Southern California Edison OCPP Use Cases

Final v1.0

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Contents

Introduction

Since the dedication of the Electric Vehicle Technical Center in Pomona CA in 1993, Southern California Edison (SCE) has been a leader in integrating electric vehicles (EVs) into the grid. Since then, SCE has been actively working with the automotive industry, standards bodies, academics, regulators and other stakeholders to support EV integration. This includes research and technical pilots related to how these Distributed Energy Resources (DERs), which include EVs, smart inverters, and energy storage systems, can support the reliable operation of the transmission and distribution grid, as well as allow for their further integration into smart grid systems. Though current capabilities of these resources is somewhat limited, SCE foresees a day when their locations and status is known, and they are able to be autonomously or directly managed to not only meet environmental and customers' transportation needs, but also to support the grid.

Scope

This document details the specific message elements used by Southern California Edison to meet use cases desired to be supported by the OCPP standard currently in development within the Organization for the Advancement of Structured Information Standards (OASIS®), a standards development organization. These use cases are derived from multiple sources including SCE's demand response (DR) programs and pilots, existing electricity rate tariffs, and future grid integration needs. The objective of this effort is either for OCPP to have a 1 to 1 mapping of these fields to OCPP data elements or to add native support to enable the use case. Though all use cases refer to specific SCE requirements, it is highly likely that these are relevant to other transmission and distribution grid operators around the United States.

System Architecture

This document describes scenarios whereby SCE will interface with charging station aggregators (the Central System) with OpenADR 2.0 in order to manage the charging station as a grid resource. The Central System can convert SCE's signals to the appropriate OCPP messages in order to meet the desired objectives. This requires OCPP to have capability to use the SCE messages to convey messages to a charging station. Out of scope are scenarios where SCE interfaces with building energy management and control systems, gateways or other proxies. Also out of scope are interactions through OCPP to the Electric Vehicles over the pilot wire using a separate standard or protocol.

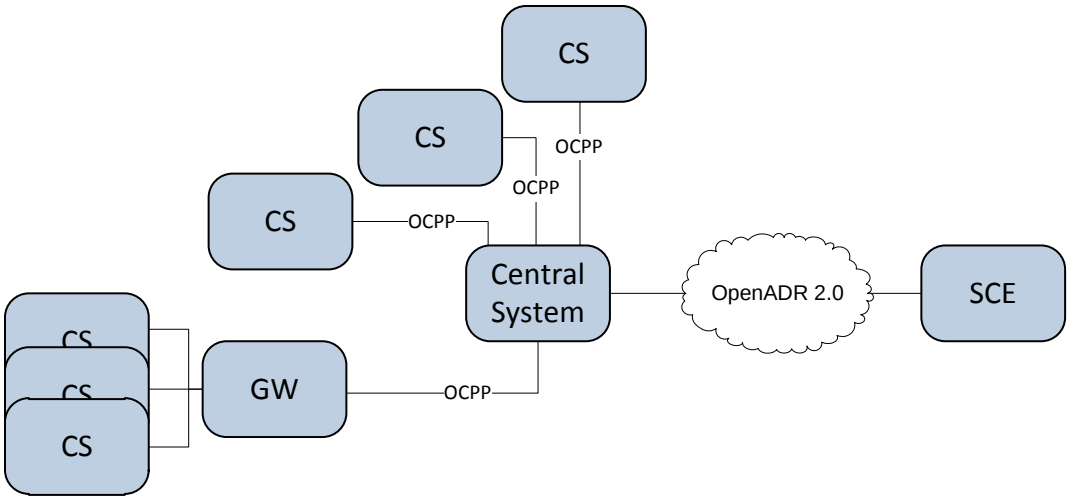

Figure 1 The Central System manages charging station (CSs) across a large area and at a single location. Note that charging stations are aggregated customer devices in residential, commercial, or public locations.

Use cases

The following use cases describe the type of programs and provide sample payloads (where applicable and known), along with requirements for OCPP. Not included are program implementation specific examples including registration, bidding, grouping, etc.

Demand Response (DR)

SCE's existing and future DR programs manage the energy and capacity on its electrical systems. These are accomplished through explicit controls, aggregator management, and pricing programs. Existing and future programs use the OpenADR 2.0 standard for its DR interfaces and several existing and planned DR implementations are applicable to OCPP to manage EV, as a grid resource. Key elements of DR events include, an event signal name, market context, location, signal type (e.g., price, load increase/decrease, percent increase/decrease), notification date and time, a start date and time, and duration.

