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TECHNOLOGIES APPLIED TO THE TRANSPORT SECTOR: ELECTRONIC FARE COLLECTION SYSTEMS

Electronic transactions are becoming increasingly commonplace in the countries of Latin America and the Caribbean, despite the collapse of many dotcom firms and the failure of e-commerce to make inroads in the region. In the transport sphere, the gradual incorporation of technology in support of processes and the exchange of money flows between players has brought greater versatility, security and flexibility. In public transport, such initiatives take the form of automatic ticket machines and prepaid card dispensing machines. In urban transit, electronic purses used for the supervision and payment of parking time, and in road pricing, electronic toll systems streamline the process of collecting money; this is especially the case with motorways and urban concessions. And in shipping, electronic transfers are increasingly being used for the payment of customs dues and port charges.

In view of the importance of the topic and the interest expressed in it, the Transport Unit has begun a study of these issues, and recently published a paper entitled *Sistemas de cobro electrónico de pasajes en el transporte público,* ("Electronic systems for payment of tickets in public transport") LC/L.1752-P/E, July 2002, on which this issue of the Bulletin is based.

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The successful introduction of technology depends on having an integrated vision

All players in public transport, including users, business owners, drivers and governments, acknowledge the importance and the benefits of incorporating technology into the fare collection

process, whether for reasons of security, flexibility or to enhance intermodal integration. However, in Latin America, several experiments with implementing and operating such technologies have met with failure, amid controversy and strong union pressure.

The reason for this failure appears to lie in the fact that it is often impossible to reconcile competing considerations, viz.: the technology selected by the **authorities**, which is often oversized or unsuitable in view of the measures it is hoped to implement; the conditions demanded by **transport company owners** as regards sale, clearing and operations; the desire for safety and operability on the part of the **drivers**; and the fare level and functionality expected by the **users of the service**. When the discussion is not couched in technical and objective terms, so crucial in matters of technology, an atmosphere of mutual tension inevitably develops, marked by unproductive talks that typically end in the withdrawal of the initiative or the imposition of the authorities' wishes in the form of strict regulations; the outcome is often onerous and complicated systems, which company owners purchase solely to comply with the new regulations, and this ends up sooner or later reflected in the fare. The upshot is that the users, including those on the lowest incomes, end up footing the bill for the technologies acquired, while receiving no improvement in the level of service, and the initiatives fail to have the effect sought by the authorities; both the government and the use of new technologies are discredited in the eyes of business operators and the general public.

Along with the urgent need to professionalize the technology debate, it is vital to understand that successful implementation depends not only on the technology used, but also on the setting-up of an integrated system that meets the needs of the users and operators of public transport, bearing in mind the characteristics of the agents involved together with those of the environment in which they operate.

The choice of an electronic payment technology is a key step, as it has a significant impact on both the clearing of the resulting proceeds and the conditions of sale offered the service; these factors determine how the system is perceived and to what extent it is adopted by transport operators and users, whose actions ultimately lead to the success or failure of the initiative.

It is essential to carry out an exhaustive investigation into existing technology options in order to achieve optimum balance between: the desired objectives, the costs that participants are prepared to pay and the common good. It is also important to consider sociological aspects of the city and country where it is hoped to implement the system, since a solution that proves successful in one place may not be successful in another, as the users, social variables and the environment are all different.

The right choice of technology must ensure that multiple objectives are adequately met

Today, the most widely used prepaid devices are contactless cards, cards featuring a magnetic stripe and, to a lesser extent, contact cards. However, these are not the only options, as alternatives range from ticket machines through to systems based on m-commerce (that is mobile commerce), which provide for payment of the fare via mobile devices such as a cellphone, with the amount charged to the monthly phone bill.

Cost and features of the main prepaid systems available

Feature	Contactless card	Magnetic stripe card
Cost of a disposable card, in US$	Does not exist	0.02 - 0.05
Cost of a reusable card, in US$	1.6 - 3.2	0.08 - 0.12
Transaction time per passenger, in seconds	0 – 1	2 - 3
Average life of a reusable card, in terms of number of trips	3 000	200 - 300
Cost of maintaining read/write device	0	180 - 225
Security offered	High	Low

Source: Jorge Rebelo, The Buenos Aires Metropolitan Region and the Smart Card, World Bank, 1999.
The "security offered" item was added in 2002.

Choosing the right technology for an electronic payment system is not a trivial matter, because there are at least four contrasting considerations pointing in different directions, viz. the **cost of equipment, the processing speed, the security offered** and **the number of available suppliers**. So, for example, the need to be fitted out with low-cost equipment may impact adversely on the considerations of security and processing speed.

