

TRIMET

Fare System Migration

A White Paper on Electronic Fare Collection

11/17/2011

This document outlines both the fare policy and technology choices that need to be made as TriMet migrates to a new electronic fare collection system

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White Paper Team:

Carolyn Young, Tom Strader, Drew Blevins, Dan Caufield, William Hu, Tim McHugh, Claire Potter, Chris Tucker, and Nancy Jarigese

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Fare System Migration White Paper

November 2011

Section I. Introduction

Background

TriMet established an Electronic Fare Collection (EFC) team to research the state of electronic fare collection and produce this White Paper. Various members of the team conducted site visits to Salt Lake City, Minneapolis/St. Paul and Seattle. In addition, team members have talked to several other transit properties and reviewed the available program design papers from New York, Chicago, and Washington DC. The team met with several Electronic Fare System vendors at the APTA Trade Show in New Orleans in October 2011.

Based on this research, the General Manager directed the team to produce a White Paper and to begin planning for an Electronic Fare Collection system. Although an exact schedule of EFC implementation has not been established, it is anticipated that TriMet will begin to procure equipment for EFC in conjunction with the opening of the new light rail line to Milwaukie which is scheduled to begin operations in September 2015.

Strategic Objective

TriMet plans to upgrade the fare collect system and implement an electronic fare collection (EFC) system that is based on open standards, and capable of accepting a variety of payment media, bringing TriMet into the mainstream of next generation payment technology. The system will be simple to use, convenient for the customer and cost-effective to maintain.

Purpose of Document

This document describes the fare policy and fare collection technology options TriMet will review as it migrates to an electronic fare collection system. The new fare payment system will be implemented on all TriMet buses and at all rail platforms. It is anticipated that a compatible payment system will be developed and implemented for TriMet's partners, Portland Streetcar Inc. and C-TRAN.

Other agencies in the TriMet region may also implement payment systems based on open payment industry standards for bike sharing, parking charges or other services. These systems could be designed in a manner that would accommodate a regional payment card in the future.

This document outlines the fare policy and technology issues and choices TriMet will review as it moves towards electronic fares. It also examines the state of electronic fare collection technology. It will serve as a resource and a guide for TriMet and partner agencies for procurement and acquisition of an electronic fare system.

Project Overview

The new fare payment system will enable TriMet to accept contactless payment cards (both open and closed loop cards) and payment-capable mobile phones supporting Near Field Communications, for fare payment directly at MAX platforms, WES platforms and on buses. Implementation of the first phase of a pilot program could begin as early as September 2015 when the MAX Orange Line opens.

The new system could enable customers to purchase fare products and manage stored accounts through on-line and other sales channels or to use their own credit cards and mobile devices. Contactless cards and mobile payment devices such as mobile phones would be required to meet current ISO standards and be PCI compliant. It is anticipated that the system would be implemented with off-the-shelf technology and existing processes and infrastructure as much as possible.

An important aspect of the project will be to review and potentially restructure TriMet's fare policy to facilitate a smooth implementation of electronic fares. The goal of the review would be to simplify the fare structure for increased customer convenience and streamlined collections.

New Fare System Objectives

The new fare payment system would have the following objectives for fare policy and fare payment:

1. Easy to understand, simple to use and convenient for customer
2. Easy to understand and convenient for operators and fare inspectors
3. Reduce the cost of fare collection and equipment maintenance
4. Work on all transit modes, including bus, MAX light rail, and WES commuter rail
5. Accommodate seamless transfers between vehicles, within the TriMet system, as well as with partner providers including C-TRAN and the Portland Streetcar
6. Bring TriMet into the mainstream of next generation payment technology
7. Reduce fraud

Elements of the future Fare Collection System

It is envisioned that the new fare payment system will have the following elements:

1. Electronic fare collection system based on open standards that enables payment through a variety of fare media.
2. The fare collection system will continue to accommodate passengers who use cash for single ride trips on MAX and bus.

3. Electronic readers will be available at all MAX, WES and streetcar platforms.
4. Electronic readers will be available on all buses.
5. TriMet will issue smart cards (account based) for employer pass programs to include a photo ID.
6. The fare collection system will accept credit cards with a smart chip that are issued by banks.
7. The fare collection system will accept payments from mobile devices issued by a cell phone company using near field communications (NFC), or perhaps micro SD.
8. TriMet's 10-ride books will be discontinued and associated validators will be removed from rail platforms.
9. TriMet will likely issue smart card media for prepaid, stored value fares. The complete sales and distribution strategy may include a combination of purchase options such as online, by mail, by phone, retail outlets/ticket office, and TVMs. A decision on including this option need not be made until later in the project.
10. The fare collection system will comply fully with all PCI DSS requirements.
11. The system will be able to easily adapt to future generations of contactless payment technologies.
12. TriMet will develop strategies to accommodate people who do not have credit cards or a bank.

Fare Policy Considerations

Zones

As TriMet migrates to EFC it has is an opportunity to review and simplify fare policy. TriMet's current fare policy with multiple zones, discounts and fare instruments is complex and difficult for both the riders and bus operators to understand. New riders and visitors often complain that it is difficult to determine the correct fare to buy. While the intent of the zone system is to provide a reduced fare for short distances, it has inherent inequities, especially for people who live near a zone boundary.

Zone would be very difficult to manage with electronic fare collection, especially when making transfers between bus and rail. It would also require riders to tap on and tap off to inform the system of the number of zones they passed through. Elimination of the zone system would have a positive impact on the customer convenience and cost of electronic fares.

Options for changes in fare policy that should be reviewed include a distance based fare, flat fare, peak hour fare, revision or elimination of the Free Rail Zone, a special WES commuter rail fare and a downtown fare.

Transfers and Proof of Payment

TriMet currently requires a transfer to be issued when a cash fare is purchased on a bus or at a Ticket Vending Machine. A ticket purchased through a ticket vending machine serves as the proof of payment and transfer for rail riders. Bus operators issue a paper transfer when a rider purchases a fare on-board. The transfer is also a proof of payment. Bus transfers are made of flimsy paper, are extremely difficult for riders to decipher and difficult for operators to issue because they are ripped individually. While electronic payment will eliminate the need to issue some transfers, transfers will still be needed for people who pay with cash.

There are four key decisions that need to be made regarding transfers and proof of payment:

1. Should the policy be changed to issue bus transfers only upon request as many other transit properties do? This would change the requirement to have a proof of payment on the bus.
2. Should TriMet purchase new equipment to print bus transfers?
3. Should transfer policy regarding the time allowed for a transfer be reviewed?
4. Should transfers be limited to trips in one direction with no round-trips allowed?

Section 3 explores these fare policy questions in detail.

Hardware Considerations

Fareboxes

TriMet's bus fare boxes are over twenty years old. These fareboxes can continue to be used for several years into the future with upgrades and proper maintenance. Existing fareboxes do not issue transfer receipts, and the operator manually issues a transfer receipt for proof of payment. TriMet will refurbish the existing fareboxes in early 2012. When an Electronic Fare Collection (EFC) system is implemented, card readers on buses will be installed to "stand alone", separate from the fareboxes.

Ticket Vending Machines

TriMet's ticket vending machines (TVMs) are also aging. TriMet uses two generations of TVMs that have been purchased as part of different rail expansion projects. The older TVMs, dating from the late 1990s, use out-of-date computer operating systems, but will be refurbished in 2012 to the same generation of TriMet's newer TVMs, dating from the late 2000s. All TVMs have received updates in late 2011 for PCI compliance. In implementing an EFC system, TriMet has several options. It could elect to upgrade existing TVMs, or replace them with new

models, in order to provide the ability to vend and/or read a smart card at rail platforms. This would only be necessary if TriMet decides to issue traditional smart cards. If TriMet determines that other options such as a credit card or mobile device are widely available, an upgrade will not be needed and some TVMs could be removed from platforms.

TriMet will need to purchase new TVMs for the opening of the Portland to Milwaukie Light Rail Project in 2015. To make the most of this opportunity, some decisions regarding fare policy and smart card technology should to be made in advance of the procurement.

Title VI Considerations

TriMet is required to conduct a Title VI review of all fare policy changes and fare increases. Title VI considerations are important when transitioning to an electronic fare collection system because low-income riders may not have access to credit cards and banks which are needed to purchase monthly or multiple fares on a smart card and may be necessary to recharge the card. Low income riders may not be able to afford even low cost card reloading.

Fare policy strategies that address Title VI issues include moving to a flat fare rather than zones, giving longer rides to transit dependent riders who are least able to pay. Another consideration would be a fare instrument that provides a discount after a certain number of rides is taken to alleviate fare equity issues associated with discounts for monthly passes which are not affordable for many low income riders. Finally, a prepaid credit card may be used that would not require riders to have a bank or traditional credit card.

TriMet will need to develop a strategy for low-income riders and those who are unbanked.

Section 2. TriMet's Existing Fare Collection System

Introduction

TriMet has an aging fare collection system that uses out-of-date technology. Though fare revenue has grown from less than \$5 million a year in 1971 to over \$100 million a year in FY11, TriMet is still operating essentially the same paper based ticketing system that existed when TriMet first started providing service. This system relies on “visual” authentication of fare media to support a proof-of-payment system. Inspection of tickets and passes is done either by the operator when a patron boards a bus or by enforcement personnel during fare checks on a train.

On buses, the fare collection equipment consists of traditional fareboxes that are over twenty years old. These fareboxes can continue to be used for several years into the future with some upgrades and the proper maintenance. Existing fareboxes do not issue transfer receipts, and the operator manually issues a transfer receipt for proof of payment.

Ticket Vending Machines (TVMs) are used to sell fares at rail platforms. TriMet uses three types of TVMs that were purchased as part of rail expansion projects. The oldest TVMs use out-of-date software that will be updated in 2012. With the proper software upgrades and maintenance this equipment will be expected to have a useful life of several more years.

Overview of TriMet's Fare System

TriMet's fare system is comprised of the policies, processes, and related equipment and software technologies that support the collection of fare revenue. TriMet offers monthly passes; 7, 14 and 30 day passes; day tickets and single-ride tickets. Discounts are offered for seniors and students. Children under six ride free. In addition, TriMet offers special pass programs for colleges and employers.

Zones

TriMet's service area is divided into three fare zones, organized in somewhat concentric circles around downtown Portland. Within zone 1 is a special fare zone called the Free Rail Zone, including most of downtown Portland and the Lloyd District, in which all train trips within the area are free. Adult fares are based on the number of zones you traveled in. Honored Citizen and Youth fares are valid in all zones.



Reduced fares

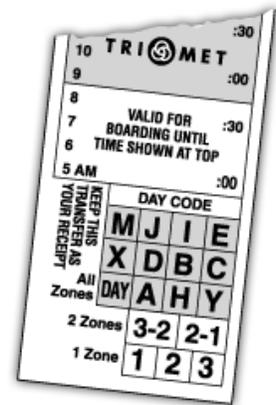
Reduced fares are available for Honored Citizens (individuals aged 65+, with a disability, or Medicare card) as well as Youth (individuals aged 7-17, and students in high school or pursuing a GED), during all hours. Proof of eligibility for a reduced fare is required when boarding. The Federal Transit Administration (FTA) requires that Honored Citizens are not charged during non-peak hours more than 50 percent of the regular peak hour fare. Because there is no requirement for a reduced peak hour fare, TriMet exceeds the FTA requirement by making the reduced Honored Citizen fare available during all hours. There is no FTA requirement for Youth fares.

Transfers

TriMet's service is designed as a grid system that encourages customers to transfer from bus-bus, or from bus-rail. Bus transfer receipts and machine validated tickets are intended to allow the customer to complete their trip *in one direction* by allowing transfers between vehicles.

On rail, tickets are validated by a ticket machine or a platform validator to be good for two hours.

Transfers are significantly more complicated on the bus, where operators must manually issue a transfer receipt. On *weekdays*, when most bus service runs at least every half-hour, bus transfer receipts are valid for *1 hour past the last scheduled stop on the route or downtown*, allowing ample time to make a connection with another vehicle. On *weekends and holidays*, when some lines run only every hour, transfer receipts are valid for *2 hours past the last scheduled stop*. Expiration times are rounded up to the next 30 minute increment, and will vary based on where the customer boards in relation to the end of the route.



September 2011 fares

			1-Day Pass	7-Day Pass	14-Day Pass	1-Month/ 30-Day Pass	1-Year Pass
	1 Ticket	Book of 10					
Adult All Zones	\$2.40	\$24	\$5	\$24	\$46.50	\$92	\$1012
Adult 2 Zones	\$2.10	\$21	\$5	\$21	\$41	\$81	\$891
Honored Citizen All Zones	\$1	\$10	\$5	—	\$13.50	\$26	\$286
Youth All Zones	\$1.50	\$15	\$5	—	\$14	\$27	—
LIFT Paratransit All Zones	\$1.85	\$18.50	\$5	—	\$26.50	\$52	\$624

One Zone Fares

TriMet also offers 1-Zone tickets, at a 5 cent per ride discount over the 2-Zone fare. The 1-Zone ticket was designed as a special discounted fare that was originally intended to build ridership by attracting customers that make short, infrequent trips. There is no 1-Zone cash or pass fare, as the intent was not to create a 1-Zone fare, but rather to provide a benefit to those who were traveling short distances on an occasional basis. The 1-Zone tickets are sold only in books of 10, and are available only at neighborhood retail outlets such as Safeway, Albertsons, and Fred Meyer stores, as well as TriMet's Ticket Office at Pioneer Courthouse Square.

