Metropolitan Transit System (MTS) Fare Collection Whitepaper

November 2016

Introduction

MTS assumed responsibility for the regional electronic fare collection system, Compass Card, from the San Diego Association of Governments (SANDAG) in 2014. The agency immediately began to review the current system’s status and to begin the process for modernization and replacement of components of the system that was originally procured in 2003.

Agency staff at multiple levels have been reviewing the latest industry technology, attending vendor demonstrations and industry conferences and tradeshows, and engaging in discussions with peers regarding best practices and vendor experiences. MTS’s current vendor was asked to provide alternatives for upgrading the existing system.

A Fare Collection Working Group was established in 2016 to spearhead the creation of a set of preliminary requirements for the future electronic fare collection system. The Working Group hired a consultant to assist in its work, held a peer agency workshop, reviewed numerous documents produced by other agencies, and attended an international workshop. This whitepaper details the results of the Working Group’s efforts.

Whitepaper Purpose and Scope

The purpose of this whitepaper is to provide MTS decision makers with a framework for discussions regarding expectations for the next version of the San Diego regional electronic fare collection system. The current system has reached its useful life, and system hardware and software components must be upgraded or replaced. There are three general alternatives available at this point:

1. Upgrade the current Cubic system to the latest version of NextFare software, maintaining the same general functionalities as available today while modernizing the equipment and improving security features. New options such as Stored Value and mobile ticketing may become available in coming months.

2. Seek greater functionality and modernization through the initiation of a full procurement for a next generation electronic fare collection system. This option could result in significant improvements, but also highest cost and potential implementation risk.

3. Perform a strategic upgrade analysis on the existing system, identifying incremental upgrades and integration opportunities that can transition to a new system with minimal impact to customers. Consider multiple procurements between “best of breed” vendors to maximize flexibility and control costs.
This whitepaper provides high level requirements and cost estimates associated with the full system replacement described in the second option. In Chapter 1, the whitepaper relates the results of a workshop that was held with eight peer agencies around the U.S. and Canada in various stages of their own fare collection system upgrades. Chapter 2 details ideal system requirements for the next generation fare collection system. Chapter 3 provides Rough Order of Magnitude (ROM) estimates for the full system replacement. Finally, Chapter 4 provides the high level recommendation described in option three, and a scan of vendors to show level of ability to fulfill the recommended next-generation system attributes.
Fare System Goals

Prior to the initiation of this whitepaper, MTS developed a number of objectives to help guide the concept and early requirements for the next-generation fare system. An early critical step for project success is to identify the highest priority goals. Establishing the most important end goals will help to determine what success will look like when the project is complete.

The best resources for identifying these goals are the fare system stakeholders, project advocates, and eventual end users of the system. As an action to generate a list of system goals and determine the best order of priority, the fare system goals and priorities were discussed with the following key stakeholders within MTS:

- Executive
- Finance
- Rail Operations
- Bus Operations
- Marketing
- Customer Service
- Planning
- Information Technology

The results of those discussions gave the following ranked priorities for the future fare system:

1. Open architecture
2. Expandable
3. Simple
4. Manageable operation
5. Secure
6. Stable
7. Cost-effective
8. Meets customer market needs
9. Proven, leading technology
10. Operational efficiency
11. Low-risk
12. Delivered quickly

These priorities will help to form the project scope for the next generation fare system procurement and request for proposals, as well as provide basic metrics for the future system to be measured against. The project goal can be summarized as follows:

*MTS’s next-generation fare system shall: be a non-proprietary open architecture system; have an expandable and flexible design that is able to evolve as needs and technology change; be simple for both customers to use and MTS to manage; be stable and compliant with security standards; and use leading, yet proven, technology for fare payment that maximizes media already held by customers.*
Fare Collection Steering Committee Members

Metropolitan Transit System (MTS)

Denis Desmond  Planning Manager
Israel Maldonado  Revenue and Compass Card Manager
Julia Tuer  Executive Assistant to the CEO
Katie McCanna  Digital Design and Content Specialist
Kristine Villa  Regional Revenue Administrator
Larry Marinesi  Chief Financial Officer
Marcus Smith  Compass Card Supervisor
Michele Giovinazzo  Reports Development Analyst
Rob Schupp  Director of Marketing and Communication
Robert Borowski  Enterprise Business Solutions Manager
Scott Donnell  Revenue Manager, Rail
Sharon Cooney  Chief of Staff

North County Transit District (NCTD)

Mary Aykroid  Deputy Chief Accounting and Finance Officer

San Diego Association of Governments (SANDAG)

Brian Lane  Senior Transit Planner

Phase 1 Project Lead  Sharon Cooney, Chief of Staff, MTS
Phase 1 Consultant  Alan Cheng, Principal Consultant, CH2M HILL
Attendees for the San Diego Metropolitan Transit System Fare Collection Workshop
July 25-27, 2016

Facilitator: Alan Cheng (CH2M)

Peer Agencies

<table>
<thead>
<tr>
<th>Agency</th>
<th>Contact</th>
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<tbody>
<tr>
<td>TriMet (Portland)</td>
<td>Chris Tucker, Fare System Project Manager; and Rhyan Van Horn</td>
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<tr>
<td>DART (Dallas)</td>
<td>Tina Morch-Pierre, Sr. Manager, Revenue Administration</td>
</tr>
<tr>
<td>Sound Transit (Seattle)</td>
<td>Brittany Esdaile, Regional Program Manager, Next Generation ORCA</td>
</tr>
<tr>
<td>CTA (Chicago)</td>
<td>Michael Gwinn, Director, Revenue and Fare Systems</td>
</tr>
<tr>
<td>SEPTA (Philadelphia)</td>
<td>Kevin O’Brien, Fare Collection Project Manager</td>
</tr>
<tr>
<td>Metro (Minneapolis)</td>
<td>Nick Eull, Senior Manager – Revenue Collection</td>
</tr>
<tr>
<td>TTC (Toronto)</td>
<td>Arthur Borkwood, Head of Customer Development, Strategy &amp; Customer Experience</td>
</tr>
<tr>
<td>WMATA (Washington, DC)</td>
<td>Jim Bongiorno, Treasury Technical Manager</td>
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Regional Partners

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MTS Fare Collection Whitepaper
Chapter 1
Peer Agency Workshop Summary

Prepared for

MTS
Metropolitan Transit System

August 2016
Peer Agency Summary

As part of its next generation fare collection project, the San Diego Metropolitan Transit System (MTS) invited several peer agencies to MTS headquarters to discuss next generation fare collection topics. At the outset of this peer workshop, the participating agencies each gave a presentation on their existing system and next generation fare collection plans. Each agency was at a different phase of next-generation planning or implementation. Here are summaries of their respective fare systems.

Dallas Area Rapid Transit (DART) – Dallas, TX

Agency Information

Dallas Area Rapid Transit (DART) provides bus, light rail, commuter rail, streetcar, vanpool, and paratransit services. Features of the current system include:

- 69 Million Annual Riders
- $70 Million in Annual Fare Revenue
- 700 Square Mile Service Area
- 661 Fixed Route Buses
- 62 Light Rail Stations
- 10 Commuter Rail Stations
- 184 TVMs
- 13 Participating Cities
- 15.6% Farebox Recovery Ratio
- 900 Retail Locations

Fare Collection System

DART is in development of an account-based open payments fare collection system. In 2011, DART began the initial planning for the new fare collection system and plans for system rollout in mid to late 2017. DART is currently in the final design review phase of the project. VIX was selected as the primary fare collection system vendor and Unwire was selected as the mobile ticketing vendor. Unwire worked with PayNearMe to facilitate cash payments for mobile ticketing. The combined fare collection vendor and mobile ticketing contracts are valued at $31 Million.

Validators will accept fare payment from NFC mobile wallets and agency issued/third party cards. Customers will be able to load value and purchase fare products from the website, mobile app, and retail locations. PayNearMe allows customers to select the option to pay with cash while making mobile ticketing purchases. For those mobile cash payments, PayNearMe provides cash paying customers with a barcode and a list of nearby participating retail locations. Retailers scan the mobile barcode and customers pay with cash to complete the transaction at PayNearMe’s retail network of 900 locations.

DART designed the fare collection system to reduce TVMs and farebox payments. TVMs will be converted to only sell two hour passes. Additionally, Dart is purchasing simplified fareboxes which only accept cash and will not print fare media. DART currently offers 63 fare products for adult and reduced fare riders. The agency is planning to simplify the fare structure and focus on daily and monthly fare capping. DART captured their system design in a Concept of Operations prior to vendor award.
Agency Information

The Chicago Transit Authority (CTA) provides bus, heavy-rail, and paratransit for Chicago and 35 surrounding suburbs. CTA’s regional partners include Pace Suburban Bus and Metra Commuter Rail. The current system includes:

- 516 Million Annual Riders
- 1.5 Million Weekday Riders
- $587 Million in Annual Fare Revenue
- 1,900 Fixed Route Buses
- 145 Rail Stations
- 420 TVMs
- 1,300 Retail locations

Fare Collection System

In 2013, CTA replaced all their legacy fare systems with a new open payments and closed loop Ventra fare collection system. Cubic was selected as the primary fare collection system vendor. Key subcontractors include moovel, First Data Corporation (FDC), and Vantiv. The 12 year contract is valued at approximately $520 million. Ventra was developed on a very rapid timeline; the contract was awarded to Cubic in November 2011 and the full system rollout occurred in September 2013. The aggressive timeline was the result of strict payment milestones and a public launch schedule. While the rapid timeline prevented long and costly delays, it also shortened the testing and piloting phases.

