Appendix-14

Final Audit Report

California Road Charge Pilot Program
Account Manager Audit Report

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Account Manager Audit Report

Contents

1. Introduction

This Report contains the results of audits of Account Managers (AMs) as part of the Road Charge Pilot Program (RCPP). The goals of the audits were twofold:

- Design the rudiments of a process that could be implemented and expanded in a live state-wide road charge system
- Identify changes to improve AM compliance with the RCPP requirements

The audit team, which comprised staff from D'Artagnan led by Stephen Moon, CPA, determined two major activities that needed to be completed to generate information to fulfill the two goals:

- Individual account auditing: Based on one month of data, compare (or trace) raw data provided by each AM with data provided in the Vehicle Identification Number (VIN) Summary message, and observe any anomalies that may occur. December 2016 data were used for this analysis. This audit process was designed to provide additional assurances that AMs are sending data to the AMO that corresponds to their own raw data.

- Account manager documentation analysis and interviews: The audit team requested and received a range of system documentation from the AMs. They then developed a questionnaire that addressed a range of pilot development issues and circulated it to the AMs in advance. During the interview, the audit team asked AMs to provide input into how they created their system; explain successes and disappointments (if any); and offer suggestions to improve the program. At least two main AM staff members joined from each AM.

Both of these activities are discussed in detail in the following two sections. The final section offers observations on the audits' achievements of their stated goals along with overall conclusions.

2. Individual Account Audits

2.1. Accounts Selected for Auditing

D'Artagnan requested and received raw data from each of the four AMs to audit by randomly selecting VINs from each mileage reporting method. In doing so, D'Artagnan employed the audit technique of random sampling, to confirm the accuracy and reliability of the occurrence of an event by choosing accounts to analyze at random.

As specified in the memo describing the audit procedures mutually agreed with Caltrans, D'Artagnan audited the following numbers of vehicles:

- Azuga
  - 20 on-board diagnostic (OBD-II) device vehicles
  - 10 Driveway vehicles
  - 8 MVerity vehicles
  - 5 smartcar vehicles
- IMS
  - 12 OBD-II device vehicles
  - 5 smartcar vehicles
- CalSAM
  - 10 odometer charge vehicles
  - 6 mileage permits
  - 5 time permits
- EROAD
  - 1 account, which includes 5-10 vehicles

2.2. VIN Data Audit Procedures

D'Artagnan requested raw data for the number of accounts specified above from each AM to perform individual VIN audits. D'Artagnan selected VINs at random and provided them to AMs. The AMs then provided their raw data on each of these VINs in Excel spreadsheet formats.

D'Artagnan and Caltrans designed the audit procedure to confirm that information provided in the Account Management Oversight (AMO) VIN Summary message each month by AMs corresponded to the raw data those AMs recorded for each VIN. To confirm this, D'Artagnan compared AMO data to the raw data that AMs provided in spreadsheets. The reports below confirmed that the data for all test VINs in the VIN Summary report were identical to raw data used by AMs to prepare their monthly reports, subject to rounding errors, and in the case of EROAD, conversion from kilometers (unit in which EROAD raw data is stored) to miles (unit in which the VIN Summary Method is reported).

For the AMs who provide automated methods (Azuga, IMS, and EROAD), the VIN Summary Report provides data on all participants enrolled with these AMs. Each month, this information is used to validate the Mileage and Road Charge Revenue report by confirming that the totals presented are identical to the sum of the values

reported for participants. Thus, auditing individual VINs in the VIN Summary report confirms the accuracy of the Mileage and Road Charge Revenue report as well.

The CalSAM provides data to the AMO each month in the VIN Manual Methods Summary message. For the CalSAM, the audit team compared raw data with the VIN Manual Methods Summary message.

2.3. VIN Audit Findings

The sections below present VIN audit findings for each AM based on individual sample size. For each mileage reporting method within each AM, we describe the raw data provided by the AM and documentation of the comparison of the "critical values" for the mileage reporting method for the randomly selected VINs. The critical values audited varied by mileage reporting method. For example, for most reporting methods, the critical values were for miles traveled or most recent odometer value. For time permit, for example, the critical values were start and end dates.

Note that throughout this section, the VINs are masked for data security.

2.3.1. CalSAM

The CalSAM provided raw data from December 2016. For the 5 time permit vehicles audited, CalSAM provided data on each one's most recently purchased permit.

2.3.1.1. Time Permit Audit

The CalSAM provided time permit raw data in a spreadsheet containing a range of data for each permit. These data included identifying values for the record, including VIN, license plate, vehicle name, activation code, and other values. Most importantly, the raw data contained start and end dates for each time permit. The audit team compared the start and end dates for each randomly selected VIN from the raw data with the dates in the Manual Methods summary message, indicated below as "AMO."

