IN YOUR POCKET:
USING SMART CARDS FOR SEAMLESS TRAVEL

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

With automated fare collection equipment that was widely installed in the 1980's and 1990's rapidly approaching the end of its useful life, many transit operators now have an opportunity to benefit from new technologies in their fare collection systems. One such technology is the smart card, which in most transit applications is a semi-rigid plastic card, similar to a credit card, containing a microchip that stores value or user account information. Because of the microchip's capabilities and its compatibility with wireless technology, smart cards are a major advance over magnetic stripe technology and hold the promise of greater convenience for transit users and more efficient operations for transit agencies. Smart cards can streamline fare payment, reduce customer service, administrative and maintenance costs, increase throughput, and decrease bus dwell times for transit operators. Non-transit applications of smart cards may also generate income for transit operators.

The commitment to implement a smart card fare collection system is complex and requires a number of specific decisions. Prior to confronting hardware and operational issues, a transit operator must make a fundamental decision whether it will be:

1) The sole issuer and acceptor of its proprietary fare media,
2) A partner with a co-issuer of fare media,
3) An administrator of a payment program that accepts fare media issued both by itself and by others, or
4) A merchant accepting media, such as credit card based or linked smart cards, for fare payment.

Detailed technical and operational planning can proceed only after this fundamental issue is resolved.

Planning Resources

Although MTA has yet to test the use of smart cards for fare payment under real-world conditions despite funding allocated for a pilot study in its 2000-2004 Capital Program, the agency has a wealth of experience that it can use in planning to include smart cards in an automated fare collection system. The *EZPass* system is essentially similar to a smart card based fare collection system, and MTA New York City Transit's Reduced Fare Mail and Ride program follows the model of an account-based smart card fare collection system, albeit using magnetic stripe fare media. Trials of smart card based credit and debit card systems by MasterCard (PayPass) and American Express (ExpressPay) are sources of case studies of smart card based retail payment and could prove valuable as elements of a transit fare payment pilot study. MTA can also draw upon the experience of the I-95 Corridor Coalition and the Transportation Operations

Coordinating Committee (TRANSCOM) as examples of the operation of regional transportation improvement initiatives.

Most directly relevant to planning, however, is the experience of other transit operators in implementing a smart card based fare collection system. While much of the early use of smart card transit fare media occurred outside of the United States, several domestic transit operators now have experience with administering smart card fare collection systems. We examined systems in Chicago (*Chicago Card/Chicago Card Plus*), San Francisco (*TransLink*), and Washington D.C. (*SmarTrip*) to formulate the recommendations contained in this paper. In addition, MTA can consider the experience of the Port Authority of New York and New Jersey as it implements the *SmartLink* smart card, which will be a part of its next automated fare collection system. A summary of the characteristics of smart card programs examined is contained in Table 1, below.

Permanent Citizens Advisory Committee
Table 1
Comparison of Smart Card Programs

Agency	Port Authority of New York and New Jersey (PANYNJ)	Metropolitan Transportation Authority (MTA)	Chicago Transit Authority (CTA)		Metropolitan Transportation Commission [San Francisco Bay Area] (MTC)	Washington Metropolitan Area Transportation Authority (WMATA)
Card Name	SmartLink	None	Chicago Card	Chicago Card Plus	TransLink	SmarTrip
Smart Card Start Date	2001-2005 (Pilot)	None	2002	2004	2002	1999
# of Transit Agencies To Be Linked with Smart Card	2	N/A	3	3	26	16
Transportation Modes in Phase 1 Pilot Tests	Monorail (AirTrain Newark), NJT Commuter Rail	N/A	Subway, Bus	N/A	Subway, Bus, Ferry, Commuter Rail	Subway
Can Parking Fees Be Paid with Smart Card?	No	N/A	No	No	Yes	Yes
Automatic reload: customer's credit card charged a predetermined amount when card account balance falls below specified value.	Yes	N/A	No	Yes	No	No
Guaranteed Last Ride Feature: Allows customers one last ride with any value remaining on the card.	No	N/A	Yes	Yes	No	No
Are Smart Card Distribution, Customer Service, and Reconciliation of Revenues Outsourced?	No	N/A	No	No	Yes	Yes
Can the Card Be Purchased Online?	No	N/A	Yes	Yes	Yes	Yes
Can the Card's Value Be Reloaded at Retail Outlets?	No	N/A	No	No	Yes	Yes*
Current Smart Card Uses	Monorail (AirTrain Newark), NJT Commuter Rail	N/A	Subway, Bus	Subway, Bus	Bus, Commuter Rail, Light Rail, Ferries	Parking, Subway, Bus
Next Steps	Implement on PATH service. Outsource smart card revenue allocation functions. Formalize operating rules and procedures for revenue sharing. Investigate partnerships and business opportunities to recover smart card costs.	N/A	Focus on building greater interest in the Transit Benefit program and increasing the distribution of the Chicago Card and Chicago Card Plus with the current functionality rather than adding other features to the cards at this time.		Enable customers to travel on any system without purchasing a particular type of pass. Make smart cards available at hotels by connecting it to guests' room keys.	Offer limited-use disposable smart cards to serve the infrequent user. Transfer the transit card application, payment, and customer service activities to a WMATA contractor or financial institution who can issue a card for use in the Metro system.
Available to Visitors for Purchase for Short-Term or	N/A	N/A	No	No	No	Yes

* Available at WMATA's Retail Stores Located Within the System

ii

FINDINGS

Smart Card Programmatic Features

CTA in Chicago, MTC in San Francisco, and WMATA in Washington, D.C have used a layering approach to employing smart card technology in their transit systems, continuing to offer magnetic stripe fare cards to customers along with other fare payment options and programs, such as special daily, weekly, and monthly passes and individual pay-per-ride fares. Each of these agencies chose to pilot test and initially implement its smart card program in a subway system, while MTC and CTA also implemented smart card fare payment on some bus lines in the first phase of implementation, and MTC chose to accept smart cards on ferry and commuter rail services in the first phase.   Smart cards have also been accepted by WMATA for payment of charges at its parking facilities and by MTC at electronic parking meters in San Francisco.

The three agencies differ in their distribution, customer service, and revenue accounting procedures. Unlike MTC and WMATA, CTA has chosen to process its smart card transactions internally instead of outsourcing smart card distribution, customer service, and reconciliation of revenue receipts. CTA also offers an interesting feature in its *Chicago Card Plus* program, where customers can elect automatic reloading features that guard against being left with a valueless card. The cards also include a "guaranteed last ride" function that provides one last ride as long as there is any value left on the card, with the resulting negative balance resolved when value is added to the card.

In addition to the ability to purchase the *TransLink* card online, MTC plans to offer customers the option of reloading value on their smart cards at participating retail outlets. WMATA's *SmarTrip* card is available for purchase online as well as in WMATA's retail stores located within the system, which makes the card available to visitors for short-term or infrequent use. CTA's *Chicago Card* and *Chicago Card Plus* are not available for purchase at retail outlets. MTC is exploring the possibility of making smart cards available at hotels for visitors to use for local and regional transportation.

Lessons Learned

CTA, MTC and WMATA recommend the following, based on their experience with implementing smart card technology:

- When developing the regional fare collection system, develop and resolve the procedures and policies for processing various agency transactions and distributing revenue prior to implementing the smart card program systemwide.
- A standard interoperable operating system and a smart card having common radio frequency identification (RFID) capabilities enable transit agencies to better

accommodate and integrate different fare media systems developed by multiple vendors.

- Smart Card systems requiring relatively little data processing at the point of payment are faster and less subject to operational difficulties than more data processing intensive systems. Since speed is a primary benefit of using contactless smart cards, the design of the farebox or turnstile portion of the fare collection system should lean toward simplicity.
- Maintaining the project schedule is a challenge. Coordinating and integrating the work of more than one contractor makes the implementation process more difficult.
- Sufficient staffing is necessary to carry out a smart card program.
- A project manager from each participating agency in a smart card project should be responsible for project implementation at that agency.
- Training for front line and other agency personnel should focus on information that employees need to properly respond to customers and to do their jobs. Training should not only focus on operation of equipment.
- Clear and concise customer information, such as explanations of options available for riders, is critical to minimize customer confusion.
- Different marketing approaches are needed to make the public aware of the smart card program and to educate the public about its operation.
- Participating agency departments and systems must be ready before introducing the smart card program to the public.

Benefits Realized

CTA, MTC and WMATA have received or anticipate the following transit system benefits due to the transition to smart card automated fare collection technology:

- Lower fare card equipment and turnstile maintenance costs.
- Faster customer boarding times with contactless smart card technology, improving overall service delivery.
- Automated reload and recharge capabilities via the Internet, telephone, and credit card link purchase options increase customer convenience and encourage system ridership.
- Additional ridership data will allow planning operations to more accurately address customer travel patterns and conserve agency resources.
- The ability to use one card on multiple transportation modes saves the customer time used to research travel information and purchase individual tickets.
- Smart card technology enables transit agencies to better control, monitor, and influence ridership patterns through congestion pricing techniques.
- Outsourcing smart card procurement, distribution, and clearinghouse functions streamlines agency system operations and financial accounting and reduces the amount of cash handled by agency personnel.

RECOMMENDATIONS

Managing New York City's multi-modal transportation systems is a regional issue. The growth and interdependency of local and state economies within the New York region extends beyond geographic boundaries and spurs the need for an integrated seamless regional transportation network. The success of *EZPass* is evidence of the benefits of a customer driven, agency improved transportation management system.

The use of smart card technology to integrate regional transportation systems is a 21st century solution to meeting growing consumer demands for ease of mobility, convenience, and speed. Public transportation is key to economic growth in the New York region and must adapt accordingly to meet the needs of its users.

Governing Principles

The actions of the Metropolitan Transportation Authority and its operating agencies in planning for and implementing an automated fare collection system that uses smart card technology should be governed by several principles reflecting the state of technology and current operations. These principles include the following:

- The most prudent course of action in implementing new technology and practices is to proceed in a way that preserves flexibility to adapt to changing conditions. Technology and institutional arrangements in the smart card field and the financial services industry are rapidly changing. Solutions that require large irreversible commitments of resources should be pursued only where the case for these solutions is extremely compelling.
- While smart cards can be an important part of MTA operating agencies' fare collection systems, they will not be a total fare collection solution. For example, MetroCard has been implemented on all MTA NYC Transit subway and bus lines for more than seven years, but a proportion of riders prefer to pay fares in cash. Despite considerable discounts available to MetroCard purchasers, many riders continue to use single ride tickets on the subways and would probably be using tokens if it were still possible. The MTA should not expect these riders to readily accept smart cards for fare payment.
- Establishing an entirely new fare collection system is difficult, costly, and in a system as large and complex as MTA, probably completely impractical. MTA should leverage its resources to introduce smart card technology into its existing automated fare collection systems.
- The incremental cost of adding smart card technology to the replacement or upgrade of an automated fare collection system is minimal, compared with a stand-alone project to add smart card functionality to the fare collection system. The introduction of a smart card should therefore be coordinated with planned fare collection system improvements, when possible.
- The expected cost of a smart card system, including both initial capital and life cycle costs, is a primary consideration. While costs must be balanced against

factors such as customer convenience, risk, and compatibility with existing practices and systems, it must be recognized that if fares can be collected more efficiently, this will free additional resources for MTA to provide vital services.

The following recommendations suggest means by which the Metropolitan Transportation Authority and its operating agencies- New York City Transit, Long Island Rail Road, Metro-North Railroad and Long Island Bus- should initiate the planning and implementation of smart card technology.

Metropolitan Transportation Authority (MTA)

As the umbrella organization, the MTA sets policy for and issues directives to MTA operating agencies. The following recommendations are made to further the MTA's development of a smart card program among its operating agencies.

