White Paper: Mobile NFC in Transport

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Non Confidential
Forewords

Mobile NFC promises to put passengers in control, reducing stress and making travelling by public transport a more pleasurable experience. This easy-to-use contactless technology, combined with mobile connectivity, makes it straightforward for passengers to modify their travel plans on the move.

Passengers will simply buy a travel ticket online, download it to their handset and then validate it with one tap on their way into the station: No more queuing to buy tickets. Equipped with a mobile NFC handset, Europeans will ultimately be able to travel across their continent, moving swiftly and seamlessly from one transport network to another.

Robust mobile NFC services will depend on a strong ecosystem and collaboration across the value chain. It is crucial that transport operators, mobile operators and their partners fully understand each other’s requirements and the benefits these services can bring. Containing insights from both the transport industry and the mobile industry and co-published by the GSMA and the International Association of Public Transport (UITP), this white paper seeks to help to create that common understanding.

 Implemented well, mobile NFC could usher in a new era for public transport.

Anne Bouverot

Director General GSMA
UITP members strive to provide seamless mobility: the smooth coherent combination of information, travel, sales and ticketing. Besides travel, these elements could easily be delivered to mobile phones today - and even better when “NFC enabled”. From a customer point of view, this technology could significantly simplify a public transport journey, especially by different operators and across borders.

For many years, this welcome outlook was postponed. There have been successful pilots, but not the expected revolution. The problem - interoperability - lies on both sides: the very fragmented public transport sector clinging to subsidiarity; and the competitive private sector finding it hard to offer a truly global solution.

But the smart traveller of tomorrow has high expectations. His mobile phone will be a virtual gateway to the real world. To be present on this channel, UITP members must work together with “new profiles” like the members of GSMA. This may actually be the real challenge.

Fortunately, the mere co-writing of this paper already aligned frequencies enough to identify the key problem areas and bring potential solutions in close range.

This paper is our first solid step into a new world. I am looking forward to the next few steps.

Alain Flausch

Secretary General UITP
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1. Executive Summary

Near Field Communication, or NFC, is a contactless radio technology that can transmit data between two devices within a few centimetres of each other. Mobile phones are increasingly being equipped with NFC capabilities, enabling an array of new digital services that could greatly improve the passenger experience of public transport.

The combination of NFC, an easy-to-use and versatile technology, with mobile connectivity could realise many benefits in the transport sector.

Potential benefits of mobile NFC for transport operators include:

- Enhance the value and functionality of existing contactless infrastructure
- Greater passenger convenience – ability to buy NFC tickets via a mobile connection and avoid queuing
- Lower sales and distribution costs, combined with possible dematerialisation and environmental benefits
- Fast, accurate and transparent ticket validation
- More flexible and interoperable ticket systems – NFC handsets can support multiple ticketing standards, creating a seamless experience for passengers
- Personalised communication with passengers and promotion of public transport
- Platform for mobile commerce services, such as targeted advertising and marketing
- Eventually, could pave the way for complete, integrated solutions covering different modes of transport

Potential benefits for mobile operators include:

- Greater usage of mobile services – NFC interactions could prompt more usage of the mobile network
- Spur adoption of mobile NFC and accelerate upgrade of handsets and UICC
- Platform for mobile commerce services, such as targeted advertising and marketing

Although some of these benefits could also be realised using alternative technologies, they are unlikely to be as user-friendly as mobile NFC, which enables passengers to interact with their immediate surroundings and online services in an intuitive and straightforward way. An NFC interaction requires a deliberate, yet simple, action on the part of the passenger. Rather than scanning codes or inputting text, a consumer simply touches their NFC handset against a terminal to complete an interaction.

However, pilot and commercial deployments of mobile NFC in the transport sector to date have shown that the technology needs to optimise costs and overcome a number of complexities. They have also shown that transport and mobile operators need to take into account an array of commercial, technological, user-experience and political considerations to deploy mobile NFC effectively.

Commercial considerations: Strike a balance between using existing infrastructure and the pursuit of widespread interoperability and economies of scale. Moreover, the use of joint ventures, associations or hubs could reduce the need for bilateral negotiations, while the provision of “off-the-shelf” solutions would help transport operators develop and deploy mobile NFC applications quickly and easily.

Technological considerations: Ensure that ticket distribution and validation at transport termini is quick enough to meet the transport operator’s requirements with any handset, while keeping sensitive data in a secure domain at all times. An NFC phone with a flat battery should be able to interact with an NFC terminal, so a traveller can complete their journey.

User experience considerations: The enrolment process needs to be straightforward, yet secure. Transport-related NFC services should support a range of different payment options, offer full transparency, choice and control around the use of customer data and be supported by effective customer service, particularly in cases of lost handsets.

Political/regulatory considerations: The mobile NFC ecosystem should highlight the potential of the technology to increase usage of public transport and encourage greater mobility of citizens within Europe. Service providers should also seek to work with regulators to establish who can do what with sensitive customer data and ensure that mobile NFC can be used by as wide range of service providers as possible. Moreover, mobile NFC solutions should, as much as possible, be based on open standards that are implemented consistently.

In summary, a carefully-designed and well-implemented mobile NFC solution could put valuable information at passengers’ fingertips, giving them a compelling experience that will encourage them to make greater use of public transport.
Near Field Communication, or NFC, is a contactless radio technology that can transmit data between two devices within a few centimetres of each other. Mobile phones are increasingly being equipped with NFC capabilities, enabling an array of new digital services, such as:

- **Ticketing** – interactive fare media on public transport systems
- **Payments** – an alternative to cash and plastic credit cards to purchase goods and services
- **Access control** – an alternative to traditional keys and access codes
- **Couponing** – an interactive alternative to paper vouchers and coupons

### Purpose of this paper

This white paper is designed to help transport operators and mobile operators deploy mobile NFC solutions to enhance the efficiency and effectiveness of public transport. It aims to set out the potential benefits, the potential obstacles and the key considerations relating to the deployment of transport-related mobile NFC services.

Drawing on the views of the broad ecosystem, the paper is intended to be a comprehensive and wide-ranging reference document, rather than a prescriptive template. It is designed to support business discussions between mobile operators, transport operators and transport authorities.

Rather than reading this paper from start to finish, we expect the target audience to simply refer to the sections most relevant to them. Please note that some of the benefits, obstacles and considerations outlined in the paper may not be applicable to each and every specific mobile NFC deployment in the transport sector.

### Scope of this paper

This white paper considers mobile NFC solutions in the public transport sector in Europe and other developed countries, for commuters, as well as occasional travellers. It is applicable to all forms of land-based public transport, such as trains, buses, trams and hire bikes, but it does not consider air or long-haul sea travel. Although the paper’s primary focus is Europe, much of the content is relevant to public transport systems in other countries.

Although mobile NFC services may in practice be secured in various different ways, the paper focuses on mobile NFC services in which the universal integrated circuit card (the UICC, commonly referred to as a SIM card) inside a mobile handset is used to secure the service. It envisages that sensitive data related to the mobile NFC service will be stored in an applet in a dedicated secure domain within the secure element (in this case the UICC) where it cannot be accessed by unauthorised applications running on the handset.

Figure 1 is an example of a possible architecture for a mobile NFC solution in the transport sector. It illustrates several different processes:

- How a transport operator’s applet can be added to a UICC by a trusted intermediary (sometimes known as a trusted service manager or TSM) via the mobile operator’s network
- How a transport operator’s mobile NFC application can be downloaded on to a passenger’s handset via the mobile network
- How a transport operator’s application on the handset can be used to book and pay for travel. Once a payment has been completed, the electronic ticket would be delivered over the air via the mobile network as an update to the UICC applet
- How a contactless reader can validate a ticket on a UICC applet via NFC

This white paper also envisages that a mobile wallet application running on the handset will enable an individual to view their NFC-enabled services and content, such as payment cards, vouchers and travel tickets. The mobile wallet, which could be used to complete transactions, will also provide access to digital versions of payment cards, receipts, vouchers, loyalty cards, tickets and any relevant stored value.

The paper assumes that passengers will typically access mobile NFC services by opening a dedicated travel application, a browser or a mobile wallet on their handset, which would then interact with the relevant UICC applet. However, a transport operator’s contactless terminal will generally interact directly with the UICC applet to validate a ticket, thereby simplifying passenger access to transport services.
The widespread deployment of mobile NFC using the UICC as the secure element will provide authentication, security and portability across many different handsets. Adopting UICC-based NFC as a global standard will also ensure economies of scale and interoperability, enabling people around the world to benefit from mobile NFC services, regardless of their operator network or device type.

Figure 1: An example of an UICC-based mobile NFC solution
Methodology

In preparing this paper, the authors interviewed representatives of mobile operators, transport operators, transport authorities, equipment providers and trade associations from across Europe. The organisations involved in the development of this paper include:

AFSCM
AFIMB
Bouygues Telecom
ATM, Metropolitan Transport Authority, Barcelona
ATM Milan
Belgacom
Broadcom
Calypso Networks Association
Cubic
Deutsche Bahn
Deutsche Telekom
ETSI
E-Plus
Giesecke & Devrient
Indra
Infineon
Insidesecure
ITS Spain
ITSO
JCDecaux
Malaga Transport
MTA - Mobility, Ticketing & Applications
Nextendis
NXP
Oberthur Technologies
Orange
OSPT
RATP
RIM
SNCF
Samsung Semiconductor Europe GmbH
Thales
Telefonica
Telecom Italia
TeliaSonera
Transport for London
VdV Kernapplikation GmbH & Co.KG
Veolia Transdev & Mercur
ViVOtech
Vodafone
Verkehrsverbund Rhein-Rhur

This paper aims to reflect the views and requirements of both the transport and mobile industries. However, it should be noted that the individual organisations listed above may not agree with each and every statement listed herein.

