

TRB Research Needs Statements

Strategic Analysis of Open Fare Payment Systems

Note: *Opinions expressed are the authors' and do not necessarily reflect official policy or positions of the Metropolitan Transportation Authority State of New York, MTA New York City Transit, the Transportation Research Board, or any other organizations.*

Task: Review and establish a baseline state-of-practice and array of technologies for “open” fare payment systems (OFPS). Identify and classify different approaches to OFPS, and document industry trends. Explicitly identify and critically evaluate goals and motivations for adopting OFPS. Enumerate, qualitatively and quantitatively if possible, the costs and benefits of each approach, based on identified goals and motivations. Assess different institutional setups, their associated issues, and factors transit agencies will want to consider when setting up new institutions to administer OFPS. Appraise the impact of OFPS on fare policy and transit access by low-income groups. Provide an honest assessment of the future of OFPS, provide different recommendations for “ways forward”, and define alternative implementation paths for agencies considering OFPS.

Objective: Creation of a resource book that will serve as an industry reference for methods, strategies, and technologies that transit systems have proposed or adopted for OFPS. The aim is to create a work of reference that does not prescribe a single solution but instead guides and empowers practitioners to consider OFPS issues and approaches based on their local situation and philosophy, that can be embraced and adopted by multi-modal transit systems and long-distance surface transportation carriers in the United States and potentially elsewhere in the world.

Research Need/Goals:

Fare payment technologies have evolved from paper tickets and tokens to magnetic stripe cards and smart cards. Latest developments include the implementation of open payment systems, including mobile phones, credit cards, and other implementations of near-field communication and radio frequency identification technologies. What are the different OFPS approaches, their features, advantages and disadvantages? What are the implementation issues and customer acceptance?

Tasks:

1. **Goals and Motivation for Fare Collection and Open Fare Payment Systems.** Enumerate the motivation of having a fare payment system: the fare payment system is not an end in itself but a way to achieve different objectives within a transit organization. Various organizations may value those objectives differently. A critical view of how different technologies and institutional setup can facilitate or impede the achievement of those objectives would be useful. The technologies used by transit organizations are very diverse: from old (token, paper ticket), medium-old (magnetic, registering farebox) to recent (proprietary smart card). In what situations a new fare technology is needed? Explicitly identify and critically evaluate goals and motivations for adopting OFPS. At a minimum, this task will evaluate why transit systems would want to adopt OFPS, including:
 - a. decreasing maintenance costs/cost of fare collection,
 - b. decreasing card issuance costs,
 - c. improving customer service,
 - d. making public transit simpler and more accessible to potential riders,
 - e. outsourcing of non-core functions,

- f. enabling more complex and nuanced fare rules/control fare policy (e.g. for zone fare systems, volume discounts, time-based pricing, value-based pricing, or individualized pricing),
 - g. mitigating risks of fare media fraud,
 - h. creating vendor community to encourage more competitive bids on fare system components,
 - i. creating a local micropayment standard to develop potentially a profit center through transaction fees charged to non-transit subscribers,
 - j. enabling regional fare integration and fare media interchangeability,
 - k. higher operating performance (passenger throughputs at turnstiles, bus dwell times, automated and proper zonal fare verification for commuter rail),
 - l. reducing payment processing costs,
 - m. “keeping up with technology,”/improve image of transit
 - n. leveraging existing open source/open standards components to reduce development costs, etc.,
 - o. collect data on the transit system and its users,
 - p. develop customer loyalty.
2. **State-of-Practice and Technologies.** Review and establish a baseline state-of-practice and technologies for “open” fare payment systems (OFPS). At a minimum, this task will:
- a. Provide a definition of “open” (which could mean payment-industry standards, transit-industry standards, open architecture, open source, multi-vendor, interoperability, etc.)
 - i. It may be more a continuum from close to open system instead of a purely open or purely close system. Transit organizations realize that:
 - 1. they cannot take the risk of building a (open-architecture) system from scratch
 - 2. they cannot afford the cost and inflexibility of proprietary (closed) systems
 - 3. they cannot lose all the control on fare policy and data collection by completely adopting open bankcard payment.
 - ii. There is a need to examine cases of hybrid approach where parts of the system are closed and other parts open. This is especially useful for recent smart card AFC adopters as they try to evolve or add more features to the existing proprietary systems. Software/hardware/platform, etc.
 - iii. How open is open? Which parts of it needs to be open, which parts closed?
 - 1. Is Chicago’s proposed project “open” because it uses bankcard technologies?
 - 2. Is Boston’s CharlieCard “open” because it uses industry-standard hardware that has several “clone” manufacturers?
 - 3. Is Washington’s SmarTrip system “open”? Can it be extended to support future needs?
 - iv. How does each fare payment technology deal with field/portable/off-network solutions, when on-line communication with central server is not possible?
 - b. Review different systems that have been proposed or implemented, providing detailed description of the system, its history, its technologies, and its capabilities. Systems reviewed will include at minimum:
 - i. three North American systems (for example but not necessarily restricted to: Boston’s CharlieCard, New York’s proposed NFPS, Chicago’s current proposal),
 - ii. three European systems (e.g. London’s Oyster Card and Future Ticketing Project; Netherlands’ OV-Chipkaart),