The 1-Zone ticket is an exception from the rest of the system, and adds a layer of complexity to the fare structure that is confusing for customers and operators. Sales of 1-Zone tickets have always been very low, and even when the 1-Zone discount was greater, they were not much of an incentive to encourage short trips. The 1-Zone tickets exacerbate the problems inherent in a zone system, and elimination of the product would remove an inconsistency in the fare structure and help to make the system more intuitive and easier to understand.

Upgrades

Upgrade tickets allow a customer to “buy up” from a 2-zone ticket or pass to an all-zone fare. Upgrades are available for payment of 30 cents from bus operators when boarding a bus, or from TVMs on rail platforms. Upgrades are a nice convenience for riders that occasionally travel in all zones, in that the payment they have already made for their 2-zone fare is applied toward their all-zone trip. For example,

someone that typically travels in zones 1 & 2 may upgrade their pass or ticket for travel to the airport, without purchasing an entirely new fare. The drawback to upgrades is that they are yet another fare product that adds complexity to the fare system, existing only to accommodate zones, and they are not well understood by customers. If zones were eliminated, upgrades would not be needed.

Policy for Fare Increases

TriMet's Fare Policy establishes a framework for the TriMet Board of Directors to review fares annually to ensure fare levels keep pace with increases in the costs of operating the transit system. Fare adjustments to cover general increases in the cost of providing service regularly occur in September of each year, and TriMet customers have become accustomed to increases of at least five cents annually.

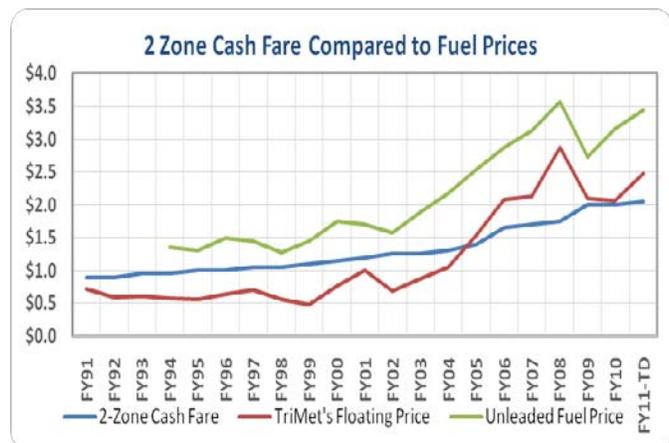
TriMet does recognize the need to keep fares low so that the system remains affordable for the many people who depend on it. However, TriMet is continuously faced with the need to balance affordable fares with the need to increase revenues to keep up with the cost of providing service.

The policy for increasing fares in small, regular increments that keep pace with the increases in the cost of providing service (generally 5 cents on an annual basis) instead of larger, less frequent increases (25 cents) is designed to achieve this balance with the least financial impact on our customers. This practice continues to serve TriMet well, as the agency has been able to avoid the large drops in ridership seen by other transit properties around the country when they implement significant fare increases.

In addition, TriMet maintains a policy specifically to account for unanticipated increases in the cost of diesel fuel. The *Diesel Cost Response Policy* provides a procedural framework for informing the Board about increasing costs fuel, and developing a plan to address a budget shortfall.

The Policy directs the General Manager to provide a report to the Board when the amount paid for diesel fuel exceeds, or is expected to exceed, the budgeted amount by 10 percent for two consecutive months. When this occurs, the General Manager is directed to provide the Board with a proposed Corrective Action Plan that includes recommendations on actions to offset the fuel prices, including, but not limited to, a proposed fare increase.

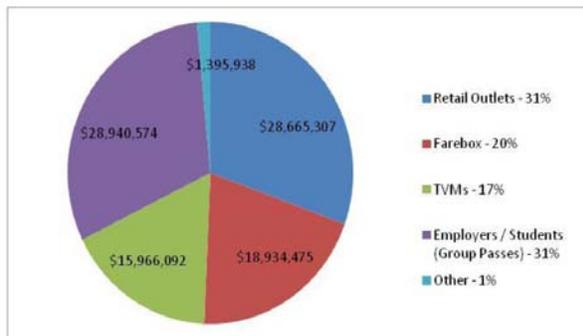
Despite the actions TriMet has taken to implement regular fare increases, however, fare levels have generally not kept pace with the cost of fuel, as displayed in the chart to the right.



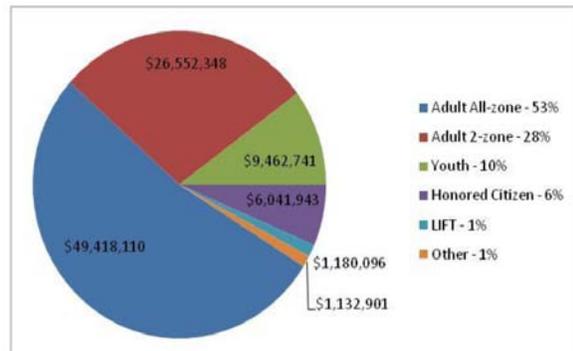
Fare Revenue

TriMet's fare revenue exceeds \$100 million annually, which represents approximately 25%-26% of the system cost. The following three charts display detail for fare revenues by distribution channel, by fare category, and by ticket type. Distribution data is from Fiscal Year 2010.

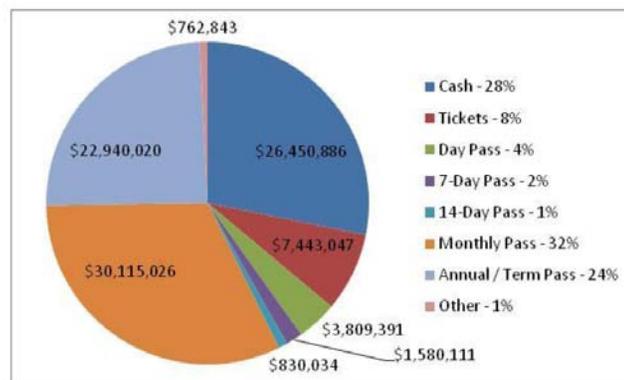
Fare Revenue – By Distribution Channel



Fare Revenue – By Fare Category



Fare Revenue – By Ticket Type



Fare Revenue Collection

TriMet collects fare revenue through the TriMet Ticket Office at Pioneer Courthouse Square in downtown Portland, a network of local retail sales outlets, by mail, online in the TriMet store, employer and school programs, ticket vending machines (TVMs) on rail platforms, and fareboxes on buses, issuing paper tickets and passes as proof of payment. Some equipment and software currently in use is at or near the end of the designed service life, and is in need of being upgraded or replaced in the near future.

The software and backend systems that support these various distribution channels are built separately from each other. For fare changes, staff is required to coordinate software updates with each database administrator separately. The method to process fare changes is distinct within each database, when ideally only one system should be needed to implement a fare change for all distribution channels. Having a single consolidated database for fare revenue would greatly improve operational efficiency. Migration to a new fare collection system, such as smart card technology, provides the opportunity to build a single holistic database for the future fare collection, and would allow migration of each paper based fare sales program into the new system.

Fareboxes

Fareboxes accept any combination of bills and coins for payment of fare on buses. The bus operator manually issues a transfer receipt to the customer as proof of payment. Operators cannot make change.

TriMet uses a CENTSaBILL registering farebox manufactured by GFI Genfare. The designed service life of the farebox is 10-12 years, and we have had our current system since approximately 1989. However, a complete replacement of the fareboxes is not required at this time. A farebox consists of mechanical and electronic components, as well as software. In late 2011, TriMet committed to a comprehensive refurbishment/upgrade of the fareboxes which will be performed in early 2012 and which will extend their mechanical service life on the order of 10 years or more, including an up to date farebox revenue information system.



Ticket Vending Machines (TVMs)

Ticket Vending Machines (TVMs) are used to sell fares at rail platforms, issuing paper tickets and passes for proof of payment. TriMet uses two generations of TVMs that were purchased as part of rail expansion projects. The older TVMs, dating from the late 1990s, use out-of-date computer operating systems, but will be refurbished in 2012 to the same generation of TriMet's newer TVMs, dating from the late 2000s. TVMs accept either a combination of bills/coins/bankcards, or bankcards only. Bankcard-only TVMs are less expensive to purchase and maintain, and TriMet's strategy has generally been to maximize the use of card-only TVMs, by maintaining at least one full service machine on each platform to accommodate customers that need to pay with cash.



Group Pass Programs

TriMet offers group pass programs for both employers and colleges. Participants may choose from two annual pass options, and one monthly pass option, depending on their needs. The programs are:

- *Universal Annual Pass and Universal Term College Pass Programs* – The employer or college purchases passes for every one of their employees or students.
- *Annual Pass and Term College Pass Programs* – The employer or college purchases passes only for those employees or students that are interested in a TriMet pass.
- *Monthly Pass Program* – Employers and colleges also have the option of participating in the Monthly Pass program, where they opt to sell passes and tickets to their employees or students on a month-to-month basis.

There are several benefits to TriMet pass programs. The Universal Pass, Annual Pass, and College Term Pass Programs are the most convenient for riders and their respective institutions. Participants receive an all-zone sticker to put on their company or college-issued photo ID. This allows the participant the convenience of using their ID as their TriMet pass, and there is no need to keep track of a separate fare instrument, or worry about picking up a new pass every month.

TriMet pass programs are offered as an employee benefit by employers of all sizes. As an added benefit for larger employers, pass programs help to reduce auto trips in order to comply with the State's Employee Commute Options (ECO) legislation, and provides the opportunity for TriMet to help collect regional data on travel modes. For TriMet, annual programs are the most cost effective means to distribute fare media, where fulfillment of orders occurs once each year, instead of on a monthly basis.

The Monthly Pass options allow the employer or college the *flexibility* to adjust their order from month to month. The participant is mailed regular tickets and passes each month, based on their order for that month. They pay a small shipping and handling fee.

Pass programs are a significant source of revenue for the agency. In FY2011, group pass programs accounted for nearly one-third (*over 31%*) of the agency's fare revenue.

2010-11 Group Pass Program Summary

Program	Accounts	Revenue
Universal Annual Pass	207	\$14,046,932
Annual Pass	36	\$2,544,710
Universal Term Pass	4	\$310,239
Term Pass	7	\$4,236,300
Monthly Pass	288	\$7,055,185
Total	542	\$28,193,366

All employer programs make it easy for the company to subsidize a portion of their employee's transit cost, and many employers do, opting to pay for up to 100% of the program cost. All employer programs can provide both the company and their employees with significant tax savings when the employer offers a pre-tax payroll deduction program to pay for a portion of the transit cost. Until the Oregon Legislature eliminated the program this year, employers could also offset the cost of their transit program by up to 35% through the Oregon Department of Energy's Business Energy Tax Credit (BETC) Program.

Retail Outlets and the TriMet Ticket Office

Retail sales of tickets and passes occur at TriMet's Ticket Office (TTO) at Pioneer Courthouse Square, as well as a network of approximately 130 neighborhood retail outlets. The large number of outlets offers convenient locations for customers to purchase passes and tickets throughout the Tri-County area. Tickets and passes are distributed by mail each month to the outlets. Tickets (unvalidated) have a long shelf life, and are ordered on an as-needed basis. Monthly passes, which expire at the end of each month, are distributed to outlets each month, and unused passes are returned to TriMet at the end of the month for account reconciliation and billing. TriMet also supports a Pass



by Mail Annual Pass program, as well as the TriMet Online Store, as additional options for customers.

The TTO offers the added convenience of providing the customer with a more personalized customer service experience. In addition to fare sales, customers can go to the TTO for: schedules, system maps and other brochures, trip planning assistance, information about accessible services, Honored Citizen IDs and Honored Citizen Downtown Portland Bus Passes, and TriMet collectibles.

The TTO has also implemented a TriMet-developed print-on-demand (POD) ticket printing solution, which has provided significant benefits for customers, as well as internal efficiencies. The POD has allowed TriMet to quickly offer new rolling period pass products for customers that, without this technology, would not have been possible. Operationally, the POD system eliminates the need to manually count calendar month pass inventory on a regular basis. A new 30-day rolling pass allows customers to purchase a pass from the TTO good thirty days from the date of purchase. This will reduce long customer lines at the end of every month. TriMet will seek to make the POD system available at other outlets.

Money Room

TriMet's Money Room is where cash, coins and tickets from fareboxes are collected and counted. This is a labor intensive, costly process, which begins with the manual collection of money from each TVM and farebox. Money room equipment has been recently updated for better efficiencies and the farebox and TVM upgrades noted above will provide improved accounting modules used to balance cash receipts and reconcile credit card transactions. Moreover, extensive cash reconciliation processes are required for internal controls.

A goal of the Electronic Fare Collection system is to provide convenience so riders will shift from cash to the new fare products. To the extent the system is able to accomplish this goal, there will be a cost savings in money handling and accounting. TriMet's Money Room is where cash and tickets from fareboxes are collected and counted. This is a labor intensive, costly process. Money room equipment has been recently updated for better efficiencies and the farebox and TVM upgrades noted above will provide improved accounting modules used to balance cash receipts and reconcile credit card transactions.

Customer Concerns

Though TriMet strives to balance simplicity and ease of use for the customer vs. offering different products to address specific markets, it is apparent that over time the fare system has become too complicated, with too many different products. It is very difficult

for new and infrequent riders to figure out, primarily due to a zone system that can be complicated even for frequent riders. This can be a barrier to new riders, and for existing riders, the complex fare structure can lead to disputes at the farebox. Another source of customer concern is that transfer times are different on bus and rail. TriMet will review changes to both fare policy and technology to address these concerns.

