A Global Study in Transport
How Mobile Technology is Enhancing the Passenger Experience

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The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai and the Mobile 360 Series conferences.

GSMA’s Digital Commerce Programme
As the number of commercial mobile commerce services around the world rises, the GSMA continues to promote the use of common standards to enable the global interoperability of services and generate economies of scale. Working with mobile operators, regulators, banks, card schemes, retailers, transport operators and other service providers across the globe, the GSMA’s Digital Commerce programme is active in driving the mass adoption of SIM-secured digital commerce services globally.

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Table of Contents

About GSMA
1 Executive Summary
  1.1 The position of transport operators
  1.2 The value to mobile operators
  1.3 The value for passengers
  1.4 Implementation considerations
2 Introduction
  2.1 The rise of mobile transport services
  2.2 The objectives of this paper
3 Market by market overview
  3.1 China
  3.2 Hong Kong
  3.3 France
  3.4 Italy
  3.5 Japan
  3.6 The Netherlands
  3.7 South Korea
  3.8 Poland
  3.9 Spain
  3.10 United Arab Emirates
4 Key takeaways
  4.1 Business model for the transport operators
  4.2 Business model for the mobile operators
  4.3 Value chain
  4.4 Customer proposition
  4.5 Technical implementation
  4.6 Deployment strategists
5 Conclusions
6 Glossary
Commercial services that enable consumers to use mobile phones to pay for transport are now live in many markets in Europe, the Middle East and Asia. In cities in China, France, Hong Kong, Japan, Poland, South Korea, Spain and the United Arab Emirates, for example, passengers can buy tickets using their mobile phone, store them on their SIM card and then validate them via the short-range wireless technology NFC. In Italy and the Netherlands (the other two markets covered in this paper), transport operators have trialled SIM-based NFC solutions and are considering commercial launches. While SIM-based NFC is gaining considerable momentum, other mobile technologies, such as SMS and QR codes, are also used in some markets to enable passengers to pay for transport and validate tickets.

1. Executive Summary
1.1 The position of transport operators

There are multiple business drivers behind the adoption of SIM-based mobile NFC by public transport operators. These include:

Providing a better passenger experience, fuelling greater usage: Transport operators are keen to provide a holistic mobile service that supports travel information, payments, ticketing and loyalty. A solution that enables passengers to buy tickets or pay for travel directly from their mobile phone results in shorter queues at ticket machines and a faster throughput in transport terminals, improving the passenger experience.

Although some transport operators already enable regular passengers to bypass ticket machines by configuring their plastic smart cards to be topped up automatically via a linked payment card, a mobile solution could be convenient for occasional travellers (including tourists and business travellers) who don’t own the relevant smart card.

Cross-selling/up-selling transport services: Some transport operators see opportunities to use a mobile app to advertise cross-sell and up-sell services. For example, the app could enable a passenger to easily upgrade their ticket from standard class to first class.

Supporting third parties: Transport operators can enable the consumer to use their stored value account on a mobile phone to make micropayments in convenience stores and web shops. The transport operator then earns a commission on the transaction.

Negotiation points: Even though many transport operators see considerable value in using SIM-based NFC services, they are prepared to negotiate hard on some issues, such as:

- The scale of mobile operators’ SIM-related charges
- The extent of cellular coverage on their transport networks
- The pre-installation of applets on the NFC SIM cards issued by mobile operators

1.2 The value to mobile operators

For mobile operators, the roll out of mobile transport ticketing and payments will help them broker more advertising and marketing, while reducing customer churn.

Negotiation points:

- The pre-installation of applets on the SIM card and enabling the consumer to use their stored value account on a mobile phone to make micropayments in convenience stores and web shops. The transport operator then earns a commission on the transaction.

1.3 The value for passengers

For passengers, the value proposition of mobile transport solutions typically revolves around greater convenience. As well as enabling consumers to buy tickets or pay for transport without visiting a ticket machine, a mobile transport solution can provide timely and targeted information that can help passengers avoid delays and purchase the optimum ticket. In some deployments, passengers may also benefit from rewards and incentives, together with personalised offers and information.

1.4 Implementation considerations

In the markets covered in this paper, mobile operators and transport operators are assembling a variety of different value chains. While some markets are employing hubs and aggregators to achieve economies of scale, others are relying on direct one-to-one relationships designed to support customised solutions. There are significant differences between markets in terms of the use of trusted service managers (TSMs), pre-installed applets and the user experience, particularly with respect to registration requirements.

In most implementations, the transport operator is providing a mobile app that can interact with the relevant applet on the SIM card and enable the consumer to buy tickets and/or store value. In some cases, the consumer may also be able to use a mobile wallet provided by the mobile operator to make transport-related purchases. In other cases, the mobile operator’s wallet may act only as a discovery mechanism that helps consumers find mobile NFC apps. And some mobile operators are not providing any kind of wallet at all.

While some deployments are low-key and small scale, some mobile operators argue it is crucial to grow a mobile transport service rapidly to reach volumes that make the business model viable for all the parties in the value chain. To that end, they argue that the service should be integrated into transport operators’ existing mobile apps via an upgrade, rather than requiring the consumer to download a special app or wallet to support NFC. Some mobile operators also believe it is important to offer incentives to consumers, such as free journeys or free tickets, to try the service.
2. Introduction

2.1 The rise of mobile transport services
Consumers have become accustomed to using social networks, dedicated apps and mobile web sites to quickly access information and make purchases. They increasingly expect to be able to use their handset to also perform daily tasks, such as paying for transport. Mobile technologies and services can enhance the passenger’s experience in multiple ways. These include:
- enabling the consumer to buy a new travel ticket from anywhere
- sending personalised updates on how the transport network is running
- notifying the consumer of transport-related offers

At the same time, many transport operators are under pressure from transport authorities to cut costs while making their services easier to use and more appealing for passengers, encouraging modal switching away from their private car. This pressure reflects policy makers’ desire to reduce both congestion on roads and the impact of private cars on the environment. At the same time, transport operators are typically required to keep ticket prices down to a level where public transport is affordable for the vast majority of the population.

2.2 The objectives of this paper
This paper explores how mobile technologies and services are helping transport operators to both contain costs and improve the passenger experience. It provides a factual overview of mobile transport deployments in various markets round the world and related analytical insights designed to highlight current trends and best practice.

The paper explores the deployment of mobile transport services in 10 very different markets: China, France, Hong Kong, Italy, Japan, The Netherlands, Poland, South Korea, Spain and the United Arab Emirates. Transport operators and mobile operators in many of these markets are using a combination of cellular networks and short-range technologies, such as Near Field Communication (NFC), to make it easier for consumers to pay for travel and access relevant information.

The authors interviewed mobile operators and transport operators in these markets to understand the business rationale and business models behind the deployment of mobile transport services, the value chain supporting these services, the consumer experience, the technical solution and the deployment models used.

This paper’s primary objective is to give transport operators, transport authorities and ticket distributors greater insights into how their peers are deploying mobile technologies and services to enhance the travelling experience. But its findings will also be valuable for mobile operators and technology vendors within the mobile ecosystem.
3. Market by market overview

This section of the report outlines how mobile technologies and services are being deployed by public transport systems in 10 countries in Asia, Europe and the Middle East.
3.1 China

In China, each city’s transport operator issues its own contactless cards for public transport. These cards, which tend to use different validation protocols, can typically be used on buses, trams and metro trains, and also in retail shops in some cities.

All three of China’s mobile operators are working with various city transport operators to enable passengers to use NFC-enabled mobile phones to validate travel on buses and metro systems. China Mobile, for example, provides mobile NFC transport services in 24 cities, enabling passengers to top-up their credit over the air rather than queuing at a ticket machine or sales desk.

