The future of ticketing

Paying for public transport journeys using Visa cards in the 21st century

January 2013

Contactless Smart cards are already very popular with public transport passengers and operators. But current systems have reached their limits for cost reduction, interoperability and security; forward-looking operators are now designing and implementing systems that allow Visa payWave and other “open-loop” contactless cards to be used directly at the gate. This can shorten queues and boarding times, reduce card issuing costs and make the network more accessible to casual users, in particular.

This paper shows how operators are using these cards and the benefits they are seeing; it also addresses objectively the challenges and considerations that any operator must address for a successful implementation, and the next steps to take towards this next generation of Automatic Fare Collection system.

Executive summary

Smart cards are already very popular with public transport riders and operators

Smart-card-based Automatic Fare Collection (AFC) systems have transformed the travel experience for hundreds of millions of public transport users in major cities round the world. Whether they are entering mass transit rail networks or boarding a bus or ferry, passengers love the speed and convenience of “tap and go” technology at the turnstile or boarding gate. These systems have reduced queues and made public transport more accessible, flexible and safe.

For operators and fare collection agencies, they have reduced fraud and free-riding, lowered the cost of revenue collection and increased ridership.

But current legacy systems are generally based on proprietary technology which may be less secure and more expensive to maintain than systems based on open standards and payment networks. Individual cities can be considered as islands, with no interoperability between systems, so visitors and casual users in each must obtain the appropriate card before they can travel. These accounts are usually prepaid and must be topped up before travel.

Growing numbers of customers have contactless payment cards

Over the past seven years, card issuers in many countries have added contactless capability to their payment cards. The new cards share many features with the smart cards used in AFC systems, however they use the most up-to-date, open standards combined with a security system that is both robust and easier to manage.

At this stage the distribution of contactless payment cards varies widely from one country to another; in some cases such as Australia, Hong Kong, Taiwan and Singapore, a high proportion of credit and debit cards have this feature. But at the same time the number of prepaid cards carrying a Visa logo is increasing rapidly; these cards can be used in a wide range of shops and services. For many people, they represent the first step on the financial ladder, while for others they are simply a budgeting tool which allows them to set aside money for travel and daily expenses. Prepaid cards are likely to account for an increasing share of contactless cards issued in many countries, and will allow more customers access to formal financial services.

Mobile payment uses the same acceptance infrastructure

Payment facilities are also being added to mobile phones, using Near Field Communications (NFC) and downloadable applications (“apps”). This is not just another form factor for a contactless card (although it can be used that way); rather it opens up the possibility of payment and public transport apps co-operating, and allows the user to enter data and view transactions. NFC phones use the same acceptance infrastructure as contactless cards, so by installing contactless readers an operator automatically enables mobile payment and the further benefits this technology will bring.

The ecosystem that will support mobile payment is still developing but operators will be able to make use of these structures and extend the range of services they offer, particularly to smart phone users.

Open loop and open standards offer flexibility and future-proofing

Visa contactless cards are “open-loop”: that is, a Visa card issued by any bank can normally be used anywhere in the world where a Visa card is accepted. They use open (industry) standards, so equipment from different manufacturers and software from different suppliers are generally compatible with one another. And because the cards are accepted by retailers all round the world, equipment prices are very competitive; a reflection of demand from the much higher volumes in the retail business. Products are continuously developing and reflect changing consumer needs and expectations; contactless cards, prepaid cards and NFC phones are only a few examples.

Five options offer increasing integration

Visa sees five general ways to integrate open-loop payment with a public transport AFC system:

i. Using an open-loop card to buy tickets and top-ups: many systems currently allow this.
ii. A higher level of integration exists where the transport card is co-branded or simply funded by an associated open-loop card through a link in the transit operator’s back office; top-ups can then be automatically initiated as soon as the balance drops below a set amount.
iii. Using a Visa card for Pay As You Go travel. In this case the card is tapped directly on the gate and the fare is deducted from the account after the fact. For riders and operators, this is relatively straightforward where the fare is fixed, but can also be implemented with a more sophisticated middle office system for variable fares where the points of entry and exit must be tracked.
iv. Using the Visa card for Pay In Advance travel. In this case the rider must buy a transit product, such as a time-based pass or multi-ride ticket in advance and associate the fare product with the Visa contactless card. The card is still tapped directly on the gate, but no separate or additional payment is made. Since the payment was completed when the rider purchased their product before riding, the tap or ride is reconciled against the pre-purchased transit product.
v. Some open-loop cards may in the future carry an additional data file which can be used for storing tickets and other data; this is most likely to be used by transport operators for any prepaid cards they issue using open-loop standards, and is less likely to be offered on general-purpose cards issued by banks.

Each of these options has been successfully implemented in different parts of the world, and this paper includes case studies of Istanbul Sea Buses, the KLIA Ekspres in Malaysia, Transport for London and the MTA in New York City.

Benefits include shorter queues and a reduction in ticket issuance costs

All of the systems described above have seen or anticipate a reduction in queuing time - as customers no longer have to queue to obtain a ticket - and lower ticket issuance costs, as fewer passengers need to be issued with a card by the Public Transport Operator (PTO), and no ticket is normally needed. Systems are also seen as more accessible, particularly to overseas travellers or infrequent visitors to the city.

Passenger	• Speed: no need to purchase a ticket • Easy to understand: just tap and go • System is capable of ensuring best value
Public transport operator	• Reduce costs of ticket issuance, particularly for casual riders • Fare tables etc stored centrally; easy to change or update • Open standards allow equipment to be purchased from any mix of suppliers, avoids supplier lock-in; • Helps focus more on value added client services than on just ticket issuance
Transport authority	• Allows one fare medium to be shared across many operators which allows detailed data analysis
Card issuer	• More usage of contactless cards, both within and outside transport network • Greater use of open-loop prepaid cards, bringing more participants into the formal financial system

Critical success factors

There are several factors which operators must take into account for a successful implementation. They include:

i. High level of contactless bank card issuance in the market and the corresponding consumer awareness about the product. If there is no critical mass of cards, there should be at least one issuer willing to invest in mass issuance and develop distribution capabilities;
ii. Determining who will issue prepaid cards to those who do not have, or do not want to use, a debit or credit card;
iii. Designing an inspection system that will work in all the physical environments of the system;
iv. Providing a communications network that meets the demands of the operator's authorization policy;
v. Within the back-office systems, ensuring that passengers can access their own journey details while at the same maintaining privacy and security of sensitive payment data;
vi. Setting and implementing clear business rules and commercial arrangements between the parties involved;
vii. Tight co-ordination between the operator, its suppliers, processors and banks to ensure that any technical or customer service issues are identified quickly and can be resolved.

Operators with existing smart card systems will be seeking different benefits from those moving from magnetic-stripe or paper-based systems. In each case careful planning and learning from the experience of others should ensure a smooth transition and successful implementation.

Contents

Introduction

Cities round the world have embraced with enthusiasm the use of smart cards (chip cards or Integrated Circuit (IC) cards) for travelling by public transport. Passengers welcome the convenience and speed of boarding, while operators gain additional information on journey patterns, and often significantly higher revenues as well.

The first generation of these systems used proprietary memory cards or fixed-logic cards. This meant that most of the intelligence and fare tables had to be contained in the boarding gates or readers in buses, with journey records uploaded periodically to a central system. There are no international standards for these systems, and so proprietary specifications were used.

But over the last decade, major advances in connectivity mean that it is now possible for gates and buses to remain in continuous, real-time contact with the central fare system.

Visa and other international card associations have introduced contactless versions of the EMV[1] chip card specifications. Banks around the world have issued hundreds of millions of these cards to their customers. They are already widely used in retail and fast-food outlets, but the improvement in communications now allows Visa contactless cards to be used in public transport as well. This removes the need to buy a ticket in advance, and means that any passenger arriving in a new city can travel immediately using his or her existing card. This technique is already being applied in several cities (starting with Salt Lake City in 2010) and is being implemented in others, as described later in this paper.

This paper examines the objectives of such an "open-loop" public transport payment system and how they differ from those of a traditional Automatic Fare Collection system. It covers the implementation requirements, with a number of case studies ranging from simple, fixed-fare systems to more complex multi-modal networks with a wide range of fare types and concessions. It finishes by looking at the steps a PTO should follow if it wishes to investigate and implement such a system.

The paper is written primarily for PTOs, fare collection agencies and transport regulators and so uses terminology and concepts which will be familiar to PTO staff. It also explains the terminology and systems used by banks and card payment systems. However it is also intended to be used by banks and payment organisations who wish to co-operate with their local PTOs and so the concepts and terminology of Automatic Fare Collection are also explained in the following section.

[1] EMV is the international standard for payment by chip cards; it is an open standard and is used by all international card associations.

Background: Public transport Automatic Fare Collection

Aims of public transport Automatic Fare Collection

Automatic Fare Collection (AFC) systems improve the efficiency of public transport systems by automating the processes of collecting fares and controlling boarding.

It is important for banks and payment specialists to recognise that an AFC system has many more objectives than payment. A good system:

i. Combines the functions of payment and ticketing, providing proof of right to travel for those entitled to free travel or reduced fares, single and multiple journeys;
ii. Allows very high throughput of passengers when boarding a bus or other mass transit system;
iii. Reduces losses through fraud or "free-riding";
iv. Gives the operator or planning authority very good visibility of journey patterns, which in turn allows more efficient route planning; this information is in a form which can easily be anonymised and shared between operators;
v. Allows the division of revenues between multiple operators: e.g. a mass transit system, several bus operators, trams and ferries. Taxis also form an integral part of the network in many cities, particularly in China.

Most systems combine concession fares, season passes and "Pay As You Go" travel. Pay As You Go travel usually operates on a prepaid basis, with a balance held on the card which represents a "float" for the operator or fare collection agency (on which it can earn interest, subject to any local regulations).