Glossary

NFC – Near Field Communication – A short range (typically 4cm) communication technology which is compatible with ISO/IEC 14443 and FeliCa contactless technologies.

NFC terminal – An NFC-compatible device in a fixed location, such as a validation gate or a ticket machine, capable of two-way interaction with another NFC device. The transport industry’s existing contactless smartcard readers, based on the ISO/IEC 14443 type A and B standard, can function as NFC terminals.

NFC tag – An NFC device in a fixed location, such as a smart poster or billboard, that stores information that can be read by another NFC device.

Mobile wallet – A handset application designed to enable a consumer to view and use digital versions of payment cards, tickets, receipts, loyalty cards and other items typically found in a physical wallet. A mobile wallet also enables a consumer to browse through and then access mobile NFC services.

UICC – A Universal Integrated Circuit Card, commonly known as a SIM card, acts as the secure element for the storage of sensitive data.

Secure domain – A dedicated space within the secure element reserved for data related to a specific set of mobile NFC services.

UICC applet – An application running on the UICC that holds secure data and interacts with an NFC terminal. It typically interacts with a dedicated application running on the handset and/or the mobile wallet.
3. The Vision – How mobile NFC could transform transport

This section illustrates how mobile NFC, combined with conventional mobile connectivity, could eventually enhance an international train journey. It is a high-level, long-term vision that demonstrates how mobile networks and NFC infrastructure can work together to provide a passenger with a cohesive and compelling experience. Note, this example is not intended to be exhaustive – it is intended to give a flavour of the potential and versatility of mobile NFC in a transport context.

Journey planning

Stefan wishes to travel from his home in a suburb of London to visit a friend living in Cergy, a suburb of Paris. Stefan inputs his destination and date of departure into the travel app on his mobile handset. Although it is supplied and branded by his local train company, the app can pull in data from transport operators across Europe. The app uses that data to suggest several different ways to make the journey, showing departure and arrival times and the cost of the journey in each case.

Stefan selects one of these options and decides to buy a ticket, spanning the entire journey and three different transport operators. He uses the travel application on his handset to validate his local season ticket, which gives him a discount on train journeys within London and complete the payment. The electronic ticket, along with loyalty points from the different operators and seat allocations, is delivered over-the-air to his handset and stored securely on his UICC. The ticket and the loyalty points are visible in both Stefan’s mobile wallet and the travel app.

On route

When Stefan arrives at his local station in London, he taps his NFC handset to validate his ticket and open the gate. Before boarding the international train to Paris, he taps his handset against another terminal to buy an NFC-enabled voucher, which will enable him to avoid the queue at the on-board buffet car.

While travelling to Paris, Stefan’s friend calls to say she is going to have to work late and won’t be home until 10pm. He decides to do some sightseeing in the centre of Paris. Stefan opens the travel app and inputs the name of an art gallery he would like to visit. The app tells him the direct route to the art gallery and offers to upgrade his Paris metro ticket to an NFC-enabled travelcard so he can use his handset to validate his journeys on the Metro and bus network. It also offers him a discounted NFC-enabled ticket for the gallery. He accepts, completing the transaction over-the-air.

When he arrives in Paris, Stefan taps his phone on an NFC tag, which triggers the travel app to activate his ticket for contactless usage on his handset and to download a map showing how to locate the right Metro line for the art gallery. In the Metro station, he taps the handset against an NFC terminal to validate his ticket and open the gate.

On arrival

When Stefan arrives at the right Metro stop, the travel app vibrates his handset, so he knows it is time to alight. As he exits the station, he touches his handset against an NFC tag, prompting the travel app to display walking directions to the gallery. While he is looking at the paintings, Stefan’s handset vibrates in his pocket – a message from the travel app warns him the last train to Cergy will be leaving in 30 minutes.
4. Why use Mobile NFC in transport - the value proposition for the transport industry

4.1 The near-term value proposition

This section considers the positive impact mobile NFC could have on public transport. Note, some of the potential benefits detailed below are not unique to mobile NFC - they could be realised by alternative systems that use electronic validation infrastructure and/or online interactivity. However, such systems are unlikely to be as ubiquitous or user-friendly as mobile NFC, which enables passengers to interact with both their immediate surroundings and online services in an intuitive and straightforward way: An individual simply touches their NFC handset against a terminal to complete an interaction. For this reason, mobile NFC may be the most effective way to realise the benefits detailed below.

In some cases, the potential benefits outlined below may only be realised once there is mass-market usage of mobile NFC. It should also be noted that the actual benefits that will be realised by a transport operator will depend on their current infrastructure, particularly whether they have already deployed some form of mobile and/or electronic ticketing system.

Enhance the value of existing contactless infrastructure

For transport operators that have already installed infrastructure that can validate contactless smart travel or payment cards, the deployment of a mobile NFC solution is a natural and incremental next step. The existing contactless infrastructure could be used to validate virtual versions of the cards held on NFC handsets. Equipped with travel apps, these handsets could then provide a much higher level of interactivity, increasing the value of the existing contactless validation infrastructure to both the passenger and the transport operator.

Greater passenger convenience

An NFC handset combines the ease and speed-of-use of contactless smartcards with interactivity. As an NFC handset has a user interface, it enables the passenger to interact with the transport operator in a way that isn’t possible with a smartcard or conventional ticket. A passenger could, for example, use their handset to buy or amend an electronic ticket over a mobile network or via a contactless smartcard reader. The NFC-enabled ticket could be downloaded immediately and stored securely on the UICC inside the handset. The passenger wouldn’t have to queue or print out a ticket or pick up a paper ticket from a ticket booth or vending machine. They also wouldn’t have to look after a separate paper ticket. The ability to buy NFC-enabled tickets over a mobile network might result in a reduction in so-called passive fraud in which passengers don’t buy tickets from a vending machine because the bus or train is about to leave.

Moreover, an electronic ticket inside a handset could also be accompanied by links to live travel information relating to the journey, which a passenger could access where there is mobile coverage. Alternatively, a passenger could touch their handset against NFC tags in transport termini to receive links to information in their own language about their locality and onward transport options.

Lower sales and distribution costs, dematerialisation and environmental benefits

By delivering NFC-enabled tickets over-the-air to mobile handsets (a fully-automated process), transport operators could ultimately reduce their ticket sales and distribution costs as the technology achieves a critical mass. The adoption of mobile NFC by passengers would also mean less usage of plastic cards or paper tickets, cutting the cost of supporting these physical tokens. Eventually, widespread use of mobile NFC would enable transport operators to pare back their physical ticketing infrastructure, including ticket machines and manned ticket booths, lowering both their capital and operational costs.

Using NFC handsets, instead of paper tickets or plastic cards, may also lower transport operators’ impact on the environment. An electronic transaction facilitated by an existing mobile handset could result in lower greenhouse gas emissions than the use of a paper ticket, for example.

Fast, accurate and transparent ticket validation

Passengers entering a station, a train, a tram or a bus will be able to validate their tickets (or where appropriate, a payment card) simply by tapping their handset against a contactless reader, enabling faster throughput and more reliable validation than paper and magnetic tickets. Moreover, an NFC-enabled handset will also be able to show that the ticket (or a payment card) has been validated, making for a more transparent process for the passenger. Fast, transparent and accurate ticket validation should create a better experience for the passenger, resulting in greater usage of public transport. Validating an NFC ticket doesn’t need an additional ID or online check,
so they can be validated faster than tickets that use 2D barcodes, for example, by control staff on board of buses and trains.

**Low cost validation equipment**

With appropriate security measures in place, staff on board trains, buses, trams and other forms of public transport could use NFC-enabled smartphones to validate and sell tickets or charge debit and credit cards. Benefitting from the major economies of scale in the mobile handset industry, these smartphones could be low cost alternatives to specialist validation machines. However, some transport operators may prefer to use ruggedised versions of conventional models. Ticket inspectors could also use the smartphones for other purposes, such as retrieving information, making phone calls, interacting with other transport staff and taking (and uploading) photos of incidents or equipment that needs repairing.

**Useful data, real-time information and pricing**

Using NFC handsets to store and validate transport tickets (or substitutes, such as payment cards) creates a digital record of the travel for both the passenger and the transport provider. This record enables the passenger to review how much he or she is spending on travel, check which journeys were undertaken when and, if necessary, prove to employers or other third parties when they entered the transport system. Subject to data protection laws, the transport operator can use the highly-detailed, but anonymised, data captured by electronic ticketing to monitor congestion, understand passenger journeys and travel requirements and plan enhancements to the existing transport infrastructure.

This data could be used proactively to direct passengers away from congested stations, for example, by sending text message alerts to people that regularly use a particular route. These alerts could offer passengers a discount if they alight at a specific station, rather than a congested one nearby. The discount could be automatically applied when they touch their handset against an NFC terminal to leave a station or disembark a train.

**Less cash handling**

The rollout of mobile NFC handsets would introduce another way to pay for travel electronically, in addition to plastic credit, debit and stored value cards. That could mean transport operators will have to handle less cash, lowering their costs by reducing the need to collect and transfer coins and notes to the bank. Moreover, on buses, cash payments can slow down boarding, resulting in delays.

**More flexible and interoperable ticket systems**

As NFC handsets will all be equipped with the same standardised contactless capabilities, the deployment of mobile NFC could help reduce the complexity of moving to flexible and interoperable ticketing systems that enable passengers to buy a single ticket system spanning several European transport networks. Unlike proprietary plastic cards or paper tickets, a travel application running on an NFC handset (and a related applet on a UICC) can be created and personalised over-the-air to support several different validation systems.

