



**CONCEPT OF OPERATIONS
FOR MTA NEW FARE PAYMENT SYSTEM: BUS AND SUBWAY DEPLOYMENT PHASE**

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1 PURPOSE OF DOCUMENT

This document defines the concept for the Metropolitan Transportation Authority (MTA¹) New Fare Payment System (NFPS) that will be based on open payment industry standards and implemented for all MTA bus and subway services. New York City Transit (NYCT), MTA Bus, Long Island Bus (LI Bus) and the Staten Island Railway (SIR) currently operate the MTA bus and subway services. In the future, NFPS must support Metro-North Railroad (MNR), Long Island Rail Road (LIRR), and MTA Bridges and Tunnels (B&T). The NFPS may also support MTA paratransit services.

Other agencies in the New York region may also implement fare payment systems based on open payment industry standards. NFPS does not assume the existence of interagency fares, revenue sharing agreements or a shared server infrastructure outside of the MTA.

This document does not cover the implementation of NFPS for MNR, LIRR, B&T or other agencies; these services will be covered in future documents.

This document provides the MTA, its agencies, and potential vendors with:

- A definition of the selected approach for the new fare payment system,
- A description of the system's technical, business, and functional objectives and the fare payment transaction processes that it needs to support, and
- A summary of the expected operations of the new system on MTA subways and buses.

This is a concept of operations document; it is a key step in developing a requirements document. It defines neither the requirements nor design of the NFPS, nor does it define all of the potential ways a customer may interface with the system, all of which will be covered in future documents.

This document is based on the MTA's strategic objective to develop an open-standards-based, MTA-regional payment system. Core aspects of this document were developed through a series of stakeholder workshops involving representatives from all MTA operating agencies and detailed input received from NYCT, MTA Bus, and SIR.

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¹ The MTA is comprised of MTA Headquarters and the following operating agencies: MTA NYCT (which includes its subsidiary, the Manhattan and Bronx Surface Transit Operating Authority), MTA LIRR, MTA MNR, MTA Bridges and Tunnels, MTA Capital Construction, MTA Bus and MTA Staten Island Railway. MTA Long Island Bus will cease being part of the MTA as of 12/31/2011.

2 SCOPE OF PROJECT

The NFPS project will design, develop and implement a new fare payment system that enables the MTA to accept contactless payment cards (and other contactless form factors) and payment-enabled near field communication (NFC) phones for fare payment directly at subway and bus points of entry. (These devices will hereafter be called contactless payment (CP) devices.) The NFPS project will also enable customers to purchase fare products and obtain and manage stored account information through various channels.

The CP devices must meet ISO/IEC 14443 contactless card and payment industry standards; the NFC phones must meet ISO/IEC 18092 NFC and mobile phone payment standards. The payment industry standards will be those customarily used by acquiring banks, issuing banks and payment networks. See Appendix 2 for a list of currently identified relevant standards; this list may not be complete and will continue to evolve.

The system will be developed and implemented based on commercial, off-the-shelf (COTS) technology and existing processes and infrastructure to the greatest extent possible, utilizing payment industry services for retail merchants who accept CP devices. The NFPS requirements will be written to also include capability to process transactions from new payment schemes that use the basic communications protocols in ISO/IEC 14443 and ISO 18092 and that may offer MTA and its customers' advantages in terms of costs and/or customer service.

NFPS will be a large system. It will support the following MTA facilities:

- NYCT: 468 subway stations; and 4,355 buses
- SIR: 22 stations
- MTA Bus: 1,347 buses

These stations and vehicles will be equipped with NFPS contactless readers that will interface with all turnstiles/gates, validators² and on-bus equipment. The readers will be supported by communications networks and NFPS servers, which must handle the required volume and types of transactions within defined performance standards.

The average weekday transaction volumes³ at the existing MetroCard readers and that will move to the NFPS more or less in similar numbers are:

- NYCT: 5.2 million subway, and 2.23 million bus
- SIR: 25,000⁴
- MTA Bus: 394,000⁵

² Validators will be used only at the 20 non-gated SIR stations in this phase of NFPS.

³ 2010 average number of revenue trips per day, including 0.7 million transfer trips. This number does not include trips made with employee, police or fire department passes.

⁴ Currently, revenue is only collected at two stations. The number of 2010 average weekday revenue trips is 14,904. Estimated actual weekday ridership is 25,000.

In addition, the system will provide in-station service, remote and out of system sales channels and other supporting equipment and services. The system will also provide Contactless MetroCards (CMCs)⁶, which are CP cards issued by MTA, for customers who choose not to use or do not possess their own CP device. These services are defined in this document and supplementary documents.

Last, deployment of NFPS on MTA buses and subway will require that provision be made for the impact on LIRR, MNR, PATH⁷, LI Bus, JFK AirTrain, Westchester Bee Line Buses, and the Roosevelt Island Tram, all of which currently accept MetroCard or support sales of a jointly-ticketed MetroCard. NFPS will not require integration with MetroCard during the transition period when NFPS is introduced and MetroCard is phased out.

2.1 Purpose of system

The NFPS is a system for:

- Allowing entry to transit services without the need to purchase a fare card in advance.
- Electronic payment of fares in a manner that is equitable for all customers.
- Transit system access on an unpaid basis for employees, pensioned employees, contractors, emergency personnel and others to fare-paid areas for business purposes
- Configuration and management of fare collection and non-revenue access functions, including the implementation and management of fare policies.
- Superior customer service and support for all system users.
- Management of revenues, and reduction of risk, fraud and abuse costs.
- Collection of ridership and fare data to comply with federal reporting requirements and internal analytical procedures.

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

This new fare payment system must be available and accessible to all customers of MTA's bus and subway systems, and by its implementation must not disadvantage any customer who does not own a CP device.

2.2 Merchant Model: Fare media, products and customer service

In the NFPS, the MTA is a merchant with its point of sale (POS) devices (to be known as "readers" hereinafter) placed at points of entry and in some cases, exit to the transit system.

⁵ LI Bus's average weekday volume is 102,000. Because it will no longer be part of the MTA after 12/31/2011, it has not been decided whether this traffic will move to the NFPS.

⁶ See document titled "Contactless MetroCard: Supplement to Concept of Operations for MTA New Fare Payment System: Bus and Subway Deployment Phase, Release No. 1.2"

⁷ Port Authority Trans Hudson (rail transit system of the Port Authority of New York and New Jersey)

The NFPS will be based on open standards to the maximum extent possible. It will allow customers to use common retail payment methods, including a range of bank-issued, prepaid, and MTA-issued CP devices, to pay fares at the point of entry to the subway and bus. CP devices that can be used in the NFPS directly at entry include contactless credit cards, debit cards, and prepaid cards, and NFC phones, as well as potentially contactless non-MTA employee or student ID cards and other ID-related media (such as Driver's Licenses) that meet the MTA standards for acceptance of payment devices.

It will also enable customers to use personal computing devices, in-station services, and external retailer equipment to purchase fare products, view their transaction history and perform other fare payment-related functions.

The MTA, as a merchant, will offer two broad types of fare products:

- Pay-as-you-go (PAYG) fare products, used by customers with their own CP device simply by walking up to a turnstile, gate or validator, or boarding a bus, and tapping on the reader. In most cases, the customer is purchasing a single ride or single linked trip fare product. PAYG products are "sold" only at readers.
- Pay-in-advance (PIA) fare products are those products purchased by customers before reaching point of entry and electronically stored by MTA for the purchaser's use.
 - PIA fare products include:
 - Period passes (such as weekly or monthly)
 - Discounted value (typically at a discount to single ride fares)
 - Undiscounted value (single ride fares purchased in bulk)
 - Single ride tickets
 - PIA products are sold through:
 - Website
 - Call center/integrated voice response (IVR)
 - SMS
 - Mobile van
 - External reload and in-station channels
 - PIA products may also be sold through institutions such as employers and universities that issue contactless ID cards and can make payment arrangements with the MTA.
 - PIA products are immediately available for use after purchase. Customers use CP devices associated with the products at readers to obtain entry with a PIA fare product.

The NFPS will accommodate current MTA fare policy, and include the ability to process free transfers associated with PIA and PAYG fare products, and reduced fare versions of all PIA and PAYG products, if a customer is eligible and registers his/her CP device.

The NFPS will give the MTA the future ability to configure products flexibly to meet customer needs. Examples of new products that the MTA could offer in future, subject to governing fare policy change regulations and procedures, once NFPS is implemented include:

- PAYG single-ride products for customers who value convenience and are willing to pay a premium for it.
- PAYG best value caps for frequent users.
- Discounts that may be offered by the MTA or the issuer of the fare payment medium
- Time of day or day of week fares, to manage peaking, for either PAYG or PIA pass or value products.
- Marketing and incentive fares, offered to groups of customers or for a set of services for which the MTA wishes to encourage more use. These can be offered for limited periods of time.
- Joint fares with other agencies that accept CP devices.
- Any other fare policy that can be defined by mode, agency, time, customer group, frequency of use, and sales channel.

It should be noted that this document is not intended to convey any recommendation for a change to fare policy. The above examples are noted only to indicate the high level of flexibility that the new technology will provide the MTA with regard to ability to technically implement different fare structures.

The NFPS will shorten the time it takes to implement changes in fare policy by providing a flexible, easy-to-use means for the MTA to quickly define, configure and implement new fare products to be offered at readers and through all other sales channels.

The NFPS will provide customers with widely accessible, convenient self-service support, including online, telephone and station-based channels, and a geographically robust external reload network, at which customers may obtain CMCs and add PIA products to accounts associated with the cards. The NFPS will also provide self-service account management for customers who use the system.

NFPS will replace the MetroCard, the MTA's current fare payment system for bus and subway. NFPS will be deployed through a series of like-for like fare product introductions until all PAYG and PIA products are available through NFPS and no longer available through MetroCard. While MetroCard will be eliminated in a staged process during the phasing in of NFPS, it is expected the two systems will be operated in tandem for an extended period of time, in order to assure a smooth transition for customers. The phasing out of MetroCard will not commence until MTA can assure all of its customers have appropriate access to CP devices accepted through NFPS and fare options available through NFPS.

3 REFERENCED DOCUMENTS

Please refer to Appendix 2.

4 BACKGROUND

4.1 Current system

The fare payment medium required for bus and subway entry today at MTA is the MetroCard. This section provides a high level summary of the operations and maintenance of the MetroCard system. See Appendix 3: “Current Conditions” which provides a more detailed description of this legacy system.

MetroCard is a stored value fare card that is activated through magnetic stripe read/write technology at MetroCard readers. There are over 40 variations of MetroCard encoding and graphic design produced for revenue and non-revenue entry and used at a variety of entry points.

A MetroCard is required for customer’s paid access to all MTA subway stations and buses, except that local and express buses also accept coins at the on-board farebox unit for fare payment. On MTA Select Bus Service (SBS) buses, customers pay the fare off-board at the bus stop. Employees, contractors and emergency personnel (police, fire and others) also may be issued MetroCards for non-revenue access to facilities and services. On many of these non-revenue variations, a photo is included for identification, and use may be time-and-location restricted.

The MetroCard system only supports PIA fare products. The MetroCard fully supports the current bus and subway fare policy, which includes a flat single ride fare, free transfers for most subway/bus and bus/bus linked trips, time-based passes and value-based discount fares, a reduced fare program for senior citizens and persons with qualifying disabilities, and fare programs for students and groups.

Customers can obtain and reload the MetroCard with time- or value-based PIA fare products within the subway system at:

- Station booths, with cash only,
- MetroCard Vending Machines (MVMs), with cash, credit, and debit (including electronic benefits transfer (EBT)) cards, and
- MetroCard Express Machines (MEMs), with credit and debit (including EBT) cards.

Customers can also obtain⁸:

- The single ride ticket version of MetroCard at MVMs,
- A pre-encoded (fixed value or time-based) MetroCard at an extensive network of authorized retail merchants,
- MetroCards with time- or value-based fares through employer-based pre-tax transit benefit programs

⁸ There are some restrictions as to what fare products can be loaded onto MetroCards based on previously loaded fare products.

- MetroCards with automatic top-up through MTA’s EasyPay (reduced fare) or EasyPay Xpress (regular fare, also with automatic pass renewal) programs, and
- MetroCards as part of a joint ticket with LIRR or MNR.

4.2 Current MetroCard system usage and assets

The approximate volume of card activities in 2010 was:

- Revenue card swipes on an average weekday: 7.9 million⁹
- MetroCards issued through vending machines and station booths: 137 million
- Single Ride Tickets issued through vending machines: 38 million
- MetroCards issued through out-of-system sales¹⁰: 35 million
- MetroCards issued with photo IDs¹¹: 788,500
 - Reduced Fare program (covers , seniors, disabled): 726,000
 - Employee passes (including police¹²): 55,300
 - Other passes: 22,200
- Student MetroCards (time and ride restricted): 1.7 million shipped per semester. Distribution and replacement are controlled by NYC Department of Education
- Active accounts issued through Easy Pay and EasyPay Xpress programs, each with one or more MetroCards issued during the year: 136,000
 - 100,000 Reduced Fare participants¹³
 - 31,000 Full-Fare Pay-Per-Ride
 - 5,000 Full-Fare Unlimited Ride
- Add-value transactions through vending machines and station booths: 93 million

The approximate annual sales by payment method in 2010 were:

- Total MetroCard sales¹⁰: \$3.5 billion
 - \$1.5 billion through credit and debit card purchase at NYCT vending machines
 - \$1.4 billion through cash purchase
 - \$0.7 billion at NYCT vending machines
 - \$0.7 billion station booth sales
 - \$34 million through EasyPay and EasyPay Xpress
 - \$15 million from Reduced Fare
 - \$15 million from Full-Fare Pay-Per-Ride
 - \$4 million from Full-Fare Unlimited Ride
 - \$0.6 billion from external sales¹⁴:

⁹ Includes 0.6 million transfers on MetroCards and 0.1 million paper magnetic transfers.

¹⁰ This number includes MetroCards sold through retail merchants, transit benefit programs, social service organizations, government agencies, joint tickets with each LIRR and MNR (not including ticket vending machines or ticket offices). Does not include MetroCards sold through other transit agencies.

¹¹ Employee and Reduced Fare passes are not scheduled to be renewed annually; they are valid for about 33 months from time of encoding.

¹² FDNY receives approximately 2000 non-photo IDs for placement in trucks.

¹³ These customers are already included in the photo ID figures above.

¹⁴ Merchant commissions are about 2% of gross external sales.

- 45% from approximately 2500 retail merchants
 - 10% governmental and social service agency benefit provider distributors
 - 45% pre-tax transit benefit providers.
- Onboard bus cash revenue, including SBS and half-fare students, was \$142 million

The annual MetroCard sales revenue by fare category in 2010 was:

- Time-based passes: \$1.547 billion
- Discounted fare: \$1.475 billion
- Non-discounted fare: \$0.380 billion
- Single Ride Ticket: \$0.086 billion

The approximate MetroCard assets installed in 31 bus depots, approximately 6000 buses, 79 bus stops, 468 subway stations and 2 SIR stations are:

- 2,270 vending machines
- 530 booth terminals
- 4,100 reader-enabled gates in three styles (tripod, high entry, autonomous access)
- 1,400 subway service gates, without readers
- 800 readers in subway stations for customers to check balance
- 221 SBS MetroCard Fare Collectors at bus stops
- Over 6,000¹⁵ bus farebox units (including NYCT, MTA Bus, Westchester Co. Bee Line, MNR¹⁶)

The list of assets above does not include the equipment required to produce, encode, package, secure and distribute MetroCard, the off-board SBS coin collectors, or the farebox probes and coin vacuum systems at bus depots.

The MetroCard system is owned and operated by NYCT. Approximately 700 full-time and part-time personnel maintain and operate the system.

4.3 Drawbacks of current system

The key drivers to replace the current system are:

- **High cost.** A 2009 study commissioned by the MTA identified \$460 million in annual NYCT operating costs attributable to its fare payment systems (based on 2007 figures). This translates to an average of \$0.15 per \$1 revenue collected. The average cost per NYCT sales transaction was \$1.36, and the average revenue per sales transaction was \$8.88.
- **Proprietary system.** MetroCard is a proprietary, custom implementation for NYCT for which NYCT must manage card production, encoding, issuance, security and system support. NYCT has licenses that permit it to use the proprietary fare collection technology and to sublicense it to third parties. The vendor is also obligated to provide much of the software source code for the system to NYCT. However, even with such intellectual property rights

¹⁵ The exact number of buses /bus farebox units fluctuates.

¹⁶ MetroNorth operates bus service, the MetroNorth Hudson Rail Link.

and information, NYCT relies upon third parties for certain aspects of operation and maintenance of the system. Additionally, significant resources are dedicated to avoiding loss of revenue through card theft and fare evasion. Card production and encoding is expensive, requiring significant record keeping and reconciliation.

- **Cash handling cost.** Cash is used extensively as payment for MetroCards (almost 50% of all in-system sales) and bus fares, bringing in over \$1.5 billion in coins and bills annually. It is relatively expensive to handle, requiring armored car support for station booth and vending machine restocking and armed security for maintenance and repairs.
- **Obsolescence.** The legacy system is now over 15 years old. MTA faces parts obsolescence for critical subassemblies. Failure rates for these subassemblies are steadily increasing, increasing the labor and material resources needed to maintain an acceptable level of performance. Some parts are no longer available in the marketplace and have to be fabricated internally.
- **Long bus boarding and dwell times.** It is estimated that the MetroCard fare payment transaction time is 2-6 seconds on buses. Cash transactions on buses are even slower.
- **Lack of interoperability within MTA or regionally.** MTA does not currently use a single fare collection system across all of its agencies, and the MetroCard is not interoperable with the other MTA and non-MTA agencies' systems. This hampers a regional approach to mobility across MTA services and makes intermodal travel less convenient for our customers.
- **Limited ability to accommodate fare policy initiatives.** Fare product capabilities are limited by the data structure and limited storage of the magnetic stripe cards and the limited processing available at the reader.
- **Vandalism at vending machines.** Vending machines are becoming more prone to vandalism, with vandals jamming machines as part of fraud activities. The machines themselves have become the target of scams perpetrated on unsuspecting customers involving the offer of illegal entry.
- **Limited out-of-system sales potential.** The nonstandard MetroCard magnetic stripe format does not allow out-of-system reload.

4.4 Key aspects of NFPS

The MTA expects the NFPS to address the many drawbacks of the current system, and to meet the objectives listed in Chapter 7, by focusing on the following aspects:

Accept payment industry issued CP devices directly. MTA wants to accept bank-issued and prepaid CP devices directly at the subway turnstile and bus boarding for fare payment, as a merchant in payment industry terms. Which device the customer uses will be his/her choice as long as it is contactless and has the appropriate spending authority.¹⁷ Fees for card

¹⁷ PIN = Personal Identification Number. PIN-only debit cards may not be accepted at readers because requiring customers to enter a PIN at readers will slow down entry speed. MTA is not intending to have a PIN pad available on the entry readers. This is an example of how the MTA differs from other merchants. Further research needs to be done on the acceptance of contactless PIN debit cards at points of entry. MTA may be able to reach agreement with the financial institutions that provide these cards.

transactions at the reader are expected to cost the MTA less than cash transactions today at the vending machines, station booths and farebox units.

Use a merchant model. The MTA will sell PIA fare products, through multiple channels, including website, SMS, call center, mobile van, and external channels that are very similar to mainstream retail sales channels. Many customers will have MTA accounts, while some will purchase MTA fare products on an ad-hoc basis. MTA's sales and customer support functions will follow a merchant model. By using a merchant model, the MTA will maximize its ability to use existing components and services.

Promote self-service. Customers will have the convenience of being able to purchase fare products and manage their account. Account management features include auto reload options, email or text alerts to warn of a nearing expiration date or low balance on fare products, and viewable travel and transaction history (kept up to date in near real time) associated with a particular account. Moving to highly-available, flexible self-service is a mainstream means of reducing operating costs while improving the customer experience.

Use existing payments services and standards. Moving to existing payment industry services and standards means that MTA itself does not have to be an end-to-end provider for transaction processing. MTA can take advantage of well-established payment industry infrastructure that provides processing activities linked efficiently to card networks and card issuers. Modifications of typical practice will be necessary to increase reader transaction speeds and to handle some transit-specific issues such as passes and transfers and non-revenue access.

Use open standards. Open standards create a competitive market and more choice for the MTA and the end-user. Use of open standards for all or parts of the system solution will not lock the MTA into a particular vendor or group because the components built on the standards are commodity in nature. MTA will specify open standards in hardware, software, computing, payments, network communications and other relevant areas.

Future proof system. MTA wishes to build a system based on technology where the choice to renew components or subsystems or adapt to an emerging technology during the system's lifecycle is not an all-or-nothing choice.

Minimize customization or proprietary elements. There are three areas in which MTA may require transit-specific processing. Otherwise standard components and processes will be used. MTA will look to partner with other transit agencies for shared development of the following transit-specific elements:

- MTA will need faster speeds for transaction processing at the reader than merchants typically experience in order to speed and keep passenger flow smooth. It will be important to identify solutions to meet MTA's needs that are not MTA-specific or necessarily even transit-specific.

- MTA fare structures are more complex than most retail product prices, and a “fare engine” to compute applicable fares based on customer taps at stations and on buses will be required. Prices do not need to be known at the time of an individual tap.
- Taps of cards associated with PIA fare products are processed as access transactions at entry points, not as merchant payment transactions; this is different than usual payment card practice.

Issue Contactless MetroCard supported by a widespread reload network. MTA anticipates that every customer will not have his/her own CP device for many years. In order to ensure that no customer will be excluded from travel or fare products because s/he does not own a CP device or chooses not to use his/her own CP device, MTA will need to issue a CP card itself (the Contactless MetroCard) and provide for card issuance and account reload at a wide variety of places even more geographically robust than the MetroCard external network is today. The CMC will be a closed loop card. The MTA expects a payment industry organization to provide and manage the CMC, which may be a white label or a co-branded card. The CMC will also be used for special and restricted access and for non-revenue access for employees, contractors, and other non-revenue users.

Use centralized server/account-based, rather than decentralized, card/reader-based fare payment processing. Server/account-based processing is a more secure and flexible means for customers to purchase fare products, and increases the flexibility MTA has in developing fare policies. It also creates the opportunity to manage the system in real time.

Accept some risk to improve the customer experience and reduce total cost. MetroCard is currently based completely on PIA fare products, therefore customers can only use the system by purchasing a MetroCard first with fare payment guaranteed for MTA before the customer enters the system. The MTA recognizes there is risk in accepting cards for PAYG fare payment without prior financial authorization. MTA will have to manage risk while maintaining transaction speeds. NFPS will manage overall MTA risk by establishing agreement with bankcard issuers and where applicable, other prepaid card companies, regarding the placement of liability for “first tap” and PAYG risk and also, by adopting payment industry and merchant best practices in fraud and risk management.

5 CONCEPT FOR THE PROPOSED SYSTEM

5.1 Alternatives considered

MTA conducted a detailed examination of three system types deemed to be the most viable:


- The MetroCard system, as described briefly in Chapter 4 and in detail in the Current Conditions report.
- Transit smart card technology. Closed loop smart card technology is based on a chip embedded in a card; the chip stores information including fare value and ID information, usually customized for each transit system. Fare logic, also customized for each transit system, is implemented on gate and farebox units. Closed loop smart cards are widely used in transit systems throughout Europe and Asia, and have been adopted by a number of systems in North America. Most closed loop smart card implementations are based on proprietary technology, since mature standards do not yet exist for them.
- Contactless bankcard standard technology. Bank-issued CP card technology is relatively mature, but has yet to become ubiquitous among merchants and consumers. The technology relies on payment industry standards, which define cards and readers that are accepted by a wide variety of merchants. No transit customization of cards or readers is required. Fare payment processing through this system is primarily managed through the payment card industry when customers use their own CP devices.

5.2 Evaluation of alternatives

Studies and pilots were conducted to examine the alternatives:

- 2006 Phase 1 NYCT open payment pilot. MasterCard and CitiBank installed readers at 30 Lexington Avenue Line stations; CitiBank customers with MasterCard *PayPass*™ devices entered the system by tapping directly at the readers on the subway turnstiles. During the period April 2008 to May 2009. MTA identified objectives for the future fare system, analyzed the current fare system, developed evaluation criteria, provided a technology overview, assessed the payment industry's capabilities to provide transit fare collection, provided cost-benefit analyses of the options and examined economic feasibility and business cases for the open payment option. Table 5-1, drawn from the report, summarizes the key dimensions and the assessment of each alternative along these dimensions.
- 2010 Phase 2 NYCT open payment pilot. MasterCard expanded the phase 1 pilot to include buses on eight routes, connected to the backend by 3G wireless, any card issuer, Visa *PayWave*™, other transit agencies (PATH and NJT buses), PIA fare products and free transfers, and online processing.

SUMMARY COMPARISON OF FARE PAYMENT TECHNOLOGIES

 Optimal

	Option A: MetroCard	Option B: Transit smart card	Option C: Bank card
1. Gate performance (throughput speed)	<ul style="list-style-type: none"> • Low/medium – 20% error rate and juggling multiple MetroCards reduces throughput speed 	<ul style="list-style-type: none"> • High – fastest option; tapping is faster than swiping and has fewer errors; riders have just one card 	<ul style="list-style-type: none"> • High/medium – potential need for real-time authorization/authentication adds time, but speed sufficient
2. Fare policy flexibility	<ul style="list-style-type: none"> • Low – 128 class codes available 	<ul style="list-style-type: none"> • Medium – 256 class codes available 	<ul style="list-style-type: none"> • High – fare logic resides on server, enabling a virtually unlimited number of fare policies
3. Transaction model	<ul style="list-style-type: none"> • Offline (stored value) – value read/written onto card; card can only store one transit fare product 	<ul style="list-style-type: none"> • Offline (stored value) – value read/written onto card, but can store more than one transit product 	<ul style="list-style-type: none"> • Online (account-based) – enables pre- and post-pay products and self-service channels (e.g., web)
4. Required network capabilities	<ul style="list-style-type: none"> • Medium – real-time server network not required for transaction to process but needed for TVMs, hotlists 	<ul style="list-style-type: none"> • Medium – same as MetroCard 	<ul style="list-style-type: none"> • High/medium – online transactions require high network performance and reliability
5. Level of security	<ul style="list-style-type: none"> • Medium – card duplication possible, but can be detected (e.g., by serializing cards) 	<ul style="list-style-type: none"> • High/medium – processor-based cards support encryption; low-end cards are less secure 	<ul style="list-style-type: none"> • High – follows payment card industry (PCI) security standards, which are strong, well-supported
6. Lifecycle risk	<ul style="list-style-type: none"> • Low/medium – mature technology; likely to exist in 10 years, but potentially as a legacy technology 	<ul style="list-style-type: none"> • Medium – mature technology, though standards are not; overall newer technology than MetroCard 	<ul style="list-style-type: none"> • Uncertain – pilot in progress; bankcard technology is mature, but direct use in transit is new
7. Technology risk	<ul style="list-style-type: none"> • Low – technology proven to be relatively reliable; performance issues with credit/debit at TVMs 	<ul style="list-style-type: none"> • High – potentially requires multi-year development of detailed specifications for MTA use 	<ul style="list-style-type: none"> • Medium – network outages possible; adoption risk of contactless cards by banks
8a. Implementation considerations	<ul style="list-style-type: none"> • Low – requires replacement/renewal of existing AFC equipment components 	<ul style="list-style-type: none"> • Medium – new readers/fareboxes, new/refitted TVMs, changes in card issuance 	<ul style="list-style-type: none"> • Medium – new readers/fareboxes, possibly new TVMs, less card issuance, more payments participation
8b. Business risk	<ul style="list-style-type: none"> • Low – current "as is" state; most business risks already known and managed 	<ul style="list-style-type: none"> • High – complexities of technology pose significant risk to cost, procurement, and implementation 	<ul style="list-style-type: none"> • Medium – relies on payments industry for many functions; new in N. America
9a. Inter-agency interoperability	<ul style="list-style-type: none"> • Low – requires transit authorities to agree to use MetroCard data layout, fare logic, back office 	<ul style="list-style-type: none"> • Medium – requires authorities to agree on common data, fare logic, back office not specified in standard 	<ul style="list-style-type: none"> • High – common standard requires less coordination between authorities
9b. Inter-modal interoperability	<ul style="list-style-type: none"> • Low – requires gates or validators at commuter rail stations, mag stripe readers for conductors 	<ul style="list-style-type: none"> • Low/medium – requires gates or validators at commuter rail stations, card readers for conductors 	<ul style="list-style-type: none"> • Low/medium – requires gates or validators at commuter rail stations, card readers for conductors
10a. Ability to serve unbanked customers	<ul style="list-style-type: none"> • High – currently serves banked and unbanked customers 	<ul style="list-style-type: none"> • Medium – smart cards available for multi-rides; lower cost fare media may be needed for single rides 	<ul style="list-style-type: none"> • Low – potentially requires parallel system (e.g., MetroCard or prepaid card) for unbanked riders
10b. Ability to serve banked customers	<ul style="list-style-type: none"> • Medium – banked customers must purchase and use MetroCard 	<ul style="list-style-type: none"> • Medium – banked customers must purchase and use smart card 	<ul style="list-style-type: none"> • High – banked customers use contactless bank card media; have one less card to carry

Table 5-1 Summary of Comparison of Fare Payment Technologies

5.3 Selected alternative

MTA has selected the contactless open payment standard technology as its platform for implementation of a new fare payment system.

The key advantages, as summarized in Table 5-1, are listed below. The numbers in each bullet correspond to the numbers in the table:

- **1. Gate/farebox unit performance:** Faster bus boarding compared to current system. Reduced transaction time at the farebox unit/reader, along with reduced use of cash payments through the availability of the CMC, will reduce dwell times of buses¹⁸.
- **2, 3. Fare policy flexibility, and transaction model.** Since fare logic is held on a server and not on cards or gate/farebox readers, the range and types of fare policy rules that can be implemented is unlimited. MTA can consider innovative policies that previously could not have been implemented that could help promote and increase ridership
- **5. Level of security.** CP devices use highly secure data protection standards, supported by the expertise of the payment industry.
- **6. Lifecycle risk.** MTA can leverage payment industry expertise, systems, and services. MTA can use mainstream payments technology and processes with minimum changes for transit-specific needs. This also will lower costs for the MTA.
- **8b. Business risk.** Use of open standards translates into the availability of commodity hardware and software that meets those standards, and a wider range of suppliers from which to procure them making for a more competitive environment and lower costs for the MTA.
- **9a. Interagency interoperability.** Customers with CP devices based on open standards can travel on any public transportation agency accepting these devices. Within the same geographic region, this provides for the opportunity for customers to experience “seamless transfers” between services from a fare payment perspective.
- **10b. Ability to serve banked customers.** CP devices offer users the same experience in the transit environment that they experience at other merchants. It is familiar, convenient (no requirement to obtain a transit-specific card if a customer has a CP card), and flexible.

The key disadvantages or risks are:

- **4. Required network capabilities.** Gate and farebox unit performance depends on network and server performance. Wireless and fiber optic networks must perform well for transaction times to meet transit throughput needs, which is 500 milliseconds or less.
- **6. Lifecycle risk.** Although contactless payment technology is widely used for public transportation payments, CP devices and contactless POS terminals are far from ubiquitous in the US. NFPS must be developed robustly to accommodate new payment schemes and technologies beyond plastic CP devices in order to avoid utilizing a potentially stranded technology.

¹⁸ Dwell time is also a function of the placement of the reader, design of the bus, and level of crowding.

- **7. Technology risk.** The MTA would be an early adopter of open payments for transit. While most technology is standards-based, some elements are transit-specific and will have only a few previous implementations to provide experience.
- **8a. Implementation considerations.** This requires contactless readers to replace the current magnetic stripe readers at subway turnstiles/gates and on buses, and it requires high availability network connections to all readers.
- **8b. Business risk.** A tighter relationship with the payment industry results. The MTA must negotiate rules and fees more intensively with this industry.
- **Customer risk profile changes.** The risk profile of transit customers is no longer consistently low across all customers once fare payment is not required in advance. The MTA risk profile takes on the risk profile of the cards being used.
- **Financial and customer experience risks.** The decision rules for allowing or denying entry based on anything other than financial authorization can result in some possibility of allowing entry and not getting paid, as well as in denying entry erroneously and reducing customer satisfaction. The rules for managing these risks must be negotiated with the payment industry.
- **10a. Provisions for unbanked users.** A CMC will be issued, which must be defined and procured.

The MTA study and the two open payment pilots have addressed some of the drawbacks and risks satisfactorily:

- Network capabilities were proved in the Phase 2 pilot, with most transaction times between 400 and 800 milliseconds.
- Lifecycle risks based on MasterCard, Visa and American Express operating rules are in discussion, and a satisfactory outcome appears likely.
- The technology risk is somewhat mitigated by Transport for London (TfL)'s adoption of open payments, planned for 2012, and its role in advising the MTA and potentially sharing technology.
- The business risk can be managed by process and rules changes. MTA accepts credit and debit for a large fraction of fare product purchases currently, and is familiar with credit and debit risk management.

