Contactless Smart Card Schemes in the Asia Pacific Region

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INTRODUCTION

This report provides an overview of the major contactless smart card schemes in the Asia Pacific region. It is not intended to be exhaustive because that would be impossible, due to the many small contactless smart card schemes related to physical access applications, particularly in China. It is also not intended to be a quantitative report (although we have included some comments of our own on this subject below). Lastly, it should be noted that the report is concerned with contactless smart cards used as consumer tokens, for whatever application, and not with the subject which is now known as RFID. Radio Frequency Identification (RFID) is the use of radio frequencies, or thereabouts, to read information on a small device known as a tag, or a smart label, but neither are intended as consumer tokens.

While there are many applications for contactless smart cards outside of public transport, the size of public transport ticketing schemes for automatic fare collection (AFC) and the potential volume of transactions are now driving the growth of contactless smart cards. In many cases there is a clear business case for the introduction of contactless smart card technology into transport ticketing schemes for automatic fare collection, particularly where the transport ticketing scheme is already based on an AFC scheme and is reasonably efficient and well designed. It is also clear that contactless smart cards will give transport operators an opportunity to expand away from their core ticketing business and into other business sectors. The potential of large populations of contactless smart card holders that like the convenience of fast “touch and go” transactions and have the habit of using their cards several times a day is rapidly being appreciated by other card issuers and acceptors such as banks, credit card issuers and retailers. This impact is being felt both on the smart card technology suppliers which are developing products for this market, and on smart card issuers, acquirers and scheme operators that are keen to be either issuers of contactless cards, partners in contactless schemes, or to accept contactless cards at their points-of-sale.

Outside of AFC ticketing schemes, another public transport application which can be provided using contactless smart cards is payment of road tolls. There is now a global trend towards road tolling, whether for road privatisation schemes or for electronic road pricing schemes. The basic requirement of a road tolling scheme involves stopping at a toll booth, paying and driving on, and there is a good business case for the use of contactless smart cards to automate payment and eliminate cash in the basic ‘stop and go’ lanes. More advanced freeflow systems that do not require the driver to stop can use smart cards in an in-vehicle reader/transponder, or a transponder as part of an account-based back-end payment system. Electronic road pricing schemes can be aimed at ‘use-orientated’ costing or at encouraging the use of public transportation, by reducing the use of private cars, and also incorporate transponder-based systems to provide freeflow systems. It is worth noting that there are now growing concerns from privacy commissions and advocates that account-based payment systems and systems based on personalised smart cards have the potential to enable data surveillance of the movements of vehicle owners and drivers, and thereby constitute an infringement of privacy. Contactless smart cards issued by public transport operators are typically anonymous and satisfy such privacy concerns.

One more public transport application which can be provided using smart cards, and is likely to employ contactless technology, is electronic ticketing for air travel and airport operations. Electronic ticketing is common in the US airline industry and around the world several airlines are experimenting...
with smart cards for passenger identification, tracking, access, boarding passes and loyalty. The International Air Transport Association (IATA) recognises the importance of smart cards and has published an implementation guide to aid understanding of the processes involved in the airline application of smart card technology. Despite this increasing interest in smart cards for electronic ticketing, at the present time there are, as far as we know, no pilots or rollouts of smart cards for electronic ticketing in the Asia Pacific region.

Although public transport is currently the ‘killer’ application for contactless smart cards, there are other applications now just launching that offer the same promise of large transaction volumes on city-wide or even national scales. One of these applications is electronic purse, or electronic cash, as it is sometimes described in Asia. It would be an understatement to say that the business case for electronic purse has proved to be very difficult globally and one reason cited is the transaction times of contact e-purse smart cards which are much longer than the transaction time for the cash notes and coins that they are intended to replace. Other difficulties with contact e-purse smart card schemes are the training required by staff and the space that the terminals occupy at the point-of-sale. A number of e-purse scheme operators have for some time been considering contactless technology as a route to faster, more convenient transactions and one Japanese scheme operator has now launched such a scheme. Japan is also the first market to trial a contactless credit card payment system initially only for online transactions, although a similar system in Korea is now being used for payment of transit fares.

It has, so far, been difficult for anyone to obtain accurate, or indeed any, statistics and figures of contactless smart card shipments and sales. Smart card statistics produced by research companies as well as by smart card and smart silicon manufacturers do not provide a complete picture. Some reports focus on smart card shipments by geographical region but without, for example, any indication of the proportion of Asia Pacific figures that are contactless shipments. Reports often include a breakdown by market sector but contactless smart cards now cover a number of market sectors. A few reports show a breakdown of smart card shipments by technology, such as memory cards and microprocessor cards. Unfortunately contactless smart cards fall into both these categories, in fact many utilise ASIC or “hard-wired logic” technology and do not fit neatly into either category. While it is true that (for now) there are relatively few contactless (or dual-interface) microprocessor smart cards, the category of memory cards also includes pre-paid phone cards, of which the vast majority are contact smart cards. As a result we do not believe that there are any accurate published reports which give a clear and accurate quantitative picture of the market for contactless smart cards globally, and certainly not in the Asia Pacific region. This region is further complicated by China, a vast market about which no-one can claim to be well informed, and which has a large number of small to medium-sized contactless smart card projects. For the purpose of this report, we consulted several smart card and smart silicon manufacturers (who requested not to be named as official sources) to provide, what we consider to be, the best estimate of the global contactless smart card market. We believe that we have avoided multiple counting which occurs when chips, modules and cards are repeatedly counted. The figures that we have obtained from various sources indicate that by the end of 2002, approximately 250 million contactless smart cards will have been shipped globally, of which dual-interface (or combi) cards make up 10-15%. Of this figure, just over 200 million are Mifare or follow the ISO 14443A standard, 15-20 million are Sony technology and the remainder follow the ISO 14443B standard or other proprietary standards. We welcome further information about contactless smart card statistics and if anyone vehemently disagrees with the above conclusions then please...
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Contact us with your opinions and information. The fact that in 1995 there were only around 7 million contactless smart cards globally indicates the rapid growth in the contactless smart card market.

The development of international standards for contactless smart cards, over the last few years, has caused considerable problems for scheme operators issuing contactless smart cards, as well as for contactless smart card solutions providers. The International Organisation for Standardisation (ISO) has been working for several years on the ISO 14443 standard for proximity cards. As parts of the working draft for the standard were developed and updated over time, manufacturers were forced to modify their products (which they originally designed to adhere to the standard) to continue to meet the standard. This also affected scheme operators which were issuing, or planned to issue, contactless smart cards since they could not be sure if cards which they had already purchased, or which they were planning to purchase, would eventually meet the ISO 14443 standard. On top of this confusion, there have been, and still are, extensive arguments over the advantages and disadvantages of the various contactless smart card technologies. The arguments over technological superiority are uninteresting and in many cases, irrelevant, particularly while most contactless smart cards are not microprocessor-based. It has been claimed that the ISO 14443 type B standard is more suitable for microprocessor-based contactless smart cards because of the way that RF power is delivered to the chip in the card. It is also possible to technically explain that ISO 14443 type B technology may be able to provide a faster data communications speed than ISO 14443 type A technology. On the other hand, scheme operators that have decided to use Sony contactless smart card technology state that the Sony technology offers the fastest data communications speed. Despite these competitive arguments, there are large rollouts of all of the above three contactless smart card technologies in the Asia Pacific region, and all of these rollouts have exhibited no technical problems to date.

However what is true, is that certain contactless smart card technologies are likely to dominate certain geographical areas in the Asia Pacific region, and are also likely to dominate certain applications sectors. The first use of contactless smart card technology in the Asia Pacific region was in Korea where a Mifare scheme was implemented in the mid-Nineties. Korea now has a thriving contactless smart card market which is almost exclusively dominated by Mifare technology and only the government is attempting to implement ISO 14443 type B contactless smart cards. China is another market where Mifare technology was introduced early on and is now the dominant contactless smart card technology in that market, although the government plans to encourage smart card scheme operators to move to its own locally developed contactless smart card technology for commercial reasons. Taiwan and Malaysia look set to follow the ISO 14443 type A contactless smart card technology since transport operators in those countries have already implemented Mifare technology. The success of the Octopus Card system means that Hong Kong will be dominated by Sony contactless smart card technology. The Hong Kong success has meant that Shenzhen (and probably Zhuhai) has also adopted the Sony technology with the aim of developing an interoperable system for the Pearl River delta. In Japan, Sony appears to be leading with contactless smart card projects in the private commercial sector. However for public sector purchases of cards, governments that are members of the World Trade Organisation (WTO) are required to accept bids based on either the ISO 14443 type A or type B standards. The Japanese government is therefore planning to issue ISO 14443 type B dual-interface microprocessor smart cards for its Basic Residency card and local government citizens cards. Other government departments in the Asia Pacific region that are planning to issue cards (whether for identity, transport or other applications) are also supposed to follow the
same WTO guidelines. In Singapore, the transport operator has currently implemented Sony contactless smart card technology but has indicated a long-term goal of combining with the local electronic purse scheme by issuing a dual-interface card, for which no technology choice has yet been made.

