



# Appendix-8

## End-to-End Test Results



**End-to-End Test Results**

# End-to-End Test Results

Version 1.3

Prepared by D'Artagnan Consulting, LLP

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## Revision History

| Name Of Person Responsible For Change | Date Of Revision | Reason For Change and Short Summary of Revisions Made                    | Version Number |
|---------------------------------------|------------------|--|----------------|
| Matthew Dorfman<br>Roshini Durand     | 6/30/16          | First Draft  | 1.0            |
| Matthew Dorfman                       | 6/30/16          | Minor Errors Corrected   | 1.1            |
| Matthew Dorfman                       | 8/3/16           | Added discussion of Driveway Failure Conditions (section 5.5, pp. 23-25) | 1.2            |
| Matthew Dorfman                       | 5/18/17          | Updates for inclusion in appendix of Final Report                        | 1.3            |
|                                       |                  |  |                |
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|                                       |                  |  |                |



## End-to-End Test Results

### Executive Summary

This document contains the results of End-to-End testing. End-to-End testing is a pre-operational launch trial and a system acceptance test. Five test cases for End-to-End testing including a range of scenarios were carried out over a one-week period in May including all Road Charge Pilot Project Account Managers simultaneously. Further description of End-to-End testing is given in section 1.

During testing, 35 participants created a total of 40 actual accounts, including several who signed up for two different accounts (transitioned during End-to-End testing). All operational concepts (mileage reporting methods) were included for all Account Managers offering them:

- ▶ OBD-II device without GPS
- ▶ OBD-II device with GPS
- ▶ Smartphone without Location
- ▶ Smartphone with Location
- ▶ Vehicle Telematics
- ▶ Commercial Vehicle Mileage Meter

Further statistics of End-to-End testing are given in section 2.

The testing was generally technically successful, but a range of human interface issues were discovered in four areas:

- ▶ Account Sign-up
- ▶ Participant Experience Between Sign-up and Payment (General)
- ▶ Mileage Reporting Method-specific
- ▶ Payment and Closeout

Actions were taken to correct all of these issues prior to pilot enrollment. Details of these human interface issues are given in section 3.

The testing devices were accurate measures of distance. Median error rates ranged from 0.3% to 2.3% depending on the mileage reporting method—and some of these small errors may have arisen from the participant recording mileage instead of the device itself. While there were not sufficient devices in the test to ensure statistical significance, these small error rates should reassure participants that their distances are being measured accurately. More details on accuracy computations are presented in section 4.

Failure conditions testing was generally successful. OBD II devices recorded instances of being plugged into a new vehicle as well as instances of being unplugged and re-plugged. For manual methods, the CalSAM correctly identified instances of unreasonably high or low mileage being entered into the system. The only failure condition that could not be observed was with Driveway: the one attempt to create a Failure Condition with the Driveway device did not succeed. However, there was no lack of accuracy in the device's measurements—the observed error for all days of testing was less than 1%. More details on failure conditions testing are presented in section 5.



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Interoperability testing was successful, in that both Azuga and IMS were capable of creating invoices for a simulated out-of-state road charge entity. This lays the groundwork for simulated interoperability testing in the actual pilot, in which a number of vehicles near a state border can be used for simulated interoperability testing with a simulated entity in another state for a limited period of time. More details on failure conditions testing are presented in section 6.

Account Management Oversight testing was generally successful. Useful mileage data was collected from all account managers. A few data discrepancies were noted, which will be resolved directly with Account Managers. More details on Account Management Oversight testing and an example Account Management Oversight Report Template are presented in section 7.

The conclusion of End-to-End testing is that the pilot system is ready for the start of enrollment and go-live. This conclusion and some high-level lessons learned are presented in section 8.



## End-to-End Test Results

# 1. Introduction

This report describes the results of the End-to-End Testing of the California Road Charge Pilot Project system.

## 1.1. Contents

The remainder of Section 1 provides a description of the events End-to-End testing, including the background and preparations for End-to-End testing, and the test cases performed.

- ▶ Section 2 provides basic statistics on the test cases, both as they were originally planned, and as they were actually performed.
- ▶ Section 3 provides an analysis of the implications of testing for the basic functionality and human interfaces.
- ▶ Section 4 is an analysis of device accuracy both for distance and fuel measurement.
- ▶ Section 5 describes the failure conditions during End-to-End testing.
- ▶ Section 6 describes the testing of interoperability during End-to-End testing.
- ▶ Section 7 describes the use of the Account Management Oversight system during End-to-End testing.
- ▶ Section 8 provides the next steps and lessons learned from End-to-End testing.

## 1.2. Description of End-to-End Testing

End-to-End testing is a pre-operational launch trial and a system acceptance test. The test cases for End-to-End testing include a range of scenarios to be carried out over a one-week period for all Account Managers simultaneously. The original target number of vehicles for mileage reporting methods is that each account manager, for each mileage meter/operational concept that they support, will have three vehicles outfitted with that mileage meter/operational concept type.

Each test case given below describes a different scenario that was tested during End-to-End testing. The testing team secured test vehicles and drivers from within Caltrans and other California government agencies.<sup>1</sup> The Account Managers were responsible for providing any necessary equipment or software for outfitting the vehicles. Account Manager verified that the vehicles were compatible with their intended products prior to testing.

Taken together, the test cases were intended to represent the circumstances that participants may experience during testing.

Test Background and Preparations is described in section 1.2 below.

End-to-End Testing includes six test cases described in subsections 1.3 below.

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<sup>1</sup> Drivers came from Caltrans and other government agencies including: California Board of Equalization, California Department of Motor Vehicles, California Highway Patrol, California State Transportation Agency, California Transportation Commission, Legislative Assembly Transportation Committee, El Dorado County Transportation Commission, Association of Monterey Bay Area Governments.





## End-to-End Test Results

### 1.3. Background and Preparations

#### 1.3.1. Actors and Roles

The roles of the primary actors in End-to-End testing are as follows:

- ▶ **Participants**—the individuals selected to support the End-to-End testing, representing participants in the larger pilot.
- ▶ **Account Managers** (Account Managers)—the two Commercial Account Managers (CAMs), one California State Account Manager (CalSAM), and one Commercial Vehicle Account Manager (EROAD) supporting the pilot.
- ▶ **Testing Team**—Pilot Delivery Team conducting and observing the test.

At the end of End-to-End testing, participants were asked to submit a survey about their experience of End-to-End testing. This survey appears below in Appendix A.

#### 1.3.2. On-Boarding of Participants and Their Vehicles

On the morning of the first day, each End-to-End test participant/driver was added to an Account Manager (one of the Commercial Account Managers or the State Account Managers). Commercial Vehicle Account Manager completes these same activities separately.

### 1.4. Test Cases

#### 1.4.1. Mileage and Optional Fuel Usage Data Collection, Including Accuracy and Location-Based Measurement Testing for Devices with Location-Based Functionality

All vehicles were driven for Monday-Thursday of the week of testing. Mileage and fuel usage data were reported and recorded, and checked against odometer records for the week. Some vehicles were equipped with Trimble GPS devices to check measurement accuracy. Some vehicles with GPS devices traveled to Reno to check location-based measurement. Commercial vehicles completed these operations separately.

#### 1.4.2. Interoperability

Two of the GPS participants driving to Reno, Nevada, were chosen to simulate interoperability (one from each of the three operational concepts with GPS).

Each of these participants/vehicles was registered to live at an address in Reno, Nevada. They acted as Nevada vehicles and receive an invoice corresponding to the Nevada mileage.

The testing team will simulate interoperability with a hypothetical Nevada road charge entity. Interoperability will be demonstrated through simulated invoices generated by the account managers.

#### 1.4.3. Change Account Details and Change Operational Concept

In this test case, selected End-to-End test participants changed operational concepts or Account Managers. This test case was intended to verify that the change was smooth for the participant, and that no data was lost.



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### 1.4.4. Account Closeout, Invoicing, and Payment Processing

In this test case, all participants will close out their accounts. Commercial Vehicles complete this process separately.

### 1.4.5. Operation Under Failure Conditions

In this test case, reasonable failure conditions will be simulated to be sure that the system is fault tolerant, i.e., that it can operate correctly under failure conditions.

Failure conditions to be tested will be as follows:

#### OBD-II devices (both Azuga and IMS):

The main failure modes checked were the appropriate response to the devices being removed from a vehicle and not plugged back in, or plugged back into a different vehicle:

- ▶ One vehicle for each account managers was unplugged, and not plugged in until the next day.
- ▶ One vehicle with each device will be asked to plug it into another vehicle at the time of Payment.

#### Manual Methods

Unrealistic self-reported odometer readings were tested:

- ▶ Mileage Permit, unrealistically high second self-reported odometer reading
- ▶ Mileage Permit, unrealistically low second self-reported odometer reading
- ▶ Odometer Charge, unrealistically high second self-reported odometer reading
- ▶ Odometer Charge, unrealistically low second self-reported odometer reading

#### Smartphone with location

The only known failure mode would be if an individual were to disable GPS / location-based services for the app. One Friday, after the app has been fully tested, one vehicle will sign up for the app again and follow the following procedure:

- ▶ Step 1: Make sure that trip capture status of the app is on. Drive for 10 miles. Wait 1 hour.
- ▶ Step 2: Disable location services and make sure that trip capture status of the app is off. Drive for 10 miles. Wait 1 hour.
- ▶ Step 3: Enable location services and make sure that trip capture status of the app is on. Drive for 10 miles.



## End-to-End Test Results

## 2. Test Case Statistics as Planned and Performed

This section provides statistics on the test cases. Information is provided both on how the test cases were planned as well as on how they were actually performed.

### 2.1. Test Case Statistics

The following are the basic parameters of testing:

- ▶ **Testing Start:** May 16, 2016
- ▶ **Testing End:** May 20, 2016
- ▶ **Total Number of Participants:** 35
- ▶ **Account Managers Supporting:** Azuga, IMS, CalSAM
- ▶ **Mileage Reporting Methods:** see below, section 2.1.3 in Table 2-2
- ▶ **Test Cases:** see below, section 2.1.4 in Table 2-3.

Note that two of the test cases—failure conditions and interoperability, are covered in detail in separate sections. Failure Conditions is covered in detail in Section 5, and Interoperability is covered in Section 6.

#### 2.1.1. Number of Enrolled Participants

32 out of the 35 participants actually enrolled with at least one of the three Account Managers. The remaining three participants did not enroll either because they experienced difficulties with the enrollment process or because they chose not to enroll due to their time commitments on other projects.

