littlepay

The Fundamentals of Transit Payments Explained

Written by Amin Shayan

Introduction

As CEO of Littlepay, the first payment service provider specialising in public transit, I have the privilege of meeting with hundreds of public transit agencies, operators, consultants and vendors - an ecosystem that plays a vital role in the daily life of millions of people.

Through these interactions, I've come to realise that there is still a lot of confusion and misinformation when it comes to contactless open payments. So I decided to put pen to paper and write this primer, providing a broad overview of open payments, and the key considerations in the design, implementation and procurement of such a system.

This was written primarily for the benefit of transit authorities, agencies and operators who are considering the addition of contactless payment acceptance to their ticketing systems. I hope that by sharing the experiences we've gained in over 250 deployments around the world you can better navigate this complex domain.

I hope you find this useful, and would appreciate your comments and questions so we can further refine the content.

Contents

CHAPTER 1

Introduction to Contactless Payments (cEMV) in Transit

The journey - From Cash to Open loop to Closed loop

Transit ticketing and fare collection has evolved through 3 major phases over the decades: Cash, Closed Loop and Open Loop. Cash fareboxes were introduced in the 1880s, followed by token-based systems in the 1930s which reduced the need for cash handling. In the 1990s, magnetic stripe cards, like New York's MetroCard emerged enabling stored value and convenient swiping at fare gates, marking a shift towards smartcard based systems.

Closed Loop systems (Smartcards)

A closed loop payment card is a type of card that can only be used at a specific set of merchants or locations, rather than being accepted widely like a credit or debit card. These cards are typically issued by a specific organisation, and can only be used to make purchases within that organisation's network of products or services.

An example is a transit card, which is used for transportation systems such as buses, subways, and trains, and can only be used within the transit system's network. There are many examples of these around the world such as: Oyster Card (London), Myki (Melbourne), Clipper (San Francisco), Leap Card (Dublin). The Octopus card in HongKong is a somewhat unique example of a transit closed-loop card that was then opened up for use by other retailers.

Closed Loop cards are sometimes referred to as Smartcards, or Stored Value Cards. The card itself usually holds data about the amount of funds currently held by the customer, and is adjusted through a back-office, or ledger system for the application.

The value on the card can be 'topped up' by the customer by cash (at a Kiosk or Retail outlet) or through an online payment using an Open Loop card.

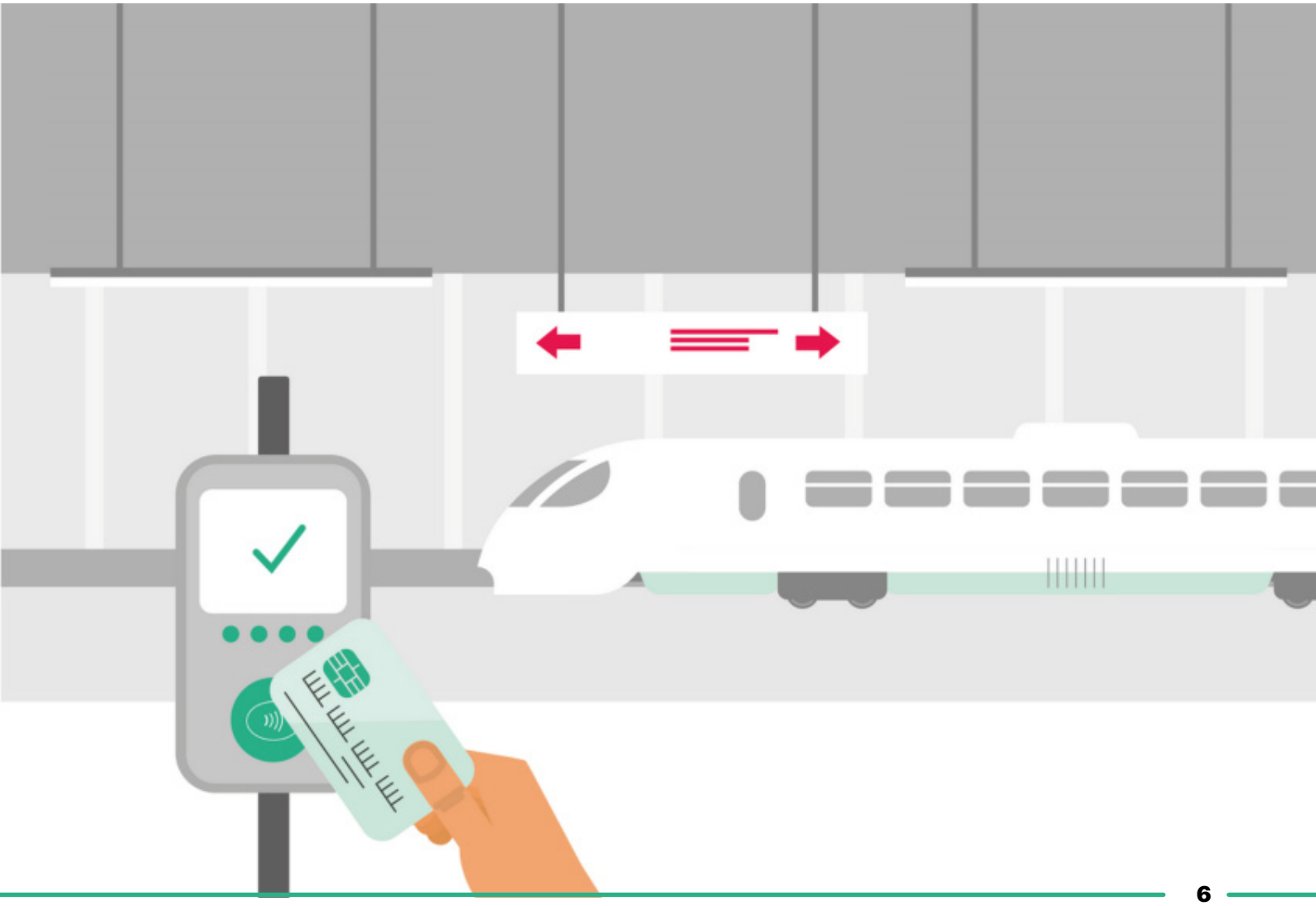
Open Loop Systems (Bank issued cards)

Open loop payments are typically associated with payment cards such as credit cards, debit cards, and prepaid cards. These cards are usually issued by financial institutions such as banks.

Open loop payments are processed via payment card networks (also referred to as "schemes") that facilitate the transfer of funds between the merchant's bank and the customer's bank, and provide security and fraud prevention measures to prevent loss.

These systems (sometimes referred to as 'payment rails') have been developed over several decades and billions of dollars of investment. Visa and Mastercard are the two largest open card networks.

When we refer to 'contactless payments' in transit, we are usually referring to a particular type of Open Loop payment - that doesn't require card insertion or a swipe.



Challenges of Open Loop Systems

Open Loop, Contactless Payments (cEMV) - A road paved by the retail sector

In 2007, the UK card industry set contactless payments in motion to provide a fast and frictionless payment experience in retail. Shoppers could now buy their groceries, the weekly newspaper or a pair of socks all with a simple tap of their card at the checkout.

Today, contactless accounts for 50% of global in-person transactions handled by Mastercard[1], and the global contactless payment market is projected to garner $32.75bn by the end of 2024[2].

The speed at which customers could just tap and pay proved ideal in fast-moving industries such as events, retail and hospitality. Any merchant with the right payment terminal (hardware), whether at a sports event or convenience store could now deliver a more frictionless payment experience, improving efficiency and customer satisfaction.

It's a trend that further exploded in the early months of the pandemic. Mastercard saw over 40% growth in contactless transactions globally in the first quarter of the year[3]. For Visa in 2020, the percentage of transactions that were contactless more than doubled year on year in parts of Europe[4]. While over in the U.S., 19% of consumers made their first contactless payment in May 2020[5].

What is cEMV? And how can it make catching a bus, train or tram as easy as buying your morning coffee?

What is EMV

EMV stands for Europay, Mastercard, and Visa, which are the three companies that originally developed the EMV global standard for payment cards that use embedded microchip technology, also known as "chip cards" to enhance payment security and reduce the risk of fraud. Today, EMVCo members include American Express, Discover, JCB and UnionPay.

EMV cards store payment information on a small chip embedded in the card instead of the traditional magnetic stripe. When a customer uses an EMV card to make a payment, the chip generates a unique code for that transaction, which is transmitted to the payment terminal along with other information, such as the card number and expiration date. The technology makes it much more difficult for fraudsters to create counterfeit cards, which is a common form of credit card fraud with magnetic stripe cards.

What is cEMV

cEMV stands for Contactless EMV, which is a variation of the EMV standard that uses near field communication (NFC) technology to communicate wirelessly with the payment terminal and make a payment. A customer using a cEMV card to make a payment, simply holds their card close to the payment terminal. The card and terminal exchange information wirelessly, and the transaction is processed quickly and securely.

cEMV technology is becoming increasingly popular, particularly for low-value transactions, because it is faster and more convenient than inserting or swiping a card. It is also more secure than traditional magnetic stripe cards because the wireless communication between the card and the terminal is encrypted and the transaction data is protected by dynamic authentication technology.

1. PYMNTS.com: Mastercard: Contactless Payments Now 50% of Global in-Person Transactions
2. Research Nester: Contactless Payment Market
3. Mastercard global consumer study, April 2020
4. VisaNet data June 2020
5. National Retail Federation survey, August 2020

"Retail stores can still afford a slight delay of two or three seconds to authorise a payment... in transit the standard required is 300 milliseconds to keep people moving."

Rerouting from retail to transit

The challenge

While contactless payments are widespread in the retail world, they have been slower to catch on in public transit due to a number of challenges:

- **Payments need to be processed instantly**. Retail stores can still afford a slight delay of a few seconds between the moment a customer taps their card and the moment the payment is authorised. In transit, the standard is 300 milliseconds. Even a third of a second pause per passenger can cause congestion at a station gate. Acceptance with this speed means payments processors can't check if the customer has adequate funds in their account. This in turn has implications for risk.

- **Values are often unknown at the point of sale.** When a customer taps to pay at a retail store, the value of the payment is known. With transit, the value will differ depending on how far they travel, what zones they go through, whether they are eligible for discounts or whether they have hit a fare cap. There can be thousands of different fare variations, which require a set of complex rules to manage.

- **The system needs to work online and offline.** Retailers are usually connected to Wi-Fi or a mobile network. If the point of sale device is down, the customer has to wait. In public transit, it is sometimes necessary to take payments underground or in remote, rural areas, where connectivity isn't guaranteed.

- **There is risk to manage.** Given the speed of processing, variability of transaction values, and wide range of globally issued bank cards, there are a range of risks to manage. If the transaction fails somewhere along the process, you need a system that can recover the debt payment and prevent the passenger travelling again to reduce losses.

- **Transaction costs must be managed.** The average transaction value (ATV) of a retail transaction is $20-$50 depending on the market. In transit the average value is an order of magnitude smaller, $2 - $5. The ability to aggregate transactions before processing, to minimise fixed interchange fees can have a big impact on overall cost in some jurisdictions.

London was one of the first cities to rise to the challenge, with Transport for London (TfL) introducing a contactless payment system to London's buses in December 2012, which expanded to cover Tube and rail services in September 2014.

The unique characteristics of contactless EMV payments for transit add a layer of complexity when compared to retail tap and pay. Solving these problems is the role of a specialist.

> ***As of April 2022, Transport for London's contactless payment revenue had already returned to pre-pandemic levels"***

London: a brief stop

Contactless payment cards, phones and smart watches have been used on London's transport systems for over 10 years, and to great success. In 2017, 40% of all pay as you go journeys were made using contactless payment[6] in 2021 that figure was at 70%[7], and now contactless payments revenue has already returned to pre-pandemic levels.[8]

It's a model that many want to replicate. Chicago and Salt Lake City were the first to adopt the technology in the U.S. but as Bloomberg reported, they were quickly hamstrung by "long-term equipment contracts."[9]

Few operators can afford a bespoke system like TfL. And few cities want to wait years for a ticketing system integrator to develop it for them. Agencies and operators with enough resources, such as New York's MTA, the largest transit authority in the U.S., can achieve similar results to TfL. But this type of built-from-the-ground-up system cannot feasibly scale across a country or state in the way that is now being seen in California. More on that in later chapters.

Open payments are a crucial step in meeting the needs of the modern passenger and luring them back to public transport. So another answer was needed.

