ASSESSMENT OF MOBILE FARE PAYMENT TECHNOLOGY FOR FUTURE DEPLOYMENT IN FLORIDA

FDOT

Assessment of Mobile Fare Payment Technology for Future Deployment in Florida

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Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Florida Department of Transportation or the U.S. Department of Transportation.

The authors do not endorse products from any vendors. Products illustrated in the report are used as examples of available technology.

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Executive Summary

The Florida Department of Transportation (FDOT) is conducting a two-part research study to evaluate the efficacy of deploying a mobile phone fare payment system at a transit agency in Florida. FDOT selected StarMetro as the pilot agency. This final report describes tasks conducted for Phase I of the study. The goal of Phase I was to provide FDOT with a framework for the implementation of a future mobile payment pilot with a Florida transit agency. Phase II will deploy and evaluate the pilot at StarMetro.

The first task of Phase 1 reported on an industry scan of mobile phone fare payments. To collect and disseminate lessons learned from deployments in transit agencies nationwide, the research team selected the following five transit systems for interviews:

(a) Dallas Area Rapid Transit (DART), TX, (Vendor: Unwire)
(b) New Jersey Transit, NJ (Vendor: Xerox)
(c) Nassau Inter County Express (NICE), NY (Vendor: Masabi)
(d) Central Midlands Regional Transit Authority, Columbia (COMET), SC, (Vendor: Passport)
(e) Chicago Transit Authority (CTA), IL, (Vendor: GlobeSherpa)

Lessons learned from these interviews included:

- The development of specifications and solicitation documents is a complex and technical process. Significant planning and technical expertise is necessary, but unlike the very early industry adopters, there are now opportunities to learn from the experiences of other agencies.
- It is recommended that agencies engage all levels of transit agency employees in the planning process in preparation for deployment. Ongoing training as technology features changes is also important. Employees involved in beta testing of mobile payment systems, however, have valuable insight to offer.
- External beta testers (selected from riders) should represent a good cross section of transit service area demographics and should be users of the specific modes where mobile payments can be used. Facebook, focus groups, surveys, phone, and email communications are effective tools to solicit input during a pilot phase as well as after full deployment.
- Agencies should anticipate technical challenges identified during testing phase and build additional time into the deployment schedule to adequately address challenges.
- Mobile ticketing requires extensive marketing activities in order to be successful. Agencies should build customer outreach activities into their planning activities and deployment budgets.
- Agencies should carefully evaluate desired data and reporting needs when defining technology requirements. If data such as utilization by route, stop, or type of fare are needed, that should be factored into procurement decisions. It is also important to have a good dashboard system to track sales trends and system performance.

- Building redundancy in back office functions /servers is recommended in case of any interruptions in communications. The failure of any system can have huge implications and agencies should be prepared to react instantly to any problems that may arise.

Based on insights gained from the interviews conducted with transit agencies, the research team developed a concept of operations (ConOps) that can be used by any transit agency to plan for deploying a mobile fare system. The ConOps detailed the following:

- Customer-facing Mobile Ticketing Application
- Additional Mobile Ticketing Application Features
- Fare Inspector Application
- Reporting and Backend System
- Financial Processing
- Estimated Pilot Project Timeline and Budget
- Roles and Responsibilities of Agency Staff
- Proposed Evaluation Plan

In both the initial procurement of the mobile ticketing system for the pilot, as well as when looking towards a full public deployment of the mobile ticketing app, the participating agency should consider the following:

- Experience of the vendor – Prior to procurement for the pilot, references for the vendor should be checked. Mobile ticketing apps for transit is still a relatively new industry, and many vendors are new to the technology.
- Anticipated ability to make future changes to the mobile fare payment apps – It is likely that the agency will want to include new features or integrate with other systems in the future.
- Potential future impacts/disruptions if the mobile fare payment app vendor changes following a public deployment. The agency should consider these intellectual property issues for all systems they procure.
- Ownership of data – The agency should specify that all data generated by the system is owned by the agency. This gives the agency the most flexibility in accessing and sharing data as they wish.

The framework of the ConOps was followed to plan the next steps for conducting a pilot at StarMetro. To estimate the budget and time, an invitation was sent to vendors to participate in the pilot. Some estimates received will be incorporated into Phase 2 that will deploy, evaluate, and report on the pilot.

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Chapter 1 – Introduction and An Overview of Transit Fare Payment

Introduction

The goal of this project was to provide FDOT with a framework for the implementation of a future mobile payment pilot with a Florida transit agency. The objectives of the research project were to:

- Evaluate the "state of the industry" in mobile fare payment technology from a national and Florida perspective.
- Analyze the experiences of agencies that have or are in the process of implementing mobile payment systems in order to identify best practices.
- Explore the applicability of transit mobile fare technology in Florida.

This final report is a compilation of three technical memoranda that reported on the above three tasks. Tech Memo 1 of this study, "Industry Scan of Vendors and Agencies Outside of Florida," reviewed available mobile ticketing apps nationwide and provided case examples by summarizing interviews conducted with the following agencies that deployed mobile ticketing apps (vendors):

(f) Dallas Area Rapid Transit, TX, (Unwire)
(g) New Jersey Transit, NJ (Xerox)
(h) Nassau Inter County Express, NY (Masabi)
(i) Central Midlands Regional Transit Authority, Columbia, SC, (Passport)
(j) Chicago Transit Authority, IL, (GlobeSherpa)

Tech Memo 2, "Florida Transit Agencies' Existing and Planned Transit Fare Technology Procurements," reported on a survey conducted in Florida as part of this study to collect data on plans for mobile ticketing deployment at transit agencies in Florida.

Tech memo 3, "Considerations for Future Florida Transit Mobile Payment," outlines a framework for a future mobile fare payment pilot in Florida. The framework includes a concept of operations, estimated pilot project timeline, estimated budget, roles and responsibilities for the transit agency, and a proposed plan for evaluation. The proposed pilot project includes a mobile ticketing system comprised primarily of a smartphone application ("mobile app") that displays a visual electronic "ticket" for inspection by a transit agency employee. The mobile app system also includes a machine-readable Quick Response (QR) code or barcode, so both visual validation and QR Code validation features are available. QR codes / barcodes can be scanned at readers; however, that generally involves higher capital costs and longer installation times. This combination of visual and QR code validation is proposed for the pilot project because it is relatively easy to deploy, as it requires limited hardware upgrades and integration into existing systems. Moreover, it is likely that

this system will be relatively low cost. More details are provided in the following sections, beginning with details about the concept of operations (ConOps).

Since FDOT selected a pilot agency, StarMetro, for mobile fare payment in Florida, the final section of this final report applies the concept of operations to the specifics of that agency to further refine the proposed Phase II of this research project that will evaluate the pilot deployment at StarMetro.

Overview of Transit Mobile Fare Payments

Over the course of the last decade an increasing number of transit agencies have conducted mobile phone fare payment pilot projects and more recently full system deployments. Many agencies see mobile ticketing as an opportunity to offer greater convenience to customers, reduce fare collection costs, and increase efficiencies.

There are three main types of mobile ticketing applications currently available in the market. The first displays a visual electronic "ticket" for inspection by a transit agency employee to confirm the customer has purchased the appropriate fare. The electronic ticket typically contains a visual validation security feature such as animations, countdown, or a "color-of-the-day" to prevent users from creating fraudulent electronic tickets through screenshots or other means. The second is a machine-readable two-dimensional Quick Response (QR) Code, which is a two-dimension barcode that contains information such as payment account data that can be quickly scanned and decoded. Some mobile apps offer both visual validation and QR Code features so the ticket can be validated visually by agency staff at locations where QR Code readers are not available, but QR Codes can also still be validated via a scan where readers are available. Figure 1 shows the electronic ticket from an app by the vendor Passport, which includes both a visual validation component as well as a scannable QR Code. Mobile ticketing apps using visual and QR Code validation are software based and are relatively easy to deploy since they require limited hardware upgrades and integration into existing systems. Riders download the ticketing app, create an account, and add credit or debit card numbers to fund their ticket purchase. The payment occurs in real-time over a cellular network and is processed on the back-end like a standard credit or debit card transaction. They are primarily developed for the two most common smartphone operating systems in the U.S. – Google Android and Apple iOS.

Visual validation does not require any real-time communication with the transit vehicle or backend servers, and therefore requires no additional equipment onboard the vehicle or at a station – it is simply visually confirmed by transit agency staff as being a valid ticket, and the rider is then allowed to board. As a result, visual verification is an attractive, cost-effective first step towards implementing a mobile ticketing solution. It is also very fast to validate – a human operator can, at a glance, verify whether the ticket is valid. Vehicle operators can keep track of a boarding that is visually verified by pressing a button in an existing on-board computer, such as that provided by a CAD/AVL system. However, with visual validation, this also means that the transit agency has very little data available on how electronic tickets are being used.

Verification of QR Codes requires the installation of a QR Code reading (i.e., scanning) device at a station or on-board a vehicle. It also requires real-time communication with a server to verify if a

ticket is valid, which means a wireless connection (WiFi or cellular) must also be available. As a result, deployments utilizing QR Codes are more expensive than a simple visual validation system. Depending on the equipment (reader, wireless connection, and mobile device), QR Code validation when the user is boarding the vehicle can also be more time-consuming than visual verification. The device screen must be bright enough to be scanned (including shielding from any other light sources such as outdoor sunlight that may reduce screen contrast), and the device and QR Code on the screen must be properly oriented in relationship to the scanner. However, QR Code verification potentially provides the agency significantly more data about how a rider is using purchased electronic tickets. Each QR Code verification can be tied back to a particular rider as well as the particular pass they purchased. It also allows the agency to build sophisticated maps showing where users are boarding (and potentially alighting, if scanning is performed upon exiting the vehicle) public transportation over time, and the relationship to ticket purchases.

Figure 1 - Visual Validation and QR Codes are Available in the Electronic Ticket

The third type of mobile ticketing application uses Near Field Communication (NFC). NFC is a standards-based wireless communication technology that allows data to be exchanged between devices that are a few centimeters apart. In a public transportation environment, users pay via NFC by "tapping" their device on an NFC reader installed at a station or on-board a vehicle. Although NFC contactless mobile payment transaction volume is currently low, it is expected to increase with broader availability of NFC-enabled smart phones and increased consumer awareness of mobile wallets such as Apple Pay and Android Pay. NFC technology is well suited for gated fare schemes particularly because of the faster read-speed NFC affords versus QR Codes, which benefit large transit systems with a high volume of transactions.[1] NFC technology is in the planning stages at several U.S. transit agencies including the Chicago Transit Authority via the Ventra app and

1 Ibid.

potentially at New Jersey Transit. QR Codes do have one advantage over NFC; they can be shown on any device's screen and do not require specialized hardware in the device. This is the primary reason why QR Codes have, to date, been deployed in place of NFC – historically there has not been a high penetration of devices with NFC and standardized mobile wallet support across a large number of devices in the smart phone market. However, as mentioned above, the introduction of Apple Pay in late 2014 and Android Pay in late 2015 should quickly change this.

Implementation of NFC is more complex and requires an ecosystem in which multiple stakeholders must cooperate – hence the relatively late development of mobile wallets in relationship to the evolution of smart phones. The NFC ecosystem includes the following key stakeholders:

- Secure element (SE) providers and issuers – A secure microprocessor that includes a cryptographic process to facilitate transaction authentication and security.
- Mobile network operator – maintains the mobile communication infrastructure and wireless settings
- Handset manufacturer – defines which mobile phone models will be NFC enabled
- Operating system providers – maintains the core operating system used by various handsets, including version upgrades and application programming interfaces
- Mobile wallet developers – provides the consumer with an interface on the mobile phone to managed NFC applications and credentials
- Trusted service manager – a trusted third party who provides Over the Air (OTA) services to the NFA application service provider
- Application service provider – bank card issuers, transit agencies, merchants, and other application providers
- Passengers/consumers – the customer of the NFC application provider
- NFC application acceptors – merchants transit agencies who have enabled their acceptance infrastructure to interact with a consumer's NFC enabled phone
- Transaction processors – for open bank card payments the merchant or transit agency routes the transaction to the merchant bank card acquirer for authorization, clearing and settlement. For closed payment systems, the merchant or transit agency routes to appropriate back-ends system for processing and settlement.[2]

There is an emerging fourth type of mobile fare payment technology – Bluetooth Low-Energy (BLE). BLE is an evolution of the Bluetooth technology used for short-range (up to ~10 meters) communication between devices, such as a mobile phone and a hands-free headset or car system, and has a longer range than NFC. Unlike traditional Bluetooth communications, BLE is designed to be very energy-efficient and be constantly "on" and running in the background. As a result, when a BLE beacon/reader is installed at a location, a BLE mobile device can detect and instantly

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2 Ibid.

communication with that device when the user is nearby without the user needing to take the device out of their pocket or unlock their device. As a result, as long as Bluetooth is turned on, a rider's ticket could potentially be verified simply by walking through the fare gates or boarding a vehicle. BLE-based mobile ticketing solutions for public transportation are currently being evaluated by some mobile ticketing vendors and transit agencies[3], but to the research team's knowledge, there are currently no existing deployments of BLE in production at transit agencies.

NFC and BLE validation would provide a similar level of detail of usage data as QR Codes, in terms of boarding and alighting being tied to a particular passenger and transit pass. BLE could also potentially provide even more fine-grained data – if beacons/readers were installed around a transit station, data about the riders movement within the station itself could also potentially be tracked without the rider needing to interact with their device. New technologies such as BLE that are capable of collecting increased amount of data about transit riders movements and potential connections to payment for and usage of transit passes may raise privacy concerns. These concerns are not unique to public transportation – there are ongoing discussions in the mobile device industry about how to protect user privacy in an information-rich age. Transit agencies should, however, keep end-user privacy in mind with mobile ticketing solutions and be transparent with users about what type of data is being collected and how it is used.

Any technology that involves the exchange of electronic payment information is subject to the Payment Card Industry Data Security Standard (PCI DSS),[4] which defines a level of encryption and protocols that must be in place when information is exchanged over a wired or wireless network to ensure its security. This includes mobile fare transactions for public transportation. As a result, the operator of the mobile ticketing solution for a transit agency must be PCI certified. PCI compliance applies to the mobile ticketing solution no matter what type of verification technology is utilized (e.g., visual verification, QR Codes, NFC, BLE).

Figure 2 is provided as an illustration of different types of validation tools. The vendor is a UK company, Access IS, that the team did not scan but the types of visual verification types may be give the reader a good overview of options for verifications. The QR code is the equivalent to Mobile 2D in Europe.

Mobile 2D & linear barcode gate reader with NFC capability
Mobile 2D barcode reader with NFC capability for entry gate integration

[3] http://www.nfcworld.com/2015/02/09/334002/bluetooth-beacons-just-ticket-uk-rail-passengers/
4 https://www.pcisecuritystandards.org/

Figure 2 – An Illustration of Types of Validation from a UK Mobile Ticketing App Provider

CHAPTER 2 - INDUSTRY SCAN OF MOBILE FARE TECHNOLOGY

Table 1 provides a summary of known vendors of transit mobile fare payment identified through an industry-wide scan. The table lists the transit agencies where the vendors have deployed mobile fare packages as well as some characteristics of the technology provided by each vendor.

Table 1 - Scan of the Vendors Offering Mobile Fare Payment Systems

Company - Headquarters - Year Founded	US Deployments	Summary / Characterization	Miscellaneous
Bytemark **New York, NY** **2011**	New York Waterway (NYPP app); Capital Metro in Austin, Texas (CapMetro app); Massachusetts DOT (BusPLus+)	Bytemark is a small American company that has a mobile ticketing platform for transit, tourism, and events.	Offers a Software Development Kit (SDK) that allows integration of mobile fare payment features in existing apps.
CooCoo **New York, NY** **2009**	CDTA in Albany (iRide); NCTD in San Diego (mTicket)	CooCoo is a small, American company that provides mobile ticketing for transit.	CooCoo is partnering with Genaro.
GlobeSherpa **Portland, Oregon** **2010**	TriMet in Portland (TriMet Tickets); Virginia Railway Express (VRE Mobile); Pilot program with Los Angeles DOT (LA Mobile); Planned deployment with SFMTA; Partnering with Cubic for CTA Ventra App in Chicago	GlobeSherpa is an American company that has developed a mobile ticketing system that was first launched in Portland.	Globe Sherpa also offers parking payment solutions. Globe Sherpa is partnering with Cubic and Ridescout.
Unwire **Copenhagen, Denmark** **1999**	DART in Dallas; Fort Worth Transportation Authority (The T); Denton County Transportation Authority (GoPass)	Unwire is a Danish mobile service and payments company with subsidiaries in the Nordic countries, Germany and the USA. Unwire's customers include some of the region's largest financial institutions, mobile operators, and retail merchants.	Unwire provides SMS and app-based mobile ticketing solutions. Unwire also has a ticketing API that enables developers to build ticketing services and custom user interfaces.
Xerox **Norwalk, CT (Parent Company) 1906**	NJ TRANSIT (MyTix) SunRail in Central Florida	Xerox acquired ACS, which provides mobile ticketing and ITS technologies for transit.	
Passport Parking **Charlotte, NC** **2010**	Columbia, SC Comet Bus (Catch the Comet)	Passport Parking is a small, American company that provides mobile ticketing for transit and parking payment.	Passport has parking payment applications in Chicago, Columbia, SC, Boston, and other locations.

Company - Headquarters - Year Founded	US Deployments	Summary / Characterization	Miscellaneous
Masabi **London, UK (US HQ in New York City)** **2001**	Boston's MBTA (mTicket); San Diego's MTS and CrossCountry Trains (mTicket); NICE Bus on Long Island (go Mobile); Under contract with New York's MTA for both Metro-North Railroad and Long Island Rail Road	Masabi is a British company with 19 deployments of mobile ticketing in transit/railroads. Masabi's smartphone application is called JustRide.	

Summary of Features by Different Vendors

Table 2 below provides detail on the features of the vendor's mobile fare payment systems at select U.S. transit agencies. Mobile fare payment is available on various modes including bus, rail and ferries although some agencies do not accept mobile payments on all modes they operate. For example, the MBTA in Boston accepts mobile payment for commuter rail and ferry fares but not on buses or its light rail system. CTA have recently deployed their transit app utilizing NFC.

The most common form of fare validation is visual inspection and QR code scanning. In addition to mobile fare payment, other common mobile applications deployed at these agencies include static transit maps and schedules and trip planning that allows customers to identify the appropriate mode based on their origin and destination and time and date of travel. In addition, all systems offer trip planning and real time status of vehicle locations either as a feature of their agency mobile app or via mobile phone through independent data providers. Appendix A provides visual illustrations of apps.

Table 2 - Different App Features by Vendor

Agency App Downloaded*	DART	MBTA	The COMET	TriMet	NY Waterway (EDC)	NCTD	NJ TRANSIT
Name of App	GoPass	mTicket (Justride)	Catch the COMET App	TriMet Tickets	NY Waterway	COASTER Mobile Tickets	NJ TRANSIT App (Note: mobile ticketing portion called MyTix)
Validation Process	Visual	Visual; barcode scanned by inspector	Visual	Visual and barcode scanned by inspector	Visual	Visual and barcode	Visual; barcodes scanned at a small number of fare gates
Modes for which Tickets can be Purchased	Bus, light rail	Commuter rail and ferry	Bus	Commuter rail, light rail, bus	Ferry, bus	Commuter rail	Bus, rail, light rail
Forms of Payment	Credit and debit cards	Credit and debit cards	Credit and debit cards	Credit and debit cards	Credit and debit cards	Credit and debit cards	Credit and debit cards; PayPal
Other Mobile Services	Trip planner, Real-time bus information; real-time train information; Lyft, Uber and Zipcar links; events and offers (coupons)	Maps; schedules; offers (coupons); trip planning; real time	Trip planner; real time bus location	Trip tools directs riders to TriMet's mobile website for trip planning, real-time information and service alerts	Schedules; route maps; bus locator	Schedules; maps; Real-time train information	Train schedules; Train real-time Information; Bus real-time information; Trip planning; Police

* Android applications were downloaded for evaluation; most vendors also offer iPhone applications with comparable feature sets

Identification of Agencies with Different Brands/Packages of Mobile Fare Systems

The purpose of this section is to describe the rationale for the selection of five transit agencies for in-depth case studies of mobile ticketing. The following ten transit providers were considered for the case study analysis, which includes the most current deployments of mobile ticketing in the United States :

1. Capital Metropolitan Transportation Authority (CAP METRO)
2. Chicago Transit Authority (CTA)
3. Dallas Area Rapid Transit (DART)
4. Massachusetts Bay Transportation Authority (MBTA)
5. Nassau Inter County Express (NICE Bus)
6. New Jersey Transit (NJ Transit)
7. New York Waterway (NY Waterway)
8. North County Transit District (NCTD)
9. The Comet
10. Tri-County Metropolitan Transportation District of Oregon (TriMet)

Table 3 presents the following information compiled for each transit operator:

1. City/region
2. Year mobile ticketing first deployed
3. Modes of transit operated (with mobile ticketing)
4. Mobile ticketing vendor
5. Mobile ticketing website

The following five agencies were selected for the in-depth case study analysis.

