

Ticket to ride

John Elliott — Head of Public Sector at Consult Hyperion.



John Elliott

After years of hearing about the potential benefits of paperless ticketing for public transport, a workable solution has finally arrived, says John Elliott. With live trials delivering positive results in both the UK and abroad, NFC technology is set to revolutionise the way that people purchase tickets for transport.

At Consult Hyperion, we have been involved in developing business cases and building cost/benefit models for e-ticketing for transport for several years now. As part of this research, we have examined how Near Field Communications (NFC), a short-range high frequency wireless communication technology that enables the exchange of data between devices, can be used to support paperless ticketing.

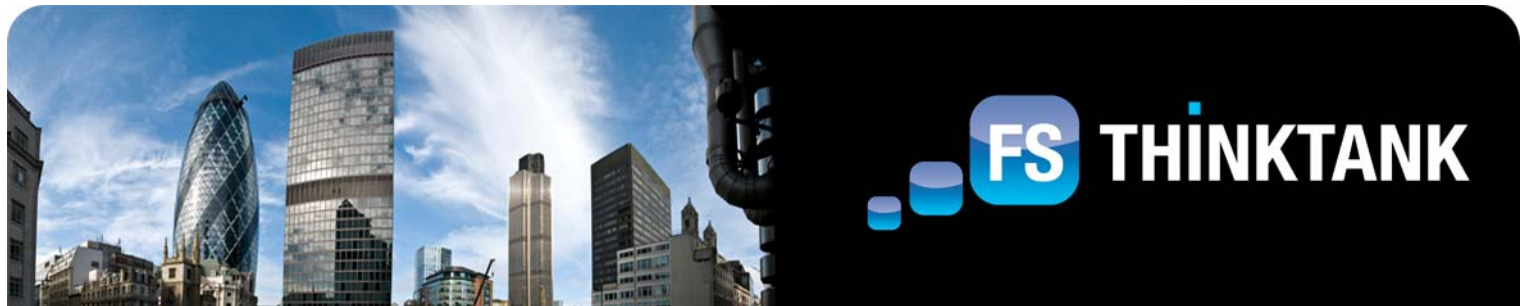
With this high-tech approach, so-called "contactless tickets" make use of smart card technology using radio waves (rather than physical contacts) to communicate with the chip inside the card. As such, these electronic tickets – also known as e-tickets – can be used to help reduce the production and distribution costs connected with traditional paper-based ticketing channels, and can also increase customer convenience by providing new, secure and simpler ways to purchase tickets.

For obvious reasons, transport is a sector where this kind of technology could make a huge and positive difference, as it could help cut journey times whilst also increasing capacity, comfort and convenience for passengers. As such, the UK Department for Transport (DfT) is currently considering various strategies for smart and integrated ticketing schemes. Since the required technology already exists, the DfT is keen to pursue the use of e-ticketing not only to help passengers, but also to reduce congestion, pollution, improve the local environment, and to help plan more effective local transport systems.

London, Scotland and Wales to become voting members, whilst providing less representation for individual transport operators.

“these electronic tickets – also known as e-tickets – can be used to help reduce the production and distribution costs connected with traditional paper-based ticketing channels ”





Ongoing technological developments are also continuing to drive progress in this area, thanks to the strategic collaboration between some of the world's leading mobile technology developers, smart card manufacturers, service providers, and standards bodies.

NFC in real-world trials: NoWcard in northwest England



Screenshot of mock NoW card details

Earlier in 2010, Consult Hyperion published a report based on an 18-month research project on “The use of Near Field Communication technology in mobile phones for public transport ticketing”, which was performed as part of the Department’s Transport Technology and Standards research programme (www.dft.gov.uk/pgr/scienceresearch/orresearch/nfc). The Transport Technology and Standards Research programme had identified NFC as a technology with potential as both an ITSO ticket carrying device and an ITSO ticket reading device (for retail sales and / or ticket validation).

