

May 31, 2008

National Surface Transportation Infrastructure Financing Commission

RE: Commission's Interim Report

Purpose of this submission

The purpose of this submission is to update Commission members on recent developments in GPS-based technologies enabling *mileage-based, congestion-sensitive, road use charging* (RUC) to be assessed *securely and at acceptable costs without violating the privacy* of road users.

Skymeter Corporation has a financial interest in the development of these technologies, as have other companies such as Satellic, Siemens, and Toll Collect.

Technology Enabled Reform

There is a technology now available that enables significant and sustainable reforms of Transportation Finances. Recent studies in Oregon and Washington State funded by the Federal Highway Administration have demonstrated that GPS technology can enable a switch to mileage-based road use charging (RUC). Skymeter has resolved shortcomings of the specific technologies employed in those trials; issues of accuracy, repeatability, reliability, evidentiary weight, self-installation, enforcement, cost, and privacy have been successfully addressed.

- **Accuracy** is provided by a set of telematic components including multiple sensors, GPS reception, and specialized tolling-specific filters for removal of the signal-disturbance errors caused by tall buildings (known as "urban canyon" error). Figure 1a compares a test-comparison with one of the worlds top-ranked navigation GPS chips. This test was made in the Singapore harbour, selected as the one of the harshest locations for GPS navigation signal reception.
- **Repeatability** is provided by a set of spatial filters and a specialized method of price geocoding. This allows us to promise "**same-trip = same-charge**". Figure 1b shows three separate trips taken in Singapore, illustrating both accuracy and repeatability.



- **Reliability** is provided by high-sensitivity, multiple sensors, accurate and repeatable processing and a series of tamper-proofing steps. The in-vehicle sensor detects jamming, shielding, spoofing, removal, and physical intrusion.
- **Evidentiary weight** is provided by a series of steps including assurance testing and statistical measurement taken at each second of the metering process. For example, in

Figure 1b, above, each point in the measurement holds information regarding the error performance of that measurement. Errors are typically well under 10 meters. The likelihood that the vehicle was not where the meter says it was at any second is nearly zero. The likelihood that the meter is wrong for tens of sequential seconds is immeasurably small.

- **Self-installation** is enabled because the in-vehicle device is autonomous: it does not need to connect to any car-system except power (from the cigarette lighter) and the windshield. On contact with the windshield, the device identifies itself to the metering network automatically and anonymously. Everything is fully automated from that point.
- **Enforcement** is handled for the device user mostly by the build-in tamper-proofing elements. Enforcement for non-users is handled by a combination of guest-passes and mobile (random) camera enforcement, making enforcement the equivalent to speed enforcement or enforcement of current vehicle registration payments. Enforcement is managed as a profit center, rather than a cost center.
- **Cost** is minimized by removing all road-side infrastructure such as gantries, beacons, toll booths, etc., by using new telematics component innovations, by removing the need for GPS-based map-matching (an expensive and error-prone method common to other providers), and by reducing telco costs via extreme compression. In volume, the cost for the in-vehicle component is nearing \$100 and will soon approach \$50. Because this same system addresses RUC, parking and PAYD insurance that reduced expense is further diluted by amortization over multiple applications. Costs for these transactions can now be obtained at costs similar to that of a credit card.

What is far more critical is that with zero fixed infrastructure every square meter in the United States becomes tollable on a time, distance and location basis as any State or local government decides. Once the system is adopted, the cost of tolling a new lane mile becomes zero excepting for mobile camera enforcement. The cost of in-car devices, can be borne by the user, but credited by the state by providing usage credits equal to or greater than the cost of the device.

- **Privacy** is provided the *privacy shield* that is inherent in the system design. The in-vehicle meter (sensor) forwards location information (without knowledge of vehicle or user ID) to an off-board calculator that provides billing information either to an independent Billing Operator that is given no location information or back to the vehicle for payment there. Hence, Skymeter knows nothing about the vehicle or its operator and the billing authority knows nothing about the vehicle's location history. Police subpoenas can be handled as an exception.

In addition:

- The system can **route revenues** to owners of the roads on which travel takes place, whether the owners be public or private entities, and
- **"equity"** concerns can be addressed by giving away mileage credits [at federal or state expense] with each in-vehicle sensor, and/or by exempting from mileage charges on local roads those who finance those roads via their property taxes.

Telecom Providers Replace Gas Distributors

One of the advantages of the current gas tax system is its cost-effective and easy means of collection. Approximately 1600 fuel distributors currently pay the gas tax based on the amount of fuel they sell to retailers who in turn collect these taxes from road users. Replacing gas tax is not an easy proposition – any new system must be fraud/tamper-proof and robust and most importantly be cost-effective.