Fare Enforcement

TriMet's current fare collection system relies on "visual" authentication of fare media to support a proof-of-payment scheme. Inspection of tickets and passes is done either by the operator when a patron boards a bus or by enforcement personnel during fare checks on a train. Recently, TriMet has taken a more aggressive stance in ensuring customers have paid the correct fare, which is important, and challenging, in a system with open rail platforms. Increased enforcement adds integrity to the system, ensures TriMet collects the correct fare revenue, and gives paying customers the confidence that everyone is paying their fair share.

Cost of Collection

Each fare distribution channel described above utilizes different processes, materials and equipment, and therefore, has a different cost structure. Generally, fare collection methods that require a significant investment in ongoing equipment maintenance, and which tend to support high volume/low value transactions, will have a much higher cost-to-revenue ratio.

Table 1 on page 19 displays the costs associated with each of the four distribution channels. Costs include fare media, distribution, processing, credit card fees, discounts, staff costs, equipment maintenance, and capital costs.

Total costs of collection, including depreciation and fare inspection were \$9.7 million in FY11, about 10.5% of revenue. The lowest collection costs are for the Universal Pass Programs, which cost \$282,000 to collect \$21,000,000 in fares, or 1.4%.

The next lowest collection costs as a percent of revenue collected are the outlets and the TriMet Ticket Office, which cost \$2.1 million to collect \$36 million of revenue (5.8%) from the sale of passes and tickets.

The cost of collecting cash fares on buses is \$1.5 million to collect \$20 million of cash fares (7.6%). These costs include current farebox depreciation of \$330,000 a year for ten years to extend the useful life of the farebox fleet from 20 to 30 years.

Ninety-six percent of the fares collected at the TVMs are single ride fares. TVMs operating and capital costs are \$4.7 million a year to collect \$17 million in fares, a 28% cost of collection. If these \$17 million in fares were sold through outlets, it would cost about \$1.0 million, \$3.7 million less than the cost of selling these fares through TVMs.

Almost 75% of the costs of collecting fares at TVMs are related to the actual TVM equipment. Over half (53%) of the cost— or \$2.5 million a year — is from the cost of maintaining the fare equipment, while capital depreciation accounts for about 22% of the cost of collecting fares from TVMs.

Cash transactions and the many different fares sold at TVMs contribute to high maintenance costs. These maintenance costs include mechanisms for ticket stock, bill and coin collectors and change makers in the type 3 and 5 machines. Most of these costs are associated with cash transactions. Forty-five percent of TVM transactions are cash and 55% are credit/debit transactions. Credit/debit payments are not mechanical and do not generate a lot of maintenance.

Capital cost of credit/debit only TVM machines are about half the cost of full service TVM machines. Of TriMet's 229 TVMs, 68 accept only credit or debit cards. These Type 4 card-only TVMs are installed across MAX and WES so that at platforms with more than one TVM, there is 1 full service and 1 card only machine.

It may be possible to upgrade all of TriMet's TVMs contactless operation for about \$2 million.

If TriMet could move customers from making their purchases at TVMs to making their purchases at retail outlets or online fewer TVMs would be needed, reducing both capital and maintenance costs.

If TriMet decides to issue its own smart card, it should set a goal of obtaining wide spread use of the card to limit TVM sales. Strategies to accomplish this include increasing the number of outlets from 130 (already high compared to most transit agencies), having a contactless card that can be loaded at any retail debit/credit machine, and targeted marketing toward TVM users. TriMet will conduct a survey to better understand TVM customers and other cash customers. The survey results will help TriMet develop a strategy to reduce costs.

Table 1

Cost of Collecting Fares

Function	Farebox	TVM	Outlets & CAO (1)	Universal Pass Prgm (2)	TOTAL Costs
<i>Fare Media Costs</i>					
TVM ticket stock	\$0	\$90,000	\$0	\$0	\$90,000
Pass & Ticket Printing	\$0	\$0	\$130,000	\$0	\$130,000
PASSport Stickers	\$0	\$0	\$0	\$8,000	\$8,000
Transfers	<u>\$68,000</u>	<u>\$0</u>	<u>\$0</u>	<u>\$0</u>	<u>\$68,000</u>
	\$68,000	\$90,000	\$130,000	\$8,000	\$296,000
<i>Distributing, Collecting, Processing Fares</i>					
TVM Revenue Collection (contract & van)	\$0	\$129,357	\$0	\$0	\$129,357
FB Revenue Collection (Pullers & Money Van)	\$263,453	\$0	\$0	\$0	\$263,453
Counting & Reconciling Fares (Money Rm)	\$456,507	\$185,915	\$0	\$0	\$642,422
Armored Money Transport	\$13,224	\$5,486	\$0	\$0	\$18,710
Credit Card Fees	\$0	\$700,824	\$77,869	\$0	\$778,693
Bank Fees (Count, Deposit Cash & Coin)	\$31,920	\$10,080	\$0	\$0	\$42,000
Credit Card Fraud	\$0	\$85,000	\$0	\$0	\$85,000
Courier Services to Outlets	\$0	\$0	\$25,000	\$0	\$25,000
Postage Pass by Mail	\$0	\$0	\$13,077	\$0	\$13,077
Postage for E-Pass & Internet Sales	\$0	\$0	\$9,095	\$0	\$9,095
Mailing Passes (Mail Clerk)	\$0	\$0	\$5,097	\$0	\$5,097
TTO Office Maintenance	\$0	\$0	\$600	\$0	\$600
Selling Fares (TTO)	\$0	\$0	\$360,748	\$0	\$360,748
Processing Outlet & TTO Sales	\$0	\$0	\$330,626	\$0	\$330,626
IT Support	\$0	\$18,047	\$31,953	\$0	\$50,001
Selling & Administering Employer Pass Programs	\$0	\$0	\$45,246	\$273,812	\$319,058
Commissions to Outlets for Selling Fares (5)	<u>\$0</u>	<u>\$0</u>	<u>\$1,025,416</u>	<u>\$0</u>	<u>\$1,025,416</u>
	\$765,104	\$1,134,709	\$1,924,728	\$273,812	\$4,098,352
<i>Maintaining Fare Equipment</i>					
Fare Equipment Maintainers	\$0	\$1,610,516	\$0	\$0	\$1,610,516
Fare Supervisors & Engineers	\$0	\$417,886	\$0	\$0	\$417,886
System Software Engineer	\$0	\$108,889	\$0	\$0	\$108,889
TVM Maintenance Materials	\$0	\$280,000	\$0	\$0	\$280,000
TVM Contracted Maintenance	\$0	\$42,000	\$0	\$0	\$42,000
TVM Maintainer Vehicles & Radios (4)	\$0	\$35,538	\$0	\$0	\$35,538
Farebox Maintenance & Repair	\$199,625	\$0	\$0	\$0	\$199,625
Farebox Maintenance Materials	\$80,000	\$0	\$0	\$0	\$80,000
Farebox Problems - Road Supervisor response	<u>\$87,783</u>	<u>\$0</u>	<u>\$0</u>	<u>\$0</u>	<u>\$87,783</u>
	\$367,409	\$2,494,829	\$0	\$0	\$2,862,237
<i>Capital Cost of Equipment (replacement value) (6)</i>					
TVM Maintainer Vehicles Depreciation	\$0	\$21,000	\$0	\$0	\$21,000
TVM \$\$ Collection Van Depreciation	\$0	\$4,200	\$0	\$0	\$4,200
Money Truck Depreciation	\$4,000	\$0	\$0	\$0	\$4,000

Fareboxes Depreciation	\$884,533	\$0	\$0	\$0	\$884,533
TVM Depreciation (units, validators, computers)	\$0	\$999,600	\$0	\$0	\$999,600
	\$888,533	\$1,024,800	\$0	\$0	\$1,913,333

Fare Inspection (7) \$1,144,873

Total Costs of Collecting Fares:	\$2,089,046	\$4,744,337	\$2,054,728	\$281,812	\$10,314,796
Total Passenger Revenues (FY11) (8)	\$20,065,664	\$17,128,163	\$35,987,727	\$19,676,423	\$92,857,977
Costs as % of Revenue:	10.4%	27.7%	5.7%	1.4%	11.1%

(1) Outlets & TTO also includes on-line sales, Pass by Mail, E-Pass

(2) Universal Pass Programs include PASSport, Select Term Pass, Annual Photo ID pass programs

(3) New, lower banking fees are being negotiated for next year. Currently fees are 6.5%-7.0%. The new agreement will be for around 4%.

(4) Radio payments to City of Portland will cease at the end of 2012

(5) Depreciation is calculated for the replacement cost of items. Straight-line depreciation at 10 years for trucks & vans, 15 years for fareboxes & TVMs.

(6) Public sales outlets receive a discount on their sales based on the quantity of monthly pass sales: \$1,000 - \$4,999 = 1%, \$5,000-\$49,000 = 2% , \$50,000 - \$100,000 = 3.5% and and \$100,000 & above = 5% discount. The discounts are only \$50,000-\$99,000 = 3.5% and \$100,000 & above = 5% discount. The discounts are only applied if outlets pay within the contract terms of net 60 days.

(7) While clearly a cost of collecting fares, fare inspection costs are related to train service & fareless square, rather than the mode of distributing fares.

As a result, these costs are treated as an overhead cost and are not allocated directly to any one distribution mode.

(8) FY11 passenger revenue is estimated. It does not include Fareless Square, PGE Park, BETC, or ATP Retained fares revenues.

Section 3. Fare Policy Considerations

Fare Policy Review Objectives

TriMet's objectives for potential changes to the fare policy review include:

1. A system that is easy to understand and convenient for the customer
2. A system that is easy to understand and convenient for operators and fare inspectors
3. A system that will accommodate transfers between vehicles and between partner agencies
4. A system that supports a predictable and understandable rationale fare increases
5. A system that meets transit equity objectives
6. A system that will support the implementation of fare policy changes that are revenue neutral or increase revenue

Background

TriMet has a complex set of fare policies that have been developed and implemented over several decades. As TriMet migrates to Electronic Fare Collection (EFC) it has an opportunity to review and simplify fare policy to facilitate the new fare collection system and to provide an easier system for riders.

TriMet's current fare policy with multiple zones, discounts and fare instruments is complex and difficult for both the riders and bus operators to understand. The fare system consists of three zones along with a free rail zone in downtown Portland that extends to the Lloyd district. Transfers are issued without extra charge and are good for about two hours. New riders and visitors in particular complain that it is difficult to determine the correct fare to buy. TriMet's own research on how riders buy fares shows that new and infrequent riders often buy the wrong fare because they have difficulty figuring out zones.

In addition to the zones, the fare structure is complicated by the fact that TriMet has more than 35 different fare instruments, including a variety of tickets and passes, for customers to choose. For example, there are 5 different monthly passes: adult all zone, adult zone 1 and 2, adult zone 2 and 3 zone, honored citizen, and youth. In addition, TriMet issues an annual pass, a half monthly pass, a 30 day rolling pass, a 14 day rolling pass, a 7 day rolling pass, a packet of ten ride tickets, a seven day scratch-off pass, an upgrade, and employer passes.

TriMet staff have reviewed several fare policy options and researched fare systems around the world. The research shows that there is about as much variety in fare policies as there are transit agencies. Many large transit agencies such as Washington

While the intent of the zone system is to provide a reduced fare for short distances, it has inherent inequities, especially for people who live near a boundary. For example, a person who lives in zone three can travel a great distance without crossing a zone boundary. This rider can travel from the Sunset Transit Center to Forest Grove, a distance of about 16 miles, and stay entirely in zone three which requires a one zone fare. On the other hand, that same rider can travel from Sunset Transit Center to the Oregon Zoo less than three miles away and travel through three zones, which requires an all zone fare. A person who lives near a boundary could travel only three blocks across the boundary and need to pay for travel in two zones.

Another problem with the zone system is that it provides a lower fare for riders who are traveling short distances, but at the same time charges a higher fare to transit dependent riders who use the entire system for basic mobility.

An inherent complexity of the zone system is that a rider who wants to purchase a monthly pass needs to decide what zones they will ride in. For example, a person who typically rides from southeast Portland to downtown would purchase a 1-2 zone monthly pass. However, if that person wants to travel to the airport, they would need to purchase an upgrade for the trips to and from zone 3. The necessity to purchase an upgrade from the TVM or bus operator is an additional complexity of the zone system.

TriMet's zone system would be difficult and expensive to manage with electronic fares. Other fare structures should be explored before EFC implementation. Options for changes to the zone fare policy include a distance based fare, flat fare, peak hour fare, revision or elimination of the Free Rail Zone, a premium fare for WES commuter rail, and a downtown fare. These alternatives are explored below.

Alternative Fare Structures

Flat fare

Several transit agencies around the world use a flat fare. The primary advantage of this option is that it is easy to understand and administer. The customer knows exactly how much the fare will be for every ride. The disadvantage is, of course, that riders who travel only a short distance pay the same as riders who travel a great distance. The benefits of a simplified system must be weighed against the benefit of trying to allocate fares based on total distance. If the transit agency has a goal of easy to understand fares, a flat fare is the best option. A smart card that calculates the fare for the rider addresses the complexity of zones. In some cases the flat fare is combined with a premium fare for express commuter service and a peak/off peak fare.

Peak/off peak fares

A system with peak fares varies the fare by time of day, with riders paying more in the highest demand, peak hours. Peak fares are frequently charged for several hours in the morning commute and several hours in the afternoon commute.

Although full vehicles are efficient, when the vehicle is overcrowded the transit agencies must add new vehicles and vehicle operators to meet the demand. Peak fares are charged by several transit agencies including Washington D.C., Seattle Metro and Minneapolis/St. Paul.

