Vehicle Use Case Task Force
S3: Customer connects vehicle to premise using Premise EVSE that includes the charger

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 10 & 13. Added U4 & L4 to section 4.	
			Added Section 1.2.	
	1-7-09	Gery Kissel	Added reference to Use Cases "U" to steps 10 & 13. Added key to Activity Diagram.	

Approvals

This document requires the following approvals.

Name	Title

Vehicle Use Case Task Force
S3: Customer connects vehicle to premise using Premise EVSE that includes the charger

1.1 Use Case Title

S3 – Vehicle Use Case
Customer connects vehicle to premise EVSE that includes the charger. This allows DC energy transfer to the vehicle. This EVSE also retains the AC energy transfer capabilities described in S2.

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 includes 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. Including the charger in the EVSE removes this burden from the vehicle (less weight, cost, etc) and retains it within the EVSE. This may be a favorable option for customers that trade vehicles frequently and only want to purchase the charger (or a large charger) one time and include it with the installation of the EVSE in their home or other locations. The customer could include a small charger on a PHEV for convenience charging using an EVSE cordset (1.5 to 2kW) and then use a larger charger in a premise EVSE, when available for faster charging rates. This may be a favorable option for EVs where they may require up to an 18 kW on-board charger that could be in the EVSE and the vehicle would only need a 3 kW unit.

This premise EVSE that includes the charger would be used for higher power levels than a premise EVSE without a charger. This EVSE would also include a selection device that would allow it's charger to be bypassed and also deliver AC energy to a vehicle.

Vehicles that use this premise EVSE may or may not 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

3. Step by Step Analysis of Each Scenario

Use Case S3: Customer uses a premise EVSE (that includes 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

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	EVSE	Selection is made if AC or DC energy is to be transferred.	The premise EVSE that includes a charger can also deliver AC energy to the vehicle (bypassing the EVSE charger and using the vehicle charger, if so equipped).
3	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.
3a	EVSE	If the EVSE has multiple cords, the customer may have to enter more info.	This may or may not be required at a customer's home.
3b	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.
4	PHEV	PHEV wakes up.	The pilot signal wakes up the vehicle to a state sufficient to participate in charging.
5	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.

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Step #	Actor	Description of the Step	Additional Notes
6	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. 5% PWM is automatically transmitted if DC energy is requested in step 2. AC energy transfer would transmit the PWM rate mating ALC of the EVSE. Refer to S1 or S2 for this.
7	EVSE	Pilot PWM is reduced to 5% since additional communication is required.	Additional communication for DC energy transfer is identified in J2293. This will be updated in J2836-2 & J2447-2.
8	PHEV/ESCI	PHEV and Energy Services Communications Interface (ESCI) initiate a secure communications session.	Implementation could have PHEV or ESCI as initiator of session.
9	PHEV	PHEV sends VIN	Utility authenticates PHEV is connected and implements program criteria.
9a	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).

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Step #	Actor	Description of the Step	Additional Notes
10	PHEV	PHEV sends Energy Request (amount & rate)	Amount is total (based on RESS SOC). Rate is the off-board charger size. Utility compares request with available and confirms or adjusts for message back to PHEV.
10a	PHEV	PHEV sends schedule for energy request	Based on TOU program. Schedule is Connection Time, Full Charge Time and Balance Charge Time.
10b	PHEV	PHEV sends request for discrete event info.	Based on Discrete Event demand side management program.
10c	PHEV	PHEV sends customers predetermined pricing info to utility	Based on Periodic/Hourly Pricing Price Response program.
10d	PHEV	PHEV requests Critical Peak Pricing (CPP) or Hourly/Periodic Pricing info.	Based on Critical Peak Pricing (CPP) or Hourly/Periodic Pricing program.
10e	PHEV	PHEV sends …	Based on Active Load Management program.
11	Utility	Utility verifies PHEV ID (premise ID and/or customer ID) to ESCI	PEV binds (or rebinds) with utility
12	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
13	Utility	Utility sends Energy Available (amount & rate)	

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Step #	Actor	Description of the Step	Additional Notes
13a	Utility	Utility sends schedule for energy available (time spread energy will be delivered)	Based on TOU program.
13b	Utility	Utility sends discrete event alerts.	Based on Discrete Event demand side management program.
13c	Utility	Utility sends periodic/hourly prices.	Based on Periodic/Hourly Pricing Price Response program.
13d	Utility	Utility sends Critical Peak Pricing (CPP) or Hourly/Periodic Pricing info.	Based on Critical Peak Pricing (CPP) or Hourly/Periodic Pricing program.
13e	Utility	Utility sends …	Based on Active Load Management program.
14	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.
15	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.
16	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.

