conforming.

In December of 2016, the California Energy Commission (CEC) hosted a VGI Communications Standards Workshop[6] for stakeholders and interested parties to present and discuss the ACR and ISO 15118 protocol. The presentations by the participants revealed two differing viewpoints: European automakers (except BMW) and related stakeholders belief that the ISO 15118 communication requirements met the needs of VGI and should remain; and utilities, EPRI and many automakers (IOUs/OEMs) requesting the formation of a working group in order to conduct a rigorous technical process to determine whether one or more standards should be mandated and to determine the value of related grid services that can be enabled by it.

In March 2017, the CPUC and CEC issued a Straw Proposal[7] that outlined the formation of the Vehicle Grid Integration Working Group (VGIWG) with the stated objective of assessing "how and whether the adoption of a communications protocol is necessary to enable Plug-In Electric VGI resources to more economically participate in electricity markets at scale." The proposal included many questions for the proposed VGIWG to consider, but was light on a specific process for the group to follow, proposing approximately 10 bi-weekly calls from April until November to complete the work.

The VGIWG kick-off meeting occurred on April 24, 2017. Along with introductions and opening comments, the agenda consisted of reviewing and discussing the straw proposal. The overwhelming consensus was that the group needed to follow more of an engineering process (e.g., use cases, requirements, etc.), use subgroups to complete most of the work, and use the bi-weekly and periodic

5 http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M167/K099/167099725.PDF. See section 3.10 and Appendix B

6 Presentations and recording at http://www.energy.ca.gov/altfuels/2016-TRAN-01/documents/

7 http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442453060

face-to-face meetings to review subgroup work and plan out next steps. On May 8, 2017, VGIWG staff (Regulatory leads) issued a draft Workplan[8] that was essentially a replacement of the straw proposal. It addressed many of the concerns expressed during the kick-off meeting as well as comments the IOUs and EPRI provided that related to the Straw Proposal. Though the Workplan was periodically updated until the end of October 2017 when it was essentially abandoned, a version that reflected the final proposed scope of work was released on May 30th, 2018.

EV Management Overview

It is important to understand what led to the ACR's ISO 15118 requirement. Table 1 shows that each of the IOUs have grid-friendly rates meant to incentivize charging to occur at times when there is normally sufficient or too much generation to serve the loads on the electrical grid. This is also known as balancing supply and demand. PG&E and SCE provide Time of Use (TOU) rates that define three or four daily time blocks with differing energy costs when usage is higher or lower. These time periods and fees typically only change a couple of times a year. SDG&E uses a "Vehicle Grid Integration" hourly rate that is published a day ahead by the California Independent System Operator (CAISO) and reflects the next days' predicted cost of generation and transmission to serve the load. These rates can be considered forms of VGI.

VGI denotes the optimal integration of large and flexible electric vehicle (EV) loads onto the distribution and transmission grid. At minimum, VGI includes the decision to deploy lower-power chargers or distributed generation to support charging costs. Initiating charging based on price signals as mentioned above, whether through delaying plugging in or using the automated scheduling functionality on an EV or EVSE is also VGI. Remote charging control, whether dynamically or in advance, provides a more advanced type of VGI.

Not noted in Table 1 is that all three IOUs have also implemented remote metering and charging management functionalities in the EVSEs and related communications. Just about all Alternating Current (AC) EVSEs but Tesla (who uses proprietary or non-standardized communications) use the Society of Automotive Engineers (SAE) J1772[9] standard for charging. As part of the negotiation between the EVSE and EV, J1772 uses Pulse Width Modulation (PWM) signaling from the EVSE to tell the EV how much current is available. The duty cycle of this signal can be altered to tell the EV that less current is available and to draw less, thus reducing the charging current. J1772 can also be used to curtail charging completely. SDG&E's Electric Vehicle Service Providers (EVSPs) will use this capability to remotely manage charging at times when customers determine on a smart phone app the price is too high. The other IOUs are in the process of determining their use of it. Table 2 shows PWM duty cycles.