The project objectives were 1) to demonstrate the use of an NFC device as a certified ITSO customer medium, 2) to demonstrate additional functionality to enable an NFC device to perform as an ITSO-compliant terminal capable of reading, validating and updating ITSO customer media, and 3) to develop the ITSO Specification changes necessary to enable the certification of an NFC device acting as an ITSO terminal as per the second objective.

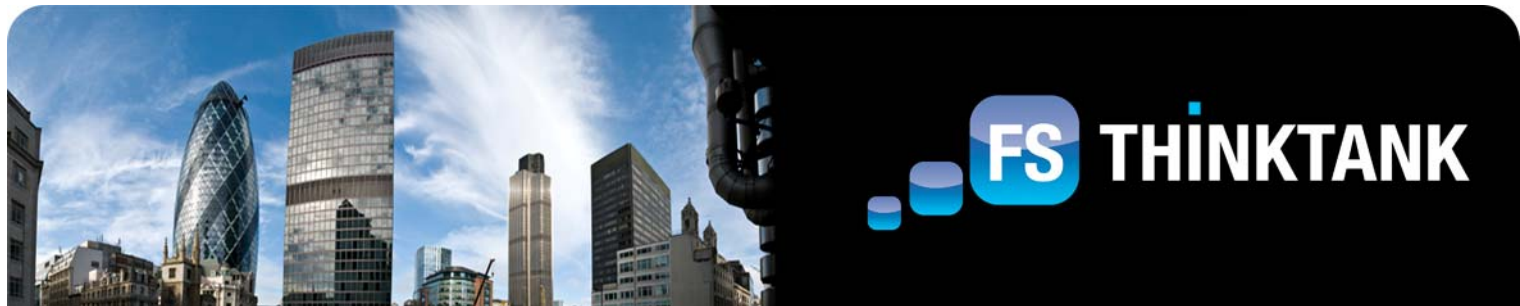
The study included a six-month trial of e-tickets held on NFC mobiles on NoWcard buses in northwest England, using the phones as tickets in order to show the potential for NFC as an alternative to traditional printed tickets.

To test the scheme's potential in a real-world setting, 40 trialists used NFC phones loaded with ITSO-compliant e-tickets to travel on three different bus fleets in Lancashire and Cumbria. ITSO is a strategic initiative supported by the major bus and rail transport organisations of the UK, as well as the Government, to provide interoperable contactless smartcard based ticketing.

Not only did the NFC technology work extremely well during the trial, but the majority of users were very positive with their overall feedback. As a result, the study concluded that NFC

“Not only did the NFC technology work extremely well during the trial, but the majority of users were very positive with their overall feedback”





technology is entirely suitable for use as NFC customer media right now. Even more interesting, the same trial also included a bench test to show other uses of NFC, including the ability to top-up tickets "over the air" and the possibility of using NFC phones as inexpensive ticket inspection devices.

The changing role of ITSO

“the re-organisation would allow Transport for London, Scotland and Wales to become voting members, whilst providing less representation for individual transport operators.”

In September 2009, the DfT decided to review how ITSO was performing, and decided to appoint a new CEO to help modernise the organisation. Consult Hyperion drew up a five-year roadmap for DfT and ITSO and new possibilities for the organisation were explored with key members of the payments and mobile telecoms industries. As a member of ITSO, Consult Hyperion voted in favour of its re-organisation, as felt that these changes would allow the DfT to take a more active role in setting the direction. Plus, the re-organisation would allow Transport for London, Scotland and Wales to become voting members, whilst providing less representation for individual transport operators.

