

Tolling by Telco

A newly developed, liability-critical GPS subscription feed, cell phone networks and banks provide a ready means of achieving reliable, infrastructure-free billing feeds to network tolling operators in any roadway environment for a few dollars a month. Bern Grush writes

Consecutive US Secretaries of Transportation have stated that the declining performance of the country's road system can be understood as a failure to apply the same market principles of supply and demand that have guided the development and modernisation of other utilities. Current Secretary Mary Peters made precisely that point in the Minority View of the just-released report from the National Surface Transportation Policy and Revenue Study Commission – a report she declined to approve, from a Commission she chaired.

Three of 12 commissioners (the other two were Maria Cino, former US Deputy Secretary of Transportation, and Rick Geddes, Associate Professor, Department of Policy Analysis and Management, Cornell University), voted against accepting the Report, because in advocating an increase in fuel tax while hedging bets on pricing research and trials it failed to teach

“Right now we collect taxes from 1,600 fuel distribution operators. How will we collect charges from 200 million motorists?”

Roadmap to market pricing

It seems probable that all 12 Commissioners understand that market pricing is critical to network performance. I also suspect that each Commissioner agrees with Secretary Peters theoretically but not seeing a practical way around a 12,500-fold increase in the number of apparent collection points could not recommend that to Congress.

But there is a way. It is possible to use GPS, cellular providers and banks to manage Road User Charging (RUC) as an eventual replacement for the fuel tax. Money can be gathered, from a State or Federal perspective, at far fewer than 1,600 collection points – more likely less than 200 and possibly as few as 10.

These users, on average, talk enough to buy US\$42 in airtime monthly, excluding other charges. This compares well with my expectation that an average motorist's RUC payment services cost would be of the order of \$10 per month – which is also remarkably less than the approximately \$135 monthly cost of driving a car into the London congestion zone each workday.

Everything that GPS-based, free-flow tolling requires is already in place for wireless communication networks: back office billing systems; customer service facilities; experience with massive numbers of small, mobile units; experience with high system up-times; payment settlement systems for low-cost events that overlap competing network boundaries; banking for pre-pay, credit or debit; user trust regarding privacy protection; and, of course, the communication network itself. Many of these same providers also provide prepaid handsets that can be used anonymously (Figure 1).

Wireless companies are only missing one thing – a robust, privacy-assured tamper- and jam-proof road use metering system that always calculates the correct toll. In other words, if we replaced the cell phone handset with the right form of road use metering system, a cellular operator would become a road Network Tolling Operator (NTO). Other than enforcement the two jobs are nearly identical.

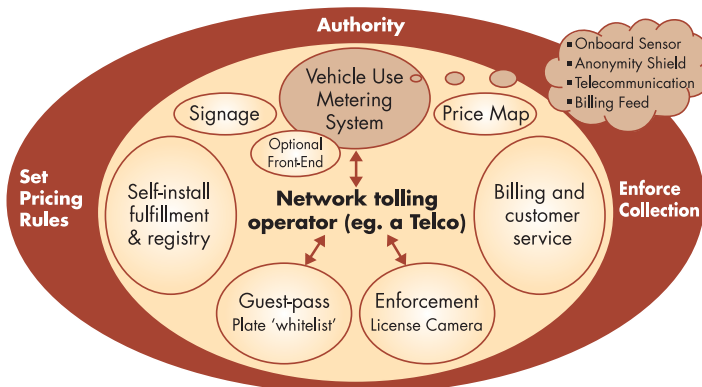
So what about this reliable road use metering system? An acceptable implementation will require it to have several properties:

Evidentiary issues drive technology

First, a metering system for tolling must produce an adequate evidentiary process. For an evidentiary record to be useful in a legal circumstance to enforce collection of a charge or a tax it must be relevant, admissible and carry sufficient weight. All the technology involved has to pass rigorous tests to fully satisfy this.

To be relevant it must capture evidence of the journey that is being charged. A TDP system will require a record of an entire journey, rather than a few waypoints as is afforded by current RFID systems. Hence, to generate and defend such a record a reliable positioning system such as GPS is best suited. ➔

Figure 1: Technology now exists to enable a telco to be a network tolling operator. By incorporating metering and billing feed services and subcontracting mobile license plate enforcement, the workflow and OSS/BSS systems requirements for network tolling closely match the current systems and customer service operations of a mobile telephony operator.



how to create sustainable, efficient funding mechanisms. In the Minority View, the three dissenters wrote “...such an approach promotes relative indifference to the revenue mechanisms themselves so long as adequate revenue is generated”.

