Contactless Fare Collection in an Interoperable, Multi-Operator Age
From ticket-punchers to contactless fare collection systems – what progress has been made in the past thirty years!

Two generations of increasingly sophisticated fare collection systems have been introduced, and Thales has participated in each and every technological breakthrough.

First came the magnetic ticket, which made it possible to read and record data automatically. Then came the contactless card, and with it a great technological leap forward. Unlike the traditional smart card, the new contactless card fulfills the specific requirements of public transport, in particular the need to process fare media quickly.
Automatic Fare Collection:
Magnetic Stripe Tickets and Contactless Smart Cards

The first magnetic ticket fare collection system was set up in Montreal in time for the 1967 World’s Fair. Mexico City was the next to adopt magnetic stripe tickets for its public transport system, and shortly thereafter Paris followed suit with tests on metro line no. 1. From the 1970s onwards, all new metropolitan transport networks - such as the metro systems in Santiago and Sao Paulo - were equipped with automatic ticketing or fare collection systems. San Francisco’s BART was the first metro to use the electronic purse concept for fare collection (1974), while Hong Kong’s MTRC was the first to use recyclable magnetic stripe tickets (1982).

Magnetic ticket systems offered a lot of benefits for passengers as well as operators: they were easier to use, and they automated the process of data collection and management.

In 1984, after inaugurating lines n°1 and n°2, the MTRC (Hong Kong city network) set up an agreement with the KCRC (Hong Kong’s suburban train lines) to use a joint electronic purse system for fare collection. Later, in 1990, this system was extended to include KMB, main operator of the Kowloon bus network (4,000 buses) for fare collection on buses carrying passengers to metro stations.

In 1993, after using the magnetic-card based electronic purse for several years, Hong Kong decided to move to contactless smart cards. The change from magnetic to contactless technology brought the transport operators a number of advantages: the equipment was more reliable, maintenance costs dropped sharply, transactions were quicker and security was enhanced. Last but not least, greater data storage capacities led the way to new applications.

Thales: Contactless Fare Collection in an Interoperable, Multi-Operator Age
Technical Prime Contractorship and Partnerships

Thales positioned itself on this market very early on, and in the 1980s the company already had a market share of over 50% (not including Japan). As a result, Thales has acquired experience and skills in the field that few other companies in the world possess. In addition to its experience with large-scale projects, Thales is a major system integrator with specialised expertise not only in automatic fare collection but also in related fields such as supervision, remote surveillance and fleet management.

The contactless fare collection project implemented in the Netherlands – the first nationwide contactless fare collection system ever built – is a perfect illustration of what Thales can do.

Thales offers two key capabilities. First, as technical prime contractor, the company delivers comprehensive solutions covering an infrastructure’s entire life cycle, including development, commissioning, maintenance, technical upgrades and functional enhancements. Second, Thales has the capacity to form and coordinate the partnerships required for multi-operator projects where interoperability, security and clearing and settlement solutions are essential.

Building on its technical expertise and experience, the company is capable of designing systems encompassing several generations of technology (magnetic stripe, contactless), such as the KCRC network in Hong Kong, as well as all-contactless interoperable multi-operator systems such as the solution developed for the Oslo transport network. And Thales designs and develops its own equipment, further enhancing its technical capabilities.
Combination of Magnetic and Contactless Technologies in Hong Kong

One technology cannot be replaced by another overnight, so there is also need for hybrid systems that allow several generations of technology to coexist.

This is the case of the Hong Kong KCRC transport network, for which Thales designed a complete automatic fare collection system that processes both existing magnetic tickets and contactless cards.

The hybrid system was used for an entirely new line (West Rail) and an existing line (East Rail). It was put into service progressively in 2003 and 2004. Although 90% of the 2 million transactions handled by the system each day are contactless, the magnetic system must also be extremely reliable. This vast project includes nearly 500 control gates, 350 distributors and over 100 ticket office machines – all designed and installed by Thales.

Oslo, a Multi-Modal, and Interoperable System

Nowadays, interoperability between several transport operators is listed as a system requirement in RFPs for large-scale projects.

One example is the Oslo city system to be put in service in September 2005. The project covers the entire urban network: 100 metro stations, 330 buses, 72 light rail trains and 7 ferries. The system obliges all passengers to validate their transport fare media. It interoperates with the bus and ferry company SL and with the national railway (NSB).

The system uses only contactless technologies: smart cards for long-term passes and e-purses and smart media for occasional passengers.
Paris & Strasbourg: A Combination of Contactless and Magnetic Technologies in a Multi-Modal Application

Thales was selected by the RATP to design, supply, install and maintain the Navigo contactless card validation system used on the entire Parisian RATP bus and light rail network, which has 4,000 buses and a hundred light rail trains.

