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**SYMPOSIUM ON MILEAGE-BASED USER FEES:
TECHNOLOGY WORKSHOP**

Proceedings of the 2013 Symposium on Mileage-Based User Fees: Technology Workshop

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Proceedings of the 2013 Symposium on Mileage-Based User Fees: Technology Workshop

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Proceedings

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Welcome and Introduction

Ginger Goodin, Texas A&M Transportation Institute (TTI)

Slide Presentation

Slide 3 – Why MBUF?

A number of commissions and other independent studies have identified MBUF as a promising long term replacement for the fuel tax to provide a sustainable revenue source.

Slide 4 – Annual Fuel Tax Revenues in Texas

As an example, Texas annual fuel tax revenues peaked in 2007, and are now declining even with increasing population of 1,000 per day. This decline is due to increased fuel efficiency of cars.

Slide 5 – Why MBUF?

Fuel tax is an unsustainable funding source. When charging by fuel use as opposed to road use, CAFE standards and alternative fuel vehicles influence a decline in revenue.

With this decline, equity concerns arise: how much you pay depends on your vehicle's engine type and fuel efficiency, rather than how much you use the road.

Variable pricing schemes can be established based on congestion, system management, environmental and other factors, but are these all secondary to the revenue issue.

Slide 6

A number of research efforts have been undertaken, including two pilots in Oregon, and other states have a growing interest in MBUF studies.

Slide 7 – Where Do We Go From Here?

We are hearing that MBUF implementation is inevitable, but that it is 10-15 years away. What is going to help us get there? What are the near term and longer term paths to implementation?

If technology is not the issue, why are we having a technology symposium? Elected officials need to be anchored in public acceptance, or at least indifference, in order to have political willingness to move forward. Around the country, the same concerns are being voiced over privacy, cost of administration, fairness, compliance, and interoperability among states. So we can now examine what technologies will help to address these concerns. What can we test and demonstrate to address the public concerns?

In this symposium, we will review our progress since the first Oregon pilot and look to the future to complementary activities ongoing in the transportation industry to see how these can correlate with MBUF implementation.

Slide 8 – Today’s Agenda

Today’s program consists of:

- Update from demonstrations
- Panel on implementation challenges – public concerns and what the technology may be to address them
- National perspective from MBUFA
- Discussion of the nexus between road user fees and other emerging technologies in insurance, connected vehicles, etc.
- Conversation circle when we will engage in open discussion on three key questions:
 - What are the promising technology platforms or enabling systems for MBUF systems?
 - What are the research, development and testing needs?
 - What is the role of the ITS community in enabling road user fee charging systems?

Additionally, ITS America’s position statement on mileage-based user fees is available on the tables.

Session 1: Implementation Pathways: Research Initiatives and Demonstrations

Moderator:

Richard “Trey” Baker, Texas A&M Transportation Institute (TTI)

The first session featured representatives of three state departments of transportation (DOTs) that recently completed or have ongoing MBUF pilots: Oregon, Nevada, and Minnesota. These speakers gave updates on their research activities and, when applicable, discussed results.

Speaker 1: Alauddin Khan, Nevada DOT (NDOT) ***“Alternative Transportation Funding”***

Mr. Khan is Chief of the Strategic and Performance Management Division at the Nevada Department of Transportation and discussed his perspectives on public outreach, road blocks and lessons learned in developing the Nevada field test. He expressed his hope that national and international dialog on MBUF implementation can continue to grow and expand.

Slide 3 – Financing Our Way Out Is Not the Solution

When discussing MBUF with policy makers, NDOT stressed the difference between financing and funding, because the two differing issues tend to get combined. Having a good funding source can lead to good financing practices and can attract private investors. However, policy makers tend to want to look at financing solutions to the state’s transportation problems, such as public-private partnerships, and don’t understand why the DOT would be looking at MBUF and other funding mechanisms.

Slide 4 – Focus of VMT Fee Research Study

The overall objective for MBUF should be to replace the fuel tax funding mechanism, which does not necessarily require sophisticated technology. Nevada initially looked at a variety of technology and fee assessment options for MBUF, but due to public concerns, ultimately chose a simple and easy technology solution. The Nevada public had significant concerns about “tracking” with GPS, and were most open to a simple on-board diagnostic (OBD) device that did not collect location data. Once GPS was taken out of consideration, participants became more accepting of MBUF.

Nevada collaborated with Oregon and Washington on their studies and will be looking at MBUF issues from a non-DOT perspective. Partner agencies need to be engaged on this topic, which is something that does not happen a lot. MBUF development should not focus solely on DOT needs, goals and objectives. Up to \$3 million will be added to the third phase of the study to comprehensively examine an array of policy and technology issues.

Slide 5 – Reaction of Media

Media reaction to the Nevada study often incited vocal opposition from the public. When drivers see headlines such as, “With tracking devices, the miles you drive may get to be taxing,” they react with

concern about their privacy and contact elected officials. After encountering negative press, Nevada DOT sought to engage the media as well as the public and policy makers. Nevada DOT learned that it is important to contact editorial boards from all the major newspapers early on to make relationships and inform them about the study.

Slide 6 – Reasons for Public Outreach

One of the biggest reasons for undertaking public outreach efforts on this topic is to provide information on how much money is really needed for transportation investment. Figures can be expressed per mile, per gallon or total money going into the system. The news media has many different ways of communicating so different messages and outreach methods need to be used.

Slide 7-8 – Extensive Strategic Political Involvement

The Nevada DOT did not have legislative approval to implement MBUF, so NDOT's efforts have focused on research. In the current phase NDOT is engaging four levels of constituents: 1) the political policymakers and legislators, 2) influential bodies in banking, finance and taxation, 3) private sector stakeholders, and 4) the public. These interactions will provide significant input for future policy making and will help reduce political risk. Most of NDOT's outreach efforts are taking the form of one-on-one meetings.

Slides 9-12

One of the primary reasons Nevada legislators opposed the MBUF concept is their concern over managing administrative costs. NDOT examined the state's Department of Motor Vehicles (DMV) systems and databases and determined that support of an MBUF system in Nevada would run 20-25 percent. However, Nevada legislators want administrative costs capped at 5 percent.

Nevada's state highway fund is constitutionally protected and this same protection will need to be extended to MBUF revenues if they are implemented. The federal government should consider similar limitations on the use of future MBUF revenues.

Another major issue that needs to be addressed is the allocation of revenues among multiple states. Many are interested in looking at how out-of-state drivers would pay for their road usage under an MBUF system.

Nevada legislators wanted to know what other innovative solutions NDOT was considering besides MBUF, but there really were none. There is a need to show that there are indeed numerous options for meeting revenue needs and that they all are thoroughly assessed. This requires that states and other transportation entities come together to collaborate on research, identify the most pertinent issues and determine why there has been no significant improvement in the last 20 years in the way we pay for transportation.

Slide 13 – Underlying Dilemma – Core Strategic Missteps

It is important to articulate a direct benefit to the public from implementing MBUF. Public and political support can be generated if benefits are emphasized.

Speaker 2: Ray Starr, Minnesota DOT (MnDOT)
"Minnesota Mileage-Based User Fee Test Results"

Ray A. Starr is the Assistant State Traffic Engineer for ITS with the Minnesota Department of Transportation.