CTA did not provide any upfront capital costs for the new Ventra system. Instead, CTA pays a monthly base fee and a variable tap fee to Cubic. This payment model was attractive to the agency due to obsolescence of the prior system and limited availability of capital funding.

The Ventra Card is the primary fare media with 2 separate accounts; a branded MasterCard which allows for debit and transit transactions, in addition to closed loop Ventra transit account. Customers are initially charged $5 for the purchase of Ventra Cards, but they can recoup the $5 cost as transit stored value when the card is registered. Customers can also utilize the MasterCard pre-paid debit account to ride transit and make purchases wherever MasterCard is accepted. In October 2014, CTA introduced the Ventra mobile app. The app allows customers to manage accounts and purchase fare media. The app also provides visually validated mobile ticketing for Metra Commuter Rail.

Over 6 million user accounts have been created since the introduction of Ventra. There are approximately 2 million accounts which have been actively used in the past 90 days. Open payments have accounted for a very small fraction of total transactions. During the past 90 days, open payments accounted for less than one tenth of a percent of total transactions. Cash payments account for approximately 9% of bus payments. The introduction of Ventra did not significantly decrease the percentage of cash payments and the agency believes that it is unlikely that cash will ever be fully removed from the system in the near term.
Washington Metropolitan Area Transit Authority (WMATA) – Washington, DC

Agency Information
The Washington Metropolitan Area Transit Authority (WMATA) provides bus, heavy-rail, and paratransit services in the District of Columbia and in four surrounding counties. The current system includes:

- 337 Million Annual Riders
- $900 Million in Fare Revenue
- 1,500 Square Mile Service Area
- 91 Rail Stations
- 1,500 Fixed Route Buses
- 670 TVMs

Fare Collection System
WMATA has recently been in the extended process of procuring and implementing a next generation fare collection system. After a protracted procurement process, the agency issued a contract to Accenture for an account-based, open payments fare collection system in January 2014. In total, the contract was valued at over $400 million. However after implementation challenges and cost concerns, the contract with Accenture was canceled in April 2016. The agency is now exploring alternative system designs and procurement approaches to upgrade their existing fare system.

WMATA currently utilizes the SmartTrip card-based fare collection system. TVMs have been upgraded to utilize SmartTrip cards and no longer sell paper tickets. Bus riders paying with cash currently account for 15% of bus ridership. The majority of TVM sales are from credit/debit cards. Cash payments account for approximately 15% of all TMV transactions. Government prepaid benefit programs account for 40% of system ridership.

WMATA charges distance and time of day based fares for rail service. Bus fares are flat and do not vary by distance or time of day. A higher fare is charged for Express Bus service. WMATA is piloting a price point based pass program, where customers select a trip price point from $2.50 to $6.00 as their base fare and get unlimited travel for all trips of equal or lower value. When making trips above the price point, the difference is withdrawn from stored value.
Metro Transit – Minneapolis, MN

Agency Information

Metro Transit operates bus, light rail, commuter rail, BRT, and paratransit services in the seven county Minneapolis-Saint Paul Region. The current system includes:

- 86 Million Annual Riders
- 907 Square Mile Service Area
- 7 Commuter Rail Stations
- 37 Light Rail Stations
- 900 Fixed Route Buses
- 140 TVMs
- 120 Retail locations

Fare Collection System

Metro Transit currently operates a card-based closed loop fare collection system from Cubic. Metro Transit introduced the Go-To Card in 2006. The Go-To Card utilizes the MiFare Classic 1K media standard, and Metro Transit upgraded fare validators utilize NFC technology in 2016. The Go-To Card currently accounts for 54% of system ridership. The Cubic system has been incrementally upgraded over time in order to maximize investment in the current system. These upgrades include updated Cubic TriReaders, TVM upgrades to Windows 7, and procurement of new mobile validators. Furthermore, Metro Transit purchased low-cost BRT TVMs from Parkeon, and developed in-house website and customer relationship tools. The original fare collection system contract was valued at $15 million, however numerous additional contracts have been executed to upgrade the system.

Customers can purchase and/or reload Go-To Cards at TVMs, 120 retail locations, Metro Transit Service centers, and through the website. The website allows customers to order new cards, add value or passes, and sign up for autoload. In addition to the Go-To card, customers can make cash payments at bus fareboxes, purchase single use magstripe tickets at rail TVMs, and purchase flash passes at BRT TVMs. Cash payments currently account for 20% of bus fare payments, and credit cards account for 60% of TVM purchases.

The current base fare includes a two and a half hour transfer. Metro Transit charges a $0.50 upcharge for peak period travel. The same fare is charge for cash and Go-To Card stored value, however a 10% bonus is provided for stored value loads. Time and trip based passes are only offered on the Go-To Card.

Metro Transit offers several institutional passes including; Metropass (corporate program), Student Pass (high school program), College Pass (college program), and U-Pass (University of Minnesota program), Jobseeker Program, and various homeless relief programs.
TriMet – Portland, OR

Agency Information

TriMet operates bus, light rail, and commuter rail in the Portland Region. Regional partners include C-TRAN suburban bus service and the Portland Streetcar. The current system includes:

- 100 Million Annual Riders
- $115 Million in annual Fare Revenue
- 650 Fixed Route Buses
- 100+ Rail Platforms
- 6 Commuter Rail Cars
- 17 Street Cars
- 130 Retail Stores

Fare Collection System

TriMet currently operates a paper ticket Proof of Payment (POP) system. Starting in 2012, they designed and developed an account-based, open payment, closed loop, and open architecture fare collection system. The full system rollout is planned for 2017. With a strong internal steering committee and technical consultant, TriMet developed a Concept of Operations (ConOps) prior to system procurement and ultimately selected Init as the primary fare system integrator. TriMet is utilizing the open architecture requirement by employing several sub-contractors to implement system elements and integrating with the primary Init back office. Major sub-contractors include: Scheidt & Bachmann (TVMs), moovel (mobile apps), The Brigade (websites), Enghouse (IVR), and Ready Credit (retail network). Init provided the Application Programming Interfaces (APIs) that the sub-contractors are interfacing with. The combined fare collection system contracts are valued at around $30 million.

TriMet is issuing an agency branded Hop Fastpass Card as the primary form of media, but will also accept open payment bankcards and mobile wallets. Customers will be able to purchase and load Hop Cards from retail locations. Unlike many current cased-based retail networks, the Hop Fastpass will be available for purchase alongside standard gift cards. Reducing reliance on TVMs is a major goal of the agency. The current TVMs will be upgraded to issue limited use (LU) cards for a limited number of fare products.

The Hop mobile app will allow customers to manage their account, add value, and purchase passes. The current version of the mobile app is currently a visual mobile ticket, since the existing paper system is visually validated. The current app will also be adding with Lyft, Car-2-Go and BIKETOWN bikeshare program prior to the launch of the future Hop mobile app.

The current base fare is $2.50 for two and a half hours of unlimited travel on all modes. As part of the Hop Fastpass launch TriMet will eliminate all public pass products and introduce fare capping. Fare capping will allow customers to earn day and monthly passes as rides are taken, offering the value of a pass without requiring the upfront pass cost. This allows customers to receive “best fares” as they ride, and greatly simplifies the public fare purchasing experience since there will be no products to purchase.
Sound Transit – Seattle, WA

Agency Information
The Puget Sound Region around Seattle is home to 7 transit agencies which operate bus, BRT, commuter rail, light rail, streetcar. The current regional system includes:

- 190 Million Annual Riders
- $350 Million Fare Revenue ($220 Million on ORCA)
- 2400 Fixed Route Buses
- 60 Rail Stations (All Modes)
- 100 TVMs
- 123 Participating Retailers

Fare Collection System
The Seattle Puget Sound Region is currently in the process of designing an account-based, open architecture fare collection system. The next generation ORCA fare collection system is planned for delivery in 2021. The new fare collection is being planned in tandem with significant service expansions. The planned future system will specify open APIs in order to facilitate future upgrades. There is currently a dedicated team of 5 staff members planning for the next generation fare collection system.

As part of the next-generation ORCA system, a regional program team was formed to lead the system design and technical requirements along with technical and management consultants. The planning process is currently underway with participation from all regional transit agencies and a technical consultant team.

The seven regional agencies currently use the ORCA card-based fare collection system. ORCA currently accounts for approximately 62% of transit trips and has over one million active cards in use. Institutional business programs currently account for 50% of ORCA system revenue.