The evolving value chain

China’s mobile operators are working independently of one another, forging direct relationships with each transport operator and their trusted service managers (TSM) to provision their applets on NFC SIM cards. But the Chinese government is considering enabling transport roaming through the creation of a TSM hub. It has set up two alliances, controlled by the Department of Building and Housing and the Ministry of Communications, which are trying to set standards and push all transport operators to use the same protocols, which would reduce costs, simplify deployments and make it easier for passengers to travel across multiple networks.

Since the start of 2015, China Telecom has been piloting a solution that enables a mobile phone to be used as a top-up machine for plastic cards, a NFC wallet or an RFID card with a non-NFC phone (see graphic). Telecom’s EasyCardTopup service, which is in the BestPay app, is supported by more than 10 transport operators.

China Telecom’s EasyCardTopup service

China Telecom has piloted its transport ticketing solution in more than 60 cities. Each pilot involved several hundred customers. By the end of 2015, China Telecom plans to provide commercial SIM-based services in more than 50 cities, including Shanghai and Beijing, enabling consumers to use the same protocols, which would reduce costs, simplify deployments and make it easier for passengers to travel across multiple networks.

To use China Mobile’s transport service, customers have to download the relevant transport operator’s applet and top-up card. China Unicom customers can register for its mobile transport services in Unicom retail stores, which also supply a NFC SIM, and then download the Unicom wallet app from an app store.
3.2 Hong Kong

Octopus - the only transport payment card in Hong Kong - was launched in 1997 by the Octopus card company, which is owned by five major transport operators - Mass Transit Railway (MTR), Kowloon & Canton Railway (now merged with MTR), Kowloon Motor Bus (KMB), Citibus, and the Hongkong and Yaumati Ferry (HYF) (now belonging to New World First Bus).

Since 2000, Octopus has also supported non-transportation services, such as small transactions in convenience stores and entry access for buildings. Octopus has said that more than 45% of its revenue is generated from non-transportation payments, highlighting how a closed loop payment system for transport can evolve into a multipurpose prepaid card.

In 2001, Octopus extended its services to cover most transport services in Hong Kong, such as peak tram, public light bus, some taxis and many public recreation services payments. In 2003, it added support for payments to parking meters and public utilities. Octopus cards, which use Sony’s FeliCa contactless technology, can now be used in Hong Kong and neighbouring Shenzhen for transport payments.

More than 27 million Octopus cards have been issued in Hong Kong, while more than 70,000 readers have been deployed across the territory.

In 2013, Octopus and PCCW (now Hong Kong Telecom) launched the Octopus Mobile SIM. The Octopus applet is pre-loaded into the NFC SIM for Android handsets to enable consumers to pay for transport services with their phone. The daily payment limit is HK$1,000. To date, the Octopus Card Company is only working with Hong Kong Telecom to provide mobile transport payment services.

The consumer inserts the Octopus Mobile SIM into a compatible NFC-enabled smartphone running Android. They then need to download the Octopus app from Google Play on to their handset and add value with cash at any MTR Customer Service Centre or Octopus Authorised Add Value Service Providers - up to a maximum of HK$1,000. The consumer can then use the Octopus Mobile SIM by tapping it against Octopus readers. No activation or further steps are required.

The consumer can use the Octopus app to check their balance and the last 40 transactions. As with a plastic Octopus card, the consumer can also apply to use the auto-top up service from participating financial institutions, which will input funds when the balance falls below a specific threshold.

The role of mobile operators

The Octopus Mobile SIM employs the Felica contactless standard, which has been built into mobile phones in Japan since 2004. A wide variety of card services have been developed, including public transport tickets, electronic money and various types of ID services.

However, Hong Kong Telecom had to re-certify its existing EMV-endorsed NFC SIM before Octopus could be loaded into the SIM and used together with the SIM applet of Mastercard.

Supplied by Gemalto, the Octopus Mobile SIM uses the Single Wire Protocol to communicate between the SIM card and the NFC chip in the handset. However, unlike many SIM-based NFC services, the Octopus Mobile SIM can’t be used when the phone’s battery is flat.

In February 2014, Octopus launched a new version of its mobile app supporting the Octopus Online Payment Service, which enables consumers (even without an Octopus Mobile SIM) to make online payments by linking their Octopus card to their mobile phone via NFC. Octopus said in June 2014 that there have been more than 600,000 downloads of the Octopus app. It also noted that there were more than two million NFC phones in use in Hong Kong.

Along with SK Telecom, Chunghwa Telecom, China Telecom and KDDI, Hong Kong Telecom is part of the Asia NFC Alliance to facilitate mobile NFC roaming. International mobile Octopus services are now under development between Taiwan, China and Hong Kong with a goal of enabling subscribers in the three areas to download the Octopus applet on their phone before they travel to Hong Kong. Then they could top up and use the Octopus applet in Hong Kong.

1 EMV (European Multi-Card Vox) is a technical standard to enable smart payment cards and terminals to interact.
3.3 France

Most local transport operators in France enable people to use smart plastic cards to access and pay for public transport, typically via the Calypso validation protocol. A growing number of French cities, including Strasbourg, Nice, Caen, Lille, Tours, Bordeaux, Toulouse and Marseille, are also adopting mobile NFC solutions, while the Paris area is launching a major project to use mobile NFC as part of an industrial plan supported by the government.

Transport is the largest of the four streams in the government’s NFC development project, which is led by technology vendor Gemalto. As part of this NFC development project, Gemalto, RATP, SNCF and Orange have initiated a common approach to facilitate the issuance of tickets on mobile NFC handsets. The aim is to make it easy for consumers to use their mobile phone to buy and validate tickets combining several transport modes, such as metro, train, bus, or tram. It is by far the most ambitious project launched in France.

In Nice, one of the first deployments of mobile NFC in France, 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 SIM card 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.

Similarly, CTS, the transport operator in Strasbourg, launched ticketing on NFC smartphones running Android in June 2013 in partnership with mobile operators Orange, Bouygues Telecom, SFR and NRJ Mobile. However, CTS didn’t want to replace its existing readers, so it is using low cost NFC tags, which are not interactive, rather than NFC readers (see below).

Passengers can use the U’Go mobile application to buy either monthly or daily tickets for bus and tram journeys. Payments of up to 15 euro can be charged to the user’s mobile phone bill or paid via their bank card. For payments higher than 15 euro, users are required to enter their bank card details to complete the purchase. NFC tags are located in train stations and attached to ticketing machines on buses in the Strasbourg region for customers to tap their phones on to validate their prepaid ticket before travelling.

The transport applet on the passenger’s SIM card is then updated via a mobile data connection, as soon as possible. The system also allows ticket inspectors to check mobile tickets for up to 24 hours after a passenger’s battery goes flat or while their phone is turned off. CTS isn’t using photos for ID. The inspectors typically just check that the ticket has been validated. If they have doubts, they can check the name encrypted on the SIM card and ask the passenger to show some matching ID.

Regional and national travel

National train operator SNCF has also deployed mobile NFC services on several regional routes. For example, passengers traveling in the Bretagne region are able to use NFC handsets to access information about local buses, station parking, regional trains and national trains.

Building on the e-ticketing system largely developed for the TGV, SNCF has also started an NFC service on the route 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, they can buy a ticket, cancel a ticket or change train if, for example, they have arrived early at the station and want to take the earlier train.
3.4 Italy

In Italy, mobile operators and transport operators have been working together for several years to enable passengers to pay for journeys using their mobile phones. Transport operators in some of the largest Italian cities, including Rome, Milan and Florence, now enable consumers to purchase tickets by SMS.