8 All VGIWG materials can be found at www.cpuc.ca.gov/vgi/

9 https://en.wikipedia.org/wiki/SAE_J1772

TABLE 2. SOME PWM DUTY CYCLES AND DEFINITIONS

PWM	SAE CONTINUOUS
50%	30 A
40%	24 A
30%	18 A
25%	15 A
16%	9.6 A
10%	6 A

J1772-based charging management will probably be desirable for fleet management. In many workplace scenarios, it will be suitable for managing charging when requirements are fully defined, driver input is known (or at least they have agreed to abide by any constraints) and the drivers' charging decisions do not negatively impact the site host's bill. If extrapolated out to include many locations, EVSE charging management can also be used to reduce demand at a system-wide level such as is typically done with aggregator Demand Response (DR) programs. More sophisticated user inputs such as SDG&E's hourly pricing and real-time management may even allow for more fine-grained charging management at a particular location.

However, there are also issues with the use of EVSEs as controllable endpoints. These can be distilled into two overarching constraints: customer constraints and EVSE constraints. Customer constraints are due to the fact that EV owners' charging needs and preferences do not always align with the needs of the grid. After all, EV capacity can only support the grid if it is available. This further implies that using or projecting the use of EV capacity to support supply and demand or other objectives is not certain. Even when an approximate available capacity is known, charging session durations and power levels are variable based on multiple parameters, perhaps most important being the schedule and needs of the driver in relation to the required state of charge (SOC) of the EV battery when they depart. Neither of which are easily obtained with accuracy by an EVSP or local managing system. A DR program such as the one mentioned above will most likely not be able to guarantee any real-system capacity without overly sophisticated and burdensome customer input requirements and constraints. EVSE constraints point to the fact that there is other desirable functionality for EV management beyond what is available from J1772-PWM capabilities. After all, EVs are mobile energy storage systems, and storage resources have the capability to provide many services, including discharging, load-shifting, and more advanced reliability services. Table 3 shows the storage domains and services.

TABLE 3. STORAGE DOMAINS AND SERVICES [10]

DOMAIN	RELIABILITY SERVICES	NON-RELIABILITY SERVICES
Customer	None	TOU bill management; Demand change management; Increased self-consumption of on-site generation; Back-up power; Supporting customer participation in DR programs
Distribution	Distribution capacity deferral; Reliability (back-tie) services; Voltage support; Resiliency/microgrid/island	None
Transmission	Transmission deferral; Inertia*; Primary frequency response*; Voltage support*; Black start	None
Wholesale Market	Frequency regulation; Spinning reserves; Non-spinning reserves; Flexible ramping product	Energy
Resource Adequacy	Local capacity; flexible capacity; System capacity	None

*Voltage support, inertia, and primary frequency response have traditionally been obtained as inherent characteristics of conventional generators, and are not today procured as distinct services. We include them here as placeholders for services that can be defined and procured in the future by CAISO.

To access these services though requires the management of the EV as opposed to the EVSE. This is because of both J1772 limitations (in reality, the EVSE just informs the EV that it is ready to charge, the power available, etc.) and the EV requirement to manage charging and discharging and other advanced functionality within the constraints of its internal battery management system. Furthermore, since an EV knows its SOC and charging capacity, by providing a desired charge level and departure time, the EV or EV operator could feasibly negotiate the dispatch of these services in real-time. If enabled, an EV can also plug in and be automatically authorized to charge and provide these services by providing its credentials to the EVSE or another entity. The pursuit of a standardized method of managing the EV to be deployed by the IOUs in their SB 350 programs led to the original ISO 15118 mandate and the subsequent formation of the VGI Working Group (VGIWG).

[10] From http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M206/K462/206462341.PDF

VGIWG

SCOPE

As party comments proposed, the VGIWG Workplan originally outlined three Deliverables:

1. **Deliverable 1: Map Existing Communication Protocols to the VGI Use Case Requirements**

   The objective of Deliverable 1 is to determine which protocols are necessary or can be used to meet VGI use cases and requirements. The determination of these protocols was based on: use-case identification, architectures development and requirements derivation process.

   Deliverable 1 was broken up into three subgroups to complete the tasks:

   - **Subgroup 1: Terms and Definitions-** The scope of this subgroup was to create a common list of terms and definitions for use in the other VGIWG activities.
   - **Subgroup 2: Use Case Identification-** This subgroup included the technical processes supporting the VGIWG. Its first task was to identify and categorize VGI use cases according to the VGI Roadmap[11] categories. The next task was to extract functional and non-functional requirements from the use cases, and finally derive the relevant network architectures.
   - **Subgroup 3: Mapping the Communication Protocols to the Use Case Requirements-** The third subgroup's task was to map the possible relevant protocols to the requirements gathered by Subgroup 2.