1. Dallas Area Rapid Transit, TX, (DART)
2. New Jersey Transit, NJ (NJ Transit)
3. Nassau Inter County Express, NY (NICE Bus)
4. Central Midlands Regional Transit Authority, Columbia, SC, (COMET)
5. Chicago Transit Authority (CTA)

Table 3 - List of Transit Providers Considered for the Case Study Analysis

Transit Provider	City / Region	Year	Primary Transit Mode(s)	Vendor	Website
Capital Metropolitan Transportation Authority (CAP METRO)	Austin, TX	2014	Bus & Commuter Rail	Bytemark	http://www.capmetro.org/app/
Chicago Transit Authority (CTA)	Chicago, IL	2015	Rail & Bus	GlobeSherpa (with Cubic)	https://www.ventrachicago.com/
Dallas Area Rapid Transit (DART)	Dallas, TX	2013	Bus & Light Rail	Unwire	http://www.dart.org/gopass/
Massachusetts Bay Transportation Authority (MBTA)	Boston, MA	2012	Commuter Rail, & Ferry	Masabi	http://www.mbta.com/fares_and_passes/mTicketing/
Nassau Inter County Express (NICE Bus)	Nassau County, NY	2014	Bus	Masabi	http://www.nicebus.com/Passenger-Information/Mobile-Ticketing.aspx
New Jersey Transit (NJ Transit)	New Jersey	2013	Rail & Bus	Xerox	http://www.njtransit.com/var/var_servlet.srv?hdnPageAction=MobileTicketingTo
New York Waterway (NY Waterway)	New York City, NY	2012	Ferry	Bytemark	http://www.nywaterway.com/MobileAppDownloads.aspx
North County Transit District (NCTD)	San Diego, CA	2013	Commuter Rail	CooCoo	http://www.gonctd.com/eticket
The Comet	Columbia, SC	2014	Bus	Passport	http://catchthecomet.org/app/
Tri-County Metropolitan Transportation District of Oregon (TriMet)	Portland, OR	2013	Bus, Rail & Streetcar	GlobeSherpa	http://trimet.org/mobiletickets/

These five case studies were selected because they represent systems that are in different stages of development. DART has offered its GoPass mobile app since 2013 while the CTA Ventra mobile app was just deployed in November 2015.

The case study sites were also selected to represent various vendors of mobile payment systems. The CTA has contracted with GlobeSherpa, NJ Transit works with Xerox, DART has contracted with Unwire, NICE has contracted with Masabi, and The COMET has deployed a mobile fare payment solution with Passport.

Although regional or multi-agency mobile payment systems are somewhat rare at this time, this study interviewed two agencies that have implemented mobile fare payment spanning across the region or through a multi-agency effort. DART offers a regional pass on its GoPass app and the VTA is in the early stages of integration with Metra, the Chicago area commuter rail system and the Pace suburban bus system.

Finally, these five case studies include bus, rail (both heavy and light), ferry and streetcar modes that offer mobile ticketing.

Assessment of Mobile Fare Payments Deployed to Selected Case Examples

To assess their experiences with mobile fare payment deployments, telephone interviews were conducted with representatives from each of the five agencies. An interview guide was developed (see Appendix B) and distributed in advance to facilitate the discussion. Following are the general areas the interviews were designed to evaluate and the high level "takeaways" from the interviews.

- Rationales for pursuing a mobile payment system – agencies were interested in potential cost savings, added customer convenience, improved transit agency image or were mandated by state law. Increasing ridership while attracting younger demographics of riders was a common rationale as well
- Timeline for planning, testing, and deployment of the system – on average, it took most agencies approximately two years to deploy the systems.
- Fare policy decisions related to mobile fare payments – no fare policy changes were made pre-deployment, but in several systems not all fare types can be paid via mobile app.
- Vendor solicitation procedures and outcomes – agency experiences ranged from no solicitation (no cost pilot) to supplementing existing systems with exiting vendors to through RFP process.
- Associated costs - wide variations in startup costs, ongoing maintenance and fee structure/commissions.
- Fare validation – currently visual and QR code but several agencies plan to introduce NFC in the future
- Financial settlement procedures and processes – handled by vendors/subcontractors
- Recommendations for other agencies considering mobile fare payment systems – Plan! Test! Market!

Summary of Interviews with Transit Agencies

Tables 4 through 14 present the data collected from interviews. Table 4 identified the contacts interviewed from each agency.

Table 4 – Contact Information of Transit Agencies Interviewees

Transit Agency (Vendor)	Interviewees
DART (Unwire)	Name: Lawrence Sutton, PMP (previously DART's Mobile Fare Project Manager) Title: Project Manager – Technology Services, Transit and Rail, CH2M Email: Lawrence.Sutton@ch2m.com
NICE (Masabi)	Name: Omar Alvarado Title: Senior Planning Analyst, NICE Bus Email: omar.alvarado@transdev.com
COMET (Passport)	Name: Samuel Scheib Title:: Transit planner and manager, The COMET Email: samuel.scheib@catchthecomet.org
CTA (GlobeSherpa)	Name: Michael Gwinn Title: Director, Revenue And Fare Systems, Chicago Transit Authority Email: mgwinn@transitchicago.com
NJ Transit (Xerox)	Name: Frank Gorman Title: Manager, Point of Sale & Fare Collection Systems, NJ TRANSIT CORP Email: fgorman@njtransit.com

Table 5 summarizes the responses on the rationale for introducing mobile fare payment apps among fare media in agencies interviewed. Enhancing customer experience and increasing ridership while attracting younger demographics of riders was a common rationale as well as rebranding and portraying an innovative side such as in the case of The COMET. CTA and NJ Transit included mobile fare apps as an interoperability tool among systems or modes within the systems.

Table 5 – Agencies Interviewed Explain Rationale for Deploying Mobile Fare Payment

Transit Agency (Vendor)	Rationale
DART (Unwire)	Reduce cash handling expenses, better serve customers (increase ridership), mobile payment interface can be easily changed (vs. ticket machines).
NICE (Masabi)	Wanted a lightweight flexible system that would improve the customer experience.
COMET (Passport)	Agency was last utility-owned transit agency in US. Wanted to be perceived as innovators – mobile payments were part of rebranding, including the changing of the agency name to "COMET". Goal to make accessible to younger demographics of riders (historically agency hasn't worked with local university)
CTA (GlobeSherpa)	Previously had reloadable magnetic stripe cards, cash, credit cards and Chicago Cards (smart cards); rail -no cash; recently converted the entire system to Ventra, which is open payments. A major motivation for adding mobile payments (joined with Metra, commuter rail partner) was that state law requires Universal fare payment so CTA's Ventra contract was supplemented to include Pace.
NJ Transit (Xerox)	Emerging programs - MyTix mobile ticketing app, web component (purchase and display ticket via website - can print at home), Contactless banking cards (mix of NFC and remaining contactless credit cards). Mobile ticketing on buses - MyTix had an element of bus for 7-8 months, but initially introduced bus monthly pass sales, enlarged to entire bus system in last few months. Just monthly passes for bus. Mobile ticketing on rail - offer all 9 one-way, weekly, monthly tickets via mobile app.

Table 6 shows the timeline between planning and deployment. Approximately 12 months seem to be the timeline that is most common among agencies. DART expended one year due to changes in the app that Unwire had to perform.

Table 6 – Timeline of Mobile Fare Payment Deployment at Agencies Interviewed

Transit Agency (Vendor)	Deployment Timeline
DART (Unwire)	Sept 2012 - started development with goal of March 2013 launch. In Dec 2012 - DART discovered Unwire needed to make major changes for mobile apps to allow for purchased but not activated tickets (no additional cost to DART - Unwire did changes on their own). Instead of Phase 1 and Phase 2, they did pilot/beta testing in mid-June-July 2013. Then back to development stage for some changes, official rollout Sept 2013 (Phase 1). Wished they had pushed Unwire harder to include design changes/other features prior to launch.
NICE (Masabi)	Started looking into mobile payment about 2-3 years ago. Nice did a 1 month beta test - about 6 months from concept to full deployment
COMET (Passport)	Started with a 6 month pilot with Passport (at no cost – Passport provided equipment). Operations are contracted – no issues with training – contractor trained drivers. COMET issued RFP for full deployment.
CTA (GlobeSherpa)	First meeting with 3 agencies (CTA, PACE and Metra) about Mobile ticketing in February 2014; Contract approved by CTA board in October 2014; Currently beta testing; going live fall 2015. Original timeline was May/June but needed more time to iron out kinks.
NJ Transit (Xerox)	Began planning in the early spring of 2012; the first alpha test in October of 2012; They got hit by hurricane Sandy in November 2012, which delayed deployment. First rail line deployed in May 2013 and railroad was complete in December 2013. 10 rail lines over 6 month period.

Table 7 confirms the finding that mobile fare apps reflect the regular fare structure and no special discounts or other fare changes were made as part of the mobile fare app deployment. Some apps may not reflect all types of fares at agencies (for example, no one way fare is available from COMET) but plans to mitigate the unavailability of more fares types are ongoing.

Table 7 – Mobile Fare Policies at Agencies Interviewed

Transit Agency (Vendor)	Fare Policy
DART (Unwire)	No fare policy changes. No discounts due to Title VI concerns. Must have proof of payment to board vehicles. Annual passes currently not available in mobile app, no student passes in app (fear inside agency how to validate student). All regional agencies could include their only fare policies. Prices: https://www.dart.org/fares/fares.asp
NICE (Masabi)	NICE generally tries to mirror MTA fare structure, since many riders transfer to the MTA. Ridership dependent on NYC - don't have "say" over fare cost changes with MTA fare system. NICE does have autonomy with cash fare system, and extended this flexibility to mobile app. Only offer single-ride tickets via mobile app. No time-based tickets via mobile (day pass, etc.). But they do have normal time-based fares.
COMET (Passport)	Most but not all fares are currently available on mobile app (vets, disabled, seniors, and 16/17 years of age). No reduced fares specifically for mobile users. Can't get a one-way fare in mobile app.
CTA (GlobeSherpa)	All CTA fares will be available on app – app is just extension of existing fare payment system. In the Ventra system, Metra riders use their phone to display tickets and the app currently can be used by CTA and Pace riders to reload value on their Venta cards. Can use Apple Pay or Android Pay on Ventra reader for flat rate. Can override with half fare for kids by asking operator.
NJ Transit (Xerox)	Most fare types, but not all, are available at this time; rest will be phased in. No special discounts for mobile users. 3 core riders - monthly passes, discounted/ten trip tickets, one way that's full fare. Rail and bus tickets priced differently - on rail ticket, have zone equivalent - allows rail ticket/rider to ride "of equal value" on buses. Works same as mobile app ticket.

Table 8 shows the different ways that agencies tested the technology before deploying it where DART recruited 700 individuals to test the app and provide feedback to improve it while NJ transit and NICE had an average of 25 testers providing feedback to the agencies. Some agencies emphasized that it was vitally important to hear from their customers during the initial phases and that help with development of user interfaces. The table also shed light on how these testers were recruited and how the feedback was regularly obtained.

Table 8 – Pilots or Beta Testing as Described by the Agencies Interviewed

Transit Agency (Vendor)	Pilot/beta testing/pre-deployment
DART (Unwire)	700 beta users were recruited through DART's email list and through Facebook. Users answered other users' questions and continued after launch on main DART FB page. Beta test revealed issues -Good input from testers. Dart also used an outside testing service (formerly known as U-test, now known as Applause). Created bus and rail operations group to meet monthly including fare inspectors, customer service reps, and finance. Internal training very important. Early on, created operations group that met monthly - fare inspectors, customer service, finance, project manager, bus operators. Had constant line of communication to group. Lawrence would not recommend doing pilot without commitment to eventually expand into larger deployment - operations adjustments require huge time/effort commitment that are only worthwhile if agency is committed to launching on full system.
NICE (Masabi)	Picked a good cross section of customers – 20 to 30 system wide beta testers. Held two meetings for instructions and received feedback via phone, email and exit interviews. NICE produced video, training seminars, and instructions for staff- 2-3 times a week. Monthly and bi-monthly training sessions, 15 min instructions for validation within these sessions.
COMET (Passport)	Pilot was open to all
CTA (GlobeSherpa)	Beta testing internal (employees) and external – call for volunteers. Various user experience (UX) issues with interactions not being intuitive (e.g., users didn't understand how to add fares). Found issues with functionality of mobile tickets that needed to be fixed. Found issues with backend of Ventra system to make sure transactions were priced correctly. Changed name from "Trip tools" to "transit tracker" Changed process flow (back button on Android was strange). Response from testers and members of public has been "frighteningly positive". Metra conductors have heaviest lifting for training, CTA had to brief call centers, will do more training in future. Training and briefing for call center and other front line employees. Many internal testers in addition to external testers.
NJ Transit (Xerox)	Significant pilot testing and refinements before launch. Did 25 person alpha test first. Used existing email list to select beta testers living along a small rail line. Eventually selected 25 who provided valuable input. They each received a few hundred dollars. Training wasn't a significant issue. Mobile payments were treated "just like another terminal type" because the app was integrated with existing interfaces (bank, reporting etc.) there wasn't a significant learning curve. Did focus group, talked like next-door neighbors. In person meetings, testing. Phone and email contact to communicate with users. Good user feedback is important - needs to be integrated into app without app development team feeling like app is failing. Feedback should be expected as part of improvement process.

Table 9 reveals answers from respondents on challenges they faced during the initial phases of deployment of mobile fare payment apps. Some "bugs/kinks" associated with the app were

experienced at DART where the software architecture had to be changed to make it possible for the phone to store tickets that have not been activated. CTA had issues integrating the mobile app within the Ventra payment system that was deployed to accommodate different types of transit mode with different means of payment. With the NJ Transit, some customers were frustrated for lack of continuously available wireless service but antennas are being placed to boost the wireless connectivity.

Table 9 - Initial Challenges as Described by the Agencies Interviewed

Transit Agency (Vendor)	Initial Challenges
DART (Unwire)	During beta test, Unwire had to make significant changes. Previously used SMS only. For mobile, they had to allow for purchased but not activated tickets – had to change architecture, which delayed rollout
NICE (Masabi)	Operational challenge for color/word of the day - how do you tell drivers what this is, so they can validate visually? NICE came up with screen at each depot that showed color and word of day where driver could see it. Color/word of day is auto-generated by Masabi's system - not repeated more than every 30 days or so
COMET (Passport)	No major obstacles so far – glad they avoided integration with existing fare system. Would be nice to have more data from users, but it's a tradeoff with visual validation
CTA (GlobeSherpa)	It was difficult to integrate GlobeSherpa with Cubic backend. 5-6 seconds for ApplePay, much worse than .5 second transaction from tap transit card. The Ventra system had many highly publicized issues, CTA is trying to avoid problems with the Ventra app; therefore, they are doing lots of user testing before launching
NJ Transit (Xerox)	Transfer station readers originally had a delay of 1 to 1.5 seconds when switching between processing paper barcodes vs. phone barcodes, which significantly slowed processing of boarding users. Readers are now being updated to remove this delay. There are locations with limited cell coverage prompting NJT to introduce wi-fi. At Penn station (owned by Amtrak) cell providers are installing new antennas

Table 10 compiled answers to question on funding process of deployed mobile fare payment. NICE, CTA, and NJ Transit did not go through the RFP process while COMET did and only got 2 bids. NJ Transit was already under state contract with Xerox for the provision of other electronic payment options. The cost of the system to DART was $1,498,500. Data from other vendors are discussed in a presentation by DART published at http://www.scribd.com/doc/104434264/DART-Mobile-Ticketing-Presentation. The actual costs negotiated when the contract was signed may differ than the one offered in the bid. The presentation provides valuable information about the selection process.

Table 11 gives some insight for the selection process of vendors. Both NICE and COMET selected "lightweight" solutions implying no integration with other fare systems was needed and the deployments were expected to take place within a few months. NJ Transit worked with Xerox to develop a system that integrated and combined the fare systems in the state.

Table 12 reports where the interviewees were enthusiastic to talk about the features of the apps of their systems. NJ Transit had developed web apps in-house that covered trip planning and real-time info and worked with Xerox on adding feature to the mobile fare payment app before releasing it to the public. Agencies may have had web apps for these purposes but they were not mobile apps when the agencies were interviewed. COMET and NICE has plans to include planning and real-time info in their apps in the near future. DART developed its own Application Programming Interfaces (APIs) to provide real-time and planning. Unwire was responsible for integrating the fare app into DART's API.

Table 10 – Procurement Process, Funding Sources and Cost of Mobile Fare Payment System at Agencies Interviewed

Transit Agency (Vendor)	RFP Process	Costs and Funding source
DART (Unwire)	RFP issued - 14 proposals total, but only 6 had existing mobile ticketing products in service at time of RFP (requirement of RFP)	Funding came from funds allocated to new fare payment system (capital). Unwire is paid per transaction fee.
NICE (Masabi)	No RFP	Maintenance is approximately $80,000 per year They did a one route pilot with readers, and the initial pilot readers (Cubic) were free, but would have cost ~ $10,000 each. Funding for project - a lot of system is being paid for via fares. Not huge capital cost. $7k per month for mobile payments system w/o onboard equipment.
COMET (Passport)	RFP issued - Passport won RFP. Only 2 submitting teams. Passport - was lightweight solution, didn't need to integrate with fare box	Passport offered the six month pilot free of charge. Passport waived start-up fee of $150,000. They charged $15,000 for start-up and support and collect 10% of gross mobile app sales. Comet pays $20/month/vehicle for cellular until wi-fi is introduced.
CTA (GlobeSherpa)	No RFP. Existing contract with Cubic was amended to include mobile payments.	System total was 2.5 million. CTA's share of Ventra contract was 1.7 million through 2024 plus $15,600 for monthly support, and this is a supplement to the original Ventra contract. No additional cost per transaction for CTA for mobile, but Metra does pay cost per transaction. Not sure, what additional activation fee would be per transaction.
NJ Transit (Xerox)	Worked with Xerox in developing the app(s). There was no RFP process. Did not want to duplicate existing systems, wanted to build on existing system from Xerox.	No revenue paid to Xerox for ticketing sales (still have to pay credit card fees, not to Xerox). Define functionality of what the agency wanted to build. Xerox comes back with cost for development, quality assurance, administration - already have rates from Xerox for all stages. Agreement on specific cost for feature with Xerox. Have flexibility from board to expand systems in scope based on change order.

Table 11 – Reasons that the Vendor Was Chosen by the Agency

Transit Agency (Vendor)	Selecting the Vendor
DART (Unwire)	See DART's presentation here for details on vendor selection http://www.scribd.com/doc/104434264/DART-Mobile-Ticketing-Presentation.
NICE (Masabi)	NICE picked Masabi because Masabi had just built MBTA's mobile ticketing system. NICE wanted to launch mobile ticketing fast. Masabi was lightweight and fast. Six months from concept to deployment.
COMET (Passport)	COMET wanted "lightweight" solution that didn't require integration with existing farebox system. Customer - enters credit card number in app, Passport handles all charges etc. PIN in app. Quick to purchase from customer's perspective.
CTA (GlobeSherpa)	Cubic is vendor for Ventra backend system, they are providing mobile app under that umbrella. Have state law that requires region adopts regional payment system. Cubic presented solution. Amended contract to include Metra.
NJ Transit (Xerox)	Didn't want to duplicate existing systems, wanted to build on existing system from Xerox. Xerox brought on mobile app developers (3 person units) to work on NJ Transit. Xerox role - managing the technology - responsible for software app, managing servers, NJ Transit dictated design and features. NJ Transit can add features. If Xerox left, NJ Transit would need to start over on apps. Reporting - have all core reporting - EFT (credit/debit). MyTix - want to know how many monthly/weekly/one-ways are sold. Break down many different ways. Can look at individual user accounts. Daily downloads. New accounts. Need to have good dashboard - very useful as system is being deployed. Example - in Oct, 30,500 customers who are using mobile phones to display monthly tickets (bus and rail). On top of that, last month 680,000 one way tickets sold via MyTix. Important to be able to track sales trends at a glance via good reporting – they have seen continuous growing trend of usage.