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Step #	Actor	Description of the Step	Additional Notes
17	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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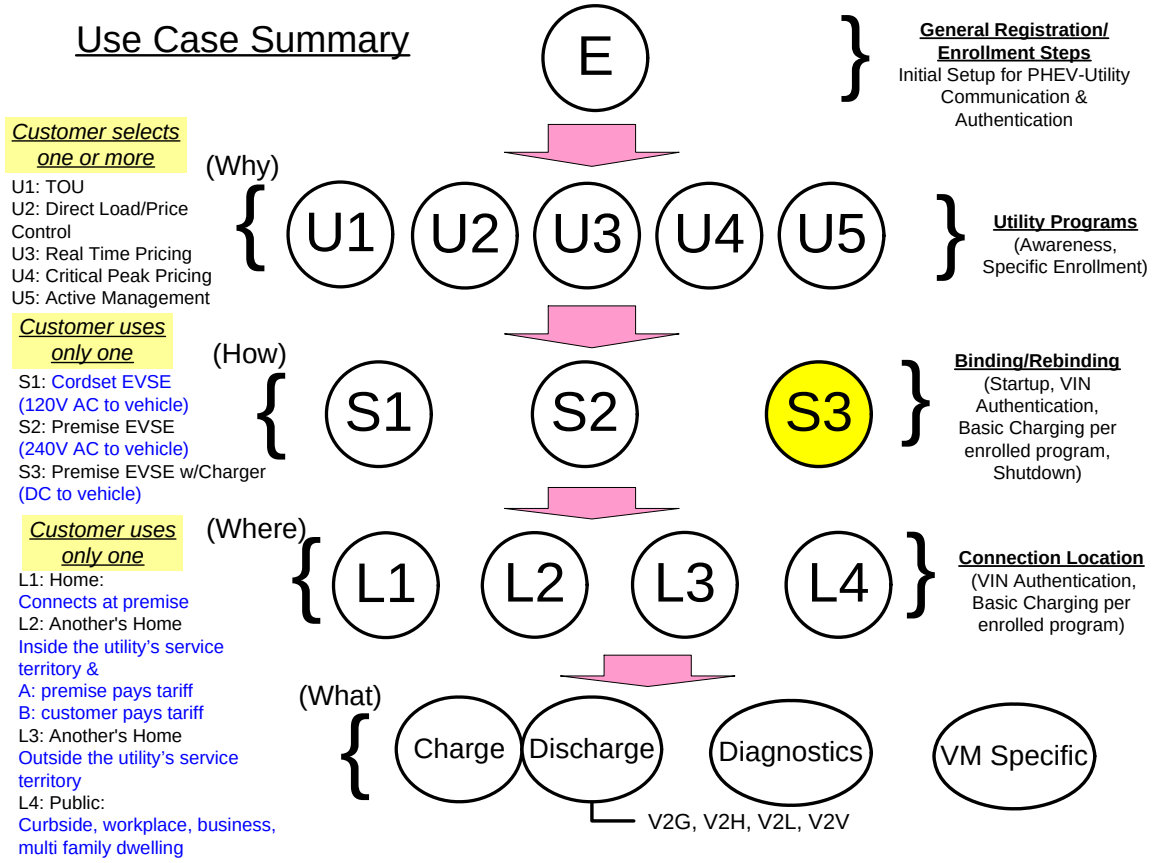
4. Requirements