Aggregator Managed DR Programs

Overview- This use case covers many types of DR programs that could involve charging station aggregators. It usually includes an aggregator bidding in a certain amount of capacity monthly, but is not always necessary. When SCE issues an event the aggregator reduces load as required by the program terms. This could be done by curtailing or reducing charging during a specific requested time. The sample payload provided includes 2 signals. Targeting of resources through the Central System may be used.

Sample OpenADR Payload[1]:

```
<oadr:oadrPayload>
<oadr:oadrSignedObject>
<oadr:oadrDistributeEvent ei:schemaVersion="2.0b">
<pyld:requestID>OadrDisReq091214_043740_513</pyld:requestID>
<ei:vtnID>TH_VTN</ei:vtnID>
```

[1] The OpenADR sample payloads are from the OpenADR 2.0 DR Program Guide. The guide as well as the specification are found at www.openadr.org

```
<oadr:oadrEvent>
<ei:eiEvent>
<ei:eventDescriptor>
<ei:eventID>Event091214_043741_028_0</ei:eventID>
<ei:modificationNumber>0</ei:modificationNumber>
<ei:priority>0</ei:priority>
<ei:eiMarketContext>
<emix:marketContext>http://MarketContext1</emix:marketContext>
</ei:eiMarketContext>
<ei:createdDateTime>2014-12-09T12:37:40Z</ei:createdDateTime>
<ei:eventStatus>far</ei:eventStatus>
</ei:eventDescriptor>
<ei:eiActivePeriod>
<xcal:properties>
<xcal:dtstart>
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</xcal:dtstart>
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</xcal:duration>
<ei:x-eiNotification>
<xcal:duration>PT24H</xcal:duration>
</ei:x-eiNotification>
</xcal:properties>
<xcal:components/>
</ei:eiActivePeriod>
<ei:eiEventSignals>
<ei:eiEventSignal>
<strm:intervals>
<ei:interval>
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</xcal:uid>
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<ei:value>2.0</ei:value>
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</ei:interval>
</strm:intervals>
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<ei:signalType>level</ei:signalType>
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</ei:payloadFloat>
</ei:currentValue>
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<ei:eiEventSignal>
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</xcal:duration>
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</xcal:uid>
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</ei:payloadFloat>
</ei:signalPayload>
</ei:interval>
</strm:intervals>
<ei:signalName>BID_LOAD</ei:signalName>
<ei:signalType>setpoint</ei:signalType>
```

```
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<power:powerReal>
<power:itemDescription>RealPower</power:itemDescription>
<power:itemUnits>W</power:itemUnits>
<scale:siScaleCode>k</scale:siScaleCode>
<power:powerAttributes>
<power:hertz>60.0</power:hertz>
<power:voltage>220.0</power:voltage>
<power:ac>true</power:ac>
</power:powerAttributes>
</power:powerReal>
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<ei:payloadFloat>
<ei:value>0.0</ei:value>
</ei:payloadFloat>
</ei:currentValue>
</ei:eiEventSignal>
</ei:eiEventSignals>
<ei:eiTarget>
<ei:venID>venID_1234</ei:venID>
</ei:eiTarget>
</ei:eiEvent>
<oadr:oadrResponseRequired>always</oadr:oadrResponseRequired>
</oadr:oadrEvent>
</oadr:oadrDistributeEvent>
</oadr:oadrSignedObject>
</oadr:oadrPayload>
```

OCPP Load Management Requirements:

- OCPP shall support the capability to limit charge current. This should be done via J1772 PWM Duty Cycle commands.
- OCPP shall support the capability to curtail or initiating charging by signaling opening or closing of contacts.
- OCPP shall support the capability to send event start dates/times and durations with events.
- OCPP shall be able to manage or collect data from pre-determined groups (1 to many) of charging stations based upon SCE signals.

Pricing DR Programs

Overview- Pricing programs encourage reduced usage or shifting of loads during high wholesale prices or system contingencies. As with Aggregator Managed programs, pricing events include a start time and a duration, and also may include targeting of specific chargers. It is assumed that prices are either consumed by the Central System for management of the Charge Points under its control using OCPP Load Management as described above or sent to Charge Points for display or management by Charge Points or users. As with DR programs, differing pricing signals may be sent to different targets (e.g., one or more price/event time may be sent to customers in zip code A and a different price/event time to zip code B).

