



Update: 5-Year Fare Policy and 10-Year Fare Collection Outlook

Date: May 12, 2021
To: TTC Board
From: Chief Strategy and Customer Officer

Summary

The purpose of this report is to provide an update on the development of TTC's 5-Year Fare Policy and 10-Year Fare Collection Strategy (Fare Policy and Collection Strategy). This report will outline the emerging insights from Phase 1 of the Fare Policy work stream and the proposed policy goals that will guide the development of a modernized fare collection system for the TTC and YRT.

In addition, this report will provide the key learnings from stakeholder engagement, peer transit agency reviews and the TTC's Automated Fare Collection Technology Request for Information (RFI), which closed on February 5, 2021.

These key learnings from both the Fare Policy and Collection Strategy work streams will provide the basis for testing and modelling fare structures and viable fare collection options in the next phase of work. The potential fare policy and fare collection options will be presented to the Board in July 2021.

Recommendations

It is recommended that the TTC Board:

1. Endorse the proposed fare policy goals and objectives in Attachment 1 of this report to inform the development of fare options to be presented to the Board in July 2021;
2. Receive the results of the RFI and peer agency reviews in Attachments 2 and 3 of this report to inform the development of viable fare collection models to be presented to the Board in July 2021; and
3. Proceed with demonstrations from RFI respondents beginning with System Integrator vendors, to present their solutions to the TTC prior to the July Board meeting.

Financial Summary

In 2020, the TTC Board and City Council approved \$1.0 million to undertake the 5-year Fare Policy and 10-year Collection Strategy with work commenced in 2020 and the balance to be completed during 2021.

There are no direct financial impacts arising from the adoption of the recommendations in this report. However, the fare policy goals being recommended for endorsement by the Board will guide the TTC's approach to establishing the fare structure and the implementation of the collection of passenger fare revenue, which represents 62% of the pre-pandemic funding sources for the TTC's conventional service.

In recognition of the above, a fare policy goal has been established that will incorporate a fiscal lens that will be applied in the development of the TTC's fare policy framework and its infrastructure. This is to ensure the TTC's financial sustainability can be maintained and resiliency can be improved to prevent the erosion of transit service and the benefits realized by customers and the public at large.

The Interim Chief Financial Officer has reviewed the report and agrees with the financial impact information.

Equity/Accessibility Matters

The Fare Policy and Collection Strategy will include reviewing and addressing various fare options as well as ensuring all forms of fare media are readily available and accessible to TTC customers. A key component of the fare policy review is to understand the current barriers and gaps that exist, and help the TTC develop fare policies and a collection model that is equitable and addresses the needs of all customers and equity-seeking groups.

In Phase 1, the TTC has committed to engaging key stakeholders, including ACAT as well as customers through a public survey and focus groups. The focus group sessions allowed customers to voice their concerns and highlight their transit needs. This helped to inform the development of the TTC's fare policy goals that will lay the foundation for developing fare options and fare collection models as we move into Phase 2 of the project. We will continue to engage key stakeholders in Phase 2 through additional focus groups, a second public survey, and a virtual public town hall.

The TTC continues to work closely with ACAT as well as the City of Toronto's Poverty Reduction Strategy Office to support the implementation of the 2019-2022 Poverty Reduction Strategy, which includes public transit within the city. Key stakeholders from this office have also contributed to Phase 1 and will continue to be engaged through workshops with TTC staff for the project's entirety.

Decision History

At its meeting on January 25, 2018, the TTC Board considered and adopted, with amendments, the TTC Corporate Plan. This plan highlights the need to develop a fare strategy and connect the region by achieving broader fare integration. The TTC will also need to ensure that it keeps up with the changing technologies and strides in modernization as outlined by Critical Path 5 in the plan.

TTC Corporate Plan: Advancing to the Next Level – 2018-2020 & Beyond

[http://www.ttc.ca/About the TTC/Commission reports and information/Commission meetings/2018/January 25/Reports/Decisions/1 TTC Corporate Plan 2018-2022 Decision.pdf](http://www.ttc.ca/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2018/January%2025/Reports/Decisions/1%20TTC%20Corporate%20Plan%202018-2022%20Decision.pdf)

At its meeting on October 24, 2019, the Board moved a motion to complete a Fare Collection Request for Information (RFI). The RFI will help the TTC determine new service providers and technologies, including open payment, being used by transit properties worldwide. The intent is to provide customers with a modern, efficient and customer focused fare collection system.

[http://www.ttc.ca/About the TTC/Commission reports and information/Commission meetings/2019/October 24/Reports/Decisions/5 TTC Revenue Operations Phase Two PRESTO TTC Fare Equipment.pdf](http://www.ttc.ca/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2019/October%2024/Reports/Decisions/5%20TTC%20Revenue%20Operations%20Phase%20Two%20PRESTO%20TTC%20Fare%20Equipment.pdf)

At its meeting on December 12, 2019, the TTC Board considered a report entitled the 5-Year Service Plan & 10-Year Outlook, which identified service-related improvements to public transit in the City of Toronto between 2020-2024 and beyond.

[http://www.ttc.ca/About the TTC/Commission reports and information/Commission meetings/2019/December 12/Reports/16 5 Year Service Plan and 10 Year Outlook.pdf](http://www.ttc.ca/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2019/December%2012/Reports/16%205%20Year%20Service%20Plan%20and%2010%20Year%20Outlook.pdf)

At its meeting on May 13, 2020, the TTC Board considered a report detailing the proposed scope of work for two TTC policy documents: the 5-Year Fare Policy and the 10-Year Collection Outlook.

[https://www.ttc.ca/About the TTC/Commission reports and information/Commission meetings/2020/May 13/Reports/11 Development of the 5 Year Fare Policy and 10 Year Fare Co.pdf](https://www.ttc.ca/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2020/May%2013/Reports/11%20Development%20of%20the%205%20Year%20Fare%20Policy%20and%2010%20Year%20Fare%20Co.pdf)

At its meeting on September 24, 2020, the TTC Board received an update on the PRESTO implementation achievements, the progress on the negotiations with Metrolinx on further improvements to the PRESTO system, how to achieve the remaining key milestones, and resetting the TTC's ongoing relationship with PRESTO.

[http://ttcstaging.affsys.com/About the TTC/Commission reports and information/Commission meetings/2020/September 24/Reports/4 PRESTO Annual Update.pdf](http://ttcstaging.affsys.com/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2020/September%2024/Reports/4%20PRESTO%20Annual%20Update.pdf)

At its meeting on February 10, 2021, the TTC Board received an update on the PRESTO implementation achievements, progress made since the last update in September 2020, and ongoing negotiations with Metrolinx on achieving the key

remaining milestones. This report also provided a progress update on the development of the 5-Year Fare Policy & 10-Year Fare Collection Outlook.

[http://www.ttc.ca/About the TTC/Commission reports and information/Commission meetings/2021/February 10/Reports/5 PRESTO Fare Policy and Collection Strategy Update.pdf](http://www.ttc.ca/About%20the%20TTC/Commission%20reports%20and%20information/Commission%20meetings/2021/February%2010/Reports/5%20PRESTO%20Fare%20Policy%20and%20Collection%20Strategy%20Update.pdf)

Issue Background

The TTC is committed to developing a customer-focused fare system, making transit the primary choice of travel, and inclusive of all customers.

The mandate of the Fare Policy and Fare Collection Strategy is to understand the gaps in the current system and find opportunities for improvement in the current fare structure, policies and collection practices. It will also guide all aspects of future TTC fare policy and fare collection developments.

The Fare Policy will review the current fare structure, consider all fare options to determine fare policy goals, and guide the TTC's fare system over the next five years. This period has been selected so that a new fare structure can be introduced and evaluated over a relatively short period of time. Towards the end of the five-year period, the policy goals of the fare system will be re-evaluated, and any changes to policy or implementation can then be identified and implemented.

The Fare Collection Strategy will conduct a review of the current fare collection model and determine any gaps that exist between the identified policy goals and the current system. It will be improved or redesigned to ensure that it is flexible to meet the identified policy goals, as well as reflect industry best practices. It is being developed as an outlook that spans 10 years, which reflects the time remaining on the current agreement with Metrolinx and the time that it takes to implement new fare collection technologies. It will also allow the fare collection system design to be flexible and adaptable as future fare technologies advance.

The modernization of PRESTO, including the introduction of Open Payments is an opportunity for the TTC to develop a fare policy that will lead the technology.

The current PRESTO system was implemented based on existing fare structures and limitations of the PRESTO technology. The TTC did not have a comprehensive fare strategy at the time of its 2012 PRESTO Agreement. There have also been delays in implementing critical functionalities, including Open Payments that have further limited customer fare choices and the implementation of new fare policies.

As PRESTO develops its recovery plan to achieve Open Payments including the modernization of TTC's PRESTO devices, TTC staff have been coordinating the findings of Phase 1 with PRESTO modernization to ensure that the final outcome of Open Payments is driven by fare policy and not dictated by legacy systems and/or previous technology limitations.

Comments

Fare Policy

An analysis of the existing TTC fare policies and structures found common and diverging trends for different customer types.

In Phase 1, the TTC's existing fare policies and structures were analyzed and found the following key elements:

- The TTC is reliant on its farebox, which contributed 62% of the TTC's total operating budget funding in 2019.
- Future changes to fare policy (new concessions/fare policy programs, etc.) may have a direct or indirect effect on fare revenue.

These findings were compared against the practices of several peer transit agencies, and the following common lessons were learned:

- Alignment with policy: strategic planning and vision of public transit are either underpinned by or aligned to local, regional or national policies.
- Reliance on farebox revenue: most international public transit networks struggle to achieve a farebox recovery ratio greater than 50%, much lower than TTC.
- Customer friendliness: many international cities operate a more complex fare system than the TTC, while still maintaining high levels of user simplicity.
- Smart ticketing and traditional fare media: adoption of smart ticketing technologies have allowed other cities to offer more diverse, integrated fare systems while continuing to offer non-smart alternatives.
- Strong communication: marketing and communication of new policy and technologies is key to establish public trust and high levels of adoption.

In addition to this review, several engagement sessions, including an internal workshop were held with TTC and City of Toronto staff, a customer survey was launched, and an external workshop and two customer focus groups were held to better understand customer concerns and perceptions of TTC fares. This engagement provided richer insight into decision making, identifying priorities and values, and revealed common and diverging trends for frequent and less frequent riders. The following are key themes that have emerged from this analysis:

- The extra cost of crossing a fare boundary can be a financial burden;
- The existing fare structure for cross-boundary trips is confusing and inconsistent;
- Extra fares for premium services like the TTC's downtown express routes are not justified;
- Distance-based pricing would be beneficial for short trips. However, a flat fare is more equitable for customers who make long trips across the city;
- The two-hour transfer helps make trip chaining more affordable;

- More customers should be eligible for fare discounts for equity reasons;
- Frequent customers chose transit as their primary choice of travel because it was the most cost effective based on fares, travel time and service frequency; and
- Less frequent riders thought they would take transit more if fares were lower and service frequency increased.

The proposed fare policy goals will provide a foundation for addressing customer experience, but requires a perspective that balances the importance of farebox recovery.

The key themes identified in the current state analysis were used to help develop the TTC’s fare policy goals. An additional internal workshop with the same participants was held to define the TTC’s emerging vision and highlight the TTC’s transit priorities based on the feedback received through the internal and external engagement. Having clearly defined fare policy goals will allow the TTC to:

- Balance the need to attract customers and ensure fiscal sustainability is maintained with other community objectives such as equity and economic opportunity.
- Direct fare pricing and fare structures to maximize customers’ positive experience and support TTC’s mission to provide convenient and affordable transit.

The proposed fare policy goals requiring approval are outlined in Table 1.

Table 1: Proposed Fare Policy Goals for Approval

| CUSTOMER | |
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| <i>1. Affordability & Equity</i> | The price of public transit should reflect customers ability to pay, minimizing cost as a barrier to travel wherever possible. |
| <i>2. Simplicity & Accessibility</i> | The customer proposition should be easily understood by all users. Customers should be confident that they will be charged an appropriate fare for their journey. Advancements in technology should not leave customers behind. |
| <i>3. Integration</i> | Travel around the Toronto and York regions should be as intuitive as possible, regardless of the operator of the services that customers decide to use. |
| <i>4. Mode of Choice</i> | Public transit is a key part of a liveable city and should be the favoured mode for a variety of journeys. Encourage existing customer loyalty and new markets to use public transportation. |

COMMUNITY

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| 5. Maximizing Benefits | Fares should stimulate growth in demand where and when there is sufficient capacity to accommodate it and enable greater access to destinations. |
| 6. Collaboration & Transparency | The process of establishing fares will be conducted publicly to ensure agency accountability and enhance public trust. Rationale for policy should be clear to customers. Data will be publicly owned and used for planning, monitoring and reporting. |

FINANCIAL

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| 7. Financial Sustainability | The Fare Policy and all aspects of its implementation should ensure fiscal sustainability and improve resiliency so that customers and the public may maximize the service benefits they receive. |
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While the focus of these policy goals is geared towards creating a better customer experience and meeting customer needs, the TTC remains aware of the need to recover costs through customers' fares. Phase 2 of the project will begin with modelling and testing potential fare structures, concessions and pricing, including the range between free fares and full cost recovery. This will help staff and stakeholders understand the costs and implications of implementing new fare structures.

Fare Collection Strategy

As previously directed by the Board, an industry-wide Automated Fare Collection (AFC) RFI was issued, which is the first step on the critical path for the TTC to procure a new vendor to potentially replace the current PRESTO system by the end of the TTC-Metrolinx Agreement in 2027.

While collaborating with Metrolinx on PRESTO's 2022 re-procurement remains a priority, the TTC has a risk mitigation program underway to chart a critical path for a future TTC fare collection system as early as 2027. Staff are taking steps now to be prepared to procure a new fare collection system by 2027, which would require preparations to begin as early as 2022. The first step on this critical path is the completion of an initial fare collection RFI to understand best practices and innovative technologies. These learnings will be used to inform the final 10-Year Fare Collection Strategy. Once this fare collection work is completed in Q4 of 2021, the TTC would issue another comprehensive RFI, developed with the requirements and direction received from this work.

The first industry-wide Automated Fare Collection (AFC) RFI on the critical path was issued in January 2021, which rendered 21 responses from vendors, including PRESTO.

The first Automated Fare Collection (AFC) RFI was publicly posted on January 18, 2021 and closed on February 5, 2021. The intent of this first RFI was to collect industry information regarding the variety of fare collection technologies, system operations and business models available. It was also geared towards understanding Canadian and international trends and industry best practices. A total of 21 responses were received and reviewed. An overview of the key findings is outlined below.

1. Establishing strong governance, simplifying fare policies and establishing strong project management is essential in ensuring that the business processes and policies implemented are successful and reflect lessons learned and industry best practices.

Establishing a strong governance model between all agencies that includes clear decision-making processes is critical when considering merging multiple service providers into one fare collection solution. Having a predetermined interagency agreement will allow for smooth migration achieving an integrated fare collection model.

In addition, simplifying the fare policy to better take advantage of account-based systems before selecting new technology is also crucial to developing a successful solution. Many vendors note that overly complex fare policies often lead to agencies being unwilling to abandon solutions that were developed based on card-based technologies. Account-based fare collection solutions provide agencies with the opportunity to simplify fare policies and take advantage of new technology.