The initial system cost can often be recouped quite quickly through reduced losses and increased ridership, while the cost of issuing cards can be offset by charging passengers a deposit for their cards. Operational costs should be lower than for paper tickets, with fewer staff needed for ticket issuance and inspection. There is an established eco-system of suppliers, providing:

i. Cards: many of today's cards use the well-established MiFare™ or FeliCa™ technology families; these cards store any fixed entitlement, as well as a prepaid balance.
ii. Readers: readers may use one of the international standards (ISO 14443 A or B) or a proprietary standard for communicating with the card, but in all cases the logic for decrementing balances and allowing boarding is proprietary to the PTO/supplier.
iii. Gates and bus boarding systems: turnstiles or barriers are activated by touching the card on to the reader, while on buses an audible signal is often enough to advise the driver of a successful or unsuccessful tap (boarding allowed or denied).
iv. Back-end systems collect transaction data from gates and bus readers, and use them to analyze journeys, allocate revenue and detect fraud. They may also spot problems such as a malfunctioning card or reader and trigger remedial action.

Limitations of existing systems

The first generation of AFC systems has delivered many benefits to operators and the travelling public. However there are also several issues with these systems:

i. The initial system cost is very high; although it can usually be justified by the largest cities, smaller cities, towns and rural areas find it difficult to make a business case for converting all buses and bus depot systems, installing intelligent gates and often redesigning the physical layout of stations. A network of load stations must be set up to allow passengers to load their cards, and ongoing costs include commissions that must be paid to load agents.

ii. For large networks, particularly where there is a commuter network as well as the city transport, it is often difficult to ensure that everyone entering the system has a valid smart card. This means that legacy systems, including manual ticket sales and inspections, must be retained and quite a small proportion of journeys may account for a high proportion of costs.

iii. One of the reasons for the relatively high cost of the equipment and systems is the proprietary nature of existing systems: not only do the cards themselves use standards that are owned and licensed by a small group of manufacturers, but there are only a few suppliers of central systems with the wide range of functionality required. It is not possible to mix equipment and systems from different suppliers – the whole system must generally be purchased from a single supplier. Once a system is purchased, the PTO is "tied in" to that supplier and must purchase upgrades and maintenance services from that supplier.

iv. The security of the system depends on cryptographic "Secure Application Modules" (SAMs) in every reader; these are also proprietary and must be bought from a licensed supplier; the need for a physical device in each reader limits the scope and range of the system that can be deployed.

v. Most public transport cards and systems use symmetric cryptography, in several cases with proprietary algorithms. Some of the first-generation algorithms and systems have already been broken, which in principle would allow fraudsters to issue value or to change the validity of tickets.

vi. Each system is free-standing and there is generally no provision for interoperability[2] between systems. Cards from one city cannot be used anywhere else, and it is difficult for a city to serve a surrounding area or other towns.

vii. Fare tables must be stored in each gate and bus; this leads to problems when these must be updated, and limits the types and complexity of fares that can be used. "Action lists" of blocked cards, cards needing updating etc must also be sent to each relevant reader.

viii. The cards themselves are not valued by passengers; this allows them to "play the system" by sharing cards, including concession cards, to get round fare rules or obtain a better fare.

ix. Issuing cards is not a core activity for a PTO; this is a cost centre rather than a profit centre and distracts from the core activity of running a transit system. Often a city, or operators within the city, must appoint a fare collection agency to work on behalf of the PTOs. system, several bus operators, trams and ferries. Taxis also form an integral part of the network in many cities, particularly in China.

The effect of these has been to restrict each smart-card-based AFC system to an "island" where one operator or fare collection agency takes responsibility for the whole system. Where multiple PTOs have attempted to integrate through an interoperable AFC infrastructure, typically across a large municipal area, the implementations have been delayed by the complexities and costs involved. Integrated and interoperable AFC systems remain a vision rather than a reality.

[2] The international standard ISO 24014 defines the requirements and architecture for Interoperable fare management systems in public transport, and this is used by, for example, the European Calypso network.

Open loop payments

Background and terminology

Just as Automatic Fare Collection involves several new concepts for payment system specialists, the world of open-loop card payments uses its own terminology and structures.

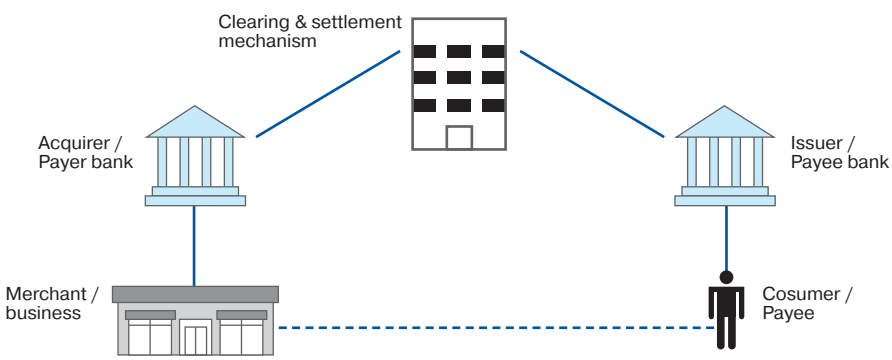


Figure 1 - Four-party model for open-loop payments

Payment cards are issued by banks to cardholders; they are accepted by merchants, who connect to the payment network through an acquiring bank. International associations such as Visa, or domestic networks (in some countries), ensure the clearing and settlement function which allows the money to flow from issuing to acquiring banks, and hence to and from consumer's accounts.

Cards may be operated on a credit, debit or prepaid basis, with different funding rules in each case, but using the same infrastructure. Prepaid cards that carry the Visa logo are classed as "open-loop": they can be used in any merchant that displays a Visa logo. This is in contrast with prepaid cards issued by a single retailer or PTO, which are "closed-loop" because they can only be used in that network. Open-loop cards are subject to strict banking regulation and protection, which do not apply to closed-loop cards in most countries.

Many countries in Asia-Pacific are now following the European model of licensing electronic money (e-money) issuers. E-money is issued by a commercial operator but can be used in a specified range of outlets as well as those of the issuer. The level of regulation is between that of open-loop and closed-loop cards: for example, issuers will probably be required to retain the float in "safe" reserves rather than using it to fund operations.

Technology

Banks pioneered the use of international standards to provide a global interoperable payment card service in the 1970s. Originally based on magnetic stripes (ISO 781x series), the networks introduced chip cards, using the international standard ISO 7816 and the application standard known as EMV. There are now almost 1.5 billion chip cards using EMV standards, and 19 million chip terminals round the world that all accept every EMV card.[3]

[3] See www.emvco.com

In most cases, the contactless cards introduced by issuers in the 2000s make use of the same EMV data structure and messaging, and can be used either as a contact chip card or contactless card; the exception is the USA, where cards are most often contactless only, but are expected to migrate to the same dual-interface cards used elsewhere, over the next four to five years.[4]

Chip cards can carry multiple applications: an EMV card can carry two or more accounts or can work in different ways in different circumstances (for example at the bank's own ATMs or at point of sale terminals). And an EMV card can also carry other ISO 7816-compatible applications, such as a loyalty, identification or ticketing application. For example, banks and airlines have introduced co-branded dual-interface cards which combine the ability to move through the airport using the card, to track frequent-flier points and to make payment.

With trillions of dollars of card sales volume passing through its network, security is at the heart of all Visa's cards, terminals and networks. EMV uses a combination of high-strength symmetric and asymmetric cryptography which means that terminals only need to carry one set of public keys, which can be downloaded and have proved much easier to manage than SAMs.

NFC and NFC payments

Banks and payment networks have also been at the forefront of the introduction of Near Field Communications (NFC). This technology allows users with a suitable mobile phone to use it for making payments, storing transactions and loyalty points, and communicating with a host system. The mobile phone's ability to download and install a wide range of applications is combined with the functionality of a contactless card to make a very powerful tool.

NFC extends the capability of the contactless card, since the cardholder can also enter data (such as a PIN), view transactions and link the data with other applications on the phone; these might include a dynamically updated timetable or route calculator.

NFC also uses internationally-accepted standards; for the communication between phone and terminal, the standard emulates that used for contactless cards, so any terminal that accepts contactless card payments can also accept NFC-enabled phones for payment. NFC applications only have to be developed for the two or three different operating systems offered by the phone manufacturers and can then be used on most smart phones.

Several banks and non-banks are now running small-scale NFC payment services, linked to an application on the phone, and as NFC is rolled out to more phones it is likely that these offerings will become widespread. In the future, the application may be downloaded from an "app store" or from the service provider's website (this could be the bank or transit operator).

[4] See http://corporate.visa.com/newsroom/press-releases/press1142.jsp, http://newsroom.mastercard.com/press-releases/mastercard-introduces-u-s-roadmap-to-enable-next-generation-of-electronic-payments/

Trends

Within the payment industry a number of trends are apparent. They are happening at different speeds round the world, but some of the most exciting trends can be found in the Asia-Pacific, Central Europe, Middle East and Africa regions:

There is a **secular shift from cash to electronic payments**: although cash is very tenacious, several countries are now seeing an absolute fall on the volume of cash in circulation, despite rising incomes and expenditure. Once the costs of reconciliation, banking, security and theft are taken into account, retailers and other cash acceptors now find that cash is significantly more expensive[5] than cards and electronic payments. For operators of unattended terminals, the case is even stronger; a card-only vending machine breaks down less often, never requires emptying and is less prone to criminal damage.

The mobile phone has been a major factor in improving **financial inclusion**. Electronic payment services now reach sectors of the population who would never visit a bank branch; in many cases there is no bank branch within hundreds of miles. The "unbanked" sector is mostly defined by a lack of data, and a combination of government registration schemes and mobile phone coverage is reducing the size of this sector. At the same time, a growing percentage of the population in many countries has disposable income or benefits from transfers from overseas (which are increasingly electronic).

Another factor is the **explosive growth of prepaid cards and accounts**. The public transport industry was a pioneer in using prepaid cards for travel, but telephony was again the sector which brought it to the wider mass market. There are now over 5 billion prepaid cards in this sector, including both mobile and fixed-line telephony. As more sectors and services now make use of prepaid cards, the benefits of **open-loop cards** have become apparent: the customer no longer has to keep a balance for telephony, another for travel and a further balance for shopping. With open-loop prepaid cards, a single card and balance will do all these jobs, while those who receive remittances from overseas, or a government benefit, can receive them directly to their card account.

