



SEPTA Transfer Pricing Analysis

August 2012



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Executive Summary

The Southeastern Pennsylvania Transportation Authority (SEPTA) is presently in the process of modernizing its fare collection system through the New Payment Technology (NPT) project. This process offers an opportunity to evaluate the existing fare structure and current fare policies and make adjustments to take advantage of the added flexibility smart cards will offer. Some peer transit agencies have altered fare structures and policies, including how transfers are priced and valued, when introducing new fare systems. The specific purpose of this analysis was to explore the impacts that discounting single-trip transfer fees would have on revenue, ridership, and operations, based on historic SEPTA data and the experiences of peer transit agencies.

Taken as a whole, this project's analysis resulted in a handful of conclusions as well as further questions:

- ▶ The elasticities calculated for historical SEPTA passenger responses, as well as the experiences of peer agencies, suggest that free or deeply discounted single-trip transfers would result in fewer TransPass sales and lead to farebox revenue losses (despite ridership gains), particularly in the near term.
- ▶ Peer agencies made up for short-term revenue losses in a variety of ways. In some cases, however, the savings used by peer agencies to offset revenue losses from discounting are savings that SEPTA would achieve (at least partially) through fare modernization alone, regardless of transfer pricing. Such savings include operating efficiencies by removing transfer processing from a driver's responsibilities; savings through mitigating paper transfer fraud; and savings on paper transfer printing, handling, and processing.

There are at least two strategies that may offer SEPTA and Philadelphia an opportunity to achieve the positive outcomes of transfer discounting without the short-term revenue losses. First, rather than discounting transfers in isolation, SEPTA could pursue transfer discounting on at least an experimental basis simultaneous to its next base fare increase. Slightly higher base fares could be used to offset the cost of transfer discounting, essentially incentivizing linked tripmaking at the expense of unlinked tripmaking. This sort of incentive could be sound for a grid-based network of routes like Philadelphia's, where network connectivity has been the priority (as opposed to a network surgically crafted to serve as many trips with one-seat rides as possible).

A second option is to offer free transfers for passengers who have adopted an NPT fare instrument but discontinue all other single-trip transfer discounting. This is the most common approach among peer large transit agencies with smart-card fare instruments. This option would at least partially mitigate any short-term revenue losses, maximize efficiency gains through a complete discontinuation of paper transfer handling, and incentivize NPT adoption. Such a strategy is attractive for these reasons but would generate its own equity challenges and questions. It might need to be combined with policies to help ameliorate these, such as the proposed fare caps (or guaranteed lowest fare) strategies discussed in this report.

Smart Cards:

Review of Peer Agency Transfer Policies

Introduction

SEPTA is presently in the process of modernizing its fare collection system through the NPT project. This process offers an opportunity to evaluate the existing fare structure and current fare policies and make adjustments to take advantage of the added flexibility smart cards will offer. Many peer agencies altered fare policies, including transfer policies, when introducing new fare systems. The purpose of this analysis is to explore the impacts that reducing or eliminating single-trip transfer fees would have on revenue, ridership, and usability.

Since transfers are currently free for SEPTA passengers using weekly/monthly passes and other specialized media (principally senior IDs and student passes), the passengers at issue are those who use cash, those who pair a cash base fare with a paper transfer for a linked trip, and those who pay with a combination of a token and paper transfer. Roughly 16 percent of passengers who pay by token or cash also purchase a paper transfer, and paper transfers amount to about 7 percent of total trips.

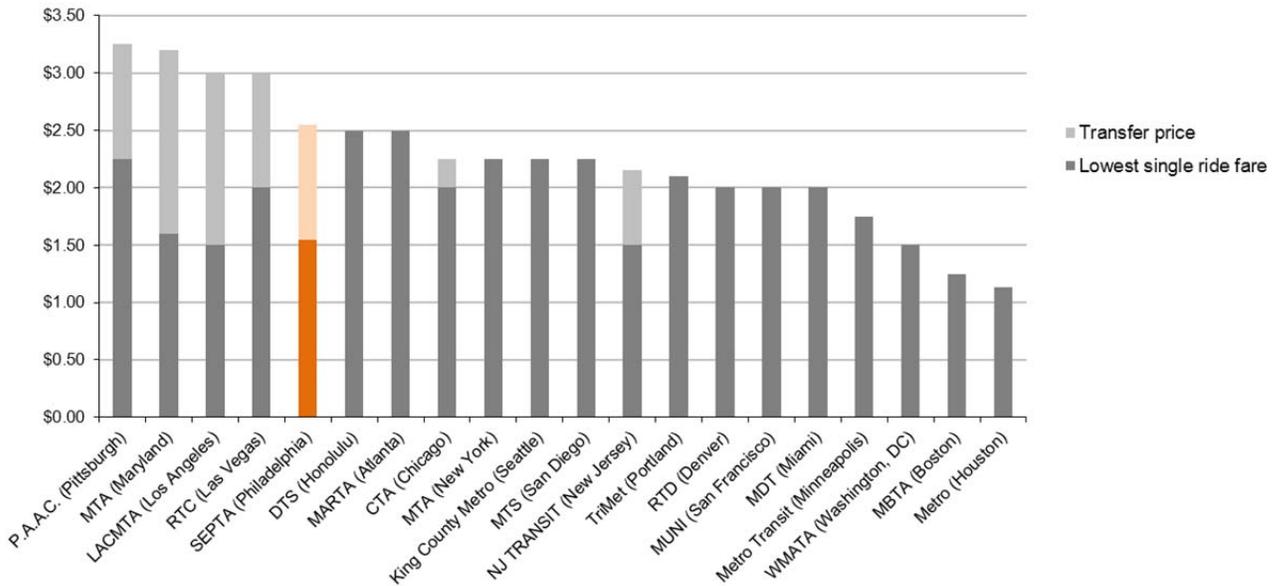
This document is structured as follows:

- ▶ Chapter 1, which draws on peer transit agency interviews and a literature review, summarizes the state of the practice nationwide regarding transfer policies, transfer pricing, and the adoption of new fare technology.
- ▶ Chapter 2 uses an analysis of passenger and fare mix data to explore how SEPTA passengers have responded to fare media price changes in the past, and uses these historical responses to estimate future outcomes for free or discounted transfer scenarios.

Peer Transfer Policies

To better understand the state of practice regarding transfers, the Delaware Valley Regional Planning Commission (DVRPC) examined existing policies among the 20 largest transit agencies in the United States (in terms of annual unlinked passenger trips¹). Figure 1 summarizes the lowest combined cost of a single linked trip for these 20 agencies.

Figure 1: Lowest price of a single linked trip (lowest base fare plus transfer cost, if any) for the 20 largest U.S. transit operators



Source: individual transit carrier websites, 2012.

As Figure 1 indicates, SEPTA's lowest price for a single linked trip (\$2.55 for one token plus one paper transfer) is on the higher end of the spectrum among peer large agencies, although its lowest fare for a single unlinked trip (\$1.55 for one token) is among the lowest. Table 1 details the state of the practice for transfer pricing among the 20 largest transit agencies.

¹ Top-20 transit agencies for the National Transit Database's 2009 reporting year, as summarized in the 2011 American Public Transportation Association *Public Transportation Fact Book*. Where a given region was represented by multiple agencies in the top 20 (New York, San Francisco), fares for that region's top agency are included; Las Vegas is number 20 in this report's list but number 26 overall.

