Vehicle Use Case Task Force
S2: Customer connects vehicle to premise using Premise EVSE

Document History

Revision History

Revision Number	Revision Date	Revision/ Reviewed By	Summary of Changes	Changes marked
D	12-23-08	Rich Scholer	Added U4 to steps 9 & 12. Added U4 & L4 to section 4.	
			Added Section 1.2.	
	1-7-09	Gery Kissel	Added reference to Use Cases "U" to steps 9 & 12. Added key to Activity Diagram.	

Approvals

This document requires the following approvals.

Name	Title

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Vehicle Use Case Task Force
S2: Customer connects vehicle to premise using Premise EVSE

1.1 Use Case Title

S2 – Vehicle Use Case
Customer connects vehicle to premise EVSE

1.2 Use Case Summary

This use case details the Binding/Rebinding (Startup, VIN Authentication, Basic Charging per enrolled program, Shutdown) process for the customer to use a premise mounted EVSE that does not include a charger. This is precluded by specific enrollment process by one or more of the Utility Use Case categories as described in Use Cases U1-5. This sequence of Use cases is followed by Use cases L1-4 that include the connection site variations.

1.3 Use Case Detailed Narrative

The vehicle connects to the grid using a cord that is included in the premise mounted Electric Vehicle Supply Equipment (EVSE), as described in J1772. These are expected to be available in both home and public applications.

The premise EVSE would be used for higher power levels than a Cordset EVSE and is expected to be permanently connected to a 240V premise source that is capable of delivering up to 80A.

Vehicles that use this premise EVSE are expected to include on-board chargers.
The premise EVSE could also include more than one cord allowing it to be connected to more than one vehicle at a location.

The PHEV & Utility will communicate to implement one or more the following Utility programs.

- U1: Time of Use (TOU) pricing demand side management programs are when the customer has agreed to limit charges to the utility schedule for load balancing. (e.g., off-peak, mid-peak, on-peak, etc.).
- U2: Discrete Event demand side management program (Direct Load Control)
- U3: Periodic/Hourly Pricing Price Response program
- U4: Enrollment Process to Critical Peak Pricing (CPP) or Hourly/Periodic Pricing Program
- U5: Active Load Management program

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3. Step by Step Analysis of Each Scenario

Use Case S2: Customer uses a premise EVSE (that does not include a charger) to connect the PEV to the utility.

3.1 Scenario Description

Primary scenario is the customer connects a premise EVSE to the PHEV, at home to charge the PHEV. The customer wants to take advantage of one or more of the utility programs.

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
Customer connects premise EVSE cord to PHEV.	Customer	Customer has enrolled PHEV with home utility	The utility has a record of the energy agreement related to the customer premise and the associated PHEV ID. PHEV binds or rebinds with utility.

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3.1.1 Steps for this scenario

<Describe the normal sequence of events that is required to complete the scenario.>

Step #	Actor	Description of the Step	Additional Notes
1	EVSE	When the EVSE has power from the premise, it sends a 12V signal on the pilot circuit.	
2	Customer	Customer connects EVSE cord to PHEV.	When the EVSE cord is connected to the PHEV, this 12V signal is reduced to 9V thru a vehicle resistor on the PHEV.
2a	EVSE	If the EVSE has multiple cords, the customer may have to enter more info at the EVSE.	This may or may not be required at a customer's home.
2b	EVSE	A public EVSE with or without multiple cords may require the customer to enter billing and/or personal info or verify the customer is authorized to connect at this site.	Billing could be for a parking space rather than cost of energy.
3	PHEV	PHEV wakes up.	The pilot signal wakes up the vehicle to a state sufficient to participate in charging.
4	EVSE	EVSE monitors pilot voltage drop from 12V to 9V.	This reduction to 9V tells the EVSE a vehicle is connected. It is also used by the EVSE that is also detecting the output of this circuit to start its PWM generator.
5	EVSE	EVSE starts Available Line Current (ALC) PWM generator.	The PWM generator magnitude is then transitioning from +9V to -12V magnitude and the rate matches the chart for Available Line Current (ALC) identified in J1772

