

GAUTRAIN MANAGEMENT AGENCY



GMA CASE STUDY - AUTOMATIC FARE COLLECTION

AUTOMATIC FARE COLLECTION FOR THE GAUTRAIN

The case study sets out the requirements and developments of the AFC system from the time the AFC supplier was appointed, to the completion of the AFC system, in June 2012, for Phases 1 and 2 of the Gautrain system. The challenges experienced in implementing the system are highlighted and recommendations are made for implementing an AFC system in any large transport infrastructure project and for adapting the system in line with technological advances and future expansions of Gautrain.

HIGHLIGHTS

THE CHALLENGE

The collection of income from passengers on the Gautrain has depended on implementing an effective automatic fare collection (AFC) system. The AFC system forms the interface between the Gautrain rapid rail service and its users and is the means through which revenue is collected from passengers. Fare adjustments are implemented as part of the AFC system and are used as a form of demand management as well as to implement overall fare increases.

THE OUTCOME

The AFC system was developed and installed according to pre-determined specifications and has been functioning successfully since 2010. The system complied with all the requirements as set out in Schedule 1 Part 1 and Schedule 1 Part 2 of the Concession Agreement (CA) and additional user-friendly features were introduced over time. The success of the AFC system was largely the result of the close co-operation between the Gauteng Provincial Government (GPG) and the Concessionaire in its roll-out.



1. HOW IT ALL STARTED

The Gautrain Project was announced as a Blue IQ project in 2000 and officially approved by the Gauteng Provincial Government (GPG) in 2001.

As a Blue IQ project, the primary aim of the Gautrain Project was to stimulate economic growth in Gauteng through enhancing infrastructure development and creating employment. The further aim was to alleviate

the traffic congestion on roads between Johannesburg and Tshwane by promoting public transport as an alternative to private vehicle usage.

The Gautrain Project is a public private partnership (PPP) between the Gauteng Provincial Government (GPG) as the public partner and the Concessionaire (Bombela

and its subsidiaries) as the private partner. The relationship between the partners and the rights and duties of each partner are governed by the terms and conditions contained in the Concession Agreement (CA) between the partners.

A highly efficient, as well as user-friendly, automatic fare collection (AFC) system had to be developed in order to promote Gautrain as a viable alternative to private modes of transport.

The case study sets out the development and requirements of the AFC system from the time the AFC specification was developed, to the completion of the AFC system, in June 2010, for Phases 1 and 2 of the Gautrain system. Thales Group, as an AFC supplier, was appointed during the first half of 2007. The challenges experienced in implementing the system are highlighted and recommendations are made for implementing an AFC system in any large transport infrastructure project and for adapting the system in line with technological advances and future expansions of Gautrain.

2. FACING THE CHALLENGE

The money spent and all the effort that went into making the Gautrain Project a reality, from the first feasibility studies and plans to the completion of the rail, the stations, the parking areas, the buses and the trains, would have been of little value, if a successful automatic fare collection (AFC) system had not been developed to put Gautrain into revenue generating service. The AFC system forms the interface between the Gautrain service and its users and is the means through which revenue is collected from the operation of Gautrain.

Fare adjustments, as a function of the AFC system, are used as a form of demand management as well as to implement annual fare increases.

“The AFC system forms the interface between the Gautrain rapid rail service and its users and is the means through which revenue is collected from the operation of Gautrain.”



Whereas numerous stakeholders were involved in all the aspects of Gautrain, only a few stakeholders were directly involved in the AFC system:

- The Gauteng Provincial Government (GPG) as the owner of the Project and the public partner in the PPP Project;
- The Department of Transport (DoT);
- The Concessionaire, the Bombela Consortium and its subsidiaries, from mid-2005, as the preferred bidder and then as the private partner in the PPP;
- The Gautrain Management Agency (GMA) appointed as a statutory agency in 2006 to manage the Gautrain Project from the beginning of the operational phase onwards;
- Thales Group, the AFC Supplier; and
- Current and potential passengers.

Several factors had to be considered and steps implemented to create an efficient AFC system for Gautrain. These are listed below and discussed in the next section:

- Scope of the Project;
- Responsibility for AFC within the PPP setup;



- Essential requirements for a rapid rail AFC system;
- Stringent testing procedures;
- Safety and security requirements;
- User-friendly requirements;
- Revenue management and fare optimisation; and
- Technological evolution – and migration to ticketing compliant with EMV standards.

3. GRAPPLING WITH THE ISSUES

Scope of the Project

There are currently two main lines on the Gautrain system: a North-South line from Hatfield to Park Station, and an East-West line from O.R. Tambo International Airport to Sandton Station (via Marlboro).