Table 1: Fare policies for the 20 largest U.S. transit agencies (ranked by total annual passenger trips)

Overview information			Transit					Commuter rail (same or partner operator) to transit				Transit fare collection	
Rank	Agency	City/region	Discounted transfers	Policy	Transfer cost	Cash fare	Lowest single-trip regular fare	Discounted transfers	Policy	Transfer cost	Base fare	Fare types	Transfer media
1	Metropolitan Transportation Authority (MTA)	New York City	yes	1 free transfer to bus within 2 hours, unlimited transfers between subway lines	\$0	\$2.50 (single ride ticket)	\$2.25	Limited			Zonal	Cash, smart card	MetroCard only (limited paper transfers with coin payment on some bus routes)
2	Chicago Transit Authority (CTA)	Chicago	yes	Transfer valid for 2 hours	First: \$0.25 Second: free	\$2.25 (bus only)	\$2.00 (bus); \$2.25 (rail)	Limited	Metra (commuter rail) passholders can purchase unlimited monthly CTA rides as a pass add-on	\$39/month	Zonal	Cash, smart card	Smart card, paper stored value
3	Los Angeles County Metropolitan Transportation Authority (LACMTA)	Los Angeles	limited	\$0.35 transfer to partner agency buses or \$5.00 day pass	n/a	\$1.50	\$1.50	Yes	Commuter rail tickets valid on local transit	\$0 with commuter rail ticket	Zonal	Cash, smart card	
4	Washington Metropolitan Area Transit Authority (WMATA)	Washington, DC	yes	Unlimited transfers between buses for 2 hours	\$0	\$1.70 (bus only)	\$1.50 bus; \$1.70 rail	Yes	Discounted bus-rail transfers for SmarTrip card users	\$0.50	Zonal	Cash, smart card	Smart card only
5	Massachusetts Bay Transportation Authority (MBTA)	Boston	yes	Free bus to bus transfer within 2 hours; bus-rail transfers pay only the \$0.20 fare premium for subway	\$0/\$0.20	\$1.50 bus; \$2.00 subway	\$1.25 bus; \$1.70 subway	Limited	Free transfers with pass	\$0 with valid pass	Zonal	Cash, paper ticket, smart card	Smart card only
6	Southeastern Pennsylvania Transportation Authority (SEPTA)	Philadelphia	yes	Up to 2 transfers per linked trip; heavy rail transfers free at select locations	\$1.00	\$2.00	\$1.55	Limited	Free transfers with pass	\$0 with valid pass	Zonal	Cash, token, swipe passes	Swipe passes/paper transfers
7	New Jersey Transit	New Jersey	limited	Paid transfer tickets for bus-to-bus; available for one-zone continuation only	Vary by service (lowest \$0.65)	Zonal (lowest \$1.50)	\$1.50	Limited	Free transfers with pass	\$0 with valid pass	Zonal	Cash, paper transfers	Paper transfers
8	San Francisco Municipal Transportation Agency (MUNI)	San Francisco	yes	Unlimited free transfers within 90 minutes	\$0	\$2.00	\$2.00	Limited	\$0.25 transfer discount from BART	\$1.75 when using same Clipper Card	Zonal	Cash, paper ticket, smart card	Ticket and smart card
9	Metropolitan Atlanta Rapid Transit Authority (MARTA)	Atlanta	yes	4 free transfers within 3 hours; not permitted for round trips	\$0	\$2.50	\$2.50	Yes	4 free transfers within 3 hours; not permitted for round trips	\$0	\$2.50	Cash, smart card	Smart card only
10	Maryland Transit Administration (MTA)	Maryland	no	No transfers (pay second full base fare) but \$3.50 day pass	n/a	\$1.60	\$1.60	Limited	Free transfers with MARC pass	\$0 with valid pass	Zonal	Cash, smart card, limited paper	n/a
11	King County Metro	Seattle	yes	Free transfers within 2 hours; pay difference between 2 fares (i.e., zonal upcharge may apply)	\$0	\$2.25–\$3.00 (peak, zonal)	\$2.25–\$3.00 (peak, zonal)	Yes	Free transfers between bus and Sound Transit rail within 2 hours for most ORCA trips; charged highest base fare among modes used	\$0	Distance	Cash, ORCA card, Flash passes (phasing out)	ORCA card or Flash passes
12	Tri-County Metropolitan Transportation District of Oregon (TriMet)	Portland	yes	2 hours unlimited travel	\$0	\$2.10–\$2.40 (zonal)	\$2.10–\$2.40 (zonal)	Yes	2 hours unlimited travel	\$0	\$2.10–\$2.40 (zonal)	Cash, paper	Paper
13	Miami-Dade Transit (MDT)	Miami	yes	Free bus to bus / \$0.50 rail to bus	\$0 to \$0.50	\$2.00	\$2.00	Yes	Discounted transfers to/from Tri-Rail using Easy Card	\$0.50 (bus) or \$1.00 (MetroRail)	Distance	Cash, paper ticket, smart card	Smart card only
14	Regional Transportation District (RTD)	Denver	yes	60 minutes free transfer (same direction)	\$0	\$2.25–\$5.00 (zonal)	\$2.00–\$4.50 (via ten-trip packs)	N/A	RTD light rail: same as transit			Cash, paper ticket	Paper
15	Metropolitan Transit Authority (Metro)	Houston	yes	3 hours free transfer (same direction)	\$0	\$1.25–\$4.50 (zonal)	Smart card users get 5 free trips per 50 paid	Yes	3 hours free transfer (same direction)	\$0	\$1.25	Smart card, cash	Smart card only
16	Metropolitan Transit System (MTS)	San Diego	limited	Only between trolley lines for a same direction trip; day pass suggested for intermodal trips (\$5.00)	\$0	\$2.25–\$2.50	\$2.25–\$2.50	Limited	Free intermodal transfers using day pass or wkly/mthly	\$0	Zonal	Cash, smart card, ticket	Smart card or paper ticket
17	Department of Transportation Services (DTS)	Honolulu	yes	1 free transfer to be used within 2 hours	\$0	\$2.50	\$2.50	N/A				Cash, paper ticket	Paper ticket
18	Metro Transit	Minneapolis	yes	Unlimited transfers among bus and light rail routes within 2.5 hours	\$0	\$1.75–\$3.00 (zonal; express)	\$1.75–\$3.00 (zonal; express)	Yes	Northstar rail fare permits free transfers to bus and light rail	\$0	Distance	Smart card, cash	Smart card, paper ticket
19	Port Authority of Allegheny County	Pittsburgh	yes	1 single-zone ride within 3 hours	\$1.00	\$2.25–\$3.25 (zonal)	\$2.25–\$3.25 (zonal)	N/A				Cash, swipe pass, paper ticket	Paper ticket
20	Regional Transportation Commission (RTC)	Las Vegas	yes	Unlimited rides within 2-hours (\$3 2-hour pass)	\$1.00	\$2.00	\$2.00	N/A				Cash, paper pass	Paper ticket

Source: APTA, 2011; individual transit agency websites, 2012.