5.4 Funding

Funding for the new fare payment system project is programmed in the MTA's 2010-2014 Capital Program. A significant portion of the project is included in the first two years of the capital program, which is funded. The remainder of the project is provided in the remaining three years of the capital program for which funding sources have yet to be identified.

5.5 High-level operational description

See Appendix 1 for Key Concept Terms. See Appendix 4 for acronyms used in this document.

MTA will grant customers entry to its transportation services, and process fare payments for those services, through the NFPS. The NFPS system will be based on standard merchant transaction processing.

The system is comprised of contactless readers installed at subway and bus entry points individually communicating, wired or wirelessly, with a server where all fare payment transactions will be processed. It also includes online, phone, external and in-station sales channels for fare product purchase and account management. The server also provides the application interfaces with external standard merchant processing services (e.g., acquiring services and payment networks).

Customers must possess a CP device to ride MTA services (with the exception for non-SBS buses that will continue to accept coins for payment), although they may purchase fare products with other forms of payment through some channels.

The payment medium may be a bank-issued credit or debit card, but will also include prepaid cards, key fobs, payment-enabled NFC phones, and other form factors tied to financial accounts, such as employee or personal identity verification (PIV) cards, or CMCs. CP devices that meet payment industry standards will be authorized, cleared and settled through an external payment network or internally through MTA.

When a customer taps his/her CP device on the reader, the reader collects the card or device number and other data, immediately encrypts the data, and sends it to the server. After processing at the server, a message is sent back to the reader with an 'accept' or 'deny' message. Sufficiently secure communications protocols are used.

If the tap is a PAYG transaction (and therefore transacted through a bank-issued or prepaid device), fare revenue will be collected after entry from the customer's account, held at the issuing financial institution. Fare revenue was collected from the cardholder before travel if the tap is for a PIA fare transaction. (Purchased PIA fare products are not recorded as MTA revenue until the trip is taken, as an accounting principle.)

The key operational features of the NFPS are listed below.

5.6 Customer types

There are multiple customer types with differentiated fare payment requirements. The largest volume of customers will be:

- Revenue customers with CP devices
- Revenue customers without CP devices
- Customers with transit benefit cards, treated as other revenue customers but with additional restrictions such as the card not being valid for multiple customers, not allowing refunds, requiring the MTA to manage tax benefit information, and others.

These customers will be served by CP devices issued by banks, third-party issuers or the MTA.

Additional customer types that must be served include:

- Non-revenue employees and contractors who require access, sometimes on a limited or restricted basis and photo ID.
- Students
- Disabled customers who have special access needs (and where photo ID required).
- Seniors (where photo ID required)
- Group sales customers
- Other groups that may be identified

5.7 Fare purchase options

- Customers may buy either PIA or PAYG fare products for travel:
 - PAYG customer taps his/her CP device at a reader to pay his/her fare without any prior action.
 - PIA customer purchases fare products through his/her choice of sales channel and then taps his/her CP device associated with the purchased product at a reader to pay his/her fare.
- Customers who use PAYG fare products can choose from these methods for purchase and entry, which occur simultaneously:
 - Contactless credit cards
 - Contactless debit cards, but only signature debit, not PIN debit
 - Contactless prepaid cards
 - NFC phones
- Customers who purchase PIA fare products may do so through multiple sales channels:
 - Website
 - Call center (agent/IVR)
 - SMS
 - Mobile Van
 - External reload locations
 - In-station
 - Employers or schools, or any party that reaches an agreement with the MTA
- Customers may purchase PIA fare products at these sales channels using multiple payment methods.
 - Credit cards, contactless or magnetic stripe
 - Debit cards, both PIN and signature debit, contactless or magnetic stripe
 - Prepaid cards, contactless or magnetic stripe
 - EBT cards
 - Electronic funds transfer (EFT) on behalf of contactless (non-MTA) employee ID, student ID, or PIV cards. This occurs through the employer or school sales channel only.
 - Cash, which is not accepted on website or through the call center
- Customers who purchase PIA fare products choose at the time of purchase which CP device to tap for entry. Within certain parameters, customers may choose from these CP devices to tap for entry:

- Contactless credit cards
- Contactless signature debit cards [Refer to Footnote 1717 for note on PIN debit.]
- Contactless prepaid cards
- CMC
- Contactless (non-MTA) employee ID, student ID card, or PIV card, if supported for payment
- Contactless single ride tickets (SRTs) (if SRTs not provided through CMC)
- NFC phone

5.8 Stored Accounts

Using a CP device in the NFPS system is defined as purchasing either a PIA or PAYG fare product. Once a CP device is first used in the NFPS system to purchase a PIA or PAYG fare product, a stored account is created in the MTA account server associated with device ID.

At the time of purchase of a PIA fare product:

- The fare product is stored electronically in the server and is immediately available for use.
- The fare product must be associated with a CP device, which the customer intends to tap for entry. Use of that CP device for travel will link payment processing to the fare product.

At the first-time purchase of a PAYG fare product by a CP device not previously seen in the NFPS:

- The CP device ID, which was tapped for entry, is stored in a non-funded, anonymous MTA account in the server.
- Similar to PIA accounts, transactions associated with the CP device are recorded.
- If the customer should choose subsequently to purchase a PIA product, such product would be stored electronically in that MTA account.

The storage of CP device IDs, fare products and customer information cannot compromise the principle of maintaining customer privacy and confidentiality and security of transaction data.

MTA will maintain an account for each CP device associated with fare products. Ground rules for associating cards and fare products are:

- For any one account, there can only be one CP device associated with it for travel.
- The card used to purchase the fare product has to be the card used for travel, unless the card used for travel is a CMC or some contactless device not backed by a financial account. If a CMC is used for travel, it may be linked with one other payment card, contactless or magnetic stripe, which is used for PIA purchases. MTA shall enforce this rule in the fare product purchase process.
- Pre-tax transit benefit monies are administered by transit benefit providers and are either:
 - Distributed to customers in the form of a CP card provided by transit benefit provider. These cards can be used to purchase PAYG or PIA fare products and tap for entry.

- Distributed to customers in the form of a magstripe card provided by transit benefit provider. These cards can be used to purchase PIA fare products associated with a CMC to tap for entry.
- Transferred electronically (EFT) from the employer by the transit benefit provider. The transit benefit provider provides the MTA with information on the desired fare product and card account when the EFT is made. This is done once per month at a minimum. With this information, the MTA associates the desired fare product with a CMC for the customer's use.
- Non-MTA Employee IDs, student IDs and similar media that are funded by EFT from the employer or school. The employer or school indicates the fare product purchased when the EFT is made. This is done once per month, although the frequency may be increased in the future.
- A fare product can only be associated with one CP device.
- A CP device can have more than one fare product associated with it as long as the fare products are unique. For example, an unlimited pass product and value product both can be stored. Value products can be used for express bus rides where regular unlimited passes are not accepted.
- Customers who have two CP devices associated with one account (e.g., when two cards with the same PAN (Primary Account Number) are associated with a joint bank account) may have to take some action to differentiate taps made by each card¹⁹. Currently, the industry does not consistently support individual card identification in this situation.

Website, call center, IVR, SMS, and mobile van processes used to purchase PIA products entail standard merchant processes. For example a standard online merchant process:

- Registered customer will log in with a username and password
 - Unregistered customer is a "guest" and is provided a link/option to register
 - Unregistered customer enters card number to be used for travel
- Customer selects fare product from menu
- Product, price, access card and payment card are displayed for customer confirmation
- MTA submits payment for authorization

The account server must be able to maintain well over 10 million accounts for bus and subway customers, and have appropriate storage, security, and backup capability. The accounts must be maintained until the MTA decides to delete the accounts, which may be never.

¹⁹ This is only necessary if one of the two cards is associated with a PIA fare product purchased in a card-not-present (CNP) transaction. An example of customer action might be: viewing tap transactions associated with both cards and identify which set of taps is to be associated with the fare product. This issue is due to the fact that some cards belonging to a joint bank account have the same PAN number (used in CNP transactions) but are usually distinguishable in card-present transactions.

5.9 Account Features

5.9.1 Registration

- To the extent possible, the MTA account and its customer service will follow online merchant account and service practices. Processes will be consistent across all channels.
- A customer can register anonymously to access and manage his/her MTA account, creating a username and password to view stored information. *A card ID can never be used as either the username or password.*
- The customer must enter the ID (the PAN) of the card s/he will use at readers when establishing the account.
 - The MTA will notify customers to only associate CP devices for travel with the account. The MTA cannot verify if the device is contactless through the CNP transaction.
- The customer has the option to provide identifying information to get additional customer service benefits. For example, the MTA may only offer email and text alerts, auto-reload and the ability to view tap transactions to this non-anonymous customers.
- Multiple card accounts can be linked to a single username and password. For example, a household can create an account in which parent and child travel can be managed, and products purchased.
 - Data for each account should be partitioned and viewed separately to avoid confusion when viewing account history.
- Registering for an MTA account is optional.
- A customer is able to terminate his/her registration at any time.

5.9.2 Use of registered account

- The customer logs into his/her account with a username and password via the website. CMC users may be allowed to log in with their CMC number.
- The customer can view information associated with the customer's card used for travel in the system.
 - Registered accounts should be designed so that both PIA and PAYG products can be viewed. Customers can set up registered accounts whether they use PIA, PAYG or both. MTA may choose to configure the system to disallow the availability of certain features for different fare products, but the system should be built flexibly.
 - Account information is available to customers in close to real time and adequate for self-management.
- Registered accounts may contain the following information:
 - Payment method for purchase of fare product and, if applicable, payment card ID (securely stored, with only the last 4 digits generally displayed).
 - CP device ID (securely stored) used for travel, if different than card used for purchase.
 - Fare products purchased and status (e.g., balance, time left on expiration date)
 - Travel history (e.g., where taps were made on buses or subway)
 - Transaction history: the fare charged for each trip, based on taps

- Product purchase history
- The customer can set preferences for automatic reload, and low balance, time expiration or renewal alerts, and provide an email address or text-capable phone number to receive such alerts.
- The customer can send inquiries to dispute charges. The customer may be allowed to self-serve on a limited basis for refunds.
 - For example, a customer could request a refund for PAYG tap or PIA fare product if their tap history reveals that they were travelling on an MTA service that was disrupted. If the refund request is accepted, a credit will be posted to the customer's MTA account.
 - This function also provides an example of a way in which this function of NFPS might support future policy and service innovations. For instance, customers could obtain a delay verification to submit to employers if late to work due to service disruption or other problems.

5.10 Customer Service

- Customer service will be provided through multiple channels. All NFPS channels are available 365 days per year, 24 hours per day. Channels may include:
 - NFPS website (including mobile website)
 - NFPS call center
 - NFPS IVR system
 - SMS
 - Mobile van
 - Card issuer (including issuer of CMC) website, call center, IVR
 - In-station
 - Station personnel
 - Bus operators
- Multiple types of customer service queries will be handled by the MTA channels and by the card issuers. All channels will handle all queries, although queries can be handled by referral to another channel when appropriate. Typical queries are:
 - Declined cards
 - Defective, damaged, lost or stolen card
 - Billing questions
 - Refunds
 - Service disruptions: claims, etc.
 - Disputes

5.11 Reader operation

- Readers will be placed at all MTA subway turnstiles and gates, and on or near bus farebox units at front door for all buses, and at all other doors for all buses for which open

boarding²⁰ is permitted. Readers will also be placed at validator units at non-gated SIR stations.

- An MTA customer will tap his/her CP device on a reader and receive a message indicating acceptance or denial and, if in the subway, accompanied by release of the turnstile arm or gate.

5.12 Server operation and transaction processing

- The NFPS will have the following server functions, which may be implemented on one or multiple servers in the actual system:
 - Account server. Maintains account and balance data, transaction history, tap history, purchase history for all MTA travel. Handles accounts for all card types. Website/sales channels. Provides customer access to registered customers for PIA and PAYG fare products. Will handle all queries. It is expected that non-web sales channels (i.e., SMS, IVR/call center) will access account information via web services provided by the website.
 - Transport Authorization Proxy Server (TAPS). The TAPS is a transit-specific server that provides a rapid response to bus and subway readers after a customer taps a CP device.
 - Billing/Authorization Server. Manages payments, clearing, settlement, exceptions and other payment processes between the MTA and the payment industry, either through MTA's acquirer or directly. Implements risk management. Manages authorization and aggregation processes. Handles payments and funds transfers for media such as student or PIV cards. Updates customer accounts when payment events occur.
 - Fare engine. Implements MTA fare and transfer policies. Computes the fare to be charged for each tap or set of taps that define a trip, based on location and time of taps. Transmits this fare to the account and Billing/Authorization Servers.
 - Device and network management server(s). Manages readers and the wired or wireless links from the field hardware to the servers.
 - Data warehouse. For data storage and operations analysis, fraud analysis and reporting.
- NFPS will grant customer entry to MTA services, and process fare payments for those services, through a series of steps:
 - Process customer's tap at reader and send to TAPS. Entry allowed if the CP device meets applicable tests executed at the reader and at TAPS:
 - Device is not on the server Deny List²¹.
 - Device has not passed a local or server velocity check threshold²².
 - Device has not violated passback restrictions²³

²⁰ Open boarding is fare payment (PIA or PAYG) and boarding at all doors of a bus.

²¹ Deny and Accept List defined in section 5.13.

²² Velocity Check is a limit to the number of times a device can be used in the NFPS system over a certain time period.

- Allow entry if device is on the local and/or server Accept List. Accept List used for devices with valid products and valid non-revenue access.
 - Allow entry if no response from TAPS within time limit, and device is not on local Deny List.
 - Compute the fare for the tap through a fare engine.
 - Request payment for PAYG taps by presenting the transaction (which may be bundled through aggregation with other PAYG taps) to the acquirer under standard practices.
 - Payment sent from acquirer to MTA bank through a settlement and clearing process nightly.
 - PIA fare product taps are processed internally with account server.
- NFPS must provide operational support
 - Real time remote monitoring of system components
 - Remote diagnosis and, if possible, remote software problem resolution of reader and communications problems
 - Real time monitoring of transaction and account data
 - Data warehouse for business intelligence

5.13 List management

NFPS will manage lists to minimize risk and speed acceptance. Deny Lists are a requirement to allow NFPS to reject taps from CP devices that should not be allowed in the system. Accept Lists are used to allow access for CP devices associated with PIA fare products and non-revenue access, and can be configured to support other MTA business decisions regarding card-based access. There may be Deny and Accept Lists stored locally at readers as well as at the server, if necessary due to network availability and performance issues. A card may not be on both the Deny List and Accept List. A card on neither list is assumed to be a PAYG transaction.

Server Deny List: A list of cards that NFPS will reject, either permanently or temporarily. This list is checked each time a tap is processed for server transport-authorization. Some reasons to be permanently on the server deny list include being on the payment industry Deny List, a lost or stolen card, or a card used only at the MTA losing its good standing with the MTA. Some temporary reasons include surpassing the server velocity check, or having a decline. NFPS has flexibility in how it handles cards put on Deny Lists for temporary reasons.

Local Deny List: A Deny List may be present at each reader; it is a subset of the server Deny List. It also may include cards that violate a local velocity check threshold. This local Deny List is used for risk management when readers are unable to connect to the server.

²³ Passback restrictions limit the use of a single device at one station or bus service and are a part of transport-authorization process. This restriction exists to limit the sharing of fare products. The restrictions vary by fare product and CP device type.

Server Accept List: A list of cards that NFPS will accept without requiring authorization. This includes cards that are associated with a PIA fare product in good standing, authorized cards at the start of an aggregation cycle, CMCs in good standing, and employee and contractor cards. If a card is on the Accept list, it is not sent for authorization.

Local Accept List: An Accept List may be present at each reader; it is a subset of the server Accept List. It may be location-specific, e.g., it may include cards belonging to contactors that are only allowed access to certain parts of MTA, or mode specific, e.g., local Accept Lists on express buses may only contain card IDs associated with an express bus weekly pass. If a card is on a local Accept List, it is immediately accepted without server communication, and therefore reduces the transaction time.

5.14 Contactless MetroCard

See the supplemental document, Contactless MetroCard: Supplement to “Concept of Operations for MTA New Fare Payment System: Bus and Subway Deployment Phase, Release No. 1.2”.

5.15 Fare payment operations

- Local and express buses will continue to have a farebox unit
 - Accept CP devices as preferred payment method
 - Accept coins (nickels, dimes and quarters)
 - No bills accepted; exact fare required; no change is given
 - Split fares are not allowed; customer cannot partially pay fare with cash and remainder with CP devices
 - Farebox counts number of and dollar volume of cash fares
 - Bus operator must log in to farebox unit, possibly with employee CMC
 - Bus operator must be able to confirm a valid transaction was completed by all means of payment
 - Customer must be able to confirm accept or deny message
- SBS fare payment to move on-board
 - Readers placed at all doors and open boarding allowed at all doors
 - No cash (coins or bills) accepted
 - No contactless paper transfer tickets
 - Wayside equipment discontinued
 - Random fare payment inspection conducted by Special Inspectors
 - Bus operator will not confirm fare payment by any customers
- Other buses with open boarding
 - Readers placed at all doors and open boarding allowed at all doors
 - Coins accepted at front door farebox only; farebox counts number of and dollar volume of cash fares
 - Random fare payment inspection conducted by Special Inspectors
 - Bus operator will confirm fare payment by customers boarding only at front door
- Subway station turnstiles and gates will all have contactless readers

- SIR to implement readers at all stations
 - Customers must tap in or tap out at St. George and Tompkinsville, which are gated
 - Readers are part of validator units at other stations, which remain ungated
 - Random inspection on trains and on station platforms, which are fare paid areas
 - Handheld devices and inspection process similar to that of SBS program

5.16 Single ride ticket (SRT)

- NFPS prefers to offer the SRT through the CMC. If this is not feasible because of equity issues, the SRT will be a standalone contactless single ride paper ticket.
- If the SRT is offered through the CMC, it:
 - Will be available for purchase where CMC is sold.
 - Not be offered for bus transfers for cash paying customers.
- If the SRT is a paper contactless ticket, the ticket:
 - Will only be available for purchase at stations.
 - Will be issued on buses for bus transfer for cash paying customers upon request.
 - Cannot be reloaded or refunded.
 - Will be able to be written to (so that it will not be able to be used again).
 - Will be packaged, distributed and secure inventory managed by NYCT Revenue Control.

5.17 NFPS variances with payment industry operating rules

MTA has CP device acceptance needs that may require changes to or waivers from the payment industry operating rules. Differences between the MTA and mainstream merchants that may require operating rule changes or waivers or other industry accommodations include:

- Price of transaction at time of tap may be unknown. This may be due to:
 - Tap may be a free transfer and needs associating with prior tap to establish transfer eligibility.
 - Previous tap may not have been received by server because network communications are down.
 - Zone or distance-based fare is charged (not current bus or subway fare policy; example is current railroad tariffs)
- A tap at a reader may not result in a merchant transaction to be passed to a payment industry organization. This may be due to:
 - PIA fare product was purchased that covers this trip
 - Free transfer
 - Employee and non-revenue access
 - Service disruption that requires the customer to take an alternate route
- Online transport-authorizations (at NFPS server) or authorizations (at payment industry server) from taps must be processed more quickly than the current payment industry transaction time.

- Flawless access and efficient passenger flow requires transaction speeds similar to those achieved on other transit systems using closed-loop CP devices. MTA is targeting 500 ms or less for total transaction time at the reader for all transactions.
- MTA transport-authorization may benefit from access to industry Accept/Deny Lists, if feasible.
- Simple customer messages are displayed that indicate the accept/deny response and include other information as appropriate to meet customer needs and build customer trust; no receipts are given.
- Readers may need to be more robust due to difficult environmental conditions on buses (such as vibration) and in subways (such as extreme heat and vandalism).
- Management of Accept and or Deny Lists at card readers may be required.
- Ability to use aggregation of transactions prior to settlement as a means of reducing the cost of interchange.

Figure 5-1 below shows the standard four-party flow of transactions, funds, goods and services in a payment industry merchant transaction process. Figure 5-2 shows the same flow for NFPS, and is generalized to include various emerging payment schemes that involve new technologies and alternative authorization and settlement services (e.g., NFC phones and PayPal). Figure 5-2 also lists the elements that are unique to the MTA in the NFPS transaction model, as outlined above. The differences are primarily at the merchant's (MTA's) servers and readers, though the acquirer or alternate authorization provider may need to provide faster authorization, and payment networks may need to approve rule changes.

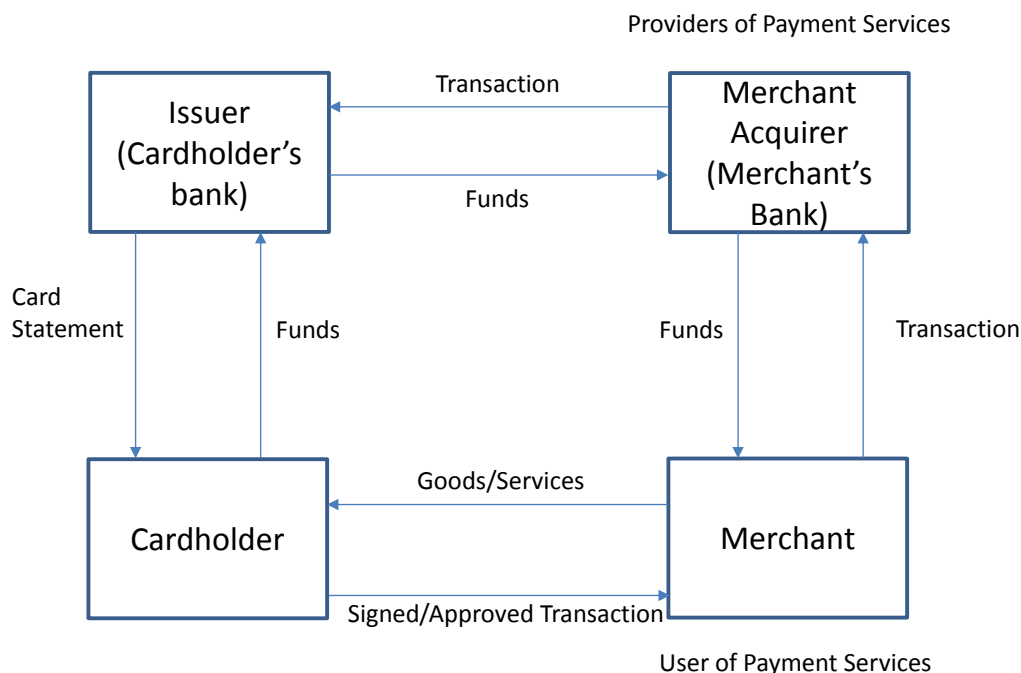


Figure 5-1 Standard Four-Party Payment Transaction Model

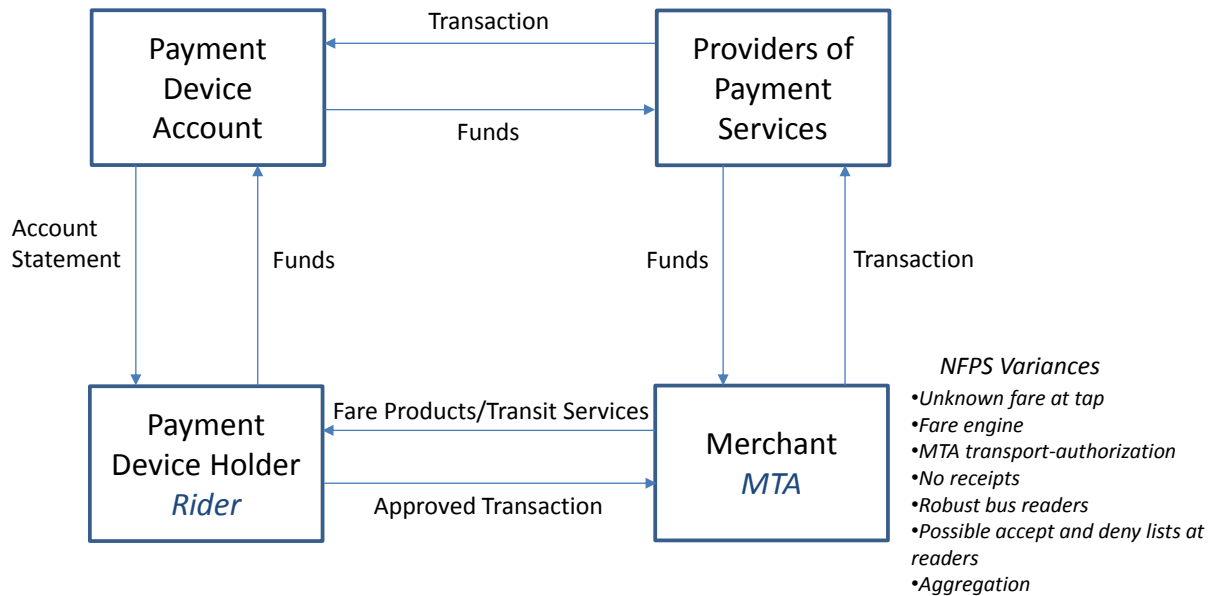


Figure 5-2 Four-Party Payment Transaction and NFPS Variances

5.18 Transition from MetroCard

Phasing out of fare product availability on MetroCard and MetroCard acceptance will not begin until:

- NFPS is live across the whole of MTA's bus and subway services
- MTA has complete confidence in NFPS risk management rules, transaction speed, revenue collection and accuracy of charges to customers' cards and backend reconciliations
- The CMC and supporting reload network are available.

In particular, the phase out of Pay-Per-Ride (or value) products, with or without the bonus feature, on MetroCard and of MetroCard generally for acceptance on buses both require the CMC be widely available and the reload network be widely placed. MetroCard and NFPS will not be interfacing systems, but there may be policy decisions that allow for customers to transfer balances from MetroCard into MTA accounts in NFPS.

6 USER ORIENTED OPERATIONAL DESCRIPTION

6.1 Strategies, tactics, policies and constraints

Three key elements critical to the success of transition to and acceptance of NFPS are (1) communications with both users and stakeholders; (2) a detailed staging strategy before, during and after rollout that considers phase-in by the different services and fares available and users (this is especially critical since NFPS and the legacy system will not interface and transfers cannot be processed between the two); and (3) adequate training before, during and after rollout.

6.2 User acceptance

The key strategies for ensuring strong user acceptance of NFPS include:

- Inform employees of system features and operational changes for employees through many channels:
 - Internal electronic and print media (e.g., Bus and Subway operator bulletins), intranet webcasts, etc.
 - Videos in depots
 - Meetings
 - Training
 - Help Desk
 - Meeting with labor representatives
- Inform customers of system features, rollout dates and changes through many channels
 - MTA system-wide: Web, print, ads, stories, interviews, press, and other media
 - Route and agency-specific:
 - Staged implementation plans, dates
 - SBS and other buses with open boarding changes
 - SIR changes
 - Other service changes (AirTrain, etc.) where MetroCard is accepted.
 - Customer groups: Disabled, student, seniors, others with specific changes in their fare payment processes.
 - Sales channels: Information on obtaining and reloading CMC, obtaining CP devices from banks, where to purchase PIA fare products, how to use PAYG, phase-out of MetroCard, cash acceptance changes
- Co-marketing with card issuers, partners and other organizations
 - Co-branding, reward and promotional programs, and other opportunities.
 - Retail reload marketing, opportunities to encourage lower fees.
 - Launch promotional programs and products.
 - On buses: informational pamphlets (“take ones”).
 - In station: signage, turnstile decals, KA railing signage.
 - Use new media available at time of deployment.

6.3 External²⁴ organizational acceptance

The key strategy for NFPS for ensuring external organizational acceptance is to inform and engage key stakeholder groups. These groups are:

- Customers, including customer advocacy groups
- General public in the New York region
- Other public transit agencies in the MTA region (where MetroCard is accepted and/or customers make intermodal trips)
- City of New York, including relevant city agencies, elected officials and emergency responders
- State of New York including interested elected officials and relevant state agencies
- Press, TV, blog and other media outlets
- Government and social service providers (issuers of EBT)
- Pre-tax transit benefit providers
- Retail merchants potentially in external reload network
- Payment industry
 - Bankcard networks
 - Issuing banks, alternative banks
 - Acquiring, alliance banks
 - Prepaid card issuers (open/closed loop)
 - Transaction processors
- Telecom carriers
- Suppliers/vendors
 - Equipment suppliers
 - Software developers
 - System integrators

6.4 Organizational structures

1. MTA will own NFPS. MTA will provide:
 - a. Management of NFPS
 - i. Overall project governance, direction and program management
 - ii. Fare and customer service policies
 - iii. Ownership, use and development rights, and management of intellectual property
 - iv. Performance reporting, analytics and planning
 - b. System requirements, design and implementation
 - i. Ensure stakeholder input
 - ii. Project strategy
 - iii. Project management methodology
 - iv. Planning
 - v. Budgets and schedules

²⁴ See section 12.4 for a list of internal stakeholders.

- vi. Risk management
- vii. Procurements and negotiation for components, services, integration
- viii. Implementation
- c. System lifecycle operations
 - i. System operations and maintenance
 - ii. System upgrades
 - iii. CMC issuance
 - iv. Commercial arrangements
 - v. Interfaces with operating agencies and service providers, including system capabilities to allow agencies to manage portions of NFPS
- d. Standards-based system components, using COTS components and existing services to the extent possible. These may be obtained from third parties where cost-effective.
- e. CMC, which may be a white label or co-branded prepaid card
 - i. Issuance, production, distribution, card management
 - ii. Reload network
 - iii. Customer service, account management
- 2. MTA will oversee provision of services from third parties for:
 - a. Acquiring services for Visa, MasterCard, Diners Club American Express, and Discover card transactions
 - i. American Express requires authorizations be directed through its network, but settlement and clearing can be performed either through American Express or a third party acquirer at MTA's option.
 - ii. Discover allows authorizations to be directed through its network but prefers acquiring services be consolidated with a third party acquirer.
 - b. Payment gateway services for required interface between NFPS servers and acquirer
 - c. Revenue enhancement opportunities
- 3. MTA agencies will manage some agency-specific elements of NFPS; these are still to be determined but may include:
 - a. Revenue control
 - b. Analytics and operational planning
 - c. Some operations and maintenance functions
 - d. Some customer service functions
 - e. Selling and reloading fare media

7 OPERATIONAL NEEDS

7.1 Vision, goals, objectives and gaps

The vision, goals and objectives for NFPS are listed below. Limitations of current practice are in *italics*.

- NFPS ultimately will be a single, regional fare payment system capable of use across modes and agencies. It provides for seamless travel across agencies by taking advantage of the payment technology and communications infrastructure that customers already know and use in their daily lives.
 - This vision encompasses the new fare payment system to be deployed on the MTA commuter railroads in the future. Significant differences exist in commuter railroad fare collection environment that will be addressed in a future phase.
 - The system must scale to accommodate future growth in NY/NJ regional travel via public transit
 - *The current MetroCard is not interoperable on MTA commuter rail services, or with several other regional agencies.*
- The system will reduce costs associated with fare collection, revenue processing, and reconciliation.
 - *The current cost of revenue collection at NYCT is 15% of each \$1 of revenue collected. The NFPS goal is to reduce this cost significantly.*
 - *MetroCard card life is relatively short, which increases card production and distribution costs.*
 - *MetroCard is a proprietary system which, due to its age, has increasing maintenance and operational costs.*
- NFPS will provide a customer experience that is superior to the MetroCard experience.
 - The NFPS will make using MTA services faster, easier, more convenient and secure than ever. All customer interfaces managed by MTA must meet this goal and MTA will strive to work with the other interface providers to ensure its customer service is of similar quality.
 - At every interface, customers will be provided the information they need to properly use the system and to earn and maintain their trust in the integrity of the system.
 - Best practices in merchant processing and customer service will be applied across the customer interfaces that comprise the NFPS customer experience.
 - A customer will be able to choose his/her own CP device. Most customers will not have to acquire and carry an additional card *as is required with MetroCard*.
 - A customer with a bank-issued CP device will not be required to pay his/her fare in advance *as is required with MetroCard*.
 - Customers will pay for MTA fare products in the same way they purchase other retail products; the same payment media, account management, billing, dispute resolution, and rewards programs are used as for other merchants, *instead of an MTA-specific set of procedures that is likely to be less familiar*.
- A customer may register for an account with the MTA, either providing personal information or anonymously, and will have online and telephone access to his/her own

account, including the ability to view payment transactions, and history of trips taken in near-real time.