In March 2012, for example, the city of Florence launched a mobile ticketing service on the city’s public transport system, which is managed by ATAF, together with mobile operators Telecom Italia Mobile (TIM), Vodafone, Wind and 3 Italia, supported by equipment supplier Ericsson. The service enables passengers to buy bus tickets through their mobile bill by sending a SMS. The passengers pay the cost of the ticket, plus the cost of the SMS, which varies by operator.

A few seconds after they send the SMS, the passenger receives a message containing the details of the ticket, such as the issuing time and the period of validity. The passenger then shows the bus conductor the code received via SMS. The transaction, which uses an encrypted data channel, is handled by the operators’ billing systems.

In June 2015, Milan’s public transport company, ATM, began to enable commuters to purchase their tickets via SMS and store them on their mobile phone. The service works in a similar fashion to the SMS ticketing service in Florence and is also supported by the four major Italian mobile network operators.

Since May 2015, TIM customers can store and view the SMS ticket purchased inside the TIM Wallet. Moreover, TIM says it has forged partnerships with transport operators in Bologna, Napoli, Milan, Ravenna, Torino, and other major cities and with several third party companies which act as hubs.

TIM says participants in these trials can access transport services using the TIM Wallet. A Calypso or Mifare Classic applet is downloaded onto the user’s SIM card, enabling it to use NFC to interact with the contactless validation systems used by Italian transport operators.

For the applet download and activation, the transport operator can choose whether to use a hub TSM or have a direct connection to TIM. However, in the case of the SMS-based services, the transport operator has to connect to the TIM SMS Hub.
3.5 Japan

Japan’s transport networks use a contactless payment system based on the FeliCa technology developed by Sony. Since 2013, FeliCa plastic smart cards, on which consumers can store value, can be used on any of the transport networks in Japan.

Japan was the first country in the world to integrate transport payments into the mobile phone, with the launch of the Mobile Suica service in 2006. Mobile Suica is part of the Osaifu-keitai (wallet phone) suite of services, which enable customers to use their handsets to make contactless micro-payments at point of sale. There are 33 million Osaifu-keitai cellphones in circulation in Japan.

Osaifu-keitai employs an embedded FeliCa chip provided by FeliCa Networks, which is owned by NTT DoCoMo, Sony and East Japan Railway Company (JR East). The FeliCa chip is now embedded in all smartphones, other than the iPhone, sold in Japan.

Japan is now upgrading its Mobile FeliCa infrastructure to support the international NFC standard, ISO/IEC 14443 A & B, while its mobile operators are offering handsets that are compatible with both FeliCa and ISO/IEC 14443 SIM-based NFC services (see diagram opposite).

Although one in two people in Japan has a mobile phone with NFC FeliCa functionality, according to FeliCa Networks, the iPhone accounted for more than 60% of smartphones sold in Japan in the third quarter of 2014, according to IDC.

The Mobile Suica solution makes it easy for passengers to check up-to-date transport information, the total amount of money stored on their virtual card and the cost of each journey on the phone. Mobile Suica also enables passengers to buy tickets online. JR East gives loyalty points to Mobile Suica users, which can be exchanged for items of value.

In the air travel sector, All Nippon Airways (ANA) has enabled passengers to use feature phones with embedded FeliCa as a boarding pass from 2004. The other major airline, Japan Airlines (JAL), launched the same service in 2005. Both airlines employ NFC readers at their counters, baggage inspection gates, lounges and boarding gates. In 2012, the service was extended to NFC smartphones. JAL’s and ANA’s frequent flyer programmes provide customers who use their mobile services with extra points.

The role of mobile operators

Japan’s mobile operators formed the Japan Mobile NFC Consortium (now called the Mobile NFC Association) in 2011 to make it easier for transport card issuers, transport operators, airlines and any service providers in Japan, to deploy mobile NFC services based on Type A/B technology on the SIM. Underpinned by the Consortium’s specifications, the mobile operators provide common and consistent requirements to handset manufacturers, such as Sharp, Samsung and Sony, UIM manufacturers, TSM vendors and service providers.

The payment networks, such as VISA and MasterCard, run conformance test programmes to ensure interoperability. To use FeliCa, handset manufacturers have to pass conformance tests regulated by FeliCa Networks and JR East.

Japanese mobile operators’ wallets act primarily as a launcher for service providers’ applications. However, some of the mobile operators have issued credit cards for their customers, such as iD card provided from NTT DoCoMo. The mobile operators earn a commission when a customer uses their credit card to top-up the FeliCa transport card in the phone.

Support for wearables

FeliCa Networks is reported to be modifying its FeliCa contactless card technology for use in wearables. The company is said to be designing a low-power chip that could be used in smart watches and smart bands. That could allow users to board a train or bus simply by waving a smart watch near a chip reader, eliminating the need for a separate smart card.

2 Source: Computerworld article
3.6 The Netherlands

In the Netherlands, there are 10 transport operators, including bus companies and the national rail service. Translink handles payments on behalf of the transport operators via the OV-chipkaart system. Translink issues OV-chipkaart smart cards, which employ the Mifare protocol for communication between the card and terminal.

Translink says the OV-chipkaart is used for millions of transactions every day, including check-ins, check-outs and purchases, resulting in more than two billion transactions every year. After checking and processing the transactions overnight, Translink distributes revenue to the transport operators.

The OV-chipkaart is designed to exchange information with a reader within a very short time window (around 250 milliseconds). This exchange can take place over distances of up to 10 centimetres, depending on the make and model of the terminal. The chip in the card includes a public transport application, which contains details of the last 10 travel transactions, the last two reloading transactions, optional travel products, an electronic purse holding credit and the cardholder profile.

There are three types of OV-chipkaart:

- A personal OV-chipkaart that displays a name, date of birth (enabling terminals to apply automatic age discount where applicable) and photograph and can only be used by the cardholder. The profile can be configured to support automatic reloading, so that each time the owner’s credit drops below €0, a fixed amount will automatically be added to their OV-chipkaart, which is debited from the user’s bank account after a few days.

- An anonymous OV-chipkaart that does not display any personal details. It can, therefore, be used by more than one passenger - but not at the same time. It is a pre-paid proposition, where the cardholder must charge the card with money (or a travel product) upfront, in order to travel.

- A business OV-chipkaart that is issued and distributed by individual business card providers (Translink only produces the card). It is based on a post-paid proposition, where employees of a company can travel using the card without charging it upfront, because the company is invoiced by the business card provider afterwards.

Trials of a mobile solution

In the past year, Translink, KPN and Vodafone have carried out a proof of concept, using SIM-based OV-chipkaart running Mifare4Mobile in a NFC smartphone. Translink created the high-level design of the system that allows for remote issuance of the OV-chipkaart to the NFC-SIM using the Vodafone Wallet, SIM and TSM infrastructure. The solution enables purse top-ups and product sales after the OV-chipkaart has been issued, reusing the TSM infrastructure.
3.7 South Korea

There are two major transport payment card schemes in use in South Korea: T-Money and Cashbee. T-Money was launched in 2007 by the Korea Smart Card Company (KSCC), which is owned mainly by Korea Metropolitan Government, LG Group and Credit Card Group Company. T-Money can be used with more than 9,000 readers in metro stations, 20,000 buses, 120,000 taxis and more than 80,000 retailers in Seoul.

The Cashbee e-money card was launched in December 2010 by EB Card, an affiliate of the food and shopping multinational corporation Lotte Company. It has about five million users and is accepted at some 54,000 locations, including department stores and convenience stores in the Lotte group, as well as most subways, buses and taxis in Seoul.

Both the T-Money and Cashbee plastic cards use the Mifare validation protocol.

Mobile NFC deployments

Working with the three mobile operators in South Korea (SKT, KT and LGU+), T-Money and Cashbee have enabled consumers to access their services via their handsets. Consumers can now use a compatible NFC handset instead of a plastic card to make T-Money and Cashbee payments in the transport system, as well as in retail outlets and restaurants.

