Public transport in the UK: almost always connected?

Author: Peter Tomlinson, Iosis (pwt@iosis.co.uk)

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This is the first in a series of now 6 short papers – this is a fast moving environment, with the latest event being a letter from Govt Transport Minister Claire Perry to the Rail Delivery Group company, which is a Membership Company with the UK's franchised heavy rail service public transport operators as its Members.

With the formation of the Rail Delivery Group company that is apparently concentrating on ticketing and journey management for only the single heavy rail mode of travel by public transport, and also the stepping back of DfT and some of its partners from complex but limited-in-scope ticketing and journey management schemes, in December last year it was seen by the author of these papers that it is time for something different, something national and multi-modal. The author of this paper argues that:

- Public transport in the UK (surface and sub surface) is a universal service, must be viewed as such by both public and private sector, and must further develop to meet growing user requirements and aspirations.
- Public transport providers and their partners must move to deliver seamless multi-modal multi-operator travel.
- The ever growing capacity and speed of data networks means that we now have the opportunity to develop a national *almost always connected* methodology to support the users and operators of public transport (with credible local fallback for the occasions when a data link fails).

The proposed methodology is to be based on *push* techniques: when on the UK mainland you buy and use travel by public transport, the data about your entitlement and progress will be *pushed* to the places where it has to be, or may have to be, available for use. The consequence is that multiple copies of each ticket and journey's dataset may well be pushed out – but many of them, perhaps most of them, will be transient copies.

In the environment of surface and sub-surface public transport in the UK, for over a century we have lived with separate physical or logical train tickets and tram tickets and bus tickets and coach tickets and ferry tickets and London Underground tickets (and perhaps more). Physical paper and card tickets to start with. Later in the 20th Century, magnetic stripe tickets appeared, along with the equipment to write and read the stripe. Just before the end of the 20th Century, the ITSO methodology was outlined and started to be developed as a carrier of electronic representations of tickets, with national scope. Thus came about ITSO compliant ENCTS[1] passes (for wrinklies and the disabled on the buses) in a smart card – an isolated example of interoperability both geographically and across multiple operators of public transport in England – but, until a change believed to be now

[1] English National Concessionary Travel Scheme: https://en.wikipedia.org/wiki/English_National_Concessionary_Travel_Scheme

under way, in London the ENCTS pass has been usable only as a physical flash pass. There are very similar Welsh and Scottish concessionary travel schemes, technically very much the same as ENCTS but not (except on a very few cross-border routes) interoperable across national borders. Also, there are now many local but non-interoperable paid-for ticket schemes implementing the ITSO method, even though the technology is designed to enable interoperability of the ticket medium – but that next step in interoperability will only happen if the operators implement the next level of secure functionality proposed here.

This paper and the other papers in this short series are about ideas for that next level of functionality across the UK. They are not just about interoperability of smart cards and of representations of the same in smartphones. Instead the author here proposes harnessing connectivity through digital networks in order for the passenger to be able to experience seamless journeys across all modes of surface and sub-surface public transport, using a variety of carriers of permission to travel. Proposed here is a project to authorise and deliver such multi-modal seamless journeys within an *almost always connected* environment.

In this new century we have had handed down to us a govt policy paper 'Door to Door by Public Transport' – but that seems to have already turned to dust in the hands of the public sector, having been described to me late in anno domini 2015 (by someone whose identity is best withheld), as being from the 'previous administration'. Thankfully, one of the fears that operators had, that of being accused of law breaking if they even appeared to be discussing operational matters with each other, has been successfully challenged by lawyers and found to be a fiction of politicians or their servants – thus in particular we now have route sharing in appropriate circumstances, and in general we can conceive of operators working together on journey authorisation and management methods. This paper is therefore about possibilities for multi modal, multi operator implementation of smart media ticketing and journey management, with the public sector as partner, not as driver or barrier.

So how? It needs the will to take a big step forward. First to do is heed the cry for all of the present ticketing stuff to be capable of being hosted and used in smart mobile devices. Here the technology is that of NFC, for which the Smart Ticketing Alliance (www.smart-ticketing.org*)* is working on interoperability. But the implementations are still incomplete islands, although the MultiPass scheme (https://multipass.co.uk/public/home.html) has moved further along the road towards *almost always connected*.

The heavy rail passenger operators, gathered together in a Membership Company (the Rail Delivery Group), quite rightly want to retire the magnetic stripe ticket. But do they accept that rail ticketing and the associated journey management functions (such as seat reservations and disabled assist) are just one component in the overall multi-modal public transport environment? Do they accept the need to become part of something much bigger? They need to take that step.