As detailed in Table 1, large agencies generally have one or more of the following approaches regarding linked trips and transfer discounting:

1. Provide free transfers within a limited time span. Many agencies restricted passengers to transferring a fixed number of times within the allotted time span.
2. Provide transfers for a fee discounted from the full fare. This is the system currently used by SEPTA.
3. Provide no discounted transfers but offer a 24-hour pass priced less than the cost of a round-trip, multi-route journey. This policy is used most notably by the Los Angeles County Metropolitan Transportation Authority (Metro). Metro's base fares are among the lowest of large transit agencies, but no discounted transfers are provided for Metro-to-Metro trips (discounts exist for Metro to partner agency trips). Metro does provide a day pass for the cost of a single round-trip.
4. Provide discounted transfers with only certain kinds of fare media. Increasingly, agencies are abandoning paper transfers because of their susceptibility to fraud and theft. Most agencies with stored-value fare collection systems provide discounted transfers only for fares paid with tickets or smart cards.
5. Permit discounted transfers between commuter/regional rail and transit. Some commuter rail systems, including Minneapolis, Seattle, Portland, and Los Angeles, allow even single-trip rail riders to transfer for free to local transit. In Washington, DC, and San Francisco, riders transferring between local transit and commuter rail receive a discount. Some larger systems, including SEPTA and the Massachusetts Bay Transportation Authority (MBTA), provide commuter rail passholders free use of bus and subway.
6. Provide no discounted transfers. Of the 20 largest transit agencies, only the Maryland Transit Administration did not discount transfers.

Influence of Smart Card Transfer Discounting on Revenue and Ridership

One key takeaway from Table 1 is that **of the 10 peer large transit agencies that offer discounted transfers and have stored-value fare instruments, 7 offer discounted transfers only to users of those stored-value instruments.** In order to explore the influence of transfer discounting policies on revenue and ridership, and specifically the impacts of transfer discounting associated with stored value or smart card fare systems, DVRPC staff:

1. conducted a review of published literature; and
2. conducted phone interviews in October 2011 with several peer agencies that made changes in transfer pricing as part of their implementation of a smart-card or stored-value fare technology (Sound Transit [Seattle], Metropolitan Transit Authority [MTA];

New York], and MBTA [Boston]); these interviews were supplemented with notes from an interview of Metro Transit (Minneapolis) staff by the Philadelphia Mayor's Office of Transportation and Utilities staff in June 2010.

Gauging the impacts of transfers on ridership and revenue through peer interviews proved problematic, chiefly because the agencies interviewed lacked baseline/"before" data on fare mix and transfer rates. Further, agencies were unable to isolate the "after" impact of transfer fee changes on total ridership due to extraneous factors like economic growth, employment levels, and simultaneous changes in base fare pricing. It also bears noting here that some outcomes will be highly dependent on local nuances: Each transit service area, network, passenger base, and fare mix is unique, making generalizations difficult. Nevertheless, considered in this context, the experiences of peer agencies and the literature reviewed are instructive and highlight a number of considerations and outcomes. More detailed notes from peer agency conversations can be found in Appendix A.

Ridership Impacts

As may be expected, agencies that reduced or eliminated transfer fees generally saw changes in passenger usage patterns in response to these new incentives. New York's MTA began providing free intermodal transfers in 1997 as part of a broader fare restructuring and increase in the base fare. Incentives such as free transfers and unlimited ride passes were introduced to mitigate the impacts of base fare increases, and MTA's experience suggests that this strategy was effective. Unlike across-the-board fare increases in the 1980s and 1990s, the more surgical fare increase of 1997 did not seem to depress ridership.

As detailed in the *Transportation Research Record* paper "Effects of Fare Incentives on New York City Transit Ridership" (TRR 1735), the introduction of free subway to bus transfers, together with a loosening of restrictions on bus to bus transfers, was associated with short-term ridership gains of about 20 percent for buses and 3 percent for subways (compared to 2.5 percent job growth over the same timeframe). The paper suggests that most new bus trips replaced walk-to-subway trips and also identifies a shift of some bus to bus trips (which were previously subsidized via paper transfers, though with restrictions) to bus to subway trips. Longer-term (two-year) ridership response was larger, with unlimited ride passes and continued economic growth also contributing. Unfortunately it was not possible to isolate the elasticities associated with modifying the fare structure, as fare changes impacted ridership groups unevenly and strong economic growth increased natural demand for transit.

The Chicago Transit Authority (CTA) reduced transfer fees in 1998 as part of a service overhaul following the introduction of plastic and paper stored-value fare media in 1997. Over the next seven years, both bus and subway/elevated ("L") experienced ridership growth, with a small modal shift to rapid transit (similar to the experience in New York). Since per-passenger mile operating costs for the rapid transit lines were below those of buses, this mode shift was desirable to the agency (CTA, *President's Report on CTA's Fares and Proposal for the FY2004 Budget*, 2004).

In 2007 Boston's MBTA introduced free intermodal transfers between bus and subway. At the same time, the agency eliminated combined bus/subway "combo" tickets and increased fares

across the board. As was projected, the fare increases had a negative impact on ridership. However, since the fare increases disproportionately affected riders not using the agency's smart card, these fare policy changes helped to encourage passenger adoption of the CharlieCard (*Impact Analysis of the 2007 MBTA Fare Increase and Restructuring*, Boston Region Metropolitan Planning Organization, September 2008).

Revenue Impacts

Eliminating or reducing transfer fees can lead to a short-term revenue loss unless sufficient new riders can be attracted to offset it. Revenue losses can also be offset through other fare changes or operational savings from the new fare system. As discussed above, New York's MTA offset the cost of eliminating transfer fees by raising the base fare for trips; by coupling fare increases with new discounted fare types, the MTA saw ridership increase even while they collected more revenue. Similarly, according to Jonathan Davis, current acting GM and CFO at the Massachusetts Bay Transportation Authority (MTBA), that agency experienced large revenue gains with the introduction of the CharlieCard, due in part to an across-the-board fare increase introduced alongside it.

One of the benefits of smart cards is that they make fare evasion and fraud more difficult. During interviews for this project, MTA staff estimated that introducing the MetroCard reduced fraud by about \$100 million per year, and MBTA's CharlieCard was stated to have had an estimated annual positive revenue impact of about \$13 million due directly to reduced fare "leakage."

In a nationwide survey of transit agencies² concerning smart cards, agencies who reported estimates of revenue lost through fraud indicated annual losses of 5–15 percent. However, the majority of agencies did not have reliable estimates of losses, even though many (77 percent) indicated that fraud reduction was at least a "somewhat important" consideration in pursuing smart cards. This suggests that potential revenue gains through reduced fraud will be highly variable among agencies and localities. It further bears noting that if paper fares are eliminated, these gains from reduced fraud will accrue to the transit agency from the new fare system alone, irrespective of transfer discounting.

Operational Impacts

Smart cards help allow transit agencies to automate the fare collection process. Cash and paper fares can be time consuming and expensive to collect. According to a study by the Federal Reserve Bank in Boston (*The Contactless Wave: A Case Study in Transit Payments*, 2008), approximately 22 cents of every dollar in cash fare revenue goes to cash handling. In contrast, a fare paid through a ticket vending machine (TVM) with a credit card typically costs agencies much less. At the New York MTA, cash fares cost the agency 27 cents on the dollar to collect while credit card fares cost the agency only 3 cents on the dollar.

As a result, agencies can achieve significant savings by reducing cash handling and even their involvement in fare collection. By allowing passengers to pay with their credit cards at fare gates,

² Iseki et al., "Survey on Status of Knowledge and Interest of Smartcard Fare Collection Systems Among U.S. Transit Agencies." California PATH, University of California at Berkeley, 2006.

agencies reduce the need to issue proprietary fare cards and provide TVMs. This bodes well for SEPTA's intended open approach for NPT, which is planned to accommodate contactless bank card payments.

The literature³ identifies transfer handling as among the greatest points of conflict between drivers and passengers. By removing transfer fees, agencies also remove the burden of handling transfer sales and enforcing transfer pricing for drivers. Some of this benefit could also be achieved through moving transfers to a smart card mechanism alone, as the collection of transfer fees would be automated.