Table 12 – Other Mobile features Deployed with Mobile Fare Payment

Transit Agency (Vendor)	Other features deployed with mobile fare payment app.
DART (Unwire)	Wanted native apps!! Did not want mobile web app due to user experience quality issues with web applications. Wanted all features (trip planning, real-time info, mobile ticketing) integrated into a single app. Developed internal APIs at DART for real-time information that Unwire was responsible for integrating into the app; Used Google Maps API for trip planning. Launched on iOS and Android.
NICE (Masabi)	Currently payments are only feature within native app (native apps do have links to web pages for items like trip planner, maps, etc.). Plan to deploy real time info, trip planner, service alerts within same app.
COMET (Passport)	They hope to evolve into a 3 button (plan, track, pay) to include travel planning and real-time functions in addition to mobile payment.
CTA (GlobeSherpa)	Had web CTA bus tracker and train tracker before, but previously no mobile apps. Pace (bus) and Metra (commuter rail) will also have real-time information included in the mobile app that will launch this fall. Phase 2 of the app will include trip planning, bike sharing. Working with Globe Sherpa to design mobile app. Previous approach was open data approach for real-time data, spawned many 3rd party apps. This mobile fare payment app will be the first time CTA is launching own app.
NJ Transit (Xerox)	There were existing NJ-developed web applications that were rolled into the MyTix system. Trip planning, real-time info - built as plugins for native apps (same backend as web applications) - NJ Transit gets code from Xerox for mobile app payment portion of apps, then NJ Transit adds features and publishes final app release to end users.

The discussion in Table 13 about the validation process echoes section, "Overview of Transit Mobile Fare Payments," where types of validations were discussed. All 5 agencies have visual verification.

Table 13 – Validation Process of Mobile fare Tickets at Agencies Interviewed

Transit Agency (Vendor)	Validation process
DART (Unwire)	Two levels of validation - 1) visual (recently activate - 2 minutes screen active with animation), 2) QR Code on "back" of ticket that can be scanned (police were using for e-ticket solution) 3G network allows validation in real-time. Additionally, every 6 minutes QR code changes to allow local (without remote) validation. DART requires proof-of-payment to board vehicle. Fine people that "recently activated pass" on train. Customers afraid of public humiliation of getting identified as not paying fare.
NICE (Masabi)	Fare system now - equipment - mobile - verified visually, rider shows mobile app screen, which has color and word of the day, verified by operator. Ticket is live for 2hr 15 min following activation by user. Mobile ticketing is NOT interoperable with MTA at this point - can only be used at NICE.
COMET (Passport)	Visual inspection. Currently user boards the bus and shows the phone to operator, fare operator hits a button when user shows phone app. To validate - active screen - countdown clock, moving screen and QR Code, can see transaction #. Now asking users to rotate phone, so users can't fake it with video. Next phase is actually scanning the QR Code - equipment rolling out in Nov. 2015. Cost is $750 per vehicle. This would allow more data collection and usage info/route.
CTA (GlobeSherpa)	NFC potentially planned but no timeline. NFC is currently used for flat fares on CTA, but in the future, the agency would like to offer all fare types that can be paid using NFC. This would be done by having the phone become a "virtual" Ventra card.
NJ Transit (Xerox)	Visual inspection is the primary means, and two station readers have readers (Secaucus Junction and Newark Airport). Initially planned for NFC but barcodes are working well so NJT may continue with barcodes.

Table 14 reflects lessons learned from agencies interviewed. The agencies appreciated all the positive press their agencies received from deploying mobile fare apps. It may have appealed to new younger riders that they are targeting to use public transportation. Apps with college student population may have received support from that segment as low hanging fruit successes which brings an important question into this research. If FDOT is interested in a pilot project, a college town is appropriate for attracting users, however, if the transit agency provides students with free passes, it would be difficult to evaluate performance. Aalthough many times boarding by students are counted and registered, it does not give a realistic assessment of how payments were processed or issues associated with back-end procedures.

Table 14 –Initial Challenges When Deploying Mobile Fare Payment Systems and Advice for Other Agencies

Transit Agency (Vendor)	Advice for Other Agencies / Customer Feedback / Next Steps / Planned Improvements
DART (Unwire)	The RFP development is difficult Customers thought it was cool to have all DART features in one app—more secure, less rushed. Training customers was easy. Tickets not stored locally - tickets stored in the cloud. Tied to phone number, so change in phone number causes problems if partially into annual pass (e.g., monthly payments) - given current Unwire billing structure would require full refund of annual pass. Mobile ticketing requires large marketing effort to be successful, and needs to solve a customer problem. Got lots of positive press from mobile ticketing launch. Advertised at football games, colleges. Sent live apps to QA testers via Utest around the country. Call center volume decreased. New features - corporate passes, include photo for ID (company can upload photos), users get passes activated. "Corporate" student passes - SMU - in past would make passes and students would not pick them up, or they had to wait until 2 weeks (after drop/add) to get ticket. Now, they can get pass electronically and cancel remotely (big deal). Subsidized by university (free to student). NOT same as regular student pass (high school, etc.), which is not offered via app.
NICE (Masabi)	Was able to learn from MBTA's implementation in Boston, which was very recently completed at the time. The only data NICE can gather from ticket use is the number of boardings (and that is manually indicated by driver "clicking F5"; They have not utilized many reporting features. If NICE started using on-board readers that would capture additional origin-destination information for riders. Biggest barrier is no mobile ticketing/interoperability with MTA and 60% of Nice riders transfer to MTA- Vision for MTA interoperability - two separate apps (NICE or MTA), but same payment methods that are interchangeable. Biggest advantage - so much autonomy on fare structures inside mobile app (maybe try mobile-only college pass?). When have critical mass, expected to speed up people boarding (i.e., reduce dwell time) - instead of 10 quarters, just flash pass. Metro card on bus - magnetic ticket - takes a while to read card, can be slow. Next steps - on-board equipment on back burner. Piloted last year w/ on-board equipment - maybe eliminate stop, have on-board readers (5-vehicle peak, only needed 7 readers, including spares). Expected to reduce running times. Lots of operational issues - false positive/negatives. Possible rear entry with faster validations. QR code scanner was the technology tested - slower than visual validation, but faster than cash or magnetic ticket. Selected best drivers when testing onboard equipment. Other features with fare payment app - want to be one-stop shop for customers. To include Twitter link, service alerts, trip plan. Schedule info will be replaced by real-time info when real-time is deployed. MTA procured fare boxes that NICE uses - they are Cubic Westerns. Cost of readers (ballpark) in pilot - free. Got readers via Masabi for demo. Off shelf around $10k.
COMET (Passport)	Additional reporting features are desired (which route and type of fare payed by route), will come with QR code scanning. No nearby agencies that need to be integrated. Focus now is on integrating travel planning and real time. Considering other features seen in testing at CapMetro system in Austin (via Bytemark vendor). Works via Bluetooth Low-

Transit Agency (Vendor)	Advice for Other Agencies / Customer Feedback / Next Steps / Planned Improvements
	Energy, NFC, and/or QR Code. Can scan at distance (up to 3-6 feet), or scan short range, can switch between technologies for each interaction (has backups).
CTA (GlobeSherpa)	Integrate trip planning, 5-6 seconds for Apple Pay (in general), much worse than .5-second transaction from tap transit card. Concerns about sinking dwell time. They are planning to introduce a "virtual" Ventra card that uses NFC on the phone and has all fare types integrated into it. IMPORTANT - is not just a "mobile ticketing app" - also includes full integration with Ventra backend, buying tickets, etc. P.S. The Ventra system had many highly publicized issues, CTA is trying to avoid problems with the Ventra app; therefore, they are doing lots of user testing before launching
NJ Transit (Xerox)	There are always things but some not necessarily under the control of NJT. NJT stressed the importance of beta tester input in addressing issues that would eventually become problems. Brought in security consultant and implemented security features such as requirement that tickets must be activated on-line Expansion and enhancements planned. Important to do a phased approach. Make sure front line employees are kept up to date on system changes Very important to have redundancy in back office functions/servers, especially when tickets are verified in real-time. Any interruptions in communications (either for the user or for the server systems) bring this process to a halt. Install readers on all buses, add additional tickets to mobile app. Create a dashboard to carefully monitor system performance and develop push notifications to alert customers if problems occur Dependency on this system functioning properly is enormous - need to react instantly to any problems with system. Part of next release - deploy redundant clustered servers. NJ Transit does things differently - they require all one-way tickets (and monthly first time used) to have online activation for security reasons. Online connectivity is vital. Example problem - for 45min 25% of customers could not connect - learned - better levels of support for systems, dashboards showing what is going on. NY Penn station has internet connectivity issues, also biggest hub - been working with Amtrak. In some locations, introduced Wi-Fi to try and fix problem, other locations try to work with service providers to accelerate growth of cellular network. Wi-Fi enhanced through overall plan for enhancing customer service. For rail, allow ticket to be activated and displayed for 2hr and 45 min - some abuse, but allows isolation from some issues (wireless coverage). Customers seem to learn how to activate tickets around wireless coverage issues - they tend to accept limitations, can see other online services also have issues. Two considerations upon original deployment: Did not have a lot of other agency experience to inform plan, had to start from scratch / think things out on their own. Did integrate mobile ticketing with existing infrastructure. Built app within DMZ/PCI-compliant environment (within firewall) (not in cloud) - has interfaces to processing, other systems. Mobile app is "just another terminal" - taps existing systems. Can view MyTix sales from existing system reports.

The interoperability issue is a very important challenge in agencies that have had recent fare payment systems installed. For example, CTA had Ventra take over fare payment system regionally. Any mobile fare payment app had to be integrated into Ventra's fare system. Ventra already had some issues with the initial deployment but as with any new technology but this was talked about in the media with negative implications that all agencies do their best to avoid.

DART provides GoPass in Dallas, Fort Worth Transportation Authority (The T), and Denton County Transportation Authority (DCTA), see Figure 3. The interoperability issues did not seem to be a problem for DART as the main entity that provides mobile app for the other agencies.

Figure 3 – Example of Regional Mobile Fare Payment App that is Used by DART, DCTA, and the T

Lessons Learned

Although mobile fare payment systems are relatively new, customer acceptance of this payment option continues to grow. As transit agencies explore options to reduce cash handling and fare media production costs, or contemplate replacement of aging fare collection systems, it is likely they will consider mobile fare payment systems. While difficult to quantify, agency representatives interviewed for this report believe they have achieved many of the objectives they attempted to address through their mobile fare system deployment. Those with first-hand experience in implementation offered a number of suggestions and advice to others who are currently considering or planning a mobile fare system:

The development of specifications and solicitation documents is a complex and technical process. Significant planning and technical expertise is necessary, but unlike the very early industry adopters, there are now opportunities to learn from the experiences of other agencies.

Agencies should carefully evaluate desired data and reporting needs when defining technology requirements. If data such as utilization by route, stop or type of fare are needed, that should be factored into procurement decisions. It is also important to have a good dashboard system to track sales trends and system performance.

Building redundancy in back office functions /servers is recommended in case of any interruptions in communications. The failure of any system can have huge implications and agencies should be prepared to react instantly to any problems that may arise.

It is recommended that agencies engage all levels of transit agency employees in the planning process in preparation for deployment. Due to the aging transit employee base, many are not as tech savvy as those in other industries and may require additional training to become comfortable with new systems. Ongoing training as technology features changes is also important. Employees involved in beta testing of mobile payment systems, however, have valuable insight to offer.

External beta testers should represent a good cross section of transit service area demographics and should be users of the specific modes where mobile payments can be used. Facebook, focus groups, surveys, phone, and email communications are effective tools to solicit input during a pilot phase as well as after full deployment.

Agencies should anticipate technical challenges identified during testing phase and build additional time into the deployment schedule to adequately address challenges.

Mobile ticketing requires extensive marketing activities in order to be successful. Agencies should build customer outreach activities into their planning activities and deployment budgets.

CHAPTER 3 - FLORIDA TRANSIT AGENCIES' EXISTING AND PLANNED TRANSIT FARE TECHNOLOGY PROCUREMENTS

Introduction

The research team conducted an online survey of Florida transit agencies[5]. The purpose of the survey was to assess the types of fare collection equipment currently used in Florida. In addition, the survey would also inform the team on plans for fare collection system procurements and whether or not those plans include mobile phone payment options.

Survey Implementation

The online survey was conducted in September/November 2015 via Survey Monkey (please see Appendix C for the survey questions). A link to the survey was sent out via e-mail to a list of Florida transit planners and to the Florida Operators Network listserv. Respondents from the following 12 agencies completed the survey:

1. Bay County Transportation Planning Organization (TPO)
2. Collier Area Transit
3. Hillsborough Area Regional Transit
4. Hernando County Transit
5. Lakeland Area Mass Transit
6. LeeTran
7. Martin County Public Transit
8. Ocala/Marion TPO
9. Pasco County Public Transportation
10. Pinellas Suncoast Transit Authority
11. Manatee County Area Transit
12. StarMetro

[5] *using Survey Monkey*

Survey Analysis

Forms of Fare Payments Currently Used by Agencies Surveyed

Figure 4 compiles the different types of fare media accepted by agencies that responded to the survey. Since one or more fare types can be used by an agency, the total of these percentages can exceed 100 percent as demonstrated in the figure. Transit vouchers are used by only one agency whereas tokens and smart cards (a plastic card with a built in microprocessor) are each used by two agencies. Cash is still the most utilized form of fare payment (85%) while magnetic stripe fare cards (cards encoded with machine readable data on a strip of magnetized material) and paper tickets follow at 54% and 46%, respectively.

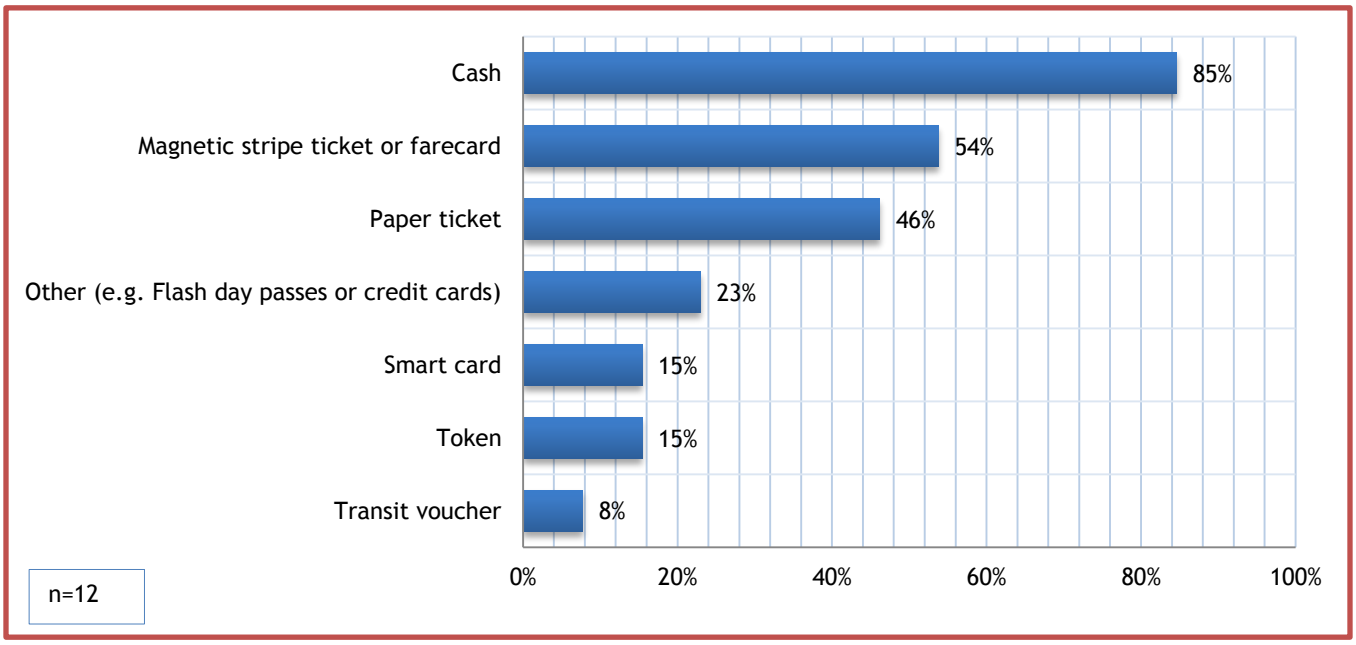


Figure 4 - Forms of Fare Payments Currently Accepted by Florida Agencies

Current Fare Equipment Systems at Agencies Surveyed: Vendors, Strengths, and Weaknesses

On the survey, transit agency respondents were asked about the vendors that provide their current fare collection equipment. Only 10 out of the 12 respondents indicated the vendors who supplied their existing fare system and the date it was installed. The most common vendor for fareboxes was GenFare, an Illinois-based fare system solution provider to transit agencies of all sizes throughout North America. Transit agency respondents were also asked to describe the strengths and limitations of their current fare system. Table 15 summarizes the responses of transit agencies regarding their current fare system's vendors, strengths, and limitations.

Table 15 – Brands of Current Fare Systems at Agencies Surveyed with Strengths and Weaknesses of Each

Transit Agency	Fare Payment System	Strengths	Limitations
Bay County TPO	SPX Genfare	Provides us with the ability to accept multiple forms of payment from one location or fare box. The system has wireless capability so that all financial related data is automatically down loaded to the company server when vehicles enter the transit yard. Stationary vault allows drivers to deposit the collected fares from their fare boxes without ever having to actually touch the money thus reducing the opportunity for theft.	SPX Genfare is extremely expensive and does not have the best customer service.
Collier Area Transit	FareLogistics (Trapeze) Voyager V36 Electronic Validating Farebox	Smart card technology, report capabilities, software ease of use	Day pass requires a specific date; we would like an open date system.
Hillsborough Area Regional Transit	SPX Genfare (GFI) - dates unknown. Most of the current equipment goes back 15+ years.	Simple legacy system.	Limited data retrieval. No longer 100% reliable. Boxes jamming and failing on-route.
Hernando County Transit	N/A	None	Skipped question
Lakeland Area Mass Transit	Genfare	Skipped question	Skipped question
LeeTran	Genfare Centsabill	Our current system is very old and we are in the process of reviewing potential replacement systems.	Weakness in recognizing bill types. Limited applications for media types other than magnetic strips.
Manatee County Area Transit	Genfare	For the operator, there is minimum interaction when collecting fares. With majority of passengers using the tickets, the operator only has to review ID if necessary or push a button to identify which type of fare was paid in cash.	skipped question

Transit Agency	Fare Payment System	Strengths	Limitations
Martin County Public Transit	As of this date MARTY has a simple drop box for cash fares and the 1-Day and 20/4/20 paper printed fare passes are purchased on the buses with cash. In the process of putting out a RFP for AVL/CAD/GPS system that will have the ability to accept fare by phone pay upon boarding through an app. Will not able to afford either magnetic strip fare cards/fare boxes or smart card technologies. In the near future, MARTY will accept cash, paper fare media locally printed and sold on the buses and pay by phone upon boarding.	Inexpensive	Cash only
Ocala /Marion TPO	No vendor, it is a manual system.		
Pasco County Public Transportation	SPX Genfare Odyssey Fareboxes Many dates for the installations	Back office is very good. Ease of use for the passenger.	Very little, they are smart card ready.
Pinellas Suncoast Transit Authority	SPX Genfare (GFI). The fareboxes have been in place for 10 years with some updates.	The system is reliable with minimal problems. Most parts can be easily replaced by the maintenance staff.	The fare system can only be used in Pinellas County with some connecting routes with HART.
StarMetro	FareLogistics, however they were purchased by Trapeze. We installed our fareboxes in 2007.	Able to get reports on ridership at the stop, run, route, and system level. Able to maintain separate databases for the different fare types	Memory limitations causes lost data at the stop and run level. Current devices are obsolete with limited support options. Difficult to customize fare programs to better meet the needs of our customers.