VIN	Start Date (Raw Data)	Start Date (AMO)	End Date (Raw Data)	End Date (AMO)
XXXXXXXXXXXX90516	2016-10-29	2016-10-29	2017-01-27	2017-01-27
XXXXXXXXXXXX33588	2016-08-01	2016-08-01	2016-10-30	2016-10-30
XXXXXXXXXXXX18512	2016-08-10	2016-08-10	2016-08-20	2016-08-20
XXXXXXXXXXXX11584	2016-06-17	2016-06-17	2016-06-27	2016-06-27
XXXXXXXXXXXX09612	2016-10-28	2016-10-28	2016-11-27	2016-11-27

The data were identical, confirming that CalSAM is accurately populating the VIN Manual Methods summary message for time permits.

2.3.1.2. Mileage Permit Audit

Arvato provided mileage permit raw data in a spreadsheet containing a range of data for each permit. These data included identifying values for the record, including VIN, license plate, vehicle name, activation code, and

other values. Most importantly, the raw data contained start and end odometer readings from each mileage permit. The audit team compared the start and end odometer readings for each randomly selected VIN from the raw data with the values in the Manual Methods summary message, indicated below as “AMO.”

VIN	Start Odometer (Raw)	End Odometer (AMO)	End Odometer (Raw)	End Odometer (AMO)
XXXXXXXXXXXX79898	150,869	150,869	151869	151869
XXXXXXXXXXXX97624	16,252	16,252	17,252	17,252
XXXXXXXXXXXX54328	113,465	113,465	123,465	123,465
XXXXXXXXXXXX00167	6,441	6,441	7,441	7,441
XXXXXXXXXXXX22636	176,979	176,979	186,979	186,979
XXXXXXXXXXXX01456	73,599	73,599	74,599	74,599

The data were identical, confirming that the CalSAM is accurately populating the VIN Manual Methods summary message for mileage permits.

2.3.1.3. Odometer Charge Audit

The CalSAM provided odometer charge raw data in a spreadsheet containing a range of data for each permit. This data included identifying values for the record, including VIN, license plate, vehicle name, activation code, and other values. Most importantly, the raw data included final odometer readings from each odometer charge vehicle. The audit team compared the ending odometer readings for each randomly selected VIN from the raw data with the values in the Manual Methods summary message, indicated below as “AMO.”

VIN	Ending Odometer (Raw)	Ending Odometer (AMO)
XXXXXXXXXXXX31041	104,831	104,831
XXXXXXXXXXXX00812	86,184	86,184
XXXXXXXXXXXX73417	121,609	121,609
XXXXXXXXXXXX78837	90,326	90,326
XXXXXXXXXXXX68423	116,936	116,936
XXXXXXXXXXXX28365	112,412	112,412
XXXXXXXXXXXX29539	157,595	157,595
XXXXXXXXXXXX50054	64,051	64,051
XXXXXXXXXXXX73372	108,550	108,550
XXXXXXXXXXXX14748	184,592	184,592

The data were identical, confirming that the CalSAM is accurately populating the VIN Manual Methods summary message for the odometer charge.

2.3.2. IMS

IMS provided raw data from December 2016.

2.3.2.1. IMS Location-based Plug-in Device Audit

IMS provided raw data in the form of spreadsheets containing trip logs (with multiple entries for each VIN for each day) and day logs. For each VIN, for each day, the data contained a separate record of miles traveled for each day, for every state and chargeable/nonchargeable region. Each record contained a range of data, most importantly mileage. The sum of total mileage for every entry in the month of December was compared to the VIN Summary value for December.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX65081	603.3	603.3
XXXXXXXXXXXX08247	120.2	120.2
XXXXXXXXXXXX21222	224.4	224.4
XXXXXXXXXXXX54289	651	651
XXXXXXXXXXXX05127	369.2	369.2
XXXXXXXXXXXX01184	2,015.1	2,015.1
XXXXXXXXXXXX76466	179.9	179.9
XXXXXXXXXXXX79841	726.4	726.4
XXXXXXXXXXXX38898	1,884.6	1,884.6
XXXXXXXXXXXX**51361**	189.9	189.9

The data were identical, confirming that IMS is accurately populating the VIN Summary Message for location-based plug-in devices.

2.3.2.2. IMS Non-Location-based Plug-in Device Audit

IMS provided raw data for non-location based plug-in devices in the same files, in the same format, as the raw data for the location based devices.

VIN	Miles in VIN Summary	Miles in Raw Data

XXXXXXXXXXXX52660	1,659.9	1,659.9
XXXXXXXXXXXX01233	828.1	828.1

The data were identical, confirming that IMS is accurately populating the VIN Summary Message for non-location-based plug-in devices.

