CONCEPT OF OPERATIONS
FOR MTA NEW FARE PAYMENT SYSTEM AND NYCT DEPLOYMENT PHASE

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1.0 PURPOSE OF DOCUMENT

This document defines the Metropolitan Transportation Authority (MTA[1]) New Fare Payment System (NFPS) to be 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 travel on Metro-North Railroad (MNR) and Long Island Rail Road (LIRR) and cash acceptance for toll (E-Z Pass) accounts at 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. Consideration may be given by MTA and agencies outside of MTA to a shared reload network for a single closed loop card for all agencies' customers not possessing contactless payment cards or payment-capable phones.

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

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 all of the potential ways a customer may interface with the system, 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, LI Bus and SIR.

[1] The MTA is comprised of MTA Headquarters and the following operating agencies: MTA New York City Transit (which includes its subsidiary, the Manhattan and Bronx Surface Transit Operating Authority), MTA Long Island Rail Road, MTA Metro-North Railroad, MTA Bridges and Tunnels, MTA Capital Construction, MTA Long Island Bus, MTA Bus and MTA Staten Island Railway.

2.0 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-capable mobile phones for fare payment directly at subway and bus points of entry. The NFPS project will also enable customers to purchase fare products and manage stored accounts through on-line and other sales channels. The contactless cards must meet ISO/IEC 14443 contactless card and payment industry standards; the mobile phones must meet ISO/IEC 18092 Near Field Communications (NFC) and mobile phone payment standards. The payment industry standards will be those customarily used by acquiring banks, issuing banks and bankcard associations. See Appendix 3 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 off-the-shelf technology and existing processes and infrastructure to the greatest extent possible, utilizing payment industry services for retail merchants who accept bank-issued cards. 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 4,538 buses
- SIR: 22 stations
- MTA Bus: 1,347 buses

These stations and vehicles will be equipped with NFPS card readers that will interface with all turnstiles/gates, validators[2] 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 volumes[3] in the existing MetroCard fare collection system are:

- NYCT: 5.1 million subway, and 2.3 million bus
- SIR: 25,000
- MTA Bus: 394,000
- LI Bus: 104,000

[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.

Station kiosks and MTA Card issued to riders who don't possess a contactless card or payment-enabled phone, contactless single ride tickets and other supporting equipment and services must also be provided. These are defined in this document.

Last, deployment of NFPS on MTA buses and subway will require that provision be made for the impact on LIRR, MNR, PATH[4], New Jersey Transit (NJT), 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:

- The electronic payment of fares in a manner that is equitable for customers including those without their own contactless bankcard or phone payment medium
- Secondarily, the provision of access on an unpaid basis for employees, contractors, emergency personnel and others to fare-paid areas for business purposes
- The configuration and management of fare collection and non-revenue access functions, including the implementation and management of fare policies
- The provision of customer service and support for all system users
- The management of revenues, and reduction of risk, fraud and abuse costs.

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.

2.2 Merchant Model: Fare media, products and customer service

In the NFPS, the MTA will be a merchant with its point of sale (POS) devices (to be known as readers hereinafter) placed at points of entry to the transit system.

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, MTA-issued and third party payment-enabled media, to pay fares at the point of entry to the subway and bus. Payment media that can be used in the NFPS include contactless credit cards, debit cards, prepaid cards, employee benefits transfer (EBT) cards, and payment-enabled mobile phones, as well as potentially contactless employee or student ID cards and other media.

It will also enable customers to use mobile phones, smart phones, desktops, laptops, ATMs, and other merchants' POS terminals to purchase fare products, view their transaction history and perform other fare payment-related functions.

[4] Port Authority Trans Hudson (commuter rail system of the Port Authority of New York and New Jersey)

The MTA, through NFPS, will be a merchant that will offer two broad types of fare products:

- Pay-as-you-go (PAYG) fare products, used by customers with their own contactless payment media simply by walking up to a gate or validator, or boarding a bus, and tapping. In most cases the customer will be purchasing a single ride or single, linked trip fare product. PAYG customers may have access to best value caps, or loyalty discounts that may be offered by the MTA or the issuer of the fare payment medium. PAYG products are "sold" only at readers and validators.
- Pay-in-advance (PIA) fare products will be purchased by customers before riding. PIA fare products include period passes (such as daily, weekly or monthly), PIA value (typically at a discount to single ride fares) and PIA single ride tickets. PIA products are sold through on-line, call center/integrated voice response (IVR) retail reload and station kiosk 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 their own contactless payment media or an MTA-issued contactless payment medium at readers and validators to obtain entry with a PIA fare product.

The NFPS will include the ability to process free transfers associated with PIA and PAYG fare products.

The NFPS will offer the ability to purchase a series of fare products within these two types. The MTA will be able to configure products flexibly to meet customer needs. Examples of products that the MTA may offer include:

- PIA period passes that provide unlimited ride products for frequent customers
- PIA value products for value-conscious customers who plan ahead to obtain a discount; the cost to MTA for PIA products are relatively lower than for PAYG products because the purchase amount is higher making the volume of transactions lower (for the same purchase value) and lowering risk
- PAYG single-ride products for customers who value convenience and are willing to pay a premium for it
- PAYG best value or loyalty fares for frequent users
- Reduced fare versions of all PIA and PAYG products, if a customer is eligible and registers his or her payment card
- 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 contactless bankcards
- Any other fare policy that can be defined by mode, agency, time, rider group, frequency of use, sales channel, and type

The NFPS will provide a flexible, easy-to-use means for the MTA to quickly define, configure and implement new fare products offered at readers and through all other sales channels.

The NFPS will provide customers with widely accessible, convenient self-service support, including on-line, telephone and station-based channels, and a geographically-robust account reload network through retail merchants, at which customers may obtain MTA Cards and place value or other PIA products on them. The NFPS will also provide self-service account management for customers who use the system.

NFPS will replace the MetroCard, the current fare payment system. NFPS will be deployed through a series of fare product introductions until all PAYG and PIA products are available. Similarly, MetroCard will be eliminated in a staged process during the phasing in of NFPS. The phasing out of MetroCard will not commence until MTA can assure all of its customers have appropriate access to NFPS fare payment media and fare options.

3.0 REFERENCED DOCUMENTS

Please refer to Appendix 2.

4.0 BACKGROUND

4.1 Current system

The fare payment medium used for bus and subway entry at MTA is the MetroCard. This section provides a high level summary of the operations and maintenance of the MetroCard system. See Appendix 3 for "Current Conditions" which provides a more detailed description of MTA's legacy systems including MetroCard.

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 access points. See the description of entry points in the "Current Conditions" document for a more detailed description.

A MetroCard is required for customer access to all MTA subway stations and buses, except that local and express buses also accept coins at the on-board farebox unit. On MTA Select Bus Service (SBS) routes, riders pay before boarding. Employees and contractors may be issued MetroCards for facilities access. Emergency personnel (police, fire and others) are issued MetroCards for access. On many of these non-revenue variations, a photo is included for identification, and use may be time- and location-restricted.

Fare products are always PIA in the MetroCard system. 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 load 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, debit and EBT cards, and
- MetroCard Express Machines (MEMs), with credit and debit cards.

Customers can also obtain:

- The single ride ticket version of MetroCard at MVMs,
- A pre-encoded (fixed value) MetroCard at an extensive network of authorized retail merchants,
- MetroCards with time- or value-based fares through employer-based transit benefit programs, and
- MetroCards with automatic top-up through MTA's EasyPay (reduced fare) or EasyPay Xpress (regular fare, also with automatic pass renewal) programs.

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 million[5]
- 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 sales[6]: 35 million
- MetroCards issued with photo IDs[7]: 788,500
    - Reduced Fare program (covers students, seniors, disabled): 711,000
    - Employee passes (including police[8]): 55,300
    - Other passes: 22,200
- 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 participants [9]
    - 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 sales[6]: $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 sales[10]:
        - 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 $0.142 billion

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

- Time-based passes: $1.547 billion
- Discounted fare: $1.475 billion

[5] Includes 0.6 million transfers on MetroCards and 0.1 million paper magnetic transfers

[6] 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.

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

[8] FDNY receives approximately 2000 non-photo IDs for placement in trucks.

[9] These customers are already included in the photo ID figures above.

[10] Merchant commissions are about 2% of gross external sales

- Non-discounted fare: $0.380 billion
- Single Ride Ticket: $0.086 billion

The approximate MetroCard assets installed in 31 bus depots, 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 riders to check balance
- 221 SBS MetroCard Fare Collectors at bus stops
- 6,000 bus fare boxes (including NYCT, MTA Bus, LI Bus, Westchester Co. Bee Line, MNR[11])

The list of assets above does not include the equipment required to produce, encode, package, secure and distribute MetroCard, the off-board 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 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 $780 million in annual operating costs attributable to its fare payment systems (based on 2007 figures). This translates to an average of $0.15 per $1 revenue collected and varies from $0.08 to $0.22 among the agencies. Subway and bus fare collection costs were $0.15 per $1 of revenue. The average cost per transaction was $1.36, and the average revenue per 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 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 encryption is expensive, requiring significant record keeping and reconciliation.
- **Cash handling cost**. Cash is used extensively as payment for MetroCards and bus fares, over $1.5 billion annually, and it is relatively expensive to handle, requiring armored car support.

[11] MetroNorth operates bus service, the MetroNorth Hudson Rail Link

- **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 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 agencies' systems. This hampers a regional approach to mobility across MTA services and makes intermodal travel less convenient for our customers. Please see "Range of Legacy Systems" in the "Current Conditions" document for an overview of the various fare payment systems employed at MTA's agencies and compared to MetroCard.
- **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 makes out of system card stock more expensive and does not allow out-of-system reload.

4.4 Key aspects of NFPS

The NFPS will be based on a retail merchant model - with MTA as the retail merchant - and use payment industry, communications and other open standards for fare collection. 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 cards directly. MTA wants to accept bank and third party issued credit, debit and prepaid cards directly at the turnstile and farebox unit for fare payment**,** as a merchant in payment industry terms. Which card the customer uses will be his/her choice as long as it is contactless and has the appropriate spending authority. PIN-only debit cards will not be accepted at the readers[12]. Fees for card 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 fare products, either PAYG or PIA, through multiple channels, including on-line, call center and reader channels that are very similar to mainstream

[12] PIN = Personal Identification Number. 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.

retail sales channels. (Readers are similar to point of sales terminals.) 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 retail model. By using a merchant model, the MTA will maximize its ability to use existing components and services.

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 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.

Provide MTA Card and widespread reload network. It is not anticipated that payment industry contactless cards will be in the wallet of every customer for many years. In order to implement the new fare payment system, MTA has to issue an MTA Card reloadable at a wide variety of places just like MetroCard is today. The MTA Card is a contactless prepaid card with a rich set of features. The MTA expects a payments industry organization to provide and manage the MTA Card, which may be a white label or a co-branded card. The MTA Card will also be used for non-revenue access for employees, contractors, and other non-revenue users.

Use server/account-based, not 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. The NFPS will support regional travel, family and group fares, and other innovative fare policies.

Use existing computing and telecommunications standards. 3G, or 4G wireless services if available, WiFi wireless services, fiber optic network standards, service-oriented architectures, and other industry standard approaches will be used. Modifications of typical practice to increase reader transaction speeds and to handle some transit-specific issues such as passes and transfers will be necessary.

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 transit-specific elements:

- MTA fare structures are more complex than most product prices, and a "fare engine" to compute applicable fares based on customer taps at stations and on buses will be required.
- 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.
- Additionally, MTA will need faster speeds for transaction processing at the reader than merchants typically experience in order to 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.

Promote self-service. Customers will be able to purchase fare products on-line, and manage their account on-line through several features including auto reload options, alerts to warn of a nearing expiration date on a time-based pass or a low balance reminder on their pay-in-advance value, and travel and transaction history associated with a particular card. Moving to highly-available, flexible self-service is a mainstream means of reducing operating costs and improving the customer experience.

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. Basing a new fare payment system on open standards will ensure MTA can adapt to evolving technology in the payments arena and network environment. Components based on open standards have a shorter refresh cycle and can be replaced as the technology evolves without having to modify the entire system.

Accept some risk to improve the customer experience and reduce total cost. MetroCard is currently based completely on PIA fare products, therefore fare payment is guaranteed before the customer enters the system. The NFPS will not require the advance purchase of all fare products. The MTA recognizes there is risk in accepting cards for fare payment without prior financial authorization. NFPS will manage overall MTA risk by adopting payment industry and merchant best practices in fraud and risk management.

5.0 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. Contactless bankcard payment 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 bankcards. Customers without their own contactless payment cards will use cards supplied by the MTA or a third party that meet payment industry standards.

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 and gates.
- 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 on-line 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)	• **Low/medium** – 20% error rate and juggling multiple MetroCards reduces throughput speed	• **High** – fastest option; tapping is faster than swiping and has fewer errors; riders have just one card	• **High/medium** – potential need for real-time authorization/authentication adds time, but speed sufficient
2. Fare policy flexibility	• **Low** – 128 class codes available	• **Medium** – 256 class codes available	• **High** – fare logic resides on server, enabling a virtually unlimited number of fare policies
3. Transaction model	• **Offline** (stored value) – value read/written onto card; card can only store one transit fare product	• **Offline** (stored value) – value read/written onto card, but can store more than one transit product	• **Online** (account-based) – enables pre- and post-pay products and self-service channels (e.g., web)
4. Required network capabilities	• **Medium** – real-time server network not required for transaction to process but needed for TVMs, hotlists	• **Medium** – same as MetroCard	• **High/medium** – online transactions require high network performance and reliability
5. Level of security	• **Medium** – card duplication possible, but can be detected (e.g., by serializing cards)	• **High/medium** – processor-based cards support encryption; low-end cards are less secure	• **High** – follows payment card industry (PCI) security standards, which are strong, well-supported
6. Lifecycle risk	• **Low/medium** – mature technology; likely to exist in 10 years, but potentially as a legacy technology	• **Medium** – mature technology, though standards are not; overall newer technology than MetroCard	• **Uncertain** – pilot in progress; bankcard technology is mature, but direct use in transit is new
7. Technology risk	• **Low** – technology proven to be relatively reliable; performance issues with credit/debit at TVMs	• **High** – potentially requires multi-year development of detailed specifications for MTA use	• **Medium** –network outages possible; adoption risk of contactless cards by banks
8a. Implementation considerations	• **Low** – requires replacement/ renewal of existing AFC equipment components	• **Medium** – new readers/fareboxes, new/refitted TVMs, changes in card issuance	• **Medium** – new readers/fareboxes, possibly new TVMs, less card issuance,more payments participatior
8b. Business risk	• **Low** – current "as is" state; most business risks already known and managed	• **High** – complexities of technology pose significant risk to cost, procurement, and implementation	• **Medium** – relies on payments industry for many functions; new in N. America
9a. Inter-agency interoperability	• **Low** – requires transit authorities to agree to use MetroCard data layout, fare logic, back office	• **Medium** – requires authorities to agree on common data, fare logic, back office not specified in standard	• **High** – common standard requires less coordination between authorities
9b. Inter-modal interoperability	• **Low** – requires gates or validators at commuter rail stations, mag stripe readers for conductors	• **Low/medium** – requires gates or validators at commuter rail stations, card readers for conductors	• **Low/medium** – requires gates or validators at commuter rail stations, card readers for conductors
10a. Ability to serve unbanked customers	• **High** – currently serves banked and unbanked customers	• **Medium** – smart cards available for multi-rides; lower cost fare media may be needed for single rides	• **Low** – potentially requires parallel system (e.g., MetroCard or prepaid card) for unbanked riders
10b. Ability to serve banked customers	• **Medium** – banked customers must purchase and use MetroCard	• **Medium** – banked customers must purchase and use smart card	• **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 MTA Card (described in detail in section 5.14), will reduce dwell times of buses.
- 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**. Contactless cards use highly secure data protection standards, supported by the expertise of the payments 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**. Riders with contactless open payment media can travel on any agency accepting contactless open payment media. This provides for the opportunity for customers to experience "seamless transfers" between services from a fare payment perspective.
- 10b. **Ability to serve banked customers**. Contactless payment cards 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 contactless bankcard), 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 be transit throughput needs, which is near 500 milliseconds.
- 6. **Lifecycle risk**. Although contactless payment technology is widely used for public transportation payments, contactless bankcards and point-of-sale terminals are far from ubiquitous in the US. NFPS must be developed robustly to accommodate new payment schemes and technologies beyond plastic bankcards in order to avoid utilizing a potentially stranded technology.
- 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 payments 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 full 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 payments industry.
- 10a. **Provisions for unbanked users**. An MTA Card 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 mitigated by Transport for London'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.
- MTA Card will be offered to unbanked users.