Current and Future Regional Fare Collection Systems

The survey asked participants, if their agency is part of a regional (more than one agency) fare collection system. Among agencies responding, 25% indicated that they are part of a regional fare system while 33% are working toward being in a regional system and 8% indicated that they might consider that for the future, (see Figure 5). Some agencies further explained their answers:

- Martin County Public Transit - "We have a transfer policy with St Lucie County where a paper transfer is issued free of charge with the purchase of a regular fare that is accepted by both County's"
- Pinellas Suncoast Transit Authority – "The Regional Revenue Collection system has gone out for bid with a vendor selected. The contract will be presented to the boards before the end of the year"
- LeeTran – "Considering how we could implement a system to work with neighboring counties transit systems"

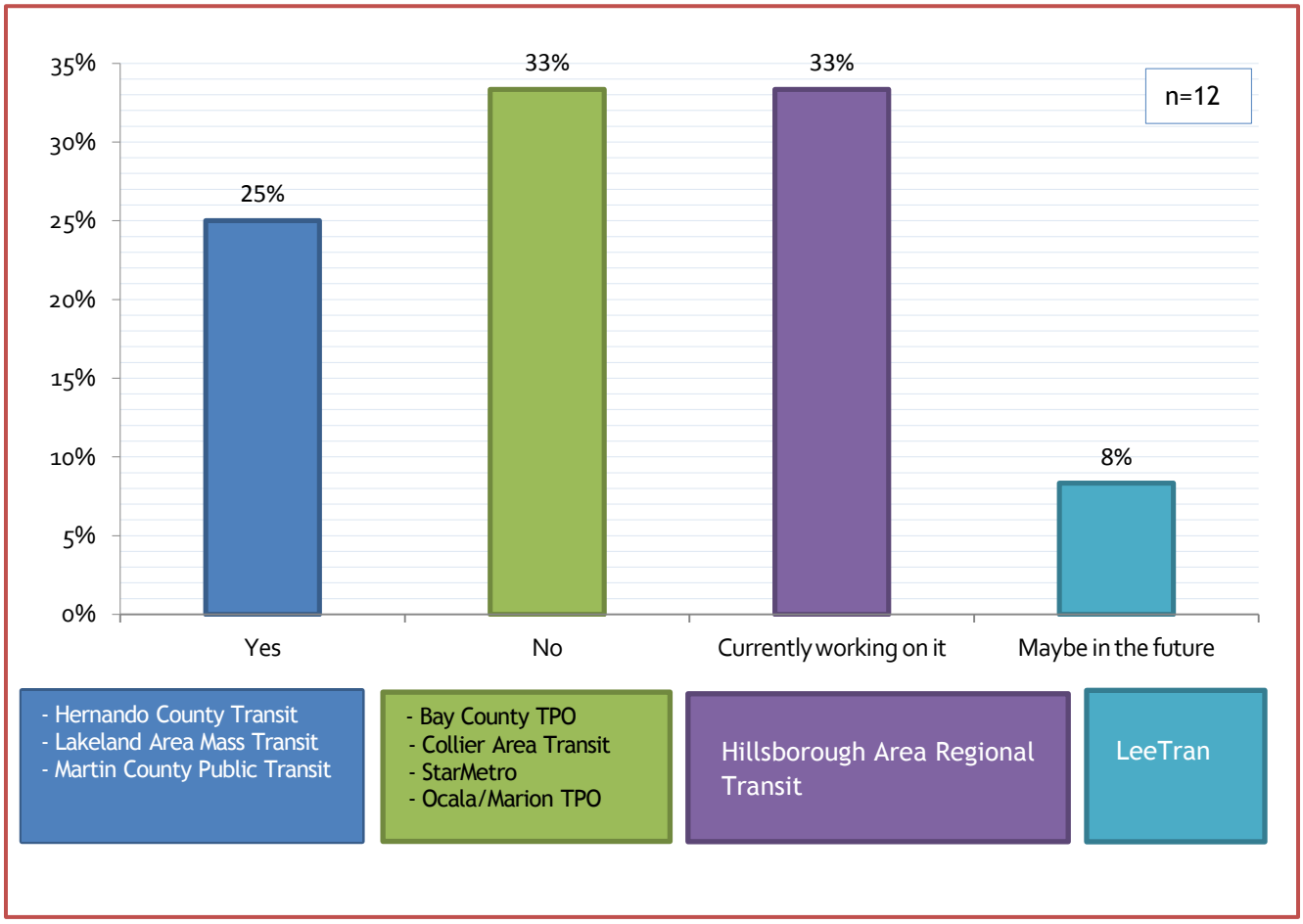


Figure 5 – Regional Partnerships among Florida Transit Agencies Surveyed

Reasons for Planning to Deploy Mobile Ticketing

The respondents were asked to rank their reasons for considering mobile ticketing, with one as a major contributor and five as a minor contributor. Table 16 reveals that the majority of transit agencies surveyed look at mobile fare payment as a way to help with streamlining fare payment and as a tool for deploying real-time information and other features as part of the fare payment app. It seems that responding agencies did not consider other regional deployments of mobile fare payment solutions as major factor when considering their own mobile fare payment deployment. When asked if your agency plans to deploy mobile ticketing what are the most important reasons with 1 being a major contributor and 5 as a minor one, survey respondents provided the following rankings:

Table 16 - Reasons for Planning to Deploy Mobile Ticketing

	Reasons for Planning to Deploy Mobile Ticketing Ranked 1 to 5					
Answer Options	1 Major contributor	2 Moderate contributor	3 Neutral	4 Less of a contributor	5 Not a contributor	Weighted average
Our regional partners are deploying mobile fare payment	✓	✓	✓✓✓	-	✓✓✓✓✓	3.7
Funds for procuring mobile fare payment system are available	✓	-	✓✓✓✓	✓✓	✓✓✓	3.6
It can help with streamlining fare payment	✓✓✓✓✓✓	✓	-	✓	✓✓	2.09
Deploying real-time and other info apps with fare payment app	✓✓✓✓✓✓	-	✓	-	✓✓✓	2.27
Other factors (inexpensive, part of regional, convenience for patrons, reduce are collections errors)	✓✓	✓	✓	✓	✓	2.67

Stages in the Process of Procuring a Mobile Fare Payment System

Figure 6 shows that 4 out of the 10 agencies responding to this question are researching mobile fare payment options while 2 are in the procurement process 'other' included the following 3 responses:

- HART – "Bids just accepted last week. Innovations in Transportation (Init), Inc. successful bidder."
- StarMetro – "FDOT selected us to be pilot system for their program starting in summer 2016."
- Hernando County Transit - "We are part of the regional working group."

An important finding from this question is that, at the time of the survey, no respondents indicated their agencies have beta tested or deployed mobile ticketing systems. However, two agencies were preparing RFPs, and two were selecting vendors. Subsequent to the survey, the research team learned that the Jacksonville Transportation Authority recently deployed the MyJTA app with a

mobile payment feature. Sun Trolley, administered by the Downtown Fort Lauderdale Transportation Management Association has also recently received approval from its Board of Directors to conduct a mobile payment pilot project. As indicated in the survey, efforts are underway for a regional fare collection procurement with mobile fare payment features that will eventually include transit operators from Pinellas, Hillsborough, Manatee, Hernando, and Polk Counties.

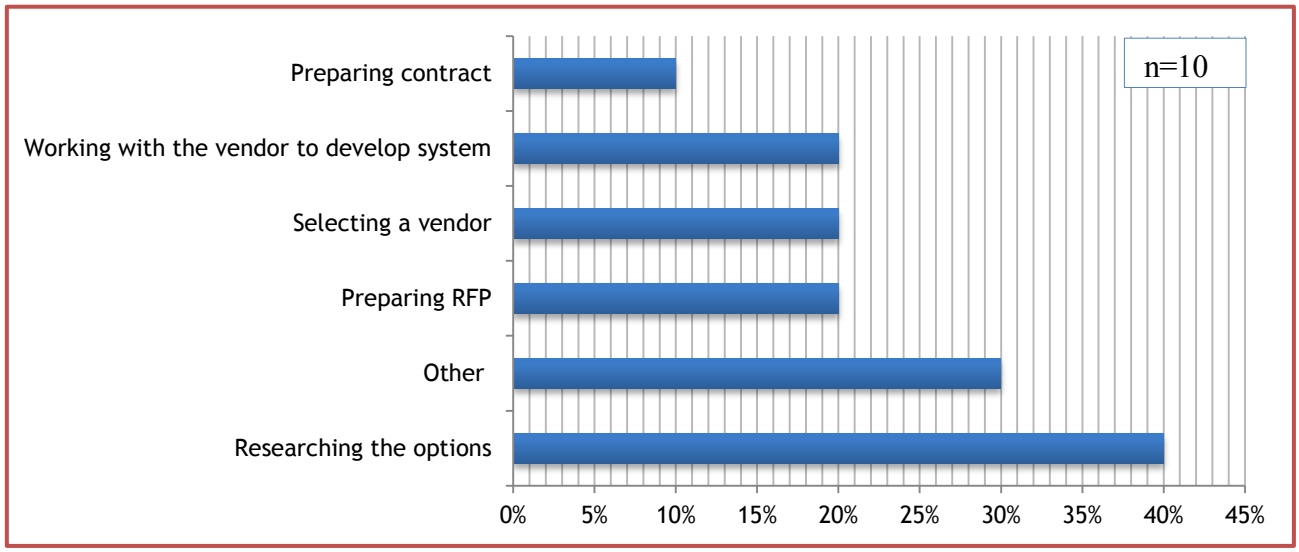


Figure 6 – Status of Mobile Fare Payment Process among Florida Transit Agencies Surveyed

In addition to the survey conducted for this project, teleconference calls were conducted to learn more about the status of mobile fare deployment in Broward County Transit (BCT) and in the Tampa Bay Area (with HART and PSTA).

- Status of BCT's Mobile Ticketing Project
  - BCT and Palm Tran received funding from local government for a fare interoperability project, which includes mobile ticketing technology
  - With political push from the local government, they are speeding through the process
  - BCT completed both RFI and RFP for the Mobile Ticketing and Fare Interoperability project. BCT received responses from 8 vendors on the RFI. The RFP was present to Broward County Board on 1/5/16 for approval to issue solicitation; expected date for solicitation is 1/7/16.
- Status of Mobile Ticketing Project in the Tampa Bay Area
- Currently, HART and PSTA are finalizing the contract with the vendor to ensure that all parties are satisfied with the specifics of the contract and that it meets all the legal requirements of the organizations. The final request will then go to the HART Board for approval on February 1, 2016 and the notice to proceed (NTP) will be given to the vendor. It is anticipated that the kickoff meeting will happen within a week of NTP.

Types of Information Needed to Make a Decision on Mobile Fare Payment Option

Figure 7 shows that the cost of a mobile fare system is one of the important pieces of information that agencies are examining in order to make informed decisions about a mobile fare payment option (70%). Specifications and case studies were valuable to half of the respondents while RFP examples were perceived as a helpful resource in the process of researching mobile fare payment options.

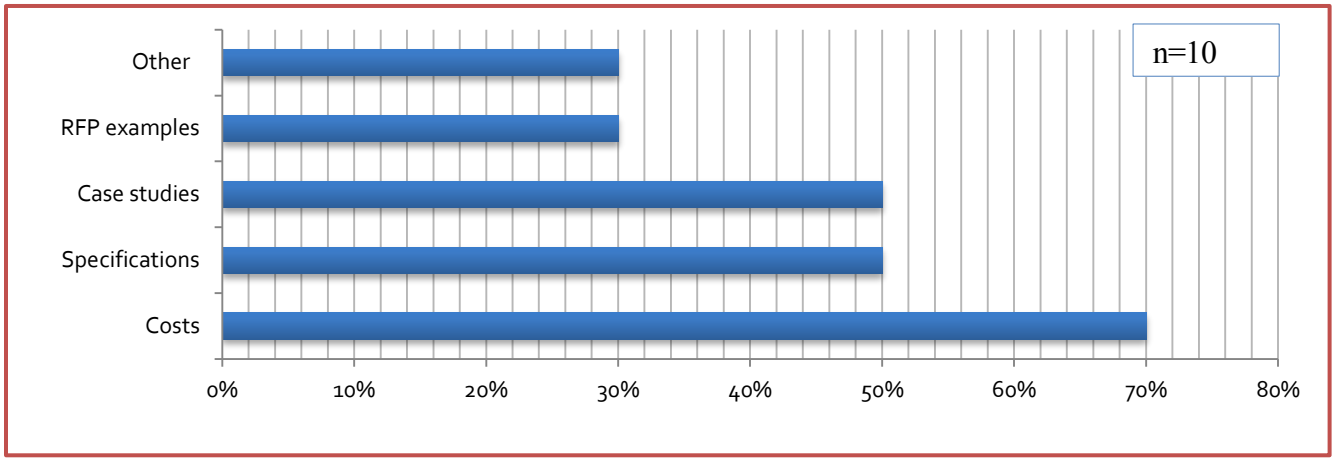


Figure 7 – Types of Information Respondents Need to Make Decisions about Mobile Fare Payments

The "other" category in the survey included the following responses:

- HART – "We are past this point. We have decided."
- StarMetro –"Waiting on FDOT."
- LeeTran – "Technologies in fare systems have far exceeded our current system. We want to make sure we are entering into a system that will allow us the maximum flexibility in fare collection and providing convenience to our patrons."

Current Mobile Apps Offered to the Public by Participating Agencies

Only 5 agencies responded to the question about other mobile apps that they are offering. Trip planning is offered by 3 of the 5 agencies, scheduled arrival time information is offered by two and real-time arrival information is offered by one agency, see Figure 8.

'Other' in the figure indicated the following:

- Not applicable
- Not at this time
- We are looking into one that has Google maps along with the fare app.
- PSTA – "Working with USF/CUTR, PSTA is working to release One Bus Away app."

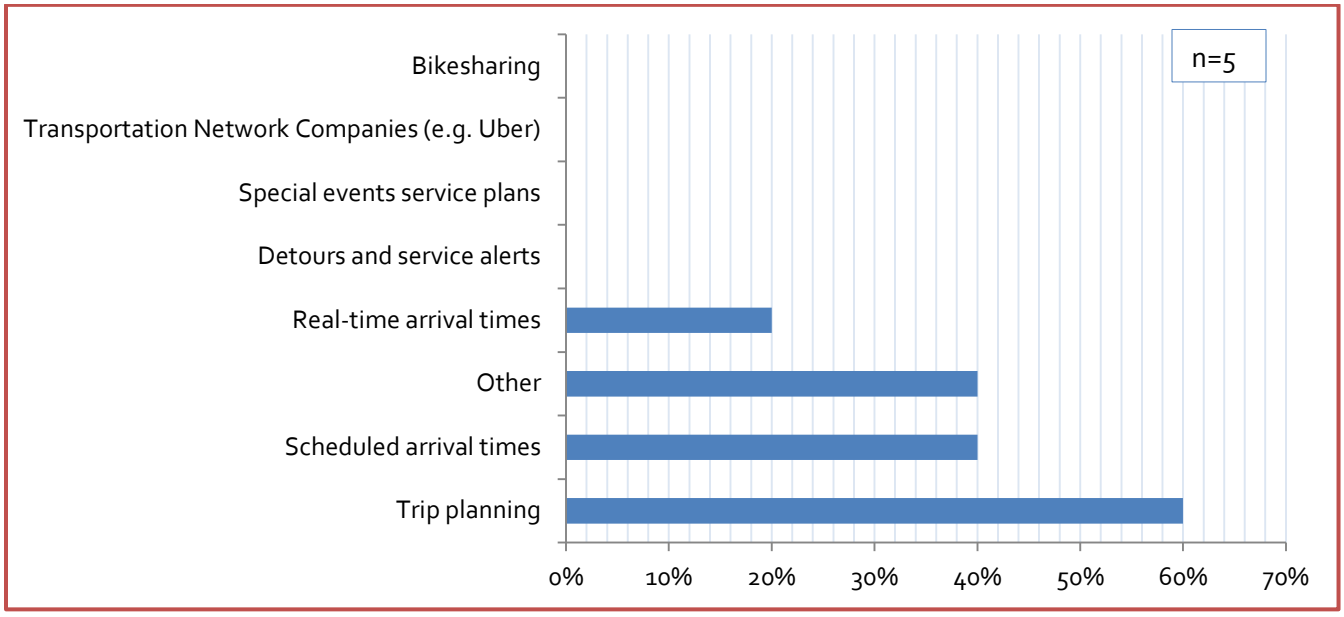


Figure 8 - Current Mobile Apps Offered to the Public by Participating Agencies

Other Comments, Questions, or Suggestions Relevant to Mobile Ticketing

Open-ended comments from survey participants included the following:

- "We are currently working with a vendor to develop a mobile app for next bus technology."
- "I would like to know if you could provide a contact list of agencies with mobile fare systems so we may find out best practices."
- "Concerns exist on how to collect fares if partnering with other transit agencies in utilizing these technologies."
- "I think it would be a great way to collect the fares for better accuracy, reliability, and accountability."

In addition to the comments received from the survey, ongoing discussions on the integration of regional transit mobile fare technology to the Turnpike office. In the future, the Turnpike Office may consider developing an app that would allow for transit payment using a single Sunpass payment card.

Conclusions

Mobile ticketing applications using proof of payment (visual verification) are typically done as an add-on to pre-existing fare payment systems using cash, paper tickets, or other fare media. Transit agencies in Florida could follow the example of transit operators in other regions who have added mobile ticketing apps as an additional, more convenient method of fare payment. However, if transit agencies in Florida wanted an NFC-based mobile ticketing solution, this would require extensive overhaul of most pre-existing fare systems, including likely changes to backend systems and fare boxes / fare gates. The survey of some Florida agencies gives insight into what planners are doing about new fare payment options as well as what they would need to make an informed decision about that option. The potential costs of deploying a mobile fare system topped the list of needed information to make an informed decision. More than half of the respondent skipped the question about other apps they have or are working to attain, while some answered with 'not applicable' instead of none available. Further investigation to get a better understanding of mobile apps used by Florida transit agencies and the trends of use by time would inform the industry of how Florida is progressing on this front. From the open-ended comment section, it seems that more information is being sought to address concerns for regional system deployments. The final report of this study will indeed address some of these information needs with case examples and lessons learned.

Chapter 4 - Concept of Operations for a Pilot Project

Introduction

The main goal of the mobile ticketing pilot project is to assist the transit agency in assessing if mobile ticketing will help reduce cash transactions on transit vehicles and provide customers a new, convenient way to pay their fares. This pilot test is intended to allow the transit agency to evaluate the efficacy of this solution and gauge public interest in a full rollout of mobile ticketing in the future.

Concept of Operations

Customer-facing Mobile Ticketing Application

During the pilot project, customers will be able to do the following:

- The mobile ticketing system will allow customers to download and install a mobile application (mobile "app") on their smartphone (iOS, Android, and possibly other platforms).
- After downloading the mobile app, customers will create an account through a one-time setup process that prompts users for billing information (e.g., credit cards, debit cards or other electronic payment).
- Once a customer has an account, the user will be able to login using an ID and password. They will then be greeted with the home screen of the mobile app.
- On the home screen, the user will see the name of the transit agency. The user will then be directed to a page that allows them to purchase fare products.
- Users will be able to purchase multiple fare products at once, and maintain multiple fare products attached to their account and accessible for use within the mobile app.
- At the time of travel, customers will launch the mobile app, select the fare product they wish to use, and then activate the ticket. Activation of the ticket should be able to occur in an offline mode (i.e., Internet/network access is not necessary to activate the ticket).
- After activation, the mobile ticket will provide a visual indicator that the customer can show to the driver / fare inspector. This visual indicator will be available for a set period of time for which the ticket is valid.
- An activated mobile ticket should be presented in two configurations: a visually validated ticket and a barcode / QR code. The visually validated ticket will have an interface that enables drivers / fare inspectors to easily identify a valid ticket. The visual indicator should include anti-tampering features that would prevent users from fraudulently using images or videos of invalid tickets as a valid proof-of-payment. The barcode / QR code ticket can be validated by having the fare inspector scan it using a "fare inspector mobile application".

- All mobile tickets will include the following: a high security image with anti-tampering features, a barcode / QR Code, transit agency logo, validity period, and the fare type.
- After a set period, the activated mobile ticket will expire and will no longer be available for use. Expired tickets should be easily visually distinguishable from valid tickets. The customer will be able to view a history of purchased and expired mobile tickets.
- At any time during the use of the mobile app, the customer can access a "help" page with frequently asked questions (FAQs) about mobile ticketing.

Additional Mobile Ticketing Application Features

In addition to the mobile ticketing functionality, it is envisioned that the customer-facing mobile app will have additional useful features for customers. These could include, but are not limited, to the following:

- Trip planning functionality using transit schedule information;
- Real-time vehicle tracking and estimated vehicle arrival information;
- Ability to access ride-sharing services (such as Uber or Lyft);
- Security reporting, such as "see something, say something" functionality to report suspicious behavior; and/or
- General feedback / non-emergency issue reporting (e.g., for broken benches or bus drivers compliments and/or complaints).

While not all of these features are required for the pilot project, the transit agency and app developer should consider incorporating as many of them as possible during the pilot. At a minimum, the transit agency and app developer should ensure that they could easily be incorporated into the mobile ticketing app in the future.

Fare Inspector Application

During the pilot project, the transit agency will test a fare inspector mobile application that can be used to validate mobile tickets with a barcode / QR code. Fare inspectors will be able to use this smartphone app to conduct more detailed ticket checks (beyond visual validation) by scanning the barcode / QR code on the customer-facing mobile app. The fare inspector application will automatically report to a backend system the following information about validated tickets:

- Date and time of validation;
- Date and time of ticket purchase;
- Date and time of ticket activation;
- Location;
- Inspector ID number;
- Fare type; and
- Customer account ID number.

Reporting and Backend System

For the pilot project, the developer will provide a web-based tool for use by transit agency staff. This will include, but not be limited to, the following functionality:

- Access to records of all customer transactions using mobile ticketing, including all ticket purchases, validation, and activation, as well as the ability to export these records to a machine-readable data format such as Comma-Separated Values (CSV) files that could be viewed and analyzed in another application (e.g., Microsoft Excel);
- Electronic reports summarizing daily, weekly, and monthly sales
- A mechanism for reimbursing customer mobile tickets; and
- A mechanism for receiving questions and comments from customers (i.e., "Contact Us").

