



Minnesota Mileage-Based User Fee Test Results

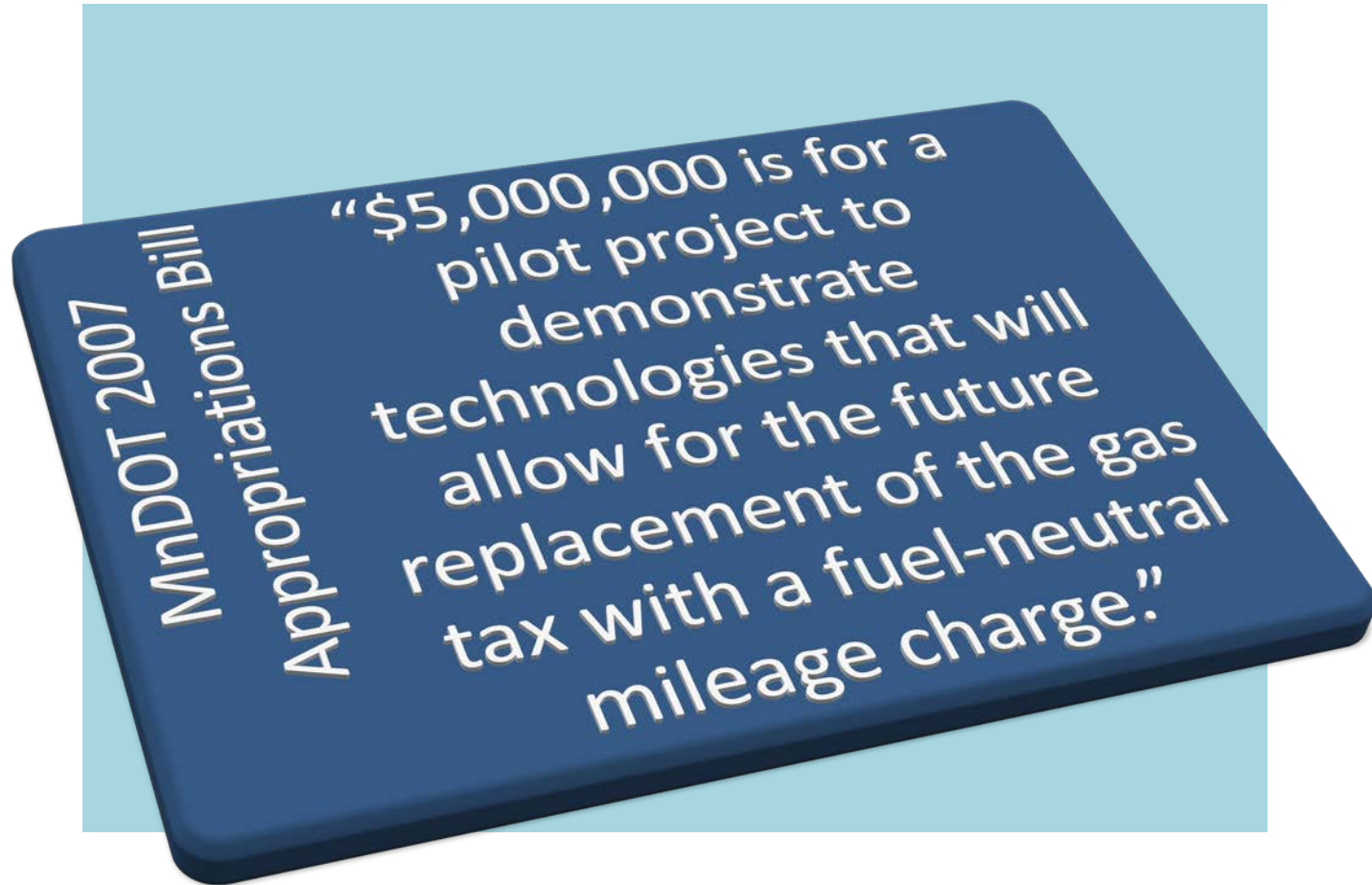
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MnDOT



What am I going to talk about

- Who, What, Where, When, Why, and How of the Demonstration project.
- And Finally the Results.....

Statutory Direction



Miles Based User Fees: a Two-Part Research Effort

1. Technology Demonstration
(Battelle, SAIC, Mixon Hill)
 - 500 volunteers from Wright County, MN for 13 months
 - Existing smart phone and cellular communications
 - “Opt-In” design with odometer readings
2. Policy Study (University of MN)
 - Engage key MN stakeholders
 - Identify and evaluate MBUF policy issues



Technical Approach

- System designed to use commercially available technology in order to:
 - Assess if a mobile application could be used to implement MBUF
 - Assess the viability of Connected Vehicle safety signing applications, especially for rural deployments
 - Demonstrate the ability to provide location and vehicle specific trip information