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 card 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 on-line, phone, retail reload and station kiosk sales channels for fare product purchase. The server provides the two-way application interfaces with external standard merchant processing services (e.g., acquiring services and payment networks).

Customers must possess a contactless payment medium 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 will typically be a bank-issued credit or debit card, but will also include prepaid cards, key fobs, payment-enabled mobile phones, and other form factors tied to payments, employee or personal identity verification (PIV) cards, contactless EBT cards, or MTA Cards. Payment media 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 or her card on the reader, the reader collects the card number and other data and sends it to the server. After processing at the server, a message is sent back to the reader with a card- accepted or denied message. Secure communications protocols are used.

Fare revenue will be collected after entry from the card holder's card-issuing financial institution if the tap was for a PAYG transaction. Fare revenue was collected from the card holder before travel if the tap was 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 contactless cards
- Customers with transit benefit cards, treated as other revenue customers but with additional restrictions such as the card not being valid for multiple riders, not allowing refunds, requiring the MTA to manage tax benefit information, and others.

These customers will be served by bankcards and MTA Cards.

Additional customer types that must be served include:

- Non-revenue employees and contractors who require access, sometimes on a limited or restricted basis.
- Students
- Disabled customers who have special access needs (where photo ID required).

- Seniors
- Group sales customers
- Other groups that may be identified

MTA Cards will primarily serve these customers where photo ID is required, although some may use bankcards.

5.7 Fare purchase options and entry

- Customers may buy either PIA or PAYG fare products for travel:
    - PAYG rider taps his/her contactless credit, debit, prepaid or EBT card at a reader to pay his/her fare without any prior action
    - PIA customer purchases multi-ride value or time-based fare products through his/her choice of sales channel and then tap his/her contactless card 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
    - Contactless EBT cards
- Customers who purchase PIA fare products may do so through multiple sales channels:
    - On-line (Web server for Customer Service)
    - Call center (agent/IVR)
    - Retail reload locations
    - Mobile Sales and Support, operated by MTA agencies
    - Station kiosks
    - Employers or schools
- 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 employee ID, student ID, or PIV cards. This occurs through the employer or school sales channel only.
    - Cash, which is not accepted on-line or through the call center
- Customers who purchase PIA fare products choose at the time of purchase which access method (i.e., payment device) to tap for entry. Within certain parameters, customers may choose from these access methods to tap for entry:
    - Contactless credit cards
    - Contactless signature debit cards [Refer to Footnote 12 for note on PIN debit.]
    - Contactless prepaid cards
    - Contactless EBT cards
    - MTA Card

- Contactless employee ID, student ID card, or PIV card, if supported for payment
- Contactless single ride tickets (SRTs).

5.8 Stored Accounts

Using a card in the NFPS system is defined as purchasing a PIA or PAYG fare product. Once a contactless card 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 the card.

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 contactless card, which the customer intends to tap for entry. Use of that contactless card for travel will link payment processing to the fare product. If a customer does not have a contactless card, he or she must obtain an MTA Card.

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

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

The storage of contactless card IDs, fare products and customer information cannot compromise the principle of maintaining customer privacy and confidentiality and security of transaction data. Customers can maintain anonymity and need not register with personal information to purchase fare products. If customers wish to view and manage their accounts, they can register anonymously.

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

- The card used to purchase the fare product has to be the card used for travel, unless the card used for travel is an MTA Card. If an MTA Card is used for travel, it may be linked with one other payment card, contactless or magnetic stripe, which is used for PIA purchases.
- Fare products to be purchased with pre-tax transit benefit monies and associated with a contactless transit benefit provider card or MTA Card are administered through transit benefit providers who administer the electronic funds transfers from the employer and indicate the fare product purchased and the card account when the electronic funds transfer is made. This is done once per month at a minimum.
- Employee IDs, student IDs and similar media are funded by electronic funds transfer from the employer or school. The employer or school indicates the fare product purchased when the electronic funds transfer 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 contactless card.

- A contactless card can have more than one fare product associated with it as long as the fare products are unique. For example, an express bus pass and a value product can be stored; the value product is used for subway or local bus trips.
- Customers who have two bankcards associated with one account (e.g., when two cards with the same PAN (Primary Account Number) are associated with a joint bank account) may not use them for MTA travel unless the individual cards used can be identified in every transaction[13]. It is MTA's understanding that currently the industry does not consistently support individual card identification in this situation.

On-line, call center and IVR processes used to purchase PIA products entail standard merchant processes. For example:

- 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

5.9 Account Features

5.9.1 Registration

- To the extent possible, the MTA account and its customer service will follow on-line merchant account and service practices. Processes will be consistent across all channels.
- A customer can register anonymously to manage his or 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 of the card used at readers when establishing the account.
    - The MTA will verify that the card is contactless, if possible.
- The customer has the option to provide identifying information to get additional customer service benefits. For example, if a customer provides identifying information, his or her MTA Card can be replaced if it is lost or stolen.
- 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.
- Registering for an MTA account is optional.
- A customer is able to terminate his or her registration at any time.

5.9.2 Use of registered account

- The customer logs into his or her account with a username and password via the website. MTA Card users may be allowed to log in with their MTA Card number.

[13] If the individual cards cannot be identified, then an MTA Card must be obtained by one of the card holders. The MTA will request or require the payments industry to decline these cards if presented for PAYG travel.

- 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.
- Each registered account contains 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).
    - Card 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 service disruptions and other problems. The customer can provide an email address or text capable phone number to receive balance/expiration/auto-reload notifications or alerts.

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.
    - NFPS website
    - NFPS call center
    - NFPS IVR system
    - Card issuer (including issuer of MTA Card) website, call center, IVR
    - Kiosk
    - 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
    - Billing questions
    - Refunds
    - Service disruptions: refunds, etc.
    - Disputes

5.11 Card-reader operation

- Card readers will be placed at all MTA subway turnstiles and gates, and bus farebox units at front door for local and express buses, and also at middle and rear doors for SBS service. Card readers will also be placed at validators at non-gated SIR stations.
- An MTA customer will tap his or her card on a card reader and receive a message indicating card 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. Interfaces with web server.
    - Web server. Provides customer access to registered customers for PIA and PAYG fare products. Will handle all queries.
    - Authentication server. This is an atypical use of the term. The authentication server is a transit-specific server that provides a rapid response to bus and subway readers after a rider taps a card.
    - Billing server. Manages payments, clearing, settlement, exceptions and other payment processes between the MTA and the payments 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 servers.
    - Device and network management server(s). Manages readers and the wired or wireless links from the readers 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 tap at reader. Entry allowed if card meets applicable tests executed on MTA authentication server:
        - Card may not be on the Deny List.
        - Allow entry if card is on the Accept List. Accept List used for cards with valid products and non-revenue access.
        - Allow PAYG access if rider's contactless card is authorized by the card issuer or its agent for payment.
            - More rapid authorization than current practice may be required.

                - Authorization may be for different amount than fare. The fare may not be known at the time of the first tap in some cases, such as zone fares.
            - Allow access if no response from authentication or billing server within time limit, unless:
                - If local Deny List is present on reader, it is checked
    - 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. This handles all MTA Cards, student cards, PIV cards, employee cards, and it handles all PIA fare products.
- 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 cards that should not be allowed in the system. Accept Lists are used to allow access for cards 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 authentication. Some permanent reasons 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, having a decline, or passback restrictions. (Passback restrictions limit the number of times a single card can be used at one station or bus service.) 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.

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, MTA Cards 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 MTA Card

- MTA Card is a contactless prepaid fare card issued by MTA.
- MTA Card will be contactless and have a magnetic stripe
    - Magnetic stripe is used only for reload at non-contactless terminals
    - Magnetic stripe payment card technology is not appropriate for the high volumes and rapid transaction times required for public transportation; only contactless cards may be used for access.
- MTA Card can be used only for MTA travel.
    - It is a closed loop card, initially accepted only at the MTA (in the future may be accepted by other agencies to support regional interoperability), to lower its complexity and risk
    - All products purchased for the MTA Card are PIA products, unless the MTA allows MTA Card holders who link their card to a bank-issued payment card to pay as they go.
- MTA Card is issued through one channel, either:
    - Directly, using a third party under contract to the MTA
    - White label arrangement with payment industry organization
- MTA Card will be available for purchase (for a one time retention fee) and reload through multiple channels. If a card is purchased through on-line, IVR or call center channels, it will be mailed to the customer. MTA Card can be reloaded through multiple forms of payment, but not all channels accept all forms of payment. The channels are:
    - On-line: purchase and reload via credit, debit, EBT or prepaid card
    - IVR: same as on-line
    - Call center: same as on-line
    - Mail: purchase only, via check, credit, debit, EBT or prepaid card
    - Retail reload locations: purchase and reload via cash, credit, debit, EBT or prepaid card
    - Mobile vans: same as retail reload. (This is a minor channel and is not described further in this document.)
    - In stations: same as retail reload

- Retail reload points for MTA Cards will be geographically extensive. They may be provided by:
    - Merchant point of sales devices
    - Envelope-less ATMs
    - Kiosks and vending machines
- The retail reload process is:
    - Existing POS terminals or kiosks at merchant locations will be used.
    - Merchants will establish a reload process that conforms to MTA guidelines but may have variations that fit the merchant's equipment or sales processes.
    - Customer swipes or taps his or her MTA Card.
    - Customer purchases value or pass using payment means accepted by the merchant. Cash is expected to be the primary payment means in this channel.
    - The merchant enters the product type and amount at the POS terminal or kiosk.
    - The merchant retains the reload service fee. The MTA credits either the actual amount or a standard service fee to the customer's MTA account. The MTA will negotiate service fees, as feasible.
    - The merchant system may show customers their MTA pass/value balance, but this is not required.
- MTA Card will be used by:
    - Customers without a bankcard of any type
    - Customers without a contactless bankcard
    - Customers with a contactless bankcard who prefer not to use it
- The organization that provides the MTA Card may also process employee, student and other ID cards. Such cards must meet payment industry standards; much of the processing for employee/student cards is similar to that for MTA Cards
    - If the third party MTA Card provider does not process employee, student, contractor and other cards, MTA will need to issue these MTA Cards itself. This is not the preferred option.

5.15 Fare payment operations

- Local and express buses will continue to have a farebox unit
    - Accept contactless cards as primary payment method
    - Accept coins (nickels, dimes and quarters) as secondary method
        - No bills accepted; exact fare required; no change is given
        - Contactless SRTs for transfer are issued on request
        - Farebox counts number of and dollar volume of cash fares
    - Bus operator must log in to farebox unit, possibly with employee contactless card
    - Bus operator must be able to confirm fare paid by all means of payment
    - Customer must be able to confirm fare payment/receive accept message
- SBS fare payment to move on-board
    - Contactless readers placed at all doors where boarding is allowed
    - No cash (coins or bills) accepted
    - No paper transfers

    - Wayside equipment discontinued
    - Random fare payment inspection conducted by Special Inspectors
    - Bus operator will not confirm fare payment for any customers
- Subway station turnstiles/gates will all have contactless card readers that replace MetroCard readers
    - Subway gate operations remain the same
- 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 SBS program

5.16 Single ride ticket (SRT)

- SRT is a contactless single ride fare ticket.
- It can be purchased only at station kiosks by cash, credit, debit, EBT or prepaid cards. Coins and bills will be accepted.
- SRT is issued on buses for transfer for customers who pay fare with cash.
- SRT can be used only for MTA travel and cannot be reloaded or refunded.
- SRT will be packaged, distributed and secure inventory managed by NYCT Revenue Control.

5.17 NFPS variances with payment industry operating rules

MTA has card payment acceptance needs that may require changes to or waivers from the 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 card is presented to reader may be unknown, and a defined amount may be pre-authorized if necessary. This may be due to:
    - Zone or distance-based fare is charged (not in current bus or subway fare policy)
    - Previous tap may not have been received by server because network communications are down, and this tap may be a free transfer after the previous tap
- Presentation of a card to 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 rider to take an alternate route
- On-line authentications (at MTA server) or authorizations (at payment industry server) from taps must be processed more quickly than the current payment industry transaction time
    - Efficient passenger flow requires transaction speeds similar to those achieved on other transit systems using closed-loop, contactless cards
    - MTA authentication may benefit from access to industry Accept/Deny Lists, if feasible
- Simple go/no go customer messages are displayed; no receipts are given

- Bus readers may need to be more robust due to difficult environmental conditions on buses
- 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 fees.

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 card associations may need to approve rule changes.

In the NFPS transaction model, PAYG and PIA fare product purchases are processed in the same way as standard merchant transactions. After a customer has bought a PIA fare product, his or her taps at readers are processed by the MTA authentication server.