2. Technological considerations for fare collection solutions include implementing a modernized system with robust open architecture requirements and applying a customer-focused approach and self-service functions.

Modern fare collection solutions include an account-based backend with open payment support and varying levels of open architecture. While open architecture varies amongst vendors, the lack of openness is commonly acknowledged as a key issue with integrating across multiple solutions or vendors. Robust requirements around open architecture will help migrate these issues and provide ongoing flexibility in the future.

Account based solutions also provide many opportunities to allow customers to take control of fare payment management by offering improved self-service functions previously unavailable to them. Customer-friendly solutions, such as virtualizing fare media in mobile wallets, expanding retail networks, and providing customer friendly mobile apps and websites empower customers to improve their experience by making transit simple and easy to use.

A summary of the key AFC technologies identified in the RFI vendor responses for achieving a modernized and customer-focused fare collection system is found in Attachment 2.

A series of peer agency reviews were conducted to understand the technologies proposed in the RFI vendor responses in practice and real time.

The peer agency reviews were conducted concurrently with the RFI posting and review. The intent of the peer agency reviews is to understand the current fare collection technologies found in the RFI in practice and real time. Interviews were conducted with six peer agencies across North America, and topics of discussion were grouped into two key parts: (1) Program Lifecycle, which includes procurement, implementation, operations, reducing cash and regional integration; and (2) Fare Collection System Features which includes open architecture, open payments, account based implementation, mobile payments, and Mobility as a Service (MaaS). Key trends from the peer agency interviews is outlined below:

- Focus on fare policy before designing a technological solution.
- Open architecture provides the agency with flexibility and opportunities.
- Having a comprehensive transition plan and good communication between departments is essential.
- Engaging with key stakeholders across a diverse cross section of the agency when highlighting requirements for fare collection is critical for planning and implementation.

Further details on the peer agency interviews as they relate to these topics can be found in Attachment 3.

Next Steps and Upcoming Phase 2 Deliverables

We continue to progress through Phase 2 of both the fare policy and collection work. This will include testing and modelling fare options, pricings, concessions and viable fare collection options against the identified policy goals. This phase will also seek to understand the impacts these options will have on revenue, ridership and service levels. We will also be conducting detailed vendor demonstrations with the respondents from the RFI. This will be beneficial to the TTC in understanding new technologies and system integrators.

A report incorporating the preferred fare structures, pricing and concessions, as well as viable fare collection options will be provided to the Board for approval in July 2021. Additional details on project timelines and future Board reporting can be found in Attachment 4.

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Signature



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Attachments

- Attachment 1 – Proposed Fare Policy Goals
- Attachment 2 – Automated Fare Collection Technology RFI Review Summary
- Attachment 3 – Fare Collection Peer Agency Review and Interview Summary
- Attachment 4 – Fare Policy & Collection Project Timeline & Board Reporting Schedule

Attachment 1: Proposed Fare Policy Goals

CUSTOMER

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|--|---|
| 1. <i>Affordability & Equity</i> | The price of public transit should reflect customers ability to pay, minimizing cost as a barrier to travel wherever possible. |
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FINANCIAL

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Attachment 2 – Automated Fare Collection Technology RFI Review Summary

RFI Summary

TTC 10-Year Fare Collection Outlook

Presented To:

Toronto Transit Commission (TTC) and York Region Transit (YRT)



Prepared By:



April 2021

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Introduction

The Toronto Transit Commission (TTC) and York Region Transit (YRT) are developing a 10-Year Fare Collection Outlook to inform decisions related to the introduction of new Automated Fare Collection (AFC) systems and technologies over the same period. The work is being developed in parallel with the 5-Year Fare Policy for the two agencies. Together, these initiatives will provide a roadmap for future technology decisions to further fare integration between the two agencies while simultaneously ensuring accurate revenue collection and broader application of fare policies.

The 10-year fare collection outlook is divided into 3 distinct phases:

- Phase 1 – RFI and situational analysis: This phase focuses on understanding the existing solution, including PRESTO, and gathering information regarding the current state of the fare collection industry from both vendors and peer agencies.
- Phase 2 – Future direction: Using the information from Phase 1, this phase will develop and evaluate options for the future fare collection system for the agencies.
- Phase 3 – Develop 10-year fare collection outlook: The final phase of the project will be the culmination of the previous phases and will result in the development of the 10-year fare collection outlook and provide an approach for meeting the needs of the agencies that correlates with the agency's fare policy plan and efforts.

This summary focuses on the results of the Request for Information (RFI) that was issued by the agencies asking for industry input from vendors. The RFI included questions on fare collection systems, innovations in the field, and insight into lessons learned when implementing AFC solutions.

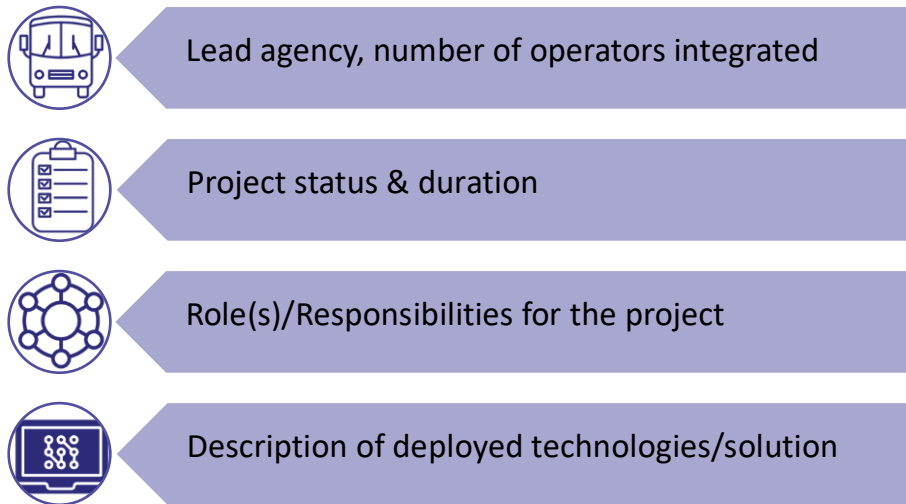
Approach to developing the RFI

Stakeholders participated in a series of workshops to identify the gaps in the existing fare collection system, based on identified needs. Using results from these workshops, the project team developed 76 questions for the vendor community that focused on best practices and lessons learned regarding the implementation of AFC solutions. Stakeholders were also keenly interested in innovations and technology around modern account-based fare collection systems.

The RFI was structured into two distinct parts:

- Questions regarding AFC technologies
- Capabilities and experience for the responding vendors

The questions reflected Stakeholder's desire to understand more about existing solutions for modern AFC systems, industry best practices, and lessons learned rooted in practical experience. The questions also asked about innovations that the TTC and YRT should be considering as part of a next-generation fare collection solution. Respondents were asked to provide a high-level description of their solution and experience implementing AFC systems for other agencies. As part of their response, the vendors were asked to provide five recent and relevant project examples that identified the following:



A high-level summary of the key takeaways from both the technology and best practices questions, as well as a brief vendor overview, is provided in this summary document.

Brief overview of responders

This summary pulls content directly from vendor responses and provides supplemental information. Much of the content, figures and tables within this document may be considered confidential and proprietary to the responding vendors. Agencies should use discretion in sharing this document.

The RFI generated significant interest from the industry, with twenty-one (21) vendors responding, representing a broad spectrum of the AFC solution providers, ranging from full-service system integrators to single component hardware/equipment providers to new service providers promoting specific solutions, services, or technologies. As such not all questions were answered by each vendor, and subsequently, not all vendors provided project examples. To help provide structure for this summary responders were separated into four categories:

- **System Integrators:** Vendors that provide a full-service implementation for some or all parts of an AFC solution. A System Integrator (SI) may provide an AFC backend, fare collection equipment, implementation services, and ongoing operations and maintenance. However, some respondents to this section do not provide any software or hardware, but rather bring together the different components of the solution by relying on third-party providers. SIs are the prime contractor and work collaboratively with other vendors to deliver a full, complete solution to agencies.
- **AFC Lite:** Vendors that provide account-based backend solutions that offer limited features and functionality. These solutions typically tend to be based on a software as a service (SaaS) model and with limited (if any) opportunity to make core changes to the platform.
- **Service providers:** This category includes all the other vendors that responded that are neither a SI nor an equipment provider. They include mobile app developers that offer services such as mobile ticketing or trip planning; payment providers that enable open payment acceptance for public transport; and other service-related solutions that may directly tie to the questions included in the RFI.
- **Equipment providers:** Vendors that provide hardware or equipment components for fare collection solutions. This may include TVM vendors, Fare gate vendors, and other equipment required for an AFC solution. These vendors are typically sub-contractors to an SI or are

contracted to provide specific elements of an AFC solution, but integrate to the SI-provided backend.

- **Other:** This category includes Metrolinx, who responded to the RFI as the entity that currently manages PRESTO, the current AFC solution provided by Accenture.

Full System Integrators

Of the 21 respondents, most identify as System Integrators, however the ability to provide a comprehensive AFC solution for the TTC and YRT varied by respondent and so this category was divided into Full System Integrator and AFC Lite Integrators. Full System integrators include a broad range of solutions and project experience. Vendors within this category range from large to small implementations but all offer an account-based backend, some level of open architecture, some equipment common in modern AFC solutions, integration experience, and some experience with key features of a modern fare collection solution.



Accenture was founded in 1989 and operates globally in over 200 cities with over 500,000 employees. The company offers a broad range of consulting, processing, operations, and technology services to clients. Accenture is the current AFC provider for the PRESTO system. ***Accenture did not provide recent example projects as part of their RFI response and does not provide their own hardware.***



Conduent Transportation, a division of Conduent, provides a broad range of technology solutions to public transit including fare collection systems. Conduent Transportation's AFC system accommodates a wide range of fare collection methods from e-Ticketing solutions to account-based solutions.



Cubic offers a range of AFC service and system solutions in the market. Cubic delivers integrated payment and transaction processing systems that lead to the creation of safe, reliable, and convenient public transportation services. Located in San Diego, California, Cubic also has numerous offices across North America, Europe, Asia, and Australia. Currently, Cubic is the manufacturer for YRT's TVMs used for Viva bus fare collection.



Scheidt & Bachmann (S&B) was founded in 1872 and operates in approximately 50 counties. S&B's largest division is fare collection, comprising approximately 1,200 employees. S&B's Canadian headquarters are in Toronto, and it has operated in Canada for over 25 years. S&B is the existing supplier of TTC's Fare Vending Machines (FVMs), Self-Serve Reload Machines (SSRM), Single Ride Vending Machines (SRVMs), and faregates.



STraffic is a South Korean-based transportation technology company founded in 2013, with North American offices in Washington, DC. STraffic is a provider of e-payment, smart airport, and ground transportation technology solutions. For transit, STraffic provides AFC solutions including e-ticketing, open payment, and end-to-end smart card solutions.



Thales Group was founded in 2000 in La Défense, France. Operating on all continents, Thales serves the aerospace, space, ground transportation, defense, and security market. One of Thales service streams is providing AFC for transit, offering complete end-to-end solutions to customers.

AFC Lite Integrators

System integrators within the AFC Lite category offer account-based fare collection services that typically are software as a service (SaaS) built on their standard platform, with limited configurations available to for the agency. Notably, Flowbird does offer a more customized solution for features and functions, however they are relatively new to software solutions and their standard offerings are not as developed as Full System Integrators. Additionally, the responses from Vix indicate that they have moved away from custom developments and are offering SaaS solutions that are based on a common platform.



Flowbird, founded in 2018 by a merger of two large companies, Parkeon and Cale. The company offers cloud-based fare payments services across transportation modes including transit, parking, mobility management. The company's transit AFC solution includes open payments, mobile applications, and account-based fare solutions for transit agencies.



Masabi launched in 2007 as a mobile ticketing provider and pioneered the fare payments-as-a-service model. Since launching, they have expanded their account-based ticketing solutions to support payment through a variety of fare products and open payment options. Their system expanded to include limited hardware to support their platform.



Ridango provides technology solutions exclusively for public transit. It was established in 2009 and is based in Tallinn, Estonia. Their core offering includes mobile ticketing applications and open-loop contactless payment alongside an account-based ticketing back end. They offer limited hardware that can be sold or leased to an agency.



Vix is one of the oldest established players in the AFC marketplace, with North American offices in Denver and Seattle. Established over 30 years ago, their focus is almost exclusively AFC. Vix offers a full range of solutions, ranging from closed loop to open loop and payment, account-based solutions, and mobile payment and ticketing.

Other service providers

Responders that offered services outside of a full AFC solution or hardware fell into the other service provider category. These vendors provide integration services, mobile application development, or mobile ticketing solutions without hardware or integration with a full AFC backend. These respondents include stand-alone software solutions and services that are often components of modern fare collection systems. The vendors included here are mobile ticketing, open payment solutions, and trip-planning service providers.



Adyen was founded in 2006 in Amsterdam, the Netherlands focused on building modern infrastructure directly connected to card networks and local payment methods to unify commerce and providing merchants with customer data insights. The Adyen platform enables merchants to accept payments in a single system, enabling revenue growth on mobile devices and at the point of sale. **Adyen did not provide recent example projects as part of their RFI response.**



Bytemark was founded in 2011 in New York City and also operates regional offices in Canada and India. Bytemark offers a variety of comprehensive fare collection and payments backend systems including customer mobile apps, merchant validation apps, web portals, API integrations, and many more. Currently, YRT utilizes Bytemark's eticketing solution and has plans for future integration of eticketing and Transit App with Metrolinx.



FAIRTIQ was launched in Switzerland in 2014. The company focuses on delivering smart mobile ticketing solutions that leverage new technologies. FAIRTIQ's solution is entirely app-based, with Android and Apple iOS versions.



Littlepay was founded in 2016 and offers a mass transit transaction payment solution for transit operators, authorities, and agencies. After deploying the first project in Oxford, United Kingdom, Littlepay has now expanded to over 100 operators across the UK and Ireland. Littlepay focuses on delivering fast and cost-effective open payment solutions.



Mastercard was founded in 1979 in New York and is one of the world's largest financial payment processors and the card issuer. Mastercard supports transit agencies to design open payment fare solutions that will work with its ecosystem of products.



SMRT International is a public transport service provider serving various clients from around the world, including in India, China, UAE, the Philippines, Mauritius, and Indonesia. SMRT International acts as an engineering firm and project manager to implement fare systems for transit.



Founded in 2012 in Montreal, Transit App has been deployed in over 200 cities. Transit's primary use case is for trip planning and to access agency information. More recently, Transit has integrated ticketing solutions with multiple vendors, including Bytemark, Masabi, and Token Transit. Transit also integrates real-time information, payment, and booking functionalities for various modes of transport including conventional transit, ridesharing, bike-sharing, and scooters.

Equipment providers

Equipment providers are identified as hardware providers that are often included as a subcontractor on fare collection solutions. They work with system integrators to integrate their hardware solution into the fare collection backend. Of the vendors that fall into this category, GenFare provides a limited AFC solution, however, Garival appeared to only respond to the RFI as an equipment provider.



Since 1983, Garival has been the Canadian distributor for Genfare products. Traditionally a farebox vendor, GenFare has expanded its product offerings to include hardware and software to support a limited AFC solution. Currently, YRT utilizes GenFare fareboxes for cash collection on local bus services.