- This provides a high degree of account visibility and transparency. Users registered with personal information may have protection on products purchased if their card is lost or stolen.
- *MetroCard account information provided to customers is limited in scope and where made available. Currently, it is limited to balance, expiration date and insufficient funds messaging. E-ZPass customers do have online access to more account information. They must register with address and credit card information. Cards are managed through serial numbers associated with the customers and time and value based passes are protected from loss or theft.*
- *MetroCard currently provides fare being charged, and balance and expiration date information at turnstile and farebox units and on in-station equipment (vending machines and swipe readers). Depending on the level of list management that can be performed at readers, NFPS may or may not be able to provide this type of information at readers. Information needs regarding fare product eligibility will be considered. For example, a customer who purchases a subway/bus pass but boards an express bus where subway/bus passes are ineligible may not otherwise realize s/he is paying a PAYG fare and not with his/her PIA product. Improved signage may be required on express buses and other situations where this may be an issue. NFPS, however, will provide adequate information for the customer to quickly know next steps to gain entry while limiting the need for customer to pause and read. A declined card, for example, would receive messaging based on the reason for the decline and direct the customer to either use another payment device, and/or call his/her card issuer.*
- For customers without a CP device or who prefer not to use their CP card at entry, MTA will make available the Contactless MetroCard. Customers with cash only can purchase fare products through in-station services and a robust external reload network. It gives the CMC user the ability to use the same services the bank-issued CP card holder enjoys, with the exception of using PAYG fares.
 - *Both MetroCard and CMC support unbanked customers with capabilities equal to banked customers.*
- The NFPS will be a server- and account-based system that is more capable than a card- and reader-based system, in terms of software reconfiguration and transaction processing parameters. This architecture is more flexible to implement fare policy changes, to access system data, and to manage the system for the benefit of customers and MTA alike. NFPS will have minimal customization to meet transit needs; it will be based on a mainstream merchant payment model.
 - *MetroCard System has limited flexibility, is time-consuming and costly to upgrade, and is not “future proofed”*

7.2 Economic objectives

- Lower required capital investments in the long-term. Capital expenditures for the NFPS in the long-term should decrease relative to currently planned capital spending for MetroCard.

- Lower operating costs. The NFPS should have an operational model and cost structure at least as efficient as current payment systems of agencies covered by NFPS, and to show improvement over the long term.
- Generate net integration savings across MTA agencies and modes. This applies when the NFPS is deployed at the commuter railroads, but the implementation for subways and buses should be done so that a future system operating across all agencies will reduce total operating costs at each agency by streamlining and merging redundant functions as well as reduce infrastructure and total costs when combined with NFPS costs at MTA.
- Minimize implementation costs.
 - Manage NFPS implementation to use COTS components and existing processes as much as possible.
 - Use existing gate and other infrastructure as feasible.
 - Use existing payment processes and agreements where possible; MTA has substantial credit and debit card operations under current MetroCard and other fare payment systems.
 - Avoid interfaces between NFPS and MetroCard during NFPS implementation period
 - Implement NFPS as rapidly as possible.
 - *MetroCard is reaching the end of its useful life. NFPS should be implemented before significant costs would have to be incurred.*
- Enable the MTA to negotiate business relationships that reduce reliance on single vendors, and ensure competition among potential partners for most needs.
 - *MetroCard is a proprietary system from single vendor*
- Have an appropriate technological lifecycle so that MTA can take full advantage of future technologies, ensured by:
 - Implementing technology that is at the appropriate stage in its life cycle,
 - Using open standards-based hardware, software and processes to promote competitive procurement, and
 - Managing systems integration to allow competitive, cost-effective migration and upgrades of components and vendors through time.
 - *MetroCard components cannot be upgraded independent from each other or from sources other than the single vendor. MetroCard is not standards based.*

7.3 Customer objectives

- Increase the ease, speed, convenience and flexibility with which customers may purchase fare products and use self-service channels to directly manage accounts.
 - NFPS allows purchase of PAYG products at turnstiles/gates, validators and farebox units
 - NFPS has website, IVR, call center, SMS, mobile van, and other channels for sale of PIA products
 - PIA purchases immediately available for access, regardless of sales channel used
 - NFPS provides account management, including self-service on a limited basis for approved refunds, and claims for service disruptions and other problems

- *NFPS sales channels are more flexible and easier to use and operate than MetroCard channels*
- Acceptance of wide range of standard CP devices that customers may choose among, such as bank cards, payment enabled mobile phones, pre-tax benefit cards, employer-issued ID cards, or non-traditional payment cards and other devices as they evolve.
 - *MetroCard is sole payment medium currently (except on buses). Customers will choose their payment media with NFPS.*
- Simplify how customers pay for fares
 - For bank-issued CP card holders, there is no requirement to know, select and purchase fare products in advance to enter any of MTA bus and subway services.
 - International travelers and tourists can easily use the system without prior knowledge.
 - *MetroCard users must select and prepay fares and MetroCard required for entry on bus and subway, although coins accepted on bus.*
- Ensure all customer groups, such as unbanked, reduced fare and others, have equitable access to fare payment options.
 - Users have no obligation to use a own CP device to access public transit
 - CMC supports all PIA fare products. *MetroCard at retail outlets supports only a subset of fare products.*
 - MetroCard and CMC equally available to all groups
- Have no MTA-imposed customer fees for use of CP devices for fare payment (besides the cost of the fare).
 - CMC will have a one-time cost to obtain. This may or may not be a deposit fee.
- Deliver a flexible access experience for families and groups
 - The MTA may allow families/groups access from the same card by accepting multiple PAYG or PIA value taps on one card for the same ride.
 - MTA may increase the limit from today's four MetroCard swipes per group, keeping a cap in place to minimize fraud. This will require a tap for each person making a transfer in the group on same card.
 - *NFPS can be more flexible than MetroCard for group travel.*

7.4 Operational objectives

- NFPS must support the allow/deny decision at readers with transaction speeds that do not exceed the target transaction time of 500 milliseconds (ms). 500 ms is the target for every reader transaction.
- Lower bus boarding times.
 - NFPS on-bus payment should result in no increase in SBS dwell time.
 - Open boarding should be implemented on all SBS routes and as many articulated and high volume bus routes as practicable to reduce dwell time.
 - *MetroCard bus fare payment times are slower than with a CP card*
 - *MetroCard mis-swipes²⁵ are relatively high compared to most fare systems*

²⁵ This includes both bus and subway mis-swipes.

- Operation at high levels of reliability and availability, meeting transaction speed and quality standards for MTA passenger volumes and operational characteristics. The MTA will set values based on typical payments and transit industry practices.
 - NFPS must support real-time monitoring of readers, servers, communication networks and other key components. *MetroCard reader, turnstile and gate monitoring is based on aging equipment.*
 - *NFPS new hardware will be more reliable than MetroCard. NFPS components must be tested/verified for ruggedness/durability in bus and subway station use.*
- Facilitate regional (MTA and outside MTA) transit interoperability through using the same fare media. Minimal or no fare coordination across agencies is required on ongoing basis: regional fares will be the sum of local fares unless agencies adopt joint fares.
 - *MetroCard has limited ability to cover commuter rail, NJT, etc.*
 - *With NFPS based on open payments, it creates potential for interoperability.*
- Compliance with ADA (Americans with Disabilities Act), egress standards, and other safety and service standards across all components

7.5 Security and risk management objectives

- Robust risk management processes based on payment industry practices will be used for the administration of card acceptance, accounts, cash, audits and other safeguards.
- Measures to prevent fare evasion or uncollected fares will be implemented based on transit best practices from MetroCard and other agency experiences. NFPS will support more frequent updates of Deny Lists, better passback control with server transport-authorization, and other improvements.
- Meet card security standards, including compliance with payment industry security standards (PCI-DSS and PA-DSS²⁶).
 - MetroCard vending machines meet prevailing security standards.
- Provide security measures to protect all components from viruses, intrusions (to steal credit card and personal account data), code-breaking, card replication, and other malicious attacks.
 - *Both MetroCard and NFPS must meet prevailing security standards*

7.6 Planning objectives

- Capture rich and valuable insights into customer behavior through improved operational data. NFPS will provide MTA with increased knowledge of customer behavior and habits through increased granularity of travel data and potential access to payment industry databases. Knowledge of travel and fare payment patterns and preferences will help management improve service and station planning. As a result, services can be better targeted and marketed to customers to improve the travel experience and potentially increase ridership.
 - *MetroCard data is captured at six-minute intervals; NFPS data will be more granular and flexible.*

²⁶ Payment Card Industry Data Security Standard and Payment Application Data Security Standard

- *Cash payment provides little data on the users of MTA services. NFPS will lower cash usage.*
- *NFPS data can more easily be used with other planned projects (such as Bus CIS and the Bus Camera project) for even richer set of data.*

7.7 System architecture objectives

The NFPS supports the following system elements:

- Use of COTS components and existing payment industry processes
 - *MetroCard uses proprietary, custom cards, readers and server software.*
- Open architecture that defines interfaces between components that can be separately procured and upgraded.
 - NFPS will allow MTA to procure readers, communications, server software, sales channels, CMC, and other components from different vendors. MTA can replace or change these components at different times, since they will meet standards to interface to other components.
 - *MetroCard is a single, proprietary system in which all components are delivered and integrated by a single vendor.*
- Support of key standards for payments:
 - North American contactless payment (“magstripe emulation”) standards, implemented as PayPass, PayWave, Blink, Express Pay and others.
 - North American magnetic stripe payment standards, at devices other than entry readers (turnstiles/gates, farebox units or validators).
 - EMV contactless standards. MTA will implement EMV (Europay MasterCard and Visa) in its readers and processing.
 - Standards for transactions between merchants, acquirers and payment networks: ISO/IEC 8583 Standard for Financial Transaction Card Originated Messages and others.
 - Best practices for Web and call center sales sites.
 - *MetroCard MVMs and MEMs support magnetic stripe payment cards. MetroCard readers support only MetroCards. No CP device acceptance capabilities currently exist.*
- Near Field Communications (NFC) for mobile phone payments:
 - The NFC standard supports payment applications that have not gained wide acceptance. The MTA will implement NFC in its readers to be prepared for NFC mobile phone payment, which is expected to become a mainstream technology in the next few years. NFC introduction has been slower than expected by many in the industry; the MTA will support NFC in anticipation of deployment of viable products and services in the mobile phone industry.
- Wireless telecommunication standards.
 - NFPS will initially use 3G wireless, from either the CDMA or GSM family of standards. 4G services may be specified in the future.

- *MetroCard uses older telecom services in subway environments, and does not use networks for communications with bus fare payment equipment. All fare payment is done offline, and bus fare collection information is manually removed from buses.*
- Public transportation specific software
 - Open payment public transport software (such as end-to-end server software for transport-authorization services, authorization services and a fare engine) is being developed by other transit agencies that have demonstrated ability in contactless open payment solutions. MTA may be able to obtain the major elements of the open payment fare system from these agencies through license, build or operating agreements, if any such arrangements prove economically advantageous to the MTA.
 - *Opportunities for sharing software and reducing costs will be higher in the open payment architecture than in a vendor architecture.*

7.8 Other objectives

- Facilitate potential non-transit business development and revenue
 - NFPS allows card issuers and others to offer rewards programs for MTA travel as a marketing strategy.
 - If a user has a CP card, joint product offerings such as concert or event promotions with MTA travel, and others, are feasible.
 - *These options are difficult to implement with MetroCard.*
- Leverage, don't duplicate, existing or planned MTA or NYCT investments to maximize scale and cost efficiency, where possible.
 - NFPS will share its on-board bus equipment with the bus CIS, as an example.
- Support of staged implementation of the new system for customers, MTA and agency staff and MTA operations and management.

8 SYSTEM OVERVIEW

This section describes the scope of the NFPS, expected users of the new system, with what the system interfaces, its states and modes, the planned capabilities of the system, its goals and objectives, and the high level system architecture for the NFPS. This chapter provides additional detail on these topics, which have been introduced in earlier chapters.

8.1 Scope of the NFPS

The scope of the NFPS encompasses all the hardware, software, networks, processes, people and organizations in the MTA family, and technological and institutional interfaces with outside entities required to support the NFPS. These are described in detail in Chapter 8 and 10.

MTA will own and manage the NFPS and operate and maintain some of the NFPS subsystems. Some subsystems may be provided to MTA by third parties; others will be provided by existing systems operated by MTA agencies.

8.2 System Interfaces

An interface is the point of interconnection between two systems, subsystems, or components. It is defined by the messages and physical characteristics that each system supports and how they communicate with each other. Operational interfaces support the core activities of NFPS and must be highly available and reliable. Management and planning interfaces may operate at lower levels of availability, and are often based on batch file transfers.

8.2.1 Internal interfaces

Operational interfaces between NFPS and internal MTA and operating agency systems include:

1. Links from MTA.info website to servers for purchase of fare products.
2. Interface between MTA NFPS servers and MTA bus customer information system (CIS). NFPS on-bus hardware is shared with Bus CIS.
 - See Bus CIS Concept of Operations for more information on scope of Bus CIS.
3. Interface between bus reader and other on-bus equipment, such as the destination sign controller (operator display keyboard) for operator login.
4. Interface between subway reader and turnstile/gate release mechanism.
5. Interface between NFPS servers and internal enterprise systems (such as Unified Timekeeping System).
6. Interface between NFPS servers and Reduced Fare information servers (currently PIC database).
7. In the future, MNR, LIRR and B&T will be included in NFPS.

Interfaces to internal MTA and agency support systems are described in Chapter 10.

NFPS also has management and planning interfaces to internal systems:

1. MTA and NYCT accounting and financial systems. NFPS must provide data to:

- NYCT Controller
 - NYCT Office of Management and Budget
 - MTA Controller
2. MTA audit systems. NFPS must provide data to these systems, including PCI-DSS and PA-DSS audits.
 3. MTA security systems. NFPS must provide data to these systems and comply with related security policies.
 4. NYCT employee pass issuing office. The CMC provider must obtain personnel data from this system and each employee's building access system provider (e.g., Kronos).
 5. NYCT Department of Security's Contractor pass issuing office. The CMC provider must obtain personnel data from this system.
 6. MTA Planning and Operations. NFPS must provide data to these systems through the data warehouse.
 7. NYCT Planning and Operations. NFPS must provide data to these systems through the data warehouse.
 8. Bus CIS. Initially, Bus CIS will provide bus location data to be merged in a relational database with NFPS tap data in order to analyze bus customer travel patterns. Future plans call for pairing of bus location data and revenue taps to be paired and encrypted and transmitted from the reader to the NFPS server.

8.2.2 External interfaces

Operational interfaces between NFPS servers and external systems include:

1. Acquirer(s) for settlement and clearing, for card and (future) mobile phone payments.
 - The acquirer may be requested to provide industry Deny Lists to the MTA TAPS for faster performance.
2. Bankcard networks (directly or indirectly) for authorization, payment transactions, settlement and clearances.
3. Telecommunication carriers for network configuration and management, for both wireless and fiber optic services.
4. Data Center for data archiving and reporting.
5. CMC issuance and management servers. A direct interface, not via an acquirer, may be used for high performance and availability.
6. Interface between CMC provider and reload network merchants.
7. CP device issuers and bankcard networks, for customer service issues.
8. Component and services vendors, for maintenance and support.

Existing standard interfaces will be used. If there is no appropriate existing standard, MTA will define an interface in consultation with potential vendors.

Institutional interfaces between NFPS servers and external systems include:

1. Government and social service providers (EBT cards).
 - EBT card holder may individually acquire a CMC, in which case no system interface is needed; or

- NFPS servers must obtain data on card IDs and selected fare products from EBT providers' systems with payment made through EFT.
- 2. Providers of pre-tax transit benefits. For pre-tax transit benefits provided through EFT, NFPS servers must obtain data on card IDs and fare products from the providers.
- 3. Police (MTA, NYPD). CMC provider must obtain data from these systems.
- 4. Emergency personnel (NYPD, FDNY, etc.) CMC must be provided to these groups.
- 5. MTA employees and contractors. CMC providers must obtain personnel data from these systems.
- 6. MTA Inspector General.
- 7. Employers that issue PIV cards (contactless ID card). NFPS servers must obtain data on card IDs and fare products. Payment would be made through EFT.
- 8. Universities and schools that issue student cards (contactless ID card). NFPS servers must obtain data on card IDs and fare products. Payment would be made through EFT.
- 9. Other non-MTA agencies accepting and selling CMC.

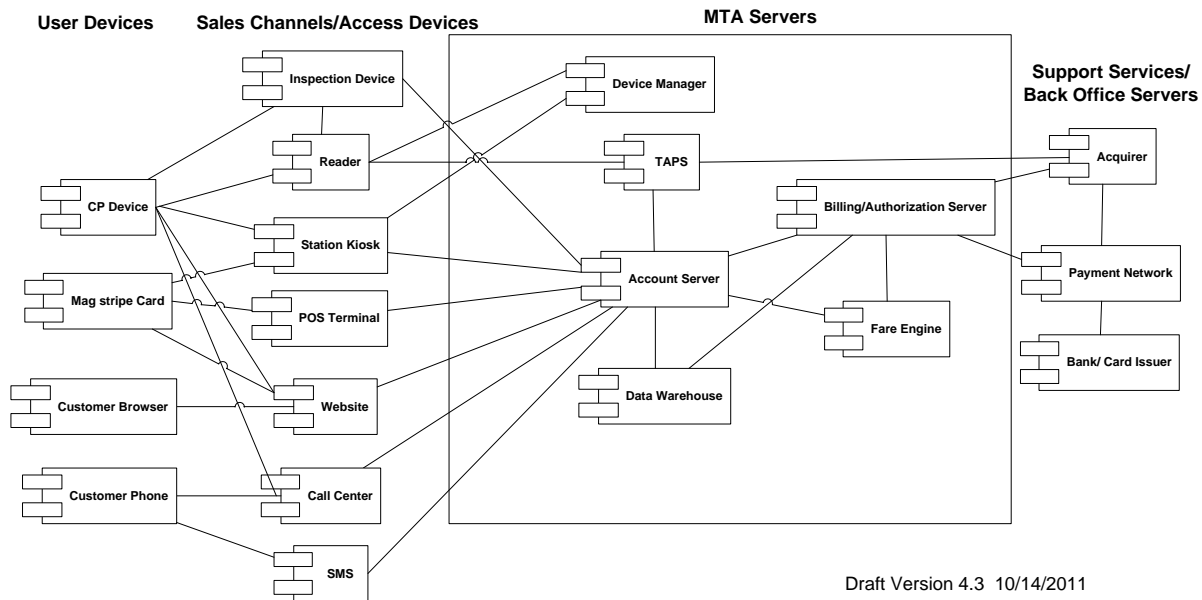
The MTA will publish a standard specification for these transactions that all of these interfaces will follow. The interface may involve batched payments, immediate and online payments, or both. High availability of the interface may not be required. The MTA will consult the external providers in this process. Exceptions to the specification will be handled as needed.

8.3 System architecture

Figure 8-1 is a high level sub-system diagram that illustrates NFPS's concept and will guide the requirements and design process. COTS components form the basis of the system:

1. User devices are general-purpose cards, phones and browser devices owned by MTA customers. (Users buy a CMC if necessary.)
2. NFPS sales channel and access devices are standard retail readers, website, and call center, with minimum customization for the MTA.
 - a. The inspection device is used to verify that users have tapped their CP device where entry is not gated (e.g., SIR and on buses with multi-door boarding).
 - b. The in-station services may consist of both station personnel and in-station kiosks.
 - c. Other channels with limited usage such as mobile vans and EFT processes are not shown.
3. NFPS servers are based on standard components as much as possible:
 - a. The device manager, data warehouse, account server, and billing/authorization server are based on retail software products, with minimum modification.
 - b. The TAPS and fare engine are custom MTA software.
4. The payment industry servers are standard.

NFPS Sub-System Diagram
Bus and Subway



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Footnotes:

1. Components in the MTA servers box are not necessarily stored in different servers. These components signify various applications and management routines that need to occur in the MTA back office. This component diagram does not specify the number of servers and the locations of these servers. MTA will consider alternate options that could further leverage existing vendor assets and experience, while keeping MTA's objective of modularity.
2. This component diagram does not include the Contactless MetroCard sub-system.

Figure 8-1 NFPS System Component Diagram

8.4 CP Devices

The NFPS should be designed to process a large number of CP device types, but decisions on specific types and the timeline for doing so will need further analysis. The planned capabilities are:

- “Magstripe emulation” CP devices from all card network brands and issuing banks will be accepted at MTA readers and PIA sales channels.
 - Contactless single ride paper tickets, if not offered through the CMC, will be accepted. A protocol must be selected.
 - Magnetic stripe cards from all card network brands and issuing banks will be accepted at PIA sales channels, but not at MTA readers.
 - Contactless EMV devices will be accepted at MTA readers and PIA sales channels.
 - PIV cards may be accepted. The MTA will perform an analysis and request vendor input.
- Key issues are:

- If regional institutions (such as employers and schools) issued PIV (FIPS 201) cards, sold MTA products to their card users, and paid the MTA through EFT, it would be a low-cost sales channel for the MTA.
- The MTA would need to have PIV software on its readers.
- NFC phone payment may be accepted. The MTA will perform an analysis and request vendor input. Key issues are:
 - There is some uncertainty as to when NFC payment is expected to be implemented.
 - NFC phones operating in NFC card emulation mode require no additional MTA reader software or differences in processing; they are emulating a CP card. However, this payment model has not been implemented widely.
 - NFC phones operating in peer-to-peer mode can support payments, and may be the platform used by innovators in the future. The MTA would need to have NFC software on its readers to support this option. This would future-proof the system for mobile phone payment.
- The MTA must be able to select card types it would not honor for business or risk management reasons, as far as is allowed by merchant and card network agreements

8.5 Contactless MetroCard

See the supplemental document, Contactless MetroCard: Supplement to “Concept of Operations for MTA New Fare Payment System: Bus and Subway Deployment Phase, Release No. 1.2”.

8.6 PIA sales channels and customer service

While the PIA sales channels are for use by both customers with their own CP device and CMC users, these subsystems and their functionality are preliminarily covered in the document, Contactless MetroCard: Supplement to “Concept of Operations for MTA New Fare Payment System: Bus and Subway Deployment Phase, Release No. 1.2”. PIA sales channels will be covered in depth in the future Concept of Operations document for the Contactless MetroCard. This document is not yet available to the public.

8.7 Reader subsystem

The reader subsystem is made up of several components:

On buses, the subsystem contains a terminal/CPU, modem, display (LEDs and audible messages for customer and bus operator), power supply, contactless reader, and an enhanced GPS component to provide location. It connects to the bus destination sign controller and keyboard for operator login. Details include:

- Initially, readers will be separately installed from legacy farebox units although the readers may be installed physically adjacent to or (preferably) on top of the farebox unit.
- In the future, the next generation farebox unit will comprise the reader, coin acceptance, and the bus operator log on components. Local and express buses will eventually use the next generation farebox units.

- SBS, articulated buses, and buses on selected high volume routes will have multiple readers placed at each door used for boarding, but no farebox units. Whether these readers work with a single terminal or multiple terminals (one for each reader) will be decided during design and be specific to each bus model.

In subway stations, the subsystem contains a terminal/CPU, network interface (wired or wireless), customer display (LEDs and audible messages), power supply, and contactless reader. It is connected to turnstile arm/gate release to provide access. Details include:

- The NFPS will use the existing turnstile and gate equipment in the subways with no reliance on existing vendor proprietary software for the gate arm or lock release (i.e., the NFPS will have a direct means of gate arm or lock release that functions side by side with the existing MetroCard system until the MetroCard system is retired from service).
- The addition of the readers to the turnstiles and fare gates will maintain compliance with ADA, NYS building code and other station-related code requirements.
- NFPS must be able to configure and manage up to 100²⁷ turnstiles in a station.
- If possible, NFPS will be installed to allow for the possibility of future deployment of exit or out-of-station transfer readers. The MTA will study the feasibility and costs of this option.
- When a CP device is accepted at the reader in the subway, there needs to be simultaneously release of the turnstile arm or gate lock with the “allow” message to customer.
- The system must allow for remote release for at least one turnstile or gate in each array by station personnel or the command center.

At non-gated SIR stations, it contains a terminal/CPU, network interface (wireless), display (LED and audible messages), power supply, and a contactless reader. It is enclosed in a validator unit (that is free-standing or installed on a wall) on a station platform.

The reader subsystem is based on COTS components and is updatable at any time by the MTA. The MTA-specific changes are:

- To accept all CP devices selected by the MTA.
- In buses, additional Bus CIS software application. See the Bus CIS Concept of Operations for more detail.
- To communicate with the MTA TAPS through a secure communications channel. This function will follow standard merchant terminal authorization practice as closely as possible.
 - The reader may need to check local Accept and Deny Lists as part of the MTA transport-authorization process. These lists will be periodically updated.
 - The reader must allow access if no response is received from the MTA TAPS within a timeout period.

²⁷ This number was determined by doubling the maximum number of turnstiles in a station currently and rounding up.

- The reader must resend the taps without a response when the communications link and TAPS are up.
- The audible and visual displays will show transit-specific responses and data. On buses, both the customer and operator must be able to see and hear them.
- Fare transactions must be recoverable from the readers by technicians if they cannot be sent through the communication channel.
- As indicated earlier, the total reader response time to the customer after card tap must be 500 milliseconds or less.

The proposed process for handling fare taps when reader-to-server communications are down (orphan mode) in both bus and subway environments is:

- Reader checks its local Deny List, if present. If a card is on the Deny List, it is declined. Otherwise it is accepted.
- Reader stores all taps and sends them in a batch when communications is re-established. It may be necessary for each reader to wait a random time before sending, so that all readers don't attempt to send at once if there was a network-wide outage, for example.
- The TAPS handles all taps as delayed taps, not real-time taps. They are sent to the Billing/Authorization Server and fare engine to be priced, authorized if needed, and recorded in the account server. (The data warehouse will be used to analyze the risks and losses when taps are delayed, and to suggest procedures to manage the losses.)

8.8 Inspection device

An inspection device will be used by authorized personnel on SBS and SIR, and as needed, other buses on which open boarding is implemented, to inspect and verify fare payment. Details include:

- The inspection device communicates with the NFPS server to obtain information on valid taps made on the SBS bus or the SIR system within a certain timeframe. This is expected to use wireless data communications.
- After the tap information has been downloaded to the inspection device, the inspector will ask users to tap their CP devices on the inspection device to verify that they have valid fare media.
- The inspection device should be COTS. If COTS inspection software is not available, an MTA inspection application must be written.

8.9 Transport Authorization Proxy Server (TAPS)

The TAPS is a transit-specific server that provides a rapid response to bus and subway readers after a customer taps a card. The MTA expects this server to be custom software with standard interfaces.

The TAPS:

- Receives all CP device taps from all readers:
 - If a CP device is not accepted by the MTA for various reasons (described below), the server denies access immediately and sends the response to the readers.

- The reader may act locally by granting or denying access if no response is received from the TAPS within a defined time.
- Processes taps:
 - Checks for a valid CP device number.
 - Checks Deny List of devices that will not be accepted.
 - Checks PIA products associated with a card, and allows access for valid products
 - Performs system-wide velocity checks.
 - Enforces passback restrictions on unlimited pass products for CMCs.
 - Checks access rules for non-revenue CMCs
- Interfaces with the billing/authorization server to request authorization from card issuer for PAYG taps. Receives and stores authorization responses from Billing/Authorization Server.
- Sends response to reader to allow or deny access if device is transport-authorized or if authorization response not received within a set time.
- May forward the time and location attached to each tap to the Bus CIS server.
- Must allow flexibility for the MTA to configure and enforce risk and revenue management rules and parameters.
 - Risk and revenue management rules must be set and implementable in accordance with the liability MTA will assume under payment network operating agreements and with issuers which may be negotiated. MTA revenue risk is ideally nil.
 - MTA wishes to obtain industry Deny Lists via the billing/authorization server, and store the lists at TAPS.
 - The TAPS must contain programmable logic for placing and removing cards on the MTA Deny and Accept Lists.
 - The TAPS will manage the download and updating of local Accept and Deny Lists on readers, if used. The update interval and list size will be analyzed by the MTA.
 - Historical risk factors may be taken into account. For example, if risk experience is good for certain cards, or if an issuer will take the risk on the first tap of a card, the server may place these cards on the Accept List.
 - The TAPS may configure the amount to authorize for a tap.

8.10 Billing/Authorization server

The Billing/Authorization Server manages the payment processes between the MTA and the payment industry. These processes occur either through MTA's acquirer or directly between the MTA and payment industry. The Billing/Authorization Server also manages settlement with internally stored accounts in the NFPS account server.

The Billing/Authorization Server will have standard risk management features and is a typical merchant application. The MTA prefers a commercial retail software offering that can be configured to meet its needs. If that is not possible, an MTA-specific Billing/Authorization Server can be written as customer software by a third party with substantial experience and software assets in retail billing.

The detailed capabilities of the Billing/Authorization Server include the following standard elements for all merchants:

- Submits payment transactions for PAYG taps, PIA fare products to acquirer or payment network. It should be configured to request the lowest cost payment network for a given transaction, e.g., credit, PIN or signature debit, when there is a choice.
- Manages clearing, settlement, and exceptions; clears holds.
- Updates product purchases and payment transactions in customer accounts.
- Manages exceptions such as refunds and disputes.
- Uses typical transaction messages to and from acquirers, so the MTA can change acquirers without substantial software expense.

Capabilities that may require configuration for the MTA include:

- Ability to support rapid authorization for some card types or issuers, if available.
- Sends authorization approval or decline messages received from the acquirer or issuer to the MTA TAPS.
- Aggregation of transactions, by device type and by purchase type, as allowed by payment network rules for transit. The Billing/Authorization Server aggregation parameters must be configurable and flexible to meet the evolving risk management needs of MTA and adapt where appropriate to changing payment industry operating rules.
- Accepts Industry Deny Lists and passes the lists to the MTA TAPS (and possibly to readers) to allow rapid transactions at readers. This is subject to industry rules.
- Handles payments and funds transfers for media such as student or PIV cards.

8.11 Account server

The account server maintains account data, transaction history, tap history, and purchase history for all MTA travel, except coins used on buses. It provides registered customers access to their stored accounts.

The account server is a typical merchant application. No significant MTA-specific requirements are anticipated, beyond the typical tailoring done for any merchant.

The detailed capabilities of the account server include:

- Manage PIA value product account balances, credits, and debits
- Manage PIA time product validity dates
- Manage stored accounts and associated fare products
- It is queried by the TAPS to place or remove cards on the MTA Accept List that have valid or invalid PIA products. Rules for determining valid or invalid PIA products should be configurable.
- It supports accounting, audit, customer claims, revenue reconciliation, and other account management functions.
- It is queried by the NFPS sales channels to obtain transaction and travel history.
- It has a product price and features table that can be queried by sales and other channels.

- It will support account management actions from NFPS sales and customer self-service channels (including employers and school administrators who wish to view/manage their participation with the MTA) to change customer details, and allow correction of some errors (for example, in the event that future policy permitted trip refunds when service disruptions occurred)
- It will support customer queries and password management via a customer account server.

8.12 Fare engine

The fare engine implements MTA fare and transfer policies. It computes the fare to be charged for each tap or set of taps (e.g., a tap on a subway and a second tap on a bus that counts for a free transfer) that define a trip, based on location and time of taps. It transmits this fare to the account and Billing/Authorization Servers.

The MTA expects this server to be custom software.

The fare engine performs the following computations. When requested by the account, Billing/Authorization Server, the fare engine computes the fare for a trip based on tap locations and times, customer type, and MTA fare and transfer policies:

- The fare engine receives a set of taps for a CP device, and the set of fare products associated with the device.
- It computes the trip segments: single travel legs on a single mode or vehicle.
- It then computes the trips: linked travel legs on one or more modes or vehicles, including transfers. If the requirements for a free transfer are not met, two trips are created.
- It then computes whether the trips are fully, partially or not covered by a PIA product.
- The fare is based on:
 - Fare and transfer tables, including special fare restrictions.
 - Representation of the MTA network, including out of station transfers, and other special cases.
 - Tap location and time. The tap location determines the type of service.
 - Fare products held by the customer.
 - Customer type (e.g., reduced fare, student).
 - Optionally, service disruption information to automatically adjust fares.
- It returns the result to the server that requested the computation.
- If the set of taps for a device changes, the fare engine may be invoked to recomputed the fare. The requesting server will manage the fare/price adjustment in the customer account.

The fare engine must be able to handle the following fare products, policies and scenarios:

- PAYG (single ride, including transfers).
- PIA value (SRT, pay-per-ride, including transfers).
- PIA period passes.
- Non-revenue employee passes.
- Group travel, when a card is tapped multiple times.

