Road Usage Charge

Pilot Program

Preliminary Findings

February 2013

Oregon
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Date: February 21, 2013

To: Kevin Hayden, Legislative Administrator
The Honorable Peter Courtney, Senate President
The Honorable Tina Kotek, Speaker of the House

From: James M. Whitty
Administrator of the Road Usage Fee Task Force

RE: Report of the Road User Fee Task Force to the 77th Legislative Assembly

The 2001 Legislative Assembly enacted House Bill 3946, mandating establishment of the Road User Fee Task Force. The statutory purpose assigned to the task force is to "develop a design for revenue collection for Oregon's roads and highways that will replace the current system for revenue collection."

The Road User Fee Task Force is charged with the responsibility of reporting to "each regular session of the Legislative Assembly on the work of the task force," the Oregon Department of Transportation and the Oregon Transportation Commission "in designing, implementing and evaluating pilot programs." I hereby enclose the report of the Road User Fee Task Force on the preliminary findings for the Road Usage Charge Pilot Program for your review.

Road Usage Charge Pilot Program Preliminary Findings

February 2013

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Table of Contents

Definitions and Abbreviations 1

Executive Summary 3

1 Introduction 7

Purpose and organization of this report 7
Oregon road usage charging program background 9
RUCPP background and description 14

2 Description of RUCPP Evaluation 23

Description of evaluation activities 23
Surveys 25
Data collection 26

3 Evaluation Metrics 29

Evaluation category 1: Policy and public acceptance 30
Evaluation category 2: Technology 36
Evaluation Category 3: Operations 42
Evaluation Category 4: Costs 42

4 Technical Recommendations 43

Recommendations for the future based on operation of RUCPP 43
Recommendations for system improvements based on feedback 43

5 Conclusions 45

Appendix A: System architecture and data flows for Operational Concepts 47

Appendix B: Results of Surveys and Data Collection 51
RUC Payer Surveys 51
Vendor Survey: Sanef/IMS 58
Vendor Survey: Raytheon 62
Data Collection 66

List of Figures

Figure 1: Oregon Road Usage Charge System Goals 12
Figure 2: Mileage Reporting Device for Basic Road Usage Charge Plan 14
Figure 3: Mileage Reporting Device for Advanced Road Usage Charge Plan 15
Figure 4: Mileage Reporting Device for Smartphone Road Usage Charge Plan 16
Figure 5: Screenshot of App for Smartphone Road Usage Charge Plan 16
Figure 6: RUCPP Installation Guide 20
Figure 7: Typical Installation of Mileage Reporting Device 21
Figure 8 Typical Road Usage Charge Invoice 22
Figure 9: Respondents' opinions about the ease of various aspects of the RUCPP 33
Figure 10: RUCPP survey respondents' views on fairness of RUC for various types of vehicles 34
Figure 11: Importance of various types of RUC service plan choices to RUCPP participants 35
Figure 12: Pre-RUCPP attitudes toward road usage charging 36
Figure 13: Information Flow in Undifferentiated Road Usage Charge Reporting Concept 47
Figure 14: Information Flow in Differentiated Road Usage Charge Reporting Concept 47
Figure 15: RUCPP Architecture with Account Management by Certified Service Provider 48

Figure 16: RUCPP Architecture with Account Management by ODOT 48
Figure 17: RUCPP Architecture for Flat Rate Plan.....49

List of Tables

Table 1: Summary of RUCPP participation by phase and state 7
Table 2: Summary of RUCPP participation by plan and state 8
Table 3: Road usage charge plans available in the RUCPP 19
Table 4: Overview of RUCPP Evaluation Strategy.....23
Table 5: Summary of Evaluation Results 29
Table 6: Characteristics of RUCPP first billing cycle, November 2012.....30
Table 7: RUC vs. fuel tax revenues for various MPG scenarios.....31
Table 8: RUCPP participation characteristics.....32
Table 9: RUCPP Vendor responses to questions on anti-tampering measures 38

Definitions and Abbreviations

In this document, the following definitions and abbreviations are employed.

Term / Abbreviation	Definition/Description	Remarks
COTS	commercial-off-the-shelf	
CSP	Certified Service Provider	
EV	Refers to Electric Vehicles	While EV and PHEV have some important distinctions, these two classes of vehicles are often bundled together, particularly within the latest Road Usage Charge legislation.
GPS	Global Positioning System	
ICD	interface control document	
JSON	JavaScript Object Notation	JSON is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999.
MRD	Mileage reporting device	
OBE/U	On Board Equipment/Unit	
OIPP	Oregon Innovative Partnerships Program	Program administered by ODOT's Office of Innovative Partnerships and Alternative Funding
PCI compliant	Payment Card Industry compliant	
PHEV	Plug-in Hybrid Electric Vehicles	
RFI	Request for expressions of interest	Alternately RFEI (RFI is used in Oregon)
RFP	Request for proposal	
RP	Responsible Party	See RUC payer
RUC	Road Usage Charge is the name of the ODOT program to collect a tax on the miles traveled by a vehicle.	
RUCA	Road Usage Charge Accounting	Also referred to the "Taxing Authority"
RUC payer	RUC payer refers to any individual subject to and responsible for paying the Road Usage Charge, including the registered owner of a motor vehicle that is registered in Oregon, and any person who leases a motor vehicle that is registered in Oregon.	
RUCPP	Road Usage Charge pilot program	
SOAP message	Simple Object Access Protocol message	SOAP is an XML-based messaging protocol. It defines a set of rules for structuring messages that can be used for simple one-way messaging but is particularly useful for performing RPC-style (Remote Procedure Call) request-response dialogues.
TP	Transaction processor	
VIN	Vehicle Identification Number	

Executive Summary

The objective of the Road Usage Charge Pilot Program (RUCPP) is to demonstrate several choices for measuring and paying a road usage charge that are easy for motorists to perform while maintaining an efficient collection system administered by multiple interoperable providers, including ODOT and private sector entities. The RUCPP, which features technology and services of three private vendors, has successfully measured mileage and distributed invoices to 93 participants (people who volunteered to pay the road usage charge) from three states (Oregon, Washington, and Nevada) over a 2-month period with high levels of ease of compliance, convenience of use, and responsive customer service. By the most important measures—ease of use, motorist choice and open, interoperable private sector administration—the RUCPP has thus far been a success.

The purpose of this report is to evaluate the detailed results of the first six weeks of the RUCPP, for which survey and other objective data are available. A final evaluation report that covers the entire four months of the RUCPP will be written after the completion of the RUCPP in March. This report provides background on road usage charging activities in Oregon, a description of the RUCPP and its evaluation, the evaluation results, and recommendations and conclusions for future pilot testing.

RUCPP Background

In 2001, in response to anticipated improvements in light vehicle fuel efficiency leading to declines in fuel tax revenues, the Oregon legislature created the Road User Fee Task Force (RUFTF) to identify a new road funding program. The RUFTF identified a road usage charge as the most promising alternative source of broad-based funding for roads. ODOT, with policy guidance from RUFTF, developed and tested a “pay-at-the-pump” approach to mileage-based road usage charges in which 285 subject vehicles were equipped with GPS receivers. The 2006-2007 pilot test of this approach was technically and administratively successful, but did not lead to legislation because of the following primary concerns:

- The public and decision makers shared concerns about privacy due to the requirement of a GPS device in every vehicle.
- The implementation of the system was potentially complex and expensive and could lead to a costly, permanent new government bureaucracy.
- The applied technology, if developed and owned by ODOT, would not be subject to market forces, leading to the fears of slow technology evolution and high costs.

By 2010, as fuel tax revenues began to decline and electric vehicles entered the market, RUFTF was reconstituted. RUFTF formulated a new vision for road usage charges that removed the vehicle location technology (GPS) requirement, maximized participation by private firms, and emphasized “user choice”—providing drivers choices for reporting and paying for mileage. The current RUCPP demonstrates the viability of this new vision.

The new vision includes a range of mileage collection and reporting plans, five of which were tested in the RUCPP:

1. **Flat Rate plan, administered by ODOT:** Unlimited mileage purchased for a high flat annual or monthly fee, with no technology required, administered by ODOT.
2. **Basic plan, administered by ODOT:** Wireless reporting of mileage data without vehicle location data, with accounts managed by ODOT.
3. **Basic plan, administered by a private service provider:** Wireless reporting of mileage data without vehicle location data, with accounts managed by a private sector partner.
4. **Advanced plan, administered by a private sector provider:** Wireless reporting of mileage data with vehicle location data to avoid charging for out-of-state and off-road travel, with accounts managed by a private sector partner.
5. **Smartphone plan, administered by a private sector provider**: Wireless reporting of mileage data with vehicle location data capability, transferred using a smartphone, to avoid charging for out-of-state travel, with accounts managed by a private sector partner.

Under the new vision, mileage collection and reporting plans can be offered to users and operated by private sector partners called Certified Service Providers (CSPs). CSPs store mileage data, maintain user accounts, send monthly invoices, collect road usage charges and remit charges to ODOT. In addition, ODOT operates a public administrative alternative that supports only the Flat Rate and Basic plans.

ODOT undertook a multi-stage engagement with industry to procure the RUCPP. First, ODOT issued a Request for Information (RFI) regarding the operational concepts that industry foresaw for implementing the above options. The RFI received 28 responses from a variety of domestic and international companies, including tolling, insurance, telecommunications, and financial companies. Next, ODOT issued a Request for Proposal (RFP) to these 28 companies. ODOT received responses to the RFP from nine teams comprising 19 companies. Seven of the nine teams were awarded five-year agreements to provide equipment or services to ODOT. Of those seven teams, ODOT chose three as potential vendors for the initial RUCPP and invited them to detailed in-person interviews and unit testing. Finally, ODOT contracted with two of the teams, Sanef and Raytheon, to provide equipment and services for the RUCPP.

Sanef is providing two mileage reporting devices (for the Basic Plan and the Advanced Plan) and account management services. Raytheon is providing one mileage reporting device that interfaces with a user's smartphone to report mileage. ODOT tested these devices and systems thoroughly.

After procurement of mileage reporting devices and services, ODOT set up the pilot by creating the support tools, including a web page and a help desk. ODOT recruited participants and introduced them to the various road usage charge plans. The participants signed a participation agreement, chose a plan, and set up an account. They then received mileage reporting devices by mail and installed them in their vehicles. The mileage reporting devices activated immediately upon installation: mileage reporting began and participants were assessed a road usage charge. Each participant receives an invoice at the end of each month, which they pay by check for the ODOT plans or online for plans administered by the private sector.

Phase one of the pilot officially began with 34 participants on November 1, 2012 with participants continuing participation through January 2013. This report covers evaluation of phase one participants' experiences. Phase two began on December 1, 2012 with participants continuing participation through February 2013. Evaluation of the 59 additional phase two participants is not included in this report.

Evaluation of the RUCPP

In November 2011, RUFTF approved four categories of metrics to be used in evaluation of the RUCPP and any follow-on demonstrations or pilots: policy and public acceptance; technology, operations, and cost. Each category includes several detailed metrics. Two data sources have been used to compute these metrics: objective, quantitative data collected during the RUCPP and surveys completed by participants and vendors. Participants have completed two surveys thus far: one prior to the start of the RUCPP and another following receipt of first invoices. All vendors were surveyed prior to the start of the pilot.

Evaluation Results

Analysis of the evaluation data has resulted in the following key findings:

- Based on surveys feedback to date, users regard the system as acceptable because it protects privacy, offers multiple reporting and payment choices, and, above all, is easy to use. In particular, pilot participants found mileage reporting equipment easy to install; plan type selections easy to make; and account management and bill payment easy to complete.
- The mileage-based road usage charge demonstrated in the RUCPP generates slightly more revenue than the fuel tax for participating vehicles. Mileage-based charges can generate more revenue from highly fuel efficient vehicles than the current gas tax generates from highly fuel efficient vehicles.
- The RUCPP demonstrates that mileage reporting hardware is safe and, based on statements of mileage reporting hardware vendors, resistant to tampering and fraud attempts.
- The RUCPP system performs well on a number of other system criteria: it is feasible, accurate, reliable, secure, and open.

Conclusions

The evaluation team drew the following conclusions from the results:

1. The RUCPP to date appears to have met its objectives to demonstrate an easy-to-use mileage reporting and payment system replete with palatable choices administered in an open, interoperable fashion by multiple private sector vendors.

2. Results suggest that a road usage charge with an open system is feasible, and a private market exists for the provision of a range of services related to road usage charge collection and administration.
3. Giving participants a choice of road usage charging plans is possible and supports the success of the pilot based on participant feedback.
4. The perception of user privacy appears to be improved when ODOT does not operate the mileage recording and tax processing systems.
5. 1.56 cents per mile was generally acceptable as a price point.
6. A road usage charge is generally perceived as being equitable by the participants in the RUCPP.

1

Introduction

Purpose and Organization of this Report

This report provides a summary of evaluation results to date of phase one of the Oregon Road Usage Charge Pilot Program (RUCPP). A final evaluation report that covers both phases one and two for the entire four months of the RUCPP will be written after the completion of the RUCPP in March.

The RUCPP demonstrates the new direction of the Oregon Road User Fee Task Force (RUFTF) that was formulated after an earlier trial in 2006-2007. RUFTF's new policy directives include the following: user choice; open system for access to the existing technology market with no mandate for particular technologies such as GPS; and utilization of private sector hardware, software, and services to the extent practical.

The portion of the RUCPP involving Oregon residents is a pilot test whereby participants pay a mileage-based charge over a three-month period beginning in November 2012. The individuals participating in the trial (pilot participants[1]) installed mileage reporting devices in their vehicles to record mileage, compute gas tax credits, and serve as the basis of billings and actual payments for road usage based on mileage as well as offsetting refunds for any gas taxes paid.

There are two phases of the RUCPP. Phase one began on November 1 with 34 participants, including 31 Oregon residents and 3 Washington residents using several mileage reporting devices that completed acceptance testing prior to November 1, 2012. This report includes analysis of phase one participants' experiences.

Phase two includes 59 additional participants from Washington, Oregon and Nevada, and includes additional mileage reporting devices that were accepted during November and December 2012. The 59 participants in phase two registered for the RUCPP throughout December 2012 and January 2013. This report does not include analysis of phase two participants' experiences.

The following table summarizes participation as of January 24, 2013:

Table 1: Summary of RUCPP participation by phase and state

	Oregon	Washington	Nevada
Total participants	45	21	27
Total Phase 1 participants	31	3	0
Total Phase 2 Participants	14	18	27

[1] For the purpose of the Oregon portion of the pilot, participants are defined as those individuals who signed up for the pilot, chose a mileage reporting plan, installed the mileage reporting device if applicable, and drove chargeable miles on the Oregon public roadway network.

On days when motorists drive, their mileage reporting devices report mileage travelled. At the end of each month, participants receive an invoice or statement indicating Road Usage Charge owed and gas tax credits earned, which they then pay. Further highlights of the RUCPP include the following:

- Three models of mileage reporting devices are being offered: one without GPS and two that use GPS. These mileage reporting devices are provided by two companies (US contractor Raytheon and French integrator Sanef teamed with Canadian pay-as-you-drive insurance hardware provider IMS).
- For participants who prefer not to have a mileage reporting device, the RUCPP includes a flat rate option for unlimited mileage. The rate is based on 35,000 miles per year at 1.56 cents per mile, prorated to a monthly fee of $45, or a total of $135 for the three months of the RUCPP.
- In addition to being offered choices for mileage reporting, users are also offered a choice of two Account Management Systems—one provided by the private company Sanef and one provided by ODOT.

The following table summarizes participation by plan as of January 24, 2013:

Table 2: Summary of RUCPP participation by plan and state

Plan/OBU	Oregon	Washington	Nevada
Sanef Advanced	23	16	7
Sanef Basic	8	5	18
ODOT Basic	7	0	0
Smartphone	4	0	0
Prepaid Flat Rate	1	0	0
No plan yet chosen	2	0	2
Totals	**45**	**21**	**27**

This document presents the evaluation of the RUCPP on a range of criteria, which fall into four main categories: policy and public acceptance, technology, operations, and costs. Each of these categories includes several distinct metrics. Inputs used to measure the metrics are a combination of quantitative data collected from the mileage reporting devices and users as well as qualitative surveys of key stakeholders involved, such as participants and vendors.

The remainder of this report is organized as follows:

- The rest of this chapter presents a more detailed background on the Oregon Road Usage Charge program, and the RUCPP.
- Chapter 2 presents RUCPP evaluation activities in detail.
- Chapter 3 gives the actual evaluation metrics computed.
- Chapter 4 presents the technical recommendations of the evaluation team.
- Chapter 5 presents overall conclusions for the program.

Oregon Road Usage Charging Program Background

2001-2007: Origins and First Pilot Tests

In 2001, it was brought to the attention of the Oregon Legislative Assembly that highly fuel efficient light vehicles were about to enter the marketplace, that this trend was accelerating due to new technologies such as hybrid vehicles, and that in the long term this trend would negatively impact transportation revenues from fuels taxes. In response, the Assembly established the Road User Fee Task Force (RUFTF), specifically to answer the questions: What would happen to state road revenues if Oregonians started buying and driving these new vehicles in large numbers? And how should the Oregon road revenues system be adjusted to respond?

The RUFTF determined that the fuel tax cannot be directly connected to the burden the vehicle places on a state highway system—a burden that is proportionate to vehicle miles driven and the time of day in which they are drive—and therefore unable to support any form of road usage charging. Even more significantly, the RUFTF noted all vehicle fuel efficiency improvements reduce fuel tax payments per vehicle mile traveled, and many vehicle fuel efficiency improvements can be expected due to rapidly advancing technology. The RUFTUF suggested a new road revenue program with four policy remedies for these trends:

1. A tax on studded tires, which cause a disproportionate amount of roadway wear and tear (which was proposed as legislation in 2003 but did not pass in the legislature).
2. Tolling of new highway capacity (note: three tolling projects stalled in 2007 owing to financing difficulties and lack of public support, with the exception of a fourth, the on-going mutual effort with Washington State to rebuild the Columbia River Crossing).
3. Congestion pricing (which was determined to be primarily an issue for the City of Portland, which is still considering it).
4. A Mileage Fee or Road Usage Charge (which has since this time been studied by the Oregon DOT Office of Innovative Partnerships and Alternative Funding, OIPP).