The system was commissioned in two phases, 1 and 2. Phase 1 includes stations at Sandton, Marlboro, Rhodesfield and O.R. Tambo International Airport. Phase 1 was operational by June 2010. In Phase 2 the system was extended from Sandton to Rosebank and Park Station – in Johannesburg – and from Midrand to Centurion, Pretoria and Hatfield. Phase 2 became operational in June 2012.

Phases 1 and 2 comprise 10 stations in total. This means that the AFC installations had to be implemented on 10 sites. The AFC system furthermore had to integrate ticketing procedures for the trains, buses and parking facilities. There were a total of 9 car parks (O.R. Tambo does not have a Gautrain car park) and 125 buses for Phases 1 and 2.

Responsibility for AFC within the PPP setup

In accordance with the specifications in Schedule 1 Part 1 and Part 2 of the CA, it was

the duty of the Concessionaire to supply an AFC system that complied with the requirements as set out in the specifications.

Thales, a reputable international supplier of AFC systems, as well as many other diverse electronic systems, was appointed to design, install and commission the Gautrain AFC system through an intermediary. The GPG fulfilled an oversight and assurance role through its agency, the Gautrain Management Agency (GMA).

Essential requirements for a rapid rail AFC system

The requirements for the Gautrain AFC system, as set out in Schedule 1 Part 1 of the CA, can be summed up as follows:

- The fare collection system: The system had to cater for regular commuters, as well as occasional users, and had to make provision for both the airport passenger service and the general passenger service. The system had to ensure integration of the rail service, the dedicated feeder, bus services and the parking services. The system had to comply with international standards and had to be electronically based and auditable. This meant that the system had to be linked to a management information system (MIS) that would provide information on ticket sales and actual passenger trips.
- The access control system: The system had to operate in a closed environment, where access to and exit from any of the services would be gained by means of a valid ticket. The facilities had to be aesthetically pleasing and merge well with the facilities where they were installed, without compromising their functional performance.
- Automatic fare collection: Prior to the development of Gautrain, fare collection for modes of public transport was largely paper based or media based. Contactless Smartcards (CSC) (for payment purposes) were prescribed for the Gautrain system. The

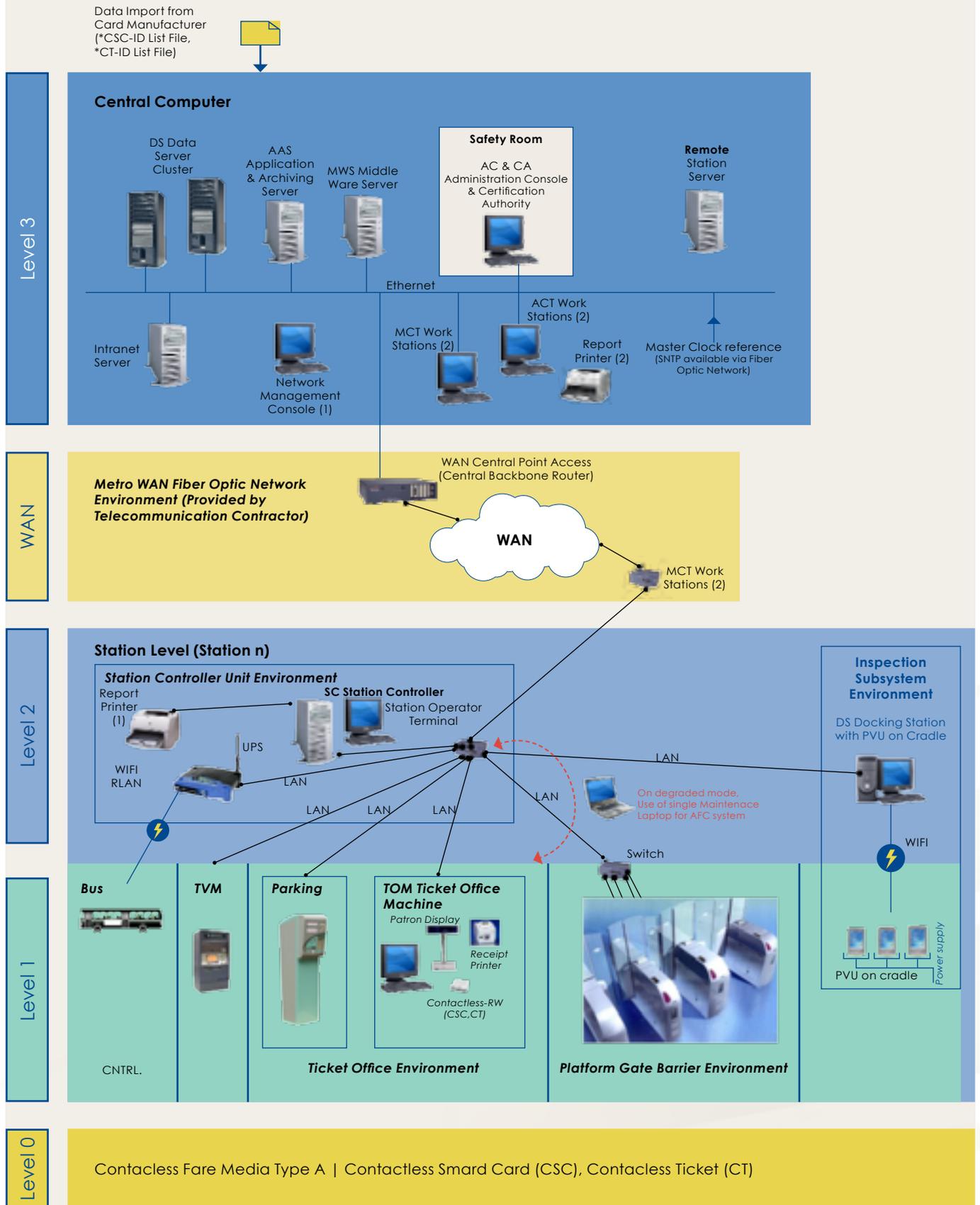
cards had to comply with all the relevant ISO standards, namely ISO 14443 A and B, ISO 10373 and ISO 7816. The cards are subject to the relevant policies of the South African banks and the South African Reserve Bank (SARB). The cards developed for Gautrain had an electronic purse (e-purse) application, in that value could be loaded onto the cards as needed and the cards could be re-used over and over again to pay for Gautrain services. The e-purse facility had to be CEPS (Common Electronic Purse Standard) compatible.