2.3.2.3. IMS Automaker Telematics Audit

IMS also recorded data from automaker telematics vehicles in the same spreadsheets as the plug-in device data, with one record every time that the IMS system polled the vehicle's telematics system.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX65081	603.3	603.3
XXXXXXXXXXXX08247	120.2	120.2
XXXXXXXXXXXX21222	224.4	224.4
XXXXXXXXXXXX54289	651	651
XXXXXXXXXXXX05127	352.2	352.2

The data were identical, confirming that IMS is accurately populating the VIN Summary Message for OEM telematics.

2.3.3. Azuga

Azuga provided raw data from December 2016.

2.3.3.1. Azuga Location-based Plug-in Device Audit

Azuga provided raw data in a large spreadsheet. For each VIN, for each day, the spreadsheet contained a record of miles traveled for each day, for every state and chargeable/nonchargeable region. Each record contained a range of data for each VIN, most importantly mileage. The audit team compared the sum of the total mileage for every day in the month with the value in the VIN Summary message. The raw data contained more decimal places than the VIN Summary, which was defined in the ICD to have mileage data recorded with a precision of only tenths of a mile.

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VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX73550	2,187.8	2,187.8
XXXXXXXXXXXX37146	633.7	633.7
XXXXXXXXXXXX25318	2,227.8	2,227.7
XXXXXXXXXXXX07390	1,814.7	1,814.7
XXXXXXXXXXXX62296	873.7	873.8
XXXXXXXXXXXX**88170**	886.6	886.6
XXXXXXXXXXXX03813	284.9	284.9
XXXXXXXXXXXX08295	769.7	769.7
XXXXXXXXXXXX49831	515.3	515.3
XXXXXXXXXXXX25011	0	0
XXXXXXXXXXXX26167	664.3	664.3
XXXXXXXXXXXX30624	1,017.1	1,017.3
XXXXXXXXXXXX57887	1,020.1	1,020.2
XXXXXXXXXXXX30626	756.7	756.8
XXXXXXXXXXXX45422	0	0
XXXXXXXXXXXX51722	3,258.1	3,258.1
XXXXXXXXXXXX11413	941	941

The data was identical, aside from rounding to reduce the number of decimal places, confirming that Azuga is accurately populating the VIN Summary Message for location-based plug-in devices.

Note that there were two VINs for which zero miles are listed. Although participants had devices plugged in during the month, these vehicles actively reported zero miles to the Azuga system. The VIN Summary corresponds to the raw data for these VINs.

2.3.3.2. Azuga Non-Location-based Plug-in Device Audit

Azuga provided the same raw data for non-location-based devices as for the location-based, but all miles are considered non-chargeable California miles.

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VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX69220	465.8	465.8
XXXXXXXXXXXX01510	842.4	842.4
XXXXXXXXXXXX03680	718.9	718.9

The data were identical, confirming that Azuga is accurately populating the VIN Summary Message for non-location-based plug-in devices.

2.3.3.3. Azuga Vehcon MVerity Data Audit

Azuga provided raw Vehcon MVerity data as a spreadsheet of data received from Vehcon. For each VIN, the spreadsheet included current and previous odometer values as well as the difference between these values. The data also included timestamps for the odometer values. If a vehicle did not report in November, the value for the most recent month was used.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX19930	1,438	1,438
XXXXXXXXXXXX36540	715	715
XXXXXXXXXXXX02167	947	947
XXXXXXXXXXXX54333	631	631
XXXXXXXXXXXX36176	1,098	1,098
XXXXXXXXXXXX55955	498	498
XXXXXXXXXXXX50213	1,319	1,319
XXXXXXXXXXXX04081	861	861

The data were identical, confirming that Azuga is accurately populating the VIN Summary Message for Vehcon MVerity odometer reported vehicles.

2.3.3.4. Azuga Driveway Data Audit

Azuga provided raw Vehcon MVerity data as a spreadsheet of data received from Vehcon. For each VIN, the spreadsheet included current and previous odometer values as well as the difference between these values. Driveway provided out-of-state travel data, if any, in a separate column, to indicate how many of the total miles were non-chargeable. The data also included timestamps for the odometer values. If a vehicle did not report in November, the value for the most recent month was used.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX66662	605	605
XXXXXXXXXXXX32349	618	618
XXXXXXXXXXXX11235	481	481
XXXXXXXXXXXX10736	2664	2664
XXXXXXXXXXXX54405	360	360
XXXXXXXXXXXX03136	1516	1516
XXXXXXXXXXX55987	814	814
XXXXXXXXXXXX48693	1295	1295
XXXXXXXXXXXX88538	460	460
XXXXXXXXXXXX11207	2080	2080

The data were identical, confirming that Azuga is accurately populating the VIN Summary Message for Driveway reported vehicles.