#### 2.1.2. Number of Active Accounts

The measure of active accounts includes 2 accounts for vehicles that were planned to switch accounts. There were 40 active accounts instead of the 44 initially planned due to the 3 individuals who did not create accounts, one of whom was scheduled to switch accounts from one account manager to another. The number of planned and actual accounts by Account Manager is presented below in Table 2-1.

**Table 2-1 Number of Planned and Actual Accounts by Account Manager**

| Account Manager | Number of Active Accounts |           |            | Explanation                                    |
|-----------------|---------------------------|-----------|------------|--|
|                 | Planned                   | Actual    | Difference |  |
| CalSAM          | 13                        | 13        | 0          | N/A  |
| Azuga           | 22                        | 19        | 3          | 3 participants did not activate their accounts |
| IMS             | 9                         | 8         | 1          | 1 participant did not activate his account     |
| <b>TOTAL</b>    | <b>44</b>                 | <b>40</b> | <b>4</b>   |  |

#### 2.1.3. Test Cases Per Mileage Recording Option

There were 4 less test cases for OBD-II no GPS, OBD-II GPS and vehicle telematics mileage reporting option. The number of planned and actual accounts by mileage reporting option is presented below in Table 2-2.



**End-to-End Test Results**

**Table 2-2 Number of Planned and Actual Accounts by Mileage Reporting Option**

| Mileage Recording Option      | Number of Accounts |           |            | Explanation  |
|-------------------------------|--------------------|-----------|------------|--|
|                               | Planned            | Actual    | Difference |  |
| OBD-II no GPS                 | 6                  | 5         | 1          | 1 participant did not activate her account   |
| OBD-II GPS                    | 11                 | 10        | 1          | 1 participant did not activate her account   |
| Smartphone without GPS        | 7                  | 7         | 0          | N/A  |
| Smartphone with GPS           | 3                  | 3         | 0          | N/A  |
| Vehicle Telematics*           | 4                  | 2         | 2          | 1 participant did not activate his account<br>1 participant's mileage was not recorded due to a telematics initialization issue<br>*Telematics tests were performed separately by Smartcar |
| Mileage Permit                | 4                  | 4         | 0          | N/A  |
| Odometer Charge (Vehcon)      | 4                  | 4         | 0          | N/A  |
| Odometer Charge (BAR Reading) | 2                  | 2         | 0          | N/A  |
| Time Permit                   | 3                  | 3         | 0          | N/A  |
| <b>TOTAL</b>                  | <b>44</b>          | <b>40</b> | <b>4</b>   |  |

**2.1.4. Specific Test Cases**

All the test cases were performed as planned, except for the vehicles using the vehicle telematics concept. For vehicle telematics, one vehicle supported for the base cases of Mileage and Optional Fuel Use Data Collection and Account Closeout, Invoicing and Payment Processing for both account managers (Azuga and IMS). The number of planned and actual accounts by specific test cases is illustrated below in Table 2-3.

**Table 2-3 Number of Planned and Actual Accounts by Specific Test Cases**

| Specific Test Cases                                | Planned | Actual | Discrepancy | Explanation   |
|--|---------|--------|-------------|---|
| Mileage and Optional Fuel Use Data Collection      | 32      | 32     | 0           | N/A   |
| Out of State Travel                                | 9       | 9      | 0           | N/A   |
| Interoperability                                   | 2       | 2      | 0           | N/A   |
| Change of Operational Concept                      | 9       | 7      | 2           | 2 participants on Smartcar telematics were inactive |
| Change of Account Details                          | 4       | 4      | 0           | N/A   |
| Operation Under Failure Conditions                 | 3       | 3      | 0           | N/A   |
| Account Closeout, Invoicing and Payment Processing | 32      | 32     | 0           | N/A   |

**2.2. Data Sets Available**

32 participants successfully registered with the three Account Managers (Account Manager). 40 accounts were activated for the tests as summarized in the chart below including eight accounts created to test change of operational concepts. The number of active accounts per Account Manager is illustrated below in Figure 2-1.



**End-to-End Test Results**

**Figure 2-1 Number of active accounts per AM**

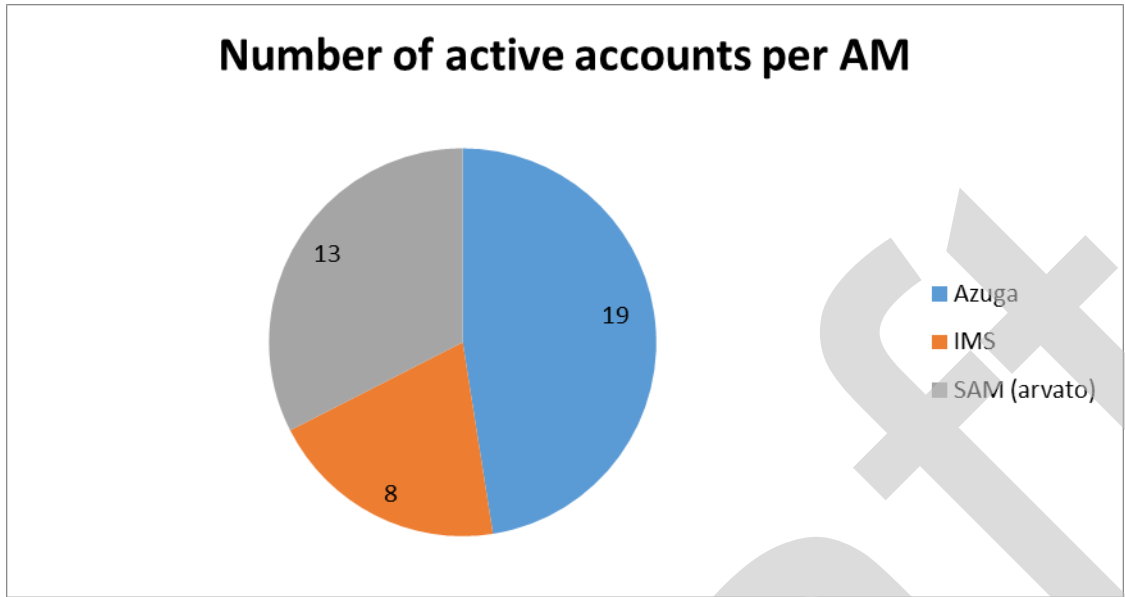
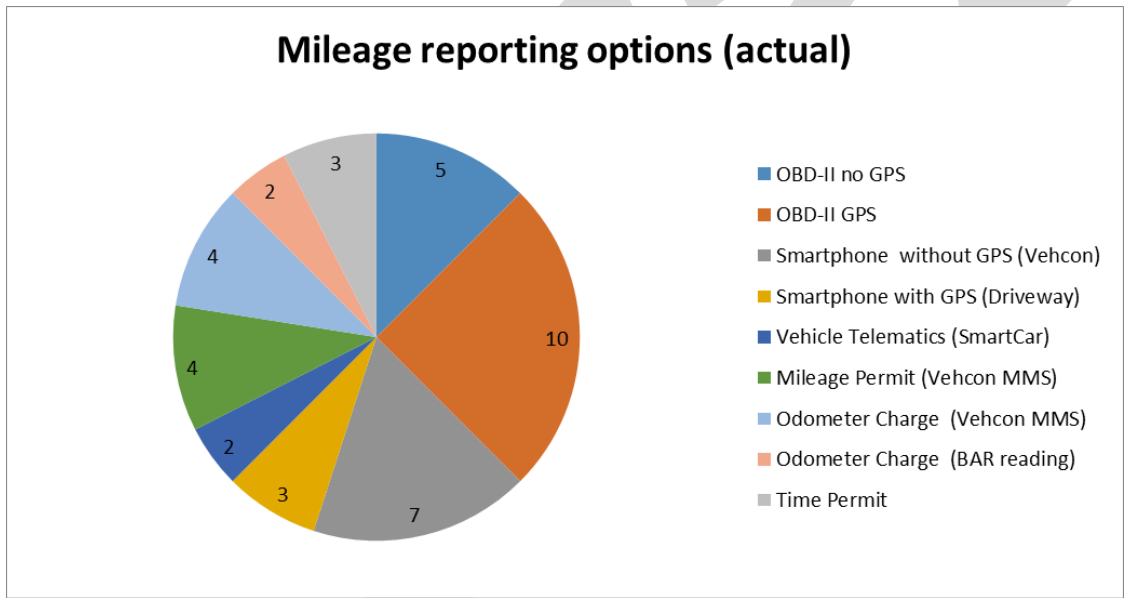


Figure 2-2 below shows the number of test cases per mileage reporting option.

**Figure 2-2 Mileage reporting options (actual)**



**2.2.1. Data Sets for Device Accuracy**

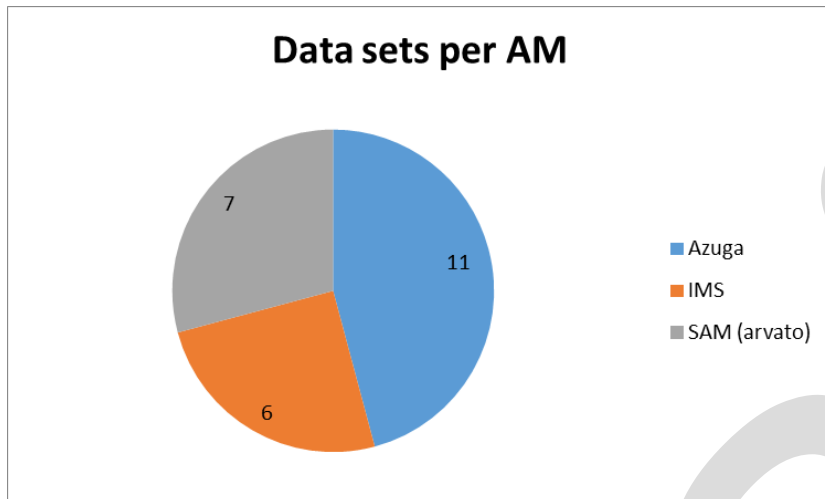
**GPS Trimble Data:** Trimble data was collected for the nine participants who drove to Reno (interstate travel). Eight data sets were used to determine accuracy of miles traveled in-state (Rule ID) and out-of-state (SubRule ID).



## End-to-End Test Results

**Fuel and Mileage Records:** 24 participants submitted Fuel and Mileage records used to evaluate accuracy of the mileage reporting devices. Figure 2-3 below shows the number of records available per Account Manager (Account Manager).