TABLE 4. CANDIDATE VGI PROTOCOLS AS IDENTIFIED BY VGIWG STAFF

CANDIDATE VGI PROTOCOLS AS IDENTIFIED BY VGIWG STAFF
Institute of Electronic Engineers (IEEE) 2030.5
Telematics
Open Automated Demand Response (OpenADR) v2
International Organization for Standardization (ISO) 15118 v1
CHAdeMO (IEEE 2030-1-1)
Charging Network Management Protocol (CNMP) IEEE 2690
SAE J3072, J2847, J2931, J1772
Open Charge Point Protocol (OCPP) v1.6

At the conclusion of this work, the VGIWG staff prepared a summary for the entire VGIWG and identify which protocols were necessary to meet the use cases.

[11] http://www.caiso.com/documents/vehicle-gridintegrationroadmap.pdf

2. **Deliverable 2: Costs and Benefits of Choosing a Protocol to Enable VGI**

This deliverable was intended to be broken up into two tasks:

a. Identify costs and benefits of use cases and protocols from multiple perspectives. The outcome of this task was meant to be a matrix of costs and benefits associated with the use cases and protocols.

b. Using the outcome from the first task, determine whether one or more protocols provides the greatest amount of benefits for each use case and the use cases as a whole

3. **Deliverable 3: Policy Recommendation**

The outcome of the final deliverable was to be a recommendation of either one or protocol(s) to the CPUC if there was consensus outcome from Deliverables 1 and 2, further actions related to the utility TE proposals should there not be consensus, and additional work moving forward based on issues that arose during the course of the VGIWG.

VGIWG Outcome and Discussion

Deliverable 1

Subgroup 1: Terms and Definitions: What started out as a worthy endeavor and took a tremendous amount of work did not yield worthwhile results, at least for the purposes of the VGIWG. The original intent of the subgroup was to provide baseline terms for the remainder of the tasks and deliverables and it is not apparent it accomplished this task. This is probably due to the lack of support for completion of the work and the removal of the Deliverable 2 for which its availability would have been most useful. However, because the document eventually grew to cover terms indirectly related to VGI, it can be used for not only further VGI work, but also other proceedings related to roadmaps, distributed energy resources (DERs), grid related programs and standards, networks, and communications.

Subgroup 2: Outside of the Terms and Conditions subgroup: The vast majority of the VGIWG output ended up emerging from this group however, it was not a simple exercise. After a long process to validate use cases was completed, a total of 77 use cases were submitted to the VGIWG efforts[12]. Many were discarded due to repetition. Because of the large amount, the submitters were also asked to support the requirements derivation process. Even so, these efforts lasted until September. The resulting set of requirements were extremely comprehensive on the functional side (what must be done) but much less so for non-functional requirements (how it must be done). In the end, 55 functional requirements were identified and categorized as follows:

- Rule 21 (distribution interconnection and support)
- Pricing

[12] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454524

- Load Control
- Smart Charging (negotiated charging)
- Monitoring (metering)
- Restart and Miscellaneous (Support GPS Location and Sending Renewable Mix).

Each of the requirements were additionally mapped to a specific interface that was also determined by the Subgroup 1 and 2 participants.

Table 5. Rule 21

RULE 21: FOR GENERATION CONTROL, SEND DER CURVES AND CONTROLS (RULE 21) AS EVENTS OR CONTROLS WITH START-TIME AND DURATION
Low And High Voltage Ride-Through
Low And High Frequency Ride-Through
Dynamic Volt-Var Operation
Ramp Rates
Fixed Power Factor
Frequency/Watt
Volt/Watt
Connect/Disconnect
Set Max Active Output
Set Active Power Setpoint
Scheduling
Dynamic Reactive Current (Optional)
Site Information (e.g., Line Voltage)
Permission to Discharge
Contain Dispatch Location Information
Provide Inverter Make, Model, and Approval Status
DER Status Information

