SMART TRANSPORT

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ABSTRACT

A smart card is usually a plastic card with an embedded silicon microchip and can vary in size from a credit card to a cell phone sim card. The chip provides the intelligence for the smart card to perform processing functions and storage of data or software programs for various applications.

There are currently about 4 billion smart cards in use worldwide and, although South Africa cannot compare with China's 1.2 billion cards, we do have around 50 million smart cards in circulation (including 20 million sim cards and 1 million transport cards / tags). By the time of the 2005 SATC this worldwide figure (including South Africa) should be boosted by the rollout of EMV (Europay / Mastercard / Visa) banking smart card which will replace the current mag-stripe card in an effort to reduce rampant fraud. So this is not just another luxury item that our emerging economy cannot afford. On the contrary, these smart cards will soon be in everyone's pocket providing routine functions such as access control, biometric identification and electronic purse for cashless transactions.

The challenge for the transportation industry is to be ready for this technology when it sweeps across our country in the next few years and have systems in place to take advantage of the simple but effective smart card features on offer, such as:

- Paper (disposable) cards for once off parking or public transport payment
- Stored value in the form of an electronic purse on a public transport token or plastic card, which is rechargeable and holds value (e-money)
- Multi-applications for transport and other personal type of transactions such as passenger fares (taxi / bus / train), parking fee (garage / meters) & toll fees & fleet fuel payments

This paper explores the whole concept of smart cards and their suitability for South Africa (in general) and our transportation industry (in particular) and addresses potential problems such as the need for standardisation and the huge cost of setting up the required infrastructure.

The impending 2010 Soccer World Cup will force us to make the choice:

"CAN WE AFFORD SMART CARDS OR CAN WE AFFORD TO BE WITHOUT THEM?"

1. INTRODUCTION

Smart Transport refers to the integration of Smart Cards with Intelligent Transport Systems (ITS) in order to increase the efficiency and attractiveness of public transportation services, to reduce traffic congestion and help prevent fraud by reducing the amount of cash in the transportation system. This paper explores the whole concept of Smart Cards and their suitability for South Africa (in general) and our transportation industry (in particular) and addresses potential problems such as the need for standardisation and the huge cost of setting up the required infrastructure.

1.1 What is ITS?

ITS refers to Intelligent Transport Systems that apply computer and communication technology to improve the operation of transport systems generally, it simply addresses the need to monitor and react to traffic conditions on the street and to relay this information to travellers. ITS should also not be confused with IT - granted the computers provide the intelligence but implementation of more efficient transport projects is the main focus of ITS.

ITS is not new and is a continuation of a process of infusing technology into surface transportation management that began in the 1960s with the advent of integrated circuits and microprocessors. Around the 1990s the idea to incorporate modern technology into surface transportation was initiated with the aim of reducing traffic congestion and accidents without building more roads. The term Intelligent Vehicle Highway Systems (IVHS) was originally coined but the name was later changed to Intelligent Transportation Systems.

ITS is now well established in the USA, Europe, Asia and Australia and, while the concept has been widely accepted in South Africa for a few years now, only recently have we seen any ITS projects implemented in this country (ie. electronic tolls, dynamic message signs, electronic fare payment and CCTV for traffic control & security - to name a few). One of the difficulties in implementing ITS projects in South Africa is co-ordinating all the role players involved (different traffic engineering aspects, feasibility study, funding etc) whereas the respective National Departments of Transport (NDoT) manage this role in those countries with a successful ITS infrastructure. Unfortunately, while our NDoT fully support ITS, they choose not to participate in the management and co-ordination of ITS in South Africa so it is therefore up to the Municipalities, SA National Roads Agency (SANRAL) and a few of the provincial road authorities to provide for this in their transportation planning and work closely with the SA Society for ITS (SASITS) in implementing ITS projects.

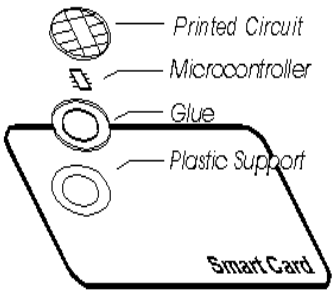

Figure 1. Smart card.