- Special passes for law enforcement, local police, fire, court officers, etc.
- Reduced fares for elderly, disabled, student fares, with varying fare pricing depending on distance and grade level. Time limitations may apply.
- All product pricing may vary by mode and agency.
- All product pricing may provide free or reduced fare transfers.
- The fare engine must handle end-of-fare-policy-period fare products. For example, if fare policy changes on January 1, customers with PIA products bought before January 1 may have special fare rules for a limited time.
- The fare engine should be able to handle fare policy changes that occur on different days for different modes. For example, in the future, new subway fares might begin at the end of the month, while new commuter rail fares might begin at the start of the month.
- The fare engine should be updatable within 15 days or less for a fare increase (an increase in amount of an existing PIA and/or PAYG products) and 30 days or less for new products.
- The MTA may define new fare types that combine the parameters listed above as well as new parameters, and the fare engine must be able to apply them to taps.
- The fare engine should be able to charge amounts as small as \$0.01.
- The fare engine should know the real-time location of each tap.
- The fare engine stores the fare table and transfer tables for all products.
 - It provides this data to other servers on request, such as the account server for sales and customer support.
 - Data transfer between MTA's fare creation software and the fare engine should be seamless and automatic.
- A minimum time is defined before a fare is computed and returned to the other server. Typically, this is greater than the maximum transfer period (currently about two hours). This allows a full trip to be completed, properly recorded in history, and properly priced.
 - A server may request an immediate fare calculation based on taps on hand, regardless of the minimum time.
- Delayed taps may be sent to the fare engine; these are taps transmitted substantially after the tap timestamp due to equipment or network failures. The fare engine returns the trips and fares to the requesting server, which handles any required credits or rebilling.
- Open payment technology will support the implementation of a wide range of innovative fare policies, if they were to be adopted, such as:
 - Period passes may have fixed or variable start days; for example, weekly passes may always start on Monday, or may start at the time purchased, or may start with the first tap after purchase. This is configurable.
 - All product pricing may vary by day of week (weekday, weekend, holiday), or time of day (more than two times of day), or direction (peak/off-peak) or a combination of these parameters.
 - All products may have distance based or zonal pricing (applicable to commuter rail fares).
 - Product pricing may vary by branch or line (applicable to commuter rail fares).
 - Products may include "step up" and "step down" fares (transferring from a local bus to an express bus).

- Promotional products that may be defined that give discounts to specific customer groups on specific services for marketing reasons.
- New fare products may include best value and capping for daily, weekly and other periods.
- Refund or discount amounts may be computed in response to refund requests for service disruptions.

8.13 Data warehouse

The data warehouse stores fare payment and usage data for NFPS analysis and reporting purposes. It supports the needs of the NFPS managers, operators and maintainers; and MTA and agency planners. It does not support real-time transaction processing.

It will be a COTS package with some configuration for interface with MTA systems. The system will be a widely accepted system in conformance with MTA enterprise requirements. All necessary reports and analysis tools will be supported by the warehouse.

The key features are:

- Records are kept for the purposes of:
 - reconciliations
 - transaction history
 - audits of system performance
 - risk management performance
 - customer claims
 - bank claims
 - authorization clearing checks
 - operations planning
 - system upgrade planning
 - police actions or fraud patterns/detection
- Maintain records for all taps received and read at readers by location and include all decisions made on the tap through to settlement and clearing, and account updates, if any.
 - The fare engine relates taps to trip segments and billed trips, and these relationships must be retained
- Maintain records for all customer account transactions and parameters.
 - Fare product purchases, transactions, authorization status, credits/adjustments, disputes.
- Maintain records of NFPS equipment status, errors, configurations, for audit reasons (e.g., when bus readers were in service on which routes) and reliability analysis reasons (not available for real time use²⁸).
- Maintain records of NFPS performance measures, as discussed in chapter 12.
- System capacity, data retention and ownership:

²⁸ Real time operational and performance reporting will be provided by the application servers described in Chapter 10.

- Greater capacity and functionality than the current NYCT Data Mart is required. The needed capacity will be analyzed by the MTA.
- The data will be stored in:
 - A reporting database, accessible in real time and online.
 - A historical database, accessible in near real time and online.
 - An archive database, accessible offline.
- All NFPS server generated data will be routinely backed up and after pre-determined time intervals, archived. For all outside providers, the service level agreements will require the same.
- A business recovery plan will be developed and implemented.
- MTA will need unlimited and free access to stored data for any purpose.
- The data captured will be replicated during and after transaction processing, in compliance with security requirements such as PCI-DSS version 2 and MTA's own policies regarding customer information.
- Data and systems will be exclusively owned by MTA.
- It is not mandatory to store all data in a single environment.
- Data warehouse should have its own dedicated hardware, not to be shared with other server applications.
- Reporting and analysis features:
 - Dashboard to provide MTA and operating agency personnel near-real-time data on sales, ridership, system performance and equipment availability.
 - Multi-stage reporting platform that accommodates detailed data, business operations, management reporting and customer applications.
 - Data extraction should be easy, fast, and cost effective.
 - Data formats should be user friendly, acceptable and based on open standards.
 - Report formats should be easily configurable.
- Access control and security:
 - Data must be secured, through encryption and other protection mechanisms, consistent with PCI-DSS requirements.
 - Access to the data warehouse by users will be controlled based on MTA data security and other applicable procedures.
 - Data must be auditable.
 - Data must be securely replicated and archived off-site.
 - Secure data must be kept separately from non-secure data so access to non-secure data can easily be given.

8.14 Networks

The telecommunications networks for NFPS will connect:

- All readers to the TAPS and device management servers,
- All sales channel servers to the account and device management servers
- The MTA Billing/Authorization Server to payment industry servers, and
- Processing servers to other servers in data centers

One of the primary objectives of the NFPS project is the actual delivery of a high quality, subways communications network infrastructure utilizing a flexible and cost effective technology capable of providing future-proofed services that processes fare collection transactions timely.

NFPS requires an end-to-end subway network design, installation and on-going management plan for a resilient Wide Area Network (WAN) and a Station Local Area Network (LAN) solution for all NYCT 468 subway stations and the 22 Staten Island Rail (SIR) stations. The following defined terms will be helpful in clarifying the concept:

- Fare Control Area (FCA): The FCA is an aggregation of turnstiles, access gates, High Entry/Exit Turnstiles (HEET) and (if deployed) Station Kiosks.
- Point of Sale (POS): POS devices are networked terminals and readers deployed by NFPS that are available at every Fare Control Area (FCA) to gain entry into the subway system.
- Station Local Area Network (Station-LAN): The Station-LAN will provide the core infrastructure that will be used in an open payments account based solution as required by NFPS and connects all Point of Sale (POS) devices installed by NFPS to one or more network interfaces.
- Wide Area Network (WAN): Connects the Station-LAN to network demarcation points terminating at the backend infrastructure supporting NFPS transaction processing
- Backend Cloud: NFPS transaction processing infrastructure

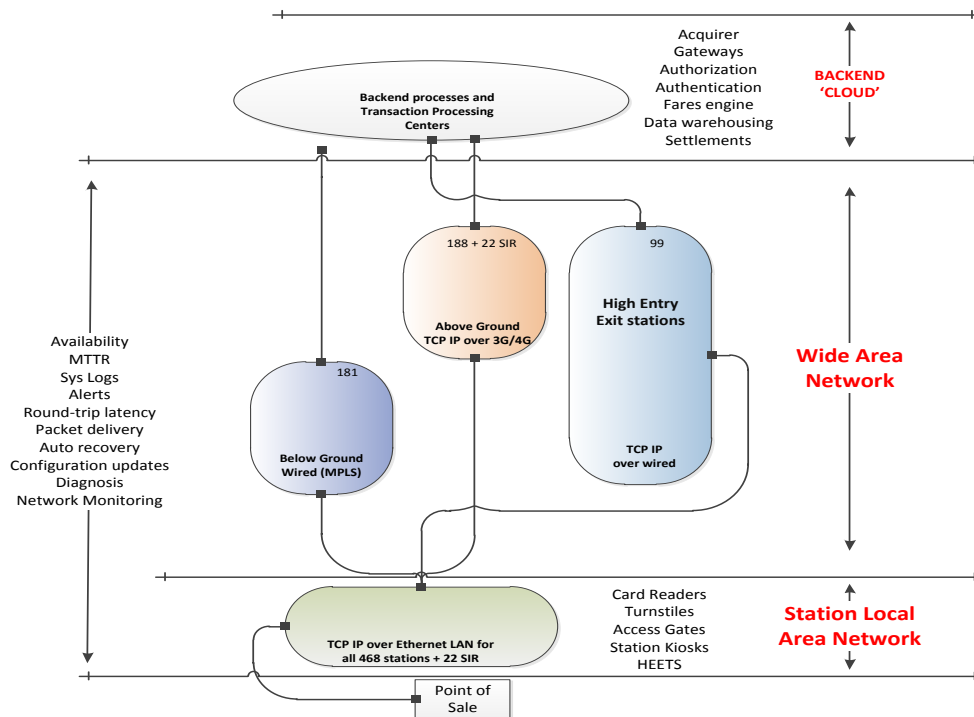


Figure 8-2 Concept of Point of Sale, WAN, Station-LAN and Backend Cloud

The network infrastructure for NFPS will consist of the following:

- Installation of a high availability WAN between the 188 above ground, the 181 below ground stations, the 99 high entry-exit stations and the 22 SIR stations.
- Installation of a TCP/IP Ethernet based LAN at all Fare Control Areas within the 468 subway stations and the 22 SIR stations.

NFPS will obtain the services of a 'Lead Carrier' that would manage all network SLAs in an end-to-end manner between the Point of Sale to the network demarcation point terminating at the NFPS transaction processing center(s). The concept of a 'lead carrier' managing the network infrastructure supporting both the Station LAN as well as the WAN holistically is critical for the following reasons:

1. Clear performance accountability
2. Effective network system monitoring
3. End-to-end SLA management
4. Simple contractual approach

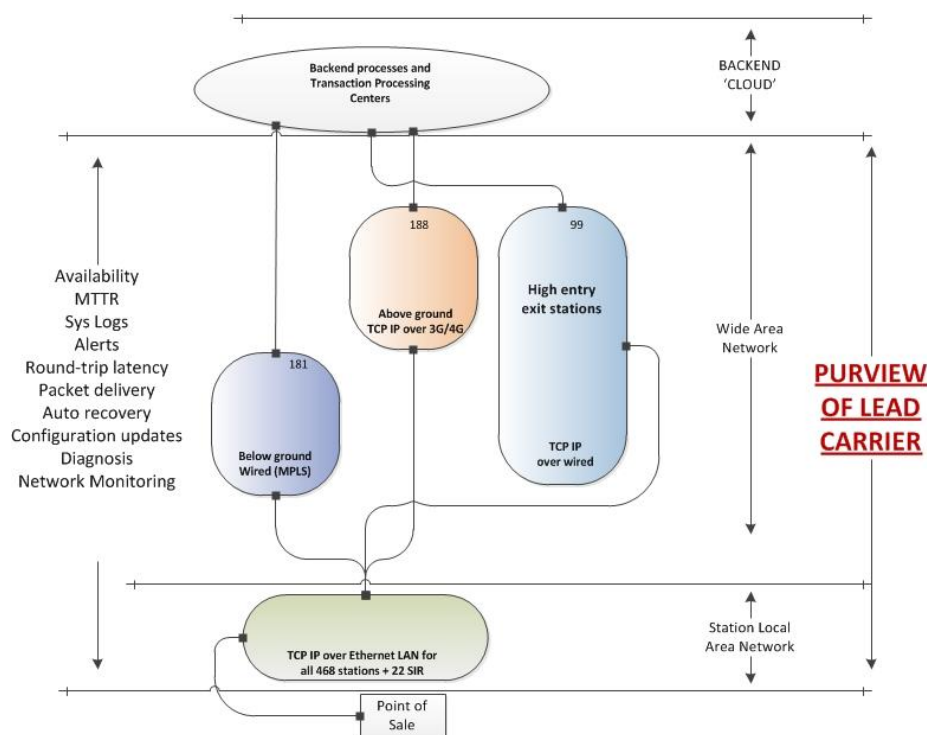


Figure 8-3: Concept and purview of the lead carrier

The MTA requires a 99.99% robust network solution and availability. If 99.99% availability is possible, simple processes for handling fare collection during network outages may be sufficient. Server availability should be 99.99% or better, based on typical commercial service levels.

The Station LAN and the Fare Transaction Processing Centers should be connected to a Multi-Protocol Label Switch (MPLS) backbone network. This infrastructure will provide a secure, fully private environment delivering high levels of service and performance. The backbone network should be engineered to support the highest possible levels of availability and performance which provides the MTA with a strategic platform for today, ensuring high priority data such as bank card transactions, are able to be exchanged with external systems at all times and allows for growth in the future.

The minimum bandwidth requirements are 1.5Mbps per station site. There may be future requirements to transfer more data. Station sites should be configured to meet the metric of an approximate 500ms transaction time at a future NFPS device. To support 99.99% service availability guarantee, station sites should be configured with a primary and backup access link. Further metrics should be measured and established depending on chosen technology. Traffic prioritization is required to ensure that the highest priority data such as bank card data is sent first in the event of congestion.

8.15 System security

NFPS security will be based on merchant practices, certified to PCI-DSS and PA-DSS standards. The key security elements in NFPS are:

- Security protocols and key management for reader-server communications and for payment data on readers. The readers will meet PA-DSS standards.
- Data will be encrypted at readers/terminals according to PCI-DSS standards, sent over the network, and decrypted at the TAPS.
- Data protection on several MTA and other servers, which must meet PCI-DSS standards:
 - The TAPS processes tap information and transmits it to the authorization server when necessary.
 - The Billing/Authorization Server processes and transmits tap information.
 - The account server processes customer and NFPS entry of CP devices.
 - The fare engine should not handle payment card identifiers; it can use an account or proxy identifier and should not require PCI-DSS compliance
 - The data warehouse stores tap data, as allowed by the rules, and must be protected.
- Security protocols and key management for server-to-server communications, which will handle tap data and must be protected.
 - This applies to acquirer, bankcard network, issuer, and other payment industry (and mobile phone payment industry) servers.

Data must be sufficient to comply with audit requirements and to satisfy settlement and dispute processes with banks.

The MTA must protect the privacy of the customer and his/her transactions as required by laws and regulations, including the MTA All-Agency Policy on the Release of Customer Account Information, the New York State (NYS) Personal Privacy Protection Act and the NYS State Technology Law. MTA must provide appropriate access for law enforcement.

9 OPERATIONAL ENVIRONMENT

The NFPS will operate in a 24 hour/7 day per week/365 day per year environment requiring reliable, high performance devices, components, networks, and systems to support high throughput.

This section describes the physical operational environment in term of facilities, equipment, computing hardware, software, telecommunications, personnel, operating procedures, services and interfaces necessary to operate NFPS. The operational environment for the NFPS will be supported by components and services (some of which already exist) that are primarily commodities with little need for customized hardware and software. Commodity items are expected to include the following, though modifications are required in some cases:

- Readers
- Subway turnstiles
 - Accessible subway gates (AFAS [ADA Farecard Access System] Service)
- Bus farebox units
- Wireless communications
- Fiber optic communications
- CP Devices: credit, signature debit, prepaid, PIV, student, pre-tax benefit cards, CMCs
- Bankcard issuer/merchant acquirer/payment network, including CMC
- Website (including mobile phone interface), call center, SMS
- Station kiosks
- Inspection device

The operational environment will also be supported in a few cases by services that have limited precedent in the transaction processing and subway environments, but are services that otherwise exist:

- Billing and account servers: Based on typical merchant practice
- Fare engine and TAPS: Precedents:
 - Developed by MasterCard for NYCT phase 2 pilot
 - Being developed by TfL for open payment
- 3G/4G wireless for bus server communications
 - Common precedent found in logistics industry, e.g., FedEx, UPS; also in NYC Taxis
 - Demonstrated 3G successfully in NYCT phase 2 pilot
 - 4G may be available before year end 2011
- Wireless communications to fare equipment in subway stations
 - Demonstrated successfully in NYCT phase 2 pilot and in experiment in Fall 2010
 - Limited use in other transit systems
- External reload network
 - Prepaid card and reload services exist through POS terminal or kiosk
- NFC phone use at readers with open payments
 - Many NFC trials have been conducted, and initial open payment efforts are underway

- PIV, student, and pre-tax benefit cards

The components involved in operating the NFPS are listed below. The relevant standards, MTA and NYCT operating procedures and, if necessary, service level agreements must be developed for each component. Data centers, servers and similar components for which there are no custom NFPS requirements are not listed.

9.1 Stations and bus depots

- Subway stations
 - Fare control areas²⁹ which contain:
 - Contain kiosks and customer signage with NFPS information
 - Turnstiles with readers and audio-visual displays
 - Turnstiles/gates with readers and audio-visual displays
 - Some turnstiles/gates may be remotely connected to NYCT Rail Control Center
 - Roving personnel to provide customer assistance, including for customer queries about NFPS
- SIR stations
 - Validators with readers at ungated stations in stations and on platforms
 - Roaming Special Inspectors with inspection devices
 - Inspection devices
 - Recharging stations for inspection devices, as needed
- Bus depots
 - Coin collection equipment, either vacuum or lock box procedures and storage. No change from current equipment.
 - Reader test and support equipment for repair and maintenance
 - Recharging stations for inspection devices, as needed

Within these facilities, NFPS equipment must operate within current conditions to the extent possible. In general, stations and bus depots will support commercial components. Detailed environmental operating parameters will be developed as part of the NFPS requirements process. Key parameters include:

- Power supply: uninterruptible power supplies for readers and network components
- Temperature: storage (spares) and operating
- Humidity
- Tamper resistance
- Vibration/shock:
 - Readers and kiosks must be able to handle vibration from train movements.
- Abuse:

²⁹ A fare control area is the section of the station providing gated entry through which customer travels prior to entry up to fare payment point.

- Readers must be able to withstand limited abuse from customer tapping, bumping and spilling.
- Components accessible to customers must be vandal-resistant.
- Display visual and audio quality
 - ADA compliance
 - Visibility in varied light conditions
 - Audible in varied noise conditions

9.2 Buses

Equipment on bus vehicles must work within current conditions. Detailed environmental operating parameters will be developed as part of the NFPS requirements process. Key parameters, in addition to the parameters listed for Stations and Bus Depots, include:

- Audio-visual displays must be visible and audible to both customers and bus operators.
- Power must be provided for up to 60 minutes during driver breaks and route turns when the bus is not running.
- NFPS equipment should not impede bus operator actions and passenger flow.
- It must allow operator logins similar to current practice.
- The location of readers must allow an unobstructed view for the driver through the windshield.
- Detailed environmental operating conditions will be developed for the same list of parameters as stations.
- The readers on buses must be more rugged and resistant to failure from shock, vibration, moisture, voltage variations and temperature variations than readers normally found in retail merchant environments.

9.3 Personnel

The deployment of NFPS will require changes to responsibilities of operating personnel within the MTA and the agencies operating buses, subways and SIR. The number, level and skills of personnel required to manage and operate the NFPS have not been estimated yet. The numbers and types of skills required will depend in part on which functions and support systems are operated in-house and which are operated by a third party for or on behalf of MTA. MTA agency personnel and external staff (third parties that may maintain or monitor equipment) will require training in new processes or systems.

10 SUPPORT ENVIRONMENT

10.1 Network Management System (NMS)

The NMS will monitor wired and wireless networks connecting almost 15,000 assets in NFPS. It will be a COTS standards-based system with the minimum configuration required for the MTA. Its functions include:

- Monitor, troubleshoot, diagnose and, where feasible, repair network elements in the commercial and MTA-owned networks used in NFPS. The majority of the network is expected to be provided by commercial wireless networks for 6,000 buses and all above-ground subway stations. Network connections for underground subway stations will be provided by a mix of commercial and in-house networks. Wired or wireless LANs will be present in all stations and must be monitored. The full network should be visible to the monitoring staff. The network may be divided into geographical areas or by network type (wired, wireless and LAN areas) if cost-effective.
- Provide secure remote access from workstations and wireless hand-held devices to enable monitoring and diagnosis in real time.

Telecommunications provider service level agreements must define network monitoring responsibilities, performance requirements and required network response times.

The MTA anticipates no customization to be required.

10.2 Remote Software and Configuration Update

The Remote Software and Configuration Update system provides the capability to remotely manage the field-deployed devices over the network. Management capabilities will include:

- Remote updates of configuration files, parameters, etc.
- Remote software updates
- Remote firmware updates

These capabilities will allow operational and maintenance staff to conduct all necessary update and management of field devices without having to physically visit those devices.

It is expected that these capabilities will be implemented using standard tools communicating with devices via open standard interfaces and protocols. However, based on the secure nature of some open payments hardware, it may be the case that these capabilities will be implemented via a “manager of managers” approach. In such an approach, proprietary or vendor-specific protocols and server-based tools (typically called “element managers”) would be used to directly affect such management, but a commercial/standards-based tool would be used to manage the devices via those element managers.

10.3 Device Monitoring and Management System

10.3.1 Device Monitoring

The maintenance management system remotely monitors system assets on wired and wireless network segments, and automatically reacts to failures in real-time. It may be possible to monitor devices and the network within a single or centralized device management system. The MTA will analyze this option.

Readers (and all their components) and station kiosks are the primary device types to be monitored. These will be new assets acquired by NFPS and will meet monitoring standards that the MTA will specify. Gates, turnstiles and other existing components are monitored by legacy systems. The MTA will analyze options for integrated monitoring.

The monitoring and management system will provide standard features, such as fault monitoring, performance monitoring, diagnostic and repair processes, remote access (including remote device disabling), inventory management, tracking, reporting, and others. It, or a related system, will provide the capability to download software and firmware updates.

The MTA will have a software and hardware test lab to assist in problem resolution and maintenance/upgrade management.

Servers are monitored as is standard for data centers.

10.3.2 Device Repair and Maintenance

The MTA or its agencies will have repair services equipped to replace any components of the readers in the field, and will have repair capabilities in bus depots and at subway maintenance facilities. The repair and maintenance processes are:

- Failures will be detected through the monitoring and management system or from bus operator or station personnel reports
- Bench test equipment will be used to troubleshoot components in a centralized facility
- Portable test equipment will be used to troubleshoot components in the field
- Remote diagnosis may be used to troubleshoot components in the field
- Repairs will be made in the field, if feasible, and in a central facility otherwise
- The monitoring and management system requirements to support device repair and maintenance are to automatically document the status, type and cost of repairs of components

10.3.3 Maintenance Employee Help Desk and IT Support

A help desk will be established to support MTA and NYCT field personnel maintaining the system. The help desk will provide the following:

- Staff with knowledgeable personnel and available online or by phone 24/7/365.
- Dispatch of troubleshooting and repair personnel as required.

- Ability to access NMS and Device Monitoring and Management System, as part of supporting field personnel
- Provide access to online training videos, drawings, schematics, files, knowledge base, and other technical materials.

Help desk software must be COTS software running on standard hardware.

10.4 Revenue Collection and Cash Settlement System

Current systems for cash collection and settlement will remain in place. They will interface with NFPS at the data warehouse, where audit and control processes will verify total revenue.

Subway: The current system used for stocking vending machines will remain in place for use with NFPS in-station kiosks if provided by the MTA.

Bus: Current systems will remain in place as long as current farebox units remain in place.

10.5 Training systems

Training for employees responsible for operating and maintaining all aspects of the NFPS will be needed to ensure personnel are current on their understanding of the NFPS and have the information they need to keep the system in a state of good repair and meet the performance standards established for the NFPS. Training will be provided through:

- Bulletins
- In-person classes
- Web-enabled instructional system
- Videos in the workplace
- On-the job training
- System-related certification
- Rules & Regulations (NYCT Rulebook)
- Other appropriate means

Training materials will leverage existing materials from payment industry and others.

11 OPERATIONAL SCENARIOS

The scenarios in this chapter are described by text or activity diagrams, or both. They provide more detail on the processes used by MTA employees and the MTA TAPS. Since these are the key MTA-specific elements of the system, they are described in detail here.

Figure 11-1 is an explanation of the symbols used in activity diagrams in this chapter.

Activity Diagram Legend

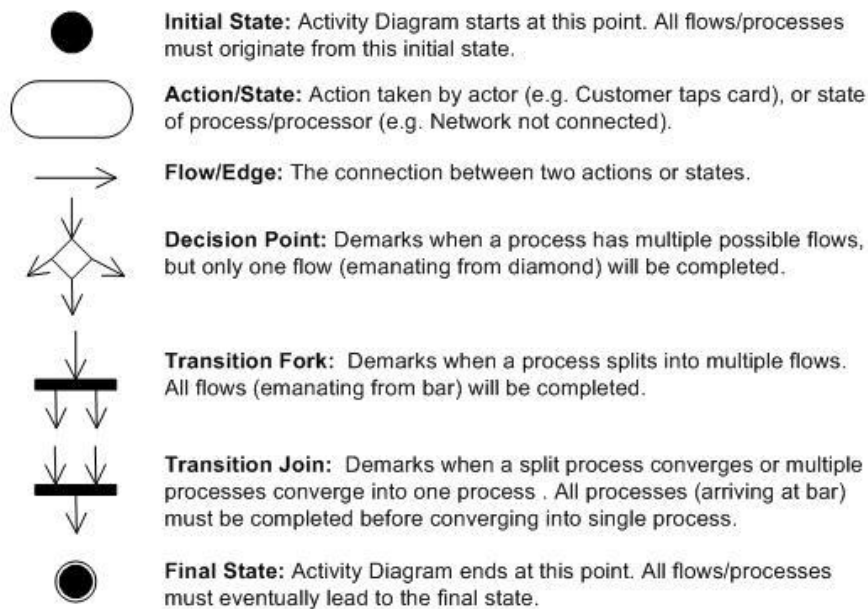


Figure 11-1 Activity Diagram Legend

11.1 Station personnel

Station personnel (agents) handle the following NFPS functions:

- Customer requests account information.
 - Personnel direct customer to other account information channels.
- Customer requests assistance with “problematic card” at reader
 - Personnel tell customer to call the card issuer (bank, prepaid, CMC, employer, other), and/or direct customer to MTA call center where the customer may request assistance.
 - If a call center cannot resolve card issue, personnel instruct the customer to either use another MTA accepted CP device.
- Customer requests assistance with “problematic device” at kiosk
 - Personnel tells customer to call his/her CP device issuer. Personnel instruct the customer to use another payment method to make purchase.
- Personnel tells customers when readers are known to be broken

- Personnel gain knowledge of non-working readers, turnstiles and gates through failure during previous customer use, or from notification from device management and maintenance process. The personnel will instruct customers to only use working readers through posted signage on broken reader entrance mechanisms
- Customer requests AFAS/emergency gate be opened
 - Personnel will instruct the customer to tap his/her card on the reader at a designated turnstile.
 - If the customer receives an “allow” message, the personnel will instruct the customer to turn the turnstile tripod to complete front end of fare payment process. The personnel will then remotely unlock the AFAS/Emergency gate and the customer will be allowed through the gate.
 - If the customer receives a “deny” message, the personnel will not open the gate and will instruct the customer to use another MTA accepted CP device to enter the system.

Activity Diagram: Station Personnel



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Figure 11-2 Station Personnel

11.2 Bus operators

Bus operators input crucial information into the farebox unit (or keypad provided on SBS since SBS has no farebox) at the start of a run or when the route changes, act as the gate on single door boarding buses, and provide a customer service function to customers boarding the bus. This section describes current operating procedures. NFPS differences are *italicized*.

- Bus pull out
 - At the time of pull out, the bus operator initially logs into the farebox unit with operator ID, route, and run number. *In the future, operators may use their CMC to log in.* After completing the pullout process, the bus operator enters the fareset and destination data into the farebox unit or keypad and automatically places the farebox unit *or readers* in revenue collection mode.
 - Additionally, bus operator will check to make sure farebox unit *and readers* are working.
- Travel within depot or to/from terminal
 - The bus operator may enter a not-in-service destination code for travel within the depot, or for deadhead travel. The bus operator may also enter a valid revenue destination when s/he is ready to pull out from the depot.
- Route/run number change
 - When the route or run number changes, the bus operator indicates the change via the farebox unit.
- Bus operator relief
 - When a relief occurs, the new bus operator ID will be entered along with the route and run data. Entry of a new operator automatically logs off the previous operator at the farebox unit and puts the farebox unit into the pull-in state. The new operator places the farebox unit into revenue collection mode by completing the pull-out procedure and entering a valid fareset and destination code.
- Last revenue trip/deadheading
 - When an operator completes his/her last trip and is deadheading, the operator will change the destination sign to the “Not in Service” state. When the bus operator returns to the depot he/she needs to sign off the farebox unit.
 - *Whenever the bus is placed in the “Not in Service” state, the reader will send any unprocessed taps to the server.*
- Customer requests assistance with “problematic device” at reader
 - *The bus operator will instruct the customer to contact device or card issuer (which could be CMC provider) call center for problems with his/her card, and to either tap another CP device at the reader, or pay for the trip using coins.* On SBS, the cash option will not be available to customers. Bus operator may also direct customer to a handout (“take one”) or information on overhead signage onboard the bus.
- Defective farebox unit/reader
 - Report defective equipment.
 - Bus Operator will immediately notify the Bus Command Center (BCC) whenever a farebox unit/reader defect (steady or intermittent) develops while in service. If the defect cannot be repaired through remote diagnostics and software fixes, Road Operations will arrange for the bus to be swapped within the time it takes to make a full round trip along the route.
 - If the farebox unit has been placed in bypass mode, the bus operator will inform the BCC console dispatcher and state the reason.

- *The reader is remotely monitored. The bus operator may also receive a message from the device manager indicating that the reader is faulty. In this situation, the bus operator must follow the same procedure as above.*
 - The bus operators will immediately report any instance in which the coin bezel is jammed and revenue is visible on top of the farebox unit. When this condition exists, the bus operator who pulls the bus into the depot will remain on the bus until properly relieved by supervision.
 - The bus operator will record defective farebox units on the Operator's Vehicle Condition Report.
- Defective *reader* or farebox- bus with single farebox unit/*reader*
 - If farebox unit/*reader* is deemed defective, the bus operator will follow Department of Buses' policy regarding taking buses out of service.
- Defective *reader* or farebox- on SBS or other buses with open boarding and multiple readers
 - *The bus operator will instruct customers to tap CP devices on other working readers, if any. If there are no other working readers, the bus operator will follow Department of Buses' policy regarding taking buses out of service.*
- Disabled passenger boards bus through backdoor and cannot tap CP device at reader. Follow current practice (bus customers fill out form and mail to the MTA).
- Issue contactless SRT for transfer
 - Customer pays for ride using cash (coins only) and requests a transfer ticket. Bus operator may issue the contactless SRT to the customer for transfer.

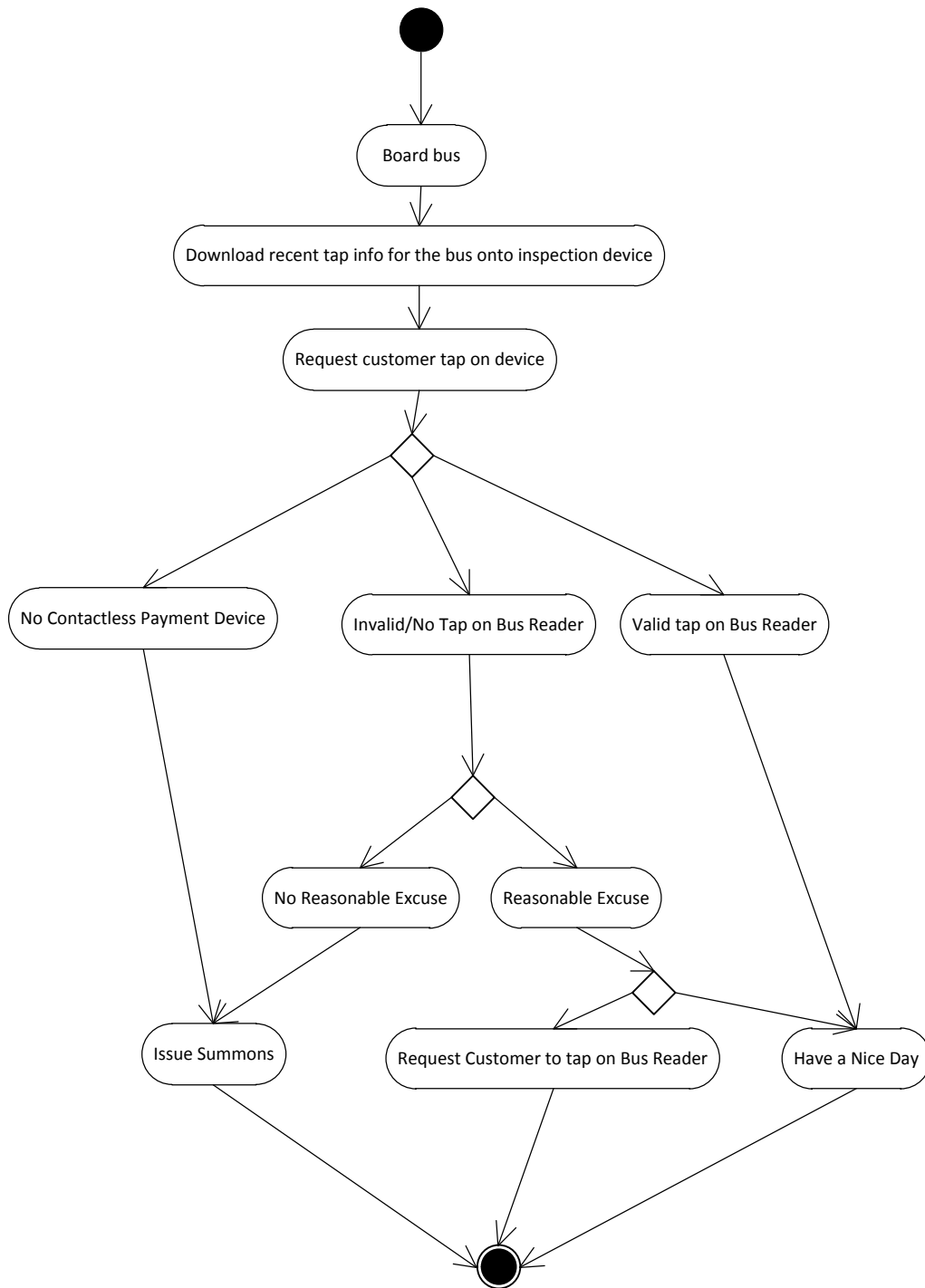
11.3 Inspection for Select Bus Service (SBS) and Staten Island Railway (SIR) and other buses with open boarding

On a multi-door-boarding bus (SBS), the following process will be used:

The inspector boards the bus and requires proof of payment from passengers. The process is described in Figure 11-3.