Financial Processing

The mobile ticketing system will have the following financial functionality:

- The system will accept MasterCard, Visa, debit cards and PayPal payments;
- The developer will be responsible for all back office functions;
- The developer will comply with the latest Payment Card Industry (PCI) data security standards, including all audit and compliance certification activities; and
  The developer will deposit fare revenues (minus applicable fees and taxes) into the transit agency bank account on a regular basis (with the specific dates / frequency to be agreed upon).

Estimated Pilot Project Timeline

The estimated pilot project timeline incorporates the preparation of solicitation documents, the vendor award process, the design and development of required software, a pilot phase, and a pilot project evaluation. These timeframes are variable and will be subject to change depending on the specific transit agency chosen for the pilot project. Therefore, this timeline should be treated as a broad guideline, and ranges are given for each task. A best-case timeline is approximately 12 months, and a longer timeframe is approximately 24 months from start to finish.

Five stages of the timeline suggested are shown in Figure 9. First, the solicitation documents will be prepared by the transit agency conducting the pilot project based on the concepts outlined in this report. This process could take between one and three months and is subject to internal agency review and procedures. Next, the vendor will be selected and awarded a contract, which could take approximately two to three months depending on agency procurement procedures. After that, it is envisioned that the contractor will have three to six months for software development, which is likely to primarily consistent of modifications to their preexisting mobile ticketing application and backend system to meet the needs of the participating transit agency.

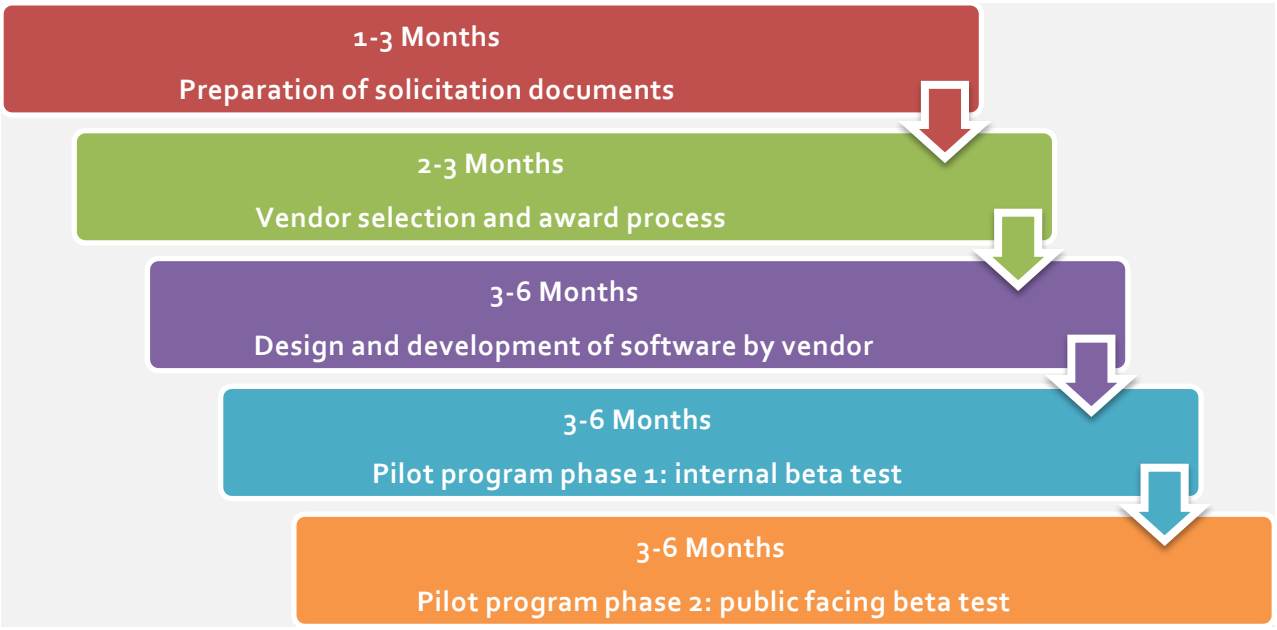


Figure 9 - Estimated Timeline for the Pilot Project

Following the implementation of the system, the pilot project will begin. It is recommended that this pilot be conducted in two phases. The first phase consists of "beta" testing with agency staff. By conducting internal testing first, the transit agency can work hand-in-hand with the contractor to identify any immediate issues. The second phase of the beta test would include a public facing pilot program. This public facing beta test could include recruiting a select number of transit riders (e.g., 100 to 1,000 riders) and having them use the mobile ticketing app as they ride the transit system over a predetermined time period (e.g., 1 or 2 months). This second beta test can help to identify missing use cases; problems with the mobile app on specific mobile device make, models, or software versions; logistical issues with operations related to issuing or validating tickets; or other possible areas for improvement before a full-scale public launch of mobile ticketing at the agency.

Estimated Pilot Project Budget

Because the actual budget of a pilot project will heavily depend on the procurement process and vendor responses to a solicitation, this section presents budget numbers from preexisting mobile ticketing programs at other transit agencies as a reference. These numbers provide "ballpark" figures that may be reasonable to expect should a mobile ticketing project be implemented at a transit agency in Florida. It is likely that the primary mechanism for compensation for the contracted mobile ticketing vendor will be via a transaction-based fee. For example, this transaction-based fee could be a percentage payment for all mobile ticketing transactions (such as is done by Passport at COMET) or a flat fee based on an estimated number of mobile ticketing transactions (such as is done by Masabi at NICE). There could also be fixed upfront costs for the initial development of the mobile ticketing system, if vendors responding to the solicitation do not have turnkey systems available that meet the agency's needs.

The actual costs for two transit providers, which serve as ballpark estimates for what transit agencies in Florida could expect in a pilot.

- NICE (Masabi)
- NICE pays Masabi a fixed annual fee of approximately $80,000 per year for maintenance of the mobile ticketing system.
- COMET (Passport)
- Passport waived the start-up fee of $150,000. They collect 10% of gross mobile app ticket sales.

Roles and Responsibilities

The following is a brief delineation of important roles and responsibilities for a transit agency considering a mobile ticketing pilot. This information can be used to ascertain the level of interest of an agency in participating in a pilot and clearly communicate the expectations for participation in a pilot.

A participating transit agency would first need to identify if a mobile ticketing system fits into its overall business plan. Does the agency have the resources that will be necessary to participate in a pilot? Can it make a commitment to devote those resources to ensure a successful pilot? Is there a reasonable expectation that the project would be go beyond the pilot project phase?

In most case studies reviewed by the project team, agencies that deployed mobile payment systems devoted a significant amount of staff effort in the areas of planning, procurement, training, beta testing, and system modifications. One representative actively involved in a mobile ticketing deployment suggested that due to the level of effort involved (especially in the area of training employees to handle new logistics and customer questions), a pilot should not be undertaken unless an agency has plans for a full rollout post pilot phase.

The following is a list of general roles that transit agency staff would be responsible for as part of a mobile fare payment pilot deployment, as well as typical agency staff that may fill these roles (provided that the agency has sufficient internal expertise for the given roles):

- Managing the pilot program – This role could potentially be assumed by a manager within the existing revenue collection team.
- Training drivers and/or fare inspectors to understand how to identify active mobile tickets and answer customer questions about mobile ticketing – This role could potentially be assumed by existing personnel responsible for training new employees, and/or the existing customer service department.
- Updating internal accounting and reporting procedures to include mobile ticketing transactions – This role could potentially be assumed by existing personnel in the financial/operations departments.

- Marketing to educate riders and the public about the availability of mobile ticketing – This role could be assumed by existing personnel in the marketing, public relations, or customer service departments.
- Information technology integration (if required) – This role could potentially be assumed by an information systems department representative.

The transit agency's first responsibility would be to identify a project manager and representatives from key functional areas (i.e. revenue collection/finance, operations, customer service, etc.) that will participate in system planning and deployment activities. This group should establish a frequent and regular mechanism for both internal communications within the various transit agency departments, as well as external communications with consultants and vendors in order to provide feedback and appropriately respond to any issues that may arise in a timely fashion.

A transit agency's team would also have to commit to work cooperatively with a consultant(s) to develop a detailed Concept of Operations (ConOps) for the mobile payment project. The ConOps would be a document designed to describe the need for the project and the desired project outcomes, based on the specific needs and available resources of the participating transit agency. This ConOps will likely be more detailed than the Concept of Operations supplied in this report and will explain in detail how the proposed system is expected to work within the context of the participating agency and will describe the system's technical, business, and functional objectives. The CopOps would address what the mobile app experience will be from a user's perspective, as well as internal functionality requirements such as necessary updates to internal accounting and reporting procedures to include mobile ticketing transactions.

The ConOps will answer the following questions, both from a customer (i.e., rider) perspective and a transit agency's management perspective:

- What – the desired system capabilities;
- When – the time sequence of planning and deployment activities;
- How – user interface features;
- Who – identification of system internal and external stakeholders; and
- Why – justification for the system and identification of what it will provide.

Once a vendor(s) has been selected and system functionality has been defined, the transit agency would need to ensure that front-line employees receive adequate training so they are able to identify active tickets and answer customer questions about mobile ticketing. This group will likely include drivers/fare inspectors, customer information representatives, and street supervisors. The training should also include elements on how to respond to any fare disputes during the testing phase. An information-sharing process by which any known technical issues can quickly be passed from pilot project managers to the front-line employees, and by which any new problems can be reported by front-line employees to pilot project managers, should be established. Effective information sharing between front-line employees and pilot project managers will allow new

problems to be quickly triaged and addressed, and will mitigate the impact of known issues on customers.

The transit agency would also need to participate in the selection of beta testers/pilot project participants, which would likely include agency employees in addition to existing customers. The total number and desired demographics of recruitment of testers will ultimately depend on the final scope of the project (selected mode, route, fare type, or system-wide pilot). Regardless, a mechanism for the agency to receive feedback from testers should be created. This could take the form of surveys, direct telephone communications, and/or social media. As mentioned above, front-line employees will also be a key contact point for customers to provide feedback.

Marketing the mobile ticketing system will depend on the scope and nature of the pilot, but the agency would be expected to use its resources (website, videos, print media, etc.) to inform the public about the availability of mobile ticketing and to educate individuals on how the mobile app is used.

This research study recommends that an agency target visual and QR code-based validation as part of the pilot project, as these technologies typically require less integration with existing fare payment systems and therefore are typically less costly to deploy. However, based on the exact systems proposed by vendors in response to the agency solicitation, integration with an agency system may be needed. If integration with existing agency systems is required, a member of the information technology department from the transit agency should participate in the pilot project. Even if integration is not required, it is advised to keep the information technology department up-to-date with the ConOps details and project specifications and expectations so they are fully informed and can identify any problems based on future information technology plans and/or needs.

Proposed Evaluation Plan

The following describes a proposed plan for evaluating the efficacy of the pilot project. This evaluation is divided into two components: 1) evaluation by the transit agency staff and 2) evaluation by the public. The first component would largely take place during Phase 1 of the pilot program (internal beta testing), when agency staff are testing the mobile app. This could include regularly scheduled (e.g., biweekly) meetings with agency staff "testers" to discuss functionality of the mobile app, logistical issues given current agency workflow (including potential delays during ticket validation when boarding a transit vehicle), and areas for improvement. The second part of the proposed evaluation plan would be conducted during phase 2 of the pilot program (public facing beta test). The public facing evaluation could be done in multiple ways, including (1) a survey of the beta testers and (2) focus groups / user testing with the beta testers. One or more short surveys of beta testers could be conducted using web-based survey software to easily understand their level of satisfaction with the mobile ticketing app, their level of utilization of the mobile app (e.g., daily, weekly, etc.) and/or the areas of the mobile app that they identify for improvement and additional development. Focus groups, for both internal agency staff and transit riders, could also be used to

ascertain satisfaction with the mobile app and areas for potential improvement. Following the evaluation, the agency team should meet to summarize the results of the pilot test and evaluations, and determine the action items for the next steps forward.

Helpful Tips for Consideration

In both the initial procurement of the mobile ticketing system for the pilot, as well as when looking towards a full public deployment of the mobile ticketing app, the participating agency should consider the following items:

- Experience of the vendor – Prior to procurement for the pilot, references for the vendor should be checked. Mobile ticketing apps for transit is still a relatively new industry, and many vendors are new to the technology.
- Anticipated ability to make future changes to the mobile fare payment apps – It is likely that the agency will want to include new features or integrate with other systems in the future. The agency should evaluate the vendor's ability and willingness to make changes to the mobile apps, and whether an application-programing interface (API) is available for easy integration with other systems, including those provided by other vendors.
- Potential future impacts/disruptions if the mobile fare payment app vendor changes following a public deployment – For example, if Vendor A launches a mobile fare payment app publicly with the agency, but then raises their costs significantly after the initial contract period expires, how does this affect the agency and its customers? Does the vendor own the mobile app and source code? If so, and the agency switches to Vendor B, all transit riders may be forced to download a new mobile app, and may lose any existing payment credit from the previous mobile app. Alternately, if the transit agency owns the mobile app and source code (or an open-source project is used), the agency could potentially keep the same mobile app and have Vendor B integrate the app with Vendor B's backend system. This change would be far less disruptive to riders (they keep the same app on their phone), while avoiding vendor lock-in at the agency and retaining the cost advantages of open competition for support contracts. The agency should consider these intellectual property issues for all systems they procure.
- Ownership of data – The agency should specify that all data generated by the system is owned by the agency. This gives the agency the most flexibility in accessing and sharing data as they wish. If the vendor asserts ownership over the data, the agency will be subject to restrictions imposed by the vendor. For example, if the agency wanted to work with a consultant to independently evaluate their mobile ticketing deployment, and the mobile ticketing vendor owned the data generated by the system, the agency would need to get the vendor's permission before sharing that data with the consultant. Additionally, the vendor could opt to only share certain views of the data (e.g., aggregate instead of disaggregate records) which could alter the evaluation in their favor. If the agency owns the raw data, they are able to provide the full dataset to third parties to ensure impartial evaluation.

Chapter 5 - Selected Pilot Project for Implementation and Evaluation

FDOT selected StarMetro as the pilot agency. StarMetro is the city-owned and operated public bus service for Tallahassee, Florida. It operates fixed-route, a FLEX route, and dial-a-ride service in the Tallahassee metropolitan area. Figure 10 is the service map of StarMetro showing 12 fixed routes.

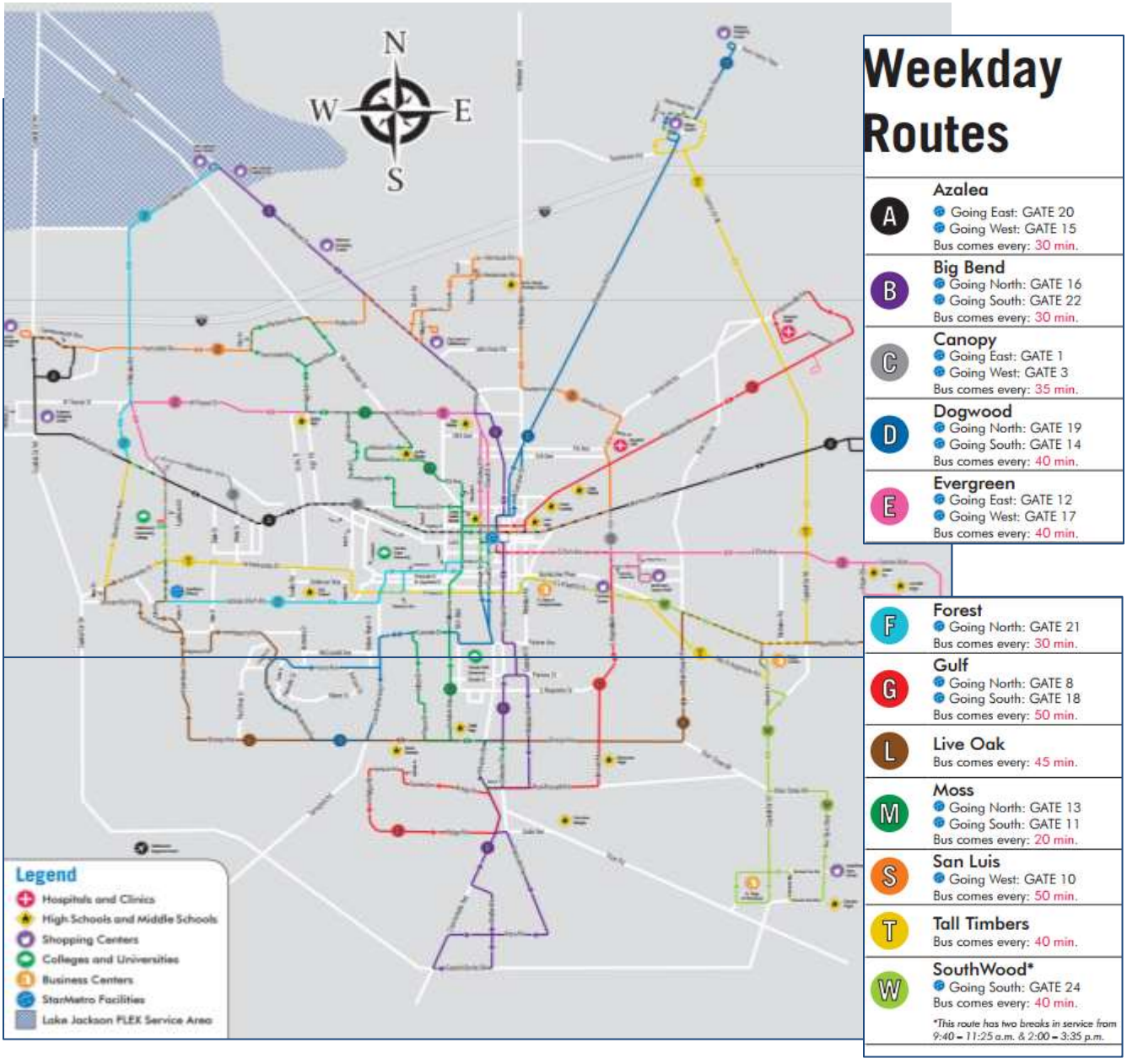


Figure 10 – Weekday Service Map of StarMetro, Tallahassee, Florida

Figure 11 is a screenshot of the app that allows riders to get real-time vehicle location and to plan their trips.

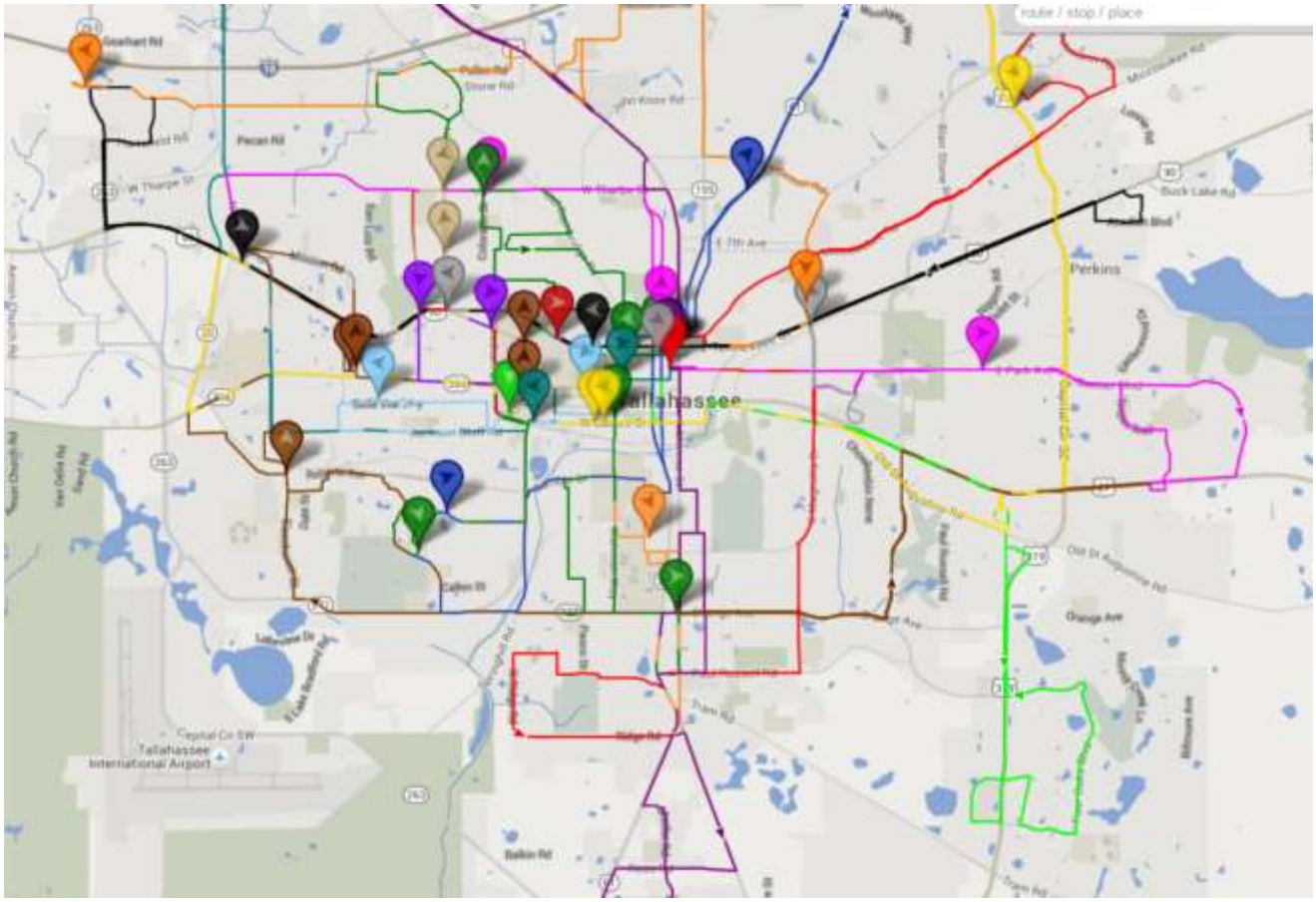


Figure 11- StarMetro Provides a "TransLoc Rider" App for Trip Planning and Real-time Bus Location

Table 17 presents StarMetro's fare structure. Transfers are Free with each one-way fare purchased and are valid for 90 minutes from the time of issue.

