Executive Insights

Second-Generation Fare Collection Systems: The Current State of Play

In September 1997, Hong Kong implemented Octopus, a "first generation" smart card system, which paved the way for agencies around the globe to revolutionize their fare collection systems. These first-generation smart card systems delivered reduced fare evasion and significantly higher levels of customer convenience, removed cash from the system, and enabled significant savings, such as through the closing of station ticket offices.

Fast-forward two decades, and some of the largest global transport agencies have made or are making significant investments in "second generation" smart card systems. This issue of *Executive Insights* explores the triggers for the procurement of these next-generation systems, the challenges faced by agencies and the options on the table.

Meeting customer needs

Today's customers are more connected than ever, and they expect products and services to follow suit. For transit payments, this means customers expect digital payment channels that streamline the journey process and eliminate non-value-adding activities such as handling cash, acquiring a stored value card or topping up.[1, 2, 3]

Figure 1
Consumer payment trends

Almost one-fifth of Australians under 40 years of age use contactless payment every week[1]

In the U.S., a third of adults under the age of 50 do not use cash during a normal week[2]

One in every 10 millennials uses a digital wallet for every purchase[3]

Second-Generation Fare Collection Systems: The Current State of Play was written by **Mark Streeting**, Partner at L.E.K. Consulting (Sydney), **Becrom Basu**, Partner at L.E.K. Consulting (London), and **Noor Abdel-Samed**, Managing Director at L.E.K. Consulting (Boston).

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Contactless open loop payments or EMV[4] is progressively opening transit systems to payment by credit and debit cards, allowing customers to pay for transit as they would pay for any other service or product. Contactless open loop payments are attractive to many regular customers as well as infrequent users and tourists; they do not require a transit-specific app/payment form; they remove the need for selecting tickets; and they enable post payment (via tap out). It is important to acknowledge, however, that not everyone can be served with EMV, as is the case for children without credit/debit cards and the unbanked population. For those customers, traditional payment avenues will continue to be necessary.

The vast majority of EMV deployments around the world have coincided with the migration to second-generation systems. Two notable exceptions are Sydney and London, which both added an EMV payment channel to their first-generation card-based systems.

The use of contactless payments progressively increased to two-thirds of noncash payments in London by 2019/20, with the Oyster smart card accounting for the remaining one-third.[5] Coinciding with the increased use of cashless payment channels, the cost of revenue collection reported by Transport for London had been on a downward trajectory since 2009/10 with the cost of farebox revenue collected relative to revenue reported at 9.6% in 2015/16. A target of 7% was originally set for 2021, but this has been compromised by fare freezes and lower-than-expected demand.[6]

Unfavorable financial and operating environments

Improving customer satisfaction is not the only driver behind the many global city transit fare system upgrades. While many first-generation systems have arrived at or are approaching the end of their economic life, the global COVID-19 pandemic has raised the urgency for the transition to second-generation systems in the world's largest cities and the consideration of innovative transit "payment as a service" models for midtier cities that have less complex needs and can accept less customization.