Based on the available studies, the RUFTF in 2003 determined that a Road Usage Charge should have two purposes:

- To replace the gas tax—not just supplement it, and
- To manage congestion.

Based on these purposes, ODOT developed a ‘pay-at-the-pump’ system for deployment in its first pilot, in which all vehicles would have a device installed in their vehicles to measure mileage, and that when vehicles refueled, the motorist would pay their road usage charge when the device in their vehicle communicated with a receiver mounted near the gas pump. To fulfill the first purpose, drivers would pay the road usage charge *instead* of the fuel tax—the fuel tax would not be charged at all, demonstrating that this tax replaced the fuel tax, instead of supplementing it. To fulfill the second purpose, the system included higher pricing for travel during rush hours in the Portland area.

The in-vehicle device included a GPS receiving unit to measure mileage and to determine when the vehicle was in Oregon and in the Portland area. ODOT was well aware of privacy concerns surrounding the use of GPS, and so chose to use a ‘thick client’ device—one in which the distances driven, both inside and outside the Portland region, were computed in the device, and only these distances were transmitted to the gas-pump mounted receiver. Specifically, the GPS coordinates of the vehicle where never transmitted outside of the in-vehicle device.

The device used was developed specifically for the pilot, as no commercial-off-the-shelf (COTS) equipment to fulfill these requirements was available at the time.

The pilot ran for 12 months from March 2006-March 2007, with 299 participants, most of whom were members of the public. The pilot was technically and administratively very successful. Vehicles were successfully charged the mileage fee instead of the fuel tax, and participants were pleased with the convenience.

However, the public discussion of the pilot pointed out some challenges with this system:

- State-wide implementation of the tested system was potentially complex and expensive due to the need for a device in each vehicle and new hardware at all gas stations, among other reasons.
- Because the system employed specially-designed, specified, and built hardware, it would permit only a slow technological evolution. Hence it was "stuck in time," a closed system not allowing marketplace innovations to drive prices down and services up.
- Despite the fact that the in-vehicle device reported only summary mileage data and was not capable of transmitting vehicle location data outside of the vehicle,[2] some members of the public expressed great concerns about privacy because the system mandated the use of vehicle location technology.
- Because the State would own and operate the entire system, the public expressed concerns about a costly bureaucracy.

For these reasons, no legislative action took place following the 2006-07 trial, and RUFTF temporarily ceased work.

2010-2012: Reconstitution of RUFTF

The RUFTF was reconstituted in 2010 for three reasons: continued financial trends, the fact that some new vehicles were not paying the fuels tax at all, and the fact that now commercial-of-the-shelf (COTS) hardware had become available to support a road usage charge payment.

First, by 2010, it had become clear that the financial issues that motivated the RUFTF's earlier work and the first pilot were real and starting to impact Oregon's transportation budget. Specifically:

- Oregon's and the US federal government's fuel tax receipts were now in permanent decline, and
- U.S. new vehicle fuel economy (CAFE) standards for 2016 and 2025 will impact the entire future passenger vehicle fleet composition and fuel efficiency.

Second, vehicles were entering the marketplace that were not paying for some road usage:

- Standard passenger vehicles with 100 percent electric motive power entered marketplace in 2010, and
- Plug-in hybrid vehicles entered the marketplace in 2012.

[2] This type of approach is also called a 'thick client' solution because the in-vehicle device, or client, requires significant computational resources to translate the vehicle location data into a distance measurement.

Third, COTS technology had become available that would support the payment of a road usage charge. Such technology currently includes equipment used to report pay-as-you-drive insurance (such as the Progressive Snapshot), various toll payment devices and factory installed telematics (such as On-Star, Ford Sync and Nissan Car Wings).

Since 2010, the reconstituted task force has met eight times to assess the viability of a new approach for the per-mile charge collection system, to develop policy mandates, and to develop draft legislation in support of a mileage-based road usage charge system in Oregon. One piece of recent legislation – H.B. 2138, which was passed and signed by the Governor in 2011 – reinforced the RUFTF's mission to further develop a system to support the enactment of a Road Usage Charge, and directed the RUFTF to consider new criteria for the design of pilot programs to test alternative approaches for a Road Usage Charge.

During these meetings, the reconstituted RUFTF developed several policy directives for a Road Usage Charge system in Oregon based in part on the lessons learned from the 2006 Road User Fee Pilot Program. These policy directives, coupled with directives contained in the original legislation and information obtained during a series of workshops, led ODOT to develop the following list of Road Usage Charge System goals.

Figure 1: Oregon Road Usage Charge System Goals

- **Implement a cost-effective and transparent system for collecting the vehicle Road Usage Charge,** one that is highly automated and is easy to use and simple to understand.
  - Automation via on-board equipment and wireless communications.
  - Data collection and payment systems that access existing processes familiar and acceptable to the public.
- **Provide RUC payer(s)[3] with choices** regarding road usage reporting and methods for invoicing and payment.
  - At least one method for collecting and reporting the number of miles shall not use vehicle location technology (for example, GPS).
  - Provide a high flat annual charge option that RUC payers may adopt in lieu of paying based on miles traveled in order to purchase the ability to drive an unlimited number of miles.
  - Provide multiple options for payment, including cash, check, credit/debit card, electronic transfer of funds from bank, and so forth.
- **Establish public-private partnerships** to develop a system that allows responsible parties to interface directly with a certified service provider (CSP) of their choice to record mileage and/or provide invoicing and payment.
  - Tap into market forces to the greatest extent possible for providing mileage collection and road charge processing services. The use of such third party CSPs not only provides RUC payers with choices, but also helps dispel the perception that a new Road Usage Charge would necessitate a new, expensive governmental bureaucracy.
  - It is envisioned that the Road Usage Charge services will eventually become a "value added" to other services offered by private entities, such as Pay As You Drive insurance and factory-installed in-vehicle devices and services (such as On-Star, Sync, and other vehicle telematics).
  - ODOT will be responsible for the certification program and monitoring of third parties and the services they provide.
- **Implement a government system** as an alternative to the CSPs and as "provider of last resort" for basic measuring and invoicing activities for those individuals who cannot qualify or choose not to use a CSP.
- **Protect privacy of motorists.**
  - No government mandate for any particular technology including GPS/vehicle location.
  - Legal requirements for protection of any personally identifiable information used in reporting highway use and invoicing.
- **Only charge Oregon residents for in-state travel,** unless travelers report mileage undifferentiated by geographic location (in which case, all recorded mileage will be assumed to have been driven within the state).
- **Provide credits or refunds for travel on private property** within Oregon by residents.
- **Provide credits or refunds for fuel taxes paid for vehicles** that are subject to the vehicle Road Usage Charge.
  - The measurement of fuel consumed to calculate the fuel tax credit should be automated.
- **Ensure efficient account management operations** that provide a convenient way for taxpayers to access, administer, and make inquiries regarding their accounts and the processes by which the Road Usage Charges are calculated.
- **Provide viable audit trail** to ensure proper recording of mileage and associated payments.
- **Promote compliance** and minimize evasion through a combination of education, regular audits (and associated audit trail), and enforcement activities to minimize avoidance and payment violations.

[3] The term **RUC payer** refers to individuals who are subject to and responsible for paying the Road Usage Charge, including the registered owner of a motor vehicle that is registered in Oregon, and any person who leases a motor vehicle that is registered in Oregon.

- **Base the system design on an open architecture using common standards** for the system components and processes that need to be interoperable for an efficient and cost-effective system.
  - Use of standard functional requirements and interfaces that are fully accessible to the market place, allowing various private entities to participate in the parts of the program that they are best suited to support.
  - Through an independent certification entity selected by ODOT, certify commercial-off-the-shelf (COTS) technologies according to applied standards for data message format, data accuracy and security and anti-tampering protocols.
  - Prevents the system from being locked into a single provider for any system components.
  - Allows technology to evolve and future scalability.
- **Develop a system design that does not preclude future expansion and/or collection of a variety of transportation charges**.
- **Future connections to other states** with Road Usage Charge systems for sharing information and revenue transfers, including taxing out of state vehicles for miles driven within Oregon.

Restated at a high level, the Road Usage Charge system has the following goals:

- **No Technology Push.** The government should not mandate or push motorists to particular technologies, especially GPS.
- **An Open System.** Allow for system technologies to evolve with marketplace capabilities and motorist preferences. *"An integrated system based on common standards and an operating system accessible to the marketplace whereby components performing the same function can be readily substituted or provided by multiple providers."*
- **Private Sector Administration.** Tap into market forces to allow the public to choose either government or private sector provision of data collection and payment services.
- **Motorist Choice.** Motorists should choose from several collection methods and technologies to meet individual preferences.
- **Standards.** ODOT sets standards for mileage data messaging and tax processing systems.
- **Certification.** ODOT engages an independent certifications entity to certify on board technologies, transaction processing and account management.
- **Respect Markets.** Minimize disruption to existing markets.
- **Allow Unrelated Services.** Certified service providers allowed to offer services not directly related to the road usage charge.

Based on these goals, ODOT developed four mileage collection and reporting options, called **road usage charge plans**:

- **Basic:** Wireless transfer of mileage data directly from OBD-II port or odometer.
- **Advanced:** Wireless transfer of mileage data with vehicle location capability to allow refunds for out-of-state travel.
- **Smartphone:** Wireless transfer of mileage data with vehicle location capability provided by user's smartphone to allow refunds for out-of-state travel.
- **Flat Rate:** Purchase unlimited mileage for a flat annual (or monthly) rate.

RUCPP Background and Description

This section provides a summary on the background of the RUCPP and operational concepts tested in the RUCPP, and include a summary of the implementation and execution of the RUCPP.

RUCPP Background

In the early 2012, ODOT initiated efforts to a run a Road Usage Charge pilot program (RUCPP) based on the new policies adopted by RUFTF. ODOT's goal was to start the pilot and have some preliminary results ready for the 2013 legislative session. The purpose of the RUCPP was to demonstrate the rudimentary features of a fully implemented RUC. The RUCPP was intended to address many of the overall RUC goals, including choices for mileage reporting (types of mileage reporting technologies) and for account management, an automated process for determining the amount of gas taxes paid and providing a credit for this amount, protecting the motorist's privacy, and an actual "open" system that includes more than one vendor. In addition, the RUCPP was intended to demonstrate problem free account processing and technologies and system that are simple and easy to use, and work with minimal errors and mistakes

The RUCPP was planned for a select group of volunteer motorists from Oregon. The RUCPP was planned not to just be a paper exercise—it was planned include real payment of funds and credits for fuel taxes paid under the authority of Oregon statutes.

During the preparations for the RUCPP described below, Washington State DOT and Nevada DOT both approached ODOT, and asked to participate in the RUCPP. Both had modest funding to contribute to the costs of the pilot—sufficient to cover the marginal cost of their participation in the trial. Unlike the Oregon RUCPP participants, Washington State and Nevada participants would not actually pay real money (or be given real gas tax credits for participating in the trial). Rather, their miles traveled would be recorded, and their hypothetical road use charges calculated, but they would receive an illustrative billing and not pay real funds to the state.

Operational Concept Developed for the RUCPP

After the state decided to move forward with a pilot project, the ODOT team first developed an operational concept to fulfill the objectives for the RUCPP outlined in the last section. The core of the operational concept comprised the four road usage charge plans: basic, advanced, smartphone, and flat rate.

Figure 2: Mileage Reporting Device for Basic Road Usage Charge Plan

The Basic Road Usage Charge Plan employs a mileage reporting device that does not measure vehicle location, but uses only information from the vehicle electronics to measure and wirelessly report distance traveled and fuel consumed. Fuel tax rebates or credits are computed based on all fuel consumed. Basic Road Usage Charge reporting does not support refunds for out-of-state or off-road travel.[4] A mileage Reporting Device for this plan is pictured in Figure 2.

Figure 3: Mileage Reporting Device for Advanced Road Usage Charge Plan

The Advanced Road Usage Charge Plan employs a mileage reporting device that measures vehicle location so it can report miles traveled by zone or region. In the pilot, the state of Oregon is one zone, and the other states, including Washington and Nevada, are other zones. The advanced plan supports refunds or credits for miles driven outside of Oregon from the state's road usage charge.[5] Fuel tax rebates or credits are computed based on fuel consumed on public roads in the state of Oregon.[6] ODOT envisioned two types of devices for reporting mileage under the Advanced Plan: aftermarket devices and factory-installed in-vehicle telematics devices.[7] Some personal navigation devices may also be able to support this plan.[8] A mileage reporting device for this plan is pictured in Figure 3

The Smartphone Road Usage Charge Plan employs a mileage reporting device that wirelessly communicates with a smartphone provided by the RUC payer, and the RUC payer-provided smartphone measures vehicle location so it can report miles traveled by zone or region. The mileage reporting device itself should wirelessly report mileage traveled to the road usage charging system. Similar to the advanced plan, the smartphone plan supports refunds or credits for miles driven outside of Oregon from the state's road usage charge. Fuel tax rebates or

[4] Basic road usage charge devices include some pay-as-you-drive insurance devices such as some provided by IMS (Intellimec).

[5] Note that, just like for Oregon participants, Washington participants using a differentiated mileage concept are charged only for miles driven inside Washington, but not for miles driven outside of Washington. Unlike Oregon, however, Washington participants are not actually paying the road usage charge as part of the pilot. Nevada participants are similar to Washington participants: they are only charged for miles driven in Nevada, but they are not actually paying the road usage charge.

[6] Fuel tax credits were only provided for chargeable miles—miles driven on public roads in Oregon. Non-chargeable miles include out-of-state miles and off public road. To ensure that fuel tax credits were only provided for travel on public roads, the fuel tax credit was computed by multiplying the ratio of chargeable miles (chargeable miles divided by total miles) times the estimated amount of fuel consumed times the fuel tax.

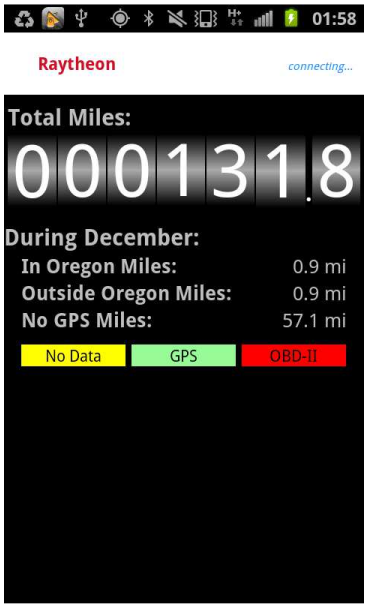
[7] Factory-installed telematics devices are available from most major automobile manufacturers. Examples include GM's OnStar, Ford's Sync, Toyota's Entune, Nissan's Carwings, and Mercedes' mbrace. Aftermarket devices include some pay-as-you-drive insurance devices such as those provided by IMS (Intellimec), Scope Technologies, Xirgo. Aftermarket devices also include GPS toll tags such as those provided by Siemens, GMV, EROAD, and many others for truck tolls, and many others.

[8] Personal navigation devices with integrated wireless communication such as the Garmin Nuvi 1600 series and 3700 series or the TomTom Go series could serve as mileage reporting devices. However, these devices would require a software update and additional security measures to serve as a mileage reporting device.

credits are computed based on fuel consumed in the state of Oregon.[9] In addition, the smartphone plan offers the user the ability to disable vehicle location reporting at any time through a setting on the smartphone application. A mileage reporting device for this plan is pictures in figure 4. A screenshot of the Smartphone App for this plan is pictured in figure 5.

Figure 4: Mileage Reporting Device for Smartphone Road Usage Charge Plan

Figure 5: Screenshot of App for Smartphone Road Usage Charge Plan



The Flat Rate Road Usage Charge Plan does not employ a mileage reporting device. Participants who opt for this plan pay a monthly fee for unlimited road usage and are ineligible to receive a fuel tax credit.

In the Basic, Advanced, and Smartphone plans, users have Road Usage Charge accounts that store their miles driven and charges owed. For the advanced and smartphone mileage reporting plans, the account management system is supported only by a private company, called a Certified Service Provider (CSP), and not ODOT. For the basic mileage reporting plan, the account management system may be provided by either a CSP or ODOT itself. In this way, privacy is even more securely protected because the CSP and only the CSP (and not ODOT) is in possession of any location data.

In general, data flows from the mileage reporting device to an account management system (provided either by a CSP or by ODOT), and excerpts of that data are forwarded to ODOT's

[9] As with the Advanced Plan, fuel tax credits were only provided for chargeable miles. However, the smartphone mileage reporting device was not configured to measure whether travel was on public or private land, so non-chargeable miles on the smartphone plan included only miles traveled outside Oregon.

mileage tax accounting division for audit and reconciliation purposes. High-level details of the data flows and architecture are provided in Appendix A. The full details of these architectures are explained in the *ODOT Operational Oregon Vehicle Road Usage Charge System and Road Usage Charge Pilot Program Updated Concept of Operations* Version 1.1 March 15, 2012.

Implementation of RUCPP

After ODOT developed the operational concept, ODOT acted to implement the pilot with maximum participation of private industry. To do so, ODOT and its contractors employed an iterative procurement process that began with a widely publicized Request for Information (RFI), followed by a Request for Proposal (RFP) open to those who had responded to the Request for Information. ODOT awarded all vendors whose proposals met minimum qualifying criteria with five-year contracts to provide products and services. Nevertheless, ODOT would not grant all of the awardees contracts for the initial RUCPP. From among the awardees, ODOT would choose a select number of firms to actually support the RUCPP.

ODOT released the RFI, which presented the RUCPP objectives and operational concepts outlined above, in early February 2012. ODOT received a total of 28 responses from domestic and international companies that represented a mixture of tolling hardware, tolling software / management system / integrators, pay-as-you-drive insurance providers, and major IT integrators and consultants.