2.3.3.5. Azuga Automaker Telematics Audit

Azuga provided the raw data on automaker telematics vehicles in a spreadsheet of data received from pings (or polls) of the vehicle using smartcar's system. The spreadsheet included current and previous odometer values for the vehicle, as well as the days upon which those odometer values were recorded, and also the total traveled miles, which is the value that appears in the VIN Summary message.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX15273	907.2	907.2
XXXXXXXXXXXX52045	2,296	2,296
XXXXXXXXXXXX06913	955.1	955.1
XXXXXXXXXXXX84261	313.8	313.8
XXXXXXXXXXXX14406	977.5	977.5

The data were identical, aside from rounding, confirming that Azuga is accurately populating the VIN Summary Message for OEM Telematics vehicles.

2.3.4. EROAD

The audit team requested the data from the account of KKW Trucking, based in Pomona California, which had five vehicles in the pilot. EROAD provided raw data for December 2016, including spreadsheets for raw event and travel data for each VIN. Travel data included values for each VIN, for each day and location (state, on/off-

road). The audit team summed all miles across all days in the month and compared the value with the VIN Summary. All EROAD raw data is recorded in kilometers; it needed to be converted to miles.

VIN	Miles in VIN Summary	Miles in Raw Data
XXXXXXXXXXXX65825	7,162.5	7,162.5
XXXXXXXXXXXX65823	7,910.4	7,910.3
XXXXXXXXXXXX65821	10,165.6	10,165.7
XXXXXXXXXXXX65824	6,258.9	6,258.9
XXXXXXXXXXXX65822	6,564.4	6,564.4

The data were identical, aside from rounding differences, which is due to slightly different factors and significant digits used in converting from kilometers to miles. This confirms that EROAD is accurately populating the VIN Summary Message for their vehicles.

2.3.5. Account Manager Audit Conclusion

The auditing of VINs, including comparing the raw data records of AMs to the data in the VIN Summary, was successful. This result confirms the accuracy of the data that is used to produce summary reports for oversight and control of the program that the AMs provide in the messages to the AMO.

This result is not surprising, but it is reassuring to know that the AMs can easily provide raw data to back up the summary data that they provide to the AMO. The exercise also demonstrated auditability of AM accounts, a key evaluation criterion put forth by the Technical Advisory Committee.

3. Audit Interviews

3.1. Audit Interview Purpose, Scope, and Procedures

This section contains summaries of the teleconference conversations ("interviews") held with each AM team during the period January 31-February 3, 2017. The purpose of the interviews was to obtain accurate, valid, perceptive, and useful insight about the program.

This process of data review and interviewing is similar to surveys and document review processes used in financial or management review audits. D'Artagnan had previously asked AMs to provide system documentation they may have used in the development process. Reviewing system documentation and interviews are a useful way to determine strengths and weaknesses in system development and assist in strengthening the ability to generate accurate data, convert data to useful information and demonstrate that a system is providing results that are expected.

D'Artagnan provided all AMs with the same questionnaire in advance of the interview. This provided each AM with knowledge and direction of the review, as well as provide an opportunity to prepare accurate responses. The interviews themselves sought candid feedback to highlight problem areas for each AM and solutions to improve the program.

Interviews took place via teleconferences. Matthew Dorfman and Stephen Moon represented D'Artagnan. Each AM provided appropriate representatives to answer questions. The interviews included a range of questions on the following topics:

- Program understanding
- System design and implementation
- Strengths, weaknesses, and lessons learned

At the beginning of the teleconference, D'Artagnan explained the interview purpose: to receive candid comments and thoughts from AMs as to their unfiltered experiences and opinions about the preparation of the initial program documents, their efforts to comply with the requirements contained in those documents, the problems and issues encountered when transitioning into operations, experience is generating reports, and overall quality of guidance. D'Artagnan also asked AMs candidly about their experiences with the project and to provide any information or comments that could improve future program development. Each interview lasted approximately 60 minutes.

3.2. Interview Findings

3.2.1. Azuga

3.2.1.1. Program Understanding

Azuga had a deep understanding of the program, including its motivations and requirements. They were familiar with road charge principles from their observation of the programs across the country and their experience from Oregon. The main reason for a road charge is to make up for declining fuel tax revenues. Azuga explained that the main reason for doing a pilot is to demonstrate the fundamental aspects of a road

charge system to participants and the public, and to trial a range of methods for recording and paying the road charge.

3.2.1.2. System Design and Implementation

To design and implement their system, Azuga reviewed the requirements documents and recorded all areas in which they would have to modify their existing system to accommodate the new or changed California requirements. Azuga built a new, separate system for California. It was based on same platform as their previous systems, but modified for California.