This Use Case (S3) refers to the steps the customer will use while using a premise EVSE that includes the charger. 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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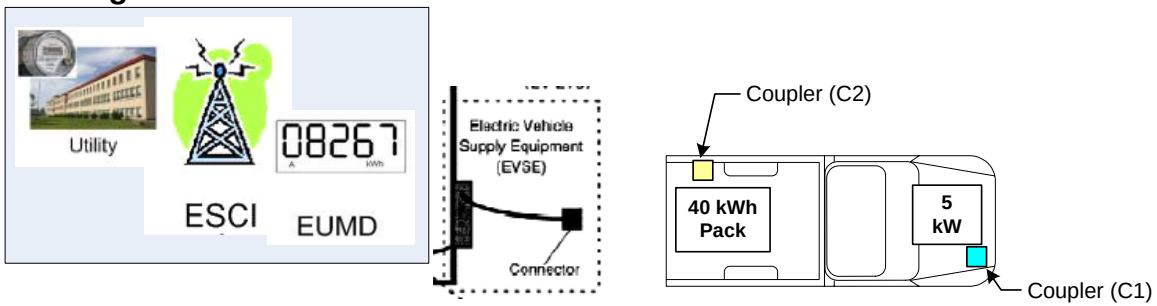
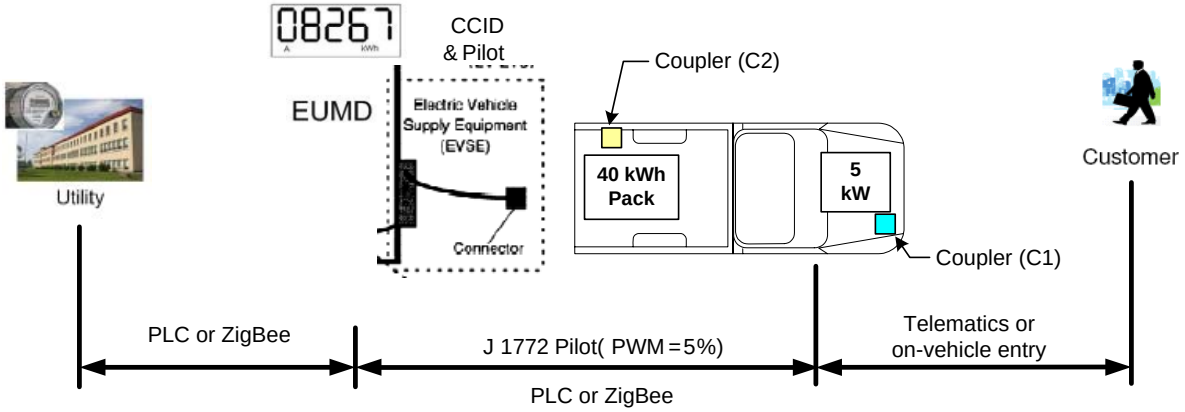
5.1 Equipment Diagram



PHEV Assumptions

The PHEV includes coupler (C1) for AC energy transfer and includes a second coupler (C2) for DC energy transfer.

5.2 Communication Path Diagram



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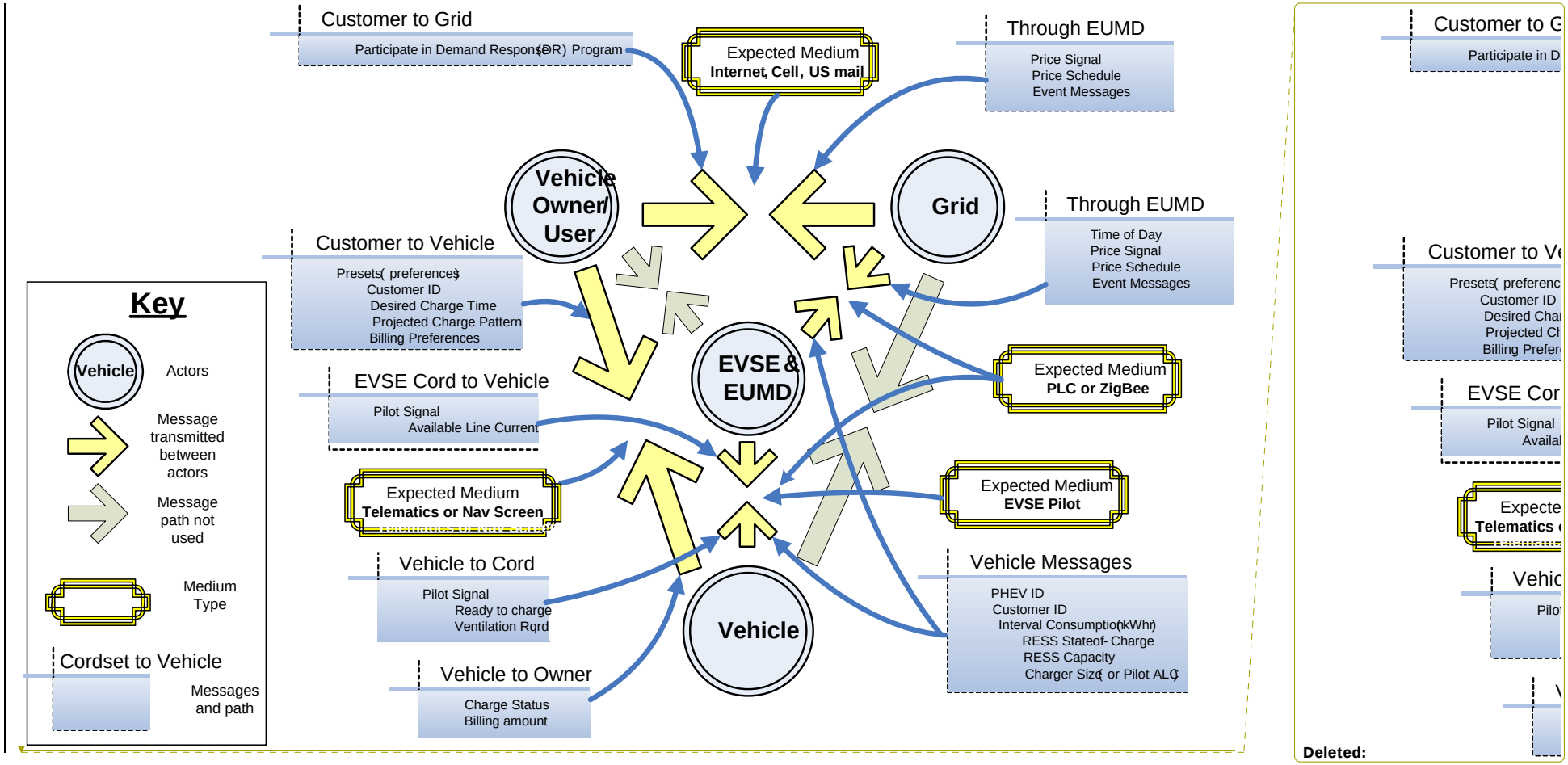
5.3 Activity Diagram