- Ticket issuing, vending and verification: Machines had to be installed for the automatic vending and sale of tickets at outlets, including outlets at the rail stations and offsite. The ticket-vending machines had to accept credit and debit cards, as well as cash. The number of ticket-vending machines installed at a station had to satisfy international standards for queuing. The ticket-issuing system also needed to be auditable.

The key feature of the system implemented for Gautrain is the use of a 100% contactless fare media operation. This was done through the introduction of the Gautrain Gold Card and contactless access gates.



AFC Automatic Fare Collection System



Stringent testing procedures

In fulfilling its assurance role of the AFC system, the GMA implemented stringent testing and quality control procedures in co-operation with the Concessionaire. All electrical and mechanical systems were subjected to various rigorously defined testing phases. Pre-installation testing was done through prototype reviews of the AFC system. The contractor, Thales, built a platform prototype for this purpose that contained the essential physical and functional facilities of the AFC system.

Post-installation testing consisted of three components: SAT's (site acceptance tests), PICO's (post-installation checkouts) and SIT's (site integration tests). Testing was completed at the end of March 2010. The whole system was fully tested with the System Performance and Verifications Tests (SPVT) prior to operational commencement.

Safety and security requirements

A high level of security and a low level of criminality were key success factors in obtaining and retaining a sustainable revenue stream for the Gautrain. Control of fare evasion formed an important portion of the overall safety and security measures implemented as part of the Gautrain AFC system. Research undertaken by the GPG indicated that there was a direct relationship between the level of fare evasion and the level of criminal incidents in a public transport system. It was found that criminals intending to rob someone were not inclined to pay public transport fares and that a general atmosphere of lawlessness and lack of law enforcement are linked to fare evasion.

As a result, the GMA required that the Concessionaire implement stringent anti-fare-evasion measures. For instance, the access gates had to be of sufficient height so as to prevent persons from jumping over. The electronic mechanism of the access gates also had to prevent tailgating and passing back of cards over the access gates.

Commuters are moreover provided with a facility for registering their Gautrain Gold Cards at a ticket office, which will enable the blacklisting of a card should it be lost or stolen. They will then be able to transfer an unused value on such a card to a new card.

User-friendly requirements

In addition to the essential AFC requirements as contained in Schedule 1 Part 1 and Part 2 of the CA, the GMA and the Concessionaire implemented specific user-friendly features for commuters.