Equipment provided by Thales includes more than 10,000 single- and double-sided contactless validators, 4,000 onboard concentrators and some 30 depot processing systems.

The contract for the Paris project was awarded in 2002. The system is based on specific technologies. It uses Calypso contactless cards, which can offer additional services to transport.

Thales has also implemented a similar system for Strasbourg’s urban transport network (CTS) with the integration of car parks, which offer preferential fares to public transport users.
The Netherlands Sets Up a Nationwide Fare Collection System

This automatic fare collection system is a showcase of Thales capabilities in several respects. It is the world’s first automatic fare collection system to cover an entire country and all modes of public transport, including trains, buses, light rail trains, metros and ferries. When fully operational, the new system will be used by over two million people. It is based entirely on contactless technologies: smart cards (Mifare 4k) for long-term passes, and transport purses and single-use smart media (Mifare Ultralight) for single-trip tickets.

The project was launched by a joint venture composed of 5 transport operators: the national railway (NS), urban network operators in Rotterdam (RET), Amsterdam (GVB) and The Hague (HTM) and the inter-urban bus network Connexxion. In 2003, the joint venture signed an initial contract with East West, a consortium made up of Thales, Accenture and the Dutch company Vialis.

Based on its expertise in contactless technologies and systems integration, Thales was chosen to design and implement the system and provide equipment in partnership with MTRC and Octopus, which will handle the clearing and settlement system. The new system guarantees interoperability between the five public transport operators, thanks in particular to a contactless multi-standard reader designed and supplied by Thales. The new reader can process practically all cards available on the market.
Thales Designs and Develops its Own Equipment

Rounding out its expertise as a systems integrator, Thales maintains a comprehensive understanding of the key technologies involved in fare collection systems by designing and developing its own equipment. Thales’ control gates are secure, reliable, robust and capable of delivering the performance levels required by the most demanding operators. They can operate autonomously or in conjunction with a central processing system.

Other equipment produced by Thales includes point-of-sale terminals, portable ticket analysers, automatic distributors and onboard validators in buses and light rail trains. To optimise costs, Thales entrusts production of this equipment to local companies. This approach helps to make Thales solutions among the most competitive on the market, while opening up new markets and creating jobs throughout Europe.

The Two Main Automatic Fare Collection Systems

There are currently two main types of fare structures: the transport e-purse and the transport pass. The transport e-purse, used mainly in Asia and northern Europe, stores information on the amount available on the card, and deducts transport expenses as they are incurred. The system can also calculate the fee for a given voyage, even when fares are determined according to complex rules. It can also be used as a form of payment for other transportation-related products, such as parking, and in some cases for completely unrelated expenses. In Hong Kong, for example, the transport e-purse can be used just like any other electronic purse.

Passes are usually valid within a given geographic zone and for a certain period of time. The best-known example is perhaps the «Carte Orange» that Parisians and commuters from nearby suburbs can buy on a monthly or weekly basis. This system is widely used in the rest of Europe and in North America as well.
## Examples of Thales capabilities

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<th>Cities or countries</th>
<th>Partners for the project</th>
<th>Technologies used</th>
<th>Characteristics</th>
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| **Taipei**          | Partnership with Alstom. | Contactless cards and tokens (Mifare). | Complete replacement of the existing system, line extensions and new lines. From 64 stations presently to 104 stations in 2010, with the EasyCard interoperable system between TRTC (metro operator), 13 bus operators and 47 public car parks. 1,500 control gates and over 700 automatic distributors. | June 2002 (EasyCard)  
2007 for existing lines  
2010 for new lines |
| **The Netherlands** | East West consortium including Thales, Accenture and Vialis. | Contactless cards and tickets (Mifare). | Interoperability between five operators: NS, RET, GVB, HTM and Connexxion. | 2005 |
| **Oslo**            | -                        | Contactless system: smart cards and single-use smart tokens (Mifare). | Interoperability between two operators: SL (bus and ferries) and NSB (railway). | 2005 |
| **Paris**           | -                        | Contactless cards (Calypso) Integration of contactless validators. | Multi-modal system 10,000 validators, 4,000 onboard processing systems and 30 depot processing systems. | October 2004 for zones 1 and 2 |
| **Bangkok**         | Project carried out with Siemens in cooperation with Mitsui. | Contactless smart cards and token (Sony Felica). | - | July 2004 |
| **Hong Kong**       | -                        | Combination of magnetic and contactless technologies (Sony Felica). | Nearly 500 control gates, 350 automatic distributors, 120 ticket office machines, 50 information points, 36 local station computers and 2 systems connected to the existing system. | 2003/2004 |