It took 35 years to move from magnetic-stripe cards to chip cards, but the **move to contactless cards** is happening much faster: in several countries critical mass was reached within one card replacement cycle (usually three years). There are now over 250 million contactless bank cards in the USA, Europe and Asia-Pacific. The move to NFC may be faster still, as this is driven by customers seeking more functionality from their mobile phones. In each case the range of applications and users is smaller than for the previous generation but the advantages are greater.

The number of **non-bank e-money issuers** is growing rapidly: fare collection agencies, mobile telephone networks and independent operators have all taken advantage of the legislation now emerging in many countries.

Applications are converging: within transportation we see mass transit applications extending into taxis, road tolling and other travel-related functions such as parking. Passengers gain when they can travel on more modes of transport using a single card. Airlines sell a ticket and download a boarding pass in a single operation. Shopping applications include not only the ability to find goods and compare prices, but also to buy the goods and pay for them.

[5] See "The Single Euro Cash Area"; EPC Newsletter, October 2010

Benefits

Open-loop cards bring many advantages:

i. They are based on open standards; products are available from a wide range of suppliers, who compete with each other on a global basis. Licence fees are limited to a small number of features and do not have a significant effect on product prices.
ii. Products are interoperable at a national and global level; a visitor from another city or arriving at an airport from overseas does not have to obtain a new card or understand the special features of the local systems.
iii. Mobile phone and NFC developments are likely to gather pace as smart phones become near-universal and offer future-proofing for services based on open-loop products.
iv. The network of ATMs and retail acceptance is both widespread and varied: for a public transport operator it offers a large and cost-effective reload network.
v. The security of open-loop cards is higher than for most closed-loop cards and is carefully monitored by the international associations.
vi. By eliminating multiple cards, the cost of card issuance is minimized. In the future it is possible that the PTO will not have to issue any cards at all.

Using Visa payments in public transport

There is a range of options for payment and ticketing in public transport, from paper tickets bought with cash, up to a fully integrated solution in which the payment media are also the ticket media:

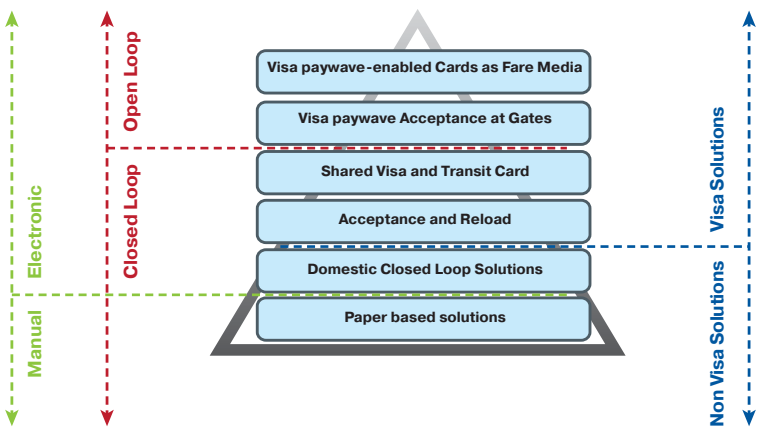


Figure 2 - Public transport payment mechanisms

The first two solutions, at the bottom of the pyramid, are closed-loop and do not involve an open-loop payment network. However the remaining four options represent increasing integration of payment and ticketing:

Buying tickets or top-ups

There are already many examples where a public transport card can be bought or topped up using a Visa card. For this any card type can be used: contactless, contact or even magnetic-stripe. Where the amount of the top-up or value of the ticket is known, contactless offers the fastest transaction and will usually be a very attractive proposition.

An advance on this is to use a co-issued or co-branded card, where the public transport application co-exists with a payment application on the card. In Taipei eight banks are authorised to issue cards that carry the EasyCard public transport application alongside the bank's payment functions; when the prepaid balance on the card drops below NT$100 (approximately US$3.35), the balance can automatically be topped up from the credit card account.

Using the card for travel

However, the newest and most exciting development is where a Visa card is used directly at the gate or when boarding a bus; the payment card itself is used as the fare medium.

Within this method two types of fare product can be used:

i. Pay As You Go fares allow casual users to charge their travel directly to their card at the time of travel. Depending on the fare structure, payment may be immediate or at the end of the day.

ii. Pay In Advance products include season tickets, multiple-ride tickets and free passes; payment is made in advance and journeys are reconciled against the pre-purchased transit product. These products are more likely to be used by regular travelers.

The two may be combined (part of a journey may be covered by a season ticket and the balance is paid by Pay As You Go); the card can also be associated with a concessionary (e.g. child) rate and this rate is used for the Pay As You Go fare calculation.

Fare calculation

There are also two options for fare calculation:

Known fare on entry

Where the fare is known in advance (such as most ferry crossings, or cities with a fixed-fare structure) a contactless transaction can be performed directly at the gate or on the bus. This transaction takes place in a fraction of a second and the passenger can board the ferry, train or bus immediately. There is not normally any need to issue a ticket.

Case study: Istanbul ferries

Istanbul is a city of 13.5 million people, straddling Europe and Asia. Istanbul Sea Buses (IDO) provides the all-important link between the two halves of the city; its fleet of fast ferries carries over 100 million passengers and seven million cars a year. During peak periods, a ferry leaves the Eminönü terminal every few minutes.

60-70 percent of customers pay using the “Sea & Miles” contactless credit card issued by DenizBank. This is a Visa payWave card (Visa’s marketing name for its contactless cards), which is co-branded with IDO. Passengers tap their card at the turnstile, the fixed fare (4 TL instead of the cash fare of 6 TL) is deducted from the account and the turnstile opens within 500 milliseconds. Customers using the Sea & Miles card also earn loyalty points (a critical factor in the very crowded and competitive Turkish credit card market).

In addition to Visa payWave, the card has full Visa functionality and can be used anywhere in the world that Visa is accepted; other Visa payWave cardholders can also board the ferries directly using contactless payment.

Since contactless functionality was added to the Sea & Miles card, in 2009, the program has grown from 60,000 to 450,000 cards: a testament to the appeal of the programme to the many regular Bosphorus commuters in particular.

Even if there is a choice of fares, the passenger or driver can press a button to indicate the desired fare, after which the passenger taps the card and the fare is paid. In the case of taxis, the card can be tapped on the meter at the end of the journey.

This mode of operation works with credit or debit cards: the fare is debited immediately from the customer's account and the PTO receives the payment the next day or day after. But it also works perfectly with prepaid cards: the customer loads his or her account in advance and the balance is reduced by the amount of the fare at the time of travel. The prepaid card can also be used for making purchases in shops or for other services.

Case study: KLIA Ekspres (Malaysia)

KLIA Ekspres is the high-speed, non-stop rail link from Kuala Lumpur International Airport into the centre of Kuala Lumpur, 57 kilometres away. Passengers can buy a single-ride ticket, multiple rides or a monthly pass.

Since 2010, passengers also have the option of simply tapping a Visa payWave contactless card on the gate. The fixed fare is deducted from the card account, and the gate opens within a few seconds. Malaysians are already well used to the concept of contactless as contactless cards are issued by most Malaysian banks, and can be used in thousands of retail outlets. KLIA Ekspres is one of the highest-profile acceptance points for both Malaysians and overseas visitors.

See the detailed case study at the end of this report.

Variable fares

Where the fare structure is more complex (for example, it includes multiple fare stages or modes of transport), the model needs to be adjusted slightly to allow the fare to be calculated or adjusted after travel.

In this case the PTO keeps a record of every card that it sees, in a "middle-office" system to which all gates and bus readers are linked. An authorisation is obtained at the start of the day, for an amount agreed by the PTO and its bank. Subsequent taps of the card are recorded in the middle-office system, and at the end of the day the actual amount is calculated and sent to the bank.

London, New York and Chicago will be the first cities to move to this system, starting in 2012. Such large cities, with their complex, multimodal networks and fare structures, find it advantageous to manage all fares centrally (the gates and bus readers do not need to store fare tables or action lists).

Case study: Transport for London

Transport for London has since 2003 operated a very successful smart card scheme, known as Oyster. As part of its ongoing need to refresh technology and improve customer service, TfL started in 2012 the introduction of a new payment option: customers will be able to board buses and Tubes simply by tapping their bank-issued contactless cards. Those who do not have a bank-issued card will be able to obtain a TfL-branded card that will also use 'EMV' open-loop payment technology.

This system, which is part of TfL's Future Ticketing Project, is described in more detail in the Case Study at the end of this report.

Risk management is also carried out centrally: suspicious journey patterns can be spotted and investigated. Cards that are following a well-established pattern of travel can be authorised less frequently but for larger amounts than those that are new to the system or following an unusual pattern.

Where a card has been denied authorisation, it is added to a "Deny list" and can be refused entry to, or exit from, the system when it is subsequently seen, until it is removed from the Deny list.

Season tickets, concession fares and other information can be associated with the card in the central system; this information can be used when calculating the fare or the amount to be authorised (a season-ticket-holder travelling within the validity of the season ticket should not need any authorisation).

Again, this system can be operated on a prepaid basis, using transactions directly on a credit or debit card, or a mixture of the two.

Holding ticket data on the card

In all the cases described so far, each "tap" of the card is stored on the central system and is used for all subsequent operations. The system also identifies unsuccessful taps, where the card was denied entry (because it was on the Deny list or was denied authorisation), provided the card could be identified; holding all data centrally makes it much easier for the PTO to manage.

However there are certain situations in which it would be advantageous to be able to store on the card itself a record of the taps, fare type or ticket purchased. These include inspections (it is easier to inspect data on the card than for each inspector's device to communicate with the central system), and also long-distance travel where there may be several route options or fare types for the same journey.