Slides 2-3

The Minnesota Department of Transportation's project was the result of state legislation directing the DOT to conduct a mileage-based user fee technology demonstration. The first phase of the project was a policy study, as there was no policy guidance provided in the legislation. The report on this phase of the research is available online at <http://www.dot.state.mn.us/mileagebaseduserfee>.

The technology demonstration was built and operated by Battelle, SAIC was the evaluation contractor, and Mixon Hill was the support contractor in charge of developing the concept of operations and procurement documents. Through the demonstration MnDOT was able to get a better understanding of how an opt-in, discount-based approach to MBUF might work.

The demonstration included 500 participants who utilized smartphones equipped with a specialized app, which was offered as an opt-in addition to an odometer read. The smartphone app applied a discount formula to mileage assessed through the odometer read, and thus it was in the best interest of the driver to use the smartphone app as much as possible. Researchers found that 77 percent of the mileage assessed under the demonstration was recorded on the app. Odometer mileage not captured by the app was assessed at a rate of 3¢ per mile. Mileage recorded on the app during peak time in a metropolitan area was assessed at the same rate. Mileage accrued off peak or outside of a metro area was assessed a rate of 1¢ per mile, and mileage accrued outside of Minnesota was not assessed.

Participants were provided an initial stipend from which they paid their mileage fees. Several billing methods were tested, but participants were most accepting of modest monthly MBUF invoices. MnDOT collected just over \$32K in fees during the test.

The smartphones utilized in the demonstration were also used to test some connected vehicle applications including in-vehicle signing for work, speed, and school zones, curb warnings, and travel time applications using probe data.

Slides 4-17

There were several noteworthy conclusions coming out of this second demonstration:

- Smartphones are viable as an MBUF assessment and communication device.
 - They have a good and familiar user interface.
 - Custom applications can be written for them.
- Smartphones suffer from GPS and other location-based issues.
 - Identical phones placed next to each other might now show the exact same location.

- Placement of the phone in the vehicle could affect accuracy. Battelle found results varied with placement of the phone near a window or on the dash (most reliable), A/C vent, on the seat, or under the seat (least reliable).
- Simplicity in system design is important to participants.
 - Participants did not like having to continually remove and then reattach the smartphones from their vehicles.
 - Participants indicated a general preference for a device built in to the vehicle that would reduce their interaction with the system.
 - Drivers did not like the app's visual and audio notifications in response to various road conditions or driving behaviors. However, drivers generally altered driving behavior in response to the notifications.
- System administration was labor-intensive and required a significant level of one-on-one interaction with participants. MnDOT concluded that future deployment might be better centered administratively within the DMV – a unit with existing one-on-one relationships with drivers – rather than within MnDOT.
- The demonstration was judged a success in that it was able to
 - satisfy legislative directive;
 - determine that the technology worked (with some limitations);
 - prove participants could use the system;
 - prove that participants were willing to share their data; and
 - achieve customer payment on most bills.

Slide 18 - Summary

MnDOT is currently in the process of sharing the results of the demonstration and is working to pass a bill in the state legislature that would keep various participant data from being publicly disclosed. MnDOT is also working to establish a pooled fund project among the states to enable further research on this topic.

Speaker 3: Chuck Larson, Oregon DOT (ODOT)

“Road Usage Charging Pilot Program”

Chuck Larsen is an Information Systems Program Coordinator who for 14 years led ITS software development for the Oregon Department of Transportation.

Oregon has been a leader in MBUF research since 2001 when the state legislature established the Road User Fee Task Force, which ultimately recommended that the state work to develop the MBUF concept.

In 2006, ODOT conducted a successful pilot of a pay-at-the-pump mileage fee system, demonstrating that mileage fees can be incorporated into the existing fuel tax system. However, when ODOT officials tried to move the concept further towards implementation, there was significant resistance, as there were several outstanding policy issues that had yet to be addressed – primarily equity, efficiency and

privacy. There were additional questions about pricing structure – whether there would be flat rates or perhaps congestion pricing.

For its latest pilot, ODOT developed a new vision for deployment, based on what was learned in the initial pilot:

- technology use by drivers should be voluntary;
- the state should not regulate the type of device(s) used; and
- technology-free options should be offered to enhance public acceptance.

ODOT incorporated significant private sector involvement in order to address concerns about government involvement and administrative costs. These entities are already collecting data and money from drivers. By leveraging private sector data collection and transmission systems, ODOT believes it is possible to contain administrative costs to within 5 percent of revenues.

Open architecture was used for the technology components so that, if fully deployed, the system could evolve over time. ODOT has developed a concept of operations, system architecture diagrams, system requirements, interface control documents, and test plans for the pilot.

The policy tenets supporting the most recent pilot are as follows:

- Focus on public acceptance.
- Make the system easy to use.
- Keep cost down.
- Protect motorist information.
- Do not require use of GPS technologies.
- Fee should replace, not supplement, the fuel tax.
- Do not charge for out-of-state miles if technology is utilized by the driver for assessment.

ODOT had discussions with the legislature and ACLU to come up with language related to how long to keep driver data, underscoring the importance of addressing privacy.

Drivers from Washington and Nevada participated in the pilot but were subject to different rates than the Oregon participants. While all participants received invoices, only Oregon had legislation that allowed for collecting fees from its state's participants.

Participants were able to choose a provider and level of technology from options that included private and public entities with commercially available system components. Several vendors responded to the request for proposals (RFP) and ODOT selected two vendors with technology platforms that could meet the requirements of the RFP.

Participants selected a mileage plan by visiting a website, choosing among four platforms with varying levels of technology and one technology-free option. Sanef was the provider for two of the technology-based plans. Sanef's basic plan used an on-board unit (OBU) that simply counted the miles traveled,

while its advanced plan utilized a GPS-equipped OBU that would determine when mileage occurred out of state or on a private roadway; in either case, these miles were not assessed a fee. Another private vendor, Raytheon, provided a smartphone-based plan, which was also known as a “switchable” plan in that the device could be switched to detect and not charge for out-of-state miles.

As an alternative to the private vendors, participants could choose ODOT as their provider, utilizing a basic non-GPS OBU that logged only total miles. The final option was a plan that did not count miles or use any technology, instead levying a higher, flat monthly rate. Only one participant chose that option.

After picking a plan, the participant installed the device in the car and began accruing mileage over a four month collection period. Under the ODOT plan participants were mailed a monthly paper bill that could only be paid by check. Sanef invoiced via e-mail and provided electronic payment options. Participants generally felt that the system was accurate and easy to use.

Since the conclusion of the second Oregon pilot, conversations at the legislature have changed from whether or not mileage fees can be implemented to when and how they should be implemented. There is now bipartisan support in the Oregon legislature for the concept since ODOT was able to demonstrate that the system could be implemented with a positive response.

ODOT has carried out policy work over the past year, which includes a vehicle fleet forecast in order to project how many vehicles with 55mpg and greater fuel efficiency (mostly electric cars and hybrids) will be on Oregon roadways in the future. ODOT has also done some revenue forecasting and work developing an organizational structure within the agency to support MBUF. Finally, ODOT has examined rural and urban issues associated with MBUF.