- **Make smart card an MTA priority.** Initiating a transition to smart card technology requires that the MTA make the development of a smart card program a priority. Adequate funds should be allocated to the MTA and its operating agencies in the 2005-2009 Capital Program to cover development, implementation, and evaluation of a smart card pilot program, the acquisition and upgrade of necessary automated fare collection equipment, and smart card technology support services.

- **Create an MTA interagency task force to develop an MTA strategy and plan for implementing smart card technology systemwide**. MTA's first efforts toward smart card interoperability should focus on providing seamless transitions between separate MTA operating agencies. An interagency task force should be created to research smart card technology options and develop an MTA agencywide plan for a regional smart card program. The task force should also include representatives from MTA Bridges and Tunnels (B&T) to build upon its experience with *EZPass*. Key issues to be discussed and determined should include, but not be limited to:

  - *Clearinghouse functions.* Undertake discussions and make decisions about how MTA will distribute smart cards, provide customer service, and resolve agency revenue receipts and transfers. Investigate opportunities for partnering with the financial services industry as a part of the discussion and decision making process. MTA should investigate using its relationship with JPMorgan Chase Bank, which is interested in exploring the uses of smart cards and administers the MetroCard Mail and Ride program, as the basis for a pilot study of smart cards in the MTA network.
  - *Fare policies.* Undertake discussions and make decisions about how the MTA will handle intra- and inter-agency fare structures.
  - *Smart card specifications.* Undertake discussions and make a decision to accept specifications compatible with the Regional Interoperability Specification (RIS) being developed by PANYNJ and other area transportation providers.

- o ***Smart card type interoperability***. Undertake discussions and make a decision to install smart card readers complying with ISO Standard #14443 in MTA fare collection systems to provide for interoperability with multiple smart card systems.
  - o ***Agency specific plans.*** Develop guidelines and direct all MTA operating agencies to develop agency specific plans in conjunction with an MTA overall strategy.
  - o ***Smart card pilot program.*** Plan for a six-month to one-year smart card pilot program to test smart card technology and operations on the MTA system. A first smart card pilot should include segments of NYC Transit subway and bus systems. As plans are developed, additional pilot programs should be conducted on the LIRR, MNR and Long Island Bus.
  - o ***Opportunities for smart card integration with EZPass***. Identify the potential MTA and regional transportation system benefits and disadvantages and logistics of integrating public transportation smart card technology for use with MTA Bridges and Tunnels' *EZPass* program.
  - o ***Opportunities for inter-agency smart card procurement opportunities, where applicable.*** Investigate opportunities for joint procurement of smart card technology among the MTA operating agencies, where applicable, to reduce capital costs.
  - o ***Training for front line and other agency personnel.*** Plan for appropriate and extensive training for front line and other agency personnel that focuses on interacting with the public regarding smart card issues as well as performing job functions. Develop guidelines and direct all MTA operating agencies to develop agency specific training, as necessary.

- **Continue involvement in the Regional Interoperability Standard process.** The interagency task force discussed above should also maintain regular contact with the Port Authority of New York and New Jersey, New Jersey Transit and Regional Interoperability Standard (RIS) working groups to ensure that MTA smart card strategies are consistent with those planned for other regional transportation systems. Where modifications to the RIS are needed to maintain compatibility with current or potential future MTA systems, MTA should propose that those modifications be made.

- **Consider including specific smart card programmatic elements, such as an automatic reload or negative balance feature that either maintains a minimum level of funding in the account or allows riders to charge a last trip to a card having remaining funds.** MTA should consider incorporating these two features into any program where MTA is an issuer or co-issuer of a smart card. CTA's *Chicago Card Plus* provides an automatic reloading feature that allows customers to charge a user-determined amount to their credit or debit card accounts each time that the card balance falls below $10. The $10 threshold provides a minimum balance on the card during the 24-hour period it takes to process a credit card transaction. The *Chicago Card* also provides a "negative balance" feature that allows the card to carry a negative balance up to the value of a single ride to allow

for a last ride, as long as there is some value remaining on the card. The next time value is added to the card, the amount of the negative balance is deducted.

- **Adopt an MTA authoritywide smart card technology plan and implementation schedule and an associated capital budget.** Once the interagency task force has developed an overall plan for a regional smart card program, the MTA should adopt the plan with an earmarked capital budget for implementation.

- **Develop smart card program customer information, education and marketing campaigns for MTA and its individual operating agencies.** The MTA should investigate and learn from CTA's, MTC's and WMATA's experiences with smart card public information efforts for use in developing campaigns to provide customer information and smart card program customer education as well as to market the program.

New York City Transit (NYC Transit)

- **Make a smart card automated fare collection upgrade a priority for the subway and bus systems.** The subway and bus automated fare collection (AFC) equipment has reached the midpoint of its expected operational lifespan. NYC Transit should plan now for a system upgrade that includes smart card capability. The estimated cost to upgrade the NYC Transit bus and subway AFC systems with new equipment, computers, databases and other required elements is about $90 million. The cost of adding smart card capabilities to subway communications, station computers, area controllers, and bus fare boxes is negligible; the system upgrade accounts for the bulk of the cost. It therefore makes sense to include smart card functionality as part of the upgrade.

  An upgraded AFC system could easily be compatible with both magnetic stripe cards and smart cards. NYC Transit should retain magnetic stripe technology to allow use by visitors and infrequent riders, accommodate customer preferences, and provide flexibility.

- **Conduct a time sequence study to compare smart card and magnetic stripe fare card (MetroCard) bus loading and trip time reductions for articulated buses.** One significant disadvantage of articulated buses is the length of time required to load passengers, which results in increased bus dwell times. Smart cards can reduce loading time and make articulated buses more efficient. NYC Transit should undertake a pilot study to investigate ways in which smart card technology can improve the performance of articulated buses on high volume routes.

MTA Railroads – Long Island (LIRR) and Metro-North (MNR)

- **The LIRR and MNR should begin planning for smart card.** LIRR and MNR have yet to begin thinking seriously about the use of smart card technology. Studies and agency plans should be developed in conjunction with the MTA and NYC Transit to

ensure that any system installed addresses regional transportation considerations and provides MTA with interagency interoperability capabilities.

- **Conduct research on smart card automated fare collection systems in use or being planned by other railroad systems.** Three railroad systems are currently conducting pilot programs or are in the process of planning or implementing a smart card program. The Port Authority of New York and New Jersey has a pilot program testing the use of a smart card monthly pass at the Newark International Airport Station on the New Jersey Transit Northeast Corridor Line (AirTrain Newark). The Port Authority Transportation Corporation (PATCO) Lindenwold line, between New Jersey and Pennsylvania, has released a Request For Proposals (RFP) for a system upgrade of its automated fare collection system including smart card capability. Chicago's Regional Transportation Authority (RTA) is currently beginning planning to introduce smart card technology on the Metra commuter rail system. MTA's commuter railroads should monitor these efforts and use the results in planning for smart card implementation.

Long Island Bus (LI Bus)

- **Make a smart card automated fare collection system a priority for the Long Island Bus system.** LI Bus should undertake planning studies and agency plans for implementing smart card in conjunction with the NYC Transit Department of Buses to ensure that regional transportation considerations are addressed and MTA interagency interoperability capabilities are provided. LI Bus should discuss research and strategies with the NYC Transit Department of Buses to capitalize on NYC Transit's information resources and to promote interoperability between LI Bus and NYC Transit fare collection systems.

INTRODUCTION

With automated fare collection equipment that was widely installed in the 1980's and 1990's rapidly approaching the end of its useful life, many transit operators now have an opportunity to benefit from new technologies in their fare collection systems. One such technology is the smart card, which in most transit applications is a semi-rigid plastic card, similar to a credit card, containing a microchip that stores value or user account information. Because of the microchip's capabilities and its compatibility with wireless radio frequency identification (RFID) technology, smart cards represent a major advance over the magnetic stripe technology used in MTA's MetroCard system.

Smart card technology holds the promise of greater convenience for transit users and more efficient operations for transit agencies. Transit riders can pay fares by merely placing a smart card, which may not need to be removed from a wallet, holder, or handbag, adjacent to a card reader. Riders need never worry about purchasing additional fares, since the card's value can be automatically recharged through links to a credit card or bank account, and the value can be protected against loss if the card is misplaced or stolen. Riders who use more than one transit system can be freed from having to manage multiple fare media when smart cards are implemented through an areawide consortium of transit operators. For the consumer, smart cards can remove many of the worries and frustrations that reduce satisfaction with using transit.

Transit operators can also benefit from introducing smart card technology through lower customer service, administrative, and maintenance costs. Readers for contactless smart cards, which are generally preferred for transit applications, have no moving parts and much lower maintenance costs compared with magnetic stripe card readers. Smart cards can reduce handling expenses associated with the collection of cash fares and, because of the ease of recharging the card using a vending machine, over the Internet, or automatically through a linked bank or credit card account, can reduce sales costs for fare media. Where multiple transit operators accept a common smart card, automated systems can reduce the cost of revenue accounting and payment settlement among participating agencies. While they are relatively expensive per unit, smart cards' longer useful life makes their per ride costs competitive with other fare media.

Smart cards can also save transit operators money by increasing throughput and reducing bus dwell times through the cards' "touch and go" passenger interface. Transit fare payment with a contactless smart card takes about 150 milliseconds, or less than one-sixth of a second, compared with about one second with a magnetic stripe card.[1] Smart cards are more difficult to alter or duplicate than magnetic stripe fare media, reducing losses due to fraud, and the data storage and computational capabilities of smart cards can help transit agencies generate detailed and reliable ridership data.

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[1] Davis, Donald "The Contactless Wave", *Card Technology*. January 2003, p. 33.

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In addition, smart card issuers can receive transaction fee revenue where the card is used for non-transit applications, such as parking or making small purchases of goods or services. The volume of non-transit transactions can be considerable; for example Hong Kong's Octopus transit smart card system generates 25 percent of its transactions through retail uses not related to transit.[2] The operators of the Octopus system earn a one percent fee on non-transit transactions, but it remains to be seen whether a similar system implemented in the United States would be adopted as readily by merchants and consumers, since many consumers carry credit and debit cards.

Institutional Framework for a Smart Card-Based Fare Collection System

While riders will be most immediately affected by the fare media and readers that are chosen for the system, the selection of an institutional framework supporting a fare collection system is perhaps of greater importance to the success of the system than the choice of hardware to be used. Within this framework, the transit operator can assume one of four basic roles. The operator can be:

- The sole issuer and acceptor of its proprietary fare media. In a variation on this role, the operator can be the sole issuer of fare media for its system, but arrange for other transportation providers to accept its fare media and to receive payment for trips made. NYC Transit assumes this role with respect to the MetroCard system;

- A partner with a co-issuer of fare media, which may be available for non-transportation uses. In this role, the transit operator shares the risks and rewards associated with the venture. A number of proposed fare collection systems that include financial institution partners and the use of fare media for small retail purchases give the transit operator this role;

- An administrator of a payment program that accepts fare media issued both by itself and by others. In order to be accepted the media issued by others must meet specified technical requirements, and its issuers must agree to financial and operational arrangements for the settlement of charges incurred by riders. A transit operator taking this role would be similar to a member of the *EZPass* Interagency Group, where a number of agencies issue transponders that are accepted for payment by other agencies according to the terms of their payment program;

- A merchant accepting media, such as credit card based or linked smart cards, for fare payment. In this role, the transit operator is freed from much of the responsibility of operating a fare collection system. The operator must maintain smart card readers and submit charges for payment in a manner acceptable to the card issuer, but as long as

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[2] Smart Card Alliance, **Transit and Retail Payment: Opportunities for Collaboration and Convergence.** October 2003. Publication Number PT-03005, p. 19.

procedures are followed, the operator is guaranteed payment for each ride. In exchange for this level of convenience, the operator typically pays the card issuer a fee amounting to between 2 and 4 percent of each charge. In the merchant role, the transit operator functions as a retailer selling transportation.   No transit operator is currently accepting credit card based smart cards, but the Valley Metro (Phoenix, Arizona) transit system accepted major credit and debit cards for on board fare payment from 1995 to 2003.[3]

In planning to include smart cards in an automated fare collection system, it is important to enter the process without preconceived ideas about the roles that MTA should assume. Because both technology and institutional arrangements are rapidly changing, the expected costs and benefits of each of these roles should be considered in the light of current and probable future conditions.