The sources for the information provided in this report consist of the smart card scheme operators and/or their system integrators and their contacts are provided at the end of the report.
TAIPEI’S EASYCARD

In Taiwan on June 12 2002, the Taipei Smart Card Corporation (TSCC) launched Taipei’s contactless multi-modal transit card for automatic fare collection (AFC) on the city’s public transportation system.

TSCC was established in March 2000 by the Taipei city government, Taipei Rapid Transit Corporation, several privately owned Taipei City and County bus operators, an I.T. company and three banks. The scheme’s card has been named “EASYCARD” after a competition conducted with Taipei citizens. The card has a distinctive logo reflecting the ability of cardholders to go in any direction in style, while, at the same time, representing a smiling face – clearly the scheme operators have a savvy understanding of the future commercial marketing and branding opportunities of the card and this bodes well for the future success of the scheme.

The card uses Mifare technology, sometimes also referred to as Type A of the ISO14443 standard for contactless proximity cards. The systems integrator for the project is MITAC, a Taiwan systems integrator, which won the tender in an open bid system. The schedule for developing the scheme was originally set unrealistically and the original first stage launch date of December 2000 was not achieved. The Taipei Smart Card Corporation (TSCC) began piloting Taipei’s contactless multi-modal transit card in January 2001. The first pilot lasted from January 31 to April 15 and was conducted over the Mucha Line of the Taipei Rapid Transit Corporation, and the 48 feeder buses which feed riders to the line. This first pilot involved 1000 riders who were selected from 4,000 applicants, according to specific criteria. After the pilot, market research carried out by TSCC produced a positive response from over 80% of riders who said they would be willing to accept and use the EASYCARD if it was introduced. A second pilot was conducted from April 26 to May 25, 2001, across the entire Taipei Rapid Transit Network (64 TRTC stations) and 48 feeder buses. The second pilot involved 3000 riders, selected on different criteria from 51,000 applicants. A third pilot was conducted from June 1 to July 10, 2001, again across the entire Taipei Rapid Transit Network. The third pilot also included a trial use of the card in payment for off-road parking. All of these three initial pilots involved EASYCARDS which were given to riders only for the duration of the pilot and did not involve real money (i.e. the riders did not have to pay for rides). A fourth pilot involving real value (participating riders were entitled to a 60% discount on standard fares) was conducted from October 30 to November 30, 2001. For this pilot, there were 5000 participants (the applicants queued from midnight on the previous night for the privilege). The real value pilot produced a positive response from over 85% of riders who said they would be willing to accept and use the EASYCARD in place of the existing ticketing system.

The large number of Taipei commuters who applied to take part in these pilots was indicative of the growing interest from Taipei citizens in the scheme and of the efforts made by the city government to promote the scheme. The scheme has an influential champion in the shape of the Mayor of Taipei who has been working particularly hard to promote the project (including giving an EASYCARD to the Chief Executive of Hong Kong during a press conference, while on a visit to the territory). The EASYCARD
was originally designed to be used for fare payments on the Taipei MRT and feeder buses, Taipei City/County joint-operation buses and 15 public car park complexes in the greater Taipei area. Since the June 12 launch date the EASYCARD is now accepted on all MRT lines, the number 5 bus line and the 15 public car parks. Acceptance will be extended to cover all bus lines in Taipei City and County as well as an additional 16 public car parks before October 2002. The cost of the EASYCARD is NT$500, which includes NT$300 fare value and NT$200 as a card deposit. Cards can be reloaded at add-value machines installed in all MRT stations and commissioned car parks. If a card balance reaches NT$1000 or more then a bonus of NT$200 is added to the card balance. The maximum reload amount is NT$10,000. Cards can be returned to the operator in which case the cardholder’s original deposit of NT$200, and any remaining balance, is refunded. Travellers on the MRT can use transfer (feeder) buses free-of-charge within two hours of their last MRT journey. The EASYCARDs can currently be purchased at ten designated MRT stations. TSCC has initially ordered 2.3 million cards.

Taipei Smart Card Corporation’s EASYCARD is Taiwan’s first integrated contactless smart card-based AFC scheme for a multi-modal transport infrastructure. There is a long-term goal, on the part of the government, to expand the use of contactless smart card AFC systems to other transport schemes and projects outside of Taipei, first to Kaohsiung transport operators, then to the rail link between Taipei and Kaohsiung, and then to other parts of Taiwan (including the highway tolling system operated by ChungHwa Telecom) - to provide an interoperable transport ticketing infrastructure. The Ministry of Transport and Communications (MOTC) has recently begun an initiative to formulate a “one-card” policy with the aim of creating interoperability between transport systems run by independent operators. The barrier to this seems to be that every operator wants to own and operate their own clearing house and transaction processing system but work is progressing on this initiative. Taipei Smart Card Corporation has a website (in Chinese only) at www.tscc.com.tw.

**SINGAPORE’S EZLINK**

In Singapore, the Land Transport Authority’s contactless smart card-based automatic fare collection (AFC) system went live on April 13 2002. The Land Transport Authority (LTA) is a statutory board under the Ministry of Transport, spearheading all land transport developments in Singapore. In 1999 the ERG Motorola Alliance won the LTA tender for an integrated contactless smart card-based automatic fare collection (AFC) system. The LTA subsequently chose the Sony Felica contactless smart card technology for their smart card, although they apparently have an aim to move to the type B version of the ISO 14443 proximity standard for contactless smart cards (because they expect type B to have more suppliers and products in the long-term). In 2000 almost 120,000 Sony contactless cards were issued in two pilots across a limited number of gates across the Singapore Mass Transit Network. During these pilots 1.7 million transactions were generated and the LTA subsequently approved the system. The
development of the entire AFC system then began and a third pilot was done in November 2000 involving selected “feeder” bus routes which enabled testing of the multi-modal system. The Land Transport Authority held a naming competition for the contactless smart card (CSC) in March 2000 and “ez-link” was chosen as the winning entry. The panel of judges felt that it would best reflect the convenience that the CSC brings to users, as well as the many other potential services that the card can be used for.

The Singapore bus system uses distance-based fares which created an additional challenge not encountered in other cities such as Hong Kong. Commuters present their smart card to a reader at the front of the bus when boarding, to record the start of their ride. When alighting from the bus they must present the card to a reader at the exit door of the bus, at which time their fare is correctly calculated and deducted from the balance on their card. To enable this function all buses use a GPS vehicle location system and wireless LAN technology to ensure that the correct fare is deducted for the commuted distance. Unlike most other transit projects the Singapore system incorporates equipment and systems from a relatively large number of suppliers and the required integration was therefore more of a challenge. Cards are sold to commuters through General Ticketing Machines (GTMs) supplied by Cubic. These GTMs are located in all LTA rail and bus stations and will act as smart card vending, value reloading and retrieving and recycling machines. When passengers return cards for recycling, the GTMs will refund passenger deposits which are required at the time of purchase. The GTMs include an interactive touchscreen display, a multi-language application including English, Tamil, Malay and Chinese, and credit/debit card payment capability. Cards can also be reloaded at selected NTUC FairPrice outlets, Cheers convenience stores and 7-Eleven stores. The ez-link Card system will run concurrently with the magnetic Farecard system for a period of about six months, before the magnetic Farecard is phased out.

EZ-Link Pte Ltd, a subsidiary of the Land Transport Authority, was formed on 8 January 2002 to expand the use of the ez-link contactless smart card beyond the public transport industry as a general micro-payments card. EZ-Link Pte Ltd has now appointed Citibank, N.A. as the stored value card issuer of the ez-link Card. EZ-Link Pte Ltd will be responsible for the sale, distribution and management of ez-link Cards for use in transit and non-transit applications. For the transit applications, EZ-Link has appointed Transit Link Pte Ltd as the agent to manage the use of ez-link Cards on public transport. Transit Link Pte Ltd will, under this arrangement, sell and distribute ez-link Cards, as well as provide value reload, card replacement and refund services to holders of ez-link Cards. For non-transit applications, EZ-Link Pte Ltd has already invited third party organisations to submit their proposals to expand the use of the ez-link Card beyond public transport. EZ-Link believes that with public transport applications providing a large user base, there is a significant potential for the ez-link card to proliferate beyond transit applications and become a multi-purpose stored value card. They have suggested that the ez-link Card might eventually be combined with the CashCard, Singapore’s long-running contact smart card-based electronic purse, to form a single national dual-interface (contact and contactless) smart electronic cash card for transport and non-transport payments across Singapore. The CashCard electronic purse scheme, operated by NETS and CashCard International, has been in use since 1996 for retail point-of-sale, parking, Internet
payments and other applications. Transaction volumes were low until the introduction of the electronic road pricing scheme, for which the CashCard is the sole form of payment. A merger of the ez-link Card and the CashCard is now being considered at some point in the future in order to reduce the inconvenience to Singapore citizens of having to carry and reload two cards for e-cash payments. Such a merger of the two schemes is not likely to take place until three to four years later.