In March 2012, ODOT released the RFP, which specified that responders could bid to fill one or more of three necessary roles and one optional role: mileage reporting device vendor (necessary), account management system vendor (necessary), Mileage Tax Accounting (necessary), and data aggregator (optional). Mileage reporting device vendors could bid on any or all of three categories of mileage reporting device: basic, advanced (either aftermarket telematics or factory-installed telematics), and smartphone. All of the RFI respondents could bid on the RFP, and all were invited to bid on all of the roles. ODOT received a total of nine responses to the RFP. The nine responses included several mileage reporting device providers. Since none of the bidders provided a suitable advanced factory-installed telematics mileage reporting device, the advanced factory-installed telematics device was not included in the pilot. ODOT received suitable bids for all other categories. ODOT chose not to award either the role of data aggregator (the optional role) or the role of mileage tax accounting (which for the pilot was provided by ODOT's consultants). The awardees were Battelle, Brisa, GMV, Accenture, Raytheon, Sanef (teamed with IMS), and IBI.

Of the seven awardees, ODOT chose three for potential inclusion in the RUCPP based on evaluation results of the RFP and the complimentary nature of their systems: IBI, Raytheon, and Sanef (teamed with IMS). The other four may still be used in future pilots or related testing.

Each of the three firms chosen for potential inclusion attended a daylong interview and technical demonstrations of their products. Of the three, ODOT did not select IBI for inclusion in the RUCPP based on the interviews and demonstrations. ODOT chose French integrator Sanef, teamed with Canadian pay-as-you-drive insurance hardware provider IMS, and US contractor Raytheon for the RUCPP.

Sanef is providing three components of the system: the basic mileage reporting device, advanced aftermarket telematics mileage reporting device, and the account management system. Raytheon is providing the mileage reporting device that connects with a smartphone application. The device provided by Raytheon does not include hardware to report mileage to the road usage charging system as envisioned in ODOT's operational concept; instead, it employs the user's smartphone to transmit that information. In a fully operational system, ODOT would require a mileage reporting device that includes wireless transmission hardware, so

transmissions can occur even if the user forgets to bring his/her smartphone into the vehicle, or the smartphone's battery dies.

Raytheon and Sanef spent several months implementing the ODOT Interface Control Documents (ICD), including the "mileage message" which specifies how mileage data was to be transmitted to the account management system. After this development, ODOT subjected Raytheon and Sanef's products and services to intense testing. First, the products went through bench testing to verify that the products worked correctly on their own. Next, the products went through integration testing to verify that the product interfaces including the mileage message were implemented correctly. Finally, the products went through system testing to verify that they worked correctly as a system.

While product testing was underway, ODOT's contractors prepared for the RUCPP by setting up a help desk to support participants during their involvement in the pilot. ODOT set up two websites and the contractor, Sanef, set up one website as noted hereafter:

- http://www.oregon.gov/ODOT/HWY/RUFPP/Pages/rucppvolunteers.aspx: This is the road usage charge pilot program website for the participants.
- http://roadchargeoregon.org: This is the dedicated pilot website and is also for the public who are interested in the trial.
- https://www.sanef-oregon.com: Once a participant has signed an agreement with ODOT, this is where participants go to choose their plan and set-up and manage their accounts.

Execution of the RUCPP

ODOT recruited a select group of volunteer participants to participate in the RUCPP. The participants were solicited from the Transportation and Revenue Committees of the Oregon Legislature, the Oregon Transportation Commission, and Road User Fee Task Force and ODOT executive management. A few others were accepted after requesting participation upon hearing about the pilot. All participants were required to have a vehicle from model year 2004 or newer, and were willing to participate in the pilot and pay the road usage charge in lieu of the fuel tax.[10]

RUCPP Participants were introduced to the pilot activities through an onboarding process. In that regard the Participants were:

- Sent regular communications to update them on the pilot timelines,
- Sent a participant overview sheet explaining how the pilot would operate, and
- Provided help desk support throughout the onboarding process and the pilot itself. To start the pilot, all participants signed a participant agreement confirming their willingness to participate.

Mileage Reporting Plan Selection. Once signed on, the RUCPP Participants chose their preferred road usage charge plan and set up their accounts. The following table explains the essential elements of the five plans available for the pilot.

[10] Certain earlier models of vehicles were able to be accepted for participation provided they were equipped with an adequate on board diagnostic port (a.k.a., OBDII port).

Table 3: Road usage charge plans available in the RUCPP

RUCPP Plan	Miles Reported	Invoice	Payment Method	Online account management	Uses GPS?
ODOT Basic Plan	All	Mailed Monthly	Check	No	No, does not report where miles are driven
ODOT Flat Rate Plan	N/A	Once, at start	Check	No	No device
Sanef Basic Plan	All	Emailed Monthly	Credit/debit card	Yes	No, does not report where miles are driven
Sanef Advanced Plan	Public roads in Oregon only	Emailed Monthly	Credit/debit card	Yes	Yes
Sanef Smartphone Plan	With application running, only roads in Oregon; without application running, all roads	Emailed Monthly	Credit/debit card	Yes	Yes, when the application is running

Installations. Everyone who was on any plan other than the flat rate plan was sent a mileage reporting device in the mail. They were also sent instructions on how to install the mileage reporting devices in their vehicles. These instructions appear in Figure 6 below. A photo of a mileage reporting device being installed appears in Figure 7 below.

Figure 6: RUCPP Installation Guide

ODOT Road Usage Charge Pilot Program (RUCPP)

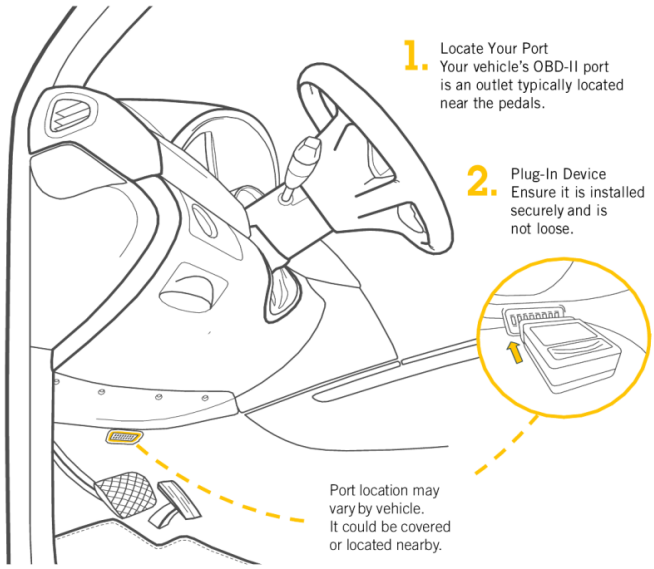
Mileage Reporting Device - Installation Guide

Before You Begin:

The Device needs to be installed in the same vehicle that was registered during account set up.	For a better connection, perform installation outdoors or in a well – lit place.	For your safety, ensure that your vehicle ignition is OFF during installation.

If you have any queries, contact the RUCPP Help Desk at 855-797-1266

HOW TO INSTALL THE MILEAGE REPORTING DEVICE



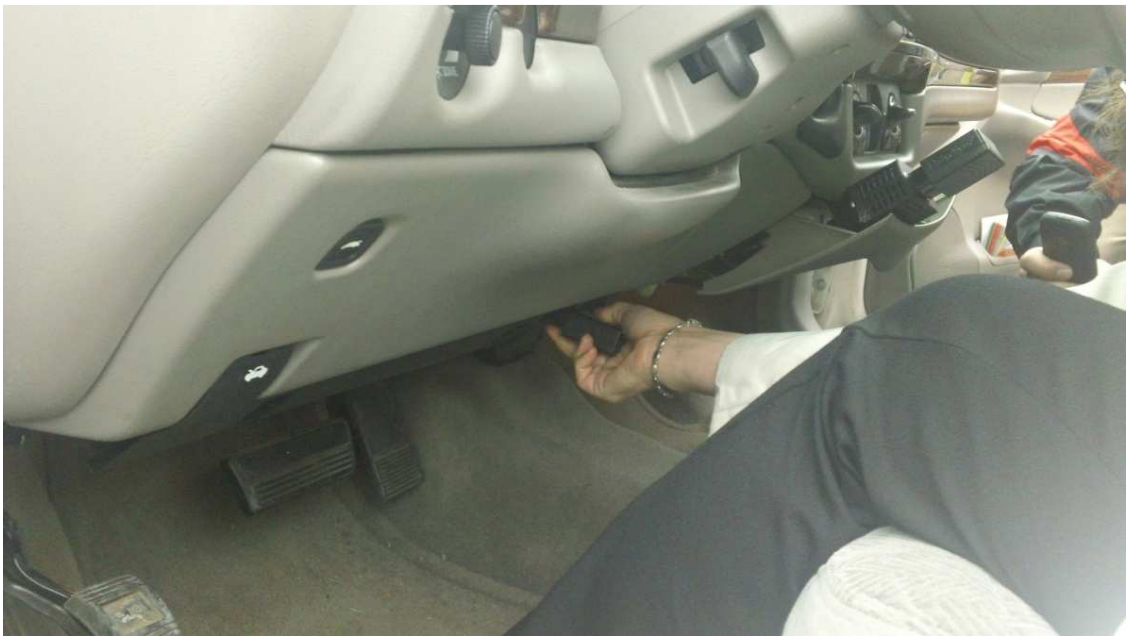
Once installed, it is important you wait 1-2 minutes before starting your vehicle to allow the Device to configure.

Your mileage data will be automatically recorded and sent for processing.

It is important to ensure that the Mileage Reporting Device does not interfere with your ability to safely enter, exit, or operate the vehicle. If so, contact the Help Desk.

If your OBU becomes disconnected for any reason, simply repeat these steps.

Figure 7: Typical Installation of Mileage Reporting Device



Invoicing and Payment. After the pilot participants installed their mileage reporting devices, they drove, and received a monthly invoice that informed them of the number of miles they drove, the road usage charges that they owed and their fuel tax credit earned. Participants with an ODOT Plan pay invoices by check mailed directly to ODOT. Participants with a Sanef Plan pay invoices online with a credit or debit card. A typical invoice is presented ahead in figure 8.

Figure 8 Typical Road Usage Charge Invoice

From :
Sanef S.A.
8130 SW Beaverton-Hillsdale Hwy
Portland, Oregon
97225

On behalf of :
Road Usage Charge Pilot Program
355 Capitol St. NE MS 32
Salem, Oregon
97301-3871

To :
[redacted]

Invoice No: SI1210-19
Invoice Month: September 2012
Issue Date: Oct 25 2012

ROAD USAGE CHARGE PILOT PROGRAM
CUSTOMER INVOICE

Item Description	Amount	Rate ($)	Subtotal
Vehicle: Ford Mustang License Plate Number: [redacted] PLAN: ADVANCED			
Mileage Tax			
Total Mileage	176.30 miles		
Oregon Taxable Miles	176.30 miles	$0.0156	2.75
Fuel Tax Refund	7.65 gals	$0.3000	-2.30
		Subtotal	**0.45**
TOTAL Mileage Tax Due			
		Total Mileage Tax Due	**$0.45**
		Payment Due Date	**Nov 25 12**
		Your account balance	**$0.45**

The pilot is being conducted in two phases:

- Phase one, which began on November 1, 2012 and will end January 31, 2013.
    - Phase one includes 34 participants: 31 Oregon residents and 3 Washington State residents.
    - It includes all plans except the Smartphone Plan.
- Phase two, which began December 1, 2012 and will end February 28, 2013.
    - Phase two includes 59 total participants: 14 additional Oregon residents, 18 additional Washington State residents, and 27 Nevada residents.
    - It includes all plans, including 4 Oregon residents using the Smartphone Plan.

The remainder of this report includes an evaluation of phase one only, for the period from November 1 (pilot start) through December 21, 2012 (thus covering the experiences from the first invoice run, but not the second).

2

Description of RUCPP Evaluation

Description of Evaluation Activities

Evaluation means determining the impacts of the RUCPP and, by extension, the potential future impacts of the RUC program. The impacts of the RUCPP and RUC program can be determined by evaluating how well the programs fulfill their intended goals.

The specific goals measured by the evaluation of the RUCPP have two sources:

1. The evaluation strategy that was accepted by RUFTF for the overall measurement of the Road Usage Charge program (encapsulated below in Table 4: Overview of RUCPP Evaluation Strategy). Using goals from this document ensures that the goals here reflect the overall evaluation goals for the RUC program.
2. The goals and objectives of the RUCPP as stated in the RUCPP Concept of Operations, and listed below in table 4.

Table 4: Overview of RUCPP Evaluation Strategy

Goal	Impacts	Evaluation Criteria Category	Metrics[11]
Determine the level of public acceptance of the RUC program	Customer program acceptance and response AND Public attitudes	**1. Policy and public acceptance**	a. Similar revenue contribution by RUC payers under RUC as under the motor fuel tax
			b. Acceptance by RUC payers and other system users concerning: • Costs to RUC payers • Ease and convenience to RUC payers • Privacy protection • Fairness • Transparency • Aversion/attraction • Choice
Demonstrate and measure the technical and operational viability of the proposed RUC concept through demonstrations	Infrastructure and usage impacts AND System operational factors	**2. Technology**	a. Adaptability of the RUC system
			b. Ease of installation of mileage reporting devices
			c. Safety of mileage reporting devices, mileage reporting device installation, and system operations for motorists.
			d. Anti-tampering
			e. System performance

[11] In this evaluation, a **metric** is defined as the value to be measured to determine how well each program goal is fulfilled. For example, "Ease of Mileage Reporting Device Installation" is a metric that measures how easy it is to install the mileage reporting device, a key part of the first system goal—that the system is easy to use. The specific numerical value held by a metric is called an **indicator.** The indicator for the "Ease of Mileage Reporting Device installation" is the average (mean) of the responses to the following survey question: What was the level of difficulty to install the mileage reporting device? Response options: 1. Very high, 2. High, 3. About right, 4. Low, and 5. Very low

Goal	Impacts	Evaluation Criteria Category	Metrics[11]
			f. Hardware, software and other system elements including • Feasibility • Accuracy • Reliability • Security/encryption • Open system • Energy consumption • Account management system experience
Gain a preliminary understanding of the operational aspects of the RUC program	System operational factors	**3. Operations**	a. Ease and cost efficiency of administering the RUC
			b. Ease of use and cost of compliance with the RUC system by RUC payers and other system users, including evasion potential
			c. Accuracy and perception of accuracy of data transmitted to the central database and used for assessing mileage taxes
			d. Privacy options for RUC payers in protecting personal, private data
			e. Ability to audit
			f. Usefulness for phasing and partial implementation
Gain a preliminary understanding of the costs associated with implementing the RUC program	Financial impacts Economic impacts	**4. Costs**	a. Start-up costs (capital and retrofitting)
			b. Operations and maintenance
			c. Costs of collection relative to fuel tax

The term "Stakeholders" refers to all parties involved in the RUCPP. The evaluation team identified the following six key RUCPP stakeholders. Evaluation activities comprised surveys of and data collection from these groups:

1. **Participants or RUC payers**
   Individuals who were responsible for paying the Road Usage Charge, typically vehicle owners or lessors. For the purpose of the pilot, participants are defined as those individuals who signed up for the pilot, chose a mileage reporting plan, installed the mileage reporting device if applicable, and drove chargeable miles on the Oregon roadway network.
2. **Mileage reporting device vendors**
   Representatives of the companies who supplied the mileage reporting devices.
3. **Account management system vendors**
   Representatives of the company who provided the private account management systems.
4. **ODOT pilot participant coordinators**
   The ODOT representatives who coordinated activities of the pilot participants.
5. **ODOT Road Usage Charge Accounting System Operator**
   The ODOT contractor who operated the ODOT Road Usage Charge accounting system.
6. **ODOT System Integrators**
   The ODOT contractors who integrated, tested, and provided ongoing support for all elements of the RUCPP.

One of the first steps in the evaluation was distribution of initial surveys to vendors and participants in order to determine their positions going into the RUCPP. Note that surveys of other RUCPP support stakeholders, including ODOT and its consultants were also conducted, but these results and opinions are not as useful given the longstanding involvement of ODOT staff in the road usage charge program.

Participants have been surveyed twice thus far:

1. A pre-screening survey to determine RUC payers' opinions, thoughts, and behaviors at the outset of the program.
2. A mid-point survey to determine RUC payers' opinions, thoughts, and behaviors during the program following receipt of the first invoice.

A third and final survey will be distributed at the conclusion of the pilot to determine RUC payers' opinions, thoughts, and behaviors after the program is finished. This final survey will be evaluated by itself and against the data received in the previous two surveys. Trends and shifts in attitudes will be of special interest in evaluating this final survey.

Vendors were surveyed during the stakeholder information sessions before the start of the RUCPP, as described above, and will be surveyed again at the end of the RUCPP. No midpoint survey was held.

During and after the data and survey collection, the evaluation team compiled responses, analyzed indicators, and prepared this report.

This report is prepared using only a portion of the data for the first phase of the RUCPP in order to be available early enough to inform Oregon legislators about the RUCPP activities at the beginning of the legislative session.

The final report will be made with all the data from the RUCPP, and it will include data from the other participating states of Washington and Nevada.

Surveys

One of the most important sources of information for evaluating the performance of the pilot was feedback received from surveys of participants and vendors. Below we describe the process of obtaining survey data from these two important groups.

Participant Surveys

In order to track feedback and opinions from pilot participants in a dynamic fashion, two surveys have been employed so far. Surveys included a combination of multiple-choice questions, rankings, and open-ended questions posted online. Participants were given approximately two weeks to respond to each survey at their convenience.

- Pre-pilot survey. The first survey was distributed to participants within a week of signing the participant agreement, in late October 2012. The survey had 26 questions, and 24 participants out of 42 responded, a rate of about 57 percent.
- Midpoint survey. The second survey, consisting of 41 questions, was distributed in early December 2012, approximately at the halfway point of the pilot, after the first round of invoices was distributed to 31 participants[12]. Out of a total of 31 surveyed, 18 participants responded, for a participation rate of 58 percent.

The third and final survey will be distributed at the conclusion of the two phases of the pilot:

- February 2013 for phase 1 participants, and
- March 2013 for phase 2 participants.

Analysis of the responses to participant survey questions is shown in Chapter 3.

