A CONCEPT OF OPERATIONS FOR DEPLOYING A MOBILE TRANSIT FARE COLLECTION APP

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6370 words + 2 (250) = 6870 words

ABSTRACT
To enhance riders' experiences and to attract new riders, many transit agencies are offering a variety of mobile apps that make trip planning and real-time information easy to access from any place at any time. A growing number of agencies are adding a mobile fare payment and ticketing option to the suite of mobile apps offered to their riders. Not only does this form of ticketing cater to current and potential future riders but also offers the agencies another option for marketing and data collection while increasing system efficiency by reducing the costs of collecting fares. This paper presents a basic concept of operations (ConOps) for use by transit agencies that are considering the addition of a mobile ticketing application to their fare collection system. The ConOps was developed based on lessons learned from five transit agencies (representing five different vendors) in various stages of mobile fare deployment. The ConOps details the customer-facing and fare-inspecting apps, the reporting and backend system, financial processing, roles and responsibilities of agency staff, and estimated timeline and budget, and marketing and training efforts. One of the key findings is that marketing was considered vital to the success of the effort. Additionally, transit agencies are encouraged to investigate the vendor's references. The ownership of data as well as the ability to make future changes to the app should not be overlooked. Agencies are also advised to conduct sufficient beta testing to work out any glitches before full deployment. If an agency elected to conduct a pilot before full deployment, a suggested pilot evaluation plan is included in the paper.

INTRODUCTION

This paper presents a basic concept of operations (ConOps) for use by transit agencies that are considering the addition of a mobile ticketing application to their fare collection system. The ConOps was developed based on lessons learned from five transit agencies (representing five different vendors) in various stages of deployment of a mobile ticketing app. The ConOps details the customer-facing and fare-inspecting apps, the reporting and backend system, financial processing, roles and responsibilities of agency staff, and estimated timeline and budget, and marketing and training efforts.

The first section provides a brief discussion on the value of exchanging lessons learned among transit agencies. The review also briefly presents types of mobile fare payment technologies in the field. The study background section includes some of the lessons learned from interviewing five transit agencies that were in different stages of deployment. A detailed discussion of the ConOps is presented to inform transit agencies on elements to consider when planning a mobile fare system. If an agency elected to conduct a pilot before full deployment, a suggested pilot evaluation plan is included in the paper. Finally, a summary and conclusions section discusses tips to consider when deploying a mobile fare payment system.

MOBILE TICKETING: A PERSPECTIVE FROM A SURVEY OF TRANSIT AGENCIES

The use of smart phones has drastically transformed society over the past decade becoming an integral part of everyday life, including travel. An April 2016 report articulates what transport professionals have been anticipating with more transportation-related mobile apps being developed and utilized at a fast pace *(1)*. The report offers an overview of apps that have been transforming travel mobility options, identifies challenges, and provides guiding principles for public agencies. *Public transit apps* are defined in the report as "apps that enable the user to search public transit routes, schedules, near-term arrival predictions, and connections. These apps may also include a ticketing feature, thereby providing the traveler with easier booking and payment for public transit services." With the exception of a ticketing app, the transit agency can release its route and schedule data in an open-format that allows third-party developers to offer apps that can be used by riders freely. Because a ticketing app involves financial transactions between the rider and the agency, it is a more complex effort for a transit agency to support.

Transit agencies considering the inclusion of mobile ticketing to their fare collection system can benefit from experiences of other agencies that have gone through the experience. The importance of collecting and disseminating lessons learned from experiences of others was emphasized in the responses of a survey that was conducted by the authors in September 2015 *(2)*. The survey was part of an effort to gather data from the 41 transit agencies in the state of Florida, (response rate was 37.5%). A link to surveymonkey.com was sent out via e-mail to a list of Florida transit planners and to the Florida Operators Network listserv. Survey questions sought to assess the level of interest and involvement in mobile fare payments systems by these agencies. One element of the survey investigated the reasons agencies were considering mobile fare payment systems. The majority of responding transit agencies looked at mobile fare payment as a way to help with streamlining fare payment as well as a tool for deploying real-time information and other services as part of the fare payment app. In response to a question researching mobile fare payment options, in order of importance, the following resources were perceived helpful:

(a) the cost of a mobile fare system,
(b) specifications and *case studies*, and
(c) examples of requests for proposal.

This paper fulfils this need by providing lessons learned from other agencies and guidance in planning for a ticketing app.

OVERVIEW OF TRANSIT MOBILE FARE PAYMENTS APPS

There are four main types of mobile ticketing applications currently available in the market, which can be classified as (1) visually validated, (2) machine-readable two-dimensional QR Codes, (3) Near Field Communications, and (4) Bluetooth Low Energy.