SOLARI DI UDINE SPA was founded in 1948 in the Province of Udine, Italy, and has since branched to Canada and the USA. SOLARI offers a wide range of fare and ticketing solutions, including account-based ticketing options, mobile ticketing, ticket vending machines, on-board and mobile validators, and fare gates.



VenTek International is a US manufacturer established in 1950 and offering revenue control systems, with solutions for parking and transit. For transit agencies, VenTek supplies Ticket Vending Machines to support agency operations.

Other



Metrolinx was founded in 2006 in Ontario to plan and integrate transportation across the Greater Golden Horseshoe. PRESTO, an operating division of Metrolinx, is currently the electronic fare payment system serving the Greater Toronto and Hamilton area, with devices installed across the TTC and YRT networks.

Summary of responses to the AFC questions

Over seventy (70) questions were asked in the RFI that were separated across eighteen (18) different categories.



Figure 1: RFI technology question categories

- **General:** Procurement and implementation best practices and lessons learned.
- **Open architecture:** Ability to support open architecture and lessons learned integrating with other vendors.
- **Account-based solution with real-time communications:** Best practices and lessons learned leveraging account-based solutions with real-time communications; ability to support real-time fare calculation.
- **Open payments:** Ability to support contactless EMV payment cards, deployment approaches, and lessons learned.
- **Fare integration with regional systems:** Industry best practices and lessons learned deploying multi-agency/regional solutions.
- **Technology innovations:** Emerging technologies or innovations within the industry that agencies should be considering for next-generation fare collection solutions.
- **Inspection solutions:** Ability to deliver fare inspection solutions across a variety of fare media including contactless EMV, and virtual cards in the mobile wallet.
- **AFC equipment:** Targeted questions regarding faregates, fare validation hardware, and fare vending machines integrating with an account-based solution.
- **Fare media:** Fare media supported by the vendor's existing solution and lessons learned in facilitating the adoption of electronic fare media.
- **Supporting changes to fare policy:** Best practices in modern fare collection systems to support changing fare policies and the types of products and fares available.
- **Revenue control:** Solutions that support reducing the overall cost to collect fares, providing revenue assurance with account-based systems, and offering tools for reconciliation and settlement.

- **Data analytics:** Questions regarding the tools that are being used to analyze data from fare collection solutions to provide better insights into how riders are using and paying for fares.
- **Retail partnerships:** Experience in expanding and integrating with retail stores to offer to expand this sales channel for customers.
- **Customer experience and user interfaces:** Best practices and lessons learned in providing a first-rate customer experience and meeting customer's expectations for features and functions with new fare collection systems.
- **Employer/Institutional programs:** Experience and lessons learned supporting agency employer, and special fare programs.
- **Other back-office applications:** Questions about customer relationship management (CRM) and point of sales solutions for agencies to support customer requests and issues with fare collection systems.
- **System monitoring and key performance indicators:** Best practices with meeting performance requirements and monitoring modern AFC solutions.
- **System maintenance and operations:** Lessons learned and best practices for operating and maintaining AFC systems, specifically as it relates to evolving technologies and solutions.

The following sections below will provide a high-level summary of key items within each category.

General procurement and implementation

Within the fare collection industry, traditional AFC solutions have required agencies to put forth a large capital investment for a highly tailored solution and equipment purchases. However, this model may not be as cost-effective for smaller agencies looking to implement a more out-of-the-box solution. Given this, vendors have started offering different procurement models for agencies including:

- Software as a service (SaaS) – Full account-based solutions that include all software and back-office components and requires a much lower capital investment. Although there is a large variety of SaaS solutions, in general, agencies pay for the solution as a service through operating fees and/or a percentage of revenue, rather than purchasing the software and equipment upfront.
- Infrastructure or Device as a service – Similar to the SaaS model, agencies can opt to lease equipment or infrastructure, lowering the initial capital investment. Additionally, many Device-as-a-Service solutions can include system operations and maintenance, with the vendor performing all day-to-day operations and preventative maintenance on provided equipment.

Successfully delivering solutions based on practical experience from vendors

One of the questions in this section specifically asked what an agency can do to avoid an unsuccessful fare collection implementation. Vendor responses were consistent and repeatedly mentioned six key indicators for successful project implementation for multi-agency, regional solutions.

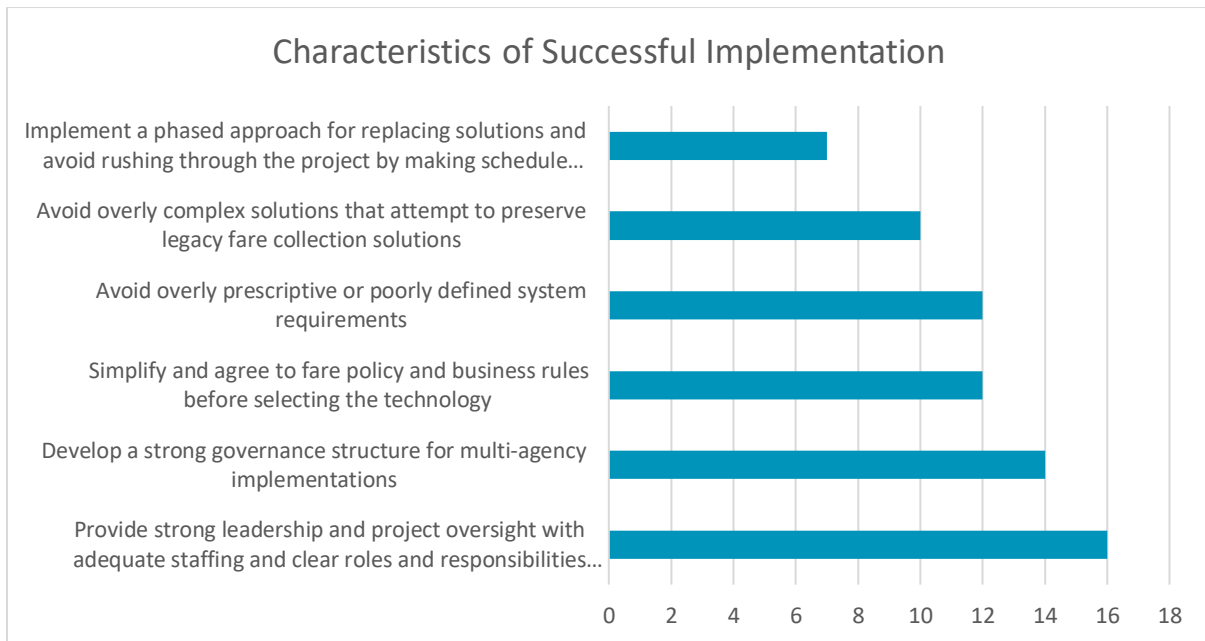


Figure 2: Characteristics of successful AFC implementations from respondents

A key theme across most all the vendors responding to the RFI was the importance of establishing a strong project management team and including subject matter experts across the agency as part of the stakeholder overseeing the implementation. Equally important, was identifying key decision makers to facilitate design decisions and keep the project moving. The term “overly complex” was used often to describe fare policies when discussing ways to avoid an unsuccessful implementation. Many vendors noted that fare policy alignment and, in many cases, simplification, was critical in the success of implementing solutions.

“...any new system implementation should include a disciplined, critical review of fare policies and procedures...” -Flowbird

Respondents to the RFI consistently spoke about the importance on having clear requirements. Many emphasized that requirements should be clear, yet not overly prescriptive. This will provide each vendor flexibility in meeting the intent of the solution rather than trying to build a system that is rooted in a “how it’s always been done” approach. Another noteworthy item was that most vendors recommended a phased approach for transitioning to next-generation solutions. While some vendors stated that they could have a full AFC system up and running in under a year, many acknowledged that transitioning from a legacy card-based AFC system to modern fare collection solutions required a phased approach with realistic timelines to allow customers to transition by choice. Phased implementations were noted not only for reducing customer inconvenience, but also allowing agencies to fine-tune their system and make adjustments before rolling out subsequent phases, leading to successful implementations for each of the following phases.

Open architecture solutions

Open architecture describes an approach to system design and deployment whereby methods used to access all system functions are published in documents known as Application Programming Interfaces (APIs). This in turn allows third-parties to build solutions (i.e., devices and systems) that access those functions. The primary benefits of this are freedom from proprietary systems and independence from a single vendor.

All software-based systems, regardless of the specific design, use defined interfaces to connect various components. In this way, all systems have the potential to be open architecture, simply by publishing specification documents for the interfaces that already exist and making them available to parties that need to use them. This makes achieving an open architecture as much a contractual issue as a technical one.

For an electronic fare collection system to be considered using truly open architecture, several key criteria must be met, regarding both the design of the APIs and delivery of the associated specifications:

1. APIs must be provided to access all core functions provided by the fare system (e.g., fare payment/validation, fare inspection, fare sales, transit account management, customer account management, etc.)
2. APIs must, wherever possible, be built using modern software development standards.
3. API specifications must be published as part of the initial system delivery and updated on an as-needed basis throughout the life of the system.
4. The transit agency must either own, or have a perpetual, royalty-free license to use, the API specifications for any purpose related to maintenance, operation, or expansion of the fare system, including distribution to third-parties at the agency's sole discretion.

Most respondents demonstrated a general understanding of open architecture principles and showcased experience through providing and using APIs in various capacities. While no respondents indicated an unwillingness to provide an open architecture, the extent to which the solutions described meet the key criteria for an open architecture varied widely. The following are key takeaways with regards to vendor responses regarding open architecture solutions:

- A number of electronic fare system suppliers indicated that they provide APIs for only a subset of the functions that would typically be required for maintenance, operation, and expansion of a fare system.
- Among the electronic fare system suppliers, there were varying levels of experience and commitment regarding the use of modern software development standards (e.g., HTTPS, REST, JSON, OAuth2, etc.).
- While almost all electronic fare system suppliers stated that they used APIs in the design and operation of their respective systems, an explicit commitment to provide API specifications for agency use was not always present.

Account-based, Real-Time Communications

Almost all electronic fare collection systems being designed and deployed today make use of an account-based architecture. This means that fare media (i.e., what a customer presents upon entering/boarding) such as a transit card serves only as an identifier for a back-office account. The fare collection back office not only manages the accounts used to hold value loaded by the customer and retain a history of customer activity (similar to a bank account), but also performs all calculation of fares, and is the primary source for determining whether a customer has a valid fare to enter the system (i.e., fare validation). Since the role of the back office is so critical in account-based systems, all devices must be equipped with high-speed, persistent communications (e.g., cellular or fiber), providing an always-active connection to the back office.

In contrast, fare collection systems built on a card-based architecture, such as PRESTO, rely on the data representing the value loaded by customers to be stored on the transit card itself. When the card is tapped on a reader, this data is read and local software on the reader is used to calculate the

fare, perform fare validation, and write an updated balance back to the card (if necessary). While a transaction record is typically sent to the back office, this can occur as a batch process whenever a connection becomes available (i.e., store-and-forward). The primary benefit of these systems is the ability to operate in an off-line environment.

The industry transition from card-based to account-based systems has occurred in the last 5-10 years, largely driven by the ubiquity of affordable, fast cellular communications. Account-based systems provide many advantages over card-based solutions:

- Immediate availability of value loaded through e-commerce channels (e.g., web and mobile).
- Real-time availability of transaction records (for customers and the agency).
- Reduced software management and instantaneous fare policy changes (i.e., no fare calculation software on readers).
- Better support for modern fare payment options, such as mobile phone-based and open (i.e., credit/debit) fare payment.
- Fare rules do not have to be replicated to every device in the network.
- New fare products and fare changes can be instantly and safely implemented across the entire network.

While these benefits are significant and justify the move to an account-based system, agencies need to be careful to not sacrifice the benefits of a card-based architecture in the transition. Because all fare processing occurs at the reader using local software, card-based systems have near-100% revenue assurance (i.e., prevent customers entering without valid fare), and can provide customers with instantaneous feedback on the fare paid, the balance remaining, and other payment information (e.g., transfer status) at the time of tap.

With the reliance on the back office for fare calculation and validation, account-based systems must be specifically designed with a focus on retaining the benefits currently provided by card-based solutions. While a connection to the back office cannot always be guaranteed, the online fare validation rate needs to be optimized as much as possible, and when processing a fare validation request, the back office must perform a real-time fare calculation to validate proper payment and respond with relevant fare payment information. In instances when an online validation is not possible (e.g., in a cellular dead zone), the system must employ robust risk management controls to make the most informed offline decision possible.

Most respondents demonstrated knowledge of the basic elements of account-based system design; however, experience implementing these designs varied greatly. Another differentiator was knowledge of the more nuanced elements of account-based solutions, including the benefits of real-time fare calculation and best practices for managing offline fare validation scenarios. The following are key takeaways with regards to vendor responses regarding account-based systems and real-time communications:

- While almost all electronic fare system suppliers acknowledged real-time fare calculation is possible, only two vendors definitively stated that their system currently supports it.
- Almost all fare system suppliers pointed to risk lists stored locally on readers as the primary means to mitigate risk in offline validation scenarios.
- Several suppliers recommended writing minimal data to the fare media (e.g., timestamps), when possible, as an additional risk mitigation measure.
- Fare system suppliers identified two potential approaches for a card- to account-based transition:

- **Parallel Operation:** New system is deployed and operated in parallel with the old system (e.g., two readers on a bus) until the agency is ready to make a hard cutover to the new system.
 - **Media Conversion:** New readers are installed, which are capable of reading both the old and new media; old media is eventually converted to an account-based token.
- While both transition strategies carry significant risk, most fare system suppliers recommended the media conversion approach.

Open payment solutions

In the world of electronic fare payment, the term open payment, also known as EMV payment, refers specifically to the acceptance of bank cards (i.e., credit/debit cards) as well as virtual bank cards stored in mobile phone-based digital wallets (e.g., Apple Pay and Google Pay [GPay]).

The contactless interface used in physical bank cards, as well as the Near-Field Communications (NFC) interface used by mobile phones, are compatible with the contactless technology already used to read agency-issued (i.e., closed-loop) transit cards, such as PRESTO. Given the sensitivity of bank card data, however, strict security requirements are imposed on any transit agency (considered the merchant) looking to accept bank cards for payment. The most prominent of these rules are documented in the Payment Card Industry Data Security Standard (PCI-DSS), which defines end-to-end physical and logical security for any devices, systems, and networks handling bank card data. As such, significant fare payment system enhancements, including new PCI-compliant readers, are typically required to support the acceptance of open payments.



Figure 3: Example open payment media supported by Accenture

Open payment acceptance can also drive operational changes, especially related to customer service and outreach. This method of payment is often new for many customers and can lead to confusion when related charges appear on bank card statements, especially if transaction aggregation (i.e., combining multiple fare payments into a single bank card transaction) is used by the agency. Another impact to customer service can arise from the fact that card security features purposely hide bank card information from the merchant. Most bank cards use substitute card numbers (i.e., tokens) when sending information to a contactless reader. This can become an issue when cards are lost, replaced, or added/removed from mobile wallets, since what looks like one card to the customer, may be seen by the system as different cards all with a unique number/token.