Vendor Surveys

In order to gather feedback from vendors providing technology and account management services during the pilot, a pre-pilot survey was conducted with each vendor. The surveys were conducted as interview-style teleconferences, led by members of the evaluation team. The first pre-pilot survey was conducted in late October 2012 with two representatives of Sanef. A second pre-pilot survey was conducted in November 2012 with two representatives of Raytheon. Post-pilot surveys will be conducted in early February 2013 with both vendors.

Questions asked during the interview included multiple-choice question, open-ended questions, and free format comment opportunities.

The results of the vendor surveys are summarized in Chapter 3.

Data Collection

In addition to the largely qualitative feedback from surveys, the evaluation team collected raw data from a range of pilot stakeholders at various points throughout the pilot as summarized below. The evaluation team asked each of the stakeholder groups to provide the data in the original formatting in which it was recorded (whatever spreadsheet or other formatting had been used to record the data).

[12] It should be noted that 11 of the original 42 participants signed up for RUCPP service plans that began in Phase 2 and as such they did not receive the first invoice in early December.

RUCPP Coordinators

The following data were collected at the start of the pilot:

- Number of Participants in Pilot.
- Participant vehicle make, model, and year.
- Participant vehicle odometer reading immediately before mileage reporting device activation (if provided by Participant).

Much of this data was actually provided by the System integrators (support team).

Immediately following the pilot, the following data will be collected:

- Number of Participants who successfully completed the pilot.
- Number of Participants who did not complete the pilot, when they dropped out, and why.
- Number of Participants who fully paid the Road Usage Charges owed.
- Number of Participants who did not fully pay the Road Usage Charges owed, and how much was owed by any Participants that did not fully pay.
- Odometer reading of each vehicle immediately after mileage reporting device deactivation (if provided by Participant).
- Number of mileage reporting devices that are reported broken.

System Integrators (support team)

Prior to the pilot, the following data were recorded:

- Number of mileage reporting device options available to Participants.
- Number of data collection, transactions processing, account management system options available to Participants.
- Whether the mileage message was used by all mileage reporting devices.

Immediately following the pilot, the following data will be recorded:

- Whether any mileage reporting device, data collection, transactions processing, account management system options available to Participants before RUCPP failed, and why.
- Compilation of Road Usage Charge Accounting reports.
- Whether mileage reporting devices that provided by one vendor used with all transactions processor/account management system vendors.
- The capital and retrofitting costs that ODOT incurred starting up the Road Usage Charge pilot system.
- The operations and maintenance costs that ODOT incurred starting up the Road Usage Charge pilot system.
- The marginal costs of operating Road Usage Charge system in multiple states.
- A documentation of any unexpected problems that arose, if they were resolved, and how long it took to resolve them.

Vendors

Immediately following the pilot, the following data sheet will be distributed:

- Miles travelled (by zone) and taxes owed and paid for each RUCPP participant (may be provided as part of road usage charge accounting records)
- Customer service logs and issue logs (may be included in Help Desk Logs).
- Logs of road usage charging transactions.

Road Usage Charge Accounting

Immediately following the pilot, the following data will be collected:

- The total cost of operations by RUCA (Road Usage Charge Accounting) and TP (Transaction Processor) vendors.
- The marginal costs of operating the RUCA in multiple states.
- An estimate of quality of audits of RUCPP participants.
- Whether all information for audit is available, and if not, what is missing?
- Whether the multi-state nature of the pilot complicated the auditing process, and if so, what system improvements could be made to support multi-state audits.

3

Evaluation Metrics

This chapter presents the actual computation of the metrics that constitute the evaluation of the RUCPP. The raw data used to compute these metrics is included in Appendix B.

The following table provides a summary of the evaluation results for the metrics for each evaluation category.

Table 5: Summary of Evaluation Results

Evaluation Category	Metric	Performance
Policy and public acceptance	Metric 1: Similar revenue contribution by RUC payers under RUC as under the gas tax	In aggregate, RUCPP participants had an average of 24.3 MPG and contributed more RUC than they would have fuel tax.
	Metric 2: Acceptance by RUC payers and other system users concerning several criteria	a) Impacts to RUC payers: average of $0 cost and 44 minutes per participant. b) Ease and convenience to RUC payers: all participants responding to the survey lauded the ease of use of the RUCPP. c) Privacy protection: privacy was protected and adequately explained through user choice of GPS vs. non-GPS mileage reporting devices. d) Fairness: almost all participants agree that RUC is at least as fair as a gas tax. e) Transparency: this metric has not yet been measured. f) Aversion/attraction: overall, participants found the RUC methods acceptable. g) Choice: providing user choices alleviated many of the concerns about RUC beyond privacy.
Technology	Metric 1: Adaptability of the RUC system	This metric was not yet measured as part of the RUCPP but will be measured in post-RUCPP vendor surveys.
	Metric 2: Ease of installation of mileage reporting devices	All but one participant installed the devices themselves in a matter of minutes.
	Metric 3: Safety of mileage reporting devices, mileage reporting device installation, and system operations for motorists	There have been no reported incidents of mileage reporting devices compromising the safety of any aspect of the system, from driving to bill paying.
	Metric 4: Anti-tampering	Vendors have expressed confidence in device anti-tampering features and algorithms in their products.
	Metric 5: System Performance	Overall system performance has been high—it has exceeded expectations in terms of accuracy, efficiency, and ease of use.
	Metric 6: Hardware, software and other system elements	a) Feasibility: Yes. b) Accuracy: Yes. c) Reliability: Yes. d) Security/encryption: Yes. e) Open system: Yes. f) Energy consumption: Yes. g) Account management system experience: Yes.
Operations	Operations metrics were not computed for the legislative report due to the need for a full 'post-mortem' interview with the vendors before operations can be accurately evaluated. Operations will be evaluated after the RUCPP is complete.	N/A

Evaluation Category	Metric	Performance
Costs	Cost metrics were not computed for the legislative report due to the need for a full 'post-pilot cost analysis before costs can be accurately evaluated. Operations will be evaluated after the RUCPP is complete.	N/A

Evaluation Category 1: Policy and Public Acceptance

Policy and Public Acceptance Metric #1: Similar Revenue Contribution by RUC Payers Under RUC as Under the Gas Tax

The purpose of this metric is to assess the difference in revenue generated by road usage charges and fuel taxes in order to show that the road usage charge generates a sustainable amount of revenue. The analysis of the RUCPP shows that the RUC does in fact generate as much or more revenue when compared with the fuel tax, so long as the fleet to which it applies has a fuel economy of at least 19.2 mpg.

The road usage charge used in the pilot is a per-mile fee that, unlike the fuel tax, does not vary based on the fuel efficiency of the vehicle. The amount of road usage charge revenue a group of vehicles generates stays the same, but the amount of gas tax they pay decreases as the efficiency of the group increases. The most recent policy adopted by RUFTF is to subject only those vehicles with a fuel efficiency of 55 miles per gallon or higher to the road usage charge. Most of the vehicles participating in the RUCPP had fuel efficiency ratings below 55 miles per gallon and, therefore, would not be subject to road usage charges according to this policy. Still, it is useful to compare the amount of revenue generated by these vehicles under a road usage charge and the amount that they would have generated if they were subject to fuel taxes instead.

The table below summarizes the actual distances driven and road usage charges paid by vehicles participating in the RUCPP during the first month of operations. These participants activated their accounts and began recording mileage in November 2012 and received invoices during the second week of December 2012, with payments due in January 2012.

Table 6: Characteristics of RUCPP first billing cycle, November 2012

Number of Oregon-registered vehicles	31
Total miles driven during Nov. 2012 billing cycle	31,478.4
Total chargeable miles driven during Nov. 2012 billing cycle	30,746.6
Total road usage charges billed for Nov. 2012 billing cycle	$479.65

As shown in the table above, the 31 participating vehicles paid $479.65 in road usage charges. For the same mileage, the RUCPP recorded that these vehicles consumed 1,263.65 gallons of fuel, or above 24.3 miles per gallon. At the Oregon tax rate of $0.30 per gallon, these vehicles contributed $379.10 in fuel taxes. Road usage charges generated $100.55, or about 26 percent, more revenue than the fuel tax. This scenario appears in the second row of the table below. For comparison, we also show scenarios where the vehicles subject to road usage charges have an average fuel efficiency of 19, 40, and 55 miles per gallon, as well as a final scenario in which only electric vehicles are subject to road usage charges.

Table 7: RUC vs. fuel tax revenues for various MPG scenarios

Scenario[13]	Gallons of fuel consumed	Nominal fuel taxes	RUC Paid	RUC paid minus nominal fuel taxes	RUC vs. fuel tax percent difference
19.2 MPG	1,598.90	$479.65	$479.65	$0.00	0%
24.3 MPG (RUCPP actual)	1,263.65	$379.10	$479.65	$100.55	+26%
40 MPG	768.67	$230.60	$479.65	$249.05	+52%
55 MPG	559.03	$167.70	$479.65	$311.95	+186%
All electric vehicles	0	0	$479.65	$479.65	N/A

This chart illustrates that in the RUCPP, about $100 more revenue was generated in the first month than under a fuel tax. If the average fuel efficiency of the fleet in the RUCPP was higher (40 or 55 mpg), or if the fleet in the RUCPP was all-electric, even more revenue would be generated. Only if the fleet in the RUCPP were to have an average fuel efficiency of 19.2 mpg or lower would the expected revenue of the RUC be less than that of the fuels tax.

In general, if the average of the vehicle fleet is 19.2 mpg or better, the revenues of the RUC will be equal to or greater than the revenues from the fuels tax.

Since the road usage charging system for the pilot does ask participants to specify the states in which fuel was actually purchased, it was not possible to provide precise refunds on an individual basis. Instead, ODOT relied on the following reasonable assumptions:

- Motorists in general are likely to purchase fuel where they are incurring mileage. Oregon-based motorists are more likely to purchase fuel in Oregon than elsewhere because they live in Oregon. Consequently, for participants with an Advanced Plan, ODOT refunded fuel taxes in proportion to miles driven in Oregon. For example, if a participant paid $100 in fuel taxes but drove only 50% of miles in Oregon, then ODOT refunded only $50 of fuel tax.
- For participants with a Basic Plan, ODOT refunded all fuel taxes. Since the Basic Plan requires participants to pay for all miles, regardless of location, a refund for all gas taxes paid, also regardless of location, is appropriate.

The table provides a range of scenarios that fulfill this metric regarding the ability of road usage charges to generate revenues relative to the fuel tax in Oregon. These figures are derived from actual distances driven in the RUCPP by participating vehicles as well as, in the case of the second scenario, the actual gallons of fuel consumed in the RUCPP.

Policy and Public Acceptance Metric #2: Acceptance by RUC Payers and Other System Users Concerning Several Criteria

The RUCPP shows that the RUC system is very acceptable to participants. Evaluation of the RUCPP entailed two types of road usage charge acceptability measurements: data (objective) and survey (subjective). In this section we present results of both.

First, the table below summarizes objective data collected from users and vendors during first phase of the RUCPP.

[13] All scenarios are based on the 30,746.6 chargeable miles driven during the November 2012 billing cycle of the RUCPP.

Table 8: RUCPP participation characteristics

Item	Value
Average participant cost in dollars	$0
Average time devoted to the RUCPP per participant, in minutes[14]	44[15]
How many participants started the pilot?	45
How many participants are still enrolled in the pilot?	45
How many participants have dropped out of the pilot?	0
How many participants have fully paid the RUC they owe so far?	31/31
How many participants have not fully paid the RUC they owe so far?	0

Based on the first two months of operations, all Oregon participants in the RUCPP who started the pilot are still enrolled. They have devoted an average of 45 minutes per person to the pilot test so far with zero costs beyond the cost of the road usage charge itself.

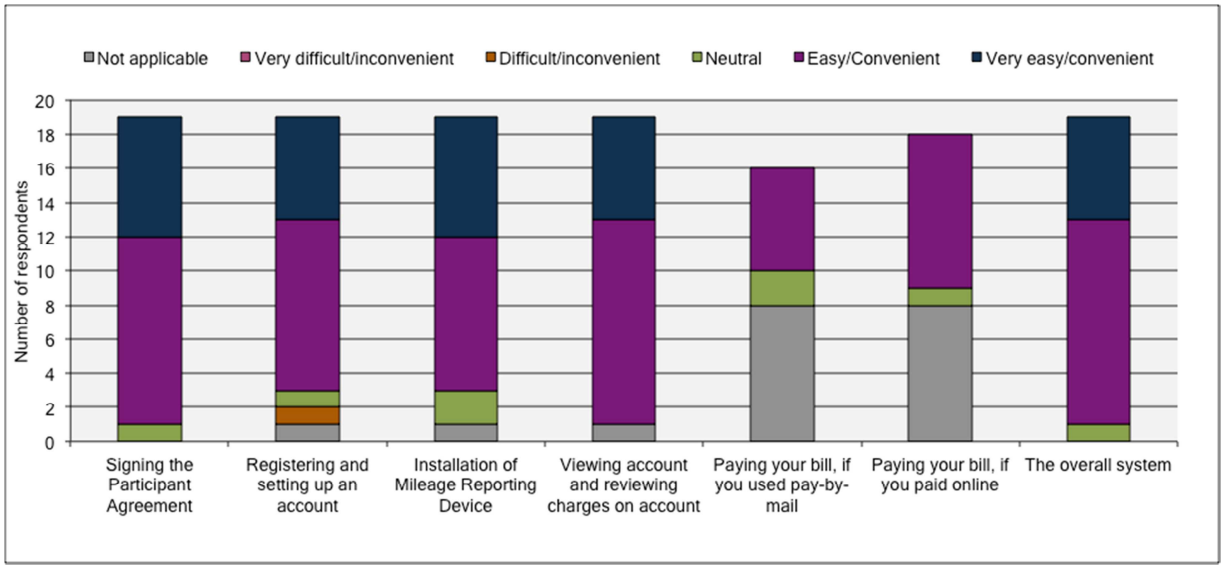
Next, the evaluation process considered responses to survey questions. All participants were asked to complete a survey before the start and at the midpoint of the RUCPP. Approximately 60 percent of those surveyed responded, and the responses form the basis of the metrics presented below.

[14] Includes time devoted during the first 1.5 months of the pilot to the following activities: reading and signing the participant agreement; selecting a plan; setting up an account, installing the mileage reporting device; troubleshooting issues with the device; reading, understanding, and paying a bill; troubleshooting account problems; and completing evaluation surveys.

[15] Based on participant responses to surveys. The minimum time devoted was 10 minutes. The maximum time devoted was 85 minutes. The average time devoted of 44 minutes has standard deviation of 25 minutes.

Ease and convenience. RUCPP participants found the system to be very easy and convenient. The table below summarizes survey responses regarding ease and convenience of a variety of aspects of the RUCPP. In addition to the six categories, the far right column represents ease and convenience of the overall system. For each category, the majority of respondents viewed the RUCPP as "easy/convenient" or "very easy/convenient," as illustrated by the blue and green shaded columns. The number of "neutral" responses ranged from zero to two depending on the category, and there was only 1 "difficult/inconvenient" responses for the "registering and setting up an account" aspect. Eighteen out of nineteen respondents rated the overall system as easy/convenient or very easy/convenient, while one rated the overall system neutral. Of the 11 survey respondents who answered the question "what aspects of the mileage tax system do you like best so far," all of them cited "ease" or "simplicity" of the system.

Figure 9: Respondents' opinions about the ease of various aspects of the RUCPP



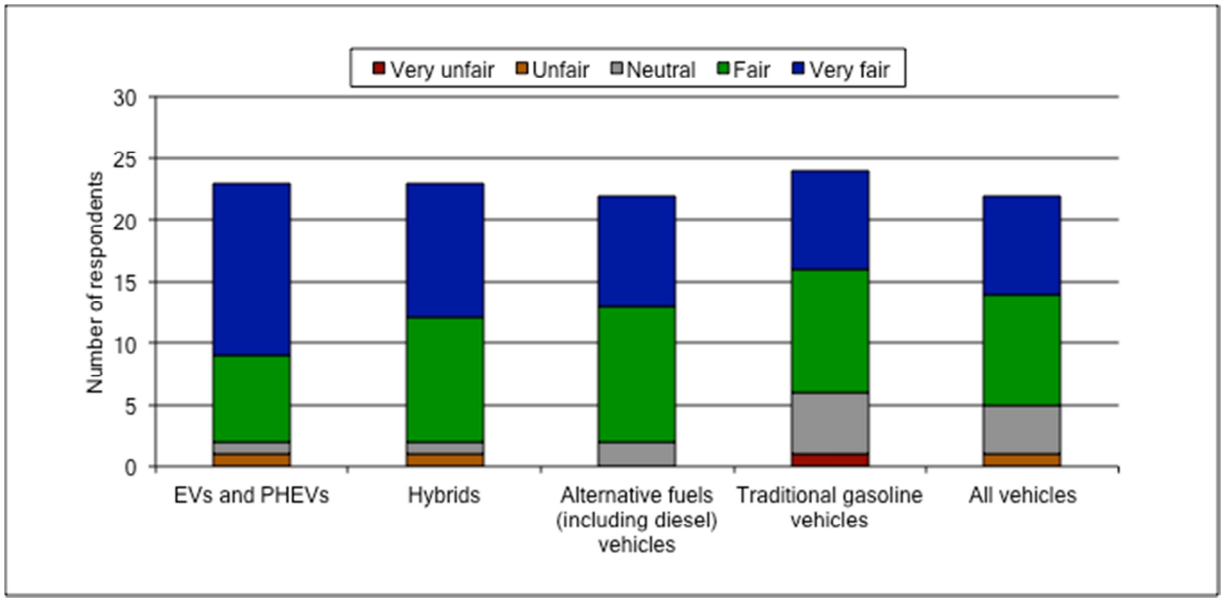
Privacy protection. RUCPP participants found that the system protects their privacy well. A variety of privacy issues were explored through the survey instrument both before and during the RUCPP.