6. Transport for London: One billion journeys made by contactless payment on London's transport network
7. Mobility Payments: Contactless Transactions Soar, but Transport for London Affirms that Oyster Will Remain Payments Option.
8. Mobility Payments: Transport for London Sees Open-Loop Revenue Return to Pre-Pandemic Levels
9. Bloomberg: Contactless Transit Fares Get a Pandemic Boost

A fast lane for the wider world

At Littlepay, we set out to create something that was affordable and easy for public transport operators and agencies of all sizes - a simple, modular, contactless open-loop system that was vendor agnostic and could work with all suppliers. All you need is an EMV capable card reader, a bank account and our standard contract, and you're good to go.

Open payment technology offers a simple solution for passengers, reducing the hassle of having to carry around multiple cards, or tickets. Your own payment card effectively becomes your ticket to travel. We asked: "Why does it have to be so complex and expensive to set up payment acceptance in transit when it can be done in minutes for retail?"

After successfully creating this platform, and helping hundreds of operators to deploy contactless, Littlepay built on this foundation with additional capping and concession features. These features deliver convenience for the passenger, and enable operators to keep existing fare structures whilst maintaining transit equity for their customers. We'll unpack these features further in later sections.

The second connection: Open loop payment systems Making travel payments easier for everyone

The closed loop past

Legacy closed loop payment systems are still found in cities all over the world.

Closed loop systems can make travelling easier for passengers that use the same network every day, and they are especially convenient for children and passengers who don't have a bank card. They also give the operator complete control of their fare collection system and its data.

That control comes at a cost, however. Closed loop systems often require the issuance of millions of pieces of plastic, not to mention ticketing machines and the costs of handling the cash that goes with them – up to 15%[10] of each sale. And while the pre-pay nature of the system means that operators can benefit from unspent funds (there was over £550 million on unused Oyster cards in March 2021[11]), this is hardly a pro-passenger approach.

For cities with legacy systems, open payments are usually adopted in parallel with a closed loop payment system.

10. IHL Services: The cost of cash
11. BBC: London's Oyster card: Are its days numbered?

> ***We're looking to blow complicated closed loop payments out of the water"***
>
> Sheryll Ricketts, Solutions Consultancy Lead, Littlepay

The open loop future

We know that the benefits of open loop have the potential to solve many of the problems facing modern mass transit – for operators and passengers.

Unlike closed loop cards, they don't require passengers to prepay. That means they don't need to find a fixed kiosk to top-up or struggle for five minutes through an app's UX before they can get on a bus or train. They can simply step aboard.

It also means transport providers don't have to fret about offering bespoke card management systems, reducing their costs. Transport for London's revenue collection costs fell from 14.3% in the 2005-2006 fiscal year to 9.6% after the introduction of contactless payments, and the cost has only continued to drop.[12]

Sheryll Ricketts, Solutions Consultancy Lead at Littlepay, says, "We're looking to blow complicated closed loop payments out of the water. With closed loop, you have to invest in all the backend systems yourself, but with open loop the bank is taking care of the security and the tech and the card issuance. This makes the total cost of ownership significantly lower"

"If passengers have a pre-paid closed loop experience, it's sometimes lucrative for the operator. But making travel more cost-effective for the passenger will encourage passengers to use transport more often, which adds further value and is better value for operators in the long term."

12. Mobility Payments: Contactless Transactions Soar, but Transport for London Affirms that Oyster Will Remain Payments Option.

Benefits of Open Loop, and Contactless EMV

Good for passengers

One card, one tap. Passengers can easily tap their contactless card, or contactless-enabled smartphone or smartwatch on a payment reader to access transit services.

Uncomplicated. Ticketing complexity is the bane of many riders' public transport experiences. But with EMV, flexible fare models can be calculated in seconds. Taps of a bank card can be aggregated together over a given period. Simple flat fares, fare caps or concessions for students or pensioners can be applied, with the best value fare automatically calculated.

Convenient. Passengers can pay for public transport trips using the same bank card or mobile wallet they carry day-to-day. This benefits low-income riders in particular, as a pay-as-you-go solution means you don't have to stress about forking out the upfront costs of a weekly or monthly pass.

Adaptive. With pay-as-you-go contactless EMV, passengers can travel irregularly and still get the best value from automatic fare caps, an essential for a hybrid-working world. Buy now, tap later EMV options are also possible for passengers who prefer to get organised up front.

Good for operators

Lures riders to transit. Contactless EMV payments make the rider experience effortless, and increases customer satisfaction. It's simpler to use the system for the first time, and passengers are more likely to return. Tourists don't need to wrap their heads around local ticketing systems, or talk to the driver in an unfamiliar language to pay for a paper ticket.

Inspires more frequent travel. Dynamic fare caps can be automatically applied to reward frequent travel. These can be daily, weekly or monthly caps that mimic period passes, or they can be flexible, applying incremental discounts with each tap until a cap is reached.

Quick. A simple, tap and pay system, instead of using cash, speeds up boarding. Dwell times are reduced by an estimated 25%[13] , improving public transport efficiency and traffic.

13. Federal Highway Administration: Massachusetts Automated Fare Collection System

Good for operators (cont)

Works anywhere. Taps are securely processed offline, it doesn't matter whether you're in a remote rural town, or underground with no signal, payment can still be settled.

Saves the planet. Decreased dwell times means less time spent stationary. Idling for more than 10 seconds contributes more emissions than stopping and restarting the engine.[14] Contactless EMV payments reduce this impact considerably. It also reduces the need to issue additional plastic smartcards that are required in closed loop systems, further reducing the environmental impact of transit.

Save on infrastructure. EMV cards are issued by personal banks, not transit operators, so issuance and replacement costs are non-existent. Phasing out closed loop infrastructure means that operators won't have to allocate budget for maintaining ticketing kiosks or issuing cards.

Save on cash. Cash is costly, with leakage and handling costing. With contactless EMV payments, operators will no longer need to spend as much as a whopping 15%[15] of each sale on cash handling. Going cashless reduces operating costs and also prevents theft, removing a security risk for bus drivers.

Less revenue lost. With a open loop partner like Littlepay managing near-real time deny lists and debt recovery, operators can keep fare losses at an ultra-low 0.2%

14. U.S Department of Energy: Idling Reductions for Personal Vehicles
15. IHL Services: The cost of cash

CHAPTER 2

Architecture of an Open Loop Transit System

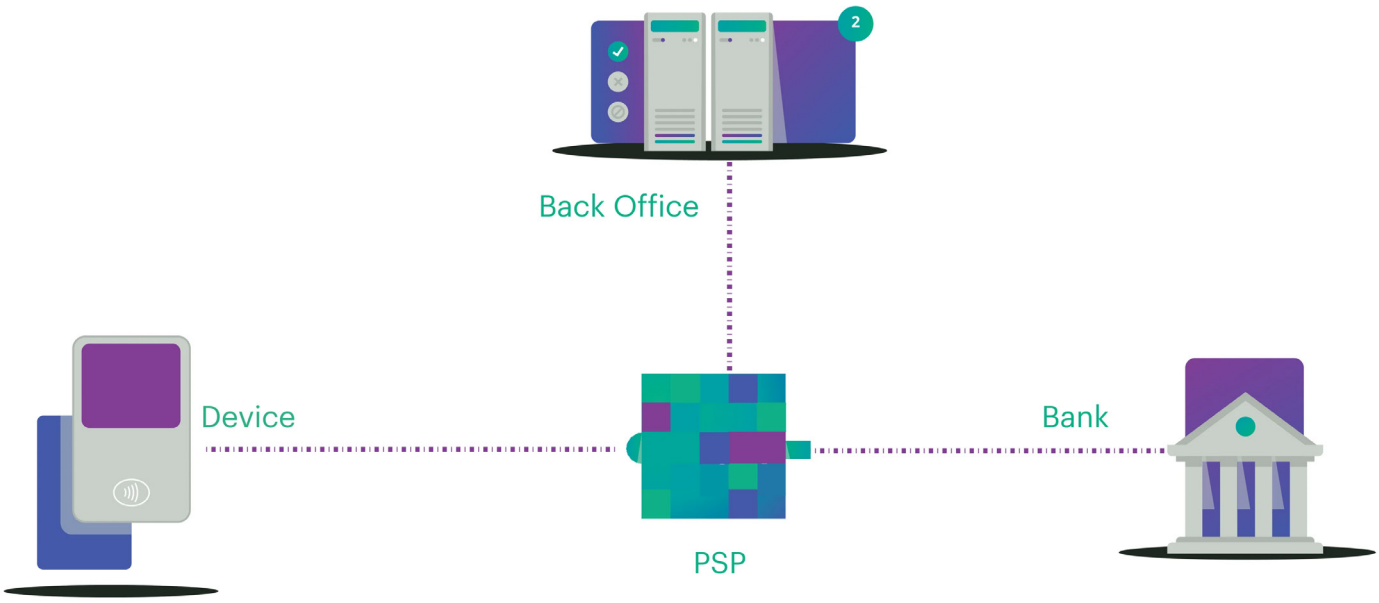
Overview of the system

A modern contactless fare collection system has four major components:

1. **Acceptance devices, or validators (hardware) (front office)**
2. **Fare engine (back office)**
3. **Payment gateway (PSP or gateway) (middle office)**
4. **Payment acquiring (banking)**

Additional components, such as data analytics and customer apps, can be added to the above to further enhance the system.

The diagram below shows an abstract of a contactless fare collection architecture.



1. **Acceptance Devices (Front Office):** These are the point-of-sale terminals or devices used to accept and process payments from passengers. There is a wide range of hardware options for varying use cases, including validators on gates, driver consoles (Electronic Ticket Machines, ETMs), and simple low-cost pole-mounted validators. Transit hardware must be designed to be durable and reliable, able to withstand heavy usage and extreme weather conditions, and have the appropriate certifications to accept contactless EMV transactions.

2. **Fare Engine (Back-office):** The fare engine manages fare rules and applies these rules to passenger travel. This is the heart of the transit ticketing system and, depending on the complexity of the fare rules and their interoperability with numerous modes of travel, it can be the most complex and expensive component of the solution. Simplification of complex legacy fare rules is perhaps the most effective way for a transit agency to reduce the overall cost of fare collection, including the cost of hardware.

   There are broadly three types of fare systems: Automated Fare Collection (AFC); Account Based Ticketing (ABT); and Mobility as a Service (MaaS).

3. **Payment Gateway or Payment Service Provider (PSP) (Middle Office):** In a contactless ticketing system, once a fare is calculated, the system must connect to the payment card networks to authorise and settle the payment. This is done by a Payment Gateway or Payment Service Provider. A PSP is a third-party service provider that facilitates the secure flow of payment information between the passenger and the transit agency's banking institution. PSPs must be PCI Level 1 certified, and handles payment security compliance burdens for transit operators through the use of encryption technologies, tokenisation, and key exchange protocols with other parts of the system.

Third party PSPs are sometimes referred to as the 'middle office' and act as a connective layer between the Front Office (Hardware) and Back Office (Fare Calculation) enabling a more flexible and modular fare system. With its exclusive focus on the transit sector, Littlepay stands as the global leader in payment processing for transit.

4. **Payment Acquiring (Banking):** This is a licensed and regulated financial institution, acting on behalf of the Merchant to process transactions and handle customer funds. The Acquiring Bank is connected to the payment card networks and manages the risk associated with processing payments to ensure all transactions are secure and compliant with regulations.

Models of Open-loop Systems

While all open loop fare collection systems will have the four key components, how these fit together can vary markedly. There are 3 models which can be adopted:

1. Build to Own

These are systems built from the ground up to meet the specified requirements of a transit agency. The components are bespoke, built to requirements, and tightly coupled as there's no need to be interoperable.

This was the conventional approach to ticketing systems in the pre public cloud era, when system integrators charged eye-watering sums to develop large, complex, on-premise systems, and then charged even more to operate and maintain these systems for the transit agency.

During the development phase, these are complex waterfall projects, that carry high risk. Hardware and Software, including Ticketing, fare management, payment processing, customer management are all developed in a monolithic system that is inflexible, expensive to manage and even more expensive to upgrade. This approach locks in a single vendor, who then holds the transit agency hostage to the vendors timetable, and every more exorbitantly priced change requests.

A classic example of Build to Own systems was Melbourne's disastrous Myki system. A two year project that took 9 years to complete and was more than $500m over budget.