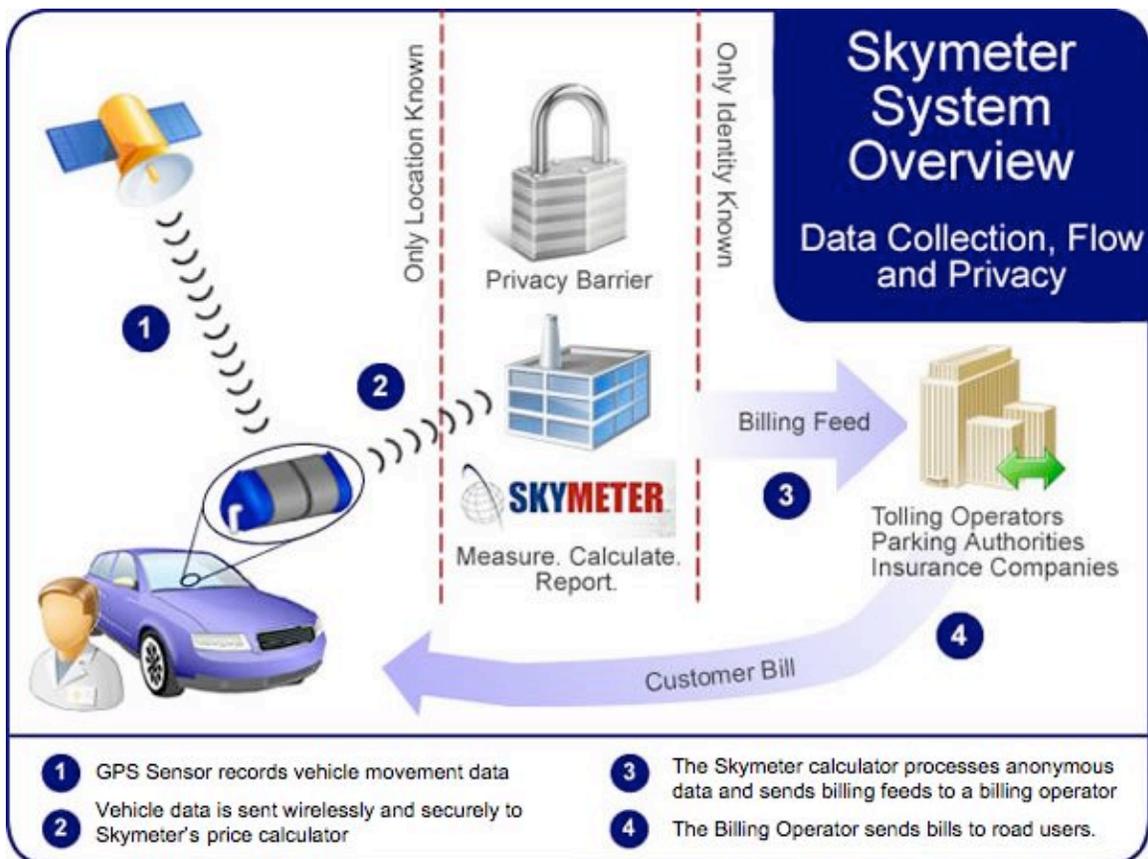
Such a system as we describe here could be operated by the network of telecom providers that currently offer communications infrastructure to the public for cellular phones. These companies have a track record, issue many bills to many customers, have existing reciprocal agreements for debiting/crediting accounts of users 'roaming' on other networks and are familiar to the public.

By using the telecom network as a communication backbone and billing operator for RUC, the federal and state governments can utilize existing private infrastructure and leverage further private investment in the US transportation system. This solution offers win-win-win scenarios for road users, road providers and governments.

Big Brother Fears Addressed

Until now, concerns over user privacy and accuracy in urban areas have prevented widespread adoption of GPS-based RUC. Skymeter has given considerable thought and dedicated our system design to the protection of end-user privacy. This system not only provides privacy, it also enables anonymous, pre-paid accounts that can address voter and privacy-advocate concerns by completely removing the need for vehicle tracking.

By separating vehicle and motorist information from location data we create an "information firewall" between a private-sector metering-system operator and a government or government appointed billing operator. We know where a vehicle has been, but we cannot identify it or its driver. Likewise, the billing authority that may know the vehicle and what is owed, will not know where a vehicle has been. This is illustrated in the following figure:





DSRC/5.9 GHz vs. GPS for RUC

Many experts and technologists believe that the answer for all demand-related traffic issues lies in the promise of DSRC/5.9 GHz. However, given the fiscal state of the Highway Trust Fund and the massive costs associated with installing, operating and maintaining roadside infrastructure on a national scale, we think this proposition is highly unrealistic.

GPS-based RUC, on the other hand, eliminates the need for expensive fixed roadside tolling infrastructure, particularly in a full-scale, built-in implementation and since Skymeter can be self-installed, the existing US fleet can easily be retrofitted. Notwithstanding the need for testing, public consultation and conversion of the pay-at-the-pump system, if approved today implementation of a GPS-system like Skymeter's could commence immediately and roll-out over a number of years, including a retrofit of the existing fleet of vehicles.

In addition, Skymeter enables Municipal and State partners to manage parking payment, commuter-trip reduction programs, driver rewards/benefits programs as well as allowing Insurance providers to implement Pay As You Go Insurance policies. One platform for all payments offers across the board cost savings.

Conclusion

The technical developments described above enable road use to be charged for as easily as is mobile telephony, and enable the Commission to make bold recommendations for the revitalization of our transportation system. Such recommendations would encourage leaders at all levels of government to envision a new paradigm for the efficient use of our roads by all modes of transportation. RUC based on the time, distance and place of travel will achieve substantial societal benefits while raising the funds required to maintain and expand our aging infrastructure. If we charge differently, sending signals to motorists about travel choices, we can raise needed funds to fix our aging infrastructure while achieving substantial societal benefits at a lower total cost to motorists and government.

Sincerely,

A handwritten signature in black ink, appearing to read "Bern Grush". The signature is fluid and cursive, with a small flourish at the end.

Bern Grush
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Cc: US Secretary of Transportation Mary Peters