1.2 What is a Smart Card?

A Smart Card is usually a plastic card with an embedded microchip that can vary in size

from a credit card to a cell phone SIM card. The chip provides the intelligence for the Smart Card to perform processing functions and storage of data or software programs for various applications. Of particular interest to the Transportation field is the electronic payment of fares in public transport applications (ie. with regard to the taxi recap, rail and bus operations), electronic toll collection and electronic licensing of motor vehicles. The impending issue of electronic identification cards by the Department of Home Affairs and the banking fraternity finalising standards for the operation of an electronic purse (E-purse) on Smart Cards is currently the flagship project for South African Smart Cards.

There are currently about 4 billion Smart Cards in use worldwide and, although South Africa cannot compare with China's 1.2 billion cards, we do have around 50 million Smart Cards in circulation (including 20 million SIM cards and 1 million transport cards / tags). By the time of the 2005 SATC this worldwide figure (including South Africa) should be boosted by the rollout of EMV (Europay / Mastercard / Visa) banking smart card which will replace the current mag-stripe card in an effort to reduce rampant fraud. So this is not just another luxury item that our emerging economy cannot afford. On the contrary, these Smart Cards will soon be in everyone's pocket providing routine functions such as access control, biometric identification and electronic purse for cashless transactions.

The challenge for the transportation industry is to be ready for this technology when it sweeps across our country in the next few years and have systems in place to take advantage of the simple but effective smart card features on offer, such as:

- Dumb (disposable) like the phone card
- Stored value which is rechargeable, in the form of public transport tokens
- Multi-application for transport and other personal type of transactions such as passenger fares (taxi / bus / train), parking fee (garage / meters) & toll fees & fleet fuel payments

Evolution of Smart Cards:

1878 American Ed Bellamy predicts that by 2000 all transactions will be by credit card
1888 American Express launches a pre-paid newspaper stamp
1901 Conrad Merciers card provides access to public telephones
1918 Western Union provides a metal company card to be used as proof of identity
1951 Diners Club uses pre-paid paper booklet to pay hotel and restaurant bills
1958 American Express launches a paper bank (later plastic) card.
1967 Clients of Societe Marseillaise use a punch card to withdraw cash.
Europay launch their Carte d'or.
First Magnetic Stripe card launched in France for access control.
1974 Robert Morena files a patent for a secure portable electronic device in France.
1980 Historic birth of the chip-based card in France.

The rest is history …

2. SMART CARDS WORLDWIDE

2.1 New Zealand and Australia

A good example of the use of Smart Cards, tags and radio-locators are the "city cards" which replace cash and paper tickets for parking, transport, entrance to museums, leisure centres, etc in New Zealand cities. These invariably repay their capital outlay from the traffic and transport applications. A particularly interesting city card is being implemented in Wellington that combines public and private sector facilities and services.

In Sydney, Australia, the Integrated Smart Card Transit Solution covers all commuter rail, state transit and private operator buses, public and private ferries, as well as Sydney's light rail and monorail. Sydney's transport system handles around 630 million passenger journeys a year and collects revenues of about Aus$800 million.

2.2 North / South America and Canada

The Philadelphia Parking Authority has introduced a Smart Card for use at all of the city's 14,500 parking meters and is selling the disposable cards for US$20, carrying the same amount in value, but distributes 20,000 cards free with US$5 worth of value each holiday season. This authority has purchased 60,000 cards at a cost of US$1 per card but they do not accommodate multi-applications so can only be used for transit (including payment of fares and toll fees).

In June 2002 the San Francisco Bay Metropolitan Transport Commission launched a single fare payment smart card covering the entire transport system in the region. The area in question has 9 counties, over 100 towns and a population totalling more than 6 million. Over 1.5 million journeys are clocked up each day, involving 8 major transport operators and 18 smaller companies. Travellers no longer have to carry out complicated calculations when buying their tickets from various operators - a machine now does it for them, calculating a total figure for the entire journey. No need either to hunt for change when buying tickets as there are now a number of ways for users to reload these cards - by phone, by post, on the Internet or at kiosks inside transport terminals. The net result is a noticeable reduction in queues and improved traffic flow. The benefit to each operator (aside from removing the need for their drivers to carry cash or having to search for the right change) is that he can receive a daily report from the system, listing all the transactions for their network. This Smart Card is also valid for other transit applications such as paying parking fees, tolls, taxi fares, etc.

