DEVELOPMENT OF AN INTEGRATED TICKETING SMARTCARD

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1. INTRODUCTION

1.1 The Background to Integrated and Smart Ticketing

Technology:

Those working in the passenger transport sector over the last decade or more are conscious of advances in technology, such as in vehicle construction, engine emission control and tracking systems providing real time passenger information.

However the advances in technology in other sectors, such as in communications including mobiles and Apple iPhones, digital radio and HD 3D wide screen television, have been both rapid and immense. Indeed many products have achieved total market saturation. Avid viewers of Star Trek science fiction programmes in the 1970s marvelled at the flip-lid *personal communicators* but few ever thought that, in their lifetime, they would have purchased many evolutions of it!

Whilst passengers have embraced these new technologies, most would never have expected to see little advance in transport ticketing in a century; paper tickets are common issue on buses outside London. Whilst rail and underground systems have utilised magnetic stripe ticketing for twenty-five years, it has played a minimal role in passenger flow management or even the provision of data on journeys, as few main line stations had gates or mechanisms capable of handling such ticket media. Indeed even today, RSP's system of distributing revenue amongst TOCs is based on ticket sales and not recorded journeys. Likewise, most integrated multi-modal ticketing arrangements still have to resort to passenger surveys to provide a sampling base to apply their methodology for revenue distribution.

In London, the Oyster smart travel card rapidly gained acceptance over five years ago. In 2010 Scotland became the first nation on earth to have all its buses equipped with smart readers for regular use by 1.2m concessionary travel smartcard-holding citizens.

Introduction of 'open' technologies tend to offer *added value* faster, whereas a 'closed' smart ticketing system that replicates existing ticketing is likely to offer little for passengers.

Introduction – The Background (continued):

Momentum:

In recent years, the political vision for adoption of smartcards as a travel imperative for UK citizens has advanced further:

- It began in 2009 with a requirement for all rail franchises to offer smartcard ticketing by 2020 ;
- The new UK Transport Minister advanced this target date in September 2010 to 'within a few years';
- The UK White Paper on local transport, published in January 2011, states 'The Government is committed to deliver, with operators and public sector bodies, the infrastructure to enable most public transport journeys to be undertaken using smart ticketing by December 2014'.

Environment:

Meeting the environmental targets for emission reductions will be assisted by promoting modal shift from car to public transport. However, some argue that it is the large number of smartcard systems across the world that drives the greater political pressure and the growing expectation that the UK, outside London, should also have smart ticketing.

De-Regulated Transport:

Those who travel to London or abroad are increasingly aware of modern, paperless smart ticketing, such as the *Oyster* or *Octopus* smartcards. This technology has served the massive urban populations in London and Hong Kong well and delivered efficient, fast ticketing where expediting passenger flows through crowded transport infrastructure is crucial for citizens and the local economy. This has significantly increased the capacity of London Underground stations to handle higher volumes of passengers in recent years.

However implementing this technology required extraordinary sums of capital investment to achieve such a transformational change, even in such simple, highly regulated markets, often with flat fare pricing. Whereas, in the UK outside London, a large unregulated market in public transport exists which is relatively unique in the world and where fares are set at commercial rates broadly reflecting journey length. These are the main reasons why the UK has so few integrated smartcard ticketing arrangements; clearly, if there were strong commercial justifications for investing in them the private sector would have already done so.

Introduction – The Background (continued):

Why is the UK falling so far behind? The answer is that the fragmentation of transport provision, a legacy of bus de-regulation outside London necessitates an advanced, secure smartcard and a multi-operator settlement system to fairly distribute ticket revenues to all participating operators. In regulated transport markets in London and overseas most ticketing revenues belongs to one, or a very few, number of operators and systems to facilitate smartcard inter-operability and equitable fare revenue distribution systems are unnecessary. This is not a case for re-regulation, simply one theory as to why few significant smartcard solutions have been implemented in the UK.