Regional agencies offer a wide range of fare structures and fare products. Many agencies offer a combination of flat, time of day, and zonal fares. The regional PugetPass includes over 21 unique pass products. Regionally, four fare policy options are being considered for the new fare collection system. These options include eliminating zone based fares, eliminating time of day fares, creating a fully regional policy, and introducing fare capping.
Southeastern Pennsylvania Transportation Authority (SEPTA) – Philadelphia, PA

Agency Information

The Southeastern Pennsylvania Transportation Authority (SEPTA) provides bus, trolley, NHSL (Norristown High Speed Line), trackless-trolley, heavy rail, commuter rail, and paratransit service in the City of Philadelphia and in 4 regional counties. The current system includes:

- 330 Million Annual Trips
- 1.3 Million Weekday Riders
- $476 Million in Annual Revenue
- 2,200 Square Mile Service Area
- 55 Subway Stations
- 8 Trolley Lines
- 2 Trackless-Trolley Lines
- 150 Commuter Rail Stations
- 1500 Retail Locations

Fare System

SEPTA is currently in the testing and pilot stage of an account-based, open payment fare collection system. Xerox is the primary fare collection system vendor. SEPTA developed clear goals for the new fare collection system at the beginning of the design process. The new system was designed to provide more flexible payment options, reduce the reliance on cash, and provide greater control of data management and reporting. In late 2011, SEPTA awarded a $130M contract to Xerox for the open payment fare system. The anticipated system rollout for all modes is planned for 2017.

The new open payment fare media will be branded the Key Card. Key Card will be a branded contactless debit card which will combine fare and retail payment into one card. Use of the debit card is optional, and card fees apply for debit card transactions. The new fare collection system will allow customers to pay with SEPTA Key Cards, bank issued contactless cards, NFC phones, third party cards, pre-paid cards, and institutional cards. The open payment system will allow riders to more easily pre-fund travel, provide greater options for unbanked customers, eliminate fees for transit purchase, and allow for efficient revenue sharing.

SEPTA currently accepts cash, magnetic stripe passes, paper tickets, tokens, and paper transfers. Riders using pass products account for 44% of total ridership, adult customers paying with cash account for 13% of ridership, and customers using token payments account for 23% of ridership. As part of the Key Card program, fare simplification is anticipated including the phasing out of legacy fare media.
Toronto Transit Commission (TTC) – Toronto, ON

Agency Information
The Toronto Transit Commission (TTC) operates in and around Toronto, Canada. The current system includes:

- 535 Million Annual Riders
- $1.2 Billion Annual Revenue
- 69 Subway Stations on 4 Subway Lines
- 12 streetcar lines
- 1800 Fixed Route Buses
- 120 TVMs at Rail Stations

Fare Collection System
The TTC is currently in the process of a large scale fare collection system modernization campaign. This campaign began in 2013. TTC is in the process of integrating the regional PRESTO Card, the regional smartcard system that was initially introduced in 2009. The PRESTO Card is administered by the Metrolinx regional transportation planning authority and is currently available on 11 regional transit agencies. TTC pays Metrolinx 5.25% of fares paid via PRESTO. Due to the wide availability of contactless credit cards in Canada, open payments are a major component of the new fare collection system.

PRESTO is being rolled out incrementally and in parallel with existing fare equipment. Bus validators will become operational as they are installed, and will be available on all buses by the end of 2016. PRESTO is currently available at roughly 30 rail stations and will be introduced in a phased approach throughout the rail system. Open payments abilities are scheduled to be available in early 2017.

Customers can pay fares using cash, magnetic stripe tickets, PRESTO Card (at available stations), tokens, streetcar proof of payment, and mobile ticketing (for select passes). Mobile ticketing is available for customers using day passes, family passes, and special event passes. A flat fare is charged across all modes. PRESTO Card, tickets, and tokens are slightly discounted relative to cash payments. PRESTO will allow customers to load stored value and purchase fare products.
<table>
<thead>
<tr>
<th>Agency</th>
<th>Annual System Ridership</th>
<th>Initial Planning Start</th>
<th>Planned Completion</th>
<th>Fare System Cost</th>
<th>Staffing Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DART</td>
<td>69 Million</td>
<td>2011</td>
<td>2017</td>
<td>$31 Million</td>
<td>Manager with supporting team including consultants. Will maintain fare collection team after launch for future integrations.</td>
</tr>
<tr>
<td>CTA</td>
<td>516 Million</td>
<td>2010</td>
<td>2013</td>
<td>$520 Million</td>
<td>Dedicated internal and fare consulting staff during rapid implementation schedule. Retained staff after problematic launch.</td>
</tr>
<tr>
<td>WMATA</td>
<td>337 Million</td>
<td>2009</td>
<td>2017 *</td>
<td>$400 Million *</td>
<td>Dedicated staff to manage procurement and pilot phases.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* In 2016 canceled contract awarded to Accenture due to cost concerns. Pursuing alternative account-based system.</td>
</tr>
<tr>
<td>Metro</td>
<td>86 Million</td>
<td>2002</td>
<td>2006</td>
<td>$15 Million</td>
<td>Dedicated fare manager and staff since introduction of card-based system in 2006. Staff have made incremental upgrades to expand system life and functionality.</td>
</tr>
<tr>
<td>Transit</td>
<td></td>
<td></td>
<td></td>
<td>(Excludes Upgrades)</td>
<td></td>
</tr>
<tr>
<td>TriMet</td>
<td>100 Million</td>
<td>2012</td>
<td>2017</td>
<td>$30 Million</td>
<td>Dedicated fare staff and consultant team that fluctuates depending on project phase. Currently three additional part time staff.</td>
</tr>
<tr>
<td>Sound</td>
<td>190 Million (Regional)</td>
<td>2014</td>
<td>2021</td>
<td>TBD</td>
<td>Dedicated regional project fare collection team. Currently discussing hiring additional specialists for specific areas.</td>
</tr>
<tr>
<td>Transit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEPTA</td>
<td>330 Million</td>
<td>2008</td>
<td>2017</td>
<td>$130 Million</td>
<td>Full time internal and consulting staff. Had considerable delays in design phase, now implementing an incremental rollout.</td>
</tr>
<tr>
<td>TTC</td>
<td>535 Million</td>
<td>2013</td>
<td>2017</td>
<td>TBD</td>
<td>Limited internal staff. Currently implementing an incremental rollout of existing PRESTO regional fare collection system.</td>
</tr>
</tbody>
</table>
Topic Based Discussions

Following peer agency introductory presentations, the workshop focused on a series of topic-based open discussions. The topics were related to the design, procurement, implementation, and operation of next-generation fare systems. In addition, specific technical subjects were discussed where any peers could ask or answer questions. This format encouraged informative discussion and clarification by all agencies no matter where they were in their planning process.

Project Phase: Planning

Concept of Operations

- TriMet devoted several months to developing a Concept of Operations (ConOps) with a fare consultant prior to drafting technical specifications to share with the industry and internal stakeholders.
- Sound Transit also developed a ConOps which included various user scenarios to inform the system requirements.
- DART made fundamental changes to the Concept of Operations, even after vendor selection. This included changing the strategy from purchasing some new equipment to refurbishing.
- DART recommended having each department sign off on the ConOps to prevent disagreements or protests in the implementation and operations phase.
- Several peers noted that the Concept of Operations needed to be a living document which would be updated throughout the design process.
- Several peers noted that a ConOps allowed the agency to advance a consistent message to the board, to the regional partners, and to general public. This was a very important element of the project approach.

Internal Staffing

- SEPTA noted that the size of internal fare collection team determined the degree of outsourcing of responsibilities to vendors. The size and capability of internal staff was a limiting factor for how much could be operated internally.
- Sound Transit and SEPTA mentioned that it is critical to determine which departments will take particular responsibilities of the system when fully operational.
- TriMet currently has a dedicated staff of 5 employees in addition to a consultant team working on the fare collection system team. Some staff performed other responsibilities, depending on which phase of the project was underway.
- CTA recommended maintaining the fare collection team after implementation in order to address troubleshooting and unforeseen issues.
- Sound Transit formed a Regional Project Team (RPT) comprised of leads across several disciplines, and coordinated participation and review by all 7 regional agencies.
- All agencies stressed the need for dedicated fare collection staff that did not have significant other day-to-day fare responsibilities. The necessity and type of staff will likely change over the course of the project, but dedicated staff was highly recommended by all agencies.
Regional Partners

- CTA developed a phased strategy for engaging regional partners. The agency noted the importance of presenting options, providing opportunities for limited participation, and fostering advocates from regional agencies.
- Many agencies noted that having advocates at regional partners greatly facilitated the process. Involving regional champions early and often encourages regional success.

Transition Plan

- SEPTA highlighted the importance of developing a plan to transition responsibilities once the system becomes operational.
- Sound Transit developed a transition plan and procurement plan in parallel. It was also determined early that the region did not want to run parallel systems. This influenced the initial design requirements and required a more comprehensive transition plan.
- CTA was in the position where aging legacy fare systems needed to be transitioned to the new Ventra system very quickly. They accomplished the transition in a timely manner, but saw several public issues that may have been mitigated with more extensive testing.

Project Phase: Procurement

Request for Information (RFI)

- Sound Transit and TriMet both issued a Request for Information (RFI) to the fare industry and select peers to provide feedback and comments on their fare collection strategy and ConOps.
- DART issued a Request for Qualifications (RFQ) as opposed to an RFI. This allowed DART to interview technical staff from vendors and pre-select qualified vendors. The RFQ was part of the official procurement process, and vendors had to prove their technical approach prior to selection.