Most of the respondents demonstrated some knowledge of bank card processing and the related security requirements. Responses varied greatly, however, in demonstrating an understanding of the specific challenges faced by transit agencies looking to accept open payments and showing experience with best practices used to mitigate risk. The following are key takeaways from the vendor responses regarding open payments:

- Most fare system suppliers described a system architecture used to process open payments that sought to keep as much of the system out of PCI scope as possible.
- Only a few suppliers referenced the implementation of End-to-End Encryption (E2EE) solutions, considered a best practice to keep sensitive data off of agency systems and networks.
- Several suppliers referenced Offline Data Authentication (ODA) as an essential risk mitigation measure, used to verify bank card authenticity before acceptance.
- In general, the fare system suppliers did not provide innovative solutions for the handling of card loss and expiry, with most suggesting customer registration of open payment cards, and only one confirming use of the Payment Account Reference (PAR) number, which is specifically designed for this purpose.
- Almost all fare system suppliers recommend against allowing bank cards to be used as a means to access closed-loop fare products (e.g., passes), noting card association (e.g., Visa, Mastercard, American Express) objections, and the strong likelihood of customer confusion.
- Several suppliers recommended the use of fare capping as a means to provide customers using open payments similar benefits to those using the closed-loop card and passes.

Fare integration

Fare integration to support seamless transfers between operators within a region, and also with 3rd party mobility providers, is an area of interest for many public transportation agencies looking to implement modern fare collection systems. To achieve this, sufficient processes and technology must be in place to support the integration of fare payment and products with other mobility providers. Overall, the vendor responses did not showcase innovations regarding regional fare integration with only a few vendors noting that they offer experience integrating other mobility providers, such as scooter/bikeshare and ride-hailing services. While some vendors do not have experience with multi-agency, regional implementations, most vendors that responded as SIs demonstrated not only experience with regional solutions, but also limited experience with integrating other mobility providers.

Vendors commented on the challenges faced by transit agencies in facilitating inter-agency transfers and the appropriate allocation of the collected fare. Transit App noted this challenge can be addressed through platforms that can understand a rider's complete origin-destination information. Conduent noted common challenges in integrating with other agencies stems from integrating multiple legacy systems, delivering multiple bespoke solutions for each agency performing the same set of

✓ Experienced
 ✗ No Experience
 ⊖ Limited Experience

| | Multi-agency, regional systems | 3rd party mobility providers |
|------------|--------------------------------|------------------------------|
| Accenture | ✓ | ✗ |
| Adyen | ✗ | ⊖ |
| Bytemark | ✓ | ✓ |
| Conduent | ✓ | ✗ |
| Cubic | ✓ | ✓ |
| Fairtiq | ⊖ | ✗ |
| Flowbird | ✓ | ⊖ |
| Genfare | ⊖ | ✗ |
| LittlePay | ⊖ | ✗ |
| masabi | ⊖ | ✓ |
| mastercard | ✗ | ⊖ |
| Presto | ✓ | ✗ |
| Transit | ⊖ | ✓ |
| Ridango | ✓ | ✓ |
| S&B | ✓ | ⊖ |
| SMRT | ✗ | ✗ |
| Solari | ✗ | ⊖ |
| STraffic | ✓ | ✓ |
| Thales | ✓ | ⊖ |
| VenTek | ⊖ | ✗ |
| Vix | ✓ | ✗ |

Figure 4: Vendor fare integration capabilities

tasks (multiple apps, websites), and lack of integration in fare products, concessions schemes, and processes. To address these challenges, Conduent stated that agencies should consider upgrading systems that need to be integrated across agencies to enable open APIs. It was also recommended that using white-label solutions for websites and applications allow for each agency to customize appearance and branding without requiring separately procured solutions.

Technology innovations identified by respondents

While many vendors referred to major trends such as account-based systems, open architecture, and open payments, there were also several other technology innovations that vendors promoted in response to this question within the RFI. Most vendors that responded with innovative options noted that these leading (and often “bleeding”) edge features are either in pilot phases or early development. A brief description of the innovative technologies noted by the different vendors are included below:

- **Hands-free validation:** Passive fare validation that enables hands-free payment without requiring riders to “tap”. Rather the solution detects the rider entering/exiting an area and charges the rider appropriately. Although there were some pilot projects and ongoing development in this area, it was noted that technology is still not yet standardized and is therefore still unproven.
- **Expanded fare media options:** Several vendors noted expanding fare media to include mobile devices by including closed-loop fare media on a mobile device, either through a barcode or NFC virtual card in mobile wallets.
- **Integration of third-party mobility providers (e.g., mobility as a service):** Vendors also noted the popularity of incorporating integrated payments with 3rd party mobility providers, such as integration with bike-sharing, electric scooters, and ride-hailing solutions.
- **Personalized messaging for riders:** Although agencies have been aware of using mobile devices as a way to message and connect with riders, vendors mentioned leveraging the account-based backend and data provided to include targeted, personalized messages. This included reminding riders their balance is running low before boarding the vehicle or informing riders of delays specific to the route that they take frequently, based on tap history.
- **Leverage advancements in mobile technologies:** Facial recognition is beginning to trend in some Asian countries an alternative was to validate or verify identity. Far more common is facial recognition as a verification method to log into your device or authenticate payments. Although this brings many privacy concerns, agencies are leveraging mobile devices as fare media. Agencies may start to require that mobile solutions include bio-metrics or other more advanced verification technologies to access account information, bypassing the need to manually enter a password.
- **Big data analysis:** Advanced data analysis was not commonly mentioned, and this is most likely because many modern fare collection solutions implemented include a business intelligence tool such as PowerBI, Tableau, or QuickSight. Utilization of these tools, and the development of dashboards for executives and agency staff managing and operating the system, are standard offerings for most SIs. However, ideas on how to turn this data into usable information are still evolving, with vendors and agencies working to provide better insights into rider behavior and system performance.
- **Demand-based pricing:** Though not common, demand-based pricing was mentioned by a few vendors, and includes the ability for agencies to provide flexible pricing to shift rider behavior.
- **Loyalty/rewards programs:** A few vendors noted that programs to incentivize public transportation are on the rise. Loyalty or rewards programs are looking to increase and

maintain ridership. This includes offering free passes, or discounts based on rider behavior, and offering transfers to/from other mobility modes to provide first- and last-mile solutions.

Fare inspection solutions

Fare inspection is an important function for all fare collection systems. Confirming that customers have paid the appropriate fare requires handheld readers that can read the payment media and determine whether the rider has paid the correct fares for the service being inspected. In card-based solutions, these devices read the data written to the card and make decisions based on the recent information, such as the last location and date/time of the card was tapped, the result provided by the validator, and products/value stored on the card. In some solutions, details of the last few transactions are displayed to staff inspecting fares as supplemental information. In account-based solutions, transactions and account information are stored in the backend. This can complicate fare inspection, requiring active network connectivity and mitigations if the inspection device is offline. Additionally, as agencies incorporate open payment acceptance, special consideration for PCI compliant inspection solutions must be considered.

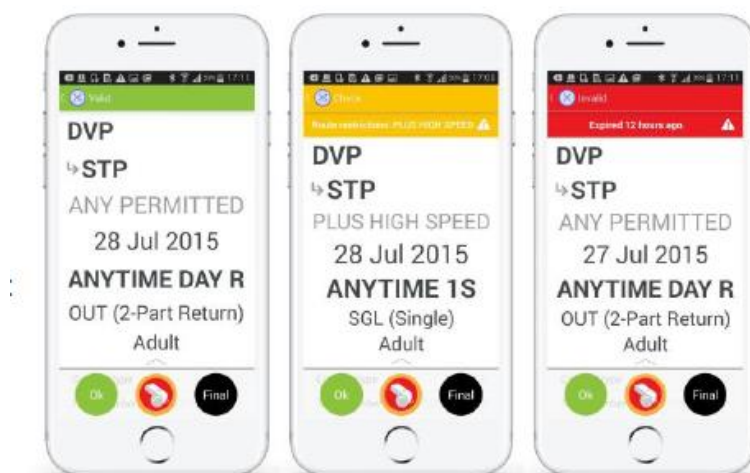


Figure 5: Masabi's inspect enterprise mobile application is available for Android and iOS to enable fare enforcement personnel to scan tickets using an Android/iOS app.

Among the RFI responses, inspection solutions ranged from specialized hardware devices running proprietary software to software-only solutions that can be ported over to the agency's desired mobile hardware (providing it meets certain criteria and the agency work with the manufacturer to make the necessary firmware updates). Nearly all vendors stated they can support inspection of open payment and mobile media, albeit with different approaches. For example, some vendors suggested charging the card at the time of inspection if a valid tap could not be found, then crediting the charge back at the end of the day if needed, once all taps were in (STraffic). Other vendors suggested not doing open-payment inspections in real-time, but reading the open-payment card and storing those transactions until the end of the day to see if a valid tap was made, then charging the card either the cost of fare or an applicable fine if needed.

In describing their varied approaches, vendors consistently stressed the importance of reliable communications and some level of network and hardware redundancy to ensure customers are not wrongly penalized. Vendors also suggested policy mitigation strategies, in conjunction with the technology solution.

Fare collection equipment

Automated Fare Systems rely on varied hardware to work seamlessly together through high-speed wireless communications:

1. **Media and Fare Products:** This is the physical or digital payment instrument that customers carry with them that they use to pay their fare. This includes cash, traditional tickets, flash passes, and smart cards. In open-payment systems, this extends to smartphones, credit cards, and anything with an EMV payment capability (e.g., smart watch) that allows a customer to pay their fare.
2. **Fare Payment Touchpoints (validators):** This is the device that interacts with the customer's fare media or product to deduct a fare.
3. **Fixed Assets:** This can include fare gates and fare vending machines (to sell or re-load funds into an account or card).
4. **Mobile Assets:** This includes the devices that would be installed on vehicles (including the validators), as well as handheld validators for fare inspectors.
5. **Software and Server Systems:** This includes back-office services and supporting communication to integrate all the pieces into a single cohesive system.

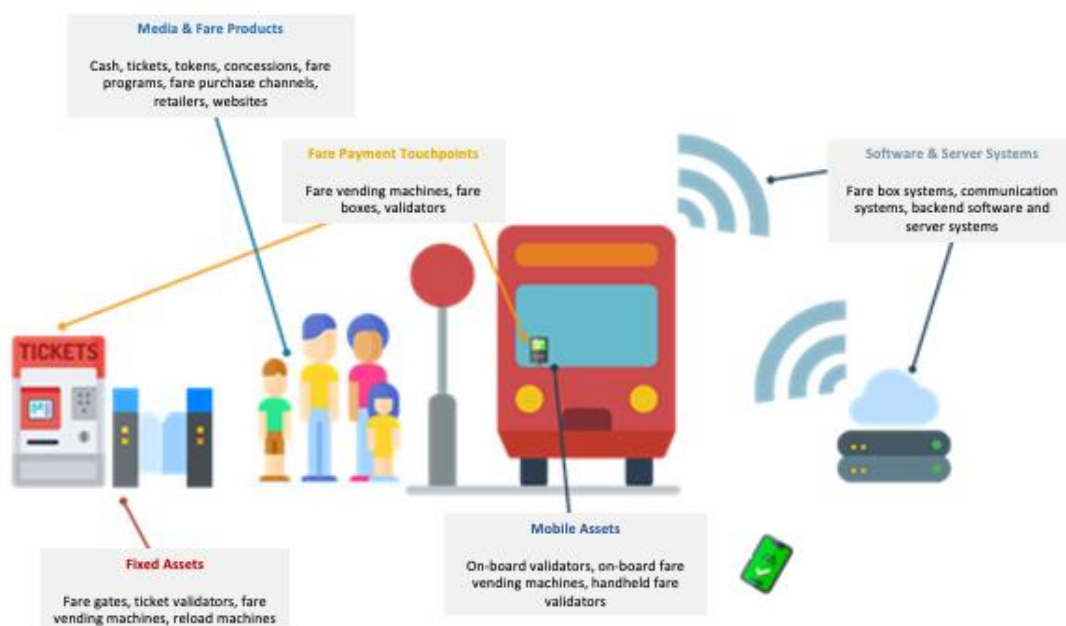


Figure 6 - Types of fare equipment supporting automatic fare collection systems.

Some AFC vendors provide some or all the required equipment, but many rely on partnerships with specific equipment vendor implementations. As such, the SI role becomes important to bring together the varied components and ensure they work together. This function can be performed by the agency itself, typically running multiple procurements and ensuring vendors work together effectively, or included in a single, larger procurement that puts the integration requirements and risk onto a single vendor. Just over half of the respondents offer fare collection equipment. These vendors include:

| | |
|---|---|
|  Validator, Gates, Vending machine |  Validator, Vending machine |
|  Validator, Vending machine |  Validator, Vending machine, Fareboxes |
|  Validator |  Validator |
|  Gates, Vending machine |  Validator, Gates |
|  Validator, Gates, Vending machine |  Validator, Gates, Vending machine |
|  Vending machine |  Validator |

Figure 7: Types of fare equipment solutions offered by vendors.

Vendors who did not have offer a full suite of fare collection equipment recommended integrating with existing or legacy fare collection solutions. However, it was noted that a direct integration to a modern AFC backend requires the legacy equipment to be Payment Card Industry (PCI) compliant and certified to accept open payments. All vendors with experience integrating with other vendors stated that integrating legacy fare equipment is challenging and costs are dependent on the level of cooperation with the legacy vendor. To mitigate this, agencies should ensure that the roles, responsibilities, and resources allocated for the integration are agreed to in advance to reduce delays and escalating costs.

Reliable communications for mobile assets are critical to AFC operations. Most vendors require integration of their hardware to an onboard or station router to enable communications. Cubic noted that they are working to future-proof their validation equipment by supporting 4G, Wi-Fi, and Bluetooth from the validator to improve system reliability and performance.

Fare media

Fare media are physical or digital payment instruments used to pay fares on board vehicles and at rail stations. There are a variety of fare media options, and they differ across agencies based on customer needs and the technology available to support them. Ensuring that convenient and modern fare payment options are available to customers, and providing support for cash-reliant customers, are both essential to providing good and equitable transit service.

The review of RFI responses showcased the following types of fare media supported by various vendors.

- **Paper tickets/tokens:** Traditional paper tickets purchased at stations and retail locations and collected onboard in fareboxes.
- **Smart cards:** Physical plastic cards with a built-in magnetic stripe or a chip that can store information. Fares are paid onboard and at rail stations by tapping the card on a validator.
- **Limited Use Media (LUM):** LUMs are disposable fare payment products that are used 1-10 times and support all of the functionality of smart cards.
- **Mobile tickets:** Virtual limited use tickets that are loaded onto mobile phones in the form of barcodes or QR codes.
- **NFC/ Mobile wallet:** Closed-loop card with a stored value in a Near Field Communication (NFC) based mobile wallet. Customers can tap their phones onto validators to make a payment on board and at rail stations.
- **Bank cards/Open payment cards:** Bank-issued credit or debit cards used to pay fares onboard and at rail stations. Cards accepted in AFC systems must support contactless payment, including cards in mobile wallets (e.g., Apple Pay and Google Pay), and meet global interface and security standards, such as the contactless Europay Mastercard Visa (cEMV) standard.

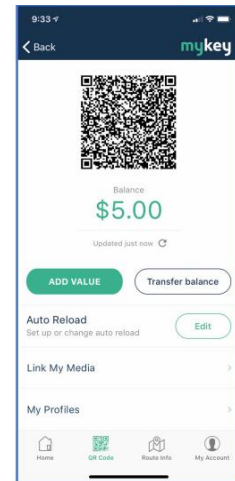


Figure 8-Flowbird mobile ticket interface

The following figure summarizes the types of fare media supported by various vendors.