The items below cover specific technical audit questions:

- Verify that all AMs' participants have transactions posted to their accounts in a timely manner. Azuga posts transactions in a timely manner. They post trip logs with miles traveled for trips each day for participants with in-vehicle devices. They perform nightly post-processing on trip logs to create "day logs." The day logs include road charges and fuel tax credits, while the trip logs only include miles. Day logs are then posted to the web portal for participants to view. For other reporting methods (Vehcon, Driveway, and Smartcar), Azuga posts mileage promptly once per month based on data received from each technology partner.

- Observe and comment on AM data posting process. Plug-in devices push data to the Azuga system, and the devices wait for an acknowledgement from the system that the data have been successfully transmitted. If not acknowledged, Azuga devices retain the data. They can store up to three full months of driving data. For devices with general location information, the Azuga system performs prompt post-processing of trip data to determine miles by zone (by state and chargeable or non-chargeable). For the other reporting methods (Vehcon, Driveway, Smartcar), Azuga posts mileage promptly once per month.

- Verify that transactions are posted sequentially, in whatever sequence was defined by the AM. Azuga maintains sequential trip numbers throughout their system. The system checks that messages from the device are sequentially increasing when it receives a message from the device. It also checks for increasing odometer values.

- Check AM procedures to review, confirm, and ensure quality of data. The Azuga system performs a number of post-processing checks on trip logs when it transforms them into day logs. It ensures that all mileage is counted, and that no mileage is counted twice. In addition, Azuga performed checks of data reasonableness on third-party vendor data after one incident in January in which Driveway reported a participant having traveled 8 million miles.

- Check AM procedures to ensure security of data. Azuga performs a range of security measures (including authentication, authorization, 256-bit AES encryption, and strong network security practices), as confirmed by Cambria in the data security verification.

- Review AM error logs. Azuga maintains a range of error logs for all accounts and devices, most notably, plug and unplug events of devices.

- Review AM simulated payment processes. Azuga's simulated payment method is constructed as an electronic wallet similar to the one that travelers maintain on a transit smart card or a toll pass—it is a virtual wallet of prepaid money, from which funds are withdrawn as they are used for travel. Participants can add money to the e-wallet with a simulated credit card number or voucher which participants were given when they signed up with Azuga. There is a daily withdrawal of funds from e-wallet for travel when the day logs are created.

3.2.1.3. Overall Strengths, Weaknesses and Lessons Learned

Azuga observed many strengths in the Road Charge Pilot Program:

- It has successfully demonstrated many different mileage reporting methods on one system.
- It has shown that a standard mileage message can be used on multiple programs to transmit road charge information regardless of the reporting technology.
- It provided value-added services to pilot participants that proved popular.

Azuga learned a few lessons for future programs:

- When time permits, integration with the live Department of Motor Vehicles (DMV) motor vehicle registry would bring major benefits for quality control—and in particular could eliminate participants having to enter their own VIN.
- Systems should be designed with participant compliance in mind—to measure both initial compliance and ongoing compliance automatically, and to automatically send reminder e-mails to participants who are not compliant.
- Azuga would like in the future to create one integrated road charge system that would handle all of their state customers, but would allow customization for different rules in various states.
- Mileage reporting vendors (like Driveway, Vehcon, and Smartcar) should have test systems as well as production systems so that they can test new features and modifications with their technology partners without impacting the live, production system.
- There should be tighter integration between the AM and mileage reporting vendors (to provide a single "face" to the system for participants).

3.2.2. CalSAM (arvato)

3.2.2.1. Program Understanding

The CalSAM understood that Caltrans wants to evaluate a long-term solution to fix decreasing tax revenues in California—to test a model for maintenance of roadways based on per-mile payment—to evaluate different methods and find the most efficient and effective.

3.2.2.2. System Design and Implementation

Creating the CalSAM was a new development for arvato, although they used some existing tools, such as those for customer service and account maintenance. They followed the requirements closely to develop these tools.

- Verify that all AMs' participants have transactions posted to their accounts in a timely manner. The CalSAM posts all transactions immediately when they occur, which is easy for them to do, since all

their transactions are manual and occur on their website (including "offline" participants, whose transactions over the phone are posted to the website by call center agents).

- Observe and comment on AM data posting process. The CalSAM stores the complete record of each transaction immediately. They store information from Vehcon immediately when they receive it.

- Verify that transactions are posted sequentially, in whatever sequence was defined by the AM. The CalSAM records transactions with a unique transaction number and timestamp. This includes the recording of the sequential order of transactions.

- Check AM procedures to review, confirm, and ensure quality of data. The CalSAM checks user-reported data for reasonableness, for example, that mileage traveled is not negative or excessively positive (e.g., >1,000 miles per day).

- Check AM procedures to ensure security of data. The CalSAM recognized that this was a strong requirement by Caltrans and took steps to implement it correctly. They use secure logins and passwords, and they have defined user roles. Their web connection is HTTPS secured. Their database is hosted by Amazon web services and encrypted with 256 AES. Their backups are encrypted. CalSAM underwent and passed Cambria's security verification.