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Step #	Actor	Description of the Step	Additional Notes
6	PHEV	PHEV prepares for charging rate (charger size or ALC, whatever is lowest).	The vehicle reads this PWM signal and if the on-board charger can draw more current, it will scale back to this ALC to prevent overloading the circuit on the premise. (e.g. a 40A premise circuit provides 32A and the PWM is 53.3%, whereas a 10 kW charger could draw 41.6A and overload the circuit).
~~6a~~	~~EVSE~~	~~Pilot PWM is reduced to 5% if additional communication is available.~~	~~We need to figure out why this is different than a cordset and if this 5% PWM is actually required.~~
7	PHEV/ESCI	PHEV and Energy Services Communications Interface (ESCI) initiate a secure communications session.	Implementation could have PHEV or ESCI as initiator of session.
8	PHEV	PHEV sends VIN	Utility authenticates PHEV is connected and implements program criteria.
8a	PHEV	PHEV sends Billing Request	This would confirm PHEV billing at premise (customer's home). Optional billing requests may be request if connecting to another Utility territory or public premises. These options would have been transmitted to the utility during the enrollment or could have been agreed to at public sites (i.e. curbside, etc).
9	PHEV	PHEV sends Energy Request (amount & rate)	Amount is total (based on RESS SOC). Rate is the lesser of ALC or charger size. Utility compares request with available and confirms or adjusts for message back to PHEV.

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Step #	Actor	Description of the Step	Additional Notes
9a	PHEV	PHEV sends schedule for energy request	Based on TOU program (See Use Case U1). Schedule is Connection Time, Full Charge Time and Balance Charge Time.
9b	PHEV	PHEV sends request for discrete event info.	Based on Discrete Event demand side management program (See Use Case U2)..
9c	PHEV	PHEV sends customers predetermined pricing info to utility	Based on Periodic/Hourly Pricing Price Response program (See Use Case U3)..
9d	PHEV	PHEV requests Critical Peak Pricing (CPP) or Hourly/Periodic Pricing info.	Based on Critical Peak Pricing (CPP) or Hourly/Periodic Pricing program (See Use Case U4)..
9e	PHEV	PHEV sends …	Based on Active Load Management program (See Use Case U5)..
10	Utility	Utility verifies PHEV ID (premise ID and/or customer ID) to ESCI	PEV binds (or rebinds) with utility
11	Utility	Utility transmits confirmation message via ESCI to End Use Measurement Device (EUMD) indicating successful binding with premise ESCI.	EUMD is required for revenue metering of electricity
12	Utility	Utility sends Energy Available (amount & rate)	
12a	Utility	Utility sends schedule for energy available (time spread energy will be delivered)	Based on TOU program (See Use Case U1).
12b	Utility	Utility sends discrete event alerts.	Based on Discrete Event demand side management program (See Use Case U2)..

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Step #	Actor	Description of the Step	Additional Notes
12c	Utility	Utility sends periodic/hourly prices.	Based on Periodic/Hourly Pricing Price Response program (See Use Case U3)..
12d	Utility	Utility sends Critical Peak Pricing (CPP) or Hourly/Periodic Pricing info.	Based on Critical Peak Pricing (CPP) or Hourly/Periodic Pricing program (See Use Case U4)..
12e	Utility	Utility sends …	Based on Active Load Management program (See Use Case U5)..
13	PHEV	PHEV prepares for charging.	When the vehicle is ready to accept energy, another resistor is switched into the pilot circuit that drops the +9V to either 6V or 3V. 6V means the EVSE does not have to turn on ventilation at the premise and 3V means it does. This voltage drop signals the EVSE to close it's switches and allow power to flow to the vehicle.
14	EUMD	PHEV Charges	EUMD records charging information and energy supplied to PHEV for each charging session. Charging information is included with additional info collected by ESCI (PHEV ID, Premise ID, Date & Time stamp) for each metering interval.
15	ESCI	ESCI transmits Date, time, duration and energy delivered to Utility and Vehicle.	This is the status of the cycle for the Utility, PHEV and Customer information.
16	Utility	Utility records each PHEV charging session for bill generation and reporting to customer account associated with this premise and PHEV ID.	