Request for Proposal (RFP)

- Several agencies recommended developing both technical and functional requirements for the RFP specification. Functional requirements are useful to give vendors some flexibility since fare collection technology is changing so rapidly.
- WMATA had its fare collection system vendor provide a number of validator vendors in order to demonstrate the open architecture requirement.
- Sound Transit will specify which elements the vendor will contract to a third party, such as website and Customer Relationship Management (CRM) tool.
- Several agencies commented that traditional fare collection vendors do not have strong offerings in areas such as websites, mobile apps, CRM tools, reporting, and data analytics.
- SEPTA specified both performance and technical elements in the RFP and mentioned the need to draft technical requirements when elements needed to comply with agency design requirements.
- Metro Transit developed a functionally driven RFP which was used as a starting point for negotiations. The agency noted that over-specifying technical requirements can lead to sub-par systems.
Best and Final Offer (BAFO) Negotiation

- TriMet felt that it would have been more efficient to have had external legal counsel manage terms of the vendor contract.
- DART recommended taking extra time to ensure that the master service agreement is thorough and comprehensive.
- TriMet intentionally over-specified functional requirements in the RFP in order to facilitate negotiations with vendors. Some vendors offered credit or other features in exchange for requirements they couldn’t meet that weren’t high priority for TriMet.

Project Phase: Implementation

Design Reviews

- SEPTA recommended preventing delays during the final design review phase as much as possible. The agency’s final design review phase was scheduled to take 4 months but ended up taking 1.5 years.
- DART recommended performing a secondary design review if the first review was unsatisfactory.

Testing/Pilot

- There was consensus that it was better to incur delays from additional testing than rolling out a system with technical bugs and unproven processes.
- All agencies noted that field testing was extremely important as many environmental factors cannot be replicated in lab testing.
- CTA stressed that a pilot was one of the most important parts of the process and was the only way to find bugs in day-to-day operation.
- WMATA stressed the importance of developing a clear pilot with clear success metrics and consideration for operational factors.

Installation

- Several agencies mentioned that there was a trade-off between an incremental installation over a long period and “overnight” installation of validators and TVMs.
- TTC is in the process of parallel installation of PRESTO equipment alongside existing equipment in rail stations. There are challenges communicating to the public which equipment can be used with what media.
- CTA replaced legacy equipment with new Ventra equipment rapidly, and stopped accepting legacy fare media over a short time period. While there were many complaints and negative publicity, the new Ventra system was installed quickly and is operating well today.
- Agencies with gated rail stations mentioned having issues with integrating new validators on existing fare gate hardware.
- Sound Transit had concerns integrating new fare validators with the various types of CAD/AVL system onboard regional partners. Various bus types complicate onboard integration projects.
- TriMet hired a third party to audit TVM installations in order to reduce complications at launch.
Project Phase: Transition

Executive Outreach

- TriMet engaged with executives and the board several years before anticipated project launch. They mentioned that having a Concept of Operations was key to maintaining a consistent plan during a multi-year project.
- DART had their Chief Marketing Officer as a major advocate. This greatly facilitated communications with the board of directors.
- Sound Transit recommended engaging executives from regional agencies early in the process. The executives buy-in ensured participation from their staff on the project.

Public Outreach

- TriMet began public outreach one year into the initial design process, 3 years prior to the anticipated system launch. This allowed for meaningful engagement from low-income, unbanked, and reduced fare customers. It also allowed for clear messaging of fare policy changes.
- WMATA recommended frequently engaging groups and clearly explaining why a change needs to be made, what is being taken away, and what is going to be provided instead.
- Sound Transit engaged the public early on, in order to develop high level system requirements. In addition, frequent engagement during a long procurement can mitigate dissatisfaction from additional delays.

Parallel Systems

- SEPTA and TTC are incrementally rolling out new fare collection systems. New validators become active upon installation. As a result, the new fare collection system is not available on all buses or at all rail stations, and will be phased in over time. This has led to some customer confusion and installation challenges.
- Sound Transit plans on requiring new validators to also read legacy ORCA fare media. This will require parallel coordination between the back ends of new and old system. The region does not want operate the old and new systems in parallel, but the technical details of parallel operation still need to be determined.
- WMATA recommended keeping the same data warehouse during the transition in order to reduce the need reconcile multiple reports.
- DART discovered during design reviews that some legacy equipment could be repurposed instead of purchasing new equipment. In addition, they originally planned on using their existing bus fareboxes but discovered it was more cost effective to purchase new simplified fareboxes.

Project Risks

Design Risk

- Many agencies agreed that over-specifying technical requirements can prevent agencies from adopting innovative and/or upcoming technologies. Functional requirements allow vendors to propose new technologies as long as they meet the intended function of the requirement.
• Several open payment systems anticipated higher adoption of open payment bank cards in the US. The actual adoption has been negligible, although mobile wallets such as Apple Pay and Android Pay may become more popular over time.

• TriMet mentioned that the open payment design process was extremely complex and new for the vendor. As a relatively new feature in transit fare collection, they have been working through the technical details since the start of the design process.

Procurement Risk

• Several agencies noted that a long procurement process increases the risk of technical obsolescence due to rapid technological changes in the fare collection industry.

• Many agencies mentioned that having a comprehensive Concept of Operations, executive level advocates, and well defined vendor schedules reduced the risk of having to cancel vendor contracts.

• WMATA and SEPTA both experienced procurement processes that were significantly longer than anticipated due to technical requirement clarifications, vendor changes, funding constraints, and internal staffing changes.

Implementation Risk

• Many agencies stated that vendor staffing, technical capabilities, and scheduling as major potential risks.

• DART worked with vendors to create a detailed and reasonable schedule at the outset and have dedicated agency staff manage vendor schedules and progress.

• SEPTA recommended including comprehensive contract resolutions measures in place from the start of the project.

• A combination of cost, schedule, and technical issues caused two agencies to cancel their fare vendor contracts.

Operations Risk

• Most agencies recommended having the ability to write limited transaction data to account-based cards. This would preserve some transaction data in the event of real-time communication failures. Communications on bus can be unreliable due to inconsistent cellular coverage.

• CTA noted that it was much more difficult to change customer behavior and fare media usage patterns than expected.

Risk Management

• TriMet performed an external audit of potential risks at the beginning of the process. Mitigation strategies were developed for each potential risk.

• WMATA recommended creating a risk register at the beginning of the process and reviewing the register at each stage of the process.

• SEPTA noted cyber security as a major source of risk. The agency recommended clearly defining legal liabilities in the event of a cyber breach.

• All agencies stressed the importance of PCI and PII security. Increasing PCI and/or PII scope by storing bankcard or personal information on agency system was highly discouraged. Hiring one
or more Qualified Security Assessor (QSA) to constantly evaluate potential PCI issues was recommended.

Mobile Ticketing

Vendor Experience

- All agencies with mobile app vendors under contract noted some staffing and scheduling issues. Some agencies noted that particular mobile vendors were undergoing significant internal change and restructuring.
- DART originally selected moovel as their mobile ticketing vendor, but had to cancel the agreement due to scheduling and staffing constraints. They contracted with their original mobile ticketing vendor, Unwire.
- TriMet felt that moovel (formerly GlobeSherpa) had good engineering and was able to customize many features of the app initially. TriMet was GlobeSherpa’s first client, and one of the first bus mobile ticketing projects in transit.
- DART has been relatively happy with Unwire. Unwire was able to integrate with ride sharing and other innovative services. They are currently integrating with PayNearMe, which allows customers to pay their mobile tickets with cash at a network of retailers.

Validation Technology

- Most agencies stated that it was costly and difficult to directly integrate mobile validators into existing fare systems. It was more cost effective to separately implement mobile validators that were installed beside legacy fare equipment.
- Some agencies required that the primary fare collection vendor provide a list of potential mobile validator sub-contractors in order to pilot mobile ticketing.

Shared Ride Services

- Integration with ride sharing apps was listed as a goal of most agencies, however many details, such as revenue sharing, require considerable negotiation and technical challenges.
- TriMet launched a new version of their moovel mobile ticketing app this year that integrated Lyft, Car-2-Go, and their local bike share service.

Smartcard Integration

- Many agencies currently utilize mobile ticketing either on limited modes, limited fare products, or using visual validation. Those with card-based smartcard systems generally operate in parallel with mobile ticketing.
- CTA, TriMet, and DART are planning or operating account-based smartcard systems and focus on account management and mobile purchase functionality.

Fare Policy

Fare Simplification

- Most peer agencies plan to use the enhanced functionality of account-based systems in order to simplify fare structures or introduce new products and/or policies.
Many agencies stated that the fare policies and structure should be in line with the greater fare collection systems goals.

Several agencies noted that customers are more strategic with purchasing products and loading value under an account-based system. This can lead to a potential decrease in revenue as customers are less likely to purchase higher cost passes if more flexible products are available.

CTA replicated the current fare structure and fare policies to allow customers to become more accustomed to the Ventra system.

SEPTA noted having challenges integrating the complex regional fare structure, which includes zones, transfers, and multiple users into the new Key Card system.

