

# THE FUTURE OF AUTOMATED FARE COLLECTION SYSTEMS: A PERSPECTIVE FROM THE eTHEKWINI MUNICIPALITY

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## ABSTRACT

In 2009, the National Department of Transport (NDoT) legislated, as per the National Land Transport Act (NLTA), 2009 (Act No.5 of 2009), that fare payments must be made through any bank-issued fare payment system and be interoperable through all participating banks. Commuters with participating bank accounts should be able to use bank cards and commuters without bank accounts should be able to use prepaid cards. NDoT defined an Automated Fare Collection (AFC) data structure that must be loaded onto all the Smart Cards and stipulated that the Europay, Mastercard, Visa (EMV) card is the standard of card technology that must be used to enable the hosting of the NDoT data structure.

The eThekweni Municipality (herein after referred to as “the City”) went out to tender in 2010 for an AFC system that was compliant with the requirements of the Act and the system was successfully implemented in 2012 and is still in use today.

The system did not meet all the objectives that it was originally intended to. There were aspects of the system that worked well but there were also several challenges that were experienced. One of the major issues with the system was related to the inoperability of the banks with the EMV/NDoT pre-paid cards. This issue only surfaced once the City had already implemented the first compliant system and was in the process of implementing a new system. The technical constraints were identified with NDoT and the participating banks at the time, but there was a lack of capacity by the banks to co-operate to resolve the issue. In addition the system was costly and complex to manage requiring cumbersome reconciliation processes and technical constraints imposed by the restriction to utilise the EMV/NDoT compliant card.

The lessons learned from the AFC implementations conducted by the City to-date has informed the City’s procurement approach for future AFC systems. Research has been conducted through various literature and discussion with colleagues in the sector to establish the latest trends globally for AFC systems, exploring changes that have been made to the technology and implementation approach that is being adopted to cater for the future needs of Public Transport in the City. The findings show that the future of AFC’s should first and foremost take into consideration the needs of the commuters by providing convenience, ease of use and cater for seamless travel between multiple modes of

transport. Consideration also needs to be given to the overall operating costs for the City and sustainability in terms of the ratio of AFC system implementation costs to fare revenue.

The NDoT is in the process of legislating the South African National Roads Agency's (SANRAL) Account Based Ticketing (ABT) system as the AFC solution to be adopted for all Public Transport in the South Africa (herein after referred to as "the country"). The City has engaged with other Cities regarding the benefits, pitfalls and views on the recommended approach with regards to AFC systems for use in Public Transport across the Country. Considering global trends, current limitations, and unique challenges within the context of the country, the collective view is that AFC systems should not be restricted to a "one-size-fits-all" approach and the objectives of customer centricity and minimising operating costs are paramount.

## **1. INTRODUCTION**

eThekweni Transport Authority is responsible for the procurement, maintenance, and management of Public Transport Services in the City of Durban. The information and data related to all fare collection transactions and commuter statistics that occur from the various operations are managed by (AFC) systems.

The current AFC System was implemented in 2012, in compliance with the NDoT's gazette (Gazette No. 9545, Vol. 552, 17 June 2011). The gazette stated that any automatic fare collection system must be EMV NDoT compliant. The requirements also stated that any fare payment media must be through a prepaid bank issued card that could be reloadable. This required that the successful AFC vendor had to partner with a registered bank within South Africa.

An EMV/NDoT, AFC system was implemented in 2012 by the City through the appointment of Almex Transport Solutions partnering with Standard Bank, via an open procurement process. The system was implemented for the subsidised public transport services managed by the City. The rationale for the new AFC system was to replace the old paper ticket system. The benefits of the AFC were to:

- Improve the fare payment method for commuters.
- Protect and enhance revenue collection.
- Improved planning / management information.
- Enable the City to move to an integrated multi-operator and multi-mode environment, enabling seamless transport for the commuter.

The key functionality of the AFC system implemented in 2012 catered for:

- Receipt of cash on the bus for cash paying commuters.
- Receipt of cash at the kiosks for loading the monetary value onto the pre-paid Smartcards.
- The use of prepaid Smartcards on the bus.
- Reconciliation and management of information on all transactions that take place on the system.