- iii. three Asian systems (e.g. Japan’s Suica, Hong Kong’s Octopus Card, Taiwan’s Taiwan Tong), and
 - iv. three “emerging” systems (e.g. cellphone providers, Chase “Blink”, Google Wallet, etc.).
3. **Approaches and Industry Trends.** Identify and classify different approaches to OFPS, and document industry trends. What new technologies are out there that are likely to come into play in the future? At a minimum, this task will identify the major different approaches to OFPS, including:
 - a. single-vendor build (SEPTA, MBTA, CTA),
 - b. multi-vendor build with open standards (MTA proposed),
 - c. contracting with vendor (MTA’s MasterCard trial),
 - d. in-house build with a marketing push to become the local micropayment standard (Hong Kong),
 - e. industry clearinghouse build with commodity parts but with transit-specific functionalities (Taiwan Tong can use bus GPS/AVL systems to localize the position of boarding and disembarkation and therefore charge distance-based fares automatically).
4. **Costs and Benefits.** To enumerate, quantitatively if possible, the costs and benefits of each approach, based on identified goals and motivations. Is funding for the changeover a major impediment? This task will include:
 - a. procurement costs (hardware and software),
 - b. maintenance costs,
 - c. potential increases in revenues,
 - d. “softer” benefits such as offsetting of risks,
 - e. making regional fare integration simpler, thereby increasing ridership, by the nature of using bankcards/cellphones, people won't have to buy multiple different tickets/fare media/etc., but you might want to do things to allow people to get discounted transfers;
 - f. providing amenities such as the ability to make micropayments to bodegas/local businesses using a transit farecard.
 - g. What data can be available from the solutions that help agencies know how people travel?
 - h. Benefits of open architecture and open standards: even with zero functionality for integrating with intermodal, multi-agency, or regional systems, open architecture allows extensions to be built at a later date, does not require design for every eventual functionality up front.
5. **Institutional Organization.** To assess different institutional setups, fare payment terms and conditions, processing policies, and associated issues. In North America and in some countries of Europe, some would think that the adoption of fare technologies by transit organizations is not a technological problem but an institutional one. At a minimum, this task will review and document various organizational models including:
 - a. in Asia, where the fare payment technology company is usually a third party processor that is neither a bank nor a transit agency (but usually its shares are held by both, sometimes also the local government) and derives its revenue through processing contracts with various transit and non-transit merchants, making regional fare integration a matter of signing up additional transit providers;
 - b. in the U.S., where the fare payment technology is usually owned by the transit agency or a regional transit integrator;

- c. in the Netherlands, where the fare payment system goes through a national clearinghouse;
- d. in Germany and Eastern Europe, where fare payment systems may be owned by local transit federations that are conglomeration of multiple local transit providers; and
- e. the proposed models where a bank or financial company could own and operate the payment system.

This task will also analyze these organization models in the context of answering these questions:

- a. What are the characteristics of institutional setup that favor rapid adoption/implementation of new technologies (most of them happened in Asia pacific)?
- b. How to get non-transit vendors to accept the farecard, is this important?
- c. What is the relationship with the banking system (with banks and monetary authority) when providing a micropayment system and who takes the risks? Risk management issues (max stored value amount, etc.)?
- d. What are the common and specific barriers to new fare technology observed in North America context? As technology changes, there is risk that fare payment technologies could go in all directions, thereby risking excessive diversity that will impede future technological advances, and inconvenience passengers who might require a multitude of fare payment technology obligations.