### Innovative Strategies

- Several agencies are exploring or planning for fare capping, or best fares. This allows customers to ride with stored value, and get “capped” at preset daily and/or monthly amounts. This effectively allows riders to get day and month pass discounts without having to purchase the passes up front. This is much more simple and equitable for customers, but could potentially reduce revenue since customers will only pay for what they ride.

- Several agencies have incentivized their smartcards and other forms of electronic media over cash payments. This includes providing free transfers on smartcards, or charging more for cash payments or more expensive LU media.

- CTA charges a $0.50 fee for purchase 1-way Limited Use (LU) tickets from TVMs.

- While several agencies charged higher fare for cash, Metro Transit is providing a 10% loading bonus for stored value on smartcard.

### Fare Policy Timing

- Most peer agencies advised against raising fares while implementing a new fare collection system. This could lead to the perception that the new fare system is the cause of higher fares.

- SEPTA made minor changes to fare policy when KEY was introduced, but delayed fare increase due to customer concerns.

- TriMet is introducing fare capping during the launch of the new HOP fare system. This is being marketed as a major benefit and potential fare decrease for most riders.

### Title VI

- TriMet performed a Title VI assessment of changes and used GIS graphical analysis to assess the impact of changing their retail network.

- DART saw daily and monthly caps as Title VI improvements for low-income groups who cannot pay upfront cost of day or monthly passes.

- DART found that PayNearMe would be sufficient for providing mobile benefits to unbanked customers since it would allow them to pay with cash.
Partnerships

Vendor Experience

- All agencies noted various concerns with their traditional fare collection system vendors. Concerns included technical capabilities, staffing shortages, unforeseen costs, inflexibility, lack of transparency, and general inability to manage complex projects.

- Some newer vendors seemed to have solid technical capabilities and transparent access to engineers, but were constrained due to their relatively small size.

- All agencies wanted more control over their fare systems and wanted to reduce reliance on a single vendor for system upgrades and changes. In order to accomplish this, an open architecture requirement was required by several peer agencies for their next generation systems.

Institutional Programs

- Account-based systems can allow institutions to self-administer their fare programs. Sound Transit mentioned that the University of Washington was interested in moving from pre-selling passes to post pay system with a cap. This may have revenue impacts as institutional customers would only pay for rides taken.

- Several agencies are considering loading institutional passes onto non-agency media, such as university IDs, in order to reduce card production and distribution costs. However the integration and security costs for sharing media and encryption keys had to be explored.

- CTA mentioned having issues with using account-based cards with social service programs as many of those programs serve transient or limited time customers.

- Several agencies are considering providing limited-use (LU) tickets to social service agencies as opposed to extended-use (EU) media. While LU media is costly compared with paper media, they may offer flexibility and increased functionality in an account-based system.

Eligibility Process

- Most agencies noted that account-based fare collection systems provide greater more robust control reduced fare eligibility enforcement. Smartcards and mobile apps can be configured to limit the sale of reduced fare only to registered reduced fare accounts.

Data and Reporting

- All agencies agreed that it was very important to specify that the agency owns and has unlimited access and query rights to all system data.

- There was a consensus that all vendors had limited data warehousing or analytics capabilities, and that most often agencies exported data into their internal data warehouse for reporting.

- CTA noted that it is very difficult to get custom queries and reports from their vendor. This hinders their ability to research/analyze usage data.

- TriMet is having the vendor re-create the data warehouse and provide the data dictionary in order allow the agency to write custom queries in house.
Real-Time Communications

- Network response time was listed as a primary area of focus for account-based systems. Rail platforms are generally not a concern since they are hard wired, but bus communications rely on comprehensive cellular coverage and reliable network performance.
- CTA launched their Ventra account-base system with 3G cellular since 4G was unavailable at the time. Their coverage is sufficient but will explore if upgrade to 4G will improve performance.
- Several agencies piloted mobile routers from several vendors in order to test cellular coverage and real-time communication capabilities.

Central Computer Systems

Customer Relationship Management (CRM)

- Most agencies felt that vendors had issues implementing CRM systems and recommended sub-contracting CRM systems to third parties.
- Metro Transit specified having access to the necessary Cubic APIs to integrate with their internally developed CRM system.
- Since CRM systems store PII information, agencies generally hosted their CRM databases separate from the fare system transaction database.

Financial Clearing and Settlement

- Several peers mentioned that vendors are not always familiar with accounting principles, and recommended involving accounting staff early in the design process.
- The interface to standard General Ledger (GL) systems are not sufficient with most standard fare system vendor systems.
- Regional peers mentioned that clearing and settlement is especially important since the participating agencies need access and transparency to the settlement process.

PCI/EMV Certification

- Each agency had a different PCI certification status, but all agreed that the process to get certified is complex and costly.
- Several agencies retained multiple Qualified Security Assessor (QSA) to evaluate and monitor Payment Card Industry Data Security Standard (PCI DSS) compliance. Some agencies commented that different QSA’s often have different opinions about PCI rules.
- Several agencies emphasized the importance of having experienced payment processors and Merchant banks to process payments and provide reasonable rates.
- Strong encryption of PCI and PII data was recommend by several agencies, in addition to supplementary security techniques like tokenization.
- All agencies strongly recommended designing separate fare transaction and payment information databases.
Hosting

- All agencies stated that there was a definite trade-off between traditional hosting at local data centers, compared with cloud-based or outsourced hosting services.
- Most agencies noted that cloud based hosting was more expensive than local hosting, but offered benefits such as scalability and performance.
- TriMet noted that moovel uses the Amazon Web Services (AWS) for mobile data hosting. TriMet felt that the cloud based hosting was able to quickly scale during surge events.
- Most agencies specified instant server transition during failover events. However, one agency noted that actual transition time took up to three hours.
- Many agencies recommended specifying the functional hosting requirements and letting vendors propose the option for cloud hosting to evaluate the cost/benefit.
MTS Fare Collection Whitepaper
Chapter 2
Preliminary Requirements

Prepared for

MTS Metropolitan Transit System

September 2016
Preliminary Requirements

As part of its next generation fare collection project, the San Diego Metropolitan Transit System (MTS) developed this list of preliminary system requirements of a model future fare system. These preliminary requirements were built upon staff needs in addition to discussions from the peer agency workshop.

While these requirements represent high level requirements for a future system, the decision to replace the entire system, or upgrade elements the existing system has not occurred. Additional efforts including a transition plan, procurement approach, operations model, fare structure analysis, and more detailed requirements capture will be needed prior to a final decision.

Account-Based System with Real Time Communications

The next generation fare payment system will utilize an account-based architecture for the processing and validation of fare payments. All fare products and value loaded by customers will be stored in the account-based backend and all validation and sales devices deployed within the system will be equipped with a real-time communications. This will allow centralized processing of business rules and simplify field validation devices. It will also enable more comprehensive integration with third party systems.

- Account-based architecture centralizes all fare processing in the back office
- Enables the use of simplified and low cost validation devices
- Reduces the need for complex device configuration and software updates
- Eliminates the 24-48 hour “autoload” delay associated with card-based systems
- Requires reliable real-time communications on bus and rail platforms
- Cellular coverage, cost, and network throughput and latency should be analyzed in advance
- Risks associated with offline devices must be considered

Open Architecture

One of the most important requirements of the next generation MTS fare collection system is an open architecture, or providing full access to system Application Programming Interfaces (APIs) and data formats. This allows the flexibility to procure software and hardware outside the primary fare system vendor, and facilitates easier third party integration. While all vendor hardware will have some proprietary design, access to system APIs will allow the agency to purchase from third party vendors. As an example, a simplified TVM could be procured from a larger pool of TVM vendors, which can interface with the central back office through provided APIs. Integration with the legacy Cubic system will still require cooperation/cost from Cubic.

- Reduces reliance on single fare system vendor
- Enables use of non-proprietary hardware and software
- Free access to Application Programming Interfaces (APIs)
- Ability to modify or adjust graphical user interfaces for devices (TVMs and validators), or back office tools (CRM, maintenance and monitoring tool, etc.)
- Allows usage of commercial off-the-shelf (COTS) validators and smart devices
- Accommodates easier integration with legacy hardware
- Allows option for a lower cost “TVM lite”
- Provides fare media independence and integration with third party devices
- Detailed hardware requirements including durability, power, compatibility, and usability will be specified to match the unique MTS environment

Closed-Loop Foundation

A key component of the next generation fare system will be a closed-loop back office. Every next-generation fare system is built upon a closed-loop back office, which enables transit-specific business rules including reduced fares, transfers, and pass products. While the current card-based fare collection system also has a closed-loop back office, an account-based closed-loop back office will allow for increased functionality including instant autoloads, centralized fare processing, and greater third party integration. A closed-loop back office is also essential for processing open payments.