To cater for these situations the latest versions of the Visa payWave specifications include an optional file in the card which issuers can configure to allow use by a retailer or transit operator. Terminals with appropriate software and keys can write to and read from this file. There are various ways in which this can happen, including:

i. Temporary storage only, which may be overwritten by subsequent card interactions but would for example be sufficient to identify the date, time and result of the last few taps;
ii. Cyclic storage which can be claimed when needed and then released;
iii. Records permanently allocated to an operator, for example in a co-branded card or in conjunction with a national scheme.

Examples of ways in which these records could be used include:

i. Store details of the last few taps for inspection purposes;
ii. Store limited details of each transaction and send these details to the host with the next transaction for "gap-filling" and system reliability purposes;
iii. Allow customers to view tap records stored in the card (in simple fare systems this could also include fares charged);
iv. Store in the card details of any period pass or entitlement, for identification by inspectors or at gates;
v. Store in the card full details of a ticket, including routing and time limitations (this is most likely to apply to long-distance rail or very complex networks).

ISO TR14806: "Public transport requirements for the use of payment applications for fare media" covers the transport industry requirements for use of these records on payment cards, and has been taken into account in drawing up the Visa payWave specifications. The first cards using these specifications have been issued and operators are following the results carefully. However it is important to stress that none of the live applications described above makes use of these extra fields and open-loop public transport payment schemes can be very successful without using them.

Benefits

Everyone gains from using open-loop payments:

Customers get a smoother, easier experience: they no longer have to go through the process of buying a ticket or topping up their card before use. They can just turn up, tap and go. Their card can work in any city in the world where open-loop payments are accepted, and across all modes of transport.

It is fast: the transaction is authorised and the gate opens or reader beeps within half a second. If an online authorisation is not required, or is not possible within that time, then risk management rules can be designed to allow boarding. The whole system is well-suited to the fast pace of life in modern cities.

With credit and debit cards, the customer no longer has to reserve a balance specifically for public transport travel. Those who do like to budget can still choose a prepaid card; but the balance is no longer restricted to travel – it can be used for other everyday purchases, in fact wherever Visa is accepted.

Transport operators can greatly cut down the number of cards they have to issue; in particular they can reduce the issuance of cards to visitors and infrequent users, who often make up a very small proportion of journeys but a high proportion of cost.

Ridership often increases because some users who would otherwise face inconvenience, or be unable to purchase a ticket or card in advance, can simply step up and travel. For example, visitors from overseas may not want to deal with counter staff in a foreign language, but find the instructions on a ticket machine confusing. When they see a Visa contactless logo on a gate, they know just what to do: they tap and enter the system.

Typically, the overall cost of revenue collection for a PTO is likely to be in the range 10 – 15 percent.[6] By using open-loop payments this figure can be reduced considerably: the main direct cost will be the Merchant Service Charge paid to the PTO's acquiring bank, while the systems and back-end services required should always be simpler and more cost-efficient than those for a legacy system.

[6] According to 'Smart Ticketing: The move to open loop transit' from Mercator Advisory Group published in June 2011, Transport for London spends 14% of their revenue for the maintenance of the Oyster card system based on 2007 audited figures. NY MTA quotes a collection cost of 15% in its COO.

Open-loop payments use international standards; they are identical throughout the world and all suppliers' systems are compatible. There are no licence fees to be paid[7] and no need for special SAMs in readers: all the front-end components are available off the shelf.

There are fewer limitations on the size of the system: an open-loop payments system can be extended, merge with a neighbouring system or share data with another city or operator. The privacy and data protection requirements this introduces are very common in open-loop payments and can readily be met using off-the-shelf tokenisation techniques.

Issuing and acquiring banks are very keen to see usage of their contactless cards in public transport: cardholders who use their cards regularly to travel are more likely to use them in shops and restaurants, and to appreciate the advantages of speed and convenience they bring. More frequent usage has risk management advantages for the issuer as well: it establishes a pattern which allows unusual or fraudulent expenditure to stand out.

All parties can future-proof their systems and ensure compatibility with emerging technologies, in particular NFC and mobile applications. Using open-loop payments, and the open standards that go with them, means that when a new application is developed it can be loaded and updated using standard Over-The-Air protocols.

Transit authorities and regulators gain the confidence that the systems they are investing in have been successfully used, all round the world, for decades; there is already a history of hundreds of millions of cards and billions of transactions. The business is very competitive and any financial institution can take part.

Operating model

With a legacy AFC system, the PTO is responsible for all aspects of fare collection, from setting fares and policies to issuing cards and tickets, collecting payments (in cash, by card or bank transfer), and servicing all kinds of customer query. Sometimes this is delegated to a separate fare collection agency, which assumes all these responsibilities but is then a cost centre for participating PTOs.

With an open-loop system, the card issuance and all customer servicing in relation to the card are carried out by the bank that issues the card. As with most AFC systems, it is possible to allow both anonymous users (at least as far as the PTO is concerned) and registered users; however the financial regulation ("Know Your Customer") aspects of registering users are handled by the bank. If customers choose to register their cards with the PTO then they may be eligible for extra services.

The issuer and acquirer between them ensure the payment flows smoothly and promptly into the PTO's account. Fraud risk is managed by both parties: the issuer must manage the risk of lost and stolen cards, while the PTO manages the risks of fraudulent travel (for example, an adult travelling on a child's pass, or several people share the same day travel pass).

[7] There may in some cases be licence fees for the card application, but these are payable by the bank issuing the card, not the PTO.

Any prepaid float is managed by the issuer of the prepaid card. This may be a bank, a specialised non-bank issuer, or it can be the PTO or fare collection agency itself. Prepaid cards are likely to be co-branded: they are issued by a bank but prominently display the logo of the co-brand partner; the operating costs are offset against float income and the benefits shared between the two parties. This arrangement also works well for cards that must be issued by the PTO or its representative: for example children's or old people's concession passes. These cards may carry a photo or other identification mark, and will often generate a different sound or message.

The PTO provides the acceptance infrastructure (gates, readers and communications networks) and the back-end systems that collect transactions and calculate fares. It should also provide a system for customers to be able to view details of their travel, since these details will not be available on the card statement.

It must also ensure that there is a way for everyone to pay: this will usually be by arranging for some cards to be issued in the name of the PTO, often by using a co-brand or white-label[8] arrangement with an established card issuer.

Bank responsibilities	PTO responsibilities
Card issuance Customer service in relation to card Lost and stolen cards	Acceptance infrastructure Fare calculation Fraudulent travel Customer service in relation to travel
Prepaid cards and float management (may be bank, PTO or co-brand)	

Figure 3 - Bank and PTO responsibilities where open-loop cards are used

[8] A "white-label" card issuer uses its name and systems to issue a card on behalf of a PTO, retailer or other organisation; the name of the issuer is usually in small print on the back of the card, while all contracts, customer correspondence and card logos are in the name of the PTO or retailer.

Important considerations

Although open-loop payments in public transport offer undoubted opportunities and potential benefits, these benefits do not flow automatically. The system must still be well-designed and adapted to the local conditions in order to be successful. Some of the critical factors that will help to ensure the success of a project include:

The level of contactless bank card issuance in the market

This varies widely from country to country. While in certain markets like Australia, Hong Kong, Singapore and Taiwan contactless bank card issuance has reached a high level, in some other geographies there are very few or no contactless bank cards. In such markets, PTOs can partner with one or more issuers who are willing to invest in building a critical mass of issuance and to develop distribution capabilities.

Customer awareness of contactless products

It is important that customers who have a contactless bank card understand what the card can do and how it works. Many customers were first introduced to contactless through public transport cards, and so they expect other contactless cards to operate in a similar way. Debit and credit cardholders will now find that contactless transactions appear on their account in the same way as other purchases.

Those who do not have a credit or debit card must be made aware that they can obtain a prepaid contactless card (whether from the PTO or another issuer). For some, this will be their first bank payment card and an important step on the financial inclusion ladder. These cards can be distributed through convenience stores, kiosks, Post Offices and other easily-reached outlets.

Need to link payment to card

For a credit or debit card, the named cardholder should always be the person travelling. Some PTOs may even make this a part of the Conditions of Carriage (the general terms and conditions that apply to all travel).

Bank card issuers also want to ensure that the card being used for travel is also the one that was used for payment: they do not want their cards being used repeatedly without their knowledge. So PTOs may have to make rules that ensure, for example, that a season ticket being linked to the passenger's personal credit card has been paid for using that card (and not by an employer or parent).

Prepaid cards

One of the major advantages of open-loop payments is that they can take place immediately (debit card), post-paid (credit card) or prepaid (using an “electronic purse”). As we discussed earlier, there is rapid growth in the availability and take-up of prepaid cards, and in many countries this is filling a gap in penetration of bank accounts.

Customers who need to budget carefully may also prefer prepaid cards, as will those who cannot obtain a bank account or debit card. So in many countries there will be a high proportion of commuters wanting to use a prepaid card, whether it is issued by a PTO, bank or e-money issuer. This will also benefit a wide range of stakeholders in Government and finance, as these customers will be able to use their cards in shops and online and thereby build a financial history in order to provide usage trends for fraud protection.

However prepaid cards can also cause a difficulty where the fare is not known at the start of the journey (as in the London and New York cases mentioned above): unless the maximum fare is deducted when the passenger first enters the system, there may not be enough in the account when the final settlement is made (since the customer could have made other purchases in the meantime). However many customers may see it as unfair to deduct a maximum fare when they only wanted to travel a short distance (and indeed they may not have enough funds to do this). PTOs will have to agree with their acquirers a strategy and risk management process for managing this situation.

Inspection

Mass transit systems generally rely on good boarding controls, combined with infrequent inspections and revenue protection checks. But the inspections are an important deterrent that can prevent passengers from “playing the system”. With no ticket or receipt, passengers must be able to show the inspector that they tapped their card on entry to the system (known as “proof of payment” {POP}). In a legacy system the data are held on the card and so an inspector only needs a device that can read the card to get POP. On a bus the record of all taps should be held on the bus reader, and so the inspector can download this information to his or her device before checking passengers’ cards in order to compare cards tapped with cards presented for inspection. However on a Mass Transit system where all the records are held centrally, the inspector would need to be able to access the central record to perform POP inspection, which can be technically challenging in some environments.