Singaporeans can use their cards on all 52 of the Mass Transit Rail network stations, on the Light Rail Transit and on 4000 buses. Some additional non-transit applications have already been tested, including public payphones and vending machines. Identity will also be an application as every school child in Singapore will carry a card which they will also use for attendance recording at school. The LTA expect that the population of contactless smart cards will eventually reach 5 million (the population of Singapore is just over 4 million). They have said that they have learned (as has every scheme operator?) that smart cards are more difficult than they expected, and that they have encountered many problems that they had not anticipated. They have also reported that implementing the bus AFC system was considerably more difficult than the transit system (obviously not helped by their distance-based fares). The Adult ez-link card costs S$15 (comprising a $5 deposit and a $10 stored value). EZ-Link has a website at www.ezlink.com.sg

HONG KONG’S OCTOPUS

Hong Kong’s Octopus contactless smart card ticketing scheme has been called “the world’s most successful smart card scheme” (by another scheme operator). Developed as an automatic fare collection (AFC) scheme for Hong Kong’s transit operators and launched in 1997, over 8 million Octopus cards have been issued (as well as 150,000 smart watches) and over 7 million transactions are recorded on a daily basis for a daily transaction value of over HK$47 million (about US$6 million). This multi-modal contactless smart card ticketing system is currently made up of over 100 service providers including all the major transport operators: franchised bus (4 operators), maxicab (over 40 operators), other buses (over 10 operators), Mass Transit Railway (subway), Kowloon-Canton Railway (overground train), trams and ferry services. The name of the joint venture company which operates the scheme was originally called “Creative Star” but has now been changed to “Octopus Cards Limited” since January 1, 2002. The territory’s three major bus operators, Kowloon Motor Bus, Citybus and New World First Bus, now have over 6,000 buses involved in the scheme. There are a number of smaller bus and minibus companies which are also Octopus-equipped. Both the subway and overground rail lines are completely equipped, including around 200 add-value machines (there are, in total, over 16,000 reading and loading devices). The scheme uses the Felica contactless smart cards and readers from Sony, using proprietary technology developed by Sony which is not part of the ISO14443 standard for contactless smart cards.
Before 1997, the MTR and KCR already had a highly successful existing AFC scheme based on stored value and single journey magnetic tickets which was widely used and extremely efficient, but they claimed that the new scheme would enable travellers to get through the turnstiles faster. Because Octopus Cards made the decision to charge travellers a refundable HK$50 (US$6.50) fee for each Octopus card, there was initially a public outcry over the scheme and calls for the government to force the operator to issue the cards free of charge. However on the day the scheme went live, over 250,000 transactions were recorded. Initially the existing magnetic stored value tickets could still be purchased, but Octopus Cards still managed to sell almost 3 million Octopus cards in the space of four months. In early 1998 the 3 million Octopus cards were completely sold out and the scheduled date for the complete withdrawal of the magnetic stored value tickets had to be postponed.

The first non-transit applications for the Octopus card were allowing the card to be used for payment at photo booths within the MTR stations as well as payphones operated by New World Telephone. Several other non-transit applications were added over time but these applications were always restricted to those which operated within the subway stations. This was because Octopus Cards only had a restricted license to issue the Octopus card for transit applications with only 15% non-transit transactions allowed. In mid 2000 Octopus Cards obtained an extended license from the Hong Kong Monetary Authority for the Octopus card to be used for a wider range of applications – including at the retail point-of-sale, and for public sector applications. Non-transit transactions can now constitute up to 25% of total transactions. In granting this extended license, the Hong Kong Monetary Authority required the scheme operator to change its financial status and become a deposit taking company (a form of bank) and as a result, Octopus Cards is now subject to supervision under the Hong Kong banking ordinance. The extended license will enable it to expand into retail and fast food point of sale, telephony and vending applications outside of the transit stations. Hong Kong’s retailers can now apply to Octopus Cards to be signed up as Octopus merchants so that they can accept Octopus at the retail point-of-sale. Several Hong Kong retailers are now accepting the Octopus card at the point-of-sale, including 7-11 stores (which also offer reloading facilities), Starbucks and Maxim’s fast food outlets. In June 2002, Park’N Shop became the first supermarket to accept the Octopus card at the point-of-sale. The transport department of the Hong Kong government has completed a trial on the use of the card in parking meters and off-street parking, and is widely expected to incorporate it as part of Hong Kong’s proposed electronic road pricing (ERP) scheme which the transport department has been considering for several years.

Octopus cards are anonymous by default, but over 500,000 personalised cards have been issued and these are mandatory for the Octopus Automatic Add-Value Service first launched in 1999 together with the credit card department of Dah Sing Bank (the Octopus card is automatically reloaded with a preset amount and debited from the credit card, as soon as the Octopus balance falls below zero at any Octopus reader). Another eleven Hong Kong banks and one credit card company have now joined the automatic add-value service. Personalised cardholders also benefit from loyalty schemes, and these cards can also be used as staff ID cards. Octopus Cards admits to having more potential applications than they can currently explore but still want to focus on expanding the transport systems first.
This scheme has widespread usage and total consumer acceptance (despite charging consumers US$6.50 per card). As of December 2001, it was used by 95% of the economically active population and had recorded 6.6 billion transactions which amount to over HK$46 billion. The scheme has succeeded because it offers cardholders real convenience. There is a real consumer imperative to use the cards because they see real benefits. Travellers can now board an Octopus equipped bus and pay their fare without stopping to search for change and even in the MTR and KCR travellers can pass through station turnstiles even faster than before (15-20% faster according to Octopus Cards statistics). No need for riders to remove the card from their wallet, or even from their handbag. In April 2002, Nokia launched a cover with an embedded Octopus chip and antenna for one of their mobile phones, enabling commuters to use their phone to make Octopus payments. Consumers (and businesses) are now demanding more applications for the card and Octopus Cards are now in the process of developing the non-transport Octopus applications, such as retail, but admit that this is harder than developing transport applications and currently less than 3% of daily revenue is generated from non-transport applications. Octopus Cards have not so far compiled any research on how many cardholders have used Octopus for retail payment. However a survey was carried out at the end of 2001 and found that the awareness of Octopus acceptance in retail outlets is quite high and that 89% of respondents could name at least one non-transport application, with 7-11 point-of-sale and reloading being the best known.

Octopus Cards have now implemented a reader replacement on the earlier installations, primarily to be able to accept the latest version of Sony’s Felica cards which are essentially the same as existing Octopus cards but with triple DES security. Since the beginning of 2002 all installed readers have been able to accept both Octopus and the new Felica cards. To keep their options open (for say single journey cards) they are requiring that the new readers can take Sony original Felica and newer version Felica cards, as well as ISO14443 type B but they have no plans to move to type B for the entire system. Octopus Cards has a website at www.octopuscards.com

MALAYSIA’S TOUCH’N GO

In Malaysia the Touch’n Go contactless smart card-based AFC scheme has been operating since 1997. The scheme is operated by Rangkaian Segar Sdn Bhd and is based on the Philips Mifare technology. The Touch’n Go card can be used on 90% of highway tolls in Malaysia and in around 10% of the public transport and parking applications. The reason for the relatively low acceptance on public transport is because the card is only accepted on public transport systems operated by Rangkaian Segar. Other competing operators of public transport systems have so far refused to accept the card. There is also little market pressure on Rangkaian Segar competitors to accept the card since usage is not high, even on those transport services operated by Rangkaian Segar. The competing transport operators want to see incentives before they will join the scheme and Rangkaian Segar has so far
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resisted, probably because the requested incentives are incompatible with the operating costs of the scheme operator (i.e. no business case).

As of today, 85% of Touch’n Go transactions come from highway tolling and less than 15% from public transport fare collection. According to Rangkaian Segar, this situation stems partly from Malaysia being a developing country with large numbers of low-income citizens, and partly from the Malaysian culture. The target market for public transportation in Malaysia is largely the low-income Malaysians. Research indicates that this market avoids the pre-payment Touch’n Go card since they are unable to budget enough for the advance payment, even though this would enable them to save money through the discounts provided via the card.