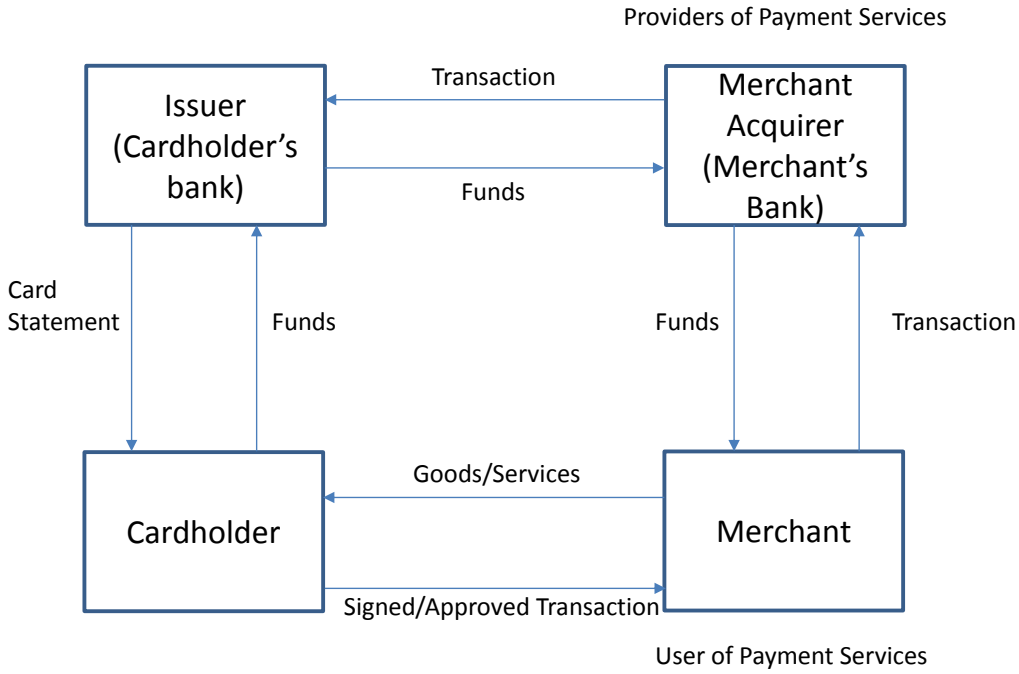


Figure 5-1 Standard Four-Party Payment Transaction Model

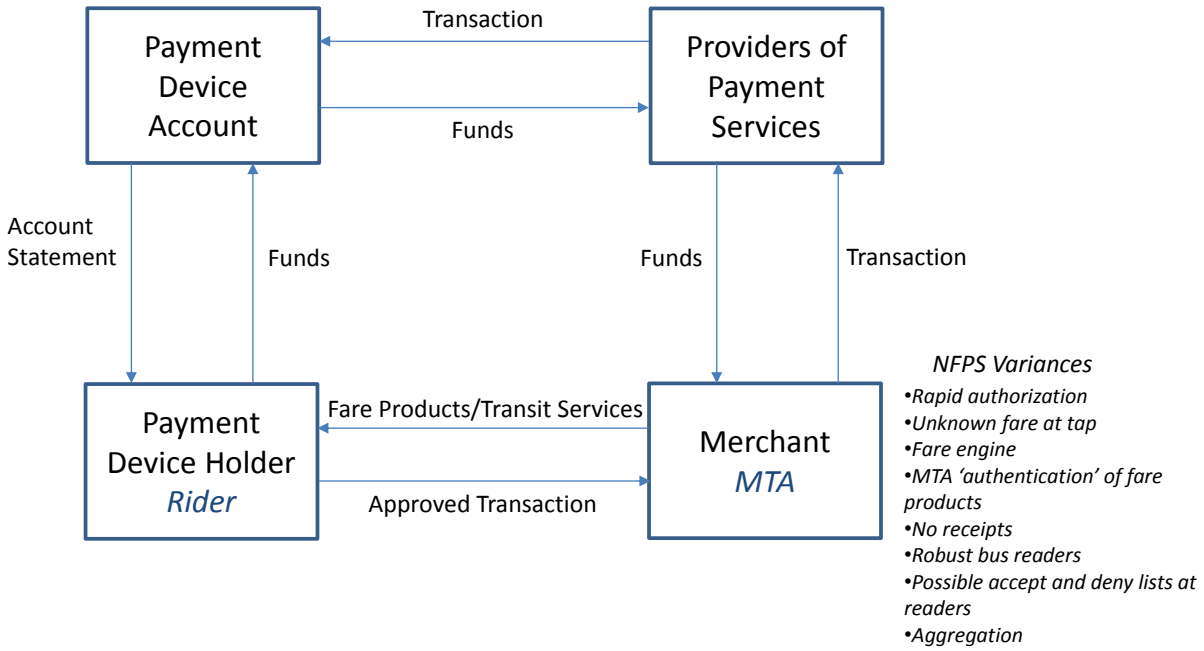


Figure 5-2 Four-Party Payment Transaction and NFPS Variances

5.18 Transition from MetroCard

Phasing out of MetroCard availability and acceptance will not begin until NFPS is live across the whole of MTA's bus and subway services and MTA has complete confidence in NFPS risk management rules, transaction speed, revenue collection and accuracy of backend reconciliations. Phase out of MetroCard for acceptance on buses in particular requires the MTA Card be widely available and the reload network be widely placed.

6.0 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:
        - Bus and Subway bulletins
        - Videos in depots
        - Meetings
        - Training
        - Help Desk
        - Meeting with unions
- Inform riders 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 changes
        - SIR changes
        - Other service changes (AirTrain, etc.) where MetroCard is accepted.
    - User groups: Disabled, student, seniors, others with specific changes in their fare payment processes
    - Sales channels: Information on obtaining and reloading MTA Card, obtaining contactless media 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

6.3 External 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 region (where MetroCard is accepted and/or customers make intermodal trips)
- City of New York, including relevant city agencies
- 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
- Payments industry
    - Bankcard networks
    - Issuing banks, alternative banks
    - Acquiring, alliance banks
    - Third party 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
        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. MTA Card

iv. Single Ride Ticket (SRT)
v. Commercial arrangements
vi. Interfaces with operating agencies and service providers, including system capabilities to allow agencies to manage portions of NFPS

d. Standards-based system components, using off-the-shelf components and existing services to the extent possible. These may be obtained from third parties where cost-effective:
    i. Gate and farebox unit hardware for subways and buses
    ii. Communications network between readers and servers
    iii. Fare engine
    iv. Account management server
    v. Authentication server
    vi. Billing engine/Authorization server: all interactions with payment industry
    vii. Web server for customer service (sales, account management, etc.)
    viii. Call center for customer service (agent, IVR)
    ix. Maintenance management, device management
    x. Server hosting
    xi. Data warehouse
e. MTA Card, 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
f. SRT production, distribution

2. MTA will oversee provision of services from third parties for:
    a. Acquiring services for Visa, MasterCard and optionally for American Express, Discover
        i. American Express, Discover may use direct connections
    b. 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

7.0 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 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 is 15% of each $1 of revenue collected. The NFPS goal is to reduce this materially.*
    - *MetroCard card life is relatively short, which increases card production and distribution costs.*
    - *MetroCard is a proprietary system with increasing maintenance and operational costs.*
- NFPS will provide a customer experience that is superior to the MetroCard experience.
    - A customer will be able to choose his or her own contactless payment device. Most customers will not have to acquire and carry an additional card *as is required with MetroCard*.
    - A customer with a bank-issued contactless payment card will not be required to pay his/her fare in advance *as is required with MetroCard*. The MTA may allow MTA Card holders who link their card to a bank-issued payment card to pay as they go.[14]
    - Customers will pay for MTA fare products in the same way they purchase other products; the same payment media, on-line account access, 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 on-line and telephone access to his or her own account, including the ability to view payment transactions, and trips taken in near-real time.

[14] NFPS should be configurable to permit MTA Card holder to use PAYG if MTA decides the risk and operation of such policy is manageable.

- 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 riders is limited to balance, expiration date and insufficient funds information.*
- *MetroCard currently provides fare being charged, and balance and expiration date information at turnstile and farebox units.* NFPS does not envision providing this information at points of entry. NFPS will also not provide information on the fare product used at points of entry; a customer will not know from the turnstile or farebox indication if his or her pass covered the trip, or whether it was a PAYG trip. An example is a rider who purchases a subway/bus pass but boards an express bus where subway/bus passes are ineligible. Improved signage may be required on express buses and other situations where this may be an issue.

- For unbanked customers (those who do not have bankcards), banked customers without a contactless bankcard and banked customers with a contactless bankcard who prefer not to use their bankcard to directly pay their fare, MTA will make available the MTA Card. Customers with cash only can purchase fare products through a network of station kiosks, which may include ATMs), and retail reload network. It gives the MTA Card holder the ability to use the same services the bankcard holder enjoys, with the exception of using PAYG fares.
  - *Both MetroCard and MTA Card support unbanked riders 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 difficult 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 merging redundant functions and infrastructure and total costs when combined with NFPS costs at MTA.
- Minimize implementation costs.

- Manage NFPS implementation to use off-the-shelf components and existing processes as much as possible
- Use existing gate and other infrastructure as feasible
- Use existing payment processes 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 MetroCard renewal 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 to allow customers to directly manage accounts.
  - NFPS allows purchase of PAYG products at turnstiles/gates, validators and farebox units
  - NFPS has on-line, IVR, call center, and other channels for sale of PIA products
  - PIA purchases immediately available for access, regardless of sales channel used
  - NFPS provides on-line account management
  - *NFPS sales channels are more flexible and easier to use and operate than MetroCard channels*
- Acceptance of wide range of standard payment media, such as 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 contactless bankcard holders, there is no requirement to know, select and purchase fare products in advance to enter any of MTA bus and subway services.
  - *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 bankcard or third party card to access public transit
    - MTA Card supports all PIA fare products. *MetroCard at retail outlets supports only a subset of fare products.*
    - MetroCard and MTA Card equally available to all groups
- Have no MTA-required customer fees for use of bankcard or MTA Card for fare payment.
    - MTA Card will have one-time cost to obtain
- 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 can increase the limit from today's four MetroCard swipes per group, but it still needs a cap 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 500 milliseconds for subway turnstiles/gates and 600 milliseconds on buses.
- Lower bus boarding times.
    - NFPS on-bus payment should result in no increase in SBS dwell time
    - *MetroCard bus fare payment times are slower than with a contactless card*
    - *MetroCard mis-swipes are relatively high compared to most fare systems*
- 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, which is at end of life. NFPS components must be tested/verified for ruggedness/durability in bus use.*
    - *MetroCard MVM and MEM reliability is less than their goal levels as they near end of life. NFPS station kiosks will have newer hardware but must be designed to counter vandalism and fraud.*
- Facilitate regional (MTA and outside MTA) transit interoperability through seamless transfers 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, 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 authentication, and other improvements.
- Meet card security standards, including compliance with payment industry security standards (PCI-DSS and PA-DSS[15]).
    - MetroCard vending machines must meet prevailing security standards.
- Provide security measures to protect all components from viruses, hacking (to steal credit card and personal account data), code-breaking, card replication, and others.
    - *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 payments industry databases. Knowledge of travel and fare payment patterns and preferences will help management improve service planning, trafficking and service adjustments. 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 flexible.*
    - *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 Bus Camera project) for even richer set of data.*

7.7 System architecture objectives

The NFPS supports the following system elements:

- Use of commercial off-the-shelf components and existing payments 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, MTA Card, 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.*

[15] Payment Card Industry Data Security Standard and Payment Application Data Security Standard

- Support of key standards for payments:
    - North American contactless payment 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).
    - Standards for transactions between merchants, acquirers and bankcard associations: ISO/IEC 8583 Standard for Financial Transaction Card Originated Messages and others.
    - Best practices for Web and call center sales sites.
    - EMV contactless standards, used globally but not widely implemented in the US. MTA may implement EMV (Europay Mastercard and Visa) in its readers and processing to support foreign cards, and it may adopt EMV for the MTA Card to provide a higher degree of security and risk management.
    - *MetroCard MVMs and MEMs support magnetic stripe payment cards. MetroCard readers support only MetroCards. No contactless or phone payment 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 may implement NFC in its readers to be prepared for 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 off-line, and bus and subway collection are separate processes.*
- Public transportation specific software
    - Open payment public transport software is being developed by Transport for London (TfL). TfL is developing end-to-end server software for authentication services, authorization services and a fare engine. MTA may be able to obtain the major elements of the open payment fare system from TfL through license, build or operating agreements. TfL is also developing readers for fare payment for its own system.
    - *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 contactless payment 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 can 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

8.0 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 and the MTA Card. 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 interfaces with outside entities required to support the NFPS.

The NFPS includes the following systems and interfaces:

- Card issuance
    - Merchant agreements for MTA to accept payment industry issued cards and mobile phone payments
    - MTA Card
    - Agreements for MTA to accept employer IDs, student IDs, transit benefit cards, and other cards
- Fare product sales (PAYG and PIA) and customer support
    - Sales channels: NFPS website, call center, IVR, readers, station kiosks, retail reload network
    - Customer information interfaces: same as sales channels
    - Customer service: NFPS website, call center, IVR, card issuer (including issuer of MTA Card) website, call center, IVR, station kiosk, station personnel
    - NFPS on-line account registration and management: NFPS website, call center, IVR
    - Reduced fare enrollment
    - Agreements with other transit agencies and modes
- Transaction processing for fare product purchase through all channels except readers
    - Card acceptance: contactless and magnetic stripe
    - Cash acceptance on bus (except SBS): single ride only
    - Fare engine: computes price of fare product before authorization
    - Billing engine: requests payment authorization, updates user account
    - Billing engine: standard merchant processes for settlement and clearing
- Transaction processing at readers for access to MTA services
    - Card acceptance: contactless only
    - Authentication: MTA server checks Accept List for PIA product, checks Deny List
    - Billing engine: seeks PAYG authorization if card not on Accept or Deny List
    - Fare Engine: computes price of fare product after trip completed
- Billing Engine: updates user account, processes settlement and clearing
    - Network Connections from website, call center, IVR, station kiosks and other sales channels to MTA billing, fare engine and account servers
    - Connections from readers to MTA authentication, billing and fare engine servers

    - Connections from MTA servers to acquirer, payment network, MTA Card issuer and retail reload network, and others
    - Connections to financial support systems such as data warehouse, revenue collection and cash settlement systems
    - Connections to device and network management systems
- Accounting, operations and maintenance
    - Revenue accounting
    - Cash settlement
    - Revenue protection
    - Risk and security management
    - Data warehouse
    - NFPS system maintenance (hardware, software, network)
    - Network management
    - Device management

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. Interfaces with these systems are defined in this chapter.

8.2 System Interfaces

An interface is the point of interconnection between two systems. 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 or file transfers.

8.2.1 Internal interfaces

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

1. Interfaces between subway readers and MTA servers. Both NYCT and third party network services may be used.
2. Interfaces between bus readers and MTA servers. 3G or 4G wireless services will be used.
3. Interfaces between station kiosks/other internal MTA sales channels and MTA servers. Both NYCT and third party network services may be used.
4. Links from MTA.info website to servers for purchase of fare products.
5. 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.
6. Interface between bus reader and other on-bus equipment, such as the destination sign controller and keyboard for operator login
7. Interface between subway reader and turnstile/gate release mechanism
8. 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.
4. NYCT employee pass issuing office. The MTA Card issuer must obtain personnel data from this system.
5. Contractor pass issuing office. The MTA Card issuer 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 authentication server 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. Externally provided fare sales channels: website, call center and IVR system. Fare engine provides fare calculations to sales channels. Sales channels provide purchase information to the customer account manager, billing and authentication servers.
5. MTA Card issuance and management servers. A direct interface, not via an acquirer, may be used for high performance and availability.
6. Interface between MTA Card provider and reload network merchants. This may not require a direct interface to NFPS servers.

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

Interfaces between NFPS servers and external systems include:

1. Government and social service providers (EBT cards). If EBT cards are not contactless:
    - EBT card holder may individually acquire an MTA Card, in which case no system interface is needed; or
    - MTA 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. MTA servers must obtain data on card IDs and fare products from the providers. Payment would be made through EFT.
3. Police (MTA, NYPD). MTA Card issuer must obtain data from these systems.
4. Emergency personnel (NYPD, NYFD) MTA Card issuers must obtain names and other relevant data from these systems.
5. MTA employees and contractors. MTA Card issuers must obtain personnel data from these systems.
6. MTA Inspector General.
7. Employers that issue PIV cards (contactless ID card). MTA 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). MTA servers must obtain data on card IDs and fare products. Payment would be made through EFT.
9. Other non-MTA agencies accepting and selling MTA Card.

The MTA will publish a specification for these external ID and fare product transactions that all of these interfaces will follow. The interface may be batch or on-line or both; high availability may not be required. The MTA will consult the external providers in this process. Exceptions to the specification will be handled as needed.