A physical ticket vending kiosk, called the Ticket Office Machine (TOM), staffed by Gautrain employees, was introduced at all ten stations to assist people who experience difficulties in using the ticket vending machines (TVMs), or are reluctant to make use of these as a result of inexperience in electronic vending functions or preference to interact with a human being.

The Gautrain fare policy was designed to attract maximum commuter usage. Fares are lower than the cost of using a private car for the same journey. Reduced rates were introduced for commuters who combine a bus trip or parking



usage with a train journey. Special weekly and monthly packages were made available for regular users at a discount.

In keeping with the main languages used in Gauteng, the vending machines were designed to allow a choice of English, Afrikaans, isiZulu and Sesotho.

Revenue management and fare optimisation

The GMA's assurance role includes revenue management. Revenue management incorporates annual fare adjustments, accounting for the revenue collected by the Concessionaire and ensuring that the Concessionaire implements income protection through the fare evasion management plan.

Fare adjustments are a sensitive and challenging issue since care should be taken to balance optimisation of commuter numbers and revenue levels. The GMA worked out a strategy of using fare adjustments to influence the behaviour of commuters in line with capacity. For example, in the 2014/15 financial year, the Gautrain bus fares were not increased, so as to stimulate demand for under-utilised bus transport, while the daily parking fare was increased substantially to alleviate parking capacity challenges.



Technological evolution – EMV ticketing

The ticketing system for the Gautrain Project is about to be upgraded in accordance with international EMV level 2 standards. EMV is a technical standard for smart payment cards and signifies Europay, MasterCard and Visa, the three companies that created the standard.

In July 2015, Gauteng MEC for Roads and Transport, Dr Ismail Vadi, announced the future implementation of the new EMV ticketing system for Gautrain. This means that instead of using the Gautrain Gold Card, commuters will be able to use a bank-issued credit or debit card equipped with an imbedded contactless smart card facility with a transport usage interface. In terms of the policy of the Department of Transport (DoT), these smart payment cards will eventually be used for all public transport in South Africa, not only for the Gautrain system. The new system will enhance interoperability and regulatory compliance and will result in a more integrated public transport system. Once the system is up and running, public transport users will be able to use one smartcard to access different modes of public transport.

The EMV system will be rolled out in phases from 2017. Testing of the system will be done after hours to avoid disruptions to the ticketing service. A pilot phase will be implemented on the east/west link between O.R. Tambo International Airport and Sandton. This will be followed by the implementation of the full system.

The EMV system will also allow for use of preloaded EMV cards on BRT systems such as the ReaVaya, a move from the current card-centric system to a back office system functional approach. Currently the cards of commuters who evade the fare or tailgate through the system are blocked. This penalty will also be applied to all EMV cards inclusive of credit and debit cards. Commuters will be denied access until the outstanding debt for tailgating is settled in full.

4. WHAT WE LEARNT

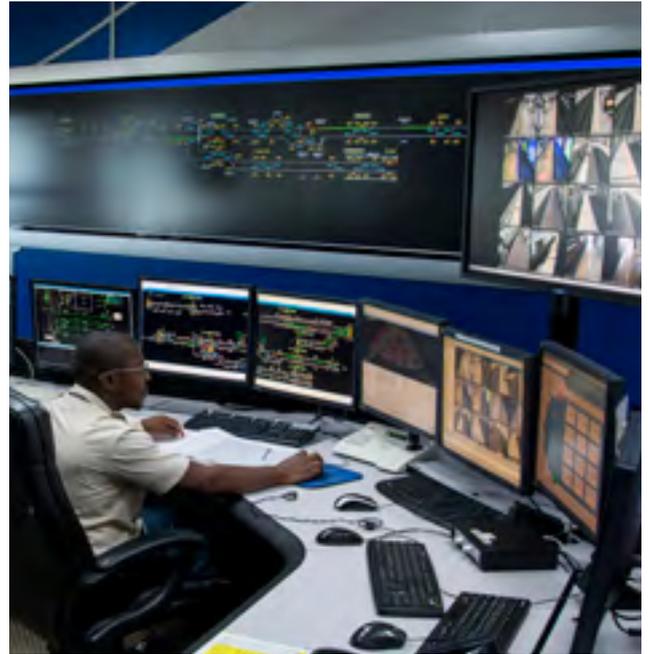
What worked well?

Besides a few minor hiccups as discussed below, the AFC system was developed and installed according to specification and has been functioning successfully. The system has complied with all the requirements as set out in Schedule 1 Part 1 and Schedule 1 Part 2 of the CA, and additional user-friendly features were introduced. The success of the AFC system was largely due to the close co-operation between the GPG and the Concessionaire in the areas of stringent system testing as well as safety and security.