The Touch’n Go card is currently accepted at over 80 Toll Plazas (PLUS, Elite, Linkedua, Penang Bridge, Metramac, Besraya, Prolintas, SPRINT) and Rangkaian Segar is currently negotiating with 4 new Toll Operators. In the public transport sector the card is accepted on the Cityliner network (400 Buses), on the Putra Line (60 Buses) and on the Putra Light Rail Transit, at 24 Stations. Rangkaian Segar is currently negotiating with the other five major public transport operators in Kuala Lumpur – KTMB, ERL, Monorail, STAR and Intrakota to try to persuade them to join the Touch’n Go scheme. They are also now expanding the scheme into parking applications and by the end of 2002 it will be possible to use the card at 200 in-building car parks and in 1000 Pay-and-Display machines for on-street parking.

Today there are 1.6 million Touch ‘n Go cardholders and 90,000 SmartTAG holders. The SmartTAG is a windscreem-mounted device with infra-red communications, into which a Touch’n Go card can be inserted for payment of highway tolls. Many of the Malaysian highway tolls have SmartTAG lanes equipped with infra-red antennas which automatically read and deduct value from the Touch ‘n Go card inserted into the SmartTAG device. This allows drivers to pay tolls without having to open the car window and manually touch the Touch ‘n Go card to the reader.

Touch’n Go card vending is mainly done through Touch’n Go Customer Service Centres (91 outlets), although there are now 10 Petronas petrol stations which can also sell the cards through their kiosks. Both the Touch’n Go and Petronas petrol station outlets can also provide value reload for the cards. A partnership has also been established with Bumiputra Commerce Berhad, a leading bank in Malaysia, to allow reloads to be performed at their ATMs (100 ATMs). Rangkaian Segar is now negotiating with three major banks to install the Touch’n Go reload facility at their ATMs and this is expected to be operational by the second quarter of 2002.

A partnership has been established with the Network for Electronic Transfers of Singapore to combine the NETS CashCard and the Touch’n Go card. A dual chip smartcard that combines the contact (NETS Cash Card) and contactless (Touch ‘n Go) technology on a single card allows cardholders to use a single card in both Malaysia (only Touch ‘n Go Chip) and Singapore (only NETS chip). This is aimed at drivers who need to pay highway tolls in Malaysia and the electronic road pricing (ERP) tolls in Singapore.
The biggest potential boost to the Touch’n Go card population (and hopefully usage) is the inclusion of the Touch 'n Go chip in the MyKad (Government Multipurpose Card for national ID) by the National Registration Department of Malaysia. The MyKad with Touch ‘n Go was first launched on 2 January 2001 in a pilot of 10,000 cards. It is expected that 100,000 MyKad cards with Touch ‘n Go will be issued by end of 2002 and the national roll-out will be in year 2003. Another move by the Malaysian government which is certain to boost both card numbers and usage is the selection of Touch ‘n Go as the platform of the Common Ticketing System (CTS) for a public transportation scheme now being initiated by Dewan Bandaraya Kuala Lumpur (Kuala Lumpur City Hall). The aim is that under the CTS, the Touch ‘n Go card will eventually be accepted on all public transportation in Kuala Lumpur particularly, buses, LRT and trains. This will presumably provide the incentive (or perhaps, directive) for the other transport operators in Kuala Lumpur to join the Touch’n Go scheme. Touch’n Go have a website at www.touchngo.com.my

KOREA’S METROPOLITAN AFC SCHEME FOR SEOUL

The world’s first major contactless smart card-based automatic fare collection (AFC) system was launched in Seoul, Korea in 1996. The scheme now covers the area of metropolitan Seoul, which includes Seoul, Incheon and Kyunggi province. Nearly 80% of travel in Seoul is on public transport. In 2001 there were almost 8 million bus commuters and almost 6.5 million transit commuters every day. Seoul has 139 bus companies servicing three bus operator networks with a total of 13,600 buses, and 4 subway operators with a total of 294 stations and 5,325 gates. In August 1995 the Seoul Bus Association began planning an AFC system for Seoul bus operators. A pilot was carried out in September, and RFP issued in November and in December, Intec (backed by Motorola) was selected as the prime contractor and operator. By March of 1996, 24 bus companies (a total of 1,167 buses) were equipped and by July, the total had risen to 65 bus companies (a total of 7,552 buses). By December 1996, Kyunggi province had its own bus AFC system with 23 bus companies and 2,284 buses, and Incheon also had its own bus AFC system with 10 bus companies and 1,194 buses. These two AFC systems were then integrated with the Seoul AFC system. The three bus operators (Seoul, Kyunggi and Incheon) use the same system provided by Intec (from Motorola), the same card with a proprietary pre-paid electronic purse and each operator can issue cards. There is a common inter-clearing system between the three bus operators but they use different reload systems for security. Cards can be reloaded at the point-of-sale, at reloading kiosks and at self-service reload machines (Seoul only). There are now about 14.25 million cards in circulation.
Unfortunately the subway systems of Seoul were not included in the Seoul Bus Association scheme. Instead the subway operators developed their own contactless smart card-based automatic fare collection (AFC) system together with the Kookmin Credit Card Company which is effectively based on a post-paid system. In this system, the Kookmin MasterCard-branded credit card acts as a contactless subway pass, and is the only form of smart card-based subway ticket issued. Students and anyone under the age of 18 were therefore not eligible for this smart card subway pass since they are not eligible for a credit card. The card is shown opposite and the contactless chip is located in the upper left corner, approximately under the photograph. The subway operators consist of the Seoul Metropolitan Subway Corp. (SMSC), Seoul Metropolitan Rapid Transit Corp. (SMRTC), Korea Railway Corp. (KRC) and the Incheon Metropolitan Subway Corp. (IMSC). The AFC system of the Incheon Metropolitan Subway Corp. (IMSC) is still under construction but the SMSC, SMRTC and KRC all had AFC systems based on two types of magnetic ticketing equipment. Due to technical and intellectual property issues it was necessary to add a new extra gate, station level computer and host computer to cater for the subway contactless card AFC system. When passing through a subway gate with a Kookmin credit card, the credit card account number is read by the gate from the contactless chip in the card and the card is updated with the trip information. The transaction is passed from the host computer to the credit card company and the transaction is reconciled (paid) by the credit card company on the same day. The commuter however, only settles the transit fares when the credit card bill is settled at the end of the month and is effectively benefiting from a post-paid system. As with the pre-paid card issued by the Bus Association, the cardholder is entitled to a discount by using the contactless smart card.

Integrating the Seoul bus AFC scheme with the Seoul transit AFC scheme has been very difficult for several reasons.

**Different system architectures and contractors**

1. Subway : uses Credit Card Post-Paid System implemented and maintained by C&C
2. Bus : uses Prepaid Card System implemented and maintained by Intec (Motorola)

**Commercial and technical issues**

1. Subway and bus operators were reluctant to disclose their technology to the other party due to intellectual property and security reasons
2. Subway and bus operators were reluctant to co-operate and had difficulty in negotiating commercial terms

Nevertheless there were compelling reasons to integrate the bus and subway AFC systems, including

1. Approximately 4 Million passengers use both Subway and Bus public transport
2. Only Kookmin Credit Card Company can issue the smart card subway pass (in a credit card)
3. Students are not eligible for credit cards
4. Credit card holders want to use any form of public transport, not only subway.

5. Prepaid card holders want to use any form of public transport, not only bus

As a result the pre-paid bus card has now been integrated into the Seoul subway AFC system. The Kookmin subway pass system has also been integrated into the Seoul bus AFC system and this now seems to have influenced the future of the entire Seoul public transport AFC system. Other credit card companies in Korea have now begun to license the post-paid credit card subway pass concept and technology from Kookmin Credit Card and there are now other credit card companies issuing credit cards embedded with the contactless chip for use as subway passes in Seoul. The Seoul City Government also likes the idea (they apparently believe it is fairer for citizens of Seoul to post-pay rather than pre-pay) and it has been suggested that they may force the Seoul Bus Association to forego the pre-paid float altogether and only use credit cards as subway passes for those over 18. This idea would pose some potential problems which would need to be overcome. The size of the blacklist is likely to grow dramatically unless all the pre-paid cards are removed from circulation and terminal blacklist storage capacity will then be a problem, as will downloading the new list to the terminal on a daily basis.

Neither the Seoul Bus Association nor the Seoul subway operators have so far ventured outside of the transport sector. Unlike most other countries, there appears to be no legislation to prevent them from doing so. From 2002 they will apparently be looking at this idea of becoming another e-purse scheme operator for general retail payments. Or perhaps that should be post-paid electronic purse provider? Or non-authorised micro-credit card payment service? They have a plan to sign accepting merchants and offer a reload service for each merchant.