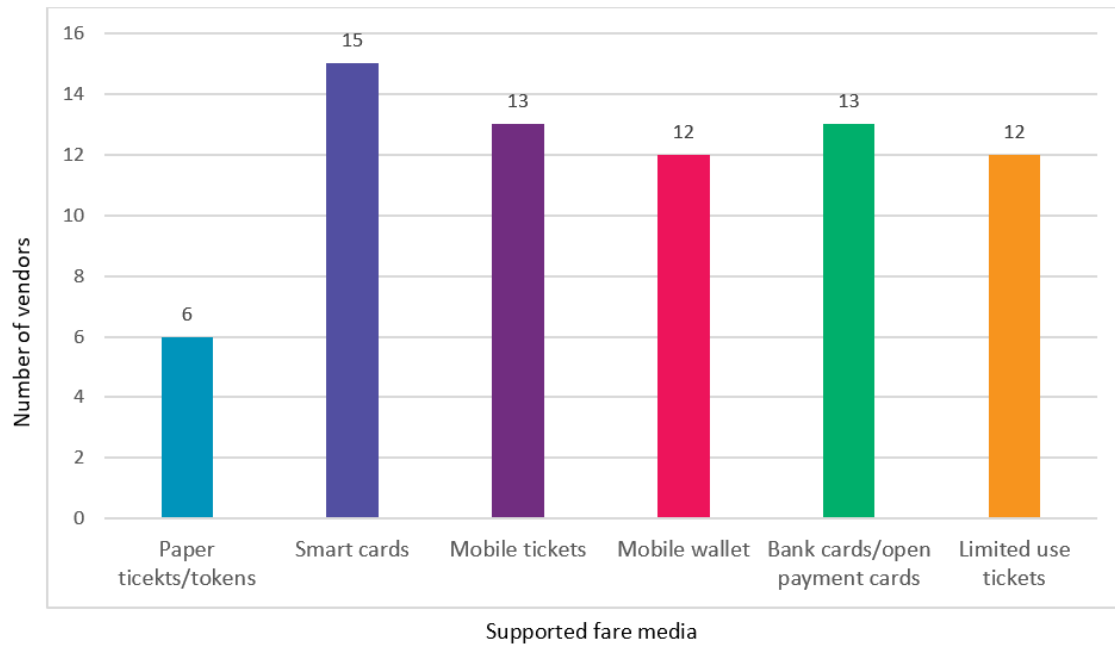


Figure 9: Types of fare media supported by vendors.

In addition to the above, newer alternative forms of fare media are being showcased by vendors. Two vendors (Bytemark and Vix) introduced Bluetooth fob/bracelet applications; an option primarily designed to support customers with disabilities. The Bluetooth devices connect to the customer's account when they enter or depart a station. Cubic indicated potential applications to do contactless payment using biometrics, proximity sensors, and cameras.

Support for fare policy changes

While agencies should strive to simplify and streamline their fare policies, inevitably changes are required to adapt to the evolving needs of the agency. While all vendors indicated that their system supports fare policy changes, the responses varied as it related to complexity, with some mobile app suppliers only offering support for more simple fare policies (e.g., defined fare products) while other solutions were able to support more complex policies. Most vendors offer a backend web portal (see example below) for agencies to make fare policy changes, including duplicating existing policy data or creating a new changeable set of fare policies in their system.

The fare policy changes made by the agencies, and typically supported through these web portals, are often smaller or common fare policy changes, such as adjusting the value of fares, or defining discounted fares, time-based fares, and zone-based fares. Depending on the vendor, the timeframe for changes may be immediate for smaller changes but may require several months for testing of more complex changes, such as demand-based pricing to move riders from one mode to another. Such changes should be done with increased support from the vendor.

Revenue control

Fare revenue reconciliation and clearing are key functions underlying fare collection systems, whereby the revenue collected is accounted for and distributed between partner organizations. While partner agreements can define how revenues are distributed, the AFC system has a critical role in ensuring that the tabulated revenues are accurate, and that the distribution is in line with the established agreements.

Most vendors did not provide detailed responses on their processes to ensure the reliability of revenue data. Of those that did, reconciliation processes are conducted through online systems and are largely dependent on merchant acquirers, payments processors, and banks. Vendors with Quality Assurance (QA) and Quality Control (QC) processes are capable of addressing missed or incorrect transactions through an automated system to minimize revenue leakage. Some vendors are not fully automated and have limited integration with payment providers.

Fare collection operations can often cost an agency as much as 12% of collected revenue to administer. A few notable suggestions to reduce the total cost of fare collection were provided by vendors. Ridango stated that one of the main cost drivers of Account-Based Ticketing (ABT) systems is the number of stationary front-end devices, such as vending machines (TVMs) and dedicated POS hardware. These devices are generally expensive to maintain, but also require routine servicing for replacement of consumables and cash collection. Vix noted that leveraging an expansive retail network is most effective at reducing the overall cost of fare collection.

Data analysis and business intelligence

The ability to capture data is important for agencies to be able to report on ridership, reconcile revenue, and monitor how well the system is performing. Having access to data that is detailed, robust, and usable is important to obtaining operational insights and maintaining a transparent fare reconciliation process. Vendors like Cubic noted the variety of data that their system can collect, including validator and gate usage, inspections and citations, device states, and media sales and usage. The calculation of ridership often involves configuring transfer rules to count linked trips (journeys) as a single ride.

While many vendors have a proprietary BI tool, several support more advanced analytics through third-party BI tools. These tools and analytics platforms are capable of integrating with several transit applications, including CAD/AVL and scheduling systems. Many vendors are also providing analytical tools to support advanced, AI-enabled analytics for applications such as predictive equipment maintenance and ridership trend analysis.

Data ownership can be reasonably expected to lay with transit agencies. The ownership of data allows agencies to apply this information for fraud prevention, preventative equipment maintenance, fare product analysis, and general rider and schedule insight. Finally, it is common amongst all vendors to comply with standard privacy regulations. Vendors have built solutions that protect and prevent unauthorized access to personal and financial information, while maintaining the ability to analyze trends. Ridango achieves this by anonymizing the data to track generic passenger flows and trends. Masabi also ensures minimal Personally Identifiable Information (PII) is requested, and also stores data in an anonymized format wherever operationally viable.

Retail partnerships

Transit agencies have historically relied on retail partnerships to provide customers with greater access to fare products. Typically, this has involved establishing distribution channels to circulate fare tickets and passes, using database systems to track inventory that is in circulation, and having complex processes to collect sales data and settle revenues. This traditional sales approach carries substantial risk of leakage and requires substantial staff resources to be successful.

Modern AFC systems provide the opportunity to simplify much of the processes used in the past. While some vendors have point-of-sale solutions that can be distributed to retail partners, other vendors are working with third-party providers to support this functionality.

The most common third-party solution is offered by InComm Payments. Cubic, Bytemark, Flowbird, Garival S.E.C, and Vix all indicated experience working with InComm as a partner. InComm Payments offers pre-paid cards, online reloading options, mobile ticketing, and self-serve ticket vending machines. Consumers are very familiar with this type of solution – commonly found in the form of gift cards on racks at supermarkets and drug stores. This allows easy access for passengers to add value to their transit accounts, overall creating a more efficient commerce experience.

Customer experience

Vendors recommended several technological solutions to make the system simple and easy to use for the customer. These included contactless and open payments, secure payment processing, access to data, user-friendly and accessible interfaces, and the design of mobile applications and websites with self-serve options. Through their responses, vendors highlighted accessible user interface features, such as displaying stops/vehicles that are handicap accessible within the mobile app and incorporating interactive voice response systems and live chats.

Other common solutions to enhance the customer experience included integrating with retail service providers to expand access to fare media. This serves as a transit equity measure (providing alternatives to cash users), but also enables agencies to more readily move to all-door boarding (supported by off-board validators), which reduces dwell times and improves the overall reliability of transit operations. A customer experience focus for vendors was on enabling customer self-service through a variety of options and features:

- **Autoloads:** Autoloads/Auto top-ups will automatically charge customers a set amount once the balance in their transit account/card falls below a certain threshold. This is normally done by linking a debit/credit payment option to the account.
- **Pass Auto-Renewal:** Auto-renewal features automatically reloads transit passes depending on the type of pass (ex: monthly passes will renew monthly).
- **Website/Mobile Refunds:** Web/Mobile refunds allow customers to make refunds for purchased items through the website or the mobile app without the need for contacting customer service.
- **Trip and Purchase History:** Customers can view their trip and purchase history through a website or mobile app without the need for contacting customer service.
- **Real-time Information and Passenger Counts:** Real-time information is reported to transit riders regarding the current status of vehicles, approximate arrival times, and passenger counts.
- **Trip Planning Features:** Trip planning features allow customers to navigate their route by inputting their current location and destination into the system. This feature is often supported by schedule and real-time information.
- **Notifications:** Notifications are often integrated into transit systems to notify users of low funds in their accounts or service disruptions through app alerts, emails, or text messages.
- **Interactive Voice Response (IVR):** Interactive Voice Response (IVR) allows customers to communicate with the computer-automated website or mobile system through speech recognition. This is usually integrated through pre-recorded messages.

The following figure showcases the various self-serve options described above.

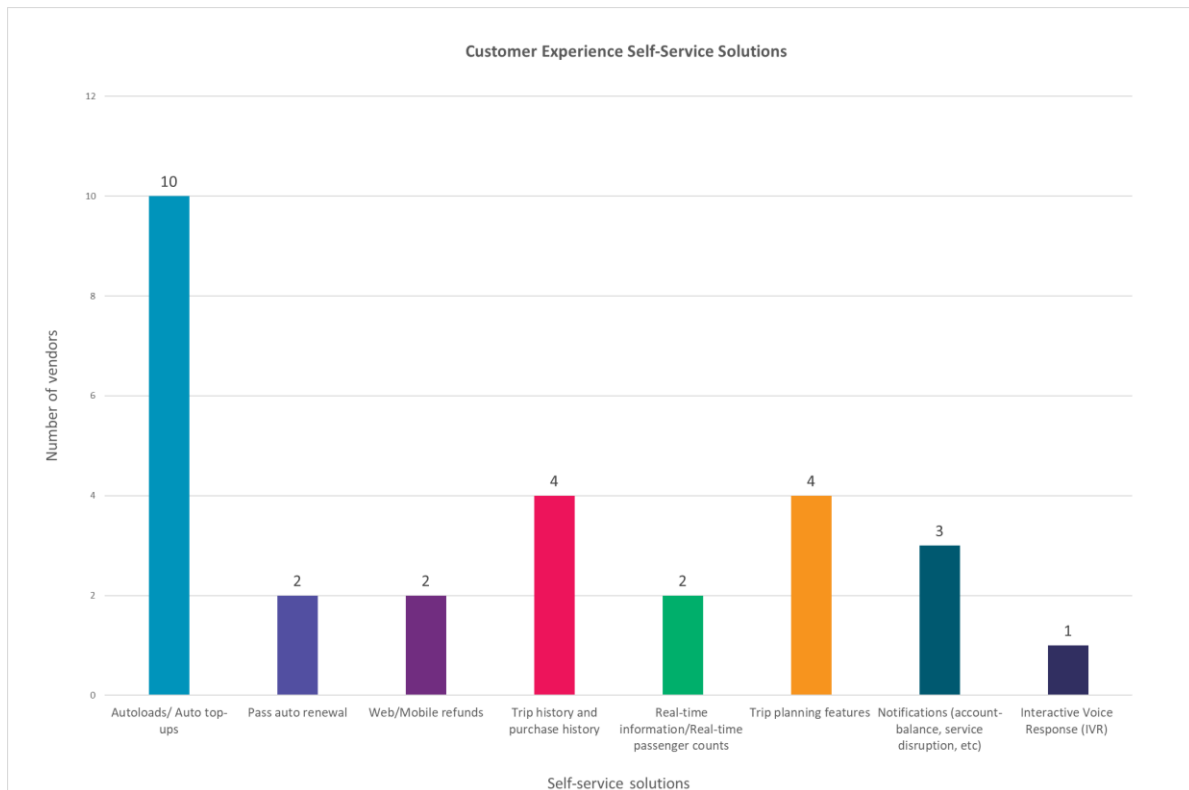


Figure 10-Types of self-serve options offered by vendors.

Vendors also described customer-friendly fare capping solutions that offer customers a pay-as-you-go model with the benefit of passes. One vendor, Ridango, provided additional detail on this – though others also offer this solution. Ridango’s ticketing system has a built-in fare engine, which allows all types of fare logic to be implemented, including Best Fare Calculation and Pay-As-You-Go with period (daily, weekly, etc.) capping. This fare capping functionality is fully configurable and can be applied to any time period, as well as payments with bank cards (EMVs).

Institutional/Employer Special Programs

Many transit agencies such as the TTC and YRT have agreements with employers, academic institutions, and other organizations to provide fare products to a large number of individuals within those groups. While this is relatively straight-forward to do with traditional fare media, it can be more challenging to accomplish with AFC, because typically electronic fare products must be tied to a user account. Most responses did not directly address the vendors’ capability to support such institutional, employer, or other special programs. The most notable solutions were discussed by Bytemark, Masabi, and STraffic.

- Bytemark provides the agency with the ability to sell and distribute bulk passes to large groups such as students or employees.
- Masabi has a dedicated web portal that enables authorized third-party users of partner organizations to issue tickets, passes, or mobility credits to accounts.
- STraffic’s software supports card media lifecycle management. Their software and central fare system can be interfaced with external systems or accept data files to validate institutional partners. STraffic’s Central System can also interface with other systems internal to transit agencies to support financial operations related to bulk sales.

Most vendors did indicate having tools to support specific institutional or employer programs. These systems are configured according to customer requirements, including different types of fare value, or ticket types. With these special programs in place, partners can fund or subsidize specific trips, ultimately creating more affordable options than buying individual passes. Furthermore, vendors also enable agencies to administer the sale and distribution of these cards or passes internally.

Back office integration

Many AFC systems can integrate their back-office systems with third-party applications to extend the capabilities of their overall solutions. This type of integration occurs via an Application Programming Interfaces (APIs). APIs for AFC systems are typically proprietary to the vendor, although in other technology applications (e.g. CAD/AVL), there has been a move to standardize some APIs (e.g. GTFS). APIs are typically defined by the primary provider or SI of the AFC system.

Most vendors described potential integrations through their current back-office system, specifically as it relates to integrating Customer Relationship Management (CRM) and Point-of-Sale (POS) solutions. Scheidt & Bachmann (S&B) noted that efficiencies can be gained from the integration of Customer Relationship Management (CRM) systems used to support help desk agents.

Customer self-service portals are also common among these vendors' solutions, through integrations using open APIs. Some of the vendors indicated they use the same APIs internally between applications as they do for integration with third parties, which ensures a greater degree of robustness in the API's capacity to deliver a wide range of functionality.

Technology performance and system monitoring

One of the emergent themes from the peer agency review is that many agencies grapple with how to best monitor system performance. Vendors stressed the importance of testing during implementation. Burn-in periods, whereby systems are operated in a beta stage for 1-3 months, are also an effective process to ensure the longevity of performance.