Large system integrators, specialise in these kinds of bespoke implementations. These include Accenture (Toronto), Cubic (London, Sydney) and Thales (Netherlands).

As we've seen time and time again, these kinds of deployments inevitably end up way over budget, years late to delivery, and dysfunctional through the life of the contract. There are many case studies that should serve as a warning to agencies. However, sadly, this still seems to be the approach being adopted by many agencies such SEPTA, Melbourne (for the 2nd time) and MARTA.

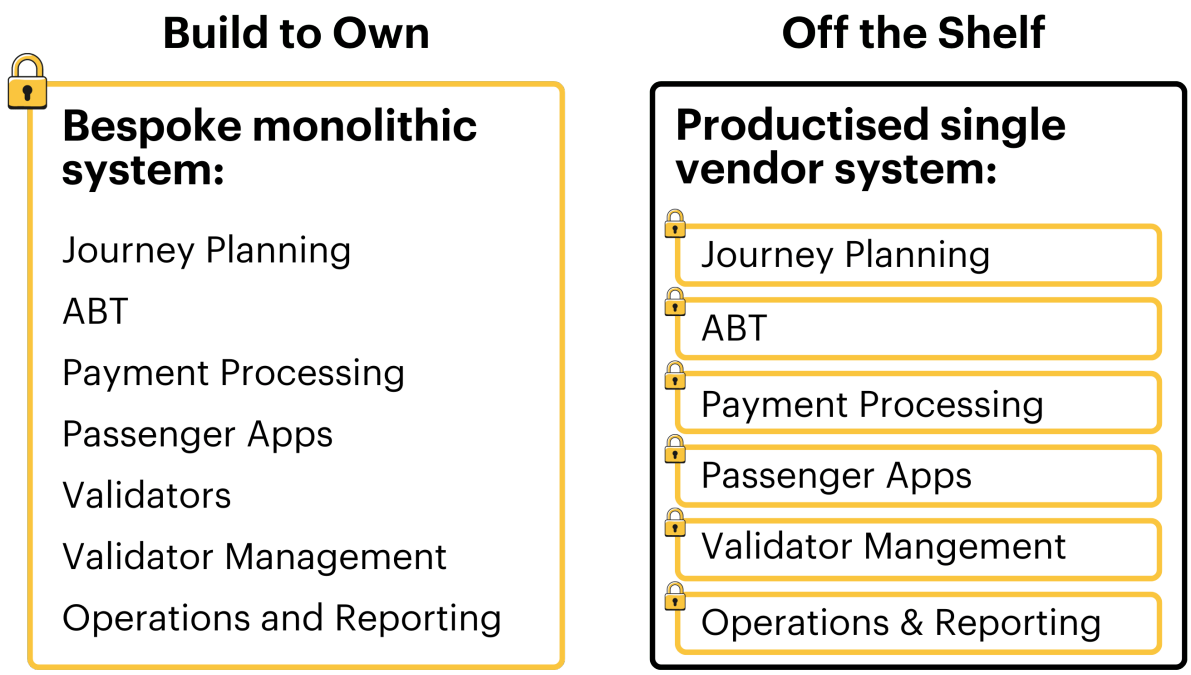
2. Off the Shelf (OTS) systems

The advent and popularisation of the public cloud by AWS kicked off the enterprise SaaS revolution in the 2010's. This significantly lowered the cost of software development and deployment, and allowed new smaller and more agile players to enter the enterprise software space and disrupt incumbent players by rapidly shortening the product development life-cycle and accelerating obsolescence.

The transition to OTS systems has been slower in fare collection than most other verticals. The interconnectedness of fare collection systems with many other external systems (accounting, financial, business intelligence etc.) has made decoupling and replacement difficult and expensive.

Some traditional 'Build to Own' system integrators have begun to 'productise' their legacy software, and moved into the cloud. This often involves front-end lipstick on legacy porcine back-end systems. For this reason some of these systems still remain relatively expensive to buy and operate, and can remain out of reach for smaller transit agencies and operators.

These newer kids on the block have the advantage of developing platforms that are native to the cloud and designed as configurable products. However, whilst configurable and more flexible (within limits), they remain proprietary with tightly-coupled components that work end-to-end. That is, you usually can't swap out components or integrate third party software from best-of-breed vendors. And with the increasingly rapid pace of technological change, and the increasing complexity of public transport networks, 'configurability' is still a poorer substitute for interoperable modular systems.



3. Modular Systems

Modular systems are the latest generation of platforms that are cloud-native and leverage the latest software architecture and application interfaces (APIs) to build a system from best-of-breed components that integrate.

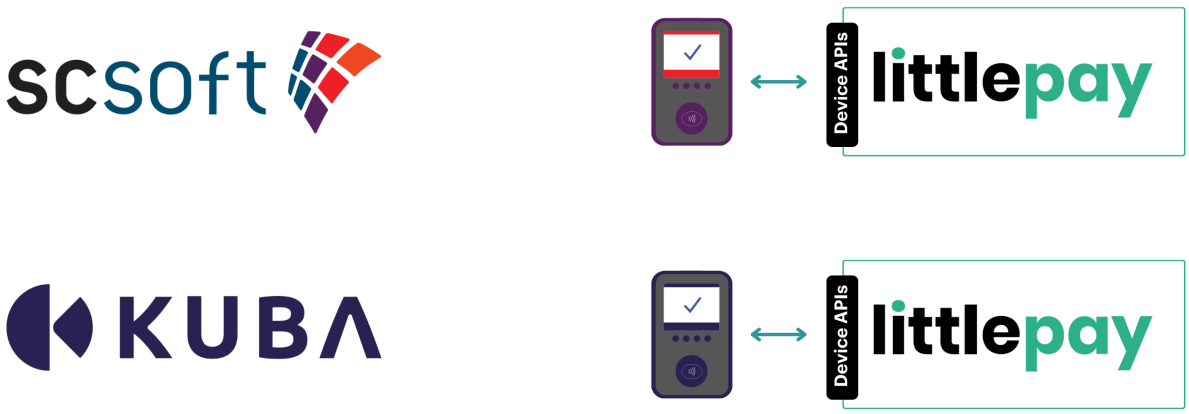
Littlepay was a pioneer in bringing modularity to fare collection in public transit by publishing APIs that device vendors and fare collection systems vendors could use to integrate with the payment platform. These APIs are standard interfaces that allow independent components from various vendors to communicate, resulting in much lower cost and friction. This is analogous to an operating system on a computer that allows other software and hardware components, such as printers and monitors, to be interoperable.

The advantages of this approach are driving more OTS vendors to open their systems and integrate with Littlepay. Today we have over 20 validators certified and five back-office fare collection systems integrated with Littlepay.

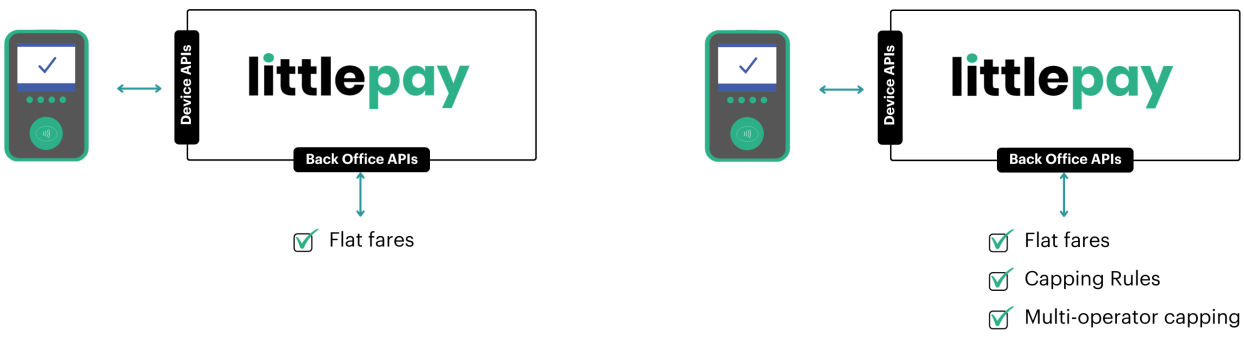
Founded in 2016 to address the growing demand for a more affordable EMV solution by the transit industry, Littlepay has built a dedicated, modular transit payments service. The platform handles the entire end-to-end cEMV payment requirements for the transit operator, removing the need to build systems, deploy software or worry about PCI compliance.

Its modular, API-based payments platform plugs-and-plays with pre-integrated, 'Littlepay Ready' validators, back offices, payment gateways and acquiring banks - giving transit agencies a fast, flexible route to contactless payment acceptance. Agencies can simply configure their preferred transit rules while benefiting from ongoing product developments.

In the United States, Littlepay has deployed its solution in multiple locations, integrating with relevant partners according to the needs of the agencies, collaborating therefore with Kuba in Santa Barbara and with SC Soft in Sacramento.



When putting together a transit infrastructure, the operator can pick the level of involvement desired from the PSP, from a "lightweight' deployment with flat fares and minimal back office integration such as Cannes to a "fully integrated" deployment with Littlepay calculating fares, caps and integrating EMV into its own ABT portals such as Leicester's multi-operator deployment.



A modular system requires a modular approach to procurement. Transit agencies have often been trapped by consultant-designed procurement processes that favour vertically integrated vendors to the disadvantage of specialist best-of-breed component vendors.

CHAPTER 3

Fare Systems in Contactless

Overview

In the age of Uber, every passenger expects price transparency and payment simplicity. Yet public transit fares in many cities remain complex, opaque and difficult to understand.

Fare calculation is arguably the central component of a transit ticketing system. The purchase of a transit ticket and fare represents the product choice of a traveller, and so of strategic importance to any transit agency seeking to engage with its ridership. The ability to create, adjust, bundle and cap fares offers an effective method for transit agencies to respond to different customer segments and changing circumstances. We've recently seen this used to great effect in the UK, where a government initiated £2 fare cap to help citizens with cost of living pressures has driven a surge in ridership.

In this section we provide a high-level overview of different fare collection systems, the fare types they manage, and how these fare types are handled in a contactless payments environment.

Fare Systems

One thing is clear - the more complex the fare rules, the more expensive the overall system that is required to manage them. Due to the complexity of many legacy ticket products, the back-end software that manages fare rules is often the most expensive component to procure, the most complex to implement, and the most risky from an information security perspective.

Fare systems fall into 4 broad categories:

i) Automated Fare Collection (AFC)

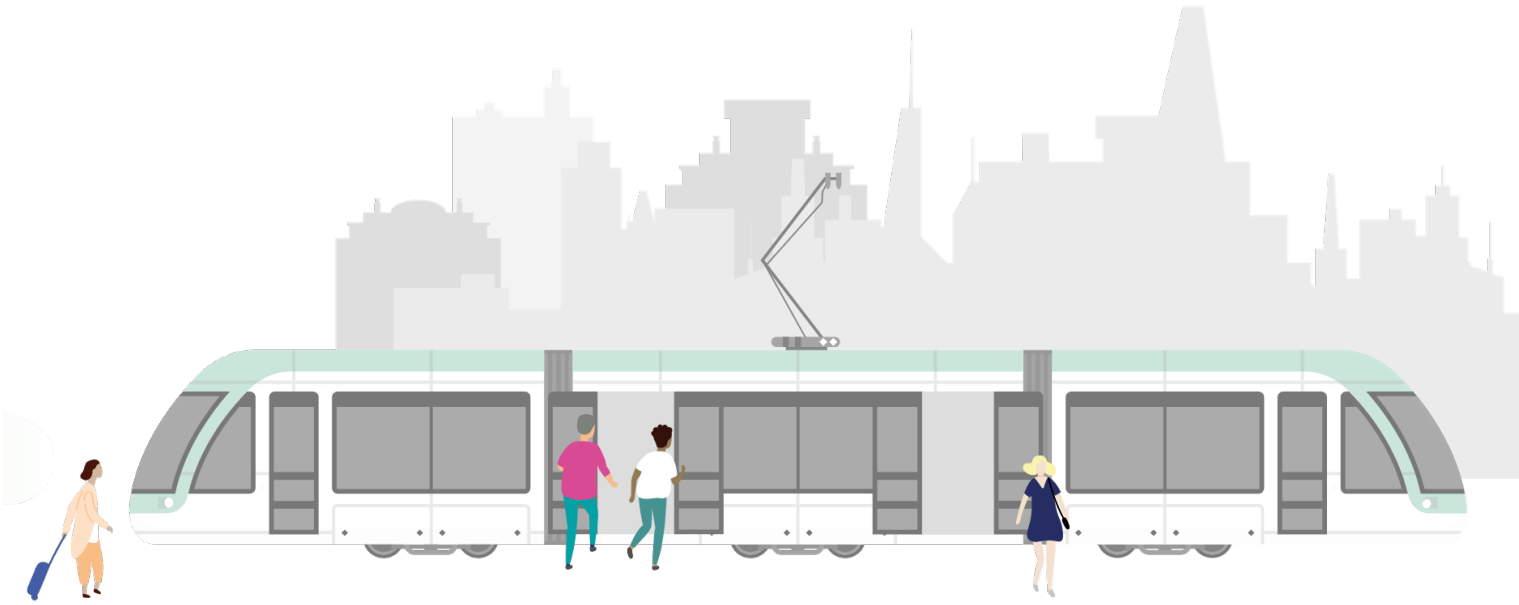
AFC systems replaced traditional manual fare collection methods such as cash and paper tickets with electronic payment methods such as closed-loop smartcards and QR codes. A closed-loop system is typically a card-centric, pre-paid system with the following attributes:

- **Fare media:** primarily based on smartcards that store value or ticket data on the card. These cards operate on a range of standards which differ by region and supplier. Some common smartcard standards include Mifare, Calypso, ITSO and Felica. Passengers can pre-load these cards with a pre-purchased ticket or value added through top up payment.

