VGI Mapping Sub-Working Group Final Report
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Introduction

The Mapping Sub-Working group was tasked with evaluating whether each protocol determined to be in scope could support the different use case requirements identified by the requirements sub-working group. The sub-working group analyzed seven protocols:

- ***Open Automated Demand Response (ADR) version 2.0b.*** Provides demand response messaging and transactive energy signaling. These events can relay price information or specific energy consumption change requests
- ***Institute of Electrical and Electronics Engineers (IEEE) 2030.5, also known as Smart Energy Profile (SEP) version 2.0.*** Allows communications between energy-related devices in the Home Area Network (HAN) with zero-configuration.
- ***Open Charge Point Protocol (OCPP) version 1.6.*** An open communication standard that enables communication between charging stations and central vendor systems.
- ***International Organization for Standardization (ISO) 15118, version 1.*** Provides communications between the EVSE and EV.
- ***Society of Automotive Engineers (SAE) suite of standards (J3072, J2847, J2931, J1772).***
- ***IEEE 2030.1.1.*** Developed as a CHAdeMO specification for DC fast charging.
- ***Vehicle telematics.*** Proprietary lower level network protocol utilized by Automakers to facilitate monitoring and communications between the vehicle and corresponding vehicle telematics server.

IEEE P2690, the Charging Network Management Protocol (CNMP), was out of scope because it is not yet fully finalized, and the Working Group is only considering existing protocols. In addition, the sub-working group gave consideration to features included within upcoming versions of the above protocols.

The Mapping Sub-Working group process started August 28, 2017 and ended September 29, 2017. The group held 12 meetings for a total of 13 hours and reviewed all of the materials related to each protocol submitted from each subject matter expert (SME).

Date	Topic(s)
1-Sep	Final call for Surveys, Distribution of actor definitions, diagram, matrix
6-Sep	Process questions and Deliverable Review
8-Sep	Process review and presentation for IEEE 2030.5 (SEP 2.0) Requirements Matrix
11-Sep	Continuation of 2030.5 and recap of process
13-Sep	Presentation of Requirements Matrix for OCPP and Open ADR
15-Sep	Presentation of Requirements Matrix for ISO 15118
18-Sep	General Meeting
20-Sep	Presentation of Requirements Matrix for SAE suite
22-Sep	Presentation of Requirements Matrix for CHAdeMO
25-Sep	Presentation of Requirements Matrix for Telematics
27-Sep	Presentation of Requirements Matrix for CNMP
29-Sep	Make up session

Process

1. SMEs completed a survey pertaining to the protocol for which they are an expert. Survey responses helped identify:
    a. Basic information about the protocol and the problem(s) it was created to address
    b. Who was involved in the development of the protocol
    c. Who is currently using the protocol
    d. The hardware and/or software needed to support the protocol
    e. What near term updates are planned for the protocol
2. SMEs matched the most current approved protocol to the matrix of 51 functional requirements to illustrate the actors involved and the communications pathway each protocol follows.
3. For each protocol, SMEs developed a matrix detailing the end-to-end path(s) taken by the messaging. The SMEs for IEEE 2030.1.1, IEE 2030.5, and the SAE Suite each developed an additional matrix to show how any proposed updates to the protocol(s) would meet the requirements.
    a. If the protocol is capable of independently communicating the information, this was indicated with a “Y”
    b. If the protocol has no standard messaging provision for communicating this type of information, this was indicated with a “N”

c. If other protocols are used for communicating between actors or if the communication depends on implementation specific dependencies, this link in the communication pathway was indicated on the matrix with "Y*" and notes fields. SMEs were requested to provide a diagram to articulate these dependencies.
d. The SME were asked to use one of two standardized diagrams to allow participants to easily visualize their protocol's end-to-end path(s)
    i. If the use of the standardized diagrams were infeasible, SMEs submitted communications flow diagrams in a more suitable format, but were asked to use the fundamental actor definitions[1]

4. SMEs presented their matrix during meetings of the sub-working group. Any disagreements on protocol capabilities were resolved and the sub-working group ratified the matrices
5. Once the matrices were ratified by the sub-working group, the supporting diagrams were harmonized to the extent possible and presented to the sub-working group
6. The matrices and diagrams will be included in the Deliverable 1 document summarizing the work of the working group throughout Deliverable 1

Results

Each individual protocol SME presented the filled out matrix and architecture diagram. Everyone was able to ask questions for clarity and discussion was continued until no objections were proffered.

The mapping sub-working group completed the matrix that maps protocols to requirements and the network architecture diagrams for each protocol. All documents are published under Deliverable 1.3 at www.cpuc.ca.gov/vgi/. These matrices were aggregated into the following rollup table indicating the ability of various protocols to support the listed requirements.

[1] The fundamental actors were defined during the Requirements Sub-Working group. The actors include EV Driver, Power Flow Entity, Utility Customer of Record, EV Battery System, DC Power Converter System, EV Supply Equipment, Energy Meter, and Building Management System. The full definitions are included in the final Requirements Sub-Working group report.

