From RFID to GPS

Bern Grush, Skymeter Corporation, on why he is convinced that the future of road user charging in the US should be satellite-based

There is a growing body of evidence which supports a move away from infrastructure-heavy RFID-based toll collection systems to infrastructure-light GPS-based Time-Distance-Place (TDP) Road User Charging (RUC) systems. One migration path superimposes GPS payment services over existing, intact tolled networks while providing new payment and other telematics services for participating users.

In 2003, David Forkenbrock wrote the award-winning *A Mileage-Based Road User Charge Concept* for the 83rd Annual Meeting of the US-based Transportation Research Board, in which he described a design for replacing the gas tax with a charge based on Vehicle Miles Travelled (VMT), a precursor to the economically efficient concept of variable charges depending on when and where one drives those miles - TDP charging.

The predominant motivation for Forkenbrock's GPS-based design is replacing the increasingly ineffective fuel tax. The implication that varying charges to reflect the time and place of driving would have impacts on peak-hour driving is made in passing, and related design hints are provided. However, two years later, Forkenbrock emphasised that information regarding when and where driving occurred is not recorded in the interest of privacy of the travelling public, making this a pure VMT system.

A project based on this design and led by principal investigator Professor Jon G. Kohl of the University Iowa Public Policy Center started in 2005 and as of the beginning of 2008 was poised to collect data from 2,700 vehicles from six test regions around the US.

In 2005, the Puget Sound Regional Council used a GPS-based pilot to evaluate travellers' responses to variable road tolling over an extensive network. It found "a dramatic opportunity to significantly reduce traffic congestion and raise revenues for investment".

The 2006 Oregon Road User Fee Pilot Program studied two things: replacing the gas tax with a GPS-based, VMT fee with collection at fuelling stations and the feasibility of this approach to collect congestion (time and place) charges. In its final report, it claimed viability and acceptability of such a system.

The 2007 National Surface Transportation Policy and Revenue Study Commission report *Transportation for Tomorrow* referenced a 2005 study of highway and transit revenue options for the US Chamber of Commerce's National Chamber Foundation which identified VMT fees and congestion pricing fees as promising options for 2020 and after.

In 2008, US Secretary of Transportation Mary Peters, speaking at The Brookings Institution, stated very clearly a need to move from a fuel tax-based funding system to a usage-based system. She pointed to the increasing use of HOT lanes as an interim measure that would acclimatise road users to paying for use at peak times.

"We will eventually go to a vehicle miles travelled form of pricing", she continued, by which she means the same thing as the European Union means by Time-Distance-Place (TDP) charging. When I later asked the Secretary how far away that might be, she said, "Some states cannot wait 10 years."

The American Association of State Highway and Transportation Officials (AASHTO) Journal for both April and May of 2008 puts the date for a switchover to VMT at 2025.

The Puget Sound Regional Council used a GPS-based pilot to evaluate travellers' responses to variable road tolling over an extensive network

The perfect storm

Several factors are converging to force a rethinking of the business and practice of tolling in the US.

First of all, the Highway Trust Fund is underfunded. Fuel taxes are insufficient, diminishing in efficacy, politically unpopular, abused by politicians and ineffective in sending pricing signals about congestion. Transportation demand management experts insist that market pricing, rather more than fuel taxes, will help manage congestion, replenish road funds and build transit infrastructure. HOT lanes have proven to be much more useful than HOV lanes but the conversions from HOV to HOT and from 'free' to tolled, even if every feasible route were to be developed, are a limited solution for both congestion abatement and raising funds - what will we do after all the HOT opportunities run out?

The current best practice short-range radio technology for Open Road Tolling (ORT), whether used for HOT or 'classic' tolled lane is infrastructure-heavy. Its practicality is inversely proportional to the number of access points. It makes sense for limited access highways like the Florida Turnpike or peninsular islands such as Stockholm but it is prohibitively expensive for area tolling such as was proposed by New York's Mayor Bloomberg.

The US has an enormous and growing investment in a massive tolling infrastructure based on an ageing technology. However, under the watchful eye of the US Department of Transportation, GPS-based TDP RUC is being studied by several states. It is being deployed in Europe and elsewhere and is less expensive, more flexible, more scalable and extensible, more powerful and can be deployed with no capital expenditure. TDP is fairer and more effective than VMT or HOT tolling, while privacy-assured GPS-based positioning is far more useful and powerful than RFID technology.

The US continues to accelerate the application of opportunistic HOT projects but is heading up a technological cul de sac. This feeds an enormous sunk investment and vested interests in obsolete tolling infrastructure - all while running out of money. Meanwhile, the US has also spent millions building an understanding and awareness of a new, open GPS technology that promises to address all of these problems.