Sample OpenADR Payload:

```
<oadr:oadrPayload>
<oadr:oadrSignedObject>
<oadr:oadrDistributeEvent ei:schemaVersion="2.0b">
<pyld:requestID>OadrDisReq091214_043740_513</pyld:requestID>
<ei:vtnID>TH_VTN</ei:vtnID>
<oadr:oadrEvent>
<ei:eiEvent>
<ei:eventDescriptor>
<ei:eventID>Event091214_043741_028_0</ei:eventID>
<ei:modificationNumber>0</ei:modificationNumber>
```

```
<ei:priority>0</ei:priority>
<ei:eiMarketContext>
<emix:marketContext>http://MarketContext1</emix:marketContext>
</ei:eiMarketContext>
<ei:createdDateTime>2014-12-09T12:37:40Z</ei:createdDateTime>
<ei:eventStatus>far</ei:eventStatus>
</ei:eventDescriptor>
<ei:eiActivePeriod>
<xcal:properties>
<xcal:dtstart>
<xcal:date-time>2014-12-09T13:00:00Z</xcal:date-time>
</xcal:dtstart>
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</xcal:duration>
<ei:x-eiNotification>
<xcal:duration>PT1H</xcal:duration>
</ei:x-eiNotification>
</xcal:properties>
<xcal:components/>
</ei:eiActivePeriod>
<ei:eiEventSignals>
<ei:eiEventSignal>
<strm:intervals>
<ei:interval>
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<ei:signalType>price</ei:signalType>
<ei:signalID>SIG_01</ei:signalID>
<oadr:currencyPerKWh>
<oadr:itemDescription>currencyPerKWh</oadr:itemDescription>
<oadr:itemUnits>USD</oadr:itemUnits>
<scale:siScaleCode>none</scale:siScaleCode>
</oadr:currencyPerKWh>
<ei:currentValue>
<ei:payloadFloat>
<ei:value>0.0</ei:value>
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<ei:eiTarget>
<ei:venID>venID_1234</ei:venID>
</ei:eiTarget>
</ei:eiEvent>
<oadr:oadrResponseRequired>always</oadr:oadrResponseRequired>
</oadr:oadrEvent>
</oadr:oadrDistributeEvent>
</oadr:oadrSignedObject>
</oadr:oadrPayload>
```

OCPP Pricing Requirements:

- OCPP shall support the capability to send a minimum of one prices from the Central System to Charge Points.
- OCPP shall support the capability to target pricing signals to charging stations.

- OCPP shall support the capability to send start dates/times and durations with pricing events.
- OCPP shall support the capability to delay charging (e.g., cause the EVSE to go to J1772 State B1 for the duration of the event).

Usage and Transactional Data

There are two use cases that require the ability for Central Systems to receive and provide individual and aggregate usage and transactional data from Charge Points to SCE. Neither currently is provided via the OpenADR 2.0 reporting (though may in the future) so no sample payloads are provided. It is worth noting here that other use cases will exist in California and elsewhere for gathering similar data from chargers[2].

Measurement and Verification (M&V)

Overview- Many DR programs require enrolled aggregators to provide pre, during, and post interval data through telemetry in order to validate customer and/or resource DR performance. This is especially true for EV charging which may be on a distinct program and tariff from other loads on the same service (i.e., the same meter is recording EV charging and other loads). Data provided for each charging station provides disaggregated usage information allowing for accurate compensation to program participants.

Charge Ready

Overview- Overview- Charge ready is SCE's EV infrastructure program intending to deploy up to 30,000 EVSEs. As a requirement to participate, all Central Systems supporting charging stations within Charge Ready are required to enroll in a DR program (TBD) and provide to SCE all charging session data via a monthly .csv file.

OCPP Data Requirements related to M&V and Charge Ready assumes that the charging station or associated systems have the ability to record and exchange the following:

Field Name	Description
Session Information- Data provided per each charging session	
SessionID	Unique identification number of the charging session
EVSEModelNbr	EVSE's manufacturer model number approved by SCE
LocationID	Unique identification number of the site provided by SCE
EVSEID	Unique identification number of the EVSE
ConnectorID	Unique identification number of the port (if available)
ChargeStartDateTime	Charge start date and time
ChargeEndDateTime	Charge end date and time
ChargeDuration	Charge duration
SessionStartDateTime	Session (connection) start date and time
SessionEndDateTime	Session (connection) end date and time
SessionConnectionTime	Session duration

[2]For example http://www.energy.ca.gov/sb350/energydata/documents/2016-09-26_workshop/2016-09-22_Working_Draft_Data_Collection_Regulations.pdf (p. 53) or https://www.cdfa.ca.gov/dms/programs/publications/frm/3-FRM_Chapter_1_Sections_%203.30-3.40_Part_3.pdf (p. 149)