- Review AM error logs. The CalSAM maintains error logs, including recording when self-reported mileage is too low (negative) or high (>1,000 miles per day). Participants see these errors immediately when they enter the data.

- Review AM simulated payment processes. The CalSAM uses simulated vouchers and credit card numbers. These were distributed at start and again in reminder mails sent by the CalSAM when reminders needed to be sent for the odometer charge, mileage permit, and time permit methods.

3.2.2.3. Overall Strengths, Weaknesses, and Lessons Learned

The CalSAM found the program to be very good overall. The primary lessons that they learned were as follows:

- They learned that they could integrate Vehcon-reported mileage directly into user accounts, instead of requiring user self-reports in addition to Vehcon official reports.
- They learned that they should have a closer integration with Vehcon, providing only one face of the system to participants.
- They learned that they should create an interface to support fleets.

3.2.3. EROAD

3.2.3.1. Program Understanding

EROAD has deep understanding of commercial vehicle charging deriving from their existing road usage charging / weight-mile tax systems in New Zealand and Oregon. The Road Charge Pilot Program was not weight-based for commercial vehicles, but this represented a simplification compared to EROAD's typical

product. EROAD understood that the purpose of the RCPP was to test the various methods of road charging to replace the fuel tax.

3.2.3.2. System Design and Implementation

To design and implement the system, EROAD looked at the requirements, mapped them out to what features their system already offered, determined changes were needed in the system, and verified their proposed changes against the SRS and ICD. EROAD's efforts for California involved simplification of what they had developed for Oregon and New Zealand, built as a new application on an existing platform. The largest change for California was developing the generation of the AMO reports.

- Verify that all AMs' participants have transactions posted to their accounts in a timely manner. EROAD's system was the timeliest of all the systems. They record mileage from vehicles immediately when communications are in range (every 250 yards or 12 seconds). They promptly check messages for accuracy and post to their system.

- Observe and comment on AM data posting process. EROAD maintains very detailed trip records based on events that the vehicle experiences (vehicle start or stop, vehicle travels 250 yards or 12 seconds, etc.). EROAD records trips as series of events, and translates them into day records.

- Verify that transactions are posted sequentially, in whatever sequence was defined by the AM. EROAD includes an incrementing serial number in each message. The EROAD system monitors the messages and highlights any anomalies. The system generally only receives messages with sequence numbers out of order when the GPS signal is poor and location can't be determined—after a distance it goes into "degraded mode," and sends the data later. If there is a long period in which the device location cannot be determined (e.g., if it is parked in a place with poor GPS), EROAD will ask the fleet why the given vehicle is experiencing that problem.

- Check AM procedures to review, confirm, and ensure quality of data. EROAD has very frequent communications, and checks each new piece of data for reasonableness. If any anomaly is detected, such as receiving data messages out of order, the system highlights it.

- Check AM procedures to ensure security of data. EROAD employs many security measures. EROAD maintains strict access control (password protection), user roles (restricting classified information to those who need it), and 256-AES encryption. In addition to the detailed verification by Cambria, EROAD experienced an extensive audit in Oregon, including a security audit.

- Review AM error logs. EROAD maintains detailed error logs, but has very few errors. Their most common error was the loss of GPS signal. EROAD error logs also record if any kind of device tampering has occurred, but this did not occur during the pilot as of late January 2017.

- Review AM simulated payment processes. EROAD offered simulated fleet account payment, with post-payment based on invoices, similar to how they offer payment to their customers in New Zealand and Oregon.

3.2.3.3. Overall Strengths, Weaknesses, and Lessons Learned

EROAD felt that the pilot program had been great: well organized; employing quick communications; and based on solid specifications. EROAD found no weaknesses in the program.

3.2.4. IMS

3.2.4.1. Program Understanding

IMS had a thorough understanding of program motivations and requirements. They were familiar with the concepts of road charging, and its general objective of finding an alternative way to pay for transportation infrastructure. However, IMS stated that their largest efforts were in trying to understand the unique aspects of California project (invoicing requirements, participant communication needs, and the various mileage reporting methods).

3.2.4.2. System Design and Implementation

IMS's original system was built for assessment of driver behavior and vehicle usage to determine: risk for insurance; information for vehicle fleets; and driver education. They took this system, which already had been adjusted to support road charging in Oregon, and customized it further for the needs of the California Road Charge Pilot Program. IMS noted that the two major data transformations in the system are: creating the mileage message from trip data; and transforming driving data to financial data.

- Verify that all AMs' participants have transactions posted to their accounts in a timely manner. IMS's trip logs are very timely. They are pushed from the vehicle to the system every day the vehicle is within communications range. Their system transforms the trip logs via post-processing into day logs. Data are pulled from Smartcar every two weeks.