In the absence of any record held on the card, the inspection system must be very carefully designed to ensure that inspectors’ devices have access to the most up-to-date information at all times.

System gating or ensuring tap on and tap off

To be completely effective and automatic, the system must be fully covered by both entry and exit gates: it must not be possible for anyone to enter or leave the system without tapping their card. AFC gates normally include ‘tailgating’ and ‘passback’ controls that prevent two people from entering together or passing the card back once the first person has entered the system. This can require major redesign of stations; it impedes passenger flow and so larger areas are needed.

Passenger safety must be the first consideration: in an emergency it must be possible to evacuate a station quickly, with minimum obstacles. Gated stations must still be manned (or at least under Closed Circuit Television supervision), to prevent or detect people jumping over barriers, to open gates in case of a malfunctioning gate or card, to accommodate wheelchair users and others needing assistance etc.

On buses, depending on the fare structure, it may be necessary to ensure that passengers tap off as well as tapping on. Where buses have two doors, it is very difficult to enforce this and many systems therefore structure their fares so that they take a maximum fare on entry and then refund the balance on exit. Good physical design can make it more likely that people will tap off, and some buses are now being fitted with turnstiles or detectors to count people boarding and disembarking; these can be married up with entry and exit taps.

Fare structures

Many city transport systems have grown organically over the years, and priorities for fare structures may also have changed during this time. Although most fare strategies have a goal of simplicity and clarity, these must also be balanced against goals of optimising off-peak ridership, allowing disadvantaged passengers to travel, and keeping fares competitive against other alternatives.

This can lead to complex fare structures which take into account the mode of transport, distance travelled, time of day, frequency of travel and other factors.

Having a central fare calculation system provides the maximum flexibility for the PTO: it can keep things as simple as possible for the passenger, or can introduce rules to achieve other goals. Fares such as “one hour’s unlimited travel” can be included. Passengers can pay different rates according to the type of card or pass they own, and one-off special offers or surcharges can be made. If there is a temporary problem with the transit service, then fares can be adjusted at the end of the day. And the journey records and adjustments are always held in the central system so that passengers can see how fares have been calculated.

Passenger throughput and authorisation times

Many mass transit systems aim for a throughput of around 30 passengers a minute per gate: this is achievable with a contactless smart card, but not really with any other technology. Open-loop cards using ‘EMV’ technologies can achieve transaction times of just under 500 ms: slightly longer than the 300 ms of legacy cards, but still within the tolerance needed to achieve 30 passengers a minute.

For some transactions (typically the first time a card is seen each day or period), the PTO will seek an authorisation from the card issuer. Authorisation times are getting continuously shorter and it may be possible to get a response within the time required for the gate to decide whether or not to allow the passenger to enter the system. But the infrastructure required for such ‘super-fast’ authorisations can be expensive and with some cards the issuer may not respond quickly enough.

In these cases a combination of risk management techniques may be used to allow passengers to enter the gate while the authorisation is taking place. A list of cards that have been declined (known as a 'Deny list') is held at the gate and prevents one of these cards from being used to enter the system. Cards that have been seen before or are following a regular pattern of use may be identified and subjected to less frequent authorisation.

When the system is first installed and data are being gathered, authorisation traffic will be quite light and so a high proportion of transactions can be authorised. As the system gathers experience and the load increases, authorisations will become more selective but may be for larger amounts.

Boarding times for buses are more variable and so the actual card transaction time is less critical. But communications are likely to be slower and less reliable, so it is less likely that a response will be received within the time required for boarding. Generally systems must make provision for allowing boarding for known cards, with the PTO or the acquirer taking some risk that the authorisation request may be declined and the fare may never be paid.

Chip card standards

In most regions of the world contactless cards, and the systems that support them, follow the 'EMV' standard that has also been adopted for contact cards. However in the USA, where by far the largest numbers of contactless cards have been issued, the protocols and messaging have to be adapted to follow the simpler magnetic-stripe standards that are still used in this country.

These 'magnetic-stripe data' (MSD) cards are more secure than the magnetic-stripe cards they replace, since they incorporate a dynamic cryptogram which changes for every transaction. However unlike EMV cards they do not have provision for offline card authentication (where the terminal can verify the authenticity of a card) and so every transaction must be authorised online (although not necessarily in real-time).

Terminals in other regions must recognise both card types and adapt their authentication and authorisation processes to the type of card being processed.

Security

Many legacy smart card systems were based on relatively simple cryptography, with short (e.g. 40-bit) keys and symmetric algorithms. This was a vast improvement on the paper and magnetic-stripe systems that preceded them, and was more than adequate to protect the relatively low values in transport cards and telephone cards. As processing power has become cheaper, the effort required to break this security has decreased, while the risk has risen as more cities employ similar technology.

No system has yet seen a major breakdown of security, but there have been enough hacks and reports of weaknesses to require these early systems to upgrade their security. However, such systems still make use of symmetric cryptography; in nearly every case they require the use of a Secure Application Module (SAM) in each reader or gate; these are difficult to manage, usually proprietary and expensive to buy and maintain.

By contrast, EMV makes use of a combination of symmetric and public-key cryptography which does not require SAMs in terminals, but still ensures that every card and every transaction can be uniquely identified and can be traced back to its issuer. A regular review by a panel of cryptography experts ensures that keys are long enough to withstand attack for many times the life of the card.

Some consumer groups have been worried that using contactless cards in public transport could lead to an erosion of privacy. However the Payment Card Industry is very tightly regulated, and there are strong standards[9] - the Payment Card Industry Data Security Standards or PCI-DSS - to protect customers' privacy. The tools that have been developed to enable companies to comply with PCI-DSS will help PTOs to separate the sensitive personal data elements from the financial card and operational data needed to run the transport network. System access controls are needed to ensure that staff only have access to (usually de-personalised) data for the purposes they need, while customer support staff can gain access to personal and journey data, but not financial card data.

Access to journey data

It is, however, important to be able to allow customers access to the journey data records associated with their card. For the same security reasons, that is likely to require a separate database with different levels of access control (in this case to ensure that each customer can only see his or her journey data).

These records complement the line on customer statements which gives an amount and probably a transaction reference; the reference can be followed back to the journey records on the PTO's system to show how the charges were calculated.

Back office processes

In the back office, the PTO or fare collection agency needs not only the ability to calculate the fares due and to submit these for collection, either by decrementing a prepaid transit product or through the acquirer. It also needs to be able to distribute those fares among participating operators, in many cases taking into account any payments that have been made through other channels.

Like other large merchants, the PTO should maintain a payment switch which manages authorisations and settlement requests, reconciles submissions with the amounts actually received, and provides the data needed in case of disputed transactions. This switch will also provide Management Information on transactions, cards used and performance metrics.

[9] See https://www.pcisecuritystandards.org/

The network of payment devices and readers must be remotely monitored in real-time and any faults followed up quickly; often it is possible to detect a device that is starting to fail before the failure is final. The system should include fraud monitoring and detection, with rules to detect unusual or known fraud patterns of usage. These rules may feed forward into the risk management engine which determines when an authorisation is sought and for how much.

Reload

For prepaid cards, the availability of a widespread reload network is a critical success factor. The network must have the same reach as the public transport network, and may have to be quite dense: the aim should be that everyone can reload their card on their journey from home to the bus-stop or mass transit station. A city of five million people may need between five and ten thousand reload points, in addition to online and telephone options.

With legacy cards, this network had to be set up specifically for the public transport application. With open-loop cards, it can be shared with all other top-up applications, including mobile phones and telephone cards, and with utility bill payment. There are networks like this in most major cities.

It is even possible to reload cards at ATMs, either by transfer from another card account or by linking the prepaid card to a credit or debit card.

NFC and mobile applications

Everyone involved in payments agrees that mobile phones will have a major influence on the future of payments; in particular NFC phones could potentially replace cards as a form factor, with much more power and facilities.

Several PTOs (including Suica in Japan and T-money in Korea) are already working directly with mobile operators to offer fare payment and travel using a contactless phone, increasingly using international NFC standards. However the issues of scalability, interoperability and security are the same as for legacy card systems, and PTOs should consider the advantages of aligning with the much more widespread evolution of open-loop NFC payments.

NFC phones are still not widely available, except in Japan and South Korea; at this stage the structure of NFC payments is still evolving and there is not yet full agreement on the way banks, mobile network operators and other service providers will work together.

Processing arrangements

The processing of payment card transactions is increasingly a specialist activity: since the advent of PCI-DSS in particular, many retailers have preferred to outsource this activity to a specialist processor. However in the case of a public transport operator using one of the integrated models described above, the need for the various sub-systems to communicate with each other may outweigh the advantages of outsourcing the switching activity.

The figure below shows the sub-systems that may typically be needed for a full implementation of an open-loop system with both prepaid and post-paid options.

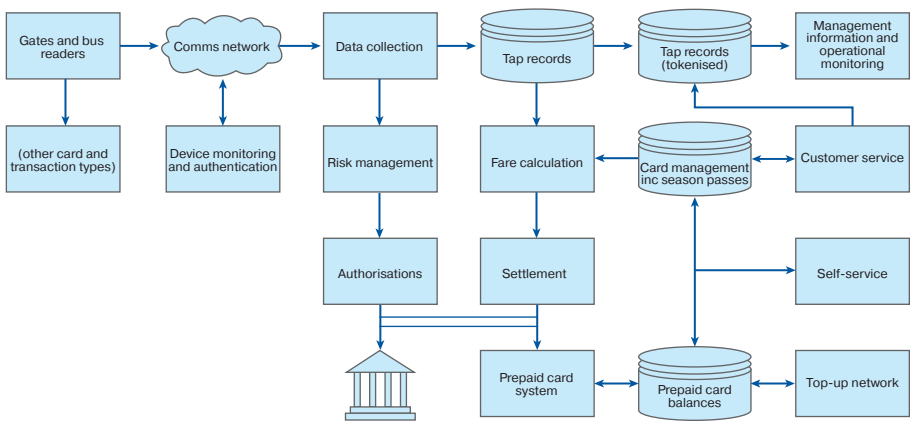


Figure 4 - Example block diagram for open-loop payment processing

If an operator has implemented a structure such as this, then it may be able to offer processing to other PTOs. Or specialist payment processors may develop the extra services needed to offer processing on a white-label basis to a range of PTOs within a country or region.

