Congestion charging: learning the lessons and moving forward

Dr John Walker[1*], Professor Phil Blythe[2], Andrew Pickford[3]

1. Transportation Research Group, School of Civil Engineering and the Environment, University of Southampton, SO17 1BJ, UK. John.Walker@soton.ac.uk +44(0)118 926 4217
2. Transport Operations Research Group, Newcastle University, UK
3. Andrew Pickford, Transport Technology Consultants Ltd., Hong Kong.

Abstract

Road user charging has been advocated for managing traffic demand since the 1960s. But it was only in the 1990s that successful working schemes emerged in Singapore, London and Stockholm. 'The technology is not proven' has been a significant excuse for not implementing schemes, along with the difficulty of making a persuasive case to politicians, businesses and travelers for its benefits in congested cities and roadways. We will argue that technology can now provide innovative charging schemes that could not be conceived a decade ago. We will review key schemes and technology trials, suggest what can be learnt from them and how innovations can be applied in conjunction with new policy thinking to make congestion charging more acceptable to the congestion, energy, climate and fiscal challenges we face today, and will offer a new 'deal' for road users based on "pay as you drive" schemes.

Keyword(s): road pricing, road user charging, congestion charging, public acceptability, ANPR, ALPR, GPS, GNSS

Introduction

Road User Charging (RUC) increasingly represents an increasingly diverse group of policies that range from toll collection through congestion charging and truck tolling to national road pricing that determines a charge based on a vehicle's time distance and place (TDP). Many other derivatives exist that complement other policies to reduce local demand and encourage the use of low emission vehicles. Congestion charging and other derivatives of road user charging have been considered as a means of managing traffic demand since the 1960s. However, it was not until the late 1980s that electronic tolling was first used commercially and later in the 1990s and 2000s that successfully working congestion charging schemes emerged in Singapore, London and Stockholm. In the past, the excuse that 'the technology is not proven' was a reason why schemes were not adopted, along with the difficulty of making a rational and lucid case to politicians, businesses and individual travellers that all would benefit from its introduction in congested cities and arterial routes. Since the 1990s the technology choice has also developed; the proven vehicle-roadside communication link has been joined by positioning systems, improved in-vehicle user interfaces, mobile communications and improved vehicle integration to enable extended RUC covering selected roads - or all roads – for different categories of vehicles used in different ways.

Technology can now provide numerous forms of innovative charging that were inconceivable only a decade ago. We review key schemes and technology trials and suggest what can be learned from them and how these innovations and the evolution in new policy thinking will allow schemes that make congestion charging and more advanced forms of RUC more acceptable and relevant to the congestion, energy, climate change and fiscal challenges we face today. Moreover, these innovations enable policy makers and road operators to offer new 'deals' for road users where ownership and fuel taxes can be replaced by more effective 'pay as you drive' schemes based on TDP technology trials in the UK and elsewhere.

We are at a critical junction in time with respect to how congestion charging may evolve due to the financial, societal and political constraints we face – it is time to take a step back to review where we are and explore whether future innovations could deliver a step-change in how we implement acceptable and effective congestion charging (one of the more controversial policy options) in the future.

Analysis of key congestion charging schemes world-wide

Walker [1] has reviewed road pricing schemes world-wide; key ones are summarised here.

Singapore

Singapore's paper-based Area Licensing Scheme (ALS) began in 1975 and was replaced by the Electronic Road Pricing (ERP) scheme in 1995 [2],[3]. It was introduced in order to management traffic rather than to raise revenue, so road tax was reduced, with a one-off rebate per vehicle, and overall the scheme is revenue-neutral. Traffic speeds are monitored and charges are increased if there is congestion, or reduced to encourage traffic if speeds are high, confirming the traffic management purpose. In 2008, public transport capacity was increased and vehicle taxes were reduced by SGD 110 million per year, much higher than the expected SGD 70 million increase in ERP revenue. There have been minimal public acceptability issues.

London

The London congestion charge began on 17 February 2003. It was originally £5, but was raised to £8 in July 2005 and to £10 in January 2011. The charge zone covers 22 square kilometres in central London, and charges apply between 7am and 6pm on weekdays. Some vehicles are exempt or get a discount, including buses, taxis and emergency services, disabled people, residents, and low-emission vehicles [4],[5]. The scheme depends on self-declaration – in advance or before midnight on the day of travel (or, since mid-2006, before midnight the following day). In 2006 there were 106,000 payments per day. Vehicles are not fitted with an On-Board Unit (OBU); the scheme is enforced by fixed cameras located at the boundary of and inside the zone which record the vehicle registration mark (VRM) using Automatic Number Plate Recognition (ANPR), and compare it to the declarations in the payment database. Users who do not pay are subject to a penalty charge (currently £120). Note that despite the cameras at the boundary, London is an area scheme, unlike Stockholm, which is a cordon scheme.

