National Evaluation of a Mileage-based Road User Charge

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Current U.S. Highway Funding Mechanisms

• The motor fuel tax has served as the primary funding source for U.S. roads for over 70 years
  – Federal tax: Currently $0.184/gallon for gasoline and $0.244/gallon for diesel
    • Provides 90% of the revenue for the federal Highway Trust Fund
    • Federal Highway Trust Fund revenue from motor fuel tax: $35.2 billion in FY06
      – $25.5 billion from gasoline/gasohol
      – $9.7 billion from diesel
• Motor fuel tax (continued):
  – State and local motor fuel tax
    • State motor fuel tax rates range from $0.00/gal to $0.40/gal
    • Some local jurisdictions (county, city) impose additional motor fuel taxes
    • Most state/local taxes are flat per-gallon fees. However some are a percentage of the fuel purchase price and others are a combination of fixed and percentage tax.
Mileage-based Road User Charging

Source: http://www.api.org/statistics/fueltaxes/
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Current U.S. Highway Funding Mechanisms (Cont.)

• Some additional constraints:
  • There are approx. 250 million registered motor vehicles in the U.S.
  • The median vehicle age is over 9 years
  • Annual distance traveled in the U.S. by all motor vehicles exceeds 3 trillion miles
  • The average driver pays a little over $20 per month
  • Total annual revenues (federal, state, local) are in the neighborhood of $80 billion.
Mileage-based Road User Charging

Mileage-based charging must work everywhere

There are 160,000+ miles of federal highways in the U.S., 46,000 miles of which are Interstates
The Looming Highway Funding Crisis

• The Fuel Tax no longer generates sufficient revenue to fund highway infrastructure needs.
• By FY2009 the Federal Highway Trust Fund will have a shortfall of $4 to $5 billion.
• If changes are not made, this shortfall is projected to reach more than $25 billion by 2012.
• Longer-term projections are even more dire.
• Equally severe problems exist at state and local levels.
• Three recent federal studies have recommended switching to a mileage-based charging system.
National Evaluation Study

• The National Evaluation of a Mileage-based Road User Charge is being conducted by the University of Iowa
  – Six test sites (year one): San Diego, CA; Boise, ID; Austin TX, Eastern Iowa; Baltimore, MD; Raleigh/Durham, NC
  – The study currently has 1200 participant vehicles
  – An additional 1500 participants will be selected in summer/fall 2009

• Study Goals
  – Preliminary feasibility assessment
  – Assess public attitude and acceptance of Mileage-based charging concept
Study Background

- **Phase I: 1999-2003**
  - Funded by the U.S. federal Highway Administration (FHWA) and a consortium of 15 state Departments of Transportation (Headed by Mn/DOT)
  - Studied wide range of issues related to the development and implementation of a mileage-based charge as an alternative to the current motor fuel tax.
  - Developed an initial architecture for a mileage-based road user charge system

- **Phase II: 2005-2009**
  - Funded in SAFTEA-LU of 2005
  - National evaluation study of a prototype road user charge system
  - Critical assessment of technological feasibility and public acceptance
Study Objectives

- Assess the feasibility and efficacy of replacing the current motor fuel tax with a mileage-based user charge
  - Technology
  - Robustness
  - Privacy and security
  - Transition/phase-in
  - Public policy ramifications
  - Public acceptance
Study Considerations

• Robustness
  – System would be responsible for collecting more than $80 billion per year in user charges
  – Must be accurate and reliable
  – Must function effectively in all environments
    • Atmospheric conditions
    • “Urban canyons”
    • Rural areas with limited wireless infrastructure
Study Considerations

• Security
  – Fraud and evasion efforts are inevitable
  – System would be an attractive target for various types of cyber-attacks.
  – Potential target for terrorism
Study Considerations

• Privacy and Public Acceptance
  – Privacy concerns: This is the “hot-button” issue
  – Many people fear that government will use the system to track them
  – Public understanding of technologies such as GPS is limited.
  – There is a fundamental tension between protecting privacy and providing auditability.
  – May be the single largest obstacle to transitioning to a mileage-based road user charge.
Study Considerations

• Cost and Efficiency
  – Cost overhead for user fee collection must be low (no more than a few % of total revenues)
  – Must be able to accommodate users who function on a cash-only basis
  – Must be efficient mechanisms for enforcement of fee payment
Study Considerations

• Phase-in
  – If necessary equipment for mileage-based charging is only included in newly manufactured vehicles, a long phase-in period will be required
  – During this period, it may be necessary to operate a dual system--i.e. some pay the gas tax and some pay a mileage-based charge.
Study Considerations

• Charging Policy
  – A mileage-based road user charge system provides great flexibility for setting charge rates. Options include:
    • Neutrality vis-à-vis gas tax
    • Incentives for fuel efficiency/ “green” vehicles
    • Charge-rate based on overall “carbon footprint”
System Architecture