**Figure 2-3 Data sets per AM**



### 2.2.2. Participant Feedback

**Survey responses:** 22 participants submitted survey responses used to identify issues with account set-up, mileage report device set-up, mileage recording and payment processes, and to seek opportunities to improve overall user experience.

### 2.3. EROAD

EROAD installed devices in two heavy trucks from the Devine Intermodal Trucking Company located in Sacramento. These were operational commercial vehicles, so they could not be guided to use specific use cases. Instead, they were simply allowed to drive on their normal trips, and records were compared to actual driver trips.

Statistics of the two trucks from the 7-day period are as follows:

- ▶ 3 roundtrips from Sacramento to Reno
- ▶ 2 roundtrips from Sacramento to Los Angeles
- ▶ 1 round trip from Sacramento to Stockton
- ▶ 4 roundtrips from San Francisco to Reno
- ▶ 14 state line crossing events (California–Nevada or Nevada—California)
- ▶ Total Fleet running time of 122 hours
- ▶ Total Fleet stopped time of 214 hours
- ▶ 36.31% running time (utilization)
- ▶ 85.46% of total distance travelled in California
- ▶ 14.54% of total distance travelled out-of-state (all in Nevada)
- ▶ 0.89% of distance travelled in California travelled on non-chargeable areas (off-road, private road)



## End-to-End Test Results

### 3. Analysis of Basic Functionality and Human Interfaces

This section contains an analysis of the results of End-to-End testing for the basic functionality of recording mileage and providing account management services, as well as providing the basic human interfaces needed to support the road charging system. Essentially, this section combines the non-numerical analyses of the three test cases 1.4.1, Mileage and Optional Fuel Usage Data Collection, Including Accuracy and Location-Based Measurement Testing For Devices With Location-Based Functionality, 1.4.3, Change Account Details And Change Operational Concept and 1.4.4, Account Closeout, Invoicing, and Payment Processing.

Numerical accuracy analyses are presented in section 4.

Data for this section was taken from participant survey responses, as well as from account manager self-reporting and general observation. This section presents the highlights and major changes resulting from the participant surveys. Survey Questions are presented in Appendix A. Details of survey responses and post-survey action items are presented in Appendix B.

For the purpose of composing this section, the aspects of the participant experience have been divided into four areas:

1. Account Sign-up
2. Participant Experience Between Sign-up and Payment (General)
3. Mileage Reporting Method-specific
4. Payment and Closeout

#### 3.1. Account Sign-up

The issues presented in this subsection have to do with the participants' experience of account sign-up.

##### 3.1.1. Vehicle Activation Code

Two participants reported difficulties with the Azuga Vehicle Activation Code input form, specifically, that it stated that the code would be 8-10 digits long, when in fact it was 6 digits long. Several incidents of participants having difficulties inputting the Vehicle Activation Code were also reported. In these incidents, the individuals reported confusion between the characters for 1 and l (lower case L).

##### Resulting Actions:

- ▶ Azuga Vehicle Activation Code indicator was revised to 6 digits long
- ▶ Vehicle Activation Code was switched to uppercase to prevent confusion between "1" and "l."

##### 3.1.2. E-mail Addresses

Two participants reported that they were unable to sign up for the pilot with their desired e-mail address. In both cases, this was because they attempted to sign in with an e-mail address e-mail address different from the one that was used to sign up these individuals' for End-to-End testing in the Vehicle Activation Code database.



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### Resulting Actions:

- ▶ Participant invitations were written to clearly state that participants must use original provided, as displayed in the invitation

#### 3.1.3. Simplify/streamline Sign-up

Three participants (2 on the CalSAM and one on Azuga) asked for vendors to provide fewer and clearer instructions and more comprehensive explanation of user responsibilities.

### Resulting Actions

- ▶ Reduce email—all account managers were instructed to reduce their necessary e-mail traffic with participants. The CalSAM eliminated two e-mails in its sign-up process. IMS used just one main welcome e-mail in its sign-up process. Azuga used one welcome e-mail, but participants on the smartphone options also receive an e-mail from their smartphone service providers
- ▶ Make sign-up forms as simple as possible—both Azuga and IMS simplified their “enrollment funnels,” the forms that participants use to sign up. The CalSAM revised the language of its sign-up form
- ▶ Add link to FAQs for participants—a link to the participant FAQ was added to the invitation e-mail, which provides general instructions for signing up with an account manager

#### 3.1.4. Remove Technical Language

One participant stated that the language describing the telematics option was too technical; in particular, the acronym “OEM” (which actually stands for Original Equipment Manufacturer or automaker) was undefined.

### Resulting Actions

- ▶ No acronyms (except OBD-II) were allowed in descriptions
- ▶ Vendors were asked to use as simple language as possible

#### 3.1.5. VIN

One participant experienced difficulty inputting the VIN to sign up with for her account—the system seemed to hang while in was checking her VIN.

### Resulting Actions

- ▶ IMS fixed a bug that caused long response time on VIN checks
- ▶ All account managers were asked to stress the importance to participants of copying and typing the VIN digits correctly

#### 3.1.6. Clarify Roles of Vendors

One participant stated that she found the roles of the mobile phone service provider with respect to the Account Manager to be confusing.





## End-to-End Test Results

### Resulting Actions

- ▶ Account Managers were asked to clarify the roles of the mileage reporting vendors in cases where participants experience multiple vendors (Azuga-Vehcon, Azuga-Driveway)

### 3.2. Participant Experience Between Sign-up and Payment (General)

The issues presented in this subsection have to do with the participants' experience between sign-up and payment—their general experience driving with the mileage reporting method.

#### 3.2.1. Reduce E-mails

Several participants commented that too many e-mails were sent—the CalSAM in particular was mentioned as having sent too many e-mails.

### Resulting Actions

- ▶ The CalSAM eliminated the Vehicle Registration Confirmation e-mail. Later, after the start of enrollment, it was determined that the e-mail confirmation e-mail could be combined with a welcome e-mail, so this was later removed as well
- ▶ IMS designed their process to feature only one welcome e-mail, and no other e-mail contact (unless a participant contacts the help desk)
- ▶ Azuga also designed their process to feature only one welcome e-mail; however, those who choose a smartphone mileage reporting method are also contacted by Vehcon
- ▶ Vehcon redesigned their system so that participants could choose how they wanted to be contacted (in-app push notifications, text messages, and/or e-mails). This applies both to the MVerity app under Azuga and the OdoCheck app under the CalSAM

#### 3.2.2. Simplify Language

Several participants commented that the language used in communications was too complex.

### Resulting Actions

- ▶ All account managers were instructed to use as simple language as possible and not to use any acronyms or technical jargon. Caltrans and CalSTA reviewed and approved all customer communications

#### 3.2.3. Clarify Roles of Vendors

Several participants asked that the Roles of the Vendors be clarified. These participants were all using the Azuga account manager, with either the Vehcon MVerity app or the Driveway app.

### Resulting Actions

- ▶ Azuga, Vehcon, and Driveway, were instructed to make the Vendor Roles clear. In particular, Azuga was told to explain the vendor roles so that participants were not surprised when they were contacted by Driveway or Vehcon



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### 3.3. Mileage Reporting Method-Specific

The issues presented in this subsection have to do with the participants' experience their specific mileage reporting method.

#### 3.3.1. OBD-II Plug-in Indicator

One individual requested a means of confirming that an OBD-II mileage meter had been plugged in correctly such as a buzzer.

#### Resulting Actions

- ▶ Both Azuga and Vehcon provide LED lights that briefly light up when a device is correctly plugged in. Azuga and Vehcon were asked to clearly mention the LED lights in their installation instructions

#### 3.3.2. Smartcar

During End-to-End testing, the following two issues with Smartcar's support of Vehicle Telematics were discovered:

- ▶ Smartcar supports fewer vehicle models than they had led us to believe. Smartcar had (unintentionally, we believe) provided us a compatibility list to us that included a large number of vehicles that they do not yet support, notably, all GM vehicles from the past few years
- ▶ Although Smartcar does, in fact, support Acura, Acura vehicles require users to purchase a telematics package beyond the base package in order to utilize their services

#### Resulting Actions

- ▶ The project team performed an exhaustive search of the vehicles in the volunteer sign-up list for which we have make/model data to determine exactly which vehicles are compatible with Smartcar vehicle telematics, in order to send a special invitation to the owners of those vehicles, gently encouraging them to choose a vehicle telematics option
  - Of the 6776 vehicles in the volunteer signup list for which we had make/model data in late May, we identified 113 vehicles that definitely are compatible with Smartcar
  - These 113 vehicles were invited early in the enrollment process, and were sent a special invitation encouraging them to use vehicle telematics mileage reporting
- ▶ Smartcar prepared a system so that if Acura owners sign up for telematics, but do not have the needed subscriptions, they will be promptly notified that is the case

#### 3.3.3. Vehcon

Vehcon participants complained that they did not find the e-mail notifications a convenient way to be reminded of the need to take an odometer image. Also, they didn't find the in-app push notifications to be worded in a very helpful way. Some participants also felt that the image process itself was difficult.

#### Resulting Actions

- ▶ Vehcon now allows participants to choose what reminders (push messages, text, e-mail) they want to receive to be notified of the need to take odometer readings promptly



## End-to-End Test Results

- ▶ Vehcon improved the language of all reminders
- ▶ Vehcon improved the instructions for of odometer image capture
- ▶ After a technical evaluation, Vehcon may possibly improve image capture process itself. It was not feasible to do this for the start of enrollment; at the time of writing, this step is still being considered

### 3.3.4. Driveway

Driveway uses a code by which their app is activated on a given smartphone. Unfortunately, this code was called Activation Code, and participants found this name to be confusing, because the primary code to sign up for the program is the Vehicle Activation Code. Also, it was discovered that Driveway was not taking an Initial Odometer Reading via Vehcon.

- ▶ Driveway renamed “Activation Code” to “App Code”
- ▶ Driveway now records the initial odometer reading

## 3.4. Payment and Closeout

The issues presented in this subsection have to do with the participants’ experience of payment and closeout.

### 3.4.1. Simplify Payment Process

Several individuals said that the simulated payment process was too complicated. It was also observed that some places did not clearly identify the payment process as being simulated.