Existing Infrastructure:

The specification for an inter-operable card exists through 'ITSO', but proven systems, to fairly calculate and distribute very large revenues to many, probably do not. Hence, the development of a truly inter-operable smartcard ticketing system is a significant challenge yet to be delivered in the UK. Ultimately, the system must deliver an integrated solution spanning all ticketing arrangements, transport operators and travel modes.

Recognising both the need for a specification for inter-operable ticketing and the importance of partnership working of both private and public sectors, ITSO was formed in 1998. Over the next few years ticketing arrangements will gradually be implemented that will test the true inter-operability of ITSO smart media and also the new business rules created for distributing revenue amongst participating operators. In England, the DfT have awarded substantial grants in 2010/2011 to the Integrated Transport Authorities to kick-start investment in smart ticketing.

The success of subsidised bus fares for elderly and disabled concessionary travellers stimulated the public sector to seek better ways of managing both the entitlement for travel and the distribution of compensation to transport operators. In Scotland, since 2010, all bus operators have used new ITSO smart-enabled electronic ticket machines that accept valid National Entitlement Cards and some of the frailties of a 'show and go' pass have been eliminated.

However, on buses in Scotland, smartcards are only read on entry, not on exit; the journey length cannot be calculated without exit readers and although these are not fitted, they are considered by some to be essential for non-flat fare systems. This would apply equally to concessionary and commercial ticketing, where there is a strong business case from the benefit of reduced operator overstaging and passenger overriding, respectively.

Bus is the primary mode of public transport in the UK, accounting for around 80% of all public transport trips. The completion of the equipping of all buses in Scotland by last year creates an immediate opportunity for smart card ticketing for *all* citizens using this mode.

Introduction – The Background (continued):

The National Entitlement smartCard (NEC) is provided by a partnership between Scottish Government and Scotland's local councils to facilitate access to council services such as cashless catering, library, leisure facilities and pay for council tax and rent. The card is a *multi-application* card that caters for such a wide range of services and also the addition of the ITSO shell, for transport, that permits the operation of the concessionary travel scheme for free-bus travel for older and disabled people and the Scotland-wide concessionary discounted travel scheme for Young People.

In Scotland, this first hurdle of significant investment in infrastructure for bus has therefore been crossed, although other challenges remain. SPT's role in operating the Subway, ferry crossings and in administering the ZoneCard multi-modal ticket will enable us to assist in the development and delivery of smartcard solutions.

1.2 SPT and Integrated and Smart Ticketing

The Regional Transport Partnership, Strathclyde Partnership for Transport (SPT), serves the West of Scotland and 42% of the Scottish population. It has a vision of "a world class sustainable transport system that acts as a catalyst for an improved quality of life for all".

In The Regional Transport Strategy SPT sets out its vision and outcomes are agreed by working in partnership with twelve constituent councils, Scottish Government, Transport Scotland and many other stakeholders.

SPT is directly involved in a number of ticketing initiatives including:

- The procurement for the Subway of a smart replacement for the magnetic stripe ticketing system;
- Working with transport operators to find a smart solution for the ZoneCard multi modal ticket;
- As directed through the Scottish Governments BUSES FOR SCOTLAND "Progress through Partnership" guidance for Local Authorities, Regional Transport Partnerships and Bus Operators, SPT has the "responsibility for the establishment and implementation of Integrated Ticketing Schemes within its area"; and plans are at an advanced stage for a launch during 2012.

The introduction of an interoperable (ITSO compliant) integrated ticketing system in the SPT area is a key component in assisting modal shift from the car to public transport. Consultations by Transport Scotland and the DfT have resulted in announcements in December 2009 on a Smart and Integrated Ticketing Strategy.

The SPT area has approximately:

- 100 private bus operators;
- 185 rail stations, served by two operators;
- 15 Subway stations;
- 24 ferry crossings served by 8 ferry operators (in the Strathclyde Concessionary Travel Scheme area).

making the introduction of a fully interoperable, multi modal smart ticketing solution arguably one of the greatest challenges in the UK.