• An electronic unit is installed in each vehicle consisting of:
  – An on-board computer system
  – A Global Positioning System (GPS) receiver
  – A simple geographic information system identifying the boundaries of all road-use charge jurisdictions
  – An associated rate table containing current per-mile charge rates for each region
  – A cellular wireless transmitter-receiver
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GPS
Mileage-based Road User Charging

Accrued Mileage Charge Data

Cellular data service
Mileage-based Road User Charging

Accrued Mileage Charge Data

Secure Network

Collection Center (Back Office)
Mileage-based Road User Charging

Collection Center (Back Office)

Payment for total accrued charges

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**Mileage-based Road User Charge System Architecture**

- **GIS Database**
  - Charging zones (geo-regions)
  - Road segment coordinates (optional)

- **GPS Receiver**
  - Vehicle coordinates (latitude/longitude)

- **Vehicle on-board computer**
  - Vehicle ID
  - Per-mile rate schedule
  - Miles traveled per charge zone
  - Miles traveled by road class (optional)
  - Odometer reading
  - Refueling events
  - Vehicle weight and config. (Heavy vehicles only)

- **Wireless data link**
  - Vehicle ID
  - Rate schedule edition
  - Total charge due
  - Charge apportionment
  - Odometer reading

- **Collection Center**
  - Prepares bills to users
  - Apportions revenue to jurisdictions
  - Checks for fraud & malfunctions
  - Maintains up-to-date charge tables.

- **Odometer feed**
- **Speedometer feed**
- **Refueling events and fuel levels**

- **Vehicle OBD bus**

* Not included in the National Evaluation Study

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Basic System Operation

- As the vehicle travels, the on-board computer uses the GPS system to determine the current vehicle location and distance traveled.
- The GIS database and rate table are interrogated to determine the current jurisdiction and charge rate.
- Accrued charges are maintained for each jurisdiction in which the vehicle travels.
- Charges are periodically uploaded to a billing and dispersal center via the wireless communication link.
- A variety of payment options could be used ranging from sending of a billing statement to automatic deduction from a credit card or bank account.
- Updates to GIS database and/or rate table can be downloaded to the vehicle via the wireless link as necessary.
Important Considerations

• The on-board unit stores and reports only the total amount owed for each jurisdiction. No detailed route or time information is collected.
• Data encryption techniques are used to further enhance system privacy and security.
• Any number of vehicle classes can be created, each with their own per mile charge rates, thus enabling a wide range of public policy options.
• The system can handle multiple levels of RUC jurisdiction—e.g. federal, state, county, city, etc.
• This system could be integrated with other road financing and traffic management options including congestion pricing and electronic tolling.
• The system could be implemented on any type of vehicle regardless of propulsion system or fuel type.
National Evaluation Study

- Two-year field study commenced in Fall of 2008
- Total of 12 sites nationwide
- 2700 total participants
- Each participant will have the mileage-based charge system installed in their vehicle for approximately 10 months
- Road user charge data is collected and reported and simulated billing statements are distributed to participants on a monthly basis
- A battery of questionnaires is administered to participants to assess perceptions, attitudes and acceptance
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National Evaluation Study Sites—Year I
National Evaluation Study Sites-Year 2 (tentative)

- Portland, Maine
- Miami, Florida
- Chicago, Illinois
- Wichita, Kansas
- Albuquerque, New Mexico
- Billings, Montana
Study Design

- Participants are selected to reflect community demographics with respect to:
  - Age
  - Sex
  - Level of educational attainment
  - Driving habits
- Subjects receive modest compensation for participation
- On-board Units are professionally installed under the dashboard—not visible to driver.
- Attitudinal surveys are administered at approximately six week intervals.
Progress to date:

– 1,200 participants for year-one were chosen from over 40,000 qualified applicants

– Participant training and OBU installation began in October, 2008 and was completed in December

– To date, more than 5 million travelled miles have been reported, accounting for approx. $120K in user fees.
• Future Roadmap:
  – Recruitment of 1,500 new participants will begin in Summer of 2009
  – Participant training and OBU installation for year-two will begin in late summer, 2009
  – In-field operations will be complete in early fall, 2010
  – Total reported mileage for the two-year study should be approx. 25 Million miles
Some Preliminary Observations:

- Participants’ level of acceptance mileage-based charging appears to increase after several months of participation in the study.
- GPS is markedly less accurate than vehicle odometer as a means of measuring miles travelled.
- Retrofitting an OBU to a wide variety of vehicles is very difficult process
  - Bus standards aren’t standard
  - Modern vehicle electronic systems are often very fragile
Mileage-based Road User Charging

Concluding Remarks

- There is widespread concern at both the federal and state levels about the long-term viability of the motor fuel tax.
- Several federal commissions have forecast the impending demise of the motor fuel tax and recommended a transition to a mileage-based fee.
- The national evaluation of a mileage-based road user charge, along with other state-level will provide important information to inform the debate and dialog on this important transition.
References and Links


National Surface Transportation Policy and Revenue Study Commission: http://transportationfortomorrow.org/

National Surface Transportation Infrastructure Financing Commission: http://financecommission.dot.gov/
Contact Information

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