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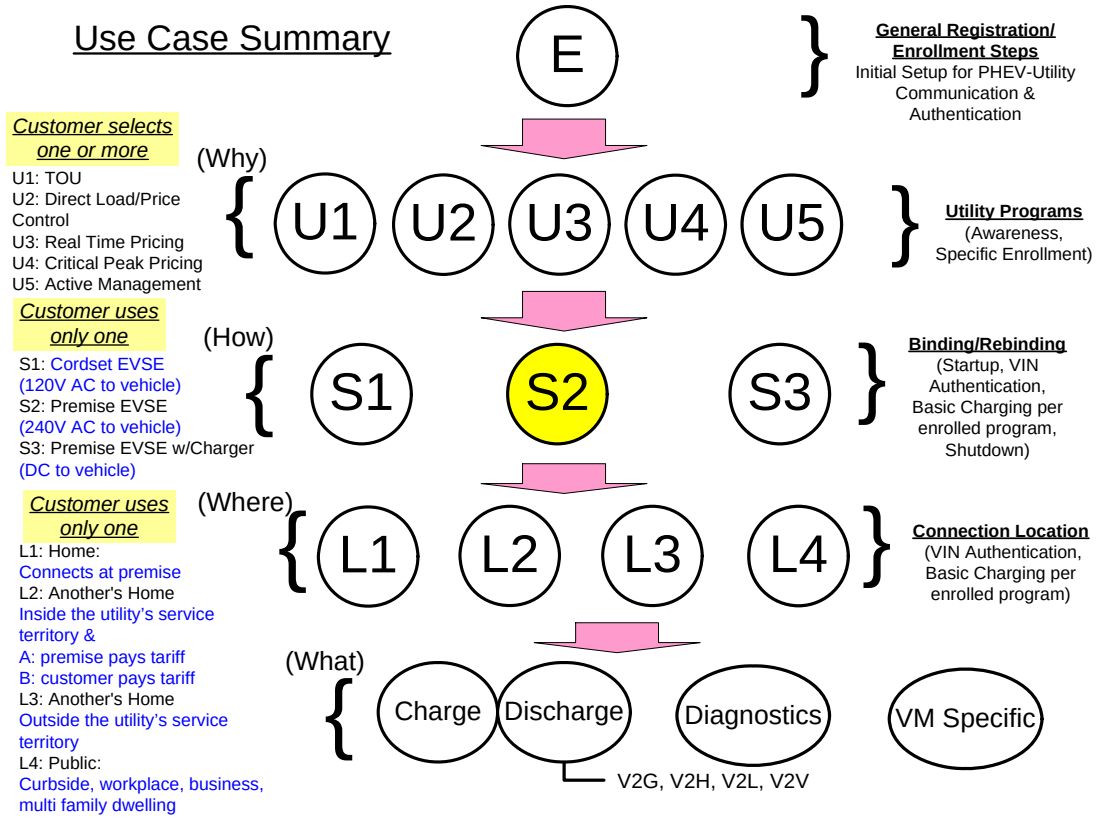
4. Requirements

This Use Case (S2) refers to the steps the customer will use while using a premise EVSE. This is preceded by one or more of the Utility program Use Cases (U1, 2 3 and/or 4) and is followed by the Location Use Cases L1, 2, etc. per the following diagram.