Vision

AASHTO's Funding and Finance team is preparing a draft Legislative Recommendations Summary. From the 3 June 2008 draft: "In 2022, begin to replace the motor fuel tax with a vehicle miles travelled user tax; lower the federal gasoline tax to 27 cents and replace with revenue from a VMT tax of one-half cent per mile; in 2025, increase the VMT tax to just over 2.0 cents per mile and phase out motor fuel taxes completely; in 2030, increase the VMT tax to about 2.2 cents per mile."

This is neither a change that can be made suddenly nor a collection system that can be instituted in a single step. Starting now, the US could move in planned stages from RFID tolling to nationwide GPS/TDP tolling that can rival the cellular phone industry in value and credit card micropayments in cost.

The US could meet AASHTO's proposal for 2025 with TDP technology - but it needs to start now. There are 250 million vehicles in the US eager to drive in less congestion and on properly funded roads but a majority of their drivers will resist the necessary change.

A pure VMT solution is predominantly an improved replacement for fuel tax and it, too, is blind to congestion and emissions. A TDP solution addresses these issues and much more.

For road owners and operators, cities and regions, this will allow tolling anywhere and everywhere without infrastructure. A city could be tolled as easily as a limited access highway. A tolling scheme could be updated or altered by changing a database and some signage. For example, in London, UK, the Western Extension Zone could have been added for US$5 million instead of $300 million and it would have been a fairer TDP toll instead of a crude, once-a-day entrance charge.

The US can start gradually, using GPS/TDP technology as a concurrent programme overlaying existing tollways and HOT projects with its added benefits for both motorists and road operators. It can be applied to simple area-wide programmes for interoperable tolling, for on-street parking management, for pay-as-you-drive insurance, for driver rewards for not driving during peak hours. This can be done in an attractive and desirable manner, without immediate increases in fees or tolls. For example, it would overlay E-ZPass, SunPass and Fastrak while leaving existing prices, vendors and equipment in place.

Departments of Transport would derive immediate benefits - wireless vehicle information readouts for commercial vehicle compliance checking at speed: truck weights, last emissions test, or hours driven in the past 24 hours, as well as anonymous, aggregated data for Origin-Destination (O-D) studies. Courier stopping fees could be applied in place of parking tickets. Using price escalation for meter violations instead of citations could reduce parking enforcement expenses.

Municipalities such as Manhattan could be tolled with a fairer and more economically efficient TDP charge instead of a flat, economically inefficient $8. It would be easy to apply lower rates for people who live in Manhattan, if that were to be required. And it can be installed for $50 million instead of $800 million.

Proposal

There are several current tolling acquisition programmes in progress in the US. Those from the E-ZPass Interagency Group and the North Carolina and Pennsylvania turnpike authorities are examples. All seek RFID solutions, currently the appropriate base technology to acquire or renew.

Herein lies an opportunity: knowing that the changeover from tolling predominantly limited-access lanes to tolling open-access road surfaces and large areas is on the horizon, it is possible to address any existing and new ORT project with a blend of the two systems, RFID and GPS, in a way which permits the bulk of patrons to use the customary RFID transponder, while a minority of patrons would elect to use the GPS-based transponder because of its additional suite of services.

If 200,000 patrons of the to-be-tolled I-80 in PA or the Triangle Expressway in NC or any of the E-ZPass facilities in the northeast elected to use a GPS road use meter in place of an RFID transponder, they could access, say, parking or insurance payment services in addition to the tolled facilities. Such a meter can be arranged to measure road use so as to calculate the identical fees as are determined by detection of an RFID transponder.

The reward is provided by the additional features. Smaller trucking companies which are not yet using asset management and tracking systems would like its additional reporting capabilities. Travelling salespeople would like it for its expense accounting for parking and tolling. Some private drivers would like its pay-as-you-go insurance offerings.

A tolling authority or any number of transportation consultants could use aggregated, anonymous data for O-D studies. Participating tolling authorities would get real experience with satellite tolling. More importantly, since such a system can overlay every tolling scheme in the US - as long as schemes' operators agreed to be paid via this meter - this 'superoperability' is the perfect method to put a full nationwide system in place, allowing the old system to wind down through attrition and making switchover virtually painless.

Conclusion

Building a parallel GPS-based tolling system with many attractive services is the best way to educate motorists and decision-makers that TDP systems are fair, private and easy to use. Depending on how service agreements are struck, the parallel system could be self-funding with the vendor either reselling additional services or selling new services to the tolling authority for additional revenue. But we need to start now to reach the majority of vehicles by 2025 while always safeguarding privacy to promote acceptance. ■