Additionally, as noted above, discounting intermodal transfers can help shift ridership to modes with lower unit-operating costs like heavy rail, depending on the nature of the transit network and passenger trip patterns. At New York's MTA and Chicago's CTA, rapid transit ridership has grown faster than bus ridership since transfer fees were reduced.

Fare Policy and Maximizing the Benefits of Smart Cards

To capture the full benefits of smart cards, peer agencies used changes in fare policy to create incentives for smart card adoption. Peer agency experiences suggest that riders can be surprisingly resistant to adopting new fare systems for simple convenience; **agencies that did not provide a financial incentive to use the smart card saw lower-than-expected adoption rates**. For agencies making significant capital investments in fare technology, a rapid adoption rate is important to recoup costs through operational savings.

The initially slow adoption of New York MTA's MetroCard illustrates the need for farecard incentives. When the MetroCard was first introduced, only about 100,000 riders used the card each day, even as MetroCards were significantly more convenient than cash and tokens. In 1997, MTA began providing free intermodal transfers and more flexible bus transfers as an incentive for MetroCard holders, and MetroCard use grew to over two million rides per day. Today roughly 80 percent of riders choose to pay with a MetroCard over cash fares.

The contrasting adoption rates of MBTA's CharlieCard and Minneapolis Metro Transit's Go-To Card further illustrate the impact of fare incentives. Both agencies provide two kinds of fare media: a paper magnetic ticket and a smart card. Minneapolis continues to price single trips by paper ticket and smart card the same and allows free transfers with both fare media. Boston provides free transfers with CharlieCard but not with paper tickets. Even though the Go-To Card is two years older than the CharlieCard, MBTA has a 20 percent higher adoption rate for its card.

Equity Issues and Opportunities

The introduction of new fare media with a reconsideration of fare structures raises some equity questions. Some studies suggest that transfer fees disproportionately impact low-income riders

³ Multiple sources, including *Regional Fare Policy and Fare Allocation, Innovations in Fare Equipment and Data Collection*, Center for Urban Transportation Research, University of South Florida, March 2010.

who depend on transferring between bus lines or between bus and rail lines at a greater frequency than the average rider.⁴

Fare structures that discourage single-ride purchases over bulk-fare purchases or monthly passes can also disproportionately burden low-income riders. Low-income riders may find the upfront cost of purchasing bulk fares and passes too high, even when such purchases would save them money in the long run. Agencies have developed a number of potential solutions to address this “barrier to entry” problem. Seattle, for example, is exploring the use of cheap disposable smart cards to allow riders without an ORCA (One Regional Card for All) card to take advantage of free transfers.

Another option that has been discussed (though so far only pursued in a limited way for London’s Oyster Card) is the fare cap or “guaranteed lowest fare.” Under this framework, riders who use smart cards, regardless of which fare type they purchase, have their daily, weekly, or monthly fares capped at the cost of an unlimited pass for the same time period. In other words, if a passenger happens to make a sufficient number of trips in a given day, week, or month such that the combined cost of those trips would exceed the cost of a daily, weekly, or monthly pass, the passenger is automatically charged for the pass rather than the combined “a la carte” fare costs.

This practice would encourage smart card adoption, because passengers using smart cards know they will always be given the best available “deal” for their individual usage patterns. Such fare caps would also be beneficial from an equity standpoint because they remove the burden of upfront payment for a monthly pass: Passengers can pay as they go, but once their fare costs reach the price of a weekly or monthly pass, they are not charged for any additional trips for that week or month.

As the industry moves toward more flexible, open electronic fare systems, other opportunities may emerge to reduce the barrier to entry for low-income riders. For example, one can envision a scenario where public assistance benefits (such as Pennsylvania’s Supplemental Nutrition Assistance Program [SNAP]) could be deposited directly onto a recipient’s stored value transit fare instrument, or—alternatively—the recipient’s Electronic Benefits Transfer card could be radio-frequency identification (RFID)-enabled and made to work as a transit fare instrument.

Summary and Takeaways

While few definitive conclusions on the impacts of transfer discounting can be drawn from the literature review and peer agency interviews, there are a handful of takeaways that are worth highlighting.

- ▶ While we were unable to isolate the direct impacts of reducing or eliminating transfer fees, the agencies interviewed:
 - experienced short-term revenue loss but long-term ridership growth;

⁴ For example, Nuworsoo et al., “Equity Impacts of Transit Fare Proposals: A Case Study of AC Transit,” *Journal of the Transportation Research Forum* 47, no. 3 (2008).

- experienced a shift toward rapid transit from bus, and from walk trips to bus;
- ▶ Nearly all agencies with smart cards provide free or discounted transfers for smart-card holders as an incentive to adopt the card. Agencies without financial incentives to use their smart card saw slower adoption rates than those that did. By encouraging a rapid adoption, transit agencies can more quickly recoup the cost of the new fare collection system.
- ▶ Fare structures that provide discounts for riders who pay a higher upfront cost have a “barrier to entry,” which may be too high for transit-dependent low-income riders. If agencies provide special pass types or discounts only for smart-card holders, they should try to ensure that all riders can affordably access those card benefits.

Transfer Fee Elimination or Reduction:

Estimating Passenger and Revenue Impacts

Introduction

The purpose of this section is to explore SEPTA ridership and fare mix data over time, particularly in the context of historical fare price increases or fare policy changes: Previous passenger responses to such changes may shed light on the responses that can be expected to transfer price changes in the future. The analysis detailed in this section focuses on City Transit Division (CTD) data, as this is the division with the highest levels of transfer usage within the SEPTA network.