Generally speaking, the security and speed of operation (number of users handled per minute) offered by current systems are sufficient for most electronic fare collection applications. By working with open architectures and adhering to international standards, it is possible to ensure that the technology acquired will not become obsolete over time, with the option of adding new equipment or switching suppliers when the incumbent fails to meet the necessary requirements in terms of price or quality.

Prepaid options that offer attractive fares for customers and adequate security for transport operators

The introduction of a prepaid system on public transport generally requires the use of a card or device that allows trips to be deducted once they take place. The monetary value represented by these devices and their widespread use may be more than sufficient reason for people to attempt to forge them. As a general rule, any device that has gained wide acceptance is a target for forgers, but the security it offers is proportional to its cost of manufacture.

These factors need to be borne in mind when choosing between systems, with purchasers attempting to strike a balance between the **price of the device**, which is reflected in a fare that is attractive to the client, and the **security** required by transport operators.

Contrary to popular belief, the know-how and technology necessary for such forgeries are relatively easy to acquire and low-cost. There are a multitude of sites on the Internet that provide information in this regard, as well as prefabricated devices.

There is currently no data available on fraud involving electronic fare collection systems, but the practice occurs quite frequently with prepaid telephone cards, though still not enough to be a major concern. Given the similarity in the technology used, fraud can be expected in public transport, and for that reason it is appropriate to bear security considerations in mind when choosing a system,

and not just the cost as is usually the case.

Factors that affect the complexity of the clearing process

Among operational considerations, the procedure known as clearing is of vital importance for operators. This is the process whereby funds obtained from the operation are received, recorded, transacted and divided up pro rata. The complexity of the clearing process depends on the payment technology used and varies in accordance both with the number of participating companies and the actual number of users and transfers in the system. Discussion on this point tends to focus on who should handle the funds and how often the service provided by operators should be settled.

The choice of prepaid system introduced, especially those that feature pre-payment and direct debit from credit cards or checking accounts, together with the number of participating organizations, may dramatically increase the operational complexity of the system, and the money and data flows involved. Due to this administrative complexity, it is usual practice for payment frequency to be restricted, and this may at first complicate the lives of bus company owners, who are used to collecting takings every day in cash.

Money and data flows in the clearing process
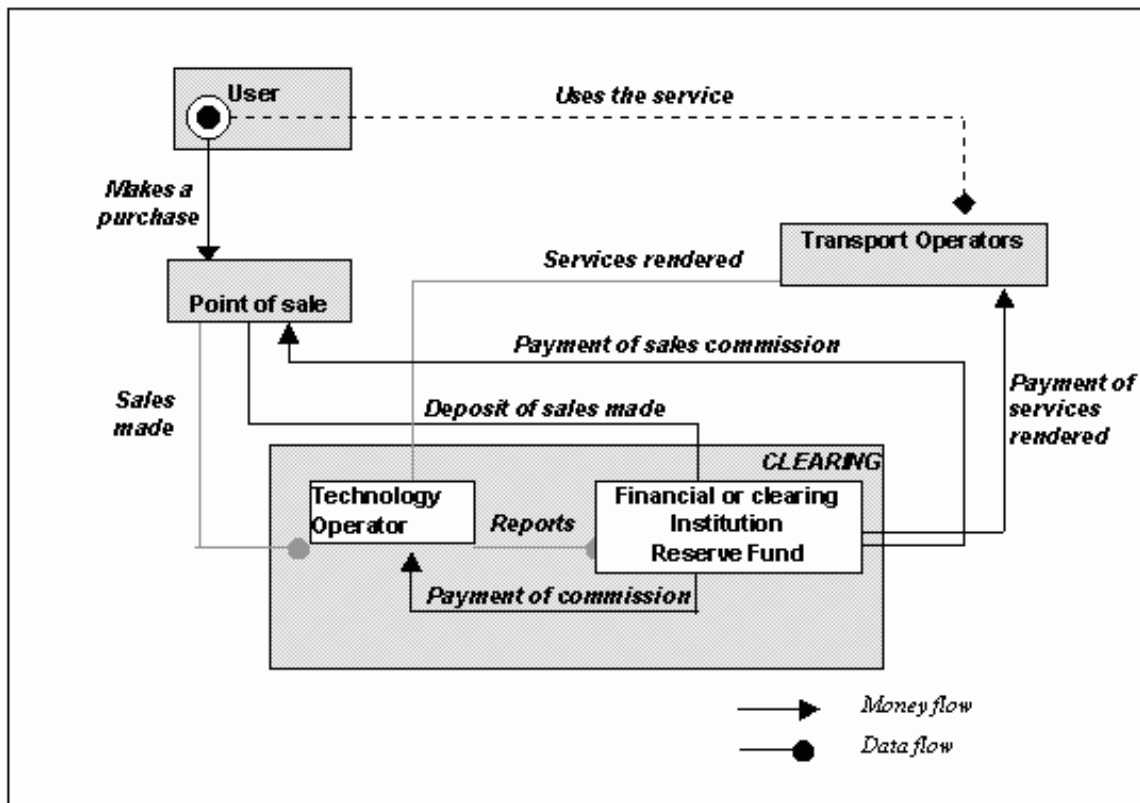
Source: Gabriel Pérez, on the basis of information provided by: "Bases Técnicas: Proyecto Medio de Pago" (Technical guidelines: Methods of Payment Project"), Banco del Estado de Chile and "El Sistema de Recaudo y la Administración de Recursos del Sistema Transmilenio" ("Collection arrangements and administration of resources in the Transmilenio System"), 2002.