ZoneCard covers a slightly smaller geographic area than that served by SPT and the existing utilisation of such multi-modal tickets in urban areas across the UK is generally less than 5% of all public transport trips. Nevertheless, it serves a significant and important part of the transport market for citizens unable to simply utilise one operator or mode to reach their destination.

Perhaps the greatest potential is to promote to the many *non*-public-transport users a smart ticket product that facilitates true seamless ticketing and travel across all modes.

2. SCOPE IN THE SPT AREA

Geographic and Modal

An understanding of the market for public transport provides a valuable perspective on the opportunity for an integrated smart ticketing system:

Operators and Passenger trip mix across modes. (Table 1):

Mode	Cars/ Operators	Passenger trips p.a.* (m)	Smart card trips p.a.* (m)
Car	875,000	700.00	n/a
Bus	100	230.00	80.0
Rail	2	50.00	0.1
Subway	1	13.00	0.00
Ferry	8	6.00	0.0
TOTALS Excluding Car	111	299.00	80.1

*These statistics, for 2010, are broad estimates for the SPT area for indicative purposes only.

Car - is the mode of choice (average of approximately two trips per car per day) for many, but in public transport, the *Bus* is the prime people mover.

Reducing the length of the 700m car journeys by replacing part of the journey with public transport alternatives is key to generating significant modal shift.

Bus - Smartcards issued for concessionary travel cater for more than 30% of bus trips, leaving around 150m trips on commercial ticketing as the greatest opportunity for operators in implementing advanced ticketing solutions for existing users.

Rail - First ScotRail introduced in 2010 live smartcard ticket products for commuters at all seven stations on the Glasgow/Edinburgh line, (including Queen Street and Croy in the SPT area). Smart card validators have been installed at all intermediate stations. Only indicative smart patronage figures have been included in Table 1, given this very recent card implementation.

Subway – The Subway will launch smartcard ticketing in 2013.

Ferry – There is potential for introducing smartcard ticketing on ferries with four operators in the SPT area and a further four in the larger Strathclyde Concession Scheme Area. In total, there are 24 crossings served by 8 operators at 49 landings.

Citizens. (Table 2):

Group	SPT area Population** (m)	Possible new cardholders (m)
Young children	0.12	0.00
School pupils	0.30	0.30
Students	0.15	0.15
In-betweens	1.06	1.06
Concessionary travel card holders*	0.50	0.00
TOTAL	2.13	1.51

* Free bus travel in the SPT area under the Scottish National Concessionary Scheme for elderly & disabled.
** Population information has been analysed from 'Scotland's Census 2001' results.

School pupils – increasingly pupils have Young Scot Cards, Kidz Cards and school bus transport passes (approximately 39,000 in the SPT area).

Students – smart cards should offer an attractive, flexible and affordable *new technology* solution for students.

In-betweens – the largest group of citizens not presently able to utilise the smart technology and with a latent potential for modal shift.

Promoting Smartcards, for the 1.51m citizens in the SPT area who do not presently have them, is perhaps the first step in generating an awareness of the opportunity for, and the ease of use of, public transport, through eliminating the fear of having to know the fare and have the necessary change.

However, a significant opportunity exists in offering a transport smartcard to over 5 million UK and overseas visitors to the SPT, Stirling and Forth Valley area each year. It is estimated that they stay for 22 million nights each year and 11 million of these are spent in Glasgow or the Clyde Valley, where use of public transport is likely.

The progression of the development of an integrated ticketing and payment system commences with an understanding of the present scope and coverage. An analysis of existing fares and their business and operating rules is essential, but exploring the opportunities for new products as well is the key

to success through *realising* the potential for identifying added value for all stakeholders.