#### Resulting Actions

- ▶ All vendors were instructed to label the payment process as “simulated” (or something similar) wherever it occurred
- ▶ Azuga and IMS completed their pre-population of the simulated credit card number. When participants get to the payment page, all they have to do is click on the “pay” button
- ▶ Part of the issue with Azuga participants was that payment was necessary immediately upon sign-up. To fix this, Azuga now pre-loads \$25 (simulated) into the Azuga Wallet
- ▶ Vendors were instructed to add direct links to the payment process wherever possible. In particular, vendors were instructed to have direct links from the payment due reminder e-mails

### 3.4.2. Day of Travel issues

A few participants on IMS and Azuga noted that their travel was sometimes recorded on the wrong day. For Azuga, the issue had already been identified during integration testing—that travel was recorded in UTC (GMT) time, instead of Pacific Time as required.

#### Resulting Actions

- ▶ IMS discovered and fixed a bug in their software that resulted in the miles being reported on the wrong day
- ▶ Azuga is changing the time zone in which travel is reported



## End-to-End Test Results

### 3.4.3. Fuel Tax Credit/Invoice Simplifications

Several participants were surprised that they did not receive a credit for their fuel taxes paid, since the road charge is supposed to be in lieu of—not in combination with—the gas tax. A few participants felt that the invoices could be simplified.

- ▶ Vendors are all adding a fuel tax credit on all concepts except the time permit and mileage permit, as directed by Caltrans
- ▶ Invoices are being simplified and will be reviewed by Caltrans

### 3.5. EROAD

Devine Trucking drivers were not given the same questions as the participants. However, in discussions with EROAD, Devine expressed a great deal of satisfaction with the program. After the End-to-End testing Devine raised the number of vehicles involved the program from the 2 that were in end to end testing to 17. Devine Safety Director Adam Gallagher commented “The EROAD device also gives us a lot of other information including electronic logging. We think it’s going to be beneficial for our company.”



**End-to-End Test Results**

**4. Device Accuracy**

Device accuracy was analyzed by comparing of mileage and fuel records logged by the participants with the mileage and fuel consumption reported by the Account Managers to Account Management Oversight (AMO). In the case of IMS mileage records, mileage and fuel records were compared with data collected by IMS directly. Data analysis was only performed for those devices for which a reliable mileage and fuel record was available, thus not all devices used in End-to-End testing are included in this section.

In general, all devices were accurate. Median error rates ranged from 0.3% to 2.3% depending on the mileage reporting method—and some of these small errors may have arisen from the participant recording mileage instead of the device itself. While there were not sufficient devices in the test to ensure statistical significance, these small error rates should reassure participants that their distances are being measured accurately.

GPS devices having a slightly higher median error than the non-GPS devices. This result is to be expected, because the reference values are the odometer readings themselves—non-GPS devices really are just measuring the Odometer through the data on the OBD-II port, while GPS devices are actually calculating the distance through the GPS data, which may not be aligned with the odometer.

**4.1. Overview of Distance Measurement from Mileage and Fuel Records**

For Azuga, 12 Mileage and Fuel records were available to evaluate device accuracy of all four automated mileage recording options as shown in Table 4-1 below. For IMS, 6 fuel and Mileage records were available to evaluate device accuracy for OBD-II GPS and OBD-II no GPS mileage recording devices as shown in Table 4-2 below.

**Table 4-1 Azuga Distance Measurement Comparison with Mileage and Fuel Records**

| Azuga                               | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|-------------------------------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II GPS                          | 4       | 1.50%          | 0.79%            | 3.23%             | 977                  |
| OBD-II no GPS                       | 2       | 1.69%          | 0.04%            | 3.33%             | 268.4                |
| Smartphone no location (Vehcon)     | 3       | 0.43%          | 0.00%            | 1.29%             | 446                  |
| Smartphone with location (Driveway) | 3       | 0.29%          | 0.00%            | 0.84%             | 1,308.1              |

**Table 4-2 IMS Distance Measurement Comparison with Mileage and Fuel Records**

| IMS           | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|---------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II GPS    | 3       | 2.34%          | 0.11%            | 4.44%             | 1,431.3              |
| OBD-II no GPS | 3       | 0.98%          | 0.18%            | 1.76%             | 404.8                |



**End-to-End Test Results**

**4.2. Distance: Non-GPS devices via Mileage and Fuel Records**

**4.2.1. Azuga OBD-II**

Table 4-3 below is an excerpt of Table 4-1 for Azuga OBD-II no GPS devices.

**Table 4-3 Azuga OBD-II no GPS Measurement Comparison with Mileage and Fuel Records**

| Azuga         | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|---------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II no GPS | 2       | 1.69%          | 0.04%            | 3.33%             | 268.4                |

Two records from Azuga Non-GPS OBD-II devices show that the deviation from the distance reported by the range from 0.04% to 3.33% with a mean of 1.69%. These two vehicles traveled a total of 268.4 miles in the four days of testing. This is well within the range of human error in recording distance, indicating that the Azuga OBD-II device accurately measures distance.

**4.2.2. IMS OBD-II**

Table 4-4 below is an excerpt of Table 4-2 for IMS OBD-II no GPS devices.

**Table 4-4 IMS OBD-II no GPS Measurement Comparison with Mileage and Fuel Records**

| IMS           | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|---------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II no GPS | 3       | 0.98%          | 0.18%            | 1.76%             | 404.8                |

Three records from IMS' Non-GPS OBD-II devices show that the deviation from the distance reported by the range from 0.98% to 1.76% with a mean of 0.98%. These three vehicles traveled a total of 404.8 miles in the four days of testing. This is well within the range of human error in recording distance, indicating that the IMS OBD-II device accurately measures distance.

**4.2.3. Vehcon**

Table 4-5 below is an excerpt of Table 4-1 for Azuga Smartphone no Location (Vehcon) devices.

**Table 4-5 Azuga Smartphone no Location (Vehcon) Comparison with Mileage and Fuel Records**

| Azuga                           | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|---------------------------------|---------|----------------|------------------|-------------------|----------------------|
| Smartphone no location (Vehcon) | 3       | 0.43%          | 0.00%            | 1.29%             | 446                  |

Three records from Vehcon's smartphone App show that the deviation from the distance reported by the range from 0.43% to 1.29% with a mean of 0.43%. These three vehicles traveled a total of 446 miles in the four days of testing. This is well within the range of human error in recording distance, indicating the Vehcon app accurately measures distance.



**End-to-End Test Results**

**4.3. Distance: GPS Devices through Mileage and Fuel Records**

**4.3.1. Azuga**

Table 4-6 below is an excerpt of Table 4-1 for Azuga OBD-II GPS devices.

**Table 4-6 Azuga OBD-II GPS Measurement Comparison with Mileage and Fuel Records**

| Azuga      | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II GPS | 4       | 1.50%          | 0.79%            | 3.23%             | 977                  |

Four records from Azuga’s GPS device show that the deviation from the distance reported by the range from 0.79%% to 3.23% with a mean of 0.79%. These four vehicles traveled a total of 977 miles in the four days of testing. This is well within the range of human error in recording distance when combined with the potential deviation of GPS from odometers, indicating the Azuga GPS device accurately measures distance.

**4.3.2. IMS**

Table 4-7 below is an excerpt of Table 4-2 for IMS OBD-II GPS devices.

**Table 4-7 IMS OBD-II GPS Measurement Comparison with Mileage and Fuel Records**

| IMS        | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|------------|---------|----------------|------------------|-------------------|----------------------|
| OBD-II GPS | 3       | 2.34%          | 0.11%            | 4.44%             | 1,431.3              |

Three records from IMS’ GPS device show that the deviation from the distance reported by the range from 0.11% to 4.44% with a mean of 2.34%. These three vehicles traveled a total of 1431.5 miles in the four days of testing. This is well within the range of human error in recording distance, indicating the IMS GPS device accurately measures distance.

**4.3.3. Driveway**

Table 4-8 below is an excerpt of Table 4-1 for Azuga Smartphone with Location (Driveway) devices.

**Table 4-8 Azuga Smartphone with Location (Driveway) Comparison with Mileage and Fuel Records**

| Azuga                               | Records | Error % (mean) | Error % (lowest) | Error % (highest) | Total Miles Traveled |
|-------------------------------------|---------|----------------|------------------|-------------------|----------------------|
| Smartphone with location (Driveway) | 3       | 0.29%          | 0.00%            | 0.84%             | 1,308.1              |

Three records from Driveway’s smartphone App show that the deviation from the distance reported by the range from 0.00% to 0.84% with a mean of 0.29%. These three vehicles traveled a total of 1308.1 miles in the four days of testing. This is well within the range of human error in recording distance, indicating the Driveway app accurately measures distance.



**End-to-End Test Results**

**4.4. Distance: GPS Devices by Comparison with Trimble GPS Data**

In general, out-of-state travel was recorded correctly. All GPS devices recorded out of state travel for the 9 participants that traveled to Reno.

Analysis of Trimble data was intended to give precise measurements of device accuracy. During data analysis, it was found that there was no way to make a clean apples-to-apples comparison for miles driven in California due to the formatting of GPS data. Thus, GPS data comparison could only be done for miles driven in Nevada.

For IMS devices, the data observed are presented below in Table 4-9:

**Table 4-9 IMS OBD-II GPS Measurement Comparison with Trimble Device Data**

| MRD Distance (miles) | Trimble GPS Distance (miles) | Delta (Trimble value is base) |
|----------------------|------------------------------|-------------------------------|
| 18.7                 | 19.1                         | -2.1%                         |
| 18.5                 | 19.1                         | -3.1%                         |
| 18.9                 | 19.1                         | -1.0%                         |
| Average              |                              | -2.1%                         |

These data suggest that IMS GPS devices are undercounting mileage by an average of 2.1%.

For Azuga devices, the data observed are presented below in Table 4-10:

**Table 4-10 Azuga OBD-II-GPS Measurement Comparison with Trimble Device Data**

| MRD Distance (miles) | Trimble GPS Distance (miles) | Delta (Trimble value is base) |
|----------------------|------------------------------|-------------------------------|
| 13.5                 | 19.1                         | -28.8%                        |
| Average              |                              | -28.8%                        |

Clearly, during this test, Azuga experienced an issue. However, the Azuga database that included the information needed to diagnose this issue was reset before the start of enrollment, which prevented the detailed analysis of the issue. However, we know that Azuga’s distance measurements are reliable because they were measured for the OReGO project, and because Azuga’s distances measured for the entire test period were accurate as documented above, with a 1.5% median deviation for the entire test period. Note that Azuga uses OBD-II miles as the primary source of mileage data—GPS is only used to determine in-state vs. out-of-state, so long as OBD-II mileage data is available (which is always the case for gasoline engine vehicles with a functional OBD-II port).