Effective fare evasion management, in particular, has ensured low levels of fare evasion, i.e. below 1%. Ridership was increased, since commuters could rely on the efficiency and safety of the AFC system. Commuters moreover benefitted from the revenue management and fare optimisation strategy aimed at keeping fares affordable. Discounts for off-peak commuters and higher charges for peak-hour commuters and parking facilities acted as a lever for influencing commuter behaviour and alleviating capacity challenges. Fare reductions on buses were introduced to increase the off-peak use of bus services.

Extensive work has gone into the preparation of Business Rules for determining the conditions of use and payment for services inside the Gautrain system. These rules set the base for discounting fares under conditions where the train service is used in conjunction with bus or parking services. The rules also make it possible to manage total time in the system to prevent passengers from riding on trains all day long while paying for one trip only. They furthermore prevent passengers from entering and exiting at the same station as part of one trip. Another benefit of the Business Rules is that they ensure passengers are well behaved in the system as the rules guide passenger behaviour.

The risk associated with the implementation of the AFC system was low, as all the technologies



had an international footprint in that they were internationally service-proven and were in use on other rail systems worldwide.

The contactless ticketing system, moreover, has the advantage of low maintenance costs, since fare gates and bus readers require no mechanical ticket handling systems or intensive maintenance of magnetic head type ticket reading units.

The EMV ticketing system to be introduced in the near future is expected to further enhance commuter experience and to improve access to the system. Commuters will be able to top up their cards online, thereby enabling them to save time, especially when using the Gautrain from and to the O.R. Tambo International Airport.

The contract for upgrading the system has been awarded to Thales Group, the same contractor that supplied the current AFC system. This will ensure continuity and will help to overcome typical challenges encountered in implementing a new system. One of the challenges is to accommodate commuters who do not have credit or debit cards. The solution is to retain the use of the current Gold Card alongside the new smart cards for the foreseeable future.

What did not work well?

Although the partnership approach worked well in the provision of the AFC system, the communication channels would have been more direct if the AFC supplier (Thales) had been contracted directly by the Concessionaire instead of through another contractor appointed by the Concessionaire. As a result the AFC contract was concluded between the Concessionaire and a middleman instead of directly with the supplier.

The stringent testing procedures ensured a seamless implementation of the AFC system. Unfortunately, the supplier did not have to hand over the testing platform to the GMA. Retaining the testing platform would have been useful in making changes to the system and developing



new products, as is required at present with the introduction of the new EMV ticketing system.

Fare adjustments are only to some extent successful in passenger demand management.

A minor problem that deserves attention is that the introduction of the Gold Card ticketing system did not cater for first-time users who did not yet have a Gold Card. This affected first-time commuters travelling by train and wanting to make use of the bus service and/or the parking facilities as well. The only way in which this problem could be solved was to apply the more expensive option of first-time users obtaining a paper-based ticket for parking facilities and to pay when exiting. The offsite ticket sales to cater for first-time bus travellers did not work, as they were limited in number.

Another issue that did not work satisfactorily is the change given by the automatic vending machine (TVM). When buying a ticket from the TVM with banknotes, the TVM gives change in coins, which naturally creates a burden for the passenger. The specification did not require the TVM to give change in notes where practicable.

The Gautrain AFC system caters for frequent users with the purchase of monthly or weekly packages, which are priced at a discount. In hindsight the system could have been programmed to offer frequent-user discount by monitoring the frequency of usage of the system over a period of time. Discounts could then be offered automatically when usage frequency goes above preset limits.

The imminent change-over from the current ticketing system to the new comprehensive public-transport-integrated EMV system, while presenting many advantages, poses challenges in that the current closed AFC system has to be changed to an open system. An added problem is that the EMV system will necessitate involvement on the part of the banks, which means that associated banking costs will be incurred.

5. MOVING FORWARD

Any large transport infrastructure project would be advised to implement an AFC system in such a way that it could accommodate future changes and upgrades. Gautrain's current AFC system was implemented as a closed system, which will now have to be changed to an open system with the introduction of the new EMV ticketing system. It is important for the business rules to be clearly defined upfront for the EMV system.

The expansions planned for the Gautrain Project should implement the new EMV ticketing system to obviate the need for changing over to a new system.

As there is no widespread use of smart cards in South Africa's transit systems, the widespread distribution and use of smart cards and tickets on the Gautrain will likely create an interest in other agencies for participation in the Gautrain contactless smart card scheme and it will, in effect, become a de facto regional standard.

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