Both the T-Money and Cashbee mobile services enable consumers to use a pre-paid account or post-paid account, compatible with the BC Card payment network, which can either be linked with a credit card or a bank account. The mobile services enable users to check recent transactions on their handsets through the relevant app and prepaid users can easily check their balance. Both mobile services offer reward points for usage. However, users may need to pay certain fees to top-up Cashbee and T-Money cards: 6% via operator billing, 2-3% via credit card and 3% via bank transfer.

The mobile Cashbee and T-Money services are compatible with handsets running Android, Windows or the iOS operating systems. However, iPhone users need an NFC case, as the NFC chip in the iPhone isn't compatible with SIM-based NFC. There are more than 4.2 million T-Money and Cashbee mobile users in Korea.

Some foreign visitors to South Korea can also use these services. Visitors from Japan are able to download the Cashbee card through mobile operators NTT DoCoMo, KDDI and Softbank on to their SIM card. Consumers in Japan can then use the Cashbee card in South Korea for payment in convenience stores and public transport. In Singapore Changi airport, travellers can also buy a NFC SIM with Cashbee pre-loaded.

The mobile value chain

The Korean Communications Commission formed the Hand NFC Korea Alliance in June 2011. Beside the three major mobile operators, the Alliance’s members include payment card providers; Hana SK Card, BC Card, Shinhan Card, MasterCard and KB Kookmin Card, device manufacturers; Samsung, LG, Pantech, UbiVelox, KEBT, MtekVision and 3A Logics, and telecoms billing service providers; Danal, Mobilians, KCP and Galakia. The Alliance is also supported by government organisations and an array of industry associations.

The Alliance was established to coordinate the simultaneous rollout of compatible NFC handsets, SIMs and point of sale equipment. It mandated the use of SIM-based NFC underpinned by the Single Wire Protocol. The Alliance also ensures the interoperability of NFC-based services, so that, for example, different merchants’ coupons will work on different mobile operators and different handsets. The Grand NFC Korea Alliance and the transport payment companies share high-level usage information with their members, including mobile operators.

The role of the mobile operators

South Korea’s mobile operators provide mobile wallets, which help users to manage different NFC applications, store credit cards, transportation cards, membership cards and coupons and enable access to special promotions. The mobile operators charge service providers whenever a NFC service is downloaded through their TSM to the NFC SIM. To enable the mobile T-Money or Cashbee services, a Mifare applet is loaded onto the NFC SIM, enabling the SIM to emulate a plastic card. Once the appropriate applet has been activated on the SIM over-the-air by the operator’s TSM, both T-Money and Cashbee services can be accessed via a mobile operator’s wallet or via the service provider’s app.

The mobile operators earn a commission when a card from their mobile wallet is used to complete a NFC transaction or top-up the transport card in the phone. Similarly, they earn a commission when carrier billing is used for mobile top-ups.
3.8 Poland

After joining the European Union many cities in Poland introduced their own plastic smart cards to enable citizens to access both transport services and other local services (e.g. banking services, bicycles rental, library access, parking). Some neighbouring cities have also merged their systems to enable citizens to use a single smart card across the conurbation. Most of the local transport systems use the Mifare protocol to store and validate tickets on the smart cards.

Consumers can also use the Skycash application to buy monthly transport tickets for seven cities and store them on their mobile phones as a QR code that can then be scanned for validation. Skycash and other applications, such as Mobilet, Mpay and CallPay can also be used to purchase short-term tickets and other services in many more cities.

The first mobile NFC deployment

In February 2015, Białystok became the first city in Poland to enable passengers to use their NFC mobile phones as smart cards for local transport services. In the north east of the country, Białystok is home to about 300,000 people.

A joint initiative by NFC4Mobile (a specialist aggregator), the Management Board of the Białystok Public Transport (BKМ) and T-Mobile Poland, the NFC Białystok City Card is hosted on SIM cards and in T-Mobile’s MyWallet application. T-Mobile subscribers can use the service on NFC smartphones, equipped with a NFC SIM card, after registering on the website www.4tap.pl and visiting the BKМ Point of Sale to confirm their identity.

For the Białystok deployment, T-Mobile has pre-loaded a Mifare4Mobile applet on the NFC SIM card, enabling it to emulate a plastic smart card. The applet supports both monthly and quarterly tickets, as well as a stored value account (ePurse) for short-term tickets enabling passengers to use their phone like a regular plastic city card to check in and out of the transport system.

The applet is personalised over the air using a provisioning platform via an IP bearer, with fall back to SMS.

Today, the Białystok service still requires consumers to use a point of sale or a website to top up their stored value account or buy a ticket. However, consumers can see what tickets and value they have on their virtual card through the MyWallet app.

T-Mobile’s transport solution works with Android handsets, which account for more than 70% of the smartphones sold in Poland, and T-Mobile plans to also support Windows Phone (about 10% of the market).

While T-Mobile is the first to launch a commercial NFC solution, the other mobile operators are likely to follow in 2015. Rather than having a direct technical or business relationship with each city transport operator, the mobile operators are likely to work with aggregators and integrators, which work with multiple cities. In time, there are likely to be a couple of aggregators linking mobile operators and transport operators.

T-Mobile Poland hopes to deploy the mobile transport solution in as many cities as possible. The capital Warsaw, which has more than two million people, is almost technically ready. However, some cities want to wait until all the mobile operators in Poland are supporting these services.
3.9 Spain

In several regions of Spain, transport operators are either piloting or deploying services that enable people to store a virtual transport card on the SIM in a NFC handset and then use the card to pay for journeys. In July 2014, Orange, in partnership with Valencia’s Department of Infrastructure and Transport, launched a commercial service in Valencia. Since then, Vodafone (December 2014) and Telefonica (March 2015) have also begun to support the service. Since the commercial launch, the number of compatible handset models has increased from 12 to 45.

To use the Valencia service, customers need to be equipped with a NFC smartphone running Android and a NFC SIM card. They then download the Mobilis NFC App, developed by Transermobile, and link their credit card to it. The consumer is then able to purchase tickets before travelling, which are stored in their NFC SIM. On board a bus or at a metro station, the passenger can validate their ticket by tapping their phone on a contactless reader via the Mifare protocol. The Mobilis NFC App also enables the user to check information about their transport card, ticket purchases, and maintaining the secure servers used for authentication.

The role of the mobile operators

Although Orange and Telefonica both have NFC apps, their primary role is facilitating discovery, displaying a list of mobile NFC services the consumer can download. The Orange NFC app, which may be preinstalled on the handset, has a ‘discover’ tab where the user can see all the NFC services available, including Mobilis NFC and La Caixa Visa cards. Vodafone has its own wallet, which can be used for transactions, but it also offers the Mobilis NFC app in parallel.

To use the Mobilis NFC app, Vodafone and Orange customers need to have opened the Vodafone Wallet or the Orange NFC app, both of which are available from Google Play, at least once. Telefonica customers don’t need to install or open any other application. Orange says the full installation process for the Mobilis NFC service takes less than eight minutes, after which, the user can buy transport cards and tickets. The user first selects the area transport card and 10, 20 or 30 travel tickets. Then they pay by inputting their credit or debit card data and complete the process by confirming the transaction with a secure payment code. The consumer will then receive a notification that their transport card and ticket is installed.

Orange says NFC validation works without a charged battery and without cellular coverage. Inspectors on the Valencia transport network have a handset that is able to retrieve the relevant information from the SIM even if the consumer’s phone has no power. They can also blacklist a person from the service.

In Valencia, MetroValencia and CITMA are giving first time users two free trips with their first purchase with Mobilis NFC. However, consumers have to pay their mobile operator €2 every five years to use the virtual Mobilis SIM card. This charge is intended to cover the cost of the SIM and maintaining the secure servers used for the TSM. Note, the consumer doesn’t pay any additional fees when topping up their balance.