- Interestingly, prior to the RUCPP, a minority of survey respondents indicated that personal location privacy is important: 42 percent rated personal location privacy as important or very important, while 21 percent were neutral and 37 percent rated it not important. On the other hand, 100 percent of respondents felt that account security is important.
- At the midpoint of the RUCPP, 61 percent of respondents believed their personal location privacy was being protected well or very well, while 28 percent were neutral, and 11 percent did not believe their location privacy was being protected well.
- Fully 79 percent of respondents felt their account security was being maintained well or very well, with 21 percent neutral on the question. No participant had a negative response for account security.

Fairness. RUCPP participants found the system to be fair. At the outset, prior to the RUCPP, 58 percent of respondents out of 24 felt that the Oregon excise tax on fuel of 30 cents per gallon is "too little" while 38 percent found it "about right" and one respondent (representing 4 percent) found it "too much." By comparison, 83 percent of the same respondents find road usage charging to be "a lot more fair" or "somewhat more fair" than gas taxes, while 13 percent are neutral, and one respondent finds road usage charging "somewhat less fair" than the gas tax.

When considering fairness by vehicle class, the responses vary. In general, road usage charges are viewed as more fair for fuel-efficient vehicles than for other vehicles. Overall, though, a majority of respondents feel that road usage charges are fair or very fair for all vehicles. The chart below summarizes detailed survey responses.

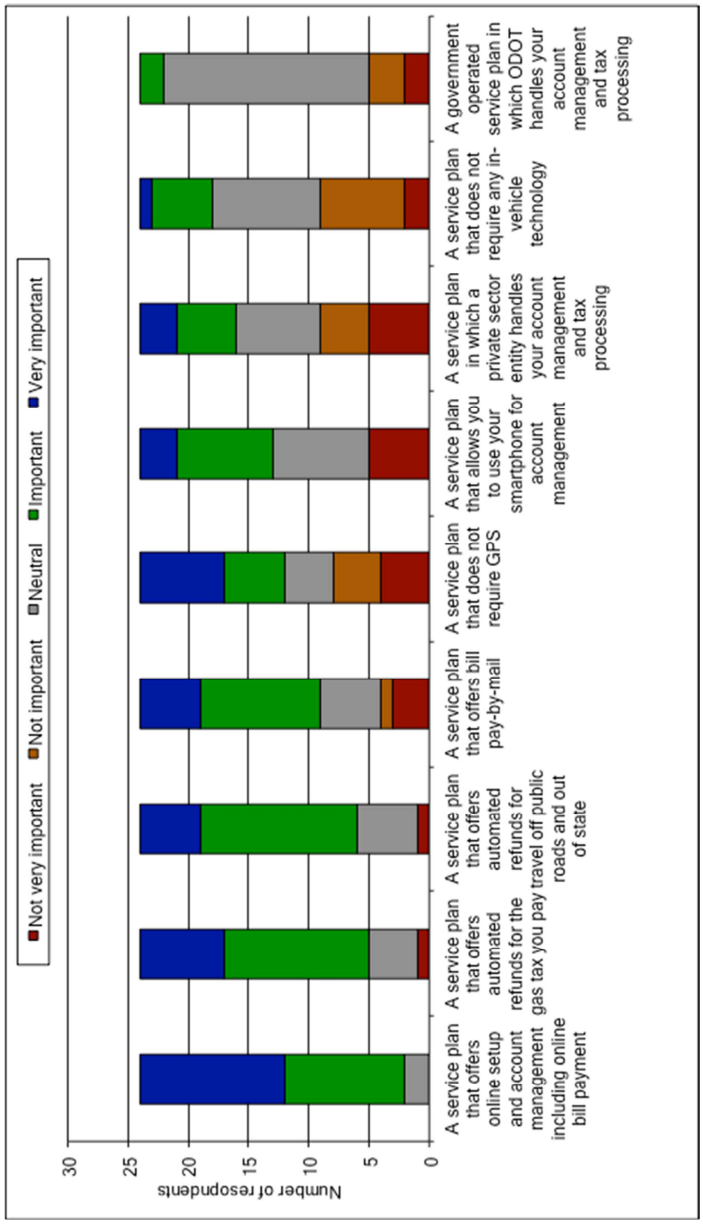
Figure 10: RUCPP survey respondents' views on fairness of RUC for various types of vehicles



At the midpoint, RUCPP participants were again surveyed about fairness. Only 11 participants responded to the question, “Do you believe the amount you paid (for your first RUC bill) was a fair price?” However, all 11 participants responded affirmatively,

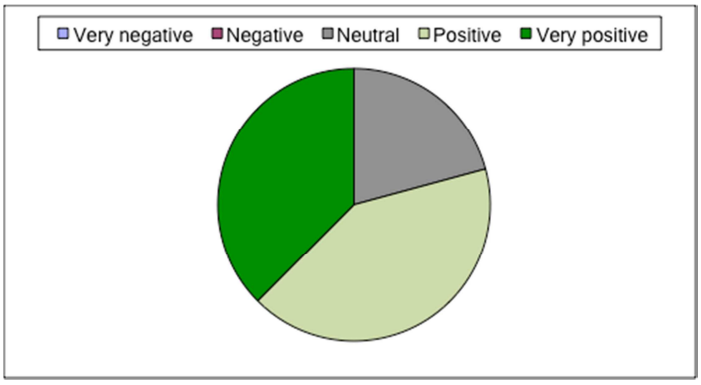
Choice. One of the principal objectives of the RUCPP is to demonstrate the concept of user choice. RUCPP participants were offered five different choices of mileage collecting and reporting plans. The level of satisfaction with the RUCPP shows that this has been well received by participants. However, there are many dimensions of choice. The following table summarizes the choices by level of importance to survey respondents.

Figure 11: Importance of various types of RUC service plan choices to RUCPP participants



Overall aversion/attraction. Prior to the RUCPP, 21 percent of survey respondents had a neutral attitude toward road usage charges, while 79 percent held a positive or very positive attitude. None had a negative attitude (see chart below).

Figure 12: Pre-RUCPP attitudes toward road usage charging



Based on responses at the midpoint of the pilot, the RUCPP experience has only improved the already positive view of road usage charging. So far, 32 percent of respondents have a “more positive” attitude, 10 percent have a “much more positive” attitude, and the remaining 58 percent report no change in attitude.

Overall, the survey responses and objective data indicated a high degree of acceptance of the system as demonstrated in the RUCPP. Measures of ease and convenience, privacy protection, fairness, choice, and overall attraction are very strong. The vast majority sees the system as easy to use, and fair, while sufficiently protecting location privacy and account security. These subjective responses are corroborated by objective data, which show a zero dropout rate and 100 percent on-time payments thus far.

Evaluation Category 2: Technology

Technology Metric #1: Adaptability of the RUC System

The questions concerning adaptability of the RUC system were not posed during the pre-RUCPP vendor surveys. This metric will feature in the post-RUCPP vendor surveys. The adaptability of the RUC system will be demonstrated by an analysis of combined vendor responses to determine overall trends.

Technology Metric #2: Ease of Installation of Mileage Reporting Devices

RUCPP participants found the mileage reporting devices very easy to install. The ease of installation of the mileage reporting devices is demonstrated by an analysis of combined vendor responses, surveys, and pilot participant coordinator records.

Vendor surveys. Both vendors indicated that the mileage reporting devices (hardware) are designed to plug into the OBDII port and should be self-installed by the users without additional assistance for most car models (if the car model has an OBDII port). The vendors stated that hardware installation process, including becoming familiar with the installation guidelines, should take an average of about five minutes. The only activity that may prolong the process is locating the OBDII port. To facilitate the installation and help desk support, IMS provided documentation to the help desk on where OBDII ports are on various car types.

Participant surveys. The main results from the respondents are derived from the midpoint RUCPP survey that included responses to most questions from 17 respondents[16]. A summary of the key reaction to each installation related question is as follows:

- Did you install it yourself or did you need help? If you needed help, who helped you?
  - All but one respondent indicated that they were able to install the device without assistance. This means that self-installation for such mileage reporting devices is possible and has been proven to be something that a vast majority of respondents are able to accomplish with little or no difficulty.
- Was there any cost to you for installation?
  - Of the 17 respondents, they all indicated that they incurred no costs for installation. This clearly demonstrates that installation of RUCPP mileage reporting devices leads to no additional installation charges for RUC payers.
- How long did it take to install the OBU start to finish?
  - The time to install for all 17 respondents with mileage reporting devices ranged from a low of only 1-2 minutes for five respondents to a high of 15 minutes for two respondents. The average time to install was 5.59 minutes. One of the key determining factors of installation time is the ability to locate the OBDII port, which depends on the make and model of the vehicle.
- What was the level of difficulty to install the mileage reporting device?
  - For this category, two respondents viewed installation of the mileage reporting device as "neutral" with the remaining 15 respondents indicating "easy/convenient" or "very easy/convenient." There were very few issues related to installation of the mileage reporting device.
- How useful were any provided installation instructions?
  - Of 17 responses, only one person indicated that instructions were not useful, two persons indicated a neutral viewpoint, 13 indicated they were useful and one indicated very useful. These results demonstrate that the installation instructions were reliable and self-explanatory.

Technology Metric #3: Safety of Mileage Reporting Devices, Mileage Reporting Device Installation, and System Operations for Motorists

RUCPP participants have found the mileage reporting devices to be very safe without any significant issues related to installation of the mileage reporting device and systems operations. The safety, installation and system operations aspects of the mileage reporting devices are demonstrated by an analysis of the responses by participants to a set of questions.

Participant surveys. The results from the respondents are derived from the following six questions:

- Did the OBU ever physically impede your driving? If so, how? And how often?
- Did the OBU ever distract you during driving? If so, how? And how often?
- Did the OBU ever cause a safety-critical event or impair the vehicle? If so, how often?
- Did the OBU ever fall out of the OBDII port? If so, how often?

[16] It should be noted that there are 17 respondents for these questions and not 18 because one person chose the unlimited mileage collection and reporting plan (unlimited mileage purchased for a flat annual or monthly fee, with no technology required, administered by ODOT).

- Did the MT system operations ever interfere with your driving in any other way? If so, how and how often?
- Have the Road Usage Charge system operations ever interfered with your vehicle or driving in any other way?

For each of these six questions, the response was "never" for all 17 respondents, except for the second question "Did the OBU ever distract you during driving?" In effect, two respondents indicated that on one single occasion for each of them, the mileage reporting device was a distraction while driving. No further information on the type of distraction was provided by these two respondents. However, there are two possible sources for the distraction:

- The lights were visible in a way that interfered with the driver's attention. While the drivers must have grown used to the lights, the device manufacturers should take care to not make them blink or otherwise disturb the driver.
- The placement of the device in the OBDII port made the driver concerned if he or she was going to hit it. Because OBDII port placement can't be controlled, the devices should be as small as possible.

The results of the survey for this metric related to safety, installation and system operations issues demonstrate that the Road Usage Charging system implemented for the RUCPP is safe and easy to use for the mileage reporting devices. This safety issue means that none of the mileage reporting devices actually fell out of the OBDII port, and no incidents transpired leading to interference with driving. Furthermore, the results demonstrate that installation and on-going system operations have been without any major issues.

Technology Metric #4: Anti-tampering

The anti-tampering metric is demonstrated by an analysis of combined vendor responses. The following table provides the indicators representing the combined vendor responses to two questions.

Table 9: RUCPP Vendor responses to questions on anti-tampering measures

Question / Vendor response	How effective are your anti tampering means?	Could an unskilled individual learn to effectively tamper with the mileage reporting device, for example, by reading how to do so on the Internet?
Sanef/IMS	• Enclosure has tamper-evident tape (see if device is opened). • Sanity checks in firmware. • Compare distance OBU in GPS to distance from engine.	• Sanef did not answer this question directly but implied that if signals used to detect device removal from vehicle were monitored by the account management system it would be very hard to commit fraud.
Raytheon	• Device, detects and logs if it is removed from vehicle.	• Raytheon believe anti-tamper prevents user from removing device from vehicle without being noticed, the main means of tampering.

Technology Metric #5: System Performance

The system performance record indicates that the system is performing very well: there have been no identified lost transactions, no inaccurate billing, and no missed or mis-recorded mileage.

The system performance metric shows these results using the following four indicators:

1. Acceptance Testing. Acceptance testing demonstrated that the mileage reporting devices, and by extension the system, could accurately measure distance traveled, and in the case of advanced mileage reporting devices, could accurately measure distances traveled off-road and out-of-state. Full details of acceptance testing are recorded in the Acceptance testing reports; however, it is sufficient to state that mileage reporting devices correctly measured distances traveled. Thus, the acceptance testing indicator shows that the system performs very accurately.

2. System and Mileage Reporting Device Errors from System Logs. The help desk monitors and logs all errors recorded by the system. During the RUCPP, no mileage reporting device errors have been logged, indicating the system has performed very well.

3. Mileage Tax Accounting Auditing of Transactions. The RUCPP includes a detailed accounting analysis of all mileage tax transactions that is designed and implemented by an accountant experienced in large government-run transaction systems. This analysis was performed on the first month of data (November 2012), and resulted in finding no errors in billing, and complete consistency in results.

4. Participant Survey Questions. To the survey question: “Do you believe any driving events or miles have been missed by the system?” All but one participant responded negatively, and the other participant provided no response.

To the question “Do you believe the system has over-counted your mileage?” All but two participants responded negatively. One participant provided no response, and the other participant indicated that about 100 miles out of state had been charged. However, this participant had selected the basic plan with a mileage reporting device that does not have the capability of reporting out of state miles driven. Thus, this participant’s basic mileage reporting device correctly counted all mileage, including the 100 miles out of state. Therefore, the survey questions indicate that participants believe that the system is performing perfectly.

Conclusion for System Performance. Taken together, these indicators demonstrate that the system is measuring all miles driven, and neither over-counting nor undercounting, and sending participants accurate bills on a monthly basis. This shows a very high level of system performance.

Technology Metric #6: Hardware, Software and Other System Elements

The RUCPP system is feasible, accurate, reliable, secure, open and has neutral or beneficial energy consumption impacts. The following sections address the evaluation results for all of these elements.

a) Feasibility

The system is feasible, as demonstrated by two indicators:

1. Acceptance Testing of Devices Used to Support Service Plans in Phase One. The rigorous acceptance testing process of devices used in phase one was successful and thus demonstrated that the system is feasible. All Advanced mileage reporting devices performed well. The Basic mileage reporting devices also performed well.

2. Vendor Surveys. In vendor interviews, Sanef/IMS indicated that their products were already in production (IMS mileage reporting devices support eight insurance companies' pay-as-you-drive insurance products; Sanef's account management systems support tens of thousands of tolling customers). Sanef stated that scaling up production and operation would be straightforward.

b) Reliability

The system is reliable, as measured by four indicators:

1. Mileage Reporting Device Failures Observed During RUCPP. Two mileage reporting devices have failed during the RUCPP so far, but neither was caused by faulty hardware. One was kicked out of the OBDII port by a driver who was unaware of the mileage reporting device. This driver then stepped on mileage reporting device and damaged it. The other mileage reporting device was plugged in a car that experienced an electrical system issue.[17] This electrical system issue damaged the mileage reporting device.

2. Mileage Reporting Device Vendor Survey. IMS stated that their devices have a minimum design lifetime of 5 years.

3. Availability of Account Management System. IMS did not specify a precise availability but stated that their system was very highly available.

4. Participant Survey Questions. The same survey questions as indicated accuracy (no missed miles, no over-counted miles) indicate that the system is reliable from the participant perspective.

c) Security

The system is secure. The indicator for system security is vendor survey responses.

The mileage message has no encryption by specification. This choice was made to ease the implementation of the RUCPP system; in full operation, encryption would be used on the mileage message

However, the choice was made during the RUCPP to use the WS-OASIS security standard for the mileage message. Online operations use AES 256-bit CVC encryption, an encryption standard equal to or better than most e-commerce websites.

Sanef's system also uses firewalls and other standard cybersecurity measures.

[17] The electrical system issue was not caused by the mileage reporting device; it was an unrelated automotive issue.

Using the cybersecurity measures included in the pilot (WS-OASIS and various firewalls) combined with additional measures such as message encryption to be implemented during revenue operations; the system is and will continue to be secure to cyber-attacks.

d) Open System

The RUCPP system is open, as demonstrated by three indicators:

1. Use of standard mileage message. All mileage reporting devices and the account Management system used a standard information format known as the **Mileage Message** to transmit mileage information. The Mileage Message is a completely open, public, standardized means of communication. Using such an open public standard means that any new vendor of either mileage reporting devices or Account Management System services can simply build a product that is compliant with the specification and be certain that it will work with the system.

2. Use of Mileage Reporting Devices by different manufacturers. Phase one included devices from only one manufacturer. Therefore, we cannot yet fulfill this indicator for this phase one report. However, at the time of report writing, Sanef's Account Management system is reading messages from mileage reporting devices manufactured by IMS (phase one) and from mileage reporting devices manufactured by Raytheon (phase two). Using multiple mileage reporting devices from different vendors demonstrates that the system is in fact open to as many vendors as wish to participate in the system.

3. Availability of choices to participants. All participants had the choice of five different mileage plans, as explained in table 1 above: the ODOT Basic Plan, the ODOT Flat Rate Plan, the Sanef Basic Plan, the Sanef Advanced Plan, and the Sanef Smartphone Plan. These plans have worked seamlessly since the start of RUCPP, and participants have the option of switching plans if they so desire. The availability and coexistence of multiple supported by different CSPs demonstrates that the system is open to participation by as many vendors as wish to support it.

e) Energy Consumption

This metric shows that mileage reporting devices do not impact energy consumption of vehicles in which they are used:

Indicator: Stated Energy Consumption of the Mileage Reporting Devices. Both the IMS and Raytheon mileage reporting devices use minimal electricity when the vehicle is operating and almost no electricity when the vehicle is off, so it will not impact vehicle operations or cause the battery to discharge.[18] These small electricity consumptions are very minor and will not impact the fuel consumption of vehicles, demonstrating that use of the mileage reporting devices does not increase energy consumption.

[18] The IMS device uses about 100mA when operating (when the vehicle is on) and about 2 mA when the vehicle is off and the mileage reporting device is in sleep mode). The Raytheon device uses less than 1 mA when it is operating in sleep mode. Raytheon did not specify the operational electric consumption of their mileage reporting device, but it is likely to be 100 mA like the IMS device.

f) Account Management System Experience

RUCPP participants found that the system has an easy or convenient account management system as demonstrated by Participant Survey questions.