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



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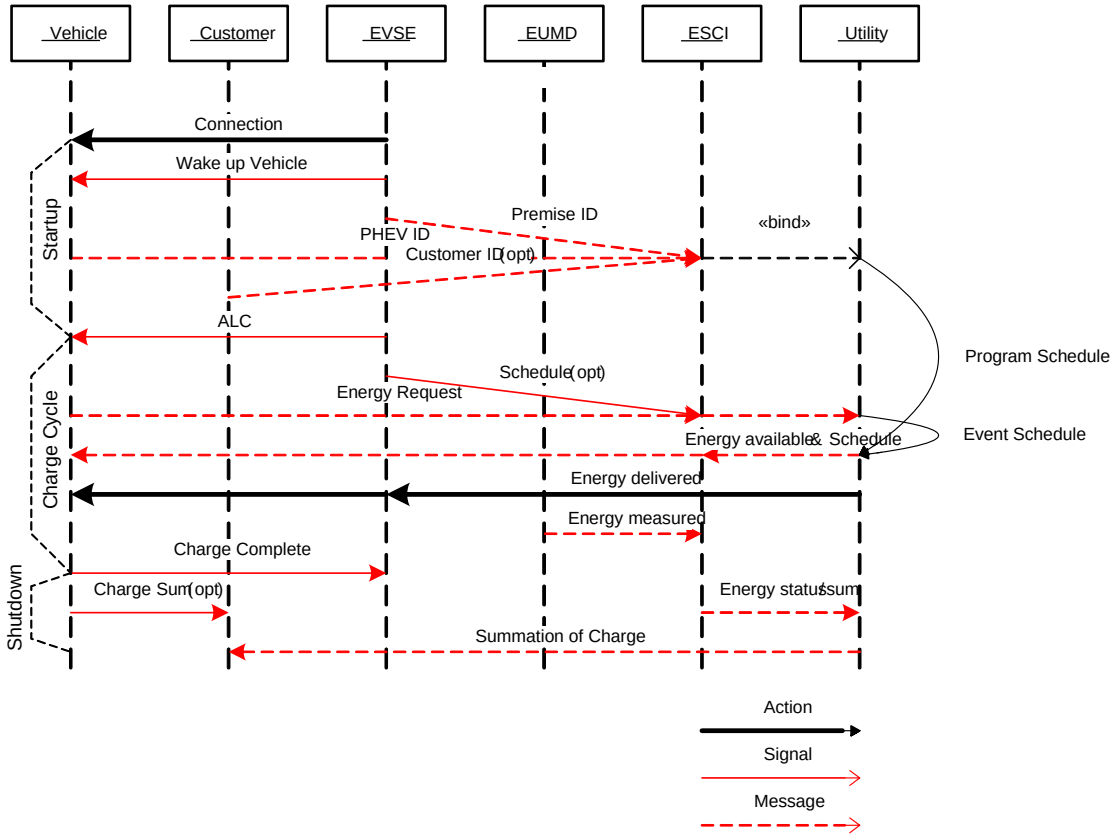
5.4 Sequence Diagram