The intention of the EMV/NDoT compliant card was to enable various modes of transport such as buses, trains and Minibus Taxi's, to have one payment system whereby commuters could use one Smartcard across all modes. The EMV card contains an

e-wallet, which commuters can load funds into, also known as stored value. Using the stored value portion on the card would enable commuters to use the card across any mode of transport that accepts the NDoT/EMV compliant cards. NDoT did advise the ETA before the implementation that the best way to optimise the EMV/NDoT card would be to have a flat fare structure across all modes and use the stored value space on the card for all transactions. The stored value portion would enable interoperability across the various modes of transport and, as a bank issued card, all clearing and settling to various operators would be done by the incumbent bank.

The EMV/NDoT card also has space on the NDoT data structure for operator specific transit products. Unfortunately, the City was not able to make use of the stored value portion and has not been able to enjoy the full benefit of the EMV/NDoT solution. The reason for this is the nature of the fare structure which requires the transit product space on the card where fees are paid up front not on usage. There is currently no intention to change the fare structure for this service. This issue will also impact on the ability to use the SANRAL ABT solution. There has also been no uptake of the EMV/NDoT compliant system by any of the other private public transport operators in the City, resulting in lack of interoperability across the various modes of transport in the City.

The NDoT/EMV compliant system implemented for Public Transport services in the City has not achieved the full benefit of its original intention. The key challenges and lessons learned are covered in the section below. The City has also conducted research on future trends and proposed a way forward for the implementation of an AFC system that will meet the City's short to medium term requirements in terms of cost savings, ease of use and commuter convenience.

## **2. LESSONS LEARNED AND CHALLENGES WITH AFC IN OPERATION**

The Smartcard in operation is co-owned by the incumbent AFC vendor (Almex) and the issuing Bank (Standard bank) and this has presented the following limitations:

- The Standard Bank issued EMV Card is the only fare payment media that can be used on the City's Public Transport service, the only other option is cash.
- The AFC tender for the Go!Durban BRT system was awarded in 2016. The Xuma Consortium (JV between Kubapay and XTelekom) partnered with ABSA bank. Although the system was also EMV/NDoT compliant and certified by NDoT it was only discovered after awarding the tender that interoperability between the two banks was not possible with regards to the transit product frame of the card. The transit product frame is required for the City due to the nature of the fare structure that is currently in use. The reason for the lack of interoperability is because the issuing banks did not have the technology in place to facilitate the loading of fares on to each other cards on the transit frame or the acquiring process at the time of usage of the card on board the bus. This resulted in the City having to implement two disparate systems in place that are not interoperable. This constraint was addressed with NDoT at the time.
- AFC systems are currently vendor based, which means that only a single vendor can exist in the environment. There cannot therefore be multiple vendors co-existing. Currently the AFC vendors supply "Closed Loop" systems. This is not a sustainable solution. The preferred option is to have a vendor agnostic solution across various modes of transport enabling different devices and back offices to co-exist by applying an integration layer in the back-office for consolidating management information.

- The EMV NDoT compliant requirement has resulted in the city having to incur costs for bank transaction fees as well as high costs for procuring cards. Given that only the transit space on the EMV/NDoT cards in circulation is being utilised, there is no benefit to the Municipality for this technology, which requires a process whereby the bank needs to authorise the loading of transit products via a bank approved card machine.
- The bank issued cards lifespan is 3-5 years forcing the City to procure new cards once the card expires. This is not only an issue in terms of the costs to replace the cards but also an inconvenience to commuters and requires marketing and communication campaigns to inform commuters of the process to deal with expired cards.
- The reconciliation process between the bank and the AFC system is complex requiring additional administration support to closely manage to ensure the protection of revenue.
- Enhancements and upgrade costs are excessive. These enhancements and upgrades do not achieve the cost versus benefit objective, yet cities are forced to be locked into one vendor due to the NDoT regulation, thereby limiting flexibility.
- Suppliers of AFC systems are, in some cases, reluctant to transfer any skills to the Municipality's staff as these are closed systems enabling vendors to charge exorbitant costs for upgrades and maintenance.
- There have also been a number of technological advancements, since the EMV/NDoT compliant AFC was implemented in 2012 and the AFC for Go!Durban was procured, that provide more convenience to commuters and can also contribute towards major cost savings for the City by reducing revenue collection costs.