It is time to develop, not a 'theory of everything' in the UK surface and sub-surface public transport environment, but rather a set of methodologies for seamless travel across all modes of the same. Permission to travel and the details of the end to end journey will continue to be visible in various ways to the passenger, to the provider of the transport service, and to other authorised persons, but as much as possible of the substantive data involved will be held in an *almost always connected* network of systems. The inclusion of the word *almost* in the method is essential, because losing a data link, or discovering that a local node or an element of the IT cloud is not functioning, must not be permitted to interfere with the journey. Why so? Because travel by surface and subsurface public transport is essential for the proper functioning of a densely populated developed country and

economy such as Great Britain. *Public transport for us, and for visitors to the UK, is overall a service, and must become a public utility operated by a mix of public and private organisations.*

The architecture of '*almost* always *connected*' needs to be intelligent and distributed and full of redundancy, needs to have a lot of 'push' about it. The smart device that most passengers will carry will have in it details of the ticket, plus ancillary data such as seat reservations, and is to be able to assert your entitlement to travel. But the gates through which you pass at the stations need to know your ticket in advance, as well as that data being in the station controller and in nodes stretching back up the network, all the way to the system that sold you the ticket. The train manager needs to know your ticket and seat reservation, as well as that data being in your intelligent device or other ticket carrier. The overall architecture is thus multi-layer. And the communications links need to be very high capacity and resilient, the nodes high performance with significant in-built redundancy. There is therefore a need for all parties to work together on the development of this resilient national method.

The resulting network will in abstract form not look a great deal different from today's network of services and infrastructure, but it will be a lot more convenient for both passengers and operators. There will, inevitably, be some situations where the necessary data about the passenger's permission to travel is simply not accessible. Therefore there continues to be the need to take default action when that happens – but always trying to ensure that the passenger can make the journey. As this is written, I heard that secret shoppers trying to obtain refunds for problem rail journeys too often find that the staff concerned do not know how to handle the situation. Remedying that will need to be bundled into comprehensive training for operating in the new national method. In the interim before the new method is rolled out, there needs to be a strengthening of oversight over existing operators, which the author submits is more likely to be acceptable in the context of a national agreement to develop the new resilient national method.

In 2007 the then owners of Trainline funded the author of this paper to study the use of finite state machine methodology[2] for managing, on UK heavy rail, the life of the ticket. The report [1] was delivered in Jan 2008. The rail industry as a whole decided not to take the concept any further. Now, in a multi-modal public transport environment that is very quickly moving to being 'almost always connected', and which exhibits ever growing data handling capacity, the author suggests that it is time to further develop and then make available the stateful concept across *all* modes of UK surface and sub-surface public transport. The purpose of that availability is to enable the implementation of ticketing and journey management for surface and sub-surface public transport, across multiple modes of travel, in a manner that fully supports the passenger's end to end journey, whether that journey uses the services of one, two, or more, travel modes and/or operators.

Immediate questions are therefore:

> Is there an owner of the concept originally described only partially, 8 years ago (see [1]), or is it an obvious use of 'state machine' methodology and therefore free to use?
>
> If there is an owner of the concept, will the owner make the concept freely available to all?

If the answers are favourable:

[2] https://en.wikipedia.org/wiki/Finite-state_machine

The concept can be used as the basis of a UK wide method for ticketing and journey management across all modes of surface and sub-surface public transport, usable both online and offline.

Because of ICT developments since the original 2007 study, the concept will translate naturally into the emerging 'almost always connected' environment with its smart media carriers of both ticket and progress information.

But:

The concept is intended to be realised alongside existing methods, is expected to trigger reducing use of those methods, and the retirement of some of them, as the new methodology spreads.

The author proposes that the national methodology be implemented using a 'data push' methodology, making readily available, where and when it is or may be needed, the data about a passenger's intentions and journey (including ensuring that a copy of the data is available locally at the times when connectivity to the ultimate host falters). Transient copies of the data will thus be pushed to the places where that data will or may be required to be used and/or updated. At the same time, the data must be protected so that it is available only to those with the authority, and/or the right, to see and use and update it.

Finally, an important feature of the push method is that, although an awesome amount of data will be created and pushed out, most of it will be short lived (less than a day) – but key data items, needing to persist for all sorts of reasons, will be retained for later examination and some will be archived for long period storage. Of course, much of the data will be rather like that held in mag stripe and bar code tickets, except that there's no environmentally unfriendly waste (paper and card) to be collected and composted or burnt. As time goes on, fewer and fewer trees will be harmed....

[1] Customer Media Ticket Clipping/Validation in UK Rail – proposal for discussion, V1-2, January 2008 (pdf version), Trainline (available from the author).

Footnote: I pay homage to Prof Eric Sampson for organising the contract for the author to develop the 1999 Framework for Smart Cards in Government, now available in the National Archives (or from the author of this paper). And Eric later provided, from I believe the Tony Blair Civil Service regeneration funds, money for the author and Mick Davies to develop, with freely volunteered contributions from numerous other people, a great deal more material about using smart cards in the public sector – a project that was closed down as Tony Blair approached his successful re-election in 2007, but which has influenced the author's thinking. The project's documents, unpublished and by no means peer reviewed, are available from the author, should anyone be interested. But, importantly, those documents pre-date the concept of the wide area connected network of systems that of course may well not always be on. Thus the content of those documents is not for direct use in deployments today.

Iosis Associates

15 Good Shepherd Close, Bristol BS7 8NF

0117 370 6313

pwt@iosis.co.uk and peter@salendine.plus.com

Peter Tomlinson t/a Iosis Associates is a Member of ITSO Ltd and has been since the beginning. He was also a Director of the Company in its early days (due to a clerical error, for a period of time it had twice as many Directors as was originally intended).