Table 17 - Fare Structure at StarMetro

Fare Type	Price
Transfers	FREE
Children Under 42"	FREE
Reduced One-Trip Fare**	$0.60
Regular One-Trip Fare	$1.25
Dial-A-Ride	$2.50
One-Day Unlimited Fare	$3.00
Seven-Day Reduced Fare**	$7.50
Seven-Day Unlimited Pass	$10.00
Monthly Pass*	$38.00
*A $3.00 service charge will be applied to the purchase of new reloadable fare cards **Reduced fare is for seniors, children 17 and younger, persons with disabilities and persons with a Medicare card.	

Concept of Operations for StarMetro

Preparation for developing the Concept of Operations

As previously discussed, the ConOps answers questions from both the rider's and the agency's management perspectives. Brian Waterman, StarMetro's Planning Manager, responded to these questions to help articulate what the agency is expecting from the pilot project study, see Table 18.

Table 18 - The What, When, How, Who, and Why of Mobile Fare Payment Pilot at StarMetro

What - What are the desired system capabilities?	Pay for fare with mobile device via QR code or NFC technology; Allow purchase of multiple fares from mobile device; Receive transfer ticket to mobile device; plan trips via mobile device; show real time bus location on mobile device
When - What is the timeline for planning and deployment activities?	Planning and training to take place during Spring 2016; Deployment during Summer 2016.
How - What are the desired user interface features?	Integration with mobile payment systems, such as Apple Pay, Google Wallet, and PayPal; notification services; Minimal driver intervention
Who - Who are internal and external stakeholders?	Internal stakeholders: drivers, planners, internal financial analysts, IT support staff, and shop mechanics External stakeholders: riders, city officials, and new customers
Why - What is the justification for the system?	Increase ridership via new payment options; improved efficiency in fare collection

StarMetro expressed interest in conducting the pilot on the routes described in Table 19:

Table 19 - Selected Routes for Pilot Project

Route	Route info
SouthWood Express route	Ridership 2200/month; units: 2 buses; 35 stops on route
Gadsden Express route	Ridership 1000/month; unit: 1 bus; 5 stops on route
Forest Route	Ridership 10,000 /month; units: 3 buses; 70 stops on route

StarMetro wanted to incorporate the use of QR readers for validation of the mobile tickets. As discussed in Chapter 2, "Industry Scan of Vendors and Agencies Outside of Florida," in the section titled, "Overview of Transit Mobile Fare Payment;" 3 main types of mobile ticketing applications currently available in the market.

The first displays a visual electronic "ticket" for inspection by a transit agency employee to confirm the customer has purchased the appropriate fare. The electronic ticket typically contains a visual validation security feature such as animations, countdown, or a "color-of-the-day" to prevent users from creating fraudulent electronic tickets through screenshots or other means. The second is a

machine-readable two-dimensional Quick Response (QR) Code; a two-dimension barcode that contains information such as payment account data that can be quickly scanned and decoded. Some mobile apps offer both visual validation and QR Code features so the ticket can be validated visually by agency staff at locations where QR Code readers are not available, but QR Codes can also still be validated via a scan where readers are available. The third type of mobile ticketing application uses Near Field Communication (NFC).

The specifications of the following features as previously described were used to draft the request for an estimate from vendors that offer mobile fare payments, see Appendix D.

- Customer-facing Mobile Ticketing Application
- Additional Mobile Ticketing Application Features
- Fare Inspection Application
- Reporting and Backend System
- Financial Processing

Estimated Pilot Project Budget and Timeline

FDOT has requested estimates from vendors within this, Phase 1, of the research project. Appendix D includes the invitation to participate in the pilot study that was sent to the following vendors:

- Accenture
- Access IS
- Am analytics
- Bytemark
- Cubic Corporation
- GlobeSherpa
- Hopon
- Masabi
- Nextperts
- Passport
- Showclix
- Token Transit
- Trapeze
- Unwire
- Xerox

Responses were received from four vendors anonymized with a range of budget estimates as shown in Table 20.

Table 20 – Summary of Responses from Vendors

Vendors	Plans	Cost Estimates	Timeline
Vendor A	• Mobile real time ticketing (MRTT): Reload, purchase, share and pay transit fare in real time with any smart card or smartphone. • Dynamic fare pricing: Create, modify, differentiate and condition transit fare pricing in real time, from anywhere. • Smart subsidy administration: Manage all subsidy programs on a single back-office interface in real time.	None for smartcard app	N/A
Vendor B	• Universal App with agency-configurable fare structure • Visual verification mobile tickets for iOS and Android devices (no hardware necessary) (no QR Code reading support – would need to be part of an additional estimate) • Secure mobile ticket purchases using a credit card or bank account • Detailed analytics and integration with existing data infrastructure	8% of the final sale value of each mobile ticket purchased through app	3 months
Vendor C	• Planning and Kick-off: During the planning phase of the project, the vendor will work closely with FDOT and StarMetro to evaluate final requirements for the mobile ticketing project, create and agree upon a project plan, and build a project schedule. • Design: During the preliminary and final design phases of the project, vendor will finalize all technical specifications, system architecture, user interfaces, and system integrations. • Development: During the development phase of this project, the vendor will perform all coding, unit testing, configuration, integrations, and necessary updates to support this project launch. • Factory Acceptance Testing: Following development, the vendor will work closely with FDOT and StarMetro to test system components of the product, integrations, perform FAT, System acceptance, and resolve all bugs. • User Acceptance Testing: Following FAT, Vendor will test the application with a limited number of pre-determined users. • Pilot: After all User Acceptance Testing has been completed and any necessary changes from FAT and UAT have been incorporated into the application, Vendor will work with FDOT and StarMetro to launch a pilot on a specific line or mode. • Deployment: In each phase of the deployment, all ticketing software will be prepared for full production release including submission to app stores, training, and full implementation.	• Costs of readers between $1,500 and $3,000 per unit while estimates of software costs included upfront fee to support deployment costs: $25,000-$125,000, monthly • maintenance fee to support ongoing support: $5,000-$15,000, • and per transaction: 2%-5% + payment processing costs.	6 months to launch
Vendor D	• System Configuration and Setup • Role creation and User group Setup • Branded and Configured Android and iOS application, • and mobile website • Native Trip Planning • Native Vehicle Tracking • Merchant processing / funds flow configuration • Digital Eligibility Systems • Business Inclusion Program (couponing system) • Payment option configuration • Cloud-based back end system for system • configuration and reporting • Onsite Operator Training • Initial marketing of the mobile system • Branded, mobile ticketing-specific landing page • Ongoing Enhancements and software updates • Ongoing Client (Transit Agency) support	• $55,000 One Year Pilot • Custom or Expedited Software Development for an expedited feature or a StarMetro specific feature build out ($250/hr) • Travel Flights, hotels, meals (Pass through cost) • Credit Card Processing Costs and all fees associated with accepting credit card payments will be the responsibility of StarMetro	3 months

Roles and Responsibilities

StarMetro has selected the following staff members to fulfill these roles and responsibilities, see Table 21. It should be noted that depending on the level of expertise of each of the selected team members, an outside consultant might be retained to provide executive assistance in management of the pilot.

Table 21 – StarMetro's Chosen Team Members for the Pilot Study

	Roles	Name and Contact Info
1	Managing the pilot program	Brian Waterman Brian.waterman@talgov.com
2	Training drivers and/or fare inspectors to understand how to identify active mobile tickets and answer customer questions about mobile ticketing	Arnetria Thomas Arnetria.Thomas@talgov.com
3	Updating internal accounting and reporting procedures to include mobile ticketing transactions	Kelly Kindell Kelly.kindell@talgov.com
4	Marketing to educate riders and the general public about the availability of mobile ticketing	LaVonia Sampson-Jones Lavonia.sampson-jones@talgov.com
5	Information technology integration (if required)	Clem Novenario clem.novenario@talgov.com

Proposed Evaluation Plan

It is recommended that Phase 2 of the project be focused on the evaluation not the management of the pilot. The evaluation is divided into two components:

Evaluation by the StarMetro Staff

The first component would largely take place during Phase 1 of the pilot program (internal beta testing), when agency staff are testing the mobile app. We recommend that there are regularly scheduled (e.g., biweekly) meetings with agency staff "testers" to discuss functionality of the mobile app, logistical issues given current agency workflow (including potential delays during ticket validation when boarding a transit vehicle), and areas for improvement. Additionally, during the first part of the evaluation, the following performance metrics should be tracked:

1. Number of mobile tickets successfully purchased by agency staff testers
2. Number of failed attempts are purchasing a mobile ticket (to be documented by agency staff testers)
3. Reason(s) for any failed attempt of purchasing a mobile ticket (to be documented by agency staff testers)
4. Amount of time it takes to validate a ticket via the mobile app when boarding a transit vehicle
5. Amount of time it takes to validate a normal fare when boarding a transit vehicle

At the conclusion of Phase 1 of the beta test, bus operators on the selected routes will be surveyed to gain an understanding of their field experience with the mobile app.

Evaluation by the public

The second part of the proposed evaluation plan would be conducted during phase 2 of the pilot program. It is recommended that the public facing evaluation be conducted in the following two ways: (1) focus group / user testing and (2) a survey of beta testers.

Focus Group / User Testing

StarMetro riders would be recruited to participate in a 2-hour focus group before the mobile ticketing application becomes available for use by any riders. The focus group could be divided in two parts, each lasting approximately 1 hour. In the first part, users would test a demo smartphone application, and in the second, they would participate in a focus group discussion. User testing can be conducted by connecting a computer to a small video camera that clipped onto the bezel of a smartphone. This setup allows observers to follow users' interaction with the app in real-time and records it for future analysis. Two smartphones should be available for testing (one iPhone, one Android) so that customers can try the application on their usual operating system. Each rider should be given a smartphone and instructed to purchase their usual ticket for StarMetro. They would receive no other directions. Instead, they are asked to figure out how to use the app while vocalizing their thought process. Once they successfully buy their usual ticket, they could be instructed to make a second purchase of another ticket type (monthly pass or single ride). If other features are available via the mobile app (real-time arrival information, trip planning, etc.), the rider can also be asked to view real-time information for their favorite bus stop, or plan a trip from their home to work, and similar observations can be made as to how the rider interacts with the application.

After participants complete testing of the smartphone application, they should join a focus group discussion about mobile ticketing. First, riders could be asked to describe the drawbacks (i.e. pain points) of the current ticketing system on StarMetro. Then, riders can be asked to provide feedback about mobile ticketing. Each participant should receive a list with the following questions to help structure the discussion:

- What did you like and/or dislike about the app?
- How would this app impact your daily commute?
- What would convince you and your family/friends to use mobile ticketing?
- Is mobile ticketing more convenient than the current method you use to pay your fare?

Survey of Beta Testers

After the focus group has been conducted, the mobile ticketing application would be provided to a small number (e.g., 100) of "beta testers". The composition of this beta testing group should ideally be close in demographics to StarMetro riders. Because one of the key goals of implementing mobile ticketing is the reduction of cash transactions, the beta testing group should contain a number of riders that typically use cash payments. The beta testers would download the app on their smartphone and use it as they ride the StarMetro system for a specified period (e.g., 1 month). Users will be asked to provide ongoing feedback regarding their experiences with the mobile app via a Facebook users' page. After the completion of the beta testing period, a short web-based survey would be sent to each beta tester to complete. The survey would contain questions on the following topics:

- Total number of mobile tickets successfully purchased by beta testers during the testing period
- Their level of utilization of the mobile app (e.g. daily, weekly, etc.)
- Issues experienced while purchasing a ticket (if any)
- Areas of the mobile app that they identify for improvement and additional development
- Level of satisfaction with the mobile ticketing app
- Their level of desire for containing to use the mobile ticketing app following the beta test
- Other features (e.g., real-time arrival information, trip planning) used
- Their typical method and frequency of fare payment prior to using the mobile app (to help capture if any riders reduced cash payments as part of the beta)

The survey results should then be reviewed to assess the performance of the app.

Additionally, the evaluation will include an analysis of StarMetro's call center activities related to beta tester inquiries about utilization and performance of the mobile app and a follow-up survey of bus operators regarding issues and opportunities for a potential system-wide deployment.

Following the evaluation, the agency team should meet to summarize the results of the pilot test and evaluations, and determine the action items for the next steps forward.

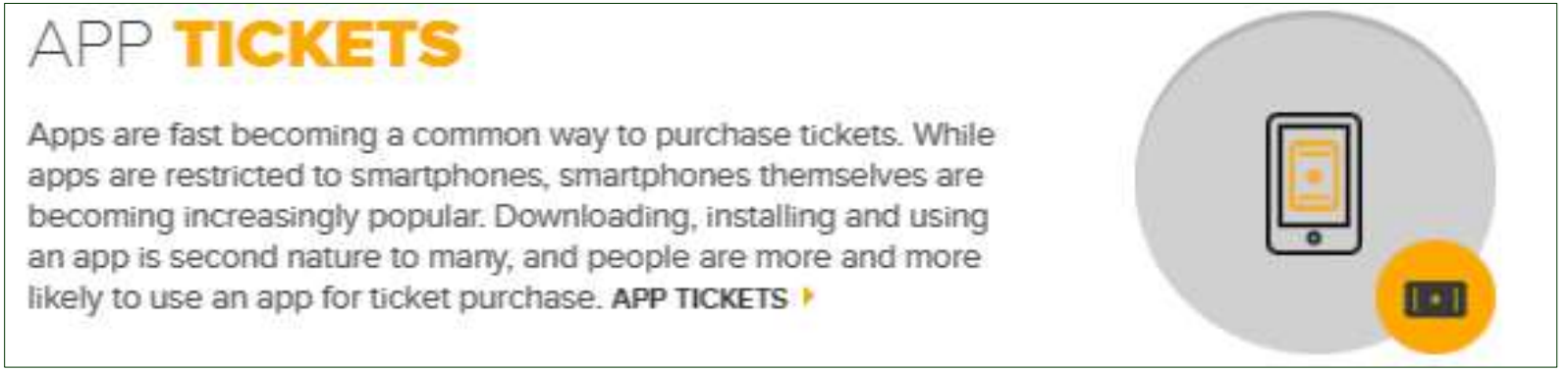
Next Steps for Conducting the Pilot Study

Phase 2 of the pilot study will involve StarMetro working with the vendor to finalize the details of terms of the pilot agreement, followed by the pilot deployment of a mobile ticketing solution. It is recommended that the management and evaluation tasks during the pilot deployment be conducted by two separate entities to maintain objectivity. The agreement between StarMetro and the vendor will likely include details pertaining to the timeline for development and launch, training terms, the terms of payment, liability issues when installing hardware on StarMetro buses, marketing plan, configuration of app to reflect the StarMetro, details of help/support pages (potentially including a Facebook or other social media group to collect user feedback), reporting requirements, and the beta testing terms with number of participants and survey instruments identified.Phase 2 of the pilot study will involve setting up a joint agreement between StarMetro and the vendor after working on the specifics of the agreement, for example, the timeline for development and launch, training terms, the terms of payment, liability issues when installing hardware on StarMetro buses, marketing plan, configuration of app to reflect the StarMetro, details of help/support pages (potentially including a Facebook or other social media group to collect user feedback), reporting requirements, and the beta testing terms with number of participants and survey instruments identified.

APPENDIX A – MOBILE FARE PAYMENT FEATURES

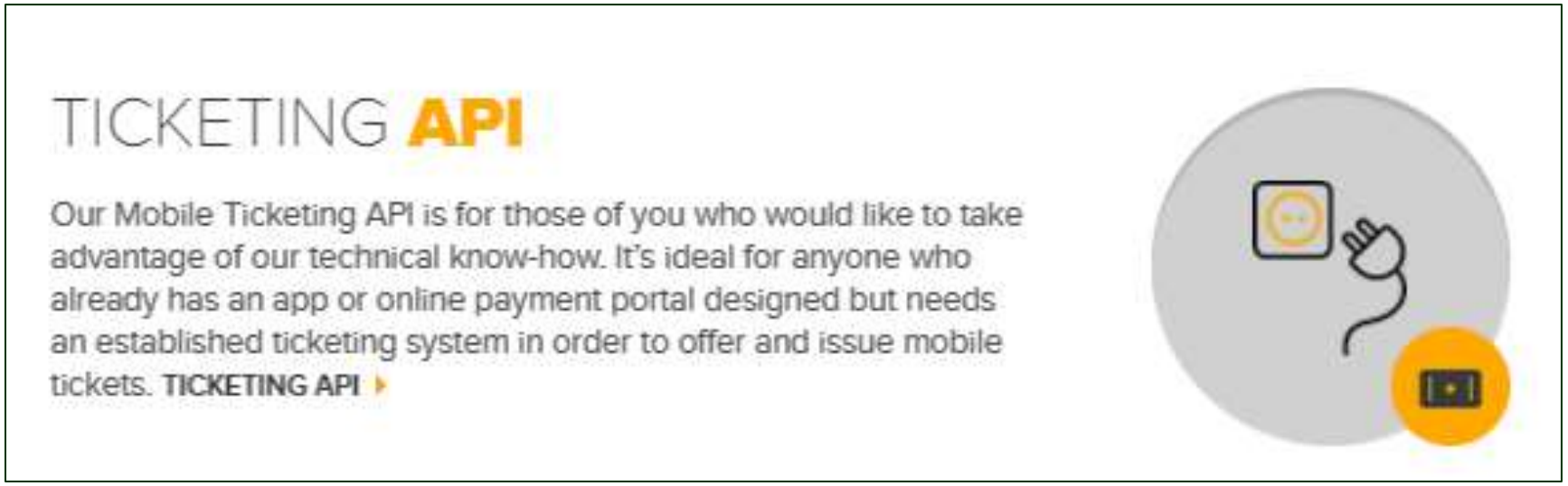
Unwire Features and Images

Unwire SMS Ticket
Source: http://www.unwire.com/products/mobile-ticketing/



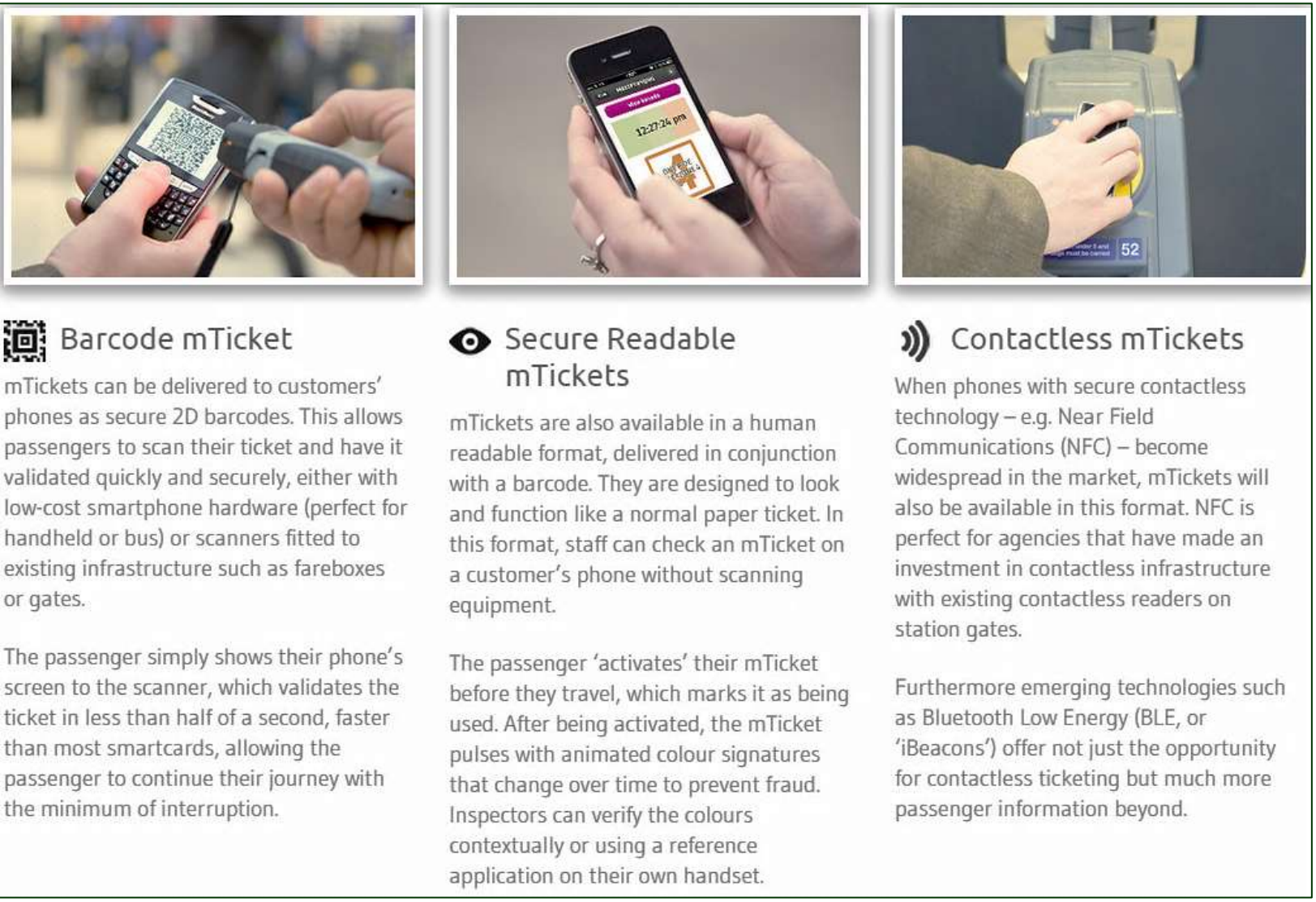
App Tickets from Unwire
Source: http://www.unwire.com/products/mobile-ticketing/