After the inspector boards the bus, s/he uses his/her handheld inspection device to collect information on successful taps recently made on the bus reader(s) by querying the TAPS using a wireless link. After the tap information is collected, s/he asks passengers on the bus to produce proof of payment. If the customer used a CP device, the customer will be asked to tap the same CP device on the inspection device. If the customer had successfully tapped his/her card at the reader when boarding the bus, the inspection device will indicate that there is a match. Otherwise, the inspection device will indicate that there is not a match. If there is no match, the customer is deemed to be a fare evader and will be issued a summons and fine. The MTA may decide to require immediate onboard payment plus a penalty fee and/or issue a summons and fine.

Special Inspector On-board SBS



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Figure 11-3 Special Inspector On-board SBS

On Staten Island Railway, the following process will be used:

The MTA Police officer will verify that passengers on board trains and on platforms, which are a paid zone, have paid their fare. The process is described in Figure 11-4. All stations (with the exception of Tompkinsville and St. George Terminal) have open platforms, with readers placed for customers to tap as they enter the paid zone. All customers exiting through Tompkinsville and St. George Terminal³⁰ must tap out, even if they already tapped in. This extra precaution is necessary because there will not be 100% inspection of customers. All readers are connected to the TAPS by either wireless or wired communications, so that an officer is able to access all taps recently made by Staten Island Railway customers.

After the officer enters the paid zone, the inspection process is identical to that of the SBS process, except inspected customers will be in the paid zone instead of on a bus. After the customer CP device has been inspected, and the inspection device indicated that customer has not tapped in, the officer uses his/her discretion to decide if there is a valid reason the customer did not tap. A reasonable excuse might be a provable extenuating circumstance, such as all readers in a station being defective. If reasonable, the customer is instructed to pay his/her fare at the nearest reader device (if possible), to obtain/reload fare media at the closest kiosk (if feasible), or is allowed to continue the trip. If not reasonable, the customer is considered a fare evader and is issued a summons and fine.

³⁰ Currently, all turnstiles/gates at Tompkinsville and St. George Terminal require MetroCard swipes to enter and exit. Since they are already set up for exit swipes, little modification will be required for NFPS.

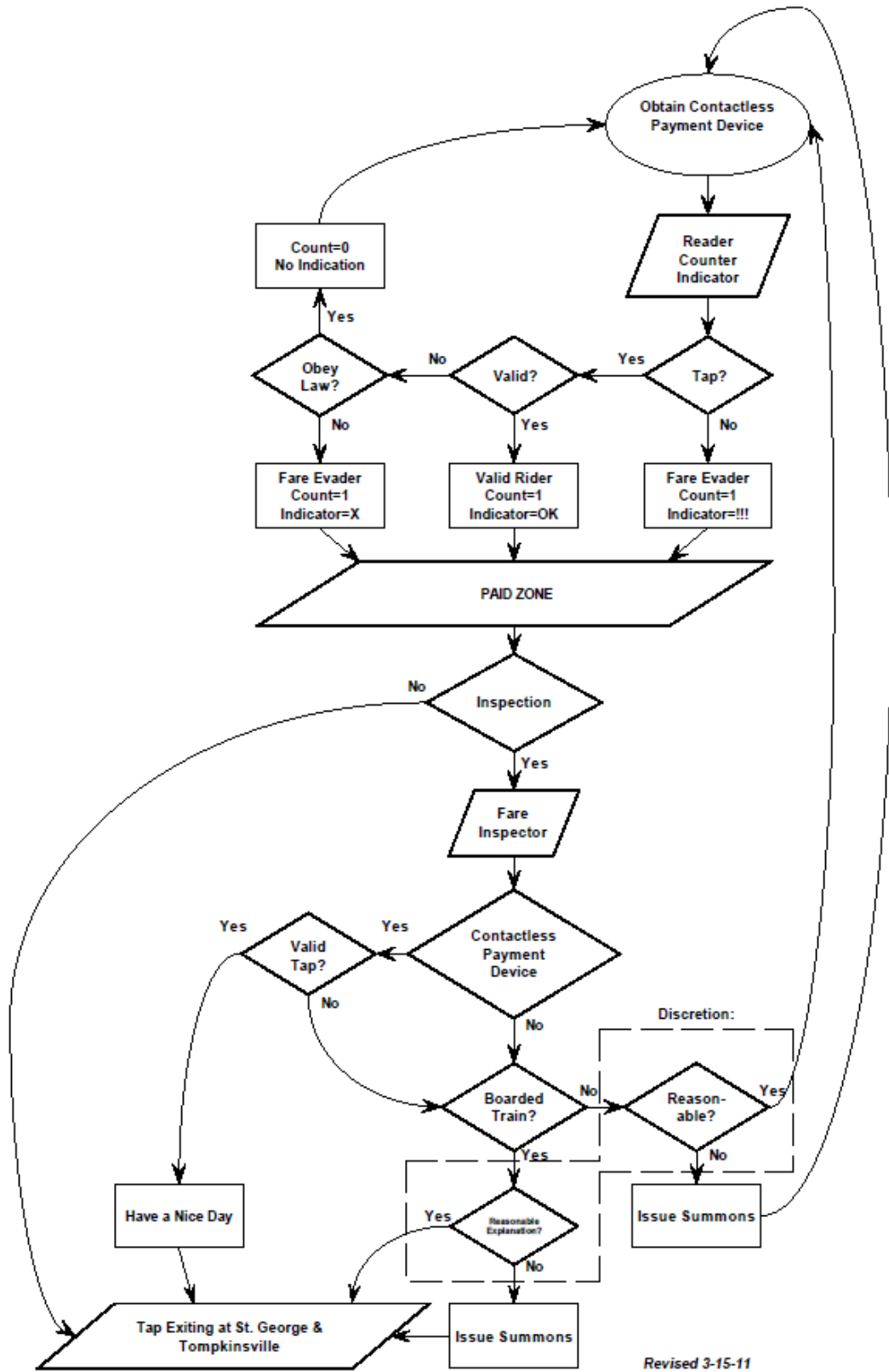


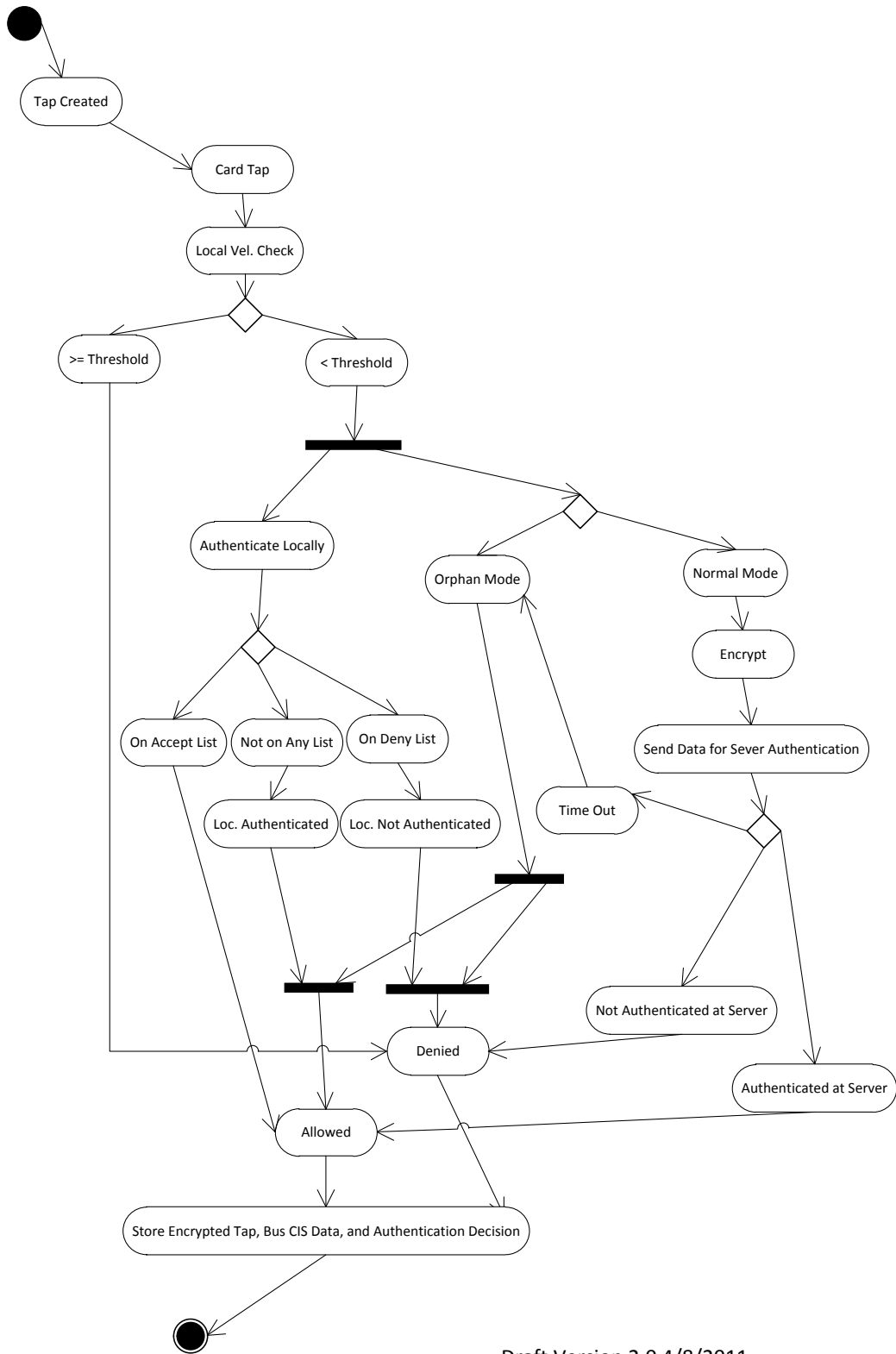
Figure 11-4 MTA Police Officer – Staten Island Railway

11.4 Transport-authorization of card taps at readers

The TAPS is described in section 8.9. The next three sections provide a more detailed description of its operations and its interaction with the readers.

Figure 11-5 and Figure 11-6 are activity diagrams of local and server transport-authorization for taps from buses. Taps from subways are similar to the examples in these figures, except that there are no phantom taps and that Bus CIS data is not copied and sent to the Bus CIS server. (See the Bus CIS Concept of Operations for more detail.)

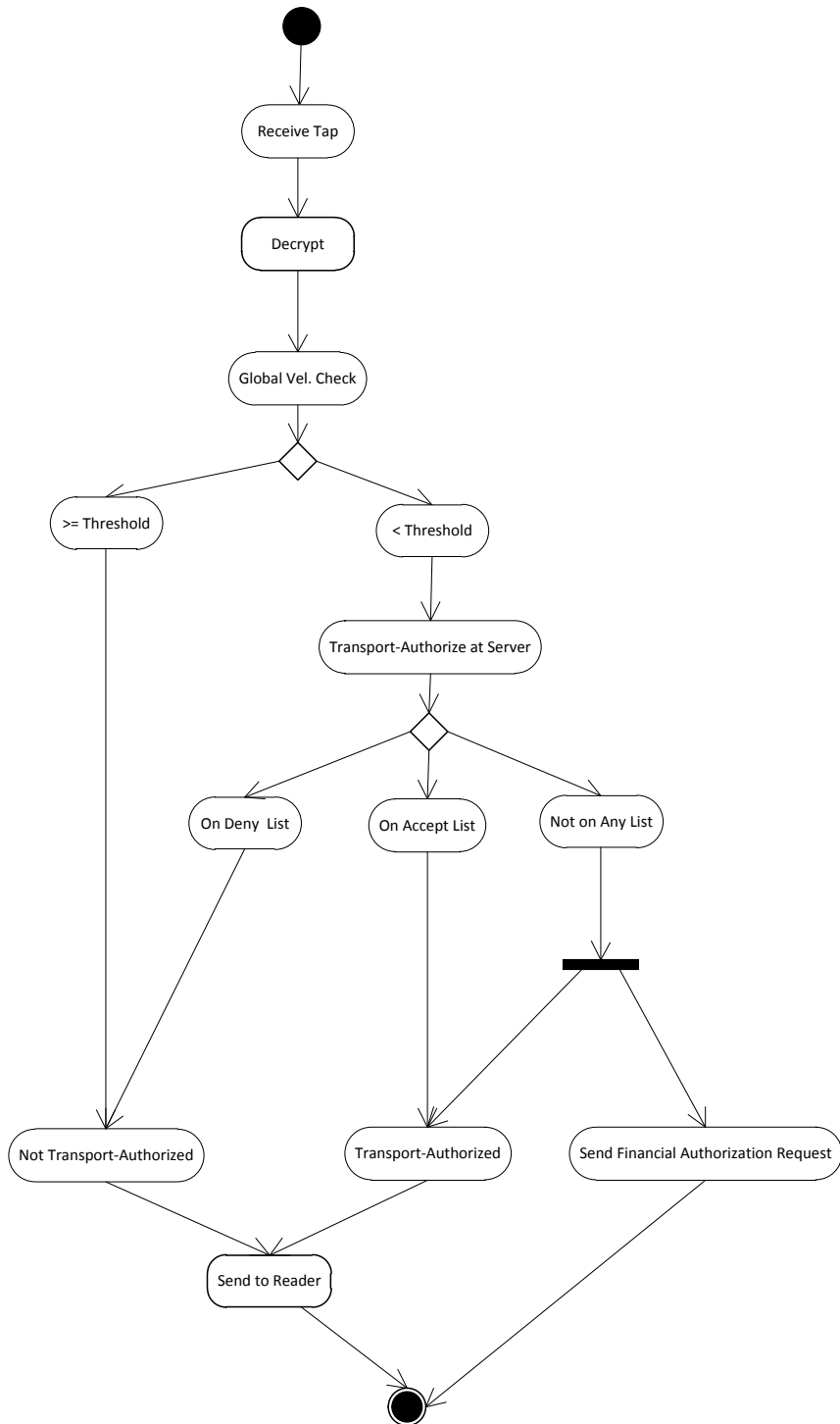
Local Authentication for taps from Bus Readers



Draft Version 2.0 4/8/2011

Figure 11-5 Local Transport-authorization on Buses

Server Transport- Authorization for taps from Buses



Draft Version 3.1 10/14/2011

Figure 11-6 Server Transport-authorization on Buses

In summary, when there are no network connectivity issues, a validated/accepted tap will be allowed if the device has passed the velocity check thresholds, and is not on the server Deny List. This response to the customer does not wait for a financial authorization response. When there are network outages, the transport-authorization process depends only on local transport-authorization decisions.

There are several conditions under which the wrong decision will be made in the transport-authorization/authorization process, mainly due to outages in communication and slow response times. “Wrong” means either a device that should have been allowed was denied entry or a device that should have been denied entry was allowed. The number and frequency of these wrong decisions will depend on the actual number and frequency of these conditions. Business rules will be defined to minimize risk of wrong decisions.

11.5 Authorization of card taps at readers

Authorization may be required any time a card does not appear on either the Accept or Deny List at the server, although the TAPS will not wait for an authorization response from the billing/authorization server. The Billing/Authorization Server will use standard merchant processes for authorization; MTA-specific differences will be implemented in the TAPS, as described below.

Generating an authorization request:

- An authorization request is generated when a tap is received at the TAPS; the card passes various checks, and is neither on the server’s Accept nor Deny List.
- The tap is deemed to be a PAYG tap.
 - If aggregation is used, the second PAYG tap in an aggregation cycle will not generate an authorization request because the card will be in the Accept List for the duration of the aggregation cycle.
- The TAPS does not wait for an authorization response from the Billing/Authorization Server to make an allow or deny decision.
- CMCs and other contactless ID cards (e.g., employer ID) do not generate a financial authorization request as is done with bank-issued cards because the cardholder accounts are not held by banks as part of the merchant acquiring ecosystem. The accounts are either held by MTA or a non-bank entity (e.g., the employer that issued the ID) and the risk associated with those types of cards and accounts is managed through lists; i.e., they are always on either the Accept List or the Deny List. These cards must have a PIA product to be used at a reader and/or be the subject of a commercial arrangement under which the issuing entity will pay the MTA for use of the cards for transit travel.

The authorization request is processed in real time:

- The Billing/Authorization Server receives an authorization request from the TAPS for a PAYG tap. The authorization amount, which may be different from the fare, will be configurable.
- The Billing/Authorization Server sends the authorization request to the acquirer and follows the standard industry process with the card issuer.

- A hold is processed or a decline is sent back to the Billing/Authorization Server, which then converts the message to an authorized or not authorized status.
- The authorization response is sent back to the TAPS, which uses this information to update the deny list.
 - If the PAYG tap is authorized, the aggregation cycle will start if aggregation is used.
 - If the PAYG tap is not authorized, the tap will be placed on the Deny List.

Where risk is placed:

- The MTA will request that the payment industry work with it to limit the risk associated with acceptance of bank-issued and prepaid cards.
 - One method would be to limit risk of “first taps”, i.e., the first time a CP device is seen by NFPS and/or the first time the CP device is seen by NFPS after being removed from the Deny List, specifically for PAYG transactions. This is similar to arrangements TFL is establishing for similar applications, particularly for PAYG transactions on EMV cards.
 - Another method may be to use aggregation, and be protected for the aggregation cycle/amount.
- To the extent MTA can influence customer behavior towards PIA product purchases, and reduce the number of PAYG transactions, it will reduce the number of PAYG transactions and the higher level of risk associated with those transactions.

11.6 Updating Accept and Deny Lists

The TAPS manages Accept and Deny Lists. The key processes are:

- Reasons to place a CP device on the Accept List
 - A PIA fare product is purchased or reloaded for the account associated with the card. This includes CP devices from other non-MTA institutions, including PIV and other cards.
 - CP device starts an aggregation cycle for PAYG products.
 - All current employee, contractor, emergency responder, or otherwise authorized CMCs.
- Reasons to remove a CP device from the Accept List
 - Fare product expires or reaches low balance.
 - Possibly ending aggregation cycle.
 - Contractor, employee, authorized card holder term expires.
 - Other non-MTA institutions request that their CP device is removed from list.
 - Placed on Deny List.
- Reasons to place a CP device on the Deny List
 - On industry Deny List, if obtained by MTA.
 - Lost or stolen card: either the CP device used for access or associated card used for payment, as required. Customers with a CMC tied to a lost or stolen payment card may opt to continue using the current fare products on the CMC.
 - Receiving a hard decline, unsuccessful settlement, or multiple declines, as available from the issuer or bankcard network. The MTA may configure these parameters.

- Debt is outstanding with the MTA.
- Any CMC that is removed from the Accept List.
- Non-MTA institution CP device that is removed from the Accept List.
- Velocity check threshold exceeded.
- Expired employee/non-transportation CMCs.
- Other rules as determined by the MTA.
- Reasons to remove a CP device from the Deny List
 - No longer on industry Deny List, if it passes all MTA checks.
 - For bank/prepaid cards added to Deny List internally, follow same process to remove from Deny List as industry follows.
 - Velocity check time period passed, unless fraud is suspected.
 - Found CMC/other contactless ID card.
 - Debt with MTA settled.
 - New PIA product purchased.

The Accept and Deny Lists may have day, time, mode, station, or other restrictions. For example, contractors may only have access during their normal working hours, or MTA employees may only have access to their respective agency's services.

12 SUMMARY OF IMPACTS

This section focuses on the new system and the impacts it might create on each of the stakeholders. Constraints, risks and performance metrics are also discussed here.

12.1 Constraints on system development

12.1.1 Funding

There are two funding issues: (1) NFPS has a fund source for only a portion of the project; a source of funds still needs to be found for the project commitment in years 2012-2014 contained in the MTA's Five-Year Capital Program for 2010 - 2014 and (2) the existing fare payment system, MetroCard, will continue to require significant funding to maintain it in a state of good repair, especially since major components of the MetroCard system are nearing the end of their useful life. Thus, the longer the development and the transition periods last, when MetroCard and NFPS must operate in parallel, the greater the investment that will be required to keep MetroCard operating reliably.

12.1.2 Speed requirements and network latency

The NFPS requirement for a 500 ms fare payment transaction time is faster than the time for average merchant transaction terminal processing. Meeting this requirement will dictate key aspects of design and commercial arrangements needed to implement the NFPS. Reader, server and network latency must be accounted for in designing for speed at the reader and negotiating the service level agreement for provision of telecommunications.

12.1.3 Payment networks' operating rules

Use of CP devices and readers to collect fare payment from PIA fare products or for trip segments that are free transfers is atypical in the payment industry. The NFPS potentially may rely on some processes not currently allowed under the Visa and MasterCard operating rules, requiring either the rules be amended or other arrangements be made with Visa and MasterCard.

12.1.4 Reader environment

The readers on buses and turnstiles/gates must be more rugged and resistant to failure from shock, vibration, moisture, voltage variations and temperature variations than readers normally found in retail merchant environments.

12.2 Risk management

12.2.1 Financial risks

- Risk profile

- MTA is moving from a legacy system for which it controls the risk profile, to a system that allows for acceptance of payment methods for which it does not control the risk profile. With NFPS, the risk profile of customers is no longer consistently low across all customers. The risk profile now takes on the risk profile of the payment devices being used. For example, debit cards and prepaid cards are higher risk than credit cards because of lower average balances.
- Offline acceptance of CP devices at readers
 - When there is no network connectivity, the MTA will need to accept CP devices offline. This may result in customers being allowed entry who should have otherwise been declined because their card would not have been transport-authorized or authorized. MTA runs the risk of not being able to collect payment from these cards.
- Penalties from payment networks or issuers for chargebacks or other issues
 - Chargebacks are risks that MTA has today with the acceptance of bankcards at vending machines. While the rate of chargebacks probably will not change, the volume will increase with the wider acceptance of CP devices across the system.
- Loss from security breaches
 - Loss from security breaches is a risk that MTA has today with the acceptance of bankcards at its 2270 vending machines in stations. The NFPS will quintuple the number of terminals from which card ID information is being transmitted. This increases the potential loss from security breaches. The use of CP cards, which have better security than magnetic stripe media, and server transport-authorization is expected to manage this risk. The most significant risk is often data center breaches, and this is unchanged.
- Aggregation
 - If MTA utilizes aggregation and reduces transaction volume in order to reduce interchange fees, MTA undertakes the risk on any transaction in the aggregated bundle that was not previously authorized. This risk, however, can be mitigated by the authorization amount, the time to aggregate and modifications or waivers to the payment networks' rules. MTA will select its aggregation policy but NFPS will need to be flexible in order for aggregation policy to be adjusted as needed as risk profile changes.
- Payment industry changes
 - The Federal government may enact laws and establish regulations that affect the marketplace for credit and debit cards, and influence the trend for issuance of CP cards by issuers.

12.2.2 Operational risks

- Network connectivity
 - If communications providers do not meet NFPS's availability and latency requirements, NFPS performance will not meet intended levels. Most carriers can provide 99.99% availability, which is sufficient.

- Wireless bandwidth demand is increasing rapidly, which may limit capacity available to the MTA. NFPS bandwidth needs are moderate and should be feasible to meet.
- Ability to minimize reliance on vendors
 - Avoiding customization along with proper MTA staff training on operating and maintaining the new system will be critical.
- Labor
 - The change from MetroCard to NFPS may result in collective bargaining and labor issues.
- Market penetration of CP devices
 - MTA must provide a CP card (CMC) to those customers without CP devices. CMC will be issued by a third party; the costs will be funded by the MTA. If fewer bank-issued CP devices are in circulation, more CMCs must be issued, at increased cost to the MTA.
- Unbanked customers
 - MTA will provide a CMC, with costs as noted above.
- Robustness of external sales network and CMC issuance
 - The provision of external sales channels for PIA products will be critical to MTA's bus customers without CP devices.
- SBS dwell times
 - Today, fare payment for SBS is off-board and therefore fare payment does not affect SBS dwell times. In NFPS, fare payment for SBS will move on-board. There is a risk that this move to on-board fare payment will affect the dwell times.
- Equipment malfunctioning
 - Revenue loss and customer dissatisfaction due to equipment malfunction is a significant operational risk to MTA.

12.2.3 Customer satisfaction risks

- Reputational risk.
 - Customer experience not matching promise of NFPS for a faster, easier, and more convenient and secure way to pay.
 - Equipment or software problems that result in wrong "denies", i.e., customers not allowed entry due to incorrect transport-authorization decision. NFPS must have high enough quality to minimize these issues.
- Customer perception of level of security
 - Today, customers use bankcards and cash at vending machines in stations. NFPS will significantly increase use of CP devices and decrease use of cash in the station and bus environment. Customers will need to have a comfort level with personal security and card security at point of use.
- Customer acceptance of online self-service options
 - NFPS represents a shift from service by vending machine to service online/by phone. Customers will need to have a comfort level with online or phone transactions.
- Passbacks, transfers, and single rides

- NFPS allows a CP device to be used very flexibly, which changes the customer experience for the better in most cases, but also has some problematic situations:
 - If a customer violates a passback restriction, the customer will be charged for an additional PAYG fare (unless s/he is a CMC user).
 - If a customer makes a transfer, the reader does not indicate if it is free or not.
 - If a customer boards an express bus mistakenly believing it is covered on a subway/buss pass, the trip will be charged as a PAYG fare.
 - If the single ride ticket is offered through the CMC:
 - Customers will have to pay for the single ride and a deposit fee for the card.
 - Customers paying with coins on buses will not receive a free bus to bus transfer.
- NFPS may specify a richer reader display interface to avoid some of these risks in the future. The TAPS knows if a passback, paid transfer or PAYG fare is to be charged, and can send an appropriate message to the reader.

12.3 Metrics for specifying system performance

The following table outlines the key performance metrics for the NFPS system. The key performance indicators are based on industry standards. These requirements are not in order of importance. Standards conformance is measured on a monthly and/or annual basis, as defined in service level agreements with providers. Service level agreements also specify the way in which the performance measures are computed.

Requirement	Definition	Implementation
R1 Reliability	Rate of hardware and software component failure (mean time between failures/repair-MTBF/MTTR), for key software and hardware components, by mode.	MTBF/MTTR will reflect typical industry specifications for readers, network elements and servers.
R2 Availability	Overall system availability allowing full reader-server capabilities to be used.	<ul style="list-style-type: none"> • Time when a reader does not receive server responses will be no more than one hour per year, an availability of <u>99.99%</u> (four 9s) during which all system elements (readers, network, and servers) are operational. This excludes planned maintenance. • Redundancy for components such as routers in subway stations and servers will be calculated such that they yield the required network availability

		<ul style="list-style-type: none"> • Bus equipment redundancy is limited.
R3 Data integrity	Complete and accurate data capture to ensure processing of all relevant customer and usage data.	<ul style="list-style-type: none"> • 99.99% of transactions should match between the reader and the server/database. • 99.99% should be billable to the customer. • 99.99% of revenue transactions should be successfully settled and MTA should receive payment in timely manner. • 100% of assigned fares should be accurate. • 99.99% of credits or other adjustments should be accurate.
R4 Extensibility	Ability to accommodate increased functions	<p>Network, server and other hardware and software components will handle new modifications as technologies evolve without requiring redesign and/or rebuild of the entire network. Examples include</p> <ul style="list-style-type: none"> • Ability to handle new network wireless technologies (e.g., from 3G to 4G) by only changing network modems • Ability to deploy different card reader equipment (be device agnostic) • Ability to handle new card (payment media) types into the system (as long as they meet standards; e.g., NFC phones, PIV cards) • Ability to handle new encryption methods • Ability to handle added applications (e.g., Bus CIS)
R5 Leveragability /Reuse	Ability to leverage common components across multiple products	All NFPS system components will be COTS except for TAPS and fare engine. The same payment networks, issuers, acquirers, card types, readers, communication networks will be reusable across bus, subway and regional rail applications.
R6 Maintainability	Ease of maintenance; level of support requirements	<p>Support and maintenance calls no more than once per 90 days per reader, modem, bus antenna hardware.</p> <p>Software support and maintenance per industry standards. Mean time to repair (MTTR) per hardware industry standards.</p>

R7 Performance	Ability to meet real-time, batch and online performance constraints	<ul style="list-style-type: none"> Operational bandwidth sufficient to transmit transaction data. MTA to analyze. Response time should not exceed 500 ms round trip from tap on reader to NFPS TAPS and back to card reader 98% of time. This is the target for required all reader transactions. Turnstile gate arm or service gate lock should be released within 50 ms of message to customer. Up to 2 seconds in financial authorization response time to TAPS, post customer entry³¹, 95% of the time. Reader software updates performed during normal hours will be completed with the reader out of service for one minute or less
R8 Quality	Low number of severe defects in delivered software	Low frequency of bug reports during acceptance tests and operation. MTA to set goal.
R9 Robustness	Ability to handle error and boundary conditions	<ul style="list-style-type: none"> No single point of failure in communications network. The readers and network will operate within the typical range of power, temperature, moisture, dirt, vibration, and customer abuse in subway and bus environments. Tamper resistance and other safeguards will not trigger under typical subway and bus conditions NFPS will operate satisfactorily with a low level of card reader errors, network packet loss, server latency
R10 Scalability	Ability to handle higher transaction volume over time; ability to grow an existing system without having to replace the entire system.	<p>Network will be scalable for 50% traffic growth in the next 10 years. Server and software architecture allows scaling.</p> <p>Operational bandwidth between reader and server can maintain or burst to 10</p>

³¹ "Post customer entry" means that the customer has already allowed entry. In this scenario, the authorization response should be returned within 2 seconds, 95% of the time.

		Mbps wired and 2Mbps wireless for each reader to support future applications such as more frequent and longer list updates or picture transfers
R11 Installability	Ease of element installation on all necessary platforms	Readers, modems, antennas, routers and other network elements will be installable, diagnosable and replaceable on buses and subway station gates and turnstiles with industry-typical technical skills and equipment.
R12 Legal and regulatory	Meets legal and regulatory requirements applicable to wireless networks, subway environment and networks carrying CP device transactions.	ADA, NYS Building Code, NFPA, electrical codes and other legal and regulatory requirements will be met by equipment after installation is completed.
R13 Internationalization	Ability to support multiple languages in application	Signage, website, call center, reader display provisions for other languages. List of languages supported to be provided by MTA.
R14 Security	Cyber and physical security risks of routers, network, data, server, and other components are mitigated.	Card reader, network, server and other components will comply with PCI-DSS, PA-DSS, and MTA policies regarding customer privacy. Equipment will be physically secure from the elements, vandalism and tampering. Chargeback/fraud protection costs will be same or lower than current MTA experience.
R15 Operability	Ease of everyday operation	NFPS managers, bus operators, station staff, network managers and staff, maintenance managers and staff are provided usable, effective tools and processes
R16 Auditability	Network facilitates auditing/determination of source of problem/outage.	Readers and network will have the ability to generate performance data and detailed system logs, and support monitoring, alerts, diagnostics and auto-recovery. The network will have the ability of determining and measuring network performance as information flows through it.
R17 Capacity	Maximum throughput available	Servers and network will handle peak period transactions at performance specified in requirement R7, with possible

		spikes for special events (e.g., sporting events and parades). System will handle at least a 50% spike in peak period transactions in a single day at select locations while meeting other performance requirements specified in requirement R7.
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Table 12-1 Performance Metrics

12.4 User impacts

Potential effects of implementation of NFPS on users, internal and external stakeholders, and other organizations are in *italics*. These impacts will be used as inputs for the NFPS implementation plan to ensure a smooth transition from MetroCard to the new system. The strategies for the implementation plan include:

- Providing information on NFPS changes to affected groups
- Providing training and support to internal and, if needed, external stakeholders
- Staging the transition to NFPS to allow learning and adjustment, if needed
- Establishing agreements with external and internal stakeholders that meet new NFPS requirements
- Custom strategies for specific impacts, as required

The appropriate strategies will be selected to manage the impacts listed in this section.