MTA Smart Card Resources

The EZPass System

A pilot project of limited scope and duration is often useful in testing a technology and deciding whether to proceed with full implementation of that technology. Despite an allocation of $32 million for a pilot study in its 2000-2004 Capital Program, the MTA has yet to test smart card transit technology under real-world operating conditions. MTA, however, has considerable experience with radio frequency identification (RFID) automated payment systems through MTA Bridges and Tunnels leading role in the *EZPass* program. Making some allowances for the differences between highway toll and transit fare collection, the *EZPass* experience can in a real sense be seen as a model for the implementation of smart card fare collection technology.

The launch of the *EZPass* program in 1990 introduced drivers in the New York region to an automated toll-payment system designed to allow cars to pass through area toll plazas faster. The *EZPass* program uses a battery-operated RFID device, or transponder, to transmit basic account information to a tollgate antenna. The motorist's toll is then paid by a debit to a prepaid account established for *EZPass* charges. The transponder may also be used for a limited number of non-toll applications, such as payment of parking charges and purchase of items at selected McDonald's restaurant drive-through locations. While its design reflects the specific requirements of a vehicle toll collection system, an *EZPass* transponder is functionally a smart card.

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[3] The program was halted due to concerns that the system's inability to perform real time payment authorizations created an unacceptable risk of fraud. This issue was discussed at the City of Tempe, Arizona Transportation Commission Accountability/Governance Committee meeting of May 4, 2004. Minutes of the meeting are available on the Internet at www.tempe.gov.

The *EZPass* program has increased tollgate throughput and driver convenience by reducing congestion caused by drivers scrambling for the exact toll amount or waiting for change. Although MTA Bridges and Tunnels has not yet implemented such a system, some *EZPass* agencies have installed equipment that allows tolls to be collected at highway speeds, further increasing throughput. As a result the travel experience for drivers as well as transportation agency operations in the New York region and beyond - from the Canadian border to West Virginia – has been transformed. Why shouldn't public transportation riders in the New York region be afforded the same convenience?

Mail and Ride Reduced Fare MetroCard

MTA NYC Transit also operates a reduced fare Mail and Ride program that, while it uses existing MetroCard magnetic media technology, is account based, allowing for automatic recharge from a credit or debit card or bank account and protection of balances when a card is reported as lost or stolen. The program is flexible, allowing users to add value to their accounts through credit or debit card, electronic transfer, check or money order. Monthly charges, except for express bus fares, are capped at $35.00, so in effect the Mail and Ride Reduced Fare MetroCard is either a monthly pass or a pay-per-ride card, depending on which is more advantageous to the rider.

The Mail and Ride Reduced Fare MetroCard operates in a manner similar to *EZPass* and is essentially a smart card based fare collection system without smart card technology. The MetroCard Mail and Ride program is administered by JPMorgan Chase Bank, which is also interested in exploring the use of smart cards. This relationship could serve as the basis for establishing a pilot study of smart cards in the MTA network.

Existing Payment Systems Using Contactless Smart Card Technology

Developing a dedicated smart card for transit payment is one way of taking advantage of the benefits of contactless smart card technology, but recent developments in the financial services industry point to another possible path. Over the last two decades credit card issuers have shown considerable interest in smart card technology. While much of this interest centers about the security, data storage, and computational capabilities of contact-based smart cards, other efforts have focused on the advantages provided by contactless cards.

Currently two credit card issuers are test marketing contactless smart card payment systems in the United States. MasterCard has introduced PayPass, which adds contactless smart card functionality to a magnetic stripe credit card, and is developing other form factors such as key fobs and mobile phones for PayPass. MasterCard International is seeking to have PayPass enter the transportation market and is willing to include a transportation fare application on PayPass. In addition, American Express is testing its ExpressPay key fob, which allows consumers to make small purchases by holding the ExpressPay card up to a reader at a checkout. It is also test marketing its

Blue with ExpressPay card, which is a magnetic stripe credit card incorporating smart card functionality.

The ExpressPay test is particularly interesting in that, while PayPass is linked to a MasterCard account, users can recharge an ExpressPay account through any major debit or credit card. Thus, ExpressPay users are not tied to American Express credit or charge cards, but can pay for purchases using debit or credit cards from a variety of issuers.

These payment systems settle charges submitted by merchants through processes developed for magnetic stripe cards. Each of these products is built around ISO (International Organization for Standardization) Standard #14443 for wireless data transmission. ISO Standard #14443 also forms the basis of the Regional Interoperability Standard for Electronic Fare Payment (RIS), developed under the leadership of the Port Authority of New York and New Jersey (PANYNJ) and adopted as a baseline for a national standard by the American Public Transportation Association (APTA). Assuming that one or more credit or debit card based payment systems are made widely available in the New York region, accepting these smart cards for fare payment, either as its sole or supplemental smart card fare media, is an option that MTA should consider.

Smart Cards and Regionalization

If public transportation in the New York region is to meet evolving needs for areawide mobility, it must operate under a regional umbrella rather than as a collection of isolated transit operators.   This will require not only conceptual changes, such as viewing success as meeting regional rather than agency-based performance objectives, but also changes in operations. An efficient regional public transportation system will include fare collection systems that provide seamless transitions between systems for riders while allowing efficient settlement of accounts among transit agencies. This regional perspective will require development of strong inter-agency collaborative partnerships, day-to-day working relationships, and systems for making transportation investments based upon regional needs.

A regional approach requires a new way of looking at transportation system performance operations and planning, including solving problems proactively, investing in customer focused projects, considering systems on a regional basis, serving riders twenty-four hours a day seven days a week, making use of a performance-based evaluation system to determine how well the system operates, being responsive to the customer, and providing and making use of real-time system information.[4]

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[4] Jeff Lindley, FHWA Office of Transportation Management. Remarks made at a panel discussion about lessons from the national arena at the conference, *Regional Partnerships in Transportation Technology, Learning from and Building upon Success*, sponsored by the NYU Wagner Rudin Center for Transportation Policy and Management, May 11, 2004.

A recent report by the Federal Highway Administration, U.S. Department of Transportation[5] identifies five key elements necessary to foster effective regional collaboration and coordination: an organizational structure for agency collaboration, documented processes for agency collaboration, a specified regional project to undertake, dedication of a combination of people, funding, and other resources to the project, and adoption of regional, customer-based performance objectives.

Several regional transportation initiatives have been undertaken in the New York region with great success. In addition to the *EZPass* program, the I-95 Corridor Coalition and the Transportation Operations Coordinating Committee (TRANSCOM) are regional highway and intermodal based initiatives aimed at making driving, rail and freight travel in the northeast corridor safer and more convenient. The I-95 Corridor Coalition is a thirteen-year partnership of transportation agencies that includes rail, freight, transit, law enforcement and U.S. maritime agencies. The Coalition deals with issues of congestion, mobility in rural areas, long distance travel, freight movement and emergency response and security through such activities as leveraging resources, coordinating project implementation on a regional basis, learning and sharing information and cohesive policy and planning.

TRANSCOM is a coalition made up of 17 member agencies and over 100 affiliated agencies with a focus on facilitating regional highway traveler and agency information. Projects have involved variable message signs, highway advisory radio, TRIP's 123 - an Internet based trip planning and information website, a video network among agencies to provide them with real-time visual incident information, and interagency construction coordination in case of accidents and traffic diversions.

Regional coordination is just as vital to public transportation as it is to highway transportation. Throughout the United States individual public transportation agencies have come together in regional collaborations. A major initiative that many of these collaborative bodies have undertaken is the standardization of fare media to allow riders to travel throughout the region using a single farecard. A common approach to fare media standardization has been the adoption of smart card technology. Thirteen cities in the United States have adopted contactless smart card fare media that use RFID to access funds stored in an electronic chip on the card or in an associated transit system database. These cards are used for travel on buses, subway, commuter rail, ferry and other modes of transportation.

This report examines the use of and plans for the implementation of smart card technology in the New York region by the Port Authority of New York and New Jersey and the Metropolitan Transportation Authority. It reviews the experiences of transit agencies in three cities in the United States – Chicago, San Francisco and Washington D.C.— that are currently operating or are implementing smart card technology in their public transportation systems, focusing on smart card program characteristics,

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[5] Federal Highway Administration, U.S. Department of Transportation, **Regional Transportation Operations Collaboration and Coordination**, Publication No.FHWA-OP-03-008, pp. 7-18.

implementation processes, lessons learned, benefits gained and future system plans. The report then discusses the experiences of these transit agencies in view of their applicability to the New York region. Finally, the report outlines recommendations to aid and support the Metropolitan Transportation Authority and its operating agencies in moving toward a regional transportation smart card program. The recommendations focus on steps needed to plan for integrating smart card technology into MTA fare collection systems; they do not advocate that MTA assume any particular role with respect to smart cards or use any particular technology.

NEW YORK CITY REGIONAL SMART CARD INITIATIVES

Port Authority of New York and New Jersey (PANYNJ)

Smart Card Program Efforts to Date

The Port Authority of New York and New Jersey (PANYNJ) manages and maintains a variety of key transportation facilities in the New York and New Jersey metropolitan region, including four bridges, two tunnels, two bus terminals, five airports, a Trans-Hudson subway line, two airport rail lines (AirTrain Newark and AirTrain JFK) and various port facilities in New York and New Jersey.

In December 2000, PANYNJ formed a committee comprised of fourteen regional transit stakeholders from New York, New Jersey, Connecticut and Pennsylvania to further the development of a regional smart card program. The stakeholders included Amtrak, Connecticut Department of Transportation, Connecticut South Western Regional Planning Agency, Metropolitan Transportation Authority, MTA/Bridges & Tunnels, MTA/Long Island Rail Road, MTA/Metro-North Railroad, MTA/New York City Transit, New Jersey Department of Transportation, New Jersey Transit, New York Waterways, Port Authority of New York & New Jersey, Southeastern Pennsylvania Transportation Authority and Westchester County Department of Transportation.

The committee's programmatic objective was to develop and provide a convenient, seamless, intermodal fare collection instrument to transit customers in the broad New York region. The objective of a regional smart card program grew out of a commissioned April 2000 report from the Volpe National Transportation Systems Center[6] that stated that there was a strong business case for a smart card transit instrument with the following probable benefits: lower operating and capital cost than other solutions (magnetic and paper), lower fraud and abuse, greater fare policy and structure flexibility, better customer convenience with faster and more secure customer response, broader capability to integrate among operators, and higher reliability. Program objectives also included developing cross industry applications, such as tolls and parking, retail, security, electronic cash, and payment services.