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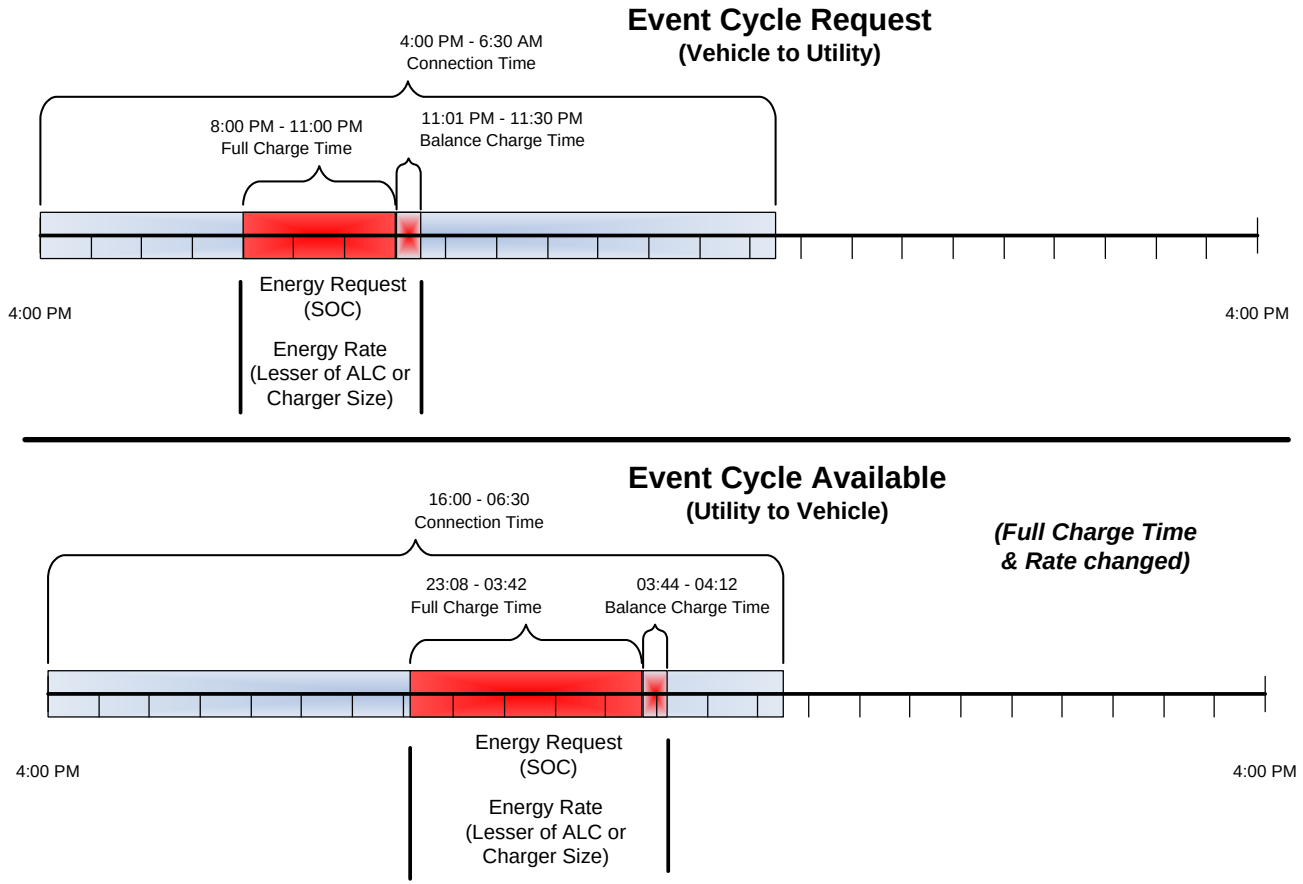
5.5 Message Diagram

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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