The MTA may need system interfaces to other external entities:

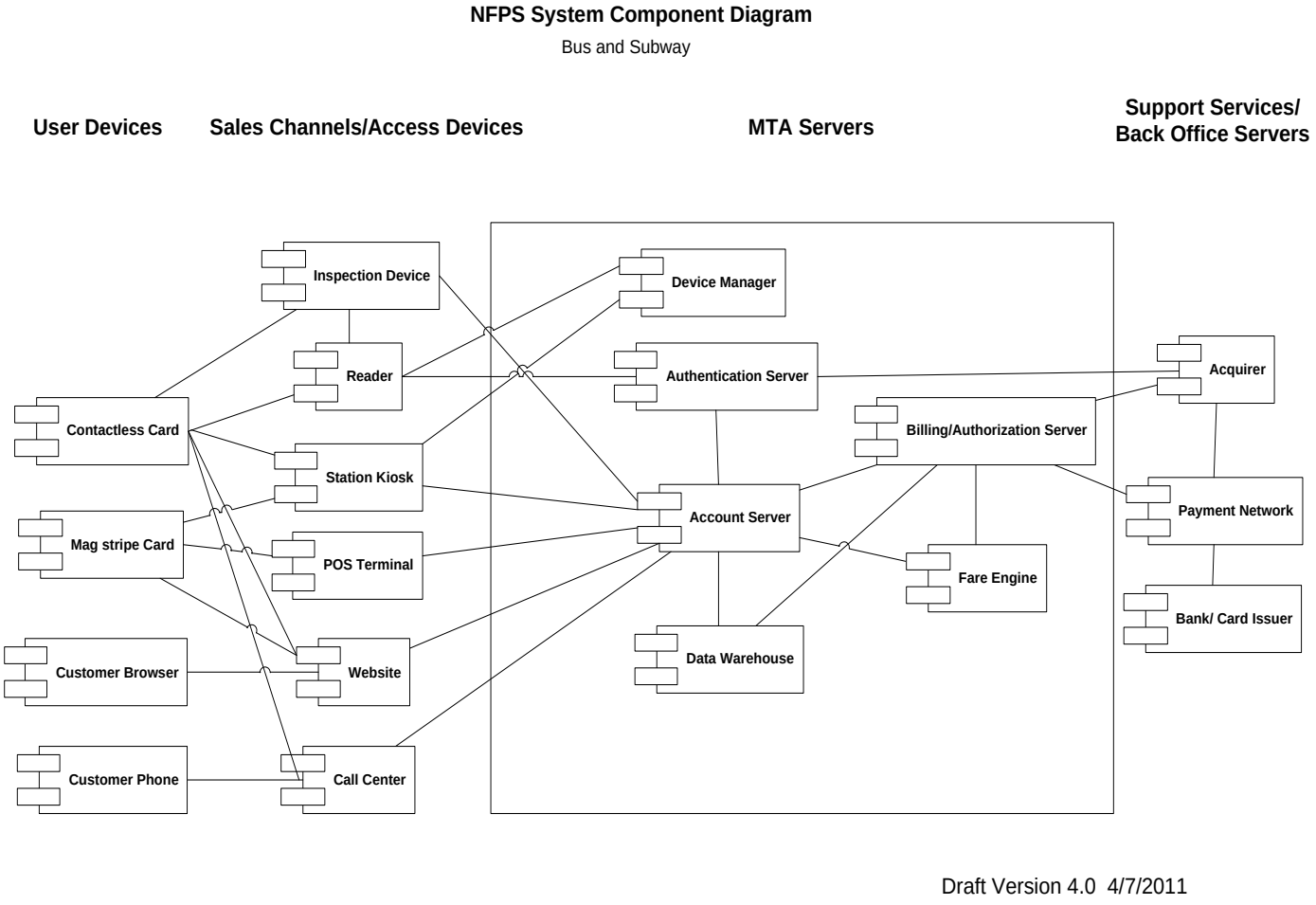
1. Payment card issuers and bankcard networks, for customer service issues
2. Component and services vendors, for maintenance and support

8.3 System architecture

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

1. User devices are general-purpose cards, phones and browser devices owned by MTA customers. (Users buy an MTA Card if necessary.)
2. NFPS sales channel and access devices are standard retail readers (reader hardware, operating system and software are standard but there are some changes required for MTA), website, and call centers, with minimum customization for the MTA.
    a. The inspection device is used to verify that users have tapped their payment medium before boarding a train. In phase 1, this is used only on SIR; in later phases, LIRR and MNR will use these devices. This device is based on a payment-enabled mobile phone or tablet, with an inspection application.
    b. The station kiosk sells fare products; it is based on commercial designs to the extent possible.
    c. Other channels with limited usage such as vans, EBT cards are not shown. The MTA Card is shown in Figure 8-2.

3. MTA 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 authentication server and fare engine are custom MTA software. The fare engine may be shared with other transit agencies.
4. The payment industry servers are standard. The MTA will request modifications to support aggregation, faster authorization, faster Deny List access, and others, as feasible.



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.
2. This component diagram does not include the MTA Card reload network. MTA Card must be value loaded to access the system depicted here.

Figure 8-1 NFPS System Component Diagram

8.4 Contactless cards

Contactless card acceptance will be determined during the requirements phase of NFPS. The NFPS should be designed to process a large number of card types, but decisions on specific card types and the timeline for doing so will need further analysis. The planned capabilities are:

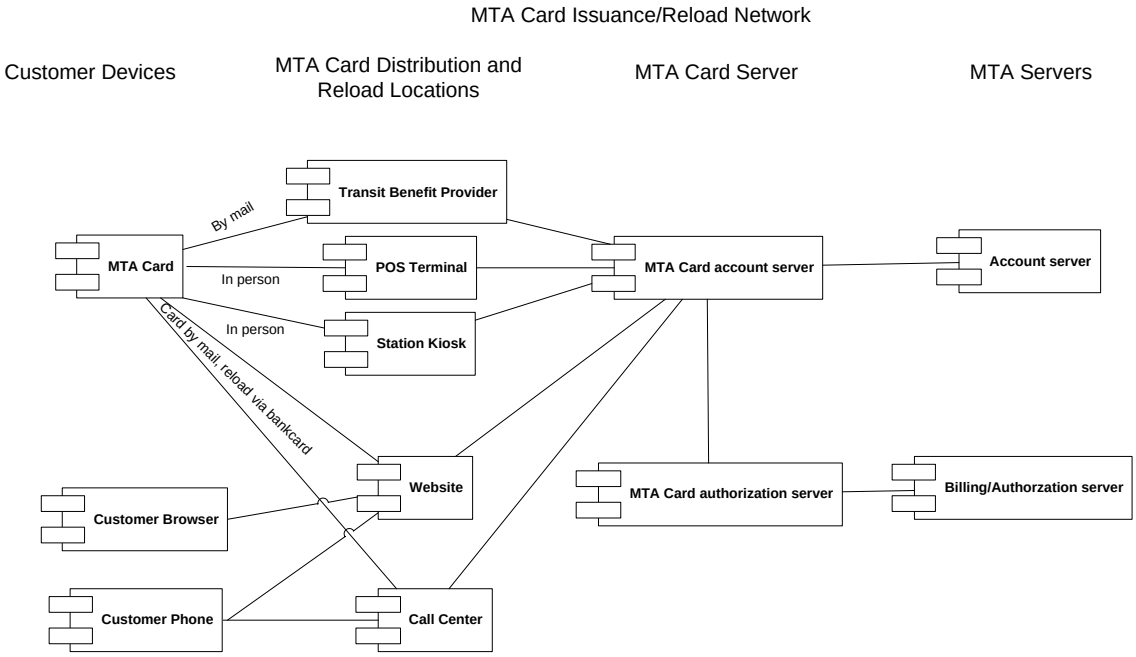
- "North American" contactless cards from all card network brands from all issuing banks will be accepted at MTA readers and PIA sales channels
- Single ride tickets on inexpensive, single-use contactless media will be accepted. A protocol must be selected.
- Magnetic stripe cards from all card network brands from all issuing banks will be accepted at PIA sales channels but not at MTA readers
- EMV contactless cards may be accepted. The MTA will perform an analysis and request vendor input. Key issues are:
    - The MTA Card may be issued as an EMV card; this would potentially speed up reader transactions, lower fraud risk (from card skimmers and other attacks), and manage MTA PIA value products effectively by using EMV off-line counters.
    - Foreign bank-issued EMV contactless cards could be used by visitors to New York.
    - It would future-proof the NFPS if North American issuers adopt EMV, which is possible.
    - EMV cards would be more expensive to issue, and MTA would need to have EMV software on its readers.
- PIV cards may be accepted. The MTA will perform an analysis and request vendor input. Key issues are:
    - If employers and schools issued PIV (FIPS 201) cards and sold MTA products to their employees and students, this would be a low-cost sales channel. The employer or school would send an electronic funds transfer and list of cards and fare products to the MTA each month, and the MTA would accept the PIV cards for access at readers. Two US transit agencies - Massachusetts Bay Transportation Authority and Washington Metropolitan Area Transit Authority - sell more than 50% of pass products through employers and schools. If the MTA could sell a significant fraction of its products through employers and schools, it would reduce its payment fees substantially
    - 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:
    - Mobile payment is expected to be implemented in the near future, though there is some uncertainty.
    - NFC phones operating in NFC card emulation mode require no additional MTA reader software or differences in processing; they are emulating a contactless bankcard. However, this payment model has not been implemented widely because of unresolved business issues among the parties involved.
    - 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 full NFC software on its readers to support this option, and additional applications would be needed for specific fare products. This would future-proof the system for mobile phone payment.
- The MTA Card will be accepted. It will also be used for non-revenue access.

- 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
- Cards are issued and managed through existing issuer processes

8.5 MTA Card

Figure 8-2 MTA Card Issuance/Reload Network is a component diagram of the MTA Card Issuance/Reload Network concept. A separate Concept of Operations will be developed for the MTA Card. The MTA Card is based on a closed loop contactless white label or co-branded prepaid card provided by the payments industry:

1. Customers obtain an MTA Card at retail reload sites, station kiosks, from transit benefit service providers, by mail via the MTA Card website or call center or the NFPS website and call center (these two websites/call centers may be integrated). There is a fee to obtain the card; the MTA will develop agreements with retail merchants to sell the card. The MTA Card fee must be paid by credit, debit, prepaid or EBT card if bought on-line or through the call center.
2. Customers reload the card in person at retail reload sites (using any payment method accepted by the merchant) and station kiosks. They can reload the card at the website or call center if they have a bank-issued credit, debit, prepaid or EBT card. (They would typically do this if their bank-issued card was not contactless; otherwise they could use the bank-issued card directly.)
3. An account server manages the products bought by MTA Card users. This function may be part of the NFPS account server or separate and provided by the MTA Card provider.
4. If the MTA Card has a separate account server from NFPS account server, it will also have an authorization server that the NFPS billing server queries when an MTA Card is presented at a reader and authorization is required. For example, authorization would be required when an MTA Card tap results in a PAYG transaction and when a PIA fare product is purchased for the MTA Card. The authorization in either case is for a linked bankcard, not for the MTA Card. This server must provide rapid authorization.
5. Whether the MTA Card website is integrated into MTA's account server or is a separate card site like bankcards have will be determined during the requirements phase of the project. Regardless, the MTA Card will need the same card management functions, as any other bankcard, for disputes, lost/stolen/damaged cards, expiration, etc.



Footnotes:
1. MTA Card retention fee is charged to customers when customer gets card from MTA Card distributors. MTA accounting later collects retention fee from MTA Card partner/provider
2. If MTA Card is purchased or reloaded with a credit/debit card, there are additional components for credit/debit purchases that are not included in this diagram. These components appear in the NFPS System Component Diagram.

Figure 8-2 MTA Card Issuance/Reload Network

8.6 PIA sales channels and customer service

The planned sales channel capabilities are:

- Customer service and sales channels must be available 365 days per year, 24 hours per day and be user friendly and have up-to-date information.
    - Reload locations will be available during the merchant's regular store hours.
- MTA will provide channels for special groups:
    - Reduced fare enrollment currently requires in-person verification; current processes will be used. MTA may accept government agency-issued contactless cards for reduced fare in the future.
    - Group sales channel will be based on current practice.
- Support for card-related questions will be provided by the card issuer: billing statements, customer service call centers, lost or stolen card emergency service, dispute resolution systems, and others. The MTA Card issuer will provide these services for MTA Card holders.
- Support for fare product and service questions will be provided by the MTA call center: refunds, billing questions, and dispute resolution. MTA and card issuer may refer questions to the other, as needed.
- Customer support will also be provided through station signage, kiosk design, rider brochures, bus farebox unit decals and station personnel and bus operator training.

8.7 Readers, turnstiles/gates, bus entry, and validators

The reader subsystem is made up of several components:

On buses, it contains a terminal/CPU, modem, display (LEDs[16] and audible messages for customer and bus operator), power supply, contactless card reader, and an enhanced GPS (global positioning system) component to provide location, both for the Bus CIS project and to determine card use location for operations and planning. It connects to the bus destination sign controller and keyboard for operator login. Details include:

- Initially, card 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 incorporate the reader and coin acceptance.
- Local and express buses will use the next generation farebox units. SBS buses will have multiple readers, but no farebox units. Whether readers work with single terminals or multiple terminals will be decided during design and specific to each bus model.

In subway stations, it contains a terminal/CPU, network interface (wired or wireless), display, power supply, and contactless card 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 (Americans with Disabilities Act) and with NYS building code and other station-related code requirements.
- NFPS must be able to configure and manage up to 100 turnstiles in a station.
- If possible, NFPS will be installed to allow for the possibility of future deployment of exit readers. The MTA will study the feasibility and costs of this option, which requires reconfiguration of turnstiles to allow “right handed” exit operation, and which requires increased management of emergency exit turnstiles/gates.
- When a card 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 (wired or wireless), display, power supply, and a contactless card reader. It is enclosed in a validator (that is free-standing or installed on a wall) on a station platform.

The reader is based on commercial off-the-shelf components. The MTA-specific changes are:

[16] Light-emitting diodes

- To accept all contactless card types selected by the MTA, possibly requiring EMV, PIV and NFC software. Software to read single ride tickets will be required
- In buses, to:
    - Interface to the destination sign controller and existing farebox unit for bus destination and operator login information
    - Include and interface to an enhanced GPS unit for accurate location information to geo code fare transactions
    - Include an additional Bus CIS software application which will initially send location, destination sign, and operator login information to a separate Bus CIS Server. Future plans may call for Bus CIS data to be paired with taps for encrypted data transmission to NFPS server.
- To communicate with the MTA authentication server 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 authentication process. These lists will be periodically updated.
    - The reader must allow access if no response is received from the MTA authentication server within a timeout period.
    - The reader must resend the taps without a response when the communications link and authentication server are up.
- The audible and visual displays will show transit-specific responses and data. On buses, both the rider 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 at subway readers, and 600 milliseconds or less at bus readers.

The proposed process for handling fare taps when reader-to-server communications are down 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 authentication server handles all taps as delayed taps, not real-time taps. They are sent to the billing 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 Validation/inspection device

A validation device will be used on SBS and SIR to inspect and verify fare payment. This is expected to be based on an NFC-equipped mobile phone or tablet computer. Details include:

- The SBS inspection device communicates with the MTA server to obtain information on valid taps on the SBS bus. In the future, it will interface with the on-bus reader to obtain information on valid taps made on board the bus. This is expected to use the NFC peer-to-peer (LLCP) interface.
- The SIR inspection device communicates with the MTA server to obtain information on valid taps in the entire SIR system. This is expected to use wireless data communications.