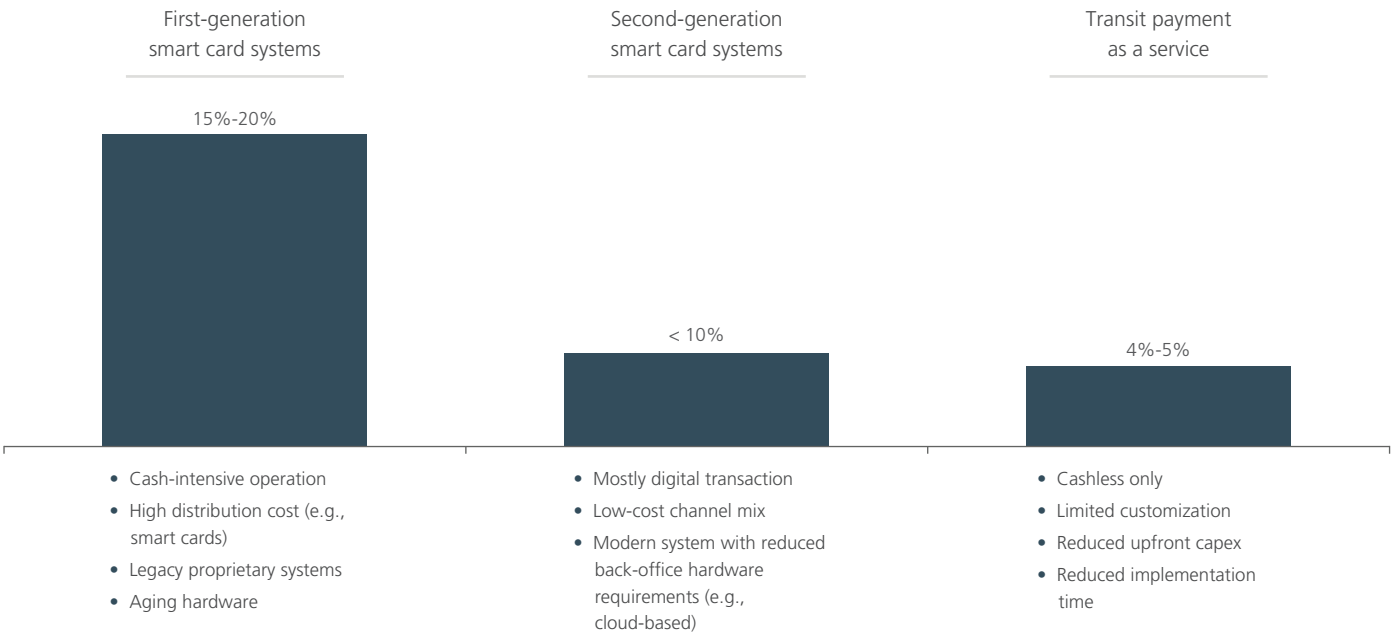
Increased health and safety concerns in public transport have led transit agencies to consider contactless payments a matter of urgency, as cash poses an increased risk of COVID-19 transmission. Customer sentiment seems to reinforce this position,[7] with c. 35% of U.S. and German citizens stating that they have used less cash since the pandemic started. This number increases to 65% in the U.K.

Finally, health concerns seem to have caused enduring behavioral changes, with 55% of consumers indicating the intent to increase the use of contactless payment after the pandemic.[8]

Increased pressure to cut costs has been driven by the sharp decrease in passenger demand (up to 90% in certain cities in the initial months of the pandemic) and the associated erosion of farebox revenue. Reducing cash handling is one of the primary forms of reducing costs. Research[9] has found that the cost of managing physical cash can be as much as c. 3.5 times that of managing revenue digitally.