In Valencia, the transport authority has a TSM and each mobile operator has a TSM. The Ministry of Infrastructure, Planning and Environment of Valencia has certified the Mobilis NFC application.

Transport operators in other cities in Spain are also considering deploying a mobile NFC service, but they are working independently of one another, each taking a different approach, depending on the validation protocols they use and the infrastructure they have in place. Although they aren’t working together, the mobile operators are talking with the same transport operators and sales channels to make their services compatible.

New trial in Madrid

In Madrid, the CRTM (Consortio Regional de Transportes de Madrid) is piloting a mobile contactless solution with the support of Telefonica. To register payment cards and purchase digital tickets, participants in the pilot download a transport application developed by Samsung for its Galaxy smartphones.

Gemalto’s TSM is used to top up the Mifare Desfire applet on the NFC SIMs issued by Telefonica with the tickets bought by passengers. The EMT (Empresa Municipal de Transportes de Madrid) has integrated Gemalto’s TSM into CRTM backend systems.

CRTM says the Madrid pilot is the first deployment of Mifare Desfire, in conjunction with a TSM, to deliver mobile contactless ticketing within public transport. The Mifare Desfire protocol is widely used by transport operators in their smart cards. “EMT developed a Desfire Commands Server in the cloud, compatible with the public transportation card of Madrid and NFC,” says Enrique Diego Bernardo, CIO for EMT. Telefonica says it has had to adapt its TSM to support transport services.
3.10 United Arab Emirates

Established by the government in 2005, Dubai’s Roads and Transport Authority (RTA) is responsible for both public transport and the road network in the Emirate of Dubai, as well as between Dubai and the other emirates in the UAE.

The RTA is aiming to increase the share of journeys made via public transportation in Dubai from 13 per cent in 2013 to 20 per cent by 2020. To achieve this goal, it is developing an integrated mass transit infrastructure that will enable people to travel to and from work with the minimum of fuss, and goods to be moved into and around the city efficiently.

Customers pay for travel on the public transport system using value stored on Nol plastic smart cards - there are more than 6 million Nol cards in circulation in Dubai. Nol uses Mifare Desfire as the validation protocol.

With Smart Nol, travellers can use their NFC phone to check in and check out at the metro stations, public bus and water bus, as well as reload and check their Nol balance. RTL says passengers no longer have to queue for tickets, have the correct change or juggle different payment systems for different modes of transport.

Passengers can review their Nol usage on their handset at anytime, anywhere, rather than having to use a machine in a metro station. The passenger can use an Etisalat or Du app, or a special SIM toolkit menu, to check their current balance and the amount and date of their last Nol recharge. They can also see the date and the cost of their most recent journey, whether they have reached the daily fare cap and their tag ID and expiry date, which a passenger needs when they contact the RTA call centre.

Passengers can top up the virtual card at RTA terminals or counters or online through the Nol web site using a unique number that appears on their display once the NFC SIM is placed into their smartphone.

Passengers need a NFC handset and NFC SIM card to use the Smart Nol service, which is preloaded with Dh 14 (almost 3 euros) of credit. Etisalat charges Dh25 (5 euros) to replace the SIM, plus an Dh50 activation fee and Dh5 monthly rental, while Du charges a flat rate of Dh55 for a SIM replacement, which was supplemented by a NFC service fee of Dh2 a month from March 2014.

Live mobile NFC service

Together with the UAE-based mobile operators Du and Etisalat, RTL has launched the Smart Nol service, which enables passengers to open ticket barriers by tapping a NFC handset against a reader. Credit is stored on a virtual Smart Nol account hosted on the SIM card inside their handset, rather than on a separate plastic card.

At the end of 2013, the RTA announced that Dubai residents will be able to begin paying taxi fares using a prepaid Smart Nol transit card stored on their NFC SIM in 2014. The RTA also plans to enable consumers to use their Nol accounts to pay for some goods and services in shops and restaurants.

If the battery on the passenger’s phone dies before they are able to check out of the metro, they need to buy a single ticket called an “exit ticket” - the same procedure as if they had lost a physical ticket during a journey. If the passenger loses their phone, they need to report it to their mobile operator and the RTA, as well as the local police department. The operator will block the SIM card and all features related to telecommunication services, while the RTA will block the Nol service.

The role of the mobile operators

Etisalat says NFC-based transport payments are an integral part of its “comprehensive NFC offering”, which also includes merchant payments, secure access, loyalty/couponing and mobile identity services. Etisalat’s Mobile NFC app enables passengers to access their Nol card, view their credit and check their transactions history.

Smart Nol is one of several services that can be managed using Du’s transport app. The app, which is available on Android handsets, enables consumers to check their Nol balance and track their recharge history. They can also use the app to recharge their Salik account, which Dubai’s citizens can use to automatically pay road tolls. Moreover, the app can be used to find the closest metro station, to book a taxi and to pay for parking over the mobile network.
4. Key takeaways

Drawing on interviews with mobile operators and transport operators in Asia and Europe, this section analyses how mobile transport solutions are evolving, identifying emerging business models, value chains and technical solutions.
4.1 Business model for the transport operators

Most transport operators are open to using SIM-based NFC services to enable consumers to pay for services with several caveats – they want mobile operators’ charges to be low, cellular coverage on their transport networks to improve and their applets to be pre-installed on the NFC SIM cards issued by mobile operators.

The research for this paper identified several major reasons why transport operators are now moving to adopt mobile ticketing and payment solutions:

**Providing a better passenger experience, fuelling greater usage**

Recognising that many passengers are now using their mobile phones to check timetables and get real-time travel information, some transport operators are keen to provide a holistic mobile service that also supports payments, ticketing and loyalty. As NFC-based mobile commerce propositions, such as Apple Pay and Vodafone Wallet, become established, some transport operators expect people to become accustomed to using their mobile phone in place of a plastic smart card.

Many transport operators see an applet on the SIM card as a natural evolution from a plastic smart card and like the fact that it is secure and tickets/payment can be validated even when the handset has no power. The ultimate goal for some transport operators in Europe, in particular, is to provide an integrated end-to-end passenger experience that advises on the best route, the best price, navigation and enables intermodal travelling. In some markets, several transport operators are likely to pursue this aggregation role competing head-to-head with one another.

In some cases, the widespread use of a solution that enables passengers to buy tickets or pay for travel directly from their mobile phone will result in shorter queues at ticket machines and a faster throughput in transport terminals, improving the passenger experience both for those people buying via their mobile and for those still using machines or kiosks to pay for travel.

If passengers are using a virtual card stored on their mobile phone to validate themselves on the transport network, they won’t be open to so-called card clash, where the reader is confronted with two NFC-based smart cards. With a mobile solution, the consumer could configure which card should be used when.

Although some transport operators already enable regular passengers to bypass ticket machines by configuring their plastic smart cards to be topped up automatically via a linked payment card, a mobile solution could be convenient for occasional travellers (including tourists and business travellers) who don’t own a smart card for that particular transport network. Occasional travellers would no longer have to try and operate unfamiliar ticket machines with the pressure of the queue behind them and would, therefore, be more likely to use public transport.

Mobile ticketing and payment solutions may also help transport operators collect real-time data on public transport use, informing day-to-day travel provision and identifying long-term trends for effective future planning.

**Cutting costs and lowering environmental impact**

Although a mobile ticketing/payments service is unlikely to cut a transport operators’ costs in the short-term, some transport operators recognise that in the mid-to-long term there will be cost savings through the removal of ticket machines and less demand for plastic smart cards. This will also lower their environmental impact.

