**Vehicle Use Case Task Force**
**S1: Customer connects vehicle to premise using Cordset 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. | |
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## Approvals

This document requires the following approvals.

| Name | Title |
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# Vehicle Use Case Task Force
# S1: Customer connects vehicle to premise using Cordset EVSE

## 1.1 Use Case Title

S1 – Vehicle Use Case
Customer connects vehicle to premise using Cordset 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 an EVSE cordset. 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 an Electric Vehicle Supply Equipment (EVSE) Cordset, as described in J1772. It is expected to have the cordset stay with the vehicle and used in both home and public applications.

The cordset would be used for convenience charging that is expected to connect to either a 15A or 20A 120V outlet.

Vehicles that include a 1.5 kW or 2 kW on-board charger uses this cordset connected to the respective 15A or 20A outlets (Energy Portals - EP).

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 S1: Customer uses an EVSE cordset to connect the PEV to the utility.

## 3.1 Scenario Description

Primary scenario is the customer connects an EVSE cordset to the PHEV and Energy Portal, 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 EVSE cordset to Energy Portal and 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 | Customer | Customer connects EVSE cordset to Energy Portal at Premise. | When the EVSE has power from the grid, it sends a 12V signal on the pilot circuit to the PHEV. |
| 2 | Customer | Customer connects EVSE cordset to PHEV. | When the EVSE is then connected to the PHEV, this 12V signal is reduced to 9V thru a vehicle resistor on the PHEV. |
| 3 | PHEV | PHEV wakes up. | The pilot signal wakes up the vehicle for it to latch on vehicle power. |
| 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 |
| 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 overload the circuit on the premise. (i.e. a 15A EP provides 12A and the PWM is 20%, 240V power levels are higher PWM rates). |

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| Step # | Actor | Description of the Step | Additional Notes |
|---|---|---|---|
| 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).<br>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.<br>Utility compares request with available and confirms or adjusts for message back to PHEV. |
| 9a | PHEV | PHEV sends schedule for energy request | Based on TOU program (See Use Case U1).. |
| 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).. |

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| Step # | Actor | Description of the Step | Additional Notes |
|---|---|---|---|
| 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) | Amount is total (based on RESS SOC). Rate is the lesser of ALC or charger size.<br>Utility compares request with available and confirms or adjusts for message back to PHEV. |
| 12a | Utility | Utility sends schedule for energy available (time spread energy will be delivered) | Based on TOU program.<br>Schedule is Connection Time, Full Charge Time and Balance Charge Time (See Use Case U1).. |
| 12b | Utility | Utility sends discrete event alerts. | Based on Discrete Event demand side management program (See Use Case U2).. |
| 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).. |

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| Step # | Actor | Description of the Step | Additional Notes |
|---|---|---|---|
| 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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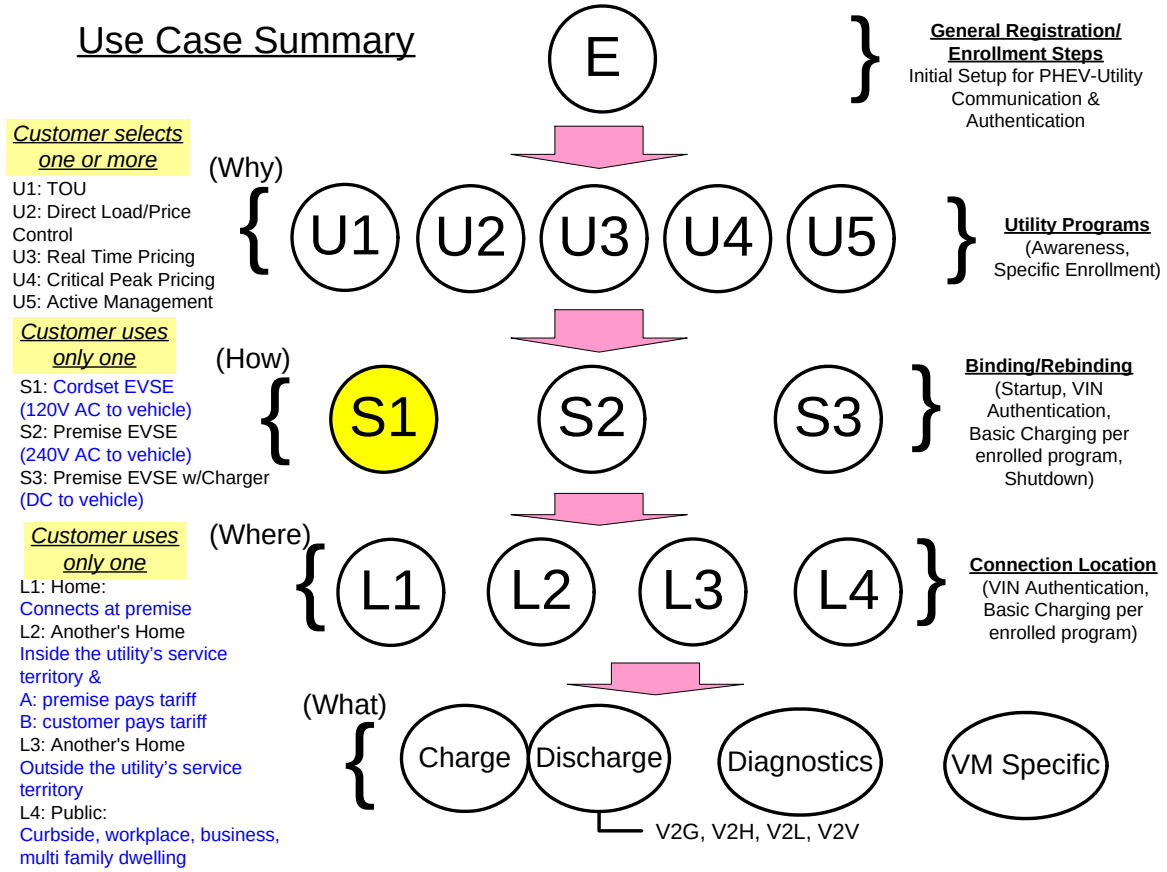
## 4. Requirements