**Ticket and voucher management**

If they are using mobile NFC, passengers can easily view, amend and redeem tickets, travelcards, loyalty points and any associated vouchers stored on their handsets. For example, a transport operator could automatically reward a passenger travelling a particular route with loyalty points, which could be exchanged for NFC-enabled vouchers. Automating loyalty programmes in this way would help the travel operator build a closer relationship with passengers and gain a better understanding of their behaviour and requirements.

As well as being easier to manage, NFC-enabled tickets and related collateral stored on a UICC are less likely to go missing or be forgotten. In the event that a passenger loses their handset and UICC, their tickets, travelcards, loyalty points and vouchers could be transferred over a mobile network to a new UICC/handset.

**Personalised communication with passengers and promotion of public transport**

With passengers’ permission, NFC handsets could be used to communicate information relevant to a passenger’s journey or profile over a mobile network or via NFC readers. For example, a travel operator could send a passenger an alert about delays on their usual line and a recommendation to take an alternative route. This kind of personalised communication could enrich the passenger’s travel experience by helping them to take the most appropriate route.

NFC enabled-handsets could also help transport operators to increase the visibility of, and simplify access to, multiple forms of public transport. When a passenger uses an NFC handset to check-out of a train station, for example, the contactless terminal could transfer a message alerting them to when the next bus or tram to their neighbourhood is leaving.
The provision of timely information would make public transport easier to use, potentially reducing private car usage. The transport operator could also provide passengers with NFC-enabled rewards in return for completing surveys or providing feedback.

4.2 The broader value proposition

This section considers how mobile NFC may ultimately add value to the transport industry and passengers in the longer term, as the ecosystem matures, gains economies of scale and becomes increasingly interoperable. Again, some of the potential benefits detailed below are not unique to mobile NFC - they could be realised by any system that combines an easy-to-use electronic validation infrastructure with online interactivity. However, mobile NFC may be the most straightforward and intuitive solution.

Mobile commerce

Some transport operators may decide to use mobile NFC as a mobile commerce platform incorporating products and services from other companies. If they have given their permission, a passenger using an NFC handset to check in and out of a transport network could receive targeted and timely offers, vouchers and information relating to restaurants, shops, attractions and other amenities at his or her destination. For example, a passenger leaving a train station might tap an NFC tag with their handset to receive personalised offers and recommendations for that locality. If the passenger likes Indian food, for example, he or she might be given links to the websites of local Indian restaurants and/or local travel instructions.

To avoid being spammed with unwanted messages, the passenger could establish a simple permissions-based profile about products and services they are interested in hearing about and in what circumstances they would like to receive offers or discounts (e.g. only outside working hours). In time, the use of mobile NFC in transport could become an efficient and effective direct marketing platform for hotels, restaurants, tourist attractions and other businesses interested in communicating with travellers in a timely and relevant fashion.

Complete, integrated transport solutions

Eventually, NFC handsets could enable the European transport system to become completely interoperable. In other words, an individual could move effortlessly around Europe using their NFC handset to buy and validate tickets across all modes of public transport, taxis, car and bike rental, parking and road tolls.

Fully-integrated transport systems could enable aggregators to offer passengers real-time advice, across all modes of travel, ensuring that they have full knowledge of their travel options at all times. For example, a passenger leaving a train station in a foreign country could input their next destination into their handset and tap it against a contactless terminal. The terminal could trigger the handset to download information in their own language outlining the different ways to get to the desired destination – for example, he or she could rent a bike for five euros, take a bus for two euros, a taxi for 20 euros or a metro train for three euros. The handset could also download real-time information on the location and frequency of each option. This would reduce the time and money travellers spend on research and journeys made in error, increasing their satisfaction and creating a compelling consumer experience.

This kind of interaction highlights an important feature of NFC handsets: They enable a user to easily interact with their surroundings to access immediately relevant information and perform real-time transactions.
5. Why Mobile Operators should support mobile NFC in transport

This section considers the reasons why mobile operators are supporting the deployment of mobile NFC in the transport sector.

Greater usage of mobile services

As it will further enhance the role of the mobile phone in everyday life, mobile NFC is a strategically-important technology platform for mobile operators. This short-range contactless technology is the ideal complement to their existing mobile networks – it enables people to interact quickly and easily with their immediate surroundings and then source additional information and services over the mobile network. Each interaction with an NFC terminal or tag may prompt the mobile customer to download more data, make a phone call or send a text message.

Spur adoption of NFC and accelerate handset and UICC upgrades

As public transport is used by tens of millions of Europeans every day, the widespread adoption of mobile NFC in the transport sector would raise awareness of the technology and its potential to enhance other facets of daily life among both consumers and businesses. The widespread usage of mobile NFC in public transport could encourage the adoption of the technology in the retail sector, in higher education, public administration and access control, for example. Mobile NFC faces lower barriers in the transport sector than it does in some other sectors – transactions tend to be low value and frequent. The widespread adoption of mobile NFC for public transport services could speed up the replacement of handsets and UICCs, significantly shortening the time-cycle required to introduce new handset and UICC technology.

Mobile commerce

Widespread usage of mobile NFC in the travel and retail sectors could help mobile operators to create a mobile commerce platform that reduces the friction between buyers and sellers, opening up new revenue streams for the mobile operator. For example, a mobile operator could provide a service that enables an advertiser to send NFC-enabled vouchers to consumers who have given their permission in a specific geographic location. The number of NFC vouchers that are redeemed at point of sale would help the advertiser to determine how effective the campaign is, enabling it to modify its messaging accordingly.

The widespread usage of mobile NFC in transport would also help people to become accustomed to using mobile wallets, enabling mobile operators to deploy other value-added services that make use of a wallet.

New upstream revenues

The deployment of mobile NFC in the transport sector may open up opportunities for mobile operators to provide upstream services to travel companies, generating new revenues. Mobile operators could, for example, provide NFC ticket distribution and application lifecycle management services.
6. Mobile NFC in transport today

This section considers progress towards actual deployments of mobile NFC in the transport sector.

Mobile NFC trials in the transport sector

There have been numerous trials of mobile NFC technology services in the transport sector in Europe and elsewhere. Such trials have taken place in parts of Germany, UK, Italy, France, Spain and other European countries. In general, they have demonstrated that the technology works in a public transportation environment.

However, most of the transport operators involved are waiting for NFC handsets to become more widely available before moving towards a commercial deployment. In some cases, they still need to resolve some technical or commercial issues before they can move to full-scale deployment.

For example, ITSO, a UK body that sets technical standards for contactless smartcard ticketing in transport, began an NFC trial in 2008, sponsored by the UK Government’s Department of Transport. The trial demonstrated that NFC handsets could be used both as an inspection device by transport operators and to hold contactless tickets for customers. ITSO has said that further development depends on the finalisation of certain specifications, while remote loading of the ITSO Application depends on the development of a standard set of messages and protocols to manage the downloading of the application by the mobile operator.

NFC handset availability

The usage of mobile NFC transport-related services depends on consumers having NFC handsets that are compatible with the ISO/IEC 14443 standard that forms the basis for contactless infrastructure in the transport industry. These handsets should be certified to ensure that they comply with the full NFC specification, but industry-wide certification mechanisms don’t yet exist. The availability of NFC handsets is now growing quickly. There will be 70 different NFC handsets on the market by the end of 2012 compared with 26 at the start of the year, according to research firm Gartner. Samsung Electronics, one of the world’s leading handset makers, has said that it sold 20 million units of an NFC-enabled, high-end smartphone, the Galaxy SIII, worldwide in the 100 days after it went on sale, according to the AP news agency. Some device manufacturers, such as ZTE of China, have also developed NFC handsets aimed at the mass-market. Deloitte has predicted that 200 million NFC phones will be in use worldwide by the end of 2012. By 2015, 50% of the smartphones shipped will support NFC, according to one leading semiconductor vendor. By then, the vast majority of handsets sold in Europe will likely be smartphones.

Live commercial services

Mobile NFC services have already been deployed commercially in several countries, such as Japan, South Korea, France and Turkey.

In South Korea, where more than 10 million UICC-based NFC handsets have been sold, mobile operator SK Telecom estimates that more than two million people have used their mobile handsets to pay transit fares via the T-money prepaid system, which is accepted by buses, subway trains and some taxis in Seoul and other parts of South Korea.

KT says that more than half a million of its subscribers have signed up for its prepaid Cashbee service, enabling them to use NFC handsets to pay for travel on buses, subway trains and taxis. About 80,000 of the subscribers are “active,” in that they are tapping their NFC phones to pay fares on a regular basis. KT has said that subscribers used the Cashbee prepaid transit service 30 million times in 2011 spending 11 billion Korean won (US$9.5 million). KT has also deployed about 22,000 NFC tags at bus stops throughout Seoul and the surrounding region. A traveller can tap the tag with his/her NFC handset and get information about the bus route, departure/arrival time and etc.

In Japan, millions of people already use their handsets to access transport systems, which are based on a local contactless technology, called Felica, which is covered by NFC specifications, but is not compatible with the ISO/IEC 14443 standards used for smartcard contactless infrastructure in other parts of the world. Japan is now upgrading its Mobile Felica infrastructure to support the international NFC standard, ISO/IEC 14443 A & B, as its mobile operators are preparing to offer handsets that are compatible with both Felica and ISO/IEC 14443 UICC-based NFC services.