For Driveway devices, the following data observed are presented below in Table 4-11:





**End-to-End Test Results**

**Table 4-11 Azuga Smartphone with Location (Driveway) Measurement Comparison with Trimble Device Data**

| MRD Distance (miles) | Trimble GPS Distance (miles) | Delta (Trimble value is base) |
|----------------------|------------------------------|-------------------------------|
| 16.6                 | 19.1                         | 13.1%                         |
| 17.2                 | 19.1                         | 9.9%                          |
| 4.3*                 | 19.1                         | n/a                           |
| Average              |                              | -11.8%                        |

\*During the trip for which 4.3 miles were observed, the app was manually terminated, and so this measurement does not count towards the overall accuracy measuring.

It appears that the Driveway app is slightly undercounting out-of-state miles. The undercounting of miles is likely due to the less sharp determination of state boundaries, and a relatively conservative calibration to ensure that all California miles are counted—the app can't be certain that the phone is out of state until it is a few miles over the border. This also means the more miles that are driven out-of-state, the more accurate the measured mileage becomes.

**4.5. Fuel**

Fuel Usage data available, as recorded on the mileage and fuel logs, was not sufficiently accurate to contain an accurate measurement of fuel use. Participants measures of fuel deviated widely do to inconsistent fueling. However, Account Managers have demonstrated that fuel use is correctly computed from EPA estimates, and for fuel tax credits in Oregon.

**4.6. CalSAM**

Accuracy measurements were not computed for the CalSAM, since the CalSAM only includes comparing the odometer reading at different times.

**4.7. EROAD**

It was impossible to equip EROAD devices with GPS for accuracy computations. However, EROAD devices have been certified as accurate both by the Oregon Secretary of State and the New Zealand Transport Agency (NZTA) as sufficiently accurate to measure distance for thousands of dollars of road charges per vehicle, and has never been subjects to any lawsuits claiming inaccuracy.



## End-to-End Test Results

### 5. Failure Conditions

This section describes the testing and observation of failure conditions in the End-to-End testing period. Overall, the testing of failure conditions was successful. The only imperfect result was the Driveway App, for which no failure condition was observed.

#### 5.1. Azuga OBD-II

For OBD-II devices, two failure conditions were measured: Connected to a new vehicle, and Disconnect/reconnects.

Over the 4 days of testing, the 6 Azuga devices reported that they were connected to a new vehicle a total of four times. Two of these times were done in following guidance of End-to-End testing. The other two may have occurred when participants switched vehicles just to try it out and see what happens. In any case, these observations indicate that this failure condition is correctly set.

Over the 4 days of testing, the 6 Azuga devices experienced Disconnect/Reconnect events 8 times, indicating that this event is triggered on a somewhat regular basis. As it is fairly common for new participants to take their devices out of the vehicle, this is not surprising, but it indicates that the Azuga device is working correctly.

#### 5.2. IMS OBD-II

IMS devices seem to be setting this value upon initial contact with a vehicle (in contrast to Azuga devices, which set this only when the device is moved from the initial vehicle to another) Two of these times were done in following guidance of End-to-End testing. The other three cases may have occurred when participants switched vehicles just to try it out and see what happens. In any case, these observations indicate that this failure condition is correctly set.

Over the 4 days of testing, the 6 IMS devices experienced Disconnect/Reconnect events 3 times, indicating that this event is triggered on a somewhat regular basis. As it is fairly common for new participants to take their devices out of the vehicle, this is not surprising, but it indicates that the IMS device is working correctly.

#### 5.3. Vehcon App

The Vehcon App has no known failure conditions.

#### 5.4. Smartcar Interface

The Smartcar interface has no known failure conditions.

#### 5.5. Driveway App

The Driveway App has one known failure condition—when GPS is deactivated in the phone. That failure condition only impacts app performance when the phone is being used to prove that the vehicle is out-of-state. When the phone is not out-of-state, the Driveway system defaults to using the data from Vehcon, which for the purposes of the pilot is integrated into the Driveway app—all miles measured from the start to the end of the month are charged, except for those for which there is a good, reliable GPS signal from an out-of-state phone.

For the Failure conditions test, Driveway provided the following instructions:



## End-to-End Test Results

### Introduction

During the End-to-end test, some drivers will be performing a Failure Condition Test. The Failure Condition Test for the DrivewayCA phone app consist of three ten mile trips. For trips 1 and 3, the phone's Location services settings are ON. For trip 2, the Location services settings are turned OFF.

Note: It is important that after the end of each trip in the failure test, you wait at least one hour before starting the next trip.

### Instructions for the Failure Condition Test

Complete all three trips one after the other, not taking other trips while performing the test.

#### Trip 1

1. On the bottom DrivewayCA main screen, confirm that the Trip capture status shows the ON status.
2. Drive for 10 miles.
3. Stop driving for one hour or longer.

#### Trip 2

4. In your phone's settings, turn off Location services.
  - a. Open your phone's *Settings* app.
  - b. Select the *Privacy and Safety* option.
  - c. Select the *Location* option.
  - d. Tap the On/Off switch on the top-right corner to turn off Location services.
5. On the bottom DrivewayCA main screen, again confirm that the Trip capture status shows the OFF status.
6. Drive for 10 miles.
7. Stop driving for one hour or longer.

#### Trip 3

8. In your phone's settings, disable the Location services.
  - a. Open your phone's *Settings* app.
  - b. Select the *Privacy and Safety* option.
  - c. Select the *Location* option.
  - d. Tap the On/Off switch on the top right corner to turn on Location services.
9. On the bottom DrivewayCA main screen, and confirm for a third time that the Trip capture status shows the ON status.
10. Drive for 10 miles.
11. Stop driving for one hour or longer.
12. Continue driving as a regular End-to-end test driver.

The tester who completed these instructions reported the test data as presented in Table 5-1 below:



## End-to-End Test Results

Date: 5/18/2016

**Table 5-1 Driveway Application Failure Condition Test Trips**

| Trip Number | Location Services (GPS) status | Start Drive Time | Start Drive Odometer | End Drive Time | End Drive Odometer | Distance |
|-------------|--------------------------------|------------------|----------------------|----------------|--------------------|----------|
| 1           | On                             | 6:35 pm          | 172,429              | 7:11 pm        | 172,446            | 17 miles |
| 2           | Off                            | 8:36 pm          | 172,446              | 9:03 pm        | 172,456            | 10 miles |
| 3           | On                             | 10:18 pm         | 172,456              | 10:30 pm       | 172,466            | 10 miles |

All of this failure condition testing was received accurately by Driveway. If the user had been out of state during the time in which the Location Services (GPS) was set to off, this data would not be used to determine that the user was out-of-state. Thus, the test was a success.

Note also that the Driveway app reported good data for the user who attempted the failure condition (less than 1% error over the whole testing period).

### 5.6. Manual Methods (CalSAM)

The main failure condition of the manual methods is incorrect mileage reporting by the participant—either unreasonably low (less than the previous entry) or unreasonably high (more than 600 miles per day over the period of a permit. In this condition, the participant is notified, and a recording is also made for the AMO

During the testing period, there was one instance of an infeasible mileage entry recorded by the AMO. In addition, infeasible mileage was tested outside of E2E testing and found to work.

### 5.7. EROAD

EROAD failure conditions testing could not be carried out because EROAD devices were installed on operational commercial vehicles. However, EROAD devices have been certified to support failure conditions in Oregon and New Zealand.



## End-to-End Test Results

### 6. Interoperability

The interoperability test was performed to simulate interoperability between California and a hypothetical road charge entity in another state, which was Nevada for the purposes of End-to-End testing. It was not intended to demonstrate real interoperability.

During the pilot project, it has now been decided that there will be a period of simulated interoperability testing, simulating interoperability between California and Oregon with a limited number of participants in the California pilot project, some of whom will act as Oregon residents. At the time of End-to-End testing, Nevada was chosen as the state with which to simulate interoperability.

One vehicle from each of the account managers was selected to represent a Nevada vehicle. Both of these vehicles received simulated invoices from their respective account managers. In the case of IMS, the data from the interoperable vehicle was erased before the start of enrollment. However, IMS was able to create an invoice for an interoperable vehicle for an account in exactly the same way that the original invoice was created. These invoices appear on the following pages—IMS' invoice in Figure 6-1, and Azuga's invoice in Figures 6-2 and 6-3. These invoices fundamentally demonstrate the capability of the two account managers, IMS and Azuga, to participate in a simulated interoperability exercise.

The invoice format of both IMS and Azuga is changing subsequent to End-to-End testing to better provide information to test participants. Before the interoperability test begins, a version of the invoice to demonstrate interoperability will need to be developed by both account managers.



**End-to-End Test Results**

**Figure 6-1 IMS Interoperability Test Invoice**

IMS  
 ON  
 Canada  
 Email: darbutnot@drivesync.com

Billed On **June 30, 2016**  
 Due On **June 30, 2016**  
 Terms **On-Receipt**  
 Invoice # **1173**

Billed To:

**CLIVE STELLINGS**

97 Vandal Way  
 Eureka, NV 89315  
 United States

|                   |                         |
|-------------------|-------------------------|
| <b>PAID</b>       | on <b>June 30, 2016</b> |
| <b>\$3.30</b> USD |                         |

| Date               | Description                | Qty | Price  | Subtotal      |
|--------------------|----------------------------|-----|--------|---------------|
| Jun 29, 2016       | 100 Chargeable miles in CA | 1   | \$1.80 | \$1.80        |
| Jun 30, 2016       | 100 Chargeable miles in NV | 1   | \$1.50 | \$1.50        |
| <b>Subtotal</b>    |                            |     |        | \$3.30        |
| <b>Total</b>       |                            |     |        | \$3.30        |
| <b>Amount Paid</b> |                            |     |        | \$3.30        |
| <b>Amount Due</b>  |                            |     |        | <b>\$0.00</b> |

DEMO ONLY  
 Sample Invoice showing billing in two states.