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4.1 Functional Requirements

Func. Req. ID	Functional Requirement	Associated Scenario # (if applicable)	Associated Step # (if applicable)

4.2 Non-Functional Requirements

Non-func. Req. ID	Non-Functional Requirement	Associated Scenario # (if applicable)	Associated Step # (if applicable)

4.3 Business Requirements

Bus. Req. ID	Business Requirement	Associated Scenario # (if applicable)	Associated Step # (if applicable)

5. Use Case Models

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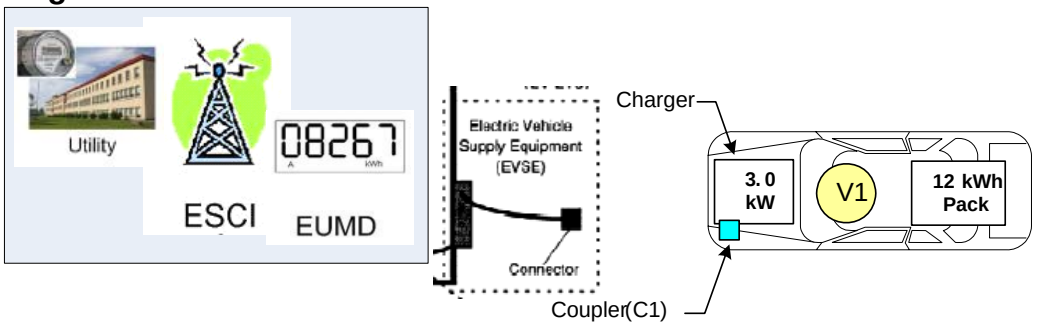
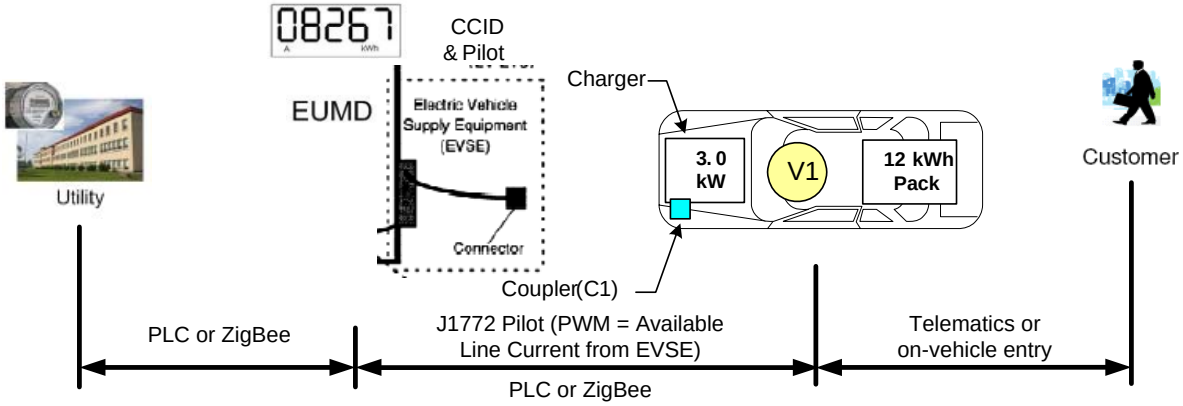
5.1 Equipment Diagram



PHEV Assumptions
EUMD & ESCI are in the EVSE The system does not include an AMI (SmartMeter).