3. DEVELOPMENT OF AN INTEGRATED TICKETING SMARTCARD

3.1 Objectives for:

Passengers:

Seamless travel across modes and a reasonable geographic area using a single smart card ticket product that is:

Accessible, anonymous, attractive, flexible, reliable, secure, with options for:

- Loading products such as stored value or travel rights;
- Registering personal details for security, if lost, of value loaded;
- Retail e purse for low value coffee/paper purchases;
- Audible & visible acceptance alerts on boarding;
- Enhanced ticketing choice including promotional offers;
- Faster journey with fewer ticket transactions (but more £ on card);
- Bank direct-debit, debit/credit card or cash top-ups;
- On-line access (registered cardholders only) for home (parental) monitoring of trips, loading value or account management;
- Discounts for Advance-purchase seasons or volume related pay-as-you-go.

Transport Operators:

Affordable cost, efficient, fast boarding transaction times, secure, sustainable, with commercial opportunities including:

- Collection of superior trip data by cardholder (anonymous but assists in joining-up inward with return or further trips to better understand customer needs);
- Reduced cash handling: improved payment/journey ratio (1:4 to 1:10);
- Lower revenue leakage (electronic validation; not by sight);
- Equitable, trusted business rules and privacy in revenue distribution;
- Out with scope of FOI enquiries where data is secure in a JV entity,
- Marketing gain from *know your customer* (registered cards only);
- Greater ticketing flexibility and patronage growth;

Other stakeholders:

Local Authorities, RTPs, society and others should benefit from:

- More efficient transport networks that better match passenger demand;
- Transport interchange infrastructure planning tailored to demand;
- Cost of scholar transport related to actual trips (excluding absences);
- Accessibility for all through ease of purchase of ticket products;
- Multi-application cards adding transport ticket to a smart *event* ticket.

3.2 Development by Transport Mode

3.2.1 The Subway

SPT awarded the contract to Scheidt and Bachmann in 2011, for the installation in 2013 of new smart gates and ticketing equipment. These will replace the existing magnetic-stripe ticketing system.

Of all transport modes in many respects *Metro* systems represent the easiest implementation opportunity as ticket control mechanisms are installed at fixed gates on entry and exit to normally 'closed' stations. This compares favourably with the complexity of bus and ferry, where controls and ticket machines are on board vehicles or vessels.

In rail, unlike Metro, only major mainline urban stations are closed, often with relatively recently installed MS gates and barriers, whilst most suburban and rural stations are open.

Traditionally Subway tickets are available primarily at Subway stations, but to embrace the full opportunities of the smart technology the vision for ticketing has to fundamentally change.

Transport operators have exercised tight control over the issue and distribution of paper tickets, not least as they represent a latent value to the holder and therefore a potential loss of revenue through unwanted leakage.

Smart technology brings a new type of ticketing media that facilitates the secure storing, monitoring, loading and releasing of value and the potential to personalise cards and then hot list for security. This significant advance also provides the opportunity to integrate ticketing with other operators' products, including in retail outside transport.

Presently rail passengers can purchase a Subway ticket add-on integrated with their rail ticket and the ability to remotely purchase sole Subway tickets could be extended by offering them from TVMs at other transport hubs, such as bus and rail stations and retail shopping centres.

The perception that acquiring a *right to travel*, in the form of a ticket at the point of travel, is a necessary transaction conducted on each trip should end soon. Instead of each traveller losing their precious time on transactions when commencing each journey, the future experience should be that of a smooth and seamless passage through the station where the only ticketing interface is the audible 'doot' of the acceptance of the smart card at the gate on entry and exit. This is enabled by a larger *value* but fewer advance *payments* and the transference of this ticket purchase, or smart card ticket product *loading*, to alternative locations and times more convenient for the passenger.

Such improvements also provide ancillary benefits through increasing the speed of transit of passengers through station concourses and the phased

removal of excess ticketing machinery as purchases decline (60% reduction experienced in one large implementation).

3.2.2 The ZoneCard

This voluntary ticketing arrangement is administered by SPT on behalf of the Forum representing more than fifty operators from bus, rail, Subway and ferry. The ticket is valid across 75 zones in the SPT area; these are not concentric circles, but part of a carefully constructed map reflecting actual passenger journeys and boundaries pertinent to modes.