When the scheme was introduced, congestion in the zone fell by 26%. Traffic entering the zone was 17% down, with chargeable vehicles down 31%. Bus patronage increased, and

journey time (and its reliability) improved. There was minimal change in the number of trips to the central area; 50–60% of travellers switched to public transport, 20–30% diverted around the zone, the remainder made other adaptations. Net revenues in 2005/06 were £122 million [5].

In January 2011 a 'payment in arrears' scheme (Auto Pay) was introduced which means that a Penalty Charge Notice is never received. The previous approach was payment in advance, which simplifies the task of ANPR, since you need to identify only non-payers.

Stockholm

A permanent Congestion Tax was introduced in Stockholm in August 2007, following a successful trial in 2006. The political situation at the time is covered in [6],[7]. The scheme is a cordon, with cameras on gantries at entry/exit points. Microwave tags were used in the trial but ANPR is used in the operational scheme. Trips to or from the city centre cost Swedish Kroner (SEK) 10-20, depending on time of day, capped at SEK 60 per day (10 SEK = 1.05€ = $1.36). The effects were remarkable, surprising even the transport planners; traffic fell from 450,000 vehicles per day to 300,000, and remained 5–10% below 2005 values after the trial. There was no diversion onto other routes, and the effect has increased; traffic was 24% less in 2009 than without a congestion tax. Surveys in 2004 and 2005 showed only 26-40% support for the scheme, with 62% against. However, support rose to 52% during the trial, and in a referendum 53% of Stockholm citizens voted to reinstate the scheme, which was done in August 2007; support is currently 74% [8],[9]. Thus Stockholm demonstrates that:

- congestion charging works: congestion is dramatically reduced;
- traffic is not diverted onto other routes: drivers have alternatives other than diversion;
- an initially sceptical public will vote for congestion charging once it has experienced the beneficial effects; it is now a non-issue in Stockholm – even amongst politicians.

The UK DfT TDP Demonstrators programme

Starting in 2007, the UK Department for Transport announced a research programme to investigate whether road pricing by time, distance and place (TDP) could operate reliably, accurately, securely and cheaply. Seven companies were selected to participate in the Demonstrations Project. Its key finding is that commercially-run time, distance place charging systems and an associated payment regime can deliver accuracy, privacy and a trusted service [10].

Lessons learned from Singapore, London and Stockholm

These schemes demonstrate that congestion charging is acceptable to public opinion, if:

- They are equitable – which in general they are, at least compared to alternatives;
- They are revenue-neutral, or that revenues are reinvested in transport;
- They do not have a high cost overhead (for historical reasons, the London scheme does have high overheads, but running costs are being reduced where possible);
- People who are affected have experience that road pricing works.

A number of aspects of congestion charging are unexpected and note-worthy:

- Significant traffic reductions can be achieved with minimal charges. In Stockholm, SEK 10-20 (between one and two euros), produced traffic reductions of more than 20%.
- There is minimal diversion onto other routes.
- Improved public transport will not of itself get most people out of their cars. In Stockholm, extra buses were introduced in August 2005, but there was no effect on road traffic until January 2006 when the Congestion Tax came into operation.
- Public opinion prefers Automatic Number Plate Recognition (ANPR) to tag-and-beacon technology, and does not like higher charges at busy periods [11].

If we review these results more broadly in the context of RUC in general, several themes emerge. Firstly, RUC is not a stand-alone policy but must be regarded as an integral part of transport policy. Secondly, the RUC policy must be clearly targeted and the related policy targets clearly defined as part of the process to secure acceptability amongst stakeholders, including businesses and private vehicle owners. In many notable cases the development of successful congestion charging schemes has been a supportive political process – lack of such support has been the main cause of scheme development failures. Thirdly, the benefits must be direct and (ideally) tangible to stakeholders to demonstrate that policy objectives were achievable and as proposed by the instigators, to provide reassurance to stakeholders who in many cases provided tacit support before scheme operation. The process to secure public support in London was regarded by the scheme operator (Transport for London) as being equivalent to a multi-phased utility nationalization process, a level of complexity that would be regarded as unnecessary for delivering many other local transport policies.