Subgroup 3: The mapping subgroup: This group invited experts for each of the potential protocols listed in Table 4 to mark whether the protocol met each of the requirements as defined per interface, as well as provide communication architectures that showed how their protocol fit into the VGI ecosystem (see Table 6). This was a very tedious process but nonetheless enlightening. First of all, it was difficult to get representatives for each of the protocols submitted by the VGIWG staff as many of the protocols were either not close to being defined (IEEE 2960), were not actual protocols (Telematics and SAE), or had well-defined roles that already supported a set of requirements (OpenADR and CHAdeMO). Two of the experts representing the protocols did not understand the process and provided all check marks despite their representative protocol clearly not supporting the functionalities; they stated support was on the roadmap or it could be done in combination with other protocols. Both had to be invited back to a follow-up meeting. In the end, they were allowed to denote where the protocols could support functionality when used with another protocol. The development of network architectures, which was originally a task of Subgroup 2, also

fell to Subgroup 3. A long debate emerged about whether a representative architecture should be used and what it should be. The results were much less useful, and in fact, were not used in the final Deliverable 1 report or elsewhere. Deliverable 1 was not frictionless and it was apparent that some felt the process was rigged to support certain protocols.

TABLE 6. REQUIREMENTS TABLE USED FOR SUBGROUP 3 MAPPING BY PROTOCOL EXPERTS. THE PROTOCOL EXPERTS ENTERED N, Y, AND Y* IN EACH BOX IF IT SUPPORTED THE MESSAGE WITHOUT THE USE OF ANOTHER PROTOCOL, IF IT DID NOT SUPPORT, OR IF IT NEEDED ANOTHER PROTOCOL TO CARRY IT RESPECTIVELY. THE GRAYED OUT CELLS ARE WERE NOT REQUIRED TO BE MARKED AS THAT THEY WOULDN'T BE NEEDED TO MEET THE GIVEN REQUIREMENT.

Functional Requirements	PFE and BMS	BMS and EVBS	BMS and DCPC	BMS and EVSE	PFE and EVBS	PFE and DCPC	PFE and EVSE	EVBS and DCPC	PFE and EV Driver	BMS and EV Driver	EVBS and EV Driver	EVSE and EVBS	Acknowledge [receive]	Opt-out [receive]
1- Rule 21	**For Generation control, send DER Curves and Controls (Rule 21) as Events or controls with start time and duration**													
Low and High Voltage Ride-Through	-	-	-		-	-		-				-	-	
Low and High Frequency Ride-	-	-	-		-	-		-				-	-	
Dynamic Volt-Var Operation	-	-	-		-	-		-				-	-	
Ramp Rates	-	-	-		-	-		-				-	-	
Fixed Power Factor	-	-	-		-	-		-	-	-	-	-	-	-
Frequency/Watt*	-	-	-		-	-		-	-	-	-	-	-	-
Volt/Watt	-	-	-		-	-		-	-	-	-	-	-	-
Connect/Disconnect	-	-	-		-	-		-				-	-	
Set Max Active Output*	-	-	-		-	-		-	-	-	-	-	-	-
Set Active Power Setpoint	-	-	-		-	-		-	-	-	-	-	-	-
Scheduling	-	-	-		-	-		-	-	-	-	-	-	-
Dynamic Reactive Current (optional)	-	-	-		-	-		-	-	-	-	-	-	-
Site Information (e.g. Line Voltage)	-	-	N/A		-	N/A		N/A				-	-	
Permission to Dischage	-	-	N/A		-	N/A		N/A				-	-	
Contain Dispatch Location Information	-	-			-			-	-	-	-	-	-	
Provide Inverter Make, Model and Approval status	-	-	N/A		-	N/A		N/A				-	N/A	N/A
DER Status information	-	-	-		-	-		-				-	N/A	N/A

Deliverable 1 summarized the Subgroup 2 and 3 work as shown in Table **7**. The first column lists the use case categories developed by Subgroup 2. Along the top row are the candidate protocols. If all available boxes for each category (e.g., Rule 21) had check marks, then the protocol was marked *Supported.* If there were one or more check marks with asterisks, it was marked *Supported in Combination.* If any N's were noted, then the Protocol was marked *Not Supported* for that category.

Table 7. Protocol Mapping from the Deliverable 1 Report13. Note that IEEE 2030.5 is the only protocol that support nearly all of the requirements without support from other protocols. It only did not support GPS locations which emerged from a telematics use case. The 2018 update of IEEE 2030.5 does support, and though this was vehemently argued against by the IEEE 2030.5 expert, the 'Not Supported' denotation remained.