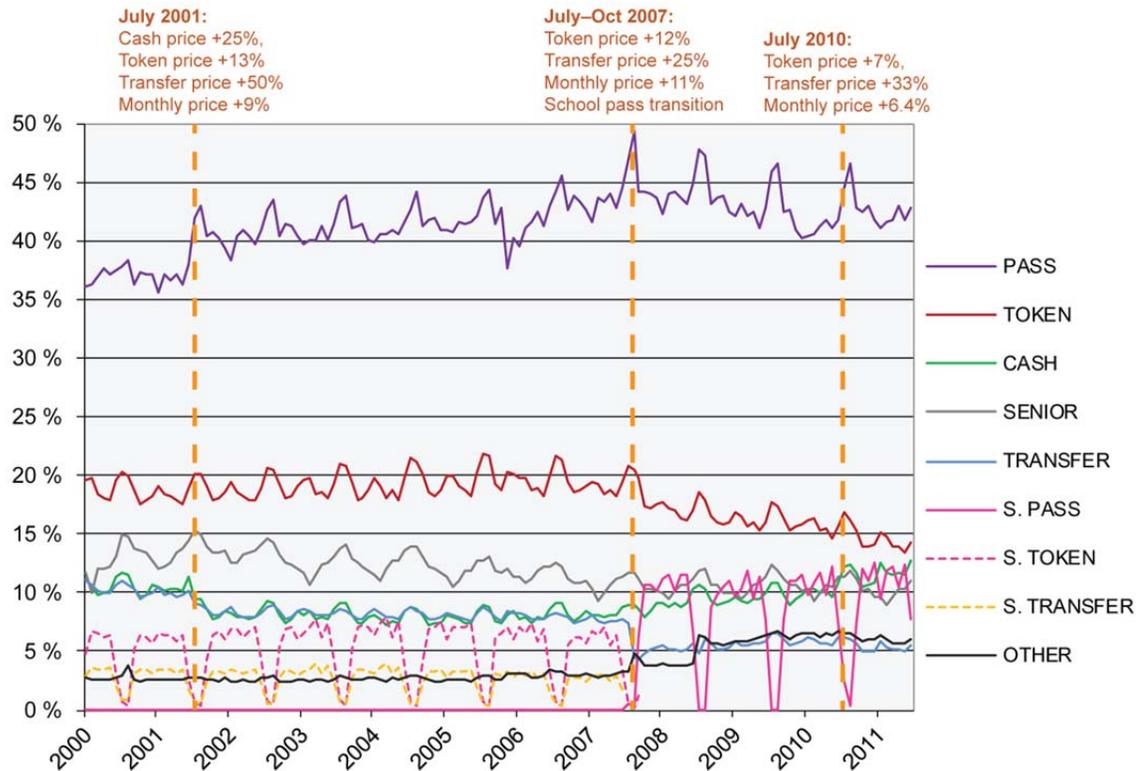
Recent Trends in the CTD Fare Mix

Figure 2 summarizes monthly CTD fare mix data for surface routes from January 2000 through August 2011 in the context of the dates and magnitudes of fare pricing and policy changes. Unfortunately, Broad Street Line and Market-Frankford Line data were not available at this level of detail due to limited data reporting capabilities for those lines' turnstiles.

As indicated in Figure 2, SEPTA's farebox reporting for surface routes divides ridership into the following fare categories:

- ▶ pass (weekly and monthly TransPass/TrailPass swipes aboard surface transit);
- ▶ adult token (regular token);
- ▶ base/cash;
- ▶ senior (discounted fare for 65+);
- ▶ school token (phased-out tokens for students);
- ▶ school transfer (phased-out transfers for students);
- ▶ school pass (free TransPass for students);
- ▶ transfer (SEPTA paper transfer ticket); and
- ▶ other (police, fire, children under 4, disabled, miscellaneous).

Figure 2: SEPTA City Transit Division fare mix 2000–2011



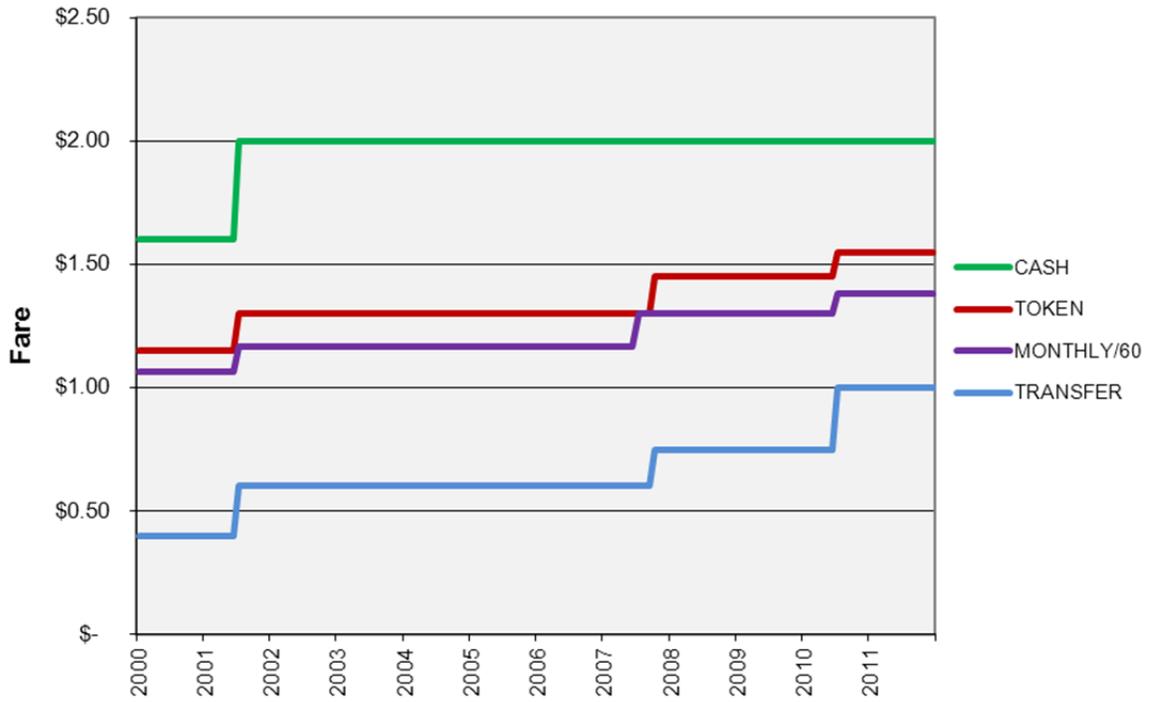
Source: SEPTA, 2011.

There are several trends discernible from the data in Figure 2 that are worth highlighting:

- ▶ From 2000 through 2007, cash fare usage tracked with paper transfer usage almost 1:1, even more closely than tokens and transfers. This indicates a relatively significant level of cash-transfer pairing.
- ▶ Of the three fare increases in Figure 2, transfer usage declined most significantly with the increase that raised transfer prices by the smallest degree (2007). This may suggest that the decline in transfer usage that year was associated in some way with other fare policy changes such as the introduction of the school pass.
- ▶ The 2007 fare price increases seem to have triggered a significant and ongoing decline in the share of tokens in the fare mix, despite fairly small price increases for tokens in both 2007 and 2010. The trendlines suggest a displacement of much of this token usage to cash fares.
- ▶ The proportion of monthly passes in the fare mix for CTD surface routes appears to have a near-term ceiling in the 40–45% range, despite ever-increasing cost competitiveness to other fare options on a per-trip basis. This may suggest a challenge to NPT adoption among CTD riders absent additional price incentives to encourage adoption.

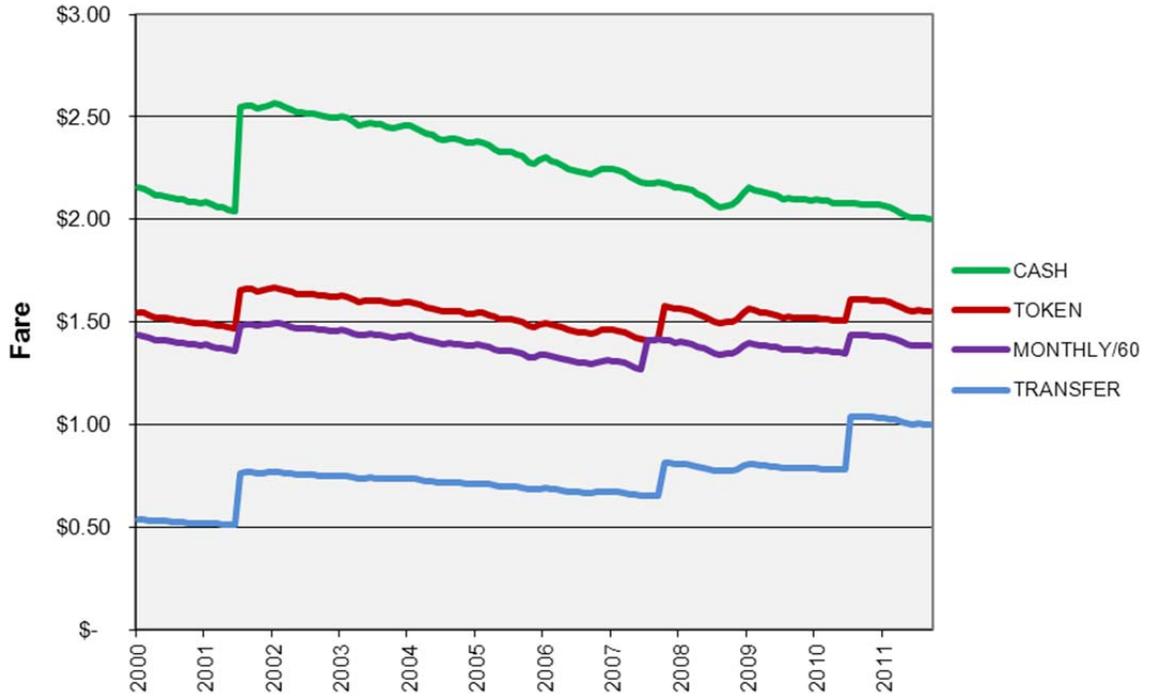
Figures 3 and 4 summarize the actual relative price levels for four principal fare media (cash, tokens, paper transfers, and monthly TransPasses) over the same time period, in simple and inflation-adjusted terms (based on monthly consumer price index data), respectively.