- **Validation devices:** ticket readers located at entry gates, on platforms or onboard vehicles that interact with the fare media to deduct the appropriate amount or validate the relevant ticket on the card.

- **Back-Office:** infrastructure that performs fare calculation, card lifecycle management, customer support, card balances, data management and analytics. Some AFC systems are cloud based.

AFC systems can be upgraded to support open-loop and accept bank cards. This requires the validation devices to be compatible and certified for open loop, and be integrated with a system able to securely manage the open-loop payment flows e.g. by integrating with a PSP such as Littlepay. In this section we provide a high-level overview of different fare collection systems, the fare types they manage, and how these fare types are handled in a contactless payments environment.



ii) Account Based Ticketing (ABT)

ABT is a customer-centric system that moves more of the processing and fare calculation into the back-office. ABT solutions usually support multiple types of token such as closed loop smartcards, open loop bank cards and QR codes.

Passengers can then travel using a valid token to tap in and out of public transport services. Their taps are stored centrally in the ABT system where the appropriate fare can be calculated and charged according to the rules set by the transit agency.

Many ABT solutions require passengers to register an account in order to travel. During registration, passengers can select their token of choice and then link various and multiple payment methods to the account for post-payment, top ups and subscriptions. This type of solution allows an interaction between closed and open loop cards. For example, a child's concessionary smart-card that is topped-up by a parent's open loop card.

Fares are typically calculated at the end of day or specified period. The system can therefore apply more granular and personalised fare rules to the passenger's travel history over that time period rather than for each single trip – for example, application of capping rules across multiple modes of transport and service providers.

However, the benefits of these additional capabilities come with the added friction of passengers having to register their information onto the ABT system.

Most ABT systems on the market are modifications of legacy AFC systems. They remain complex, expensive and add significant data risks for transit operators. Given the amount of sensitive personal data these systems accumulate, such systems can be a target for cybercriminals.

iii) Mobility as a Service (MaaS)

MaaS encompasses the idea of moving towards a more interconnected transportation system. This involves integrating various modes of transportation, such as buses, trains, taxis, ride-sharing services, bicycles, and even scooters, into a single platform or service.

MaaS platforms enable users to plan, book, and pay for their entire journey using a single application or service provider. They provide real-time information about available modes of transportation, fares, and routes, allowing users to choose the most efficient and cost-effective option for their specific needs.

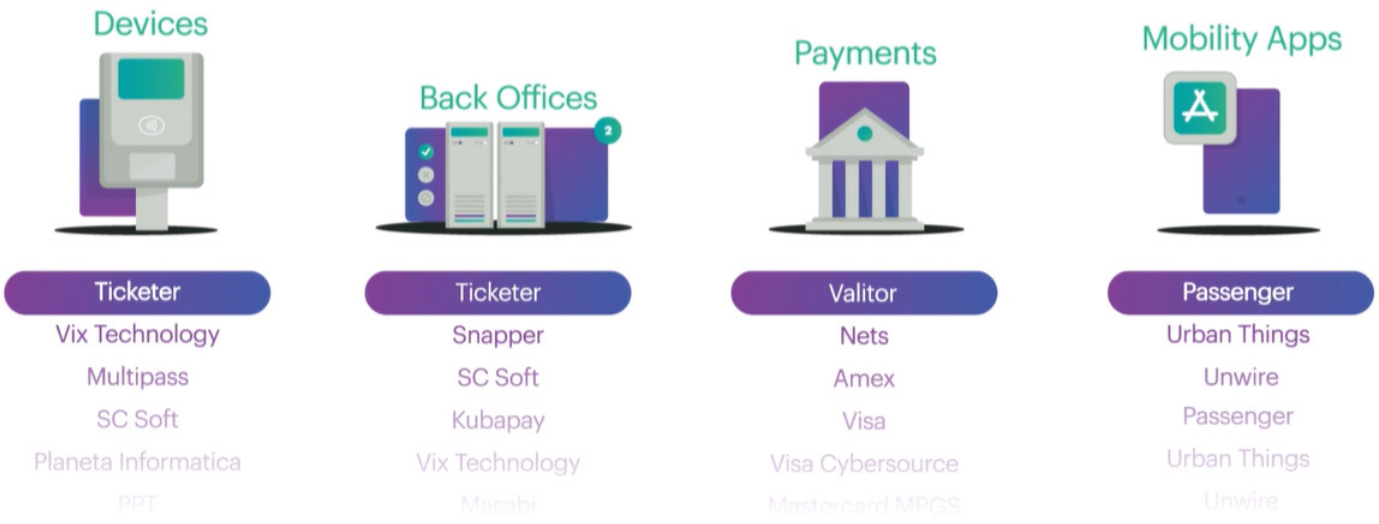
MaaS was the hot new thing for a few years, and has gradually waned in popularity as the available platforms proved to be expensive and complex with the added challenge of requiring the commercial and technical cooperation of many disparate entities. That is why there are no real MaaS success stories of significant scale in the world today. Whilst there is value in the overall vision, stakeholders are reconsidering the path to deliver value to the passenger. Building on existing commercial models and passenger behaviour is more likely to encourage interconnectivity and adoption.

iv) Littlepay - API infrastructure for open payments

The huge capital and operating expenses required to implement AFC, ABT and MaaS systems has meant they could only be afforded by transit agencies of the larger cities. At Littlepay, we set out to develop a scalable and more affordable solution for agencies and operators of all sizes, so they could easily accept open loop payments. Today, Littlepay offers cost effective open payment solutions to bus operators with as few as 5 vehicles and as many as 5000.

We achieve this by using an open, modular, cloud based infrastructure that can either integrate to existing ticketing solutions or work on a standalone basis. The foundation of the Littlepay platform are Application Programming Interfaces (APIs) that enable different components of the solution to interact and share data with each other; collaboration is at the heart of our design. This is the connectivity layer of the system. These APIs serve different functions:

Your choice of partners



i) Device APIs: used by validator vendors to integrate to Littlepay's payment gateway, and accept open payments. This approach allows the transit agency to separate decisions regarding validator selection from other components, creating modularity and reducing vendor lock-in. Once integrated and certified, the devices can be rapidly installed for a simple open loop implementation. We now have a wide selection of validators certified with Littlepay.

ii) Back-office APIs: allow various AFC and ABT systems to integrate to Littlepay's payment platform. In this modular configuration, Littlepay handles encryption and tokenisation of the payments to reduce the exposure of the AFC/ABT system to sensitive payment data. The AFC/ABT back-office can then calculate fares based on anonymised data, and then requests Littlepay to process the payment. These APIs enable larger transit agencies to upgrade legacy AFC/ABT ticketing systems with open payments.

While some AFC and ABT systems offer built-in payment solutions, given the complexity and security implications, there are many advantages to partnering with a specialised PSP that is capable of managing the compliance and security risks at scale.

Some smaller transit agencies or operators don't have the need for complex fare calculations. In this case Littlepay offers a stand-alone light-weight back-office that can handle simple fare structures (based on route, zone, time, or fixed point to point), and fare adjustment (daily, weekly capping). A number of larger cities have used this light-weight solution to expedite the delivery of open payments while they implement and transition to their newly procured AFC/ABT system over several years.

iii) Checkout APIs/SDKs: this is an e-commerce payment gateway for purchases through mobile or web channels. This allows Littlepay to offer transit agencies a single platform across all purchasing channels. In turn, this provides a single view of customer purchases on a secure and anonymous basis, without the need for account registrations.

iv) Omni-channel experience: Littlepay Checkout and Littlepay Contactless offer a unified passenger experience creating a common token for bank cards and mobile wallets used across both payment channels. A common token enables agencies to unlock passenger value in a variety of innovative ways including:

- **Buy Now Tap Later:** passengers can link the ticket purchased to their payment card or mobile wallet so that it can be used to travel. They just turn up, tap and ride.

- **Ridership engagement:** passengers can opt-in to have their physical Pay As You Go taps made using their payment card linked to their mobile app. This allows the agency to interact with the rider in real-time with focussed, added value information, notifications and services e.g. notifying a passenger via the app that they have reached a fare cap and travel for the rest of the week is free.

- **Concession and discounted travel eligibility:** using a similar feature to that used in Buy Now Tap Later, the passenger can choose to verify their eligibility for discounted travel via the mobile app or website and link their payment card or mobile wallet to the discount. When the passenger purchases tickets or travels on transport via Pay As You Go, they will automatically receive their discount before being charged.

v) Multi-Operator Adjustment (Interoperability): Littlepay's "Multi-Operator" capability enables interoperability across independently run back-offices. This functionality is currently being used in the UK, whereby independent operators are offering passengers a 'City Zone' product. Littlepay detects that the customer has travelled across 2 or more systems, and can then cap the fare and set the rules by which the revenue can be apportioned to the operators. This is a way to offer simple and low-cost multi-modal travel products (e.g. MaaS), without the need for complex new systems.

vi) Bank Integrations: Littlepay integrates with a range of financial institutions around the world to authorise and settle payments and manage risk and fraud to maximise revenue collection.

The combination of Littlepay's APIs and transit functionality allows plug and play of components to create solutions that are fit for purpose, regardless of size or complexity.

Managing Complex Fares via Open Payments

Transit agencies need to consider catering to a wide range of fare types, including:

- Flat Fares (with or without capping)
- Time-based
- Zone-based
- Route-based
- Number of stops
- Fixed Point to Point (fixed validators e.g. railway platforms)
- Variable Point to Point (moving validators e.g. bus)

AFC and ABT ticketing systems handle these fare variations through a back-office that can aggregate and adjust trips. In a closed loop system, once a dollar value is added to the card, there is no longer a need to interact with payment rails and be subject to the regulations and rules of the payment card networks. Transit smart-cards are usually only single-purpose, so there are fewer implications for fraud, theft, and misuse.

In contrast, open payments were originally designed for simple individual retail transactions. In a retail contactless EMV transaction, you will find the following:

- Transaction value is known at the time of purchase
- The retail system sends the transaction value to the point of sale device/validator which the customer taps
- Authorisation is then made for the specific value
- The device can get a real-time authorisation, which means it must be able to be 'online' and communicate with the payment network
- Transactions are individually processed, so there is no aggregation of transactions
- If the customer/passenger has no funds they will not be able to complete the transaction, and therefore there is no risk of having insufficient funds and no need for recovery of debt owed

To accommodate transit fares, which require more complex rules and adjustments, the card schemes developed specifications for two alternative transaction models:

i) Known Fare Transactions (KFT): KFT transactions are a modified version of the 'Retail' model for use in the transit context. These are single transactions with known values and usually no capping. The transactions are able to be authenticated 'offline' to allow for a vehicle such as a bus to lose connectivity, while risk is managed through deny lists and debt recovery.

Littlepay has further developed the KFT model so capping can be introduced on an incremental basis, applying discounts to flat fares. In this scenario, rather than aggregating transactions and capping at the end of day, the passenger is charged for each transaction with discounts applied as the cap is reached.

ii) Aggregated Pay as You Go Transactions (PAYG): PAYG allows for a complete set of variable fares to be adopted on contactless open payments, including tap-on / tap-off (TOTO). Passengers tap to travel throughout the day and the back-office calculates the best fare for that travel. There is no need for the passenger to pre-purchase a ticket. PAYG processing involves a 2-step authorisation process.