In both systems, after the tap information has been downloaded to the inspection device, the inspector will ask users to tap their cards on the inspection device to verify that they have valid fare media. If off-the-shelf inspection software is not available, an MTA inspection application must be written.

8.9 Authentication server

The authentication server is a transit-specific server that provides a rapid response to bus and subway readers after a rider taps a card. This server checks for a valid payment industry number, checks Accept and Deny Lists, performs velocity, nonrevenue access and other MTA checks. (Cards with valid PIA fare products are on the Accept List (among others), as are PAYG with preauthorization or aggregation in progress.) If a card cannot be accepted or declined based on these internal MTA checks, the authentication server requests the billing server to request authorization from the card issuer.

The MTA expects this server to be custom software.

The authentication server:

- Receives all reader taps from all card types
    - If a card type is not accepted by the MTA, the server denies access immediately
    - Readers check the local Accept and Deny Lists, if present, and check validity of card numbers, expiration and other parameters.
    - A reader may grant or deny access without a response from the authentication server, although all taps are sent to the authentication server. The reader may act locally if no response is received from the authentication server within a defined time, or to increase performance.
- Selects appropriate processing based on card type: payment, non-revenue, single ride, and all others
    - Checks Deny List of cards that will not be accepted
    - Checks PIA products associated with a card, and allows access for valid products
    - Performs velocity checks by reader, station, and system-wide.
    - Enforces passback restrictions on pass products.
    - Checks access rules for non-revenue MTA Cards
- Interfaces with the billing/authorization server to request authorization from card issuer for PAYG taps and MTA Card issuer for MTA Cards. Receives and stores authorization responses from billing server.
- Sends message to reader to allow or deny access if card is authenticated or if authorization response not received within a set time.

- Forwards the time and location attached to each tap to the bus CIS server.
- Must limit MTA revenue risk to no more than the first tap on a card, and preferably no risk. The MTA may require full authorization at readers or at station kiosks at the time of first use of a card in the NFPS.
- Must allow flexibility for the MTA to configure and enforce risk and revenue management rules and parameters.
    - MTA wishes to obtain industry Deny Lists via the billing/authorization server, if feasible, or to obtain fast authorization declines for cards on the Deny List.
    - The authentication server must implement criteria for placing and removing cards on the MTA Deny and Accept Lists. These must be configurable.
    - The authentication server 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 to set requirements.
    - The authentication server will implement parameters to allow the MTA to manage risk. For example, if risk experience is good for certain cards, or an issuer will take the risk on the first tap, the server may place these cards on the Accept List, or not require authorization before allowing access the first time the card is seen by the MTA.
    - The authentication server may be configured to obtain authorization in specified cases, e.g., PAYG taps, even if this causes delay at a gate or bus entry.
        - For MTA bus and subway trips, the fare is known at the first PAYG tap. Authorization may be obtained for a different amount. These rules must be established with the payments industry.
        - In future NFPS phases that support distance or zone fares (such as for commuter railroads), the amount to be authorized when the actual fare is not yet known will be a configurable parameter.

8.10 Billing/Authorization server

The billing server manages payments, clearing, settlement, exceptions and other payment processes between the MTA and the payments industry. These processes occur either through MTA's acquirer or directly between the MTA and payments industry.

The billing server also manages settlement with internally stored accounts in the NFPS account server (such as decrementing a PIA value-based pass) and, if separate from the NFPS account server, with a separate MTA Card account server.

The billing server will have standard risk management features. The server, among other functions, implements risk management by placing cards on and off the MTA-specific Deny List. It manages authorization and aggregation processes. It updates customer accounts when payment events occur. It handles payments and funds transfers for media such as student or PIV cards.

The billing server is a typical merchant application. The MTA expects either a commercial retail software offering can be configured to meet its needs, or that an MTA-specific billing 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 server include the following standard elements for all merchants:

- Submits payment transactions for PAYG taps, PIA fare products to acquirer or payment (bankcard) network
    - It should be configured to request the least expensive payment network for a given transaction, e.g., credit, PIN or signature debit, when there is a choice
    - Variations required for PAYG taps, if any, must be supported
- 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.
- Achieve transaction speeds that do not exceed 500 ms for subways and 600 ms for buses. In all cases, these speeds, even where authorization is otherwise required, shall be achieved at least 98% of the time. Where real time authorization is not feasible within the transaction time constraints (and the customer has been allowed through), authorization will still need to be completed as soon as possible to mitigate risks from future taps from that same card. When a tap triggers an authorization request, it shall be completed in 2 seconds or less, 95% of the time. MTA needs to work with the industry to ensure NFPS will support required speeds while balancing against card risk.
- Sends authorization approval or decline messages received from the acquirer or issuer to the MTA authentication server
- Aggregation of transactions, by card type and by purchase type, as allowed by bankcard association rules for transit. The billing server aggregation rules must be configurable. The payments industry must propose a set of aggregation rules and options; the MTA will select its preferred approach.
- Accepts industry Deny Lists, to be passed to the MTA authentication server (and possibly to readers) to allow rapid transactions at readers. This is subject to industry rules.

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 and SRT travel. It provides customer access to registered customers for PIA and PAYG fare products. It handles accounts for all card types. This may not include accounts for MTA Cards if the MTA Card has a separate account server.

The account server is a typical merchant application. The MTA expects either a commercial retail software offering can be configured to meet its needs, or that an MTA-specific account server can be written as customer software by a third party with substantial experience and software assets in retail account management.

The detailed capabilities of the account manager include:

- Manage PIA value product account balances, credits, and debits
- Manage PIA time product validity dates
- It is queried by the authentication server 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 MTA 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 MTA sales and customer self-service channels, to change customer details, and allow correction of some errors (for example, trip refunds when service disruptions occurred)
- It will support on-line customer queries and login/password management via a web server or customer account manager.

No significant MTA-specific requirements are anticipated, beyond the typical tailoring done for any merchant.

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 that define a trip, based on location and time of taps. It transmits this fare to the account and billing servers.

The MTA expects this server to be custom software.

The fare engine performs the following computations. When requested by the account, authentication or billing server, the fare engine computes the fare for a trip based on tap locations and times, rider type, and MTA fare and transfer policies:

- The fare engine receives a set of taps (location and time) for a card, and the set of fare products associated with the card
- 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 value or time product. For example, a user may have a subway pass that is not valid on express buses, or a user may ride beyond the valid zones of a pass in future NFPS on commuter rail travel.

- For trips not covered by a pass, it computes the single ride or PAYG fare. This may be an "extension fare" for trips partially covered by a pass. The fare is based on:
    - Fare and transfer tables, including special fare restrictions
    - Representation of the MTA network, including out of station interchanges, Staten Island ferry and other special cases
    - Tap location and time. The tap location determines the type of service.
    - Fare products held by the customer. These determine the customer type (e.g., reduced fare)
    - Service disruption information (future, optional) to automatically adjust fares
    - If PIA value is insufficient for the trip, a PAYG fare is returned. The fare for a single trip cannot be split between a PIA and PAYG product.
- It returns the result to the server that requested the computation
- If the set of taps for a card 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 and policies:

- PAYG (single ride, including transfers)
- PIA value (SRT, pay-per-ride, including transfers)
- PIA period passes, from one day to one year. Passes may have fixed or variable start days; for example, weekly passes may always start on Monday, or may start when purchased, or with the first tap after purchase. This is configurable.
- All product pricing may vary by mode and agency.
- All product pricing may provide free or reduced fare transfers
- Reduced fares for elderly, disabled, student fares, with varying fare pricing depending on distance and grade level. Time limitations may apply.
- Group travel, when a card is tapped multiple times.
- Employee benefit passes
- Special passes for law enforcement, local police, fire, court officers, etc., if a nonzero fare is charged
- The fare engine must handle end-of-period fare products. For example, if fares change on January 1, customers with PIA value or time products bought before January 1 may have special fare rules for a limited time.
- The MTA must be able to define new fare types that combine the parameters listed above, and the fare engine must be able to apply them to taps on a card.
    - All product pricing may vary by day of week (or weekend), or time 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)
    - Promotional products that may be defined that give discounts to specific customer groups on specific services for marketing reasons.
    - Best value and capping for daily, weekly and other periods.
        - If passes have variable start days, best value and capping calculations can be complex. MTA will study and define this feature.

    - Discounted or subsidized fares
- 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.
- 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 refunds or rebilling.
    - Open payment technology will support the implementation of innovative fare policies, such as route-specific discounts, automatic refunds if there are service disruptions, and many others.
- The fare engine will be designed to handle such anticipated future products.

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; MTA and agency planners; and customer service providers.

It will be a commercial, off-the-shelf 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
- 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, refunds/adjustments, disputes
- Maintain records of NFPS equipment (reader, station kiosk) status, errors, configurations, for audit reasons (e.g., when bus readers were in service on which routes) and reliability analysis reasons
- Maintain records of NFPS performance measures, as discussed in chapter 12
- System capacity, data retention and ownership:
    - Greater capacity and functionality than the current NYCT Data Mart is required. The needed capacity will be analyzed by the MTA.
    - The data stored will be accessible in near real time and stored on-line for up to six years.
    - All MTA-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 real-time, 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 warehouse data and systems will be exclusively owned by MTA
- 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 format 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 stored off-site

8.14 Kiosks

A separate concept of operations will describe the kiosk.

8.15 Networks

The telecommunications networks for NFPS will connect:

- All readers to the authentication and device management servers,
- All sales channel servers to the account and device management servers

- The MTA billing server to payment industry servers, and
- Processing servers to other servers in data centers

The reader-to-server connection will be on-line.

The network technologies to be used are:
- Bus readers to servers: 3G or 4G wireless services
- Subway readers to servers:
    - Fiber optic services at underground stations and station complexes with high throughput (which include a small number of above ground stations) connected to NYCT network, with either wired or wireless LANs, and, in some cases, with external carrier networks as backup. If wireless local area networks are used in stations, they will support NFPS and other station applications. If a 3G or 4G wireless network is used, it will support NFPS.
    - Wireless from NFPS devices to antennae and access points within all other underground stations, then fiber optic services through streets or in-tunnel ducts to base stations and outside networks.
    - 3G or 4G wireless services from commercial carriers at all other above-ground stations, including wireless LANs within stations, as needed.
- All server-to-server connections: fiber optic services from commercial carriers.

The MTA wishes to have 99.99% network availability, which translates into no more than one hour of communications downtime per year. This level of downtime would be comparable to other infrequent events such as reader failures or power failures. 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.

Standard industry telecom protocols will be used, and will be defined in at a later stage. The communications channels and modems/network equipment will synchronize time for NFPS terminals/readers.

8.16 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 protection on several MTA and other servers, which must meet PCI-DSS standards:
    - The authentication server processes payment card information and transmits it to the authorization server when necessary.
    - The billing server processes and transmits payment card information.
    - The account server processes customer and call center entry of payment cards

    - 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 (discussed later) stores payment card data, as allowed by the rules, and must be protected.
- Security protocols and key management for server-to-server communications, which will handle payment card 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 or 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.

9.0 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 [Autonomous Farecard Access System] Service)
- Bus farebox units
- Wireless communications
- Fiber optic communications
- Contactless cards: credit, signature debit, prepaid, EBT, PIV, student, pre-tax benefit cards, MTA Cards, contactless cards used for single ride tickets[17]
- Bankcard issuer/merchant acquirer/payment network, including MTA Card
- Website (including mobile phone interface), call center.
- 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 authentication server: 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
- Retail reload network
    - Prepaid card and reload services exist through POS terminal or kiosk

[17] SRT will ideally be biodegradable or made of recycled material.

- NFC phone use at readers with open payments
    - Many NFC trials have been conducted, and initial open payment efforts are underway

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
    - Unpaid zones: 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 NFPS
- SIR stations
    - Validators with readers at ungated stations in paid and unpaid areas
    - 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 without triggering the tamper proof mechanism.
- Abuse:
    - Readers must be able to withstand limited abuse from customer tapping and bumping.
    - 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. Key parameters include:

- Audio-visual displays must be visible and audible to both customers and bus operators.
- Power must be provided for up to 15 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.

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) may require training in new processes or systems.

10.0 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 commercial off-the-shelf, 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 Maintenance Management System (MMS)

10.2.1 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 MMS will provide standard features, such as fault monitoring, performance monitoring, diagnostic and repair processes, remote access, inventory management, 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.

The MTA may require the MMS to interface with in-house and vendor systems for hardware and equipment maintenance. NYCT uses a hardware and equipment maintenance system from Spear Technologies.

Servers are monitored as is standard for data centers.

10.2.2 Device Repair and Maintenance

The MTA or its agencies will have emergency repair vehicles 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 MMS 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 MMS requirements to support device repair and maintenance are:

- The status, type and cost of repairs of components will be automatically documented in the MMS.
- The MMS will interface to existing NYCT systems to record personnel information, inventory and timekeeping, if such interfaces prove to be cost effective. The MTA will provide interface specifications to potential MMS vendors.

10.2.3 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 on-line or by phone 24/7/365.
- Dispatch of troubleshooting and repair personnel as required.
- Ability to access NMS and MMS, as part of supporting field personnel
- Provide access to on-line training videos, drawings, schematics, files, knowledge base, and other technical materials.

Help desk software must be off-the-shelf software running on standard hardware.

The MTA Headquarters Department Enterprise Information Technology Group (EITG) will provide IT support for MMS and NMS.

10.3 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 new in-station kiosks if provided by the MTA. There will be no more cash to collect at booths.

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

10.4 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
- Other appropriate means

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

11.0 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 authentication server. 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.

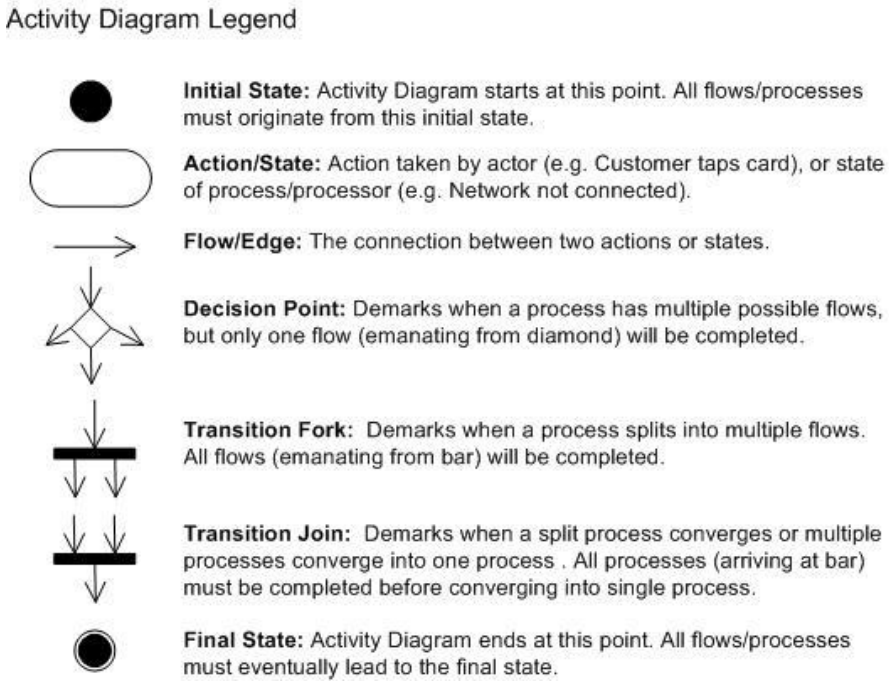


Figure 11-1 Activity Diagram Legend

11.1 Station personnel

Station personnel (agents) handle the following NFPS functions:

- Customer requests account information.
    - Personnel direct customer to call center or website.
- Customer requests assistance with “problematic card” at reader
    - Personnel tell customer to call the card issuer (bank, prepaid, MTA Card, employer, other), and/or direct customer to MTA call center where the customer may request assistance. MTA call center may issue a product for the customer’s temporary use.
    - If a call center cannot resolve card issue, personnel instruct the customer to either use another MTA accepted contactless payment device to enter the system, or to purchase an SRT at the kiosk
- Customer requests assistance with “problematic card” at SRT kiosk
    - Personnel tells customer to call his/her issuing bank or third party prepaid card company. 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 or 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 contactless payment device to enter the system.