As a major transportation authority in the region, PANYNJ has been working with MTA and New Jersey Transit (NJ Transit) to develop a smart card interoperability standard for use by the fifteen New York metropolitan transportation providers identified as stakeholders to ensure smart card compatibility and open interoperability between agencies and across transit services. The document *Regional Interoperability Standard For Electronic Transit Fare Payments (RIS)*, defines open standards for smart cards and data so that fare collection systems software, hardware, and networks can be procured on a competitive basis from a variety of vendors. Although participating agencies have yet to formally adopt the document, APTA has made it the

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[6] Volpe National Transportation Systems Center, *Creating a Regional Transit Electronic Payments System*, April 21, 2000.

baseline for its own national smart card interoperability standard for the transportation industry.

PANYNJ is also conducting a pilot program to test the use of a smart card monthly pass at the Newark International Airport Station on the New Jersey Transit Northeast Corridor Line (AirTrain Newark). The project began in the third quarter of 2001 and is expected to continue as a pilot until the end of 2005. The project introduced *SmartLink* as a regional brand for smart card transit media and is considered a laboratory for improving live operations. The *SmartLink* fits into a card sleeve with a visual display that allows the user or a conductor to see origin-destination payment information. Currently the system is being expanded to include other fare products and to comply with the RIS.

This pilot program initiative and the plan for a smart card at the AirTrain JFK have been reevaluated in light of the RIS process. The current plan is to integrate the AirTrain smart cards into the technology platform developed for the PATH smart card system. This integration is planned for 2005.

Since the existing automated fare collection (AFC) system on the Port Authority Trans Hudson (PATH) rail system needs to be upgraded, the PANYNJ will be integrating smart card technology as a component of the new system. PANYNJ has contracted with Parsons to assist in project management and with Cubic Transportation Systems, Inc. (Cubic) to design and implement a new automated fare collection system at thirteen stations including the permanent World Trade Center station. PANYNJ expects to accept smart cards along with its QuickCard and MTA NYC Transit's MetroCard magnetic stripe fare cards on the PATH system by July 2005. The new automated fare collection system will have a stand-alone central computer system and database. The PATH system will be interoperable with the MTA system and with systems maintained by other providers.

PANYNJ's smart card will be a contactless card capable of supporting multiple fare products, including the long-term potential for products beyond the transit application, such as credit or debit card account-based instruments or an e-purse, which could be used for retail purchases. There are also plans to offer a disposable limited-use smart card in the future. The original PATH scope did not specifically require a limited-use smart card, although it was to be considered when the technology became feasible and compliant with the regional standard. PANYNJ is presently researching limited-use smart cards for the PATH system.

Next Steps

PANYNJ anticipates that clearinghouse and revenue allocation functions for smart card transactions will be performed by an outside contractor. Details of these arrangements will be developed through discussions among participating agencies, as will an agreement formalizing business operating rules and the procedures for sharing revenue among agencies. PANYNJ also plans to investigate the feasibility of creating

partnerships and developing business opportunities to recover some or all of the infrastructure costs involved with implementing the smart card program.

Metropolitan Transportation Authority (MTA)

Smart Card Program Efforts to Date

The Metropolitan Transportation Authority (MTA) serves as the umbrella agency for five operating agencies and one construction company: the Long Island Rail Road (LIRR), Long Island Bus (LI Bus), Metro-North Railroad (MNR), New York City Transit (NYC Transit), Bridges and Tunnels (B&T) and the Capital Construction Company (CCC). The operating agencies provide bus, railroad, subway services and bridge and tunnel access to New York City, Long Island, portions of upstate New York, and Connecticut.

The MTA and NYC Transit have been involved in the planning efforts undertaken by the Port Authority of New York and New Jersey to develop smart card interoperability standards for the region. NYC Transit has also been involved in planning for the introduction of smart cards on the PATH system, in addition to the extension of the use of MetroCards to the PATH system.

In the 1990's, MTA Bridges and Tunnels implemented the *EZPass* program in partnership with PANYNJ and the New Jersey Department of Transportation (NJDOT). An account-based smart card technology, similar in its operation to CTA's *Chicago Card Plus* card, *EZPass* is a relatively simple application where a serial number on the *EZPass* transponder, essentially a smart card with extended range, is linked to an account database. No value, credit card information, or bank account information is stored on the transponder. When the transponder is presented at an *EZPass* enabled tollgate, the serial number is checked against a "hot list" of inactive serial numbers to ensure the transponder is valid. The cost for implementing the MTA B &T portion of the program was $90 million. Twenty-two agency partners within twelve states and at one international border crossing with Canada currently operate over 2,500 *EZPass* toll lanes, which generate approximately one billion transactions a year.

In December 2002, the *EZPass Plus* program was implemented for use at JFK International Airport to enable motorists to use *EZPass* to pay for parking charges. This program was extended to LaGuardia, Newark Liberty, and Albany Airports in 2003. There also is a pilot program expanding *EZPass Plus* at two McDonalds restaurants in Centereach and Port Jefferson on Long Island.

The *EZPass* Interagency Group (IAG) serves as the governing coalition for the partnering agencies. The partnering agencies are required to sign an operating agreement that outlines common *EZPass* operating policies and procedures.

Lessons Learned - EZPass

Implementing, managing, and operating the *EZPass* project on a regional scale with multiple agencies and within different jurisdictions was and is a complex task. Key principles for successful transportation partnerships include planning for inevitable leadership changes in government, considering the project complete only when the last agency implements the program, establishing the need for and ability of interagency governance to resolve issues at all stages of the project and operation, thinking big and never underestimating the partnership potential, and recognizing the private sector as an implicit partner, as the success of the project is dependent upon private sector decisions.[7]

Lessons learned from managing and operating the *EZPass* program include the importance of establishing an operating agreement between agencies as well as financial formulas for distributing revenue. It is important to treat all partners with respect. As for organizational or governance issues affecting program operations, it is critical to remove barriers preventing interagency coordination and data sharing, to develop a clear vision of the organization's current and desired future role and structure, to clearly define the product offered, and to understand customer expectations.[8]

Next Steps

The MTA anticipates implementing a smart card pilot project as part of its 2005-2009 proposed Capital Program.[9] NYC Transit has anticipated and been actively investigating the use of smart card technology on its subway and bus systems since its purchase of a magnetic stripe fare card and automated fare collection system in the 1990s. This automated fare collection system, which is currently in use, was designed with the capability to be upgraded to accept smart card fare media. NYC Transit's automated fare collection system and equipment has reached its functional midlife and the agency is investigating the most recent smart card technology and various options of incorporating the technology into its existing automated fare collection system. One option being explored is the possibility of partnering with the banking and credit card industries for smart card distribution, customer service and transaction processing.

NYC Transit envisions integrating smart card technology as part of a layered approach to automated fare collection. The addition of smart card fare media will allow NYC Transit to offer customers multiple and more flexible fare payment options. Subway and

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[7] Michael Ascher, President, MTA Bridges and Tunnels. Remarks made at panel discussion about regional examples at the conference, **Regional Partnerships in Transportation Technology, Learning from and Building upon Success**, sponsored by the NYU Wagner Rudin Center for Transportation Policy and Management, May 11, 2004.

[8] Walter Kristlibas, Executive Committee Chair, *EZPass* Interagency Group. Remarks made at panel discussion about regional examples at the conference, **Regional Partnerships in Transportation Technology, Learning from and Building upon Success**, sponsored by the NYU Wagner Rudin Center for Transportation Policy and Management, May 11, 2004.

[9] The MTA Board approved the 2005-2009 Capital Budget on September 29, 2004. MTA's 2005-2009 Capital Program commits $43.9 million for smart card implementation.

bus customers will still have the option to use MetroCard magnetic stripe fare cards; this option is particularly suited to the needs of visitors and infrequent riders. Other types of fare media cards will also be accepted for transit payment, such as debit cards tied to the TransitChek pre-tax employee benefit program and public assistance electronic benefit transfer programs.

OTHER REGIONAL SMART CARD INITIATIVES IN THE UNITED STATES

Chicago Transit Authority (CTA)

Chicago Card and Chicago Card Plus Program Description

The City of Chicago and its forty surrounding suburbs are served by bus and rail rapid transit service operated by the Chicago Transit Authority (CTA). The larger metropolitan area is also served by Pace buses and Metra commuter rail. Riders may pay for full fare trips on CTA buses and trains, as well as Pace buses, using either of two smart card options. Smart cards cannot currently be used to pay reduced fares for seniors, customers with disabilities, or students. CTA offers magnetic media reduced fare permits that allow these customers to travel at less than full fare.

The first of the smart card options, the *Chicago Card,* is a contactless stored value smart card that was introduced in November 2002. The *Chicago Card's* stored value is debited on a pay-per-ride basis and may be recharged at vending machines located in each CTA rail station. Balance protection, which allows the user to recover the unused balance on a card at the time a card is reported lost, damaged, or stolen, is available to registered users. Replacement cards can be picked up from CTA Customer Service or received by mail; there is a $5 fee for replacement of a lost or stolen card.

Chicago Card Plus is a contactless account based smart card that was introduced in January 2004. The *Chicago Card Plus* represents a major advance over the *Chicago Card's* capabilities. Like *Chicago Card, Chicago Card Plus* allows riders to use CTA trains and buses and Pace buses on a pay-per-ride basis, but also provides a pass option with unlimited rides within thirty days from the date that the card is first activated. *Chicago Card Plus* also adds an automatic reloading capability that allows customers to charge their credit card for a user-determined amount each time the card balance falls below $10. The $10 threshold ensures that customers will have enough value on their card during the 24-hour period needed to process the credit card transaction.

Since April 2004, the *Chicago Card Plus* has also been available through CTA's Transit Benefit Program, an employer administered pre-tax payroll deduction program. Like *Chicago Card*, the *Chicago Card Plus* is protected against loss, damage, or theft. Account balances are frozen upon report of loss or theft, and customers pay only a $5 charge for a replacement card that allows them to access that balance once again.

There is an initial non-refundable $5 charge for either the *Chicago* Card or the *Chicago Card Plus*. As an incentive for customers to use the cards, the *Chicago Card* and *Chicago Card Plus* were offered at no cost to the customer between January and March 2004. After March 2004, the fee for either *Chicago Card* or *Chicago Card Plus* reverted to $5. The fee waiver, along with increased advertising, positive press coverage, and the additional features newly available with *Chicago Card Plus* generated strong customer interest, resulting in the number of smart cards in circulation growing from

over 26,000 at the end of 2003 to more than 102,000 by the end of April 2004. Remarkably, by this time the *Chicago Card Plus* accounted for 45,000 of these cards, or almost half of the total number of smart cards in circulation.

The *Chicago Card* and *Chicago Card Plus* also provide pass-back privileges for the pay-per-ride option, which allow up to seven customers to board the same bus or enter the same rail station using one card, as is possible with CTA's stored value magnetic stripe fare media. A full fare or transfer, as appropriate, is deducted from the *Chicago Card* or from the *Chicago Card Plus* account for each rider. In rail stations, customers must touch the smart card to a touchpad to get through the turnstile before passing the card back to the next customer to use. On the bus, the same procedure is used, but the bus operator must press a button in between users to allow the next customer to board. The *Chicago Card Plus* also allows 30-Day Pass users to bring up to six customers along. The first customer's fare is recorded as a ride under the 30-Day Pass, while the following passengers are charged pay-per-ride fares. Pay-per-ride charges are recorded and deducted from the card owner's account. The *Chicago Card Plus* 30-Day Pass is the only CTA pass fare media to allow passback use.

Both the *Chicago Card* and the *Chicago Card Plus* offer features to ensure that the user will not be stranded for lack of funds. The *Chicago* Card provides a last ride as long as there is some value remaining on the card, which carries a negative balance to be repaid the next time that the card is reloaded. *Chicago Card Plus* accounts automatically reload once the cardholder's balance reaches $10 or less or on the twenty-seventh day of a thirty day cycle for riders using 30-Day passes; this feature maintains funds or time in the rider's account to allow for uninterrupted use of the card.