The policy objective of a peak fare is to control demand at the time when vehicles are most crowded and full of commuters. Peak surcharges encourage some riders with flexibility to shift to the shoulders rather than filling the vehicles at times of highest demand.

A narrow peak period of about an hour with a significant price differential has the greatest potential to shift demand. A different strategy is a long peak period (three hours) which has the benefit of generating revenue from commuters, while transit dependent riders, unemployed individuals, senior citizens, and others with flexibility can ride at discounted on off-peak hours. This approach can raise significant revenue but has less potential to shift demand.

TriMet's research shows that lengthy times for peak fares are not very effective in reducing demand. If TriMet were to implement a peak fare, the most effective time period to reduce demand would probably be two hours or less in the morning and two hours or less in the afternoon.

Washington Metro adopted a new peak-of-the-peak surcharge in 2010, in addition to increasing the peak period surcharge. The peak-of-the-peak surcharge adds an additional 20 cents on trips that are taken weekdays between 7:30 and 9:00 a.m. and between 4:30 and 6:00 p.m. This strategy is intended to raise revenue and to encourage riders with flexibility to choose to ride in less crowded times. Metro estimates that a 20 cent surcharge would shift 10% of passengers out of the peak of the peak.

The full impact of peak hour fares on TriMet's peak demand and revenue generation would need to be carefully analyzed.

Distance based fares

Distance based fares calculate the fare based on miles traveled. Distance based fares are relatively easy to understand on a rail system with closed platforms and turnstiles, such as a subway. Systems with electronic fare payments are able to

easily make the distance calculation, while the old token based systems do not. An electronic ticket or pass is read when the rider enters a gate and read again when the rider exits. The system then calculates the fare and deducts it from the card. At open rail platforms such as TriMet's system, the calculation becomes more difficult. Because a rail rider is not required to pass through a gate, the rider must tap a card on an electronic reader located somewhere near the platform, and then remember to tap the card again when they leave to let the system know where they disembarked. If they don't tap off, the full fare is charged.

On the bus, the rider would also need to tap on and tap off, necessitating card readers at both the front and back doors. Tap on and tap off systems are more expensive because of the additional equipment required on vehicles and at platforms, as well as the added complexity needed in the back-end system to handle the fare rules calculations. Extra equipment would also be needed at large event centers such as the Rose Garden.

Transfers add more complexity, especially bus transfers. Distance based fares would be difficult to calculate when the rider transfers between a train and a bus. For this reason, transit systems using distance based fares typically do not allow free transfers between buses and rail.

Downtown fare

Some cities have adopted a special downtown fare. Minneapolis/St. Paul has a fifty cent downtown fare. Salt Lake City, Pittsburg and Denver have free ride areas. Seattle's free zone will soon be eliminated. The policy objectives of downtown fares typically started out to encourage ridership, reduce air pollution and facilitate travel in the city core. As air pollution decreases and ridership increases, the policy objectives change.

TriMet's Free Rail Zone allows free rides on MAX trains downtown and on the central eastside to the Lloyd stop. The convention center and Rose Quarter are within the Free Rail Zone, but Jeld Wen stadium is not.

A downtown fare in Portland has been discussed within the boundary of the Portland Streetcar which opens operations on the eastside of the Willamette River in fall 2012. The Streetcar will "close the loop" with service extending across the new transit bridge that will be constructed as part of the Portland to Milwaukie Light Rail project in September 2015. Because the Streetcar travels only a few miles through downtown and over the river, some argue that it should cost less than a TriMet ticket. Currently streetcar fares are the same as a TriMet 2-zone ticket, but the ticket is valid on the streetcar all day.

Because there are many options to consider, the City of Portland and TriMet hired a contractor to analyze several fare scenarios. Some of the options considered include:

- A reduced fare for travel on Streetcar and TriMet within the Streetcar “Loop”
- Charge a separate fare for the Streetcar
- Remove Streetcar from the Free Rail Zone
- Eliminate the Free Rail Zone altogether

Time Based Fares

TriMet currently uses time based fares to accommodate transfers between buses and trains. The amount of time, two hours on MAX and an hour past the end of the line on bus, is intended to allow the rider to transfer to another vehicle to continue a trip. A discounted short time-based fare could be an option for short trips.

Premium Service fares

Many transit agencies charge premium fares for premium service such as express service from suburbs into downtown. Typically express commuter service is on buses with comfortable seats designed for long rides with added amenities such as Wi-Fi and reading lights, and on commuter rail service. TriMet does not operate express bus commuter service, but does have a few peak hour routes with limited stops.

The TriMet Board of Directors has discussed charging premium fares on peak hour bus routes, but concluded that an extra fee wouldn't be fair to transit dependent riders.

TriMet does operate commuter rail service. Most transit properties charge a premium fare for commuter rail service. When the WES commuter rail service began, an interagency agreement specified that the fare would not be higher than TriMet's fares. The cost to ride WES is an all zone fare with a free transfer to other TriMet service. Because WES provides premium commuter service, a premium fare could be considered as part of the fare review. However, a premium fare would need to be balanced against the potential negative effect on ridership.

Each of these alternatives should be considered in relationship to the fare policy review goals outlined at the beginning of this section. The matrix below shows how each fare alternative relates to the objectives.

Alternative Fare Structure Matrix

Fare Policy Review Objectives

1. A system that is easy to understand and convenient for the customer
2. A system that is easy to understand and convenient for operators and fare inspectors
3. A system that will accommodate transfers between vehicles and between partner agencies
4. A system that supports a predictable and understandable rationale fare increases
5. A system that meets transit equity objectives
6. A system that will support the implementation of fare policy changes that are revenue neutral or increase revenue

The matrix below shows how each fare alternative relates to the policy objective above

Objectives	1	2	3	4	5	6
Flat fare	H	H	H	M	H	H
Peak/off peak	L	L	M	M	H	H
Distance based fare	M	M	M	M	H	H
Downtown fare	L	L	L	M	L	L
Time-based fare	M	M	M	M	H	H
Premium service fare	M	M	L	M	M	H
Zone System	L	L	M	M	M	H

H= high relationship to meeting objective

M – medium relationship to meeting objective

L – low relationship to meeting objective

Transfer Policy

Background

TriMet currently issues a free transfer when a cash fare is purchased on a bus or at a Ticket Vending Machine (TVM) on a rail platform. The transfer also serves as a proof of payment. The intent of the transfer is to allow the rider to complete a trip in one direction. However, in some cases, a rider may be able to make a return trip on the same fare, if the return trip can be made within the expiration time of the transfer. Many transit properties do not allow round tripping on a single transfer. Some agencies charge a small amount to issue a transfer, or require payment of another full fare. Many agencies only issue a bus transfer upon request.

MAX and WES Transfers

The validated tickets serve as a transfer fare media between buses and trains as a proof-of-payment for riding MAX.

MAX and WES tickets are valid for 2 hours. Tickets are validated automatically when cash is used to purchase a ticket at a TVM. The customer must validate tickets that are purchased in advance at a validator on the rail platform.

The Rider can transfer to another MAX train, bus or WES anytime within the two hour expiration time. For example, a rider going to the airport can board a Blue Line Train in Hillsboro on a Saturday at 7:25 AM. The two hour transfer allows the rider to make a transfer to the Red Line before 9:25 AM. In this example the rider would arrive at the Beaverton Transit Center at 8:03 AM, leaving an hour and 20 minutes to make the transfer. With trains running every 17 to 30 minutes all transfers can be accommodated within the time limit.

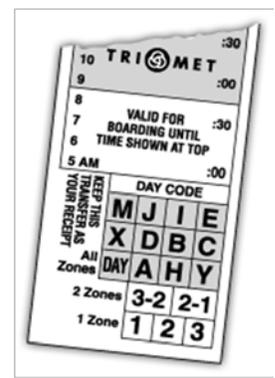


Electronic Fare Collection Implications at Rail Platforms

Electronic Fare Collection would make a positive change for providing transfers at rail platforms. Currently the transfer is either a validated ticket bought directly at a ticket vending machine, or a 10-ride ticket purchased in advance but validated at the platform. EFC would allow TriMet to eliminate the paper 10 ride tickets, which means that validators at platforms can be removed. After the initial cost of removing the validators, TriMet would have on-going savings in maintenance and replacement costs.

Bus Transfers

Bus operators issue transfers when a rider purchases a fare on-board. The transfer is issued to each cash paying rider because it serves as



proof of payment if a fare inspector happens to ride the bus. Bus transfers are made of flimsy paper, are extremely difficult for riders to decipher and difficult for operators to issue because they must be ripped individually.

Weekdays, when most bus service runs at least every half-hour, bus transfer receipts are valid for *1 hour past the time the bus arrives in downtown Portland*. If the route doesn't go downtown, the transfer is valid one hour past the last scheduled stop on the route. This allows ample time to make connections with other buses or trains.

Weekends and holidays, when some lines run only every hour, transfer receipts are valid for *2 hours past the time the bus arrives downtown*.

Transfer policy options

Questions that could be discussed about transfer policy include:

1. Should the policy be changed to issue bus transfers only upon request, as many other transit properties do?
2. Should TriMet purchase new equipment to print transfers, in order to make transfer times the same on bus and rail?
3. Should transfer policy regarding the time allowed for a transfer be reviewed?
4. Should transfers be limited to trips in one direction?

Electronic Fare Implications: Single-ride & Multi-ride Products

As mentioned above, the EFC system will be based on open standards to the maximum extent possible. It will have the capability to allow customers to use common retail payment methods, such as a bank-issued credit cards, TriMet-issued and third party payment-enabled cards or mobile devices, to pay fares at rail platforms and on bus.

TriMet's new EFC system as described will generally offer two broad types of fare products:

Single-ride (SR), pay-as-you-go fare products would be used by customers with their own contactless payment media (such as a bankcard) simply by walking up to a rail platform reader, or bus reader, and tapping. SR customers may have access to best value caps, or loyalty discounts that could be offered by TriMet or perhaps another issuer of the fare payment medium. It is anticipated SR products would include free transfers to another vehicle for a predetermined period of time.

Multi-ride (MR), pay-in-advance fare products would be purchased by customers before riding. MR fare products could include period passes (such as daily, weekly, monthly or annual), stored value (typically at a discount to single ride fares), and/or

pre-purchased single-ride tickets. MR products could be sold on-line, by mail, through the TTO, potentially at retail outlets, and perhaps TVMs. MR products may also be sold through institutions such as employers and colleges that issue contactless cards.

The EFC system could provide the ability to purchase a series of fare products within these two product types. Examples of products that TriMet may offer include:

- MR period passes that provide unlimited rides for frequent customers;
- MR stored-value products for customers who pay in advance and purchase multiple fares at a time (could be either for a defined number of trips, or a defined value);
- SR products for customers who ride infrequently and want to pay-as-you-go (product could be priced at a premium);
- SR “best value” caps (or perhaps a loyalty discount for more frequent SR users);
- Reduced fare versions of all MR and SR products, for Youth and Honored Citizens;
- Peak/off-peak fares for either MR or SR products;
- A zoned fare,
- Marketing promotion and incentive fares, for conventions or other groups/special events;
- A premium fare for commuter rail;
- A distance-based fare (though TriMet anticipates shifting to a flat fare, a distance-based fare should be feasible, but would require a substantial capital investment for readers at both the front and back of the bus and additional readers at rail platforms to accommodate the need to tap-on/tap-off);
- Joint fares with other transit providers that accept contactless cards.

Electronic Fare Collection offers several opportunities to improve the fare product inventory and collection system over the current system. Advantages include:

Operational simplicity

All products, both SR and MR, would be validated automatically by a card reader, and would not be subject to visual authentication by an operator that must keep track of a variety of fare media. This simplifies the operator’s responsibilities tremendously, and allows them to focus on operating the bus safely. Depending on the transfer policy chosen (that is, if transfers are provided only with a card transaction), the manual process of issuing paper transfers may also be eliminated.

Administrative flexibility

EFC provides the opportunity to target MR fare products at specific markets, without introducing additional complexity for the operator.

Customer convenience

In addition to being able to offer additional fare products for customers, purchasing the product and paying the fare can be much more convenient. For example, a frequent rider that purchases a MR product can load their card at home from their computer, as opposed to going to a retail outlet. They may also have the advantage of using NFC to pay with their smart phone. In addition, there are valuable tools available for MR card/account holders, including on-line account management, and other features such as auto-load and loss protection.

Operational efficiency and reduced costs

The EFC system should reduce costs associated with fare collection, revenue processing, pass distribution, and reconciliation. Cash is very expensive to collect, both at the farebox and at TVMs. Our current processes required to distribute passes to retail outlets and manage reconciliation is also a very manual and time consuming process. MR products automate the pass distribution process, and reduce the manual labor required with current systems. Ten ride tickets could be easily shifted to EFC, either as number of trips or defined value. This would allow for the removal of mechanical platform validators that perform poorly and are generally expensive to maintain. Converting customers to MR products, and offering SR products in more convenient alternatives such as NFC, will reduce operating costs by reducing pressure on equipment that is expensive to maintain.

Data Collection

Both SR and MR products in an EFC system will produce valuable data on trip patterns and fare use for pricing purposes.

Regional integration

EFC will provide robust data for MR products that are used across transit systems, thereby simplifying reconciliation.

Since MR products are more difficult to purchase for people without a credit card or bank account, TriMet will emphasize EFC options for the unbanked. Alternatives could include pre-paid bankcards (such as ReadyCredit trials in Los Angeles and Salt Lake City), or preloaded TriMet “gift-cards” that could be sold at retail outlets.