However, these benefits may not be sufficient to persuade transport operators that lack NFC-compatible validation infrastructure to upgrade that infrastructure.

Many transport operators have issued millions of plastic smart cards at a cost of several dollars per card. One European transport operator estimated that for every euro spent on transport, 15% is spent on getting the money from the customers. However, in some markets, the consumer pays a fee for the smart card, partially compensating the operator for the overheads of running its own currency.
In any case, a move to a mobile solution won't eliminate all these distribution costs. Mobile operators may charge a SIM rental fee, an activation fee or commission on transactions. However, in China and some other markets, competition between mobile operators may enable transport operators to “reverse charge” mobile operators, so that they pay a fee to enable their customers’ phones to be transport-enabled.

To avoid the expense of effectively running their own currency and make it easier to serve foreign visitors, some transport operators want to ultimately migrate to an open loop system by making use of the EMV® payment network, as Transport for London has done. However, to move to EMV, most transport operators would need to undertake a costly overhaul of their validation infrastructure to enable it to recognise EMV payment cards. For that reason, most transport operators are unlikely to move to an EMV-based system until they have to upgrade their infrastructure for other reasons, such as wear and tear.

Tackling fraud
Transport operators believe a mobile solution that enables consumers to buy tickets from their mobile phone should result in a reduction in so-called unintentional fraud, which refers to situations where people intended to pay for their travel but failed to do so because the ticketing machine wasn’t working, their train was about to leave or they didn’t have the necessary payment mechanism. A mobile solution would enable a passenger to bypass such obstacles.

While mobile solutions won’t necessarily eliminate intentional fraud, involving a successful compromise of the validation protocol, they will enable a card that is used for fraud to be disabled via the mobile networks the next time the phone goes online. With a plastic card, it can take a transport operator 24 hours to update the blacklist on every validation terminal on their network, whereas an applet on a SIM card could be disabled via the mobile network.

Cross-selling/up-selling transport services
Some transport operators see opportunities to use a mobile app to advertise and cross-sell a portfolio of services. For example, the app could enable a passenger to upgrade their ticket to first class over the air. This kind of cross-selling depends on the transport operator creating a feature-rich mobile app supporting a range of services. Therefore, in cases where customers can use a mobile operator’s app or wallet to buy travel tickets or view travel-related transactions, transport operators typically require the mobile operator to issue APIs that will enable an app to link to a virtual transport card in the wallet.

Supporting third parties
Transport operators can use a mobile ticketing/payment app as a two-sided mobile commerce platform, by enabling the consumer to use their stored value account to make micropayments in convenience stores and web shops. The transport operator then earns a commission on the transaction. Asian transport operators, in particular, are pursuing this opportunity. Several transport operators noted that an automatic top-up mechanism is important to encourage usage of a stored value beyond transportation – consumers don’t want to risk not having any credit on their card when it comes to travelling.

A stored value account run by a transport operator can also be used for online transactions in some markets, such as Hong Kong. In Japan, where the transport operators issue their own credit cards, a mobile solution could also encourage usage of these cards, earning the issuer transaction fees. In Japan, transport operator JR East waives the Mobile Suica subscription charge for consumers who use its credit card to top up their account.

With the passenger’s permission, a transport operator could also broker targeted advertising and marketing on behalf of third parties. For example, the transport app might display an advert for a restaurant near a station the passenger uses regularly.
4.2 Business model for the mobile operators

Many mobile operators in Europe and Asia are looking to support SIM-based NFC services that enable consumers to pay for public transport. The research for this paper identified several major reasons why mobile operators are pursuing this opportunity.

Seeding SIM-based NFC

Many mobile operators see support for transport services as an effective way to familiarise consumers with SIM-based NFC services and related wallet services, which could generate both direct and indirect revenues. Some mobile operators believe widespread uptake of mobile NFC-enabled transport services will strengthen their strategic position in the digital economy by expanding the role of the SIM card.

As millions of people use public transport regularly (twice a day in the case of commuters), they could soon become accustomed to tapping their NFC phone to complete a transaction. Moreover, in the many transport systems that already rely on plastic smart cards to validate a passenger, mobile NFC ticketing doesn’t require a dramatic change in behaviour on the part of the user. Some commentators believe Transport for London’s support for contactless payment cards effectively kick-started the use of these cards in London retail outlets and cafes. Moreover, in some cities, such as those in Poland, local transport ticketing and payment is integrated with other public services, such as access to sports centres, libraries and other public services.

Earning SIM rental charges/activation fees

Some mobile operators are charging transport operators so-called SIM rental fees – an annual charge for hosting the transport operator’s applet in a secure domain within the SIM card. These fees, typically a few euros a year, may be supplemented by an activation charge to cover the cost of provisioning the transport applet on the SIM card through a TSM. However, some transport operators are resisting this model, noting that it doesn’t necessarily reflect usage of the service.

Earning transaction fees

In some cases, mobile operators are charging a very low percentage commission each time the consumer tops up the credit or buys tickets that are then stored in the transport applet on the SIM card. However, these transaction fees may have to be tiered to reflect the major differences in the prices of travel tickets – the cost of a single bus journey may be one euro, while a season ticket could cost hundreds of euros.

Some mobile operators, such as those in Japan, issue their own credit cards and will earn a transaction fee if that card is used to buy a ticket or add value to a transport account. In some Asian markets, regulation allows mobile operators to enable consumers to pay for transportation via their cellular bill. Again, the mobile operator will typically earn a commission on third-party transactions that go through their billing system. Carrier billing charges can range from about 5% to 30% depending on the operator and the products involved.

Levyng volume-based charges

Some mobile operators are seeking to negotiate a bonus payment when the number of travellers using a SIM-based mobile solution rises above certain thresholds. This would act as an incentive for the mobile operator to market the solution to its customers.

Brokering advertising and marketing

If consumers use a mobile operator app or wallet to access mobile NFC transport services, the mobile operator may be able to sell advertising space in that app. They could also use the app to market other services either on their own behalf or on behalf of third parties. Some mobile operators are looking to create NFC apps that support a wide range of services, including parking, car rental, bike rental, loyalty and couponing, as well as public transport.

Adding value to 4G

Some mobile operators are positioning their support for NFC-based transport services as an additional incentive for consumers to upgrade to 4G.

Engendering greater loyalty

Some mobile operators, particularly in Asia, believe their mobile transport offerings will strengthen their customers’ loyalty and lower customer churn. They reason that once a consumer has installed applets they value on their SIM card, they are less likely to swap to a different SIM card at some stage in the future.

Accumulating customer/usage data

In most of the deployments covered in this report, the mobile operator doesn’t have access to data on what consumers are buying through the mobile transport service. But in instances where the consumer is buying tickets through the mobile operator’s wallet or app, the mobile operator will gain some insight into customers’ behaviour, which could then be used to improve existing services or develop new services. For example, a mobile operator could send a commuter a reminder when it is time to renew a season ticket. The reminder could include an offer for discounted mobile data that can be used during the morning rush hour.

Earning roaming revenues

In Asia, in particular, mobile operators are working towards enabling travellers to use their NFC mobile phones to pay for travel in foreign cities. The provision of these services may generate roaming revenues for the mobile operator as the traveller downloads the relevant app and buys tickets or stores value on the SIM card. Mobile operators could also sell local SIM cards preloaded with the appropriate transport applet and credit to foreign visitors, boosting their revenues.
Cross-sector joint ventures
In some markets, leading mobile operators and transport operators are forming joint ventures designed to act as a one-stop shop, supported by APIs for handsets and for readers, for transport operators seeking to deploy mobile NFC services. These joint ventures could act as interconnection hubs that enable multiple transport operators and mobile operators to make their systems and apps compatible through a single commercial and technical mechanism. A joint venture could, for example, have a single TSM for provisioning applets on SIM cards and a single back office that can create real-time reports.