*All amounts in United States Dollars (USD)*



**End-to-End Test Results**

**Figure 6-2 Azuga Interoperability Test Invoice Page 1**

Statement for GPS Enabled Device



Monthly Statement Road Charge

Statement Period : May 1, 2016 - May 31, 2016

Statements At a Glance

|                       |                    |
|-----------------------|--------------------|
| Account Holder        | Nate Bryer         |
| Number of Vehicles    | 1                  |
| Account Type          | GPS Enabled Device |
| Azuga Customer Number | Azuga-14           |

Road Charge Details for May 2016

|                                  |      |
|----------------------------------|------|
| Total May Mileage charges        | 1.14 |
| Estimated State Fuel Tax for May | 0.54 |
| Deductions ( if any)             | 0    |
| Total May Road Charge            | 1.14 |

Vehicle Details:

| Vehicle                 | Taxable Miles | Fuel Consumed | Estimated State Fuel Tax | Road Charge |
|-------------------------|---------------|---------------|--------------------------|-------------|
| Toyota / Corolla / 2016 | 76.2          | 2.28          | 0.54                     | 1.14        |



**End-to-End Test Results**

**Figure 6-3 Azuga Interoperability Test Invoice Page 2**

Daily Log - Toyota / Corolla / 2016 5YFBURHE3GP461338

| Date      | Taxable Miles | Non Taxable Miles | Total Miles | Fuel Consumed (Gallons) | Mileage Fees on Taxable Miles ( \$ ) | Estimated State Fuel Tax ( \$ ) | Daily Road Charge ( \$ ) |
|-----------|---------------|-------------------|-------------|-------------------------|--------------------------------------|---------------------------------|--------------------------|
| 5/17/2016 | 76.2          | 0.0               | 76.2        | 2.28                    | 1.14                                 | 0.54                            | 1.14                     |

\*\*All amounts have been rounded to two decimal places. Note that totals may differ from the sum of the individual amounts because of rounding.

\*\* Road Charges are calculated at midnight PST.

**For questions regarding your statement**

Call us at :888-829-7750 or email us at [support@azuga.com](mailto:support@azuga.com)





## End-to-End Test Results

### 7. Account Management Oversight

This section presents the results of the Account Management Oversight system during the End-to-End testing period.

In general, transmission of AMO messages was good, but some specific areas need work: IMS revenue fields are not correctly populated, and Azuga RuleID fields are not correctly populated. For Arvato We will work with the vendors in July to ensure that the correct data is available for the July full-month report in August.

Note that mileage values reported here do not reconcile with (are much larger than) the values included in section 4 because section 4 values did not include about half the participants who did not provide clean mileage and fuel logs, while the values presented here included all vehicles in end-to end testing.

#### 7.1. Mileage and Road Charge Revenue

Azuga data seems to be incorrectly populating the RuleID field as 0. Otherwise, transmission was successful. IMS data populated mileage fields correctly, but did not populate revenue fields correctly. EROAD data all populated correctly. Table 7-1 below contains the data transmitted in the Mileage and Road Charge Revenue message from the Account Managers at the end of End-to-End testing:

**Table 7-1 Mileage and Road Charge Revenue Report Results by Account Manager**

|   | Azuga   | IMS                     | EROAD   |
|---|---------|-------------------------|---------|
| California Miles                        | 3,449.8 | 1,865.4                 | 3,367.3 |
| No Location Data (non-GPS OBD-II) Miles | 355.6   | 490.2                   | 0       |
| Nevada Miles                            | 108.4   | 126                     | 572.8   |
| Total Miles                             | 3,913.8 | 3,042*                  | 3,940.1 |
| Total Road Charges (Dollars)            | \$67.54 | Not correctly populated | \$63.41 |

\* includes 563.8 miles driven in Canada by IMS vehicles not involved in End-to-End testing

#### 7.2. VIN Summary

Data was received from Azuga for hundreds of vehicles, many of which were from data added after the End-to-End testing. Thus, it could not be reconciled with the Mileage and Road Charge Revenue message data.

IMS total miles was 3,042 miles across all VINs, corresponding to the value in the Mileage and Road Charge Revenue Report. IMS reported Revenue was not correct, but that will be fixed in time for the July Reports.

EROAD total Miles was 3,940.1, corresponding to the results from the Mileage and Road Charge Revenue report.



## End-to-End Test Results

While Azuga must be further investigated and IMS revenue needs to be added, overall, the VIN summary report transmission was successful.

### 7.3. VIN Manual Methods Summary

Data received from Arvato for the period of End-to-End testing includes the following totals:

- ▶ Revenue from Time Permits: \$100 (=1x 10-day Time Permits at the old rate of \$10/10-day permit + 3x\$30 at the old rate of \$30/time permits. (Note that only 3 time permits were active in the pilot, but an additional one was purchased).
- ▶ Revenue from Mileage Permits: \$108 (= 1x 1000 mile and 1x 5000 mile Mileage Permits). There were actually 4 mileage permits active in the pilot; this discrepancy is being investigated.
- ▶ Revenue From Odometer Charge: \$37.17 (=2065 miles via Odometer Charge)

These results indicate that the VIN Manual Methods summary is reporting data correctly, but the discrepancy with the Mileage Permits is being investigated.

### 7.4. Errors and Events

Errors and events message provided the data for the Failure Conditions analysis presented above in section 6. Based on that section, Errors and Events Messaging was successful.

### 7.5. Account and VIN Update

Data was provided for participants during the test.

- ▶ ERoad: 2 vehicles added
- ▶ Arvato: 33 vehicles added (includes extra test vehicles)
- ▶ IMS: 19 vehicles added (includes extra test vehicles)
- ▶ Azuga: 20 vehicles added (includes extra test vehicles)

Thus, this test was successful.

### 7.6. AMO Report Format

#### 7.6.1. Overview: AMO reporting from Accountant's Perspective

The view of this program expressed in the AMO report is based on accounting, revenue recording, and reconciliation.

A vital component of this Road Usage Charge Pilot Program (Pilot Program) is to not only determine the feasibility of vehicle to Account Manager (Account Manager) to collect defined data, but to also provide a valid, reliable, accountable, reconcilable, and accurate reports of operations.

The initial direction of the Pilot Program is to study and determine the feasibility of data transfer from vehicles, define data required to provide operating and accounting reports. The current focus in the project has been concerned with accomplishing this goal. Data activity transaction records have been defined and now the data is being developed into basic reports. This report process (which converts data to information) can be used by



## End-to-End Test Results

program operators and others to measure the success of the program and its compliance with California Statutory requirements.

This Program is characterized by a large volume of small dollar value transactions. Assuming the full 5000 participants drove 30 days a week, the resultant amount of transactions would be near 150,000. Detailed transaction review workload would be more expensive than revenues generated by the system. With full implementation, the numbers are staggering. Thus, automated transaction review is necessary.

Daily participant travel transactions are recorded by Account Managers. Account Managers are responsible to accurately and comprehensively capture data from each participating vehicle. Account Managers are also responsible for initiating and sending billings to participants. These billings should show daily transactions and amounts billed (credits allowed, if applicable) and the net amount. Account Managers will collect payments and remit to the governmental authority. Account Managers must have reports that reconcile the number of Vehicle Identification Numbers (VIN) with to summary data provided to the Account Manager Oversight entity (AMO) responsible for managing the program. Account Managers must have internal documents to support billings, verify participant enrolments and provide a basis for remittance. Account Managers must also have the ability to monitor transactional data and determine the “operating health” of the data transaction system. It would not be economically feasible for a human to review all transactions and lists to perform oversight responsibilities. Such reviews must first be conducted by automation and anomalies and discrepancies identified (exception reporting) so that the numbers of errors and events can be researched, identified and solutions for improvements found and implemented.

The AMO on the other hand will have the responsibility to edit, audit and verify the accuracy of reports from Account Managers. After this initial verification, the AMO will be responsible for preparing accurate summary reports on the results of operations.

The Project vendors (Azuga, CalSAM, EROAD, and IMS) transmit data to the AMO database to assure project management that required data is being transmitted and can be presented in lists. This initial phase and the provided data lists provide compliance with this basic requirement.

This memo contains an analysis of the top-level data collected for AMO’s use during the initial partial week of End-to-End Testing.

Presently four reports have been produced. They are:

- ▶ Mileage and Road Charge Revenue Report,
- ▶ VIN Summary Report
- ▶ Errors and Events Report, and
- ▶ Account and VIN update.

These reports will be used for chargeable mileage participants, other reports will be developed for permit choices (fixed time and mileage products).

All of the subsections of the report below will contain analysis in addition to the numbers presented below. Precise formatting will be determined later.



**End-to-End Test Results**

**7.6.2. Mileage and Road Charge Revenue Report**

The overall report for the period will be presented as shown in Table 7-2 below.

**Table 7-2 Mileage and Road Charge Revenue Report Overall Period Report Example Format**

| Location                  | Miles | Road Charges | Fuel Tax Credits | Net Revenue |
|---------------------------|-------|--------------|------------------|-------------|
| California                |       |              |                  |             |
| California non-chargeable |       |              |                  |             |
| Oregon                    |       |              |                  |             |
| ...other states...        |       |              |                  |             |
| <b>Total</b>              |       |              |                  |             |

For each Account Manager, there will be a similar table.

**7.6.3. VIN Summary Report**

Using the VIN Summary report data, the data provided in the Mileage and Road Charge Revenue will be checked. No new data is presented—it just allows the AMO to verify that the Account Manager is correctly computing the data in the Mileage and Road Charge Revenue Report.

**7.6.4. VIN Manual Methods Summary Report**

Data for the Time and Mileage Permits will be presented as shown in Table 7-3 below:



**End-to-End Test Results**

**Table 7-3 VIN Manual Methods Summary Report Example Format**

| Permit type       | Number Purchased | Cost     | Total Revenue |
|-------------------|------------------|----------|---------------|
| Time: 10-day      |                  | \$12.38  |               |
| Time: 30-day      |                  | \$37.14  |               |
| Time: 90-day      |                  | \$111.42 |               |
| Mileage: 1000 mi  |                  | \$18.00  |               |
| Mileage: 5000 mi  |                  | \$90.00  |               |
| Mileage: 10000 mi |                  | \$180.00 |               |
| <b>Total</b>      |                  | -----    |               |

For the Odometer Charge

- ▶ Number of Miles:
- ▶ Road Charge Revenue:
- ▶ Fuel Tax Credit:
- ▶ Net Revenue:

**7.6.5. Errors and Events Report**

For Azuga and IMS, there will be the following statistics presented:

- ▶ Total number of disconnects/reconnects
- ▶ Number of Instances of suspicious disconnects (what constitutes suspicious is to be determined)
- ▶ Number of plugs into new vehicle

For Arvato, there will be the following statistics presented:

- ▶ Number of instances of mileage too high
- ▶ Number of instances of mileage too low

There are no known EROAD errors. If any occur, they will be reported here

**7.6.6. Account and VIN update**

There will be an overall and per-account manager record of the following information:

- ▶ Number of added participants
- ▶ Number of dropped participants
- ▶ Number of changed vehicles



## End-to-End Test Results

# 8. Next Steps and Lessons Learned

## 8.1. Next Steps

This report confirms that the system is ready for enrollment and pilot go live. End-to-End testing covered a wide range of issues, and some need additional work, in particular, the AMO report require some tweaking. Start of enrollment may not be without the standard minor glitches that occur when an IT system is first operated at scale. However, none of these issues is critical, nor should they prevent the start of testing.