Figure 3: Simple 10-year fare price history



Source: SEPTA, 2011.

Figure 4: Inflation-adjusted 10-year fare price history



Source: SEPTA, 2011.

Figure 4 illustrates that prices for SEPTA single-trip fares are slowly converging in inflation-adjusted terms. Cash fares are actually lower in real dollars than they were in 2000.

Analysis of SEPTA Passenger Response to Fare Price Changes

One of the purposes of this project was to draw inferences from prior SEPTA passenger responses to fare price changes to make estimates for passenger responses to free or deeply discounted transfers as part of the NPT project. In order to draw more quantitative conclusions from the passenger data illustrated in Figure 2, a series of regression analyses was conducted using fare mix, price, and other data in an effort to derive sensitivities for SEPTA passenger responses to fare price changes.

Impact of Fare Media Pricing on the Fare Mix

A series of regression analyses was conducted to test the relationships between the monthly fare mix data provided by SEPTA (2000 through mid-2011) and fare pricing over time. To reduce the impact of seasonal (including school year) variations, fare mix for the purposes of this analysis was the universe of non-school fares, with a focus on the relationships between pricing and usage for cash/base fares, tokens, monthly TransPasses, and paper transfers.

Four initial regressions were conducted. Each regression used the 2000–2011 fare share history of a particular fare type as the dependent variable, and 2000–2011 CPI-adjusted fare media prices as the independent variables. Staff chose fare share (each fare media's percentage of the fare mix) for analysis rather than simple counts for each fare type, because the former was expected to be less affected by external factors such as economic activity.

While an initial regression using non-inflation-adjusted fare prices was less conclusive, using the inflation-adjusted data showed that fare media price is a reasonably good predictor of each fare media's share of total adult fares. Table 2 summarizes the statistical significance (*t*-stats) for each relationship from the four regressions, along with each regression's *R* square, which is an estimate of the combined predictive strength of the independent variables on the dependent variable. Statistically significant results are bolded and highlighted in yellow.

Table 2: Statistical significance (*t*-stats) for relationships between fare mix share and fare media prices

Independent variables	Dependent variable <i>t</i> -stats			
	Cash % in fare mix	Token % in fare mix	TransPass % in fare mix	Paper transfer % in fare mix
Cash price	-24.3	15.6	5.4	-0.1
Token price	4.6	-3.6	-4.7	6.0
Monthly pass price	2.7	0.6	-0.1	-2.7
Paper transfer price	-1.4	-8.0	6.5	17.5
<i>R</i> Square	0.86	0.83	0.65	0.78

Source: SEPTA; DVRPC, 2011.

Note: *t*-stats greater than +/-1.98 suggest a statistically significant predictive relationship at 95 percent confidence.

As Table 2 indicates, all but four relationships tested were found to be statistically significant, including (most importantly for this study) the relationships between paper transfer pricing and three out of four fare media usage rates. Elasticities for the impact of paper transfer pricing on fare mix share were drawn from the coefficients derived from these four regressions and are summarized in Table 3.

Table 3: Calculated impacts of paper transfer pricing on fare mix

CTD surface fare media	Impact of \$1.00 increase in paper transfer price on fare mix share
Paper transfers	-15.1%
Cash fares	-0.1%
Token fares	-6.1%
TransPasses	+21.6%

Source: SEPTA; DVRPC, 2011.

The relationships summarized in Table 3 reflect both the estimated magnitude and direction of the impact of an increase in transfer prices on the percentage share of each fare media type in the non-school CTD fare mix. This analysis suggests a clear relationship between paper transfer and TransPass usage: As paper transfer pricing increases, TransPasses (which include free transfers) become a more attractive option. With this series of relationships established, these numbers can be used to estimate fare mix outcomes under various transfer pricing scenarios. For the purposes of this analysis, it is necessary to assume that these relationships are symmetric; in other words, that a decline in transfer pricing would affect the fare mix in an equal but opposite

way. The literature on this subject suggests that most public transit demand elasticities are close to symmetric.⁵

Impact of Fare Media Pricing on Ridership and Revenue

To test the effect of fare media pricing on ridership (and consequently revenue), several additional regression analyses were conducted with total ridership as the dependent variable and historic fare media pricing as independent variables. To control for external/macro factors that can be expected to play a role, other independent variables were also included:

- ▶ monthly fuel prices;
- ▶ monthly regional employment for the Philadelphia Metropolitan Statistical Area from the Bureau of Labor Statistics;
- ▶ SEPTA work stoppage: this was a binary variable for months where a work stoppage occurred.

Initial regressions that included these variables (with fare media pricing) did not result in statistically significant results. When seasonality was added, that relationship was found to be a statistically significant predictor of ridership, but the other variables still were not. As a result, it was necessary to estimate the ridership impacts of fare media pricing in another way.

One way to accomplish this is to calculate an average fare (taking into account each fare media's price and share of the fare mix) for both current conditions and under future transfer pricing scenarios (with each scenario's fare mix being changed from current conditions based on the relationships in Table 3). Ridership impacts can be estimated under this method if we apply industry-standard ridership/fare elasticities to changes in the average fare. Based on detailed fare sales and fare mix data provided by SEPTA for May 2011, an average fare per unlinked trip was calculated as \$1.12⁶ for CTD surface routes.

A literature review indicates that calculated elasticities for the relationship of fare price to ridership vary significantly by local context and time horizon. A longitudinal analysis and literature review conducted for the United Kingdom's Department of the Environment, Transport and the Regions in 1999 determined that typical near-term elasticities (<1 year) averaged about -0.3 (i.e., a 10 percent fare increase is associated with a 3 percent near-term ridership loss), and longer-term elasticities typically fell between -0.5 and -1.0. A recent publication by the Victoria Transport Policy Institute (*Transit Price Elasticities and Cross-Elasticities*, July 2011) included similar numbers for both near and long-run elasticities in all regions. For the purposes of this analysis, a -0.3 near-term fare elasticity and a -0.75 long-term elasticity will be assumed.

⁵ See Transit Cooperative Research program (TCRP) Report 95, Chapter 12—*Transit Pricing and Fares*, Table 12-6, pp. 12 to 13.

⁶ While this calculation was straightforward in accounting for cash fares, paper transfers, and tokens, accounting for a proportional share of TransPass prices was more complex. Staff calculated an average price per CTD surface pass use of \$0.75 for May 2011 after accounting for the surface share of CTD daily ridership (about 64 percent) and the portion of total TransPass-eligible trips that occur on CTD routes (about 93 percent).