After the initial tap, a 'zero' value (or small nominal value) is sent for authorisation. This allows the passenger to board their travel, but carries the risk that the passenger does not have adequate funds for the fare. At the end of a specified period (usually end of day), the back-office calculates the total fare for the passenger, factoring in any adjustments for multiple modes, zones, capping or other variables. This fare is then sent for 'final' authorisation, and settlement.

If the authorisation fails, the transit operator is protected by liability shift rules, in which the card-issuer will guarantee the 'first-ride' payment up to an amount. This protected amount varies by region. An authorisation failure will result in the payment being placed on a deny list. This list is maintained by Littlepay with updates communicated to all the validators in the network every few minutes. The validator checks a card that is tapped against the list and denies travel to the passenger.

If the transaction is above the first-ride guarantee limit and not protected, Littlepay has automated debt-recovery processes that re-attempt completion of the transaction over the following weeks. Usually passengers will at some stage add funding to their cards, and most of the debt can be recovered.

The combination of these risk processes are fundamental to minimise the revenue loss for a transit operator. Revenue loss resulting from failed transactions or insufficient funds is a direct cost to the transit operator.

As the first specialist payment service provider to the transit industry Littlepay has spent years refining risk management and automated debt recovery processes using machine learning to maximise revenue collection for operators.

	Retail	Known Fare	Pay As You Go
Fare / Value	Known	Known	Variable
Merchant Interaction	Required	Required	Not Required
Fare Calculation	Device	Device	Back Office
Authorisation Method	Online / Real-time	Online / Real-time or Offline / Deferred	Offline / Deferred
Initial Authorisation	Known Value	Known Value	Nominal / Zero Value
Aggregation	Not Supported	Not Supported	Supported
Adjustments	Not Supported	Not Supported	Supported
Liability Shift (to Issuer)	No	Yes (varies by Card Scheme)	Yes (varies by region)
Debt Recovery	Not required	Yes	Yes
Lists	No	Required	Required
Fare Types	N/A	Flat or Known Fares (by Route / Zone)	Variable Point to Point fares Tap on / Tap Off

CHAPTER 4

Hardware - Point of Sale Validators

Overview

The range of card validators available for public transit ticketing systems is varied and complex. This complexity increases further when the acceptance of contactless bank cards is added to the requirements.

We've seen numerous instances of poor decisions in validator selection leading to complications and delays in implementing contactless ticketing systems. In this part of our series, we provide a high-level overview of some of the considerations to be aware of when procuring and implementing a validator for cEMV open payments.

Understanding your requirements

The most suitable validator for a given implementation will depend on a number of requirements and considerations:

Is the fare selected before purchase? If so, there are 3 general scenarios:

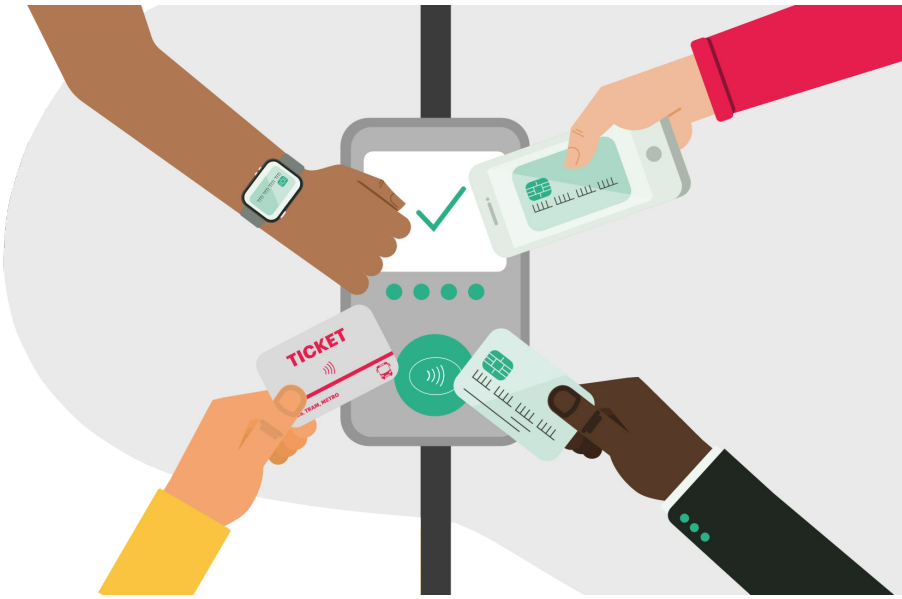
1. **Driver Intervention:** The passenger requests a specific fare from a vehicle driver (or conductor) before tapping their card to complete a purchase.
2. **Passenger Intervention:** The passenger interacts with the validator to select a ticket (e.g. select a zone, or family ticket) before tapping their card. The validator interface (screen, buttons) will handle this interaction. This type of device often has the most complex User Interface requirements due to support for the different payment and ticketing options, multi-language, accessibility legislation etc.
3. **No intervention:** The passenger simply taps their card, (tap-on) for a Known or Fixed fare.

Is the fare calculated post travel?

For the Tap-On/Tap-Off (no intervention) scenario, the fare is calculated by the system after the journey is completed. Typically this involves subsequent processing by an automated fare collection system, which assigns the fare to one or more taps.

In the two no-intervention scenarios, aggregation of the individual fares may occur at the back office and capping or other discounts may be applied before the passenger is charged for their journey(s).

Each of these scenarios implies a different set of capabilities for the validators which need to be considered.



What payment types are accepted?

A transit system may need to accept cash payments, closed-loop smart-cards, QR-codes and contactless bank-card payments concurrently. This can result in separate legacy and upgraded hardware being used side-by-side for different types of cash and digital transactions

How is the purchase verified? Is a receipt required?

Different approaches to verifying ticket purchases will have implications for the features of validators to be used.

Modern, paperless implementations of contactless are sometimes complemented with separate handheld 'inspection' devices, which can be viewed as another type of validator. The ticket inspector will request the passengers to tap their bank card on the inspection device, which will confirm whether a ticket has been purchased or if they have indeed Tapped-On as they boarded the vehicle or entered the transit system (e.g. metro). If not, a fine or penalty notice can be issued, and in some cases, the inspection device can also process a payment for a ticket or the fine.

Despite the negative impact on boarding times, physical receipts are still a requirement in some regions significantly increasing the cost of validators which then need a thermal printer or similar capability.

Where is the validator to be installed?

Transit validators can be on gates at train stations, in a bus cockpit, on a pole mount, or outdoors on a platform or pier. Conditions in various geographic regions can have implications for the suitability of validators. They may need to be certified for electrical compliance, tolerance to extreme environments such as sub-zero temperatures or exposure to dust, sand or water. In all cases, they will need to be hardened to withstand vandalism and heavy usage. This is why transit validators can be significantly more expensive than a retail POS device.

What are the basic validator types

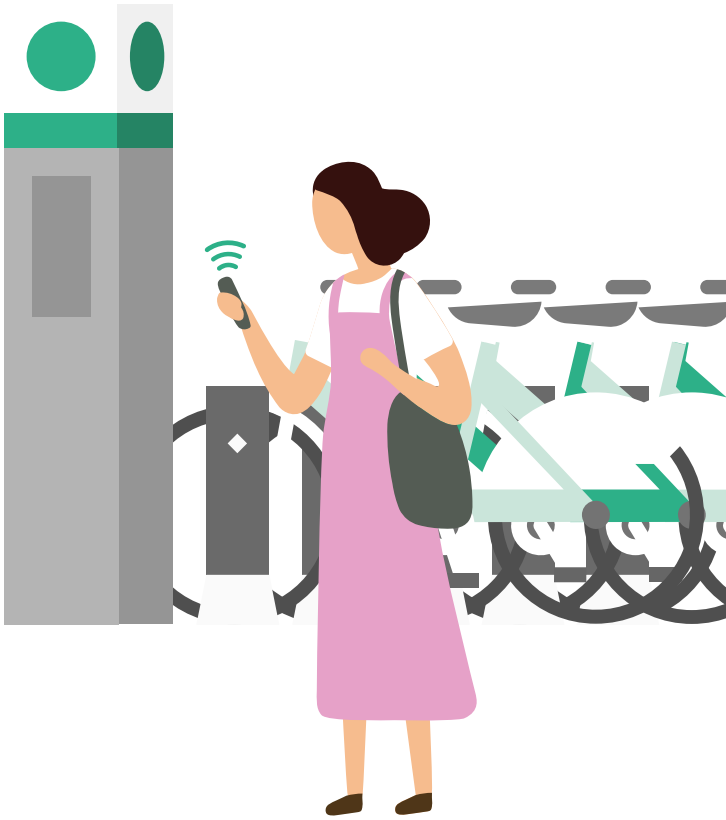
Electronic Ticket Machines (ETMs)

ETMs are usually found on buses and are generally "attended" by the driver. It is a larger unit that can allow the driver to manage routes, and select the appropriate fare before the passenger makes a contactless purchase on the card reader.

This flexibility allows bus drivers to switch from simple PAYG tap transactions, to a KFT transaction with potentially multiple passengers (e.g. family) paid for with one tap. However this can come at a cost of slower boarding times.

ETM's can also manage some parts of the fare calculation for more complex fare structures as they are integrated into route management software that can identify each stop and send the right fare to the card reader.

Ticketer's Standard ETM was the first ETM to integrate with Littlepay and now serves a significant portion of the UK bus market.



Individual / Pole Mounted Validators

Pole mounted validators include brackets for mounting and more complex electrical wiring to fit on various vehicle configurations. They can be used as primary validators which are fully certified as independent acceptance devices. Alternatively, they can be a secondary device (child to the primary parent device or ETM), often used for tap-off only, and connect through to the primary validator or ETM.

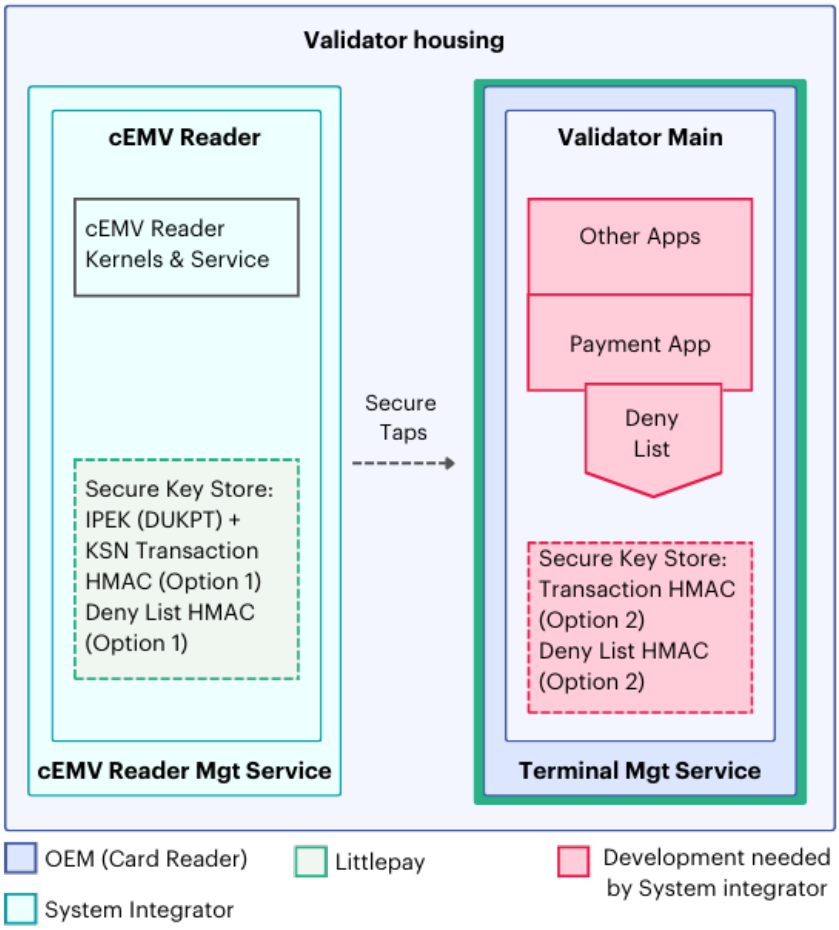
Gate Validators

A gate validator has the added signalling capability to trigger the opening and closing of a physical barrier or gate, granting or denying passenger access to the transit system. These validators are most commonly used in train and metro stations across the world. While they have a different form factor, from a ticketing perspective, they can be viewed in the same way as an individual pole-mounted validator.