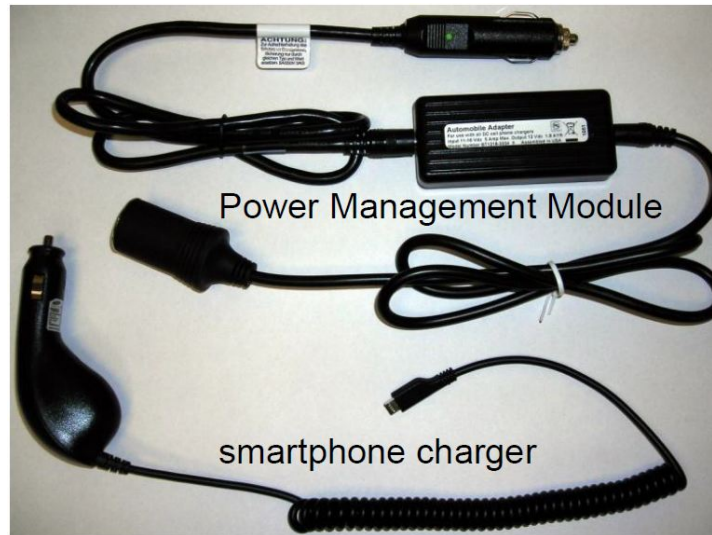
Samsung Captivate™
Smartphone



In-Vehicle Mounting
Brackets



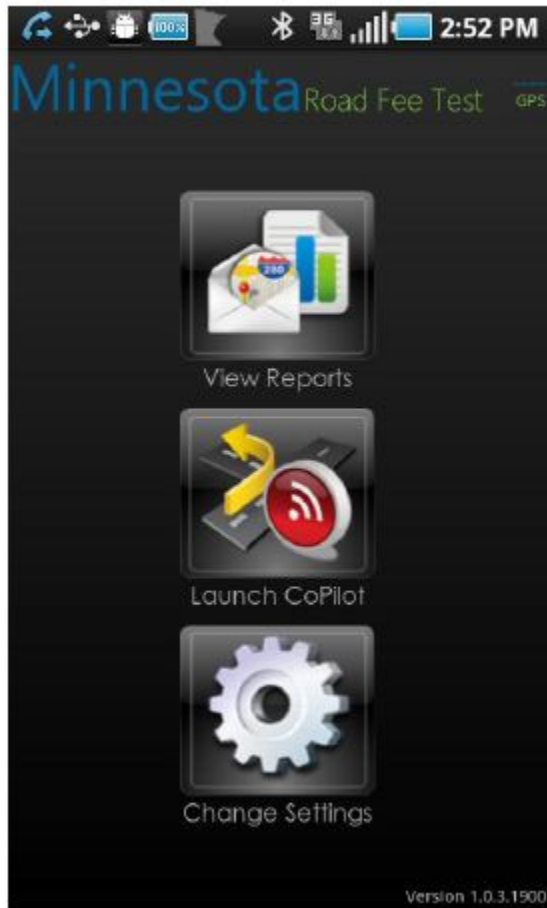
Vehicle Identification
(VIDM) Module



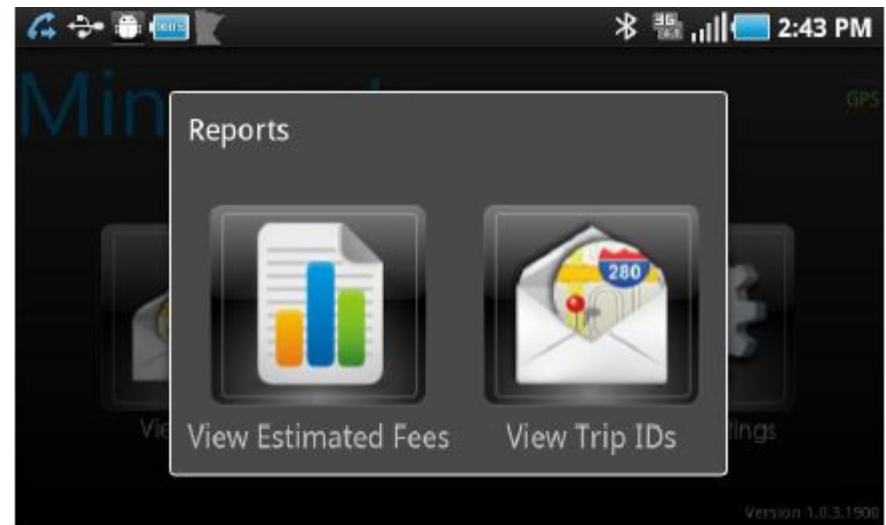
Power Management Module

smartphone charger

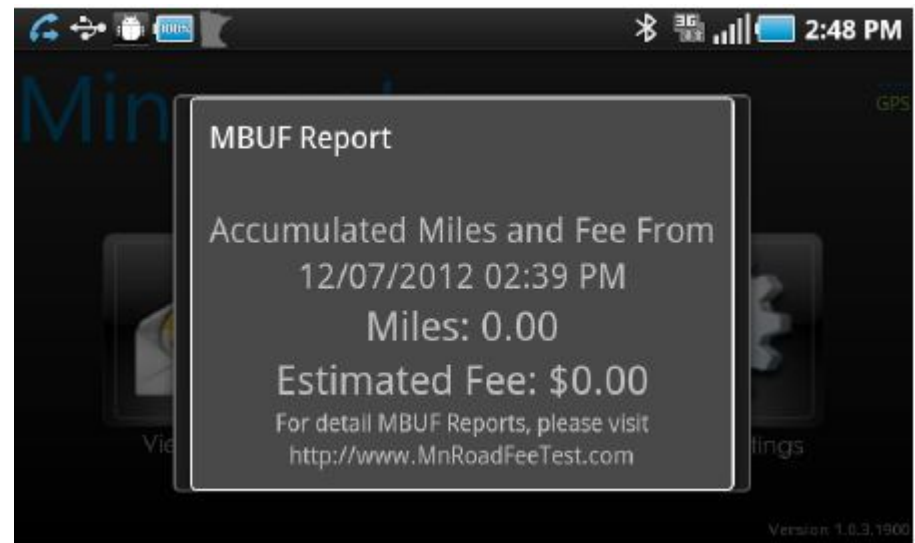
Power Cables



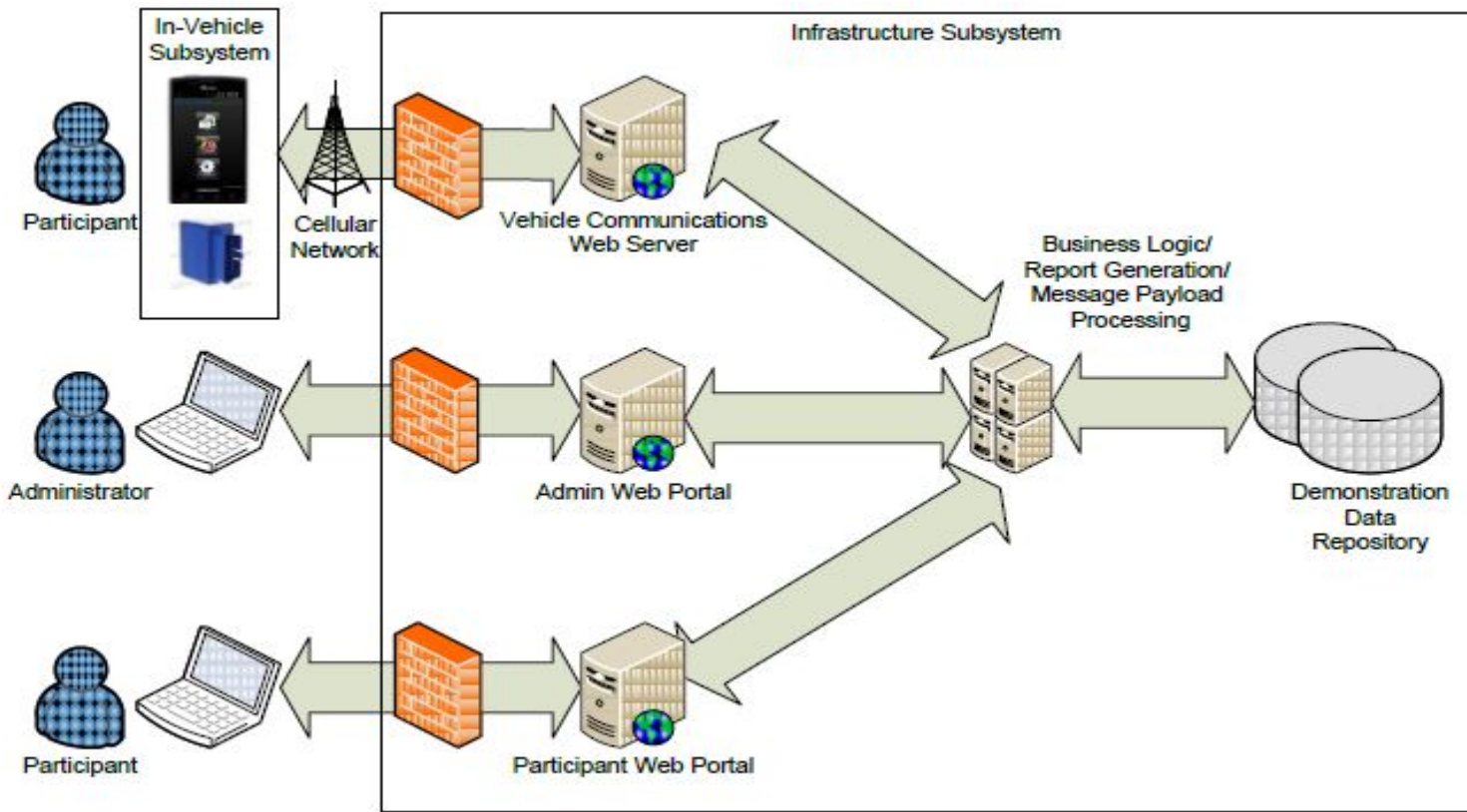
Main Menu



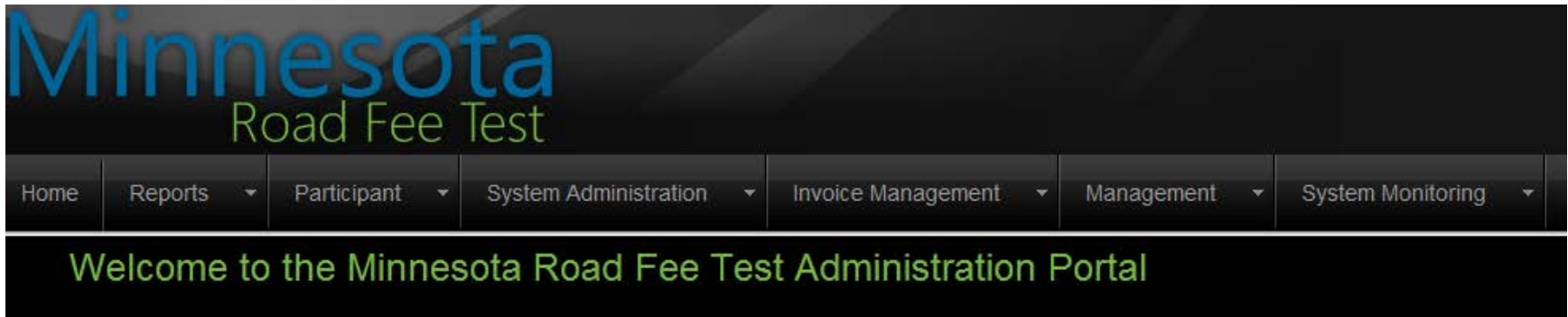
Reports Page



Example "View Estimated Fees" page



High Level System Design Concept



Participant Web-Portal Home Page

Capabilities

- The system was designed to:
 - Use the phone's onboard GPS capabilities to charge a mileage fee which could vary according to any time and location in North America
 - Display safety signage for 98 zones covering Wright County MN
 - 46 school, 17 curve, 7 construction, 28 speed reduction
 - 5 DSRC radios communicating with DSRC infrastructure, specifically CICAS intersections
 - Deliver travel time data for 3 predefined corridors in Northwest Twin Cities Metro Area

How did we Test the System

- So that was what we built and why we built it
- Now let talk about who tested the system and how they tested it.....