Having established this method of estimation, it is possible to estimate CTD surface fare mixes and resultant ridership and revenue impacts for various transfer price reduction scenarios. Table 4 summarizes estimated fare mix, ridership, and revenue outcomes under two transfer discounting scenarios:

- ▶ free paper transfers: under this scenario, single-use transfers would be free of charge versus the current price of \$1.00;
- ▶ discounted (\$0.50) paper transfers: under this scenario, single-use transfers would have a 50 percent discount relative to the current price of \$1.00.

It is important to note that for each scenario, all else is assumed to be kept equal, including the prices of other fare media, passenger trip patterns, and the current fare rules in place for single-use transfers, such as a maximum of two paper transfers per linked trip. Because we know that some of these factors (such as passenger trip patterns) can be expected to change in the real world in response to the introduction of significant price incentives, these outcomes should be viewed as rough estimates.

Table 4: Estimated ridership and revenue outcomes for two transfer discount scenarios

Measure (CTD surface routes)	Current fare mix (May 2011)	SCENARIO 1: Free paper transfers	SCENARIO 2: \$0.50 paper transfers
Cash % of non-school fare mix	13%	13%	13%
Token % of non-school fare mix	15%	21%	18%
TransPass % of non-school fare mix	48%	26%	37%
Paper transfer % of non-school fare mix	6%	21%	9%
Avg. price per unlinked trip	\$1.12	\$0.97	\$1.06
Change in average fare price	-	-13.3%	-5.0%
Near-term change in ridership	-	+4.4%	+1.7%
Near-term change in farebox revenue	-	-9.4%	-3.4%
Long-term change in ridership	-	+11.1%	+4.2%
Long-term change in farebox revenue	-	-3.6%	-1.0%

Source: SEPTA; DVRPC, 2011.

As Table 4 indicates, the calculations conducted for this analysis suggest that any significant discounting of paper transfers would result in:

- ▶ A fairly significant increase in paper transfer and token demand at the expense of TransPass demand. This passenger response is logical, as higher single-trip transfer discounting would reduce the price incentive of TransPasses' bulk transfer discounting.
- ▶ Fairly significant net short-term farebox revenue losses (and more modest long-term losses), all else being equal.

These estimated outcomes are derived from past SEPTA passenger behavior and do not account for the impact of fare modernization on its own. With that caveat, however, past passenger responses to price incentives may still be relevant predictors of passenger response post-NPT if one assumes that the token/paper transfer combination is a reasonable proxy for single linked-trip fares under NPT, and TransPasses are a reasonable proxy for weekly/monthly bulk fares under NPT.

Conclusions

This analysis was successful in developing estimates for revenue and ridership outcomes to free or discounted transfers. However, in considering these estimated outcomes, it is important to remember that they were developed using fewer data resources than initially hoped. As a result, they focus on CTD services alone and principally surface routes in the CTD. Further, the revenue and ridership analysis assumes that transfers would be discounted with all else being kept equal (such as the pricing of other fare media and passenger usage patterns). In addition, this analysis was drawn from historical passenger responses to existing fare media and as a result does not account for the impact of NPT alone.

Since we know that transfer discounting would only occur with other fare policy changes, and that passenger trip-making behavior would change in response to new transfer incentives, **the revenue and ridership outcomes summarized here should be treated with a due level of uncertainty.**

Taken as a whole, this project's analysis of SEPTA data and review of peer agency experiences result in a handful of conclusions as well as further questions:

- ▶ The elasticities calculated for historical SEPTA passenger responses, as well as the experiences of peer agencies, indicate that free or deeply discounted single-trip transfers would result in farebox revenue losses, particularly in the near term.
- ▶ Peer agencies made up for such short-term revenue losses in a variety of ways. **In some cases, however, the stated savings used by peer agencies to offset revenue losses from discounting are savings that SEPTA would achieve (at least partially) through fare modernization alone, regardless of transfer pricing.** Such savings include operating efficiencies by removing transfer processing from a driver's responsibilities; savings through mitigating paper transfer fraud; and savings on paper transfer printing, handling, and reconciling.

Assuming "no net loss of revenue" is a key factor in the decision on whether to more deeply discount single-trip transfers, the key remaining question is whether there are additional outcomes, unique to transfer discounting as opposed to NPT more broadly, that offer the potential for significant efficiency gains. For example, New York's MTA saw a redirection of some bus trips to the subways in response to intermodal transfer discounting. This is a desirable outcome given heavy rail operating efficiencies, but its transferability to SEPTA and Philadelphia is unclear given lower overall levels of rail network coverage.

Another consistent theme across peer agencies is that where transfer subsidies were offered as "carrots" as a way of encouraging smart-card adoption, that strategy was successful, resulting in

more rapid smart-card adoption. Accelerated smart-card adoption offers the potential for significant efficiency gains through reduced cash and paper media processing and handling, among many other outcomes. However, it is difficult to estimate the magnitude of these potential efficiency gains, given limited peer agency data (and questionable transferability). Gains from accelerated adoption may match or exceed short-term revenue losses from transfer discounting, but this is not verifiable.

There are at least two strategies that may offer SEPTA and Philadelphia an opportunity to achieve the positive outcomes of transfer discounting without the short-term revenue losses. First, rather than discounting transfers in isolation, SEPTA could pursue transfer discounting on at least an experimental basis simultaneous to its next base fare increase. Slightly higher base fares could be used to offset the cost of transfer discounting, essentially incentivizing linked tripmaking at the expense of unlinked tripmaking. This sort of incentive could be sound for a grid-based network of routes like Philadelphia's, where network connectivity has been the priority (as opposed to a set of routes surgically crafted to provide as many one-seat rides as possible).

Another option is to offer free transfers for passengers who have adopted NPT but discontinue all other single-trip transfer discounting. As noted previously, this is the most common approach among peer large transit agencies with smart-card fare instruments. This option would at least partially mitigate any short-term revenue losses, maximize efficiency gains through a complete discontinuation of paper transfer handling, and incentivize NPT adoption. Such a strategy is attractive for these reasons but would generate its own equity challenges and questions. It might need to be combined with policies to help ameliorate these, such as the proposed fare caps (or guaranteed lowest fare) strategies discussed previously in this report.

DVRPC looks forward to working with partners at SEPTA, the City of Philadelphia, and through SEPTA's Fare Policy Working Group for the NPT project as these and other options are explored.

Appendix A



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Select Peer Agency Interview Notes

In order to get a deeper understanding of peer agencies' experiences, Delaware Valley Regional Planning Commission (DVRPC) staff conducted interviews with a handful of peer agencies who pursued transfer discounting simultaneous to smart-card implementation. This Appendix details pertinent notes and observations from those conversations.

Seattle ORCA Card

Seattle introduced the ORCA ("One Regional Card for All") fare system in 2009. ORCA is distinctive for two reasons:

1. It is a shared fare system used by six regional transit agencies, jointly managed by staff from Sound Transit and King County Metro.
2. ORCA is one of the few fare systems in the United States that includes tap in/tap out fare collection for commuter rail and light rail.

DVRPC staff spoke with representatives from ORCA Regional Program Administration and Sound Transit's ORCA team on September 13, 2011. Notes from that conversation follow.

Impacts on Fare Revenue and Fare Mix

Sound Transit and partner agencies left the existing fare system intact with the launch of ORCA. To lower fare collection costs and encourage rapid adoption of the card, participating agencies ended free transfers for non-ORCA users. While Sound Transit has a high percentage of riders who transfer to other services, the agency is less dependent on fare revenue to cover operating costs than SEPTA.