Electronic Fare Implications for Outlet Programs

TriMet boasts 130 retail sales outlets, including large grocers such as Fred Meyer, Safeway, Albertsons, Whole Foods and New Seasons. TriMet's Fare Revenue Specialists' distribute passes and tickets to this extensive retail network, which sells our fare instruments for a small commission to the retailer ranging from 1% to 5% — depending on sales volumes. With over \$30,000,000 in annual fare revenue generated from retail outlets, they are the largest distribution channel of TriMet fares.

Electronic fare will have several implications for TriMet's Outlets Program, although the extent of the impact varies greatly on how the outlets may be used in the future. With a low distribution cost of approximately 5% of fare revenue sold at this channel, a large geographical footprint covered, and acceptance of cash and bankcards, TriMet has a retail infrastructure that is very convenient and accessible for our riders.

There are various ways to leverage a retail outlet to distribute electronic fare media, and it is important to weigh customer convenience against distribution costs. Here are few options for review:

1. Retail outlets generally carry gift cards; therefore, they have the existing infrastructure to carry a TriMet issued smart card. This smart card could be pre-loaded with value by TriMet on the back-end, which would eliminate the need for equipment at the outlet to load value. However, without a system to load value at the outlet, the customers ability to re-load card value would be reduced to other channels, including, but not necessarily limited to online or the TriMet Ticket Office. The inability to reload value on smart cards poses a challenge for the unbanked or customers without access to the internet. This is an issue pre-paid cards could help mitigate.
2. Retail outlets could be full-service smart card. If TriMet provided the retail outlet a system for reloading cards, whether it is a stand-alone reloading system, or integrated with their point of sale system, customers could buy their TriMet issued smart card at the retail store, and/or reload value using cash or bankcards. This solution provides a large, full-service network of locations for the customers. However, there is the potential for significant capital and maintenance costs for the equipment.
3. While outlets are a critical component of our existing fare distribution channels, with electronic fare technology rapidly changing, there may be an opportunity to achieve full electronic fare market penetration through NFC technology on cellular phones, pre-paid debit card distributors, contactless bank credit and debit cards, and TriMet issued smart cards reloadable online or at the TriMet Ticket Office. If these channels become mature, eliminating retail outlets, or reducing the scope and breadth of their reach is possible.

Electronic Fare Implications for Group Pass Programs

Group pass programs are a significant source of revenue for TriMet, generating over \$30 million annually. Though the cost of distributing fare media under these programs is already very low, several benefits can still be realized with an EFC system. For example, program administration, including account maintenance, distribution of fare media, and controlling participant access, can be greatly simplified using an account-based EFC format.

TriMet offers group pass programs for both employers and colleges:

- *Universal Annual Pass and Universal Term Pass Programs* – The employer or college purchases passes for every one of their employees or students.
- *Annual Pass and Term Pass Programs* – The employer or college purchases passes only for those employees or students that opt-in for a TriMet pass.
- *Monthly Pass Program* – Employers and colleges also have the option of participating in the Monthly Pass program, where they provide passes and tickets to their employees or students on a month-to-month basis.

Migration to EFC provides unique opportunities to streamline many elements of these programs. Potential benefits include:

Fare media distribution and controls

Fare distribution could become even more efficient with EFC. Currently, group pass programs essentially use two types of fare media: stickers that are adhered to employee IDs as proof of payment (for annual programs), or regular passes and tickets (for monthly programs). With an account-based EFC system, distribution frequency could be more efficient, depending on the life span of the current chip technology. For example, instead of distributing stickers annually, or tickets/passes on a monthly basis, customers could use a single card for up to 5-7 years (depending on the chip used).

Fare media management would be much improved. With EFC, there is no “inventory” of stickers or passes to maintain, and therefore, much less risk of fare media being used by individuals that are not eligible for a program. However, the cost of the cards should be weighed against the benefits. There may be strategies to offset the card cost, such as passing a portion of the cost on to the customer.

Account management and program administration

Accounts would be managed on the backend, which consequently allows much more robust controls in setting and maintaining appropriate transit privileges.

Similar to the benefits realized in managing inventory, cards could be “turned on” only for eligible employees, and could be deactivated if used in an unauthorized manor, or if an employee becomes ineligible for any other reason.

Lost cards could be deactivated, and subsequently replaced for the customer, offering substantially less risk than losing an annual or monthly pass.

As a benefit for the employer (as well as TriMet), an account-based system provides the opportunity to develop online account management tools, where an employer could view/make changes to their account, as well as potentially managing their subsidy level and pre-tax payroll deductions.

The online management would streamline distribution for the employer because they would no longer distribute physical passes each year.

Data collection

EFC provides the opportunity to collect rich data on ridership, as customers would be required to tap their card to register proof of payment. This provides robust data on where customers board, and provides both TriMet and individual employers with extensive information on ridership patterns. Customer privacy, however, is an issue that must be considered when collecting data and conducting ridership analysis. The data collection would assist the employer in setting policies about which trips the employer will subsidize.

Actual ridership data based on taps would likely yield more accurate data than ridership surveys. Currently, program pricing for the Universal Annual Pass program is based on survey data from Employee Commute Options (ECO) surveys, which are conducted over a one-week period. Ridership data collected over the course of the year would improve data accuracy and would allow more in-depth analysis for pricing purposes. Analysis might include collecting tap data over the course of a year, allowing for comparison to ECO survey data, and consideration of possible pricing strategies.

Potential impacts to employers and TriMet should be considered. As is done currently, a transition pricing plan may include caps that limit the amount an employer’s price may go up or down, in the case a new data source were to differ from ECO data.

Proof of payment and visual inspection

As is the case with all of TriMet’s fare media based on visual inspection, stickers can be difficult for bus operators to identify, especially at a quick glance. EFC provides the opportunity to improve accuracy in verifying valid fare with a “green

light/red light” approach, also simplifying the operators’ responsibilities and allowing them to focus on operating the bus safely.

Serving the unbanked

A concern that needs to be addressed when moving to an electronic fare system is the potential impact for people who do not use banks or credit cards. TriMet does not have data on what percent of the ridership is unbanked, but it is a safe presumption that of those people in our community who do not have banks, many are transit dependent.

Banks are important in taking full advantage of a smart card system. First, credit cards are used extensively to reload smart cards at platforms and sales outlets. This issue can be addressed for those without credit cards by accepting cash at the reloading machines. However, the convenience this provides should be weighed against the cost of machine maintenance for bill and coin selectors and the cost of collecting and handling the cash. Second, credit cards can be tied to a smart card for reloading on line or the customer could set up an auto-reload function to transfer money from a bank account to the smart card when the amount on the card drops to a low level.

Credit cards themselves, if embedded with a smart chip may become a important means to pay for transit fares in the future. These types of credit cards are already in widespread use in Europe and Asia. If the customer provides the credit card as a fare media, this has major advantages for the transit agencies because of the cost of issuing and administrating the card. However, those people who do not have credit cards would not have access to this fare option. This can be addressed by providing a small number of agency issued cards to social service agencies and low income individuals. Pre-paid credit/debit cards can also be used as an alternative for the unbanked.

Title VI Considerations

TriMet is required to conduct a review of all fare policy changes and fare increases to comply with Title VI of the federal Civil Rights Act. The analysis is submitted to the Federal Transit Administration. Title VI considerations are important when transitioning to an electronic fare collection system because low-income riders may not have access to credit cards and banks which are needed to purchase monthly or multiple fares on a smart card and are necessary to recharge the card. Low income riders may not be able to afford even low cost card reloading.

If fare policy changes are made, there are various strategies that could address Title VI issues. For example, a flat fare to replace the zone system would give reduce the cost

of the all zone fare and increase the cost of the 2-zone fare. This offers less expensive, longer rides to transit dependent people who use the entire system the most but are least able to pay.

An EFC system that provides a discount after a certain number of rides is taken alleviates fare equity issues associated with discounts for monthly passes which are not affordable for many low income riders.

Electronic Fare Collection and Partner Agencies - Portland Streetcar Inc. and CTRAN

The City of Portland, Portland Streetcar Inc. and TriMet have been in agreement that the Portland Streetcar should have fares that are consistent with TriMet's fares to facilitate seamless transfers.

Currently the streetcar fare is tied to TriMet's 2-zone fare. A streetcar rider buys a 2-zone fare that allows a transfer to TriMet within the two hour transfer time. The same ticket is valid on the Streetcar all day. This arrangement makes sense for Streetcar riders who are making short trips, but also facilitates easy transfers for riders who want to go farther.

Portland Streetcar also has a Free Rail Zone that uses the boundaries of the old Fareless Square. As the Streetcar expands to the east side in 2012, the Free Rail Zone is being reviewed and may be changed. A decision about changes to the Streetcar fare policy needs to be made by the Streetcar Board of Directors in early 2012 for implementation when the streetcar expansion opens in September 2012. Another logical opportunity to review Streetcar fare policy will occur in 2015 when the Streetcar "closes the loop" over the new Willamette River Bridge.

A consistent fare that allows transfers between TriMet and the streetcar can be facilitated with EFC.

TriMet will also want to work closely with C-TRAN to ensure EFC interoperability of equipment. Reciprocity arrangements between TriMet and partner agencies can be made through the EFC backend. TriMet will want to work closely with Portland Streetcar Inc. and the City of Portland to ensure both the fare policy and fare collection systems work together and are understandable for customers.

Next Steps for Fare Policy Review

1. Determine a fare policy goal and potential scenarios

The fare policy goals are outlined at the beginning of this chapter. A flat fare is the most effective in meeting goals of simplicity and customer service. A Peak hour fare is the most effective for generating new revenue. TriMet should begin reviewing both of these fare options and potential scenarios for implementation. Because both of these scenarios represent significant changes to the fare structure, it may not be realistic to implement them at the same time.

A transition to a flat fare should be a priority for smooth implementation of an EFC system. Potential scenarios for changing the fare structure are outlined below.

2. Begin to move from a zone based system to a flat fare

Due to the revenue shortfall TriMet faces in FY 2012, higher than normal fare increases will be needed to prevent drastic cuts in service.

As of September 1, 2011 fares are:

1- Zone, \$2.05 2- Zone, \$2.10 All-Zone, \$2.40

TriMet could begin to move to a flat fare with the anticipated fare increases that will be implemented in 2012. TriMet may increase fares two times with a small increase in April and another increase at the normal September time. The first fare increase will require TriMet board action in January and February. Three options are discussed below.

Eliminate 1-Zone fare

A first step to collapse the zone system could be to eliminate the 1-zone fare in April. Currently 1-zone fares are only sold at retail outlets and the TriMet Ticket Office in books of 10. They are not sold on buses or at TVMs. TriMet could implement this step by simply stopping the sale of 1-Zone fares.

Increase 2-Zone fare more than 3-Zone fare

A second step could be to begin to increase the 2-Zone fare more than the All-Zone fare, thus bringing the price for the two fares closer together over time until they are the same price. This incremental approach would be consistent with past practice. In this approach TriMet would gradually reduce the gap between the fares until the fare is flat.

Collapse the zones

In another scenario, the three zones could be collapsed in one zone all at once. Assuming there is a desire to keep the move revenue neutral, the fare today would be \$2.30. This approach would be a more dramatic change for the riders and may be less accepted than the incremental approach.

Potential Time Line for Changing Zones

The scenario below assumes a nickel fare increase in April 2012 to help offset budget reductions that will be needed in September, with a larger fare increase in September 2012. The scenarios below are for discussion purposes only.

April 2012

- Eliminate 1-Zone fare, increase 2-Zone and All-Zone fares by a nickel

1-Zone fare (no longer sold) 2-Zone \$2.15 All-Zone \$2.45

Impact:

- Riders who currently buy 1-Zone tickets would have a 10 cent increase,
- Riders who currently buy 2 and 3-Zone tickets would have a 5 cent increase
- Streetcar fares would also increase by a nickel to continue a seamless transfer opportunity to TriMet service.

September 2012

- Begin to close the gap between 2-Zone and All-Zone fares by increasing 2-Zone fares more than All-Zone fares. The scenarios below are for discussion purposes only.

Scenario 1: 15 cent increase on 2-Zone and 5 cent increase in All-Zone

1-Zone (not available) 2-Zone \$2.30 All-Zone \$2.50

September 2013 10 cent increase on 2-Zone; no increase on All-Zone

2-Zone \$2.40 All-Zone \$2.50

September 2014 10 cent increase on 2-zone; no increase on All-Zone

2-Zone \$2.50 All-Zone \$2.50

Scenario 2: 20 cent increase on 2-zone and 10 cent increase on All-Zone

1-Zone (not available) 2-Zone \$2.35 All-Zone \$2.55

Of course, there are numerous other ways to look at the increases and still begin to close the gap between the zones depending on how fast TriMet wants to close the gap and the need for revenue.

Fare Policy Change Time-Line

October 10, 2011 – TriMet board presentation on fare policy and EFC

Late 2011 – Launch public outreach to selected stakeholder and begin discussion about potential fare policy changes

January 2012 – Develop proposal for broad public and board review

January/February 2012 – TriMet board action for April fare increase

March 2012 – Develop Proposal for September fare increase

March/April – TriMet board action for September fare increase

September 2012 – implement fare increases

September 2013 – implement fare increases to continue to close the gap

September 2014 – implement fare increases to continue to close the gap

Section IV. Electronic Fare Collection Technology Solutions

Introduction

Electronic fare collection (EFC) equipment has been used in the transit industry for more than a decade. The early form of electronic fare collection was a magnetic card and a card reader just like the magnetic strip on a credit card. Magnetic readers have been used on buses and at subway turnstiles.