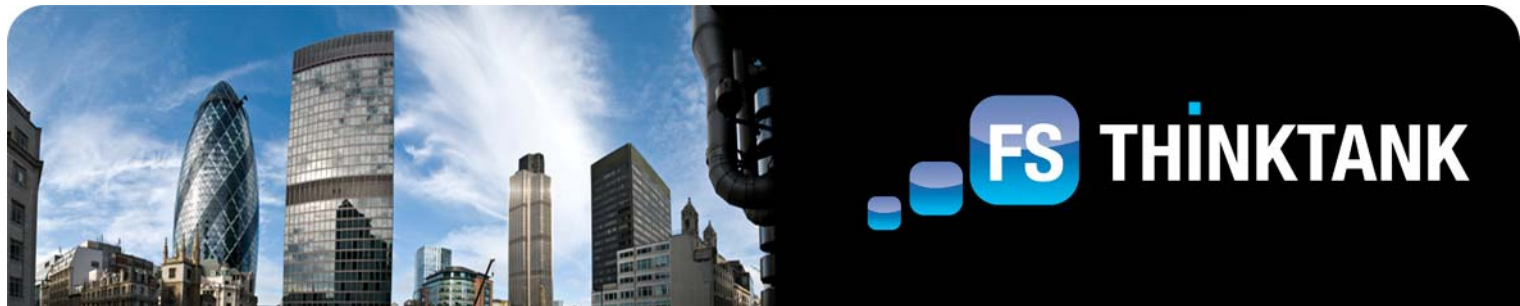
The roadmapping workshop we led for the DfT considered a wide variety of scenarios that could affect ITSO in the future, including extreme examples (where bank-issued EMV cards come to dominate transport before ITSO can be rolled out in England effectively), and more moderate ones (where ITSO and EMV co-exist in an NFC-friendly world).

Over the last two years, Consult Hyperion has been working with ITSO on some exciting enhancements to ITSO, which could allow this technology to be used in even more innovative ways, such as Internet ticket sales and the ability to store e-tickets on a wide range of NFC devices that could be "topped up" over the air. As a result of this collaboration, a new ITSO specification part (Part 11) has been developed and successfully bench tested. Consult Hyperion was also retained to perform a Security Risk Analysis on this latest specification, which means that it could be adopted by ITSO within as little as six months, and thus pave the way for NFC to be used in live ITSO schemes.

e-ticketing on a nationwide scale: benefits and challenges

Consult Hyperion has worked closely with a consultancy called





Detica to conduct a study entitled [*The benefits and costs of a national smart ticketing infrastructure*](#). This report, published last summer, was used by DfT to prepare a comprehensive strategy document on e-ticketing for the DfT. At the end of last year, Consult Hyperion with Detica advised the DfT on many different aspects of NFC and other electronic communication technologies that could be used on a national scale, and provided it with a comprehensive cost/benefit analysis of the various options identified. Although no firm commitments have been made, these are exciting developments that could offer real benefits to millions of passengers across the country.

“The potential benefits of a national e-ticketing scheme are significant, and include: Reduced cost of ticket sales, Discount fares and capping & Reduced congestion ”

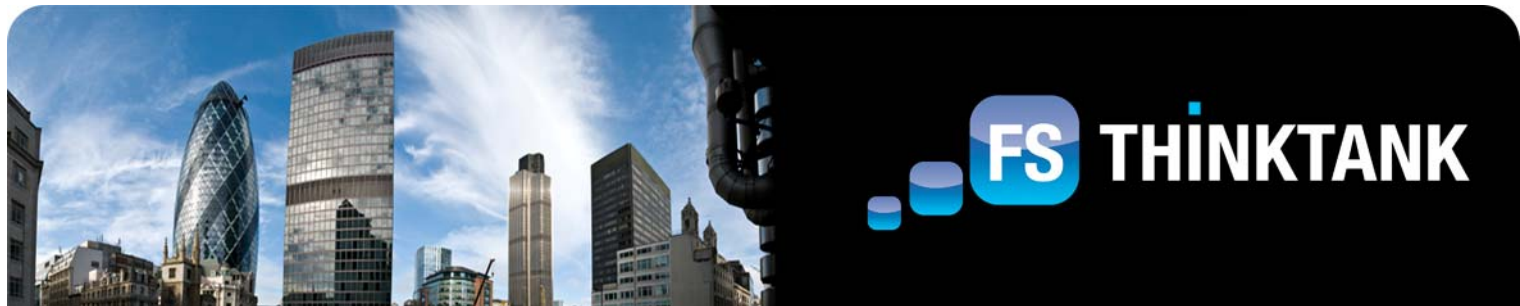
The potential benefits of a national e-ticketing scheme are significant, and include:

- Faster throughput of passengers;
- Reduced cost of ticket sales;
- Increased travel on public transport (including modal shift from cars) due to perceived better value or better customer experience;
- Discount fares and capping;
- Better use of subsidies;
- Reduced congestion from more efficient deployment of services (and modal shift from cars).

However, there are two problems with quantifying these benefits. The first is that the benefits cannot be fully realised until there is almost complete coverage of the country, so that passengers and operators can rely on the interoperable technology being there for the whole of the journey. Plus, this large-scale interoperability is necessary if the operators are to be in a position where they can remove old-fashioned alternatives, such as cash being taken off buses in London.

The second problem is that the benefits of e-ticketing have thus far focused mainly on the customers, with the assumption that they will not bear the costs. However, since the majority of the e-ticketing costs are currently expected to fall to the operators, there has been a reluctance on the operators' part to voluntarily roll out ITSO themselves. While the old paper tickets and cash payments remain, operators will have to incur the majority of the costs of implementing and running e-ticketing, whilst only reaping a fraction of the benefits.





Case study: nationwide e-ticketing in Holland

In the late 1990s, nobody realised just how hard it would be to achieve national rollout of interoperable e-ticketing, although Trans Link Systems' (TLS) OV Chipkaart in the Netherlands seems to have achieved this holy grail. Trans Link, a company established by the five largest Dutch public transport companies to implement a nationwide payment system for Dutch urban transit, was the first to roll out a nationwide e-ticketing scheme across the whole country. In the future, it may even be possible for standard transport cards from other countries to be accepted within the Netherlands, as well.

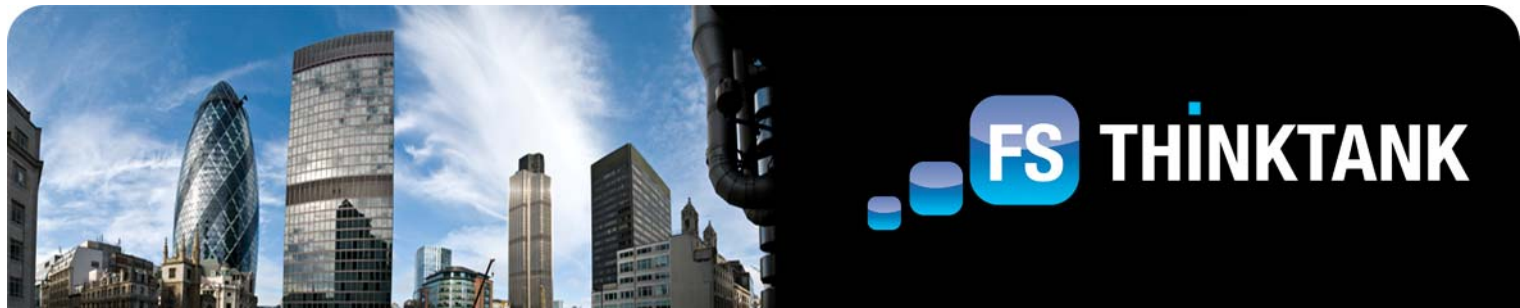
The company has developed a smart card system for transport, covering various products – e-purse and passes, and allowing different price mechanisms and different modes of transport such as bus, train, tram, metro and ferry. Cards can either be personalised or anonymous; there are also Limited Use tickets for tourists or other visitors, such as someone who plans to spend just two days in Amsterdam. To date, more than 4 million cards have been issued in the Amsterdam and Rotterdam areas for buses, trams and metro, as well as Connexion bus services (a nationwide service) that are adjacent to these areas.