- Observe and comment on AM data posting process. IMS plug-in devices push data to the IMS system, and the only data that the devices receive back from the system is the acknowledgment that the data has been received. They perform processing on any location data transmitted (into miles by state and chargeable/non-chargeable), and the data is then stored in the database.

- Verify that transactions are posted sequentially, in whatever sequence was defined by the AM. IMS uses time stamps on all messages and will only process messages sequentially. IMS also uses a message ID that increments by one for each device plugged into a given VIN. Each day, they process trip logs into day logs from the messages transmitted in a sequential manner.

- Check AM procedures to review, confirm, and ensure quality of data. For all received messages, IMS automatically verifies the following:
  - Total miles as reported in the mileage message match the sum of the previously received miles and the miles in the current mileage message
  - The sequence of all transactions, including that the date in the mileage message to be posted, is one greater than the previously received date
  - The message ID sequence is exactly one number larger than the previously received message ID for the same device ID + VIN pair
  - The reported VIN is associated with a valid road charge account

- Raw mileage data are reasonable (not greater than threshold limits)

IMS also performs extensive validation of billing data and invoices.

- Check AM procedures to ensure security of data. IMS takes extreme precautions around protection of PII and associated data. All employees have strong passwords and defined user roles, and all employees receive background checks. IMS uses encryption of data as required by the TAC, and takes a range of network security measures, including secure hosting (Tier 3 hosting facility).

- Review AM error logs. IMS maintains detailed error logs, including plugs and unplugs of devices.

- Review AM simulated payment processes. IMS supports post-payment of miles driving using a simulated credit card and/or voucher number that were provided to the participants when they signed up for IMS. The IMS system saves the simulated credit card and voucher numbers so that the participant only needs to type them in once.

3.2.4.3. Overall Strengths, Weaknesses, and Lessons Learned

IMS observed many strengths in the Road Charge Pilot Program:

- The mileage message was a useful and successful way to transmit road charging data.
- IMS' Value Added Services were popular.
- Including choice among AMs was successful and could be popular with customers in a mandatory road charging program. Having a trusted body to certify candidate AMs is an excellent way to support confidence in the system.

IMS learned a few lessons for future programs:

- Having a live lookup into the DMV motor vehicle registry would support VIN validation or even allow participants to not have to enter their VIN in the system.
- Getting the OEM telematics interface right was challenging, but it has been working for many months now.
- Providing near-real-time data with tight quality control proved to be nontrivial, but it too has been working for many months now.

3.3. Summary of Audit Interview Findings

Overall, AMs provided responsive information and comments about their systems in response to the audit interviews. Many comments were similar across AMs, but some posed alternative opinions about improvements and solutions. Several of the AMs had participated in the Oregon programs and could modify software developed for that program to meet the needs of the California pilot.

D'Artagnan summarized the significant issues from the interviews as follows:

- Program understanding: All AMs demonstrated that they had an accurate understanding of the program. Many attributed this to the following factors:
  - High quality of program documentation
  - Prior experience with road charging programs
  - Participation in periodic vendor teleconferences

  - Responses to questions that arose during the course of the pilot
- Participation account initiation and maintenance: AMs took advantage of technology to provide participants with access to create their own accounts. Inputted data were edited and confirmed. AMs used participant accounts to store data for vehicle recording, billing information, and device issuance. Participant accounts were updated either by participants or by an AM on their behalf through a customer service interaction, depending on the type of changes. AMs made use of codes inputted into the system to be able to monitor expiration dates or mileage usage (permits) and mileage traveled.
- Manual reporting: Permit products (time permits and mileage permits) have been established to automatically generate expiration of time and mileage used notices. This product is not a heavily used alternative, but may serve a valid purpose, especially in a live program (see tracing comments).
- Mileage reporting: Most program participants take advantage of automated reporting. There are various processes that can be used, but each provides mileage data for revenue billing. Vehicle codes define the fuel tax credits available and the billing generates miles, gross revenue, fuel tax credits, and net amounts due. AMs provided individual experiences, including editing and processing data and ultimately their ability to produce summary reports (AMO reports).
- Pilot participant account processing: AMs were concerned about fuel tax credit calculations, invoicing, collections, and other outside risks that would exist in a full system implementation. The cashless programs, as the pilot was designed, does not address issues that would exist if payment of money were involved. Although there would be differences in the system, the controls could be defined to minimize risks to AMs and the State. The interchange of information in a multi-state environment was also of concern.
- AMO report generation: All AMs understood the purposes of AMO reporting. AMs were able to generate AMO reports from data included in their files and records.
- Program summary: All thought the program was successful. All felt that the objectives as expressed in project documents had been realized and “lessons learned” were provided during the conduct of the project.