Likewise transit systems around Toronto are part of an integrated electronic fare system with Smart Card readers connected to a central computer system that electronically transfers money between the commuter's cards and various transport operators.

The smart driving licence was pioneered in Mendoza, the province that is reported to have the highest road accident rate in Argentina, when chip card driving licences were introduced in 1996. The provincial government decided that problems of law enforcement on the roads, where only 30% of traffic fines were being recovered, could be solved by the introduction of a chip card-based driving licence to keep track of individual drivers' offences and to control spot fines more effectively. The system allows biometric data, such as a thumb print, to be stored on the card as well as fixed data, such as the licence number, vehicle groups and the driver's personal details, including emergency medical information such as blood group, allergies and a photograph, plus a record of the driver's cautions, offences, fines and any other penalties imposed by the authorities. This data can be updated at any time during the life of the card, making it easier to pursue unpaid fines and repeat offenders. The Mendoza police are equipped with hand-held card readers to view data held on the card, which may be also be used to update the records.

100,000 Multivia contactless Smart Cards in Chile are used for fare payment at 320 turnstiles readers in 52 subway stations and cost about US$1,35 each. Cardholders receive a free subway ride after 20 rides and pay 20% less per trip than those using paper tickets. Unhappy passengers are refunded the card cost within three months of purchase.

In terms of passenger car safety, Michelin in the US has launched a tyre information system that makes use of a permanent smart tag, composed of a computer chip and sensor built into the tire, to transmit information such as tyre pressure, manufacturer's identification number, size and more. The smart tag information is picked up by a permanently mounted reader or in-car computer to provide the driver with appropriate warning when improper inflation is detected, improving safety, efficiency and convenience.

2.3 Asia

Asia is by far the leading user of transit Smart Cards and, with a population of 1.3 billion, China has over 470 million Smart Cards in use. China is rapidly modernising the ITS infrastructure in order to increase the efficiency and attractiveness of public transportation services and to reduce the growing traffic congestion problems within its major cities. As part of this process, the Chinese Ministry plans to have 120 cities within China using smart card public transport infrastructure by 2005, in preparation for the 2008 China Olympic Games - the first to use a smart card electronic ticketing system. Key attractions of Smart Cards are the range of applications that can be stored on a single card and basic access control. Public transport tickets to get to the events will provide access to parking and include an e-purse or tokens to buy food and drink at the stadium or affiliated merchants.

As early as 1997, one million Smart Card driving licences were issued in the Hunan Province of China to modernise the management of driver details and eliminate human involvement in citation cases. A network link with banks was set up to expedite fine-payment procedures. The police carry their own ID cards, hand-held reader-writers, and daily duty cards that can record the total traffic violation cases cited. Every driver in the province is required to carry a driver's licence card, which stores his personal data and driving and fine payment record.

An automobile registration card project using contactless Smart Cards has replaced the previous, paper-based registration process in the Hunan Province where more than 15% of cars were unregistered. Wireless technology is used to detect expired cars from the roadside or toll booths without setting up road blocks. Smart Cards and electronic cash methods enable vehicle owners to pay fees or inquire about their payment status at banks.

Sony controls 70% of e-commerce in Japan which makes for easy integration of their high speed contactless transport Smart Cards with the banking environment. Intermodal transport prepayment cards are often well-placed to become generally useful electronic purses because they use the latest technology and have already covered their costs through high usage. A prime example is Hong Kong which added retail and fast food restaurants, as well as over 5,000 concessionaire payphones to the capability of its 20 million intermodal Octapus rail cards. Similar projects relating to roadworthiness, tax, insurance, vehicle registration and loyalty schemes all combined on the same Smart Card have been implemented around the world, with the aim of reducing costs (personalisation, issuance and card costs) and improving convenience.

Tokyo's 16 million Sica rail cards serve a commuter population of 59 million travelling between about 500 stations. High transaction speeds are essential with peak passenger volumes of about 60 passengers / minute / gate. The processing time for a Smart Card to read / authenticate / transact is 0.1 sec or 106 kbps. (cf. mag-stripe = 0.7s).

The Seoul metropolitan area in Korea has the world's largest contactless ticketing installation with 10 million Smart Cards in circulation and over 50,000 reader terminals.