“In the future, it may even be possible for standard transport cards from other countries to be accepted within the Netherlands”

Since January 2009, Consult Hyperion has been working with TLS to help it improve this system by migrating away from cards using Mifare contactless RFID technology to something more secure. For years, researchers have claimed that it is possible to crack the secret access keys used by Mifare, and therefore to determine the access key of a Mifare chip card in a short time without any expensive equipment, merely by using manipulated read attempts and a pre-calculated table. Microprocessor smart cards, however, are not affected by the this same vulnerability and are still secure, since they (unlike Mifare chips) contain a microprocessor and use standardised secure encryption and signature functions.

In addition to these changes, Consult Hyperion is also helping TLS to design for the future, considering broader aspects such as eID and ePayments. A key part of this has been sharing how Consult Hyperion has designed London's new Oyster Card reader to accept multiple card types.





Current e-ticketing challenges

Despite recent advances in NFC technology, a number of challenges remain for the widespread adoption of e-ticketing in the UK. For a start, the costs of e-ticketing are significant: smart cards, new readers on vehicles, new readers on trains and station platforms and underground stations, back-office and transaction settlement systems, to name a few. The costs of such elements in a scheme such as ITSO seem destined to remain artificially high because of the relatively small market that the UK provides.

From an international perspective, although there are various national e-ticketing schemes being trialled and rolled out, none of them is interoperable at the technology level. Therefore, significant international suppliers of this sort of equipment simply cannot see the point of developing it for small national markets. As a result, competition has not emerged to drive prices down.

“if we are to see joined up e-ticketing across the country, the government is likely to have to also mandate commercial co-operation on shared routes”

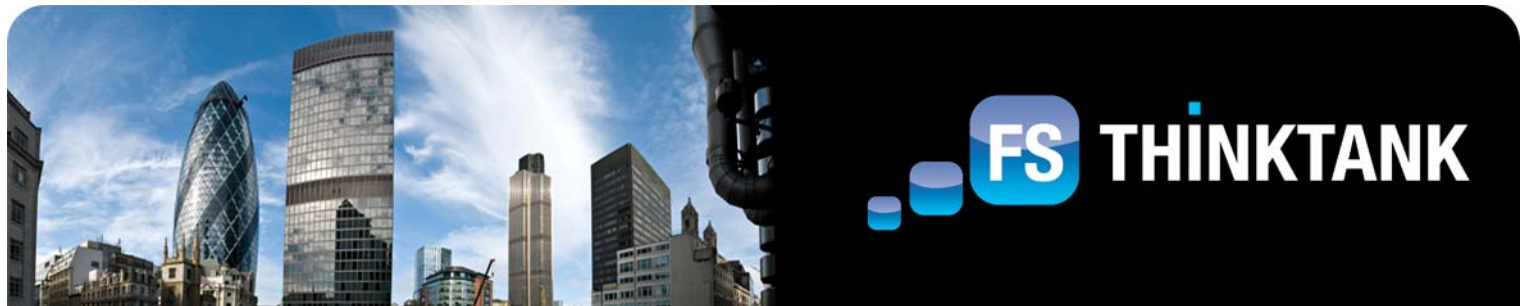
But the cost is not the only barrier. It is also not clear whether operators will be rushing to make commercial agreements with each other in an area where they have traditionally competed. So, if we are to see joined up e-ticketing across the country, the government is likely to have to also mandate commercial co-operation on shared routes. For all of these reasons, national transit e-ticketing will not happen without national strategy and co-ordination, which has been largely absent to date.

The good news, however, is that the DfT has a clear vision for public transport in England, and that is one of universal coverage of smart ticketing infrastructure, supported by integrated and innovative ticket products which can be purchased easily and quickly, leading to a significantly improved travelling experience for the passenger.