**KOREA’s MYbi CARD**

Apart from the existing 15 million or so contactless transport cards in the country, there are now an increasing number of combi smart card schemes in Korea many of them based around electronic cash (there are five e-purse schemes launched or launching in the country). Probably the most interesting and certainly the best developed so far is the MYbi (My business) scheme in Pusan. Pusan is the second largest city in Korea with a population approaching four million. The scheme began life as the DongNam Bank Electronic Purse, based on a Gemplus card and proprietary card operating system, which was approved by the Ministry of Finance and Economy (MOFE) in December 1994. Then in 1995
a plan was established for a contactless transportation smart card to be called the Hanaro Transportation card in Pusan City. This was launched in February 1998. In June of the same year the DongNam Bank ran into problems and the Pusan Bank took over their e-purse and technology.

The Pusan Metropolitan City Government saw the need to integrate the two smart card schemes and decided that the Pusan Bank e-purse scheme and the Hanaro Transportation Card should be combined. With the requirement for contact and contactless smart card usage in the same scheme it seemed a natural launching pad for the world’s first combi smart card based on Mifare technology (a variant of the ISO 14443 type A standard for contactless cards). In March 2000 an MOU was signed between Pusan Metropolitan City and Pusan Bank for the development and issuance of a “Digital Pusan Card”. KPMG, Lotte, Dream Line (ISP), Korean IT Venture and Microsoft also joined the joint venture in the next few months and by August eight companies had combined with Pusan Metropolitan City in the joint venture company. MYbi was formally established in September 2000.

The responsibilities of the key participants in the scheme are as follows:

| Pusan Metropolitan City | • Establishing the Digital Pusan Card supply and distribution policy  
|                         | • Expanding application areas and implementing database |
| Pusan Bank              | • Issuing cards  
|                         | • Electronic banking services (incl. Internet Banking) |
| MYbi                    | • System management for smart card applications  
|                         | • Develop services for the smart card |
| KEBT                    | • Technical development of Digital Pusan Card and terminal  
|                         | • Provide overall smart card technical solutions for the scheme |

The first MYbi (Digital Pusan) cards were issued in the Hae Un-Dae district in Pusan, also in September 2000. It was possible to issue the cards in the same month that MYbi was established because the solutions provider, Korea Electronic Banking Technology, had already developed the Type A combi smart card platform and terminals in January 2000. By November one of the many bus companies in Pusan (there are over 30) had already been upgraded to use the Digital Pusan Card. By December they had formed an agreement with telecoms operator n016 for the card to be accepted at payphones, and in the same month the first MYbi accepting vending machines were installed in Pusan.

As mentioned above, the Hanaro Transportation Card was first launched in 1998. The Hanaro contactless card is based on Mifare Technology and was originally launched for use on the buses and the subway system in Pusan. It was later extended to tollgates, tunnels and parking lots. In a population of approximately 4 million, 3.7 million Hanaro Cards had been issued by July 2001. The Hanaro Transportation Card usage is outlined in the following table
By the time the Pusan Metropolitan City Government decided to integrate the Pusan Bank e-purse scheme and the Hanaro Transportation Card scheme, the Hanaro card was already a success in Pusan. The card has proved very popular with citizens, reducing the need to carry small change, saving time and providing convenience in purchasing tickets. Riders also save money because of the connection discounts between different transport operators. The transport operators have reduced operating costs significantly through the use of the automatic fare collection scheme. At the same time the card has increased revenue for the operators, due to a growth in usage. (This follows research from most payment card schemes that consumers spend more because they do not equate the card with real money.) The Pusan Metropolitan City itself has been able to dramatically improve transportation facilities and services to the public.

<table>
<thead>
<tr>
<th>Items</th>
<th>No. of Transactions/day</th>
<th>Transaction Amount/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>0.94 M</td>
<td>USD $405,000</td>
</tr>
<tr>
<td>Small Bus</td>
<td>0.23 M</td>
<td>USD $36,000</td>
</tr>
<tr>
<td>Subway</td>
<td>0.38 M</td>
<td>USD $137,000</td>
</tr>
<tr>
<td>Tollgate</td>
<td>0.03 M</td>
<td>USD $900</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.11 M</td>
<td>USD $45,000</td>
</tr>
<tr>
<td>Parking Lot</td>
<td>0.04 M</td>
<td>USD $22,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.73 M</strong></td>
<td><strong>USD $646,400</strong></td>
</tr>
</tbody>
</table>

The MYbi Digital Pusan Card was conceived as a citizen’s card providing all types of services to the citizens of Pusan, including transportation, public services, e-commerce, retail payments and health membership services. The Pusan Metropolitan City decided that because payments were the core function necessary on which to build services, the MYbi scheme should be controlled by the Pusan Bank. The bank and the city government decided that due to the requirements for payments at the point of sale secured with the triple DES Algorithm, and the need for digital certificates and a public key infrastructure, therefore the card would require a contact interface. The Philips Mifare PRO Chip with contact and contactless interface was therefore selected for the MYbi card since it would be backward compatible with the Hanaro Transportation Scheme. The card uses an operating system developed by Korean Electronic Banking Technology as well as an e-purse based on KEBT’s e-purse product. Some banks in other parts of Korea are already issuing the e-purse product. In the MYbi combi card the same e-purse can be accessed through either the contact or the contactless interface. The contact interface uses triple DES to secure the transaction while the contactless interface does not. The Pusan Metropolitan City Government intends that the MYbi Digital Pusan Card will gradually replace the Hanaro Transportation Card. The float for the entire scheme is now controlled by the Pusan Bank and the clearing systems for both the Hanaro Transportation Card and the MYbi Card are now connected through a Total Information Management System (TIMS) so that transactions can be correctly reconciled and cleared. Both clearing systems are now housed in the same facility and managed by the same team. The card is expected to provide a
foundation for the new information infrastructure of Pusan covering electronic payments, certification and security. It is also being developed as a means to deliver government services to the public, allowing citizens to apply for government services online and obtain government documents at public kiosks. It is hoped that the card will stimulate the e-commerce environment and promote online business in Pusan by allowing citizens to authenticate themselves and carry out secure transactions online. The MYbi card can also be used at vending machines and public telephones around Pusan. The card is currently reloaded with value by tellers at the Pusan Bank branches or newspaper vendors on the street. There are currently no automatic value reloading machines in service but a prototype cash dispensing ATM machine with a MYbi card reloading function has been developed and is now being trialled. Pusan Bank and MYbi are planning to implement around 600 of these ATM cash dispensers with MYbi reloading facilities in Pusan city. Since there never seems to be queues in the banks, this process is quick and effortless (at least on the day we tried it). Eventually retailers around Pusan will also be able to reload the cards with value. The transportation network and automatic fare collection system is similar to those in most parts of the world except that the bus readers very politely thank you for your fare, while at the same time announcing to the driver whether you are a normal rider or using a concessionary card (i.e., for students, senior citizens, etc.). The MYbi card is only just now being integrated into the Pusan subway system but the usage will be exactly the same as the existing Hanaro cards and these appear to work exactly the same way as transit schemes elsewhere. At the point of sale, the card must be used with the contact interface and handed to the retail staff to insert into a small hand held terminal. The retail staff enters the amount and the customer is asked to press the confirm key to authorize the transaction. The retail MYbi transactions are relatively quick and an important factor here appears to be that staff in the shops and restaurants in Pusan are well trained in the acceptance of the MYbi card.

The public services kiosks are probably the best designed and the most attractive we have seen to-date. They use a touch screen to select from a wide range of government services. A smart card reader accepts the MYbi card for payment and a built in printer can print out officially recognized government documents. In the demonstration that we saw, an official from the Pusan City government purchased an official copy of a land certificate for his own home. The public service kiosk also provides value reloading for the MYbi card. MYbi also have a very small and inexpensive PC smart card reader which will be distributed free with every Digital Pusan Card. The MYbi PC reader can be used to reload value over the Internet (they have applied for a patent on this technology) and make purchases from the websites of retailers and organisations in Pusan.