The Malaysian Touch ‘n Go contactless transit card system is unique in that it operates its own clearing house to process over 15 million transactions per month with an average transaction amount of US$1. The expansion of existing application services includes a fleet card feature, which targets fleet-transport operators and companies with large vehicle fleets. Fleet operators are able to load specific value onto their cards, removing the need for their drivers to search for the right change and enabling drivers to use toll roads without the need to queue at toll booths or even to slow down. The cards can also be used to purchase fuel and so help to optimise cash management for fleet operators, as they eliminate the need to allocate cash to fleet drivers. In addition, the Touch ‘n Go Fleet Card feature offers a channel for banking institutions to acquire electronic payment transactions from fleet operators, currently running at an estimated annual value of just over US$100 million. All Touch ‘n Go users can already reload their cards at ATMs around the country and through kiosks in shopping malls or even over the Internet. Currently, over 2,000 card readers are installed across Malaysia and over 2.5 million Touch ‘n Go cards are issued.

2.4 Europe

London deployed the Oyster Smart Cards for its groundbreaking London transport ticketing and payment program, to speed the movement of ticket holders in a system that services around 6 million passengers a day, and as such set a model for urban travel in the 21st century. London taxi drivers will also be equipped with Smart Cards as part of a system to make it easier to hail a cab in the UK’s capital. A cab driver will insert his smart card into a reader in his cab when beginning a shift. The card will carry the cabby’s name and his cell phone number so a satellite tracking system can direct calls to that cab when it is the nearest available taxi to someone seeking a ride.

Holland has a fully contactless, integrated fare system used by all the different national transport operators and the project will deploy 12 million cards when fully implemented, serving more than 2 million passengers per day. One single contactless card will allow the citizen to equally access ferries, buses, metros, trams or trains to travel across the country.

Even Ireland is rolling out a contactless public transport Integrated fare system for travel on bus or rail which will cover all public transport operators serving Dublin by the end of 2005.

3. TRANSPORT SMART CARD APPLICATIONS IN SOUTH AFRICA

The benefits of Intelligent Transport System (ITS) applications rely on cooperation among the multitude of role players, coordination of transport related activities, integration of services and sharing of resources to create the synergy that will enhance efficiency and lower overall costs. The area where these objectives are most pertinent and topical is in transport fares (including toll) and the revenue collection. Instead of transport setting up its own transactioning business, it is recognised that this is the core business of the banks.

Contactless card payment enables users to simply tap or wave their payment card near a specifically equipped terminal to transmit payment wirelessly, eliminating the need to swipe the magnetic stripe of a credit / debit card. The magnetic stripe credit card is not an appropriate electronic payment media for public transport – mainly because the finance charges would be crippling for this high volume / low value application and the transaction rate is far too slow, but also the dusty, outdoor environment is not conducive to payment by continuous swiping with card contact. On the other hand public transport fare payment is the “killer application” for contactless Smart Cards. Until there is an appropriate standard for contactless operation the more expensive combi-card (allowing contact and contactless

reading of cards) would be required to comply with Philips MYFARE contactless technology, the generally accepted international standard for electronic fare payment. Money could be deposited into these cards at any ATM, Post Office or kiosk at public transport terminals. Likewise machines enabling the automatic vending of tickets would be available at public transport terminals, retail outlets etc. and the electronic ticket for the intended trip would be stored on the Smart Card and electronically validated when boarding and disembarking from the public transport. The complete phasing out of cash fare payment is not practical in the foreseeable future and this will have to be incorporated into the fare collection system.

The electronic purse on the card will also assist unbanked commuters, who are find it difficult to afford the fees associated with maintaining checking / savings accounts. With a Smart Card, commuters could receive their wages on a pre-paid card allowing them to easily retrieve their funds from an ATM or anywhere that card is accepted.

3.1 Electronic Fare Payment

Based on the sheer volume of transit commuters world wide, electronic fare payment is currently the “killer application” for the use of Smart Cards, with just under 30% lead over access control. Smart Cards also lend themselves to innovative transport applications such as offering discounts for frequent travel and riding outside of peak periods or allowing commuters to be billed directly from their bank account at the end of the month for transit rides.

User-friendly contactless fare cards enable passengers to enter the rail or bus with a single “swipe and go” gesture, within 100mm from the reader. Tickets are authenticated within 0.1 seconds (ie. 100 passengers boarding in two minutes) and within this small time, the system performs a complete and secure transaction including reading the card, checking it against the black list of lost-stolen cards, processing and updating the card data and displaying the outcome of the fare validation through an LED and an acoustic signal.