In Turkey, consumers can use Turkcell’s Cep-T Cüzdan mobile wallet running on an NFC handset to pay for some public transportation, parking fees and road-tolls using the MIFARE technology platform.
Since May 2010, in the city of Nice in France, people have been able to use NFC handsets to buy and validate NFC-enabled tickets for local public transport through the BPASS application (which is now also being piloted in the Paris area). BPASS enables passengers to use a mobile connection to buy NFC tickets from several different ticketing schemes (encompassing different modes of transport) and store them on the UICC in their NFC handset. The transport gate or validation terminal automatically selects the right ticket even when the handset battery is low or the handset is switched off.

Other French cities, such as Caen, Strasbourg, Lille, Argentan, Tours, Bordeaux, Toulouse and Marseille, have installed NFC tags that enable people to use NFC handsets to download travel information.

Preparations for rollout in European Union countries

Several of Europe’s transport operators are adapting their existing electronic ticket systems to support NFC handsets. In this section, we outline some examples:

**Deutsche Bahn**

Deutsche Bahn, Germany’s main train operator, is preparing to expand its NFC support for the Touch&Travel system. Touch&Travel is designed to collect fares automatically by enabling passengers to check in and out of the public transport system using touchpoints. Today, the passenger checks in and out by entering the touchpoint ID number into the Touch&Travel app on their handset or scanning a 2D barcode. Alternatively, a customer can ask the app to find their location (using technologies, such as GPS and/or Wi-Fi) and then choose from a list of local stations.

The handset then transmits the station information over the mobile network to Deutsche Bahn’s systems, which charges the journey to the passenger’s postpaid account, which is settled once a month.

Following an extensive pilot phase, Deutsche Bahn is now preparing to enable passengers to touch their Android and Symbian handset against an NFC tag to check-in and check-out of the transport system. The train operator deployed NFC tags at all long distance stations across Germany at the end of 2011 and will add NFC support for the next version of its Touch&Travel app for Android and Symbian handsets at the end of 2012.

**SNCF**

SNCF already has several NFC services live in France. For several years passengers travelling in the Bretagne region have been able to use NFC handsets to access information about local buses, station parking, regional trains and national trains. SNCF is now preparing to rollout the technology in other regions. Moreover, building on the e-ticketing system largely developed for the TGV, SNCF has started an NFC service between Paris and Lille. The customer can tap their NFC handset against contactless equipment in the station, located on the way to where the train will start. With one tap and a couple of clicks, he or she can buy a ticket, cancel a ticket or change train if, for example, he or she has arrived early at the station and wants to take the earlier train.

**Transport for London**

Transport for London is planning to gradually replace its proprietary Oyster electronic ticketing system with a system that simply charges a passenger’s debit or credit card for each journey made. Such a system will eventually enable Transport for London to reduce the cost of fare collection, as passengers will no longer need to purchase a dedicated plastic card and load money onto that card. Instead of tapping their Oyster card against a reader, the passenger will be able to tap a contactless debit or credit card compatible with the EMV standard. If a debit or credit card is stored in the passenger’s NFC handset, then they will be able to use their phone in the same way.

Transport for London is developing software that will register each time the passenger taps in and out of the system. At the end of the day, the software will tally up the journeys made and charge the passenger’s payment card via the existing EMV system. The passenger’s daily expenditure will be capped to ensure that they aren’t charged more than the cost of a day travelcard.

Transport for London is talking to the UK’s mobile operators about enabling their wallets to track the passenger’s spending on travel in London in real time. That would enable the passenger to see how much they have spent during the day, rather than waiting for the settlement to take place at the end of the day.

To run this new system, current Oyster readers across London are being adapted to support contactless EMV as well as ITSO and Oyster. By the end of 2012, Transport for
London plans to have enabled the readers on 8,500 buses to support EMV. In each case, the reader will determine what kind of card the passenger is using (EMV, Oyster or ITSO) and then check whether the card is valid for the journey. Using a contactless EMV card to validate takes around 500 milliseconds – the maximum acceptable time for stations with high throughput. A virtual EMV card on a handset may take 600 milliseconds, but Transport for London expects those times to fall as the technology evolves.

Transport for London intends to also introduce its own TfL card for people who don’t have an EMV card or would prefer to use a prepaid system, in which case they buy credit up front, to control their spending. Again a passenger could store a virtual version of this card in an NFC handset.

ATM, Barcelona, Spain

Barcelona ATM is the governing body for integrated fare collection covering the metro system, railways, tram systems, buses, and other forms of public transport within Barcelona and the 250 towns in the surrounding area. The agency provides the system for approximately 74 transport operators in the Barcelona metropolitan region, which covers 3,240 square kilometres and serves more than five million residents. More than 70% of the journeys made by customers are with integrated tickets.

ATM is now deploying a full NFC-contactless solution for ticketing, based on open standards and ISO-CEN compliant, which is intended to be a significant step towards the deployment of contactless services across the rest of Catalonia, as well as interoperability with transport systems in other regions. ATM is also building on the momentum of Barcelona City Council’s TAP@GO project, which is enabling NFC-payments and municipal services within the city.

The Campania and Emilia Romagna regions of Italy

The existing electronic ticketing systems in the Campania region of Italy, with its capital Naples (2.5 million inhabitants), and the Emilia Romagna region (3.5 million inhabitants), are both being adapted to be compatible with mobile NFC. In the Campania region, Unico Campania is the common fare collector in a multi-operator environment, while in the Emilia Romagna region, the MiMuovo ticketing brand is a common fare scheme used by multiple transport operators.

After trials across a large variety of handsets, both regions are preparing for a full scale rollout supporting NFC phones running the Android, Java and Bada platforms. Transport users can buy and validate tickets with their NFC handsets via a dedicated transport application with a dedicated user interface, contracts and rules.

In both regions, the transport operators are planning to use mobile NFC to extend and enhance communication with customers. They are also looking to reduce operational costs by using NFC to validate tickets, to read and write tickets and to reload tickets.
7. Costs and complexity of widespread deployment

This section considers the possible barriers to the deployment of mobile NFC in the transport sector.

**Local governance and limited funding**

In most of Europe, public transport networks are governed and funded, at least in part, by public transport authorities accountable to elected politicians, meaning the introduction of mobile NFC may need to be reviewed and approved by local government. With public funding in short supply and political pressure to keep fares low, many transport operators can’t afford to spend large sums on new infrastructure and IT systems. Therefore, they need to be sure the financial benefits of deploying a mobile NFC system will offset the cost of deployment and operations. The underlying business model needs to ensure that all parties in the value chain will benefit.

Moreover, public transport operators have to be inclusive, rather than exclusive – political considerations mean all passengers generally need to be able to access the system regardless of whether they have a mobile phone or a bank account. Some countries even have a legal requirement that people can use cash to pay for travel making it impossible for transport operators to completely remove vending machines/ticket booths. The usage of stored value on a mobile phone to pay for travel may be limited or prohibited in some European countries.

**Lack of widely-implemented validation standards**

There are a myriad of different ticket issuing and validation systems/infrastructure in use in Europe, generally using local data structures and protocols. This fragmentation makes it difficult to build out an interoperable mobile NFC ticketing solution. As transport operators will be reluctant to deploy a completely new pan-European validation standard, the existing systems need to be adapted to enable interoperability with systems in other countries and even other regions of the same country. Moreover, enabling international travel is generally not a priority for local transport operators, as the vast majority of their passengers tend to be local.

**Some NFC handsets and contactless validation systems are incompatible**

Some NFC handsets may need to be adapted to work with transport operators’ contactless validation and control systems. In some cases, NFC handsets are not compatible with the ISO/IEC 14443 standard generally used by the transport industry in its contactless infrastructure. Moreover, NFC handsets will need to be tested (and potentially certified) to ensure they offer acceptable throughput speeds.

On the infrastructure side, the signals emitted by some of the ISO/IEC 14443 contactless terminals may not be strong enough for use with some NFC handsets and these signals may need to be tuned. In some cases, the software and firmware in the existing infrastructure will need to be upgraded to be compliant with ISO/IEC 14443 and work with NFC handsets, as well as contactless smartcards. Independent test houses can test terminals against ISO/IEC compliance and issue a certificate for passed equipment.

**Long lifecycle of transport infrastructure**

Financial constraints and the need to minimise disruption mean that the ticket validation gates and readers used in train stations and on buses and trams tend to have a long lifecycle. This equipment may only be replaced every 10 to 20 years. Therefore, most mobile NFC solutions will either have to work with the existing infrastructure or wait for its lifecycle to expire.

**Wide variety of tickets**

Transport operators typically offer many different kinds of tickets, including annual passes, monthly passes, weekly passes, daily travelcards and single-use tickets. Transport operators generally enable passengers to buy several tickets and share them with other travellers (such as a family on holiday) or extend an existing pass to make the occasional longer journey. Many transport operators also issue a range of travelcards, giving discounts to the elderly, to students, to families and other groups. This array of different tickets can be compounded by complex pricing strategies, with fares dependent on when the passenger booked the travel and how flexible the ticket is. Any mobile NFC ticketing system needs to be able to distribute and validate the full spectrum of available tickets, while providing the passenger with a straightforward and intuitive user interface on their handset.

The validation system also needs to be able to check whether an individual passenger qualifies for a particular discount or possesses a specific travelcard. That may require some form of authorised photo ID that can be authenticated by the control system.
Different services have different security requirements

Some travel tickets, such as an annual season ticket, could be worth thousands of euros and, therefore, need to be stored securely and be heavily protected against fraud or loss. A transport operator may decide that other tickets, such as two euro bus ticket, don’t need the same level of protection. Therefore, a mobile NFC solution needs to be flexible enough to support different levels of security requirements.