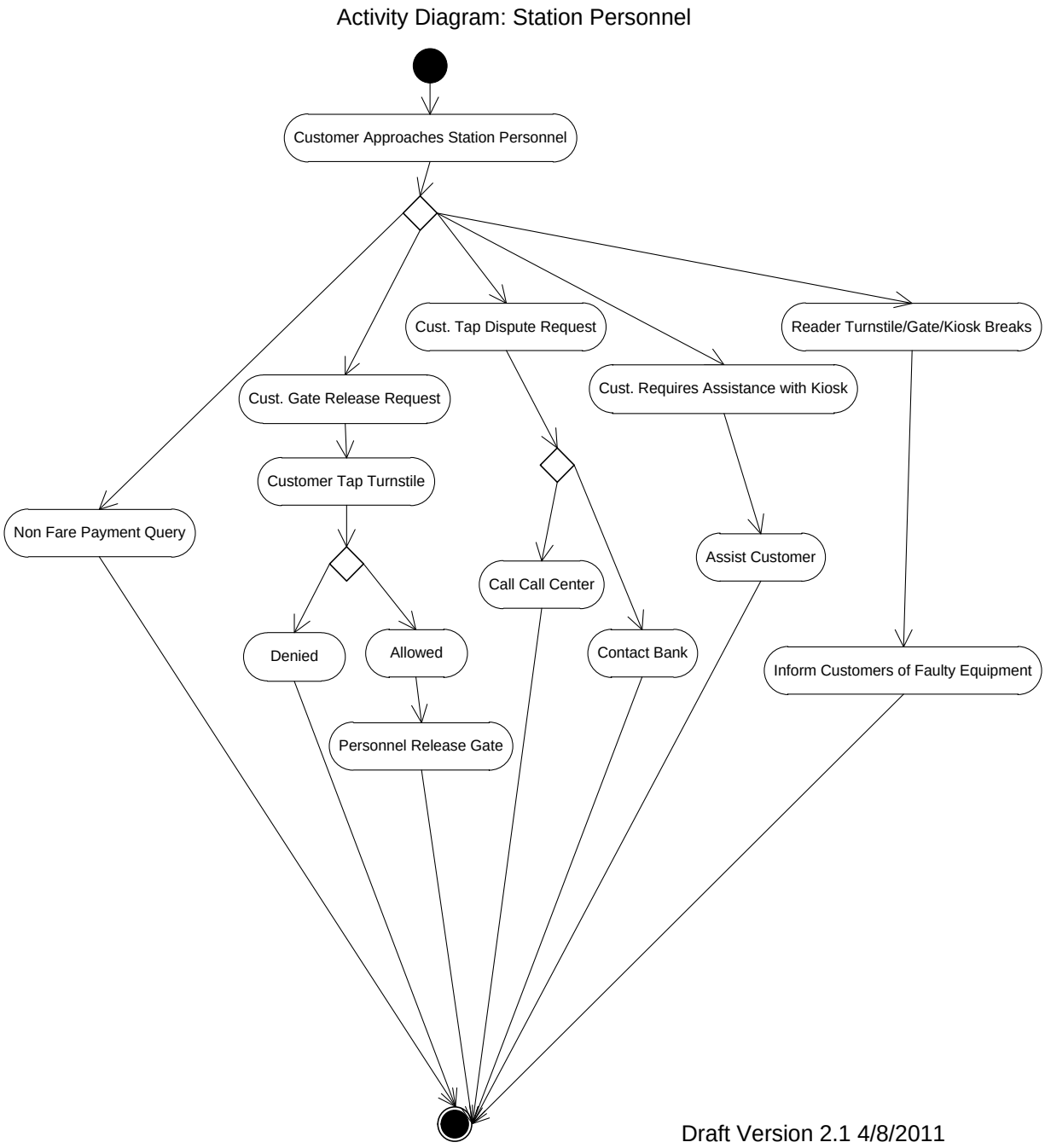


Figure 11-2 Station Personnel

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 inspector 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 MTA Card to log in.* After completing the pullout process, the bus operator enters the fareset and destination data into the farebox unit and places the farebox unit in revenue collection mode.
    - Additionally, bus operator will check to make sure farebox unit *and reader* is working.
- Travel within depot or to/from remote lot
    - The bus operator may enter a deadhead destination code for travel within the depot, for deadhead travel from a remote lot to the depot, or for deadhead travel to the beginning of his/her scheduled runs. 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 run/deadheading
    - When an operator completes his/her last run 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 is requested to send any unprocessed taps to the server.*
- *Customer requests assistance with "problematic card" at reader*
    - *The bus operator will instruct the customer to contact card issuer or third party prepaid card company, or NFPS or MTA Card call center for problems with his/her card, and to either tap another contactless payment device at the reader, or pay for the trip using cash (coins only)*. On SBS, the cash option will not be available to customers.
- 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. 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
    - *The bus operator will instruct customers to tap contactless payment 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. Follow current practice.
- Issue contactless SRT for transfer.
    - Customer pays for ride using cash (coins only) and requests a transfer ticket. Bus operator will issue the contactless SRT to the customer for transfer.

11.3 Inspection for Select Bus Service (SBS) and Staten Island Railway (SIR)

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

The inspector boards multi-door buses and requires proof of payment from each passenger. 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 authentication server using a 3G wireless link (in future, inspector may be able to query reader for taps using NFC technology.) After the tap information is collected, s/he asks each passenger on the bus to produce proof of payment. If the customer used a contactless payment device, the customer will be asked to tap the same payment 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.

Special Inspector On-board SBS

Draft Version 1.0 3/15/2011

Figure 11-3 Special Inspector On-board SBS

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

The inspector 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 reader devices placed for customers to tap as they enter the paid zone. All customers exiting through Tompkinsville and St. George Terminal[18] must tap out. All reader devices are connected to the authentication server by either wireless or wired communications, so that an inspector is able to access all taps recently made by Staten Island Railway customers.

After the Special Inspector enters the paid zone, s/he uses his/her handheld inspection device to collect information on successful taps recently made on all reader devices on the Staten Island Railroad. After the tap information is collected, s/he asks each passenger in the paid zone to produce proof of payment. If the customer used a contactless payment device, the customer will be asked to tap the same payment device on the inspection device. If the customer had previously successfully tapped his/her card at a reader, the inspection device will indicate that there is a match. Otherwise, the inspection device will indicate that there is not a match. The inspector 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 reader devices 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.

[18] 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 taps, little modification will be required for NFPS.

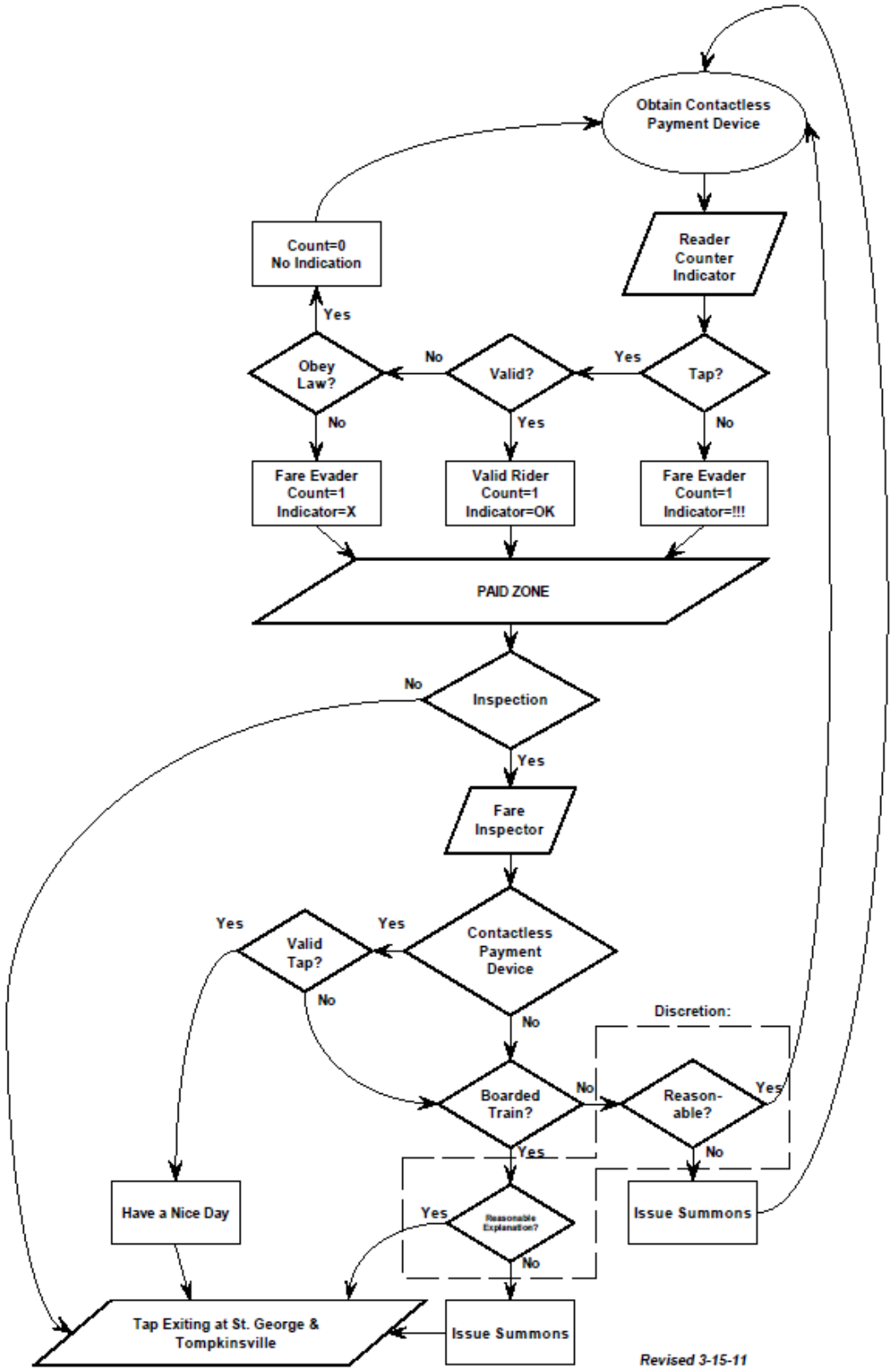
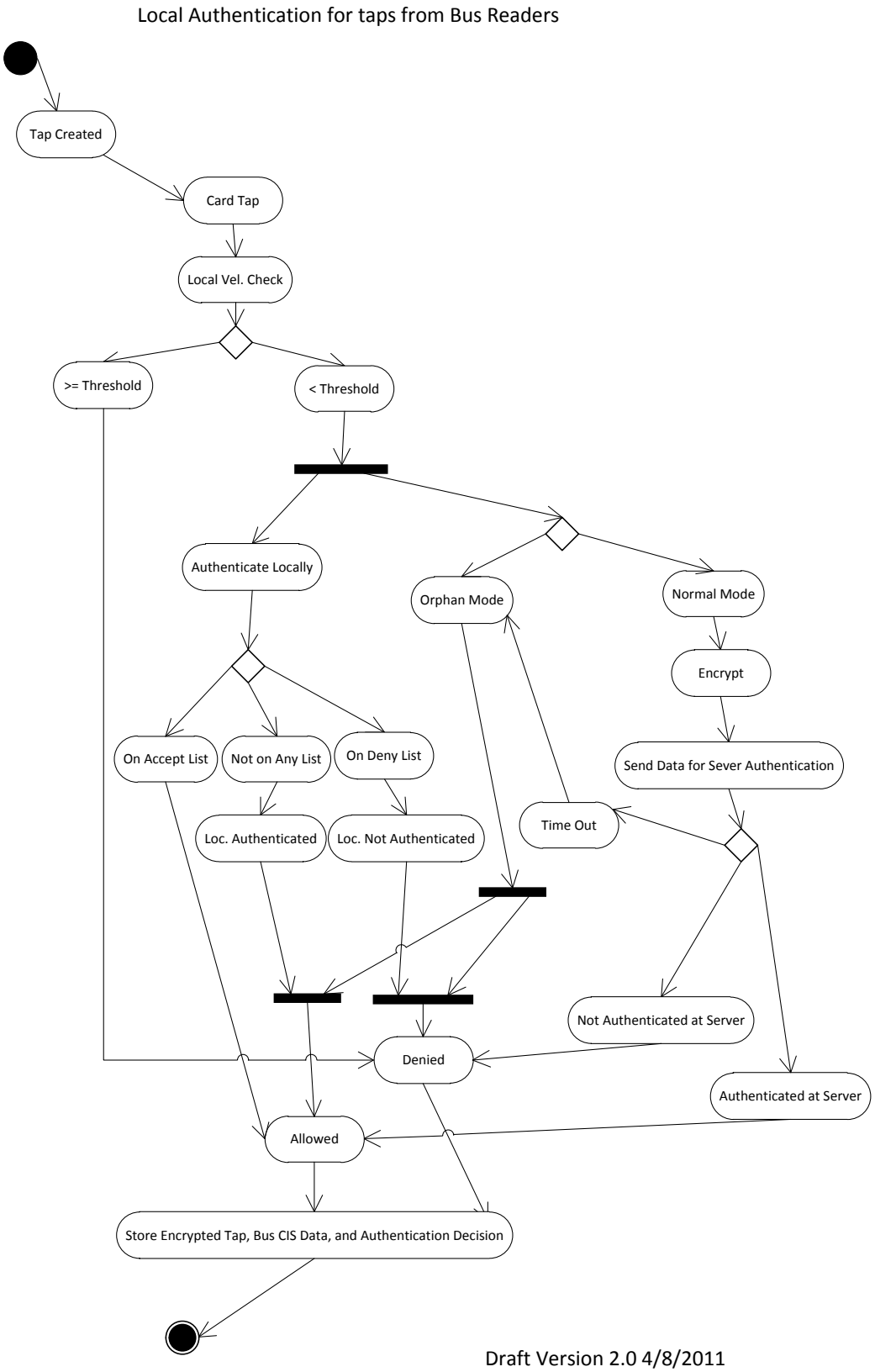


Figure 11-4 Special Inspector, Department of Security – Staten Island Railway

11.4 Authentication of card taps at readers

The authentication server 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 authentication 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.)