The Forum propose to migrate current magnetic-stripe ('MS') paper ticketing to stored travel right, and possibly stored value, Smartcards, as and when transport modes permit following installation of the appropriate infrastructure:

- Bus
    - Fully smart-enabled 3,000 ETMs (electronic ticket machines) in place and working on concessionary ticketing. Commercial zonal ticketing to be loaded and tested on Almex, ERG, and Parkeon ETMs.
- Rail
    - Only 2 of 185 stations (Ayr and Queen Street, Glasgow) have gates with QS having 30 smart enabled readers and Croy smartcard validators. Glasgow Central may be gated in 2011.
- Ferry
    - 2 crossings and 2 operators serving 5 landings.
- Subway
    - All 15 stations will have new smart enabled gates and ticket machines installed in 2013.

The existing ZoneCard ticketing comprises two parts:

- Current Photo ID and number;
- Paper or magnetic stripe ticket for use on bus, rail/Subway, with a reference to the Photo ID number.

Migration of existing ticketing to smartcard:

- This will be a phased approach requiring a possible overlap of magnetic stripe, paper and smartcard tickets until all modes have wholly adopted smartcards;
- Rail station-issued Subway tickets:
    - For use on Subway, until Subway MS gates go 'smart';

- For use on rail, until rail smart-enabled gates go ‘smart’.

3.2.3 Commercial Ticketing for Transport

- SPT is procuring an independent corporate entity to facilitate, in a Joint Venture Agreement with a technology provider, the support of a Smartcard system for Operators in the SPT area.
- This entity will provide the key components of an ITSO smart ticketing system to potentially support:
  - The Subway;
  - Integrated Ticketing products offered by ZoneCard;
  - The Strathclyde Concessionary Travel Scheme for rail, Subway and ferry;
  - A branded transit purse on a smartcard, for pay-as-you-go travel on any mode;
  - Operator specific smartcard ticket products;
  - Any other products or media found suitable for inclusion;
  - An e purse smartcard application for retail and transport ticketing.

3.2.4 ITSO and Technology

- ITSO smartcard ticketing systems typically include or require a:
  - AMS HOPs – the central server/processor and database;
  - Card Management System (for anonymous & registered cards);
  - Multi-application smart cards (DesFire, MiFare, etc.);
  - Revenue allocation system to calculate equitable reimbursements and distribute amongst participating operators;
  - Payments system to facilitate customer top-ups;
  - Web management system to permit customer and Scheme operator access;
  - Compliance to latest specification – 2.1.4 (February 2011);
  - Mapping of all ticket types to ITSO “Product types”;
  - Set of Business rules defining the handling of each ticket type;

- Equipment in train/Subway stations and on buses/ferries includes:
    - Ticket Vending Machines;
    - Smart validators to read smartcards at un-gated stations;
    - ETMs on buses and ferries;
    - Handheld smartcard readers for ticket inspection/issue on buses, trains, ferries & Subway.
- The operation of the ideal architecture of an ITSO integrated ticketing system may be limited by the level of ITSO specification reached by some or each device in the ITSO system.
- The independent implementations of concessionary and operator ticketing systems in Scotland and England is presently hindered by incompatible levels of specification whereby, although backwards compatibility exists, essential features of the new specifications not yet attained are denying operation of certain key functionality.
- The ITSO specification includes details of the IPE (ITSO Product Entities) and these categorise the scope of the tickets, payments, etc.
- The ITSO specification does not deal with all the requirements necessary to provide full functionality at ETMs, Gate displays, Posts, TVMs or other devices that interface with the passenger:
    - Business Rules must be separately constructed for each IPE that, for example, define in detail how this interface with the customer will function. For example, an operator may select that certain data from the card, or logic as a result of the recognition or processing on the card, is displayed at a gate on presentation of the card – such as the balance on the card or a signal to enter.
    - Each ticket must be mapped, in several dimensions, to parameters for:
        - ETM, gate, handheld, validators, TVM and TOM;
        - ITSO IPE – product entity type;
        - Website design for on-line purchase, loading & fulfilment;
        - TVM customer-friendly on-screen design for product;
        - Scheme or Product owner conditions of use of ticket;
        - Payment offerings for each product;