5.2 Communication Path Diagram



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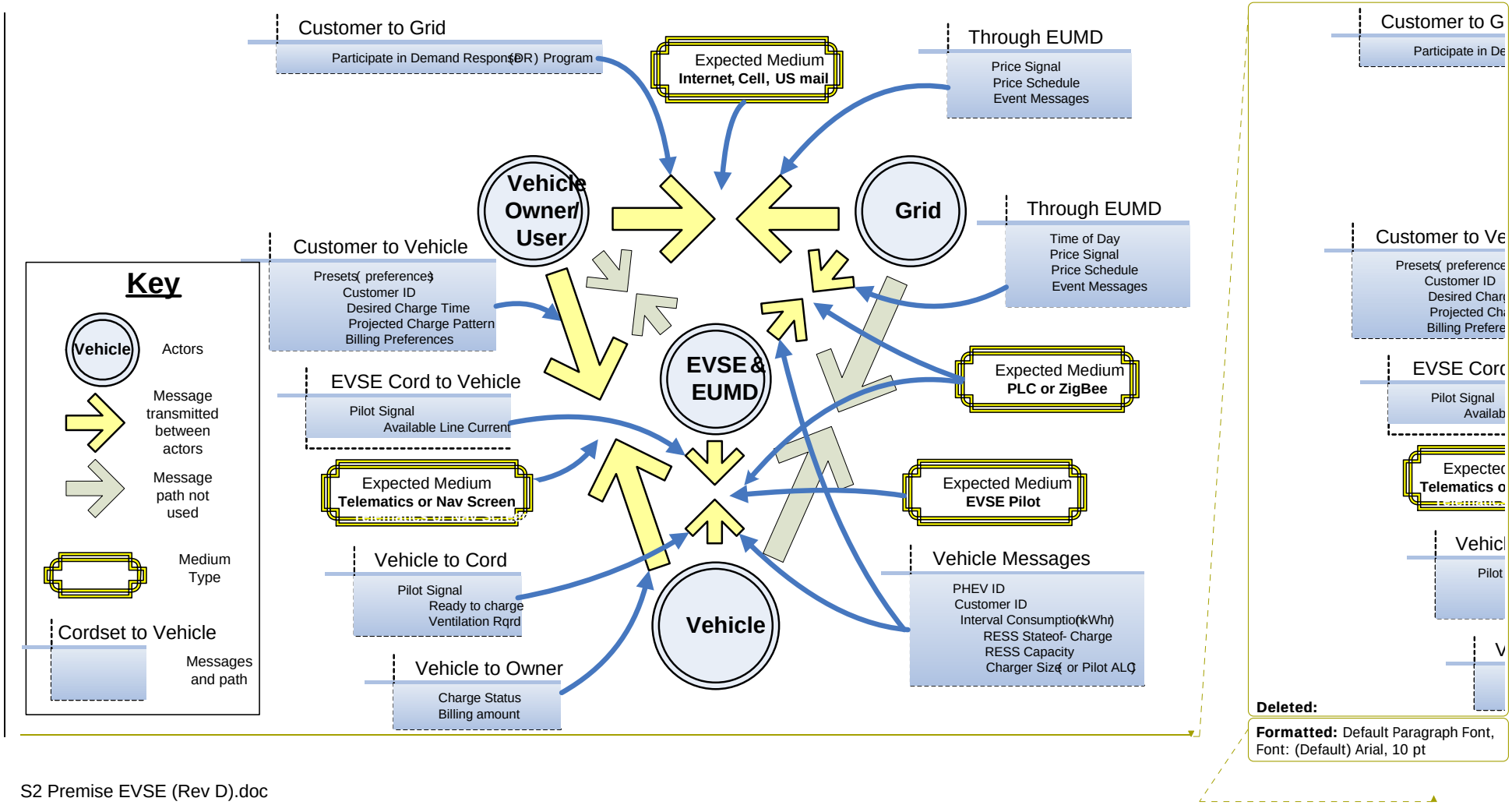
5.3 Activity Diagram

Note: Premise mounted EVSE shows ZigBee or PLC from the vehicle to utility thru the EVSE.