Two days before this Report was released, Commission Vice-Chair Jack Schenendorf spoke on a Transportation Research Board's 87th Annual Meeting panel to provide a perspective from the National Surface Transportation Policy and Revenue Commission. I asked Mr. Schenendorf his opinion regarding the application of market-based Time, Distance and Place (TDP) pricing. His response was:

In 2007, new developments in liability-critical vehicle positioning systems using Global Navigation Satellite System (GNSS) signals such as GPS were demonstrated in Europe, Asia and North America by several companies and in certain government test environments. Some of these developments have broken through reliability barriers that allow these metering systems to operate in difficult urban signal environments without roadside infrastructure and can guarantee ‘same-trip, same charge’.

In November 2007, the number of cell phone users in the US exceeded 250 million, as served by 180 providers.

➔ Admissibility of electronic records in a court of law requires standards of collection, use, preparation, maintenance and care that are often regulated or legislated for specific data-capture technologies and may be influenced by case law and specific legal challenges. There is considerable precedence for standards of admissibility of electronic records from both national and international standards organisations and this forms a basis for application to vehicle positioning records. Companies developing such GPS road-use metering systems should recognise these existing principles in their work.

In the case of positioning records, 'sufficient weight' would entail documentation of a history of accurate and reliable capture from the type of device under consideration, proof that the specific device collecting the information to be used in evidence was operating correctly, and that the record in evidence is tied to that device and remains unaltered.

This cursory overview of evidentiary records requirements makes a simple point: however technically complex RUC technology may become, one can expect the evidentiary process surrounding their deployment and use to rival that complexity. This is a case of the legal context forcing the technical content to be exceptionally reliable.

Privacy protection

Secondly, these systems must preserve privacy. A commonly held assumption is that GNSS (GPS) is a tracking system. Although GNSS can be used to enable one, it is not inherently a tracking system. Privacy is already addressable via technical and legal means in at least North America and the EU. What is missing now is user education. The technical solution to privacy protection is well understood and in a simple illustration can be compared to that

used for anonymous prepaid cell phones. Because a motorist may wish to audit his or her own charges, we need to provide a way for him or her to do that privately but with no other access possible. This is also technically accomplished with the result that upon payment (which is instant in the case of a prepaid account), anonymous location records may be moved to a numbered, user-only, Web-accessible storage area where they may be read or destroyed (but not modified). Such records, encased in anonymous wrappers, can be used as an evidentiary record if we add one more layer of security beyond that used in anonymous cell phone technology. In this way, an anonymous user would retain the ability to refute a bill.

Expense

Thirdly, any widely deployed GNSS system must be low-cost. Current RUC systems absorb 20-40 per cent of tolling revenues. This is unsustainable and if not addressed will form an insurmountable barrier to the shift from road taxes to usage charges. It already forms a considerable barrier (second only to politics) to the erection of local, CBD-area cordon systems.

Flexibility

Existing tolling systems whether kiosk, RFID or DSRC are infrastructure-heavy, dedicated to a single application, fixed and inflexible. This makes them expensive and relatively non-extensible while they serve a limited pricing policy in a fixed location. They are only appropriate in limited-access applications such as separated-grade highways and island geographies, such as Stockholm. Applications such as London or the Manhattan (PlaNYC) proposal are inappropriate for these technologies, as is nationwide TDP charging as is slated for The Netherlands. For this reason, the operational costs of the London system absorb 42 per

cent of the daily entry fee of £8 and its operator Transport for London continually seeks to improve deployment methods.

GNSS-based RUC systems require no fixed infrastructure beyond a billing centre (enforcement is more easily optimised with mobile license plate cameras). GNSS-based methods can be used to manage flexible policy for road tolling, congestion pricing, parking payment, and pay-as-you-drive insurance. They can be made secure and private, they can generate evidentiary records, and they now work in the densest urban canyon.

Most important of all, they can be offered as a service, allowing an NTO to more effectively service governments wishing to deploy more user-pays policies for transportation infrastructure. Tolling payment services can be made available to a region, city or country without incurring related capital expenses and can turn operational costs into a single-digit percentage of the charges collected.

Even more important than the technology that provides wireless, infrastructure-free payment services are the policies that are enabled by this new approach. Freedom from infrastructure and reliance entirely on vehicle positioning means that it is now possible, with a services subscription system, to not only service payments for road use, parking and insurance, but to reward drivers for *not* driving during peak hours, to escalate parking charges for overstaying a meter instead of issuing citations, to charge couriers for stopping rather than ticketing, and to turn selected city arteries into high-occupancy toll streets (Figure 2).

The technology to move from pay by fuel consumption to congestion-sensitive pay-as-you-go is here, and your cellular/mobility provider could be the one offering it to you. ■

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Figure 2: Moving away from fixed, dedicated tolling technologies to an infrastructure-free payment platform, permits many more policy opportunities and enables far more payment service competition. This will provide governments with demand management tools at politically tractable prices and the possibility to design a way out of fuel-tax dependence.