Planning and Implementation Process

In August 2000, CTA conducted a six-month smart card pilot program to test the feasibility of the technology and to gauge customer acceptance. According to CTA President Frank Kruesi, the smart card was implemented to provide easier access, greater durability, reliability and flexibility in fare payment for CTA customers.[10] All of CTA's existing magnetic stripe automated fare collection equipment, developed by Cubic, was equipped with card readers and touch pads at the time of purchase in 1997 as part of CTA's plan to move into contactless technology. The cost of this automated fare collection system was $106 million. CTA's pilot involved the distribution of 3,500 cards at sixteen sites, including high volume rail stations. Customers were charged a $5 replacement fee for lost smart cards during the pilot program, but the remaining dollar value on the card was restored upon confirmation by CTA. The cards were valid for four years.[11]

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[10] ***CTA to Introduce Smart Card Pilot Program.*** Chicago Transit Authority Press Release, 7/05/00, pp.1-2.

[11] Transportation Research Board, Transit Cooperative Research Program (TCRP). ***TCRP Report 94. Fare Policies, Structures and Technologies: Update.*** March 2003. Case Study 3, pp. 94-109; Kaplan, Rachel, personal email correspondence, July 29, 2004.

Surveys were conducted after four months (December 2000) with this group of riders. The results of the evaluation were positive.[12] In August 2001, CTA signed another contract with Cubic for 300,000 cards over three years. Cards were subsequently purchased under this contract in three different orders. The contract was for slightly more than $1.5 million, which is equivalent to just over $5 per card, and included encoding and printing. All funding for the smart card project was in place at the time of project approval and initiation.

CTA launched the *Chicago Card* in fall 2002. In late November 2002, the *Chicago Card* could be bought online or by filling out and mailing in a form obtained at train stations, on buses, and at other CTA locations. A small, on-system marketing effort supported the launch of *Chicago Card* and included several field sales days to raise awareness of the project. CTA originally planned to outsource the customer service, marketing and distribution operations, but decided against doing so after researching other transit agency experiences and assessing CTA's ability to handle the activities internally. CTA determined that it would be more efficient, cost effective, and flexible to handle the clearinghouse operations and settle revenue receipts in-house. CTA already had a system in place to settle revenues with the Pace bus system, and continuing these functions did not require many changes.

In February 2003, CTA began planning the *Chicago Card Plus* to provide additional features to meet customers' needs. The CTA had learned from customer research that customers' top priorities included the ability to reload a transit card using a credit card as well as to manage their account on the Internet. The *Chicago Card Plus* was designed to meet these needs as well as to offer a more convenient smart card for participants in the Transit Benefit program, which offers customers the opportunity to pay for commuting costs with pre-payroll tax dollars through voluntary payroll deductions.

The *Chicago Card Plus* was launched in January 2004. Chicago transit riders now have the convenience of managing their transit account through the Internet. The CTA invested over one million dollars to build a new website and customer database to support the smart card programs. This new application makes it possible to track and manage both new and existing smart card accounts and to maintain other important data, such as "hot list" information about invalid, lost, or stolen cards, protecting both customers and the CTA against card misuse and fraud. The new application allows for the collection of individual ride and credit card transaction data, which is essential for managing the *Chicago Card Plus* program.

Rather than outsourcing customer service, fulfillment, reporting and revenue clearing to a private contractor, as has been the case in some smart card implementations, CTA continues to perform these functions internally. Transactions conducted through customer service websites account for the highest percentage of sales of *Chicago Card* and *Chicago Card Plus*.   While other transit operators have issued more smart cards

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[12] Ibid.

than CTA overall, CTA has the largest number of multimodal smart cards in circulation of any transit system.

Implementation Difficulties / Lessons Learned

One of the biggest challenges CTA faced was the need to provide systematic, clear, and concise customer information about the smart card programs to minimize customer confusion. Making customers aware of the existence of smart card programs requires different approaches from those needed to educate customers about specific program features. Transit agencies need to devote adequate time, funding, and expertise to addressing both aspects. One example of an information requirement was the need to explain to customers the differences between *Chicago Card* and *Chicago Card Plus* to enable them to choose the card appropriate for their needs.

Another hurdle CTA encountered was insufficient staffing to meet an aggressive smart card program implementation timeline. The program was launched before all the required departments and systems were fully prepared, putting an enormous strain on agency resources to make the system function smoothly for the public. Having a firm program launch date, however, helped get the program implemented sooner than if the launch date was less definitive.

Benefits Realized

CTA expects to reap cost savings from lower equipment maintenance costs as well as faster boarding times, which will improve on-time service delivery. CTA staff members anticipate that greater use of smart cards within the CTA system will lead to proportionally greater benefits.

Next Steps

CTA has not made any further plans with regard to the *Chicago Card* and *Chicago Card Plus*, but the agency continues to diligently monitor the effectiveness of its current programs. CTA is focused on building greater interest in the Transit Benefit program and increasing the distribution of the *Chicago Card* and *Chicago Card Plus* with the current functionality rather than adding other features to the cards at this time.

Metropolitan Transportation Commission [San Francisco Bay Area] (MTC)

TransLink Regional Fare Card Program Description

The San Francisco Bay area supports twenty-six independently operated transit agencies within a nine-county geographic area. Modes of transit in the region include subway, commuter rail, light rail, bus, and ferry service. Among the participating agencies are the Bay Area Rapid Transit (BART), AC Transit [bus], Caltrain [commuter rail], Golden Gate Bus and Ferry Transit, San Francisco Municipal Railway (Muni), County Connection [bus], SamTrans [bus] and Santa Clara Valley Transit Authority (VTA) [bus and light rail].

The *TransLink* regional fare smart card currently is in use on two ferry lines operating out of three ferry terminals, three bus operating agencies (AC Transit, Golden Gate Bus and VTA), nine BART subway stations, nine Caltrain commuter rail stations and ten Muni rail stations. The program is being expanded to the entire network in phases. *TransLink* is a dual interface (contactless and contact) card that functions like a credit card in that every transit trip is recorded as a distinct transaction. The revenue from each transaction is processed and transferred to the provider by a single point regional clearinghouse. All system credits and debits are calculated on a daily basis to determine how much each agency is owed. As of May 2004, there were approximately 4,000 smart card holders.

The contactless interface is used in the transit system; the contact interface allows the use of other applications such as ATMs or Point of Sale (POS) terminals. Smart card readers are being installed at new electronic parking meters in San Francisco to enable people to use the *TransLink* card. Other applications such as tolls, taxis, and retail payments are also being considered. The card is currently not used for retail purchases, although customers will have the ability to reload value on their cards at participating retail outlets. The addition of new applications was part of the original vision for the card. Introduction of the card in the regional transit systems will be phased. Golden Gate Transit and AC Transit are scheduled to go on line in January 2005, Muni and BART subway systems by September 2005, Caltrain and VTA in early 2006 and SamTrans by mid-2006. The regional card will be phased in for the remaining operators by early 2008.

Planning and Implementation Process

The Metropolitan Transportation Commission (MTC), the area's metropolitan planning organization, is responsible for project planning and management of the *TransLink* project. Project implementation is done in coordination with the individual transit agencies.

The *TransLink* smart card program is the culmination of incremental steps taken after San Francisco's 1989 earthquake when a section of the Bay Bridge collapsed. With the bridge out of service, most automobile commuters who had used the bridge now relied

upon public transportation to get to work. Transit operators had to provide additional service. No parking was available at the East Bay BART stations, and there was no mechanism to pay fares on multiple transit systems in an integrated way. Customers were required to buy tickets from each operating agency. San Francisco's various transit agencies had difficulty managing and issuing the additional volume of transit fare media needed in a short period of time. After the Bay Bridge was repaired and reopened to traffic, MTC determined that better integration between the various public transportation systems was needed to enhance and facilitate regional transportation in the Bay Area. MTC had been considering the merits of this strategy prior to 1989, but had made little progress.

In 1991, MTC and the transit operators developed *BART Plus*, a joint subway/bus fare card pilot program between BART and numerous connecting bus operators. The fare card is a thin paper ticket having a magnetic stripe and stored value and is still in use. Customers swipe the *BART Plus* card through a card reader at BART stations and show the bus pass on the back of the card to the bus driver upon boarding. Since bus pass use is not recorded electronically, the perception of an inaccurate division of revenue between BART and connecting bus operators is a continuing problem.

To address the shortcomings of the *BART Plus* card, MTC initiated a multi-agency stored value magnetic ticket demonstration project in 1993. Conducted with BART and County Connection bus service between 1993 and 1995, this demonstration project attempted to use a stored value magnetic ticket on County Connection's one hundred buses. Specifications were developed for a new fare box procured from a French vendor. The BART ticket was slightly reformatted and the new ticket was called *TransLink*.

In this first demonstration project several problems emerged that informed the subsequent development and design of MTC's *TransLink* smart card program. The problems stemmed from the nature of the institutional relationship between BART and County Connection. The demonstration project did not alter the institutional relationship between the two agencies and raised new issues concerning BART's reimbursement of County Connection's operating costs due to a lack of established parameters or procedures to follow in calculating and paying reimbursements.

BART required County Connection to present ridership data as the basis for reimbursement. County Connection, however, was unable to provide BART with full ridership and transactional data due to the frequent breakdown of the fare box collection equipment on its buses and its lack of data capture and management systems. BART was aware of County Connection's problems and used ridership surveys to make adjustments to the County Connection data.

In a separate attempt to upgrade its equipment AC Transit released a Request For Proposals (RFP) for the development and acquisition of magnetic stripe fare card and fare box technology that would be compatible with BART for its eight hundred buses. The BART and AC Transit magnetic stripes were to be on opposite sides of the fare

card.   AC Transit received only one bid that was both non-compliant and over budget, and the project was dropped.

The failure of AC Transit's RFP as well as the problems with the BART and County Connection fare collection system prompted MTC to undertake additional planning. During 1995 and 1996, MTC conducted studies to determine the costs, benefits, feasibility, and steps involved in switching to a regional smart card fare system. MTC realized that a regional project would be expensive to implement; new technology was needed and it would be a long-term project. The system would also have to make financial sense.

After planning studies were completed, MTC spearheaded the effort to adopt the *TransLink* smart card, the process of managing the RFP, the negotiation of the contract, and the implementation of the project. All regional transit agencies were asked to sign on to the project and were strongly encouraged to participate. MTC produced system specifications and released an RFP at the end of 1997. In July 1999, MTC awarded an eleven-year contract to Motorola, with the ERG Group as a subcontractor. The contract was for a complete system but had a termination clause. The project was to be implemented in phases; Phase I was to be the pilot.

MTC provided the funding for the project. The capital funding for regional implementation is $87.9 million for eleven years. An additional $24 million was allocated for the pilot test of the technology, which included the installation of a systemwide clearinghouse and other items beyond the requirements of the pilot test. The $87.9 million contract included $11.1 million to integrate the ERG Group technology with an existing Cubic technology, five thousand card readers at one hundred stations and $5.4 million for smart card fare media stock. Funding for the project was provided from state and federal transit grants obtained through the 5307 Surface Transportation Program (STP) and Congestion Mitigation Air Quality (CMAQ) programs. MTC allocated these transit funds to the *TransLink* program. System operating funds were not fully in place at the time the contract was awarded.