The next generation of electronic fare collection equipment uses a “smart” computer chip embedded in a card to communicate to a card reader (RFID). This type of equipment is common on large transit systems world-wide such as the Octopus system in Hong Kong and the Oyster system in London. Smart card technology is now used by medium sized transit systems in the United States such as Seattle, Minneapolis and San Diego.

Emerging electronic fare media includes contactless credit cards issued by a bank. Low value cash fares can be paid simply by tapping a bank card on a reader with no need to buy any ticket in advance. Prepaid credit cards with smart chips are also available.

Near Field Communication (NFC) is a new technology that enables a mobile device to communicate to a reader for a transaction. As NFC becomes more established, tickets will be loaded onto mobile phones instead of smartcards, allowing people to buy their ticket over the air, check timetables and transit tracker arrival information, and view their stored tickets all on their phone.

A new fare collection system would have the capacity to allow customers to use mobile phones, smart phones, computers, ATMs, and other merchants’ Point of Sale terminals to purchase fare products, view their transaction history, and perform other fare payment and account management functions.

The new system would have the capacity to allow riders to use pay-as-you-go fare products such as a credit card, or a TriMet issued stored value card, by simply tapping a validator at a rail platform or on a bus. These customers may have access to best fare value caps, or loyalty discounts that could be offered by TriMet.

TriMet could also offer pay-in-advance fare products that would be purchased by customers before riding. These fare products could include period passes (such as daily, weekly or monthly), a certain value and possibly single ride tickets. These products could be sold online, at the TriMet ticket office, through various sales outlets and at rail platforms. These products could be reloaded at the same locations or on-line.

If new electronic fare collection media becomes more readily available in the next few years, TriMet may choose not to issue traditional smart cards, but rather rely on customer provided credit cards, prepaid cards and mobile devices. This approach would be the most cost effective, but could still accomplish the goals set out for the new EFC system. A decision on which direction to take would not need to be made for a few years.

As the new EFC system replaces TriMet's out-of-date fare payment system and paper fare media, current paper products would be phased out. Paper products would be accepted until there is widespread access to the new system and new fare media.

EFC Objectives

Below are the objectives for the new fare payment technology:

1. Easy to understand, simple to use and convenient for customer
2. Easy to understand and convenient for operators and fare inspectors
3. Reduce the cost of fare collection and equipment maintenance
4. Operate on all transit modes including bus, MAX light rail and WES commuter rail
5. Accommodate seamless transfers between vehicles, within the TriMet system, as well as with partner providers including C-TRAN and the Portland Streetcar
6. Bring TriMet into the mainstream of next generation payment technology
7. Reduce fraud
8. Provide a fare payment medium for TriMet's group pass program participants.
9. Provide a fare payment medium for TriMet employees, contractors and others for business purposes.
10. Accommodate the unbanked

Drawbacks of current fare collection system

Out-of Date Technology

TriMet's legacy fare collection system is out of date. Bus fare boxes are over 20 years old and many TVMs need to be upgraded. Modern fare collection systems no longer rely on paper fare products that can be easily damaged and reproduced. TriMet's bus transfers are made of flimsy paper, are difficult for riders to decipher and for operators to read.

Vandalism at ticket vending machines.

TVMs are becoming more prone to vandalism, with vandals finding ever new ways of jamming the equipment as part of fraud activities.

Fraud

TriMet has experienced numerous types of fraud, including criminals forging paper tickets and passes. Although TriMet is moving to provide more security in the form of foil on the paper products, fraud is still possible.

Cost

While our research shows that experience at similar transit agencies has not resulted in immediate cost savings, there may be some potential for savings after initial start up in a few areas. First, smart card readers and related equipment have proven to be very reliable, potentially reducing maintenance costs. The full implementation of EFC will allow TriMet to eliminate 10-Ride tickets which means validators will be removed from platforms, saving required maintenance on an entire line of equipment. Second, the amount of cash that needs to be handled will eventually decrease, reducing cash handling expenses. Finally, there is a potential to reduce the number of TVMs needed at platforms.

Benefits of an Electronic Fare System

Simplify how customers pay for fares

One of the primary advantages of with an electronic fare collection system is an improved experience for the customer. An electronic fare system provides simplicity, speed, convenience and flexibility in how customers purchase fare products and use self-service tools to directly manage accounts with online account management. In London, Oyster has consistently enjoyed approval ratings of around 98% among passengers.

No Need to carry cash or have exact change

TriMet requires exact change for people who want to pay cash to ride a bus. Change is available for tickets purchased at TVMs. If purchasing a ticket is difficult, confusing, or time consuming, then it is a disincentive to taking transit. A new rider or visitor would need to know the cost of the fare and arrange to have exact change before even going to a bus stop. Conversely, if payment can be quick, simple and painless, it can encourage people to use transit.

Additional Fare Payment Choices

With EFC there is no requirement to know, select and purchase fare products in advance. The rider simply taps a credit card or phone or contactless fare instrument and the fare is calculated and sent to the bank or cellular service provider.

Accurate trip data

The new system would generate accurate trip data for employer programs that would assist in pricing the programs appropriately based on actual use. In addition, TriMet would have trip origin data for all pre-paid fares.

Accurate data for regional revenue reconciliation

Currently TriMet and C-Tran have a reciprocity agreement for riders that transfer between systems. The reconciliation is based on rider surveys. An Electronic Fare Collection system will provide usage data to TriMet and its partners that can provide accurate data for reconciliation.

Electronic Fare Payment Media

There are three primary forms of electronic fare payment media in use in the transit industry today. These media are smart cards issued by the transit agency, traditional credit cards and prepaid credit cards issued by a bank, and mobile phones sold by a phone company.

To take advantage of these technologies, TriMet's system would be built on open standards rather than a proprietary system built around the products of a particular vendor. Open standards will create a competitive market and more choice for TriMet and the end-user. Use of open standards would not lock TriMet into a particular vendor or group because the components built on the standards are commodity in nature. Open standards would be specified for hardware, software, computing, payments, network communications and other relevant areas.

Smart Cards

Smart cards are well established in the transit industry. A smart card is a device that includes an embedded integrated circuit chip that can be either a secure microcontroller or equivalent intelligence with internal memory or a memory chip alone.

Smart cards have the ability to store large amounts of data, carry out their own on-card functions such as encryption and mutual authentication and interact intelligently with a smart card reader. Smart card technology conforms to international standards (ISO/IEC 7816 and ISO/IEC 14443) and is available in a variety of forms, including plastic cards, fobs, subscriber identity modules (SIMs) used in mobile phones, and USB-based tokens.

A contactless card requires only close proximity to a reader. Both the reader and the card have antennae, and the two communicate using radio frequencies over this contactless link. Most contactless cards also derive power for the internal chip from this electromagnetic signal.

In a transit setting, smart cards have an embedded microchip that holds stored cash value or a transit pass. A reader validates fare payment, and the card is updated via radio frequency data transfer. Usage data is sent to central clearinghouse for revenue accounting.

A plastic smart card has a life of about 4-5 years. Paper cards are available, but are only suitable for short term use such as a one way ticket or a day ticket. Currently the cost of a paper smart card, about \$.35 each, is too expensive for single rides. However, costs have been going down and paper smart fare media could be an option in the future.

Security

There is no personally identifying information stored on the card. The electronic fare payment system is designed with multiple layers of security subject to Payment Card Industry (PCI) audits.

Privacy

Smart cards present numerous privacy issues that need to be addressed. Of primary concern is data TriMet collects that can be associated with an individual. Another issue relates to public records. TriMet needs to determine what data would be required to be released to reporters or others under Oregon's Public Records Law. Seattle Metro spent considerable time sorting through privacy issues. These issues will need to be addressed by legal counsel.

Contactless Credit and Debit Cards

In addition to agency issued smart cards, transit agencies are moving to open bank card payments. Contactless cards are identifiable by an icon resembling a radio wave. The cards are embedded with a computer chip that communicates with a chip-reader at a turnstile or cash register.

The Utah Transit Authority became the first transit system in the United States to accept contactless credit and debit cards on its buses and trains in 2009. Other transit

agencies testing or moving to contactless credit cards include New York/New Jersey, Los Angeles, San Francisco, Chicago and London.

This approach may reduce fare collection costs and improve regional interoperability and ease of use. It is also a convenience for customers who can use a credit card that is already in their wallet rather than buying a transit-specific card. These credit cards are widely used in Europe but have not been widely introduced in the United States. Depending on the availability of these cards, TriMet may need to partner with a bank or banks to introduce the cards for the transit system.

In paper # 11-0315, the Transportation Research Board evaluated transit rider preferences for contactless bankcards at Transport for London and the Chicago Transit Authority. The results show that approximately 33% of riders in London and 36% of riders in Chicago would prefer contactless bankcards over current smart card fare media.

Prepaid Credit Cards – serving the under-banked

Prepaid credit cards offer another potential means of paying for a transit ride. These non-reloadable “instant issue” prepaid cards can provide an open loop card to anyone who has cash. There is no requirement for consumers to apply for these cards, so obtaining a card is simple. Prepaid cards offer a good solution for riders who may not qualify for a credit card or who do not have a bank. This will provide the means for TriMet to ensure all its riders can obtain a smart card regardless of their economic status. Prepaid cards are also being used to distribute federal and state benefits.

Prepaid cards are in effect a medium for converting cash to an electronic transaction. Prepaid cards could have a set value or they could be more sophisticated reloadable prepaid cards. These cards are issued by financial institutions and carry a payment network brand, such as American Express, Discover®, MasterCard® or Visa®.

Prepaid cards can be obtained in various channels including at retail locations, the internet, at self service kiosks, over the phone. There is no need to visit a bank.

TriMet could partner with a prepaid card program manager to provide TriMet branded cards or issue TriMet branded cards in conjunction with a bank and a processor. Currently, a contactless chip is not widely available on prepaid cards. However, as more transit agencies move to accepting credit cards this is likely to change.

Mobile Devices – Near Field Communication (NFC)

Near Field Communications (NFC) allows a mobile phone to emulate a smartcard. NFC has the potential to dramatically change how consumers purchase products in the future. NFC is a technology that works well for transit ticketing. The same device can be used to buy a fare, look up timetables and check arrival times on transit tracker.

NFC is not widely used in the United States, but is currently in use in Asia and Europe. In April 2011, Juniper Research forecast that a half a billion people worldwide will use their mobile devices as travel tickets on metros, subways and buses by 2015. Juniper is expecting usage to spread widely from the current concentration in Japan and European countries.

A recent survey published by MasterCard showed that 62% of Americans who use a mobile phone would be open to using their device to make purchases wherever their errands may take them.

TriMet's survey data shows that at least 92% of transit riders have a phone. About a third of transit riders have a smart phone and more intend to buy a smart phone in the near future.

Isis is a joint venture between AT&T mobility, Verizon Wireless and T-Mobile USA. Isis plans to launch a "mobile wallet" service in Salt Lake City under an agreement with the Utah Transit Authority in 2012. UTA plans to make its entire transit system ISIS enabled using its current electronic readers. The project plans to make the mobile wallet available to merchants, banks, payment networks, and mobile carriers.

Fare media for TriMet's Electronic Fare Collection System

The Utah Transit Authority (UTA) was the first in the transit industry to implement a system that does not rely on traditional smart cards. The UTA currently accepts smart credit and debit cards. In addition, it provides agency-issued cards to employers and for its university pass program. UTA plans to test NFC mobile devices in partnership with ISIS next year. Other transit properties are experimenting with credit cards and are interested in NFC.

By not issuing traditional smart cards, the EFC system would be greatly simplified. The agency would avoid the cost of smart card distribution, and fare collection. Ticket Vending Machines would not need to vend cards or add value to cards. The back end system would also be simplified.

TriMet will carefully watch the trends in the transit industry and the public acceptance of smart credit cards and NFC mobile devices. If these products become widely available, TriMet could avoid the cost associated with a traditional smart card system.

A final determination about which fare media to use would not need to be made until about 2014. TriMet could proceed with procuring card readers and retrofitting platforms without locking itself in to a traditional smart card system.

Elements of an Electronic Fare Collection System

1. Fare instrument

An Electronic Fare Collection System first needs the fare media. This can be in the form of a transit-issued smart card, a chip enabled bank-issued credit or debit card, or a mobile device equipped with near field communication.

2. Electronic Fare Payment for Rail

Each rail platform (MAX and WES) will need to have at least one chip reader and communication system to validate the fare media. The fare card reader device validates the card by communicating to a back end system. An element that will need to be reviewed is whether the reader will need to have a touch screen or buttons to allow the customer to choose a discounted fare. The card reader would need to calculate the fare. At high use platforms, or special events, several card readers may be needed.

Another important element of the system will be an inspection device for fare inspectors that can read the fare media to ensure payment was made.

An optional element of the system would be a card Vending and/or value added Machine. This element could be incorporated into TriMet's newer Ticket Vending Machines or could be a separate machine.



3. Electronic Fare Payment on the Bus

Each bus will need to be equipped with a card/chip reader. The readers need the same functionality as readers on the rail platform described above. The readers communicate through an on-board router and communication system to the back-end system.

An optional element if TriMet maintains zones or goes to a distance based fare is a reader at both doors. This would add cost and complexity to the system and may be confusing for riders.