In addition, End-to-End testing helped us identify several lessons learned—opportunities to improve overall participant experience and pilot organization.

## 8.2. Lessons Learned

End-to-End revealed the importance of having seamless processes to enroll participants and efficient communication to improve participant experience.

### 8.2.1.1. Simple Enrollment and Payment Processes

Participant feedback highlighted the need for smoother and more integrated enrollment and payment processes. Participants do not have time to understand complex details of each vendor's system. Each vendor should have a single integrated process that allows the user to enroll seamlessly, set up their devices, and start driving. Participants also requested for the use of simple, standard vocabulary within the program.

### 8.2.1.2. Clear Vendor Roles

Where more than one vendor is involved in a single operational concept, efficient communication upfront to explain roles of vendors is important to avoid confusion. In a few cases, this confusion caused participants to expect one mileage reporting vendor, Vehcon, to provide account usage and billing information, when in fact, that information should be provided by the Account Manager.

### 8.2.1.3. Simple User Information

Participants also requested that all user information use simple, non-technical language, and include documentation such as Frequently Asked Questions (FAQs) which can be easily accessed during the pilot.

### 8.2.1.4. Policy and Purpose of the Road Charge: Need for Fuel Tax Credits

Participants want to understand the policy—how the payment amount on the invoice compare to the gas taxes costs they would have incurred. This resulted in the call to provide fuel tax credits.

## 8.2.2. Device Accuracy

Device accuracy was generally good, especially related to MRDs that report odometer data. Further analysis of GPS data is needed, but IMS GPS devices appear to be slightly undercounting miles traveled.

## 8.2.3. Failure Conditions

Failure conditions for all of the devices were appropriately triggered, with the exception of Driveway, which was not triggered. However, accuracy of miles reported with the Driveway device was not impacted by the event.



## End-to-End Test Results

### 8.2.4. Interoperability

The capability to simulate interoperability was demonstrated during the test. This is described in section 6 above.

### 8.2.5. AMO

The AMO fundamentally worked. However, further work is needed to ensure all data is being appropriately transmitted. This work will be completed during July, before an end-of-the-month reconciliation report will be produced.

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## End-to-End Test Results

### Appendix A: End-to-End Participant Survey Questions

1. How did you find the process of account sign-up?
2. Is there anything that you can suggest improving?
3. How was the experience of setting up your mileage reporting method(s)? Is there anything that you can suggest improving?
4. Is there anything you'd like to share about the experience of driving / using the mileage reporting method?
5. How did you find the experience of payment?
6. Is there anything that you can suggest improving?
7. Is there any other feedback you'd like to provide the project team, especially about improving the participant experience during testing?





End-to-End Test Results

Appendix B: Post-Survey Action Items

| Action id | Actions  | Participant feedback beyond action description, if provided   | Response to participant feedback   | Resulting actions  |
|-----------|--|---|--|--|
| <b>A</b>  | <b>Account Sign-up</b>   |   |  |  |
| 1         | <b>Activation code:</b> Ensure consistency between activation code provided and number of digit required to activate on the website. | Have been provided with an 6-digit activation code when the website required an 8-10 digit code, creating confusion           | Absolutely. This is a vital change.  | A1-1. Azuga will change that instance to a "6-digit code."   |
| 2         | <b>Participant email addresses information:</b> Include the email address used along with the password in the email correspondence   | Confusion between email addresses used  | Agreed, it is vital that volunteers understand that they must use the original e-mail address they signed up on the participant with, exactly as written, in order to create their accounts with the account managers. | A2-1. RCPP Invitation & Reminder e-mails will clearly tell volunteers to use original e-mail address, exactly as written.<br>A2-2. Account Managers will be told to remind participants to use original e-mails, exactly as written. |
| 3         | <b>Instructions:</b> Provide fewer and clearer instructions and more comprehensive explanation of user responsibilities              | Vendors just need to remember that it's all new for some of us and to almost dumb it down a little so that we can understand. | Understood.  | A3-1. RCPP Invitation & Reminder e-mails will be as simple as possible<br>A3-2. Account Managers will be told to make their sign-ups as simple as possible.  |
| 4         | <b>Options:</b> Mark telematics option clearly   | The telematics option was not clearly marked (it started with OEM, which doesn't mean anything to me                          | Definitely. All acronyms will where possible be replaced with a well-known term (car maker), and otherwise be written out.   | A4-1. For RCPP site and Account Manager sites, All acronyms will where possible be replaced with a well-known term (car maker), and otherwise be written out.  |



**End-to-End Test Results**

| Action id | Actions   | Participant feedback beyond action description, if provided  | Response to participant feedback   | Resulting actions   |
|-----------|---|--|--|---|
| 5         | <p><b>Documentation:</b> Provide complete set of documentation to allow smooth participant onboarding during the live pilot: for example, written material, websites, phone numbers to call, timelines, etc.</p>                        | <p>IMS was physically present to assist participant and give instructions, but pilot participant will receive no such assistance</p> <p>Azuga walked participant through process.</p>  | <p>Agreed, the sign-up process must be simple and smooth. This requires improvements by both the account managers and on the RCPP participant website.</p> | <p>A5-1. Account Managers will be instructed to make the signup process as simple as possible, and include instructions for participants wherever helpful.</p> <p>A5-2. FAQ for participants will be added to RCPP website, along with the phone number for the help desk, in a prominent location.</p> |
| 6         | <p><b>Account Manager emails :</b> Use fewer and more concise emails. Also, allow quick identification of emails to avoid search in emails (e.g. use 'Road Charge Pilot' in the subject line or weblink in emails for more details)</p> | <p>It was very time consuming to look through all my email from different people and subject lines to find the instructions I needed to undertake the pilot. The email instructions were also somewhat disjointed and long. It would be helpful if they were more concise. Perhaps you could have a web link in the email with more detail and FAQ, if we needed it.</p> | <p>Participant is right, we should have as few e-mails as possible. I think this resulted in part from the structure of E2E testing</p>                    | <p>A6-1. RCPP site and Account Manager sites will keep e-mails to a minimum.</p> <p>A6-2. RCPP site will add a FAQ to help participants with the basic logistics of pilot participation.</p>  |



**End-to-End Test Results**

| Action id | Actions   | Participant feedback beyond action description, if provided   | Response to participant feedback   | Resulting actions  |
|-----------|---|---|--|--|
| 7         | <p><b>Vendor roles:</b> Explain vendor roles clearly especially in the case where Account Manager and Mileage Reporting method vendor are different</p> | <p>Example from a participant: “Congratulations! You have successfully signed up with Azuga Insight- your account manager during the California Road Charge Pilot Program. You're almost done!</p> <p>“We are partnered with MVerity who will manage your vehicle data and will send you an email or text with further instructions to complete your enrollment. You may need to download the MVerity mobile app and take a picture of your odometer.</p> | <p>We agree that vendor roles should be made clear. This can occur on the CAM website and in the confirmation email.</p>   | <p>A7-1. Azuga will clearly state on the website and in the confirmation email that MVerity will provide the mileage reporting technology.</p> |
| 8         | <p><b>Sign-up process:</b> Implement single sign-up if possible</p>   | <p>Tedious having to do multiple different signups</p>  | <p>Account creation and vehicle addition to the account were designed as separate steps on the CalSAM, since one vehicle could be on a time permit, and one on, for example, a mileage permit. Because of this, simplification is not possible in this case.</p> | <p>No change.</p>  |



**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided | Response to participant feedback   | Resulting actions  |
|-----------|--|---|--|--|
| 9         | <b>VIN input:</b> Implement a VIN proofing system. | If VIN input is wrong, the program fails                    | <p>Part of the issue in this case was that the participant entered an incorrect VIN (not corresponding to any known vehicle), and the system then took a long time to respond to inform her that her VIN was incorrect. IMS will fix the bug that caused a system to take a long time to respond-- response should be very fast.</p> <p>A VIN proofing system is indeed desirable, but creating one would involve creating a secure connection to DMV for each account manager. That is not feasible due to time and budget constraints. This is, however, very desirable for a future RUC system.</p> | <p>A9-1. D'Artagnan will remind all account managers to stress the importance of getting VIN right in their literature and with their call centers.</p> <p>A9-2. IMS will fix the bug that caused the system to take a long time to respond to an incorrect VIN.</p> |
| B         | <b>Payment experience</b>                          |   |  |  |



**End-to-End Test Results**

| Action id | Actions   | Participant feedback beyond action description, if provided   | Response to participant feedback   | Resulting actions   |
|-----------|---|---|--|---|
| 1         | <p><b>Instructions:</b> Provide detailed 'dummy-proof' payment instructions to guide user through all payment steps</p> | <p>- Payment process was confusing<br/>                     '- Instructions not enough for participant to continue without assistance</p> | <p>Understood. Payment process should be simplified as much as possible</p>                | <p>B1-1. Azuga will make the wallet top-up process as simple as possible. The credit card number is pre-populated, so payment should be one mouse click. Wallet will come pre-populated with \$25.<br/><br/>                     B1-2. CalSAM payment will simply involve typing in a credit card or voucher number and clicking the pay button. The CalSAM will provide these numbers to customers prominently in a welcome e-mail. Should participants inadvertently delete this e-mail, they can simply call the CalSAM call center to be reminded of their numbers.</p> |
| 2         | <p><b>Quick Links:</b> Provide quick links to payment</p>   | <p>Email noting my wallet was thin should have contained a link to take me to the website directly.</p>                                   | <p>Agreed. Having a link to the website directly, where possible, is highly desirable.</p> | <p>B2-1. Azuga will include the link for the account access on most emails requiring action by the user including the wallet thin email specified. Additionally, Azuga will pre-populate the accounts with \$25.00 in the wallet so that this particular issue won't be experienced up front before the participants get used to the account interactions.</p>  |