Web-to-Sims Tickets
Source: http://www.unwire.com/products/mobile-ticketing/



Ticketing API
Source: http://www.unwire.com/products/mobile-ticketing/

Masabi Features and Images



Features of the Masabi Mobile Fare Payment System
Source: http://www.masabi.com/mobile-ticketing/

Massachusetts Bay Transportation Authority (MBTA)

Agency Press release
http://www.mbta.com/about_the_mbta/news_events/?id=24562

Vendor info http://www.masabi.com/work-view/boston-mbta-mobile-ticketing/

The Nassau Inter-County Express, NY

Nassau County to introduce mobile payment

http://www.thetransitwire.com/2013/12/19/nassau-county-to-introduce-mobile-payment/

Vendor press release at

http://www.masabi.com/2014/02/11/nice-bus-to-become-one-of-the-first-u-s-bus-transit-systems-to-offer-mobile-ticketing/

New York's MTA for both Metro-North Railroad and Long Island Rail Road

[NYC Commuters to Use Mobile Phones as Train Tickets]

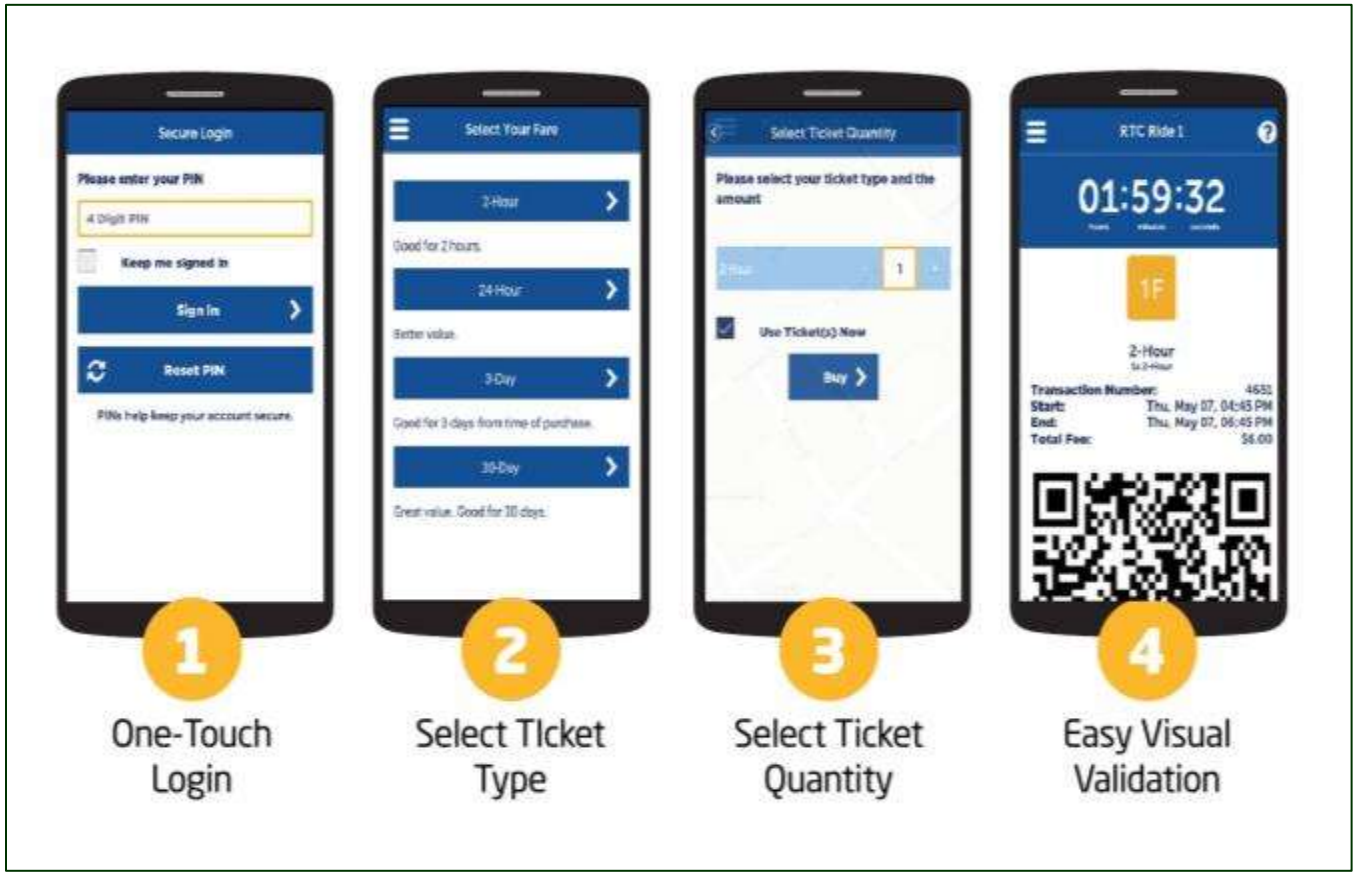
San Diego's MTS CrossCountry Trains

Metro article Posted on August 7, 2014

[http://www.metro-magazine.com/management-operations/news/292326/mts-introduces-mobile-ticketing-app-at-san-diego-comic-con]

Passport Features and Images

Concept of Mobile Ticketing by Passport
Source: Passport Presentation by David Singletary



Ticket Purchasing Process from Passport
Source: Passport Presentation by David Singletary

Passport Deployments

http://catchthecomet.org/app/

https://www.youtube.com/watch?v=G8I0wN8FlMo

Deployment at The COMET

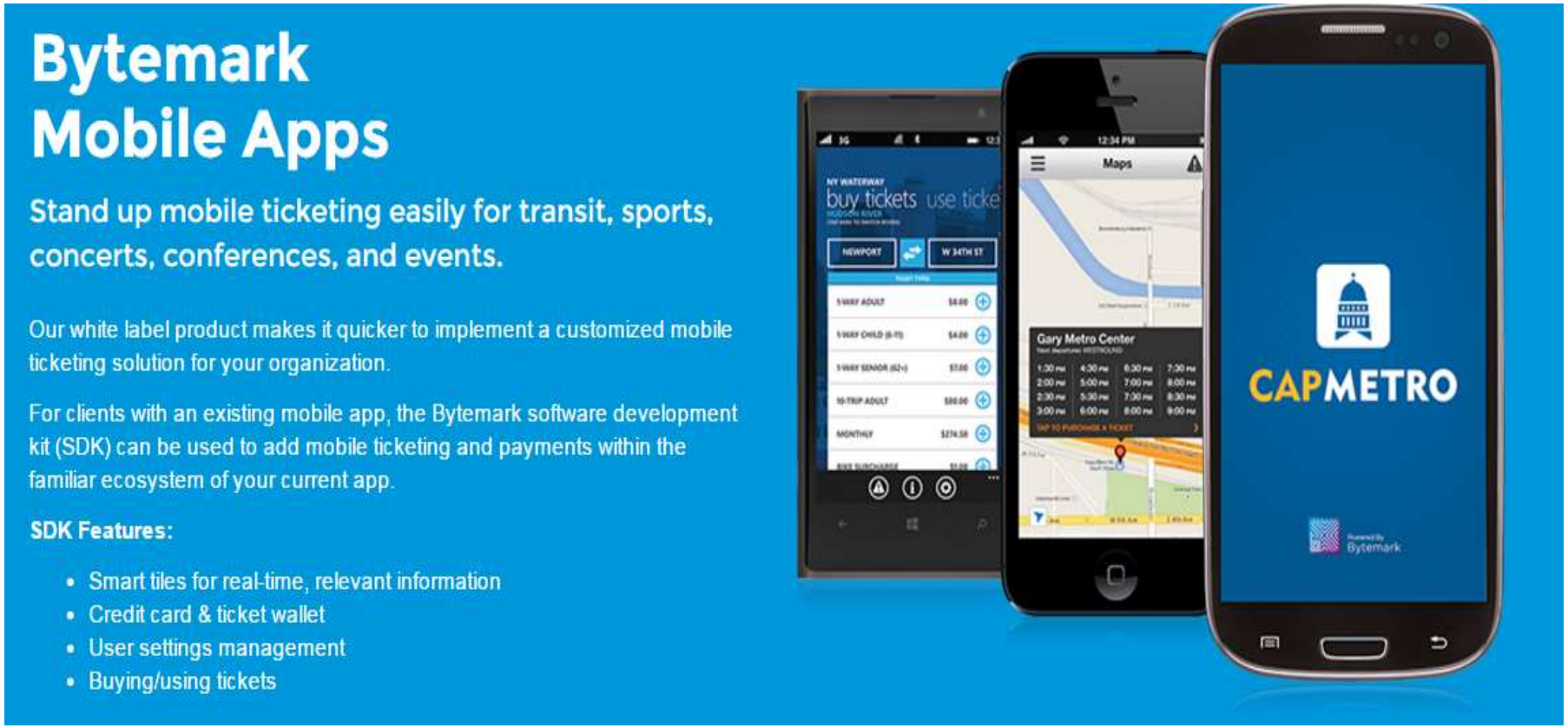
Globe Sherpa Features and Images

Platform Features from GlobeSherpa
Source: http://www.globesherpa.com/platforms/

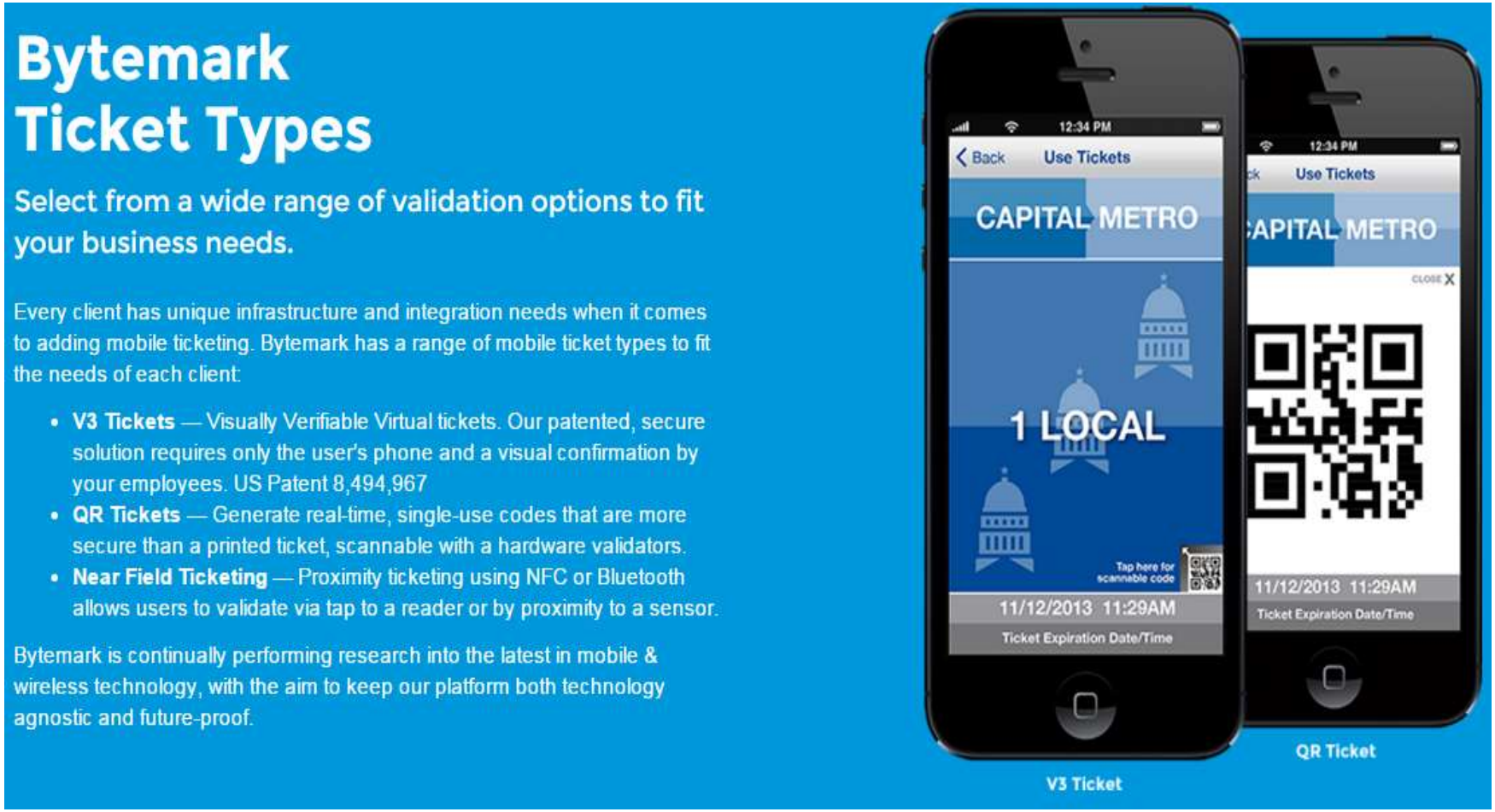
Features of Customer Relationship from GlobeSherpa
Source: http://www.globesherpa.com/platforms/

GlobeSherpa Deployments

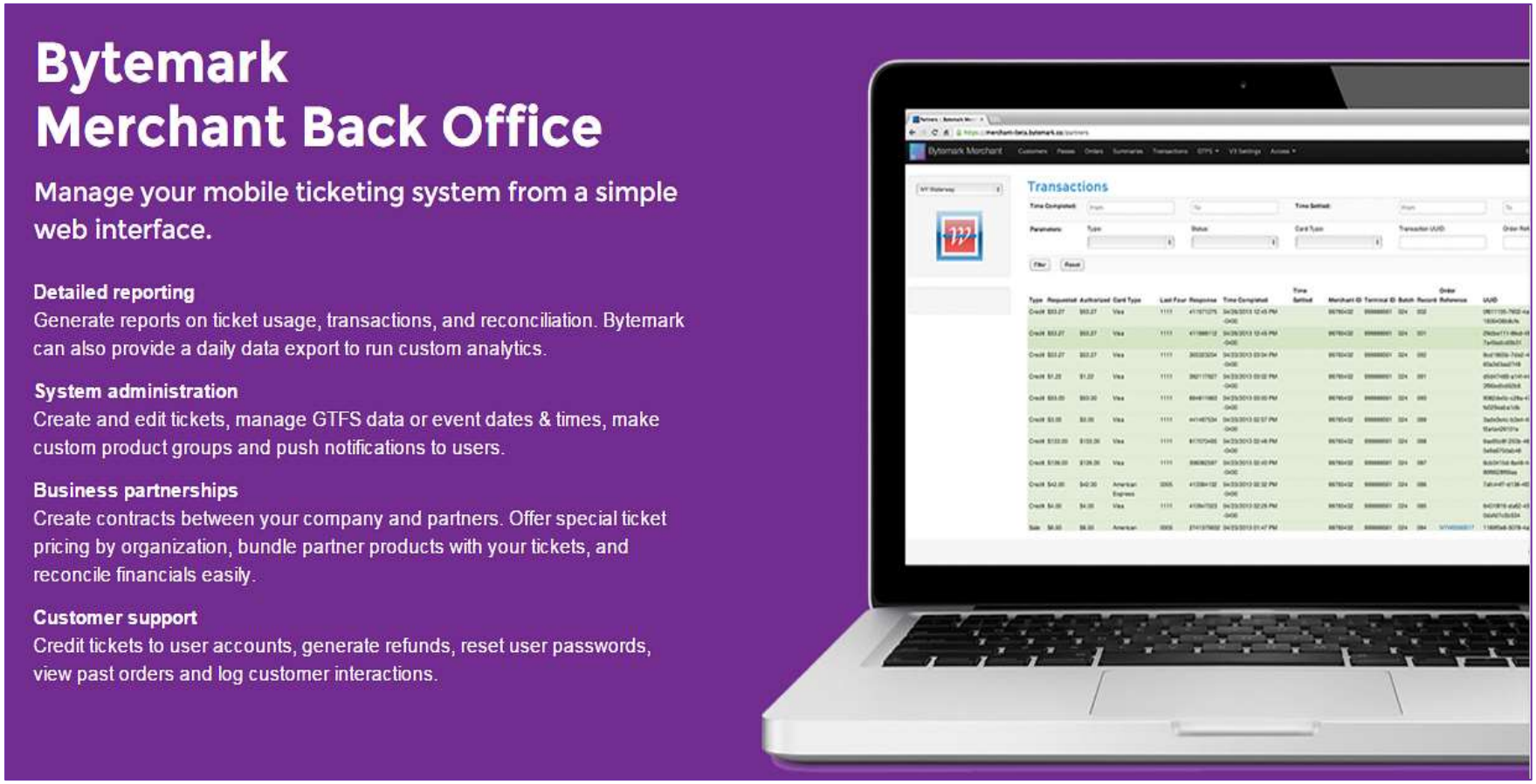
Los Angeles	TriMet	Virginia Railway Express	San Francisco Municipal Transportation Agency (SFMTA)	Ventra
Agency Info Fare options for both DASH and Commuter Express services are available on LA Mobile. Only regular fares are offered, no options are available for any form of reduced fare (e.g., Senior, Student, etc.). – See more at: http://www.ladottransit.com/lamobile/index.html#sthash.AdyG2KHl.dpuf Vendor press release http://www.globesherpa.com/ladot-and-mayor-garcetti-launch-la-mobile/	 http://trimet.org/mobiletickets/	 Agency Info at http://www.vre.org/mobile/ Vendor press release Virginia Railway Express Launches VRE Mobile	 Agency Info at https://www.sfmta.com/news/press-releases/sfmta-launch-mobile-fare-payment-pilot	Agency Info at http://metrarail.com/content/dam/metra/documents/news_relateddocs/Ventra%20App%20Feature%20Onesheet.pdf press relaease http://abc7chicago.com/travel/universal-payment-app-coming-for-cta-pace-metra-in-2015/352317/ extra Vendor info Cubic and Chicago Transit Authority Win Best New Innovative Practice-Partnership Deployment at the ITS America Annual Meeting & Expo



Features of Mobile Payment App from Bytemark
Source: https://www.bytemark.co/products



Features of the Types of Mobile Payment App from Bytemark
Source: https://www.bytemark.co/products



Features of Bytemark Merchant BackOffice
Source: https://www.bytemark.co/products

Handheld Ticket Validators

For an extra layer of security, deploy handheld validators running the Bytemark Merchant app to quickly scan and validate mobile tickets.

Easy to scan/validate tickets
Get clear, concise visual feedback to confirm that the mobile ticket is legitimate.

Track fare evasion
For invalid or fake tickets, quickly capture customer data to create a database of repeat fare evaders.

Runs on stock devices
Easily deploy the Bytemark Merchant Mobile app on stock Android phones and tablets. To speed scanning, Bytemark can also provide hardware add-ons, such as the Grabba S-5000b, for faster scans and a backup battery.