Participant Demographics

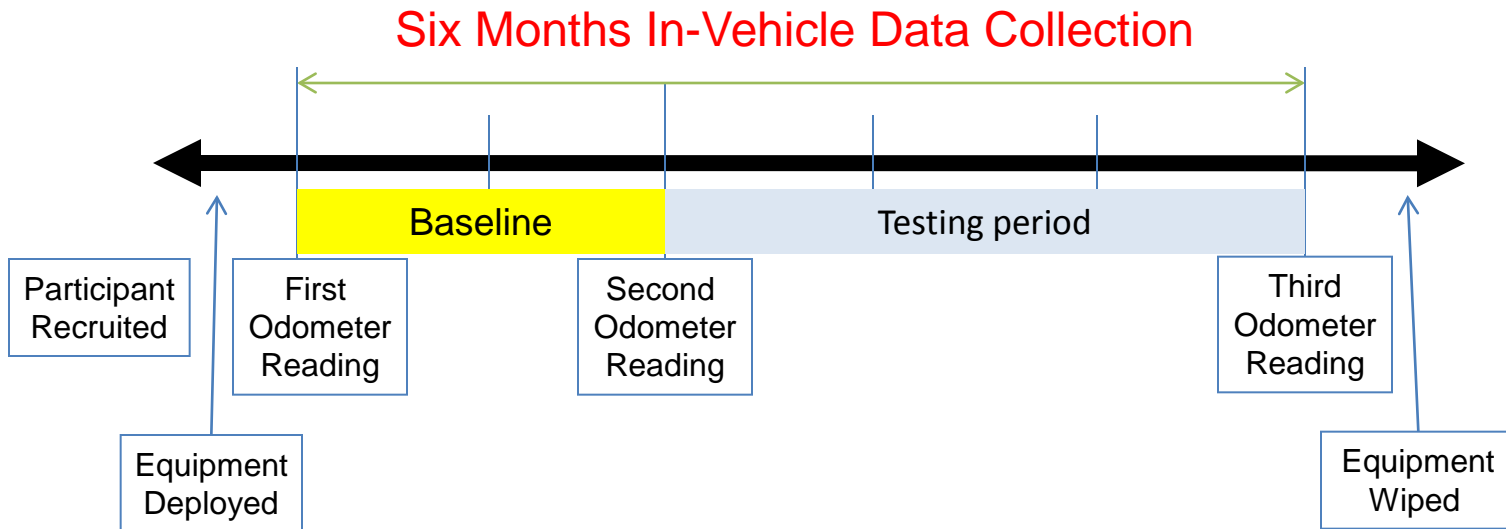
- Focus on Wright County, MN
- Recruiter made over 15,000 telephone calls
- Recruited over 650 participants to fill the 500 slots
- Paid average of \$320 per participant

GENDER	TEST	WRIGHT COUNTY
Male	46.4%	50.2%
Female	53.6%	49.8%
AGE (YEARS)	TEST	WRIGHT COUNTY
18 – 35	16.6%	22.1%
36 – 55	54.6%	47.7%
56 – 65	23.0%	15.1%
66 +	5.8%	15.1%
INCOME	TEST	WRIGHT COUNTY
<\$35k	6.0%	20.7%
\$35k – \$49k	14.0%	12.7%
\$50k – \$74k	32.6%	23.7%
\$75k +	47.4%	42.9%

Total: 500 (All Waves)

- Good balance except low income & younger drivers

Study Design Overview



- MBUF concept was to use a odometer reading with a discount fee if technology was used.
- \$0.03/mile and \$0.01/mile
- Higher rate for Metro area during congestion times and Zero cost for miles driven outside of Minnesota
- Monthly invoicing during testing period and final reconciliation at last odometer reading
- 3 waves from September 2011 to November 2012

Disputing the Fee Capability

MBUF Application	Trip Application
<ul style="list-style-type: none">• Stores accumulated miles by road rate category in OBU• Transmits cumulative miles by category and vehicle ID to Infrastructure no more than once per day• No information on individual trips	<ul style="list-style-type: none">• Latitude/Longitude on second-by-second basis• Transmitted to Infrastructure every 20 seconds• Contains a TRIP identifier (ID) but no information on vehicle or person

- “Trip” application captures vehicle location every second and sends this to infrastructure every 20 seconds.
- “Trip” does not contain ability to link a participant to a route, **only a participant can do this**