**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided  | Response to participant feedback  | Resulting actions  |
|-----------|--|--|---|--|
| 3         | <b>Payment summary:</b> Provide payment summary with option to review detailed bill                        | Similar system as cellphone bill (summary in front page and detailed consumption in the back)  | Invoicing systems used by Azuga and IMS do not allow full flexibility in invoice design. To the extent that their invoicing systems allow, Azuga and IMS will put summary data on the top/at the front, and details behind. This will occur during the month of June (not prior to participant enrollment). | B3-1. To the extent that their invoicing systems allow, Azuga and IMS will put summary data on the top/at the front, and details behind. This will occur during the month of June (not prior to participant enrollment). |
| 4         | <b>Comparison with gas tax:</b> Provide information to compare new mileage cost to gas tax costs for users | It would have been more helpful to understand how the payment amount related to my parallel gas tax costs. Was the less than \$10 equivalent to what the gas tax charge would have been for my vehicle driving the same miles with my car's MPG? | Agreed, but this is somewhat overtaken by the need to implement fuel tax credits.   | B4-1. Fuel tax credits will be implemented during June for all Operational concepts except Mileage Permit and Time Permit. For Mileage Permit and Time Permit, estimated fuel tax paid will be displayed on receipt.     |
| 5         | <b>Itemized invoice:</b> Ensure detailed information provided is clear and does not confuse participant    | Two line items with the same description was confusing. Why?<br>May 19, 2016 F150 - 82.2 miles Chargeable undifferentiated miles 0-1<br>May 19, 2016 F150 - 0.9 miles Chargeable undifferentiated miles 0-1                                      | Thank you for sharing this important observation. IMS experienced a software issue that caused this issue to be felt. The two line items describe travel on two different days. The date of travel will be included in line items to improve clarity.   | B5-1. IMS has corrected the specific software issue that caused this.<br><br>B5-2. All Account Managers will ensure line items contain sufficient information to explain when travel occurred, not just the invoice date |



**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided   | Response to participant feedback   | Resulting actions   |
|-----------|--|---|--|---|
| 6         | <p><b>Billing calculations:</b> Ensure road charge and fuel tax credit amounts are correctly calculated and displayed clearly on the invoice, and the dates are correct.</p> | <p>First Comment: The bill that I got from Azuga was incorrect. The bill was for the entire road charge amount. The intent was to have been that the road charge amount would be netted against taxes paid with the purchase of fuel. The web page seemed to show that, but the math was not properly performed. I took a screen shot of this, and gave it to the Caltrans Road Charge team.</p> <p>Second comment: ...some of the dates on the invoice did not correspond to the dates of travel. I mentioned these to IMS, and they intend to fix these issues in time for the regular pilot.</p> | <p>For First comment: Per Caltrans direction, Account Managers will implement a fuel tax credit during June.</p> <p>For Second Comment: Similar to the comment on Dawn's issue above (B-5), the Date of tavel will be included on line items to improve clarity.</p> | <p>B6-1. Account Managers will implement a fuel tax credit during June.</p> <p>B6-2. IMS and Azuga will fix all dates of travel issue during the month of June.</p> |
| 7         | <p><b>Reminders and communication:</b> Allow users to tailor reminders and communications</p>  | <p>Let the user tailor the format of the reminders and communication</p>  | <p>We will improve the language on the reminders and communication, but we believe that having uniform language for reminders and communication is the best way to communicate with participants.</p>  | <p>B7-1. Account Managers: Improve language where possible. Caltrans &amp; CalSTA will be offered the opportunity to provide input on all communications.</p>       |
| C         | <p><b>Participant experience</b></p>   |   |  |   |
| 1         | <p><b>Streamline processes</b> to reduce number of emails and</p>  |   | <p>Agreed. E-mails and steps will be kept to a minimum.</p>  | <p>C1-1. Account Managers: Reduce e-mails and steps to</p>  |



**End-to-End Test Results**

| Action id | Actions   | Participant feedback beyond action description, if provided  | Response to participant feedback  | Resulting actions  |
|-----------|---|--|---|--|
|           | steps   |  |   | a minimum.   |
| 2         | <b>Instructions:</b> Send clear instructions and ensure all email links work  |  | Agreed. All instructions need to be clear and simple. All e-mail links need to work           | C2-1. Account Managers: please be sure all instructions are simple and all e-mail links work. Caltrans and CalSTA will review instructions to verify simplicity.           |
| 3         | <b>Vendor roles:</b> Provide clear information on vendor roles when several vendors are involved (Azuga, Vehcon, etc.)  |  | Agreed. Azuga, Driveway, and Vehcon/Mverity will ensure that all roles are clearly explained. | C3-1. Agreed. Azuga, Driveway, and Vehcon/Mverity will ensure that all roles are clearly explained.  |
| 4         | <b>'Fool proof' processes :</b> during sign-on, payment, close-out, implement 'fool-proof', use step-by-step processes to avoid unnecessary errors and participant drop out |  | Agreed. In sign-on and payment/closeout, all steps should be simple and streamlined.          | C4-1. Sign-on and payment/closeout are being improved as described in the above two sections. All Account Managers are encouraged to make all steps as simple as possible. |
| 5         | <b>Single sign-up/set-up process:</b> Account sign-up and device set-up could be a unified/integrated process from the participant perspective                              | A participant: Account sign-up/installing device should be concurrent<br>Another participant: If is that we fix the communication between Azuga and Driveway. That way, the participant receives the text message to download the application instantaneously. | Agreed. Azuga will work with Driveway to ensure that the e-mails are delivered promptly.      | C5-1. Azuga to work with Driveway to ensure that the e-mails are delivered promptly.   |
| <b>D</b>  | <b>Mileage Reporting Methods</b>  |  |   |  |





**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided | Response to participant feedback  | Resulting actions  |
|-----------|--|---|---|--|
| 1         | <b>Indicator:</b> Provide clear indication to the participant that the device is correctly installed (tiny beep)                           |   | I understand why having a buzzer is desirable. However, the hardware available does not contain a buzzer, so this request cannot be met as written. Both IMS and Azuga hardware contains small lights that illuminate when devices are connected. These are described in the installation guides. | D1-1. Account Managers: ensure literature clearly indicates that correct plug-in is confirmed by lights.   |
| 2         | <b>Reminders:</b> Send reminders when participants are required to carry out actions (esp. to capture odometer readings)                   |   | Reminders are sent by e-mail, but reminders can also be sent by text message.   | D2-1. Vehcon is adding a feature for users to elect to receive reminders and other communication via "push" messages, email, and/or text message.                                |
| 3         | <b>Battery Life:</b> Improve application so that battery is not discharged quickly. Enable application to work without the WIFI setting on |   | Driveway has stated that the use of WiFi is fundamental to their software, providing much higher accuracy, especially in urban settings. However, Driveway has stated that there is a distinct "learning" process, so that after about 2 weeks, battery use drops considerably.                   | D3-1. Participants who complain of battery life issues will be allowed to switch from Driveway to a different operational concept at any time, if they wish.                     |
| 4         | <b>User friendly instructions:</b> instructions should use non-technical user-friendly language as far as possible                         |   | Agreed. Acronyms will be replaced with common words, and language will be simplified as much as possible.   | D4-1. RCPP site will be as simple as possible. Account Managers will be reminded to avoid overly technical language and acronyms, and to keep their sites as simple as possible. |



**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided | Response to participant feedback   | Resulting actions  |
|-----------|--|---|--|--|
| 5         | <p><b>Work on integrating</b> Account Manager and mileage reporting method vendor so that user receives single instructions and material to download</p> |   | <p>Providing single instructions and a single download is challenging in the immediate future.</p> <p>For the start of enrollment, the best improvement possible is to make all documentation from the CAM (Azuga) very clear about what communications will come from which vendors. Azuga will clearly inform the user that if they choose the MVerity option and/or the Driveway option that that Vehcon / Driveway will send next steps to them.</p> <p>In the longer run, having the Vehcon app downloadable based on a single text message could simplify the onboarding process. However, this is not technically feasible to offer at the start of enrollment.</p> | <p>D5-1. For the start of enrollment, Azuga (CAM) will make all documentation very clear about what communications will come from which vendors. Azuga will clearly inform the user that if they choose the MVerity option or the Driveway option that that Vehcon / Driveway will send next steps to them.</p> <p>D5-2. Vehcon is targeting to have the process of downloading based on a single text message implemented by the July 1 launch, although it is not ready to firmly commit to that date.</p> |
| 6         | <p><b>Guidance to use Vehcon app</b> (scan method) to reduce number of unsuccessful odometer captures</p>  |   | <p>We understand this relates to the "VIN barcode scan", which by its nature is more sensitive to things like lighting conditions. The app provides messaging and an alternate capture method.</p>   | <p>D6-1. Vehcon will consider enhancements to the messaging for a next release, for example displaying a detailed help screen if the user makes more than a certain number of failed attempts.</p>   |



**End-to-End Test Results**

| Action id | Actions  | Participant feedback beyond action description, if provided   | Response to participant feedback  | Resulting actions  |
|-----------|--|---|---|--|
| 7         | <p><b>Improve push notifications:</b> notifications need to specify tasks required and a brief explanation</p>   |   | <p>Reminders are sent by e-mail, but reminders can also be sent by text message.</p>  | <p>D7-1. Vehcon is adding a feature for users to elect to receive reminders and other communication via "push" messages, email, and/or text message.</p>                                     |
| 8         | <p><b>Send confirmation / ACK messages:</b> After user sends a picture of license plate, a text message with summary of account status could be sent</p> | <p>If it not much trouble, I think it would be nice to send a text message out of the summary of data. For instance after I send my picture of the dash and license plate, it would be nice to say you signed up for x miles and you used y, so this is the difference and this is you options to proceed. That is better than being directed to a website.</p> | <p>Vehcon sends confirmation or ACK messages when each new odometer reading is verified. Vehcon is adding a feature to allow these confirmations to be delivered in multiple ways ("push" message, email, and text) so they are not missed by the user. While providing summary data via text message is desirable, implementing it is nontrivial. For now, summary data is best provided on website.</p> | <p>D8-1. To provide better access to the account, Vehcon can make the bottom graphic of the app screen be a "click through" to the CAM or CalSAM website, as a convenience for the user.</p> |



**End-to-End Test Results**

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