6. Fare Policy and Accessibility. To appraise the impact of OFPS on fare policy and transit access by low-income groups. This task will, at a minimum:

- a. clearly define and seek solutions to mitigate transit access issues posed by a cashless, farecard-based transit system. The basic premise is that many low-income transit users are unbanked and are occasional cash riders. Some may have an inherent distrust of financial institutions and cannot afford or have other reasons not to use multi-ride stored-value cards. Federal regulation requires “meaningful access” to transit services in Environmental Justice populations. How can transit agencies reconcile the dual policy goals of efficient operation and lowering access barrier?
- b. Fare engine algorithms? Relationship to fare policy and choice of fare instruments?
- c. What other innovations in fare policies can be implemented as part of an OFPS?
 - i. Can there be a fare “marketplace” where different consolidators can offer different fare plans all of which rely on the transit system backbone? (Similar to airline consolidators and/or telecommunications resellers?)
 - ii. Can there be explicit subsidies for certain income- or otherwise qualified populations (similar to current blind/elderly/limited mobility benefits?)
 - iii. Can there be true willingness-to-pay based pricing for transit rides (Similar to British Rail’s national network, airline tickets, etc.)? The basis for pricing could be geographic, income-based (but must favour low-income users), zone-based, purchase-date based, time-based (peak/off-peak), etc.
- d. Other policy and implementation issues:
 - i. Should negative balances be allowed?
 - ii. What to do with balances on expiring farecards?
 - iii. How to combat fare media attrition without restricting access?
 - iv. How to optimize regional fare integration as a part of an OFPS effort?

7. Assessment and Recommendations. To provide an honest assessment of the future of OFPS and provide several different recommendations for a “way forward”. This task will provide a strategic roadmap that guides practitioners in decision-making about the next generation fare payment system. While allowing transit managers to incorporate local philosophies, fare

payment realities, and explicit goals for considering and designing an OFPS, the roadmap will include guidance on:

- a. technology,
- b. strategic and institutional issues,
- c. implementation approaches,
- d. policies.

Urgency and Payoff Potential: Advances in open payment systems and technologies are accelerating with unprecedented speed. Transit agencies need guidance now on available technologies and business models for next generation fare collection systems. Given the long lead time and capital intensiveness of these technologies the payoff and potential savings are considerable.

Estimate of the Problem Funding and Research Period:

- Recommended Funding: \$450,000
- Research Period: 24 months

Relationship to FTA Strategic Goals and TCRP Strategic Priorities:

This research problem statement supports all of the TCRP Strategic Priorities and is consistent with FTA Strategic Goal (2) Support Improving the Performance of Transit Operations and System.

User Community:

- Transit Agencies (U.S. and foreign)
- Commuter Railroads and National Railways, where appropriate (U.S. and foreign)
- Toll Road Authorities and Ferry Operators, where appropriate
- Regional Transit Integrators/Aggregators (e.g. TransitChek, SmarTrip)
- Payment Processing Companies/Micropayment Communities (e.g. Octopus Corp., PayPal)
- Merchants/Networks Interested in Adopting Transit Farecards as Form of Payment (e.g. 7-Eleven, Family Mart)
- Financial Services Industry
- Embedded Systems Component Developers/Vendors (e.g. Symbol, Verifone)
- Fare System Vendors (e.g. Cubic, Scheidt-Bachmann, ACS)
- Open Source Software Developers/Publishers/Sponsors
- Municipal, Metropolitan/Regional and State Planning Authorities (U.S. and foreign)
- Transit Planners and Researchers

Related Work:

1. TCRP Report 94: Fare Policies, Structures and Technologies: Update (2003)
2. TCRP Report 115: Smartcard Interoperability Issues for the Transit Industry (2006)
3. Smart Card Alliance. TC-11002: Transit and Contactless Open Payments: An Emerging Approach for Fare Collection (2011)
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6. Michael Frumin. *The Choice between Period Tickets and Pay As You Go on London's Public Transport System: Implications for Efficiency, Revenue, and Best Value*. Unpublished Manuscript, Massachusetts Institute of Technology, Submitted to Transport for London, Cambridge, Mass., 2008.
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