4. Back office system

The back office system is an umbrella term for the computer systems which are at the center of a smart ticketing system. The back office is where all of the data generated by smartcard readers and sales terminals is processed. The back office is an account based billing system that supports multiple fare rules that could include zones, distance, flat fare, peak hour fare and reduced fares. It could also facilitate actions such as capping an individual's expenditure over a given period to provide the best value.

The Back Office System will be the central hub for managing all activity within the fare payment environment. Careful consideration will be given to maintain a standards based, open architecture to provide durability and flexibility as conditions in the environment evolve. The entire software architecture shall be designed to allow a suite of diverse software components to plug and play. For example, a backend Account Management Module would support application programming interface (API) calls to different payment gateways. This envisioned componentized architecture could include software as a product and software as a service (SaaS) models.

As an example scenario, an externally hosted payment gateway may be desirable to TriMet due to PCI compliance requirements. A SaaS model for this gateway component could be set up, configured, and operated across the entire software architecture, while another vendor's contactless card reader device management software would be installed in TriMet's private system as a product. Under this open architecture, different vendors can provide single or multiple components and ensure overall system interoperability by following an open standard.

See the Appendix for a detailed description of technical features TriMet will be looking for as it migrates to the new EFC system.

Mobile Phone-based Fare Collection Options

As smart phones become more pervasive, start-up businesses are working on ways to use mobile phones for purchases without the necessity of near field communication. A smart phone app would display either a visual ticket or a bar code. The app would need to be very sophisticated with built in security features, a back end solution, and have a feature designed to be used by fare inspectors. A bar code would require bar code readers on buses and trains and for fare inspectors.

TriMet is closely watching the development of these smart phone options which may provide a cost-effective way to provide customers with an alternative method to purchase fares.

Electronic Fare Collection System Deployment Logistics

TriMet will need the assistance of an outside contractor to help with the logistics, procurement and implementation of an electronic fare collection system. There are a number of elements that could be contracted or performed by in-house staff. TriMet will need to determine which elements it wants to contract and which ones are better keep “in-house”. This determination can be made with the help and advice of a contracted expert in the field.

In general, deployment of the electronic fare collection system will be primarily through procurement and management by TriMet of an EFC system design, implementation, and support contract. A number of other activities performed directly by TriMet and the other agencies participating in the EFC project will occur in coordination with the EFC system contractor’s activities.

To reduce EFC system deployment cost, technical complexities, and risk, the system’s EFC card readers will be designed to “stand-alone” from existing TriMet bus fareboxes and MAX/WES ticket vending machines (TVMs). At existing light rail stations, certain card readers may incorporate EFC “addfare” capabilities if TriMet determines that adding fare at the platform is desirable.

Installation of EFC card readers in buses and on rail platforms would occur about one year before system operational startup. Other transit systems have simply “hooded” the readers between the time of initial deployment and operational startup, using this as an opportunity to inform customers of the coming system and build interest and anticipation for it.

LIFT Paratransit Service

The EFC system procurement will most likely not extend to TriMet's 267-vehicle LIFT ADA complementary paratransit service, or C-TRAN's C-VAN paratransit service. Those services utilize scheduling/reservations and dispatch systems which include a module for registered customer prepaid fare accounts. TriMet and C-TRAN expect to develop such functionalities to provide for cashless fare payments on their paratransit systems.

Development Phase (2012-2013)

Charter EFC Project Plan and Team (early 2012) – TriMet executive leadership to formally adopt:

- Project scope objectives
- Assignment of project staff, roles, responsibilities, and authority
- Project schedule
- Project budget and financing plan
- System procurement plan
- Project implementation performance monitoring plan and executive oversight

Procure EFC Systems Engineering Services in mid-2012, extending to operational startup of EFC system. The scope of such services will include:

- Technical support to development of partnership agreements
- Develop EFC procurement specifications
- Design EFC installation interfaces at station platforms and on vehicles for agencies to prepare for the EFC system contractor
- Technical assistance to evaluation of EFC system procurement proposals
- Technical assistance to EFC system procurement contract design, testing, installation, and startup phases

Develop Partnership Agreements among participating agencies in 2012. These agreements would need to address:

- Agency roles – lead, and participating
- Program governance, oversight and administration, incl. designation of agency executive and staff representatives
- Funding shares for development phase, implementation phase, and operations phase
- System procurement elements and/or options shared by the agencies, and individual to the agencies
- System implementation activities and system operation services to be provided directly by the agencies

EFC System Procurement solicitation issued early 2013. TriMet will need to decide the scope of services to include in a system procurement. The procurement contract could include:

- Design
- Furnish and install equipment
- Wireless communications services (subcontracted)
- Develop and/or provide EFC Service Center services (described below)
- Training, warranty, and system support services

Banking Service Procurement (solicitation issued early 2013; contract engaged by mid-2013) – These services could include:

- Clearing credit/debit payment transactions
- Maintaining in a pool account revenue posted by transactions, and distributing pool account funds to TriMet and participating agencies

Implementation Phase (2013-2016)

EFC Contractor Activities (implementation phase activities mid-2013 to mid-2016; pilot system 2015; full system operation Fall 2016)

- Design submittals
- System test program
- Field and central equipment installations, and system integration
- Develop Service Center, and start-up operational functions
- Training of TriMet/agency personnel
- Warranty, system support services, and spare parts

The scope of system deployment activities by the EFC system contractor will include:

- TriMet
 - 600 buses
 - 129 existing MAX and 5 WES platforms
 - 13 PMLR platforms (including EFC-equipped TVMs - see discussion later in this section)
 - Potential upgrade or replacement of existing TVMs to add fare/vend EFC media (see discussion later in this section)
 - 2 agency ticket offices and 120 sales outlets
- C-TRAN
 - 130 buses via farebox modification, or “stand-alone” (see discussion later in this section)
 - 2 agency ticket offices and 40 sales outlets
- City of Portland

- 41 existing + 28 ES Streetcar platforms (see discussion later in this section)
- parking garages and/or bike locker/rental stations
- Service Center (systems, software, and potentially, operations services – or, center functions may be operated directly by TriMet/agencies, or by a separately-contracted service provider), providing the following functions:
 - System administration and database management
 - Revenue tracking; instructions to banking service on revenue distribution
 - Software and data table update development, test and deployment
 - Web site management
 - Card media stock inventory procurement, storage, distribution and control
 - Retail add-fare network management
 - Corporate transit benefit program administration
 - Institution partnership program administration

Agency Activities to Prepare for EFC Contractor Installations (2013-2015) – A number of other activities performed directly by TriMet and the other agencies participating in the EFC project must occur in coordination with the EFC system contractor’s activities. In general, TriMet and the other participating agencies must prepare their transit vehicles and/or stations to receive the EFC system contractor's installations of EFC card readers and other equipment.

TriMet

- MAX and WES system – TriMet's Capital Projects division will develop design guidelines for placing EFC card readers and potential addfare machines on existing MAX and WES station platforms. Each type of platform will need a design guideline, and specific placements for installation bases and power and communication conduit connections for 129 MAX platforms and 5 WES platforms. The installation bases and power/communication conduits will need to be constructed during 2014-2015 to be ready for the EFC system contractor's installations 2015-2016.
- PMLR platforms – TriMet's Capital Projects division will apply the MAX station EFC design guidelines to the 13 platforms to be constructed for the Portland-Milwaukie light rail project. Power/comm conduits to EFC equipment on PMLR platforms will be embedded in initial design and construction (instead of external conduits as typically expected for retrofit of EFC equipment to existing MAX and WES station platforms).
- PMLR TVMs – TriMet will need 32 new TVMs to be delivered Spring 2015 for the Portland-Milwaukie Light Rail (PMLR) project. The EFC system procurement should include furnishing of the PMLR TVMs. A determination will need to be

made before the procurement about whether to procure TVMs with full EFC capabilities.

- TVM upgrade/conversion, or replacement – During the latter part of the EFC implementation, or soon following it, TriMet’s TVMs will need to be upgraded or replaced . A determination will need to be made about whether to include the ability to add fare and vend EFC media. Ideally TriMet will be able to reduce the variety of fare media currently vended by the TVMs to reduce maintenance effort and costs. The EFC system procurement should solicit an option for the system provider to accomplish upgrade and/or replacement of TriMet’s existing TVM fleet. As part of the EFC system procurement evaluation and selection, TriMet will need to decide whether its best strategy for the existing TVM fleet is to include upgrade or replacement under the EFC system contract, or for TriMet to separately and subsequently pursue upgrade or replacement of the existing TVM fleet. Alternatively, If TriMet decides that it does not want to issue traditional smart cards, but rather rely on bank issued credit cards and mobile phones, it would not need to upgrade TVMs for the EFC project.

C-TRAN

C-TRAN expects to replace existing fareboxes on its 130-bus fleet with new fareboxes including smart-card capabilities, by 2013. C-TRAN would prefer integration of the new regional EFC system with its new fareboxes. The TriMet-led EFC system procurement will probably require offerers to propose if and how this would be technically accomplished, or advise if the best technical approach is for card readers for the regional EFC system to “stand-alone” from C-TRAN’s new fareboxes, and for C-TRAN to decommission the smart-card element of its new fareboxes once the regional EFC system is fully in operation.

City of Portland

- Streetcar platforms – The City of Portland is procuring limited-function TVMs for the Portland Streetcar system, to be deployed mid-2012 on 41 existing and 28 new Eastside Streetcar platforms. (The Streetcar TVMs will use cellular communications – not fiber-optic like TriMet MAX/WES TVMs.) The City is requiring offerers to propose if and how the Streetcar TVMs may be upgraded for EFC capabilities. If it is feasible to upgrade Streetcar TVMs for EFC capabilities, then the TriMet-led EFC system procurement will probably need to require offerers to include such upgrading of Streetcar TVMs in the EFC proposals.
- Parking garages and/or bike locker/rental stations – The City of Portland will need to provide EFC-upgradable ticket vending equipment, or prepare installation bases and power/comm conduits for the EFC system contractor’s installation of EFC equipment, at any parking garages and/or bike locker/rental stations which the City intends to be include under the EFC payment system.

Operations-Phase: Amendment of Partnership Agreements among Participating Agencies (2015) Amendments will need to address:

- Start-up and continuation of system operation services to be provided directly by the agencies (primarily Service Center functions, and maintenance functions)
- Operational aspects of fare transactions processing and revenue distribution
- System maintenance responsibilities, how performed, and how funded
- System capital replacement responsibilities, how performed, and how funded

Other project related activities include:

- Training for operators, fare inspectors, call centers, and group pass program providers. TriMet will need to develop an extensive training plan well before system implementation.
- Business process changes for finance, Information Technology and Customer Service.
- Public Outreach, Marketing and customer support. Marketing will be critical to the acceptance of the new fare media.
- Customer Service call center. Call center customer support could be handled with existing staff or be contracted out.

Section 5 - Financial Considerations

Capital Costs

Capital costs of the proposed e-fare system are shown in Appendix 2 for TriMet bus, TriMet existing rail, Portland-Milwaukie light rail, Streetcar, C-TRAN.

General Fund capital costs in 2011 dollars range from \$13 million for a tap on only system to \$20 million for tap on/tap off system. These costs do not include upgrading TVMs for e-fare sales. Adding that feature would increase the range to \$16 million for a tap on only system to \$23 million for tap on/tap off system. Capital costs include the additional cost not currently included in the Portland-Milwaukie light rail project for fare collection.

Costs of the EFC system would be financed with debt. TriMet would identify savings in other areas to pay for the debt as TriMet cannot afford the system without offsetting cost savings. Potential savings are listed and discussed below. Debt with capitalized interest may be used to finance the project before the savings needed to pay the debt can be realized. Debt service and the present value of the debt, which shows the savings needed to fully fund the debt through savings is shown in Appendix 2 for the tap on only system no TVM upgrade. Debt service costs are \$1.7 million a year for 12 years beginning in FY17. The present value of cost savings needed to fund the debt is \$1.3 million a year. Debt service costs for the full e-fare implementation including upgrading TVMs to sell electronic fares is \$2 million a year beginning in FY17. The present value of cost savings needed to fund the debt is \$1.6 million.

Potential Savings from Changes to the Fare System

Reducing TVM direct operating collection costs to 15% of revenue (still more than twice the cost of outlet transactions) would save about \$1.2 million a year. Given the revenue loss associated with collecting fares through TVMs, a Marketing strategy is needed to move people away from TVMs to outlets and internet sales. A strategy specifically designed to reduce day-to-day TVM maintenance costs needs to be developed and implemented.

Several features of the fare system today result in revenue loss. Changing these would result in additional passenger revenue. Elements of the fare system that could change include:

Free Rail Zone

The additional revenue expected if the Free Rail Zone was eliminated is estimated to be between \$1.3 million and \$2.3 million annually after subtracting payments of about \$750,000 a year TriMet receives from the City of Portland and Multnomah County. Most of the revenue would be generated in the Lloyd Extension of Free Rail Zone because the vast majority of downtown-only trips would be made by walking or would not be made at all.

Round trips

The value of round trips on a single ride transfer is an estimated \$5 million a year. If round tripping were eliminated, additional passenger revenue is an estimated \$4.1 million a year. Some agencies, such as San Diego, have eliminated transfers, requiring customers to purchase a day pass for multiple rides. This solution reduces the number of machine transactions by half, reducing transaction costs.

Fare Evasion

Most fare evasion takes place on rail because on bus, customers show their fare to the bus operator. Fare evasion costs TriMet several million dollars a year. EFC will do little to reduce fare evasion. However, TriMet has recently added additional fare inspectors. If fare revenue increases due to increased inspection, the additional revenue could help pay for the Electronic Fare System.