In response to the question “How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Registering and setting up an account,” there were 8 responses of Easy, 6 responses of Very easy, 1 Response of Neutral, and 1 response of difficult or inconvenient. These responses generally show that users feel that setting up an account is easy.

In response to the question “How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Viewing account and reviewing charges on account,” there were 11 responses of Easy and 6 responses of Very easy. These responses generally show that users feel that viewing an account is easy.

Finally, in response to the question “How easy has it been to use the account management system website and/or access your account by other means? There were 11 responses of Easy, 2 responses of Very easy, and 4 responses of Neutral. These responses show that users feel that viewing an account is easy.

Conclusion

Metric 6 demonstrates that the Road Usage Charging system implemented for the RUCPP is feasible, reliable, secure, open, reduces energy consumption, and provides RUC payers an easy, convenient account management system experience.

Evaluation Category 3: Operations

Operations metrics were not computed for the legislative report due to the need for a full ‘post-mortem’ interview with the vendors before operations can be accurately evaluated. Operations will be evaluated after the RUCPP is complete.

Evaluation Category 4: Costs

Cost metrics were not computed for the legislative report due to the need for a full ‘post-pilot cost analysis before costs can be accurately evaluated. Operations will be evaluated after the RUCPP is complete.

4

Technical Recommendations

After the research and analysis that went into this report, the evaluation committee makes the following recommendations. The recommendations are included in three groups—those that focus on:

Recommendations for the Future Based on Operation of RUCPP

The evaluation team recommends the following:

- The Help Desk was very successful in making the pilot program run smoothly; such a help desk should always be included in any future pilot programs and the ultimate system.
- The websites set up by ODOT and the contractor, Sanef, were an important element in communicating with the general public and key stakeholders, and providing on-line account set up and management for Participants. Both public and private sector websites should be included in any future pilot programs and the ultimate system.

Recommendations for System Improvements Based on Feedback

Key recommendations for system improvements include the following:

- In future system implementations, the mileage message should not be written in protocols that are compatible with current trends in web and cloud-based service programming, and use the least resources, while providing all the functionality needed for a vehicle to report mileage message.[19]
- RUC payers should be given the following communications:
    - They should be encouraged to regularly access their user account on the web or on a mobile phone so that they can better appreciate their road usage in real time.
    - The behavior of the mileage reporting device indicator light should be highlighted and explained in several places including with the mileage reporting device packaging and on the system website.
    - The system documentation should explain that commercial vehicles already pay RUC in the state of Oregon, but also explain that the roadway wear-and-tear caused by passenger vehicles below about 6,000 pounds (including almost all SUVs, pickup trucks, sedans, and compact cars) is identical regardless of weight.

[19] From a technical perspective, this would entail that, in lieu of using the SOAP protocol, the mileage message should use the JSON protocol and use RESTful web services both of which are more recent protocols and compatible with current trends in cloud computing.

5

Conclusions

Based on the analysis of evaluation data, the evaluation team offers the following conclusions:

1. **The RUCPP appears to have successfully met its objectives to demonstrate an easy-to-use mileage reporting and payment system replete with palatable choices administered in an open, interoperable fashion by multiple private sector vendors.**

   Mileage has been measured and invoices distributed for 34 participants from two states (Oregon and Washington) during the month of November 2012. For the month of December 2012, 93 participants spanning three states (Oregon, Washington, and Nevada) received invoices. The mileage recording and billing for November has been accomplished without any significant problems, and all participants interviewed view the system as easy/convenient or very easy/convenient to use.

2. **Results suggest that a road usage charging with an open system is feasible, and a healthy private market exists for the provision of a range of services related to road usage charge collection and administration.**

   Users have been offered a total of five road usage charging payment plans, coming from two separate service providers. All payment plans and service providers are using the interfaces as specified by open specifications. Together, these facts show that the RUCPP represents a truly open road usage charging system, and the RUCPP's success so far shows that this system is feasible.

3. **Giving participants a choice of road usage charging plans is possible and supported success of the pilot based on participant feedback.**

   Almost all participants said that having a choice of road usage charging plans improved their perception of a road usage charging program and made them more comfortable with it.

4. **The perception of user privacy appears to be improved when ODOT does not operate the mileage recording and tax processing systems.**

   Most participants agreed that having a choice of system providers, including a provider other than ODOT, increased their comfort with the system.

5. **1.56 cents per mile was generally acceptable as a price point.**

   Almost all participants said that the 1.56 cents per mile price was just right or too low. Only one participant said it was too high.

6. **A Road Usage Charge is generally perceived as being equitable by the participants of the RUCPP.**

   Most participants agreed that a road usage charging program is at least as equitable as a fuel tax.

Appendix A: System Architecture and Data Flows for Operational Concepts

The following diagrams illustrate the flow of information from the mileage reporting device to the account management system and the ODOT Road Usage Charge accounting entity. In the diagram, RUC payers are represented as Responsible Parties and mileage reporting devices are represented as OBUs.

Figure 13: Information Flow in Undifferentiated Road Usage Charge Reporting Concept

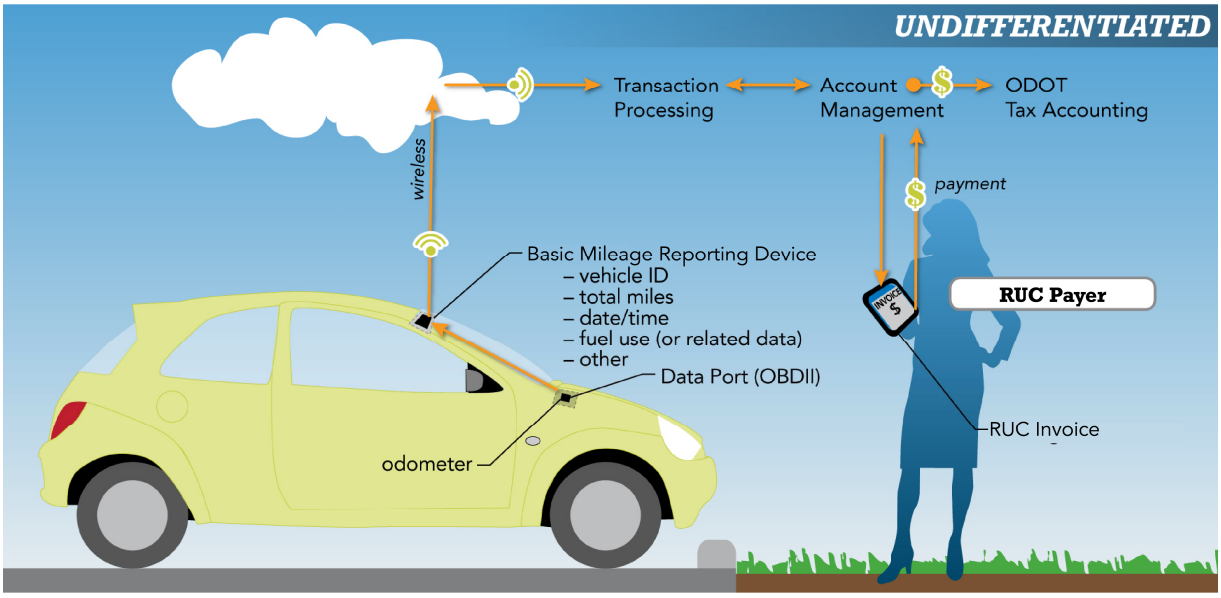
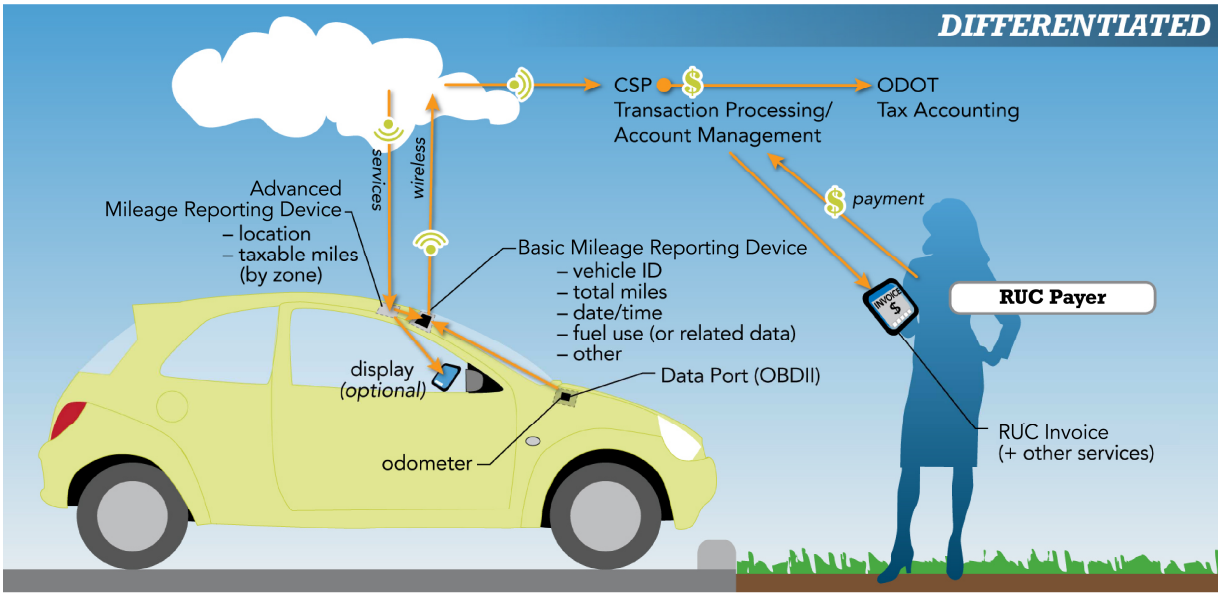


Figure 14: Information Flow in Differentiated Road Usage Charge Reporting Concept



The two concepts of account management – one provided by private CSPs and one provided by ODOT – lead to two different overall logical architectures. The following diagrams illustrate the architectures for these two cases.

Figure 15: RUCPP Architecture with Account Management by Certified Service Provider

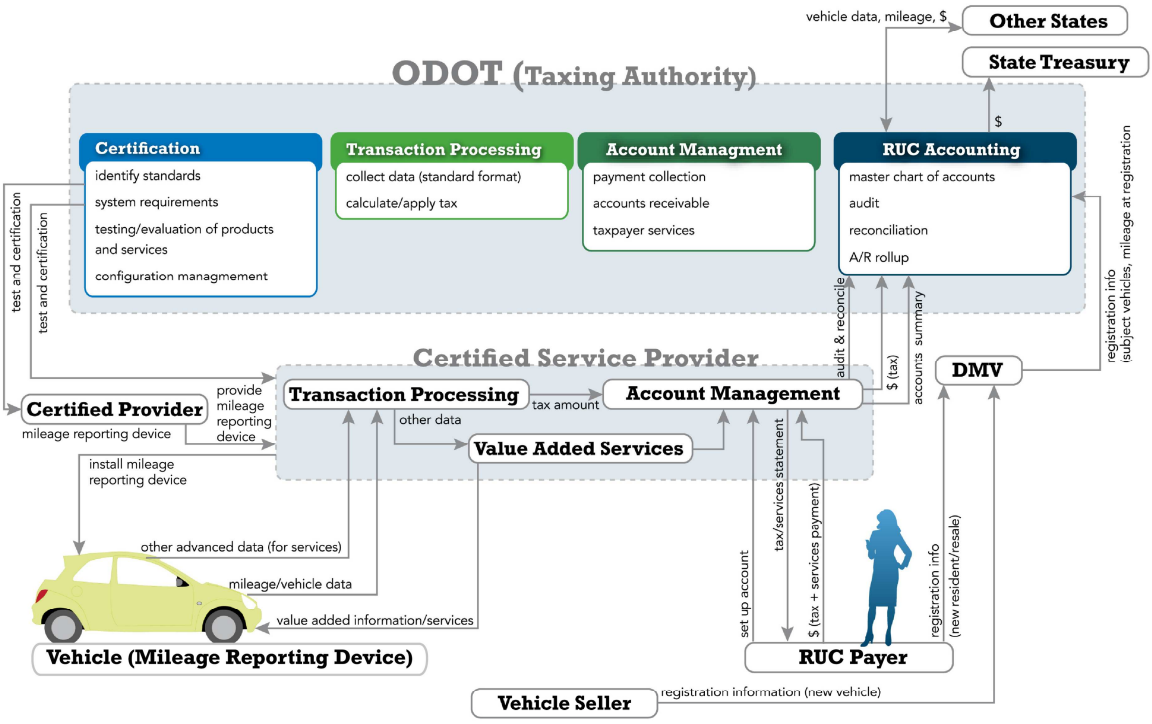
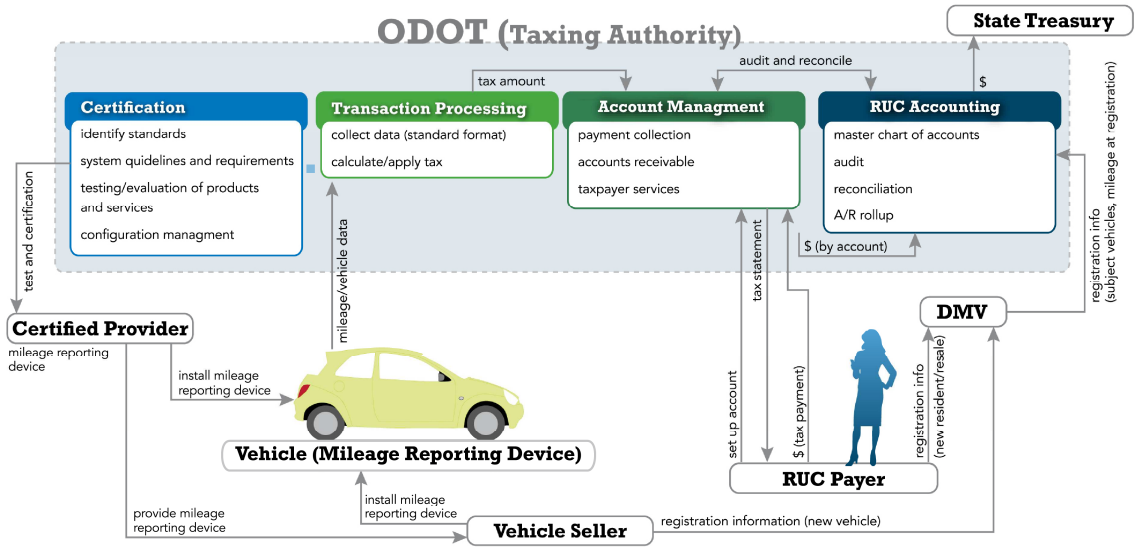
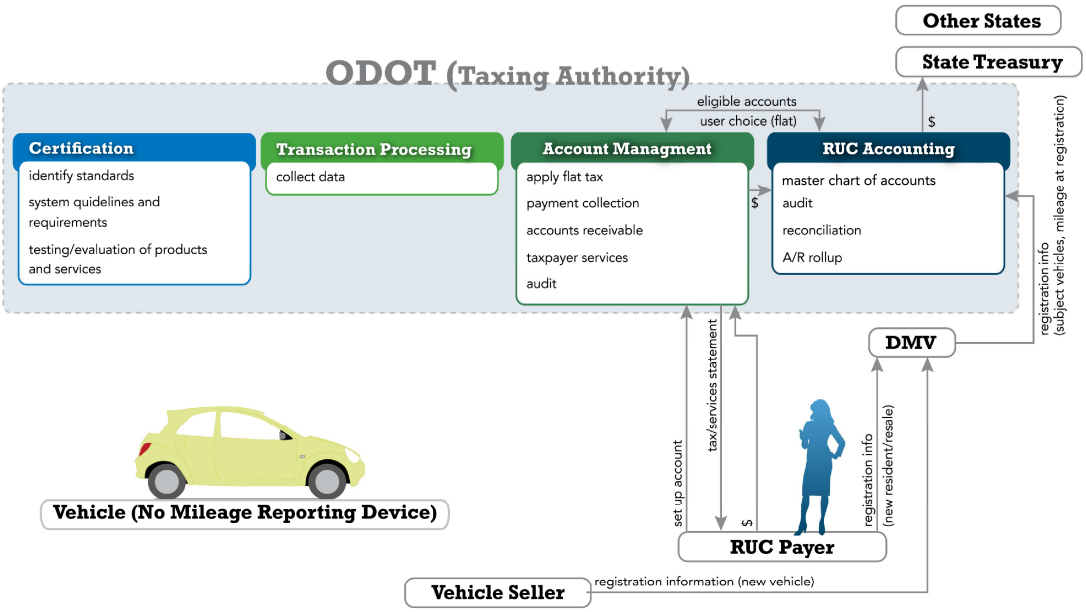


Figure 16: RUCPP Architecture with Account Management by ODOT



The Flat Rate plan has its own logical architecture, illustrated in the following diagram:

Figure 17: RUCPP Architecture for Flat Rate Plan



The architectures are presented only to give a general indication of the entities involved in the operational concepts. Details of these architectures are explained in the *ODOT Operational Oregon Vehicle Road Usage Charge System and Road Usage Charge Pilot Program Updated Concept of Operations* Version 1.1 March 15, 2012.

Appendix B: Results of Surveys and Data Collection

This Appendix provides the results for each of the following:

- Tabulated data results of surveys for RUC payers for pre-RUCPP and midpoint RUCPP surveys.
- Actual survey results for the pre-RUCPP Vendor surveys for Sanef/IMS and Raytheon, and
- Data collection results for issues logs, participant data and mileage tax records.