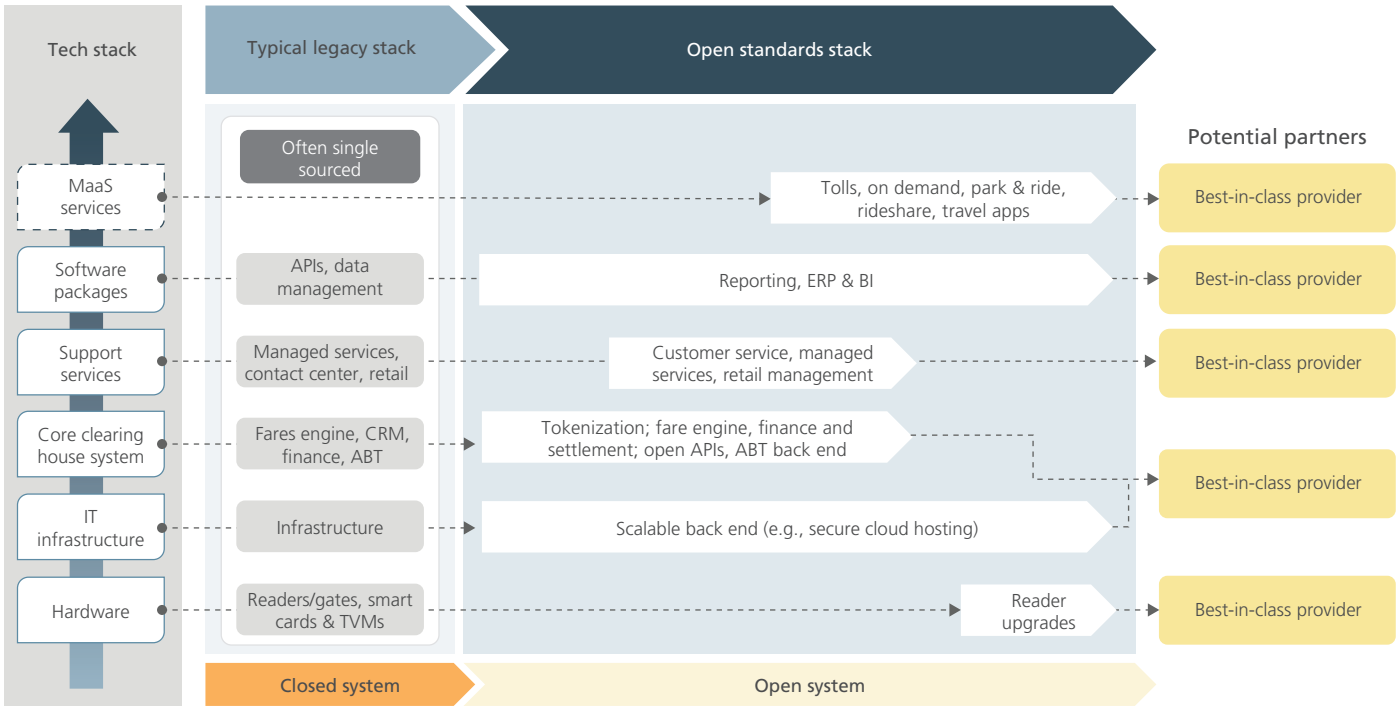
The figure below illustrates the trajectory of fare collection costs as a proportion of farebox revenue for transit operators. Again, it is important to stress that the (current) lower bound on fare collection costs will not be attainable by all, specifically larger cities with complex business rules that drive a high degree of customization.

Figure 2
Trends in cost of revenue collection as a proportion of revenue



Source: L.E.K. research and analysis

Figure 3
Illustrative automatic fare collection (AFC) technology stack



API — Application Programming Interfaces; CRM — Customer Relationship Management; ABT — Account Based Ticketing; TVMs — Ticket Vending Machines; ERP — Enterprise Resource Planning; BI — Business Intelligence; MaaS — Mobility as a Service

Source: L.E.K. research and analysis

Procurement approach

Proprietary and vertically integrated systems have long been the norm in automatic fare collection (AFC). More recently, however, providers have increasingly shown interest in an "unbundled" modular approach.

A modular system brings two advantages to transit agencies. First, it allows for solutions from different providers to be integrated in a single package. Such flexibility allows agencies to select each component separately on the basis of its ability to perform and meet the agency's needs, hence forming a "best of breed" solution.

Second, a modular system is easier to upgrade or modify over time, as changes can be made to modules rather than to the entire system. This helps with the long-standing concern of vendor "lock-in", as keeping the system up to date does not require a risky and costly overhaul each time.

The movement of transit agencies to a modular procurement approach does, however, carry a fundamental challenge: the ability to transfer risk is reduced, as the risk sits with the system integrator rather than the system operator/provider, where a fully outsourced model is pursued. As a result, despite the increasing trend toward open architecture models, many systems are likely to continue to be single sourced (or sourced via few providers) and high vendor dependency is likely to remain a reality for transit fare collection, particularly in major city deployments.

Technological and commercial innovation

Agencies looking to implement second-generation systems will benefit from important technological and commercial developments that have been introduced into the market in recent years.

Account based ticketing (ABT) is the new back-office standard for transit AFC systems. ABT delivers even greater convenience to users than its predecessors, as it enables the use of a range of "tokens" to support a transit journey. In a more novel example of the technology, ABT systems could allow passengers to pay by staring at a camera, so long as they have their image and a valid payment method linked to their account in the background. Moreover, by keeping track of a person's travel history, ABT enables a complex fares policy to be easily implemented and processed in the back office (e.g., daily fare caps, dynamic pricing to leverage surplus capacity or manage excess capacity).