12.4.1 Subway and bus customers

- All users
 - *Tap instead of swipe.*
- MetroCard user.
 - *Must switch to new form of payment*
- CP device holder.
 - *No longer required to use MTA-issued media*
 - *Will tap instead of swipe or dip*
- Non-contactless payment device holder.
 - *Likely to use CMC*
- Cash user.
 - *CP device required for entry on subways. Can continue to use cash in stations, external reload locations (for CMC), and for entry on non-SBS buses. Attempt to convert to CMC through information, incentives.*
- CMC user.
 - *New user category.*
- Fare product purchasers
 - *New sales channels and account self-service, notification and management options.*
- PAYG users.
 - *New fare option, not pay-in-advance. Most expensive form of single ride payment. Attempt to convert to PIA user through information and incentives.*

- Single Ride Ticket (SRT) users.
 - *Can use PAYG with own CP device, single ride ticket on CMC or contactless paper ticket.*
- Staten Island Railway Customers.
 - *Major change- fare collection expanded to all stations and random inspection will be instituted.*
- EasyPay/ EasyPay Xpress customer.
 - *Shift to Web/IVR sales channels to manage. Refills are electronic.*
- Seniors.
 - *Use CMC or own card if appropriate interfaces with reduced fare program are built. Identification verification will need to be addressed.*
- Disabled, including ADA community issues for process, ergonomics, payment
 - *Process: Identification verification will need to be addressed.*
 - *Ergonomics: Same as current. Bus customers who are unable to tap at bus reader will fill out form.*
 - *Payment: Use CMC or own card if appropriate interfaces with reduced fare program are built.*
- Reduced fare customers, generally
 - *If government-agency-issued CP device for reduced fare customers can be accepted for entry in NFPS, MTA may be able to eliminate in-person verification and need for photo CMC for some customers.*
- Foreign-language speakers
 - *Services in multiple languages can be provided on the website, call center/IVR. Additional resources may be required.*
- Electronic Benefit Transfer Card user.
 - *Use CMC and purchase PIA products with the EBT card. If contactless EBT card is released, it can be used for entry in NFPS*
- MTA/agency employees and pensioners with NYCT pass.
 - *Shift to CMC*
- Non-employees eligible for transit pass benefits (emergency services including MTA Police, NYPD, FDNY, District Attorney, Port Authority PD)
 - *Shift to CMC.*
- Students (currently there are 14 different types of student passes issued)
 - *Issue CMC; may be able to use student ID if it is contactless and fare product paid by electronic transfer of funds from school*
- Group sales.
 - *May be able to handle online; group must enter card number and numbers of travelers. Consider surcharge for manual handling.*
- Potential customers.
 - *MTA will develop marketing plans to attract new customers from target areas, emphasizing added convenience of NFPS over MetroCard. Since many potential customers will have their own CP device, expanded marketing opportunities are available to the MTA*

- Block ticket users. Currently distributed by subway personnel to customers in an emergency (e.g., when no train service—given as fare to board parallel NYCT bus service or other).
 - *Eliminate. Handle disruptions online through server processing; MTA can proactively remove charges and can allow customer self-service to remove disputed charges (within tight limits)*
- Other tickets (vouchers, emergency tickets, transportation certificates, transfer tickets)
 - *Changed under NFPS. Details to be established.*

12.4.2 Other MTA customers

- Other agency customers will be included in future NFPS releases:
 - Paratransit customer
 - *Possible major change to require CMC or contactless card. Blend with prepaid card program for NYC taxi service- make prepaid card contactless, for example.*
 - LIRR and MNR customers.
 - *Change from current MetroCard for trips that continue on NYCT: customers use own CP device or CMC. LIRR and MNR may sell CMCs before they accept them directly.*
 - *This does not address the deployment of NFPS on LIRR and MNR. Joint tickets will continue to be supported through deployment of NFPS on railroads.*
 - Bridges & Tunnels Customers.
 - *CMC could provide refill function for E-Z Pass accounts for cash customers.*
- Current customers where MetroCard is sold, joint ticketed and/or accepted off property.
 - PATH
 - Westchester Bee Line
 - Hudson Rail Link Bus
 - Roosevelt Island Tram
 - JFK Air Train
 - *All agencies will need to either move to acceptance of CP devices or determine alternative fare collection system to replace MetroCard on their properties. A joint planning process will be required if former path is chosen.*
- Customers of other private bus operators
 - *Potential for interoperability if they accept CP devices meeting payment industry standards*

12.5 Internal stakeholder impacts

This describes key internal stakeholder groups, their current functions and possible changes due to NFPS. Possible impacts are in *italics*.

12.5.1 Automated Fare Collection (AFC) management

- Responsible for MetroCard fare media sales, payments and usage at NYCT.
 - *Sharply reduced role: MTA will own and manage NFPS. CMC and sales channels may be handled by third party, overseen by MTA; payments and usage processed in NFPS.*

- Manages contract and business relationship with current fare system vendor, Cubic.
 - *MetroCard vendor eventually terminated with termination of legacy system.*
 - *NFPS components to be provided by multiple vendors under separate contracts. Managed by MTA.*
- Manages distribution, reconciliation, customer claim activities
 - *Sharply reduced distribution activity. Customer claim activities may be reduced as issuers, NFPS website/call center take some of this role.*
- Manages retail MetroCard sales, distribution
 - *Management of CMC retail reload network likely to be provided by third party, overseen by MTA. This activity should be smaller in comparison.*
- Supports use of MetroCard on other transit systems
 - *Bankcards already interoperable. Phase out this activity, unless other agencies choose to accept CMC. If they do, may be managed by MTA*
- Credit/debit payment operations, risk management, customer service
 - *To be managed by MTA; this activity increases due to NFPS*
- Security
 - *Continue security management under MTA, similar to large merchants, for MTA-specific security issues*
- AFC capital programs: plan, design, construction, closeout, force account.
 - *MTA manages NFPS capital work with multiple vendors, and potentially with support of NYCT force account.*

12.5.2 Station personnel

- Sell and report fare products
- Sell fare media
- Make change for customers
- Answer questions on fares and how to use vending machines
 - *New customer information to relay*
 - *New customer service channels to which to direct customers*
- Perform light maintenance of fare equipment (clean reader heads)
 - *No reader heads to clean*
- Report emergencies, vandalism, thefts

12.5.3 Bus operators

- Local. Continue monitoring fare payment.
- Express. Continue monitoring fare payment.
- SBS. Same as current.
- All buses:
 - *New farebox unit (initially, new reader installed on existing farebox unit), except on SBS buses and other buses with open boarding, which receive multiple new readers*
 - *New audio and visual messages to interpret*
 - *New customer information to relay (questions on fares, etc.)*
 - *New way of handling transfers for cash customers (local, express)*

- *Follow (potentially new) login procedures. May use CMC to logon in future.*
- *Call in defective fare equipment to Road Ops.*
- *May have new responsibility to ensure data is transferred from reader terminal to server in rare circumstances.*

12.5.4 Equipment maintenance

- *Role continues but with different components and with remote monitoring, diagnostic and update/configuration capability. May require different equipment, tools and training.*
- *Newer and fewer pieces of equipment in stations, refreshed more frequently, should reduce maintenance effort*
- *Repair and refurbish bus and subway components of fare system*
 - *Farebox units*
 - *Turnstiles and turnstile end cabinets*
 - *High entry/exit turnstiles. Will eventually be replaced.*
 - *Token booths*
 - *Fare equipment will be removed*
 - *MVM/MEM field maintenance with armed revenue collection agents*
 - *Replaced by in-station kiosks.*
 - *Perhaps provided by 3rd party.*
- *Field maintenance of bus and subway components*
 - *Role continues but with different components and with remote monitoring, diagnostic and management capability. May require different equipment, tools and training.*
 - *Newer and fewer pieces of equipment in stations, refreshed more frequently, should reduce maintenance effort required.*
- *Bus destination sign maintenance. Might be managed through interface with NFPS device monitoring and management in future.*

12.5.5 Revenue control

- *Ticket stock management*
 - *SRT retained in contactless paper ticket form or on CMC*
- *Card encoding*
 - *Eliminated*
- *Revenue collection from MVMs, MEMs, and booths*
 - *Less equipment in stations; MVMs and MEMs replaced by station kiosks; overall reduced volume of cash handling*
- *Bus revenue*
 - *No collection from wayside SBS coin collectors.*
 - *Continues from bus farebox unit units.*

12.5.6 Inspection

- *Random inspection continues on SBS, no longer inspects paper receipts*
- *Add to SIR where cost effective.*

- *May require new device, tools and training*

12.5.7 Customer relations

- Mobile sales
 - *Sell CMCs and fare products*
 - *New equipment to accept credit/debit payment and CMC reload*
 - *Cash acceptance continues*
 - *Provided with access to same sales equipment as call center agents.*
 - *Whether agents provide account information is to be decided.*
- Customer service
 - *Call center agents require new scripts for existing call center regarding NFPS, CMC and NFPS customer service channels*
 - *NFPS call center will be new*
 - *NFPS call center agent need to interface with issuer call center (bank, prepaid card company, or CMC provider)*

12.5.8 Data users

- Data users at MTA and agencies (e.g., planning, operations, financial analysis)
 - *Richer data set*
 - *More frequent and convenient access to data through a new and enhanced data warehouse (e.g., more granular payment data, no longer bundled in 6 minute intervals, addition of location information to fare payment information for all taps made on a bus.)*

12.6 Other stakeholder impacts

These are additional stakeholders on the operations side. Employee groups that have already been noted in the section above are not repeated here. Changes are noted in *italics*.

- Customer-interfacing NYCT front line employees
 - Subway conductors
 - Reduced Fare office
 - *New processes to issue CMCs and identify reduced fare eligibility*
 - *Possible new interfaces to allow reduced fare customers to use their own contactless cards*
 - Walk in center
 - *New NFPS processes*
 - Eagle Squad (SBS)
 - *Changes noted under Inspection topic above in 12.5.6.*
 - *May need to inspect for buses with open boarding.*
 - DOB (Department of Buses) Road Control personnel.
 - *Training, equipment to manage new NFPS components, revised protocols and process.*
 - Card/pass-issuing NYCT personnel in NYCT HR (for passes to MTA/Agency and non-employee personnel).

- *Training in NFPS, primarily CMC processes*
 - *Possible new interfaces with CMC provider*
- Other customer- and external organization-interfacing employees
 - MNR/LIRR Employees.
 - *No joint ticketing, but training required for selling CMCs and information on NFPS generally.*
 - Non-Employees
 - *Inform of CMC replacing current media*
 - Retail merchants (CMC sales and reload).
 - *Significant change to sell CMC and reload CMC accounts. Renegotiate agreements. Merchants will need POS terminals and/or kiosks and training. Reload network may be expanded geographically and by volume.*
 - *Agreements may be between third party provider and merchants, not MTA and merchants.*
 - Transit Benefit Providers.
 - *Shift process from card based administration to account based administration though direct EFT from employers to MTA stored accounts. Use non-MTA employee ID/PIV card if available, or transit provider issued CP device or CMC. Encourage providers to issue CP devices that can be accepted in NFPS.*
 - Employers and schools
 - *Informed of MTA acceptance of PIV cards. Encourage employers (non-MTA) to issue contactless employee ID/PIV cards.*
 - *MTA may support PIA product purchase via employer/school EFT for CMCs held by employees or students*
 - *MTA may market this option strongly*
 - Bank call center agents.
 - *Should be informed about transit use of contactless cards/help advise on training.*
 - Other (pre-tax) transit benefit providers/agents (for profit and non-profit, government)
 - *Similar to transit benefit providers above.*
- Fare payment system operators (indirect customer interface)
 - Device managers
 - *New remote monitoring and management system, need training*
 - *New equipment to repair and maintain*
 - *New testing, diagnostic and repair equipment will be required*
 - *New help desk*
 - Network Managers
 - *More networks to manage.*
 - *Wireless networks are new.*
 - *New remote monitoring and management system*
 - *New procedures and training to use.*
 - *New performance metrics to use in establishing protocols and providing performance reports.*

- Data center managers
 - *New servers*
- *NFPS command center staff*
- Fare payment system maintainers (indirect customer interface)
 - End device maintainers.
 - *New equipment, training for maintainers*
 - Device repair staff
 - *Vendors will train in new repair procedures which will be more modular*
 - Turnstile maintainers
 - Farebox maintainers
 - *New training for new farebox*
 - Network maintainers
 - *More networks to manage.*
 - *Wireless networks are new.*
 - Station cleaners.
 - *Reduced task of picking up fare payment media from floor. Assist in cleaning heads of turnstile readers- eliminated.*
 - Fare engine and TAPS maintainers.
 - *Today, it takes 60 to 90 days to implement a fare change, which includes changing fare tables.*
 - *NFPS Fare Engine will allow for dynamic changes in reduced time.*
- Third party service providers
 - *Institutions that provide MTA customers with access to ATMs, kiosks and reload*
 - *CMC provider*
 - *Card issuers*
 - *Billing and account server providers*
 - *Payment processors*
 - *Sales and customer service channels providers*
- Revenue collectors, accountants and auditors.
 - *No more MetroCard activities. Higher bankcard volumes and new CMC activity, including retention fee. Reduced cash volume. Increased near real time access to payment and usage data.*
 - *Cash, security, fraud. New risk management rules.*
 - *Controller's office personnel*
 - *Internal audit*
- NFPS managers
 - Fare policy setters.
 - *Since fare logic is on server, MTA can implement innovative fare policy not previously easily implemented, can consider fare policy modifications to simplify policy, including transfers and the transfer tables system, and reduce customer issues. NFPS will require shorter time to make changes to fare tables and policies.*
 - System performance managers.

- *Ability to monitor performance in real time and measure performance over time.*
 - *New performance requirements.*
 - Call center.
 - *One call center established for NFPS. Train other MTA and NYCT call center employees to transfer calls to NFPS Call Center. Substantial changes with NFPS.*
 - *One call center for CMC provided by CMC provider.*
 - Website.
 - *NFPS will have its own website.*
 - Account management.
 - *New in NFPS, new to customers.*
- Risk Managers
 - Data security
 - *New key management system, new servers, readers and networks*
 - PCI-DSS and PA-DSS.
 - *Independent payment industry Certification for NFPS readers, communications required (e.g., Level 1 Certification as per PCI-DSS version 2)*
 - *Reader certification (e.g., reader EMV compliance certification level 2)*
 - Financial risk management and fraud detection (transaction risk, card abuse)
 - *Changed from MetroCard to CP devices*
 - *Will have new types and new levels of potential risk to monitor and prevent*
 - Police enforcement (MetroCard squad)
 - *Changed from MetroCard to CP devices*
 - Network managers.
 - *Management of new connections through station LANs to wired network (SONET) and large 3G or 4G wireless networks for NFPS for buses and stations, managed through service level agreements*
- Acquirer relationship managers/third party managers.
 - *Acquirer role will change in NFPS and needs to be more closely managed.*
- Regulators
 - System safety.
 - *Certify NFPS equipment*
 - Engineering standards for subway environment (NYCT Capital Program Management)
 - Code enforcement (NYS Building Code)
 - Financial regulators (Cash: ATMs on property, for example)
- Non-revenue card users
 - *Eliminate MetroCard; use nonrevenue version of CMC. Or possibly have emergency personnel IDs (for NYPD and FDNY) be standard cards, so they can be used directly without MTA having to issue a separate card. Negotiate with City.*
 - Unrestricted Access to NYCT system
 - Restricted Access to NYCT system
 - Contractors, third party maintainers, emergency personnel

- *Will use CMC.*
- System and Employee Support
 - Procurers.
 - *Multiple system components, not a single vendor.*
 - Trainers.
 - *NFPS will require training for affected staff and development of new training resources.*
 - Documenters.
 - *NFPS will require comprehensive documentation before, during and after implementation*
 - Department of Buses Supervisors.
 - *NFPS will require providing supervisors with information and assisting them with preparation of employee training in NFPS procedures.*

12.7 Other organization impacts

- Potential new participants: ferries, buses, tour companies or carriers
- Other tri-state region agencies where CP devices may be accepted in future (for instance, NJT, PATH, Connecticut Department of Transportation (bus only), Amtrak, Suffolk County Transit, City of Long Beach Bus, HART; the latter three are agencies that offer travel that our commuter railroad customers could link up with in intermodal trip):
 - *Provide added customer convenience; provide opportunities for joint marketing.*
- Other operators and transportation or non-transportation organizations that decide to accept CP device standard and MTA accounts.

Appendix 1: Key Concept Terms

Term	Definition
3G	The third generation of cellular wireless standards fulfilling specifications by the International Telecommunication Union. Compared to the older 2G and 2.5G standards, a 3G system must allow simultaneous use of speech and data services, and provide peak data rates of at least 200 Kbps according to the IMT-2000 (International Mobile Telecommunications-2000) specification.
4G	The fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. Speed requirements for 4G service set the peak download speed at 100 Mbps for high mobility communication (such as from trains and cars) and 1 Gbps for low mobility communication (such as pedestrians and stationary users).
Accept List	An electronic list that identifies devices associated with accounts considered to be in good standing with MTA and considered valid for entry.
Acquirer	The financial institution that establishes and maintains the merchant account, receives transactions from the merchant, and initiates the interchange via VISA/MasterCard. The acquirer must be a licensed member of MasterCard or VISA. An acquirer can connect the merchant with American Express and Discover or the merchant can connect directly because American Express and Discover can each act as their own acquirer. Also called the acquiring bank.
Aggregation	The process of bundling small, individual transactions into one settlement transaction to reduce network and transaction fees imposed by an acquirer or card issuer.
(Financial) Authorization	The process of obtaining approval from the card issuer for a set value when a card is used for payment, the level for which the card issuer will hold MTA harmless for a given transaction or card, in the event the transaction does not result in a successful payment to the MTA. Authorization may be requested by MTA at the time of a card tap, at the time of a purchase of PIA fare products, and/or at other times to be determined.
Bankcard	A credit or debit card issued by a bank.
Billing/Authorization Server	The NFPS server that (a) submits merchant transactions to the Acquirer or Payment Network (b) aggregates the transactions if aggregation is used, and (c) implements internal transactions and adjustments to stored accounts. This server will also include authorization processes.

Bus CIS	Bus Customer Information System. An MTA initiative to provide customers with next bus location information via web, mobile, and SMS text interfaces. Bus CIS includes an application on the NFPS on-bus terminal.
Card Holder	The owner/user of the card that is being used to make a fare product purchase or pay fare at entry.
Card Issuer	The financial institution that issues a credit, debit or prepaid card to a cardholder. The issuer must be a licensed member of MasterCard or VISA. Issuers may also be payment networks, in the case of American Express and Discover. Also called the issuing bank.
Chargeback	(1) The mechanism by which a card issuer claims reimbursement for a payment, usually for reasons of fraud or errors in processing. (2) The return of funds to a customer, initiated by the customer's issuing bank. Specifically, it is the reversal of a prior outbound transfer of funds from a customer's bank account, line of credit, or credit card. A transaction that has been disputed by the customer or issuer, is sent back through interchange to the acquirer, and must be resolved by either the acquirer or the merchant.
Clearing	The exchange of <u>transaction details</u> between an acquirer and an issuer which posts the transaction to the cardholder's account and reconciles it for settlement for payment to the merchant.
Contactless MetroCard	CMC. A card issued by MTA that will be usable only at MTA readers.
COTS	Commercial off the shelf hardware or software products that are readily available for purchase and use without modification.
CP Card/Device	A contactless payment card or device that meet ISO/IEC 14443 standards and is payment enabled to be authorized and settled through an open payment network. The cards initially accepted for payment in NFPS will include credit, debit, prepaid cards as well as CMCs. It is assumed that in the near future various form factors are likely to become common such as NFC phones or key fobs.
Credit Card	A card issued by a bank that allows its holder to buy goods and services based on the holder's promise to pay in the future for these goods and services. The issuer of the card creates a revolving account and grants a line of credit to the user from which the user can borrow money for payment to the merchant as or as a cash advance to the user.
Data Warehouse	A database, typically of a transactional system, offloaded from the operational system and used for analysis, planning and

	reporting purposes.
Debit Card	A card that provides an alternative payment method to cash when making purchases. In some cases, the cards are designed exclusively for use on the Internet, and so there is no physical card. Like credit cards, debit cards are used widely for telephone and Internet purchases and, unlike credit cards, the funds are transferred immediately from the customer's bank account instead of having the customer pay back the money at a later date. Also known as a bank card or check card.
Deny List	A list of card IDs that are not valid for use in the MTA. Cards can be on Deny Lists due to being lost or stolen. Cards may also be added to deny list because of insufficient funds. This list is provided to the MTA by the payment industry and modified by the MTA. The MTA may update this list with additional cards if the cards violate in-system use rules and the MTA does not wish to accept these cards.
EBT	Electronic Benefits Transfer, a government-funded cash assistance program that distributes payments such as Food Stamps and Temporary Assistance for Needy Families on debit cards that can be swiped and used with POS terminals for restricted purchases.
Fare	The price of a journey established by fare policy.
Fare Engine	NFPS processor that assigns a price to a tap (for a ride) for billing purposes.
ISO/IEC 14443	The International Organization for Standardization, or ISO, issued its ISO 14443 standards in 2008 to harmonize the use of proximity or contactless smart cards and their communication protocol.
IVR	Interactive Voice Response, a technology that allows customers to interact with a computer through the use of voice and Touch-Tone telephones. IVR allows customers to interact with a company's application via a telephone keypad or by speech recognition, after which they can service their own inquiries by following the IVR dialogue. IVR systems can respond with prerecorded or dynamically generated audio to further direct users on how to proceed. IVR system must be TTY capable.
Kiosks	An interactive computer terminal for customer use in NYCT subway stations and/or external merchant locations to buy fare products or reload CMCs or to check the value of an MTA Account. It is operated by self-service (by customer) or by station personnel.
Merchant	A business that has contracted with an acquirer for card processing services and accepts credit and debit cards as a

	method of payment for goods or services.
Merchant Transaction	Commercial transactions initiated by a customer at a merchant location that is captured electronically and processed through a standard payment industry system.
NFC	Near field communications, a short-range high frequency wireless communication technology, which enables the exchange of data between devices over approximately a ten centimeter (or 4 inch) distance. The technology is an extension of the ISO/IEC 14443 proximity-card standard that combines the interface of a smartcard and a reader into a single device. An NFC device can communicate with both existing ISO/IEC 14443 smartcards and readers, as well as with other NFC devices, and is thereby compatible with existing contactless infrastructure already in use for public transportation and payment. NFC is primarily aimed at usage in mobile phones. NFC phones can make payments in either card-emulator mode (in which the phone represents a card and payments are processed for the card) or in peer-to-peer mode (in which payments are processed through the phone).
NFPS	MTA's New Fare Payment System.
Orphan Mode	Mode in which the reader is unable to connect to the server.
Passback	Passback rules limit the number of times a single device can be used at one station or bus service and is a part of transport-authorization process.
PAYG	Pay As You Go. Post-paid single ride trips that are not associated with a pre-funded product.
Payment Network	Card associations such as VISA® or MasterCard® (and others) that act as a gateways between acquirers and issuers for authorizing and funding transactions
PCI	Payment Card Industry, the industry that manages standards for debit, credit, prepaid, e-purse and ATM cards and POS terminals for payment and associated business functions.
PCI DSS	Payment Card Industry Data Security Standard, a comprehensive industry security standard and framework that governs the safekeeping of card holder and other sensitive transport-authorization information as it is processed, stored, or transmitted within the merchant environment. All merchants that accept and process credit/debit cards are required to comply with the PCI DSS.
PIA	Pay In Advance. To purchase fare product in advance of use, which is electronically stored for the benefit of the purchaser.

Prepaid Card	A card issued in the name of an account owner and representing money on deposit with its issuer. Can be closed loop (accepted by a single merchant), semi-open loop (redeemable at multiple merchants), or open loop (redeemable by all merchants in a branded network). A cardholder is not required to have a checking account. Some prepaid cards are reloadable, while others are not.
Reader	The reader functionality encompasses a point-of-sale device with display and audio features, contactless card recognition for the ISO/IEC 14443 type cards, terminal computer device with memory to store Accept/Deny Lists and support some local processing logic, modem (for wireless communications) and real time connectivity to servers. It can also operate in the "orphan mode".
Settlement	The <u>exchanging of funds</u> between the acquirer and the issuer. Settlement includes funding the merchant for the transaction and paying any necessary fees due to the issuer or acquirer for processing the transaction.
SRT	Single Ride Ticket. The undiscounted fare for a single ride. Offered either through CMC or on a contactless paper ticket.
Stored Account	Server based electronic storage of data related to device use in NFPS system, including purchased fare products, and other transaction information.
Tap	The act of bringing a device into close proximity with a reader to initiate the payment and entry process.
Transport-authorization	The process that determines whether a tap is accepted or denied based on a series of checks. These checks could include: checking against a deny list that consists of card numbers that have been reported lost, stolen, or have been flagged for suspicious activity; checking against an accept list for customers with PIA fare products in good standing; a velocity check to limit the number of times a card may be used to enter the system in a single day; and other checks
Unbanked	Customers who do not have bank accounts and therefore, do not have access to bank cards.
Velocity Check	A method of counting taps by a card (regardless of reader) within a set time period and comparing it to an established parameter.

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- **Federal Communications Commission electromagnetic radiation requirements**
 - FCC PART 15 REQUIREMENTS, November 25, 2004, FCC ID Number : QNP-EVREC3
- **EMV Contactless Specifications for Payment Systems - EMV Contactless Communication Protocol Specification Version 2.0 August 2007.**
- **ISO/IEC card, NFC and quality standards**
 - **ISO/IEC 7810:2003** Identification Cards – Physical Characteristics
 - **ISO/IEC 7816-4:2005(E)** Identification Cards – Integrated circuit cards – Part 4: Organization, security and commands for interchange
 - **ISO/IEC 8583-1: 2003** Financial transaction card originated messages -- Interchange message specifications -- Part 1: Messages, data elements and code values
 - **ISO/IEC 8583-2: 1998** Financial transaction card originated messages -- Interchange message specifications -- Part 2: Application and Registration procedures for Institution Identification Codes (IIC)
 - **ISO/IEC 8583-3: 2003** Financial transaction card originated messages -- Interchange message specifications -- Part 3: Maintenance procedures for messages, data elements and code values
 - **ISO/IEC 9001:2008** Requirements for a Quality Management System
 - **ISO/IEC 10373-6: 2001/Amd 3: 2006** Identification Cards – Test Methods –Part 6: Proximity Cards. Amendment 3: Protocol Test Methods for Proximity Coupling Devices
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- **PCI Standards**
 - **Payment Card Industry (PCI) Data Security Standard (DSS)**, Requirements and Security Assessment Procedures, Version 2, October 2010
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- **Bankcard association standard**
 - MasterCard, Visa, AmEx and Discover reader type certification standards
 - EMV reader type certification standards
 - Payment industry contactless standards developed and deployed by Visa (“PayWave”), MasterCard (“PayPass”), American Express (“ExpressPay”), Discover (“Zip”) and others. These include
 - EMV Integrated Circuit Card Specifications for Payment Systems, Books 1– 4, Version 4.2, June 2008
 - PayPass – M/Chip Reader Card Application Interface Specification Version 2.0 – September 2008, and MasterCard Magstripe specification
 - Visa Contactless Payment Specification v2.0.2 July 2006 with Additions and Clarifications V3.0, August 2007
 - Visa Europe Contactless Terminal Requirements and Implementation Guide, Version 1.1, February 2007, if necessary
- **PIV, CAC**
 - FIPS PUB 201-1, March 2006

14. SAE Standards

- a. J1113-13 - Electromagnetic Compatibility Measurement Procedure for Vehicle Components--Part 13: Immunity to Electrostatic Discharge
- b. J1939 – Vehicle Controller Area Network

15. Card Network Operating Rules

- a. MasterCard Rules, MasterCard Worldwide, October 29, 2010
- b. Visa International Operating Regulations, Visa Incorporated, October 15, 2010
- c. Discover Network Operating Regulations & Technical Specifications Release 10.2 DFS Services LLC, April, 2010

Appendix 3: Current Conditions

As the MTA contemplates a New Fare Payment System, it is important to understand the current condition into which this new system will be introduced. This appendix describes those conditions, especially as they relate to Phase 1 (buses and subways) of the NFPS.

1 MTA Transportation Network and Operating Environment

1.1 Overview of the Metropolitan Transportation Authority

The Metropolitan Transportation Authority (MTA) is the umbrella organization responsible for ensuring the delivery of public transportation (and some major bridge and tunnel facilities) in the New York City metropolitan area. The MTA network is the largest public transportation system in North America. MTA manages policies and budgets across its various operating transportation agencies, and oversees the agencies' capital programs. The MTA is a public authority created by New York State legislation, and is governed by a Board of Directors.

The MTA's seven operating agencies provide the region's subway, commuter rail, bus, bridge and tunnel services, operating twenty-four hours each day, every day of the year. MTA agencies provide daily public transportation operations and are financially supported by farebox revenues and public subsidies. The transportation services that MTA provides are a critical to the region's economic vitality. Counties served are: in New York City: Bronx, Brooklyn, Manhattan, Queens, Staten Island; Upstate New York: Westchester, Rockland, Putnam, Dutchess, Orange; Long Island: Nassau, Suffolk; and Connecticut: Fairfield, New Haven.

The MTA, its subsidiaries and its constituent agencies are:

- MTA – Headquarters (MTAHQ)
- MTA – Capital Construction (MTACC)
- MTA Bus
- Metro-North Railroad (MNR)
- Long Island Rail Road (LIRR)
- Bridges & Tunnels (B&T)
- New York City Transit (NYCT)
- Manhattan and Bronx Surface Transit Operating Authority (MaBSTOA)
- Long Island Bus (LI Bus)
- Staten Island Railway (SIR)

MTA does not currently use a single fare collection system at all of its agencies. Each MTA operating agency manages, operates and maintains its own independent fare collection system, with the exception of LI Bus and MTA Bus, both of which use MetroCard with NYCT support.

The current fare payment system used by NYCT, SIR, MTA Bus and LI Bus customers is the Automated Fare Collection (AFC) system, commonly referred to as the MetroCard system. MetroCard is not interoperable with the fare payment systems of LIRR, MNR or with MTA Bridges and Tunnels' toll payment system, E-Z Pass.

1.2 Primary MTA Agencies that Rely on AFC

NYCT is the largest agency in the MTA regional transportation network, operating subways in four New York City boroughs, buses in all five NYC boroughs, and SIR. This bus and subway network serves a population of almost 11.3 million people. NYCT carries approximately 7.4 million customers on average each weekday. The subway system includes 24 lines (21 routes and 3 shuttles), 468 stations, and approximately 6,400 subway cars (the largest subway car fleet in the world). The subway system carries 5.2 million passengers a day. NYCT bus system includes about 193 local and 24 express bus routes, 2 SBS routes; and approximately 4,400 buses (largest bus fleet in US). The bus system has a fleet of 4,538 buses serving 245 local and express bus routes and carries approximately 2.2 million passengers on average each weekday. Annually, the subway provides 1.6 billion rides and the buses 697 million rides. NYCT also administers paratransit service throughout NYC to provide transportation options for people with disabilities.

SIR, part of NYCT, provides train service along Staten Island's southern perimeter carrying an estimated 25,000 passengers on average each weekday. Currently, revenue is only collected at two stations and average weekday revenue trips in 2010 were 14,904. Annually, SIR provides 4.1 million rides. SIR is a single line with 22 stations and 64 subway cars.

MTA Bus operates local and express bus service in the Bronx, Brooklyn, Manhattan and Queens. MTA Bus fleet size is 1,347 buses carrying 394,000 passengers on average each weekday. Annually, MTA Bus provides 120 million rides.

LI Bus operates throughout Nassau County (with service into eastern Queens and western Suffolk County) with a fleet of 419 buses and serves 104,000 passengers on average each weekday. Annually, LI Bus carries 31.1 million passengers.

1.3 Other MTA agencies with ties to AFC

1.3.1 Commuter Railroads: LIRR and MNR

LIRR is a suburban commuter railroad serving 124 stations with 4,344 weekly revenue trains traveling between New York City and Nassau and Suffolk counties on Long Island, and carries approximately 287,000 customers daily. Annual riders total 83 million.

MNR is a suburban commuter railroad serving 109 stations with 4,078 weekly revenue trains in East-of-Hudson service between New York City and three New York State and two Connecticut counties and 12 stations with 396 weekly revenue trains in West-of-Hudson service between New York City and two New York State counties, and carries approximately 275,000 customers daily. Annual riders total 80 million.

LIRR and MNR allow passengers to purchase NYCT MetroCards from their ticket vending machines, ticket offices, Mail & Ride and WebTicket Program. This joint ticketing requires a passenger to buy a ticket or a pass for the commuter railroad with the option to purchase a

MetroCard at the same time. This function means that both railroads will be affected by the deployment of NFPS and plans for the MetroCard legacy system.