3.4. Account Manager Interview Conclusions

The monthly Accounting and Reconciliation Report includes many conclusions and recommendations that echo what AMs offered during the audit interviews. In addition, AMs expressed interest in providing for a multi-state operation (with standard common requirements as well as unique state-determined requirements made clear), allowing AMs to operate in multiple states with streamlined billing, collection, payment procedures, and risk mitigation.

Many expressed support for a third-party entity outside of each state government, which could coordinate multi-state operations and assure report accuracy and system certifications were valid for all states’ operations. An independent third-party entity could also provide initial and periodic financial and operational audits. This body would also be responsible for providing guidance on changes or upgrades to the AM systems.

AMs believed that the RCPP met its program objectives and appreciated the opportunity to provide lessons learned. They also believed that mileage monitoring systems functioned as expected, confirming vehicle-to-transaction processing center technologies. Interfaces with participants via account establishment, billing, and

simulated payments were also working effectively. AMs were able to generate required AMO reports and understood the program details.

4. Conclusion

4.1. Rudiments of an Audit Process

The process followed in this report establishes the rudiments of an audit process. The steps in such a process are as follows:

1. Road charging information request. The auditor should request both detailed system documentation and raw data from the AM. System documentation should be provided at the flowchart level (not the detailed code level), and should include descriptions of how various system components function. Raw data should be requested by VIN, and VINs should be chosen at random. Raw data should be requested for steps in the system where it makes sense, such as in the form of trip or day totals, in any case at a level of detail different from the level at which data are reported to the AMO.

2. Numerical analysis of data. Data for the selected VINs should be analyzed to see that they correspond to all expected values that the AMO has received.

3. Interview with AM. The auditor should ask questions about the system documentation provided, and the AM's overall implementation of the system, such as how requirements were interpreted, and what day-to-day operations are like.

In a potential future revenue generating Road Charge Program, there will likely be an initial financial compliance check that is part of the qualification or certification of each AM. In this case, the data requested during the initial financial compliance check should be retained and used to establish the basis of routine audits. Routine audits will still be needed, because it will be vital to check each AM's system when it is operational.

If and when the state implements a potential future Road Charge Program, the AMO should expand this rudimentary audit process into a standard audit procedure, including developing specific steps to take with specific data and a format for providing results, including findings and recommendations. In addition, the AMO should develop electronic audit techniques—automatic comparison of dollar and mileage values—to oversee the large volume of low dollar transactions. These techniques should compare mileage and dollar amounts to expected norms for periodic reporting. In an operational system, the AMO may choose to employ stratified sampling. Stratified sampling is random sampling in which subject accounts are separated into categories based on dollar value, risk, frequency of occurrence or some other characteristic, and more effort is put into observing the higher value or higher risk accounts. For example, all monthly billings over a certain threshold value could be subject to detailed audit. Similarly, accounts with no transactions for several months could be subject to audit. Vehicles with extremely high mileage usage may also need to be audited.

In addition to routine audits, there may also be reasons to initiate special audits. Such audits may be triggered by anomalies in the AMs' data—for example, if one AM is experiencing significantly fewer miles or less revenue than others, and the difference cannot be attributed to differing services or consumer demographics. Such an audit may also be triggered in cases of suspected malfeasance. In that case, the audit should be done onsite, on the AM's premises, and the auditor should demand immediate access to systems.

4.2. Changes to System Documentation to Improve AM Compliance with Road Charge Pilot Program

In general, AM compliance with the goals and requirements of the Road Charge Pilot Program were adequately met. There are several enhancements to the requirements that may be considered.

1. Design with audit documentation. As part of a business rule, the AMs should be required to maintain and provide documentation on their systems' raw data format and how it relates to the data transmitted in the ICD. The AMs were all able to provide such data, but adding this as a business rule will set expectations from the start that all AMs document and maintain a precise record of how their internal data relates to data sent to the AMO.

2. Add financial record requirements. Because real money payments were not part of the Road Charge Pilot Program, AMs did not need to keep financial-grade records of monetary transactions. Real money payments will be part of any potential future mandatory system, so maintaining financial grade records will be vital.

4.3. Conclusion

The tests and procedures performed in this review indicate that the goals of the audit were successfully achieved. The RCPP system, which covers 5000+ vehicles, is auditable. The rudiments of an audit process were developed and executed in the course of preparing this report. In case a Road Charge Program is mandated in the future, the Road Charge Administration should develop detailed processes both for initial compliance and for auditing, in conjunction with procurement of AMs. The AMs should be aware of the initial compliance and auditing processes, so that they can prepare for them. The precise processes will need to be customized to the specifics of any statute related to road charging. However, this audit demonstrates that a road charge system serving 5000+ participating vehicles across 12 distinct combinations of AMs and mileage reporting methods is fundamentally auditable.