Next steps for an operator or AFC agency

Any major public transport operator, whether a mass transit system, city-wide bus operator or a fare collection agency serving a multi-modal network, should assess the value to it and its customers of accepting open-loop payments. It will need to determine the likely costs and cost savings, as well as listing the financial and other benefits that may be obtained.

Sources of information for this will include:

i. Major suppliers who have already drawn up costs or budgets for similar services;
ii. Acquirers, issuers and payment associations in the country;
iii. Independent assessments from industry bodies such as the Smart Card Alliance and similar bodies in other countries;
iv. The Concept of Operations published by the New York Metropolitan Transportation Authority[10] and similar documentation from other agencies available through the Smart Card Alliance.

The PTO should speak with its acquirer to determine what rates and incentives it can offer, and with both transport and financial regulators in the country to determine whether suitable provisions already exist for this arrangement. It may need to liaise with the local Bankers' Association or card payment association to ascertain the status of contactless issuance in the country and its likely evolution over the coming years; the acquirer can also help in sourcing this information.

Armed with this information, the PTO can start to draw up a detailed strategy and business case. The overall objectives of the PTO or transit authority will need to be taken into account; however the customer service benefits will often predominate in the business case.

[10] Concept of Operations for MTA New Fare Payment System and NYCT deployment phase - Metropolitan Transportation Authority (MTA), Release 1.2

The business case will look quite different depending on what AFC legacy systems are already in place: where there is no existing system the benefits of moving to a modern AFC system should be compelling for all but the smallest network.

PTOs with existing AFC systems will look to make cost savings from reducing the cost of card and ticket issuance, while increasing paid-for ridership. Those with older systems may need to make upgrades anyway, for security reasons, and can take advantage of those upgrades to allow open-loop card acceptance. Reload and top-up networks can be reassessed, and the commissions paid to merchants for top-ups can be reviewed.

If the underlying business case appears positive, then detailed discussions need to take place between the PTO and its acquirer. These will cover not only rates and rules, but also the detailed processes and software requirements, communications with customers and the timescales for introduction of the service. The acquirer will in turn involve the card schemes.

As part of the project planning process, PTOs are strongly recommended to set up round table discussions with schemes, acquirers and suppliers to ensure that each party understands the technical and business requirements and their respective responsibilities. Visa representatives will be available to help guide this process and support all the players as needed.

Case study

KLIA Ekspres (Malaysia)

Case study: KLIA Ekspres (Malaysia)

KLIA Ekspres is the high speed, non-stop airport rail link service between Malaysia's Kuala Lumpur International Airport (KLIA) and Kuala Lumpur Sentral (KL Sentral) station, 57 km away. Trains leave every 15 minutes at peak times and every 20 minutes during off-peak periods. KLIA Ekspres is operated by Express Rail Link (ERL) and is Malaysia's fastest railway system with a 99.98 percent on-time service performance.

A one-way trip costs 35 Malaysian Ringgit (approximately US$11.35) for adults and 15 Malaysian Ringgit (approximately US$4.80) for children. Passengers can buy a single-ride ticket, multiple rides or a monthly pass. However ERL found that most people bought single tickets, paying cash, and this caused a bottleneck at the ticket sales point. In 2010 ERL then turned to Visa to see if these purchases could be converted to electronic transactions.

Visa started pilots of the world's first EMV-based contactless cards in Malaysia in 2004, and launched commercial services in the country in 2005. By 2010 there were already significant numbers of cards in regular use, and so allowing customers to tap their card at the gate helped to speed up transactions at the gates for those passengers. With growing contactless issuance in other countries in the Asia Pacific region, visitors from other countries can also use their Visa payWave cards and no longer have to queue up at a counter to buy tickets before or after a long air journey.

Visa payWave cardholders simply walk up to the gate and tap their card. The fixed fare is deducted from the card account, and the gate opens within a few seconds. All payments are authorised so the delay is slightly longer for overseas cards than for Malaysian-issued cards, but all are comfortably within the times set by ERL. Exit gates are simple one-way turnstiles and so there is no need to tap the card on exit.

When the system was first introduced, passengers paying this way received a discount of 10 percent off their regular ticket price. This was only implemented for a promotional period and interestingly enough, after a few months this discount was no longer required. The convenience of the service was sufficiently incentivising in itself. All gates carry clear Visa payWave signage, which can be recognised by arriving passengers from all countries.

The implementation used standard off-the-shelf components: see the box. This allowed a very fast implementation: in the first phase only Malaysian-issued cards (which could be offline-authorised) were accepted. In the second phase all payWave cards were accepted, with online authorisation where needed.

The solution components are as follows:

- GHL VR300 Contactless Reader
- VeriFone VX510 TCP/IP capable terminal
- YTLE Gate systems and controllers (existing)
- netAccess L-200 network controller
- Reconciliation back end server
- EON Bank (now part of Hong Leong Bank) is the Acquirer

The implementation of the contactless payment function was completed in less than three months. KLIA Ekspres already had a very good reputation as a modern, fast service and this service has further improved its image. Nevertheless it felt that there were several key lessons from the project:

Key Lessons	
Changing passenger behavior:	During the launch period a 10 percent discount was offered to passengers to encourage them to try out the new technology. The discount was not offered at ticket counters, even when a Visa payWave-enabled card was used.
Cashier training:	Cashiers were trained to recognize Visa payWave-enabled cards when a passenger tries to pay at the counter, and to redirect them to the pay-at-gate solution, highlighting the benefits of this payment method as well as the discount.
Integration with gate systems:	All gate controllers are proprietary, and so interfacing them with payment devices create additional challenges. Detailed discussions are required with gate system vendors in advance to address these.
Fast Online Connectivity:	A fast, always-on connection to the acquirer is crucial, so that all transactions are fast enough for the cardholder.
Tackling Interference:	Motorized gates generate electrical noise, which can affect payment devices. Extensive testing is recommended to address such issues.

KLIA Ekspres is typical of many high-speed airport-to-city rail links that are being built to service Asia's fast-growing cities. This smooth and speedy implementation could be used as an example for many of them.

“We share a common objective of improving the payment experience of the travelling public by providing continually enhanced ticketing solutions. ERL is proud to be the first public transport operator in South East Asia to introduce this facility for the convenience of KLIA Ekspres passengers, who hold Visa payWave cards.”

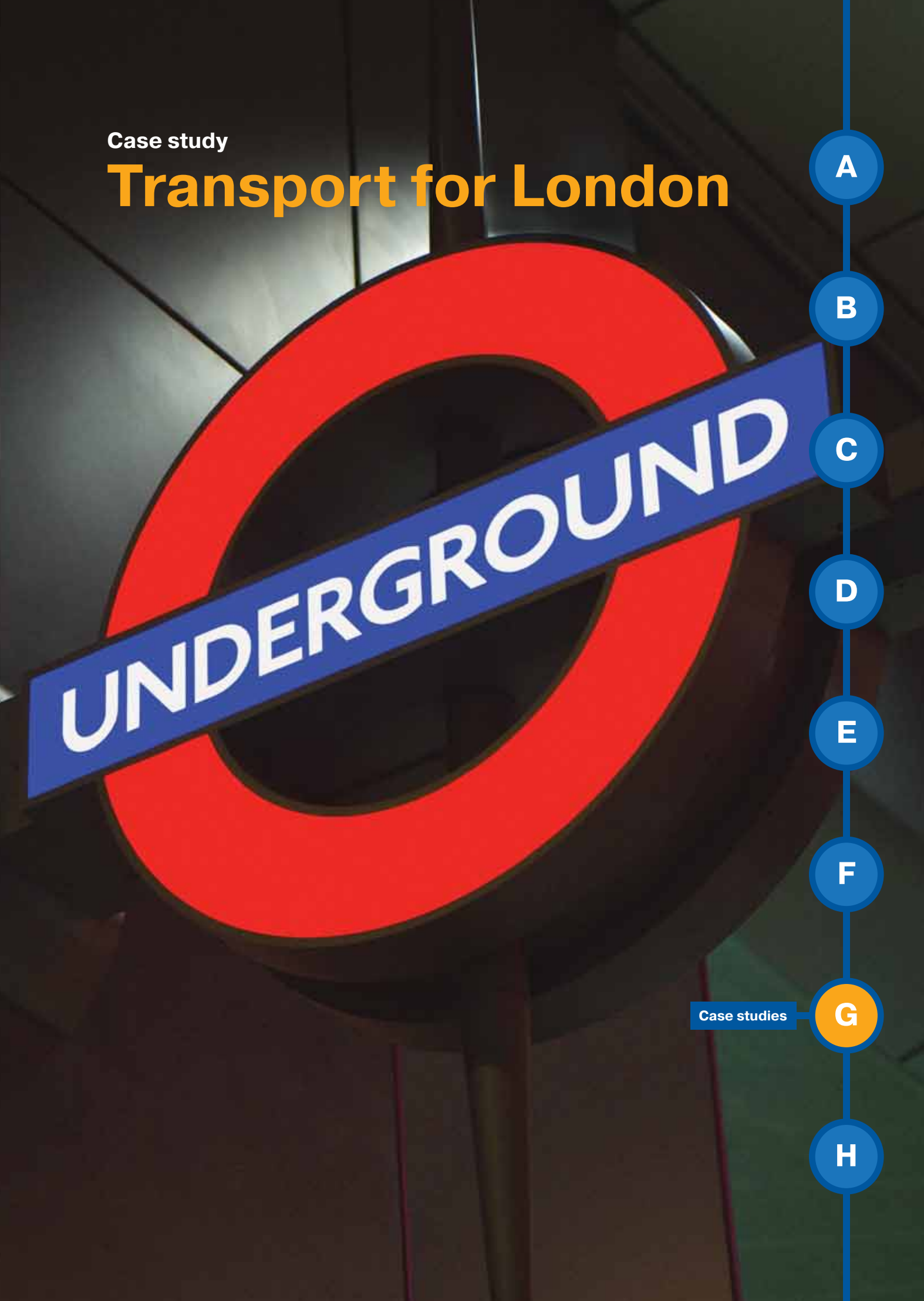
“For our passengers – local and foreign, it’s quick, convenient and secure. As there is no need for separate tickets, this also becomes an environmentally friendly initiative, further supporting our Go Green, Go Lo-Co2 cause. Of course, our customers can also use their Visa payWave card at our Ticket Counter to buy a KLIA Ekspres ticket.”