1.3.2 MTA Bridges and Tunnels

B&T operates and tolls seven bridges and two tunnels accommodating 824,000 crossings each day. Annual vehicle crossings number 291 million. B&T will be affected by deployment of NFPS in connection with B&T's plans to move to All Electronic Tolling and eliminate all cash acceptance lanes. Customers without an E-ZPass tag will be mailed an invoice. This invoice will be able to be paid in cash at retail locations. Customers who wish to pay with cash in the future may also be able to do so through a reloadable prepaid card that can be used like a bank card to fund an E-Z Pass account. Ultimately this function may be served by the CMC.

1.4 Transportation Services in the Region and AFC

Several transportation agencies in the greater New York region operate service which accept or interface with AFC/MetroCard transactions. Currently, several of these non-MTA operations sell and accept MetroCard for which NYCT provides operating and maintenance support. The following sections describe these agencies and their interface with AFC/MetroCard.

1.4.1 Connecticut Department of Transportation (CDOT)

Under an agreement with CDOT, MNR is responsible for the day-to-day operation of the commuter rail service on the New Haven Main Line (New Haven to Grand Central Terminal) as well as the Connecticut Branch Lines (Danbury, New Canaan and Waterbury). The agreement, among other things, stipulates the allocation of capital and operating expenses between MNR and CDOT based on specified formulae. To the extent the NFPS affects MNR ticketing, it could be covered by the provisions in the CDOT agreement that pertain to the ticket selling equipment and system.

1.4.2 The Port Authority of New York and New Jersey

The Port Authority of New York and New Jersey operates two transportation services which the PATH system and the JFK Air Train service. These Port Authority services accept the Pay-Per-Ride MetroCard. The Port Authority fare is deducted from the card when it is used on one of these two systems. PATH also accepts the "PATH 2-Trip MetroCard" which can be purchased from PATH station dispensers. The PATH fare is deducted per use.

1.4.3 New Jersey Transit

A combined Hudson Bergen Light Rail (HBLR) monthly pass and monthly MetroCard was available at NJT Ticket Vending Machines at HBLR stations. The combined pass was eliminated in 2008.

1.4.4 The City of New York City

Currently accepts Pay-Per-Ride MetroCard and/or Unlimited Ride MetroCard for rides on the Roosevelt Island Tram.

1.4.5 Westchester County

Accepts Pay-Per-Ride MetroCard and/or Unlimited Ride MetroCard for rides on its bus system (Westchester Bee Line Buses) serving this suburban county just north of the five boroughs of New York City.

1.4.6 Private Bus Companies

Accept Pay-Per-Ride MetroCard and 7-Day Express Bus Plus. 7-Day Express Bus Plus is a MetroCard product accepted on NYCT express buses and is also accepted on Atlantic Express, a private express bus service.

2 AFC Customer Interface

The centerpiece of NYCT's current fare payment system, also known as AFC system, is the MetroCard, a 10 mil polyester magnetic-stripe fare card. The MetroCard is a stored value (pay-per-ride) and/or time based (multiple-day, unlimited ride) card that is activated through magnetic stripe read/write technology. A paper MetroCard is used for bus to bus transfers and for Single Ride Tickets. MetroCard is used to provide both revenue and non-revenue access to NYCT, SIR, MTA Bus, and LI Bus transportation services, and at other agencies. When a MetroCard is issued, it can be programmed to provide various types of access. Local and express buses also accept coins at the on board farebox unit for passengers wishing to pay a cash fare. When a passenger purchases a MetroCard under the current AFC system, the fare is pre-funded, although not counted as revenue until the card is used for travel. MetroCard is not accepted on paratransit vehicles (operated by third party vendors).

2.1 Current Fare Structure

The MetroCard accommodates the NYCT fare structure which is based on a flat fare per ride (\$2.25) for a pay-as-you-go rides and free transfers for most subway/bus and bus/bus linked trips. NYCT charges an additional 25 cents when a passenger buys one single ride ticket. NYCT fare structure also includes options for time and value-based fare products which result in a reduced average price per ride, and a Reduced Fare Program for senior citizens and persons with qualifying disabilities. Other fare programs for students and groups, and joint ticketing with other agencies, are also part of the MetroCard product options.

2.2 Using the MetroCard

2.2.1 Subway

To enter the subway system, the customer swipes a properly oriented MetroCard, through the turnstile swipe reader/writer module on top of the turnstile. In a single swipe, the fare card is read, validated, and updated. If the fare card is valid, the turnstile controller board sends a 24V DC pulse to a solenoid that releases the barrier arm and permits entry into the system. Simultaneously, the turnstile displays the "GO" message on the vacuum fluorescent display. The actual message displayed varies, depending on the type of fare card used (e.g., value-based, time-based, employee pass, etc.). The message may include the amount of fare paid, the balance value remaining on the MetroCard and/or the expiration date of the time-limited for

passes. Similarly, at gates serving mobility impaired customers using AFAS gates with magstripe readers, the swipe of a specially encoded MetroCard triggers opening of the gate.

2.2.2 Local and Express Buses

For fare payment on local and express buses, an integrated farebox unit (IFU) is employed. The IFU is a self-contained, electromechanical device. In addition to accepting MetroCard, IFUs accept transfer tickets and coins, and can issue transfers as well. In order to board a bus, the customer dips a properly oriented MetroCard into the IFU. If the fare card is valid, the IFU provides visual and audible confirmations of the fare card's acceptance. A "GO" message for the customer is displayed at the top of the farebox unit. There is no entry barrier on the bus, but the bus operator confirms fare payment is made and can act to deny entry to those persons who have not paid their fare.

On Select Bus Service (SBS) routes, articulated buses are used with two or three doors. Passengers must pay their fares using wayside machines at SBS stops before boarding. These wayside machines accept either MetroCard or coins. These wayside machines provide a paper receipt as proof of payment, which Special Inspectors randomly check to confirm fare payment. On SBS services, passengers can board the bus through any of the bus' doors.

2.3 MetroCard Sales Channels

There are many places and ways to purchase MetroCards, as described in the following sections.

2.3.1 Subway Station Booth Sales

Booths are located in all subway stations and are staffed by station agents. Every type of MetroCard (except the Single Ride Ticket) can be purchased at the booth. Only cash is accepted for a MetroCard transaction at station booths. The MetroCard encoding equipment in the Station Booth is connected to a central support computer for the transmission of revenue/data recording and reporting.

2.3.2 Automated Vending Machines

Vending machines are located in all subway stations. They were first introduced in 1999 and can now be found in two models. Full-function MetroCard Vending Machines (MVMs) accept cash, credit cards, and ATM/debit cards in order to purchase, or add value to, a MetroCard. MetroCard Express Machines (MEMs) only accept credit cards and ATM/debit cards. Vending machines do not have the ability to accept multiple payment methods for a single MetroCard transaction. All vending machines allow a customer to purchase every type of MetroCard through a touch screen hierarchical menu, with the exception of the Single Ride Ticket (SRT) which is not sold at the MEMs. After payment is processed the MetroCard is dispensed, along with an optional paper transaction receipt. The vending machines are compliant with the Americans with Disabilities Act of 1990 through the use of Braille and a headset jack. All vending machines are connected to a central support computer system (host) for network management, transaction processing, network & data security, revenue/data recording and reporting, as well as ultimately interfacing with the clearing house vendor for credit and debit

card transactions authorization and processing. All credit /debit card transactions from vending machines are transmitted to the clearing house service provider for 'host-to-host' online authorizations over dedicated communication lines. These transactions originating at the vending machines are encrypted before transmission over the network, and all aspects of processing are handled under stringent data security methods in accordance with current card industry / associations security standards.

2.3.3 MetroCard Bus and Van

There is one MetroCard Bus and three MetroCard Vans that travel throughout NYC and Westchester County, making scheduled stops at various locations. All types of MetroCards can be purchased or refilled directly from these vehicles. Only cash is accepted for a MetroCard transaction on the MetroCard Bus and Van. The MetroCard encoding equipment on these vehicles stores the encoding information until the end of the day, at which point it is downloaded to a central support computer for the transmission of revenue/data recording and reporting.

2.3.4 EasyPay Program

EasyPay eliminates the need for customers to wait on lines at vending machines and/or fumble for cash or credit cards to put money on their MetroCard. EasyPay accommodates full and half fare customers, providing a re-load card feature for three fare products--two full-fare (EasyPayXpress 30-Day Unlimited Ride and EasyPayXpress Pay-Per-Ride) and one reduced fare (Reduced-Fare EasyPay Program).

Full fare EasyPay customers can open an account online, as well as by mail, at the NYCT Customer Service Center or at a Mobile Sales Bus or Van Unit. Eligible reduced fare customers (Senior Citizens and People with Disabilities) must establish an account by mail or in person.

After an account is established, Easy Pay customers may choose to pay for their EasyPay MetroCard fares with monthly automatic deductions from credit /debit cards, or checking accounts, in addition to mailing in payments by checks and/or transportation vouchers. Full-fare customers can pay for their EasyPay MetroCard fares from credit/debit cards and/or pre-tax transportation benefit vouchers.

2.3.5 Extended Sales Network and Bulk Sales

MetroCard can be purchased at authorized MetroCard retail merchants located throughout NYC, as well as through a number of pre-tax transit benefit providers working directly with participating employers. The number of active retail (over-the-counter only, not including the government and social service agencies) merchants is fluid over the course of a year; on average though, there are almost 3,000 merchants in the network. These retail locations (check cashers, delis, banks, etc.) and pre-tax transit benefit providers (Transit Center, WageWorks, etc.) purchase from NYCT and sell at the standard NYCT price sealed, pre-valued MetroCards in all denominations. Customers are not charged any fee for purchasing MetroCards through these out-of-system locations. These merchants purchase MetroCards in bulk directly from NYC Transit for eventual sale to individual customers and receive a commission for selling the

MetroCards on behalf of NYCT. There are also a number of social service agencies that purchase MetroCards in bulk directly from NYC Transit for eventual distribution to clients, patients, and visitors (typically at no cost). These “non-selling” locations do not receive a commission. Most of the merchants pay for their MetroCard orders by ACH (Automated Clearing House) transactions; some pay through check or wire payments; and some pay through credit card accounts. There is no connection between these retail merchants and the central support computer resident at NYC Transit for the transmission of MetroCard sales revenue/data recording and reporting.

An organization or entity can buy large quantities of MetroCards. There is no maximum purchase, however there is a minimum and they are actual MetroCards, so a group entry arrangement does not necessarily apply.

2.3.6 Block Tickets

Block tickets are kept in each booth at each station and are treated just like fare media for the purposes of inventory and control. They are issued in the event of a service disruption that would cause a customer to have to pay an additional fare to continue their journey. For example, if the #7 train were being turned back south at Queensboro Plaza, the Customer Service Agent (CSA) might issue a block ticket for a bus transfer so the customer could continue the journey towards Main Street by bus, or further into Queens using the E,F,M,R.

2.3.7 Group Sales

Large groups of customers such as school or community groups are able to buy fares so each person in the group does not have to swipe a MetroCard. This “certificate” is available only to groups that qualify as not-for-profit, and the fare is free. At the point of entry into the system, the certificate holder brings it to the CSA, who releases the gate so the entire group can enter the system together.

2.3.8 Commuter Rail Joint Ticket

See section 1.3.1.

2.4 MetroCard Non-Revenue Use

NYCT issues non-revenue MetroCards (i.e. cards that do not generate revenue for the MTA) to NYCT employees and other authorized groups as described below.

2.4.1 Employee Passes

NYC Transit issues photo identification MetroCards to active and pensioned employees of NYCT and other approved employees of the MTA, its subsidiaries and its constituent agencies. Photo identification MetroCards may also be issued to employees of other government agencies.

Individual Employee Photo Identification Cards (EPIC) are encoded using state of the art identification (ID) card printers that have dual sided lamination and security inks and holography. EPICS are photo ID MetroCards used for employee transportation and timekeeping. Each card has the employee's image, name, title, identification number, timekeeping bar code,

“DO NOT DUPLICATE” and an area for the employee's signature, which subjects the user to all applicable terms and conditions of use, including no passback feature. The card indicates specific use class and agency codes. The EPIC has an overlaid security laminate of the MTA logo. The EPIC pass is encoded to provide:

- Record an employee's attendance and leave by swiping the bar code located on the image side of the EPIC at the Kronos automated timekeeping system.
- Permit access or restrict unauthorized persons at locations equipped with Lenel security systems by use of the swipe mechanism and the 10-digit AFC serial number located on the left of the signature bar (under the word “Expires”).
- EPICs permit active MTA/NYCT/MaBSTOA/SIR/LI Bus employees and eligible spouses of MaBSTOA employees access to trains and buses in accordance with the pass holder's title or collective bargaining agreement.

The transportation pass is restricted for use only by that employee and issued by the NYCT Pass Office. MTA Headquarters employees and current MTA Board members may also receive commutation passes. Other MTA employees may receive a pass with special permission when their assignment requires them to travel for work-related reasons to different NYCT facilities.

The current pass types are described below.

- Universal EPIC - Universal EPICs are issued to operating and career and salary managers; non-represented, non-managerial employees and represented employees in accordance with their collective bargaining agreement. It is either red (male) or blue (female) and is valid for use on subways and buses operating out of NYCT and MaBSTOA depots, with the exception of express buses-. A bold letter "U" printed on the right designates the user's transportation privilege.
- NYCT EPIC - NYCT EPICs are issued to NYCT former Transit Bureau Civilians employees in accordance with the employee's collective bargaining agreement. It is either red (male) or blue (female) and is valid for use only on NYCT subways and buses operating out of NYCT depots. A bold letter "E" printed on the right designates the user's transportation privilege.
- MaBSTOA EPIC - MaBSTOA EPICs are issued to MaBSTOA employees and eligible spouses in accordance with the employee's collective bargaining agreement. It is either green (male) or yellow (female) and is valid for use only on buses operating out of Manhattan and Bronx bus depots. It is not valid on subways. A bold letter "E" printed on the right designates the user's transportation privilege.
- SIR EPIC -SIR EPICs are issued to managerial and non-managerial SIR employees. It is either green (male) or orange (female) and is valid for use only on the Staten Island Railway. Bold letters "SIR" printed on the right designates the user's transportation privilege.
- Long Island Bus EPIC –LI Bus EPICs are issued to managerial and non-managerial LI Bus employees. It is either white/blue (male) or white/orange (female) and is valid for use only on the Long Island Bus buses. A bold letter "L" printed on the right designates the user's transportation privilege.

- MTA Bus EPIC – MTA Bus EPICs are issued to operating and career and salary managers; non-represented, non-managerial employees and represented employees in accordance with their collective bargaining agreement. It is either green (male) or orange (female) and is valid for use on MTA Buses only. It is not valid for use on subways. The "MTA Bus" logo is printed on the left side of the pass.
- Pensioner Pictures- PICs are issued to pensioners who receive a monthly payment from the MaBSTOA pension fund, NYCERS BMT Pension Plan, IRT Pension Plan, Staten Island Rapid Transit Operating Authority pension plan or the New York City Employees Retirement System. Pensioner PICs permit retired employees and eligible spouses the same access on subways and/or buses as the employee's last active EPIC permitted. Pensioner PICs are distinguished from active employees with the word "pensioner" or "pensioner spouse" on the picture side of the MetroCard. Bold letters "U", "E", "L" or "SIR" and background colors are the same as those given to active employees.

2.4.2 Police, Fire, and District Attorney (DA) passes

When there is an emergency response situation, police, fire, emergency technicians are provided system entry via gates and/or turnstiles by attending personnel (Usually Rail Control Center is notified and communication is made to appropriated operating divisions). NYC Police Department and NYC Fire Department personnel have department-issued badges. All NYPD officers are issued MetroCards and all FDNY vehicles are issued one MetroCard for emergency access.

Currently, the New York Police and Fire Departments, the Port Authority Police and the NY District Attorney's offices received MetroCard Passes which allow them free access to the NYCT system. There are approximately 55,000 of these passes in circulation.

2.4.3 Student MetroCards

MTA provide 14 types of Student MetroCards (from 2-4 ride/day with varying days and hours of validity) to approximately 900,000 New York City students for transportation to and from school. The program is administered through the DOE's (Department of Education's) Office of Pupil Transportation. NYCT ships Student MetroCards to DOE three times a year for distributions to schools for the fall, spring and summer terms. Approximately 2,700,000 MetroCards are shipped during an average three-semester year.

2.4.4 Transfers

NYCT provides transfers for bus passengers who pay with cash, rather than with MetroCards. MetroCard users have a free transfer encoded on their card when used on a bus; however, passengers paying cash require a paper transfer. Transfers are similar in size and shape to a MetroCard; however, they are made of paper with a magnetic stripe and are provided in rolls of 500. Cash paying customers on buses may request a free transfer. The passenger may then use the transfer on another bus, with restrictions, but in the same manner as the MetroCard. This paper transfer is not valid for use on the subway system. For 2010, MTA ordered 3,953 cartons which equal 71,154,000 transfers.

2.4.5 Facility Access (Property Protection)

Employee Passes and Non-employee Passes are utilized for a variety of facility access purposes. At facilities with assigned Transit Property Protection Agents (TPPA), Passes must be displayed to the TPPA to gain entry. At facilities that have electronic access control devices, the Pass is swiped at a card reader, turnstile or High Entrance/Exit Turnstile (HEET) to gain access into protected properties, buildings, floors and rooms. The swiping of Passes can be electronically controlled to limit access to approved persons. The swiping of Passes is also electronically archived for forensic/investigatory purposes.

The NYCT Department of Security issues restricted access MetroCards to vendors/contractors and maintainers who must perform work in a NYCT facility that is not within the fare paid area or within the station environment. Contractors must complete an application for issuance. Use is time and location restricted and managed by the Department of Security.

3 AFC Operations: Organization and People

The AFC system is owned and operated by the NYCT. MetroCard is managed through the AFC Program Office and supported by several other departments, primarily AFC Maintenance Operations, Central Electronics Shop/Electronic Maintenance Division (CES/EMD), Technology & Information Systems (TIS), Revenue Control, Materiel's Technology Contracts Management, and Corporate Communications' Customer Service and Customer Relations Departments. The current AFC system is maintained by almost 700 full-time and part-time (some employees' responsibilities cover more than AFC) NYCT maintenance personnel spread across at least four organizations within NYCT, with reliance on continued support from the system supplier, Cubic. In addition to Cubic, the other major outside parties on which the system operation is reliant for operational support are: (1) the MTA Acquirer for processing credit and debit transactions from vending machine and online transactions and (2) the network of retail merchants who make up the extended sales network.

3.1 Division of AFC Program Management and Sales

The AFC Program Management and Sales Operations group is responsible for overall management of activities related to fare media sales, payments, and usage at NYCT. This includes managing the contract and business relationship with Cubic, NYCT's legacy AFC system vendor, as well as the distribution (sales channels), usage, reconciliation, and customer claim activities related to actual usage of MetroCards (for example, mis-swipes or defective cards).

The group has led efforts to expand the use of MetroCard as a regional fare payment instrument, managing the upgrade and modification of the MetroCard AFC system to respond to new business and public transportation opportunities, while managing day-to-day business operations related to fare media sales and payments. The latter encompasses responsibility for credit/debit payment operations, including risk management and customer service; overseeing the assurance of fare media sales availability; and the development and implementation of new initiatives to enhance customer service and security.

The division provides program management services to support the MTA AFC Capital Program and ongoing operations for AFC end-users at NYC Transit, MTA Bus, PATH, AirTrain, LI Bus, SIR, and Westchester Bus. It develops, manages, and administers all phases of AFC Capital projects. The group also develops, prepares, and updates, with input from its end-users, the five-year AFC Capital Program and the Twenty-Year Needs Assessment. As noted earlier, the division serves as the contract manager for Cubic Transportation Systems, Inc., NYC Transit's current AFC system provider.

AFC Program Management and Sales Operations is responsible for managing a diverse array of fare media distribution options making up a network of approximately 2,250 vending machines in all NYC Transit subway stations that accept cash, credit, and debit for payment, over 4,000 authorized MetroCard sales/distribution points ("Extended Sales") outside the subway system, and numerous transit benefit providers delivering tax-advantaged fare media through employer-based programs. The focus of the "Extended Sales" capability is on identifying out-of-system fare media purchase points located near bus stops and subway stations to provide cost-effective and convenient fare media sales access to customers. Along with the support activities related to these sales options, the group coordinates all of the interactions with fare media sales business partners along the payments supply chain (credit/debit acquirer, credit card companies, networks, issuers, etc.).

The division is also responsible for various customer service, risk management, and revenue reconciliation/accountability activities related to fare media sales, payment and usage at NYC Transit. Security and fraud control efforts are closely coordinated with NYPD's Transit Police Bureau and other law enforcement agencies. All of the division's operational activities are supported by an internal DataMart facility, wholly managed and operated by division staff.

The division was also responsible for overall management and operation of the Phases I and II smart card pilots designed and sponsored by MasterCard.

3.2 Front Line Customer Service

3.2.1 Subway Station Agents

Station Agents have responsibilities and duties with respect to the fare collection system. The station agent is responsible for selling, collecting and reporting fares; and allowing authorized personnel and fare-paying customers to enter the subway system. Their duties include selling fare media, making change for customers, providing information to customers (e.g., explaining fare card types and advantages of each); being responsible for the safety and proper handling of money, fare cards, block tickets; checking fare reports, performing fingertip maintenance (e.g., run cleaning cards through turnstile swipe blocks); and reporting emergencies, vandalism and thefts.

Specific to fare media, the Station Agent must be familiar with the policies and procedures associated with the available fare products, usage of vending machines, reduced fare program and reduced fare MetroCard, student transportation MetroCard passes, LIRR and MNR joint

tickets, service disruptions block tickets and emergency tickets, group transportation, free transportation rules, and miscellaneous access passes (e.g., special photo permits, special events, Verizon and ConEd employee ID cards, etc.).

The station agent is also the “eyes and ears” at a station, and together with the station cleaner coordinate communication and response with Rail Control Center (RCC) and Station Command.

3.2.2 Bus Operators

Bus operators have responsibilities and duties with respect to the fare collection system. Their responsibilities primarily are ensuring that each passenger who boards a bus pays the proper fare. Since Express fares are different from local bus fares, the operator must know what the proper fare is on the route she/he is operating, as well as discounted and special fares. SBS route operators are not required to verify fare payment, since it is done prior to boarding the SBS vehicle, however are required to issue paper transfer to customers who paid the fare with cash coins.

3.3 AFC Maintenance Organization

The physical maintenance of the AFC/MetroCard system is carried out primarily by two groups: MetroCard field maintenance for subway and bus MetroCard component maintenance, and the Central Electronics Shop (CES), where subway and bus components are repaired and refurbished.

3.3.1 AFC Maintenance

AFC Maintenance employs people who are responsible for the installing, testing, maintaining and repairing NYCT automated fare collection equipment, bus radio system and bus destination signs.

AFC Maintenance – Subways

Subways dispatches maintenance personnel from four reporting locations utilizing Subway, Bus and assigned vehicles 24 hours a day, 7 days a week. There is an average of 340,000 service calls and over 115,000 preventive maintenance actions annually.

AFC Maintenance – Surface

Surface (for Buses) has maintenance personnel assigned to each NYCT Bus Depot and operates 2 tours 7 days a week. AFC Maintenance – Surface averages 65,000 service calls and performs over 52,000 preventive maintenance actions annually.

AFC Maintenance developed and implemented a configured version of the Spear Computerized Maintenance Management System (CMMS) to effectively manage over 400,000 service calls and 165,000 preventive maintenance actions annually (Subways & Surface). The Spear data coupled with data from the On Line Monitoring and Control (OLMAC) system is utilized to produce comprehensive performance measurement reports and analyses.

Failed MVMs and MEMs automatically generate work orders in the Spear-based maintenance management system and the work orders are assigned by supervisors at the four field locations. Armed Revenue Collecting Agents are present for all MVM related maintenance. Failures of subway turnstiles, station booth terminals, HEETs, AFAS gates, MetroCard readers, SBS MetroCard Fare Collectors, SBS Coin Fare Collectors and Service Gates are reported manually and work orders are created in the Spear-based system for assignment.

AFC Maintenance utilizes applications and methodologies that address the needs of day-to-day maintenance requirements. Detailed procedures outlining these methodologies have been developed to ensure standardization and consistency in providing MTA maintenance services. The use of maintenance reports and check-lists assist in gathering accurate and timely data for direct feedback on equipment performance and reliability. Field audits ensure compliance to these established procedures.

3.3.2 Central Electronics Shop

The CES provides all “Back-Shop” repairs of AFC modules and sub-assemblies. AFC and CES establish the required “float” quantities of spare modules to effectively support the field equipment.

The CES performs the troubleshooting, testing and repair of select electronic and electro-mechanical AFC assemblies deemed repairable. The personnel at the CES are responsible for the repair of modules and components used to support a population of over 180,000 repairable MetroCard assets. These modules and subassemblies are supported and repaired by making extensive use of automated Bench Testing Equipment (BTEs) and Portable Test Equipment, coupled with associated training.

The major AFC subsystems can be sub-divided as follows:

NYCT Surface (Bus) AFC: Integrated Farebox Unit (IFU or “farebox”) which is comprised of fifteen (15) repairable sub-components. The IFU includes an indicator unit installed behind the operator that indicates the type of fare (child, pass, etc.) paid to support revenue inspection and audit of operator performance.

NYCT Subway AFC:

- Turnstiles and Turnstile End-Cabinet comprised of nine (9) repairable sub-components.
- HEET comprised of five (5) repairable sub-components.
- Token Booth comprised of thirteen (13) repairable sub-components.
- Metro Card Vending Machine (MVM) comprised of sixteen (16) repairable sub-components.
- Metro Card Express Machine (MEM) Comprised of sixteen (16) repairable sub-components.

CES also performs troubleshooting, testing and repair of an additional 1,500 Integrated Farebox Units at 12 depots for the following agencies:

- MTA Bus
- LI Bus
- County of Westchester Bee Line Bus
- Metro North Hudson Rail Link

Three levels of repair/replacement are possible, depending on the part or assembly involved. In the first level, the entire component is replaced by the operating department or division and sent to the CES. In the second level, the lowest level removable unit is replaced by the CES and in the third level, the individual failed part in the lowest level removable unit is replaced.

Upon encountering a failure in any AFC subsystem assembly, a spare part is used to perform a one-for-one exchange with the suspected faulty assembly. In turn, the faulty assembly is delivered to CES by either Supply Logistics (for all Surface AFC components) or the department performing the first level of maintenance on that particulate AFC subsystem. The rate of material pick and delivery to/from CES varies, depending upon the needs of the end user.

The second level in the maintenance management process is performed at CES, whereby the faulty subassemblies are diagnosed and repaired by the removal and replacement of printed circuit boards or mechanical subassemblies. In the event that printed circuit boards are found to be defective, additional testing and troubleshooting is performed to detect and replace faulty electronic components residing on these circuit boards. Second and third level maintenance is undertaken at CES in a specialized workshop utilizing customized test equipment and technicians with specialized training and circuit repair skills. After the repair of the AFC subassembly is completed, that unit undergoes an outgoing Quality Control test to ensure full system functionality.

In the event that a particular AFC subsystem component is deemed un-repairable, CES is responsible for the procurement of a replacement part in order to maintain consistent spare part inventory levels.

CES also has an Electronics Integration group, consisting of a technical staff that is responsible for providing the shop floor with the tools (test procedures, fixtures, etc.) necessary to perform daily repairs. Additionally, many AFC sub-component parts have reached various levels of obsolescence, requiring reverse engineering and/or alternate design approaches in order to maintain the higher order component in working order. Electronics Integration also is responsible for ensuring that test equipment is contractually delivered and designed to meet CES requirements for all future AFC emerging technologies.

CES also maintains a Training Systems to train and support maintainers of the existing AFC equipment in the form of online videos delivered over a LAN in the shop and in inspection and maintenance overviews on the NYCT TENS web site.

3.4 Division of Revenue Control

The Division of Revenue Control has three main units that interface with the AFC system: Ticket Stock Management, Revenue Collection, and Revenue Processing.

3.4.1 Ticket Stock Management unit

Magnetic fare media is supplied from three sources located in North Carolina, England and Japan. Procurements are made via the Qualified Products List (QPL) to ensure that all NYCT AFC system specifications are maintained. Upon delivery from the vendor, and prior to encoding, fare media is inspected by the Quality Control (QC) Laboratory. The QC Laboratory also performs pre-production testing to ensure that the High Production Encoding Machines (HPEMs) are meeting encoding parameter specifications.

The HPEM is used for the encoding, verifying, printing and stacking of magnetic fare cards for use in the Automated Fare Collection system. The HPEM is a free standing machine designed to operate in a controlled access area. The HPEM encodes variable and fixed data onto the fare card's magnetic stripe. The serial number, batch number and expiration date are printed by the Domino ink jet printer. The HPEM Local Controller, which contains a single board computer, interfaces with the keyboard, monitor, Transport Controller, Master Controller, audit printer, Domino ink jet printer and Uninterruptable Power Supply (UPS). The HPEM Local Controller controls operator access, monitors error conditions, assembles, encodes and prints data in specified format for each fare card type, communicates status data to each module, supports input range of serial numbers and other information, controls input via keyboard, disk or direct link and creates the audit report for each encoder. The Master Controller acts as the overall control point for fare card serialization (the gateway for fare card information transfer to the Area Controller or ACAC), controls production inventory runs to prevent duplicate fare cards, generates shift production reports and collects alert data for maintenance actions.

The Ticket Stock Management (TSM) system runs on the Area Controller and is responsible for the automated tracking of all encoded magnetic fare media, as well as all inventory reporting and accounting operations. It tracks the shipment of MetroCards by customer, quantity and class code and maintains records on a daily basis of these shipments. The TSM system provides a perpetual physical inventory and ledger reconciliation and is the vehicle for financial liability reporting. The Technology and Information Services (TIS) department utilizes data from the TSM system to prepare monthly reports for Operations Accounting.

3.4.2 Revenue Collections Unit

NYCT's Revenue Collections unit collects on an annual basis approximately \$1.5 billion in revenue from 1655 MVMs and 449 subway station booths. An additional \$109 million is collected from 19 NYCT bus depots. Select Bus Service collections presently include the BX12 and M15 bus routes. Collection services provided to other MTA and governmental agencies include B&T, LIRR, MTA and LI Bus, Air Train and the Roosevelt Island Tramway. All revenue is securely sealed and contained and transported in armored vehicles.

The Revenue Collections unit's schedules for MVMs are predicated upon real time data that reports media and revenue thresholds that facilitate cost-effective just-in-time servicing. Once collected, MVM cash and coin box ID numbers are read into the AFC Money Room System and transferred to Revenue Processing for counting.

Subway Station Booth collections are scheduled either weekly or bi-weekly. Individual bags are manually listed on a Station Agent's manifest (drop sheet) and are also transferred to Revenue Processing for counting.

Bus collections' schedules are static. Revenue is stored in Keene Coin Retrieval Vacuum System vaults at each NYCT depot that are transferred to coin processing after they have been collected.

Supporting these operations is a 24hr/7day Control Desk and a shipping/receiving vault operation.

The Revenue Collections has armed Revenue Collecting Agents (CAs) who are assigned to AFC for access to the interior of the MVM and protection of NYCT personnel and assets. AFC determines its work schedules and coverage by analyzing service call data.

3.4.3 Revenue Processing

The Revenue Processing unit handles all cash revenue processing for NYCT, including cash collected on buses, at subway agent booths, and by the MVMs.

Bus Revenue

Revenue Collections transfers vaulted coin revenue collected from each NYCT, MTA Bus and LI Bus depot to the Coin Processing operation. Revenues are "blind count" processed per vault via high speed equipment and assigned manually to each bus depot. Aggregated, segregated and manually proven daily processed coin is released to Revenue Collections by the depositing agency for bank deposit. Excel spreadsheets are utilized for data capture and reporting for daily processed coin.

Subway Booth Revenue

Revenue Collections transfers individually sealed bags of Station Agents' revenue collected from each fare control area to the Currency Processing operation. Revenues are processed via high speed equipment interfaced to a Station Booth Cash Settlement System. The identity of the Station Agent depositing the revenue and the said to contain (STC) revenue counts are entered from each deposit report (Remittance Report) into the system prior to processing. The processed revenue is automatically compared to the STC totals and electronically recorded. The aggregated, segregated and electronically proven daily processed currency and coin is released to Revenue Collections for bank deposit. Data capture and transmission for reporting are handled electronically.

Subway MVM Revenue

Revenue Collections transfers MVM revenue collected from each MVM and contained in sealed cashboxes to the Currency Processing operation. Revenues are processed via high speed equipment interfaced to an MVM Cash Settlement System. The STC revenue counts are electronically transmitted to the system and the processed revenue is automatically compared to the STC totals and electronically recorded. The aggregated, segregated and electronically proven daily processed currency and coin is released to Revenue Collections for bank deposit. Data capture, revenue processing, cashbox tracking and transmission for reporting are handled electronically throughout all stages of the process.