ODOT staff are currently working to achieve passage of two MBUF-related bills in the state legislature. The first, a House bill, would apply an MBUF starting in 2015 to vehicles with a fuel efficiency of 55 mpg or more. The other is a Senate bill that would establish a 5,000-person opt-in MBUF implementation program that would run indefinitely. While it is difficult to predict how these bills will fare, they do have good bipartisan support.

ODOT is currently updating the various aspects of the pilot to prepare a step-by-step implementation plan should the legislation pass. These activities include updating all technical documentation and test plans. ODOT is also working with Washington and Nevada to establish a Western Road Usage Consortium that would fund and coordinate more pilots, work on multi-state issues, and continue policy work. ODOT is also working with Oregon State University on in-vehicle telematics-based devices, an iPhone app, and other technology components.

The ODOT website on the second pilot program is <http://www.oregon.gov/ODOT/HWY/RUFPP/>.

Session 2: Implementation Challenges

Moderator:

Chris Hill, Booz Allen Hamilton

In the second session of the Symposium, discussion turned to the challenges facing implementation of MBUF programs. Several experts discussed policy roadblocks impeding MBUF development and how technology can help alleviate these issues.

Speaker 1: Jack Opiola, D'Artagnan Consulting ***"Challenges of Distance-Based Road User Charging"***

The fuel tax is a dying source of revenue, as the vehicle fleet gets more fuel efficient. But there are many challenges facing MBUF development.

Public debate on MBUF has centered on technology, even though all of the pilot tests and demonstrations have shown that available technology works. The biggest issues are related to policy rather than technology. Legislators perceive that MBUF systems are too complicated, too expensive, inequitable for rural drivers, invade privacy, and that there is no business case for it. It therefore becomes important to dispel these myths and perceptions.

Myth 1: MBUF systems are expensive.

Recent work is showing that MBUF systems can be competitive with other fee systems in their administrative costs if they are designed efficiently and effectively. Following the most recent Oregon pilot program, it is now believed that with 1-4 million vehicles participating in the system, administrative costs could be lowered to about 6.7 percent. This is significantly lower than the 20-25 percent cost of administration seen in tolling systems.

Myth 2: MBUF systems penalize hybrid vehicle owners and rural drivers.

While road use fees for owners of hybrids and other high-mileage vehicles would increase significantly over the amount they pay in fuel tax, this is not the equity issue. Such vehicles impact the road system the same way as less fuel efficient vehicles, and thus it is equitable for all passenger vehicles to pay for their road use at the same rate.

With regard to inequity to rural drivers, studies show that rural residents do drive farther per trip than their urban counterparts, but they make fewer trips, and that the total of miles traveled is actually a little lower for rural drivers than for urban drivers.

Myth 3: MBUF systems invade privacy.

The Minnesota study showed that people prefer a low tech approach; primarily because they associated GPS with government monitoring. Three out of four participants in that study preferred to not have GPS included in the system at all. However, there are many ways to assess an MBUF and not all of them

require GPS. The inclusion of location data is a policy decision. If traffic or congestion management is a policy goal, then location and time data is needed and GPS is among the best options. However, if the goal is to just charge for miles traveled, then there are a number of technology and non-technology options that can be utilized that would mitigate privacy concerns.

Myth 4: There is no business case for MBUF.

The decline in gasoline consumption will translate to a 37 percent drop in gas tax revenues by 2016 and a projected 60 percent decline in revenues by 2025. If MBUF were implemented in 2016, a 100 percent increase over the projected fuel tax revenue could be realized, with a 300 percent increase by 2025.

Speaker 2: Ben Pierce, Battelle

“Mileage-Based User Fees Implementation Challenges”

Slide 2 – Implementation Challenges

Battelle is a technology R&D company. Yet, we see the biggest issue for MBUF as not whether the technology can be developed but why and how it is applied. Technology will clarify policy but it will not directly change the public’s perception of the need for MBUF. Technology can help overcome other concerns regarding MBUF, some of which we will discuss today:

- ease of enforcement and evasion,
- data security and integrity,
- assessment accuracy, reliability and consistency,
- technology interoperability,
- privacy,
- equity,
- flexibility and ubiquity,
- cost,
- ease of use, and
- disputability.

Slide 3 – What does the public want?

In general, the traveling public does not want a mileage tax or even a fuel tax; the public accepts the existing fuel tax because they generally unaware that they are paying it. If they are to accept MBUF, the Minnesota pilot showed that the public wants a system that is reliable, consistent, easy to use, ubiquitous, disputable and that protects privacy. Media tends to focus on privacy issues, but participants in the pilot generally accepted the technology once it was handed to them. This is because the perception of the technology is generally different from the reality of the technology.

Technology can help address the following challenges associated with mileage-based user fees:

Slide 4 – Reliability and Consistency

Reliability

The expected standard is that the technology in the vehicle works every time. The odometer is one readily available technology for metering road use that is reliable, but it can be tampered with. OBD-II technology is also reliable and easy to install, but it is also easy to remove. GPS is accurate but can be jammed and spoofed. There will need to be a variety of technologies supporting MBUF deployment, and the general rule is that the simpler the technology, the more likely it is to always work.

Consistency

The technology must charge consistently, meaning that a trip taken at the same time every day should cost the same every day. The London charging system uses boundary crossings to calculate fees and it is easy to predict what the charge will be. Fees could also be based on other travel aspects such as dwell time and engine run time, both of which can be influenced by congestion.

Slide 5 – Privacy

Privacy concerns need to be understood and addressed. In Minnesota, participants originally stated that they did not want to use any technology but opinions changed when they began using the smartphone technology that was selected for the study. Participants concerns were eased as they became familiar with the technology, implying that the right technology can actually help ease privacy concerns.

Slide 6 – Ease of Use

There are many ways that technology can make MBUF systems easier for the traveler to use. Technology can be imbedded in existing systems such as toll tags, smartphones, vehicle infotainment systems, or the OBD-II port. However, the perception of ease will vary from person to person.

Slide 7 – Disputability

Although technology can be quite accurate, the Minnesota pilot showed that people want to be able to dispute their fees, particularly when technology is involved. This desire to dispute technology is evidenced across the country in the case of red light cameras, in spite of the fact that the technology in use provides good evidence that a particular vehicle ran a red light.

Slide 8 – Ubiquity

The lesson from the tolling industry is that there is a need for non-proprietary communication protocols. The simpler the design, the more universal it will be.

Slide 9 – Highlights

In summary, technology can be used to mitigate many challenges, but the policy is currently the major barrier. No single technology can fit all situations. Policy makers and industry specialists need to establish system needs and public concerns, and then tailor technology solutions accordingly.

Speaker 3: J.J. Eden, AECOM

“Tolling: Impact on Mileage-Based User Fee Highway Financing”

Slide 1 - Tolling

There are a number of parallels between MBUF and tolling, including privacy. Tolling had similar privacy challenges.

Slide 2 – Current U.S. Interoperability

The first electronic toll collection implementation was in Dallas. At E-ZPass, we picked different technology. The current major U.S. systems that are not interoperable with each other are as follows:

- E-ZPass is the biggest with 21M customers and billions of dollars in tolls collected annually.
- Sun Pass in Florida – uses different technology
- TxTag – uses the same technology, but not interoperable
- California FasTrak – developed their own open technology so that others could adopt it, but no one has.
- New technology that is a lot less expensive is called 6C and several states have adopted that technology.