Handheld Ticket Validators from Bytemark
Source: https://www.bytemark.co/products

Onboard Ticket Validators from Bytemark
Source: https://www.bytemark.co/products

Bytemark Deployments

Cap Metro in Austin, Texas	New York Waterway (EDC)	The Northern Indiana Commuter Transportation District	Massachusetts Department of Transportation (MassDOT) and Bytemark to launch BusPlus Mobile Ticketing App Pilot
			BUS PLUS + Bytemark Bytemark to Develop Mobile Ticketing System for MassDOT BusPlus Program https://www.bytemark.co/news/2014/09/04/bytemark-develop-mobile-ticketing-system-massdot-busplus-program
Tutorial http://www.capmetro.org/fares.dev.aspx?id=4210&terms=mobile%20app	FAQ http://www.nywaterway.com/MyApp.aspx	Tutorial http://www.nictd.com/mobiletickets/Step5.html	https://www.bytemark.co/news/2015/01/22/massachusetts-department-transportation-massdot-bytemark-launch-busplus-mobile-ticketing-app-pilot

CooCoo Features and Images

Features of CooCoo Mobile App
Source: https://www.coocoo.com/pages/service/

Step 1a - NFC Tags Installed:
Operators install tags provided by Xerox on their transportation network.

Step 1b - Xerox Seamless™ App:
Traveller downloads the Xerox Seamless™ App on their NFC-enabled phone and registers as a customer.

Seamless App from Xerox
Source: http://www.xrce.xerox.com/Research-Development/Industry-Expertise/Transportation/Mobile-Payment-in-Transportation

Step 2 - Xerox Seamless™ NFC Tag:

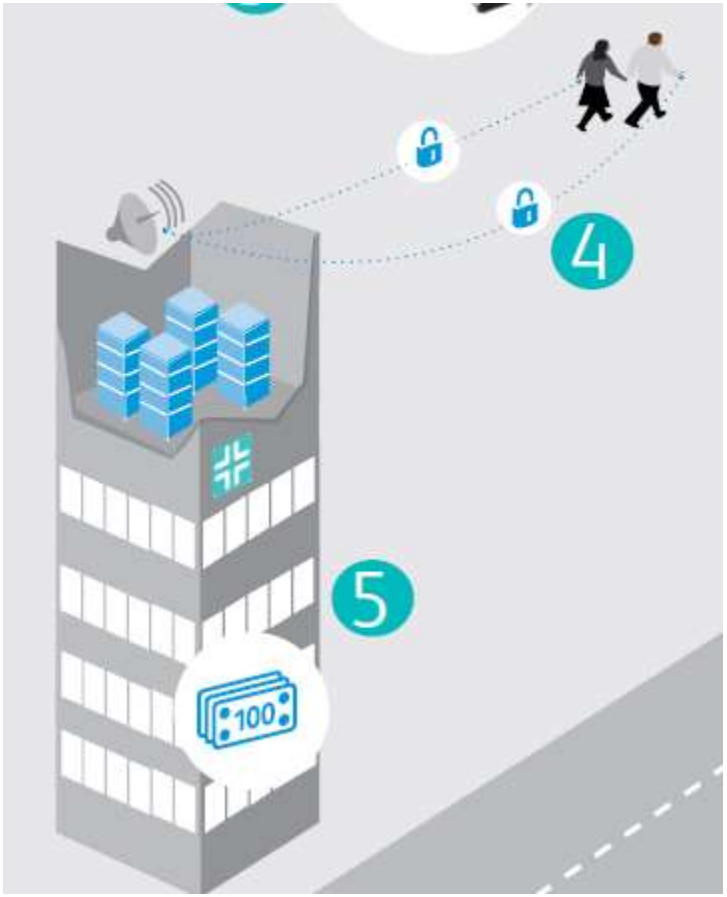
To travel the user taps their phone on any Xerox Seamless™ NFC tag. During the tap the Seamless tag creates and stores an encrypted transaction. This transaction does not contain any personal or sensitive information.

Step 3 - Transactions Uploaded:

Xerox Seamless™ Tag communicates to the Seamless App the encrypted transaction.

Seamless NFC Tags from Xerox

Source: http://www.xrce.xerox.com/Research-Development/Industry-Expertise/Transportation/Mobile-Payment-in-Transportation



Step 4 - Encrypted Transactions:
Encrypted transactions are sent to the Xerox Seamless™ server when the traveller's phone is connected to the network.

Step 5 - Payment Process:
Seamless™ bills the customer at regular pre-determined intervals on behalf of the transport provider.

Encrypted Payment Process by Xerox
Source: http://www.xrce.xerox.com/Research-Development/Industry-Expertise/Transportation/Mobile-Payment-in-Transportation

NJ TRANSIT	Information from Vendor's website on different transportation apps
	• Open Payment Fare Systems - Save money through operational efficiencies. • Transportation Made Simple - How Xerox innovations are pioneering smarter, more efficient transportation • Transit Riders: Say Goodbye to Paper Tickets – How open payments are transforming fare payments • Transportation Solutions Offering a Spectrum of Services Worldwide
http://www.njtransit.com/var/var_servlet.srv?hdnPageAction=MobileTicketingTo	https://www.youtube.com/watch?v=mS-YXJuaxf0

Appendix B - Interview Guide Used for Data Collection of Selected Agencies with Mobile Fare Payment Systems

The Public Transportation Office of the Florida Department of Transportation (FDOT) has contracted with the Center for Urban Transportation Research (CUTR) at the University of South Florida to assess the benefits and challenges associated with mobile fare technology and to examine the framework for establishing a pilot project for a transit agency in Florida. This study, "Assessment of Mobile Fare Payment Technology Deployment in Florida" will inform the industry on the state of the practice in deploying mobile fare payment technology.

As part of the study, we identified transit agencies across the nation that have or are in the process of implementing mobile fare technology, which included your agency. In relation to this, we would like to invite your agency to participate in an interview to discuss your experiences with the technology. A member from our research team will be reaching out to your agency in the upcoming week to schedule a 30- to 45-minute phone interview with members of your staff (including developers/vendors/consultants) involved in the different aspects of planning and deploying your mobile fare payment system.

Taking into consideration the importance of your time and to collect your input on the topic in an efficient manner, we attached the interview questions in this e-mail. Please feel free to forward it to staff members who can best answer these questions in full or in part.

The results of the interview will be presented in a technical memorandum that we will share to your agency once completed and will be used to develop an implementation plan for implementing a mobile fare payment pilot in Florida. If you have any questions about this study or the interview request, please contact Diane Quigley, the FDOT Project Manager, at diane.quigley@dot.state.fl.us (or 850-414-4520); or contact Nevine Labib Georggi, CUTR's Principal Investigator at georggi@cutr.usf.edu (or 813-974-9770).

Your cooperation in this research effort is greatly appreciated.

Please tell us about your mobile fare payment system

1. Describe the needs/opportunities/rationale that prompted your agency to deploy the mobile payment system.
2. What were the goals/objectives for the introduction of a mobile payment system?
3. How long did it take between completing the planning phase and the starting the pilot/deployment of your mobile payment system?
4. Was the fare structure modified in conjunction with deployment? Did the fare structure change when you deployed the mobile system? Are all fare types available on the mobile system?
5. Do you offer any discounts/reduced fares for mobile users?

6. What was the overall budget for the mobile deployment project? Can you quantify the costs associated with the planning phase?
7. Did your mobile fare deployment include the rollout of other customer-facing features accessed via mobile devices (e.g. trip planning, real-time info, etc.)? Are these features part of the same mobile app that is used for mobile fare payments? Please describe other applications and associated costs.
8. What functionality technology is included in the mobile fare payment app? Is there a built in plan-a-trip or real-time info associated with the app? Do the riders tap their phone to pay when boarding the vehicle?
9. What is the rider experience like when using the mobile fare payment system? For example, do they process the payment prior to the bus arriving, and then show a confirmation of payment to the driver?
10. Is your mobile fare payment app a native mobile app, or a mobile web application? If it is a native mobile app, what smartphone platforms is it available for (e.g., iPhone, Android, Amazon Fire Phone, Windows 8, and Windows Phone)? If it is a mobile web application, are there any devices on which the mobile web application does not work?
11. What was the source of funding for the deployment?
12. What technical specifications and/or standards were used in your mobile fare payment deployment? How were the technical specifications defined and/or chosen?
13. Describe the validation process selected for your agency? How are mobile fare payments validated? In other words, how do you confirm that a rider has paid their fare? For example, is it only visual inspection? Do you use scanners to validate a barcode or QR code shown on the rider's mobile device screen? Do you accept Near Field Communication (NFC) payments where the rider would tap their phone to pay when boarding the vehicle? Is the existing non-mobile fare infrastructure compatible with the mobile fare technology (i.e. can card swipers be used to scan mobile tickets?)
14. How did your agency confirm that the product from the vendor was working properly?

Tell us about your agency's procurement process

1. Was there a solicitation process?
2. Number of qualified respondents, app development cost, other hardware/software associated costs – Please describe method of vendor compensation (up-front payment, commission/transaction fee)
3. For each respondent to the RFP, how many individual vendors were included on the respondent team? The names of vendors are not necessary, but it would be helpful to understand how many vendors were required to produce a complete solution.
4. Can you describe the standard reporting capabilities of the selected vendor (customer behavior, financial)?
5. How are revenues from the mobile fare payment system collected? Who manages (vendor, transit agency, third party)? Who is primarily responsible for the security of fare payments?

6. Were there any technology requirements prior to deploying a mobile fare payment system? For example, did your vehicles need to be equipped with wireless data communication prior to the deployment of a mobile fare payment system? If your agency already had this technology, were you able to integrate the mobile fare payment system with this existing technology, or did you need to deploy this required technology along with the mobile fare payment system. If you needed to deploy new technology, was this part of the same procurement, or part of a different procurement?
7. For the planning phase, what did you do well and what would you have done differently?

Please tell us about your agency's pre-deployment experience

1. If you began with a pilot, how were participants/routes selected?
2. Describe internal training components (customer service, operators, and supervisors). If possible, please provide any documentation/communication materials in advance of the telephone interview, please email to georggi@cutr.usf.edu.
3. Describe external outreach/education efforts – can you provide materials/campaign info? If possible, please email in advance of the telephone interview to georggi@cutr.usf.edu.
4. Can you quantify the costs associated with the pre-deployment phase?
5. For the pre-deployment phase, what did you do well and what would you have done differently?

How was your agency's deployment experience?

1. Please describe any technical issues encountered during deployment.
2. Please describe any issues encountered by agency staff. What was the biggest internal complaint received when deploying the mobile fare payment system?
3. Please describe any customer satisfaction issues encountered during the deployment phase (anecdotal and/or documented communications/surveys).
4. Can you share utilization trends since implementation?
5. Can you quantify the costs associated with the deployment phase?
6. Have you encountered any ongoing maintenance issues?
7. Do the standard reporting features offered by the selected vendor meet your ongoing requirements or are additional features required? What additional features not "required" but would be "nice to have"?
8. Did your agency achieve its original goals and objectives associated with the mobile fare payment system?
9. For the deployment phase, what did you do well and what would you have done differently?

Other

1. Please share your plans related to system expansion. Are there any issues or barriers that make expansion challenging?
2. In addition to your thoughts regarding the activities you did well and things you might do differently, please share any additional advice or insight that would benefit an agency planning a mobile payment deployment.
3. What is next on your wish list for mobile technology that could be deployed to your riders?

Appendix C - Survey of Florida Transit Agencies on Mobile Fare Payment Systems[6]

The Public Transportation Office of the Florida Department of Transportation (FDOT) is exploring opportunities that mobile fare payment systems offer to increase ridership, improve customer satisfaction, and save costs. The Center for Urban Transportation Research (CUTR) at the University of South Florida will assess the benefits and challenges associated with such a technology and will examine the framework for establishing a pilot project for a transit agency in Florida. This study, "FDOT BDV 26 TWO 977-39: Assessment of Mobile Fare Payment Technology Deployment in Florida" will inform the industry on the state of the practice in mobile fare payment technology as well as identify best practices through compiling, analyzing, and disseminating the experiences of agencies that have or are in the process of implementing mobile fare systems.

If you have any questions about this study, please contact Diane Quigley, the FDOT Project Manager, at diane.quigley@dot.state.fl.us (or 850-414-4520); or contact Nevine Labib Georggi, CUTR's Principal Investigator at georggi@cutr.usf.edu (or 813-974-9770).

Your cooperation in this research effort is greatly appreciated.

Contact Info:

Your Name _____

Agency _____

City/Town _____

Email Address _____

Phone Number _____

What forms of fare payment does your agency use? (check all that apply)

- ☐ Paper ticket
- ☐ Cash
- ☐ Token
- ☐ Magnetic stripe ticket or farecard

[6] *The survey has been formatted from its original form in surveymonkey to fit this document style*

- ☐ Smart card
- ☐ Credit/debit/AT M card
- ☐ Transit voucher
- ☐ Other (please specify)

What vendor(s) supplied your current fare system? Please list all fare equipment and installation dates

_____

Please tell us the strengths of the current fare system, if any

_____

Please tell us the limitations of the current fare system, if any

_____

Is your agency part of a regional (more than one agency) fare collection system?

- ☐ Yes
- ☐ No
- ☐ Currently working on it
- ☐ Maybe in the future
- ☐ I don't know
- ☐ Other (please specify)

  _____

Is your agency part of a regional (more than one agency) fare collection system?

- ☐ Yes
- ☐ No
- ☐ Currently working on it
- ☐ Maybe in the future
- ☐ I don't know
- ☐ Other (please specify)

  _____

Has your agency considered mobile ticketing as an option for fare collection?

- ☐ Yes
- ☐ No

If your agency has plans to deploy mobile ticketing; rank these reasons for considering it using 1 as a major contributor and 5 as a minor one

	1	2	3	4	5
Our regional partners are deploying mobile fare payment					
Funds for procuring mobile fare payment system are available					
It can help with streamlining fare payment					
Deploying real-time and other info apps with fare payment app					
Please specify other factors if any:_____					

If your agency is currently in the process of procuring a mobile fare system, please tell us where you are in the process

- ☐ Researching the options
- ☐ Preparing RFP
- ☐ Evaluating responses to RFP Selecting a vendor
- ☐ Preparing contract
- ☐ Working with the vendor to develop system
- ☐ Beta testing
- ☐ Deploying the mobile ticketing system
- ☐ Other (please specify)

If your agency currently offers mobile apps to the public, what information do they provide?

- ☐ Scheduled arrival times Real-time arrival times Trip planning
- ☐ Detours and service alerts
- ☐ Special events service plans
- ☐ Transportation Network Companies (e.g. Uber)
- ☐ Bikesharing
- ☐ Other

Please specify what other apps you provide. Also, please let us know who developed these apps:

_____

- ☐ What type of information do you need to make a decision on mobile fare payment option for your agency?
- ☐ Costs Specifications
- ☐ RFP examples
- ☐ Case studies
- ☐ Other (please specify)

Please feel free to add any comments, questions, or suggestions relevant to mobile ticketing

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Thank you for participating. If there is more you would like to discuss, please feel free to email CUTR's project PI, Nevine Georggi at georggi@cutr.usf.edu

Appendix D – Invitation to Conduct a Mobile Fare Payment Pilot

The Florida Department of Transportation (FDOT) is conducting a two-part research study, FDOT BDV25-943-39, to evaluate the efficacy of deploying a mobile phone fare payment system at a transit agency in Florida. FDOT selected StarMetro as the pilot agency. StarMetro serves the City of Tallahassee with 18 fixed routes and complementary paratransit services. Annual ridership is approximately 4.4 million passenger trips.

FDOT is requesting a non-binding cost estimate and an estimated deployment schedule from vendors authorized to do business in the state of Florida. The purpose of the estimate is to prepare the scope of services for the evaluation study, Phase II.

The Center for Urban Transportation Research was contracted to conduct Phase I of the study, "Assessment of Mobile Fare Payment Technology for Future Deployment in Florida." Phase I included the following tasks:

- Task 1: an industry scan of known vendors of mobile fare technology in the United States to compare/contrast technology features including the different packages (bundles) associated with mobile fare technology e.g. trip planning, real-time information, security/privacy protections, etc.
- Task 2: an online survey of Florida transit agencies to assess the types of fare collection equipment currently used in Florida
- Task 3: a framework that any agency can use to develop a concept of operations to deploy and evaluate a mobile fare pilot

CUTR was tasked with applying the framework developed in Task 3 to StarMetro in order to plan for the Phase II evaluation to include the following:

- design and development of software by the selected vendor
- installing readers on the buses for ticket validation
- training of StarMetro staff and internal beta testing
- conducting a beta test with riders
- deploying and monitoring ticketing system on the 3 selected routes

StarMetro has selected three routes (6 buses and 3 spares) and four fare types (one-way, individuals, transfers, and unlimited ride cards), to deploy a mobile fare payment system for the pilot study:

1. SouthWood Express route with 2200/month in ridership, 2 buses, and 35 stops on route
2. Gadsden Express route with 1000/month in ridership, 1 bus, and 5 stops on route
3. Forest Route with 10,000 /month in ridership, 3 buses, and 70 stops on route

During the pilot project, StarMetro riders are expected to do the following:

- Download and install a mobile application (mobile "app") on their smartphone (iOS, Android, and possibly other platforms) Create an account through a one-time setup process that prompts users for billing information (e.g., credit cards, debit cards or other electronic payment)
- Login using an ID and password then be greeted with the home screen of the mobile app with StarMetro logo linked
- Purchase multiple fare products at once, and maintain multiple fare products attached to their account and accessible for use within the mobile app
- At the time of travel, riders will be able to launch the mobile app, select the fare product they wish to use, and then activate the ticket in an offline mode (i.e., Internet/network access is not necessary to activate the ticket).
- After activation, the app will provide a scannable code indicator for onboard readers. This visual indicator will be available for a set period of time for which the ticket is valid.
- All mobile tickets will include the following: a high security image with anti-tampering features, a barcode, transit agency logo, validity period, and the fare type.
- Onboard ticket readers will be provided on the buses included in the routes selected for the pilot study.
- After a set period, the activated mobile ticket will expire and will no longer be available for use. Expired tickets should be easily visually distinguishable from valid tickets. The history of purchased and expired mobile tickets can be viewed by riders.
- At any time during the use of the mobile app, riders can access a "help" page with frequently asked questions (FAQs) about mobile ticketing

Readers

During the pilot project, StarMetro will use onboard readers to validate mobile tickets by scanning the barcode on the customer-facing mobile app. The readers will automatically report to a backend system the following information about validated tickets:

- Date and time of validation;
- Date and time of ticket purchase;
- Date and time of ticket activation;
- Location;
- Inspector ID number;
- Fare type; and
- Customer account ID number.

Reporting and Backend System

The vendor will provide a web-based tool for use by StarMetro staff. This will include, but not be limited to, the following functionality:

- Access to records of all customer transactions using mobile ticketing, including all ticket purchases, validation, and activation, as well as the ability to export these records to a machine-readable data format such as Comma-Separated Values (CSV) files that could be viewed and analyzed in another application (e.g., Microsoft Excel);
- Electronic reports summarizing daily, weekly, and monthly sales;
- A mechanism for reimbursing customer mobile tickets; and
- A mechanism for receiving questions and comments from customers (i.e., "Contact Us").

Financial Processing

The mobile ticketing system will have the following financial functionality:

- The system will accept MasterCard, Visa, debit cards and PayPal payments
- The vendor will be responsible for all back office functions;
- The vendor will comply with the latest Payment Card Industry (PCI) data security standards, including all audit and compliance certification activities; and
- The vendor will deposit fare revenues (minus applicable fees and taxes) into the transit agency bank account on a regular basis (with the specific dates / frequency to be agreed upon).

Additional Mobile Ticketing Application Features (for future integration)

In addition to the mobile ticketing functionality, it is envisioned that the customer-facing mobile app will have additional useful features for customers that could be integrated in the future. These could include the following:

- Trip planning functionality using transit schedule information;
- Real-time vehicle tracking and estimated vehicle arrival information;
- General feedback /non-emergency issue reporting (e.g., for broken benches or bus drivers compliments and/or complaints).

While not all of these features are required for the pilot project, StarMetro may consider integrating them in the future and the vendor should ensure that they could easily be incorporated into the mobile ticketing app tested in the pilot. Price quoted will not be binding. It is projected that the pilot lasts 9-12 months starting this summer.

Please make it clear if you wish to participate in the pilot by providing the software and equipment in exchange for a share of the revenue, please specify that share.

Please email or fax your estimate to the principal investigator of the FDOT-sponsored research study by March 19, 2016:

Nevine Labib Georggi, Senior Research Associate
Center for Urban Transportation Research
University of South Florida
georggi@cutr.usf.edu
Phone: 813-974-9770
Fax: 813-974-5168