The Results

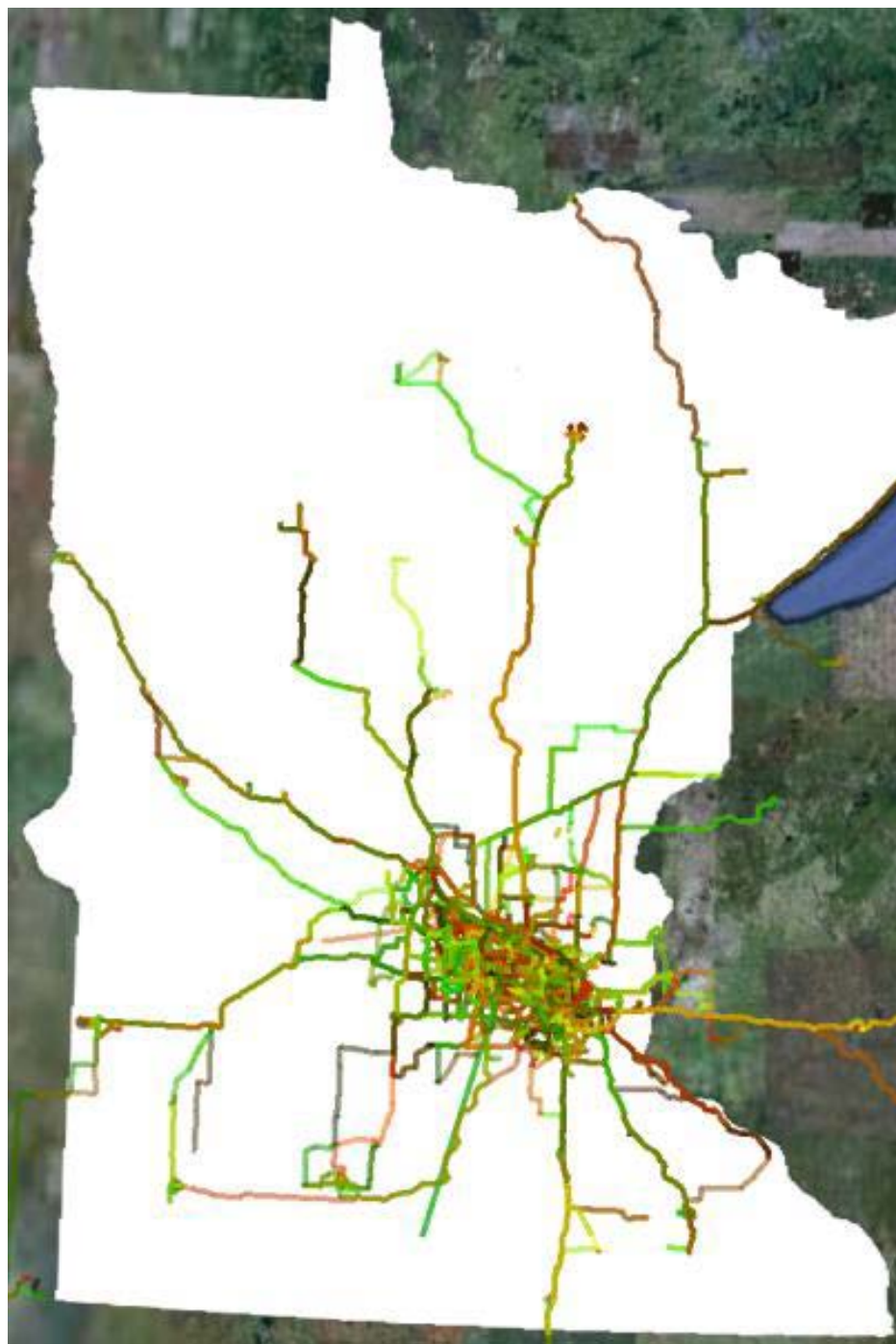
- We now know:
 - The Who, What, Where, Why, and the How the system was tested
- So lets talk about the results.....
 - 3 Final Reports covering:
 - The operational experience from the Demonstration
 - The user experience from the Demonstration
 - The policy findings (discussed last year)

Demonstration Data Analysis

- Data Sources
 - System collected data
 - # of trips, # of miles, length of trip
 - Participant Perceptions
 - Surveys, focus groups, and interviews
 - Service request and Stakeholder Interviews
- Data Collection (478 participants)
 - 660 million trip data points
 - 4 million miles collected within 500,000 trips
 - 1,411 survey response, 432 interviews, and 6 focus groups with 63 participants

Where did they drive?

- 800,000 snapshots per day for every 150 users
- November 2011
- 150 vehicles from Wave A