However, as use of Smart Cards for automated fare collection grows, so does the problem of how to handle transactions from one-time or infrequent customers. Standard contactless Smart Cards, at around R20 each, aren’t exactly the kind of cards operators want riders to toss into the dustbin after a few uses. A low cost disposable (paper) Smart Card has been developed so that passengers, whether occasional or regular, will both be able to use the convenience and speed of fare payment and validation using a contactless card. The big volume business case for operators, including reduced fraud, makes it cheaper to go for low-cost (contactless) tickets than using paper mag-stripe. A paper based ticket, providing tourists with single trip, hourly or daily tickets, could, for example,feature different artworks of the city that are collectable as souvenirs.

Advances in battery technology make it possible to integrate an affordable, ultra thin, flexible power source into thin and disposable products such as contactless Smart Cards and tags. The power source can be applied in areas of security, transportation, authentication, loyalty, identification and biometrics. A ½ mm thick, 25 mm², power cell allows over 500 hours of continuous display or approximately 30,000 transactions at 1.5v and can be stacked to provide higher voltage. Batteries allow cards to beep an identifying sound for Internet authentication and might make contactless cards more useful for paying highway tolls or opening car doors, as the battery allows the card to communicate from more than the usual few centimetres that is the maximum range of most contactless Smart Cards today.

One of the potential problems with electronic fare payment for road users (and likewise, fast food restaurants, gas stations, supermarkets, drug stores, video stores and coffee shops) is the current fee structure for this type of transaction (ie. large volume of low value transactions, with speed and convenience both important). Negotiations with the banks to charge a much reduced transaction fee are very necessary and underway. Credit cards, which account for just under half of toll fee payments, are subject to these transaction fees whereas Smart Cards are not.

The SA Rail Commuter Corporation (SARCC), with 2,2 million passengers trips per day, will be implementing Smart Cards very soon with a particular focus on reducing the rampant fare evasion. The SA Bus Operators Association (SABOA) reports that any system implemented on busses would need to be extremely robust (to cope with vibrations on bad roads), very quick (to handle the large number of transactions) and allow also for cash payments (especially in rural areas). Smart Cards implemented in conjunction with the taxi recap would enable real-time fare changes to enable cheaper travel in off-peak periods and introduce a loyalty reward (eg. special rates for customers of Pick 'n Pay Hypermarket). The taxi recapitalisation scheme will involve some 12 million cards, 100,000 card readers and more than 1,000 card loaders. Digital equipment will replace more common & easily fooled mechanical "tachographs". The Smart Cards will store digital certificates on each driver, who will authenticate himself to the recording equipment by inserting his card into one of two slots in the reader before hitting the road. The cards will also store driver's license information and record such data as the distance the driver travelled during the day and any attempts made to tamper with the motion detector or other parts of the recording equipment.

3.2 Electronic Toll Collection

Electronic payment of toll fees at free flow toll plazas (with gantries instead of booths) requires the issue of a toll tag to enable fee payment without stopping to swipe a card or pay. There are over 40 toll roads in South Africa but the only electronic toll facility is at Bakwena Toll Plaza (near Carousel, Pretoria) which allows average vehicle speeds of 30kmh through a dedicated free flow lane. The cost of these tags is around R250. A very high speed of transaction of only 0.02 seconds is essential for the more sophisticated non-stop tolls in Asia, Europe & America where drive through speeds of up to 120Kmh are common.

3.3 Electronic Licencing

An electronic vehicle licence is a windscreen-mounted credit-card-size electronic tag that provides vehicle identification in three formats (electronic, barcode and text) - with an encoded electronic chip that allows interrogation by means of roadside reader equipment that does not require vehicles to be stopped. As licences are issued annually, all vehicles could be equipped with such a device within a year and a possible option could include the annual encryption/update of tags so that the motorist would not have to replace or renew licences.

This system could be extended to many transport applications from improved licence administration and revenue capture; enforcement of vehicle and traffic regulations (roadworthiness, speed, and overloading); vehicle crime countermeasures (tracing of stolen or hijacked vehicles / cargo or vehicles used in committing crime), and electronic toll collection and road pricing. Roadside reader stations would recognise vehicles not legally licensed which could be tracked and/or stopped at roadblocks.