FUNCTIONAL REQUIREMENTS CATEGORY	OPENADR	IEEE 2030.5	OCCP	TELEMATICS	SAE SUITE	IEEE 2030.1.1	ISO 15118
Rule 21	Not Supported	Supported	Not Supported	Supported in Combination	Supported in Combination	Supported in Combination	Not Supported
Pricing	Supported	Supported	Not Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination

[13] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455246

Functional Requirements Category	OpenADR	IEEE 2030.5	OCCP	Telematics	SAE Suite	IEEE 2030.1.1	ISO 15118
Load Control	Supported	Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination
Smart Changing	Supported in Combination/Not Supported	Supported	Not Supported/Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination
Monitoring	Supported in Combination	Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination
Restart	Supported	Supported	Not Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination
Miscellaneous	Not Supported	Not Supported	Not Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination

Deliverable 2

There were a total of 15 face-to-face or half-day online VGIWG meetings between April and December. There were multiple Deliverable 1 Subgroup meetings between April and October. However, Deliverable 2 never actually happened. The first discussion about its content occurred at the face-to-face San Francisco meeting on August 7[14]. The presentation was admittedly confusing and the follow-up discussions were limited and resulted in no path forward. A follow-up of similar content that had a similar result was presented two weeks later. It was not until the face-to-face meeting on September 18th in Sacramento that an actual cost/benefit proposal emerged from the VGI staff[15]. The subsequent arguments opposed to the use of the template provided were strenuous. The objections ranged from it being too confusing, impossible to complete without a vast majority of research, or not related to the objective. Additionally, as the EVSE and EV OEMs did not provide real costs, it was argued that the results may have been subjective and unprovable. Nonetheless, it was requested that participants 'team up' to complete. To this author's knowledge, none were ever completed and Deliverable 2 effectively disappeared.

Future Proofing the EVSE

At the same meeting in Sacramento where the initial and final Deliverable 2 template was presented, SCE offered a compromise. During discussions, SCE mentioned that an alternative to mandating a protocol would be to require the EVSE to support the

[14] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454189

[15] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454679

hardware and lower layer communications for routing and bridging of protocols through the EVSE to the EV (in combination with J1772-PWM support). This will allow the OEMs, who still remained split or non-committed, to determine the value of supporting a specific protocol while being able to support it in the future. At a subsequent online meeting two weeks later, SCE presented this as a formal proposal[16]. One sticking point to the proposal, despite its strong security and cost avoidance aspects, was that it required protocols to support the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of network protocols in order to be routed or bridged through the EVSE. This effectively ruled out the use of ISO 15118 for many years until a lengthy standards update process can be completed.

Currently, Level 1 charging (120V) due to the lack of networking capabilities, Direct Current Fast Charging (DCFC) because of the quick turnover, as well as Level 2 (240V) charging deployed in Residential scenarios due to costs have been removed as candidates for VGI implementation. The multi-use L2 EVSE, such as those deployed at Workplaces and Public locations, are left as options. In addition, the remaining protocols under discussion are OpenADR 2.0, IEEE 2030.5, OCPP 1.6 and ISO 15118. An architecture presented by the IOU/OEM group showed the contrast. This is shown in **Error! Reference source not found.**.