In 2002, a six-month *TransLink* pilot was conducted to test the new system technology[13] within the complex multi-agency, multi-tariff environment. Each participating agency wanted to retain its own fare collection equipment and policies and its own independent tariff. The pilot also sought to determine whether transit riders and transit employees liked the system and the potential effects an expanded program would have on the operational and financial performance of the participating transit agencies.[14] To adequately test the system, the pilot included portions of the systems of the six largest transit operators in the San Francisco Bay Area region: AC Transit, BART, Caltrain, Golden Gate Transit, San Francisco Muni, and Valley Transportation Authority (VTA). The pilot enabled passengers to transfer between different transit operators at certain points through an integrated contactless system. Approximately 6,170 riders

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[13] *TransLink* is supported on a VHS based system.
[14] Charles River Associates, Inc. **Final Report: Evaluation of the TransLink Demonstration**.
  October 2002, p.141.

participated in the *TransLink* pilot program. Although the pilot was delayed close to a year and a half from its original start date due to development problems and contractor issues, a final evaluation of the program deemed it a success.[15]

After the pilot was completed, MTC spent a year resolving system, programmatic, and policy issues among the agencies. Key issues were cost sharing and governance. The issue of cost sharing focused on the division of costs to manage and operate the smart card system between the agencies and the vendor. All of the revenue obtained from *TransLink* is protected and held in trust for the transit agencies. MTC agreed to contribute some state and local sales tax revenue to manage and operate the system. Governance of the system was another issue. MTC holds the agreement with the contractor, but the individual agencies wanted the ability to manage aspects of the system. A consortium of agencies was formed to govern the project and assigned MTC the role of manager to oversee the contract with Motorola/ERG Group.

In November 2003, MTC directed the contractor to implement the *TransLink* program technology systemwide. Phase I of the project (the pilot) included six operators and involved some buses, light and heavy rail, and ferries, as well as the creation and installation of a clearinghouse to process transactional data and allocate agency revenue. Phase I of the project also included over 1,500 pieces of equipment, such as card processors, add-value machines, portable hand-held readers, ticket office terminals, and point-of-sale (POS) devices for use at retail locations.

The remaining phases of the project will implement the system operator by operator. Phase II targets Golden Gate Transit (bus and ferry) and AC Transit (bus) to begin using *TranLink* by March or April 2005. Phase II will also involve the addition of approximately nine thousand pieces of equipment. New add-value machines and some card processors will provide audio in two languages and have keys with Braille to aid visually impaired passengers.[16]

In Phase III, *TransLink* will be fully extended to the Muni and BART systems, and is expected to be operational in September 2005. Caltrain (commuter rail), VTA (bus and light rail) and SamTrans (bus) are to offer *TransLink* during 2006. After mid 2006, it is anticipated that the remaining operators will implement the regional card over a period of eighteen months.[17]

Annual operating costs for *TransLink* are estimated to be $8 to $14 million, depending upon usage, or 3.4 to 5.0 cents a ride. Operating expenses include data processing, network monitoring, system management, maintenance, and customer support.[18]

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[15] Ibid., pp. ix, 7.

[16] Smartcard Alliance. **Smartcard Case Studies and Implementation Profiles, A Smartcard Alliance Report**. December 2003, p. 74.

[17] Interview with Russell Driver, *TransLink* Project Manager, Metropolitan Transportation Commission (MTC). April 27, 2004.

[18] Transit Cooperative Research Program**. Developing a Recommended Standard for Automated Fare Collection for Transit: Scoping Study - Regional Fare Management Programs,** February 2003, p.19.

Implementation Difficulties / Lessons Learned

While systemwide implementation of *TransLink* is in progress, MTC has encountered a number of difficulties. One challenge has been maintaining the project schedule while coordinating and integrating the work of two or more contactors. At the time of the original 1999 contract award, the *TransLink* pilot was projected to begin in October 2000. The pilot project actually began in February 2002, due to difficulties integrating the efforts of the prime contractor, Motorola, and the subcontractor, the ERG Group. The two vendors did not work well together, which resulted in significant delays. The design review phase, which was originally scheduled to take four months, took more than a year. Motorola subsequently exercised its option to terminate its smart card contract with MTC. The ERG Group took over the project and completed the remaining tasks between May 2001 and January 2002.

Another challenge has been developing the regional fare collection system. The fare collection system requires the commitment and involvement of personnel at all levels of the participating agencies and agency board approvals. MTC has no direct role in setting fare policies. Finance and treasury personnel are involved in shaping the revenue accounting systems and fare policies, while front line staff is trained in system functions, policies, and customer service. The fare collection system affects both facilities and communication networks. Resolving the procedures and policies for agency transaction processing and revenue distribution was critical prior to the implementation of *TransLink*.

The implementation of *TransLink* also impacts customer service. The breakdown, misunderstanding, and malfunction of the new equipment have resulted in customer and staff frustration. Results from the pilot test indicated that the front line staff training was inadequate. While MTC allocated funds for employee training, many of the participating agencies resisted providing employee training for a small pilot. The vendor was obligated to provide training to agency personnel, but its training focused on operation of the equipment rather than the knowledge that employees needed to perform their jobs. During the pilot, MTC developed a brochure with the answers to frequently asked questions for employees as a supplement to the original training.

To address the training issue during future phases MTC has produced a body of materials for front line staff training to begin in summer 2004. The training will begin with the two agencies involved in Phase II. MTC is developing training courses for about twelve different categories of employees, including front line, administrative, and finance positions. MTC asked individual agencies to help compile the packets to ensure that the training reflects the tasks that employees will have to perform. MTC is also developing a "Train the Trainer" program to ensure that front line agency personnel continue to be well versed in the technology.

Transit agency skepticism was another hurdle MTC had to overcome. Because MTC is the Bay Area's metropolitan planning organization (MPO), individual transit agencies viewed MTC and the *TransLink* smart card initiative with distrust. The failed magnetic

stripe card pilot project in 1993 added to the skepticism with which the agencies viewed the *TransLink* smart card project. MTC had to work hard to overcome this transit agency skepticism. According to project manager Russell Driver, one lesson that MTC learned from this process was the importance of identifying a manager from each agency to be responsible for project implementation. Mr. Driver believes that establishing individual agency project managers would have facilitated implementation better than having the MTC manage and coordinate all aspects of the project.

Benefits Realized

While the program has yet to be fully implemented, MTC believes that the *TransLink* smart card will make transit use simpler for the customer, thereby encouraging more people to use transit. With the ability to use one card for travel on twenty-six different Bay Area transit providers, riders will be able to save time and reduce the amount of research necessary to use these multiple services. *TransLink* will allow the user to purchase the same products offered by the individual providers, such as monthly and weekly passes, as well as stored value media. Transit use will also be more convenient for riders through additional options to purchase transit fares via the Internet, by telephone, or by credit card link.

From an agency perspective, MTC anticipates that the *TransLink* program will provide a means by which agencies can better control, monitor, and influence ridership patterns through congestion pricing techniques. *TransLink* will allow agencies to offer time of day pricing by offering discounts at off peak travel times. Along with the benefits gained from congestion pricing, an anticipated increase in customer throughput and loading, especially on buses, was another reason for implementing the system. Muni has some of the highest crush loads in the United States and could benefit greatly from increased throughput and decreased dwell times.

MTC anticipates that the *TransLink* system will reduce costs for agencies. At AC Transit the existing GFI Trim Unit magnetic payment ticket and fare readers have been plagued by frequent breakdowns. With fewer moving parts the *TransLink* equipment will require less regular maintenance and repair. A cost savings report conducted for MTC after the pilot program forecast potential annual savings in equipment, maintenance, and cash handling on Muni to be about $1.16 million if existing fare media were not replaced and $2.14 million if current fare media were eliminated and cash fare payments were reduced by 60 percent.[19]

The *TransLink* card is also expected to aid system operations and financial accounting by reducing the amount of cash handled by agency personnel. The agencies will no longer need to procure fare card stock, maintain as much cash inventory, deal with as high a level of cash fares, and perform the associated accounting procedures. An outside contract will provide fare cards and deal with some of the accounting operations

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[19] Nancy Whelan Consulting report, cited in Charles River Associates, Inc. **Final Report: Evaluation of the TransLink Demonstration.** October 2002, p. 157.

for the project. Agencies will also have better fare revenue accountability with *TransLink* due to data generated from the smart card readers.

Next Steps

After the system is further underway, MTC plans to work toward providing a mechanism where customers will be able to add value on their cards and travel on any system without purchasing a particular type of pass. Implementing this mechanism will require more sophisticated pricing systems and changes in agency policies.

MTC is also exploring the possibility of making smart cards available for visitors at hotel desks. The smart card would be connected to a guest's room key and used for transit throughout the region. Visitors could add value to the card or choose to pay transit fares as a part of their hotel bill.

Washington Metropolitan Area Transportation Authority (WMATA)

SmarTrip Card Program Description

Launched in May 1999, the Washington Metropolitan Area Transportation Authority's (WMATA) *SmarTrip* card is a reloadable and rechargeable contactless multi-application card that holds up to $200 in stored value for use on WMATA's 103-mile subway (Metrorail) system. Metrorail fares are charged according to distance traveled and time of day. *SmarTrip* is also required to pay for parking at 52,200 Metro-operated parking facility spaces. Approximately 450,000 smart cards were in circulation as of mid-2004 and new smart card accounts average 7,500 per month.

WMATA is in the process of expanding use of the card to a regional multi-modal system that will encompass sixteen other public transit systems including Washington D.C.'s 1,500 bus (Metrobus) system, Maryland's local rail passenger system (MARC), and a variety of publicly operated bus and light rail systems in Maryland and Virginia.

SmarTrip features include the ability to register the card for replacement if lost or stolen. Upon being notified of a lost card, WMATA will issue a new card with the value remaining on the missing card at the point of notification. A $5 replacement fee is charged to cover the cost of the card. WMATA also makes smart cards available to visitors through its website or through purchase in the WMATA system. Visitors can register the card to their home address and keep the card for future use.

WMATA's main objective in introducing the smart card was to eliminate barriers to using public transportation by increasing customer convenience. Most riders associate public transportation with a cumbersome cash-based fare system, compared with a more streamlined credit and debit-card based system for automobiles. WMATA felt that it could encourage ridership by improving ease of access through reducing the time needed to buy a ticket and to enter and exit the system and by improving fare system reliability, thus making the "first impression" of public transportation one of speed and convenience.

Planning and Implementation Process

WMATA initiated planning for the *SmarTrip* program in 1994 with assistance from the Federal Transit Administration (FTA) to undertake a one-year pilot study with 1,500 customers. WMATA was interested in testing the new smart card technology and received a $1 million grant from FTA to support the implementation and testing of the smart card technology in its early stages of development. The pilot made use of an early version of Cubic's "Go Card". The card was a battery-powered form of radio-frequency identification (RFID) technology and was thicker and more cumbersome to use than the current smart card technology. The pilot was conducted at approximately ten subway stations, fewer than ten bus routes and ten parking lots.

WMATA hired a consultant to evaluate the 1994-95 pilot program and determined the effort was worth undertaking. Customers liked the speed and convenience of the card, but did not like its limited availability and its use at only a few stations.

WMATA included the creation of a systemwide smart card program in its 1995 Capital Budget as a line item negotiated as part of a $25 million overhaul of the Metrorail fare collection system. The $25 million was provided through an 80/20 percent split between federal and local capital improvement funds.

The decision to use a smart card was justified as a means of increasing customer convenience. The overhaul of the fare collection system included ticket vending machines, turnstiles, and software upgrades. The RFP for the overhaul was released in the mid-1990s. In 1997 WMATA signed a contract with Cubic, the contractor for the system's existing magnetic card readers, to install new smart card readers on existing magnetic card machines and turnstiles. Systemwide installation of *SmarTrip* was completed in 1998 for Metrorail and Metro-operated parking facilities.