The role of prepaid systems in encouraging the use of public transport

Sales logistics is another of the key elements in the successful introduction of a system. The creation of an extensive point-of-sale network is essential if the system is to operate properly, in a way that facilitates to the greatest possible degree transport service users' access to prepaid cards, particularly if the process is outsourced. Care should be taken to avoid, as far as practicable, build-ups, complex sales arrangements and other operational complications that encourage users to change to another mode of transport. For instance, when ticket machines were introduced and made compulsory in Buenos Aires and Santiago, users without coins on them opted for other means of transport that did not have the same restrictions, and that, along with other factors, eventually caused the initiative to fail.

Reasons for purchasing a multi-trip ticket

To ensure prepaid cards are widely used, it is essential to give financial incentives to people who purchase a large number of tickets. In instances where incentives are very low or non-existent, it has been noted that users prefer single tickets, and as a result the number of people crowding ticket offices increases, particularly in rush hours. This has been the experience with city trains in Buenos Aires and the Transmilenio in Bogotá; as there is no financial advantage associated with the purchase of a multi-trip ticket, the single trip ticket tends to be the preferred option, and this causes unnecessary build-ups at peak times as people line up to buy tickets. In most cases, it can be observed that the convenience of not having to buy tickets every day is not a sufficient reason to purchase a multi-trip card.

Users' confidence in the system is another determining factor in whether pre-payment schemes take on. If the system is unreliable or problems arise frequently with the technology, it is unlikely that users, primarily those in lower-income groups, will invest in the pre-payment concept.

The need to standardize the user interface

A well-designed user interface will make it easier for users to familiarize themselves with the technology, thereby winning them over. In the name of competition, the authorities often allow a number of technology providers to supply the equipment without setting guidelines as to the interface, in the belief that the design should be competitive. While it is important to promote measures aimed at generating a competitive market, the co-existence of multiple formats makes it harder for users to adjust and hampers training. In this regard, it is useful to draw an analogy with automatic teller machines (ATMs), which on the outside maintain an operational interface, even between different countries, though under the surface many companies are involved in implementing and integrating their technology.

Other important considerations in regard to the user interface, which should be included in the bidding conditions in order to promote user adjustment and facilitate daily use, include the need to come up with technology that is easy to operate; this involves the use of pictograms combined with written instructions that make it easy to understand how the system works and simplifies its use for old people, children and foreigners. Consideration should also be given to the use of luminous

devices featuring an appropriate level of contrast, including in extreme situations such as at night or in full daylight, as well as buttons that are easy to operate and within reach of children and the disabled.

Conclusions

The introduction of an electronic payment system for the purchase of tickets may serve as the initial stage on which to incorporate new advances in telematics in the urban transport arena. In order for implementation to be a success, it is necessary to combine the range of factors that interact and comprise the system. The decision cannot be based purely on technological considerations, since any change in payment medium has social and sociological repercussions; the interaction between the user and public transport operator is significantly changed, while the manner in which these services are marketed undergoes a complete revamp.

New requirements and challenges arise in the course of implementing these projects, such as setting-up an effective institutional and legal framework that regulates and ensures competition in the market and oversees the new entities created in the clearing process.

Other factors that determine the success of these initiatives include the creation of a suitable distribution network of payment outlets, and the conduct of marketing and educational campaigns that promote them and facilitate their use. A high degree of coordination and cooperation is required among the various agents involved; there is also a need for a professionalization of the discussion and the participants, both government and operators, so that timely and correct use is made of the solutions and options provided by the new technologies.