- Back-office functions for subsequent calculations:
    - Loyalty offers;
    - Fare capping;
    - discounting value or journeys based on usage or other rules.
- Marketing material promoting products by:
    - User group - Adult, Child, Concession, etc;
    - Ticket type - Single, return, carnet, season, PAYG, P&R;
    - Time parameters – Advance, Day, Off-Peak;
    - Geographic – zonal, distance, etc;
    - Promotional – temporary, ongoing offers, etc.;
    - Top-up methods – Web, d/d, TVM, TOM, etc.

Terminology:

Technical term	Meaning	Function
AMS	Asset Management System	Manages the assets in the ITSO system and that link the ISMS, ISAMs and HOPs, etc.
Depot Reader	Depot Reader	The PC that collates, consolidates and transfers file data from ETMs to the HOPs.
ETM	Electronic Ticketing Machines	These are standard ticket issuing machines, on buses, equipped with smart readers which typically transmit by wireless, on return to the depot in the evening, the transaction data gathered during the day, to the Depot Reader.
HOPS	Host Operator Processing System	Stores and manages the ITSO transactions generated by any ISAMs where the transaction data is for the HOPs owner.
HSAM	The Master ISAM	Located in the HOPs to control all interfaces.
IPE	ITSO Product Entity	A range of ticket, entitlement or payment types.
Technical	Meaning	Function

terms		
ISAM	Integrated Security Application Module	This is the equivalent of the 'SIM' card in the mobile phone, which sits in the ticket machines, gates, card issuing or loading devices. It authenticates, stores & transmits transactions to the HOPs. All ISAMs in buses in Scotland belong to Transport Scotland as owner of the Concessionary Travel Scheme and are primarily version 1, or version 2 if subsequently replaced. ITSO are presently developing a third generation with enhanced functionality. Rail and Subway will own their own ISAMs.
ISMS	ITSO Security Management System	The ITSO system that issues the security keys.
ITSO	No longer considered an abbreviation	A body funded by the DfT and governed by a formal Board, that sets the specification to be used in the UK for inter-operable smartcards to ensure full security and resilience are maintained.
OID	Operator Identification Number	An OID can only 'join' one scheme.
PERSO ISAM	Personalisation	To write to or 'format' a smartcard with the ITSO shells and IPEs (products) a modified version of the ISAM is used for this personalisation. The device in which this version of the ISAM is installed is called a PERSO POST.
RFID	Radio frequency Identification	A technology using radio waves to exchange data between a 'reader' and a 'tag' used for tracking or identification, such as in transport smartcards. Comprises a chip (Integrated Circuit) and an antenna for receiving and transmitting. *Passive* tags have no battery, are powered by incoming radio waves and need a large antenna.
TYP PTYP	IPE Product Types Sub product of TYP	Primary Types of each IPE. Maximum of 32 subtypes per TYP and OID.

4. NEW CONCEPTS IN TICKETING

- ITSO - New technologies drive innovation, and particularly applications, and after twelve years, ITSO has yet to achieve a critical mass of usage. The Scottish ITSO concessionary scheme was the first to implement an ITSO high volume (+150m transactions p.a.) smart system using first generation HOPS and ISAMS and more schemes should follow soon.

- EMV – " Contactless payment on bank cards by 2012" were announced by Transport for London in February 2011 as the way forward for the Underground, Docklands Light railway, tram and London Underground and buses. However, the vision is primarily to address the 'pay-as-you-go' traveller and could include overseas visitors in later years. A high cost of maintaining the Oyster system presumably arises from maintaining infrequent or single use cards. TfL's move to installing tri-readers, of Oyster, EMV and ITSO cards, recognises the opportunities to reduce Oyster running costs and enhance *customer* convenience using *their* preferred payment mode.