Most smaller vendors also referenced utilizing third-party monitoring tools, in contrast to the larger vendors that tended to have proprietary monitoring software as part of their overall solution (although some also offered third-party monitoring applications). Cloud-hosting is an effective tool to maintain a high level of system performance, as it ensures that there is a redundancy of server infrastructure to withstand hardware issues, and it provides for rapid scaling to support short- and long-term changes to loads. Nearly all responding vendors offer a cloud-hosted solution. An additional benefit is that third-party cloud hosting services also typically have applications to monitor system-uptime.

For many transit agencies, system performance has been associated with contract payments. These are typically defined in service level agreements (SLAs) between the agencies and the vendors. Nearly all vendors relayed the accepted best practice of deducting a percentage of maintenance fees based on unmet key performance indicators (KPIs). One vendor (Vix) indicated that their typical SLA involves waiving the deduction if they exceed a KPI for three months after resolving issues. This can serve as an incentive to quickly resolve issues.

System maintenance and enhancement

Effective system maintenance and enhancement processes are critical to ensuring the AFC system is kept up to date and performs smoothly with minimal downtime and maximum security. Robust

procedures taken by the vendor to maintain the system enable the agency to confidently perform its day-to-day operations without issue. System enhancements enable the agency to provide services that meet changing customer needs and ensure the agency benefits from the latest innovations in technology.

The following specific insights were notable as offered by the vendors regarding system maintenance and enhancement:

- Cubic continually maintains and upgrades security tools for monitoring network protection, device operating system patching, and various other logging tools to keep the field and the network protected.
- Bytemark uses rolling application development for maintenance and upgrades to support zero downtime. Bytemark also performs infrastructure and application security scans regularly, actively monitoring its infrastructure and application for both performance and security risks.
- Vix emphasized the importance of a robust testing process, including where possible, the use of automated test scripts, to ensure that changes rolled out do not impact operations or have unintended impacts on other components of the system.
- Masabi’s SaaS platform enables them to make enhancements to all clients, and FAIRTIQ leverages cloud services (e.g., AWS) for scalability and reliability.
- Ridango and VenTek discussed development strategies to promote flexibility. Ridango’s focus was on open-source software, while VenTek promoted modular hardware design and components.

Key Takeaways from Responses

Responses from the RFI can be categorized into two distinct topics: Business process, policies, and approach recommendations based on lessons learned and best practices; and technology recommendations for modern fare collection solutions.

Business processes, policies, and approach

Establish strong governance before issuing a request for proposals

Noted by vendors as a critical item for the success of regional fare collection implementations was establishing a strong governance model between all agencies that includes clear decision-making processes, documentation of all business rules, and the development of testing, change management, and communication plans to support system transition. Multiple vendors noted that having interagency agreements and the governance structure agreed upon before going out to market for a fare collection system is the most important thing in integrating multiple service providers into one fare collection solution.

Simplify fare policy to better take advantage of account-based systems before selecting the technology

Many vendors noted that overly complex fare policies are often the result of agencies being unwilling to abandon solutions that were developed based on card-based technologies. Account-based fare collection solutions provides agencies with the opportunity to simplify their fare policies and take full advantage of new technology. As one vendor put it “...just because you can, doesn’t mean you should.” Unclear or extraneous fare policies were often identified as key cost drivers during project implementation, with many vendors noting that the complexity of fare policies are

hard to estimate and discord across a region has an exponential impact on the ability to efficiently rollout a new fare system.

Establish a strong project implementation team with clear roles and responsibilities

Overall project management, establishing clear roles and responsibilities, and having active engagement by the agency were cited as the key elements for success. Vendors noted that project delays, and ballooning costs could often be traced back to ambiguous or changing system requirements. Having a project team made up of representatives of each impacted department across the agency, from initial development of system requirements and on an ongoing basis, was noted as a key factor in keeping the project on-schedule and minimizing surprises during implementation.

This recommendation extended to all parties involved in the project, with all vendors recognizing the importance of clearly identifying each vendor's role and responsibility within the project. This is often most critical when integrating with legacy fare equipment or components. Adequately resourcing the project from both the agency and vendor sides inherently leads to better collaboration and problem-solving, especially when coupled with strong communication across the entire project team.

Technology solutions

Implement a modern fare collection solution with robust open architecture requirements

Modern fare collection solutions include an account-based backend with open payment support and varying levels of open architecture. While open architecture varies amongst vendors, the lack of openness was commonly acknowledged as a key issue when integrating across multiple solutions or vendors. As noted earlier, robust requirements around open architecture will help mitigate these issues and provide ongoing flexibility in the future.

Although most of the respondents stated that they support open payments, vendors were inconsistent in demonstrating an understanding of transit-specific challenges. This is most evident in the lack of fare inspection solutions designed to support open payments.

As noted in both the data section as well as the technology innovations, data is a key component to modern fare collection solutions. Agencies should expect, and require ownership of their data from fare systems, with the ability to access and query data as needed. While data partitioning across regional solutions may be challenging, many vendors support this while also offering comprehensive data analysis tools such as Tableau and Power BI (two of the most popular BI tools in the market).

Apply a Customer-centric approach that focuses on the customer experience, and self-service functions

Account-based solutions provide many opportunities to allow customers to take control of fare payment management by offering improved self-service functions previously unavailable to them. While agencies may want to impose limits on the level of self-help, customer friendly solutions, such as virtualizing close loop fare media in mobile wallets, greatly expanding retail networks, and providing customer-friendly mobile apps and websites, empower customers and improve their experience by making transit simple and easy to use.

Attachment 3 – Fare Collection Peer Agency Review and Interview Summary

Peer Review Summary TTC 10-Year Fare Collection Outlook

Presented To:

Toronto Transit Commission (TTC) and York Region Transit (YRT)

Prepared By:



April 2021

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Appendix A: Deep Dive Topics

Appendix B: Minutes from Peer Agency Meetings

Introduction

The Toronto Transit Commission (TTC) and York Region Transit (YRT) are developing a 10-Year Fare Collection Outlook to inform decisions related to the introduction of new Automated Fare Collection (AFC) systems over the same period. The work is being developed in parallel to a 5-year Fare Policy Strategy for the two agencies. Together, these initiatives ensure that future technology decisions can further fare integration between the two agencies while simultaneously ensuring accurate revenue collection and broader application of fare policies.

Understanding best practices and lessons learned in fare collection will help TTC and YRT chart a successful course to modernize their AFC systems. Peer review interviews were conducted with six agencies across North America. This document summarizes the best practices and lessons learned from these peers.

Agency identification and information gathering

An initial ranking of thirty-three candidate agencies was presented during the Peer Review Workshop to TTC and YRT. From there, the candidates were narrowed down to six peer agencies based on agency characteristics, fare collection system features, technology innovation, and applicability to TTC and/or YRT. The six peers are highlighted in the image below.



Figure 1: Peer agencies selected for review (*Toronto not interviewed)

Overview of Peer Agencies

The six peer transit agencies selected for review all operate bus and rail routes and offer similar fare products. The peer transit agencies have AFC systems of varying ages and maturity. A brief overview of each peer agency interviewed is provided below:

- **Chicago Transit Authority (CTA):** The CTA implemented its first card-based smartcard system with Cubic in 1997 and introduced its open payment, account-based Ventra system in 2013. In 2015, Ventra launched a mobile application. With the mobile solution, users can register and manage their accounts, purchase tickets, and load products and value to their Ventra account. The Ventra white-label debit card being issued by the agency was discontinued in 2018 and replaced by a standard MIFARE closed-loop contactless card. The mobile application was upgraded in 2020 to allow users to use a virtual Ventra card via the Apple Pay Wallet.
- **Vancouver, BC TransLink:** TransLink's smart card solution, Compass, is provided by Cubic and launched in 2015. Compass works on all modes of transit and is required to use their highly popular SkyTrain rail service. In 2018, the system began accepting contactless bank cards, which allow riders to pay-as-you-go without needing a compass card, making TransLink the first Canadian transit agency to accept contactless EMV cards (a.k.a., open payments). TransLink also rolled out Compass wristbands which are wearable Compass card alternatives. Compass is well-regarded and achieves high satisfaction scores from customers, with a 96-97% adoption rate among riders.
- **Massachusetts Bay Transportation Authority (MBTA):** The MBTA launched its first card-based AFC system in 2006 with Scheidt and Bachmann (S&B) for all transit modes in Greater Boston. In 2018, MBTA awarded a contract to replace their existing AFC solution to Cubic. The upgraded AFC solution is account-based and will support virtual cards (in mobile wallets), contactless EMV, and agency-branded closed-loop cards. The two AFC systems will operate in parallel until customers transition fully to the new system.
- **Washington Metropolitan Area Transit (WMATA):** WMATA uses a smartcard solution, SmarTrip, developed by Cubic and implemented in 1999. At the time of implementation, it was the first smartcard AFC system in the U.S. WMATA recently contracted with Cubic to bring virtual SmarTrip cards to mobile wallets. The Apple version of this virtual Near-Field Communication (NFC) card launched in September 2020, with its Android counterpart still in development.
- **Los Angeles County Metropolitan Transportation Authority (LA Metro):** LA Metro introduced the Cubic-provided Transit Access Pass (TAP) card in 2008. In 2017, the agency performed an upgrade to include various APIs to support the integration of new third-party equipment and systems, and partnerships with external mobility providers. In 2018, LA Metro contracted with Salesforce to implement TAPforce, which added an account-based layer that introduced the TAPforce wallet and the NextFare wallet. Riders can fund either wallet from the TAP mobile application or through a broad retail network. In 2019, a virtual card was made available for Apple users that allows riders to pay with their iPhones or Apple Watches. LA Metro has also been developing Mobility-as-a-Service integrations to use the TAP Card on bike share.
- **Tri-County Metropolitan Transportation District of Oregon (TriMet):** TriMet uses an account-based, open architecture AFC solution provided by INIT. The system supports reloadable closed-loop DESFire smartcards and limited-use paper smart tickets. It has been expanded to support contactless EMV and was the first agency in North America to support NFC-based virtual cards in both Android and iOS mobile wallets. The system leverages real-time fare calculation to ensure fares are accurately collected.

A summary of the agencies is detailed in the following table.

| AFC Brand Agency | Number of operators | Service modes | 2019 Average daily ridership | Fare structure |
|---|---------------------|------------------|------------------------------|---|
|  Chicago Transit Authority (CTA) | 3 | Bus, Rail | 1.47m | Flat fare and distance based on Metra (Commuter rail system) |
|  Vancouver TransLink | 3 | Bus, Rail, Ferry | 1.4m | Flat and zone-based. The agency is trying to transition to distance-based |
|  Massachusetts Bay Transportation Authority (MBTA) | 11 | Bus, Rail, Ferry | 1.23m | Flat and zone-based for commuter rail only |
|  Washington Metropolitan Area Transit (WMATA) | 13 | Bus, Rail | 1.22m | Distance-based |
|  LA Metro | 26 | Bus, Rail | 1.21m | Flat for buses and Zone-based for rail |
|  Portland TriMet | 3 | Bus, Rail | 308k | Flat fare |
|  Metrolinx PRESTO | 11 | Bus, Rail | 2.7m | Flat fare for agency partners and distance-based for GO Transit |

Interview Topics

During the initial project workshops, stakeholders identified several detailed questions and topics to explore with the peer agencies. These questions and topics were grouped into two key parts: Program Lifecycle and Fare Collection System Features, and a questionnaire was developed to guide the interview. The Program Lifecycle questions focused on overall system procurement, implementation, operations, integration, and innovations while the Fare Collection System Features questions focused on specific technological features of the system. The list below identifies the core question topics discussed during each interview.

- Part 1: Program Lifecycle
 - System procurement
 - System implementation
 - System operations
 - Impacts of reducing cash in the system
 - Regional system integration

- Future plans for fare collection
- Part 2: Fare Collection System Features
 - Open architecture
 - Contactless EMV cards (i.e. open payments)
 - Account-based system implementation
 - Mobile payment solutions
 - Mobility as a Service (MaaS) implementation

Project stakeholders identified four areas of interest. These topics were explored in more detail as "deep dives" and include insights from agencies beyond the peer interviews.

- Utilizing open architecture
 - Best practices and trending innovations from the industry, including a focus on open architecture
- Leveraging open payment solutions
 - Allowing riders to tap contactless EMV payment cards at the validator
- Implementing AFC solutions
 - Insights and challenges with implementing account-based fare collection solutions
- Driving adoption through policy
 - Leverage fare policy to driving AFC adoption

These deep-dive topics are included in Appendix A and provide best practices, the direction the industry is heading direction, and lessons learned from agencies worldwide.

Part 1: Program Lifecycle

System procurement

Identifying the best solution for an agency is complex with many external factors. Some agencies choose to upgrade and stay with their existing vendor, while others decide to move to completely new systems and vendors. When peer agencies were asked about system procurement drivers and processes, the answers varied based on multiple factors that were unique to each agency, but three common elements drove agencies to their final decision:

- Schedule
- Budget
- Customer experience

Many agencies spoke about expanding customer features and improving the customer experience as a key motivation for their procurement decision. Most peer agencies have existing, mature solutions with high smartcard adoption and are working with their existing vendor to upgrade or add new customer-focused features.

In the case of WMATA, they worked with their existing vendor to bring mobile NFC-based virtual cards to their riders. As their existing solution is quite mature, WMATA wanted to provide customers with more modern solutions without disrupting their existing smartcard solution. By working with their existing vendor, they were able to roll out a mobile solution for their card-based implementation quickly. This mobile solution allows riders to provision a SmarTrip virtual card in the Apple Pay wallet as a new form of fare media.

CTA has also engaged in a significant upgrade project with the existing vendor. In addition to providing a seamless experience for their riders, the agency is upgrading Ventra to provide an open

architecture solution that enables third-party integrations to move away from a proprietary solution beholden to a single supplier. By migrating to an open architecture solution, CTA will offer newer features and services to their riders with minimal disruption to current operations, and minimal involvement needed by their AFC vendor.

Procurement process

Peer agencies (CTA, WMATA, TransLink and LA Metro) upgrading or adding features and services to their solution are working on older, well-established smartcard solutions. Agencies that have recently decided to procure new AFC solutions or replace their existing solution provided insights and lessons learned for their recent procurements. Some agencies opt to have a single supplier responsible for the entire project, beginning to end. This approach provides a sense of security and, in many cases, can simplify the oversight required by the agency and allow for a faster implementation. On the other hand, it can limit the scope of the solutions available, requiring the agency to accept whatever weaknesses the supplier brings with them.

TriMet and LA Metro are utilizing multiple procurements and vendors and believe that this led to greater openness, collaboration and fostered competition amongst vendors that directly benefited the agencies. This process allowed agencies to select the "best of breed" for various system components with maximum flexibility. While this approach provides an agency much greater control over the end product, it also creates a much more complex project to manage. In almost all the examples explored, the agency became the de facto system integrator, managing multiple contracts and the technical integration between the various suppliers.

Key takeaways – System procurement



- ✓ **Manage expectations and timelines by sharing realistic overall timelines for procurement and implementation with leadership.**
- ✓ **Build a negotiation phase into the procurement process to allow for refinement of terms and avoid vendors committing to requirements they never intended, or are unable, to deliver.**
- ✓ **Engage a diverse group of project stakeholders during the requirements development and system procurement process to ensure that everyone's needs are considered.**

Figure 2 – Key takeaways related to system procurement

System implementation

Many legacy and modern AFC solutions are designed and developed using a waterfall approach, whereby all components of the system must be in place and feature-complete to launch. This structure can easily create a situation where dependencies between the various components compound and ultimately lead to schedule delays. In a worst-case scenario, this results in an already out-of-date solution when it launches to the public.