### **3. CHANGES THAT THE MUNICIPALITY HAS IMPLEMENTED TO CURRENT AFC SYSTEMS**

The Municipality has implemented the following changes to address the challenges and lessons learned as described in Section 2.

- The Municipality conducted a cost benefit assessment in 2018 and applied for an exemption from NDoT to use their own AFC card that was not EMV/NDoT Compliant. This exemption was granted for the BRT service (Go!Durban), and the Municipality upgraded the AFC procured for Go!Durban to accept MIFARE DESFire EV2 technology. This technology enables up to four different vendors to have their own application on the card. This allows one card to be used across four different vendors, who are all MIFARE compliant enabling the AFC to be interoperable. The new version of the MIFARE DESFIRE card, EV3, can handle up to eight vendors, which enables the initial objective of AFC systems to be multi operator and multi modal. The AFC for the BRT has been implemented, tested and is ready to go-live once the BRT system is operating.
- The ability to share one prepaid card across different operators and modes of transport provides a cost saving to the Municipality, ease of data integration across disparate systems.

- The MIFARE DESFire solution has not been implemented on the AFC system that is currently operational within the City. This system is due for replacement as it has reached the end of its useful life, having been implemented in 2012. The estimated lifespan of an AFC is approximately 10 years. The City is currently in the process of going out to tender for a new AFC for the existing operation. The tender specification has made provision for the requirements of a fully integrated, multi-operator, multi-modal system taking into consideration global trends, overall affordability and sustainability for the City and the convenience to the commuter.

#### **4. SUMMARY OF THE CURRENT LANDSCAPE AND VIEWS ON THE FUTURE OF AFC**

The current landscape in the Municipality is that there are two closed loop systems implemented that are not interoperable and a third AFC in the procurement phase with the intention of enabling interoperability via an integration layer enabling the consolidation of data across disparate systems.

There are currently around 45 000 single users daily that make use of the current AFC systems in operation. Currently the split between cash paying commuters and users of the AFC is fifty/fifty. The system records and produces approximately 16 million payment transactions a year with an income of approximately R 200 million per year. This information has been extracted from the current Almex ticketing system's transaction reports.

NDoT are aware of the limitations of the current NDoT EMV regulations, and they are now in the process of promulgating the regulations which will require subsidised operators to adopt the SANRAL ABT system. This system is based on open standards and can function on any vendors AFC. The difference between an ABT system versus the current prepaid AFC Smartcards is that with an ABT, the funds are held in an account which is cloud based where funds are only deducted from the account once a transaction has been processed. The prepaid card loads the funds directly onto the card at the time of loading and is deducted when the card is used. Whilst the movement towards ABT's is a global trend that is being adopted globally and has several benefits to commuters, the Municipality has expressed the following concerns that relate to the SANRAL ABT in particular:

- The change to SANRAL ABT will require updates to the existing AFC systems, which the City will have to fund.
- The benefit of moving to an ABT solution is primarily to provide a wider footprint for commuters to obtain and top-up their cards (in the case of pre-paid cards), thus reducing operating costs for revenue collection services for the City and private operators. For the banked commuters, once the card has been purchased, top-ups can be made directly from their bank accounts to the cards, thereby improving on commuter convenience. Whilst there are great benefits to the commuters and Public Transport Operators with this payment method, a business case to confirm costs versus benefits has not been conducted. To prepare a business case information such as the transaction costs that SANRAL will levy and the footprint that SANRAL will provide for the loading of the cards. This information has not as yet been made available. Whilst there are a number of benefits to both the City and the commuters to use the SANRAL ABT solution, it should not be regulated as the only option for AFC system implementations in the Country. In addition, the solution does not cater

for the operator-specific fare structures at this stage. There are also other ABT solutions in the market that can be implemented, and Cities should be given the option to go out to the market to identify the most cost effective solution.