The case for time, distance and place (TDP)-based RUC

By comparison, the implementation of a new tolling scheme is most likely to be associated with new or upgraded road infrastructure and the planning process would be focused on the impact and/or benefits of new infrastructure rather than the means of tolling. Consequently, providing an electronic means to collect tolls may be regarded as a policy evolution from the more traditional methods such cash collection and therefore less of a policy or public acceptability hurdle. The policy evolution from a paper vignette for heavy goods vehicles to an electronic method based on measuring distance travelled could be similar, no doubt contributing to the early adoption of truck tolling in Switzerland, Austria, Germany, Czech Republic and Slovakia with more transitional schemes planned in Europe. The UK meanwhile plans to implement a traditional annual license charge for foreign-registered trucks using UK roads by 2016 – potentially a policy that could be refined to permit charging rates to be based on TDP principles rather than a ‘one-off’ charge for road use. The first example of distance-based charging as means of taxing diesel vehicles was established in New Zealand in 1978 and has since stimulated the use of contemporary measurement systems, including the use of Global Navigation Satellite Systems / Cellular Network (GNSS/CN) technologies to automate data collection and reporting. The US and Canada employ Dedicated Short Range Communication (DSRC) as part of local policies to charge vehicles based on distance and route travelled.

Overall, we can see that the policy for truck tolling may be defined and implemented in many different ways. However, the authors believe that many of the elements of truck tolling and the technology enablers provide some useful operational experience to pave the way for more complex policies that relate to all vehicles over a larger area, termed ‘road pricing’ or TDP charging in Europe and ‘network tolling’ in Australia. In the last 5 years the US, Netherlands

and Australia have considered such possibilities in the concept of replacing ownership and usage charges: the US as a replacement for fuel duty, the Netherlands to replace vehicle ownership charges and Australia as a charge for a utility resource. Experience to date shows that RUC as means of taxing road use, rather than charging for it (such as in London and Singapore) introduces an additional dimension of complexity and some rather awkward policy questions: who collects the charge (the road or tax authorities)? Should the tax offset fuel duty completely and who loses and gains from this different measure? Should taxes be apportioned amongst the road owners in proportion to measured usage? How would local demand management and tolling schemes complement this – without conflict resulting from the inevitable policy overlap? Whilst this suggests that the process is long-term it is equally driven by more pressing needs; an 80-year old policy of fuel taxation is in need of revision – low emission vehicles and improved fuel consumption are now reducing tax income faster than the expected growth in vehicle ownership.

Recent trends

In the United States, localized and originally non-interoperable systems are becoming interoperable through adoption of video tolling and compilation of license plate databases, and use of multi-standard microwave tags and readers [12]. In the short term the Alliance for Toll Interoperability is developing an "interoperability hub" based on Automatic License Plate Recognition (ALPR). Options for the longer term are:

- Interconnected regional networks by transactions settlements and revenue exchanges;
- a national clearinghouse for accounts dispersed across toll agencies;
- third-party nationwide toll service providers processing toll transactions and guaranteeing payment similar to the credit card model used in retailing.

In Europe a critical long-term enabler to improve the credibility of RUC would be the mutual recognition of non-payment of road user charges and harmonized enforcement policies to increase levels of compliance of cross-border vehicles. In the meantime though, small schemes could be scoped, market tested and implemented although larger schemes such as the Multi-Lane Free Flow scheme planned for Dartford-Thurrock River Crossing (DTRC) in London appears as a policy leap since it removes the traditional toll plaza used since the 1960s and ETC since the early 1990s in favour of no plaza at all. Gantries will employ DSRC and image-based charging for the first time in the UK. Successfully migrating user expectations away from being able to pay cash at a plaza can be expected to be more challenging than the routine approach of MLFF, employed since Oct 1997 on Electronic Toll Road (ETR) 407 in Toronto. Innovations such as video-based tolling and advanced Customer Relationship Management (CRM) will be critical, despite the proven MLFF operations strategies and technologies.

The next steps for road pricing

Technology now provides solutions permitting numerous forms of innovative charging that could not even be conceived a decade ago. Diversity in policy is increasing whilst technologies for vehicle identification, location and enforcement continue to improve. The rule that policy leads, technology follows has never been more true and, as we have shown, policy advances continue to develop beyond congestion charging to new means of collecting usage and ownership taxes, tolling narrow segments of road users such as long-distance

hauliers, imposing differentiated charges on vehicles that do not meet modern engine emission limits, and differentiated tolling on roads.

Although not covered in this paper, developing countries are embracing all forms, demonstrating policy and technology leapfrogging although some more successfully than others. Countries including China, Brazil, Colombia, Chile and many more have already introduced tolling into the public domain. Other areas such as the Southern African Development Community (SADC) region of sub-Saharan Africa is considering route adherence schemes for long distance hauliers, potentially graduated according to maximum goods weight and emission class.

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