Slide 3 – Communication Protocols

Many technologies are out there, and we are struggling with trying to read them and make them interoperable. These existing systems represent a giant investment of infrastructure, and a lot of money in tolls collected.

Slide 4 – Toll Business Is Changing

The toll business is changing with a new generation of user that doesn't carry cash, is more tech savvy, will pay for convenience and carries multiple transponders. Additionally, costs of managing collections in cash are increasing. As a result, customers want all electronic tolling (AET) and they want interoperability, because they don't want to keep up with different systems. AET has added benefits for customers, but more operational challenges (i.e. reading one of multiple transponders on a windshield). MBUF will encounter similar challenges.

Slide 5 – Technology Keeps Changing

Toll collection technology keeps changing. By the time we figure out which of the current protocols is the best one, there will be others that are better.

Additionally, cell phone companies and vehicle manufacturers see adding features to their products that will collect money for tolls, MBUF, parking, fast food, anywhere you take your car, as a way to make more money and gain market share.

Customers want technology that benefits them and provides service to them.

Slide 6 – License Plate Use for Tolling

Tolling via license plates is an option, but a small percentage of tolls will be lost due to customer fraud, damaged or missing plates, and inaccurate mailing records.

In tolling, we need a good source of backup ID to capture these tolls and also tolls for those who are not customers. We are working with American Motor Vehicle Association to devise standardized license plates that AET systems can read better.

Slide 7 – A Backup System

One backup system is registering video accounts of license plates. It is more expensive than electronic toll tags but good for infrequent or temporary users; this group represents up to half of some systems' revenue and they are less likely to register for an account.

Slide 8 – ATI Member Agencies

Alliance for Toll Interoperability (ATI) is a not-for-profit formed to collectively solve tolling problems. It has about 50 member agencies.

Slide 9 – Financial Implications

Tolling is a 12-13 billion dollar business, primarily electronic.

Slide 10 – ATI Hub Network

How can we bring all these systems together? Establishing common rules and business operations are the hardest part of tolling interoperability. ATI created an RFP for a hub system that member agencies could subscribe to. The hub is to receive and convert data that could be used by all members. The RFP has resulted in 11 bids which are currently being considered. The hub could receive and transmit data for parking, ferries, fast food, tolls, MBUF and other entities. All the members will generate revenue into the system to sustain it.

Speaker 4: Chris Isbell, Sanef (France)

“Implementation Challenges”

Slide 2 – Oregon Pilot Goals and Objectives

Several more studies like the Oregon pilot need to be done, to show the public that the technology can work. Future pilots should adopt Oregon's multi-vendor approach.

Slide 3 – Pilot Overview

Sanef was one of the vendors to provide the back office solution. In Europe these kinds of implementation schemes can be done quite fast, so you can expect implementation in nine to twelve months depending on the scheme selected.

Slide 4 – Technology Choice

One of Oregon's "advanced" plans tracked where participants drove, charging only for mileage accrued on public roads in a driver's home state. The number of people who opted for this plan questions whether the privacy concern is as significant as it is portrayed. The media tend to highlight the privacy as

an issue but the pilots demonstrate that technology becomes accepted once people begin participating in the program. With several European MBUF-related installations, there are no public concerns over privacy.

Slides 5-6 – The Challenges

Road user charging (RUC) is feasible and technology is not the issue. In Europe the cost is going down. Still, with regard to devices, there are issues to address. With smartphone-based technologies, users could forget to use the app, the phone battery could go dead, and not everyone has a smartphone.

How does MBUF compare to pay at the pump fees? With pump collection, there is no risk, because money is collected up front, but with MBUF you don't get funds up front. You have to figure out how to incentivize drivers to pay.

While MBUF installations are succeeding in Europe, there are culture differences between Europe and the U.S. and how each culture views driving. For example, Americans may generally believe that roads should be free to use. Greater efforts are needed to educate the public as well as policy makers on the need for MBUF.

In Europe, many governments have adopted public-private partnerships to accomplish financing. Privatizing certain system elements can reduce government involvement in data collection, potentially increasing public acceptance of the system.

Slide 7 – Moving Forward

To move forward, keep learning and doing pilots. Develop the system to be more effective and offer more types of services. Look at the standards in road user charging because every car is different. For large scale implementation, there will be many challenges to overcome with interoperability among states. (Europe doesn't have this problem.) Political discussion needs to be ongoing and more sessions like this are needed.

Slides 8-11 – European Cases

The U.S. is not alone; all across Europe we have had to roll out different road user fee projects and we have encountered similar struggles along the way. Examples include Ireland, Slovakia, Sweden and the U.K.

Lunch Address: A National Perspective: The Mileage-Based User Fee Alliance (MBUFA)

Introduction:

Lee W. Munnich, Jr., Humphrey School of Public Affairs, University of Minnesota

AASHTO represents state DOTs, ITSA focuses on technology, IBTTA on tolling, etc. In representing their own interests, these groups represent some aspects of MBUF, but none of them specifically represent the interests of MBUF. In 2010, we recognized the need for such an organization that could interface with these related groups and work particularly on MBUF outreach and education. Congress and state legislators were requesting MBUF information, and if a project was not ongoing in a particular state, it was likely not being well communicated there. MBUFA is the membership organization that was formed to meet these needs.

Speaker: Barbara Rohde, MBUFA

"MBUFA: Mileage-Based User Fee Alliance"

In April of 2010, Jack Basso and Barbara Rohde recognized the need for a united voice talking on the MBUF issue, both at the federal and the state level. MBUFA was the result, and many in the audience today are members.

Having worked at both the federal and state level, Rohde knows what drives legislators and what stops them. She indicated that the MBUFA alliance can move this issue along.

Slide 3 – About Us

MBUFA was just designated as a 501(c)3. The organization has moved very quickly in only 2.5 years. MBUFA's first meeting was in September 2010.

Slide 4 – Goals

MBUFA's goals are the same as that who are in attendance at the annual MBUF Symposia.

Slide 5 – E-Newsletter

MBUFA publishes a newsletter and Rohde encouraged Symposium attendees to sign up. Jack Basso is MBUFA's Chair, Jim Whitty, Vice Chair and Lee Munnich, Secretary-Treasurer.

Slide 6 – Transportation Finance Crossroads

What is happening at the federal level and around the states? The House Budget Committee is doing a hearing today on transportation finance. It is the first time in two years that this has happened, and whenever transportation finance is discussed on the Hill, MBUF always comes up; but when policy makers talk about the issue, the information they are discussing is out of date – it is a rapidly changing environment.

Slide 7 – Pilots and Studies

When MBUFA began two and a half years ago, a maximum of five states were looking into MBUF. With West Virginia just introducing legislation, now there are 18 states plus New York City considering MBUF.

Slide 8 – Federal Outlook – Moving Forward

The Federal outlook is moving forward:

- In December 2012, Rep. Earl Blumenauer (D-OR) introduced a bill (H.R. 6662) that would require the Treasury Department to study the viability of raising new federal highway funds by taxing cars for each mile they drive.
- A GAO Report was issued in December 2012: “Mileage Fees Could Be More Equitable and Efficient than Gas Tax.”
- Bill Schuster, new chairman of the House Transportation and Infrastructure Committee has sounded very positive about MBUF, saying, “There will be a shorter-term fix, but long term, vehicle miles traveled may be the only way to stop the decline.”