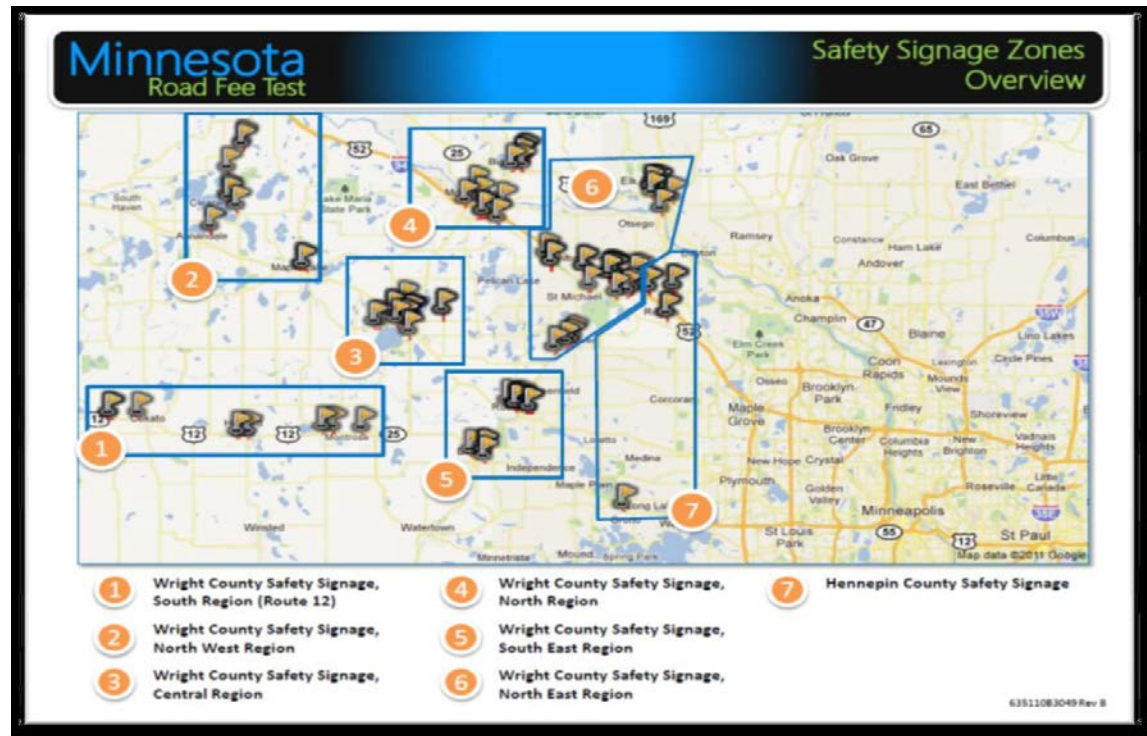
Travel Times



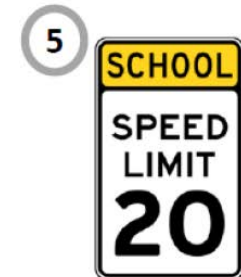
- The system collected 660 million trip data point that can be used to calculate travel times on many corridors.
- Estimates created using data collected were close to estimates created by count stations, and final time reported on trips.
- Despite the amount of probe data collected, hardware issues (GPS accuracies) hindered the amount of data which was usable to the team, pointing to the need to further develop software analysis tools

Safety Signing

- 247 Participants studied to evaluate effectiveness
- Examined driving speeds before and after auditory notification was delivered in vehicle.



1. Right Turn Ahead
2. Left Turn Ahead
3. Construction Zone Notification
4. Speed Reduction Zone Notification
5. School Zone



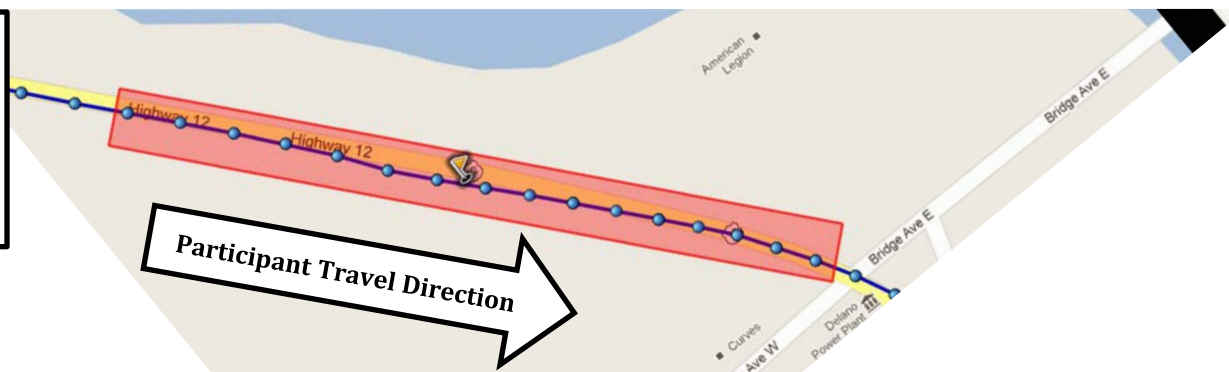
Behavior Type	Speed Limit Compliance, Before Alert (mph)	Speed Limit Compliance, After Alert (mph)	Difference in Speed (mph)	Number (Percentage) of Participants	Number (Percentage) of Trips
1-C	9.99	(2.06)	12.05	12 (5%)	66 (3%)
2-C	11.69	6.21	5.48	229 (93%)	2,104 (95%)
3-C	9.72	11.30	(1.59)	6 (2%)	40 (2%)
Grand Total	11.56	5.93	5.93	227	5,503

- On average, drivers exceeded the speed limit by 11.6 mph (+/- 9.9 mph) before receiving the alert and by 5.9 mph (+/- 13.2 mph) after receiving the alert. This reflects an overall average reduction in speed of 5.6 mph.
- Drivers on average were still not compliant with the speed limit in the time period immediately following receipt of the audible alert, although drivers did decrease to speeds more compliant with posted limits.
- **98% of drivers positively reacted (decreased speed) as a reaction to the in-vehicle audio/visual alerts.**

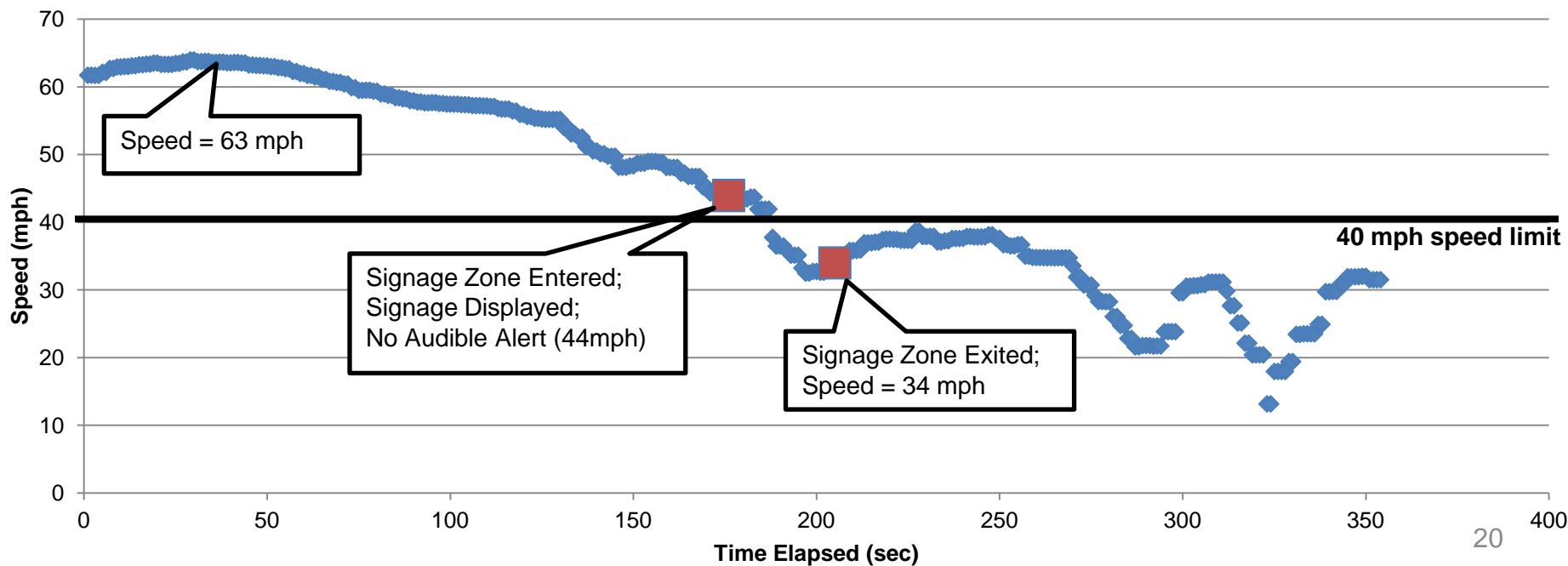
Example of Speed Profile Data for One Trip Through a Signage Zone