Apart from developing their own scheme further, MYbi are now promoting their scheme, its business models and its technologies to other cities in Korea. They have already signed an agreement with Ulsan Metropolitan City, as well as with three Gyeongnam Metropolitan Cities, all close to Pusan. They
also expect to sign agreements with the whole of Kyeong Nam Province, and with Kyeong Buk Province. Together with Pusan these two areas would provide a potential MYbi card population of over 10 million. In a recent development, MYbi launched an automatic fare collection (AFC) scheme for public transportation across the whole of Jeonbuk Province in Dec. 2001. This is the first use of a commercial e-cash product in a public service across a whole Province (2M population) in Korea. Their strategy seems to be to target the provincial banks and metropolitan banks in other provinces and cities with which they have strong relationships through their banking industry. They also plan to issue MYbi tourist cards to travellers to Pusan, with a variety of convenient benefits. There is now a plan to issue a Welfare Card based on the MYbi platform, to issue benefits to senior citizens and the underprivileged. Since September 2000, around 500,000 MYbi cards have been issued, 6,000 points of sale terminals and 15,000 PC smart card readers have been deployed, and 100 vending machines and 25 public service kiosks have been installed around Pusan. The card can currently be used on buses, the subway system and for road tolling. In the retail sector it can be used in restaurants and fast food outlets, book stores, convenience stores, discount stores and supermarkets. Online it can be used for consumer transactions, for ticketing reservations. It is planned that eventually the card can be used for business-to-business transactions. Other points of acceptance are the vending machines as well as parks, sports facilities and recreational facilities around Pusan. There are currently over 120,000 MYbi card transactions per day. MYbi is currently issuing around 5,000 new cards per day and this is limited by their existing personalization system which they are now looking to upgrade. MYbi’s infrastructure rollout plan is outlined in this table:-

<table>
<thead>
<tr>
<th>Items</th>
<th>2001</th>
<th>2002</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Cards</td>
<td>0.5 M</td>
<td>4 M</td>
<td>4.5 M</td>
</tr>
<tr>
<td>No. of Terminals</td>
<td>KIOSK</td>
<td>25 Units</td>
<td>100 Units</td>
</tr>
<tr>
<td></td>
<td>Internet Terminals</td>
<td>15,000 Units</td>
<td>300,000 Units</td>
</tr>
<tr>
<td></td>
<td>Merchant Terminals</td>
<td>6,000 Units</td>
<td>50,000 Units</td>
</tr>
<tr>
<td></td>
<td>Vending Machines</td>
<td>100 Units</td>
<td>30,000 Units</td>
</tr>
<tr>
<td></td>
<td>Reloading terminals</td>
<td>900 Units</td>
<td>1,800 Units</td>
</tr>
<tr>
<td></td>
<td>CD/ATM Machine</td>
<td>-</td>
<td>600 Units</td>
</tr>
</tbody>
</table>

Although the MYbi platform and the Digital Pusan Card is currently based on the proprietary card operating system (COS) and “A-Cash” e-purse from Korea Electronic Banking Technology, MYbi have stated that they may migrate the scheme to Microsoft’s Windows for Smart Cards platform in the future (Microsoft is a shareholder in MYbi). However the decision by Microsoft to cease support for the Windows for Smart Cards platform will have thrown that strategy into question. The MYbi scheme is still at a very early stage. However there is no doubt that it has achieved much in a very limited time. It is the first dual interface citizens card in Asia (and probably the world) and it has managed to launch a wide range of applications since it was conceived in 2000.
CHINA’S SHENZHEN TONG CARD

Sony’s Felica contactless smart cards will be used in the “Shenzhen Tong” automatic fare collection scheme for public transportation in the city of Shenzhen. Established in 1979, Shenzhen is one of the youngest cities in China but now one of the most strategically important, thanks to its location on the border between Hong Kong and China. The city was also one of China’s first four special economic zones (SEZ) established in 1980 and now has a population approaching 5 million. In May 1999, China’s National Construction Ministry issued a formal approval for Shenzhen City to act as a test city for a national construction project involving smart cards. In September of this year, the Municipal Planning Department approved the project now known as “Shenzhen Tong”, and the public transportation accounting management centre under the domain of the Municipal Public Transportation Department, was founded. Shenzhen Modern Computer Manufacturer (MCM) won the bid in a public tender in April, 2000. As the prime contractor for the project, MCM is in charge of general planning, design, software development, terminal devices research, smart card supply, computer network system integration, installation, debugging and maintenance. As there are long term plans to provide interoperability with the Octopus card scheme in Hong Kong (which also uses Sony cards), MCM is also in charge of implementing the interoperability and compatibility with Hong Kong’s Octopus system. At present there are 21 public bus companies accounting for 114 transportation routes in Shenzhen. The total number of buses in the city is now 2,255, with a total seating capacity totalling 83,500. The largest among the bus operators is the Shenzhen Public Bus Corporation which accounts for 59 transportation routes and operates 55 types of buses totalling 1,152 vehicles with a total seating capacity of 42,946 passengers. In addition the city has 140 companies and 98 operators providing minibus and taxi transportation services. The number of minibuses is currently 2,649 although this is projected to rise to over 8,500 in the future to meet Shenzhen’s public transportation requirements. There are currently 2,779 taxis in Shenzhen. MCM’s Shenzhen Urban Transport One Card Solution (their project title) will use contactless smart cards as tickets. Sony will supply their Felica cards, with 1.5kbytes memory. MCM is the third customer for Sony’s Felica card in Asia, and the company has ambitious plans to build one of the world’s largest smart card city schemes. The first cards were issued in 2001 in a pilot system installed on 10 transportation routes in the city. The rollout of the first 1 million cards will begin at the end of 2002. They expect to eventually issue 6 to 7 million contactless cards. During the first phase a clearing house and account management centre will be established to support transportation ticketing services on 8,500 taxis, 2,300 minibuses, 1,000 buses catering to the urban area and 500 buses catering to the suburban area. Smart card terminals and facilities will be installed on vehicles, major roads and bridges, and 120 points-of-sale for card vending, value adding and data collecting will be established. Systems will also be installed to allow the cards to be used for parking and fuel stations in the second phase. The second phase of the project is expected to focus on non-transport applications. The city plans that Shenzhen citizens will...
also be able to use their cards for payment of water, gas and electricity utilities, vehicle refuelling, parking, fast food, at scenic and recreational facilities, for entertainment and leisure applications, at sporting venues and in shops and supermarkets. In the long term the city plans that the “Shenzhen Tong” project be integrated with other smart card schemes in Hong Kong (i.e. Octopus) and the Zhujiang River Delta, with the aim of forming a regional smart card solutions system.

CHINA’S SHANGHAI PUBLIC TRANSPORTATION CARD

In 1999, the Shanghai municipal government decided to launch a contactless smart card solution for public transportation and a consortium of transport operators, construction and investment companies, managed by Shanghai Public Transportation Card Company, was established to implement the project. The population of Shanghai exceeds thirteen million, with a mobile population of four million, and the daily demands on public transportation services are among the highest in the world. As a result it was decided that the contactless smart card solution would need to issue up to ten million cards, and process up to eight million transactions on a daily basis. The Shanghai Public Transportation Card consortium was realistic enough to understand that the major challenges would lie firstly in the management of the system and secondly in the technical issues.

The aims of the project were to improve the management of public transport in Shanghai, increase the efficiency of operation of Shanghai’s transport industry, provide enhanced public transport services for the citizens of Shanghai, and make a significant contribution to the modernisation of the city. Major transport operators already had their own ticketing and settlement systems, such as the subway AFC system provided by CUBIC, the contactless smart cards (Dragon Cards) for taxis, pre-paid paper tickets for buses and tokens for ferries, but this was proving inconvenient for many citizens of Shanghai who needed to use several transport networks on a daily basis. The Shanghai municipal government therefore decided to integrate Shanghai public transportation ticketing systems into a “one card through” project based on contactless smart card technology.

Shanghai Public Transportation Card Company Limited, a joint venture company, was established on 25 May 1999 to deliver the “one card through” project, including project implementation, operation and management, card issuance and clearing and settlement of card transactions. Shanghai Public Transportation Card Company Limited was funded by ten companies including Shanghai Urban Construction Investment & Development Company, Shanghai Metro Company, Shanghai Bus Company, Shanghai Ferry Company and Shanghai Qiangsheng Company. System development began in 1999 and in December, Shanghai Public Transportation Card conducted the first system trial on Metro Line One (63 gates), eleven public bus routes (506 buses) and one ferry pier (8 gates). During
this trial 100,000 cards were issued and 31 card point-of-sale outlets were established (which also served as reloading sites). In 2000 the system was upgraded and expanded and by the year end 560,000 cards had been issued and could be used on 172 public bus routes (about 4,200 public buses), 25,000 taxis, 4 ferry piers and Metro Line One and Line Two (29 stations), after fully integrating the existing AFC scheme established by CUBIC. By 2001 the system was in roll-out phase and had expanded to include the Light Railway Pearl Line (19 stations), the Shanghai Hu-Hang highway toll road system (33 POS machines) and freight taxis, bringing the total number of taxis in the scheme to 34,000. Multi-fare hand-held ticketing POS machines had been launched and piloted on two public bus routes, 968 card point-of-sale outlets and 503 reloading sites had been established (including six banks), and 2.8 million cards had been issued. Currently, 100 automatic value reloading machines are being installed in branches of the Bank of Communications.