Operating Costs

Operating costs of the new fare system may be higher than current fare collection costs in two areas, Marketing and Customer Service and Information Technology. The majority of costs will simply be the same employees working on a new system.

The cost of transit agency issued cards is also higher than current media, but these costs are coming down due to competition and advancements in technology. If TriMet decides to issue traditional smart cards, it would want to make an investment up front to get smart cards into the hands of the public then charge customers a fee to replace extended use or limited use cards. However, if credit cards and mobile devices are available as fare instruments, this investment will not be needed.

Section 6. Summary of Next Steps

Background

TriMet established an Electronic Fare Collection team to research the state of electronic fare collection and produce this White Paper. Various members of the team conducted site visits to Salt Lake City, Minneapolis/St. Paul and Seattle. In addition, team members have talked to several other transit properties and reviewed the available program design papers from New York, Chicago, and Washington DC. The team met with several Electronic Fare System vendors at the APTA Trade Show in New Orleans in October 2011.

Based on this research, the General Manager directed the team to produce a White Paper and to begin planning for an Electronic Fare Collection system. Although an absolute time-line has not been established, a potential time-line is outlined below.

There are three outstanding decisions that will need to be made as the project progresses:

First, what is the scope of services TriMet wants to ask of a vendor and what does TriMet want to handle in-house. This decision does not need to be made until after a consultant is hired and the full project is reviewed, around the end of 2012 or early 2013.

The second decision that will be made is what fare media to accept. If it appears that EFC fare media including credit cards with a smart chip, prepaid credit cards and/or mobile devices with NFC will be widely available, then TriMet will not need to invest in an infrastructure to support a traditional smart card. This option is far preferable for cost and risk to the agency.

The third decision relates to the fare structure. If TriMet retains the zone system or decides to move to a distance-based fare it will need to invest in EFC readers for both door of the buses and have numerous readers available at rail platforms. A change to a flat fare will greatly reduce the cost of the project and will simplify the fare structure which helps with customer convenience and understanding.

Potential EFC Project Time-Line

- | | |
|--|------------------|
| 1. Fare Policy Review and Public Outreach | 2012 – Fall 2015 |
| • Prepare Proposed Fare Policy Changes/Options | |
| • Public and stakeholder outreach | |
| • Board Ordinance adoption of fare changes | |

2. Orange Line Design and retrofits - Capital Projects Lead 2012
 - Develop plan for Electronic Fare Collection at Orange Line platforms
 - Develop plan to retrofit existing rail platform with card readers

3. Develop Project Scope and Funding 2011-2012
 - A. Establish Project Team
 - B. Identify funding and capital plan
 - C. Hire a consultant who is an EFC expert
 - D. Determine Role of Vendor - small or large
 - a. Supply Equipment
 - b. Design and deliver system
 - c. Business Support
 - d. Cash collection
 - e. Debit/credit card
 - f. Engineering
 - g. Disaster Recovery etc.
 - h. Maintenance
 1. Repairs
 2. Preventive maintenance
 - i. Project Management
 - j. Customer Service – call center

4. Procurement 2013
 - Develop work plan and RFP
 - Issue and review RFPs
 - Finalize contract with vendors

5. Public outreach and marketing (including changes to fare policy)

6. Implementation 2014-2015
 - Equipment Installation and Testing
 - Purchase and install kiosks/readers at rail platforms
 - Purchase and install readers on buses
 - Equip onboard mobile communications router (installed in CAD/AVL project) on buses. Develop interface of reader equipment to CAD/AVL for GPS data
 - Spec and purchase cell phones for Fare Inspection or other alternate POP method.
 - Development of all backend processing

7. Pilot Phases September 2015 - 2016
 - Phase one - TriMet employees
 - Phase two – Streetcar could be a possible addition for a phase two test of readers and back end system

- Phase three - employee pass programs
- Phase four - credit cards and prepaid cards
- Phase five – mobile phones

8. Full implementation in 2016-2017

Appendix

I. Electronic Fare Collection – Technical Features

TriMet is planning for a smart media based fare collection system using open standards.

The entire software architecture shall be designed to allow a suite of diverse software components to plug and play, for example, a backend Customer Relation Module (CRM) would support API calls to different payment gateways. Such componentized architecture applies to the software as a product and software as a service (SaaS) models. For instance, when a vendor hosted payment gateway maybe desirable to TriMet due to PCI compliance requirements, thus, a SaaS modeled component is set up, configured, and operated within the entire software architecture, where another vendor's contactless card reader device management software is installed in the TriMet's private system as a product. Furthermore, under this open architecture, different vendors can provide single or multiple components and ensure overall system interoperability by following an open standard.

TriMet is seeking suggestions and dialogues with consultants, project managers, software developers, system integrators, and hardware vendors. The word vendor is used in the following sections to refer to all the above. The proposed system could be done by a single vendor, or multiple parallel vendors, or multiple vendors under a primary vendor.

The following sections describe the anticipated technical features of the fare collection system; the operational aspect of the system is excluded from this discussion. However, the technical features are defined in ways to support a flexible operational requirement. TriMet envisions a three tiered system consisting of device-in-hand, TriMet field devices, and a suite of backend systems. The device-in-hand category is used for the "proof of payment" purpose. The TriMet field devices include TVMs, Autoload terminals, and fare validators(contactless card reader). The backend system is an account based billing system that supports multiple fare rules including zone, distance, flat fee, peak hour, and reduced fares based on eligibility. The backend system should also support clearing of fare transactions from multiple transit agencies.

II. Device-In-Hand

TriMet is hoping to allow transit riders to use most known RFID tags that support ISO14443A/B/C standards as a means of fare "proof of payment". We hope to reduce the smart card production cost by allowing transit riders to use their own devices to plug and play with TriMet's fare validators and inspection readers by adopting an open standard.

Device Type	Description	Technical Standards
Bank issued contactless credit card	<ul style="list-style-type: none">• Not registered with TriMet billing system• All Taps are collected for pay as you go charges• Micropayment aggregation per fare transfer	<ul style="list-style-type: none">• Follow Global Platform standards

	rules	
Pre-registered bank issued contactless credit card	<ul style="list-style-type: none"> • Pre-registered with TriMet billing system • All Taps are collected for pay as you go or monthly pass holders • Micropayment aggregation per card count variance 	<ul style="list-style-type: none"> • Follow Global Platform standards
TriMet Issued Smart Card	<ul style="list-style-type: none"> • TriMet is planning to encode and distribute MiFare smart cards at variety of different sales channels. Card type and durability shall be based on expected use requirement and cost consideration. For example, TriMet may decide to use the low cost MiFare UL smart cards for unbanked customers, while using the MiFare Classic sticker for some Employers and Colleges. • Vendor must provide a homogeneous data and format encoding scheme across all MiFare chipset types to ensure card base transaction data consistency and integrity. 	<ul style="list-style-type: none"> • Follow NXP’s MAD design for Ultralight, Classic, Plus, DESFire EV1, and SmartMX chips • Follow TriMet’s Memory Structure Design (MSD) or propose a similar design • Login id is the logic account number and password is the first 3 bytes of the UID
NFC Smart Phone	<ul style="list-style-type: none"> • TriMet is only interested in leveraging the SmartMX emulation of a MiFare Classic 4k in a NFC phone for “proof of payment” and autoloan purpose. • For example, a software vendor could design and develop a Google Android based application utilizing the android.nfc library. Once a transit rider is registered on TriMet’s billing system, after a successful trial credit card authorization, the registered user can use the “Unknown Source” application feature of the smart phone to download the TriMet “proof of payment” application. • While in the TriMet mobile “proof of payment” application, a transit rider can log in to the application, and activate the smart card, and tap the fare validator or hand it over to the fare inspector for inspection. 	<ul style="list-style-type: none"> • The open payment aspect of the NFC smart phone needs to conform to the credit card industry’s standards • NFC mobile application to follow Android.nfc library API • Follow NXP’s MAD design for Classic and SmartMX • Follow TriMet’s Memory Structure Design (MSD) or propose a similar design
3 rd Party Smart Card	<ul style="list-style-type: none"> • TriMet would like to investigate the feasibility of using HID iClass High Security and PIV card • These devices are from some of the existing Employers and Colleges 	<ul style="list-style-type: none"> • Following HIS iClass standards and PIV standards

III. Field Device

A. Fare Validator

The fare validator should support multiple applications including the Global Platform (GP) standards and the NXP MiFare standards. The GP application should be validated and certified by each credit card brand name, and also being PCI compliant. While TriMet may choose to sponsor an “Open Source” project to develop the MiFare application, we are interested in learning from vendors about their approach according to the following hardware, operating system, and application requirements.

Platform based validator(unattended) will be designed to have a real time network connectivity, while the bus on-board validator(bus operator attended) shall be designed to have near real time network connectivity using 3G/4G cellular cards and WIFI zones.

The validator hardware should have at minimal 1GHz CPU processing speed with 2GB of RAM, and 64GB of storage. The PCB has to be industrial grade with non-soldering replaceable on board battery, and supports USB, RS232, RS486, GPS, WIFI, 3G/4G, microSD slots, touch screen. A modern “free cost” operating system is desired, such as, one of the Linux family products.

The validator firmware or a preprocessor should follow a pre-determined processing order to branch the Device-In-Hand’s tapping, the order should be configurable by a system wide parameter. For example, the GP application has to be launched before the MiFare application. Within the GP application, a local distributed database containing unreadable PANs should be used to check for pre-registered bank contactless cards. The GP application should also support VISA and Mastercard payments with a backend assisted micropayment aggregation methods. The MiFare application should support NXP’s UL, Classic, Plus, DESFire, and SmartMX chipsets. All applications needed to support the following modes: Attended, Unattended, Diagnostic, Test, Debug, Online and Offline. While the GUI touch screen application shall display the proper fare instruments configurable by TriMet, and provide GUI functionality to both the GP and the MiFare application using a local distributed database. All tapping should be categorized and store in a local distributed database for replication to a centralized tapping database in the backend. The local distributed database performance must be considered in any choice. There is usually a trade-off between functionality and performance. For example, a fully synchronous solution over a slow network might cut performance by more than half, while an asynchronous one might have a minimal performance impact.

B. Autoload Terminals

Since TriMet desires an account based fare collection system, autoload should be set up using the backend website linking funds from transit riders’ checking account or credit card account. Transit riders can use a self service website, phone a customer representative, or in person method to autoload their “proof of payment” device.

A limited numbers of both attended and unattended cash taking autoload terminals are needed for unbanked customers. TriMet is interested in hearing from vendors about the technical specification on this type of device.

C. TVM Dispensing

TriMet is interested learning from vendors on how to use existing TVMs or new TVMs to dispense TriMet issued smart cards with a pre-set dollar amount.

D. Fare Inspection

Fare inspection device needed to be rugged with long lasting battery life. Both card based transaction verification and real time backend account based verification are

required. The hardware and software design should be consistent with the validator design.

IV. Backend Software

A. Prepaid Billing Account Management

Vendors shall propose a Web 2.0 rich internet application for a customer facing billing account with the following features. The server hardware should support high availability and redundancy, with consideration of daily tapping volume at 500,000, and up to 250,000 unique registered users. This backend component is a good candidate for SaaS model.

1. For rider's login

- Simple registration allow anonymous user with one phone number
- Simple payment management allow credit card and ACH
- Simple payment subscription for monthly pass
- Log transit use by tapping data with stop id, timestamp, zone, and fare
- Allow cancellation of order or subscription
- Allow account history review for order, payments, and tapping data

2. For TriMet's login

- Support all existing and future TriMet fare structure and pricing
- Support sub-accounts for institutions where institution is the parent account, and employees are sub-accounts
- Allow cancellation of order or subscription
- Allow account history for order, payments, and usages
- Support automatic billing process with flexible due date, for example, TriMet has different institutional customers pay on different due dates, like City of Portland and PSU.
- Allow TriMet customer service representative to research and modify transactions, including the reverse and refund of credit card transactions
- Provide comprehensive transactional and financial reporting

3. Employer Site

A separate employer website may be desired for performance reasons.

B. Rule Based Fare Calculation Engine

Vendors should propose a rule based engine such as Drools to process Field Device tapping data for the following fare structures: peak hour, distance based, zone based, reduced fare, 2 hour time limit, and flat fee.

C. Device Management System

A centralized field device management system has to offer system wide configuration, system performance monitor, maintenance management, centralized time management, and central log management function. For example, the centralized software can push out anti-virus patch to all field devices, also can set credit card daily spending limit remotely in all field devices. TriMet IT prefers to have this system component install inside the existing TriMet network and server.

D. Payment Processing Methods

The backend payment gateway shall support, at minimal, the following transaction types, supporting multiple payment gateway vendors:

- Prepaid by credit card/debit card
- Prepaid by ACH
- Real time open payment authentication and authorization
- Real time load & reload using bank affiliated smart phone
- Real time load & reload using autoload terminals

In addition, the system configuration shall allow TriMet to easily switch from one payment processor to another by changing a set of minimal system parameter values.

E. Smart Card Inventory Management

If TriMet smart cards are distributed with a pre-set dollar amount, strict inventory management is required to track card number, card status, batch number, physical location, card value, distribution methods, and movements. So an inventory management system must meet the above minimal requirement.

F. Smart Card Encoding Stations

TriMet is open to have vendors provide smart card encoding and printing using TriMet's MSD data and format. However, TriMet may be required to encode smart cards for reduced fare categories. Software vendors should propose a smart card printing application using the Zebra smart card printer or other industry grade encoding printers.

TriMet is open on how to manage smart card distribution either through TriMet's own backend inventory control system or by a service vendor.