- A closed-loop back office is a necessary requirement, due to transit-specific business rules such as reduced fares, pass products, transfers, etc.
- Account-based closed-loop systems offer significant advantages over card-based systems such as instant autoloads, centralized fare processing, and improved third party integration
- All open payment systems are built around a closed-loop back office
- Closed-loop transactions are not subject to fixed and variable transaction fees that come with open payment transactions
- Closed-loop foundation allow for flexible implementation and risk mitigation strategies and unrestricted access to fare media memory

Open Payments Ready

Open payments will give customers the ability to pay fares with open-loop contactless bank cards and mobile wallets, such as Apple Pay and Android Pay. While this requirement gives customers more options, open payments are currently not widely adopted in the transit industry. Open payments currently account for less than 0.1% of total transactions in the largest open payments system. This is due in large part to the lack of issuance of contactless bank cards in the U.S. Mobile wallet usage rates are also currently low, but may increase in the future. Open payment acceptance will increase PCI/EMV scope and includes fixed and variable banking fees for every transaction. Given this uncertainty regarding the future of open payments and the additional cost, the next generation fare collection system should be open payments “ready”, but will not accept open payments at launch.

- Open-loop contactless bank cards are not currently issued at scale in the US
- Existing open payment systems have less than 0.1% of open payment transactions
- Accepting open payments increases PCI/EMV scope and includes bank fees for every transaction
- Mobile wallets such as Apple Pay and Android Pay are developing and may see increased adoption in the future
- Validator hardware will be certified to read and process open payments, but the entire back office system will not accept open payments at launch
• Proposing vendors will identify how much further work/cost will be necessary to accept open payments, if adoption of open payment adoption increases in the future.

Flexible and Expandable Fare Policy

The account-based architecture will support a wider range of fare policies compared to card-based systems. In addition to supporting pass products, stored value, and zone-based fares, account-based systems can also support tap-on/tap-off distance fares and fare capping. Fare capping involves using stored value with a set maximum amount or “cap” per day/week/month. This ensures that customers are always receiving the most equitable or “best fare”. Specifying that a wide range of fare policies be supported will provide MTS with greater flexibility to adopt innovative fare policies over the life of the system. The account-based system will also allow retailers to sell fare media in the same manner as gift cards, where customers can purchase a MTS fare card alongside an Amazon or Starbucks gift card. This allows retailers to sell media using existing Point of Sale registers and prevents the need for special fare system sales equipment.

• Will include standard fare passes and stored value
• Ability to implement tap-on/tap-off or distance based fares
• Ability for zone-based fare structure
• Ability for MTS to control and adjust fare catalog in a flexible manner
• Capable of stored value with a set maximum per day/week/month AKA best fares or capping
• Ability to sell media like gift cards at third party outlets, with no custom fare system equipment required at the outlets

Mobile Ticketing Integration

Mobile ticketing will provide customers the ability to purchase fares using their smartphones. Validating mobile tickets can be done via visual inspection of the smartphone screen without specialized hardware. However, integrating optical barcode and/or NFC contactless readers into validators can provide for more robust fare inspection and the collection of important ridership data. MTS awarded a mobile ticketing contract to moovel in 2016. In order to ensure full integration between mobile ticketing and smartcard systems, MTS must coordinate the existing moovel contract with the larger fare collection system. Integrating mobile ticketing with the next generation fare collection system poses several challenges. Mobile wallets such as Apple Pay and Android Pay utilizing NFC are currently unavailable to closed-loop applications. As a result, transit agencies cannot control the mobile wallet user interface or the NFC hardware interface. Given these challenges, specifying that validators include both an optical barcode validator and NFC hardware interface will allow for a more robust and future proof mobile ticketing solution. Customers may face difficulties purchasing/validating fares due to dead cellphone batteries and/or damaged screens. Additionally, a portion of MTS riders do not have bank accounts or smartphones. This may lead to Title VI concerns as these customers may not have full access to the benefits of mobile ticketing. MTS needs to develop a plan to mitigate potential Title VI impacts for mobile ticketing.

• Enables purchasing tickets for transit on smart phones
• Can be validated both visually and through interface with an onboard reader (barcode or NFC contactless)
- Coordinate existing contract with moovel with larger fare collection system
- Mobile wallet applications and NFC/secure element are still inaccessible to closed-loop transit applications
- Mobile wallets are currently limited to provisioning bank cards, and agencies do not control the user interface or experience
- Transit agency applications currently cannot easily utilize the NFC interface (depends on the OS and platform)
- Customer experience impacted if phone battery dies or screen is damaged
- Not all customers are banked, or have the required bank cards that are currently accepted by mobile wallets
- Cash payments in mobile ticketing may be incorporated in the future, which would require integration with a payment processor that partners with retailers that accept cash
- Specify validator that includes both an optical barcode validators and NFC hardware interface, and continue to monitor NFC development environment on iOS and Android in transit industry

Robust Back Office Hosting and Data Reporting

MTS staff consider improving the back office hosting and data reporting processes as a major goal for the next generation fare system. The current system has an overabundance of convoluted data reports and requires that custom reports/queries be performed by the current fare system vendor. Specifying full ownership and access to all data will allow MTS to freely produce custom reports and queries. This data ownership will improve internal data analysis efforts. Account-based fare collection systems depend on real-time communication. As a result, MTS should specify a back office which ensures availability, redundancy, and rapid response time. In order to achieve these goals, MTS should specify a highly available and redundant back office that can utilize at least one instance in the cloud or at a third party location to maximize uptime and scalability. The current back office includes a full set of enterprise applications, including Customer Relationship Management (CRM), financial clearing and settlement, revenue management, monitoring tools, etc. MTS should determine which existing applications can be integrated into the new back office and which applications should be purchased new.

- All data is the property of MTS to use freely without restriction with ability to warehouse and query all data
- Availability, response time, and redundancy of back office is critical for account-based system
- Reporting should be intuitive and data can be directly queried by MTS for custom reports
- Central Computer Systems and Applications will be provided or integrated:
  - Customer Relationship Management (CRM)
  - SAP interface/integration
  - Financial clearing/settling
  - Inventory management
  - Revenue Management Tools
  - Device Monitoring and Management
- Determine which existing central system applications require integration, and which ones should be purchased new
- Integration with existing financial, ERP, and CRM systems (such as the current SAP system) is important but each integration adds cost and complexity

Payment Card and Personally Identifiable Information Security

Physical and logical security is one of the top priorities of any payment system. The open payment ready requirement in an account-based fare collection system requires that all system components, including TVMs, validators, and networks be Payment Card Industry (PCI) compliant and protect Personally Identifiable Information (PII). As a result, MTS needs to specify system architecture and database design in order to limit PCI scope and protect PCI data. Designing two distinct databases to house fare transaction and payment information will improve PCI compliance. In addition to encrypting PCI and PII data, MTS should also apply supplementary security techniques, such as using tokenization to transmit sensitive data.

- Strong encryption of PCI and PII data, in addition to supplementary security techniques like tokenization
- Strictly limit the number of system components within PCI scope or that have PII by carefully specifying system architecture and database design
- Designing separate fare transaction and payment information databases
- Contract with experienced payment processors or merchant banks to process payments and provide reasonable rates

Future Expandability

The open architecture specification will allow for greater system expandability. An open architecture will lay the foundation for potential integration with trip planning, ride sharing, and other services. Open architecture will also allow for the ability to share technology, applications, and payment media across regional transportation agencies. While an open architecture does allow for greater third party integration, MTS can only control their half of the integration process. 3rd party integrators such as rideshare services, onboard equipment, and software developers may require additional funding or agreements before agreeing to integrate. As a result, MTS needs to carefully structure and manage agreements/MOUs in order foster beneficial program participation.

- Ability to share applications, technologies, and payment media across multiple transportation providers
- Ability to control and modify user interfaces such as TVM and DCU screen flows and graphics
- Opportunities to move technology across multiple transit agencies
- Requires open architecture, and cooperation/license from third party provider
- MTS can only control their half of the integration, agreements/MOUs need to be carefully structured to establish and manage beneficial program participation
Legacy System Transition

Developing a robust transition plan will not only ensure a smooth transition for staff and customers, it will also help guide the procurement process and implementation plan. The degree to which MTS chooses to maintain, upgrade, or replace existing system elements will determine the scope of new system procurement. While a full system replacement can provide more advanced features, it can cost a significant amount in cost and time. Leveraging legacy systems can extend the life of existing investments, and still provide core improvements and upgrades. MTS should develop a comprehensive transition plan prior to the development of a technical specification.

- Transition plan is key to develop prior to procurement of new system
- Determining which legacy hardware/software to keep may dramatically impact the new system’s cost and operation
- Determine what existing fare collection equipment could be leveraged or repurposed
- Determine ownership of card format/encryption keys
MTS Fare Collection Whitepaper
Chapter 3
Preliminary Cost Estimate

Prepared for

MTS
Metropolitan Transit System

September 2016
Preliminary Cost Estimate

Based on the list of preliminary system requirements of a model future fare system established in Chapter 2, a preliminary capital cost estimate was developed in this chapter. Since a detailed requirements capture process was not undertaken, key assumptions had to be made in order to complete the cost estimate.

Next-generation fare systems are incredibly complex systems that integration dozens of hardware and software components of varying size. In order to provide a reasonable range of costs, a low estimate and high estimate were provided, which are described below.

Low Estimate

The low cost estimate was developed as meeting the minimum functionality of the preliminary requirements established in Chapter 2, and assuming “best case” price scenarios. For example, the low estimate assumed express/compact Ticket Vending Machines (TVMs), as opposed to the full featured TVMs assumed in the high estimate. Furthermore, installation costs were assumed to be primarily undertaken by MTS, as opposed to the fare system vendor. More detailed assumptions are included in each line item of the cost estimate itself.