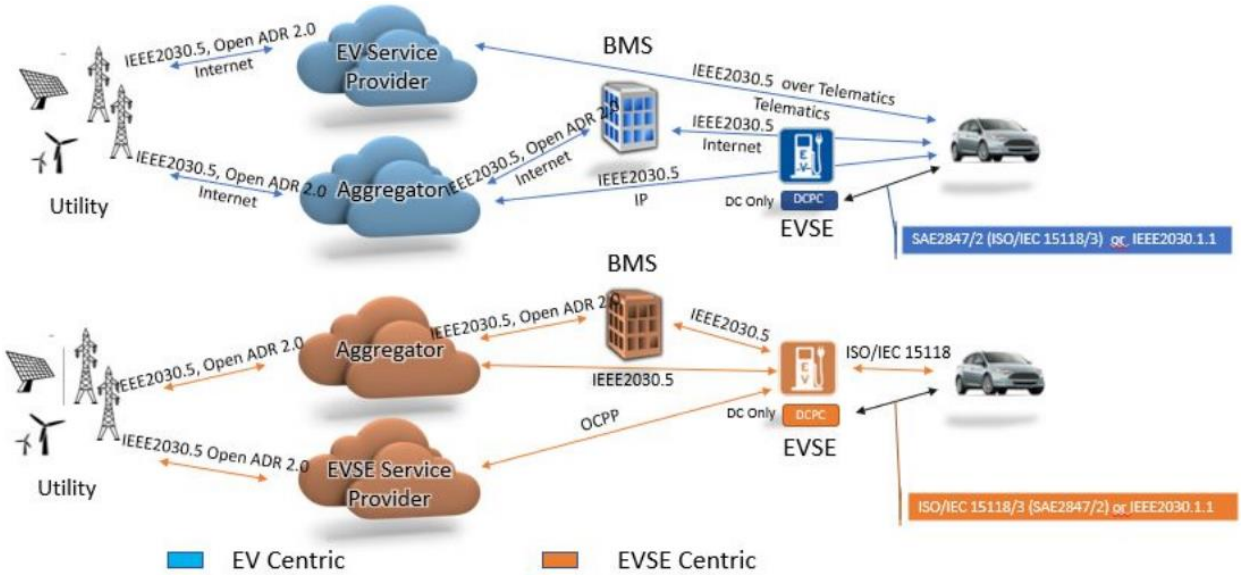

FIGURE 1. TWO SUCCINCT VGI ARCHITECTURES. EV CENTRIC WHERE THE PROTOCOL IS BRIDGED OR ROUTED THROUGH THE EVSE; AND EVSE CENTRIC WHEREBY THE EVSE TERMINATES COMMUNICATIONS AND TRANSLATES BETWEEN PROTOCOLS. ISO 15118 CAN ONLY EXIST IN THE EVSE CENTRIC ARCHITECTURE

Two weeks later on October 30th, the VGIWG Staff presented another compromise[17] that while still leaving the protocol decision to the market, proposed additional processing power on the EVSE so that protocol translation can occur. This will allow both the EV or EVSE Centric architecture and thus ISO 15118. There were minimal protests and aside

[16] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442456398

[17] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455175

from minor tweaks the VGIWG Staff compromise ended up being the Deliverable 3 Proposal. Table 8 shows the proposed EVSE requirements for Deliverable 3.

Table 8. Proposed EVSE Requirements for the Deliverable 3 Compromise. In reality, many of the available non-residential EVSE could probably already support these execpt for the the HomePlug Green PHY interface between the EVSE and EV.

Domain of Communication	Hardware Functionality/Physical Layer	Description
Power Flow Entity* to EVSE	IEEE 802.11n compliance	WiFi Connection
	IEEE 802.3 compliance	Ethernet Connection
	Field Upgradable	Ensures over-the-air updates are possible
	Sufficient processor power to perform real-time protocol and encryption/decryption, supporting IP stack.	
	Interface that provides hardware extensibility	
	Form factor that supports extensibility, via Internet Protocol version 6	Use of IPv6 will allow for third-party management of EVSE
EVSE to EV	HomePlug Green PHY for conductive EVSE	The physical layers that support the protocols identified by the working group.

*The Power Flow Entity (PFE) includes Aggregator, Utility, EV Service Provider, Energy Service Company, Alternative Energy Supplier, Building Management System, Energy Portal, and Clearing House.

The final discussion related to metering requirements. Initially, CAISO requirements were discussed. However, these were deemed too onerous. Consequently, the group agreed to reference the existing Handbook 44 (HB 44) requirements[18], which are already be required on the multi-use EVSEs where electricity is offered for sale. HB 44 requires meter accuracy of 1% at time of certification and 2% during the life of the system.

[18]https://www.nist.gov/sites/default/files/documents/2017/12/07/3-40-18-hb44-final.pdf

CONCLUSION

It is possible that the VGI standard space will remain fractured. It is also possible that, as is often the case, the protocol that is first to market will corner the market. However, until then there may be more valuable work to be done. In January 2018 the IOU/OEM group submitted a proposal to the CPUC commissioner[19]. The letter stated that due to the fact that not all of the VGIWG scope was completed, the group recommended a *VGI Value Study* to examine the benefits and value streams provided by VGI and *Large Scale Demonstrations* that can further support the determination of valuable and desired pathways and protocols that should be implemented. Additional recommendations, include updating the VGI Roadmap11[11] and further VGI work in 2018. It is debatable whether the VGIWG time and efforts spent to reach the compromise proposal were worth it. However, if the IOU/OEM proposals are realized than there would be no doubt that this was a worthwhile effort.

[19] http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442456411