Type 1: Visually Validated Ticket

A visually validated ticket is inspected by a transit agency employee to confirm the customer has purchased the appropriate fare *(3)*. It 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. 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; thus an attractive, cost-effective first step towards implementing a mobile ticketing solution, see Figure 1.

Type 2: Machine-readable two-dimensional Quick Response (QR) code

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, see Figure 1. 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 *(4)*.

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 could also allow the agency to collect very detailed data about 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: QR Ticket Sample from Masabi and Onboard Ticket Validators and NFC Technology from ACCESS-IS

Type 3: 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. NFC technology is in the planning stages at several U.S. transit agencies including the Chicago Transit Authority via the Ventra app. 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.

Type 4: Bluetooth Low-Energy (BLE)

There is an emerging fourth type of mobile fare payment technology – 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 *(5).* 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 communicate 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, but to the research team's knowledge, there are currently no existing deployments of BLE in production at transit agencies.

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.

PAYMENT CARD SECURITY

Any technology that involves the exchange of electronic payment information is subject to the Payment Card Industry (PCI) Data Security Standard (PCI DSS) managed by the PCI Security Standard Council, 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).

STUDY BACKGROUND

Table 1 provides a brief summary of the major mobile ticketing deployments in the United States. At the time of the study, several of these deployments were in planning or procurement process. Many more agencies are rapidly deploying mobile ticketing while many vendors seem to be merging and a few new vendors in the field.

Case Examples of Mobile Ticketing Deployments

Lessons learned from agencies that have already deployed a mobile fare system can benefit others considering such systems and help them avoid costly pitfalls that challenge or delay deployment. The authors completed a scan of the mobile fare payment industry and selected five agencies to interview as case examples documenting their deployment experiences:

- Dallas Area Rapid Transit (DART), TX
- New Jersey Transit, NJ
- Nassau Inter County Express (NICE), NY
- Central Midlands Regional Transit Authority, Columbia (COMET), SC
- Chicago Transit Authority (CTA), IL

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 prepared for the 60-minutes interviews and can be accessed in the final project publication *(2).* The guide was designed to evaluate the experiences and document lessons learned by asking the interviewees about their mobile fare payment system, agency's procurement process, agency's pre-deployment experience, and agency's deployment experience. At the end of each interview, the participants were given the opportunity to share their thoughts about what they could have done differently during planning/deploying the system (e.g. pitfalls to avoid). Advice and insights were also solicited from participants for the benefit of other agencies considering mobile fare systems.

Table 1: Major Mobile Ticketing Deployments in the United States

Transit Provider	City / Region	Year	Primary Transit Mode(s)	Vendor
Capital Metropolitan Transportation Authority (CAP METRO)	Austin, TX	2014	Bus & Commuter Rail	Bytemark
Chicago Transit Authority (CTA)	Chicago, IL	2015	Rail & Bus	GlobeSherpa -now part of Moovel (with Cubic)
Greater Cleveland Regional Transit Authority (RTA)	Cleveland , OH	2016	bus and rail	Passport
The COMET	Columbia, SC	2014	Bus	Passport
Dallas Area Rapid Transit (DART)	Dallas, TX	2013	Bus & Light Rail	Currently, Moovel (Previously Unwire)
Hillsborough Area Regional Transit (HART) and Pinellas Suncoast Transit Authority (PSTA)	Tampa Bay Area, FL (pilot)	2016	HART and PSTA bus services, Streetcar System, Jolley Trolley, and Looper Trolley.	Bytemark via Innovations in Transportation Inc. (INIT)
Jacksonville Transportation Authority	Jacksonville, FL	2016	Bus	Passport
Massachusetts Bay Transportation Authority (MBTA)	Boston, MA	2012	Commuter Rail, & Ferry	Masabi

Miami-Dade Transit	Miami-Dade County, FL	2016 contract awarded	Bus and rail	Passport (with Cubic)
Nassau Inter County Express (NICE Bus)	Nassau County, NY	2014	Bus	Masabi
New Jersey Transit (NJ Transit)	New Jersey	2013	Rail & Bus	Xerox
New York Waterway (NY Waterway)	New York City, NY	2012	Ferry	Bytemark
North County Transit District (NCTD)	San Diego, CA	2013	Commuter Rail	CooCoo
Regional Transportation Commission of Southern Nevada (RTC)	Las Vegas, NV	2016	Bus	TokenTransit
Tri-County Metropolitan Transportation District of Oregon (TriMet)	Portland, OR	2013	Bus, Rail & Streetcar	Globesherpa (now part of Moovel)

High-level "takeaways" from the interviewees included:

- 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 (e.g. a no cost pilot) to supplementing existing systems with vendors to through RFP process, one agency developed its app with their general fare payment contractor.
- 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.