The introduction of mobile NFC may also be accompanied by new forms of fraud. For example, a passenger may claim they have lost their handset and request that their travel tickets be downloaded to a new UICC. He or she may then attempt to use the two UICCs to take two separate journeys. There is also a risk of payment fraud in cases where an individual uses a stolen NFC handset to pay for a journey costing less than 25 euros (meaning they won’t have to enter a mobile code).

Complex ticketing value chain

Some transport operators make tickets available through a large number of agencies and resellers both online and in-store, creating a complex value chain and potentially high systems integration costs for any new ticketing system. For example, ticket distributors will need infrastructure that will enable them to transfer transport applets on to passengers’ handsets/UICC. Many of these resellers may be unable or unwilling to support the sale and distribution of electronic tickets that can be used with NFC handsets. In some countries, political pressure to maintain competition in the travel industry may mean that a transport operator can’t deploy NFC-based ticketing until all ticket distributors are able to support the technology.

Variety of different handset platforms

A transport operator will need to support its mobile NFC services with a tailored handset application. It will need to adapt the app for each of the different smartphone and feature phone software platforms in use in their market. However, the transport operator’s UICC applet should be able to work across different smartphone and feature phone platforms and across different mobile operators’ UICCs and mobile wallets.

Many transport operators have already invested in efficient electronic ticketing

If a transport operator has recently trained staff and educated passengers on how to use a card-based electronic ticketing system, they may wish to avoid introducing a new technology that creates additional complexity and confusion for staff and passengers.

Need for distribution of NFC handsets/new UICCs to consumers

As mobile NFC gains economies of scale, the technology will be added to more mainstream handsets, but most consumers only replace their handset every two or three years. It could, therefore, be several years before the majority of people in Europe have NFC handsets.

NFC handsets generally also need sophisticated UICCs that can store applets and data related to each transport operator in a secure domain. These UICCs, which cost more than conventional UICCs, need to be distributed to consumers. Some mobile operators are now issuing NFC-enabled UICCs to all customers purchasing a new UICC. As consumers may not yet see the value of NFC services, the mobile operator may need to subsidise the roll out of these NFC-enabled UICCs.

Transport operators need to deal with multiple mobile operators in each market

In most European markets, there are at least four mobile network operators and several mobile virtual network operators (which resell network capacity). That means that a travel operator will have to deal with multiple mobile operators to offer all of its passengers and potential passengers the opportunity to use NFC handsets to buy and/or validate tickets or gain access to the transport system. Different mobile operators may have different timescales for the roll out of NFC handsets and services, creating further complexity for the transport operator.
8. How to move mobile NFC in transport forward - defining roles and responsibilities

To help enable a transport operator and its partners overcome the costs and complexities detailed in the previous section and deploy a mobile NFC solution, this section identifies the tasks that may need to be accomplished. This section considers the system design and development, consumer uptake and the platform services that will be required to maintain the solution once it has been deployed.

8.1 System design and development

This section considers the steps that need to be taken to deploy a mobile NFC transport solution.

High-level scoping and design

Transport operators first need to decide on the strategic objectives and corresponding scope for their mobile NFC solution – will the solution focus on making ticket purchase and validation faster and more efficient or will the mobile NFC solution also be used to introduce new value-added services designed to enhance the customer experience?

Other key questions\(^1\) to consider include:

- Will passengers need to purchase electronic tickets or could payment for travel be deducted directly from a debit or credit card stored on their handset?
- Will contactless terminals, such as station gates and bus readers, be used to deduct payment for travel or just to validate existing tickets?
- Will contactless terminals, such as station gates and bus readers, be used to award loyalty points and/or redeem coupons and vouchers?
- How much additional information, such as status updates, will contactless terminals provide?
- Will contactless terminals be used to validate tickets when a passenger enters and leaves a station?
- Will contactless terminals be used to validate tickets on board a train, bus or tram?
- Will ticket inspectors carry portable NFC readers (such as smartphones) that can validate tickets or verify payment?
- Will contactless terminals on board trains carry out ancillary functions, such as enabling people to order food and drink or find out information about their destination?

Adaptation of ticket sales channels

A transport operator will need to adapt its existing distribution channels to enable passengers to purchase electronic tickets that are readable by contactless terminals. It also needs to decide whether new distribution channels are required, such as mobile apps, for example, that will make it easier for potential passengers to purchase tickets or pay for travel. Ideally, passengers should be able to buy NFC tickets via a mobile network or via contactless terminals in transport termini. Any new distribution channels will, of course, need to be integrated into the transport operator’s existing IT systems.

Some transport operators may not issue electronic tickets at all. Instead, they may enable passengers to authenticate themselves within a travel system and pay fares using a debit card or credit card. To support this approach, the transport operator will need computer systems that can identify whether the debit or credit card is valid. Although a standard contactless payment transaction encompasses a check on whether a card is genuine, additional processing will be required to manage cards that are lost, stolen or without available funds (e.g. via a blacklist). The payment schemes are in the process of putting in place rules to establish the risk management controls for banks and transport operators appropriate for transit usage. The transport operator may also need to work with mobile operators or banks to ensure the passenger can track how much they are spending on travel and when they have hit a daily cap and can, therefore, continue travelling for free.

However, some passengers may be uncomfortable putting their payment cards into transport validation infrastructure, fearing that they may end up spending more than they want to or that they will lose sight of what they are spending. They may prefer to buy a ticket upfront, either via a dedicated ticketing applet in the UICC, or via an extension to a payment application, capable of storing ticket data. The payment schemes are developing data storage solutions in anticipation of this market need, enabling payment cards to be used as a carrier or tickets that meet transport industry standards, such as those defined by Interoperable Fare Management (IFM).

Integration of mobile NFC ticketing into existing distribution and validation infrastructure

Passengers should be able to use contactless terminals in transport termini to both purchase mobile NFC tickets

\(^1\) If a transport operator already supports contactless smartcards, some of these questions may not be relevant
or validate mobile NFC tickets purchased via a mobile network. If an existing transport contactless system already meets ISO/IEC 14443 type A and type B standards then no hardware modification is necessary to any reader. Only if they do not meet these standards, will a change be necessary.

However, the transport operator needs to consider how its validation system will identify tickets and/or passengers. For example, will each ticket stored on an NFC handset have an unique ID number or barcode that will make it identifiable to its back-end system or whether other identifiers (such as a passenger’s mobile phone number) can be used?

Transport operators may also wish to issue ticket inspectors with NFC handsets. On a bus or tram, a ticket inspector could touch their NFC handset against the on-board contactless reader, which would then transfer details of every smart ticket that has touched the reader. The ticket inspector’s handset could then cross-reference that information against the smartcards and handsets on the bus or train to validate tickets or that fares have been paid.

**Aggregation and supply of travel-related marketing and advertising to mobile handsets**

The deployment of mobile NFC in the transport sector could make it easier for consumers to receive and redeem travel-related information, adverts, vouchers and collect loyalty points. To fully realise this opportunity, merchants, travel operators, hoteliers, restaurants, tourist attractions and other third parties will need a straightforward way to deliver advertising and vouchers to selected consumers’ handsets via NFC and/or a mobile wireless network.

In practice, this may require a broker or aggregator to provide a web-based interface that would enable a third party to quickly design and enable marketing campaigns and promotions. If it has empty tables, a restaurant, for example, may want a mechanism through which it can easily deliver a voucher to passengers who have opted-in and are over the age of 30 leaving a specific train station between 6pm and 9pm. Ideally, these brokers will have the necessary data to be able to discern when a traveller is on a business trip or a leisure trip and then deliver appropriately-targeted offers.

However, to safeguard consumer trust, marketing and advertising programmes should be permission-based and transparent – so the passenger has control over what information is used and by whom, and what marketing they receive and from whom. This may require the industry to establish appropriate standards and agreements and to ensure privacy is designed in from the outset, and to provide customers with a consistent and convenient way to manage their marketing permissions.

**Work towards national and international interoperability of ticketing systems**

Ultimately, transport operators may want to use mobile NFC to enable a passenger to buy a single electronic ticket that could be validated by contactless terminals in different cities and countries. In practice, this may require transport operators to replace existing validation protocols with more commonly-agreed and standardised protocols. To fulfill this goal, transport operators should continue to work towards a commonly-agreed and interoperable ticketing systems through the European Metropolitan Transport Authorities association and through other standards bodies.
The European Commission’s IFM project is aiming to make electronic ticketing systems across Europe compatible. The ultimate vision of the IFM project is that a single device could support zonal fares, pay-as-you-go, season passes or individual tickets, reservations, and be read and accepted wherever in Europe it is presented.

In May 2010, three European electronic ticketing organisations Calypso Network Association (Belgium), ITSO (UK) and VDV-Core Application (Germany) demonstrated that a single smart card can be used for public transport across all three ticketing systems using a new international ISO Standard for implementing IFM. IFM is also supported by a new European Work Package, proposing to standardise the way contactless standards (particularly NFC Forum and ISO/IEC 14443) are used in smart ticketing.

The IFM Alliance is working with European mobile operators through the GSMA to standardise the way transport applets are downloaded to the UICC on an NFC-enabled mobile phone and to standardise the messages generated when a transport application is used with NFC phones.

International interoperability may also need to be underpinned by a comprehensive certification and approval scheme to reassure consumers that their NFC devices will work with transport operators’ gates and validators.