- The limitations of the SANRAL ABT in terms of accommodating operator-specific fare structures, opens the discussion regarding the current complexity of fares structures that are adopted across the country. Whilst there is an opportunity to simplify fare structures, which may contribute to simplifying some aspects of Fare Collection, it is not the only factor that influences the AFC technology and future of AFC systems. There are several factors to be considered, both in the context of global trends and the unique challenges that Cities in South Africa are faced with. According to a study done regarding “Determining Fare Structures: Evidence and Recommendations from a Qualitative Survey among Transport Authorities” referenced in the bibliography, there are, interalia, advantages and disadvantages to the various fare options such as flat fare, distance based and zonal. A comprehensive study would need to be undertaken by the City in order to determine the fare structure that would be the most beneficial to the commuters and the City and to understand the trade-offs that would need to be made. The objective of this paper is to only deal with the current challenges and future plans for AFCs in the short to medium term.
- There is a risk of insufficient funds being available in the commuters ABT account and at the time of usage the system will not check the funds available in the account as this will drastically slow down the transaction time for utilisation and there are instances where the system is offline when transactions are processed. The ABT system therefore introduces the risk of losing money for the first tap of the card into the system and possibly additional taps, depending on when the transaction between the AFC and the ABT is updated.
- For the new AFC tender (that is currently being advertised by the Municipality for the current operations) the following has been specified:
  - The system must be able to accept EMV/NDoT Cards and EMV Debit and Credit Cards.
  - They system must accommodate the MIFARE DESFire EV3 Technology for prepaid Cards.
  - The system must be SANRAL ABT compliant and accept the card for usage in the system since the intention is for NDoT to change the regulations accordingly.
  - The system must allow for integration with other AFC systems and third parties.

Whilst the SANRAL ABT system will introduce benefits to cities and commuters, the primary objective of AFC systems should be to focus on the needs of the commuter by offering them fare payment options that provide flexibility and convenience.

Based on study tours, conferences that the delegates from the City have attended, as well as research into thought leadership on the future of AFC, the focus has moved from vendor-centric systems to customer centric systems. The Municipality therefore views the future of AFC to have the following features:

- The payment methodology should change to an open payment platform, which accepts any form of near field communication for payment such as EMV Debit and Credit Card, Mobile payments and Mobile top ups for prepaid cards, Smartcards such as MIFARE or CIPURSE, mobile payment methods such as Samsung pay, etc.

- Hardware and software of AFC systems should be designed and certified to enable multiple payment methods.
- The platform should provide the commuters with a customer centric solution that is more convenient, taking the various needs of the commuters into consideration, which will enable the commuter to use their payment method of choice whilst still taking the needs of the unbanked sector into consideration. The integration of various payment methods can be achieved by enabling integration between disparate AFC systems.
- There is an opportunity for various Transport Authorities in the country to collaborate to share challenges, lessons learned and plans that would allow Cities to benefit from economies of scale, more cost-effective AFC solutions that are easier to implement, upgrade, maintain and are more sustainable.

## 5. FUTURE AFC TRENDS

Based on the research conducted, the following is trending in the AFC industry:

- The introduction of Smartcards to replace the antiquated paper tickets. This has already been implemented for many of subsidised Public Transport operations in the country. Cash based system using paper tickets have proven to be open to fare evasion and abuse. In addition, the procurement of tickets or loading of cash does open the door for theft both by operators of the system and crime syndicates. Due to the demographic that utilises public transport in the City, it is not possible to implement a cashless system at this stage as a percentage of the commuter base is unbanked. The City is looking to move to a cashless AFC environment in the future.
- The introduction of mobile ticketing enables commuters to make use of their Smart devices to purchase “e-tickets” which can be validated on the AFC hardware via apps such as Google pay, Samsung pay etc. Mobile ticketing also enables functionality that offers the ability to load fares on a Smartcard via a mobile app. These methods provide a convenient fare payment method for commuters with detailed information of their transactions.
- The movement towards Providing an ABT solution as a fare payment option for commuters.
- EMV Contactless cards (Credit/Debit) are being accepted in various countries globally as well as the Gautrain. Whilst there are some challenges related to this method, such as first tap risk where available funds cannot be validated immediately, this can be negotiated between the banks and Municipalities.
- In an article titled “Automated Fare Collection System its Present and Future” by KBV Research, there is a movement globally toward dynamic Quick Response (QR) and Optical Character Recognition Codes for public transport. This is an area that the AFC team in the City will explore further to assess cost effectiveness for the City, ease of deployment and customer convenience.