CONCEPT OF OPERATIONS

Insights gleaned from the interviews as well as the King Metro County RfP informed the development of the ConOps that can be used by any transit agency to plan for implementing a mobile fare system. Descriptions of app features, functions, and specifications can be used to inform agencies on matters to collaborate on internally in decisions and planning phases, as well as drafting RFPs and negotiating contracts with vendors/developers. The ConOps presented here assumes that validation methods will be visual and QR code scanned by readers on-board the vehicles.

The ConOps described in this paper details the following elements that will be further described in the subsequent sections:

- Customer-facing Mobile Ticketing App
- Additional Mobile Ticketing Apps
- Fare-inspecting Apps
- Reporting and Backend System
- Financial Processing
- Estimated Timeline
- Estimated Budget
- Roles and Responsibilities
- Training and Marketing Efforts

Customer-facing Mobile Ticketing App

The following section describes the mobile ticketing application, as the customer will experience it, including setting up an account, ticketing validation, and additional features in the app.

Setting up an Account

- 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).

Ticket Validation

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 Features in Mobile Ticketing Apps

In addition to the mobile ticketing functionality, it is envisioned that the customer-facing mobile app could 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 initial deployment, the transit agency and app developer should consider incorporating as many of them as possible or at a minimum ensure that they could easily be incorporated into the mobile ticketing app in the future.

Fare-inspecting Apps

A transit agency can elect to do visual validation or can test a fare-inspecting mobile app that can be used to validate mobile tickets with a barcode / QR code. Fare-inspecting apps will be able to conduct more detailed ticket checks (beyond visual validation) by scanning the barcode / QR code on the customer-facing mobile app. The fare-inspecting app 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 developer will provide a web-based tool for use by transit agency staff. This may 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 can 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 Timeline

First, the solicitation documents should be prepared by the transit agency conducting based on the descriptions outlined in the ConOps. This process could take between two 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 consist of modifications to their pre-existing mobile ticketing application and backend system to meet the needs of the agency.

It is recommended that testing 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 test that 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 Budget

Because the actual budget will heavily depend on the size of the agency, projected market penetration, the procurement process, and vendor responses to a solicitation; this paper is not providing estimates for the budget. 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). Bytemark mobile ticketing costs the agency 4-5% of fare (depending on the size of the agency) while Masabi receives 2-5% of mobile transactions (4). 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.

Roles and Responsibilities

The following is a brief delineation of important roles and responsibilities for a transit agency considering a mobile ticketing. 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 necessary to commit to a new fare payment method? Can it make a commitment to devote those resources to ensure a successful deployment? In most case studies reviewed by the authors, 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 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 program – This role could potentially be assumed by a manager within the existing revenue collection team.
- Training operators and 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 paper 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 ConOps 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.

Training and Marketing Efforts

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 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 and/or 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 effort, 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.

PROPOSED EVALUATION PLAN FOR A PILOT

As previously stated, one agency from the case studies suggested that a pilot was not advisable while others thought it was invaluable to work out glitches in the system. The following describes a proposed plan for evaluating the efficacy of a pilot if an agency elected to conduct one preceding full deployment. This evaluation is divided into two components: 1) evaluation by the transit agency staff and 2) evaluation by the public.

Evaluation by the transit agency staff

This internal evaluation 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.

Evaluation by the public

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 evaluation and determine how to proceed with full deployment.

SUMMARY AND CONCLUSIONS

This section includes a summary of the key lessons learned from the case studies and important conclusions for transit agencies considering deployment of mobile ticketing apps.

Summary of 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.

Conclusions

Agencies should anticipate technical challenges identified during testing phase and build additional time into the deployment schedule to address these challenges adequately. Mobile ticketing requires extensive marketing activities in order to be successful. Agencies should build customer outreach activities into their planning activities and deployment budgets.

In both the initial procurement of the mobile ticketing system, the participating agency should consider the following:

- **Experience of the vendor** – Prior to procurement, 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, will transit riders be forced to download a new mobile app, and 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 A'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.

ACKNOWLEDGMENT

This paper is based on a research project funded by the Florida Department of Transportation's Public Transportation Office, FDOT Project BDV25-943 and conducted by The Center for Urban Transportation Research at the University of South Florida. The authors would like to thank Ms. Diane Quigley, FDOT State Transit Administrator who was the project manager for the research study.

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