In some European countries, such as Germany (VDV-Core Application), Netherlands (Translink), UK (ITSO), France (AFIMB) there are also schemes to allow smart ticketing to interoperate across the whole country. In Belgium, the MOBIB protocol (which supports Calypso and ISO/IEC 144443 A and B), is being used to make multiple ticketing schemes interoperable.

**Development of travel applications for different mobile handset platforms**

In addition to supplying a UICC applet, transport operators or third parties may also wish to develop travel applications that people can download on to their handsets and then use to plan their journey, buy NFC-enabled tickets and get service updates. For local transport, this app may also support the validation of tickets or this function could be performed by a mobile wallet provided by the passenger’s mobile operator. Many transport operators may have existing apps they can upgrade to support NFC functionality.

**Provision of “off-the-shelf” app development and delivery solutions across all handset platforms**

To make it easier for transport operators to deploy travel apps that support NFC functionality, mobile operators and other companies may provide templates and other tools that streamline the development of apps for different handset platforms. They could also provide dedicated solutions that would enable the transport operator to easily deliver their travel app and a related UICC applet to a customer’s handset.

**8.2 Consumer uptake**

This section considers the steps that need to be taken to drive consumer uptake of mobile NFC transport solutions.

**Addition of NFC chips to wide selection of handsets**

NFC needs to become a standard feature on a large proportion of mobile phones to enable transport operators to make NFC their primary platform for the validation of tickets/payment. Wider deployment of NFC services should create demand among consumers for NFC handsets, leading to a broader selection of NFC phones at a wider range of price points.

**Procurement and distribution of NFC-enabled handsets**

European mobile operators, which buy a large number of handsets, could request that device makers add NFC capabilities (compatible with ISO/IEC 14443) to more models. They could also promote NFC handsets to consumers in stores, on their websites and through other marketing and distribution channels.

**Reduce fragmentation of handset platforms**

As app developers focus their efforts on the most successful software platforms, market forces may ultimately drive a reduction in the number of operating systems used by handsets on the market. Such a reduction would help to simplify the process of developing travel apps and transport-related NFC services. Smartphone sales are growing rapidly reducing demand for feature phones, which tend to use proprietary or semi-open software. Moreover, smartphone buyers are increasingly choosing models that run one of the most popular operating systems, which could further reduce the fragmentation of handset platforms.
Promotion of mobile NFC handsets and services

Most Europeans are not aware of NFC technology and the services it can provide. The ecosystem will, therefore, need to educate consumers about mobile NFC both to encourage them to purchase NFC handsets and then use NFC services. Promotions, discounts and offers may also be needed to encourage consumers to buy NFC handsets, download NFC apps and use NFC services.

Promotion of use of mobile NFC for transport

There will be a need to highlight to passengers that they can use NFC handsets to buy and/or validate tickets or make payments on a transport system. NFC services could be advertised on posters and on ticket machines. They could also be demonstrated by transport staff. If its mandate allows, a transport operator may consider offering passengers who use their travel app to purchase tickets a discount over those using vending machines, just as some hotels offer discounts to people who book rooms online. Transport for London used differentiated pricing to successfully drive large scale uptake of its contactless Oyster card ticketing system.

Distribution and promotion of mobile wallets

In many cases, consumers are likely to discover, access and manage their NFC services through a mobile wallet. Mobile operators are likely to preload these wallets on the NFC handsets they distribute. But wallets may need to be downloaded over-the-air to handsets sold through other channels. In the latter case, mobile operators will need to make it easy for consumers to discover these wallets either by promoting them in app stores or through NFC tags that link to a download site. No matter how mobile wallets are distributed, most consumers will still need to be educated on how to use them.

Distribution and promotion of travel apps to handsets

Depending on the handset’s operating system, travel applications could be downloaded via the mobile wallet, an applications store or an appropriate website. In any case, these apps will need to be promoted to consumers and will need to be easy to discover and install. Greater use of open protocols for ticket validation could make it easier to deploy travel apps across different handset platforms.

8.3 Platform services

This section considers the platform services that are needed to ensure the ongoing operation of a mobile NFC transport solution.

Provision and management of sensitive data

To use an NFC service, (as with many existing services) some identifying (and potentially sensitive) data will need to be loaded on to the secure domain on the UICC. If necessary, the individual should be able to have the data deleted securely and transfer it to another UICC or to another device. The company that performs these provisioning and management services clearly needs to be trusted by the individual concerned, the mobile operator and the relevant transport provider.

Transport operators should consider whether they should authorise a single company to provision and manage data on their secure domain within the UICC, to gain economies of scale, or whether they would prefer to use several competing providers. In either case, they may want to avoid being locked-in by ensuring that the keys to the secure domain are held by the transport operators rather than a third party.

Management of the secure domain

The secure domain within the UICC needs to be supplied and provisioned, so that it can receive new applets and data over-the-air. UICCs are supplied and provisioned by mobile operators using their mobile networks. If a handset is stolen or lost, a mobile operator can disable the UICC remotely, ensuring that the sensitive data it contains can’t be accessed.

Enabling passengers to move tickets from one UICC to another

If a passenger wishes to change their mobile operator, they will want to be able to move any transport tickets, travelcards, loyalty points, coupons and store valued they have purchased to a new UICC. This transfer will need to be carried out by a company that is trusted by the consumer, the mobile operators and the transport operator to access the secure domain of the UICC and make the necessary changes. This process, which would typically be carried out over a wireless network, will clearly require mobile operators to take a common approach to storing applets and data in the secure domain of the UICC.
Management of the lifecycle of the travel application on the handset

Once a travel app, supporting NFC services, has been rolled-out and deployed on consumers’ handsets, it will need to be updated regularly with relevant information and, if necessary, new functionality. Such updates could be delivered via a mobile wallet or via an applications store or a web site, depending on the handset’s operating system.

Provision of ongoing connectivity

A secure wireless connection will be required to enable passengers with an NFC handset to purchases tickets over-the-air and receive real-time updates about their journey – passengers will need to be able to make both proactive enquiries and receive alerts.

In some cases, mobile connectivity will also be required to access the information advertised by an NFC-enabled poster or advert. As the amount of data that can be transferred by a single NFC tap is relatively small, an NFC service provider may choose to transmit the advertised data via an over-the-air download from a remote server over a mobile network.

Some transport operators may also wish to check the extent of passengers’ journeys using GPS and mobile networks, if the passenger forgets to check out with NFC. Moreover, a transport operator may also use a mobile network, as an alternative to a fixed-line network, to connect NFC tags to up-to-date information provided by their back-end systems. In densely-populated areas, mobile connectivity will need to have sufficient capacity to cope with large numbers of people in transport hotspots. Rural areas and underground stations will also need sufficient mobile coverage and capacity to enable people to purchase NFC-enabled tickets over the air.

Provision of different payment options

When purchasing a ticket (or the right to travel), the passenger will want a choice of different payment options. Some consumers will want to use a debit card, others a credit card, while people without bank accounts may need to be able to pay for travel using value stored on a prepaid card or a mobile operator’s bill. Rather than going through the cumbersome process of keying their card details into a web site, consumers may prefer to use an electronic wallet (typically referred to as a mobile wallet) stored on their handset.

If a passenger’s bank and the associated payment network support virtual cards, the mobile wallet could support digital versions of the consumer’s debit and credit cards and any prepaid cards. To complete a transaction, the wallet would source much of the necessary data from the UICC applet. The bank and the payment network will typically stipulate that larger transactions (usually more than 20 to 25 euros) will require the consumer to enter a mobile code, while smaller transactions can be completed simply by tapping the handset against an NFC point of sale terminal. Mobile operators may also enable passengers to use their mobile wallets to make charges to their postpaid phone bill or their prepaid airtime credit. Regardless of the payment mechanism, the process clearly needs to be simple to use and low cost, yet secure.

Sale/distribution of electronic tickets

If a transport operator continues to use a ticketing system, they will need to issue electronic tickets that can be stored in the secure domain of the UICC and can be validated via contactless smartcard readers. These tickets will clearly need to be both fraud-proof and user friendly – so a consumer can use the mobile wallet or the travel app to easily see the details of the tickets they have purchased. These virtual tickets will need to be transmitted securely over a mobile network, a wireless network and/or an NFC connection.

Management of the lifecycle of transport services/tickets

Once a passenger has purchased a ticket, they may need to change their journey. In this case, they should be able to amend their ticket through the travel app or the mobile wallet, making any necessary payments, via a wireless network. Alternatively, a transport operator may need to amend a ticket because of disruption to services or other unforeseen events and should be able to make those amends (and notify the passenger) either via the travel app or the mobile wallet. Similarly, once a travel ticket has been used, it will need to be disabled, so it can’t be used again, but can still be viewed by the passenger, if necessary.

Provision of customer service

As many passengers will be unfamiliar with the concept of using a mobile handset to validate themselves on a transport network, mobile NFC services will need to be supported by a comprehensive customer service offering.
This may range from extensive and clear FAQs on relevant websites and mobile apps through to helplines and face-to-face support in retail stores and/or stations. Some customers may require a written proof of purchase for NFC-enabled tickets.

These customer service operations need to encompass every aspect of the NFC services from registration through to service termination. They should also be equipped to disable NFC handsets that have been lost, stolen or misused. Transport operators and mobile operators will need to agree procedures covering which party is responsible for which aspects of customer service.