Slide 9 – Member Engagement

MBUFA has talked to a lot of transportation groups in Washington about what we should be doing. MBUFA was contacted in January 2011 from a senate staffer asking if Congress allocated \$300 million, could MBUFA find six states willing to do pilots?

MBUFA gets many requests from the press. They don’t understand MBUF issues and have a lot of misinformation. MBUFA’s new website helps address this.

Last year, most see the loss of the \$60M (\$30M per year placed in the House bill of MAP-21 for planning and trials) as very difficult. But we have never seen that amount of money put into a bill in 18 months, so that shows that there is great interest.

MBUFA briefed the House committees and they asked MBUFA to speak to the 50 Tea Party freshman members. It turned out positively; MBUFA was able to speak to every Senate and House office. Unfortunately the bill was pulled, at a point in the process which had never been seen before. There was discussion of a large conservative vote against the bill, and the vote was already going to be very close in the House. So instead of losing the bill, MBUF funding was removed from it.

Slide 10 – New Website

MBUFA’s new website, <http://mbufa.org/>, is getting activity, with the most hits on the myths and facts section.

Slide 11 – New Member Engagement

Looking ahead to what will be going on in the next year, it is very critical both on the state and federal level. MBUFA has been asked to sponsor workshops at the state level so states can bring all their people from their state DOT and others who can’t travel long distances and MBUFA can bring in experts in MBUFs and other experts around the Hill.

MBUFA will begin webinars in June on various road user charging topics.

MBUFA has always had quarterly meetings, but will sponsor roundtable events with staff and members from the House Ways and Means Committee, Senate Transportation and Infrastructure Committee and other policy makers so MBUFA leadership can discuss with them all the myths and benefits with MBUF.

Press inquiries to MBUFA are significant and often require information on a short lead time. Adrian Moore, MBUFA's communications person, and Jim Whitty address these.

Bruce Shollar (Deputy Director of Transportation for NYC) requested MBUFA to begin working with the General Services Administration (GSA). Their approval process on technology takes 18-24 months, so MBUFA will start working with GSA now to get approvals ready for technology that can be used in future trials.

Slide 12 – Role Models for MBUF

The potential of MBUF to move national policy is similar to the impact of other issues Rodhe has previously worked on. These issues also moved national policy: school choice, welfare to work, the smoking/health issue, and sales tax for mail order.

Session 3: Nexus of Road User Fees and In-Vehicle Technologies

Moderator:

Louis Neudorff, CH2M HILL

This panel featured discussion on the role that emerging technologies could play in implementing MBUF. A recurring theme in these discussions was the potential value of vehicle telematics as a means of deploying MBUF.

Speaker 1: Dave Huber, Kairos Solutions “Insurance Telematics”

As President of Kairos Solutions, an insurance telematics consulting company, Huber explored what relevance automobile insurance has to the MBUF conversation.

Eight of the top 10 insurers have usage-based insurance (UBI) programs in the field; 26 states have more than four programs available. Of the 250 million passenger automobiles in the U.S., 1-2 million are participating in UBI programs.

Insurance companies use telematics solely as a means to gain the most predictive data about drivers: how, when and where they drive, which is more predictive than all the traditional data (gender, age, driving records, credit history, etc.).

The expenses for UBI are known: hardware devices, data transmission, and discounts from traditional plans. The benefits are less obvious, and so many insurers are still piloting the concept to see if the benefits outweigh the costs.

UBI programs differ from insurer to insurer. The dominant UBI program is Progressive’s Snapshot program. Progressive installs a device for a period of 90 days and collects data, from which rates are set. State Farm offers a menu of value-added services which require a data logger installed for as long as the service is desired. Telematics available in factory-installed systems such as OnStar and Ford Sync can also provide data – including mileage – to insurers for rating purposes. Because of these differences in how UBI programs are administered, not all platforms will support MBUF implementation.

Consumer telematics and specifically telematics for auto insurance purposes will continue to evolve. In the future, consumers will likely be able to purchase an OBD device from a retailer to collect telematics, calculate a driving score (much like a credit score), and then shop that score around for the best car insurance rates.

Similarities exist between UBI and MBUF, including the need for transparency, simplicity, privacy and choice. But there will always be market competition among insurers offering a variety of telematics and

value-added services alongside non-UBI options. For this reason, it is unlikely that one UBI platform will ever be adopted or that UBI will ever be mandated. For this reason, UBI will not likely be the primary means by which MBUF is implemented.

Speaker 2: Brian Michie, EROAD (New Zealand)
"EROAD: The Future of Transport Technology"

Slide 2 – Background

In 2009, EROAD introduced the world's first network-wide GPS/cellular-based MBUF system for heavy and light vehicles in New Zealand. New Zealand has had road user charges since 1978, and the pay-by-mile concept is not controversial at all there.

New Zealand currently has a paper-based RUC system, and carriers and light vehicles can choose to opt-in to the EROAD electronic system. There is no mandate to use technology, consistent with the Oregon pilot. The EROAD model also adopts the West Coast or Google model in that it is free to the government. Private shareholders absorbed all of the financial and technology risk and the system was built with no government funding.

EROAD just concluded the first commercial pilot of an electronic weight-mileage tax service for heavy vehicles in Oregon. That pilot used the same model that EROAD currently has in New Zealand. The pilot was conducted with the full support of the Oregon Department of Transportation (ODOT) and the Oregon Trucking Association. Involving such stakeholders is one of the major lessons learned from EROAD's experience in New Zealand.

Slide 3 – Solution

EROAD's system utilizes cloud-based infrastructure with a global geo-sim platform for the data. The company uses one back-end system to provide commercial, regulatory and road charging services.

Slide 4 – New Zealand MBUF Collections

EROAD is now the largest private tax agency in New Zealand, approaching nearly \$200 million in annual collections from voluntary opt-in customers and more than 1 billion kilometers traveled with no known errors.

Slide 5 – Technology

Plenty of demonstrations are proving that the EROAD technology works and can be cost effective for commercial vehicles. The architecture can support a variety of tariffs. Furthermore, because it is a cellular, cloud-based architecture, deployment and expansion of the system can be readily achieved. EROAD currently has no roadside infrastructure in New Zealand.

The multi-vendor certification model has worked well in NZ. There are currently two technology providers in New Zealand that support the heavy-vehicle RUC system at no cost to the government.

Commercial vehicle implementation provides an opportunity for vendors to develop and validate their technologies which will assist in the emergence of a viable light-vehicle platform.

Slide 6 – Business

EROAD's regulatory and commercial services can be delivered with the same platform to lower agency and client costs.

Hybrid systems, such as New Zealand's paper and technology-based system, help minimize implementation risks.

There are myriad opportunities to extend EROAD's platform. The company currently logs hours of service, provides logistics services, and tracks fuel. EROAD has been asked to implement an interoperable tolling solution for New Zealand toll gateways and the company is working on an insurance system for heavy vehicles in NZ and Australia.

Ensuring privacy is a major concern but it is easily addressed with a standard IT privacy framework. EROAD never provides data to law enforcement or government without a court order.