Handhelds

Most Handheld validators in transit are modified versions of retail mobile point of sale devices. Sometimes referred to as 'queue-busters' these devices are used to accept retail or KFT transactions, by a representative who sells tickets to passengers before boarding. They are often used for Demand-Responsive Transport solutions. The devices usually come with a printer to provide paper receipt and/or can print a barcode for subsequent ticket validation.

Components of a contactless validator



A transit validator that can process open loop payments has several components. This is a high-level overview of some of the more important components you should be aware of:

cEMV Card Reader

This is the sophisticated component that sits within any validator and interacts with open-payment cards. The reader must be certified by EMV Co. to comply with the required standards of card acceptance and security (see below on certifications)

Two important sub-components within the reader are

- The Radio Frequency module that allows for wireless communication with contactless payment cards or mobile devices. It enables the exchange of data and commands between the reader and the card.
- The 'Secure Reader' which is a tamper-resistant hardware component that securely stores cryptographic keys and performs secure transactions. It ensures the confidentiality and integrity of sensitive data during the transaction process.

Card readers are manufactured by a number of OEM vendors including: Pax, Gemini 2000, Emsyscon, Ingenico and Feig to name but a few.

Security Access Module (SAM slot)

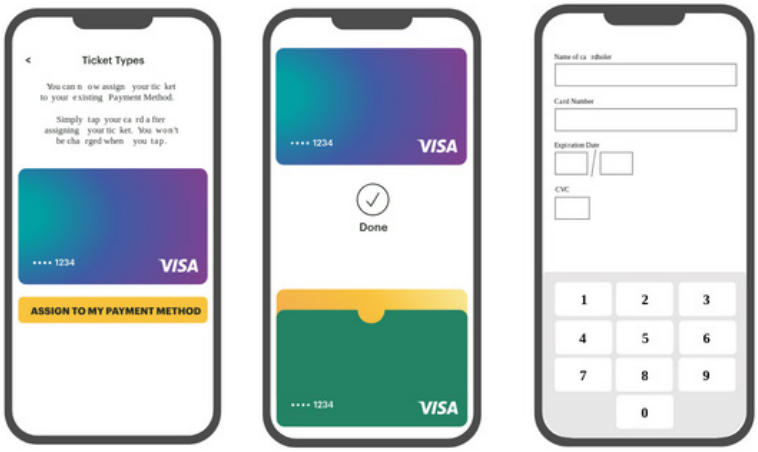
A SAM slot in a cEMV Card Reader refers to a physical slot or compartment designed to accommodate a SAM card. A SAM card is a small, removable device (like a SIM card) that may contain cryptographic keys and algorithms used for secure communication and transaction processing in a Point of Sale (POS) system or may simply provide additional services not available directly by that reader.

By using a SAM card in the dedicated slot, the POS reader has an alternative way to establish a secure channel of communication with the payment network, perform card authentication, and protect sensitive data during the transaction process if that is not already available with the Card Reader's inherent functionality. Thus the SAM is another way to help prevent fraud and unauthorised access to critical information, ensuring the integrity and trustworthiness of the transactions.

Transit validators can have multiple SAM Slots to manage different closed-loop and open-loop transaction protocols. For example, the validators commonly used in the UK have SAM cards for MIFARE DESFire closed-loop cards and ITSO cards. It is not mandatory to have or use SAM slots but is one common way to extend validator functionality.

Kernel

A kernel refers to the software component that operates at the core of the payment processing functionality. The kernel handles tasks such as reading the payment card data, encrypting sensitive information and performing authentication. It ensures that the transaction is executed securely and in compliance with industry standards and regulations, such as the Payment Card Industry Data Security Standard (PCI DSS). Each card scheme, such as Visa, Mastercard, Amex have their own required 'card Kernels' which are updated and versioned. Older Kernels may not be able to accept newer issued cards.



Payment Application

This is the software application that interacts with the Card Reader, and executes the business logic and protocols to, for example, initiating the authorisation process. It is also responsible for the user interface - such as sound, lights, receipt generation etc. Processing of Deny Lists often happens in this domain while using the cryptographic services of the EMV Reader to verify the authenticity and integrity of deny list updates.

Littlepay provides EMV reader device vendors the API's and encryption keys required to integrate their payment application to various financial institutions (acquirers).

Certifications and Security

Validators must comply with 3 levels of certification before they can be put into use for open payments. As described by EMV Co

EMV Level 1: Level 1 certification is a 'hardware' test to ensure the terminal chip reader for compliance with the mechanical and electrical protocols in the EMV Chip Specifications, which covers the transfer of data between the terminal and the card, smartphone, watch, or other device for making card-based payments. This includes tests to confirm how close the card/device and the reader need to be for information to flow so card users enjoy a consistent and reliable experience with the device.

EMV Level 2: EMV contactless level 2 is a 'software' functional test. This certification evaluates the 'EMV Level 2 kernel', which is the software inside the terminal (known as firmware) that performs EMV processing, for compliance with the EMV Chip Specifications. These tests confirm that the software supports the EMV payment application functions. Each of the payment networks (Visa, Mastercard, Amex, etc) have their own specific tests for this certification.

Level 1 and 2 certifications are valid for at least 2 years - often up to 4 years. This certification framework was originally created for the retail environment, where low-cost devices could be easily replaced after a couple of years. In a transit implementation where devices are more expensive and harder to replace, the payment networks have allowed existing certifications to be 'grandfathered' and continue in the field after certifications have elapsed. However, certifications must be valid at the time of implementation.

For security evaluation, the Payment Card Industry (PCI) Security Standards Council sets the benchmarks. The relevant SRED (Secure Reading and Exchange of Data) certification is part of the PCI PIN Transaction Security (PTS) standard and this still applies even though EMV card readers as described in the previous section are contactless only and do not support PIN. The SRED rules apply to any Point Of Interaction (POI) which is any point where cardholder data is captured. The focus of these rules and certification is to ensure that there are adequate protections in place to ensure the device will not "leak" any keys used in protecting cardholder data, that only approved algorithms are used, that keys used by devices are unique, that updates and remote access are authenticated cryptographically and that sensitive data is held for no longer than is absolutely necessary.

When purchasing a Validator, you should confirm the validity of the Level 1 and 2 certifications, and how long remains on these certificates. This will be the window of time to complete the Level 3 certification.

Level 3: L3 certification is an end-to-end test from device to Acquirer. This testing evaluates and confirms that an EMV-compliant payment acceptance terminal will work with merchant and bank systems to enable end-to-end transaction acceptance. The testing helps ensure that a new or upgraded terminal (hardware and/or software) meets the specific requirements and recommendations of the individual payment systems and the acquiring bank before it is brought to market. Level 3 for transit involves performing specific test cases for this environment.

Waivers

During the various certifications, some tests may fail on older devices. For example, a failure on a Level 2 certification may indicate some older bank card chips are not accepted. It is possible to apply to the payment networks for a waiver to allow the device to be deployed despite certain minor failures. Payment networks are more lenient on allowing older devices to be deployed if there is a plan to upgrade these within a reasonable time frame.

Encryption: Protocols, Algorithms & Keys

Central to the security of the interaction between the validator and the passenger's card, and also between the validator and the Payment Processor, is encryption. Protection of the sensitive cardholder data from point of capture to the point of payment authorisation (and at every intermediate step along the way) is essential. How this "trust" is established and assured is worthy of some comment. One way to break this down is to consider separately "confidentiality" and "integrity".

Confidentiality is where the data is protected so that it is visible only to those who have the rights (and need) to view that data. This is the role of encryption, where the data is converted; via an algorithm and a key, into something that anyone who intercepts the data (and doesn't have the relevant key) is unable to reverse into the original unprotected data or message. The choice of algorithm and the length of key used (sometimes referred to as the strength) are often specified by the relevant industry bodies. In the case of payment, this can be the payment card networks and/or PCI - both of which will be guided by national bodies such as National Institute of Standards and Technology (NIST) in the USA, National Cyber Security Centre (NCSC) in UK or Agence Nationale de la Sécurité des Systèmes d'Information (ANSSI) in France.

It is absolutely essential that only approved algorithms with the appropriate keys are used - and this is one of the primary checks performed in the certification and security assessment processes. It is also essential that these algorithms and keys are used in an approved manner - as there are "weak" ways of performing these steps that render the security offered by these trusted protocols useless. That is why it is important to use partners with experience and provenance in this domain - with up to date certification that verifies best practices are instilled in the organisation at all levels. Attacks on systems never get worse - they only ever get more advanced, sophisticated and prevalent. Security is a process, not a product.

Integrity is where the recipient of any data can confirm that what was received is what was sent without having prior knowledge of that transmitted information. Rather than encryption, this is achieved through Message Authentication Codes (MAC) or Digital Signatures. Digital Signatures can be used to prove who generated the signature (authorship) using what is called asymmetric cryptography where there is a public and private key. MACs are based on symmetric cryptography (where there is a shared secret key). A variation on the MAC is the HMAC - which uses a one-way HASH function rather than a symmetric encryption algorithm at its core.

Littlepay uses a range of encryption technologies to ensure the confidentiality and integrity of your passenger payment information.

If you have followed the discussion in this section so far, congratulations - and you would also be right to ask "How do I ensure I don't have to become an expert in cryptography just to accept bank cards on my buses?" This is where having partners with the right certifications and accreditations come in. Those partners work collaboratively to take on the security responsibility. Through a modular solution with clearly defined APIs and responsibilities, a solution can be delivered swiftly without compromising the security. Let's now look at the Certifications that enable this approach.

Littlepay test lab

At Littlepay we have our own test facility and use industry approved equipment to support validator vendors with their Level 3 certifications. With over 20 devices certified on the Littlepay platform, transit agencies have a wide variety of pre-certified devices to choose from.

We've also worked with partners to develop technology that can upgrade some older closed-loop terminals to accept contactless EMV. That is, if a device can pass the Level 1 test, we can use the SAM slot on the device to upgrade the terminal's kernel to become Level 2 compliant, and be ready for Level 3 certification.

Pitfalls in validator procurement

A transit validator vendor must be able to navigate the many complexities of open payment certifications, as well as understand the nuances of transit ticketing. A deficiency of experience in either domain is likely to lead to a frustrated transit agency, and many delays in implementation.

While it is important to ensure that all the certifications and EMV functionality is available, it is also important to ensure that the supporting transit specific functionality and services are also available. For example, does the validator provide location information in the format already used by your existing back office environment. Does it provide all the route, vehicle and driver information. If required, does it integrate with the existing Vehicle Location systems and on-board rider information system? Or does it provide integration with any existing driver consoles? Or can all the required information be provided to the agency independently of these other systems - making the installation and configuration much simpler?

When that is established, it is then important to consider how the validator and its associated Payment Services Provider must interact with any Automated Fare Collection (AFC) system or Account Based Ticketing (ABT) system. Will the validator be the source of specific information for that solution or is the fare structure simple enough that no additional fare engines are required?

Using standard APIs provided by a PSP like Littlepay can ensure the interfaces between validators and the back office are functional and interoperable between vendors.

So where can problems still emerge?
When comparing specifics of individual validators, considerations should include:

- Are all the required EMV payment schemes supported? For example: Visa, Mastercard, American Express, Discover
- Is the device already certified in a similar implementation? (validate all references!)
- For a new model, are all the relevant certifications in place?
- Are any of the certifications likely to expire before the launch?
- Are there any end-of-life notifications for any key components of the validator?
- Is there adequate support and training available?
- Are the localisation and accessibility options to be supported clear?
- Are there any geographic restrictions on the supply or use of the validator?
- Are warranties and support packages appropriate for the environment?
- Are they configurable to meet the needs of your network (consider vehicle rotation on bus routes vs. a validator that is built into a gate in a metro system).
- Do they have a decommissioning process to ensure they are securely “wiped” of any secrets that could be useful to “bad actors”

In addition, especially in the cases where a single validator must process not only open loop EMV payment cards, other critical requirements include:

- Performance of the device (particularly speed) in processing physical EMV cards vs. closed loop vs. QR code scanning.
- Performance of the device in processing digital EMV cards in mobile wallets.
- Clarity in User Experience on how EMV operates vs. closed loop card processing vs. QR code scanning.
- How revenue inspection will be performed for each type of media accepted in the scheme.