In some markets, these joint ventures may work directly with merchants, such as restaurants and retail outlets, to enable consumers to use the value stored in the mobile applet to complete small transactions via NFC.

Technical consortia
In some markets, such as Japan and South Korea, cross-sector consortia act as certification bodies, helping to ensure interoperability between handsets and operators’ validation infrastructure. These consortia typically have a broad remit, working with retailers and other merchants, as well as transport operators.

Coordination among mobile operators
In most European and Asian markets, mobile operators are working independently of one another, often entering into direct relationships with transport operators. In some markets, such as Poland and Spain, the mobile operators are looking to work with aggregators, which then work with multiple transport operators. Some transport operators don’t want to deploy a mobile solution until all the mobile operators in their market are able to support it.

Coordination among transport operators
In many markets, little coordination among transport operators, which can use different validation protocols and infrastructure. However, in some markets, such as the Netherlands and Germany, the transport operators have adopted a standard ticketing and/or payment system, such as OV Chipkaart (the Netherlands) and VDV (Germany).

Trusted service managers
Individual mobile operators are typically setting up their own trusted service managers (TSM) to provision and update applets on consumers’ NFC SIM cards. In some markets, such as China, individual transport operators are also setting up their own service provider TSMs, despite the additional cost and complexity. The Chinese government is trying to address this issue by creating a transport TSM hub. It has established two alliances, controlled by the Department of Building and the Housing and Ministry of Communications, which are trying to set standards and push all transport operators to use the same protocols, which would make it easier for consumers to use plastic smart cards or mobile NFC applets on multiple transport networks.

Some transport payment systems are reluctant to establish their own TSM because they believe they will ultimately migrate to an EMV-based system that won’t require a service provider TSM. In the meantime, the mobile operators in these markets are considering joining forces to provide these payment systems with a service provider TSM hub.

In time, many markets are likely to make use of cross-sector joint ventures to manage service provisioning and secure ticket distribution securely. Mobile operators are likely to be involved in these joint ventures because of their importance in the TSM function, and their knowledge of the mobile networks and the SIM.

Customer service
In some markets, customer service processes have yet to be defined. Transport operators and mobile operators note that passengers may not know which company to contact if their mobile phone fails to open a metro gate, for example.
4.4 Customer proposition

Convenience tends to be the primary selling point of a mobile ticketing/payment solution for public transport passengers, but the strength of this proposition varies depending on how easy it is to use the existing ticketing and/or payment system. The research for this paper identified several different aspects to the core passenger proposition:

Buy tickets or top-up stored value anywhere, at anytime
Most mobile and transport operators highlight the convenience offered by a mobile NFC solution, which typically enables consumers to download tickets or top-up their stored value over-the-air. Although some transport operators enable consumers to configure their stored value account on a plastic smart card to be linked to a payment card for automatic top-ups, others require consumers to buy tickets or top-up credit at a machine or kiosk. In the latter case, a mobile solution that enables transactions to be completed anywhere is clearly more convenient for the passenger. Some mobile operators report that most of the ticket purchases made with the SIM-based solution take place between 6pm and midnight when the passenger is at home.

The ability to buy travel tickets and/or credit using a handset should also appeal to occasional travellers and foreign visitors who are unlikely to own the appropriate plastic smart card for the transport system they want to use.

Less likely to forget their phone than a plastic card
Mobile operators point out that most people rarely leave home without their mobile phone. Although passengers may forget their physical transportation card, they are unlikely to forget their handset, so are less likely to be caught without a ticket.

More information and greater transparency
One of the biggest differences between a mobile ticketing/payment solution and a plastic smart card is the presence of a screen that enables the consumer to check the status of their account in real-time. Transport operators say passengers want to be able to see whether they have checked into the network or not — many people automatically tap their card against a reader without registering the action. Being able to see their validation status on a mobile handset could give the passenger a greater sense of control and reduce stress. A mobile solution can also enable a passenger to check how much credit they have on their account before they queue up at a validation gate.

Moreover, a mobile app can provide real-time information that can help a consumer choose the best ticket for their particular journey. For example, the app might show there are delays on a particular service and suggest the passenger uses an alternative service, requiring a different ticket. The transport operator could even implement a best ticket guarantee, whereby a consumer who buys an unnecessarily expensive ticket could be refunded the difference after their journey has been completed. Similarly, any cancellation or delay-related refunds could be automatically applied to the consumer’s ticket over-the-air.

Validation without power?
While some of the mobile NFC solutions being deployed by transport operators depend on the consumer having their handset switched on, others will work even when the phone has a flat battery. Some transport operators are thinking of installing charging stations in metro stations that will enable people to power up their handsets if necessary.

Throughput speeds
In most implementations, validation via SIM-based mobile NFC is almost as quick as with a plastic smart card, as long as applets are properly implemented. However, some trials have found that there can be a significant difference if the transport validation infrastructure uses a complex process involving a series of steps.

Loyalty incentives/rewards
Many transport operators and mobile operators envisage introducing incentives for passengers to use mobile ticketing and payment solutions for transport. If a consumer makes a certain number of journeys, the transport operator could send them a voucher for a free coffee or snack direct to their mobile handset. In some cities, such as Valencia, the transport operator is giving first-time users free trips with their first purchase with a mobile app.

Ease of registration
In most implementations in Asia and Europe, it is relatively straightforward for a consumer to register to use a mobile transport service once they have a NFC SIM and handset. If the relevant applet is pre-installed on the SIM card, the consumer can typically download the related app and provision the service in just a few minutes. However, in some markets, the consumer has to go to a transport operator outlet to verify their identity. Moreover, some mobile operators believe that mobile NFC service should be integrated into transport operators’ existing mobile apps via an upgrade, rather than requiring the consumer to download a special app or wallet to support NFC.

Cool factor
Some transport operators and mobile operators believe that a mobile NFC solution will appeal to consumers who want to appear to be at the cutting edge of technology, particularly if the relevant app is sleek and well-designed.

Personalised services
Transport and mobile operators, particularly those in Europe, say that privacy regulations make it difficult to provide passengers with personalised services based on their travel habits, even if the passengers were to opt-in to receive such services. However, some transport operators do enable passengers to enter their most travelled journey into a mobile app and then receive alerts if there is disruption on that line.
4.5 Technical implementation

Most transport operators are employing SIM-based NFC to enrich their mobile propositions, but the actual implementations vary significantly by deployment. The research for this paper identified several key considerations for a technical implementation:

Interoperability
It is important that transport operators use standard and interoperable solutions because they now all share a common component, of interacting with the handset plus the SIM.

Hardware Security
Most transport operators see the SIM as a key element of a mobile proposition, preferring to store tickets or value in a distinct piece of hardware rather than in a software system that could be hacked or tampered with. Most of the implementations researched for this paper involve installing a Mifare, Calypso or Felica applet on a secure element to handle the validation process. Some mobile operators are trialling Mifare4Mobile, a technology protocol specifically designed to manage Mifare applets in SIM cards or other secure elements.

NFC handset implementations
Several mobile operators have complained of inconsistent implementations of the NFC standard by handset manufacturers. There are two main aspects to this. One aspect is differences in the interaction range between the handset and reader. The second aspect is the need for a reference implementation and certification framework to enable the consistent implementation of Mifare4Mobile. Today, mobile operators often have to carry out extensive integration testing and develop optimised applications for different types of handsets.

Provisioning and preloading
Whereas some mobile operators are preloading transport applets on to NFC SIM cards, others are installing them over-the-air. The preferred approach typically depends on the commercial arrangements in place and the capabilities of the TSM infrastructure. In Poland, T-Mobile is preloading the Mifare applet, along with the Visa and MasterCard applets, on the NFC SIM and then personalising it over the air using a provisioning platform via an IP bearer, with fail back to SMS. However, in South Korea, the mobile operators have stopped preloading the applets on SIM cards and now provision them over-the-air. Some mobile operators want their TSMs to be able to use WiFi to speed up over-the-air provisioning.