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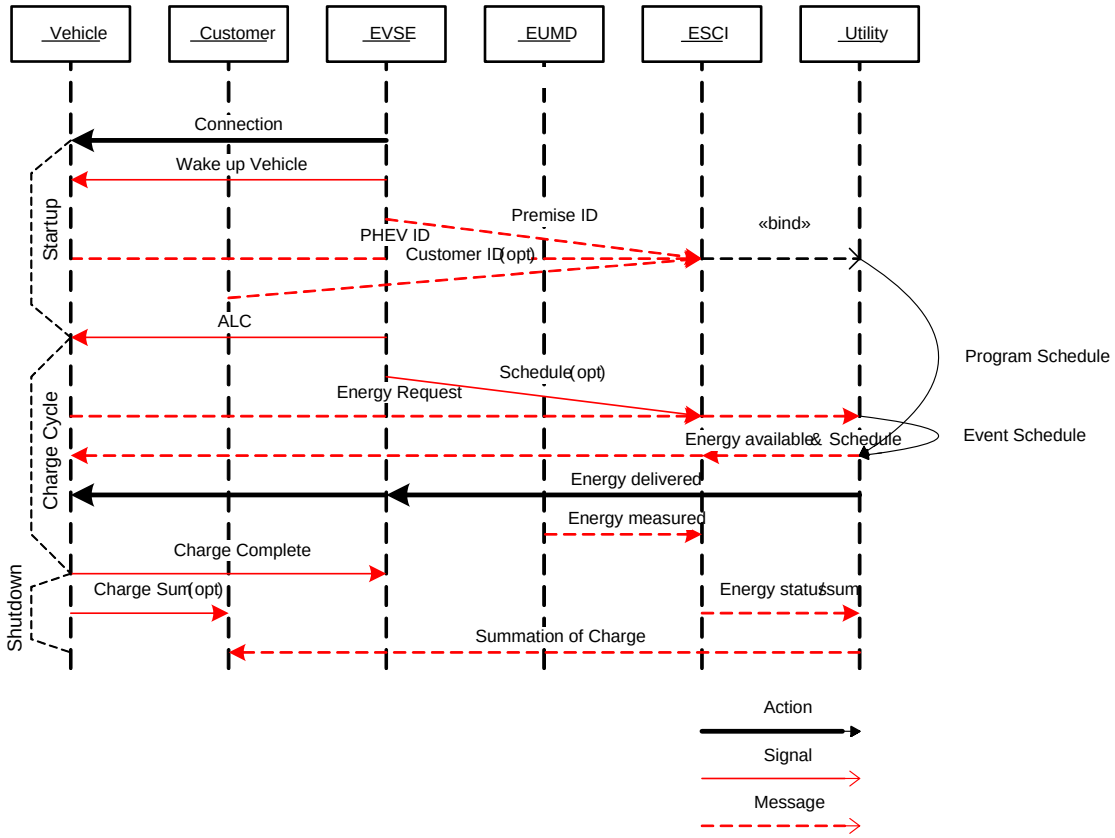
5.4 Sequence Diagram



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5.5 Message Diagram

This diagram shows the primary message requests sent from Vehicle and a potential message reply from the Utility. The Energy request (amount & rate) delivery time is based on the Utility program enrollment programmed into the vehicle or the EVSE. The utility responds with the optimization values for this cycle time.