**Delivery of loyalty programmes over the mobile platform**

To reward regular passengers with loyalty points, the transport operator will need to install IT systems that can add such points to the passenger’s travel app or mobile wallet each time they purchase a new ticket. At the same time, the transport operator’s point of sale and billing systems will need to be modified to enable passengers to redeem the loyalty points either via NFC or over a mobile network. If the transport operator chooses to make their loyalty scheme part of a broader programme, some systems integration will be required with the third parties’ IT infrastructure. Transport operators might also use loyalty points to reward passengers who make specific journeys, such as cycling rental bikes to mainline stations during their lunch hour or passengers who get off one stop earlier to alleviate congestion or as part of a health and fitness programme.
9. How to move mobile NFC in transport forward - what to consider

This section aims to outline the most significant considerations for organisations seeking to deploy mobile NFC solutions in the transport sector. As the circumstances of every deployment will differ, the considerations are deliberately high-level and generic – they are designed to act as a check-list to help the various actors ensure they don’t miss anything significant. Note, not all of these considerations will be applicable in every case.

9.1 Commercial considerations for all parties

Strike a balance between using existing infrastructure and supporting interoperability and economies of scale. In an ideal world, all of Europe’s transport infrastructure would use compatible and interoperable NFC validation and ticketing infrastructure, thereby generating economies of scale and ensuring that passengers could travel across the continent using an NFC handset equipped with a travel app and a mobile wallet.

If transport operators are replacing their automated fare collection systems, they should consider adopting a secure, flexible and interoperable solution that utilises software and hardware that can be sourced from multiple suppliers. As such a migration process can be complex and costly, transport operators need to ensure the system they adopt is future-proof.

However, many transport operators can’t afford to replace existing validation and ticketing infrastructure that hasn’t reached the end of its natural life. For that reason, the transition to a fully-interoperable NFC transport infrastructure in which passengers can use their handsets and a single travel app to “roam” across Europe’s transport system is likely to be gradual.

In the meantime, mobile NFC could enable consumers to store multiple tickets from multiple transport operators on the UICC, which can support multiple ticketing standards. However, pan-Europe interoperability, enabling passengers to buy a single ticket to travel across Europe, should be a long-term goal.

Standardisation is important to ensure interoperability and economies of scale.

Actors in the mobile NFC ecosystem should support the work of standards bodies to facilitate interoperability and economies of scale. They should seek to roll out standard mobile NFC solutions (or, at least, solutions that can easily be adapted to work with standards) wherever possible. Clearly, all new contactless infrastructure and all new handsets should be compatible with the ISO/IEC 14443 standard. In time, transport operators may also need to replace existing validation protocols with protocols that can be installed on a wide variety of handsets from a wide variety of vendors.

Develop a sustainable short-term and longer-term business model for all parties in the value chain.

The success of a mobile NFC transport solution will depend on the multiple actors required to support such services being able to build a sustainable business model. Mobile operators, transport operators and their partners need to consider both the short-term and the long-term business case for mobile NFC transport solutions for all parties in the value chain. It may be that different actors in the value chain have different time horizons for making a return on their investment in mobile NFC in transport and these differences clearly need to be catered for. Business models should also consider whether there will be a tipping point in the uptake of a mobile NFC solution in which economies of scale and network effects kick-in lowering the cost of rollout and creating a virtuous circle that makes mobile NFC increasingly attractive for all parties involved.

The actors involved in the deployment of a mobile NFC service also need to strike the right balance between ensuring the involvement of companies well-placed to play specific roles and maintaining a lean value chain that can move quickly and is cost-effective.

Some transport operators with gated systems and simple tariff structures may be able to move to a system in which payment for travel is simply deducted from debit or credit cards. They may be able to effectively outsource some
of the costs related to ticketing to the financial services industry. However, in this scenario, the transport operator may not be able to deduct payment in real time (in less than 300 milliseconds typically) and may run the risk of fraud – the passenger may have insufficient funds in their debit or credit card to pay for the travel they have undertaken.

Mobile operators will expect to generate revenues to offset the costs they incur and the risks associated with the provision of value-added services in the transport sector. Given the considerable uncertainty around the business case for NFC services, it may be appropriate to deploy business models that share the risks and rewards across multiple parties.

**Target rapid uptake to generate economies of scale**

Although the circumstances of each mobile NFC deployment in the transport sector will be different, in general, there should be an emphasis on a rapid rollout to build economies of scale for both transport operators and mobile operators. To realise cost savings, local transport operators, for example, should look to move as quickly as possible to a point where the uptake of mobile NFC enables them to reduce the number of manned ticket booths and ticket machines. As a general principle, a business model based on high volumes and low margins may be preferable to a business model based on low volumes and high margins.

**Develop a robust and secure framework for the management of customer data**

The use of mobile NFC in the transport sector will capture a lot of potentially sensitive data about individuals, ranging from bank card details to information where they live, where they work and where they were and when. Individuals are unlikely to use their handsets to tap in and out of stations if they believe that the resulting data is insecure and could find its way to unauthorised third-parties. It is, therefore, critical to communicate clearly with consumers about how their personal data is protected and the rules governing its use. Ultimately, mobile NFC solutions will only be used by consumers if they trust the companies providing those services to safeguard their personal data. As a general rule, personally-identifiable data should only be shared with third parties if the individual concerned has given their express permission.

**Where feasible, use joint ventures, associations or hubs to reduce the need for bilateral negotiations**

Given the large number of transport operators and multiple mobile operators in each European country, negotiating bilateral agreements between each of these parties would be a lengthy and resource-intensive process. Mobile operators in each country may consider establishing joint ventures that would enable transport operators and other service providers to deploy NFC services that are available to all mobile users, regardless of their operator. Alternatively, there may be scope for third parties to create international hubs or programmes that transport operators and mobile operators could use to ease the roll-out of NFC services across multiple entities and geographies. An intermediary could, for example, provide a single interface into multiple transport operators’ back-office systems.

Small transport operators need to consider the case for aggregation from both a contract perspective (the ability to gain economies of scale by aggregating their commercial requirements) and from a technical perspective. Small transport operators could band together and appoint a systems integrator/aggregator to manage distribution of applications and related UICC applets. They could also adopt a common electronic ticketing standard for use on the UICC – such an approach would reduce complexity and would be a step towards creating fully-interoperable transport systems, but different transport operators could still have their own applets to manage specific information.

**Enable passengers to easily purchase tickets across different modes of transport**

To optimise the user experience, transport operators should aim to ensure that consumers can use a single app to research and pay for travel across multiple modes of transport, such as trains, buses, trams, car hire and bike hire. Clearly, this kind of app will need to be able to source up-to-date information from multiple computer servers and interact with multiple billing systems.

**Ensure that international travellers can easily access travel applications for the countries they visit**

Transport operators will need to make it easy for foreign visitors to discover their NFC-enabled travel app. For example, local travel companies should consider entering into partnerships with airlines or long distance rail operators
to promote their travel apps – when a traveller books an airline ticket to a specific city, they could be offered the opportunity to download a travel app for the city they are visiting. Moreover, airports and major stations could be equipped with highly-visible NFC tags which passengers can tap to download the app either through a dedicated Wi-Fi network or by roaming on a mobile network. The passenger should clearly be able to use the app in their own language.

Many transport operators will want an “off-the-shelf” app solution that is straightforward to implement

To lower start-up costs, some transport operators may need off-the-shelf app templates and development tools provided by mobile operators or third parties. Supporting standard functionality, such as ticket purchase and validation, these templates and tools would enable transport operators to quickly and easily deploy travel apps compatible with many different models of handsets.

9.2 Technological considerations for all parties

Mobile NFC services need to work with existing transportation infrastructure as much as possible

To be able to interact with standard NFC handsets, NFC ticketing and validation infrastructure will need to be compatible with the NFC standard ISO/IEC 14443 at the level of the radio interface. But the on-device software – the relevant travel app, the applet on the UICC and the mobile wallet – may all need to be adapted to work with a transport operator’s existing validation protocols.

To keep mobile ticketing secure, sensitive data should stay in the transport operator’s secure domain

The transport operator’s validation architecture should be designed in such a way as to ensure that the data relating to the consumer’s identity, bank details, travel patterns and other sensitive information remains within the secure domain on the UICC, where it cannot be accessed by other applications. At the same time, NFC terminals need to be configured in such a way as to ensure that the data they exchange with the device can’t be intercepted.

Ensure ticket validation at transport termini is quick enough with any operator and any handset

To avoid overcrowding and give passengers a good experience, transport operators may require NFC infrastructure to validate an electronic ticket on a handset or register a payment in 500 milliseconds or less, particularly at busy transport termini handling thousands of passengers during rush hours. Some operators are targeting 300 milliseconds, which is comparable to electronic ticketing systems today: There is a correlation between how fast people can board a bus and how many buses are needed in a fleet – so a fast throughput can save the transport operator significant amounts of capital and operational costs.

Transport operators and mobile operators should consider setting up a compliance programme in which handsets and validation infrastructure from different vendors can be certified as compatible. The availability of several application radio frequency standards, such as ISO/IEC 14443 and NFC standards (ISO/IEC 18092 and ISO/IEC 21481), can result in a lack of interoperability between devices even where an individual device complies with one of these standards. Just as EMVCo and ICAO have defined an implementation specification of ISO/IEC 14443 for their respective industry segments, transport operators and mobile operators should agree a reference implementation of ISO/IEC 14443 for the transport industry. Compliance to this implementation specification should be checked for compatibility with ISO/IEC 10373-6 by test laboratories. Transport operators need to consider how to treat NFC handsets that are unable to meet the required validation speed.

While supporting swift and easy transactions, transport operators may also need to consider some kind of technical mechanism that prevents passengers from new kinds of fraudulent behaviour, such as last minute buying when a ticket inspector appears. Moreover, each transaction must be conducted using robust security standards.