Mobile roadside reader stations could be used to do unobtrusive spot checks for reported vehicles or vehicles not legally licensed. Vehicles with large numbers of unpaid fines could be detected in real time, enabling patrol vehicles to stop them and take strict action.

Although electronic licensing might not be financially self-sustaining, or constitutionally correct (ie. privacy issue), associated economic benefits, and the ability to introduce new forms of traffic control and facilitation of logistics, would make it a very attractive option.

3.4 Smart Cards for South African Municipalities

A city-wide, contactless smart card scheme is one solution to the problem of moving the population from their cars to use public transport more frequently. This requires the underutilised, but well equipped public transport network, to be remarketed as a well integrated, inter-modal, comfortable and convenient service where passengers can pay a flat fee for their entire trip with a smart card. This marketing involves a large scale advertising campaign to educate the public on the technology behind the system, focussing on how the transactions are dealt with by the bank and where the Smart Cards can be recharged.

The modal integration (and integrated fare payment) resulting from a successful flat fee, smart card payment system could have a spin-off in reducing congestion not only by keeping cars at home but through optimising bus routes to coincide with passenger transfer points. Smart Cards can also accumulate statistics on preferred passenger routes and time of travel which can be used to further improve the overall public transport system.

eThekwini Transport Authority is actively involved in the implementation of intelligent transport systems (ITS) but there are no smart card projects at present.

However, there are a few areas where the introduction of this technology is imminent:
- parking meter fee payment
- access control (both for parking and office security)
- fare payment for public transport (preferably integrated)

Lessons learnt from the progress Cape Town has made in the public transport area are:
- busses operating in CBD and V&A Waterfront using Smart Cards for fare payment
- problems experienced are institutional (as in Taxi Recap) rather than the technology
- integrate tourist experience to pay for other trips (cable car, Robben Island) on one card

The Smart Fuel Management technology has been implemented by the eThekwini Municipality fleet of vehicles, “tagging” a vehicle with an electronic device holding essential details, including the fuel requirement, and which automatically captures the odometer reading. At any municipal fuel depot or authorised petrol station, the system verifies the driver (and authorises payment) once communication is established between the Smart nozzle antenna and the vehicle tag and then the pump is allowed to dispense fuel. Other advantages include faster refuels, zero paperwork for the driver, a no cash security zone and access to fuel history via a dedicated website. This will not only save the city money on it’s fuel bills by preventing fraud but will also ease administrative backlogs. For more general use Smart fuel management systems also work well with loyalty programmes, eg. where customers can be awarded points for each purchase at particular filling stations and the points are collected on the Smart Cards to be redeemed against free petrol or by purchasing items off a special catalogue.

The Metro Police Department would be interested in the improved enforcement expected with the introduction of Smart Cards in such areas as:

- electronic motor vehicle licence tags to combat unlicensed vehicles
- Smart Card ID with driver's licence to combat unlicensed drivers or unpaid traffic fines
- embedded vehicle ID tags to assist in detection and recovery of stolen vehicles

Certain other municipal functions, not related to transportation, would lend themselves to the use of Smart Cards for Council employees in the areas of:

- access control,
- wages for the unbanked
- funeral insurance,
- medical aid,
- loyalty incentives,
- municipal vehicles only start with authorised driver / holder of Smart Card or tag and
- active tag (GPS) on laptop PCs will send alarm when removed from designated area.

Treasury Departments could extend this facility to all eThekwini residents as a means of paying their rates, electricity & water.

3.5 Integrating Transport and Financial Applications

A multi-application card cannot be successful without accepting transit riders, who can pay their fares by holding their cards within 100mm of card readers on buses or subway gates. The chip's dual interface allows for fast, contactless transactions, as required in mass transit applications, and also enables a cardholder to use the card for payments at traditional over-the-counter merchants. Combining contact and contactless smart card functionality on a single chip facilitates a wide array of services, supporting credit, debit and prepaid card functions, as well as a digital signature for additional security. The card can be loaded with money through either its contact or contactless interface which opens up a number of recharging possibilities - including bank terminals, bus stations and even a PC and card reader over the Internet (which also permits Internet electronic purchasing or ticket reservations). This gives tremendous impetus to the spread of electronic money.