This Use Case (S1) refers to the steps the customer will use while using a Cordset 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.



## 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) |
|---|---|---|---|
| | | | |
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## 4.3 Business Requirements

| Bus. Req. ID | Business Requirement | Associated Scenario # (if applicable) | Associated Step # (if applicable) |
|---|---|---|---|
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# 5. Use Case Models

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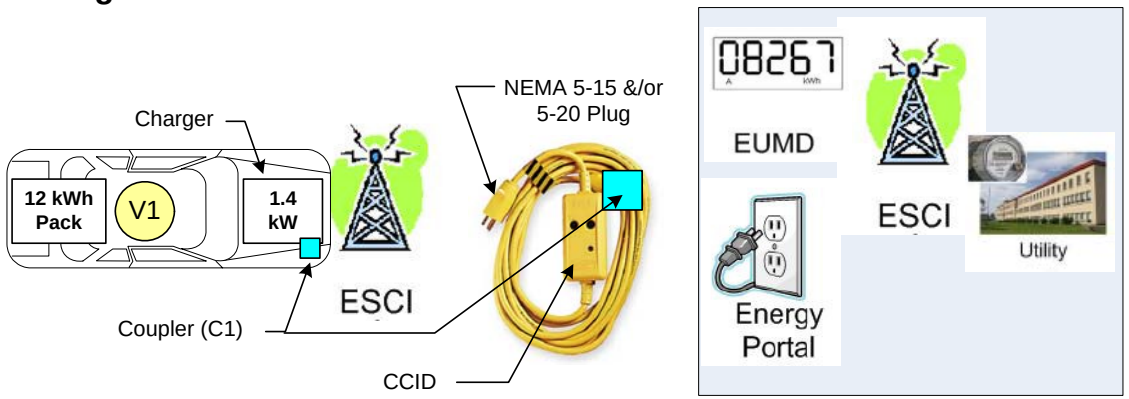
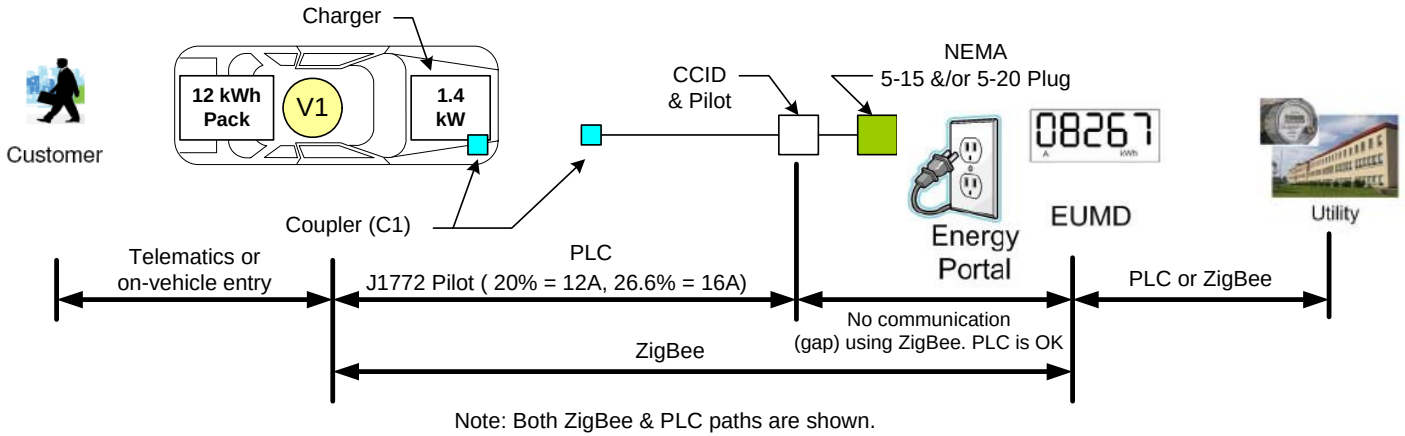
## 5.1 Equipment Diagram