If they are to work with passive type 4 reader tags, NFC handsets will have to generate sufficient power to transmit the necessary data. Such tags are designed to handle more complicated interactions, such as the verification of electronic ID, involving deciphering of long encryption keys. These tags could be used to authenticate passengers who have registered for a service online.
Complete standardisation work

Transport operators, mobile operators and their partners need to ensure that outstanding standardisation work is completed as soon as possible. Mature, robust standards are crucial to achieve as much interoperability between transport operators, service providers, mobile operators and trusted third parties as possible.

Standardisation work continues in the following areas:

- Although NFC infrastructure and NFC devices worldwide are becoming compatible with ISO/IEC 14443, the contactless standard used in the transport industry, incompatibilities between ISO/IEC 14443 and the NFC standard ISO/IEC 18092 have hindered the extension of existing contactless systems to work with NFC. The NFC standard ISO/IEC 21481, intended to bridge the gap between ISO/IEC 18092 and ISO/IEC 14443, originally left too much room for interpretation and is now being tightened. An amendment to ISO/IEC 14443, which is likely to be published in mid-2013, specifies functionalities for NFC mobile phones that will ensure they are compatible with ISO/IEC 14443. Furthermore, standardisation bodies intend to eliminate existing incompatibilities between ISO/IEC 14443 and ISO/IEC 21481.

- CEN TC278 WG3 (Intelligent Transport System) is currently working on an implementation specification of ISO/IEC 14443 for ensuring RF interoperability between contactless fare media, including NFC mobile phones, and fare management system contactless terminals. This implementation specification of ISO/IEC 14443 is designed to take into account both the needs of the transit industry and the current radio frequency limitations of NFC handsets to offer a pragmatic and fast track approach to interoperability without having to wait for the alignment and refinement of ISO/IEC 14443, ISO/IEC 18092 and ISO/IEC 21481 standards.

- At an application level, NFC handsets may also need to support ISO/IEC 7816-4 to enable them to communicate with terminals that use different ticket validation schemes.

- ISO and CEN have also agreed to adopt the recommendations of the European Commission-funded EU-IFM project. These recommendations are incorporated in a new standard, ISO/IEC 24014 Part 3, to complement the existing standard for Interoperable Fare Management, ISO/IEC 24014 Part 1. This is the standard used by ITSO and its counterparts in other countries to manage interoperable ticketing schemes.

The GSMA continues to work on improving interoperability across the NFC services provided by different mobile operators, building on its existing technical documents that address NFC services interoperability between mobile operators. These include:

- GSMA NFC UICC Requirements Specification Release 2.0 and 3.0
- GSMA NFC Handset & API Requirements Release 2.0 and 3.0
- GSMA Mobile NFC Infrastructure v1.0
- GSMA NFC MNO-SP Interface Business Process Implementation v1.0
- GSMA NFC SP Applet Development Guideline v1.0

Ensure an NFC phone with a flat battery can still interact with an NFC terminal

Given the growing use of mobile multimedia services, there are increasing demands on handset batteries. However, even if an NFC handset has a flat battery, the contactless terminal should still be able to validate a ticket or deduct a payment, as appropriate. NFC handsets should be capable of operating in these circumstances. However, an NFC handset with a flat battery won’t be able to run applications and will, therefore, only support limited functionality.

9.3 User experience considerations for all parties

Automate wherever possible

In general, the more actions required of a consumer, the less likely they are to complete an interaction. For that reason, mobile NFC solutions should be as automated where possible without compromising security and privacy. For example, the ticketing purchase process needs to strike a balance between asking a consumer to key detailed information into their handset and the need to authenticate the passenger and ensure that they are actually buying the ticket they want. Similarly, interactions between NFC handsets and terminals/tags need to be quick and easy, while ensuring that there is sufficient transparency.
to enable the consumer to easily understand what they are doing or authorising.

When a passenger touches their NFC handset against a control terminal, the terminal could auto-select the correct travel applet on the UICC to ensure quick and easy validation. Terminals and handsets that are compliant with ISO/IEC 14443 should already support this functionality.

Preinstall apps where practicable

In some cases, NFC handsets purchased in a particular country could be shipped with relevant transport apps pre-installed. Pre-installing apps in this way removes the need for the passenger to go to the trouble of identifying and downloading the correct travel apps. The presence of a well-designed travel app on their handset will also encourage consumers to learn about NFC services and experiment with them. However, the appropriate UICC applet may still need to be provisioned over-the-air.

Ensure that enrolment is straightforward, yet secure

When a consumer opens a transport operator’s app or web site, it needs to be immediately apparent how they register to use the service and what the benefits are. The enrolment process needs to be designed to be straightforward to complete on a mobile handset (key inputs should be kept to a minimum), but it also needs to be transparent, secure and fraud-proof.

Great care needs to be taken in ensuring that travel applications are simple and intuitive to use on a mobile handset with a relatively small screen and no physical keyboard. Where possible, travel applications should use icons, rather than text, and should avoid asking the traveller to key in lots of information. Ideally, they should “learn” which destinations the user is interested in and provide appropriate shortcuts that will speed up navigation through the app.

Support a range of different payment options

Ideally, travel apps will accept a wide range of payment options, such as debit and credit cards, stored-value accounts, carrier billing (the ticket is charged to the consumer’s postpaid mobile bill or available prepaid credit). Payments could be initiated by the mobile wallet application on the customer’s handset or by the relevant travel app. Note, the provision of stored-value accounts may require a licence from the financial regulator.

Ensure full transparency and offer choice and control around use of customer data

NFC services should adopt a privacy by design approach – in other words they should be developed from the outset to support a high level of privacy and data security. It is crucial that mobile operators, transport operators and their partners should be very clear with individuals about how they will use information about a person’s use of NFC services. It is also important that individuals are given choice and control over how their information is used for secondary commercial purposes such as targeted advertising. This will require giving users simple, concise, and context appropriate messages and choice mechanisms, as opposed to lengthy and legalistic terms and conditions. Before sharing personal data with third parties, mobile operators, transport operators and other actors in the transport value chain should explicitly ask the individual’s permission, stating clearly how the data will be used and for what purposes.

Consistent and clear branding and promotion of mobile NFC services

NFC services should be branded in a consistent and simple-to-understand way so that consumers quickly recognise when and where they can use their NFC handset. They should also be promoted in a consistent and clear way that carefully articulates how consumers can use NFC and what the benefits are. Consistent and clear communications both to consumers and the media will minimise confusion and increase usage.

Accessible and effective customer service, particularly in cases of lost or stolen handsets

Consumers with questions or concerns should be offered a broad range of customer care options, including clear and comprehensive FAQs and the opportunity to speak to knowledgeable staff. Individuals who lose a NFC handset will naturally be concerned that someone else could use it to make payments or purchase transport tickets. The process by which they can seek customer services support and disable a handset needs to be clear and simple to use. The process to reinstate transport-related services, tickets, applets, etc, on a handset/UICC that is subsequently found by a customer, or to transfer these to a replacement handset, also needs to be clear and simple.
9.4 Political/regulatory considerations

Win political support by highlighting the potential of mobile NFC to increase usage of public transport.

In order to win political support and possibly public funds, both the transport and the mobile industry should highlight the potential socio-economic benefits of deploying mobile NFC solutions. In particular, they should explain how mobile NFC solutions could make public transport easier to use and thereby reduce reliance on private cars. Greater use of public transport would reduce congestion on the roads, yielding economic and environmental benefits. In South Korea, for example, the government has played an active role in the roll out of interoperable mobile NFC services in the transport and retail sectors.

Highlight the potential for mobile NFC to increase the mobility of citizens within Europe

The mobile ecosystem should highlight to policy makers the longer-term potential of mobile NFC to make it easier for European citizens to use public transport to travel across borders, increasing trade and cultural exchange. As transport ticketing and validation infrastructure is upgraded to be compatible with mobile NFC standards, travellers will increasingly be able to use their handsets to roam across borders, reducing the friction involved in international travel.

Work with regulators to establish who can do what with sensitive customer data

Ideally, companies providing mobile NFC services should work with regulators to establish the ground rules for both how individuals and businesses can use NFC-derived data to support public policy objectives and help drive economic opportunities. For example, they should clarify under what circumstances transport operators and mobile operators can use the data generated by mobile NFC solutions to provide personalised services and make targeted offers.

They should also highlight the broader value and role of ‘big data’ in helping to plan for and provide transport infrastructure and services that help reduce congestion, pollution and meet a range of public transport policy objectives.

In April 2011, the European Commission signed a voluntary agreement with industry, civil society, ENISA (European Network and Information Security Agency) and privacy and data protection watchdogs in Europe to establish guidelines for all companies in Europe to address the data protection implications of smart tags (Radio Frequency Identification Devices – RFID). The agreement established the Privacy and Data Protection Impact Assessment (PIA) Framework for RFID Applications.

To encourage competition, ensure that mobile NFC can be used by a wide range of service providers

Mobile operators and their partners should seek to ensure that any legitimate transport operator, bank or payment services provider can use the mobile wallet and the UICC to provide consumers with mobile NFC services. In other words, mobile NFC handsets should be an open platform that facilitates competition between competing transport operators, banks and payment services providers.

Ensure that open standards are supported

Public transport authorities should encourage transport operators, mobile operators and their partners to comply with standards as much as possible to fuel competition and increase interoperability. In particular, they should seek to ensure that the deployment of mobile NFC services doesn’t reduce competition in the transport ticketing sector by locking elements of the ecosystem into technologies which are not available from multiple suppliers. At the same time, public transport authorities must ensure that any technological requirements or commercial requirements don’t place an excessive financial burden on transport operators that would require fare increases.