Signage Zone 128
Speed Zone
Speed Limit = 40 mph

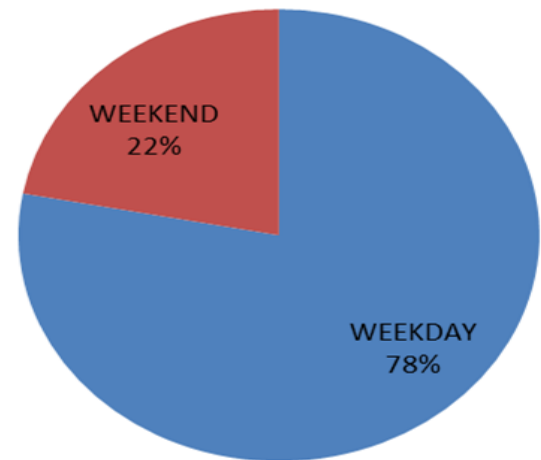
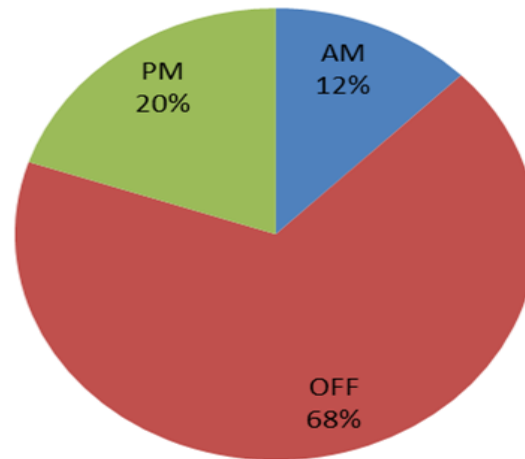
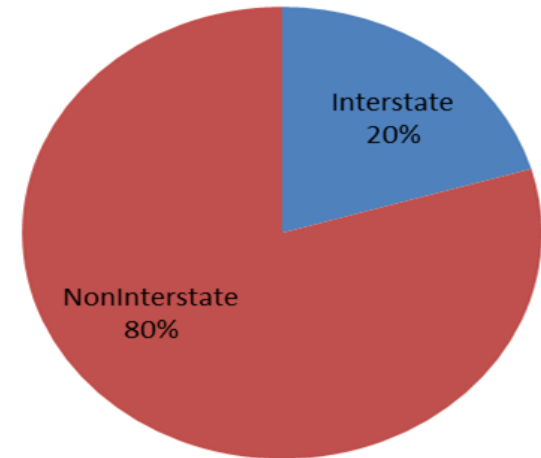
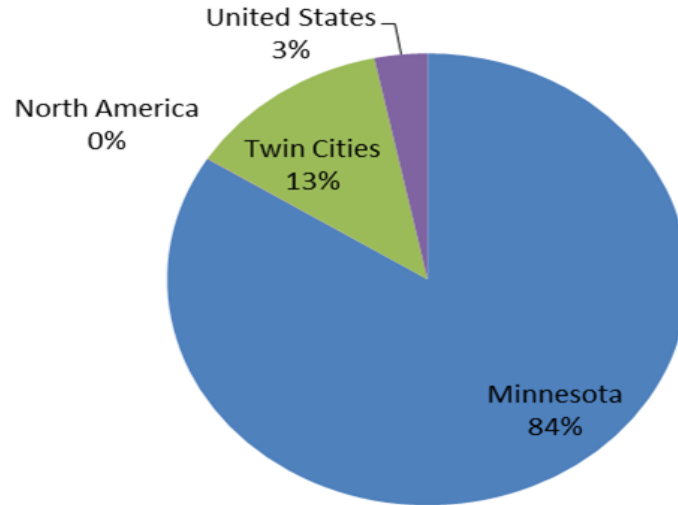
US 12 - EB
near Delano, MN