The “one card through” card uses technology developed locally in China by the Shanghai Huahong Integrated Circuit Co. Ltd. This is the first stored value contactless smart card developed in China and complies with the ISO 14443 type A standard. The security design of the “one card through” contactless smart card system, particularly the encryption key used to authenticate every transaction, is inherited from the encryption system of the State Construction Ministry. Transactions are secured using either single DES or triple DES algorithms but transactions are still completed within 300 milliseconds on every terminal. Since the transaction clearance and settlement system for the “one card through” card involves nearly 1000 companies, a number of secure authentication mechanisms are used for data transmission to authenticate transactions and verify the identity of message senders. There are also specific risk management requirements to ensure the integrity of the overall system, such as assigning the final settlement of transactions to individual operators and making the central clearing house responsible for monitoring the reloading terminals.

The Shanghai “one card through” system currently covers 10 major transport systems, and 3.2 million cards have been issued. The scheme now covers the Metro and the Light Railway (now with 48 stations), all taxis, four major ferry lines and 250 public bus routes (78% of the bus routes in Shanghai). The card can also be used in freight (goods) taxis, car parks, car rental services, the Hu-Hang highway toll system and the Shanghai Travelling Center. There are now 47,975 card readers installed across almost 1000 service providers and around 1.7 million transactions are recorded daily. Shanghai Public Transportation Card and its consortium intend that citizens will be able to use the “one card through” card on all forms of transport in the city by 2003. Future applications which are planned for the card include petrol stations, access control for intelligent residential areas and parks, water and gas bill payment systems as well as fare collection and ticketing for the transport infrastructures of neighbouring areas. Shanghai Public Transportation Card plans to improve the service and quality of their contactless smart card AFC scheme by studying and learning from other established transport smart card schemes such as the Octopus Card scheme in Hong Kong.

To date, the Shanghai transportation card system has proved to be a success and has achieved the stated aim of improving the management of the city’s public transportation and Shanghai’s modernisation programme. It is also promoting the development of new and emerging technologies.
for commercial applications and this is expected to provide future business opportunities for local companies. In the third Shanghai International Industry Exposition in November 2001, the Shanghai “one card through” system won the gold prize and market research studies have indicated that 99.7% of cardholders are satisfied with services provided by the scheme.

**JAPAN’S SUICA CARD**

East Japan Railway Company (JR East) is one of seven railway companies founded in April 1987 upon the division and privatisation of the old Japanese National Railways. As the largest railway company in Japan, JR East has a network of 7,538 kilometres of tracks in the Tokyo Area and eastern Honshu Main Island, and more than 16 million passengers use JR East services everyday. JR East launched their Suica contactless smart card system in November 2001 and the card has now been introduced into all stations within a radius of about 100 kilometres in the Tokyo metropolitan area. The name Suica stands for Super Urban Intelligent Card and, in Japanese, it conveys the idea of smooth, swift movement in a card.

JR East already had a magnetic ticket-based AFC system which was launched in 1990 and enlarged, over 4 years, to cover 350 stations in the Tokyo metropolitan area. In 1991 a Stored Fare (SF) card was launched and came to be known as the IO Card, proving very popular with passengers. However JR East was well aware of the benefits of contactless smart card technology and in the early 1990’s the company decided to introduce a contactless IC card system, which they referred to as a CIC system. From 1994 to 1997, three field tests were conducted to evaluate CIC communication speeds, transaction speeds and reliability, error rates, passenger throughput at the AFC gates. These pilot tests proved the technical achievements of the required system performance including, short transaction time (0.1 sec), communication distance (100mm) and fast communication speed (212kbps).

There are two types of Suica card: the Suica IO Card (SF) and the Suica Commuter Pass. The Suica IO Card is the standard stored-fare transit ticket and is anonymous. The Suica Commuter Pass also performs the standard stored-fare transit ticket function but also includes the season/commuter pass function which allows the rider unlimited free travel inside the Pass Zone [between two points on the JR East network chosen by the rider at the time of purchase]
during the validity of the season/commuter pass function. The surface of the Suica Commuter Pass is rewritable and shows the two stations which define the Pass Zone as well as additional information, including the Season/Commuter Pass price, the issue date and place, the passholder’s name, age and gender. Most of this information is rewritten every 1, 3 or 6 months depending on the period of the pass. Since the surface of the Suica card can be rewritten over 60 times, the life of the Suica card is 5 years. Passengers are charged a deposit of 500 Yen for their Suica Commuter Pass, which can be redeemed if they return the card. Suica IO Cards can be purchased for 2000 Yen, which includes the 500 Yen deposit.

The international tender for the first 6.5 million SUICA cards was won by Sony in June 2000 and uses the same Felica technology as the Hong Kong Octopus cards and Singapore ez-link cards [according to Sony, more than 20 million Felica cards have now been sold worldwide]. The Suica system currently includes around 3,500 automatic fare collection gate machines, 950 season ticket vending machines and 1,600 add-value machines, making the system one of the largest in the world. As with other transit AFC schemes, Suica cardholders simply touch the pass on the Suica reader/writer pad on the transit gates to pass through the gates and the fare is automatically deducted from the balance on the card. As the transit system transactions are online, the record of the card balance stored on the host computer system is also updated at the time of transaction (offline transactions are likely to be used for some future service providers such as bus operators). When the balance reaches zero the rider is prompted to add value to the card, which can be done at the automatic reload machines in the stations or at the ticket counter. Suica Commuter pass holders travelling beyond the season pass zone do not need to buy tickets or make fare adjustments because the necessary fare is automatically deducted from the Suica card at the automatic fare collection gate. Because the Suica Commuter pass cards are personalised it is possible to re-issue lost Suica Commuter pass cards to cardholders with the lost balance intact. The card balance and a print-out of the transaction history can be obtained from some Suica vending machines.

Portable Suica readers have been distributed to those stations outside of the Suica area and to the conductors of trains which enter the Suica Area. The portable Suica readers allow JR East staff to know from which stations passengers board trains, what fares have already been paid and to check card balances. This allows fare adjustments to be made even outside of the Suica Area. The portable Suica readers are the size of a credit card, 7mm thick and battery life is approximately one year.

By the end of March 2002, four months after the Suica card launch, 3.08 million cards had been issued (1.67 million Suica Season/Commuter Pass holders and 1.41 million Suica IO cardholders). Statistics then showed the average Suica reload value to be around 2,500 Yen (about 19.2 USD), and almost 2 million transactions had been recorded (this does not include the usage of Suica Season/Commuter Pass cards inside the pass zone). As part of a comprehensive internal Suica training programme, a 24-hour Suica Enquiries Center with 20 staff that are Suica experts, is available to answer all types of questions from JR East station staff.
JR East carried out a customer survey after their pilot test in 2001 (the survey involved around 10,000 riders) and is receiving customer feedback on a daily basis since the November 2001 launch (through station staff, telephone, e-mail and a customer consulting organisation in the stations). The feedback obtained indicates that riders like the convenience of not having to remove the card from their wallets and bags when passing through transit gates, not having to queue for tickets or fare adjustments, as well as the reassurance that any lost Suica Commuter pass card can be re-issued with the cardholder’s balance intact. The same customer response survey also showed that cardholders may need more information about the “touch and go” operation of their Suica cards [some personal items such as coins and telephone smart payphone cards can affect the contactless communication with the reader/writer]. There is also feedback that cardholders would like to use their Suica cards in other railways and subways operated by other transport companies. JR East is addressing this by increasing information to customers about where they can use Suica cards, as well as approaching other bus, rail and subway operators [including the Shinkansen “bullet” high speed train] to join the Suica card automatic fare collection system. Their target is that there will eventually be more than 6 million Suica cardholders.

JR East future plans for the Suica card include:

- Expanding the Suica card to a multimodal smart card scheme covering various transport services
- Adding other non-transport services to the scheme (such as electronic purse)
- Adding an automatic recharge facility at the transit AFC gates (linked to bank or credit card accounts)
- Linking the Suica card with other infrastructures such as mobile phone and ATM networks.
- Linking the Suica card with credit card schemes

Readers looking for further information about most of these proposed plans should also follow the development of the bitWallet contactless smart card scheme in Japan, launched by Sony and ten other stakeholders, and discussed below.