The way forward

In our view, the widespread adoption of NFC technology for transport ticketing is inevitable – once any problems with handset withdrawals are addressed and the necessary NFC handsets become available to support it. At the same time, international payment organisations like MasterCard and Visa





*“By utilising this
"contactless"
environment,
transport providers
will be able to benefit
from significant
operational and cost
savings”*



Suica trials in Japan

are already writing specifications to allow their EMV chip and PIN cards to work contactlessly (including via NFC on a mobile device), so that transit journeys can be billed directly to a credit or debit card with just a tap of the card.

By utilising this "contactless" environment, transport providers will be able to benefit from significant operational and cost savings, since cash-handling costs will be reduced significantly as well as smart card issuance costs (due to the acceptance of bank-issued payment cards). Not only is the cost of collecting, transporting and securing cash significant, the ability to minimise the use of cash will also reduce the risk of theft, particularly from buses.

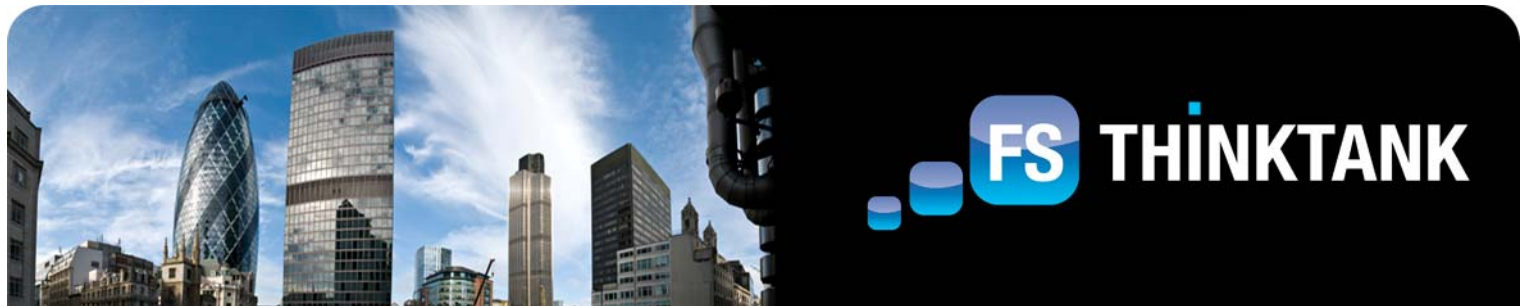
Ongoing international efforts in this area mean that the technology supporting e-ticketing continue to improve apace, and NFC mobile phones can now act as both smart cards and smart card readers that are capable of processing contactless EMV transactions. The many trials of NFC payment across the globe have already shown that it is popular with the users and fit for purpose as both a payment instrument as well as a transit ticket holder. NFC is already widely used in Asia (e.g. T-Cash in Korea; Suica in Japan).

This means that the phones in people's pockets will soon be used not only to buy and store tickets, but also to check timetables and real time travel information, and to view any stored tickets – simply by tapping them on a reader. When used in this way, NFC can deliver a number of additional benefits, as well. If someone is using a stored-value pay-as-you-go ticket, for example, then the customer will be able to use the mobile phone screen to review recent transactions and any remaining balance, making the experience much better than other schemes currently operating, such as Oyster cards.

Convergence offers added flexibility

Having already enjoyed great success with the Oyster Card scheme, Transport for London is already migrating towards contactless EMV. In fact, Consult Hyperion has been working with London Transport since 2008 to design a new card reader that will accept not only Oyster cards, but also ITSO (for other UK passengers travelling through London) and EMV (for anyone, from anywhere in the world, who has been issued with





Transport for London (TfL) is a strategic transport authority, responsible for the planning and delivery of transport services in London. In 2002 it introduced the Oyster card, which has proven an incredible success with more than 20 million Oyster cards issued and in excess of 3 billion journeys made with Oyster last year. Since its introduction the proportion of cash payments on the tubes and buses has fallen to less than 3%.