An experienced vendor in the transit space can help provide holistic insights and a roadmap on how to deploy a contactless EMV validator successfully - be that on a greenfield deployment, as an addition to an existing system of closed loop cards, or as part of an account based ticketing implementation. They will also have an appreciation of the nuances between the requirements of payment schemes in different geographic regions. If they are not aware of these considerations, it should be taken as a warning.

At Littlepay, we partner with the best validator vendors in the industry, who we've assessed, tested and certified. Speak to us to find out more about the range of pre-certified devices that are ready to be implemented in your region.

CHAPTER 5

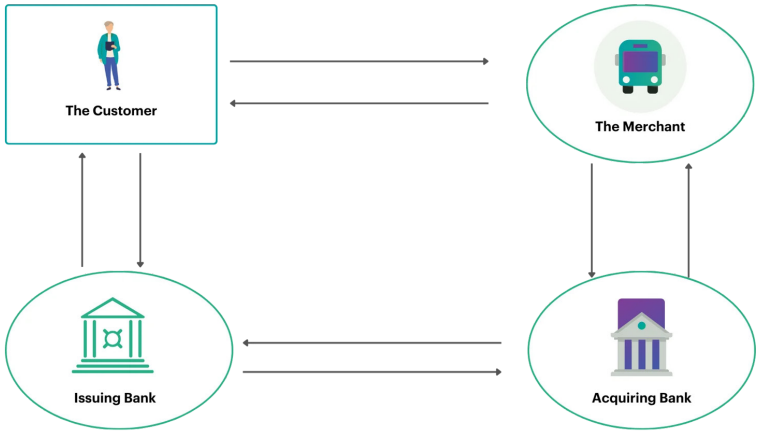
The Role of the Payment Service Provider

The Basics of Processing a Payment

In its most common form, payment processing occurs in a '4 party model'. The 4 parties are:

1. **The Customer (or the traveller in transit):** purchaser of the services and owner of the payment card or mobile wallet
2. **Issuing Bank (Customer's Bank):** issuer of the payment card
3. **The Merchant (Transit Operator):** seller of the good or service
4. **Acquiring Bank (Merchant's Bank):** responsible for processing the transaction

Payment processing involves complex and intricate relays between the Issuing Bank and the Acquirer for authorisation and settlement. A simplified description of the flow is described below.



After the customer either taps their card ('card present' transaction) or submits their payment card details online ('card not-present' transaction), the acquiring bank receives a request to authorise a payment. Acquiring banks (Acquirers) process payments for merchants. This authorisation request will contain encrypted information about the card, the expiry, the amount to be authorised. The acquirer then routes this request to the payment network of the card making the request (Visa, Mastercard, etc). Acquirers are connected to payment networks for which they acquire payments through a licensing arrangement. Some examples of Acquirers are: Elavon, Rapyd, Fiserv, WorldPay and Adyen. The payment network then routes the authorisation request to the specific issuing bank that holds the customer's debit or credit card account.

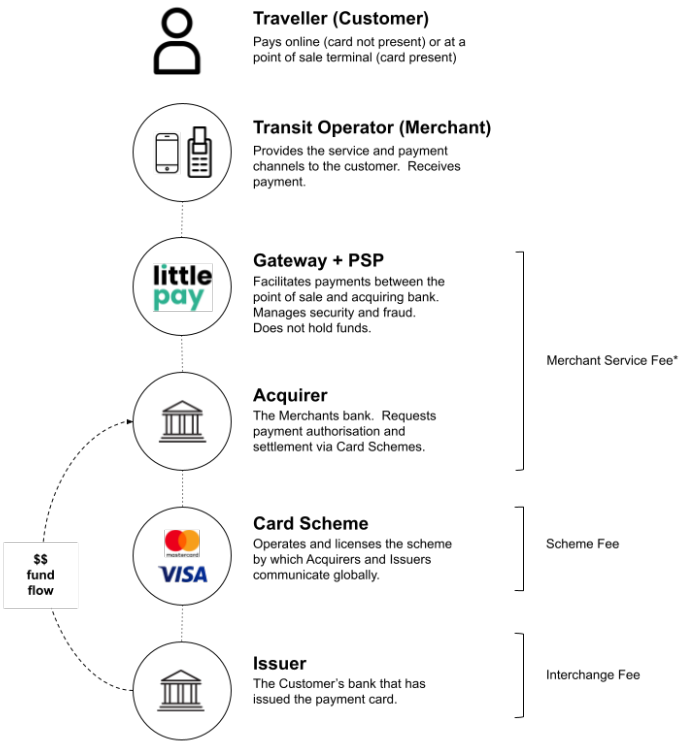
The issuing bank verifies the customer information and checks for available funds. After a range of checks, if the information is valid the issuing bank sends an approval code back to the card network, and places a hold on the funds. The payment card network in turn sends the authorisation code back to the acquirer to approve the transaction. If the transaction is 'online', this authorisation process is completed in a matter of seconds.

Once the transaction is completed, the acquirer will then send a settlement request, in a similar manner to the above, and the funds are transferred from the Issuing bank to the Acquiring bank in a few days.

It is the Card Networks, like Visa, Mastercard, Amex and Discover, who licence the 'payment rails' (or scheme) by which the Banks communicate with each other to authorise and settle transactions. The card networks specify the various rules and requirements to ensure card transactions are processed reliably and securely across the world.

Payment Processing Fees

The diagram below is a simplified illustration of a payment flow, and the fees associated with each component.



- **Merchant Service Fees:** This is the fee paid by the Merchant for payment processing services provided by the PSP and Acquirer. It is a per transaction fee and usually a small percentage of the transaction value. In most cases a transit agency or operator will contract with Littlepay to manage the acquiring relationship and will pay a bundled rate for payment processing. However larger cities may have a direct relationship with the acquiring bank, in which case the PSP and Acquiring fee may be separate.
- **Interchange Fees:** This is a fee paid to the card issuing bank. Interchange fees vary by card type, and by jurisdiction. A transaction made by a foreign card will have significantly higher interchange fees than a domestic transaction. As a general rule Debit cards have lower interchange fees than credit.
- **Scheme Fee:** The card networks charge the acquirers a licensing fee per transaction. Each acquiring bank will have its own arrangement based on the volume of transactions it processes.

Littlepay usually provides its service on an **Interchange++** basis. This means that the Interchange Fee and Scheme Fee are passed through to the transit operator at cost. The alternative to Interchange++ is a **Blended Rate**. This is where the merchant pays a single fee per transaction for all transactions, regardless of the type of card used. In order to offer this, acquirers will assess the merchants usual transaction volumes and distribution of card types to estimate the likely cost of variable fees such as Scheme and Interchange. They will then add in a buffer to cover the risk of the assessment being incorrect. Blended rates offer a known cost of processing for the merchant but can often be more expensive than an Interchange++ model.

The acquirer is able to provide detailed information regarding the fees for every transaction. Usually, all fees will be deducted from the value of the transaction and then settled into the Merchant's bank account. This is referred to as **Net Settlement**.

What is a Merchant of Record (MoR)

A MoR is a legal entity that is responsible for selling goods or services to an end customer. The MoR name appears on the customer's bank statement as the Merchant and is typically the entity that is responsible and in control of the customer relationship.

Transit operators are often already a Merchant of Record for services such as ticket office and Ticket Vending Machine (TVMs) payment processing.

Some transit ticketing vendor's offer third-party Merchant of Record services and then act as an intermediary between a transit operator and its customers, taking responsibility for all of the payment processes, retail customer support queries and liabilities on behalf of the business. That puts them in a position of power in the funds flow, acting as a reseller of the transit services and receiving the funds from the customer when purchasing a ticket. The transit ticketing vendor will then transfer the funds to the transit operator at a later date, often for an additional administration fee.

Where does the Payment Gateway or PSP come in?

Acquiring banks are large global regulated financial institutions. Their strength is having large-scale infrastructure that can process billions of transactions for tens of thousands of Merchants. Their priority is ensuring the reliability of standardised high-volume processing and managing fraud.

As a result, Acquirers are less focused on smaller merchants or providing flexibility to optimise the payment experiences for industry specific needs. This is where the more modern Payment Services Providers (PSP's) or Gateway's come in.

PSP's work in partnership with acquiring banks to improve the merchant and customer experience, and reduce friction throughout the integration and settlement process. PSP's like Stripe started out by simplifying the complex onboarding processes, digitising paper flows, and modernising user interfaces. Over time, they also added capabilities to reduce transaction abandonment rates, reduce fraud, and add functionality that improved the customer experience in industry-specific use cases, such as online marketplaces (where the merchant is not the seller) or splitting payments for a cab fare, and other variations. PSPs differ in terms of cost, speed and capability to suit the varying needs of merchants.

The unique challenges of payments in transit

As we alluded to in Chapter 1, bank card payments in public transit have their own set of unique challenges that necessitate some specialised infrastructure and flows:

- ***Payments need to be processed instantly:*** *retail stores can still afford a slight delay of two or three seconds between the moment a customer taps their card and the moment the payment is authorised. In transit, the standard is 300 milliseconds to reduce congestion. Acceptance with such timescales means we don't have time to check if the customer has adequate funds in their account. This in turn has implications for risk.*
- ***The system needs to work online and offline:*** *retailers are usually connected to Wi-Fi or a mobile network. If the POS device is down, you have to wait and try again. In public transit, it is sometimes necessary to take payments underground or in remote, rural areas, where connectivity isn't guaranteed.*
- ***There is risk to manage:*** *the first time a passenger taps their card on a transit network, the amount to charge isn't known and the payment isn't fully authorised. If the passenger has no funds, or the transaction fails, a system is required that can recover the payment and deny subsequent travel.*
- ***Values are often unknown at the point of sale:*** *when a customer taps to pay at a retail store, the value of the payment is known. With transit, the value will differ depending on how far they travel, what zones they go through, whether they are eligible for discounts or whether they have hit a fare cap. There can be thousands of different fare variations and this requires a set of different approaches.*
- ***Transaction costs must be managed:*** *the average transaction value (ATV) of a retail transaction is $20-$50. In transit the average transaction value is an order of magnitude smaller, $2 - $5. This lower ATV means that payment processing can be much more expensive due to fixed fees in place. The ability to aggregate transactions before processing, to minimise fixed fees can have a big impact on overall cost in some jurisdictions but this is not possible with standard online retail transactions*

- ***Transit data is not just about the transaction:*** *retailers are mostly interested in 'sales' data of different products. A transit 'product' is a more fluid concept that can change depending on frequency of travel (e.g. a capped product), the designation of the individual (e.g. a Veteran) or a range of other factors, about which data is needed.*
- ***Payments is a small part of a much larger, complex ecosystem:*** *large transit agencies and operators are often complex organisations with sophisticated reporting demands, control hierarchies, complex fare management systems and extensive customer support needs. Integration with this infrastructure is necessary to deliver the optimal operational and customer experience.*

These challenges have been embraced by the industry and are visible in the transit focussed specifications issued by the major Card Schemes. Examples include Visa's Urban Mobility specification and Mastercard's Global Transit rules. A PSP implementing the Card Scheme specifications offers agencies and operators payments processing with:

- Fast boarding/entry times
- Secure offline processing
- Risk management protocols to reduce the risk and volume of declined transactions
- Debt recovery processing to recover any debt incurred.

Aggregation to allow transactions to be tallied up at the end of the day to calculate fares and reduce the impact of fixed fees on cost of sale.

However, in the same way as PSPs in the general retail world differ, so do PSPs in the transit world. In addition to simply meeting the technical specifications of the Card Schemes, a true transit PSP can add value to an agency's business and its passengers, offer ROI and help to reduce the overall cost of sale. It can become a payment partner to the agency to innovate and evolve throughout the lifetime of the partnership.

Littlepay - the first transit specialist PSP

Littlepay was founded in January 2016 to address these unique challenges, and to develop a more accessible, affordable solution for the transit industry. We set out to disrupt the traditional model for transit ticketing which relied on bespoke, turn-key, single-vendor-solutions, and used expensive proprietary hardware and software technologies to accept contactless payments. Processing payments for the transport industry is the only thing that we do; it is not a sideline business for us. Our leadership and continued success is based in deep expertise in both payments and transport, allowing us to innovate and deliver value to partners, operators and passengers.