There is a shift towards acceptance of technology in the transportation industry. The world is changing.

Speaker 3: Ken Philmus, Xerox Transportation Services "Tolling and MBUF"

Ken Philmus serves as a Senior Vice President with Xerox Transportation Services, with responsibility for back office and in-lane toll services for roughly half of the electronic tolls in the U.S., or some \$4B in collections. Prior to that Philmus was with AECOM as Vice President and National Director of Tolling. He also spent 34 years in the public sector with the Port Authority of New York and New Jersey, where he was director of Tunnels, Bridges and Bus Terminals for the last 6 years and ran facilities like the George Washington Bridge, Lincoln Tunnel, Holland Tunnel and similar facilities. He brings a unique perspective from both the public and private sides of tolling.

Transportation Funding History

It is well known that transportation funding is in trouble. Most of the revenue required to maintain, manage and preserve highways comes from local, state and federal fuel taxes, which are declining because people are driving more fuel efficient cars. At the same time, costs to maintain our transportation system are increasing exponentially as facilities exceed their useful life. These competing issues are creating a widening gap in funding that we have to figure out how to meet. Additionally, political gridlock like never before is preventing us from moving out of this mess.

How Does Tolling Fit with MBUF?

When we talking about user fees, mileage-based fees are different from tolls. Some tolls are mileage-based – but both are user fees – and so are HOT lanes. An economic decision is made every time a driver elects to use a toll facility, which is what will occur with MBUF. One could say that tolling is the original MBUF, and it works.

Tolling generates the needed revenue for a dedicated capital program, in addition to the funds needed for daily operation and management. At the same time, tolling implements an economic means to manage traffic. It is here that MBUF and tolling can come together.

There are issues in tolling, such as moving towards national interoperability, which is parallel to MBUF interoperability among states. But tolling technology has evolved away from stopping and paying cash at a facility, which actually created congestion. Today, tolling is eliminating congestion by using congestion pricing. Interestingly, while no one likes to pay a toll, what people are actually concerned about is stopping to pay the toll.

Tolling is not the all-inclusive solution to the nation's transportation funding problems, but it is part of the toolkit, and the electronic tolling technology has made tolling very easy to implement.

Because funding solutions have difficulty emerging at the federal level, states are piloting programs to provide solutions at the state level.

Meanwhile, traditional electronic and cash toll facilities are being converted to all electronic tolling (AET), in locations like the Golden Gate Bridge, Henry Hudson Bridge in NY, and certain sections of the Florida turnpike.

If an MBUF implementation emerges across the country, it will have to be reconciled with tolling and its existing technology. Eventually, the systems could merge, but at least initially, the two systems will need to exist side by side until we reach the point where MBUF technology including variable rate charging is possible and accepted. Initial implementation of MBUF will likely include a simpler, flat-charge mechanism as we work to gain public acceptance of the concept, and tolling technologies that we all recognize will remain, and variable rates will continue to be assessed through tolling. How tolls and MBUF will merge and achieve national interoperability are issues, but not immediate ones.

Barriers to MBUF Implementation

The biggest impediment to MBUF implementation is that the public will find it confusing, even without variable pricing by time of day and location. The concept and need for tolling is very clearly understood today. But the public doesn't recognize a connection between fuel taxes and our roads, as evidenced by the general public's use of the term "free roads" when referring to untolled roads. Of course they aren't free; the fuel tax is supporting them. But this terminology indicates the disconnect.

Technology, as we have heard today, is not the issue. The issues are public acceptance and policy.

Summary

The speaker hoped that MBUF will one day be implemented with variable rates that can truly impact driver behavior and allow us to manage congestion through pricing. Congestion pricing is working with HOT lanes around the country. Paying by the mile itself will have an impact on driver behavior that is different from paying fuel taxes, and so policy makers will need to implement adjustments gradually.

Speaker 4: Chris Hill, Booz Allen Hamilton
“Connected Vehicles”

Chris Hill leads the highways and ITS business line for Booz Allen Hamilton, but his entire career has been in the transportation technology field. He has been involved in the research and early implementation phases of systems from electronic tolling collection to heavy vehicle pre-clearance systems, and has worked with Minnesota on mileage-based user fees. He is now involved in connected vehicle (CV) systems and spoke from that perspective.

Slide 2 – Connected Vehicles Background

Connected vehicle systems represent a national collaborative effort among auto makers, the federal government, and state and local transportation agencies. CV systems facilitate wireless communications between vehicles or between a vehicle and roadside infrastructure to support a variety of safety, mobility and environmental applications that are important to the public and private sectors and consumers.

CV applications should be adaptable for use in all kinds of vehicles, including light (passenger), heavy and transit vehicles. CV approaches may include devices that have been installed by the car maker or devices installed as aftermarket equipment. Including applications for mobile phones and other carried devices would allow connections with pedestrians or cyclists.

Slide 3 – Core Technologies

It is useful to reflect on the core technologies that support the connected vehicle environment when considering the nexus of CV and MBUF technologies. CV systems involve communication between two different components: something in the vehicle communicates with something in another vehicle or with some sort of roadside infrastructure. Dedicated short range communications (DSRC) is a piece of the radio frequency that has been set aside specifically for transportation safety applications. The use of DSRC is fundamental to the safety component of a CV system. However, other non-safety applications – including MBUF and technologies from the private sector such as consumer entertainment – could be supported by cellular and wireless technologies.

Slide 4 – Current Activities

The CV program is different from established programs such as tolling because it does not have existing infrastructure on which to build; still in the nascent stages of development, the CV environment is not ready to support implementation of MBUF.

Developmental work in CV systems, like that of MBUF, is aimed at defining types of applications, defining technology and how it needs to perform, determining the various technology, policy, and institutional issues, defining the potential benefits, and learning how the driver will accept those types of systems and technologies.

A key milestone for CV system development will come late in 2013 when the National Highway Transportation Safety Administrations (NHTSA) will decide whether to mandate the inclusion of DSRC

radios in new light vehicles. NHTSA's decision on this mandate will depend heavily on solid empirical data on the benefits for developing and deploying these technologies.

Ongoing technical and policy related research efforts are aimed at creating a large security management system so that CV applications can operate in a trusted environment. It is fundamental that messages being transmitted between vehicles and between a vehicle and the surrounding infrastructure are trustworthy, particularly for safety-related applications.

Slide 5 – Convergence Opportunities

What are the potential convergence opportunities for CV systems and MBUF? If you build out a CV system in the way that we envision with DSRC devices in vehicles and DSRC roadside infrastructure, is it possible to leverage that infrastructure for MBUF applications? For example can RSE locations support a boundary-crossing type of MBUF collection system, triggering the collection of different fees at points where you have this RSE infrastructure? Or perhaps the infrastructure can act as a vehicle data collection node that connects to some back office MBUF processing service.

There are a number of efforts underway that are looking at what the roadside equipment (RSE) infrastructure might look like for a CV system, and some work that USDOT is doing may lend insight into the suitability of MBUF on a CV system. AASHTO is currently doing a footprint analysis to determine where to place RSEs if a state or local agency is interested only in supporting their own interests, such as safety or mobility applications. That sort of network is physically quite different from a network developed from a national security planning perspective. It is uncertain whether a locally implemented network would be suitable for MBUF data collection.