Draft Version 2.0 4/8/2011

Figure 11-5 Local Authentication on Buses

Server Authentication for taps from Buses

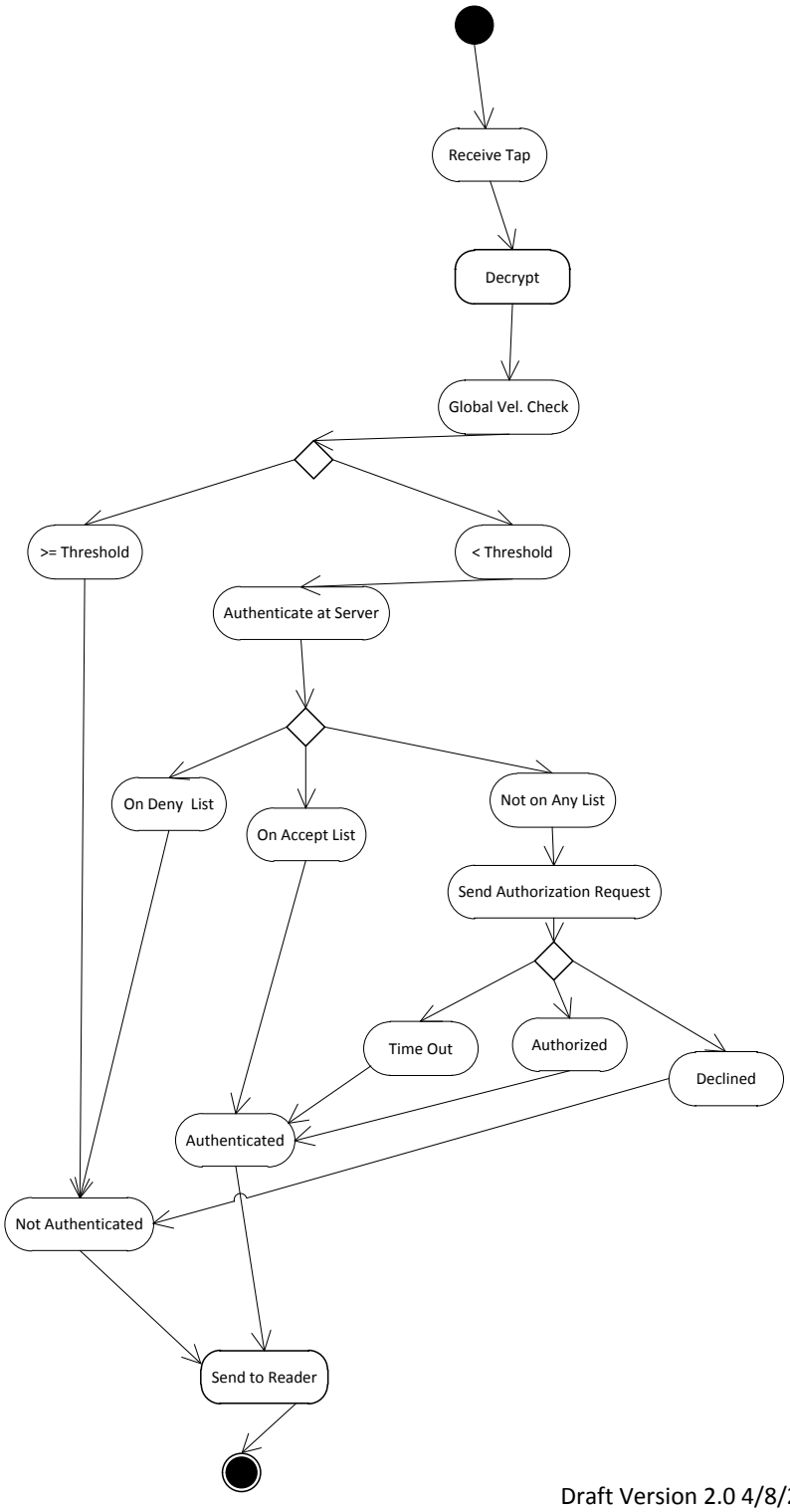


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Figure 11-6 Server Authentication on Buses

In summary, when there are no network connectivity issues, a validated/accepted tap will be allowed if the card has passed the velocity check thresholds, is not on the server Deny List, and passes through the authorization process. When there are network outages, the authentication process depends only on local authentication decisions.

There are several conditions under which the wrong decision will be made in the authentication/authorization process, mainly due to outages in communication and slow response times. “Wrong” means either a card that should have been allowed was denied entry or a card 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 is required any time a card does not appear on either the Accept or Deny List at the server. The billing server will use standard merchant processes for authorization; MTA-specific differences will be implemented in the authentication server, as described below.

Generating an authorization request:

- An authorization request is generated when a tap is received at the authentication server; 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.
- MTA Cards and other contactless ID cards (e.g., employer ID) do not generate an authorization request because 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. Because these cards are not directly associated with a bank account, an authorization request cannot be processed for these cards. One exception to this rule is that an MTA Card linked with a bank-issued card may be able to generate a PAYG tap (and therefore an authorization request) by “violating” a passback restriction.

The authorization request is processed in real time:

- The billing server receives an authorization request from the authentication server for a PAYG tap. The authorization amount will be configurable.
- The billing 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 server, which then converts the message to an authorized or not authorized status.
- If aggregation is used, this will start the aggregation cycle.
- The authorization response is sent back to the authentication server, which uses this information to make the authentication decision.
    - If the PAYG tap is authorized, the tap will be authenticated at server.

- If the PAYG tap is not authorized, the tap will be not authenticated at server.
- If the authorization response is not received within the maximum time allowed, the tap will be authenticated at the server
- If there is a failure in communication between the authentication server and the billing server or the billing server and the acquirer, the PAYG tap will be authenticated at server.

- The authentication decision is then sent to the reader.

Where risk is placed:

- The MTA may set the timeout for authorization by mode, time of day, day of week or other parameters.
- If possible, the timeout should be set to a sufficient value that most transactions will be authorized.
- When authorization is not possible, because bus boarding delays or station turnstile queues would occur, the MTA has two options:
  - It may set the timeout to a lower value. In this case, many PAYG users would be allowed access before authorization occurred or was denied.
  - In subway stations, the MTA may deny access at the reader but instruct the customer to tap at a kiosk for an initial authorization. Signage may be placed at stations to inform PAYG users to do this. The MTA may allow PAYG users who have used their cards at the MTA within some time period (perhaps a week) to bypass the initial authorization.
- The MTA will request that the payments industry provide more rapid authorization when possible.
- The MTA will request that the payments industry work with it to limit the risk
  - One method would be to limit risk of "first taps", similar to arrangements Transport for London is establishing for similar applications, particularly for EMV.
  - Another method may be to use aggregation, and the MTA takes the first tap risk and be protected for the aggregation cycle/amount.

11.6 Updating Accept and Deny Lists

The authentication server manages Accept and Deny Lists. The key processes are:

- Reasons to place a card on the Accept List
  - A PIA fare product is purchased or reloaded for the account associated with the card. This includes employee, student, PIV and other cards.
  - Card starts an aggregation cycle for PAYG products.
  - All SRT cards issued by kiosk
  - All current employee MTA Cards
  - All current authorized MTA Cards (e.g., police)
  - All current contractor MTA Cards
- Reasons to remove a card from the Accept List
  - Fare product expires or reaches low balance
  - Possibly ending aggregation cycle

    - SRT card used at reader
    - Contractor, employee, authorized card holder term expires
    - Placed on Deny List
- Reasons to place a card on the Deny List
    - On industry Deny List, if obtained by MTA
    - Lost or stolen card, either the card used for access or associated card used for payment, as required. Customers with an MTA Card tied to a lost or stolen payment card may opt to continue using the current fare products on the MTA Card
    - Receiving a hard decline, unsuccessful settlement, or multiple declines, as available from the issuer or bankcard network. The MTA may configure these parameters.
    - Any MTA Card that is removed from the Accept List
    - Employee ID, student ID or similar card that is removed from the Accept List
    - Velocity check threshold exceeded
    - SRT card used at reader
    - Passback restrictions violated. The MTA will configure this parameter to allow group travel but to disallow use after a higher threshold is reached.
    - Expired employee/non-transportation MTA Cards
    - Other rules as determined by the MTA
- Reasons to remove a card 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.
    - Placed on Accept List
    - Velocity check time period passed, unless fraud is suspected
    - Passback restriction time period passed, unless fraud is suspected
    - Found MTA Card/other contactless ID card

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.

12.0 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 period lasts, when MetroCard and NFPS must operate in parallel, the greater the investment that will be required to keep MetroCard operating reliably.

12.1.2 Subway network readiness

The readiness of the NYCT fiber optic system or SONET (Synchronous Optical Network) will be a constraint on NFPS system development where NFPS phase-in is scheduled prior to completion of the network. The SONET rings have been installed and ATM (asynchronous transfer mode) switches provided in the station communication rooms across the subway system. However, the cabling and wiring required to network station applications such as NFPS to SONET through the ATM switches has not been installed in any stations.

It is unclear whether a hardwire connection to SONET will be available at all stations in time or at a reasonable cost or level of service for the subway station rollout of NFPS.

Wireless networking solutions are being developed as an alternative measure. Wireless communications will be used for all above ground stations for the initial rollout of NFPS, and will be used in whole or in part at underground stations where the wired solution cannot be made available in time.

12.1.3 Speed requirements and network latency

The NFPS requirement for 500 ms (subway) and 600 ms (bus) fare payment transaction time is faster than merchant transaction terminal processing. Meeting these requirements 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.

12.1.4 Payment networks' operating rules

Use of cards and card 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.

12.1.5 Reader environment

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.

12.2 Risk management

12.2.1 Financial risks

- Card risk profile
    - MTA is moving from a legacy system that requires prepayment and a payment currency for which we control the risk profile, to a system that allows for acceptance of payment methods for which we do not control the risk profile, and does not require pre-payment. 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 cards being used. For example, debit cards and pre-paid cards are higher risk than credit cards because of lower average balances.
- Off-line acceptance of cards at readers
    - When there is no network connectivity, the MTA will need to accept cards off-line. This may result in card holders being allowed entry who should have otherwise been declined because their card would not have been authenticated or authorized. It is unlikely that the MTA will be able to collect payment from these cards.
- Passback control at gates/turnstiles and farebox units
    - Passback control is performed at the authentication server, which requires network connectivity from readers to the server. When network connections are down, passback control is done at a reader level, which allows riders to use a pass product at nearby subway readers to avoid the passback check. These taps will be charged as PAYG fares, and subway network availability is expected to be very high (99.99% or less than one hour of downtime per year), which may control this risk. Bus readers may be able to implement local passback control.
- Penalties from card associations 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 bankcards 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 contactless cards, which have better security than magnetic stripe media, and server authentication is expected to manage this risk. The most significant risk is often data center breaches, and this is unchanged.

- Aggregation
  - If MTA utilizes aggregation to reduce transaction volume in order to reduce interchange fees, MTA undertakes the risk on any transaction in the aggregated bundle that was not previously authorized. MTA must select its aggregation policy.
- 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 contactless 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 contactless cards
  - MTA must provide a contactless card (MTA Card) to those customers without contactless bankcards. MTA Card will be issued by a third party; the costs will be funded by the MTA. If fewer bank-issued contactless cards are in circulation, more MTA Cards must be issued, at increased cost to the MTA.
- Unbanked customers
  - MTA will provide an MTA Card, with costs as noted above.
- Robustness of external sales network and MTA Card issuance
  - The provision of external sales channels for PIA products will be critical to MTA's bus customers without contactless payment cards.
- 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.
  - Equipment or software problems that result in wrong "denies", i.e., customers not allowed entry due to incorrect authentication 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 bankcards 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 on-line self-service options
  - NFPS represents a shift from service by vending machine to service on-line/by phone. Customers will need to have a comfort level with on-line or phone transactions.
- Passbacks and transfers
  - NFPS allows a payment card 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 single ride.
    - 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.
  - NFPS may specify a richer reader display interface to avoid these risks in the future. The authentication server 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/MTBR),	MTBF/MTBR will reflect typical industry specifications for readers, network elements and servers.

	for key software and hardware components, by mode.	
R2 Availability	Overall system availability allowing full reader-server capabilities to be used.	• Time when a reader does not receive server responses will be no more than one hour per year, an availability of 99.99% (four 9s) during which all system elements (readers, network, servers) are operational • Redundancy for components such as routers in subway stations and servers will be calculated such that they yield the required network availability • Bus equipment redundancy is limited.
R3 Data integrity	Complete and accurate data capture to ensure processing of all relevant customer and usage data.	• 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 refunds should be accurate.
R4 Extensibility	Ability to accommodate increased functions	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 • 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	Ability to leverage common	All NFPS system components will be

/Reuse	components across multiple products	commodity-off-the-shelf except for authentication server and fare engine. The same card associations, 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	Support and maintenance calls no more than once per 90 days per reader, modem, bus antenna hardware. Software support and maintenance per industry standards. Mean time to repair (MTTR) per hardware industry standards.
R7 Performance	Ability to meet real-time, batch and on-line performance constraints	• Operational bandwidth sufficient to transmit transaction data. MTA to analyze. • Subway gate response time should not exceed 500 ms round trip from tap on card reader to server and back to card reader 98% of time. • Turnstile gate arm or service gate lock should be released within 50 ms of message to customer. • Bus reader response time should not exceed 600 ms round trip from tap on card reader to server and back to card reader 98% of the time. • Up to 2 seconds in response time post entry, when authorization is required, 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	• 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.	Network will be scalable for 50% traffic growth in the next 10 years. Server and software architecture allows scaling. Operational bandwidth between reader and server can maintain or burst to 10 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 network 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 bankcard payment 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.