It should be noted that, for all survey multiple rank questions, responses were assigned a number to allow for numerical analysis as follows:

Response Range 1	Response Range 2	Response Range 3	Response Range 4	Response Range 5	Response Range 6	Response Range 7	Value
Very Negative	Not important	Very Poor	Extremely low	Very unfair	Very uncomfortable		-2
Negative	Not very important	Poor	Somewhat low	Unfair	Uncomfortable	Too little	-1
Neutral	Neutral	Fair	About Right	Neutral	Neutral	About Right	0
Positive	Important	Good	Somewhat high	Fair	Comfortable	Too Much	1
Very Positive	Very important	Excellent	Very high	Very Fair	Very Comfortable		2

RUC Payer Surveys

Pre-pilot Ranking Survey Questions

	Question	Average	Std Deviation	Max	Min
4.1.2	How would you describe your general attitude toward road usage charges—specifically the mileage tax being tested as part of this pilot program?	0.33	1.37	2	-1
4.1.2 4.3.4	How important is it that the system protect the privacy of your personal location?	0.21	1.44	2	-2
4.1.2 4.3.4	How important is it that the system maintain the security of your personal account used for billing?	1.75	0.44	2	1
4.1.2 4.3.4	How well do you believe the system will protect the privacy of your personal location?	0.88	0.90	2	-1
4.1.2 4.3.4	How well do you believe that the system will maintain the security of your personal account?	1.17	0.48	2	0
4.1.2	The Oregon state gas tax is 30 cents per gallon. The amount you are paying in gas taxes for your road usage is:	-0.59	-59	1	-1
4.1.2	Compared to the gas tax, a mileage-based tax is:	1.21	0.83	2	-1
4.1.2	The rate being charged (1.56 cents per mile) in the pilot is:	0.08	0.65	1	-1
4.1.2	How fair is the mileage tax for each of the following classes of vehicles? - Electric vehicles and plug-in hybrid electric vehicles that consume little or no gasoline	1.42	0.83	2	-1
4.1.2	How fair is the mileage tax for each of the following classes of vehicles? - Hybrid vehicles	1.29	0.81	2	-1
4.1.2	How fair is the mileage tax for each of the following classes of vehicles? - Alternative fuels (including diesel) vehicles	1.21	0.72	2	0

	Question	Average	Std Deviation	Max	Min
4.1.2	How fair is the mileage tax for each of the following classes of vehicles? - Traditional gasoline vehicles	1.00	0.98	2	-2
4.1.2	How fair is the mileage tax for each of the following classes of vehicles? - All vehicles	1.00	0.88	2	-1
4.1.2	How important is it that you receive a refund or credit for gas taxes as long as you are paying a mileage tax?	1.08	0.88	2	-1
4.1.2	How important is it for you to have a choice of service plan?	1.04	0.81	2	-1
4.1.2	How important is it to have the following specific choices available to you? - A service plan that does not require GPS	0.29	1.49	2	-2
4.1.2	How important is it to have the following specific choices available to you? - A service plan that does not require any in-vehicle technology	-0.38	1.24	2	-2
4.1.2	How important is it to have the following specific choices available to you? - A service plan in which a private sector entity handles your account management and tax processing	-0.08	1.28	2	-2
4.1.2	How important is it to have the following specific choices available to you? - A government operated service plan in which ODOT handles your account management and tax processing	-0.25	0.79	1	-2
4.1.2	How important is it to have the following specific choices available to you? - A service plan that offers online setup and account management including online bill payment	1.42	0.65	2	0
4.1.2	How important is it to have the following specific choices available to you? - A service plan that offers bill pay-by-mail	0.63	1.10	2	-2
4.1.2	How important is it to have the following specific choices available to you? - A service plan that offers automated refunds for travel off public roads and out of state	0.92	0.78	2	-1
4.1.2	How important is it to have the following specific choices available to you? - A service plan that offers automated refunds for the gas tax you pay	1.04	0.81	2	-1
4.1.2	How important is it to have the following specific choices available to you? - A service plan that allows you to use your smartphone for account management	0.38	0.97	2	-1
4.2.2 4.2.5	How comfortable are you using the Internet?	1.75	0.53	2	0
4.2.2 4.2.5	How comfortable are you using the Internet for commercial transactions (e.g., Amazon, iTunes, banking)?	1.58	0.65	2	0
4.2.2 4.2.5	How comfortable are you using a smartphone (a cellular phone with Internet access such as an iPhone)?	1.25	1.07	2	-2
4.2.2 4.2.5	How comfortable are you with the technology you expect to interact with as part of this pilot?	1.33	0.64	2	0
4.1.2	Do you expect that being charged a tax per mile driven instead of per gallon of fuel consumed will change your driving habits?	-0.92	0.41	1	-1
4.1.2	If you answered Yes, how? - Open-Ended Response				
4.1.2	Do you have all the information you need to make an informed choice of service plan for the pilot?	0.92	0.41	1	-1

Pre-pilot Open-ended Survey Questions

	Question	Summary of response
4.1.2	What aspects of the mileage tax do you expect to like most? Please explain. - Open-Ended Response	Most common responses were being a better way of paying for roads and being inherently more fair. But there was a wide range of responses, including mentioning simplicity, being a true usage fee, supporting sustainability, etc.
4.1.2	What aspects of the mileage tax most concern you? Please explain. - Open-Ended Response	The most common response was that there were no concerns. There was a wide range of responses, including complexity, fears the technology wouldn't work, and privacy concerns.
4.1.2, 4.3.2	What costs, if any, do you expect to incur by participating in this pilot, not including the cost of the mileage tax itself? Please explain. - Open-Ended Response	By far, the most common response was that there would be no costs. Two individuals wrote "my time".
4.1.2, 4.3.4	Please describe any other concerns you have regarding privacy of the road usage charge pilot test. - Open-Ended Response	Only two individuals expressed any concerns about privacy. One individual mentioned malicious attempts by third parties to steal information (this is security, not privacy). The other individual mentioned that other government agencies might request access to location information.
4.1.2	The Oregon state gas tax is 30 cents per gallon. The amount you are paying in gas taxes for your road usage is:	
4.1.2	Do you expect that being charged a tax per mile driven instead of per gallon of fuel consumed will change your driving habits? If you answered Yes, how? - Open-Ended Response	One individual mentioned exploring other modes of transportation

Midpoint Ranking Survey Questions

	Question	Average	Std Dev	Max	Min
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Signing the Participant Agreement.	6.53	4.74	15.00	1.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Selecting my account type and features.	10.24	9.36	30.00	2.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Setting up my account.	6.88	4.76	15.00	0.00
4.2.2, 4.2.3	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Installation of Mileage Reporting Device.	5.59	4.76	15.00	0.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Troubleshooting problems with the Mileage Reporting Device.	0.29	1.21	5.00	0.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Reading, understanding, and paying the bill.	5.29	4.27	15.00	0.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Troubleshooting problems with my account.	1.18	3.76	15.00	0.00
4.1.2	How much time, if any, have you devoted to your participation in this pilot? Please provide an estimate of the number of minutes spent for each item below (please write in only the number). - Other administrative tasks related to the pilot, including evaluation surveys.	8.18	6.21	20.00	0.00
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Signing the Participant Agreement	1.28	0.57	2.00	0.00
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Registering and setting up an account	1.11	0.83	2.00	-1.00
4.2.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Installation of Mileage Reporting Device	1.22	0.73	2.00	0.00
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Viewing account and reviewing charges on account	1.28	0.57	2.00	0.00

	Question	Average	Std Dev	Max	Min
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Paying your bill, if you used pay-by-mail	0.33	0.49	1.00	0.00
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - Paying your bill, if you paid online	0.44	0.51	1.00	0.00
4.1.2, 4.3.2	How easy or convenient have you found each of the following aspects of the road usage charge system so far? - The overall system	1.28	0.57	2.00	0.00
4.2.5	How has your overall attitude toward road usage charges—specifically the mileage tax you are using as part of this pilot program—changed since before the pilot started?	0.50	0.71	2.00	0.00
4.2.2	Did you install the mileage reporting device yourself?	0.83	0.51	1.00	-1.00
4.2.2	Was there any cost to you for installation?	-0.94	0.24	0.00	-1.00
4.2.2	How much did it cost you to install the Mileage Reporting Device? - Open-Ended Response	0.00	0.00	0.00	0.00
4.2.2	How useful were any provided installation instructions?	0.78	0.65	2.00	-1.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Did Mileage Reporting Device ever physically impede your driving?	0.00	0.00	0.00	0.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Did the Mileage Reporting Device ever distract you during driving?	0.11	0.32	1.00	0.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Did the Mileage Reporting Device ever cause a safety-critical event?	0.00	0.00	0.00	0.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Did the Mileage Reporting Device ever impair the vehicle?	0.00	0.00	0.00	0.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Did the Mileage Reporting Device ever fall out of the OBDII port?	0.00	0.00	0.00	0.00
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Have the Road Usage Charge system operations ever interfered with your vehicle or driving in any other way?	0.00	0.00	0.00	0.00
4.2.6	Do you believe any driving events or miles have been missed by the system?	-0.94	0.24	0.00	-1.00
4.2.6	Do you believe the system has overcounted your mileage?	-0.83	0.51	1.00	-1.00
4.2.6	Have you received an invoice yet?	1.00	0.00	1.00	1.00
4.2.6	Was your invoice accurate?	1.00	0.00	1.00	1.00
4.2.6	Have you paid a bill yet?	0.06	1.00	1.00	-1.00
4.1.2	Do you believe the amount you paid was a fair price?	0.56	0.51	1.00	0.00
4.2.6, 4.3.3	If you received an invoice, were your fuel tax credits calculated correctly?	0.44	0.51	1.00	0.00
4.2.6, 4.3.3	If you have an advanced service plan, has out-of-state mileage been correctly excluded from your invoice?	0.22	0.43	1.00	0.00

	Question	Average	Std Dev	Max	Min
4.2.6, 4.3.3	If you have an advanced service plan, has off-road and private road travel been correctly excluded from your invoice?	0.22	0.43	1.00	0.00
4.1.2	How do you find the level of the rate being charged (1.56 cents per mile) for you personally?	-0.22	0.43	0.00	-1.00
4.1.2, 4.3.2	How easy has it been to use the account management system website and/or access your account by other means?	0.83	0.62	2.00	0.00
4.1.2, 4.3.4	How well do you believe that the system is protecting your personal location privacy while using the system?	0.72	1.07	2.00	-2.00
4.1.2, 4.3.4	How well do you believe that the system is maintaining your user account security while using the system?	1.00	0.59	2.00	0.00

Midpoint Open-ended Survey Questions

	Question	Summary of responses
4.2.3	Have any of the following incidents occurred since you installed the Mileage Reporting Device? - Have the Road Usage Charge system operations ever interfered with your vehicle or driving in any other way? If you answered "Yes" to any of the above questions, please provide more detail about the incident(s): - Open-Ended Response	One individual mentioned that the OBU slightly interferes with access to the parking brake. One mentioned that the OBU lights were a little distracting at first.
4.2.6	How do you know or suspect that driving events or miles have been missed by the system? - Open-Ended Response	No responses
4.2.6	How do you know or suspect that the system has over counted your mileage? - Open-Ended Response	One response: “Approximately 100 miles driven in the state of Washington. Our device simply logs total miles, I believe accurately.”
4.2.6	Please describe any issues with your bill, bill payment, or account management. - Open-Ended Response	One response—user forgot his/her password
4.2.6	Were all of your issues resolved to your satisfaction?	All issues were resolved
4.2.6	How were your issues resolved?	Users either figured it out themselves or called the help disk
4.2.6	How were your issues resolved? - Other (please describe)	No responses
4.2.6	Please describe any unresolved issues and the action you have taken to resolve them. - Open-Ended Response	No responses
4.1.2, 4.3.4	How did the availability of choices of Mileage Reporting Devices impact your level of concerns about location privacy?	Most users said “no impact”. About 20 percent of respondents said “reduced my concerns”.
4.1.2, 4.3.4	How did your choice of Service Plan affect your concerns about account information privacy?	Most users said “no impact”. About 20 percent of respondents said “reduced my concerns”.
4.1.2, 4.3.4	Please describe any other concerns you have regarding privacy of the road usage charge pilot test. - Open-Ended Response	One response: “Hard to know if mileage/off-system mileage is correctly calculated without point of comparison -- might suggest to participants that they note beginning and ending odometer readings. Unclear if the appropriate period is the calendar month; please confirm.”

	Question	Summary of responses
N/A	Have you changed driving habits since being charged per mile?	Most said no. One yes and one not sure
N/A	If you answered Yes, how? - Open-Ended Response	One user said he/she was paying more attention to the miles he/she was driving
4.2.5	Do you want to change your Service Plan?	All users said no.
4.2.5	What aspects of the mileage tax system do you like best so far? Please explain. - Open-Ended Response	About 2/3 of respondents mentioned that the system was simple and/or easy to use
4.2.5	What aspects of the mileage tax system concern you the most so far? Please explain. - Open-Ended Response	3 respondents said that they were concerned about privacy and how their location information was being used. One was critical of the mileage system for not providing “continuous feedback” on road use”
4.2.5	Please use the box below to provide any additional information or feedback you would like to share at this time. Thank you very much for taking the time to complete this survey. - Open-Ended Response	A few responses. One suggested raising the rate. One suggested congestion pricing. One suggested “Oregon should consider an optional approach that exempts a base number of miles, then has a higher charge per mile for miles exceeding that base -- perhaps in two or three steps -- per month. This would have to be done in conjunction with the feedback communication described above.

Vendor Survey: Sanef/IMS

Mileage Reporting Device Installation (Mileage Reporting Device vendors)

1. What hardware steps are involved in installation?
   - Plug and play devices, designed to be self-installed, plug into OBDII-port; customer may not know where to find port.
   - Have made available IMS's database with documentation on where OBDII ports are on various car types to help desk.
   - Straightforward to install once you find the port.
2. What software steps are involved in installation?
   - No software steps from Sanef/IMS
3. What steps must be completed by the end user (e.g., downloading an app onto a smartphone and syncing with a smartphone; downloading an app onto a telematics device)?
   - Just install it.
4. How long should it take to install, start to finish – average time for inexperienced user?
   - No idea how long to install. Generally under 5 minutes.
   - Biggest piece is just finding the port.

Anti-Tampering (Mileage Reporting Device vendors)

5. How effective are your anti tampering means?
   - Maybe refer to Ben at IMS.
   - Enclosure has tamper-evident tape (see if device is opened).
   - Sanity checks in firmware.
   - Compare distance OBU in GPS to distance from engine.
6. Could an unskilled individual learn to effectively tamper with the Mileage Reporting Device, for example, by reading how to do so on the Internet?
   - NOT ANSWERED

Reliability (All vendors)

7. Mileage Reporting Device vendors only: How reliable is the Mileage Reporting Device? What is the expected failure rate in ppm over 12 months (or another available metric)?
   - Submitted Long-term test results (in system integration test results from Lou), Task 1.2 of deliverables).

8. Data collection, transactions processor, and account management system vendors only: Specify expected availability and any other reliability measures available. What is the system uptime (defined as "ability to accept, process, and/or receive a mileage message")?
   - Encryption between OBU and Server (standard variety)

Security (All vendors)

9. What electronic security measures are you using? What type of encryption are you using—128-bit AES or another? How effective will it be compared to Internet banking transactions? Mobile phone transactions?
    - Mileage message interface using XML over HTTP (SOAP) (www.sanef.com) 256 bi encryption AES 256 cvc – see certificate on browser. Same for mileage message and public facing website.
    - Using WS-OASIS security standard.
    - Was not originally in mileage message specification.

Energy Consumption (all vendors)

10. Mileage Reporting Device Vendors only: What is the calculated electric load of the Mileage Reporting Device?
    - See system integration test results. Think it's just under 100 mA. In sleep under 2 mA.

Open System (all vendors)

11. Will the mileage message be used?
    - Yes, mileage message will be used.
12. Will Mileage Reporting Devices be used that were manufactured by a different vendor? *Could* they be used? What changes in the system or checks would be needed in order to use them?
    - IMS devices are being used.
    - Raytheon will be used.
    - Key point is that we don't like solution where OBU sends mileage messages. That means relying on a mobile device sending a large amount of data (heavyweight protocol). More common to have OBU using lightweight protocol like UDP. Try to maximize reliability by having OBU communicate with aggregators. So we expect an OBU to communicate with aggregator—but no standardized communication. Could be UDP or TCP.
    - To integrate with another supplier, they could provide aggregator, or use our proprietary protocol. IMS server doing the map matching.
    - Preference is not for OBU to send heavyweight form like mileage message.

Ease and Cost of Compliance (all vendors)

13. How much do you expect it will cost the Participant to comply with the system? How did you determine this value—what elements did you include?
    - No additional costs to customer. Would hope no telecoms costs but Raytheon OBU would cause telecoms costs on customer.
14. Do you think that pilot participants can evade the system? How? And how might that be prevented?
    - Defraud OBU by offsetting GPS signal with a spoof that it was in a different state. IMS

said that was practically impossible because of checks and balances with other data. (Check against cell phone triangulation).

System Privacy (all vendors)

15. What privacy concerns do you anticipate for the pilot?
    - Way plans are structured—need to concede a little bit of privacy to give up state they're in.
    - The more privacy they concede, the cheaper it will be.
    - In the UK they provided a map (not ODOT).
    - Way it's been structured.
16. What privacy options are available for pilot participants?
    - Just ODOT's options.
17. How well does the system protect privacy, compared with mobile phones, credit cards, online retail sites, and social networking sites?
    - Using PayPal. No storage of bankcard information.
    - UK system was by direct debit.
    - Back office is PCI compliant. So security is similar to credit cards, mobile phones, and online retail sites.
    - PayPal is not first choice.
18. Can privacy protection be improved and how?
    - ODOT's are pretty sophisticated.

Ability to Audit (system vendors)

19. Are automatic audits by outside auditing firms (licensed by ODOT) possible (even if not implemented)?
    - Certainly auditable. Probably not auditable in an automated way—it's a document database, not a relational database (no SQL query).
    - Relational database for indexing only. Use document system to overcome limitations of indexing in a relational database. Same reason that Google and Amazon etc. have moved away from relational database. All under banner of NoSQL. Phenomenon of last 5 years.
    - May be able to develop automatic auditing in future but not now.
20. How easy or difficult are manual audits to support with your system? What do you have to do to prepare for an audit?
    - Built with audit in mind from the outset, everything captured (reason why each change was made). Built into the system.