African nations make use of "Smart Card-to-Smart Card" technology to obtain cash and make purchases, even when there is no telephone service to link host computers with automated teller machines and merchant payment terminals. When a consumer wishes to get cash from an ATM he or she puts the card into the ATM and indicates the amount to be dispensed. The bank smart card inside the ATM deducts the value from the consumer's card and records the transaction. The bank periodically removes its smart card from the ATM, takes it to the bank and downloads transaction detail. Besides withdrawing cash at ATMs, cardholders also can make payments at point-of-sale terminals. Consumers benefit by not having to carry large amounts of cash or to line up at banks to make withdrawals, and merchants enjoy higher sales and guaranteed payment.

Multipurpose transport Smart Cards, particularly purse cards, have to cope with diverse applications and are therefore usually contactless because in the most demanding applications involving abrasion, damp, cold, heat and mishandling, contact cards are inadequate. However, many transport applications are slow and require contact (such as parking, taxi and bus fare payments, and in-vehicle records) where a transaction time of only 0.3 to 0.5 seconds is acceptable. Other examples are cards operated entirely indoors, such as airline electronic ticketing or fuel loyalty.

Further afield, in Singapore, electronic money is to be made legal tender by the year 2008, and all merchants will be required to accept it as payment from customers even if it is for very small amounts. Consumers will pay for goods and services with e-money loaded in electronic purse Smart Cards, or using chips in other mobile devices such as mobile phones and personal digital assistants.

Transport purses are primarily meant to benefit the owner, usually the transport service provider. However, this situation is changing, with New York Metrocard and Hong Kong Creative Star becoming independent organisations. This is not always successful. Creative Star is still located in a Hong Kong Mass Transit building, and Metrocard turned down a bank as co-owner last year, reportedly because New York Mass Transit was reluctant to accept being relegated to becoming a fee-paying service provider. However, Wizard Transcard Australia is independent, as is the Paycard in Germany, backed by the national railway (Deutsche Bahn), the Association of Transport Authorities (VDV) and Deutsche Telekom. Malaysia seems likely to see transport purses before bank purses. On rare occasions, a transport company co-owns a purse card system with banks, as in Bangkok, Thailand where an electronic purse, called Micro cash, has been launched jointly by the Micro Bus Co. and Thai Dany Bank. It is very unusual for a purely bankowned purse to give any priority to transport applications. In Colombia, the “Red Multicolor” purse has been launched by a non-profit association of financial institutions (sponsored by Mastercard) with the objective of use at toll booths, taxis and parking. However, this project might be compromised by Mastercard now standardising on a different technology.

4. STANDARDS

As always, electronic technology will continue to change on a 6 to 12 month basis providing interesting functional as well as reliability improvements. The value of open architecture is the most important lesson learnt in ITS during the past 10 years, in order to accommodate this transition of technology. To this end the STANSA SC71H committee was formed in 2003 to develop an ITS standard for South Africa to ensure that all components of an ITS system (including Smart Cards) can be fully integrated and that different systems are interoperable. For example there is an electronic ticketing standard that defines the interface between the Smart Cards and terminals.

5. CONCLUSION

By lagging behind most first world countries in the mass roll-out of smart cards South Africa at least has the opportunity of leapfrogging old technology and learning from the mistakes of others – particularly in the clearing house operation and the implementation of standards to ensure interoperability for different applications.

In essence, smart cards are already being used in a number of completely unrelated applications throughout South Africa (such as casinos and cell phones) but will only be truly successful when everyone has a single smart card in their pocket, loaded with a number of different applications. Smart Cards are becoming cheaper (will soon be less than US$1) and are freely available with a 64K capacity with much larger chips available (up to 64MB) in the near future. This memory capacity provides the foundation for multi-application schemes to be stored on a single smart card, so eventually it could be used to pay for a host of goods and services including groceries, online purchases, phone bills, road tolls, parking and entertainment tickets. Intermodal transport prepayment cards

are well placed to become generally useful electronic purses so, with a population of over 43 million that is predominantly dependant on public transport, electronic ticketing systems could provide the card volumes needed to make these multi-application schemes cost effective.

Preparations for the 2010 Soccer World Cup will focus on improving the efficiency of the country's public transport system which in turn could provide the catalyst for the large scale deployment of smart cards. The time has come for the decision to be made:

"Can we afford Smart Cards or can we afford to be without them?"