“It is our hope that technological innovations such as the Visa payWave can improve the experience for our customers while allowing us to manage fare collections more efficiently.”

Puan Noormah Mohd. Noor
Chief Executive Officer of Express Rail Link Sdn Bhd (ERL)

Case study

Transport for London



Case study: Transport for London

Transport for London (TfL) is the statutory body responsible for implementing the Mayor's transport strategy for London. As well as operating the world's oldest underground network (known as "the Tube"), it manages London's buses, the Docklands Light Railway, London Overground trains, trams, river buses and Victoria Coach Station. It is also responsible for roads, including the Congestion Charging scheme, and for regulating taxis, as well as promoting accessible transport and walking and cycling initiatives.

The TfL network includes over 8500 buses, 270 Tube stations; over six million journeys are made by bus and three million by Tube every weekday.

In 2003 TfL introduced the Oyster card, a contactless card using MiFare™ technology that allows a combination of season tickets, concession fares and Pay As You Go (prepaid "PAYG") travel on a single card. Oyster PAYG balances can be topped up at stations; at one of 4000 TicketStop shops across London, and online. They can also be set to top up automatically from a credit or debit card when the balance drops below a preset level.

London is divided into nine fare zones. Most fares are set according to the number of zones covered by the journey, with any mix of bus, underground, train or tram (but you can also buy a single bus fare for a fixed price). Oyster fares are set lower than cash fares, and are 'capped' so that a day's travel never costs more than a daily Travelcard for the same zones. Since 2010, it has been possible to use Oyster cards for PAYG travel on National Rail services in the nine London fare zones.

Oyster has proved very successful for TfL and popular with its users: Tube and bus travel both rose after it was introduced. Over 50 million Oyster Cards have been issued since launch, and around 7 million separate cards are used each month. However almost half a million new cards are still issued a month, while the system must also support paper magnetic-stripe tickets as issued by the Train Operating Companies. The technology used by Oyster has been upgraded since the original version, but it depends on proprietary algorithms and SAMs in all acceptance devices, with a complex system for maintaining fare tables and 'action lists' in each reader and gate.

In 2007 the first contactless bank cards were introduced in the UK. By the end of 2011 there were over 20 million cards in circulation, with most major issuers migrating their programmes to include contactless. Transaction volumes rose steeply when major fast-food chains, including McDonalds, started to accept the cards. Contactless debit cards, which were introduced later, turned out to be used much more often than contactless credit cards.

Since 2007 TfL has been working on the design of an open-loop payment system, part of its Future Ticketing Project. Readers will support legacy Oyster cards, ITSO cards (as issued by local authorities outside London for e-ticketing including concessionary travel) and open-loop payment cards. Customers who have a bank-issued contactless card will be able to use it to board a bus or pass through a gate on the Tube; at the end of the day the value of that day's travel will be deducted from the account. As with Oyster today, the fare will be 'capped' at the price of a daily Travelcard, and there are plans also to introduce weekly and monthly capping, offering an alternative to buying such period passes.

Those who do not have a bank-issued contactless card, or who want to keep their travel budget separate, will be able to get a TfL-branded prepaid card. Those who benefit from concession fares will also get this card.

Cities like London are leading the way in large-scale, multi-modal implementations that will use both post-paid and prepaid models, and in each case the new technology is being introduced alongside a very successful existing scheme, so the implementation is proceeding in several phases. By the end of 2012 (phase 1) passengers will be able to pay with an open-loop card on all London buses, where a fixed fare normally applies. In phase 2 this will be extended to the Tube and other modes of transport, where zone-based fares are used. Phase 3 covers other fare types, including season passes. Only at phase 4 will the TfL-branded prepaid card be introduced; this card is likely to carry the additional data files for TfL use.

"As more people use their bank-issued cards to pay for their travel directly, TfL's costs will reduce, delivering better value for money for London's fare- and tax-payers."

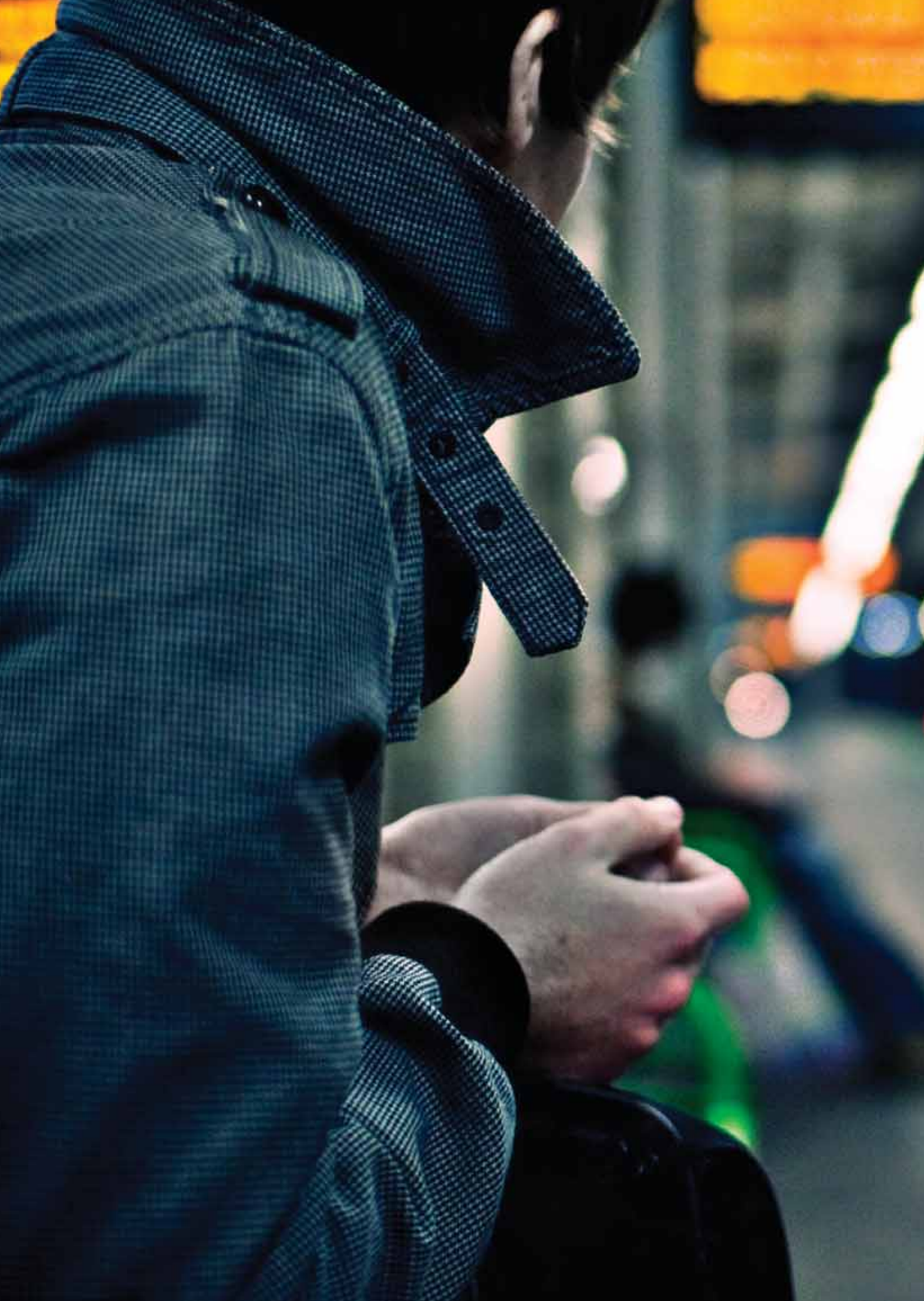
Shashi Verma,
TfL's Director of Customer Experience