Costs (all vendors)

21. What capital and retrofitting costs did you incur starting up the Road Usage Charge pilot system?
    - Cost of hosting, support.
    - Didn't procure any different hardware.
    - Majority of costs were in customization in software.
22. How would you expect costs to increase as you scale up the system for more participants?
    - Haven't skimped on design of base model so that same model would scale up.
    - Would need to have an exercise on how to scale it, including location of data centers, what level of reliability, how data centers operate. But scaling up would be straightforward.
    - Don't have to mirror Storage area network across smaller cheaper hardware.
23. Are there additional capital and retrofitting costs to support additional states beyond Oregon (e.g., in addition to scaling costs by number of users)? How much do you expect a typical additional state cost?
    - No additional costs for multiple-state issues.
    - Invoicing will be batched per state, per service provider.

Costs (system integrator/support team)

24. What capital and retrofitting costs were incurred starting up the Road Usage Charge system?
    - NOT ANSWERED
25. How would you expect costs to increase as you scale up the system for more participants?
    - NOT ANSWERED

26. Are there additional capital and retrofitting costs to support multiple states (e.g., in addition to scaling by number of users)? How much does a typical additional state cost?
    - NOT ANSWERED

Multi-state

27. What additional costs have you incurred by including other states?
    - None, cf. response to question 23.

Vendor Survey: Raytheon

Mileage Reporting Device Installation (Mileage Reporting Device vendors)

1. What hardware steps are involved in installation?
   - Physically plug in to OBDII port
2. What software steps are involved in installation?
   - Smartphone app that should be installed. Just go to website—go to web page and click install.
3. What steps must be completed by the end user (e.g., downloading an app onto a smartphone and syncing with a smartphone; downloading an app onto a telematics device)?
   - NOT ANSWERED
4. How long should it take to install, start to finish – average time for inexperienced user?
   - 10 minutes or less.

Anti-Tampering (Mileage Reporting Device vendors)

5. How effective are your anti tampering means?
   - Basically, the device, if removed from vehicle, will be detected and logged. No anti-GPS jamming. Would be recorded as undid. Check for when it's removed and reattached, we check the plug – in vehicles where access to right PIDS – check threshold amount. Can also check times of reports. (3 hours). Also health code 17 when it is replaced into another vehicle. No sticker over seams – no physical.
6. Could an unskilled individual learn to effectively tamper with the Mileage Reporting Device, for example, by reading how to do so on the Internet?
   - Believe anti-tamper prevents from removing and that's the main means of tampering.

Reliability (All vendors)

7. Mileage Reporting Device vendors only: How reliable is the Mileage Reporting Device? What is the expected failure rate in ppm over 12 months (or another available metric)?
   - Rough guess—average lifetime 5-10 years; designed for 10 years.
8. Data collection, transactions processor, and account management system vendors only: Specify expected availability and any other reliability measures available. What is the system uptime (defined as "ability to accept, process, and/or receive a mileage message")?
   - NOT ANSWERED

Security (All vendors)

9. What electronic security measures are you using? What type of encryption are you using—128-bit AES or another? How effective will it be compared to Internet banking transactions? Mobile phone transactions?
   - No encryption; compliant with ICD. Each message back contains VIN and OBUID; that pairing is the security. Mileage will be reported no matter what vehicle is used.

Energy Consumption (all vendors)

10. Mileage Reporting Device Vendors only: What is the calculated electric load of the Mileage Reporting Device?
    - Appendix – 890 Microamps is off-draw.

Open System (all vendors)

11. Will the mileage message be used?
    - Yes
12. Will Mileage Reporting Devices be used that were manufactured by a different vendor? *Could* they be used? What changes in the system or checks would be needed in order to use them?
    - n/a

Ease and Cost of Compliance (all vendors)

13. How much do you expect it will cost the Participant to comply with the system? How did you determine this value—what elements did you include?
    - Assume user has smartphone, subscription. Data will be on data plan. Cost of OBU will drop
14. Do you think that pilot participants can evade the system? How? And how might that be prevented?
    - If you don't have the PID miles travelled since codes cleared PID, don't get the miles travelled.
    - Do get unplugged event, but need to be able to allow
    - Suggest that ODOT look for a pattern of events.
    - Could also evade by putting larger tires: comparing miles travelled with GPS with miles travelled with OBDII.
    - OBDII PIDS: Say, half or more than half don't have some mandatory PIDS.

System Privacy (all vendors)

15. What privacy concerns do you anticipate for the pilot?
    - Don't anticipate any privacy concerns during the pilot. Getting data back to Raytheon for analysis during pilot. Don't send any lat/long data outside of vehicle in deployment model.
    - Getting mileage message and sparse lat/long data for pilot but not for tracking. Mostly to make sure system is working.
    - Other feature of system is that if we decide on a particular trip, can just turn phone off or leave at home. Can turn GPS off while leaving phone on. User can opt in or out on differentiated.
16. What privacy options are available for pilot participants?
    - See above.
    -

17. How well does the system protect privacy, compared with mobile phones, credit cards, online retail sites, and social networking sites?
    - HTTPS:// not built in to mileage message and interface – a security layer could be added. Not transmitting financial information at all. Mileage message transferred in the clear. Doesn't contained who person is or positional data. VIN only.
18. Can privacy protection be improved and how?
    - Maybe leave VIN out of mileage message? But helpful to know VIN, too.

Ability to Audit (system vendors)

19. Are automatic audits by outside auditing firms (licensed by ODOT) possible (even if not implemented)?
    - NOT ANSWERED
20. How easy or difficult are manual audits to support with your system? What do you have to do to prepare for an audit?
    - NOT ANSWERED
    -

Costs (all vendors)

21. What capital and retrofitting costs did you incur starting up the Road Usage Charge pilot system?
    - Adaptation for mileage message. Contract pays for adaptation to mileage message—contract costs, and services
    - Can do charging per trip or per day. Doing so per day is a change.
22. How would you expect costs to increase as you scale up the system for more participants?
    - Cost of devices in contract—would expect to come down significantly when comes to higher numbers. Back end costs (troubleshooting will need to be considered as things scale up).
23. Are there additional capital and retrofitting costs to support additional states beyond Oregon (e.g., in addition to scaling costs by number of users)? How much do you expect a typical additional state cost?
    - Operations – no. ODOT provided with a shape file. Need to change software. Would need to have shape file. Would just add multiple shape files.

Costs (system integrator/support team)

24. What capital and retrofitting costs were incurred starting up the Road Usage Charge system?
    - NOT ANSWERED
25. How would you expect costs to increase as you scale up the system for more participants?
    - NOT ANSWERED
26. Are there additional capital and retrofitting costs to support multiple states (e.g., in addition to scaling by number of users)? How much does a typical additional state cost?
    - NOT ANSWERED

Multi-state

27. What additional costs have you incurred by including other states?

- See question 23.

Data Collection

Issue Logs

#	Issue	Resolution
1	Participant contacted the help desk because they were having trouble completing the sign-up form on Sanef's website. Participant continued to get an error message.	Help Desk walked the participant through the process to identify the error. Participant had incorrectly entered the VIN number. After correcting the error the participant successfully completed the sign up process.
2	Participant can't find a link to sign up for a specific plan.	Help Desk emailed a link for account sign up. Participant successfully signed up their account shortly after receiving the link sent from the Help Desk.
3	Participant contacted the help desk to provide feedback on the account sign up process. The email from ODOT was not clear on the steps necessary to complete the process - a list of the steps to follow would have been helpful. Also, it was not obvious from the "choice" website that you can/should click the plan name for more information and to pick your plan. Too many steps/clicks involved to actually sign up - specifically for Sanef plans.	Help Desk walked the participant through the "choice website" and the "Sanef" website, until he reached the Sanef account sign up form page. Help Desk also informed the participant of the additional step to complete the subscription process.
4	Participant provided his initial odometer reading and when he confirmed that he successfully installed his device he asked how to verify if it's working properly.	Informed the participant about the indicator lights that should illuminate when the vehicle is running. Also told him the device has self-diagnostic capabilities and may automatically report a problem to the Road Charge Processor, in which case the help desk would contact him.
5	Participant emailed ODOT confirming he signed up his account and asked if he should expect to receive his device in the mail.	ODOT forwarded the email to the Help Desk and the Help Desk responded with the estimated time he should receive his device in the mail.
6	Participant was having trouble locating his OBDII Port.	Participant was not in his vehicle when he called. Help Desk emailed the participant a picture of the location of his port and told him to contact the help desk if he still was having trouble finding it and wanted installation help.
7	Participant contacted ODOT and said he signed up for the wrong plan. He initially selected the ODOT plan, before realizing he could go to the Sanef site to sign up for one of their plans, which he then completed. He would like to use the Sanef plan.	Help Desk noticed two plans had been selected and contacted ODOT. ODOT then called participant to confirm which account he wanted. The Help Desk then emailed Sanef to request deletion of the duplicate "ODOT" account.
8	This was an information call. Participant had several questions about the program. How is the fuel usage calculated, if he chooses an Advanced device can ODOT see where he went or just whether they were out of state, how will he get his device, etc.	Help Desk answered all participant's questions and also directed him onto the participant website to utilize the calculator.

#	Issue	Resolution
9	Participant provided his initial odometer reading and when he confirmed that he successfully installed his device he asked how to verify if it's working properly.	Informed the participant about the indicator lights that should illuminate when the vehicle is running. Also told him the device has self-diagnostic capabilities and may automatically report a problem to the Road Charge Processor, in which case the help desk would contact him.
10	Participant did not recall receiving a validation email. ODOT and the Help Desk notified her that she set up an account, but still needs to activate the account. She requested assistance with the validation step.	Help Desk emailed the participant the validation request email to complete her account setup.
11	Participant completed the account sign up on the Sanef website. However, the drop down options for the vehicle year would only go back to 2000, which he checked, but his car is a 1998.	Help Desk emailed Sanef tech support to see if this could be manually corrected in his account.
12	Tried logging into his account and received message that he needed to sign up for a plan. He thought he already had so he wanted to confirm he has a plan. Also providing his odometer reading.	Help Desk called participant to confirm he does have the ODOT Basic plan which means he does not have an account he can access online. He will receive all communications from ODOT regarding his account (invoices and other information). Also took down his odometer reading and asked if he had any trouble installing. Participant had no problems.
13	Participant completed the account sign up on the Sanef website. However, the drop down options for the vehicle year would only go back to 2000, which he checked, but his car is a 1999. Wanted to know if his vehicle wasn't eligible for the pilot.	Help Desk emailed Sanef tech support to see if this could be manually corrected in his account.
14	Incorrect zip code for Participant's mailing address	Emailed Sanef Tech Support to make correction.
15	Participant did not receive her confirmation email validation. She wants to know if she is confirmed on the project.	Sent validation request email to participant to verify the email signed up with the account.
16	Address explanation due to rural area: • Physical address & USPS address differ • Regular mail delivered to the post office only not physical address.	Notified participant that shipment of mileage reporting device would be via UPS to the physical address.
17	Participant would like to update her username as she had typo when she setup her account.	Email sent to Sanef tech support to see if they can update her username. Sanef updated username and had to reset password. Participant was notified of the update and change to her password and directed to reset her password to something she would remember.
18	Participant could not access the CAPTCHA image at the end of the registration form.	Replied to participant that she either right click on the missing image and select download image or to change her security settings on IE. No word yet if this has worked.
19	Participant needed Login Information	Emailed participant their username and then told them there is a "forgot my password" link on the account login page that will send an email with their password information. Received email confirmation and "Thank you!" from Participant.

#	Issue	Resolution
20	Device broken and had to be removed. After following up with the participant we learned that the device had been kicked out of the vehicle, stepped on and now was too damaged to plug back into the port.	Emailed Sanef RCP techsupport for replacement. Sanef requested additional information. Help desk contacted Participant to find out what was wrong with the device. IMS/Sanef shipped new device to participant.
21	Basic OBU was difficult to install and did not show a solid green light showing it was connected. Apparently a green and red light were shown when the device was initially connected but no other lights are lit	Forwarded to Sanef to determine if OBU is showing mileage data
22	Participant emailed ODOT and said he recently had a major electrical problem with his car that destroyed the on-board computer and it had to be replaced. He suspects that the device was damaged and he believes the data will not be accurate.	Emailed Sanef Tech Support to advise if we need to send a new device to the participant. Sanef verified with IMS that no data was being received from the device. IMS verified no data had been received since 12/11/12. New OBU was order for participant.
23	Participant needs to make correction to address setup with the account	Emailed the participant requesting the changes to be made to the address. Emailed Sanef tech support the requested changes to the address on the account (duplicate City, State, Zip line). Sanef corrected address in the participants account.
24	Participant asked where his OBD-II port is located in his 2012 Toyota Camry.	Provided picture of OBD-II installation port.
25	Wanted confirmation that device is working when installed	Emailed participant that one or more green indicator lights will illuminate when vehicle is running.
26	Participant is having trouble paying Sanef invoice through PayPal. He cannot access his PayPal account to pay the deferred bill because he cannot log into his PayPal account which is linked to an old email address he no longer uses.	Notified Sanef of the issue. Emailed participant with instructions on how to pay invoice through PayPal without having a PayPal account. Emailed Sanef when customer was still having trouble accessing PayPal to pay bill. Sanef then verified that the participant had actually already paid his bill on 12/14/12 which is why he no longer had the "Pay Now" option in his account. Participant was notified.

Participant Data

Raw Data on Participants is not included in this report to maintain user anonymity.
Of the 34 participants who started Phase 1, all have remained in the Pilot.

Mileage Tax Records

Participants are identified by number only to maintain user anonymity.

#	State	Plan	CSP	Total Mileage	Taxable Mileage	Mileage Tax	Total Fuel Consumed	Refundable Fuel[20]	Fuel Credit	Net Amount
1	OR	Advanced	Sanef	1277.8	1262.9	19.70124	54.8	53.95	$16.19	$(3.48)
2	OR	Advanced	Sanef	702.1	701.4	10.94184	31.89	31.88	$9.56	$(1.38)
3	OR	Basic	Sanef	1514.3	1514.3	23.62308	43.07	43.07	$12.92	$(10.66)
4	OR	Basic	ODOT	410.2	410.2	6.39912	29.33	29.33	$8.80	$2.38
5	OR	Advanced	Sanef	1608.9	1602.6	25.00056	56.54	56.22	$16.87	$(8.14)
6	OR	Advanced	Sanef	993	975.2	15.21312	36.89	35.86	$10.76	$(4.49)
7	OR	Advanced	Sanef	1486.8	1486.6	23.19096	62.88	62.86	$18.86	$(4.32)
8	OR	Advanced	Sanef	598.9	597.9	9.32724	34.28	34.1	$10.23	$0.91
9	OR	Basic	Sanef	143.8	143.8	2.24328	16.25	16.25	$4.88	$2.63
10	OR	Basic	Sanef	977.2	977.2	15.24432	38.54	38.54	$11.56	$(3.71)
11	OR	Basic	ODOT	1628.6	1628.6	25.40616	59.47	59.47	$17.84	$(7.54)
12	OR	Advanced	Sanef	210.9	210.7	3.28692	8.6	8.59	$2.58	$(0.69)
13	OR	Basic	Sanef	1914.1	1914.1	29.85996	0	0	$-	$(29.85)
14	WA	Advanced	Sanef	1042	1017.5	19.02725	57.16	55.7	$20.89	$1.89
15	OR	Basic	ODOT	1744.9	1744.9	27.22044	67.12	67.12	$20.14	$(7.08)
16	OR	Advanced	Sanef	1854.5	1318.2	20.56392	66.99	49.26	$14.78	$(5.78)
17	OR	Advanced	Sanef	1209.6	1208.2	18.84792	60.54	60.45	$18.14	$(0.71)
18	OR	Advanced	Sanef	567.4	567.3	8.84988	29.92	29.9	$8.97	$0.15
19	OR	Advanced	Sanef	1058.2	1039.6	16.21776	33.48	32.89	$9.87	$(6.35)
20	WA	Advanced	Sanef	330.6	330.6	6.18222	11.24	11.24	$4.22	$(1.96)
21	OR	Advanced	Sanef	873.6	873.6	13.62816	32.52	32.52	$9.76	$(3.86)
22	OR	Advanced	Sanef	350.4	338.9	5.28684	20.85	20.07	$6.02	$0.74
23	OR	Basic	ODOT	1185.7	1185.7	18.49692	35.32	35.32	$10.60	$(7.91)
24	OR	Basic	ODOT	891.2	891.2	13.90272	45.67	45.67	$13.70	$(0.22)
25	OR	Basic	Sanef	849.5	849.5	13.2522	49.31	49.31	$14.79	$1.56
26	OR	Advanced	Sanef	1461.7	1444	22.5264	86.11	84.6	$25.38	$2.78
27	OR	Advanced	Sanef	410.4	410.2	6.39912	23.8	23.79	$7.14	$0.77
28	WA	Advanced	Sanef	57.9	56.1	1.04907	3.21	3.11	$1.17	$0.11
29	OR	Advanced	Sanef	279.9	190.1	2.96556	0	0	$-	$(2.99)
30	OR	Basic	Sanef	1276.9	1276.9	19.91964	62.62	62.62	$18.79	$(1.12)
31	OR	Basic	Sanef	786.7	786.7	12.27252	35.76	35.76	$10.73	$(1.52)
32	OR	Advanced	Sanef	754.1	739	11.5284	30.52	29.52	$8.86	$(2.67)
33	OR	Basic	ODOT	1314.3	1314.3	20.50308	47.29	47.29	$14.19	$(6.26)
34	OR	Prepaid Flat Rate	ODOT							$(135.00)

[20] Two participants had zero refundable fuel because they were diesel vehicles. Diesel vehicles pay tax at the retail level unless they have an ODOT-issued emblem, in which case the seller is *not* to apply diesel tax. For the pilot, both participants with diesel vehicles used emblems. However, some retail sellers of diesel did not accept the emblem and failed to exempt the diesel tax, presumably because the emblem most commonly applies to heavy vehicles. The failure of retail diesel sellers appears to be a systemic problem, as participants reported repeated failures to receive due diesel tax exemptions at Oregon retailers.