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*
- Contactless card holder.
  - *No longer required to use MTA-issued media*
  - *Will tap instead of swipe*
- Non-contactless bankcard holder.
  - *Likely to use MTA Card*

- Cash user.
    - *Contactless card required for entry on subways. Can continue to use cash at kiosks, retail locations (to reload MTA Card), and for entry on buses. Attempt to convert to MTA Card through information, incentives.*
- MTA Card user.
    - *New user category.*
- Fare product purchasers
    - *New sales channels and account self-service, notification and management options (call center/IVR, Web, station kiosks, retail reload, employee/student IDs, limited text).*
- 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 contactless card or new contactless SRT.*
- 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 to manage. Refills are electronic.*
- Seniors.
    - *Use MTA Card or own card if appropriate interfaces with reduced fare program are built.*
- Disabled, including ADA community issues for process, ergonomics, payment
    - *Use MTA Card or own card if appropriate interfaces with reduced fare program are built.*
- Reduced fare customers, generally
    - *If government-agency-issued cards for reduced fare customers can be accepted in NFPS, MTA may be able to eliminate in-person verification and need for photo MTA Card 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.
    - *If EBT card is not contactless, the user can still obtain an MTA Card and purchase PIA products with the EBT card. If EBT card is contactless, it can be used for entry in NFPS*
- MTA/agency employees and pensioners with NYCT pass.
    - *Shift to MTA Card*
- Non-employee eligible for transit pass benefits (emergency services including MTA Police, NYPD, FDNY, District Attorney, Port Authority PD)
    - *Shift to MTA Card*
- Students (currently there are 14 different types of student passes issued)

    - *Issue MTA Card; 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 on-line; group must enter card number and numbers of travelers. Consider surcharge for manual handling.*
- Potential customers.
    - *MTA will develop marketing plans to attract new riders from target areas, emphasizing added convenience of NFPS over MetroCard. Since many potential customers will have their own contactless media, 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 on-line 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 MTA Card 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: riders use own contactless card or MTA Card. LIRR and MNR may sell MTA Cards before they accept them directly.*
        - *This does not address the deployment of NFPS on LIRR and MNR.*
    - Bridges & Tunnels Customers.
        - *MTA Card 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 bankcards and MTA Cards 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 contactless cards 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. MTA Card 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 MTA Card 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 MTA Card. 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 in-station kiosk and customer service channels to which to direct customers*
- Handle cash at booth
- 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. *No fare payment responsibility*
- All buses:
    - *New farebox unit (initially, new reader installed on existing farebox unit), except on SBS, which receives 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 MTA Card 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 new MMS with remote monitoring and diagnostic 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 station kiosks, likely fewer in number and providing less functionality, should reduce maintenance effort required.*
        - *Perhaps provided by 3rd party.*
- Field maintenance of bus and subway components
    - *Role continues but with different components and new MMS with remote monitoring and diagnostic 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 MMS in future.*

12.5.5 Revenue control

- Ticket stock management

    - *SRT retained in contactless form*
- 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 MTA Cards and fare products*
    - *New equipment to accept credit/debit payment and MTA Card 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, MTA Card and NFPS customer service channels*
    - *NFPS call center will be new*
    - *MTA Card call center will be new*

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 MTA Cards 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.*
    - 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 MTA Card processes*
        - *Possible new interfaces with MTA Card provider*
- Other customer- and external organization-interfacing employees
    - MNR/LIRR Employees.
        - *No joint ticketing, but training required for selling MTA Cards and information on NFPS generally.*
    - Non-Employees
        - *Inform of MTA Card replacing current media*
    - Retail merchants (MTA Card sales and reload).
        - *Significant change to sell MTA card and reload MTA Card 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 electronic funds transfer from employers to MTA stored accounts. Use employee ID/PIV card if available, or transit provider issued contactless card or MTA Card. Encourage providers to issue contactless cards that can be accepted in NFPS.*
    - Employers and schools
        - *Informed of MTA acceptance of PIV cards. Encourage employers to issue contactless employee ID/PIV cards.*
        - *MTA may support PIA product purchase via employer/school EFT for MTA Cards held by employees or students*
        - *MTA may market this option strongly*
    - Bank and bankcard 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 authentication server maintainers.
        - Today, it takes 30 days to change 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*
    - *MTA Card 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 MTA Card 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 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 MTA Card provided by MTA Card 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*
    - Financial risk management and fraud detection (transaction risk, card abuse)
        - *Changed from MetroCard to bankcards and MTA Card*
        - *Will have new types and new levels of potential risk to monitor and prevent*
    - Police enforcement (MetroCard squad)
        - *Changed from MetroCard to bankcards and MTA Card*
    - 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 MTA Card. Or possibly have emergency personnel IDs (for NYPD and NYFD) 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 MTA Card.*
- 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 bankcards may be accepted in future (for instance, NJT, PATH, Connecticut Department of Transportation (bus only), and Amtrak):
    - *Provide added customer convenience; provide opportunities for joint marketing.*
- Other operators and transportation or non-transportation organizations that decide to accept bankcard 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 cards 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.
Authentication	The process that determines whether a tap from a card is accepted or denied based on a series of checks. These checks could include: checking a card against a deny list that consists of card numbers that have been reported lost, stolen, or have been flagged for suspicious activity; checking a card against an accept list for customers with prefunded 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
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 pre-funded fare products, and/or at other times to be determined.
Bankcard	An ATM, credit or debit card issued by a bank.

Billing Server	The NFPS processor 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 may 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 will be an application on the NFPS on-bus terminal.
Card	A contactless payment card meeting 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 MTA Cards. It is assumed that in the near future various form-factors are likely to become common such as NFC phones or key fobs.
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 consumer, initiated by the consumer's issuing bank. Specifically, it is the reversal of a prior outbound transfer of funds from a consumer's bank account, line of credit, or credit card. A transaction that has been disputed by the cardholder 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 transaction details 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	A chip and antenna enabled method in which data communication between an object and a reader occurs with radio frequency waves between the two.
COTS	Commercial off the shelf hardware or software products that are readily available for purchase and use without modification.
Credit Card	A plastic 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 consumer (or the user) from which the user can borrow money for payment to the merchant as or as a cash

	advance to the user.
Dashboard	Generally, a graphical display of important system metrics. As an example the NFPS dashboard might display the number of active system readers or the status of a network segment.
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 plastic card that provides an alternative payment method to cash when making purchases. Functionally, it can be called an electronic check, as the funds are withdrawn directly from either the bank account or from the remaining balance on the card. 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 bearer's bank account instead of having the bearer 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. Cards can be on Deny Lists due to being lost or stolen. Cards may also be declined for accounts with insufficient funds. This list is provided to the MTA by the payments industry. The MTA may update this list 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 ride 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 database 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 web-enabled computer terminal for customer use in NYCT subway stations and/or external merchant locations to buy fare products or reload MTA Cards 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.
MTA Card	A card issued by MTA that will be initially usable only at MTA readers. Card will be available to unbanked customers, banked customers without contactless cards, or customers who prefer not to use their credit or debit cards.
NFC	Near field communications, a short-range high frequency wireless communication technology which enables the exchange of data between devices over an approximately 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 restrictions limit the number of times a single card can be used at one station or bus service and is a part of authentication process.
PAYG	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 authentication 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 and tap capturing, 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 exchanging of data or funds 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, a paper ticket for single ride use. Value cannot be added to it.
Stored Account	Server based electronic storage of data related to card use in NFPS system, including purchased fare products, and other transaction information.
Tap	The act of bringing a card into close proximity with a Reader to initiate the payment and entry process.
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.

Appendix 2: Referenced Documents

1. Rapid Development. McConnell, Steve. Redmond, Washington: Microsoft Press, 1996.

2. "Systems Engineering Guidebook for Intelligent Transportation Systems, Version 3.0." U.S. Department of Transportation, Federal Highway Administration, California Division ITS website. November 2009 http://www.fhwa.dot.gov/cadiv/segb/

3. "MetroCard Guide." MTA New York City Transit. Undated.

4. MTA funded fare payment technology studies. 2008-2009.

5. MTA Capital Program documents
    a. MTA Capital Program 2005-2009.
    b. MTA Capital Program 2010-2014.
    c. Twenty Year Capital Needs Assessment 2010-2029.

6. NYCT Phase II Smart Card Pilot, June 1, 2010 to November 30, 2010.

7. U2 Labs International Umit Uyar/Nicholas Maxemchuk/Columbia University and City College of New York Student Interns Research Reports.
    a. Summer 2010
        - "Project 1: Providing Cell Phone Service on MTA Subways Using Wireless Mesh Network Final Report." August 26, 2010
        - "Project 2: Providing Real-time Contactless Bank Card Fare Collection System for MTA Buses Final Report." August 31, 2010
        - "Project 3: Providing Dead Reckoning to Determine Location of Buses, Final Report." August 31, 2010

    b. Fall 2010
        - "Project 1: Analysis of Contactless Bank Card Fare Collection Procedures for MTA Buses and Subways." December 30, 2010
        - "Project 2: Analysis of Wireless Mesh Networking in Above-Ground and Mid-Level Subway Platforms for Fare Collection and Security Applications Final Report." December 25, 2010

8. "MTA Bus Customer Information System Pilot Concept of Operations." Frumin, Michael and Kocur, George. MTA. 12/27/10

9. "Bus Customer Information Systems Concept of Operations." Nair, Sunil. Frumin, Michael and Neiger, Bruce. MTA. 4/1/11

10. “Make Every Dollar Count”, MTA. January 2010.

11. “Make Every Dollar Count; Agenda 2011”, MTA. January 2011.

12. “MTA New Fare Payment Systems Bus Reader and Security Requirements.” Kocur, George. Paul, Elizabeth. Greenfield, Larry and Smuglin, Len. MTA. 3/31/2011.

13. Regulation/Industry Standards Compliance

NFPS shall be developed in accordance to the latest version of indicated standards, including but not limited to the ones listed below. Note that the dates listed are for reference and may not be the latest version.

- **Americans with Disabilities Act**.
  - ADA Standards for Accessible Design, 28 CFR Part 36, July 1, 1994
- **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
  - **ISO/IEC 14443-1**:2000 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 1: Physical Characteristics
  - **ISO/IEC 14443-2:**2001 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 2: Radio frequency power and signal interface
  - **ISO/IEC 14443-2**:2001/**Amd.1:**2005(E) Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 2: Radio frequency power and signal interface; **AMENDMENT 1**: Bit rates of fc/64, fc/32 and fc/16

- **ISO/IEC 14443-3**:2001 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 3: Initialization and anti-collision
- **ISO/IEC 14443-3**:2001/**Amd.1**:2005(E) Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 3: Initialization and anti-collision; **AMENDMENT 1**: Bit rates of fc/64, fc/32 and fc/16
- **ISO/IEC 14443-3**:2001/Amd.1:2005 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 3: Initialization and anti-collision; **AMENDMENT 1**: Bit rates of fc/64, fc/32 and fc/16 **technical corrigendum 1**
- **ISO/IEC 14443-3**:2001/Amd.3: 2006 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 3: Initialization and anti-collision; **AMENDMENT 3**: Handling of reserved fields and values
- **ISO/IEC 14443-4**:2001 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 4: Transmission protocol
- **ISO/IEC 14443-4**:2001 Identification Cards – Contactless integrated circuit(s) cards – Proximity cards – Part 4: Transmission protocol; AMENDMENT 1: Handling of reserved fields and values
- **ISO/IEC 18092-1:** 2004 Information Technology – Telecommunication and information exchange between systems -- Near Field Communication –Interface and Protocol (NFCIP-1)

- **PCI Standards**
  - **Payment Card Industry (PCI) Data Security Standard (DSS)**, Requirements and Security Assessment Procedures, Version 2, October 2010
  - **Payment Application (PA) Data Security Standard (DSS)**, Version 2, October 2010
- **Bankcard association standard**
  - MasterCard, Visa, AmEx and Discover reader type certification standards
  - EMV reader type certification standards
  - Payments 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.

1.0 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 fare box 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, Duchess, 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 Railroad (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 7.9 million customers on average each weekday. The subway system includes 25 lines, 468 stations, and approximately 6,200 subway cars (the largest subway car fleet in the world). The subway system carries 5.1 million passengers a day. NYCT bus system includes about 210 local and 30 express bus routes, and approximately 4,700 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 2.3 million passengers on average each weekday. Annually, the subway provides 1.6 billion rides and the buses 726 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 14,750 passengers on average each weekday. 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. 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 who wish to pay with cash in the future will only 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.

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 is available at NJT Ticket Vending Machines at HBLR stations.

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

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.

2.0 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' on-line 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 on-line, 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 the CSA, who releases the gate so the entire group can enter the system together.

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 validly) to approximately 900,000 New York City students for transportation to and from school. The program is administered thought 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.

3.0 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 on-line 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

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 MetroCard Field Maintenance

MetroCard field maintenance activities employ people who are responsible for the installation, testing, maintenance and repair of NYCT automated fare collection equipment, bus radio system and bus destination signs.

MetroCard Field 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.

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

MetroCard field 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.

MetroCard field 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. Making extensive use of automated Bench Test Equipment (BTEs) and Portable Test Equipment (PTEs), they repair over 35,000 of these modules ad components annually.

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 it 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 on-line 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 on-line MetroCard claims system to automate a portion of the claims process. The MetroCard Customer Claims Unit relies on the following systems:

- CID – Filmaker Pro Customer Information Database - being replaced by ICES SQL web-based system in 2010
- 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 backoffice/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, on average EasyPay added 1,100 reduced-fare customers, 984 Pay-per-ride customers and 360 30-Day Unlimited customers. EasyPay advances MTA's Go-Green Campaign because the number of paper statements mailed monthly have 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 on-line.

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., hotlisting, 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 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).

4.0 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 at 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 authentication 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
- manage preventive maintenance of AFC vending equipment
- 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/RDP – Windows

- 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
- effect preventive maintenance of vending equipment
- 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, on-line and through other means. BAMS handles all of the MTA's credit/debit (Cr/Db) 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 On-line 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 on-line 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 card and ATM/debit card transactions that originate from the vending machines are submitted to the clearing house via batch file processing for ultimate fund settlement with the credit ATM/debit card issuers and payment to the NYC Transit.
Authorized and completed credit card and ATM/debit 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.

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 and are included in the daily settlement file and which are netted against sales transactions.

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 (2009)
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 (2009)
Using sales figures as a surrogate for cards issued, there were about 103 million MetroCards issued (initial sales) through vending machines and station booths.

- There were about 86 million add-value transactions through vending machines and station booths.
- There were about 45 million Single Ride Tickets issued through vending machines.
- There were almost 33 million pre-valued cards issued through the merchant sales network, railroads & EasyPay.

Annual sales by payment method (2009)

- MetroCard Sales were $3.3 billion in 2009
    - $1.3 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 $0.1 billion
- Note: The acceptance of Electronic Benefit Transfer (EBT) cards at vending machines started in October 2010.

Annual NYCT sales revenue by fare category (2009)

- Time-based passes: $1.337 billion
- Value-based passes : $1.207 billion
- Non-discounted fare: $0.311 billion
- Single Ride Ticket: $0.093 billion
- Half-fare students: $0.004 billion
- Cash on Bus: $0.113 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 Fare Boxes (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.

5.0 Types of Access to NYCT Subway System

Types of Access		Description	Current Inventory
Tripod Turnstile		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. 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.	3,153
High Entrance/Exit Turnstile (HEET)		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. 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.	600

Autonomous Fare card Access System (AFAS)		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. 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.	348
Service Gates (No payment at gate)		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 the adjacent turnstile and turn the tripod. The station agent/clerk releases 33the 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.)	1,407
Station Agent		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	N/A

	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.	
Non-Fare Payment Card Users		
(A) Unrestricted Non- Revenue Access	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.	Approx. 77,500 passes in use
(B) Restricted Non-Revenue Access : Contractors/Vendors, 3rd Party Maintainers, Contractor & Supplies	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.	# of Restricted Passes Issued Per Month = Varies over time
(D) Emergency Personnel & Response	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.	54,775

Appendix 4: Acronyms

Term	Definition
3G	Third Generation
4G	Fourth Generation
ADA	Americans with Disabilities Act
AFAS	Autonomous Fare Card Access System
AFC	Automated Fare Collection
ATM	Automatic Teller Machine
B&T	Bridges and Tunnels
BCC	Bus Command Center
CIS	Customer Information System
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
MaBSTOA	Manhattan and Bronx Surface Transit Operating Authority
MEM	MetroCard Express (Vending) Machine
MMS	Maintenace Management System
MNR	Metro-North Railroad
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
PA DSS	Payment Application Data Security Standard
PAN	Primary Account Number
PATH	Port Authority Trans Hudson
PAYG	Pay As You Go (fare)

PCI DSS	Payment Card Industry Data Security Standard
PIA	Pay-in-advance (fare)
PIN	Personal Identification Number
PIV	Personal Identity Verification
POS	Point of Sale
SBS	Select Bus Service
SIR	Station Island Railway
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 Transporation
CFC	Coin Fare Collectors used on Select Bus Service (SBS)
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, Department of Subways (NYCT)
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	On-line 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