- NFC - Mobile phone businesses also recognise the potential new market for them in low-value payments, using *Near Field Communication* technology with an RFID link to the phone. Travellers therefore will enjoy a further method of ticket payment, beyond a card, using their mobile phone service. However, conflicts have first to be resolved over the differing objectives, of banks and mobile phone providers, and passengers and transport operators. Providers will want a commission on handling, but passengers and operators may only be willing to pay nominal sums?

5. CONCLUSION

With 42% of Scotland's population and excellent bus and rail services, including across the central belt to Edinburgh, the prize of true integration in the SPT area and beyond is clearly well worth pursuing and much could be achieved in time for the 2014 Commonwealth Games.

Integrated Ticketing arrangements exist to serve citizens whose journeys require more than one operator or mode, by effectively discounting the cost of travel below that of two or more separately purchased tickets. Such arrangements are facilitated through agreements amongst all participating operators and by comprehensive business rules.

Introducing smart card technology at an affordable cost is challenging, as the ability of private operators to sustain greater discounting or capping of fares, higher administration costs, and additional charges for electronic ticketing or new banking transactional charges for EMV (Europay, MasterCard, and VISA) is severely limited. The success of *Octopus* demonstrates that smart cards with an e purse provide the opportunity for retail transactions and a very welcome overall reduction in administration costs for the transport-ticketing provider through the spreading of costs.

A business case to dispense with existing low cost on-bus cash collection, low bank charges and replace a payments system that has existed for a century, can only succeed where passenger boarding times are significantly improved and patronage growth results directly from the creation of 'seamless' travel. Faster boarding times speed up journey times, which might result in a bus operator maintaining service frequencies with fewer vehicles and less cost.

Seamless travel, using a prepaid smartcard, *should be* readily sold to some fuel-price conscious motorists as a real option.

The transference of but part of the present incremental cost of a few miles of motoring, to become a new revenue stream for public transport, is crucial to a sustainable solution. As there are many more journeys made by car than by public transport, only a small proportion of the distance of car journeys need be shifted to public transport to create some benefit.

However, the public sector too must search for evidence that smart, integrated ticketing can create modal shift and not just in a low cost, subsidised and regulated market. This is a challenge that will require green marketing campaigns to promote 'park and ride' and 'joining-up-journeys' possibilities.

Truncated car journeys, through partial use of public transport, *will* save motorists money as fuel costs/litre rise again above £1.32 (£6 per gallon), or 17 pence per mile (@ 35mpg). There was evidence, in late 2008, that the £6/ gallon peak *was* generating modal shift. However, convincing the motorist to invest a £1.70 fuel saving over a ten-mile return journey in a *green* public transport ticket, with a potential time penalty, is not easy, even with reduced stress from driving on congested roads. Nor are motorists keen to recognise the real incremental cost-per-mile of running a car.

The true cost of funding smart and integrated ticketing is not evident in regulated markets, where transport provision, smart ticketing capital and revenue costs and the cost of capping fares on multi-journey trips, are subsidised. Recognition of this situation and the calculation of the additional initial investment needed to equalise the passenger aspiration of an *Oyster* equivalent system to the quite different private sector needs, will be necessary, ultimately requiring the installation of exit readers on buses and a mechanism to deliver a subsidy for capping of smart if not integrated ticket fares.

All these challenges are unlikely to, nor need be addressed in the first offering of smartcards to passengers. If implemented in incremental stages, similar to the service choices with mobile phones, the consumer can begin with a 'pay-as-you-go' transit or e purse and advance to a 'contract' of a zoned season ticket when the technology is ready.

As we advance through this decade, equipped with buses with new smart readers, we also start our journey into eliminating the motorist's common but fair excuse of a 'lack of knowledge of fares and ticketing' on public transport.

The views and opinions expressed in this paper are those of the author.