**JAPAN’S EDY CARD**

At the end of 2000, eleven Japanese organisations announced a joint venture to pilot a contactless electronic purse scheme in Japan. The eleven organisations were Sony Corporation, Sony Finance International Inc., NTT DoCoMo, Sakura Bank, Sakura Information Systems Co., Ltd., the Japan Research Institute, Toyota Motor Corporation, Denso Corporation, DDI Corporation, Sanwa Bank and Tokyo Mitsubishi Bank. Sony holds the largest stake in the joint venture, followed by NTT DoCoMo and then Sakura Bank. The joint venture company is called bitWallet Inc. and began trials in March 2001, prior to a planned rollout. The contactless cards issued are called "Edy" (Edy is an acronym for Euro-Dollar-Yen) and use Sony’s "FeliCa" contactless card (an earlier version of which is used in the Hong
Kong “Octopus” card transit scheme). The aim of the joint venture is that consumers will be able to use the Edy card in convenience stores, bars and restaurants operated by the participating companies as well as for shopping on the Internet. At the point-of-sale, consumers pay for goods and services simply by holding the contactless card near a dedicated reader/writer. As with most electronic purse schemes (except Mondex) the card holds only a record of the balance of the cardholder’s current electronic cash funds. With a small, USB interface, contactless reader/writer manufactured by Sony which connects to a PC for home use, the scheme operators stated that they would offer Internet value reloading for the card from credit card accounts as well as the ability to make online payments at Internet retailers, particularly for downloading music over the Internet. Sony has developed a copyright protection scheme which it is promoting to the music industry and music will be distributed in Japan from the bitmusic website. Sony demonstrated the first version of a PC-based contactless smart card reader/writer on their stand at IC Card World 2001 in Tokyo, although they were unable to give price indications at that time. The Sony PC reader/writer demonstrated at IC Card World 2001 was a very attractive VAIO-like design, with a PIN pad, about the size and weight of a small calculator.

The bitWallet scheme operators also stated that they planned to offer other services (applications?) other than e-purse, through the card in the future. They were open to third parties developing the new services or applications since a FeliCa development kit was being promoted on the Sony stand at IC Card World 2001. bitWallet spent much of last year signing Edy merchant acquirers, building an infrastructure of Edy value reload terminals and starting to promote the current version of the Sony personal Edy PC-based reader/writer (see left). bitWallet plans to build a user base of 30 million cards, 25,000 physical points-of-sale, 30,000 accepting websites, 1 million vending machines and 15 million personal PC terminals within the next five years. Sony and Denso will develop and manufacture the card and reader/writers, NTT DoCoMo and DDI will promote the use of Edy over the mobile and network environments, Toyota will promote the use of Edy for various automobile applications while the banks will promote Edy over ATMs, multimedia kiosks and at convenience stores. Sony and Sakura bank have already launched one pilot using the Edy card at the Gate City Osaki shopping mall in Tokyo in February 2000. That pilot involved 12,000 users, 45 shops and restaurants, 125 vending machines and 12 value reload stations. Around 5,000 transactions a day were being recorded by mid-2001 and bitWallet expects the Gate City Osaki implementation to eventually generate over 1 million transactions a year. Compared to contact smart card-based electronic purse schemes (in Japan and globally), an average transaction rate of 5,000 transactions a day with a card population of only 12,000 cards is very high and other smart e-purse scheme operators will want to know whether this is due to bitWallet’s customer proposition and marketing, or whether it is related to the convenience of faster transactions available from using a contactless smart card. It is worth noting that bitWallet are claiming that Edy card transactions are 25% faster than cash, which is certainly not the case with contact smart card-based electronic purse schemes.
A second expanded Edy pilot was launched in March 2001 and enabled Sakura Bank's Edy card holders to shop and reload their Edy cards at "am/pm" convenience stores. The Sony/Sakura pilot in the shopping mall did not require a PIN to authorise transactions. This would not be notable except for the fact that the maximum value which users can load onto the card is reported by Sony as being ¥50,000 (around US$500). Sony states that there have been no complaints from cardholders in that pilot and indeed this is unremarkable in a country with historically high card floor limits (until recently hotel transactions up to US$2,500 and supermarket transactions up to US$250 were approved offline).

In November 2001, bitWallet launched their full-scale Edy card scheme which, they say, is scalable for the whole of Japan. The scheme is initially undergoing evaluation in a promotion, again with the AM/PM convenience stores in Japan, as well as selected shopping malls. The bitWallet cyber shopping mall is also open for business and requires the Sony RC/S310/ED3 USB Contactless Smart Card Reader with which a user can make transactions over the Internet using an Edy card. The Edy card can be reloaded over the Internet. Users can also apply for the card over the Internet and a card and Sony reader/writer costs ¥3500 (US$26). The reader/writer alone costs ¥2980 (US$22). Sony began shipping the contactless Edy card reader/writer with VAIO W desktop PCs which launched in February and 50,000 of these Edy-enabled PCs have now been sold. So far over 120,000 Edy cards and 70,000 Sony reader/writers have been rolled out. All Edy transactions are completely anonymous and bitWallet, which operates the clearing and settlement of the transactions, charges merchants a fee of just over 1%, which is about half what merchants would have to pay to credit card companies in Japan. If the scheme continues to expand then bitWallet hopes that by mid-2003 they may be able to offer (anonymous) card-to-card transactions. The typical user profile so far appears to be either an Internet user or someone working in an intelligent building connected to bitWallet-equipped shopping malls (the Edy card can also be used as an access control and ID card). bitWallet say the scheme is at a very early stage and they are still analysing the marketing information gathered so far.

JAPAN’S eLIO CARD

In April 2002, Sony launched the world’s first contactless smart credit card called the MySony card. The MySony card is a Visa branded credit card which looks like any other credit card, including having a magnetic stripe on the back, except that it also contains a Sony contactless Felica chip embedded in the card body. The Sony chip contains the Edy e-purse, which enables it to be used in the bitWallet e-
purse scheme discussed above, but it also supports the eLIO contactless credit application and service developed by Sony. The eLIO application is combined with Sony’s e-SCOTT network service and Sony PC contactless card reader/writer to provide a system for making contactless credit card payments over the Internet. Sony’s e-SCOTT network service is built upon the proven and efficient network which Sony Finance has built up over many years, connecting to credit card companies and merchants in Japan, to provide financing services to consumers. The expansion of the Sony Finance network into the e-SCOTT network service for Internet transactions is apparently popular with credit card companies and merchants because it is a solution for card-not-present Internet transactions, and also offers lower discount rates than the existing credit card networks in Japan. Initially almost all of the websites accepting eLIO will be merchants that are retailers of Sony products but Sony intends to expand the e-SCOTT network to all merchants and other business sectors such as mobile operators and transport operators. At the physical point-of-sale the MySony card is used in the conventional way by swiping the magnetic-stripe on a standard PoS terminal. The MySony card can also be used on the Internet in the conventional way by typing the credit card number into a website browser. However cardholders with a Sony PC contactless card reader/writer can make a purchase online simply by resting the MySony credit card on their card reader and clicking the “pay” button on an eLIO merchant website. An ID number stored in the Sony contactless Felica chip, which is unique to the cardholder, is then encrypted and transmitted to the reader and then via the PC and Internet to the eLIO merchant website. No cardholder information, or credit card numbers are transmitted over the Internet. Every MySony cardholder will receive a free Sony PC contactless card reader/writer as part of their eLIO cardholder fee. By making eLIO online transactions cardholders can earn Edy loyalty points which can be used to make Edy e-purse transactions either online or at the physical point-of-sale. Visa’s decision to brand a contactless smart credit card that operates using a network which is not owned by Visa and could be a potential competitor to the Visa network may seem, at first sight, unusual and in conflict with their global stance on persuading their members to migrate to EMV contact smart payment cards. However Visa has a history of exploring emerging technologies and has already begun forays into the world of contactless technologies with their combi (dual interface) card product offerings. Although Visa would probably prefer an ISO contactless standard they are well aware of several points:-

- Sony’s e-SCOTT network is fast, efficient and charges merchants a lower transaction fee than the Visa network.
- The e-SCOTT network provides a solution to Internet card-not-present fraud today.
- The e-SCOTT network is proving popular with merchants and credit card companies.
- Sony might extend the eLIO credit card service to the physical point-of-sale.
- In Japan, Sony is a more powerful brand than Visa.
As a result they have made the decision to partner with Sony and explore this technology and implementation. This strategy originated at Visa Japan but the decision was made at Visa’s head office in the USA and that may be because Sony has suggested it may be interested in extending Elio and its other card products to the U.S. and Europe. At the same time, Visa are discussing their 3D Secure Internet payment solution with Sony. Sony’s eLIO contactless credit card service has only just launched and it is not yet possible to make any judgement on the success of this initiative. Nevertheless Sony is promoting the project aggressively and the company has set itself a target to put 2 million cards, accepted by 200,000 online vendors, into circulation by 2005.
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