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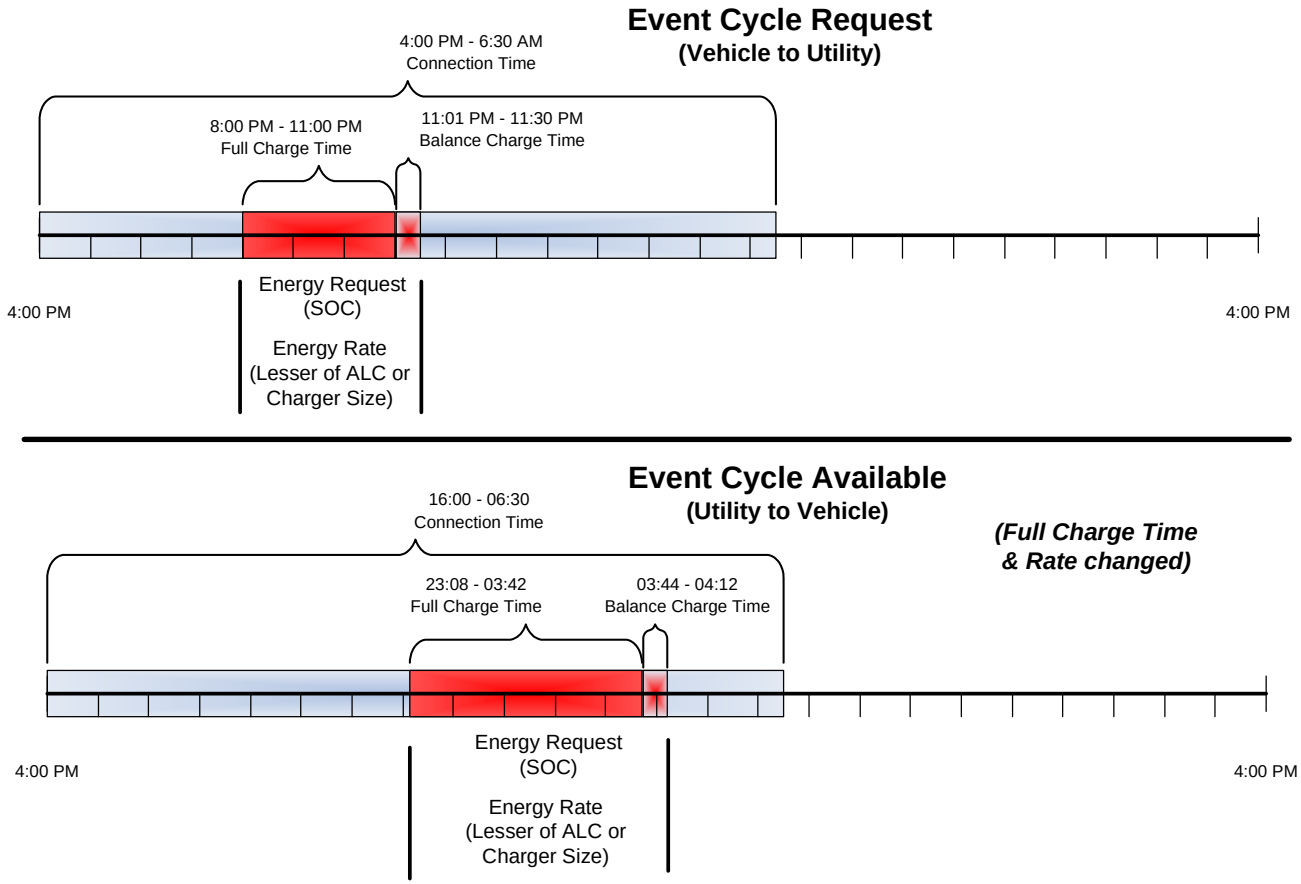

5.6 Multiple Port Scenario Diagram

Note: It is expected that some public EVSEs will need to allocate the resources for the combination of EVs and PHEVs that use them during the day. Business centers may include one or more of the following charging stations in their parking