## 5.2 Communication Path Diagram




Note: Both ZigBee & PLC paths are shown.

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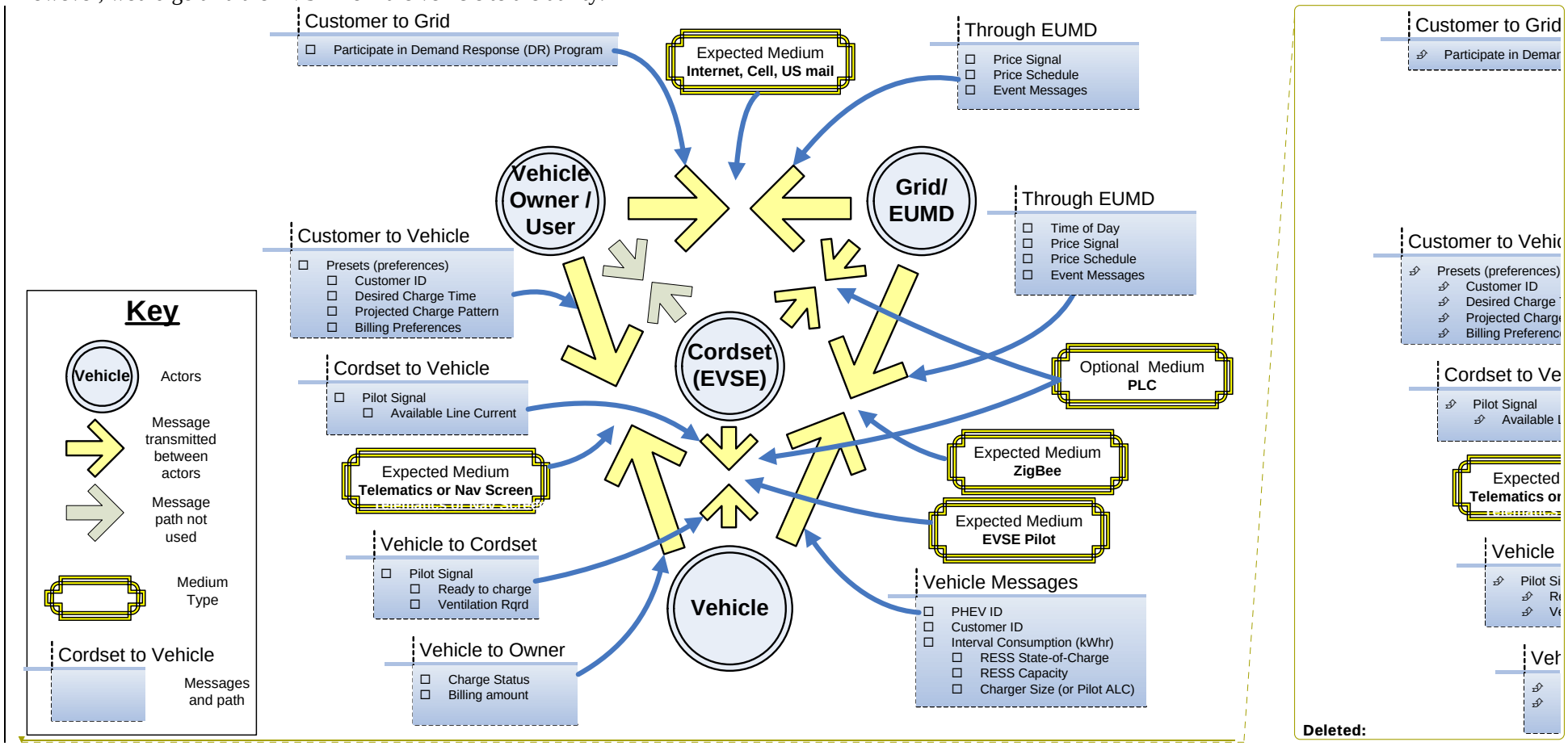
## 5.3 Activity Diagram