To address the rapid progression of technology and the need to tackle complex problems without established solutions, some agencies have transitioned to requiring suppliers to adopt some form of agile design and development with a phased delivery approach. This introduces new components and features incrementally, allowing systems to be built with fewer dependencies and, therefore, less risk, while delivering new technology advances throughout the deployment.

Unanticipated delays

Peer agencies' most significant challenge was two-fold: shifting project needs from the agency; and system vendors being ill-equipped, in structure and culture, to adopt a more flexible design and development approach. Given this, some agencies opted to define a transition plan built on phases (i.e., series of waterfalls), which provides many benefits of an agile approach without fundamentally changing (and adding risk to) how suppliers deliver these projects. While agencies have seen success with this approach, it puts the responsibility on the agency to have a clear deployment plan and communicate that plan to the supplier very early in the project. In discussing lessons learned, agencies noted that a knowledgeable project team, and establishing the project as a clear priority for the agency and its executives, were instrumental in mitigating delays. Depending on the type of project and approach, agencies noted the need to support legacy systems throughout the new system's implementation for several years.

Key takeaways – System implementation



- ✓ **Prioritize the implementation within the agency to effectively move the project forward.**
- ✓ **A knowledgeable project team (for both the vendor and agency) is critical to successful implementation of large fare technology projects.**
- ✓ **Business process reviews and extensive public outreach should be undertaken early on and staff should be included in re-engineering these processes to fit the new system.**
- ✓ **Early and frequent communication throughout the project helps stakeholders understand why decisions are being made and how it will impact them.**

Figure 3 – Key takeaways related to system implementation

System operations

The system operations topic looked at three key areas:

- The operational model used by the peer agency
- Access to and use of data generated by the solution
- Performance monitoring and key performance indicators for the solution

Operational Model

Peer agencies had a mix of operating solutions for their systems. Still, most agencies included a model where the vendor operated and maintained the system at varying levels, ranging from minimal to full operations and maintenance.

Access to data

Agencies generally had direct access to the data provided by their vendors through canned reports or data warehouses. Most agencies found the canned reporting sufficient, but almost all agencies still regularly mined data separately for executive reporting, research, internal or regional customer needs, and other regular agency needs. Some agencies, like MBTA, noted that it was challenging to obtain training from the vendor in order to access and analyze data regarding logs in devices, tap data, and sales data.

Monitoring vendor performance

Each agency had varying approaches to measuring and ensuring the performance of their fare collection systems. While most agencies relied on vendors to self-report regarding system

performance, LA Metro and TriMet took a proactive approach to obtain information about system performance, rather than relying on the vendor to inform the agency of system issues. The agencies set up an alert system that informs an agency of the system's health and Service Level Agreements (SLAs) that provide the agency an indication of system performance. CTA and MBTA enforce system performance by deducting penalties from established operations payments, based on unmet Key Performance Indicators (KPIs), and setting up a variable penalty through adjusted SLAs on system performance.

Key takeaways – Operations



- ✓ **Agencies should consider establishing independent monitoring processes that do not require vendor input.**
- ✓ **Real-time system performance should be monitored using an alert system and dashboards.**
- ✓ **Ensure the contract allows for penalties based on unmet Key Performance Indicators (KPIs), or variable operation payments tied to SLAs, which are adjusted based on system performance.**
- ✓ **Build a data warehouse that enables agency staff to query system data and generate their own reports.**

Figure 4 – Key takeaways related to operations

Impacts of reducing cash in the system

Increasing the AFC solution's adoption rate was identified as a key business goal for almost all agencies. Several took significant steps to boost adoption of their AFC solution to 70% or higher. These steps included free card give-away programs, free money or funds loaded to cards, customer outreach combined with ticket exchange programs, and a rapid and extensive expansion of their retail network. LA Metro enabled ticket exchanges for customers to mail-in tickets or come in-person to exchange their paper tickets for electronic fares at common spaces like libraries. TransLink provided free cards with five dollars in loaded value, and continues to offer 20% discount over cash on single trip fares. MBTA noted that successful customer transition was attributed to effectively allowing people to pay before they board, leveraging an extensive sales network, and implementing a reliable inspection program.

Agencies also incentivized using smartcards by only offering specific products or even transfers on smartcards. To boost the adoption rate, agencies advised that a common best practice was requiring customers to use smartcards to transfer to gated rail systems. Gated systems proved to be very effective in increasing the adoption rate with LA Metro ranging from 60-70% on the bus and 100% on rail (where faregates were installed). CTA also gated their rail system and reported a 96% adoption rate.

In 2020, many agencies noted that they briefly paused acceptance of cash onboard in response to COVID-19. LA Metro is considering going fareless, while others encouraged riders to smartcards or mobile ticketing. Agencies are still trying to understand the lasting impact the pandemic will have on cash within the system.

Goals to reduce cash in the system

There was an even split among the six peer agencies regarding goals of reducing cash in their system. Half the agencies noted that they had initiatives to reduce cash in their system. These initiatives included requiring smartcards for transfers to rail service (LA Metro and TransLink) and initiating a cashless pilot with rear-door boarding (WMATA).

TriMet, CTA and MBTA noted that they did not intend to go "cashless" or are actively working to reduce cash in their system due to social equity considerations of cash-reliant customers. However, MBTA stated that its goal is to move the process of accepting cash off-board by building out an extensive sales network, including a retail network and Ticket Vending Machines (TVMs), to limit onboard cash handling and achieve operating efficiencies.

Key takeaways – Reducing cash in system



- ✓ **To increase adoption rates, require customers to use smartcards to get the benefit of transfers or access to certain fare products.**
- ✓ **To limit on-board cash handling, build out an extensive sales network, which may include retail outlets and TVMs.**
- ✓ **Some agencies do not intend to reduce cash in they system due to social equity considerations around meeting the needs of cash-reliant customers.**

Figure 5- Key takeaways related to reducing cash in the system

Accessibility and equity

The peer review revealed various best practices to improve accessibility and equity of AFC systems. Involving the accessibility department early on, as MBTA did, was reported to yield significant downstream benefits. MBTA also stated conducting user testing with people with disabilities helped the agency to understand their needs and barriers of the current system. MBTA's key accessibility features included ensuring the readers are located in a way to not block passengers in wheelchairs and installing two readers at each door at a reachable location.

Agencies identified two best practices for managing the payment needs of low-tech or low-income customer groups. Expanded retail networks enable cash-paying customers to access and load smartcards at retail locations. Agencies also noted the development of programs to support low-income customers through subsidized transit products, although no additional details were provided about the programs.

Key takeaways – Accessibility and equity



- ✓ **Engage the agency's accessibility department early in the project.**
- ✓ **Conduct user testing with people with disabilities to understand their needs and barriers of the current system.**
- ✓ **Expand retail networks to enable cash-paying customers to access and load smartcards at retail locations.**
- ✓ **Implement subsidy programs for low-income customers.**

Figure 6- Key takeaways related to accessibility and equity

Regional system governance

Cohesive, regional systems that offer seamless transfers and operation across different operators within a region is a critical element of a successful customer experience. There were variations in the way in which agencies managed multi-operator implementations and operations. While some regions use a joint governance model, with all regional operators having an equal role in system operations and oversight (ranging from eight to twenty-six operators), other agencies, like CTA and MBTA, manage the system for the entire region, and set up agreements for operations cost-sharing and purchase fare equipment (readers and vending machines) from the same vendor.

Institutional and paratransit programs

Of the agencies interviewed, half indicated that their AFC vendor supports their institutional programs. These programs often include separate portals for the various programs and rely on businesses or institutions taking on a greater level of responsibility for program/benefit management. Overall, most agencies acknowledged that AFC vendors could support basic institutional programs, but agencies that have more complex solutions were typically only able to support a subset of the desired functionality. TransLink noted that they struggled with the ability to make bulk sales, a critical component of their institutional programs. Of the agencies interviewed, half stated that their AFC system is integrated with their paratransit service. Some of the key reasons this was not done included policy, space onboard vehicles, and vendor limitations or unwillingness to support the integration.

Key takeaways – Regional system



- ✓ **Regional fare system integration provides a real benefit to customers in large metropolitan regions.**
- ✓ **Establish clear governance structures (joint governance or lead-agency models) among partners to define operating responsibilities, cost-sharing, and the purchase of fare equipment (readers and vending machines).**
- ✓ **Plan on working closely with vendors to design and implement institutional programs and paratransit integrations for AFC solutions.**

Figure 7 - Key takeaways related to integration with regional systems

Future Plans

Many of the agencies interviewed have an existing solution that was implemented over five years ago, and some have systems over 10-years old, yet all agencies expressed a desire to continuously modernize their AFC systems and provide feature-rich solutions and options to their riders. Agency responses for short- and long-term plans varied dramatically – with some agencies planning to have a long-term relationship with their current vendor, while others shared concerns about their vendor's ability to expand with the agency. Common future plans for peer agencies include:

- Leveraging contactless EMV to tap and pay for rides.
- Replacing aging fare equipment such as fareboxes and faregates to maintain a state of good repair.
- Expanding sales channels (e.g., website, call center, mobile app for cash payments, retail network, and other solutions).

Agencies like TransLink and CTA plan to transition to an open architecture solution, which can be a significant undertaking for the agency and vendor, and may trigger equipment refreshes in support of the open architecture approach.



Key takeaways – Future plans

- ✓ **Agencies are continuously improving their system and expanding features and functionality.**
- ✓ **It is important to have a good working relationship with the vendor to jointly tackle innovations and changes.**
- ✓ **Several agencies are shifting to an account-based system, while leveraging a hybrid system as an intermediary step.**

Figure 8 - Key takeaways related to future plans to improve fare collection systems.

Part 2: Fare Collection System Features

Open architecture

One common element identified during the peer review interviews was that all agencies are actively working towards or currently have some level of open architecture in their solution. The key to open architecture is agency ownership and control over the interfaces used to integrate the various system components, commonly known as Application Programming Interfaced (APIs). As there are no widely accepted standard interfaces supporting AFC systems, APIs are supplier-developed and tailored to the delivered system. However, the "proprietary-to-the-system" nature of the APIs does not diminish a system's open architecture, so long as the agency retains the rights to use and distribute the APIs to third parties as they see fit. In this way, open architecture is as much a contractual issue as it is a technical one. All systems are built using software interfaces, so even a legacy system, with less modern interface designs, can technically become open architecture, so long as the agency gains access to the interface specifications.

The trend towards an open architecture has become so common that all major vendors in the industry provide APIs to their backend. This movement is based in part on agencies' desire to enable "best of breed" selection among suppliers and the system components they provide. Open architecture APIs provide the glue that allows components and services from multiple suppliers to integrate into a single central back office. As discussed in the system procurement section, a multi-vendor implementation can complicate the deployment and put additional responsibilities on the agency to manage the integrations. Notably, this approach is not required to achieve an open architecture, as a single-supplier system can still have all the required interfaces defined and delivered as part of the implementation. CTA is currently working with their vendor to implement an open architecture. The existing plan requires the vendor to deliver APIs for all applications and functions provided by the existing system. As part of the upgrade project and shift towards open architecture, CTA is validating the APIs to ensure that all promised functions are supported and available for future use. TriMet issued multiple procurements for specific elements of their project, which used the implementation to validate that their vendor delivered comprehensive APIs.

In practice, it is critical to have the open architecture requirements clearly defined in the contract with the central system provider, prime contractor, or system integrator. Agencies should require APIs for accessing all core functions of the back office system and rights to distribute and use all provided interface specifications. Equally important, and critical to integrating any device that will interact with fare media (e.g., validators or TVMs), is that the agency retain the rights to all closed-loop card formats and all cryptographic security keys needed to read and write to the various media types. In total, this approach enables new devices, services, and partners to be integrated without vendor involvement and provides substantial flexibility for future expansion.

Key takeaways – Open architecture



- ✓ **Design the system to have open architecture, clearly defining what is required from the vendor, both contractually and technically.**
- ✓ **Regardless of whether separate procurements are leveraged for specific aspects of the project (e.g., retail, mobile, POS), have a robust plan to validate the vendor APIs for functionality and completeness.**
- ✓ **Require the AFC vendor to use their own APIs (“eat their own dog food”) to deliver all of the system functionality that is within their scope.**

Figure 9 - Key takeaways related to open architecture

Contactless EMV acceptance (i.e., open payments)

Open-loop payment, or simply open payments, refers to the acceptance of bank-issued contactless credit or debit cards to pay fares onboard vehicles and at rail stations. To achieve this, AFC systems support contactless EMV payments, including cards in mobile wallets (e.g., Apple Pay and Google Pay), and meet global interface and security standards. Open-loop payment services are governed by organizations such as Visa and MasterCard. They require any merchant (e.g., transit agency) accepting open payments to follow strict security requirements, the primary of which is the Payment Card Industry Data Security Standard (PCI-DSS). Meeting these standards can create challenges when attempting to inspect contactless EMV cards as part of fare enforcement.

Half the peer agencies interviewed support open-loop or EMV payments; however, the customer adoption rate is low, ranging from 2-5% for TriMet and TransLink. LA Metro noted that regional operators did not have much interest in open payments since they have mobile device solutions available.

With overall advancements in payment technology and the ever-expanding adoption of contactless retail payments, customer expectations around public transport payment transactions are evolving. Still, within public transport, cash payment onboard vehicles remains a common form of payment for many riders. From the transit agency's perspective, accepting open-loop cards can shift the behaviour of some customers and reduce the cost and effort associated with the cash collection and management of agency-issued closed-loop smartcards. Complete removal of cash or closed-loop cards can be difficult based on customer access to open payment bank cards and the ability to support transit-specific use cases, such as concession (i.e., discount) fares, group travel, and institutional (e.g., employer or school) programs.

Agencies primarily use open payments to provide a convenient payment option for customers who don't have or want to acquire agency-issued fare media. Open payments are particularly well suited to tourists, visitors, and infrequent riders and provide an attractive compliment, but not a

replacement, for other fare payment options.

Key takeaways – Contactless EMV cards



- ✓ **Adoption rate of open payments remains low (2%-5%).**
- ✓ **Fare inspection of open payments may be challenging and often requires the use of custom devices.**
- ✓ **Most agencies that have implemented mobile wallet closed-loop cards (i.e. NFC-based virtual cards) do not see a pressing need to support open payments.**
- ✓ **Most open payment solutions are unable to support all transit use cases (e.g., discount fares) and are therefore only a complement to other payment methods.**

Figure 10 - Key takeaways related to contactless EMV cards.

Account-based systems

Of the six peer agencies contacted, CTA, TriMet and MBTA (planned) have account-based solutions. The others (WMATA, TransLink, LA Metro) are card-based solutions. In an account-based ticketing solution, ticket information (i.e., stored value and passes) is stored in the back office, and the data on the fare media (e.g., card) remains relatively static, consisting primarily of an account number identifying a back-office account where value is held. System designs vary, but the most sophisticated account-based solutions support real-time fare calculation.

With real-time fare calculation the back office performs the following three steps within 500-750ms (typical):

1. Fully calculates the fare due
2. Debits the account (as necessary)
3. Responds to the frontend device with a fare payment result and all fare payment data (e.g., fare charged, product used, balance remaining, transfer time remaining, etc.)