ABT systems also potentially provide a range of direct benefits to transit agencies on a whole-of-life cost basis. The extent of these savings will clearly depend on multiple factors, including the age and functionality of the current fare collection system. Furthermore, under an account-based system, nontransit payments (e.g., parking and tolling) can be integrated and managed under the same system, further reducing revenue management cost and complexity.

Finally, ABT is seen as a critical enabler for mobility-as-a-service (MaaS). MaaS aims to curate the best mobility options for users based on their individual preferences and allow for a simplified single payment for multimodal trips and services. ABT enables both these goals by allowing user accounts to store preference data (populated by users or stemming from travel history) and a payment source.

Our business case work for clients has demonstrated that the transition from first-generation systems to ABT can unlock significant commercial and economic benefits. Many of these benefits are straightforward, such as reduced customer channel management costs. Others are more nuanced, such as the economic value associated with the release of the "funds lock" as customers move from the need to hold funds in an electronic purse on the card to the ABT operating environment.

Multitenanted systems are an emerging option for agencies looking to implement the latest AFC technologies with significantly lower investment when compared with custom solutions. In simple terms, a multitenanted system is a single AFC system that is shared across multiple agencies to leverage scale economies in the back-end system. These systems are thought to be especially compelling for smaller jurisdictions that struggle with the inability to afford of a second-generation custom system and have a simpler transit network suitable for productized offerings (i.e., less customization).

There are two main forms of multitenanted systems. The first is where a large, custom AFC system is built for or extended to neighboring agencies. These cases are often pursued opportunistically and require a case-by-case approach to find a win-win commercial solution for all involved parties (e.g., how to allocate benefits of scale and decision rights/obligations over system requirements).

The second type of multitenanted system is created specifically as a productized off-the-shelf solution. Such systems are typically cloud-based with built-in flexibility for basic customization (e.g., look and feel of interfaces, fare tables), faster rollout and fewer upfront capex requirements than traditional systems since they dispense L3 and L4 hardware (e.g., on-premises servers).

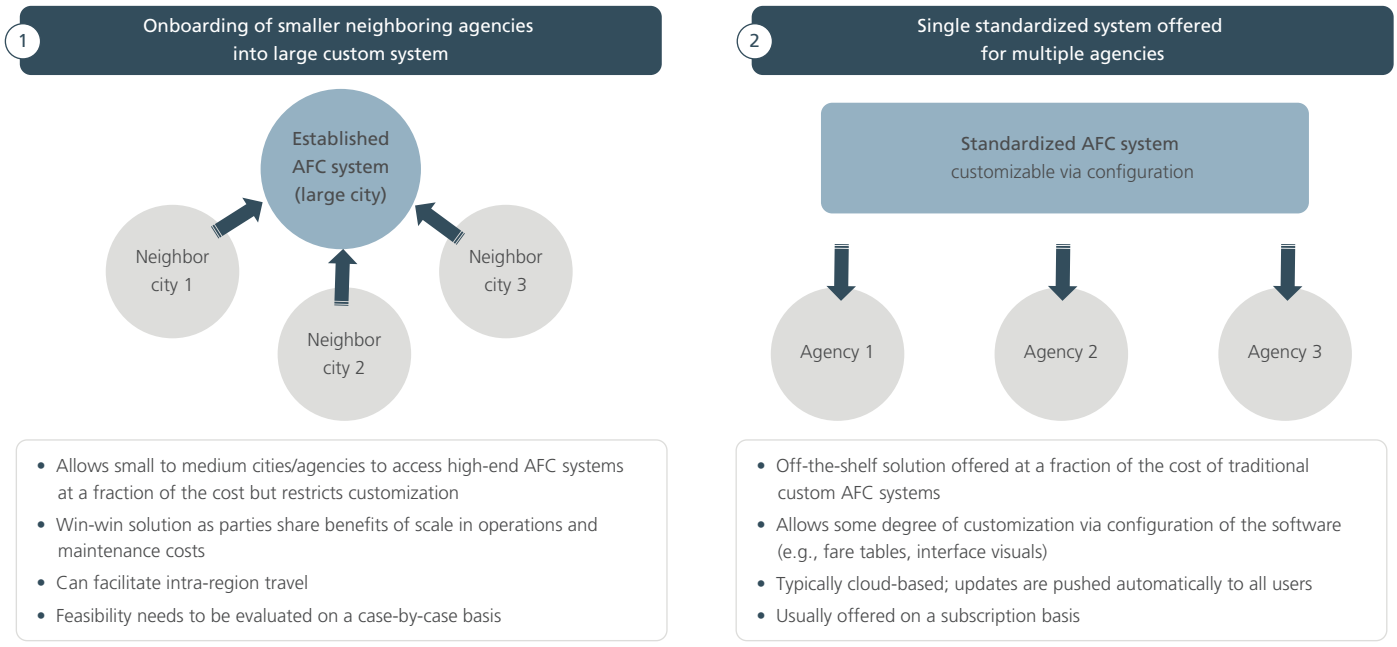
The virtual elimination of the design and build phases in productized multitenanted systems allowed the introduction of fare collection-as-a-service (FCaaS), whereby agencies pay a periodic fee to use the system rather than acquire it, thus further reducing, if not eliminating, the upfront capital requirements.