- According to an article written by Sally Burnett, Forbes Council Member, Loyalty Programmes are being explored globally to increase ridership. As Public Transport services in the country start improving, loyalty programmes can be introduced to encourage the public to utilise Public Transport services as a primary mode of travel.

## **6. CONCLUSION**

The goal of any service that the government delivers to the public should be focussed on the needs of the customer as the primary objective whilst being cost-effective for cities to procure, implement and maintain. The current AFC systems that the City have procured are not future proof and have presented challenges in terms of ease of use and affordability for the City.

Included as part of discussions and reviews of thought leadership on global trends, the City has a view on the concept of operations on AFCs that will be procured and implemented in the short to medium term. Reviews on “The Present & Future of Automated Fare Collection Systems” by Modeshift and “Important experiences and lessons from integrated fare systems” by J Robelo, Worldbank, were taken into consideration.

The Concept of Operations prepared by the City in December 2014 and updated in April 2020, is to implement AFC systems that accept any form of electronic payment with no restrictions, that will contribute towards reduced operating costs and provide improved convenience to the customer. Whilst there are still opportunities to explore other changes within the Public Transport Fare Collection space such as changes to the fare structures and elimination of cash in the system, the Country is still dealing with the dominance of the Mini Bus Taxi Industry as the main mode of transport utilised. Regulation of the industry and the transition to a world class Public Transport system which is safe, convenient, and affordable is the primary focus of Transport Authorities in the Country.

The move towards integrated fare systems addresses the challenge of interoperability and provides the opportunity to create a seamless fare payment experience for commuters and introduce convenience and reduced costs of transportation in the City. The outcome of an integrated AFC and improved management information will enable the City to rationalise transport networks by Public Transport planners, reduce overall operating costs for the City and improve Public Transport services to meet the need of the commuter. The primary objective of public transport should be to meet the needs of commuters and potential commuters by increasing accessibility, availability, affordability, acceptance, and appeal to the public who are currently not using public transport.

During the past ten years since AFC systems were first implemented, there has been a significant change to the ways in which people interact with technology. Research indicates that the next big thing in fare collection will be the development of safer and easier-to-use technologies that make the whole process of purchasing tickets, boarding and validation even quicker. This will provide relevant and up to date management information and improve the overall experience for the commuters.

As cities battle with climate change and an increase in population, improved public transport services and the technology that supports this will become increasingly important. According to an article titled “A Climate Ticket to Promote Sustainable Mobility”, mobility has an indispensable role in society and the economy. “An efficient and accessible transport system is essential for the quality of life of citizens and for planetary health”.



Encouraging the public to choose public transport as the primary mode of transport will reduce the number of cars on the road and the overall CO<sub>2</sub> emissions.

Reliable management information and flexible payment solutions have the potential to attract investment and support from the private sector. There is a large sector of the labour force in the Country who rely on public transport as their only mode of travel. The current state of public transport in the country is that it is unreliable, unsafe and costly. This results in employees often arriving late for work or not able to get to work at times. The private sector has a vested interest in ensuring their employees have access to reliable and safe public transport with seamless movement between the various modes to minimise absenteeism and reduced working hours which has a direct impact on the profitability and efficiency of organisations.

Moving towards open standards, various fare payment options, vendor agnostic and integrated AFC systems will contribute towards improving public transport within the country. There is a lot of work to be done in the country to achieve this and there are several limitations and challenges that impact on the speed at which this can be achieved. The challenges in implementing a “one size fits all” approach will be addressed by opening up AFC systems to flexibility and innovative solutions by the industry to reduce costs for the Cities and make Public Transport more accessible and attractive for the public.

There is an opportunity for National Government to facilitate a process that encourages collaboration between cities, provides learnings from global trends and opens up dialogue to jointly explore innovative solutions that National Government can support and fund. The AFC systems of the future should be affordable and improve the public transport experience for the public that it serves.

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