If no response from the back office is received within a set period (typically due to network issues), the frontend device uses status lists to perform an “offline” validation response. Account-based solutions with real-time fare calculation mimic card-based solutions in terms of revenue assurance controls and data availability, but not all suppliers offer this capability by default. TriMet was the only agency that utilized real-time fare calculation. MBTA and CTA both include an account-based system, but rely on a near-real-time fare calculation solution that relies primarily on status lists for fare validation.

Regardless of the specifics of the design, all account-based systems must accommodate offline/back office response timeout scenarios. As mentioned in the previous paragraph, this is done through a variety of risk mitigation techniques, but relies primarily on lists of cards that should be accepted or denied entry (“risk lists”), which are distributed by the back office and stored locally at the devices. The least sophisticated account-based designs rely solely on these risk lists for real-time authorization, with the actual fare calculation occurring after a go-/no-go decision has been made. Because these risk lists cannot fully mirror the complexity of most agencies’ fare policies, compromises typically need to be made, which open agencies up to greater financial risk and a diminished customer experience.

Account-based systems are becoming increasingly popular for a variety of reasons:

- Flexibility – Complex business rules (i.e., fare polices) can be supported, and business rule changes are made only in the back office and take effect immediately.
- Immediate Access to Data – Value or pass purchases made online or via mobile are immediately available for customer use; fare payment transaction data can be viewed online shortly after the transaction takes place.
- Expanded Set of Payment Credentials – Different contactless credentials or “tokens”, such as school or employee IDs, can potentially serve as account identifiers linked to a back office account and used as payment media.
- Open Payments – Most account-based solutions can support the acceptance of contactless EMV (bank-issued credit and debit) cards for the payment of fares.

However, there are also several notable challenges with account-based solutions:

- Robust Communications – The heavy reliance on the back office for fare calculation and payment requires reliable, always-on, high-speed communications.
- Back Office Reliability – The back office system must include a robust, fault-tolerant design and be configured for high-availability with a fail-over and disaster recovery measures in place.
- Throughput – Online authorization of fare payments can result in slower fare payment transaction speeds at frontend devices.
- Customer Information – Especially with less sophisticated account-based solutions, customers are often presented with less information at the time of the transaction than in prior card-based solutions.
- First-Ride Risk – Denying entry to a customer due to insufficient funds is not guaranteed, particularly in less sophisticated solutions. It is generally accepted that there is a liability of at least a single ride each time a new piece of fare media is used.

Key takeaways – Account-based systems



- ✓ **Account-based solutions provide a range of flexibility and benefits to agencies. Most all agencies are migrating their system to be account based, or include account-based features and functions.**
- ✓ **Account-based solutions that support real-time fare calculation provide both the superior revenue assurance and customer experience of card-based systems, while also delivering next-generation payment options and features.**

Figure 11 - Key takeaways related to account-based system

Mobile payments

Globally, smartphone penetration is close to 46%, with developed countries closer to 80% (Statista, 2021). To capitalize on this, most agencies either offer or are planning to provide a mobile payment solution for their riders. This is typically separated into mobile ticketing and mobile virtual cards. For mobile ticketing, these are often stand-alone solutions that are not integrated with the AFC backend. For mobile virtual cards, APIs are designed to support NFC virtual cards and some level of account management.

NFC Closed-Loop Payments (Virtual Cards)

Closed-loop credentials stored in a Near Field Communication (NFC) based mobile wallet was popular with the agencies – all agencies are offering or planning to have a virtual closed-loop card at

some point. The NFC-based closed-loop card in a mobile wallet is commonly referred to as a "virtual transit card."

A virtual card solution can bring a particular set of benefits to legacy card-based systems by providing a new mobile app sales channel that enables customers to immediately load value to their virtual card using their mobile phone, solving one of the greatest challenges of card-based systems – the delay associated with performing loads remotely (via mobile and online). For these reasons, agencies operating legacy card-based systems like LA Metro and WMATA have opted to rely solely on a virtual card solution to provide customers next-gen functionality.

Flashpass/QR Code Mobile Ticketing

Mobile ticketing has traditionally been used as part of an initial transition from manual ticketing (e.g., paper, cash or token) to automated fare collection. More recently however, mobile ticketing is being used to supplement legacy card-based AFC solutions. Flashpass mobile ticketing relies on visual validation while QR code mobile ticketing has QR code for electronic validation and inspection while still retaining components to allow for visual validation. Flashpass and QR code mobile ticketing differs from virtual card, as it does not require complex integration with mobile wallet providers, and can easily support multiple modes of transit, including commuter rail, which in most cases still relies heavily on visual inspection. Half of the peer agencies use mobile ticketing. Most notable is that TriMet initially offered mobile ticketing, but retired their solution once they fully launched their android- and iOS-based virtual card solution.

Key takeaways – Mobile payments



- ✓ **All the agencies have enabled mobile payment for customers.**
- ✓ **Mobile payment has been enabled in various forms, including through mobile ticketing, NFC-based virtual cards, and open payments.**
- ✓ **All agencies are offering or planning to have a virtual closed-loop card solution.**


Figure 12 – Key takeaways related to mobile payments

Mobility as a Service (MaaS)

Mobility as a Service (MaaS) combines payment and trip planning across mass transit and other transportation modes (e.g., bikeshare, scooter, rideshare, carshare), typically including both public and private mobility service providers. For many, the goal of including integrated services is to shift customer behaviour from personal vehicles to shared mobility services. This often correlates with transport authority sustainability goals, with many in the industry believing that public transport serves as the key to successful MaaS solutions. Agencies pursuing multi-modal and integrated services often have an approach focused on open data/open systems in order to encourage innovation and initiatives that enable mobility providers to integrate into agency-owned payment and trip planning platforms.

MaaS-related questions explored AFC system integration with third-party mobility providers and if they offered payment at retail locations. The peer review revealed that bikeshare was a popular MaaS offering across agencies. Smartcards are integrated with the bikeshare programs to enable customers to lock and unlock bikes and receive discounts, but full-scale payment integration has not been achieved. Other MaaS integrations by some of the agencies include successful pilots with

rideshare and trip planners.



Key takeaways – MaaS

- ✓ **Bikeshare integration is the most common MaaS innovation reported by agencies, although integrated payment is not always supported.**
- ✓ **Agencies are also piloting other MaaS integrations, including with rideshare and integrate trip planners.**

Figure 13 – Key takeaways related to MaaS

Peer Agency Trends

The figure below provides a high-level overview of the trends the surveyed peer agencies have either implemented, or are planning to implement, as part of their system deployment. The trends look at product types, fare media and key AFC features.

Product types

Product types include the different types of products available for riders to add to their card or account. These include:

- Stored value – dollar amount added to a card or account wallet/purse.
- Rolling passes – pass product that is good from the time it is validated for a set timeframe (e.g., 14-day rolling pass).
- Period passes – these are also known as calendar passes and are only good for a specific date range, regardless of when the product was purchased or activated (e.g., April monthly pass).
- Fare capping – used primarily in conjunction with stored value or open payments, this allows users to “earn” a pass based on their actual trips rather than pre-paying for a product.

Fare media

Fare media includes electronic and physical cards:



- Physical – normally an agency branded closed-loop card. This could be a card meant for continued and frequent usage (e.g., Extended use cards are durable, plastic cards) and cards meant for limited or one-time use (e.g., limited use cards are often paper or thin, flexible plastic) and are not as durable for continued usage over several days or weeks.
- Mobile NFC cards – electronic cards using near field communication that can exist within the mobile wallet (e.g., Apple Pay, Android Pay) and allow riders to use their phone to the validator.
- Contactless EMV cards – also known as open payment, or contactless bank issued cards. These are Visa, MasterCard, Discover, American Express, etc. branded cards that link directly to a credit or debit account.

AFC features

This section focuses on some of the most common features and known trends for the industry:

- Account based – rather than value being stored and written to the fare media (e.g., card) the card is a token that accesses the rider’s account (much like a debit card is connected to a savings or checking account).
- Open architecture – leveraging APIs to support functionality within the backend system that can be managed and exposed to 3rd parties for flexible integrated solutions.
- Mobile applications – provides riders with a mobile app to manage their AFC account (e.g., load value, check balance and ride history, etc.).
- Retail partnerships – partnering with retail network provider (e.g., Incomm, Blackhawk, Ready Credit, etc.) to provide an expanded network of stores for fares.
- 3rd party integrations – this item specifically relates to partnerships with other mobility providers like bikeshare, scooters, ride-hailing and trip planning that allows riders to plan, book and pay for mobility services.

| | | CTA | TRANSLINK | MBTA | WMATA | LA METRO | TRIMET |
|---------------|------------------------|-----|-----------|------|-------|----------|--------|
| PRODUCT TYPES | STORED VALUE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | ROLLING PASSES | ✓ | | | ✓ | ✓ | |
| | PERIOD PASSES | ✓ | ✓ | ✓ | ✓ | | ✓ |
| | FARE CAPPING | | | | | | ✓ |
| FARE MEDIA | PHYSICAL CARD | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | MOBILE NFC CARDS | ✓ | ✓ | | ✓ | ✓ | ✓ |
| | CONTACTLESS EMV CARDS | | ✓ | | | | ✓ |
| AFC FEATURES | ACCOUNT-BASED | ✓ | | 🕒 | | | ✓ |
| | OPEN ARCHITECTURE | 🕒 | ✓ | 🕒 | ✓ | ✓ | ✓ |
| | MOBILE APP | ✓ | ✓ | 🕒 | ✓ | ✓ | ✓ |
| | RETAIL PARTNERSHIPS | | | | | ✓ | ✓ |
| | 3RD PARTY INTEGRATIONS | 🕒 | ✓ | 🕒 | | ✓ | 🕒 |

 Currently available
  In development

Peer Agency Review Conclusions

Implementing technology and payment projects is not easy. Each project examined had its own share of challenges and wins. During the peer agency interviews, agencies acknowledged not just what could have been improved, but also what worked well. These findings are summarized below.

Define and document a business case that addresses internal goals and objectives, and follow it up with clear functional requirements

Many of the peer agencies took alternative approaches to defining the project. Some agencies included detailed technical specifications, while other agencies relied on industry suppliers to provide guidance on what to provide. Most provided a moderate blend of specificity and openness that allowed suppliers to determine “how” to achieve the described “what”. However, all successful projects had a common element: translation of the agency’s goals and objectives into clear functional requirements. If the business case requires features such as Fare Capping or Open Payments, these items must be functionally described in the RFP.

By example, MBTA entered into re-negotiations with their vendor to clarify functionality for key elements that were not as expected. Because the agency hadn’t clearly defined their own agency goals and objectives for the new system, and agency expectations continued to evolve around feature and functions, project design and development was delayed. Additionally, TransLink noted that there was a desire within the agency to modify the fare policy, but they were uncertain what to do because it was unclear what the system could support. In both cases, clarifying requirements upfront may have provided a smoother implementation.

CTA and LA Metro, on the other hand, carefully and intentionally approached their projects by clearly identifying the goals and objectives. Although there is a stark difference between the solutions, both projects included functional requirements that clearly reflected each agency’s business case. These different approaches show that no matter how well defined your technical scope is, business goals and objectives must be used to provide the framework for the new or updated system.

Don’t be afraid to make operational and policy changes that support agency goals and objectives

During the development of TriMet’s business case, while outlining the regional goals and objectives, they realized that achieving their goals required more than just technical solutions. To remove project obstacles, fundamental changes to how the agency operated needed to be made first. This included overhauling the agency’s fare collection process through operational, policy and governance changes to support the agency’s goals and objectives for the new fare collection system.

WMATA’s desire to provide riders with enhanced features and functions caused them to re-evaluate their priorities and the existing contract with their vendor. Prior to this, the focus of the AFC system was on maintaining their existing features and functions, by prioritizing the customer experience within the agency, they were able to make enhancements to the back office which allowed the agency to deliver customer-focused, next-generation features and functions.

Minimize migration issues by internally developing a detailed operational transition plan

Transitioning customers from legacy to new fare collection systems is often just as challenging for incremental system upgrades as it is for system replacements. Depending on the changes, a critical part of the project will involve a transition or migration strategy for customers. Many projects require the supplier to provide a transition plan; however, these tend to be heavily focused on hardware or device transition, and less focused on operational and customer impacts of the

transition. As part of the project objectives and goals, TriMet developed a detailed transition plan to migrate users from cash and paper tickets to the new electronic fare collection system. This plan was developed internally and clearly communicated across the entire agency. As a result, within 2.5 years, over 80% of all fare revenue is handled through the Hop Fastpass® system.

MBTA has a challenging job of incrementally replacing legacy hardware to transition to the new system. The agency has built a transition strategy into the project that focuses on phasing in hardware/device changes needed to support planned features and functions. The approach will require the agency to operate and manage both the new and legacy systems in parallel as riders are converted to the new system.

Understand the changing mobility landscape and decide what role the agency wants to play

Over the last decade, the mobility landscape has seen dramatic changes. Ride-hailing, bike sharing, electric scooters and car-sharing private companies have challenged traditional shared mobility concepts. Many public agencies were caught off-guard by popularity of private mobility services. Public transportation faced a new challenge. Not only were they fighting to maintain ridership, but now the old way of paying for mobility seemed antiquated and unfriendly to their riders. While the industry agrees that public transport is a fundamental player, if not the backbone of new mobility services, most public transport authorities do not know whether they want to become a manager or an operator within the mobility as a service (MaaS) landscape. Some agencies, like LA Metro and TransLink are actively working on pilot projects that will incrementally expand their payment services to directly integrate with private mobility solutions.

Deploy a feature-rich system that focuses on the customer experience system, so that people actually want to use it

All peer agencies have expanded fare payment options to include new solutions such as open payments and closed-loop virtual transit cards in mobile wallets. Several agencies, including LA and WMATA have deployed virtual fare media within their existing card-based solutions, greatly improving the customer experience. TransLink and CTA are working towards an upgraded back office that will leverage APIs to allow them to continuously and rapidly improve their systems, without customized development and increased operations and maintenance costs.

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2021

Jan

Feb

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Oct

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TTC Board Meeting Dates

★ Feb 10

★ May 12

★ Jul 7

★ Sep 15

★ Nov 17

5-Year Fare Policy

Phase 1: Situational Analysis

Current State Review & Emerging Insights

Customer Engagement (Online Survey, Customer Focus groups)

◆ Final Closeout of Phase 1

Phase 2: Future Direction

Develop Fare Policy Goals & Short List of Fare Options

Modelling & Testing of Fare Option Short

Customer Engagement (Online Survey, Customer Focus groups, External Workshop & Virtual Town Hall)

◆ Final Phase 2 Closeout

Phase 3: Development of the 5-Year Fare Policy

Develop Draft Fare Policy & Implementation Plan

Customer Engagement

◆ Final Phase 3 Closeout

10-Year Fare Collection Outlook

Phase 1: Situational Analysis

Automated Fare Collection RFI

Peer Transit Agency Reviews & Interviews

◆ Final Closeout of Phase 1

Phase 2: Future Direction

Device Refresh Planning

Gap Analysis & Refinement of Objectives

Viable Fare Collection Options & Recommendations

◆ Final Phase 2 Closeout

Phase 3: Development of Fare Collection Outlook

Develop Draft Implementation Plan of Preferred Options

◆ Final Phase 3 Closeout

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