ChargeKWH	Energy (kWh) usage per session
ChargeMaxDemandKW	Peak demand (kW) per session
ChargeAverageDemandKW	Average demand (kW) per session
SessionSaleAmount	Fees charged to end user
Opt Information	Boolean related to participation in an event
Interval information- Data provided per 15 minute interval	
IntervalID	Unique identification number of the charging 15-minute interval
LocationID	Unique identification number of the site provided by SCE
EVSEID	Unique identification number of the EVSE
ConnectorID	Unique identification number of the port
ChargeIntervalStartDateTime	Interval start date and time
ChargeIntervalEndDateTime	Interval end date and time
ChargeKWH	Energy (kWh) usage per interval
ChargeMaxDemandKW	Peak demand (kW) per interval
ChargeAverageDemandKW	Average demand (kW) per interval

Tariff

Tariffs are the agreed-to costs borne by the end users of electricity. Though there are many possible tariffs applicable to EV charging, only Time of Use Rates are at this time applicable to OCPP.

Time of Use Rates (TOU)

TOU rates are time based tariffs that attempt to price energy according to times when wholesale or other costs are high or low. TOU rates can be variable throughout the year and in some regions, including California, are undergoing modifications due to the role distributed generation (e.g., photovoltaic systems) is having on prices. TOU pricing can be consumed by the Central System or Charge Point users to manage bills.

Sample OpenADR Payload:

```
<oadr:oadrPayload>
<oadr:oadrSignedObject>
<oadr:oadrDistributeEvent ei:schemaVersion="2.0b">
<pyld:requestID>OadrDisReq091214_043740_513</pyld:requestID>
<ei:vtnID>TH_VTN</ei:vtnID>
<oadr:oadrEvent>
<ei:eiEvent>
<ei:eventDescriptor>
<ei:eventID>Event091214_043741_028_0</ei:eventID>
<ei:modificationNumber>0</ei:modificationNumber>
<ei:priority>0</ei:priority>
<ei:eiMarketContext>
<emix:marketContext>http://MarketContext1</emix:marketContext>
</ei:eiMarketContext>
<ei:createdDateTime>2014-12-09T12:37:40Z</ei:createdDateTime>
```

```
<ei:eventStatus>far</ei:eventStatus>
</ei:eventDescriptor>
<ei:eiActivePeriod>
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<xcal:dtstart>
<xcal:date-time>2014-12-09T00:00:00Z</xcal:date-time>
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```
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</ei:payloadFloat>
</ei:signalPayload>
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</strm:intervals>
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<ei:signalID>SIG_02</ei:signalID>
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```

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</ei:eiTarget>
</ei:eiEvent>
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</oadr:oadrDistributeEvent>
</oadr:oadrSignedObject>
</oadr:oadrPayload>
```

OCPP TOU Tariff Requirements:

- OCPP shall support the capability to send up to 4 TOU rates from the Central System to Charge Points.
- OCPP shall support the capability to send up to 4 TOU time blocks from the Central System to Charge Points.

Appendix A- Vehicle to Grid

Though not a near term priority, Electric Vehicles and charging systems will include Vehicle to Grid (V2G) capabilities. As with solar inverters, these interactions will be derived from California's Rule 21 interconnection tariff and related Smart Inverter Working Group recommendations[3], the California Smart Inverter Profile (CSIP)[4] of the Institute of Electrical and Electronics Engineers (IEEE) 2030.5, and the Society of Automotive Engineers (SAE) DER specifications related to on board (AC charging/discharging) and off board (DC charging/discharging) inverter use cases. The SAE documents require high level communications between the CS and EV using either IEEE 2030.5 or ISO/IEC 15118, some of which may be needed to be mapped into OCPP if the Central System is providing management of these resources for SCE or the customer.

Besides previously provided DR and Data exchange requirements, possible OCPP V2G use cases may also include (see CSIP for details):

- Real Power Management- Charge, Discharge
- Voltage Management- Updating Volt/Var Curves, Absorb or Inject Reactive Power
- Frequency Regulation- Frequency Watt Curve

[3] http://www.cpuc.ca.gov/General.aspx?id=3962),

[4] http://sunspec.org/ieee-2030-5-common-california-iou-rule-21-implementation-guide-smart-inverters/ This document describes the use of 2030.5 for smart inverter aggregator and systems, and includes sequence diagrams and IEEE 2030.5 sample payloads