The Australian-based ERG Group was later hired to develop a regional clearinghouse to handle ongoing sales and customer service and to process revenue receipts for the new *SmarTrip* system. Other costs for the *SmarTrip* program include $25 million for the regional smart card clearinghouse and $22 million for new bus fare boxes incorporating smart card readers in a subsequent joint WMATA/Maryland MTA procurement. Initial contracts with Cubic and ERG Group were signed for five to six years.

Before introducing the system to the public, WMATA conducted a limited rollout of *SmarTrip*. The *SmarTrip* card differs from the smart card that was used in the pilot in that it does not require an internal battery and is contactless. The rollout proceeded in three phases during 1998 and 1999. The first phase included automated fare collection technicians, followed by WMATA staff in the second phase, and 1,500 members of the general public in the final phase. The rationale behind the phased approach was to ensure that WMATA technicians and staff were prepared to handle the new system and to correct any problems prior to the full-scale public rollout.

SmarTrip was officially introduced systemwide in May 1999. Smart card readers were installed in every station mezzanine, at 40 percent of the entry gates in the Metrorail system, and at all thirty-three WMATA parking facilities containing 52,200 parking spaces. In 2000, one year after the program was officially introduced, WMATA installed smart card readers at all entry and exit gates in the Metrorail system. By the year 2000, 50,000 *SmarTrip* cards had been distributed.

Implementation Difficulties / Lessons Learned

WMATA's experience illustrates some of the perils of being a card issuing organization. During this past summer, faced with brisk sales fueled by the tourist season and the changeover of commuter parking lots to exclusive smart card payment systems, WMATA needed to conserve a limited stock of *SmarTrip* cards and was forced to

suspend Internet sales of the *SmarTrip* card and all *SmarTrip* promotions not aimed at persons using the Authority's parking facilities. An earlier plan to suspend all *SmarTrip* sales was reversed after widespread public objection. Less than a year earlier, WMATA had halted sales of the *SmarTrip* card due to a defect in some cards.

Some of WMATA's difficulties with its smart card system may be related to its choice of technology. The Authority's choice of a proprietary smart card distributed by Cubic for its automated fare collection system, as opposed to a more current card and reader combination conforming to ISO Standard #14443, proved to be an issue in procuring additional cards in these cases. In late July 2004, WMATA had an inventory of fewer than sixteen thousand cards with daily sales of four thousand cards. Despite its supplier's promise to devote all production capacity to *SmarTrip* cards until adequate supplies were restored, WMATA officials considered running out of the cards a real possibility. As the market shifts toward ISO Standard #14443 contactless smart cards the importance of compatibility and standardization issues is likely to increase.

It is important to have a common standard operating system that is interoperable to allow the system to accept multiple types of smart cards. The Regional Interoperability Standards for Electronic Fare Payment, developed by a group led by the Port Authority of New York and New Jersey, is an attempt to move the industry away from the use of proprietary fare collection systems. These standards have been accepted as the basis for national fare collection standards being developed by APTA.

Benefits Realized

From the customer perspective, the reload and recharge capabilities of *SmarTrip* have made it more convenient for customers to use the WMATA system. The smart card is easy to refill online or automatically through periodic transfers from a bank account. The contactless nature of smart card readers does not require riders to remove the card from their wallet but allows them to display it through a cardholder. The smart card makes entrance to and exit from the system faster and less cumbersome than common perceptions of public transportation suggest. WMATA has seen ridership increase since *SmarTrip* was introduced despite an increase in fares during this period.

WMATA has also realized benefits from *SmarTrip*. One key benefit is a savings in turnstile and fare card equipment maintenance costs. The paper fare system required ongoing maintenance and repair of turnstiles and fare card equipment. The contactless card reader is a sealed unit, which contains no moving parts and fewer components that can be damaged or vandalized. Since the *SmarTrip* program was initiated, the agency has shifted its maintenance approach from reactive to preventive. The switch to smart card technology has also aided WMATA's service planning. The smart card readers provide better origin-destination information than was previously available, informing service planning and conserving capital resources.

Next Steps

WMATA is currently taking the lead in implementing and promoting the use of contactless smart cards for transit payment in the National Capital region. Contracts are currently in place to expand *SmarTrip* to sixteen additional transit operators within Washington D.C., Northern Virginia, and Maryland.

The smart cards that are available to visitors through the WMATA website or for purchase in its system are working well. The agency anticipates the need to offer limited-use disposable smart cards to serve the infrequent user as it implements a full transition from magnetic stripe ticket to contactless smart card. Presently, WMATA has maintained its magnetic stripe fare card technology in addition to the smart card, at least for the short-term. WMATA expects to upgrade its system technology in five years.

In the long-term, WMATA's goal is to shift its operations from that of a card issuing organization to that of a card accepting organization. The aim is to transfer the transit card application, payment, and customer service activities to a WMATA contractor or financial institution who can issue a card for use in the Metro system, enabling WMATA to focus on maintaining, providing, and expanding public transportation services.

FINDINGS

Smart Card Programmatic Features

CTA in Chicago, MTC in San Francisco, and WMATA in Washington, D.C have used a layering approach to employing smart card technology in their transit systems. Similar to New York City, all three systems had automated fare collection technology with magnetic stripe fare cards prior to their smart card programs. All have continued to offer these magnetic stripe fare cards to customers along with other fare payment options and programs, such as special daily, weekly, and monthly passes and individual pay-per-ride fares.

MTC's *TransLink* card will eventually serve twenty-six independently operated transit agencies, compared to sixteen with WMATA's *SmarTrip* and three with CTA's *Chicago Card* and *Chicago Card Plus*. All three agencies chose to pilot test and initially implement their smart card programs in the subway system. MTC and CTA also made smart card fare payment available on some bus lines in the first phase of implementation, while WMATA chose to accept the smart card on buses in the second phase. MTC additionally chose to accept the smart card on ferry and commuter rail services in the first phase. WMATA has installed smart card capability at its parking facilities, and MTC is installing smart card readers at new electronic parking meters in San Francisco.

While similar, these three smart card programs have notable unique programmatic elements. CTA's *Chicago Card Plus* has an automatic reloading capability that allows customers to charge their credit card for a user determined amount each time the card balance falls below $10. The $10 threshold ensures that customers have enough value on their card during the twenty-four hour period necessary to process the credit card transaction. The card also offers a "negative balance" or guaranteed last ride feature. This feature provides the customer one last ride as long as there is some value remaining on the card. The card can carry a negative balance up to the value of a single ride. The next time value is added to the card, the amount of the negative balance is deducted.

Unlike MTC and WMATA, CTA has chosen to process its smart card transactions internally instead of outsourcing smart card distribution, customer service, and reconciliation of revenue receipts.

In addition to the ability to purchase the *TransLink* card online, MTC plans to offer customers the option of reloading value on their smart cards at participating retail outlets. WMATA's *SmarTrip* card is available for purchase online as well as in WMATA's retail stores located within the system. CTA's *Chicago Card* and *Chicago Card Plus* are not available for purchase at retail outlets.

Unlike CTA and MTC, WMATA's *SmarTrip* card is also available to visitors for purchase for short-term or infrequent use. MTC is exploring the possibility of making smart cards available at hotels for visitors to use for local and regional transportation.

A summary of the features of the public transportation smart card programs examined in this report is contained in Table 1, below.

Permanent Citizens Advisory Committee
Table 1
Comparison of Smart Card Programs

Agency	Port Authority of New York and New Jersey (PANYNJ)	Metropolitan Transportation Authority (MTA)	Chicago Transit Authority (CTA)		Metropolitan Transportation Commission [San Francisco Bay Area] (MTC)	Washington Metropolitan Area Transportation Authority (WMATA)
Card Name	SmartLink	None	Chicago Card	Chicago Card Plus	TransLink	SmarTrip
Smart Card Start Date	2001-2005 (Pilot)	None	2002	2004	2002	1999
# of Transit Agencies To Be Linked with Smart Card	2	N/A	3	3	26	16
Transportation Modes in Phase 1 Pilot Tests	Monorail (AirTrain Newark), NJT Commuter Rail	N/A	Subway, Bus	N/A	Subway, Bus, Ferry, Commuter Rail	Subway
Can Parking Fees Be Paid with Smart Card?	No	N/A	No	No	Yes	Yes
Automatic reload: customer's credit card charged a predetermined amount when card account balance falls below specified value.	Yes	N/A	No	Yes	No	No
Guaranteed Last Ride Feature: Allows customers one last ride with any value remaining on the card.	No	N/A	Yes	Yes	No	No
Are Smart Card Distribution, Customer Service, and Reconciliation of Revenues Outsourced?	No	N/A	No	No	Yes	Yes
Can the Card Be Purchased Online?	No	N/A	Yes	Yes	Yes	Yes
Can the Card's Value Be Reloaded at Retail Outlets?	No	N/A	No	No	Yes	Yes*
Current Smart Card Uses	Monorail (AirTrain Newark), NJT Commuter Rail	N/A	Subway, Bus	Subway, Bus	Bus, Commuter Rail, Light Rail, Ferries	Parking, Subway, Bus
Next Steps	Implement on PATH service. Outsource smart card revenue allocation functions. Formalize operating rules and procedures for revenue sharing. Investigate partnerships and business opportunities to recover smart card costs.	N/A	Focus on building greater interest in the Transit Benefit program and increasing the distribution of the Chicago Card and Chicago Card Plus with the current functionality rather than adding other features to the cards at this time.		Enable customers to travel on any system without purchasing a particular type of pass. Make smart cards available at hotels by connecting it to guests' room keys.	Offer limited-use disposable smart cards to serve the infrequent user. Transfer the transit card application, payment, and customer service activities to a WMATA contractor or financial institution who can issue a card for use in the Metro system.
Available to Visitors for Purchase for Short-Term or	N/A	N/A	No	No	No	Yes

* Available at WMATA's Retail Stores Located Within the System

Lessons Learned

CTA, MTC and WMATA recommend the following, based on their experience with implementing smart card technology:

- When developing the regional fare collection system, develop and resolve the procedures and policies for processing various agency transactions and distributing revenue prior to implementing the smart card program systemwide.
- A standard interoperable operating system and a smart card having common radio frequency identification (RFID) capabilities enable transit agencies to better accommodate and integrate different fare media systems developed by multiple vendors.
- Smart Card systems requiring relatively little data processing at the point of payment are faster and less subject to operational difficulties than more data processing intensive systems. Since speed is a primary benefit of using contactless smart cards, the design of the farebox or turnstile portion of the fare collection system should lean toward simplicity.
- Maintaining the project schedule is a challenge. Coordinating and integrating the work of more than one contractor makes the implementation process more difficult.
- Sufficient staffing is necessary to carry out a smart card program.
- A project manager from each participating agency in a smart card project should be responsible for project implementation at that agency.
- Training for front line and other agency personnel should focus on information that employees need to properly respond to customers and to do their jobs. Training should not only focus on operation of equipment.
- Clear and concise customer information, such as explanations of options available for riders, is critical to minimize customer confusion.
- Different marketing approaches are needed to make the public aware of the smart card program and to educate the public about its operation.
- Participating agency departments and systems must be ready before introducing the smart card program to the public.

Benefits Realized

CTA, MTC and WMATA have received or anticipate the following transit system benefits due to the transition to smart card automated fare collection technology:

- Lower fare card equipment and turnstile maintenance costs.
- Faster customer boarding times with contactless smart card technology, improving overall service delivery.
- Automated reload and recharge capabilities via the Internet, telephone, and credit card link purchase options increase customer convenience and encourage system ridership.
- Additional ridership data will allow planning operations to more accurately address customer travel patterns and conserve agency resources.
- The ability to use one card on multiple transportation modes saves the customer time used to research travel information and purchase individual tickets.
- Smart card technology enables transit agencies to better control, monitor, and influence ridership patterns through congestion pricing techniques.