Some mobile operators’ TSMs are using so-called Simple Mode to manage the transport operator’s applet on the SIM card. This mode calls for the mobile operator’s TSM to perform the card content management upon request from the service provider, which delegates full management of its application to the mobile operator’s TSM, but the transport operator still performs the personalisation itself. This approach simplifies the interaction between transport operators’ and mobile operators’ platforms.

Apps and wallets provide the interface
In most implementations, the transport operator is providing a mobile app that can interact with the relevant applet on the SIM card and enable the consumer to buy tickets and/or store value. In some cases, the consumer may also be able to use a mobile wallet provided by the mobile operator to make transport-related purchases. In other cases, the mobile operator’s wallet may act only as a discovery mechanism that helps consumers find mobile NFC apps. Some mobile operators are not providing any kind of wallet at all.

Handset operating systems
Most SIM-based mobile NFC implementations only work on smartphones that run the Android operating system. Although Android tends to be the most-widely used smartphone operating system among public transport users, a few mobile operators in Asia have developed a NFC case or dongle which enables Apple’s handsets to support SIM-based NFC, but most are waiting for Apple to open up the secure element in the iPhone for use by third parties. If a transport operator were to deploy an EMV-based system, then a passenger could use Apple Pay to pay for a journey.

Wallet integration
To enable a consumer to access their transport tickets and stored value via a mobile wallet, the mobile operator will typically need to adapt its backend systems to enable integration between the transport applet on its NFC SIM card and its wallet. Mobile operators generally use a wallet server to manage the contents – typically the depiction of services – of a wallet on the handset. If a consumer decides to use the wallet to enrol for a transport ticketing service, the wallet server will need to be able to initiate the process of provisioning the transport applet on the consumer’s SIM card.

Data exchange
Most mobile operators and transport operators are not sharing customer or usage data.

Wearables
Some transport operators see the potential to use wearables, such as a smart watch or an activity tracker, as a smart watch or an activity band, as a validation device on transport networks. In Beijing, consumers can use a basic activity tracker, called the Shuashua Band, as a transport card to pay for public transportation, according to media reports.

QR codes
In many markets, consumers can use mobile apps to buy rail and airline tickets and store them on their mobile phones as a QR code that can then be scanned for validation. However, such systems tend not to be suitable for high-throughput transit systems that need to be able to validate tickets quickly and easily.


GSMA
A Global Study in Transport: How Mobile Technology is Enhancing the Passenger Experience
Piloting
Most transport operators run pilots, involving up to 2,000 users before launching commercially, in order to test the technology and the commercial proposition. However, there is now growing confidence in the maturity of SIM-based NFC and transport operators are increasingly comfortable with a full-scale commercial launch. Several countries, including China, Hong Kong, South Korea, Japan and Spain, have commercial services up and running.

Timing of commercial deployments
Once a transport operator decides to launch a mobile NFC service, the timing of a launch is likely to be determined by how much work needs to be done to upgrade the validation infrastructure. In cities using standard Mifare validation infrastructure, deployment could be completed in just two months, according to some mobile operators. In cities that still rely on paper ticketing, the necessary infrastructure upgrade could take several years. If the right contactless validation infrastructure is in place, the timing of commercial deployments can often be dictated by local politics, particularly in cities that elect powerful mayors.

Distributing NFC handsets
In Asian markets, in particular, mobile operators are increasingly equipping their own-brand handsets with NFC and pre-installing a mobile wallet on these phones.

Distributing NFC SIM cards
While most consumers still don’t have a NFC SIM card, penetration is rising quickly as many mobile operators make support for NFC as a standard feature on 4G SIM cards. However in a number of markets, mobile operators have been reluctant to issue NFC SIM cards by default, for economic reasons.

Marketing and promotion
Some mobile operators are promoting NFC-based transport services through their mobile wallets and other apps, in physical stores and with SMS messages. Transport operators can promote the services on the sides of buses, in bus stops, in metros and on advertising hoardings in metro stations. In those markets where all the mobile operators are supporting the service, word-of-mouth can also play a strong role.

The case for scaling quickly
Some mobile operators argue it is crucial to scale a mobile transport service rapidly and achieve the volumes that make the business model viable for all the parties in the value chain. Integrating support for NFC services into the transport operators’ existing mobile apps via an upgrade, rather than requiring the consumer to download a special app or wallet to support NFC, could accelerate adoption. When promoting the service, some mobile operators also believe it is important to provide inducements to consumers, such as free journeys or free tickets, to try the service.

4.6 Development strategies
Many mobile operators and transport operators have run multiple trials and pilots of SIM-based NFC services and are proceeding cautiously, but some are now looking to reach scale rapidly. The research for this paper identified several deployment strategies:
Conclusions

Transport operators around the world are in the very early stages of trying to replace plastic smart cards with applets running on the SIM cards inside consumers’ handsets. Many transport operators see an applet on the SIM card as a natural evolution from their smart cards and like the fact that it is secure and tickets/payment can be validated even when the handset has no power.

Today, these applets typically have to be compatible with Mifare, Calypso or one of the other contactless validation systems used by transport operators. However, some city transport operators may eventually make their transport validation infrastructure compatible with the EMV standard, thereby enabling any consumer with an EMV payment card stored on their SIM or another secure element (such as that used by Apple Pay) to pay for a journey by tapping their handset against a terminal. Support for EMV would make it straightforward for visitors to a city to make use of the public transport system.

At the same time, many transport operators want to use the mobile medium to build a closer, more interactive relationship with regular travellers. Through mobile apps, most transport operators already enable customers to access real-time information on how services are running and the expected arrival of the next bus or train. The ultimate goal for some transport operators is to provide an integrated end-to-end passenger experience that advises on the best route and the best price, while enabling transactions and navigation across many different modes of transport.

To ensure these solutions offer the best customer experience, the transport operator needs to ensure they are interoperable with the handset and the SIM.

A transport operator with a widely used travel app could create a two-sided platform, which enables merchants to interact with passengers and sell travel-related products and services, such as hotels, restaurants and entertainment tickets. In some markets, several transport operators may pursue this aggregation/platform role and compete head-to-head with one another.

For mobile operators, the widespread adoption of SIM-based NFC by the public transport sector will help consumers to become familiar with the technology, encouraging them to also use their handsets to interact with retailers, restaurants, theatres, cinemas and other merchants. In time, SIM-based NFC services could yield a significant revenue stream for mobile operators and, most importantly, help ensure that they maintain a close relationship with their customers.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
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<tr>
<td>NFC</td>
<td>Near Field Communication</td>
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<tr>
<td>PED</td>
<td>PIN Entry Device</td>
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<tr>
<td>POS</td>
<td>Point of Sale</td>
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<tr>
<td>TSM</td>
<td>Trusted Service Manager</td>
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<tr>
<td>VAS</td>
<td>Value Added Services</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>QR</td>
<td>Quick Response (code)</td>
</tr>
<tr>
<td>SIM</td>
<td>Subscriber Identity Module</td>
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<tr>
<td>RFID</td>
<td>Radio Frequency Identification</td>
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</table>
600,000+ downloads of the "Octopus" app enabling payment for transport services in Hong Kong

33 million Osaifu-keitai mobile phones in circulation enabling transport payments in Japan

45 different handset models enabling mobile users to pay for travel in Spain

4.2 million+ mobile users benefiting from transport payment card schemes from T-Money and Cashbee in South Korea

Approximately 4 million NFC transport terminals accepting payments in China