Slide 6 – Potential Challenges

An infrastructure designed for connected vehicles is something that could be leveraged for MBUF, but the RSE locations, distribution and density must be planned carefully to accommodate MBUF.

There is a fundamental conflict between the very clear principles of connected vehicle data collection and possible MBUF data collection. For example, with a CV system it is important that no personally identifiable information is collected and that there is no potential for tracking individual vehicles. This is quite different than the information that could be collected for MBUF.

If MBUF implementation cannot take advantage of the RSE network for a CV system, or some other existing system, there would be significant cost implications for implementing an analogous network for MBUF.

Speaker 5: Barry Einsig, Cisco ***"Monetizing Connected Vehicles"***

Slides 2-4

The Internet of Things – or the Internet of Everything (IoE) which is Cisco's term – will connect things, people, processes and data together to create more intelligent connections and networks. Cisco is

currently working on efforts to connect the 99% of things – including many aspects of the transportation system – that are not connected today.

Cisco released a report in January of 2013 discussing the economic value and global GDP impact of connecting the currently unconnected. This includes many aspects of the transportation system.

Slide 5-6: IoE Drivers and Connectivity Platform

Many factors will drive the development of the IoE. There are different types of information that might be connected: real time, scale, security, Big Data. All of these things require some sort of connectivity platform, which is where the IoE begins to add economic value.

Slide 7 – IoE Economy

Cisco's Internet of Everything Economy Report is available at <http://cisco.com/tomorrowstartshere>.

Slides 8-9

Unlocking that economic value of connected vehicles is about a lot more than simply collecting user fees. The big picture is about the trip better taken. It is easy to focus on the automobile but there has to be discussion about mode shift. Travel has to be thought of in the context of all modes. If one mode is overburdened it will naturally cause a shift to another mode. Transportation has to be thought of from an eco-perspective, with modes acting as the subsystems that will ultimately drive travel decisions.

Slide 10 – Unlocking Economic Benefits

One way to unlock economic value is to reduce user fees associated with driving by developing new services provided equipment in the automobile. There are also societal benefits from reduced carbon emissions and lower congestion.

Slides 11-13

Consumers demonstrate that they do not value or enjoy their travel time because they text, use the phone, eat, and do many other things besides focus on the driving task. The question then becomes how to make the driving experience more enjoyable, which is where the economic value of connected vehicles and the IoE comes in.

Many companies are trying to figure out how to unlock the economic value of the IoE. This is driving the creation of a new ecosystem of connectivity, communications and infrastructure that can be exploited for mileage-based user fees and much more. Parking services are one example that gets a lot of attention. The opportunities for exploiting economic value continue to grow with new artificial intelligence and vehicle-to-vehicle connectivity. Vehicles may soon provide value to drivers similar to the internet. For example, currently someone might go to Yelp to determine a destination, Google Maps to plan the route, and then input that information into the navigation system on their car. However, a vehicle connected to the IoE would be able to handle all of these functions within one in-vehicle system.

Slide 14 – Cisco's Role

Cisco's role is to help create this architecture and build something bigger than ITS infrastructure or connected vehicle infrastructure. Cisco wants multiple clouds with multiple energy sources creating multiple modes of communications.

Slide 15 – The Cisco Vision

We are re-thinking and changing the way we work, live, play and learn, and we are re-evaluating how we use our cars, how we drive, and how we charge for the experience to exploit the economic value of driving.

Speaker 6: Jeremy Salinger, General Motors (GM) ***“Future Vehicle Technologies”***

At General Motors research and development, Jeremy Salinger is Innovations Program Manager. He focuses on implementing vehicle technologies that sense what is going on around the vehicle and then provide for the driver either increased safety or increased convenience. This is the essence of what is known as automated driving.

Slide 2 – Vehicle Electronics and Sensors

Today’s vehicles already perform many functions that rely on electronics, including electronic sensors, communication networks, controllers and actuators. These automated functions affect all aspects of the driving experience.

Slide 3 – Cadillac Driver Assistance/Active Safety

Features introduced in select 2013 GM models exemplify new electronics-based technologies that may be relevant to implementing MBUF. Other manufacturers have similar technologies. There are two packages that drivers can buy, offering two levels of interaction: Driver Awareness *provides information* to help the driver take action to avoid collisions, and includes things like lane departure warning and forward collision alert. Driver Assistance actually *intervenes* with the driving activity before the driver does; it includes features such as automatic collision preparation and low speed front and rear automatic braking.

Slide 4 – Cars That Don’t Crash

These technologies transition the fleet toward vehicles that don’t crash, and ultimately toward vehicles that can drive themselves. GM is currently developing connected vehicle and self-driving technologies that will enable semi- and fully autonomous driving, and it is anticipated that these applications will be available to the general public by the end of this decade. A driver will be able to engage these systems in certain situations such that for substantial distances the driver will not have to directly control the car’s steering or speed.

Slide 5 – Transponder Integration

GM is also working with systems that work with the connected vehicle systems Chris Hill talked about. GM is developing vehicle-to-vehicle and vehicle-to-infrastructure transponders that could be installed in vehicles as an aftermarket device to broadcast and receive information so that positions of vehicles and driving behavior can be observed and accounted for in the driving environment.

Slide 6 – Smartphone Integration

GM is also working to develop apps that would allow drivers to exploit the DSRC communication systems to receive information and warnings about what is on the road ahead, including traffic congestion, construction warnings, or other issues that need an immediate response.

Slide 7 – “Super Cruise”

We have already deployed what we call full speed range adaptive cruise control in Cadillacs this year that will control a car’s speed at highway speeds, but also take it down to stop-and-go speeds. The car responds to the surrounding traffic to control its speed.

Vehicles with automated functions are already being tested on test tracks and a few are out on public roads. In acceptable driving conditions these functions will control not only the speed of the vehicle but its maneuvering as well. The ultimate goal is to have them drive on freeways, but such vehicles will need to be equipped with radars, cameras, GPS and maps that allow them to not only figure out where the roadway is going but to also respond to traffic conditions around them.

The question for this group is, what possibilities are there for facilitating MBUF implementation by exploiting the additional information collected in these new technologies, such as traffic conditions?

Slide 8 – Electric, Connected, Autonomous

In summary, the auto industry is moving over the next decade and beyond toward vehicles that are more electronically controlled, more connected, and more automated. This progression opens opportunity for more interaction and convergence with systems that are collecting MBUF.

Session 4: Path Forward: Interactive Discussion and Wrap-Up

Moderators:

Ginger Goodin, Texas A&M Transportation Institute (TTI) and

Lee W. Munnich, Jr., Humphrey School of Public Affairs, University of Minnesota

As in previous years, the 2013 Symposium on Mileage-Based User Fees concluded with an interactive discussion circle involving symposium participants. At the start of the Symposium, participants were given three questions to consider throughout the day:

- What are the most promising technology platforms/enabling systems for delivery of mileage-based fees?
- What are the research, development and testing needs for advancing direct road use charging?
- What is the role of the ITS community in supporting the development of road use fee systems?

The following sections summarize symposium participants' responses to these discussion questions. In one instance an additional question was posed by the moderator in response to a specific comment by a participant.