3.5 NYCT Division of Customer Relations

The NYCT Customer Relations Division, which is a division of the Department of Corporate Communications, has 6 units that support AFC/MetroCard operation. These units are described below.

3.5.1 Reduced Fare Unit

The Reduced Fare Unit administers the Reduced Fare Program for seniors and disabled customers as well as MTA customers diagnosed with a serious mental illness. There are 711,000 participants in Reduced Fare Program, including senior citizens, and people with qualifying disabilities. As of June 2010 Reduced Fare customers added approximately \$29 million year-to-date to their MetroCards and taken roughly 39 million trips (inclusive of 9 million transfers). Of all participants, 24% pay for transportation by selecting one of the EasyPay payment options. Over the past three years, the Reduced Fare Program participation has grown about 5% annually. The Reduced Fare Unit must replace roughly 356,000 expiring, damaged, lost, or stolen Reduced Fare MetroCards each year (expected to exceed 365,000 in 2011). This unit also operates the Customer Service Center (3 Stone Street in Manhattan) which allows walk-in participants to address any issues in person. The unit handles roughly 4,100 reduced fare issues per month, inclusive of new enrollments into the program. The Reduced Fare Unit relies on the following systems:

- PIC - Oracle database on reduce-fare customers and employee/pensioner/contractors
- Specialized NISCA printers to encode & create photo-ID Reduced Fare MetroCard

3.5.2 Mobile Sales Unit

The Mobile Sales Unit operates the Mobile Sales Fleet (buses and vans) deployed throughout New York City's five boroughs and Westchester County (2,370 annual visits). This Unit consists of one bus and three vans that travel to various planned and scheduled sites throughout the month. Station Personnel assigned as required. This outreach programs represents an average of 200 site visits per month while generating roughly \$106,000 in revenue. The Mobile Sales Program allows reduced fare customers to easily purchase or refill MetroCards, obtain temporary MetroCards, report lost/stolen cards, and provides on-site assistance in completing reduced fare applications. This outreach program also provides customer service support, transportation assistance, bus and subway maps, and information on the EasyPay program. The Mobile Sales Unit relies on the following systems:

- Mobile Token Booth Terminal (TBT) system –on each mobile unit; information on reduced-fare customers.

- PIC - Oracle database on reduce-fare customers and employee/pensioner/contractors.

3.5.3 Employee Pass Unit

This unit is responsible for producing employee passes for employees and pensioners for various MTA agencies. It directs the production and control of new and replacement photo-id passes for all MTA, NYC Transit, MTA Bus, SIRTOA MTA Police and LI Bus employees, and pensioners of those agencies. The unit replaces lost, stolen, and damaged passes for employees and pensioners. It also initiates the deactivation of passes for employees that are no longer eligible for transportation privileges. The Employee Pass Unit relies on the following systems:

- EIS – Employee Information System
- PIC - Oracle database on reduce-fare customers and employee/pensioner/contractors.
- Links to various Lenel security systems for building/area access rights

3.5.4 Fare Media Unit

This Unit manages Student MetroCard and other NYC Agency Programs. It issues over 4.1 million regular student and X1 MetroCards for the fall, spring, and summer semesters. There are 14 different types of student passes with varying hours. The Fare Media Unit is also responsible for tracking the issuance and collection of Access-A-Ride tickets, transit entrance vouchers, return to school vouchers, confiscated student passes, senior citizen and handicapped tickets, block and emergency tickets, student ridership, and student MetroCard pass usage. The unit issues free train transportation certificates for trips to parks, beaches, concerts, etc. Such programs are organized by NYCT in conjunction with various divisions within the NYC Department of Education. It also issues and oversees passes issued to AirTrain, NYPD, FDNY, District Attorney, and Port Authority PD. The unit is responsible for coordinating the ordering and distribution of magnetic and paper transfers (65,000K) to bus depots on a monthly basis. The Fare Media Unit relies on internal “off the shelf” systems.

3.5.5 MetroCard Customer Claims Unit

The MetroCard Customer Claims Unit is responsible for investigating, resolving, and responding to all MetroCard related claims involving Pay-Per-Ride, Unlimited Ride, and Reduced Fare type MetroCards. This includes claims arising from MetroCard Vending Machines and MetroCard Express Machines. The unit receives and resolves over 360,000 claims each year. Claims are higher during fare increase years. The claims unit coordinates with various external and internal sources when resolving a customer’s claim. Customer Relations and TIS are developing an online MetroCard claims system to automate a portion of the claims process. The MetroCard Customer Claims Unit relies on the following systems:

- ICES SQL web-based system (MetroCard eFix)
- Four (4) TBT workstation system –for encoding replacement MetroCards
- PIC - Oracle database on reduce-fare customers and employee/pensioner/contractors.
- AFC

3.5.6 EasyPay Unit

The EasyPay Unit provides 100,000 reduced fare customers (with a growth rate of 12% per year) & 36,000 full-fare customers (with a growth rate 224% per year) automatic refills through debit/credit cards, check or money order. Three programs available: two full-fare (EasyPayXpress 30-Day Unlimited Ride and EasyPayXpress Pay-Per-Ride) and one reduced fare (Reduced-Fare EasyPay Program). 24% of all active reduced fare customers have selected the EasyPay payment option. In 2010, Affiliated Computer Services (ACS) awarded five year contract for back office/customer support services. Revenues collected amount to approximately \$2.57 million per month during 2010; approximately \$1.21 million for Reduced-Fare EasyPay, \$1.23 million for Full-Fare EasyPayXpress, and \$0.279 million for Full-Fare EasyPayXpress 30-Day Unlimited. During 2010, EasyPay added 1,100 reduced-fare customers, 984 Pay-per-ride customers and 360 30-Day Unlimited customers on average. EasyPay advances MTA's Go-Green Campaign because the number of paper statements mailed monthly has been reduced from 50,000 to less than 10,000. The EasyPay Unit relies on the following systems:

- PIC - Oracle database on reduce-fare customers and employee/pensioner/contractors.
- AFC - including Back office, XBOS
- ACS Database - Vector

3.6 Customer Support Call Center and IVR Systems

MetroCard Customer Service is available by telephone 7 days a week at specified hours and through an Interactive Voice Response (IVR) system at all hours. In addition, customer information on Reduced Fare MetroCards is available by telephone and TTY (teletypewriter) Monday through Friday from 9 AM to 5 PM, and EasyPay information is available by telephone and online.

3.7 Security

3.7.1 AFC Program Management and Sales

The AFC Program Management and Sales office is responsible for certain activities related to fraud investigation and prevention at New York City Transit:

- Responsible for overall risk management strategies and environment related to MetroCard sales. Activities include: identification, analysis, and hot-listing of suspicious credit/debit cards used at vending machines, and investigation of potential fraud events; and identification, analysis, and deactivation (Negative Listing) of suspicious/invalid MetroCards.
- Provides support to NYPD Transit Bureau and other law enforcement agencies through daily analysis and reporting of fraud trends related to MetroCard sales for targeted police campaigns.
- Provides analytical/technical support for stakeouts/stings of persons of interest as part of police investigations into criminal activities where MetroCard or related credit card tracking is employed.

- Identifies potential fraudulent activity and conducts follow-up investigations with issuing banks that lead to preventative and recovery actions (i.e., Negative Listing) through automated analysis of customer purchasing patterns and flagging of suspicious activity.
- Coordinates design/development of hardware and related software enhancements used to prevent/investigate MetroCard-related fraud and illegal activity.
- Apply various criteria to AFC system data to identify irregular usage activity (gained rides, time-based usage patterns, cyclical ride counts, out-of-balance conditions). Generally, MetroCards with irregular activity are placed on the Negative List.
- Provide information on MetroCard use internally (Labor Relations, NYCT CPM, Freedom of Information Law (FOIL)) as well as expert testimony regarding AFC system and MetroCard usage in court proceedings.

3.7.2 Special Investigations Unit NYPD Transit Bureau

MetroCards routinely factor into police investigations through the querying of MetroCard serial numbers used at a station or MVM machine in order to locate witnesses and/or criminals involved in incidents on the subway system. All NYPD police personnel are issued MetroCards to enable them to patrol on, and respond to, incidents on subway stations by allowing them to enter through turnstiles and HEETS.

The direct points of contact between NYC Transit and the NYPD Transit Bureau are the Fraud Investigations Unit (FIU) (Transit) and the Special Investigations Unit (SIU) (Transit Bureau).

These two units have developed a strong relationship which benefits each agency and ultimately the people of the City of New York.

This unit investigates crimes against the Transit Authority, including but not limited to: various types of MetroCard fraud; debit and credit card fraud at vending machines; selling of swipes in the subway; vandalism to system property. The SIU also coordinates with the FIU to perform surveillance and stakeouts at turnstiles for specific MetroCards.

3.7.3 Select Bus Service (SBS) Eagle Team and Property Protection

The Special Operations Unit / EAGLE Team is comprised of 2 sub-units – the SBS Fare Evasion Squad and the Vandals Squad. The SBS Fare Evasion Squad utilizes their Employee Passes to verify functionality of SBS ticket vending machines, where SBS passengers will utilize MetroCards to SBS obtain tickets. Both the SBS Fare Evasion Squad and the Vandals Squad, as well as Transit Property Protection Agents, will utilize their own Employee Passes to gain access into patrolled facilities and will challenge persons who are not displaying their own identification at facilities (employees and authorized non-employees are required to possess and display their ID upon request).

4 Technical Description of the AFC System

Each MetroCard is assigned a unique, permanent ten-digit serial number when it is manufactured. The fare product purchased is stored on the card and information is directly

written onto the card. The value is stored magnetically on the card itself, while the card's transaction history is held centrally in the AFC Database.

AFC is a store-and-forward system that tracks daily usage. All data tied to MetroCard usage and sales (with exception of credit/debit authorization requests) flows up in timed intervals as described below.

When a card is purchased and a fare product (time or value-based) is loaded onto it, the MVM (or MEM) or station agent's computer electronically registers the amount of the purchase onto the card and updates the database in batched transmissions (i.e., "sends") as described above, identifying each card by its serial number.

Transactions are processed locally at the subway turnstile or bus farebox reader. Whenever the card is swiped at a turnstile or farebox unit, the value of the card is read, the new value is written, the customer is let through, and then the central database is updated with the new transaction as soon as possible, as described above. At neither the subway turnstile nor the bus farebox unit are swiped cards validated in real time against the central database.

MetroCard information received from subways and buses is batched by the Area Controller (AC) and is processed early the following day. MetroCard usage at subway end devices (e.g., turnstiles, vending machines, etc.) flows up to the station controller (SC). The AC receives MetroCard usage data from the SCs in six-minute intervals, assuming all communication lines are functioning. On the bus side, MetroCard usage is uploaded to the depot computer (DC) at the time of farebox unit probing, which occurs simultaneously with revenue servicing when a bus returns to the depot at the end of the day. The AC polls the various depot computers later in the evening.

Several key data components have higher priorities in the system and are updated as soon as they arrive at the AC (for example, audit registers and station agent fare reports). Authorization requests associated with credit/debit sales at vending machines are processed in real time; the back-end portion of the system that tracks credit/debit confirmations (successful sales) is updated in near real-time.

Risk management is performed via storage of a hotlist of MetroCards at the reader. MetroCard authorization is performed at the reader. The application of fare rules (e.g., recognizing transfers, unlimited ride passes) is made at the reader. Debiting fares against the card's balance (for the bonus value) is done at the reader.

NYCT owns much of the source code for the system. However, the system is reliant on certain proprietary software owned by others and therefore aspects of operations and maintenance are reliant on others for system modifications and upgrades.

4.1 AFC Debit/Credit Application

The AFC Debit/Credit Application runs on an IBM mainframe, which is located at the Staten Island Data Center. The application was developed by Cubic Transportation Systems, NYC Transit's AFC vendor. The application manages all communications and data storage to and from the stations (SC). The application's main role is to receive incoming messages, log the messages to permanent files, pass the messages to the debit/credit processing application (BASE24-es), receive out-going authorization requests from BASE24 to FirstData, and receive response messages from FirstData/BASE24, and to return the response messages to the vending machine(s) via the SC(s).

By default, the AFC Debit/Credit application uses the mainframe's (AC) inherent security application, RACF (Resource Access Control Facility), as the security manager. RACF maintains profiles which determine the level of access to files, transactions, software programs, or systems (such as the Customer Information Control System (CICS) region) based on predetermined rules. These rules vary according to user groups, user ids, or the executing system.

The AFC/BASE24 applications use Virtual Storage Access Method (VSAM) files for storage of all permanent data, with the exception of the debit/credit confirmation record, which is stored in a DB2 table.

4.2 AFC Debit/Credit Network Infrastructure

There are approximately 2,250 point-of-sale vending machines, and 472 SCs located within NYC Transit's subway station environment. AFC software programs on the mainframe (AC) do not communicate directly with the vending machines. All communication is via the SCs. An SC can have up to 24 vending machines attached at any one time, sending and receiving messages.

All debit/credit requests from the vending machines are stored in a queue, in the vending machine, until the message processing is complete. Messages are complete when the response to the request is received and processed at the vending machine. The queued message is then deleted from the queue. This queue will also hold messages that are classified as "persistent"; these messages cannot be removed until they are successfully delivered to the AC.

All debit/credit requests from the vending machines travel via the SC, where the messages are again stored in a queue until acknowledged by the AC. Upon acknowledgement from the AC, the SC then marks the message as complete and removes the record. Then the acknowledgment is sent to the originating vending machine, which performs the same function(s) within its queue.

The SC communicates with the AC via a closed Systems Network Architecture (SNA) network of leased lines in which all devices (SC) need to know the partner at the AC with which they are communicating. The same type of identification is also applied at the AC end, in which the partner SC needs to be defined to the system (CICS region) that it will communicate with. As

part of the configuration setup at the SC, the partner is identified by a fully qualified parameter detailing the network identification and the CICS region id to communicate with.

Connections to MTA acquirer/processor are via SNA connectivity using isolated leased lines. Sending authorization requests and receiving the responses is performed via the Advanced Program to Program Communications (APPC), where again the systems as well as the applications need to be defined to recognize only the defined partners in all data exchanges. In addition to the APPC processing, there is also a Job Entry Subsystem (JES) node subsystem utilized to provide other types of data across the NYCT/FirstData system to process settlement data and payment acknowledgement files from FirstData. This JES subsystem is also secured, and needs to be defined and identified on both ends in order for any communications to occur.

4.3 PCI DSS

The Payment Card Industry Data Security Standard (PCI DSS) was created in 2005, resulting from a cooperative effort between the major payment card brands that include Visa, MasterCard, American Express and Discover, as well as others that have maintained their own standards and compliance programs since 2001. The PCI DSS represents a unified and comprehensive security standard that governs the safekeeping of card holder and other sensitive transport-authorization information as it is processed, stored, or transmitted within the merchant environment.

All merchants that accept and process credit/debit cards are required to comply with the PCI DSS. NYC Transit was deemed compliant with the PCI DSS in April 2010.

4.4 MetroCard DataMart

NYC Transit maintains a sophisticated data management infrastructure to serve internal customers. This infrastructure includes a data warehouse called Data Mart, in which a copy of the MetroCard transactional database that has been processed, filtered and summarized for the purpose of allowing analysis and reporting is put. It contains sales and other business data for the purpose of supporting ongoing sales operations.

In basic terms, a copy of the transactions (hundreds of millions of records) is kept in an Oracle database, allowing analysis and reporting of the data to support business operations. The work that the servers perform includes storing MetroCard-related sales and other business data for the purpose of supporting ongoing MetroCard sales operations.

Operational business functions include:

- identify and prevent fraud involving debit and credit card usage
- reconcile cash and debit/credit sales
- investigate and resolve customer claims
- process customer credit (including Balance Protection) and chargebacks
- perform business analysis of MetroCard sales

The Data Mart technical environment includes:

- Hardware: HP Blade server, located in Livingston Plaza 4th floor data center, consisting of:
 - Oracle Database – 4 Blades
 - ETL (Extraction, Transformation, Loading) – 1 blade
 - Business Objects – 1 Blade
 - Development – various Blades
 - Rapid Deployment Server (RDP) – 1 PC
- Operating Systems:
 - Oracle and ETL – Red Hat Linux version 3
 - Business Objects/xlr3 – Linux
- ETL Software: Ascential 7.51A
- Database: Oracle 10Gr2 with Real Application Clusters (RAC), Advanced Security Option Automatic Storage Management (ASM)
- Analysis: Business Objects 6.52, Apache 2.0.46, Tomcat 4.1.30

The Data Mart is used to support the following business functions:

- identify and prevent fraud involving debit and credit card usage
- reconcile cash and debit/credit sales
- investigate and resolve customer claims
- support Smart Card pilots
- perform business analysis of sales
- enable quick-turnaround of management reports used in day-to-day operations

NYCT requires speed, precision and flexibility in order to manage business operations. Data Mart enables business analysts to drill down and analyze the large amounts of data, on the fly if necessary, for day-to-day support of sales operations.

The technical underpinning of Data Mart is a clustered Oracle database that runs on a blade server. Business Objects is the business intelligence tool used for reporting. IBM InfoSphere DataStage (Ascential) is the ETL tool that is used to extract, transform and load data.

In addition to Data Mart, there is a large back office system that is the source of many of the data files that are loaded into the Data Mart. This mainframe-based system is used to serve the data needs of all MTA and NYCT departments. The back office system contains ridership, sales, maintenance and other data. While approximately 300,000 sales records are loaded in the Data Mart daily, there are 8 to 10 million daily rides including all MetroCard usage, e.g., non-revenue access on trains and onto property and into buildings) all of which are contained in the back office system.

4.5 Bank Card (Credit and Debit Cards) Transaction Processing

MTA has a current agreement with Bank of Americas Merchant Services (“BAMS”) to provide standard merchant acquiring services for all MTA agencies that accept Credit, Debit and prepaid

card payments for fare payment at vending machines, online and through other means. BAMS handles all of the MTA's credit/debit transactions for all four major card brands (Visa, MasterCard, American Express and Discover). The current provider is formed from a joint venture of Bank of America and First Data. First Data has been MTA's provider for over ten years.

4.5.1 Online Authorizations

All MetroCard sales transactions originating at vending machines with credit and ATM/debit cards as the payment method are sent to the clearing house for online authorization and data capture. MetroCards are encoded and dispensed to the customers only upon approval of the authorization requests. Correct PIN (Personal Identification Number) entry for ATM/debit or correct ZIP code entry for credit cards is required.

Credit and ATM/debit transactions from the vending machines are processed through the NYC Transit central host computer system of the automated fare collection system (and through a third-party switch application – ACI's BASE24-es) and network via direct interface to the clearing house.

4.5.2 Batch Processing

The daily credit cards that originate from the vending machines are submitted to the clearing house via batch file processing for ultimate fund settlement with the credit card issuers and payment to the NYC Transit.

Authorized and completed credit card transactions from the vending machines are accumulated at NYCT's central host on a daily basis and the batch file is transmitted to the clearing house vendor for final processing and settlement. Debit transactions are processed real time, and are not batched for settlement.

4.5.3 Processing of Refunds and Adjustments

Refunds to customers for MetroCards purchased by credit or ATM/debit card are processed back to the original payment account used by the customer. Credit card and ATM/debit card refunds are submitted as credit card and ATM/debit card transactions. Credit and debit card refunds are sent in separate credit and debit refunds files by NYCT and are not included as part of the daily settlement file.

4.6 Network Management Systems

Current activities supporting MetroCard-related networking reside in the EMD NOC (Network Operations Center) for network connectivity of the NYCT network, including externally provided segments, and in Technology & Information Systems Development (TIS) for monitoring the MetroCard network of MVM and MEM machines.

In the NOC, IBM Netview and HP Openview software is used to monitor and diagnose network problems, allowing NYCT network maintenance staff to maintain NYCT and monitor any leased

external network segments. Support from the external network providers is routinely required to maintain network connectivity.

Supplementing the monitoring effort is an EMD Help Desk which takes calls from users and manages the problem tracking using MAGIC software.

Monitoring of the MVM and MEM vending machines is managed by TIS through the use of the MetroCard Store and Forward system which collects usage of MVM and MEM machines (as well as turnstile swipes) and the Debit/Credit system which processes transaction from the machines to the IBM mainframe server and to MTA's acquirer and back to the mainframe and then the machines for customer messaging and action.

In the course of monitoring the MVM and MEM machines, a daily Health Check report is issued to appropriate management personnel. The report identifies station controllers that are off line and shows whether the cause is network or hardware-related.

With the exception of mobile phone usage for supervisors and station equipment maintainers to communicate with each other, no wireless technology is currently used in fare collection or fare collection support. As a consequence, there is no monitoring of wireless networks.

4.7 AFC System Statistics

Annual volume of transactions (2010)

Using ridership as a surrogate for successful swipes, there were approximately 2.5 billion successful revenue swipes in the calendar year, or 7.9 million on an average weekday. This figure also includes MTABC, LI Bus & SIR in addition to NYCT. Note that mis-swipes and swipes at the "check balance" readers are not recorded.

In 2009, the MetroCard Customer Claims unit received 380,780 claims, 30% of which was determined to be for damaged MetroCards. In 2010 to date, claims for damaged cards are running at about 29% on a lower overall volume of claims. Non-revenue swipes are approximately 146.5 million annually.

More than 90% of trips taken on NYCT are made with MetroCard (buses also accept exact change but no bills). MetroCard and the automated fare collection system revolutionized payment on subways and buses and brought free transfers between subways and buses; multi-ride bonuses; and 7-Day and 30-Day unlimited ride transit passes.

Annual volume of MetroCards issued (2010)

Using sales figures as a surrogate for cards issued, there were about 137 million MetroCards issued (initial sales) through vending machines and station booths.

- There were about 93million add-value transactions through vending machines and station booths.
- There were about 38million Single Ride Tickets issued through vending machines.

- There were almost 34 million pre-valued cards issued through the merchant sales network, railroads & EasyPay.

Annual sales by payment method (2010)

- MetroCard Sales were \$3.5billion
 - \$1.5 billion through credit and debit card purchase
 - \$1.4 billion through cash purchase
 - \$0.7 billion at vending machines
 - \$0.7 billion Station Booth sales
 - \$0.6 billion from External Sales, with:
 - 45% from approximately 2,500 retail merchants
 - 10% governmental and social service agency benefit provider distributors
 - 45% pre-tax transit benefit providers.
- On board bus cash revenue was \$0.142 billion
- Note: The acceptance of Electronic Benefit Transfer (EBT) cards at vending machines started in October 2010.

Annual NYCT sales revenue by fare category (2010)

- Time-based passes: \$1.547 billion
- Value-based passes : \$1.207 billion
- Non-discounted fare: \$0.380 billion
- Single Ride Ticket: \$0.086 billion
- Half-fare students: \$0.004 billion
- Reduced Fare passes: \$0.134 billion
- Cash on Bus: \$0. 142 billion

System Assets

The current AFC system assets number over 14,500, spread across 31 (NYCT=19, other bus=12) bus depots and 468 stations (representing over 700 asset locations), the five boroughs of New York City, Westchester County, and Nassau and Suffolk Counties of Long Island.


In use at NYCT are:


- 1,670 MetroCard Vending Machines (Full Service)
- 600 MetroCard Express Machines (Credit/Debit only)
- 530 Booth Terminals
- 3,142 Tripod Type Turnstiles
- 600 High Entry/Exit Turnstiles
- 172 Autonomous Fare Access Systems
- 800 MetroCard Readers (MR)
- 135 SBS MetroCard Fare Collectors – Off Board Fare Collection
- 79 SBS Coin Fare Collectors (CFC) – Off Board Fare Collection
- 1400 Service Gates/Emergency Egress System
- 4,500 Bus Integrated Farebox Units (IFUs)
- 19 Keene Coin Retrieval Vacuum Systems

Another 1,500 IFU's are in use at:

- MTA Bus
- LI Bus
- County of Westchester Bee Line Bus
- Metro North Hudson Rail Link.

5 Types of Access to NYCT Subway System

Types of Access		Description	Current Inventory
Tripod Turnstile		<p>When a passenger swipes her/his valid MetroCard through the reader at the turnstile, the gate (tripod) is released allowing the passenger to enter the subway system. If a passenger has a problem with the reader processing his/her MetroCard, s/he can consult a station agent. The tripod turnstile can be programmed or positioned to go forward or backward, but safety requirements prohibit locking exit positions. To help control customer traffic flow, the station agent can turn on a semaphore (illuminated sign) mounted on the fare gate at eye-level to read "No Exit" or "Exit" in the paid zone side of the turnstile. Although NYCT policy requires the turnstile to be set to move in both directions at all times, the turnstile software allows the station agent to control the direction the turnstile can move (exit only, entry only, or both directions) from the token booth terminal using a designated function key on the computer key board. The station agent is also able to set the turnstile direction manually at the turnstile. Each turnstile is wired to the end cabinet ("the brains" of the array of gates at a station), and the end cabinet is connected to the area controller/mainframe located in the data center.</p>	3,153

<p>High Entrance/Exit Turnstile (HEET)</p>		<p>When a passenger swipes her/his valid MetroCard through the reader at a HEET, the gate is released allowing the passenger to enter the subway system. If a passenger has a problem the reader processing his/her MetroCard, s/he must consult a station agent. These gates are installed in areas where additional station access is needed and/or where there is a high potential for fare evasion and NYCT does not want un-attended turnstiles. They were originally installed to thwart fare evasion because they are much more difficult to enter through without paying a fare than low tripod turnstiles are. A HEET occupies more space than a turnstile, and provides slower throughput of customers. They also break down more frequently than tripod turnstiles and are more difficult to maintain.</p>	<p>600</p>
<p>ADA Farecard Access System (AFAS)</p>		<p>When an ambulatory-disabled customer swipes her/his AFAS-eligible MetroCard (special issued half-fare card) through the reader at the AFAS gate, the gate automatically opens at an appropriate speed for wheelchair entry or exit. The gate closes automatically. If a passenger has a problem the reader processing his/her MetroCard, s/he must consult a station agent. The reader is located on the side of the gate and must be swiped to enter and leave the subway system. AFAS gates, including the reader location, are compliant with ADA requirements. A minimum of one AFAS gate is installed any time a station is modernized, in accordance with ADA federal law.</p>	<p>348</p>
<p>Service Gates (No payment at gate)</p>		<p>Service gates were designed for emergency exiting. In addition, they are often used to allow entry and exit for strollers, bicycles, and/or people with large bulky items that cannot get through the turnstiles. Service gates are also used for disabled customers in stations where there are no AFAS gates or for disabled customers who are not AFAS qualified. These gates are magnetically locked and have a panic bar on the paid side that will disable the magnet and allow exiting. There are no swipe readers on the gates, so when needed for entering, the customer notifies the station agent/clerk and is instructed to swipe at</p>	<p>1,407</p>

	<p>the adjacent turnstile and turn the tripod. The station agent/clerk releases the service gate from the booth using the token booth terminal that is wired to the gate. When there is no agent visible, customers activates the Customer Assistance Intercom (CAI) or Help Point Intercom (HPI) where they can communicate directly with the station agent located at the full time booth (note- currently there is at least one full time operating booth with an agent at each station).</p>	
<p>Station Agent</p>	<p>Station agents/clerks allow customers into the subway system through service gates when appropriate. The procedure for this type of entry is: (1) Customer tells the station agent/clerk they need to use the gate (disability, stroller, bicycle, package); (2) Station agent tells them to swipe at a turnstile and then turn the turnstile arm so the fare is counted; (3) Station agent releases the gate by pushing a button in the booth. Another system access duty of the station agent is to distribute “block” tickets during special circumstances. When subway service is interrupted for a long period, the station agent facilitates alternative service options by issuing and/or collecting block tickets. These are time sensitive free passes, and they can be used on alternative subway or bus routes depending on the situation.</p>	<p>N/A</p>
<p>Non-Fare Payment Card Users</p>		
<p>(A) Unrestricted Non- Revenue Access</p>	<p>NYCT employees and pensioned employees are issued standard MetroCards for commutation as part of their employee benefit package. The transportation pass is restricted for use only by that employee and issued by the Pass Office located at 180 Livingston Plaza. MTA employees and MTA Board members may also receive commutation passes. Other MTA employees may receive a pass with special permission when their assignment requires them to travel during working hours to different transit facilities. The MetroCard has a picture for identification and is programmed for building/facility access as appropriate.</p>	<p>Approx. 77,500 passes in use</p>

<p>(B) Restricted Non-Revenue Access : Contractors/Vendors, 3rd Party Maintainers, Contractor & Supplies</p>	<p>Restricted access MetroCards are issued by the Department of Security. These cards are issued and maintained to vendors/contractors and maintainers who must perform work in a facility or within the station environment. Access is for limited locations only. Depending on the work scope, transportation may be programmed on the MetroCard. Contractors must complete an application for issuance.</p>	<p># of Restricted Passes Issued Per Month = Varies over time</p>
<p>(D) Emergency Personnel & Response</p>	<p>When there is an emergency response situation, police, fire, and emergency personnel are provided system entry via gates and/or turnstiles by attending personnel (Usually RCC is notified and communication is made to appropriated operating divisions). Police and Fire have department issued badges.</p>	<p>54,775</p>

Appendix 4: Acronyms

Term	Definition
3G	Third Generation
4G	Fourth Generation
ADA	Americans with Disabilities Act
AFAS	ADA Fare Card Access System
AFC	Automated Fare Collection
ATM	Automatic Teller Machine
B&T	Bridges and Tunnels (MTA Agency)
BCC	Bus Command Center
CIS	Customer Information System
CMC	Contactless MetroCard
CP	Contactless Payment
DOB	Department of Buses
EBT	Electronic Benefit Transfer
EMV	Europay MasterCard and Visa
ID	Identification
IEC	International Electrotechnical Commission
ISO	International Organization of Standardization
IVR	Integrated Voice Response
LED	Light-Emitting Diode
LI Bus	Long Island Bus
LIRR	Long Island Rail Road (MTA Agency)
MaBSTOA	Manhattan and Bronx Surface Transit Operating Authority
MEM	MetroCard Express (Vending) Machine
MNR	Metro-North Railroad (MTA Agency)
ms	Milliseconds
MTA	Metropolitan Transportation Authority
MTBF	Mean Time Between Failures
MTBR	Mean Time To Repair
MTTR	Mean Time Between Repairs
MVM	MetroCard Vending Machine
NFC	Near Field Communications
NFPS	New Fare Payment Systems
NJT	New Jersey Transit
NYCT	New York City Transit (MTA Agency)
PA DSS	Payment Application Data Security Standard
PAN	Primary Account Number
PATH	Port Authority Trans Hudson

PAYG	Pay As You Go
PCI DSS	Payment Card Industry Data Security Standard
PIA	Pay-in-advance
PIN	Personal Identification Number
PIV	Personal Identity Verification
POS	Point of Sale
SBS	Select Bus Service
SIR	Station Island Railway (MTA Agency)
SONET	Synchronous Optical Network

Acronyms below are used only in Appendix 3: Current Conditions

AC	Area Controller
ACH	Automated Clearing House
ACS	Affiliated Computer Services, A Xerox Company
APPC	Advanced Program to Program Communications
ASM	Automatic Storage Management
BAMS	Bank of America Merchant Services
BIN	Bank Identification Number
CAC	Common Access Card
CES	Central Electronics Shop
CDOT	Connecticut Department of Transportation
CFC	Coin Fare Collectors used at Select Bus Service (SBS) stops
CICS	Customer Information Control System
CMMS	Computerized Maintenance Management System
CPM	Capital Program Management
CSA	Customer Service Agent
EIS	Employee Information System
EMD	Electronic Maintenance Division
EPIC	Employee Photo Identification Card
ETL	Extraction, Transformation and Loading
FOIL	Freedom of Information Law
HBLR	Hudson Bergen Light Rail
HEET	High Entrance/Exit Turnstiles
HPEM	High Production Encoding Machines
IESS	Integrated Electronic Security System
IFU	Integrated Farebox Unit
JES	Job Entry Subsystem
MR	MetroCard Reader
MTAHQ	MTA Headquarters
OLMAC	Online Monitoring and Control

PTE	Portable Test Equipment
QPL	Qualified Products List
QC	Quality Control
RACF	Resource Access Control Facility
RCC	Rail Control Center
RDP	Rapid Deployment Server
RFP	Reduced Fare Program
SC	Station Controller
SIU	Special Investigations Unit
SNA	Systems Network Architecture
SONET	Synchronous Optical Network
STC	Said To Contain
TBT	Token Booth Terminal
TIS	Technology & Information Systems Department (NYCT)
TPPA	Transit Property Protection Agents
TPU	Ticket Processing Unit
TVM	Ticket Vending Machine
UPS	Uninterruptable Power Supply
VSAM	Virtual Storage Access Method
XBOS	Express Back Office System