Sound Transit expects the new card will bring long-run operational improvements but do not have the same cost savings expectations as the Massachusetts Bay Transportation Authority (MBTA). Currently the new fare collection system costs partner agencies more than the previous cash/regional pass system. The higher costs are due largely to higher overheads associated with training and coordinating the new technology among so many different agencies. The team expects annual costs to decline in the coming years.

One notable cost is the "autoload" feature: ORCA allows riders to tie their card to a credit or debit card. Under the current system, ORCA cardholders are credited additional fares when their card reaches a balance of zero, but their credit cards aren't charged until they actually tap in to ride. This is done so that riders with low balances aren't automatically charged if they don't plan on making any new trips. ORCA members have lost a surprising amount of revenue from debit or credit cards being declined after cardholders are credited additional trips. In the last fiscal year, Sound Transit spent over \$180,000 to remediate lost fare revenue from rejected credit cards.

Fare Collection Issues

Sound Transit operates a multi-zone commuter rail and light rail system with self-service fare collection. In order to calculate the correct fare, ORCA cardholders must tap in before boarding trains and tap out once they get to their destination. The tap in/tap out system is widely used abroad but rarely used for barrier-free fare collection systems in the United States.

Initially ORCA had the greatest difficulties in enforcing tap in/tap out procedures with monthly passholders. Passholders previously only had to flash their pass for fare inspectors but now had to validate their cards at the start and end of the journey. ORCA requires passholders to validate their cards for two reasons:

1. It creates a standard fare collection procedure for all riders. The agency felt that making all riders tap in/tap out would reinforce the process.
2. It allows Sound Transit to better track modal and origin–destination data to better distribute revenue among the participating agencies.

Since 2010, ORCA has seen compliance reach nearly 100 percent in response to aggressive passenger outreach.

Business accounts make up another large portion of ORCA clients. ORCA found that initially many riders with company-paid cards failed to tap out properly. As ORCA charges companies a floating rate that reflects monthly card usage, employers began placing pressure on cardholders to properly validate their cards.

Miscellaneous Concerns

The ORCA team brought up three additional ongoing issues with the card:

1. *Legal standing of fare collection procedures:*
Existing laws that enable fare collection enforcement and fines did not conform to the new procedures introduced with smart cards. To clear up ambiguous legal wording, the ORCA team is working to update existing laws to explicitly mention fare collection practices like self-service fare collection and tap in/tap out.
2. *Equity issues:*
Low-income riders are less likely to have an ORCA card compared to other ridership groups. The ORCA team believes the barrier of entry to purchasing a card dissuades riders from adopting ORCA. The ORCA team is looking at the cost of providing cash fare riders with a disposable paper ORCA card that allows for transfers.
3. *Data access issues:*
Sound Transit and its partners have not been able to take full advantage of the data collection capabilities of ORCA. ORCA's vendors are only obligated to provide the agency certain kinds of ridership data, and if agencies like Sound Transit want to acquire additional data not stipulated in the contract, they must pay the vendor.

New York Metropolitan Transit Authority (MTA) MetroCard

After a series of pilot implementations and tests, MTA completed systemwide MetroCard implementation in 1997, though the use of tokens was not phased out entirely until 2003. DVRPC staff spoke with Metropolitan Planning representatives at New York City Transit on September 16, 2011. Notes from that conversation follow.

MTA historically used a fare collection system similar to SEPTA's. Riders could purchase tokens, pay cash fares for bus, and only transfer within their mode. In 1990 MTA began exploring adoption of a new fare system and surveyed 24,000 riders to understand their preference for new fare technology. The prior system effectively created two fare zones: one for buses and one for the subway.

MetroCard Phase-In

When first introduced, MetroCard did not involve any fare policies or prices that differed from the prior fare structure. The first major change was the introduction of free intermodal transfers within a two-hour window in 1997, followed by bonus discounts and unlimited ride passes in 1998.

Prior to MetroCard, MTA had been experiencing slowly declining ridership linked with steady increases in fares. The launch of MetroCard was seen as an opportunity to better target fares toward different user groups. DVRPC's interview with MTA staff focused on the introduction of free intermodal transfers.

Ridership Impacts

While the number of unlinked trips grew by 40 percent over several years following the introduction of free transfers, the actual number of new riders was relatively small. Many passengers adjusted their travel routines to include buses or trains where they previously would stick to one mode or the other. Today 21 percent of MTA trips include an intermodal transfer. Unfortunately MTA does not have transfer data for trips before MetroCard's launch.

Revenue Impacts

MTA was prepared for a revenue loss from the introduction of free intermodal transfers of about \$250 million annually (for context, 2011 revenue is anticipated to be about \$2 billion). On the positive side of the ledger, MTA anticipated higher revenues from MetroCard through reduced fraud and cash handling. MTA estimated that lost revenue due to fraud before MetroCard totaled about \$100 million per year.

In conjunction with free transfers, MTA raised base fares by 25 cents. In the long run, reduced operating costs, higher base fares, and an increase in ridership brought in higher-than-estimated farebox revenue to MTA. However, this higher revenue cannot be attributed to the change in transfer policy alone, as strong regional economic growth drove higher demand for public transit.

Fare Collection Costs

The cost of cash handling significantly declined with the introduction of the MetroCard. Debit and credit card purchases conducted at ticket vending machines (TVMs) cost the MTA roughly \$0.03–\$0.04 per transaction. Cash fares paid directly to the onboard farebox cost MTA \$0.27 on the dollar.

Move to a New Fare Card

MTA is trying to move away from directly handling fare transactions. Like SEPTA's New Payment Technology framework, MTA's new smart-card system will likely allow riders to use either a proprietary fare card or their own radio-frequency-identification-enabled credit card. While the majority of riders will probably use their own debit/credit card, those using the proprietary card would be able to purchase fares offsite at shops and newsstands.

MTA is looking to other options to reduce labor elements. The organization is currently studying the feasibility of reducing or eliminating onboard fare collection. One option is to continue to provide onboard fare collection at reduced staffing rates. Fare gates at major stations would help compensate for reduced onboard fare monitoring.

MBTA Boston CharlieCard

MBTA introduced its CharlieCard fare system in 2007. DVRPC staff spoke with MBTA about their experiences on September 19, 2011. Notes from that conversation follow.

Before launching the CharlieCard/CharlieTicket in 2007, MBTA provided free transfers only between buses. Passengers could purchase a more expensive combo pass for trips that included a transfer between bus and rail.

When the MBTA eliminated transfer fees, they saw a small increase (13 million dollars) in revenue. This revenue increase was likely due to reductions in fare evasion and other fare "leakage." MBTA believes there was a shift in ridership behavior as more people began including buses in their trips.

The agency has also rolled out TVMs at new locations for customer convenience, including transit hubs, the airport, and MBTA's transportation building downtown. The agency sells commuter rail tickets at all TVMs; however, TVM coverage on regional rail is limited to major downtown stations and transfer nodes.

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Abstract: SEPTA is presently in the process of modernizing its fare collection system through the New Payment Technology project. This process offers an opportunity to evaluate the existing fare structure and current fare policies and make adjustments to take advantage of the added flexibility smart cards will offer. Many peer agencies altered fare policies, including transfer policies, when introducing new fare systems. The purpose of this analysis was to explore the impacts that reducing or eliminating single-trip transfer fees would have on revenue, ridership, and operations.

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