What are the most promising technology platforms/enabling systems for delivery of mileage-based fees?

- The most promising technology is that which will break through the barrier of public acceptance and be the most readily adopted by the public.
- The most promising technology platform is most certainly the vehicle telematics and the "Internet of Everything" to connect everything together as discussed earlier. We could not have predicted how the Internet would disrupt traditional journalism, bypassing traditional media with technologies such as Reddit and Twitter. In the same way, we cannot predict how the Internet of Everything will disrupt how we think we will accomplish MBUFs or the funding of roads in general. The technologies we are discussing now (e.g. OBD II ports and cell phones) are really for the short term, because we don't have any idea what will be developed over time. In 20-30 years we will not even have privacy concerns.
- MBUF will not be the application that breaks through these barriers and utilizes connected vehicle technology and the IoE for significant public benefit. Applications like parking location seem to be a better fit for providing utility to drivers. Whatever that application is, it will break through the wall of unknowns that currently exist and MBUFs will then follow, along with many other technologies that have not even been predicted yet.

What is the process for mandating a system?

- We need more and more pilots.
- Leverage the experience of connected vehicles, in which an industry-government alliance defines the data to be conveyed, and a governing body (NHTSA in the case of CV systems) mandates the technology according to the standards.
- Oregon's approach of offering customer choice, allowing control in the hands of the user is maybe not the best approach, because they saw problems with technology in cell phones. Perhaps it is best to mandate a technology, similar to NHTSA considering mandate for connected vehicles technology.
- Telematics is the way things are going. The Oregon pilot did not mandate technologies, but rather worked to define data that needed to be exchanged between the car and the back office systems. More research is needed to clarify what data is needed for MBUF implementation, and then we should let the market develop the technologies to supply the solutions. The technology will evolve over time.
- Over time, people will be willing to provide information to the system, but not initially. The industry must move methodically and incrementally so that people will gradually adjust and the process will not burden existing systems such as the DMV.
- Implementation must occur gradually alongside the fuel tax. The electric car market will continue to grow but it will do so slowly. The basic MBUF architecture must be set up so that it can grow with time; that is, implementation should start with urban areas and should not include pricing options initially.
- Some policy makers oppose studying MBUF, and MBUFA has done a great job of advancing the idea, but funding could be shut down for studying at any time, so advancement on this topic should occur carefully and slowly.
- The transportation industry needs to define the MBUF specific issues very clearly in concert with the developing needs of DMVs, the insurance industry and the tolling industry in order to solve all of these issues together. Develop open standards and facilitate a business climate where technology can develop. This is not what happened in the tolling industry. In that case, vendors had specific, proprietary products that stopped development for many years.
- Local officials are going to be focused on long term planning and may tend to be agnostic about technology. They will need help in developing a vision of where transportation technologies are headed, but the transportation and technology industries have not yet come together to decide what that advancement looks like.
- MBUF is not an immediate fix to the transportation funding problem. Fuel taxes can be raised or other short-term mechanisms can be used but those decisions need to be left to the policy makers. When the transportation industry starts promoting MBUF as an immediate solution it hurts the cause. Long range plans have to be fiscally constrained, and federal authorities will not agree that MBUF is a fiscally constrained solution. Locals will have to come up with their solutions that will work as temporary solutions.

- Oregon's experience was to engage industry and let them offer solutions. This is the only approach that will succeed in the long run. Two presentations today are indicators of the exploding market activity: Cisco's monetizing of data and GM's vehicle technologies.
- Look at the experience of how local area networks (LANs) developed. At first, LANs were proprietary and protocols and standards were not established. The market and developers came up with one standard and proprietary networks disappeared. We need to allow the market to better develop the needed protocols quicker and faster.
- There may not be enough time for the slow, methodical approach to implementation over 10-15 years. The impending crisis of the Highway Trust Fund will require other solutions much faster than that. Crisis spurs innovation.
- It's all about the political will in your state, and may not take that long to initiate implementation that could develop into more over time.
- From a county and rural agency perspective, rural counties are grinding up paved roads and returning them to gravel. It's an indicator of how bad things are. Perhaps a simple odometer reading mechanism could be introduced just to get the situation addressed, and more advanced technologies could develop over time. We need something sooner rather than later.
- MBUF systems need technology options that are transparent and require no work on the part of the driver.
- There should be no mandate for standards on how to get the data out of the car. Let the market compete for that. Standards are needed for the back end, how the agency gets the data and the money from the technology providers.
- Slow doesn't have to mean 10 years. Slow means getting people comfortable with the concept of VMT. If people can accept it in two years, we can implement faster. But we cannot force it on the people. Possibly the availability of all this rapidly developing technology in connected and automated vehicles will speed up acceptance.

What are the research, development and testing needs for advancing direct road use charging?

- There is a need to develop policy regarding what MBUF revenue is to be spent on, so that any new revenues would go only for uses related to transportation.
- People don't like change, and there is a need to address the psychological aspects of MBUF.
- MBUF will break through by attaching to some other technology, but we don't know what that is. To better understand this, we should do research on user expectations to find out how people are going to use the technologies that are currently being developed.
- States need funding; the federal government does not have the large amounts we need; a little money from many different sources at the state and local level can add up to a significant amount.
- More pilots are needed, particularly pilots in new states and demonstrations that showcase the concept on a broad, multi-state scale. Until a large functional model is shown to the public and

policy makers, they will not understand the value of MBUF. Until a federal program of studies can be developed, states have to do it on their own.

- MBUFA website is striving to be a place where you can see everything that's going on around the nation.
- Focus groups are needed. Polling is too blunt for this complicated issue.
- Regarding privacy, some people want to say that the public is already being tracked on their cell phones, so they will be accepting of MBUF tracking. But there is a major difference between voluntary participation in tracking by a private company where you have recourse in the law and tracking done by the government, where the public cannot control their participation and have no access to the information and no recourse.
- There is a need for a pilot proving how interstate miles can be charged.
- More research should be done on charging according to engine runtime. This method might encourage better trip planning.
- The fuel tax, which is now a true emissions fee, will likely never be replaced. In spite of its issues in handling cars that use little or no fuel, it is still a very effective revenue source.
- If a national MBUF system is implemented then DMVs should be central to administering it as they have an existing one-to-one relationship with vehicle owners. DMV systems such as vehicle registration fees or state inspections could be modified to include assessing and collecting an MBUF.
- There is a need for more research to better understand what connection MBUF has to people's broader life decisions and land use decisions. Suggest partnering in the future for this meeting with Urban Land Institute or AMBO.

What is the role of the ITS community in supporting the development of road use fee systems?

- ITS America has published a position statement; they want to continue to be involved.
- A major issue will be dealing with opposition from the automobile industry and from drivers of high-mileage vehicles. We should seek productive interactions with auto makers since telematics is so important to this discussion.
- There needs to be a TRB ITS subcommittee on MBUF.
- Japan does not have MBUF, they use tolled highways throughout Japan to pay for infrastructure development, but local governments are responsible for maintenance fees. ITS Japan members are here to see how MBUF might help with system maintenance in Japan.
- When we have MBUF in the future, we need a two-way exchange of information so that the driver can receive information on the road pricing on every part of the network in order to make informed route decisions.