- Outsourcing smart card procurement, distribution, and clearinghouse functions streamlines agency system operations and financial accounting and reduces the amount of cash handled by agency personnel.

RECOMMENDATIONS

Managing New York City's multi-modal transportation systems is a regional issue. The growth and interdependency of local and state economies within the New York region extends beyond geographic boundaries and spurs the need for an integrated seamless regional transportation network. The success of *EZPass* is evidence of the benefits of a customer driven, agency improved transportation management system.

The use of smart card technology to integrate regional transportation systems is a 21st century solution to meeting growing consumer demands for ease of mobility, convenience, and speed. Public transportation is key to economic growth in the New York region and must adapt accordingly to meet the needs of its users.

GOVERNING PRINCIPLES

The actions of the Metropolitan Transportation Authority and its operating agencies in planning for and implementing an automated fare collection system that uses smart card technology should be governed by several principles reflecting the state of technology and current operations. These principles include the following:

- The most prudent course of action in implementing new technology and practices is to proceed in a way that preserves flexibility to adapt to changing conditions. Technology and institutional arrangements in the smart card field and the financial services industry are rapidly changing. Solutions that require large irreversible commitments of resources should be pursued only where the case for these solutions is extremely compelling.
- While smart cards can be an important part of MTA operating agencies' fare collection systems, they will not be a total fare collection solution. For example, MetroCard has been implemented on all MTA NYC Transit subway and bus lines for more than seven years, but a proportion of riders prefer to pay fares in cash. Despite considerable discounts available to MetroCard purchasers, many riders continue to use single ride tickets on the subways and would probably be using tokens if it were still possible. The MTA should not expect these riders to readily accept smart cards for fare payment.
- Establishing an entirely new fare collection system is difficult, costly, and in a system as large and complex as MTA, probably completely impractical. MTA should leverage its resources to introduce smart card technology into its existing automated fare collection systems.
- The incremental cost of adding smart card technology to the replacement or upgrade of an automated fare collection system is minimal, compared with a stand-alone project to add smart card functionality to the fare collection system. The introduction of a smart card should therefore be coordinated with planned fare collection system improvements, when possible.
- The expected cost of a smart card system, including both initial capital and life cycle costs, is a primary consideration. While costs must be balanced against factors such as customer convenience, risk, and compatibility with existing

practices and systems, it must be recognized that if fares can be collected more efficiently, this will free additional resources for MTA to provide vital services.

The following recommendations suggest means by which the Metropolitan Transportation Authority and its operating agencies- New York City Transit, Long Island Rail Road, Metro-North Railroad and Long Island Bus- should initiate the planning and implementation of smart card technology.

METROPOLITAN TRANSPORTATION AUTHORITY (MTA)

As the umbrella organization, the MTA sets policy for and issues directives to MTA operating agencies. The following recommendations are made to further the MTA's development of a smart card program among its operating agencies.

- **Make smart card an MTA priority.** Initiating a transition to smart card technology requires that the MTA make the development of a smart card program a priority. Adequate funds should be allocated to the MTA and its operating agencies in the 2005-2009 Capital Program to cover development, implementation, and evaluation of a smart card pilot program, the acquisition and upgrade of necessary automated fare collection equipment, and smart card technology support services.

- **Create an MTA interagency task force to develop an MTA strategy and plan for implementing smart card technology systemwide**. MTA's first efforts toward smart card interoperability should focus on providing seamless transitions between separate MTA operating agencies. An interagency task force should be created to research smart card technology options and develop an MTA agencywide plan for a regional smart card program. The task force should also include representatives from MTA Bridges and Tunnels (B&T) to build upon its experience with *EZPass*. Key issues to be discussed and determined should include, but not be limited to:

  o *Clearinghouse functions*. Undertake discussions and make decisions about how MTA will distribute smart cards, provide customer service, and resolve agency revenue receipts and transfers. Investigate opportunities for partnering with the financial services industry as a part of the discussion and decision making process. MTA should investigate using its relationship with JPMorgan Chase Bank, which is interested in exploring the uses of smart cards and administers the MetroCard Mail and Ride program, as the basis for a pilot study of smart cards in the MTA network.
  o *Fare policies*. Undertake discussions and make decisions about how the MTA will handle intra- and inter-agency fare structures.
  o *Smart card specifications.* Undertake discussions and make a decision to accept specifications compatible with the Regional Interoperability Specification (RIS) being developed by PANYNJ and other area transportation providers.
  o *Smart card type interoperability*. Undertake discussions and make a decision to install smart card readers complying with ISO Standard #14443 in

MTA fare collection systems to provide for interoperability with multiple smart card systems.

- o *Agency specific plans.* Develop guidelines and direct all MTA operating agencies to develop agency specific plans in conjunction with an MTA overall strategy.
- o *Smart card pilot program.* Plan for a six-month to one-year smart card pilot program to test smart card technology and operations on the MTA system. A first smart card pilot should include segments of NYC Transit subway and bus systems. As plans are developed, additional pilot programs should be conducted on the LIRR, MNR and Long Island Bus.
- o *Opportunities for smart card integration with EZPass*. Identify the potential MTA and regional transportation system benefits and disadvantages and logistics of integrating public transportation smart card technology for use with MTA Bridges and Tunnels' *EZPass* program.
- o *Opportunities for inter-agency smart card procurement opportunities, where applicable.* Investigate opportunities for joint procurement of smart card technology among the MTA operating agencies, where applicable, to reduce capital costs.
- o *Training for front line and other agency personnel.* Plan for appropriate and extensive training for front line and other agency personnel that focuses on interacting with the public regarding smart card issues as well as performing job functions. Develop guidelines and direct all MTA operating agencies to develop agency specific training, as necessary.

- **Continue involvement in the Regional Interoperability Standard process.** The interagency task force discussed above should also maintain regular contact with the Port Authority of New York and New Jersey, New Jersey Transit and Regional Interoperability Standard (RIS) working groups to ensure that MTA smart card strategies are consistent with those planned for other regional transportation systems. Where modifications to the RIS are needed to maintain compatibility with current or potential future MTA systems, MTA should propose that those modifications be made.

- **Consider including specific smart card programmatic elements, such as an automatic reload or negative balance feature that either maintains a minimum level of funding in the account or allows riders to charge a last trip to a card having remaining funds.** MTA should consider incorporating these two features into any program where MTA is an issuer or co-issuer of a smart card. CTA's *Chicago Card Plus* provides an automatic reloading feature that allows customers to charge a user-determined amount to their credit or debit card accounts each time that the card balance falls below $10. The $10 threshold provides a minimum balance on the card during the 24-hour period it takes to process a credit card transaction. The *Chicago Card* also provides a "negative balance" feature that allows the card to carry a negative balance up to the value of a single ride to allow for a last ride, as long as there is some value remaining on the card. The next time value is added to the card, the amount of the negative balance is deducted.

- **Adopt an MTA authoritywide smart card technology plan and implementation schedule and an associated capital budget.** Once the interagency task force has developed an overall plan for a regional smart card program, the MTA should adopt the plan with an earmarked capital budget for implementation.

- **Develop smart card program customer information, education and marketing campaigns for MTA and its individual operating agencies.** The MTA should investigate and learn from CTA's, MTC's and WMATA's experiences with smart card public information efforts for use in developing campaigns to provide customer information and smart card program customer education as well as to market the program.

NEW YORK CITY TRANSIT (NYC Transit)

- **Make a smart card automated fare collection upgrade a priority for the subway and bus systems.** The subway and bus automated fare collection (AFC) equipment has reached the midpoint of its expected operational lifespan. NYC Transit should plan now for a system upgrade that includes smart card capability. The estimated cost to upgrade the NYC Transit bus and subway AFC systems with new equipment, computers, databases and other required elements is about $90 million. The cost of adding smart card capabilities to subway communications, station computers, area controllers, and bus fare boxes is negligible; the system upgrade accounts for the bulk of the cost. It therefore makes sense to include smart card functionality as part of the upgrade.

  An upgraded AFC system could easily be compatible with both magnetic stripe cards and smart cards. NYC Transit should retain magnetic stripe technology to allow use by visitors and infrequent riders, accommodate customer preferences, and provide flexibility.

- **Conduct a time sequence study to compare smart card and magnetic stripe fare card (MetroCard) bus loading and trip time reductions for articulated buses.** One significant disadvantage of articulated buses is the length of time required to load passengers, which results in increased bus dwell times. Smart cards can reduce loading time and make articulated buses more efficient. NYC Transit should undertake a pilot study to investigate ways in which smart card technology can improve the performance of articulated buses on high volume routes.

MTA RAILROADS - LONG ISLAND (LIRR) AND METRO-NORTH (MNR)

- **The LIRR and MNR should begin planning for smart card.** LIRR and MNR have yet to begin thinking seriously about the use of smart card technology. Studies and agency plans should be developed in conjunction with the MTA and NYC Transit to ensure that any system installed addresses regional transportation considerations and provides MTA with interagency interoperability capabilities.

- **Conduct research on smart card automated fare collection systems in use or being planned by other railroad systems.** Three railroad systems are currently conducting pilot programs or are in the process of planning or implementing a smart card program. The Port Authority of New York and New Jersey has a pilot program testing the use of a smart card monthly pass at the Newark International Airport Station on the New Jersey Transit Northeast Corridor Line (AirTrain Newark). The Port Authority Transportation Corporation (PATCO) Lindenwold line, between New Jersey and Pennsylvania, has released a Request For Proposals (RFP) for a system upgrade of its automated fare collection system including smart card capability. Chicago's Regional Transportation Authority (RTA) is currently beginning planning to introduce smart card technology on the Metra commuter rail system. MTA's commuter railroads should monitor these efforts and use the results in planning for smart card implementation.

LONG ISLAND BUS (LI Bus)

- **Make a smart card automated fare collection system a priority for the Long Island Bus system.** LI Bus should undertake planning studies and agency plans for implementing smart card in conjunction with the NYC Transit Department of Buses to ensure that regional transportation considerations are addressed and MTA interagency interoperability capabilities are provided. LI Bus should discuss research and strategies with the NYC Transit Department of Buses to capitalize on NYC Transit's information resources and to promote interoperability between LI Bus and NYC Transit fare collection systems.

GLOSSARY

AC Transit—Alameda County Transit

APTA—American Public Transit Association

ATM—Automatic Teller Machine

BART—Bay Area Rapid Transit (San Francisco)

B&T—MTA Bridges and Tunnels

CMAQ—Congestion Mitigation Air Quality

CTA—Chicago Transit Authority

FHWA—Federal Highway Administration

IAG—EZPass Interagency Group

ISO—International Organization for Standardization

JFK International Airport—John F. Kennedy International Airport

LI Bus—Long Island Bus

LIRR—Long Island Rail Road

MARC—Maryland Rail Commuters

MNR—Metro-North Railroad

MTA—Metropolitan Transportation Authority

MTA—Maryland Transit Administration

MUNI—San Francisco Municipal Railway

MPO—Metropolitan Planning Organization

MTC—Metropolitan Transportation Commission (San Francisco)

NJDOT—New Jersey Department of Transportation

NJT—New Jersey Transit

NYC Transit—New York City Transit

NYU—New York University

PANYNJ--Port Authority of New York and New Jersey

PATH—Port Authority Trans Hudson

POS—Point of Sale

RFID—Radio Frequency Identification

RFP—Request for Proposals

STP—Surface Transportation Program

TRANSCOM—Transportation Operations Coordinating Committee

TRIPS123—Transportation Intelligent Planning System

TRB—Transportation Research Board

USDOT—United States Department of Transportation

VTA—Valley Transit Authority (Santa Clara)

WMATA—Washington Metropolitan Transportation Authority