High Estimate

The high cost estimate was developed as meeting the full functionality of the preliminary requirements established in Chapter 2, and assuming “worse case” price scenarios. For example, the high estimate assumed full featured Ticket Vending Machines (TVMs), as opposed to the express/compact TVMs assumed in the low estimate. Furthermore, installation costs were assumed to be primarily undertaken by the fare systems vendor, as opposed to MTS. More detailed assumptions are included in each line item of the cost estimate itself.
### Fare System Replacement Capital Cost Estimate

<table>
<thead>
<tr>
<th></th>
<th>Low Estimate</th>
<th>High Estimate</th>
<th>Assumptions</th>
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<tbody>
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<tr>
<td>Back Office Installation</td>
<td>$121,200</td>
<td>$244,560</td>
<td></td>
</tr>
<tr>
<td><strong>Installation Sub-total</strong></td>
<td>$1,183,075</td>
<td>$2,506,160</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Recurring Engineering</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Office System Development</td>
<td>$1,155,000</td>
<td>$2,775,000</td>
<td>Account based processor</td>
</tr>
<tr>
<td>Website Development (Customer &amp; Institutional)</td>
<td>$175,000</td>
<td>$550,000</td>
<td>May be 3rd party developer</td>
</tr>
<tr>
<td>Reader/Validator Software</td>
<td>$100,000</td>
<td>$250,000</td>
<td></td>
</tr>
<tr>
<td>Driver Console Software</td>
<td>$50,000</td>
<td>$100,000</td>
<td></td>
</tr>
<tr>
<td>TVM Software</td>
<td>$150,000</td>
<td>$350,000</td>
<td>Low: limited function, High: full service</td>
</tr>
<tr>
<td>Customer Service Device Software</td>
<td>$100,000</td>
<td>$175,000</td>
<td></td>
</tr>
<tr>
<td>Retail Device Software</td>
<td>$75,000</td>
<td>$150,000</td>
<td></td>
</tr>
<tr>
<td>Inspection Device Software</td>
<td>$100,000</td>
<td>$150,000</td>
<td>Mobile smartphone inspection app</td>
</tr>
<tr>
<td>Farebox Integration</td>
<td>$250,000</td>
<td>$500,000</td>
<td>Integrate reader into existing farebox</td>
</tr>
<tr>
<td>CAD/AVL Integration</td>
<td>$250,000</td>
<td>$500,000</td>
<td></td>
</tr>
<tr>
<td>Mobile Ticketing Development/Integration</td>
<td>$200,000</td>
<td>$400,000</td>
<td>Integrate with existing mobile vendor</td>
</tr>
<tr>
<td>Parking Integration</td>
<td>$150,000</td>
<td>$350,000</td>
<td></td>
</tr>
<tr>
<td>Oracle/SAP Integration</td>
<td>$100,000</td>
<td>$350,000</td>
<td>Utilize existing SAP ERP software suite</td>
</tr>
<tr>
<td><strong>NRE Sub-total</strong></td>
<td>$2,855,000</td>
<td>$6,600,000</td>
<td></td>
</tr>
<tr>
<td><strong>Launch Activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Testing</td>
<td>$428,250</td>
<td>$990,000</td>
<td>15% of NRE</td>
</tr>
<tr>
<td>Agency Training and Manuals</td>
<td>$142,750</td>
<td>$330,000</td>
<td>5% of NRE</td>
</tr>
<tr>
<td>Launch Services (e.g. Pilot and Marketing/Outreach)</td>
<td>$142,750</td>
<td>$330,000</td>
<td>5% of NRE</td>
</tr>
<tr>
<td><strong>Launch Sub-total</strong></td>
<td>$713,750</td>
<td>$1,650,000</td>
<td></td>
</tr>
<tr>
<td><strong>Project Management</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Management</td>
<td>$1,904,089</td>
<td>$4,196,343</td>
<td>10% of subtotal</td>
</tr>
<tr>
<td><strong>PM Sub-total</strong></td>
<td>$1,904,089</td>
<td>$4,196,343</td>
<td></td>
</tr>
<tr>
<td><strong>Unadjusted-total</strong></td>
<td>$20,944,974</td>
<td>$46,159,773</td>
<td></td>
</tr>
<tr>
<td>Warranty</td>
<td>$1,047,249</td>
<td>$2,307,989</td>
<td>5% of unadjusted total</td>
</tr>
<tr>
<td>Performance Bond</td>
<td>$209,450</td>
<td>$461,598</td>
<td>1% of unadjusted total</td>
</tr>
<tr>
<td>Contingency</td>
<td>$3,141,746</td>
<td>$6,923,966</td>
<td>15% of unadjusted total</td>
</tr>
<tr>
<td><strong>Grand-total SI Costs</strong></td>
<td>$25,343,418</td>
<td>$55,853,325</td>
<td></td>
</tr>
</tbody>
</table>
MTS Fare Collection Whitepaper
Chapter 4
Preliminary Recommendation

Prepared for

MTS Metropolitan Transit System

November 2016
Recommended Next Steps

This fare collection study began by discussing next-generation fare systems with key peer agencies across the country. From those lessons learned and MTS staff discussion, preliminary system requirements for a future fare system were developed. Those preliminary system requirements were used as the basis for a preliminary cost estimate range for a full system procurement.

While the preliminary requirements and cost estimates represent the vision for a future system, the decision to replace or maintain parts of the existing system has not been fully determined. MTS could perform strategic upgrades to the existing system, replacing obsolete or underperforming components and transitioning to a new system with minimal impact to customers. Furthermore, integration between “best of breed” vendors in mobile ticketing, website design, reporting, and various hardware suppliers could be explored to maximize benefit and control costs.

Lessons learned from several peer agencies show that additional efforts to determine critical design decisions and transition plan are highly recommended prior to initiating a system procurement. These critical design discussions usually occur over a matter of months, and are typically described in a Concept of Operations, or ConOps.

MTS may choose to maintain their existing Compass program or proceed with a full system replacement without engaging in further analysis. However, not performing some of the additional efforts described in this section carries potential risks, as evidenced by several next-generation fare collection projects. The benefits, drawbacks, and costs of the three immediate options are enumerated below.

<table>
<thead>
<tr>
<th>Maintain Existing Compass System</th>
<th>Proceed with Full System Replacement</th>
<th>Engage in Strategic Upgrade Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits</strong></td>
<td><strong>Benefits</strong></td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td>▪ Maximizes current investment</td>
<td>▪ Benefit from latest fare technology</td>
<td>▪ Explores strategic upgrades of system components while leveraging existing investments</td>
</tr>
<tr>
<td>▪ Customer satisfaction high</td>
<td>▪ Brand new hardware and software</td>
<td>▪ Can be developed with regional stakeholders and vendor community</td>
</tr>
<tr>
<td>▪ Card based system is proven</td>
<td>▪ Can define new technical and functional requirements</td>
<td>▪ Considered best practice from several peer agencies</td>
</tr>
<tr>
<td>▪ Change orders and mobile ticketing may provide incremental improvements</td>
<td>▪ Latest security and payment acceptance</td>
<td>▪ Can procure “best of breed” products and services from specialized vendors</td>
</tr>
<tr>
<td>▪ Issues with existing system are understood</td>
<td>▪ Can require open architecture to enable future flexibility and integration partners</td>
<td>▪ Enables multiple procurements to minimize costs and increase flexibility</td>
</tr>
<tr>
<td><strong>Drawbacks</strong></td>
<td><strong>Drawbacks</strong></td>
<td><strong>Drawbacks</strong></td>
</tr>
<tr>
<td>▪ Agency</td>
<td>▪ Highest cost option</td>
<td>▪ Extends the system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Given the significant investment devoted to the existing system, and the high cost and potential risk associated with a full system replacement, CH2M recommends performing a strategic upgrade analysis and detailing the results in a Concept of Operations (ConOps).

ConOps have been developed and recommended as a best practice by several peer agencies and industry vendors. It can be used as a living document that describes several critical aspects of MTS fare collection technology, procurement, and operations. By understanding and discussing each of these aspects prior to procurement, MTS can minimize the risks that have befallen several other fare collection projects. The development of a ConOps is recommended to include the following tasks.

**Needs Assessment**

The critical first step in the development of a ConOps is the completion of a Needs Assessment. The primary purpose of the Needs Assessment is to determine and define the high level goals for the new fare collection system. This process can include either comprehensively defining new goals or refining / updating previously defined fare collection system goals. These goals will serve as the guiding principles for the numerous design decisions for the fare collection system. Peer agencies have noted that a lack of clearly defined goals can lead to increased debate / delay surrounding key system design elements.