Functional Requirements Category	OpenADR	IEEE 2030.5	OCPP	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
Load Control	Supported	Supported	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination	Supported in Combination
Smart Charging	Supported in combination/ Not Supported	Supported	Not Supported / Supported in	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	Not Supported	Supported in Combination	Not Supported

The Deliverable 1.3 outputs showed that there is no singular pathway for providing the functionality dictated by the use cases. The support of multiple protocols will be needed to allow for scalable, cost-effective VGI services to be provided as the markets for these services mature. The rollup table above was derived from the following summary table. This table assigned a singular value to each requirement for each protocol

Category/ Requirement ID	Functional Requirements	OpenADR	2030.5	OCPP	Telematics	SAE Suite	2030.1.1	15118
1- Rule 21								
F.1.01	Low and High Voltage Ride-Through	N	S	N	SIC	SIC	SIC	N
F.1.02	Low and High Frequency Ride-Through	N	S	N	SIC	SIC	SIC	N
F.1.03	Dynamic Volt-Var Operation	N	S	N	SIC	SIC	SIC	N
F.1.04	Ramp Rates	N	S	N	SIC	SIC	SIC	S
F.1.05	Fixed Power Factor	N	S	N	SIC	SIC	SIC	N
F.1.06	Frequency/Watt*	N	S	N	SIC	SIC	SIC	N
F.1.07	Volt/Watt	N	S	N	SIC	SIC	SIC	N
F.1.08	Connect/Disconnect	N	S	N	SIC	SIC	SIC	S
F.1.09	Set Max Active Output*	N	S	N	SIC	SIC	SIC	N
F.1.1	Set Active Power Setpoint	N	S	N	SIC	SIC	SIC	N
F.1.11	Scheduling	N	S	N	SIC	SIC	SIC	S
F.1.12	Dynamic Reactive Current (optional)	N	N	N	N	N	N	N
F.1.13	Site Information (e.g. Line Voltage)	N	S	N	SIC	SIC	SIC	N
F.1.14	Permission to Dischage	N	S	N	SIC	SIC	SIC	N
F.1.15	Contain Dispatch Location Information	N	S	N	SIC	SIC	SIC	N
F.1.16	Provide Inverter Make, Model and Approval status	N	S	N	SIC	SIC	SIC	N
F.1.17	DER Status information	N	S	N	SIC	SIC	SIC	N

Category/ Requirement ID	Functional Requirements	OpenADR	2030.5	OCPP	Telematics	SAE Suite	2030.1.1	15118
2- Pricing								
F.2.01	Tiered	S	S	N	SIC	SIC	SIC	SIC
F.2.02	ToU	S	S	N	SIC	SIC	SIC	SIC
F.2.03	Critical Peak Pricing	S	S	N	SIC	SIC	SIC	SIC
F.2.04	Real Time Pricing (Hourly)	S	S	N	SIC	SIC	SIC	SIC
F.2.05	Special Tariffs (e.g. Price Interrupted)	S	S	N	SIC	SIC	SIC	SIC
3- Load Control								
F.3.01	Upto Day ahead using DR events	S	S	SIC	SIC	SIC	SIC	SIC
F.3.02	Upto Day ahead using DER (Load) events	S	S	SIC	SIC	SIC	SIC	SIC
F.3.03	Immediate emergency DR control (10 Minute response	S	S	SIC	SIC	SIC	SIC	SIC
F.3.04	Immediate emergency DER control (10 Minute respons	S	S	SIC	SIC	SIC	SIC	N
F.3.05	Should have Primacy and Define Priority (e.g. BMS ove	SIC	S	N	SIC	SIC	SIC	S
F.3.06	Contain Dispatch Location Information	S	S	N	SIC	SIC	SIC	N
4- Smart Charging								
F.4.01	Departure Time	N	S	N	SIC	SIC	SIC	SIC
F.4.02	Charge Rate	SIC	S	SIC	SIC	SIC	SIC	SIC
F.4.03	Energy Required	SIC	S	N	SIC	SIC	SIC	SIC
F.4.04	When the EVBS connects to the DCPC, the EVBS shall e	N	N	N	SIC	SIC	S	S
F.4.05	Exchange information to manage DC power Flow	N	N	SIC	SIC	SIC	S	S
F.4.06	Max Charge Rate	SIC	S	SIC	SIC	SIC	S	S
F.4.07	Request Current Charge Power and SoC	SIC	S	SIC	SIC	SIC	SIC	SIC
F.4.08	Departure Time	SIC	S	N	SIC	SIC	SIC	SIC
F.4.09	Charge Rate	SIC	S	SIC	SIC	SIC	SIC	SIC
F.4.1	Energy Required	SIC	S	N	SIC	SIC	SIC	SIC
F.4.11	Departure Time	N	S	N	SIC	SIC	SIC	SIC
F.4.12	Desired SoC	N	S	N	SIC	SIC	SIC	SIC
F.4.13	Price to Charge	N	S	N	SIC	SIC	SIC	SIC
F.4.14	Provide SoC on a regular basis	N	S	SIC	SIC	SIC	SIC	SIC

Category/ Requirement ID	Functional Requirements	OpenADR	2030.5	OCPP	Telematics	SAE Suite	2030.1.1	15118
5- Monitoring								
F.5.01	Start Time	SIC	S	SIC	SIC	SIC	SIC	SIC
F.5.02	End Time	SIC	S	SIC	SIC	SIC	SIC	SIC
F.5.03	KWh	SIC	S	SIC	SIC	SIC	SIC	SIC
F.05.04	KW	SIC	S	SIC	SIC	SIC	SIC	SIC
6- Restart								
F.6.01	Soft Start	S	S	SIC	SIC	SIC	SIC	SIC
F.6.02	Random delay Start	S	S	N	SIC	SIC	SIC	SIC
F.6.03	Ramp times	S	S	N	SIC	SIC	SIC	SIC
7- Miscellaneous								
F.M1	GPS Location	N	N	N	SIC	N	SIC	N
F.M2	Send Renewable or Fossil Mix	N	SIC	N	SIC	N	SIC	SIC

Most recent version or proposed (where available) version of protocol was used for evaluation of functionality		
Supports	S	It gets the message there, end to end
No Support	N	It doesn't get the message there at all
Not directly supported	SIC	It can transmit the message with some support from other protocols and/or implementation specific programming