Note: Cordset EVSE shows ZigBee from the vehicle to utility since the cordset is not expected to include a ZigBee chip. PLC however, would go thru the EVSE from the vehicle to the utility.



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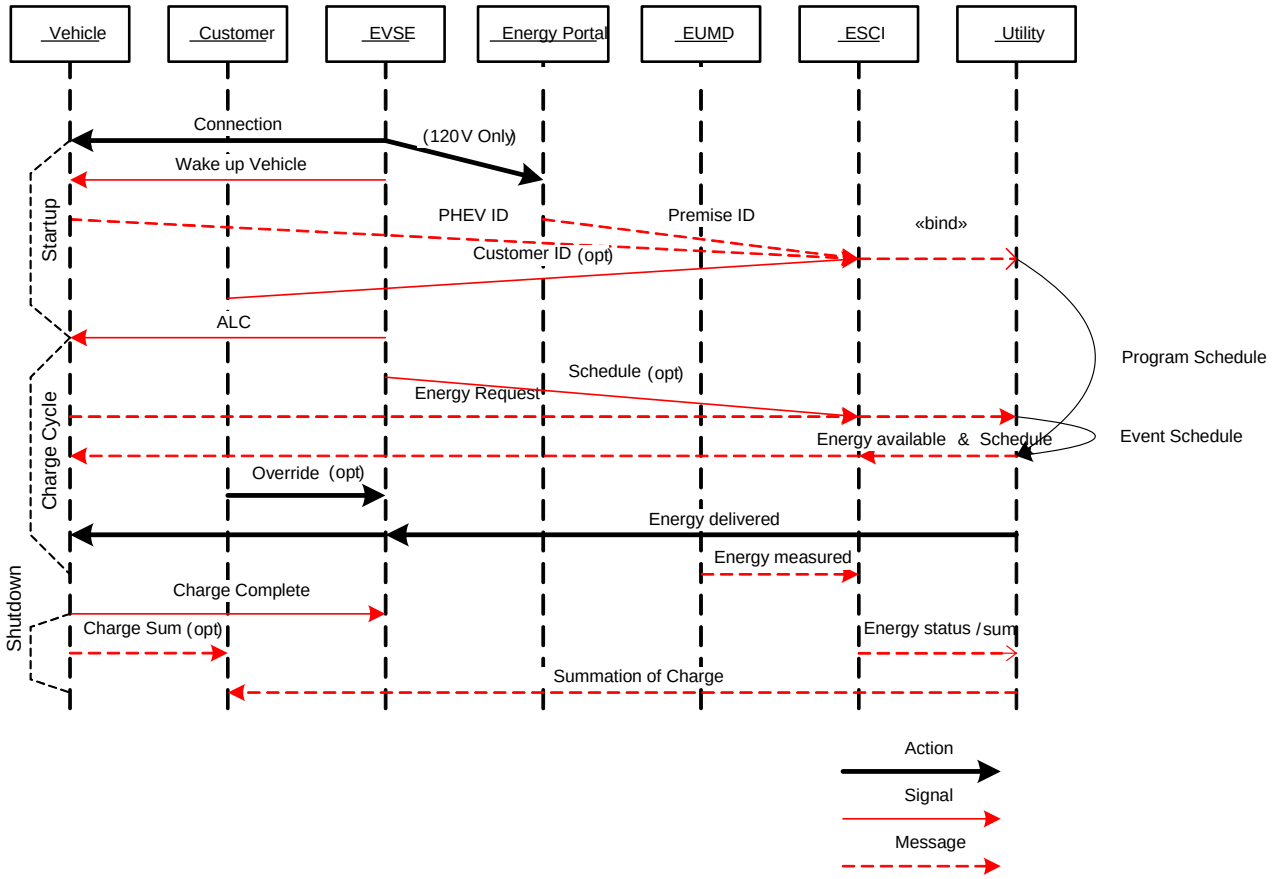
## 5.4 Sequence Diagram



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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 a smart socket. The utility responds with the optimization values for this cycle time.