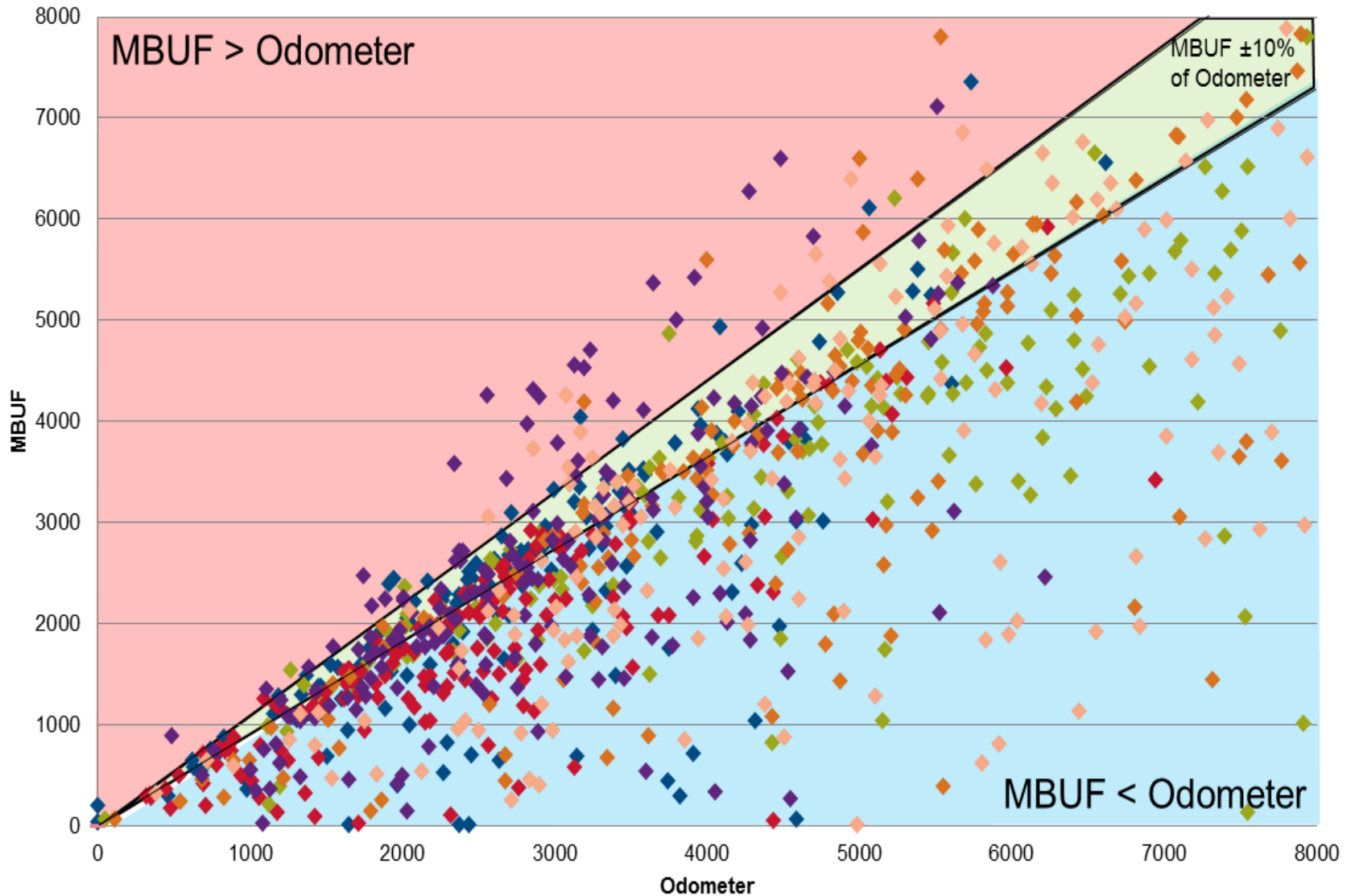
Speed Profile - Signage Zone ID 128



MBUF – Miles collected by Categories



Odometer vs MBUF miles collected



MBUF – User reactions

- Test participants learned about transportation issues and understood transportation needs
 - Users received little information about transportation funding issues before and during the test.
- 2,750 invoices collecting \$32,000 in fee
 - 95.5% collection rate (using test operational parameters)
 - Approximately equal to gas tax collection rate
- 40% of users preferred an MBUF instead of the gas tax at the end of the test

Operational Conclusions

- The Smartphone is a reasonable, viable technology to use for MBUF, but it has limitations
 - 77 percent of the time, users chose to opt-in to the system, record their miles and receive the discounted rate of 1 cent per mile
 - Using the vehicle's electrical system to detect the start of a trip did not work. Resulting in data loss rates of up to 35%
 - The ability to audit/post-process trip data is critical and vital.
 - There is room for continued field support optimization.

GPS Accuracy/Availability

- Perhaps the largest limiting factor the study
 - The quality of GPS signal is variable from phone-to-phone and is effected by physical location in vehicle
 - Phone used in the study are now considered very out of date (three versions of Samsung Galaxy™ have since been released.)
 - Advances in GPS technology have increased system accuracy from even three years ago.

User Evaluation Results

- Test participants used the technology, shared their data, and paid their bills.
 - Data security was much more important to users than data privacy (83% share rate)
 - Participants were accepting of modest monthly invoices that averaged \$20 a month (4.5% loss)
- Drivers showed increased compliance to in-vehicle safety messages (59% of drivers improved their compliance)
- Users value simplicity in the design of any alternative transportation funding

System Administration

- Administering the system to respond to users' needs was labor intensive
 - Participants reported a high level of satisfaction with the customer service
 - MnDOT does not regularly provide services to individual customers and but was required to in this scenario (4.5 calls/day plus billing, invoicing, odometer readings)
- Multi-agency interaction required.



Summary

- Conducted a successful test that satisfied the Legislative directive.
- The technology worked, but has its limits.
- Test participants used the system, shared their data, and paid their bills.
- Policy makers were engaged.
- System administration was labor intensive and focused on individual customers.

Next Steps

- Share MN test results
- Sponsor legislative proposal for keeping private data, private past August 12, 2013
- Observe other MBUF efforts especially in Oregon
- Lead Pooled Fund Project to continue to research the other MBUF concepts and related national issues



Minnesota Mileage Based User Fee Program

QUESTIONS or COMMENTS?

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Reports Available at:

<http://www.dot.state.mn.us/mileagebaseduserfee/index.html>