“Since its introduction the proportion of cash payments on the tubes and buses has fallen to less than 3%”

Already, it is expected that these readers will be operational with ITSO cards in the next two years, allowing travellers from outside London to cross London with their ITSO cards. In addition, this will give TfL a payments-ready smart card reader, and hence the option to accept contactless credit and debit cards on a similar timeframe. Contactless EMV (credit/debit) cards will be accepted on London buses starting in 2011.

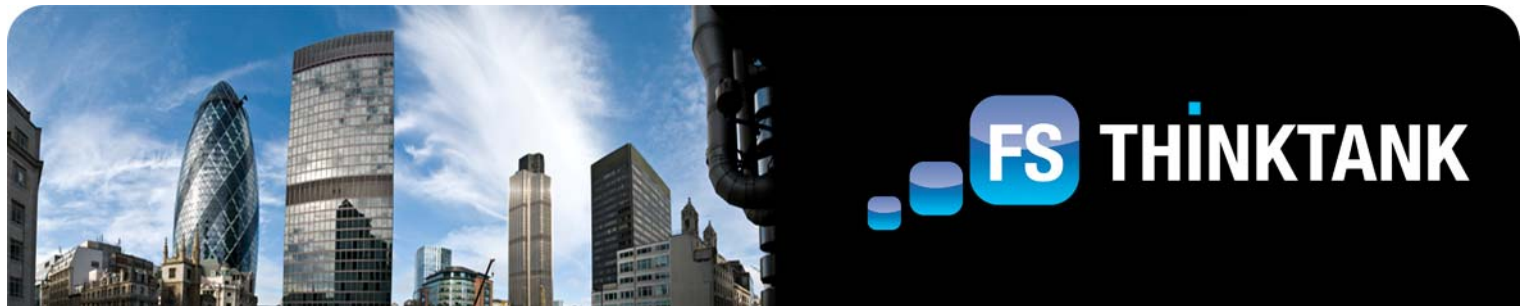
The future

The combination of simplicity and convenience that consumers want, together with the speed and security that operators need, makes the intersection of smart card and wireless interfaces a fruitful place to look for "game changing" mass market ideas. In recent years, Consult Hyperion has worked closely with a number of clients in developing a number of innovative applications of Oyster. These include the Barclay's OnePulse card that combines a Chip and PIN Visa credit card, a Visa PayWave contactless interface and an Oyster contactless interface to deliver a three-in-one card for Londoners; and last year's highly successful trial run by O2, which included the Visa PayWave application and the Oyster application on an NFC phone.

Naturally, bringing the relevant processing, communications and security technologies together in a successful combination requires a knowledge not only of the abilities and constraints of the technology, but also the longer-term business ramifications of the choices made in the early technology phases. This is why proper requirements capture, business analysis, and design specifications are crucial to organisations looking to develop new products and services in this space: a superficial understanding of either can lead to expensive mistakes and lost opportunities.

With London getting to grips nicely with Oyster and ITSO (and





“For these transport providers and others, the benefits of e-ticketing for transport are clear, and the list of possibilities for this kind of technology is endless”

EMV, in the very near future), Consult Hyperion was retained to assess the DfT's spending plans for 2009/2010 and 2010/2011. As a result, the DfT has now widened the net to include other uses of NFC technology, and has agreed to provide funding to the nine English transport authorities which represent the largest populations outside of London for this purpose.

For these transport providers and others, the benefits of e-ticketing for transport are clear, and the list of possibilities for this kind of technology is endless. We expect that, as a result, the DfT – as well as a growing number of transport providers all across the globe – will continue to pursue smart and integrated ticketing solutions, whilst also examining any barriers which could prevent their adoption. With this approach, transport operators can continue to build upon their strategic vision in this area, and to deliver the enhanced services and greater convenience that will benefit everyone.