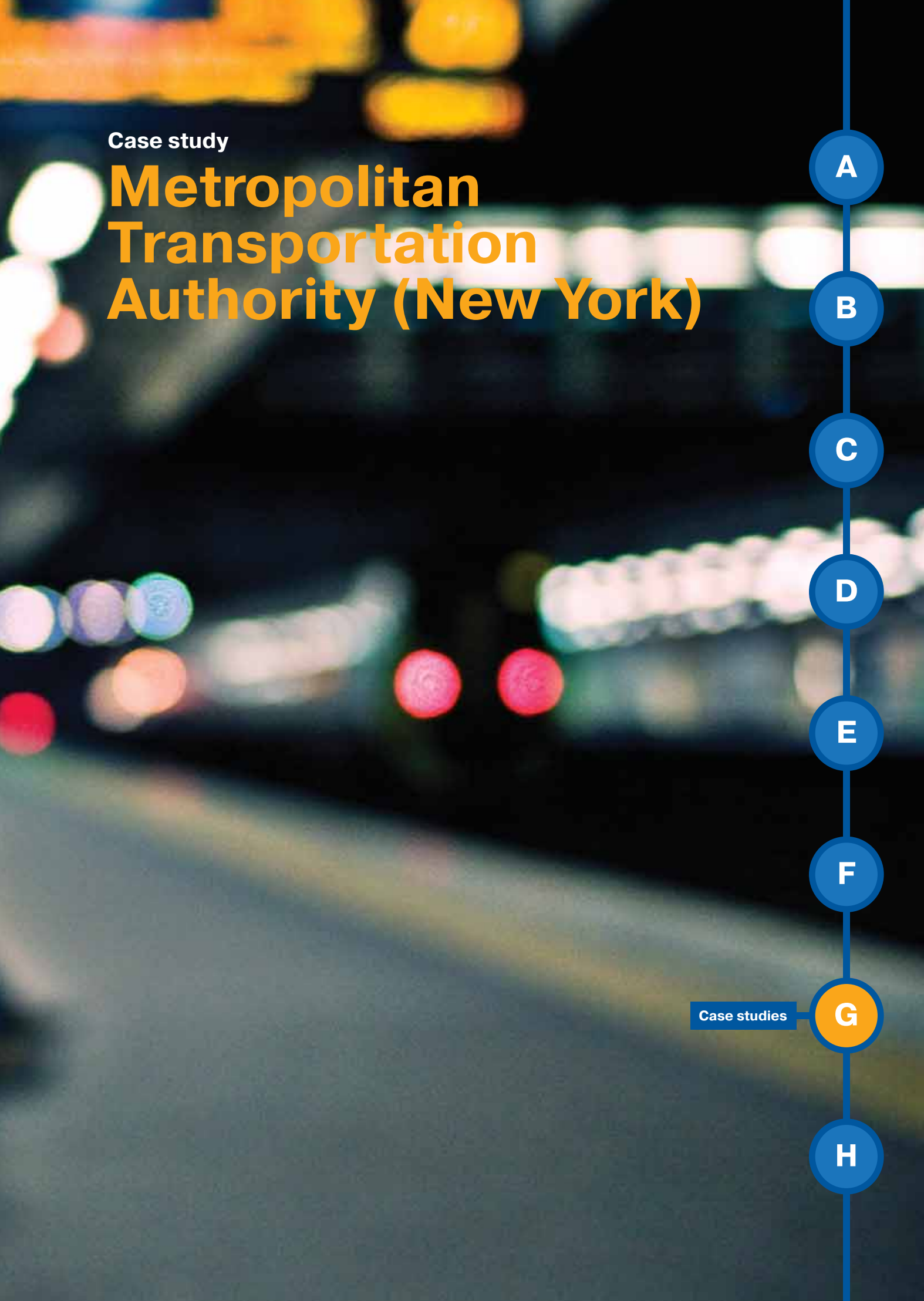
TfL is also actively working with the NFC Forum and has run pilots allowing NFC phones to be used in the system; these will automatically be enabled when the relevant stages are reached, and can be integrated with TfL's existing smart phone application.

TfL expects that customers, particularly visitors to the capital, will find the system more accessible and will spend less time in queues (since there is no need to buy a ticket). With less time spent 'managing travel', effective journey times will be faster. Station areas will be less crowded and there should be fewer customer queries. Customers will have a wider range of choice for topping up their prepaid cards or adding travel products.

From a cost point of view, encouraging open-loop payments should remove a large portion of card issuing costs (but there will still be costs for issuing concession and prepaid cards). Visitors are likely to find the system easier to use and hence may use public transport more often. Finally, TfL benefits from using world-class cryptography and security to protect its transactions.

Shashi Verma, TfL's Director of Customer Experience, says "As more people use their bank-issued cards to pay for their travel directly, TfL's costs will reduce, delivering better value for money for London's fare- and tax-payers."





Case study

Metropolitan Transportation Authority (New York)

Case study: Metropolitan Transportation Authority (New York)

The Metropolitan Transportation Authority (MTA) is a Public Benefit Corporation responsible for public transport in a 14-county region that includes New York City, and operates subway, bus, commuter rail service and tolled bridges and tunnels. It operates the New York City subway, which system has 468 stations and in 2011 carried 5.3 million passengers on an average weekday, and the bus system with 5600 buses in 2011 that carried 2.5 million bus journeys on an average weekday.

Across the Hudson River NJ TRANSIT operates a fleet of 2,180 buses, 1,300 trains and 93 light rail vehicles in the state of New Jersey, with service to New York and Pennsylvania, while PATH (a wholly owned subsidiary of The Port Authority of New York and New Jersey) operates the PATH rail network between the two cities, which carries 250,000 passengers a day.

The main method of payment for fares on the MTA subway and buses is the MetroCard; this is a magnetic-stripe card, with all details of travel products and entitlements held in a central database. PATH uses a contactless smart card, known as SmartLink, as well as MetroCard for the payment of fares.

From June to November 2010, the MTA, NJ TRANSIT and the Port Authority co-operated on a multi-agency, multi-modal pilot of contactless bankcard acceptance, which covered 30 subway stations, the Newark Liberty Airport train station, 11 bus lines and 400 buses. The travel products included flat fare Pay As You Go and time (or unlimited rides) pass products, and payment media including credit, debit, and transit benefit cards were accepted. The pilot supported transaction aggregation up to 7 days or US$15. All subway and bus transactions were authorised online; a hotlist was maintained for cards that had been declined.

Among the aspects tested were:

i. Technology: Although an earlier pilot study in 2006 had established the feasibility of reading contactless cards at the gate and charging the resulting transaction to the cardholder's account, the pilot in 2010 tested the ability to authenticate cards in real time from both subway gates and buses (using fiber optic cables at subway turnstiles and 3G wireless links on buses and some turnstiles).
ii. Fare products: The 2006 pilot tested for Pay As You Go only, whereas the 2010 pilot showed that the full range of fare products could be supported, including single and multiple rides, period passes, free transfers and reduced fares. Where journeys involved changing trains or buses, the appropriate fare rules were applied.
iii. Interoperability: The pilot verified that devices from different card issuers and schemes worked in a consistent way and gave predictable results.
iv. Risk management: The pilot gave the operators a better understanding of the risk management rules that need to be applied to open-loop products, as compared with the transit-only products they currently manage.
v. Employee transit benefit cards: US tax rules allow an employer to provide tax-free travel benefits to employees for commuting. The value of the benefit is deducted from an employee's gross pay that is prior to tax deductions being taken, and can only be used for purchasing commutation travel. The benefits can be directly deposited into a card account. Visa worked with a transit benefit services firm to target several employers in the pilot area to arrange for employees to receive contactless Visa cards, and to link those cards to an account that could be employer-funded.
vi. Consumer reactions: Consumer research carried out by Visa after the pilot was positive; it showed that most consumers were aware of contactless, and two-thirds of those questioned had a contactless card and only two-thirds of those had used it. However many were more enthusiastic about using their contactless card in transit and felt that this would be a reason to get a contactless card product.

Back-office systems were developed to handle the pilot's transaction processing and data requirements, and a pilot website and call center (agents and IVR) were established for customer support. Initial authentication checks were performed on all payment cards, together with an online authorization request to the card issuer where required. The transit agencies applied further risk management rules (based on history, velocity checks and transaction patterns) on both the transit and payment sides, and generated a Deny List that could be used locally at the gate in the event of a communications failure. Customers could register once and could buy fares from any of the three transit agencies. Data warehouse gave each operator access to journey data for dispute resolution and management information purposes.

Following the pilot, MTA announced its intention to move to a New Fare Payment System (NFPS), and in April 2011 it publicly released the first full draft of a Concept of Operations (COO) for NFPS for industry comment. The COO's stated purpose is to define what the system should do, and is not intended to be a technical requirement or design document.

The primary objectives of NFPS, according to the COO, are "to reduce the costs of fare collection, to allow seamless travel across multiple agencies and modes, to enhance customer mobility and convenience, and to place the MTA into the mainstream of next generation payment technology and processes. NFPS must be flexible enough to enable MTA to upgrade system components as technology and payment standards evolve without requiring a full system replacement."

The COO emphasizes that key to achieving all these objectives is the use of open standards, for cards and payment tokens, for readers and for the acceptance structure. The system would utilize open standards and interfaces and to the greatest extent possible, commercially available off-the-shelf hardware and software available from multiple suppliers. The system would be compatible with and leverage existing payment industry systems and services. Components would only be customized where the current state of commercially available hardware and/or software does not meet the special needs of the MTA's operating practices and environment or where such customization would minimize the complexity of operations or maintenance and reduce MTA's reliance on any particular supplier.

The contactless readers would be based on current open payments standards such as ISO 14443A and B and other open standards to be ready for emerging technologies such as NFC and EMV. The concept behind NFPS is for MTA to operate as a normal merchant within a four-party structure, with a handful of exceptions to the standard transaction model required to accommodate certain unique aspects of the public transport environment. Such exceptions would be handled through the adoption of various business rules and risk management programs, and negotiated arrangements with the acquirer, payment networks and/or issuers.

NFPS should be able to readily support practically any fare policy, including Pay As You Go and Pay In Advance fare products along with free transfers and reduced-fare travel for those entitled to it. The existing MetroCard system is a proprietary closed loop magnetic stripe system that is over 15 years old, based on card-stored value processing. It requires either refreshment or replacement in the near term. Also, even though MetroCard is used for over 95 percent of all subway and bus rides, cash is still a significant part of fare collection, resulting in over US$1.6 billion per year in required cash handling for buses and subways.

“Contactless fare payment on bank cards and mobile phones in the future will provide MTA customers with a world-class customer experience, making fare payment faster, easier and more convenient and secure than ever. Saving our customers time with faster boarding and the ability to buy and manage their fare anywhere, anytime, any way they choose, will improve their quality of life.”

Joseph J. Lhota
Chairman and CEO, Metropolitan Transportation

NFPS would shift fare collection from a card-based to an account-based system (or front-end to backend processing) by enabling acceptance of both a contactless version of MetroCard and bank or third-party issued contactless payment cards (and other chip-enabled form factors, including mobile phones enabled for contactless payment) directly at entry points. Customers will have more attractive options for how to pay their fare, facilitating a long-term shift away from cash transactions in stations. MTA is looking to NFPS to make the fare collection system more cost efficient over the lifecycle of the system, and ensure the system can be easily upgraded in accordance with changes in technology or industry practices.

The initiative is in the planning stage and a start date for design is not yet specified. In line with the expected timeframe for installation of the stations communications infrastructure, the entire bus and subway implementation is expected to take approximately three years from design notice to proceed to Go Live. Subsequent to going live, the then current MetroCard fare products would be migrated over to the contactless environment by product type over an 18 to 24-month period.

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