**Current System Analysis**

The Current System Analysis will allow MTS to summarize current fare collection system components as well as evaluate the overall strengths and weaknesses of system components. The Current System
Analysis first includes summarizing the current system’s technical components, features, policies, and existing contract terms for services including maintenance, software support services, and other vendor contracts. Next, the analysis must include examination of key strengths and weaknesses of the current fare collection system. The strengths and weaknesses may include fare collection system components such as technical capabilities, MTS / vendor interface, or customer perception. The analysis should then estimate the remaining useful life of current components including TVMs, fareboxes, validators, back office equipment, software licenses, in addition to other items. The Current System Analysis should also include an evaluation of existing fare collection proposals from Cubic as well as an exploration of costs required to retain ownership of card format / encryption keys. This will provide a rough cost estimate for maintaining the current system which will be compared against proposed new fare collection systems. The final results of the Current System Analysis will help to inform the Detailed System Requirements Capture and the Legacy Transition Plan. Foregoing analysis of the current fare collection system may lead to over-procuring a fare collection system or procurement of a system which does not address current system weaknesses.

Detailed System Requirements Capture

The Detailed System Requirements Capture provides the basis for the technical specifications included in the fare collection system RFPs. The Detailed System Requirements Capture does not set specific requirements, however it does define the types of technologies which must be supported in the fare collection system. As a result, the Detailed Systems Requirements Capture includes a review of all key design decisions regarding equipment, back office modules, and sales channels. The equipment review will consider design decisions regarding validation devices, sales devices, inspection devices, communications, and fare media. The back office review will consider the Account-Based Transaction Processor, Customer Relationship Management (CRM) System, Reporting System, Device Monitoring System, Maintenance Management System, Enterprise Finance and Settlement System, as well as others. The sales channel review will consider the retail network, ticket vending machines, websites, institutional programs, and third party distributors in addition to others. The Detailed System Requirements capture is extremely important for maintain a clear and consistent plan for the new system. A lack of well-defined system requirements can lead to continual debate over design decisions as well as procurement of a system which does not meet MTS’s fare system goals.

Mobile Ticketing Integration

MTS is currently in development of a mobile ticketing solution. Staff has indicated the desire for the mobile ticketing system to integrate with the new fare collection system. The Mobile Ticketing Integration plan is critical to ensure seamless agency and customer experience across all fare collection methods. The Mobile Ticketing Integration Plan should first review all existing mobile ticketing contract terms, project timeline, and project scope. The Mobile Ticketing Integration plan must also explore how mobile ticketing validation will occur as well as how back office processes will be integrated. Exploring the open architecture requirement can allow MTS and the fare collection system vendor to access APIs. Accessing the mobile ticketing APIs will allow for more efficient integration with the fare collection system. Review of these elements will determine the level of effort required to integrate mobile ticketing with the new fare collection system as well as designate responsibilities for mobile ticketing vendors and fare collection system integrators. The lack of an integrated mobile ticketing solution can lead poor customer experience and difficulties reconciling back office processes.

Legacy Transition Plan

The Legacy Transition Plan will help determine the extent to which existing fare collection system elements can be leveraged in the new fare collection system. The first step in the Legacy Transition Plan
is to determine which system components have remaining useful life. Next, the Legacy Transition Plan will determine which system components can be replaced or strategically upgraded. System components which cannot be leveraged or upgraded will become functionally obsolete. These system components will either need to be fully replaced or outsourced. The Legacy Transition Plan will also help determine the transition of fare media. Implementing a phased versus rapid media transition can greatly impact project budget and project schedule. A robust Legacy Transition Plan reduces the likelihood of over procuring hardware/services and facilitates a smooth fare system transition for MTS and its customers.

**Operations Approach**

The Operations Approach helps determine which fare collection services will be performed in house and which will be contracted. The Operations Approach document will first summarize fare collection operations that are currently performed in house, and those that are outsourced. Potential operations to review include hosting, system configuration, monitoring, maintenance, revenue service, customer service, retail network, marketing, card fulfillment, special program management. The result of this analysis will help determine if a new operations approach is applicable for certain practices. Peer agencies have mentioned that the degree to which operations are outsourced directly impacts internal fare collection staffing requirements. Outsourcing services may reduce MTS’s control over fare collection operations, however performing too much internally may place considerable strain on MTS staff. It is therefore very important that MTS determine an appropriate Operations Approach.

**Procurement Approach**

The results of the Operations Approach will provide MTS with which fare collection services need to be procured. The Procurement Approach will then determine the specific procurement strategy for those products and services. The Procurement Approach will also explore the benefits and drawbacks of a single system integrator versus multiple procurements. Selecting a single system integrators requires less vendor management, but will cost since the vendor is serving as a system integrator. Choosing multiple procurements can lead to cost savings, but will require MTS to serve as the system integrator. The Procurement Approach will also explore innovative funding vehicles for the new fare collection system. Finally, the Procurement Approach will determine which parties will manage the procurement(s) before and after the vendor award and Notice to Proceed (NTP).

**Cost Estimate Update**

The key decisions made in the development of the ConOps will impact the overall cost of the fare collection system. The development of the Detailed System Requirements Capture will determine whether to procure full featured or express featured hardware. These hardware features may have a significant impact on total system cost. In addition to considering the costs of a single system integrator, additional cost scenarios should be developed for a strategic upgrade option as well as a split procurements approach. Updating the capital cost estimate is a key component of the ConOps.

**Fare Structure Analysis**

The purpose of the Fare Structure Analysis is to determine which fare policies and structures should be supported in the new fare collection system. This is not meant to substitute or replace a Fare Policy Study, which recommends specific fare rates and fare policies to be adopted in the near future. By supporting a wide range of fare structures, including distance based fares and fare capping, MTS will be able to more easily adopt innovative fare structures over the life of fare collection system. Choosing to
adopt a fare structure not supported in the technical specifications would require additional costs and schedule delays.
Fare Collection Vendor Matrix

Fare collection systems are extremely complex and unique integration projects that impact every department of a transit agency. Not surprisingly, many large fare collection projects encounter issues throughout design, procurement, and implementation. The efforts described earlier in this Chapter are specifically designed to avoid some of the challenges that other peer agencies have faced. Ultimately, developing a clear design and defining unambiguous requirements can help mitigate some procurement and implementation risks. However, selecting a fare system vendor that can deliver the specified system is equally as important.

While all fare system vendors have strengths and weaknesses, the relatively low number of implemented account-based fare systems makes vendor experience especially important. This is a summary of prominent fare system vendors based on staff experience, peer agency feedback, and publicly available information.

<table>
<thead>
<tr>
<th>Notable Projects</th>
<th>Account-Based Experience</th>
<th>Key Strengths / Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accenture</strong></td>
<td>• Toronto PRESTO</td>
<td>– No fully deployed account-based systems</td>
</tr>
<tr>
<td></td>
<td>• Washington NEPP</td>
<td>– Washington project canceled by WMATA following pilot</td>
</tr>
<tr>
<td></td>
<td>• NEPP was account-based / open payment (canceled in 2016 after extended pilot)</td>
<td></td>
</tr>
<tr>
<td><strong>Cubic</strong></td>
<td>• Chicago Ventra</td>
<td>+ Strong experience implementing fare systems (including account-based)</td>
</tr>
<tr>
<td></td>
<td>• Vancouver Compass</td>
<td>– Significant operational challenges during launch of Chicago system</td>
</tr>
<tr>
<td></td>
<td>• London Oyster</td>
<td>– Client responsiveness can vary depending on local resources</td>
</tr>
<tr>
<td></td>
<td>• Chicago is largest account-based, open-payment system deployed in U.S.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vancouver is card-/account-based hybrid (still in deployment)</td>
<td></td>
</tr>
<tr>
<td><strong>INIT</strong></td>
<td>• Portland Hop Fastpass</td>
<td>+ 2 account-based systems in development</td>
</tr>
<tr>
<td></td>
<td>• Sacramento Connect Card</td>
<td>+ Highly technical staff</td>
</tr>
<tr>
<td></td>
<td>• Honolulu HART</td>
<td>– Sacramento card-based system significantly delayed</td>
</tr>
<tr>
<td></td>
<td>• Portland is account-based / open payment (still in development)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Honolulu is account-based closed loop (still in development)</td>
<td></td>
</tr>
<tr>
<td><strong>Scheidt &amp; Bachmann</strong></td>
<td>• Boston Charlie Card</td>
<td>– No fully deployed account-based systems</td>
</tr>
<tr>
<td></td>
<td>• Budapest (BKK)</td>
<td>– Technical resources based in Europe, limited U.S. staff</td>
</tr>
<tr>
<td></td>
<td>• Phoenix Valley Metro</td>
<td>– Budapest is account-based (still in development)</td>
</tr>
<tr>
<td><strong>Vix (ERG)</strong></td>
<td>• Utah FAREPAY</td>
<td>+ Has a deployed account-based, open payment system</td>
</tr>
<tr>
<td></td>
<td>• Seattle ORCA</td>
<td>– Limited U.S. engagements</td>
</tr>
<tr>
<td></td>
<td>• Utah was 1st account-based, open payment system deployed in U.S.</td>
<td></td>
</tr>
<tr>
<td><strong>Xerox (ACS)</strong></td>
<td>• Philadelphia Key Card</td>
<td>– No fully deployed account-based systems</td>
</tr>
<tr>
<td></td>
<td>• Philadelphia is account-based / open payment</td>
<td></td>
</tr>
</tbody>
</table>
| Denver RTD | (still in development) | - Launch of Philadelphia system significantly delayed (based on original schedule)  
- Technical resources based in Europe |