The introduction of multitenanted systems is expected to create downward price pressure on AFC system costs. However, the effect is not expected to play out as strongly in large global cities where the system requirements, transit network and fare rules are significantly more complex and continue to require highly tailored solutions.

Moving forward

Transit payments are undergoing several changes that are culminating in the rollout of second-generation smart card systems. While the outlook is promising and second-generation systems are poised to improve transit from both customer and agency perspectives, several questions require careful

Figure 4
Examples of multitenanted automatic fare collection (AFC) systems



- Allows small to medium cities/agencies to access high-end AFC systems at a fraction of the cost but restricts customization
- Win-win solution as parties share benefits of scale in operations and maintenance costs
- Can facilitate intra-region travel
- Feasibility needs to be evaluated on a case-by-case basis

- Off-the-shelf solution offered at a fraction of the cost of traditional custom AFC systems
- Allows some degree of customization via configuration of the software (e.g., fare tables, interface visuals)
- Typically cloud-based; updates are pushed automatically to all users
- Usually offered on a subscription basis

Source: Prepared by L.E.K.

consideration to ensure value is maximized with the transition:

1. What are the stakeholder imperatives associated with any new transit fare collection system?
2. Do these requirements dictate a stand-alone custom procurement, or can other options be considered (e.g., multitenanted approach, FCaaS)?
3. Can a robust business case be established, and what are the key assumptions required to support the business case?
4. What should the procurement approach look like (e.g., vertically integrated solution under a design, build, operate and maintain basis or, for example, a modular procurement where the agency assumes the role of system integrator)?
5. What does the transition path to next-generation fare collection look like, and how will these challenges be managed?

Endnotes

[1]Source: Consumer Payment Behavior in Australia, Reserve Bank of Australia, March 2020.

[2]Source: Pew Research.

[3]Source: Experian, 2019.

[4]EMV refers to contactless EMV. EMV originally stood for Europay, Mastercard and Visa and is the near-field communication technology typically used by today's debit and credit cards.

[5]Source: https://www.publictechnology.net/articles/news/transport-london-sticks-oyster-new-fare-collection-system (accessed June 21, 2021).

[6]Source: Cost of Fare Revenue Collection (2013/14 to 2015/16), Transport for London, March 2018, Draft v4.0.

[7]Source: COVID-19 Barometer 2020, Statista, June 2020.

[8]Source: The Strawhecker Group/Visa, November 2020.

[9]Source: *Cashless Cities, Realizing the Benefits of Digital Payments*, Visa, October 2017.

About the Authors

Mark Streeting is a Partner in L.E.K. Consulting's Sydney office and is one of Asia-Pacific's leading thinkers on airport ground transport and transport economics. He regularly advises major private and public sector clients across Australia, New Zealand, Asia and the Middle East on all forms of transport. He is recognized globally for his work associated with smart ticketing and mobility as a service (MaaS), encompassing policy analysis, procurement strategies, business case development and benefits realization.

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