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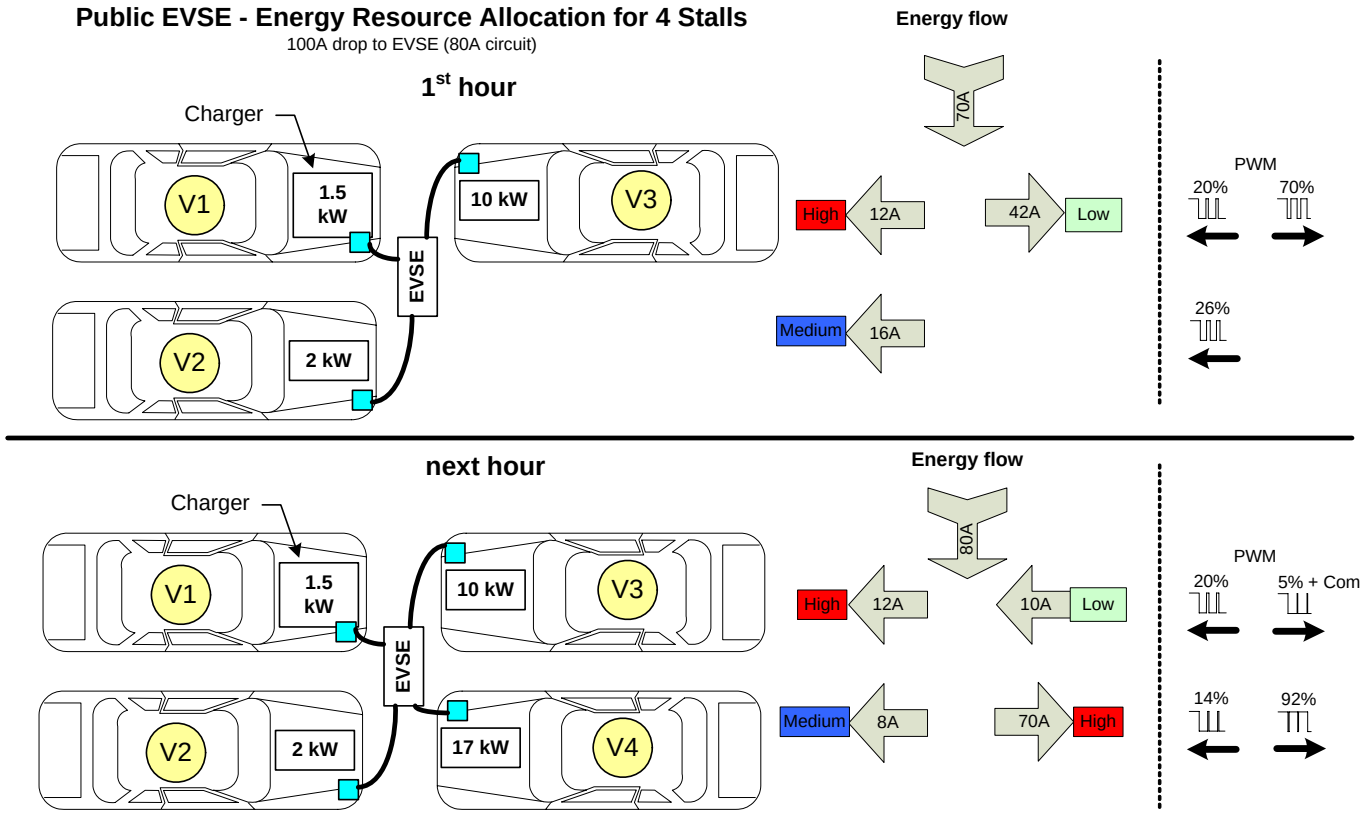
lot and are expected to have multiple vehicles use them during the day. One station may only accommodate one EV but will handle up to four PHEVs with the resources allocated.



5.7 EVSE Information Entry Screen Diagram

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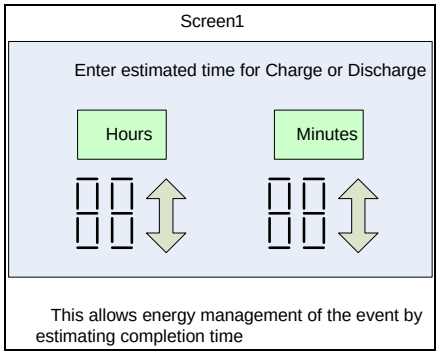
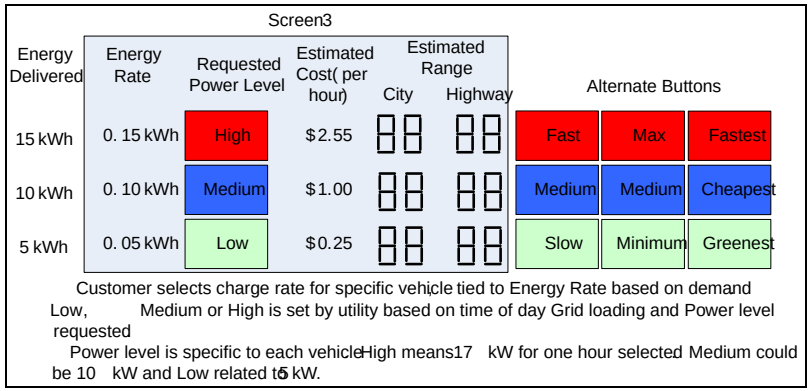
Instead of using the time identified in Step 8a, the customer may enter this on the public EVSE. It is expected the time to match the estimated time the customer will be at a particular business (i.e 1 ½ hours).
Another request may be for a certain amount of energy delivered to the vehicle. This may vary on vehicle RESS SOC and distance from home or other locations whereas the customer could take advantage of the initial enrollment program features. This is similar to a customer stopping for a couple of gallons of gas until they reach another known station for a fill-up.





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