This specialisation has proven to be our superpower, allowing us to work closely with our agency's and operators to understand their emerging requirements and evolve the platform to the benefit of all in our operator community, whether they are a three bus rural operator or a multi-thousand vehicle operating group, city or country. Together with some of our most innovative operators, we have identified product features and enhancements to offer a supercharged transit PSP service, over and above the Card Scheme transit specifications.

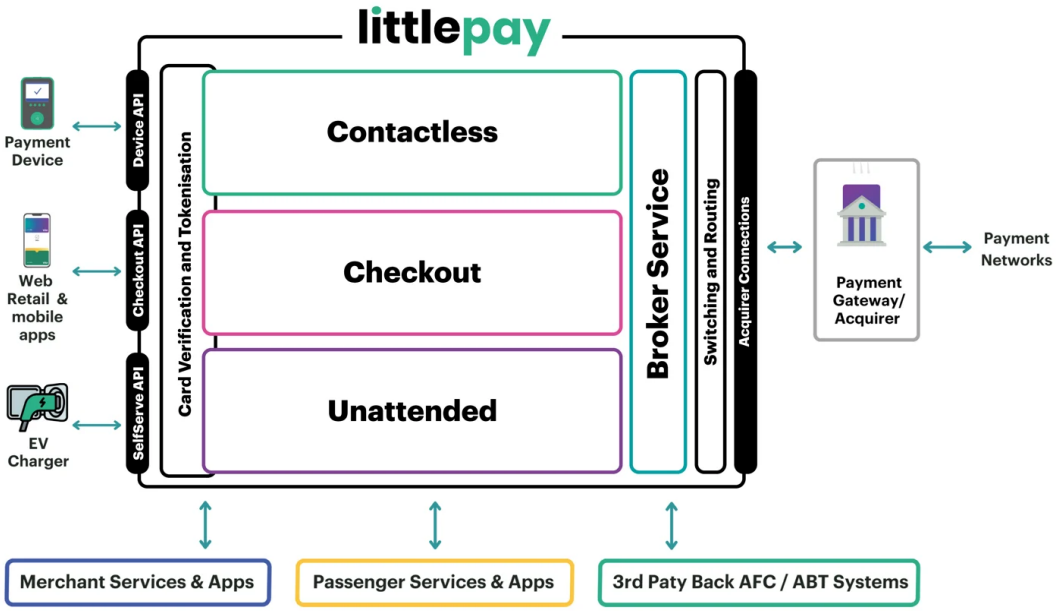
Innovation Toolbox

Modularity

We are a specialist payments provider to the transit industry. We do not sell hardware, mobile apps, or back office solutions. Instead we build APIs and open configurability to partner with like-minded organisations in the transit ticketing industry. We have over thirty different device integrations, transit apps and back office partner companies working with Littlepay today. The intention is to componentize fare collection systems allowing operators and agencies to select the best of breed solutions that are relevant to their specific requirement in their specific geography and not be forced to compromise on any one aspect of the solution.

Littlepay's approach is:

- **Open:** published APIs that allow other vendors to integrate with our platform
- **Flexible:** enabling integration with multiple vendors to avoid lock-in to a proprietary solution
- **Configurable:** a single code-base that is highly configurable - we don't code, we onboard
- **Scalable:** a fully cloud-native platform in AWS with scalable elasticity
- **Partner driven:** a network of fully integrated partners of all disciplines to get our data and functionality into specialist suppliers of data, customer management, retail and fare management systems



The Littlepay platform offers an omni-channel payment solution including:

- **Littlepay Contactless:** contactless EMV payment in transport for
- **Littlepay Checkout:** e-commerce processing for web and app based payments
- **Littlepay Unattended:** online retail payments processing in services such as queue busting, parking and EV charging

Our simple-to-use API integrations eliminate vendor lock-in, drive innovative solutions and allow great collaborations between operators and suppliers.

Enhanced Risk Management

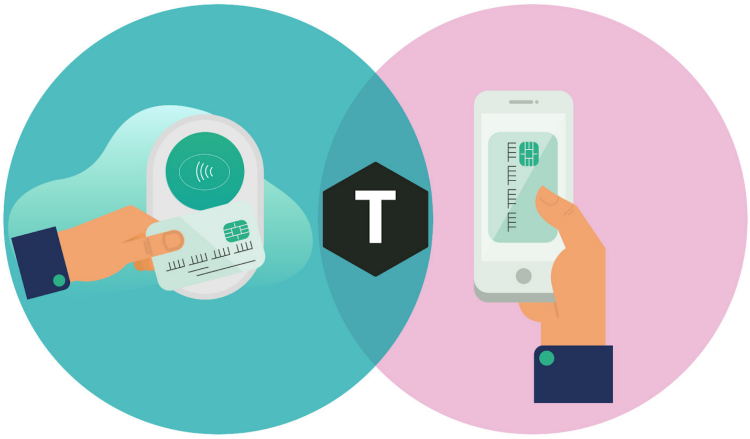
We value every penny processed on behalf of our operators. We have analysed years of transit processing data to implement features over and above the card scheme specifications to reduce revenue loss, optimise payment acceptance rates, reduce processing fees and implement fraud control mechanisms to close down transit specific threats. Some examples are given below:

- **PAR Deny Lists:** When possible fraudulent activity has been identified on a passenger's account, their payment credential is added to the deny list and all linked payment credentials, linked under the Payment Account Reference (PAR), are also added to the deny list, ensuring that there is no risk to the transport operator that further debt will be incurred from an account where suspected fraudulent debt has already been accrued.
- **Configurable Rules:** Risk rules have been implemented by Littlepay to enforce the scheme specifications and offer configuration within those parameters to tailor risk management settings. Littlepay can advise on optimum settings for configurable items.
- **Fraud monitoring:** Littlepay Operations manage a variety of fraud detection dashboards which aim to identify suspicious activity. Any issues are escalated and investigated such that remedial action can be taken to reduce the threat - e.g. adding the token to a PAR Deny List or a deny list.

Omni-channel and the shared token

Transit specifications focus purely on the Card Present experience referring to a passenger physically tapping a payment card or mobile payment device to enter a transport network. This can become a limitation for operators with multiple sales channels in their network such as e-commerce solutions for ticket purchases or post payment account based travel, who then have to use multiple PSPs.

A transit PSP offering an omni-channel transit payments platform can create a unified passenger experience with tokenisation of bank cards and mobile wallets used across channels. The resulting common token enables agencies to unlock passenger value in a variety of innovative ways.



- **Enhanced passenger engagement:** Use of the "common token" enables a new level of engagement in the mobile app creating a link between the physical PAYG taps and the cardholder via the app. When Littlepay sees a tap on a transport reader it can then match that card with a mobile app user. This enables operators to interact in real time with a user that has just tapped their card or phone. This can be used to provide contextual information, nudge passenger behaviour, or help a passenger to resolve their own queries and reduce the demand on customer support services. Littlepay has integrated with industry leading mobile app providers to help deliver valuable visibility, support and information to passengers using payment cards for public transport.
- **Card As Authority to Travel (CAAT):** CAAT involves linking a passenger's payment card with a travel right such as a weekly pass, concession or account. This association allows passengers to travel using just their bank card as their ticket in place of a paper ticket, smartcard or mobile QR code automatically receiving a discount or ensuring that they are not charged where an applicable ticket has already been purchased.
- **Regional Multi-Operator and Multi-Modal Capping:** Littlepay offers its Broker Service to deliver intra-group or region wide capping. It addresses the complexity associated with linking together different open loop solutions where tokenisation and a single view of a passenger can be difficult. Operators integrated to the Broker Service can configure their own capping products for their own services while also participating in any group wide capping initiative.

Ongoing Innovation

In a world of rapidly evolving technology it is more important than ever to work with partners that are open to working with other vendors, flexible to respond to changes, and deeply understand your needs.

No solution is fully future-proof, but having modular payment infrastructure provided by a supplier with proven expertise and a collaborative approach can expand your horizon and significantly reduce the risk.

CHAPTER 6

Procurement Pitfalls

Overview

For the most part, transit agencies around the world acquire their ticketing and payment systems through government regulated procurement processes. Poorly designed tender processes and evaluation criteria can lead to perverse outcomes, increased risks, and as we've seen far too often in public transit, massively delayed deployments with budget blowouts.

At Littlepay we've seen our fair share of these procurements, and have learned a few lessons. We'll share them here in the hope that we save the next transit authority from becoming another case study.

Don't lose sight of the bigger picture

What is the ultimate purpose of a public transit ticketing procurement? Surely it should have something to do with delivering convenience and value to commuters and passengers. Yet somehow, instead of trying to deliver this convenience quickly and efficiently, we see procurements with overly complex requirements that take many years to deliver functionality customers don't really care about.

Around the world passengers have voted with their wallets and phones indicating that they have a strong preference for the convenience of open payments. Yet we see in Melbourne (ironically, Littlepay's home-town), the government awarded a $1.7bn contract (that's billion!) to fully replace the much maligned Myki ticketing solution with an account based ticketing system. This will enable open payments to the long suffering commuters of Melbourne over the next 3 years, nearly a decade after Sydney enabled bank card payments. This, despite the fact that the existing system could have been initially upgraded to provide open payments to the majority of people at a fraction of the cost within 6 months.

Similarly, the New Zealand Transport Authority commenced their procurement of a complex national ticketing solution with a market sounding in 2019, then awarded the contract in 2022, and will now be delivering open loop to the public in 2026, assuming the project is delivered on time, which appears unlikely. These kinds of projects are never on time.

On the other hand, over the past 2 years, Littlepay has delivered open-loop payments to 10 cities across Finland, in simple rapid succession, with next to ZERO capex (other than validator upgrades)! In California, Littlepay worked with Cal-ITP who wished to demonstrate open loop with agencies in the state before procuring device and payment processing services for a statewide framework. Littlepay was selected as the sole payment processor for all of the initial Cal-ITP pilot deployments in Santa Barbara, Monterey-Salinas and Sacramento and has since been awarded all 8 projects which have since acquired services from the framework with many more expected to launch in 2024.

While its true requirements can vary by city size, network complexity, and other factors, the stark differences in implementation outcomes and costs are not explained by these factors alone. We would suggest the varying outcomes have more to do with how these procurement processes are designed, and a number of key decisions made by transit agencies, which we'll explore below. As we do so, it's worth keeping in mind Conway's Law:

Any organisation that designs a system (defined broadly) will produce a design whose structure is a copy of the organisation's communication structure.

Melvin E. Conway

Paraphrased, Conway's law suggests that:

If the procurement project involves a large, complex, bureaucratic team, you are likely to end up with a large, monolithic, inflexible, and probably expensive transit ticketing system.

If success is defined as the delivery of a system with a wide scope of complex requirements, you'll end up with a complex, multi-year project with many delays.

If you rely on consultants incentivised by daily rates to design the solution, you'll end up with more complex proposals that take longer to deliver.

You get the gist.

So, what are the key decisions and trade-offs to consider:

Big Bang v. Agile

Government procurements are time consuming and expensive, so there's a preference to do fewer of them. For this reason, too many RFPs succumb to the temptation of incorporating every foreseeable requirement, depriving customers of the higher value features they could enjoy much sooner.

This is the 'Big Bang' approach to delivering a specific solution detailed by 'requirements'. In the famous analogy by agile expert Henrik Kniberg, it's like specifying your solution as a car, and then building the components of a car in stages until you build the finished product you can then use.

Big Bang - deliver a solution

This is the approach we often find with transit ticketing procurements. Consultants will design a solution hoping to capture every foreseeable needed technology including ABT, Open loop, Journey planning, and then put these as the requirements of an RFP to be delivered over a specified timeframe of several years. These projects then inevitably run into long delays and cost overruns, as with SEPTA and Melbourne Myki.

In an alternative 'agile' approach, the focus would be on delivering an outcome for the customer. Instead of focusing on the solution (as a car in the analogy above), the focus would be on the outcome (which is to move someone from A to B). This approach focuses on delivering the earliest usable product for the customer (e.g. a skateboard) and then iterating your way to the full set of features.

Agile - deliver an outcome iteratively

In the context of transit ticketing, this might be the delivery of open payments, which the customers view as the highest value feature, followed by the addition of registration and account functionality, and then gradually other features based on customer feedback. This customer-centric approach delivers value sooner, and lowers risk of delivery.

This is the approach Littlepay has taken in California. Iterative deployments, with new partners being integrated into a modular solution. Delivering what the passengers want the most first (open payments), and then adding new functionality.

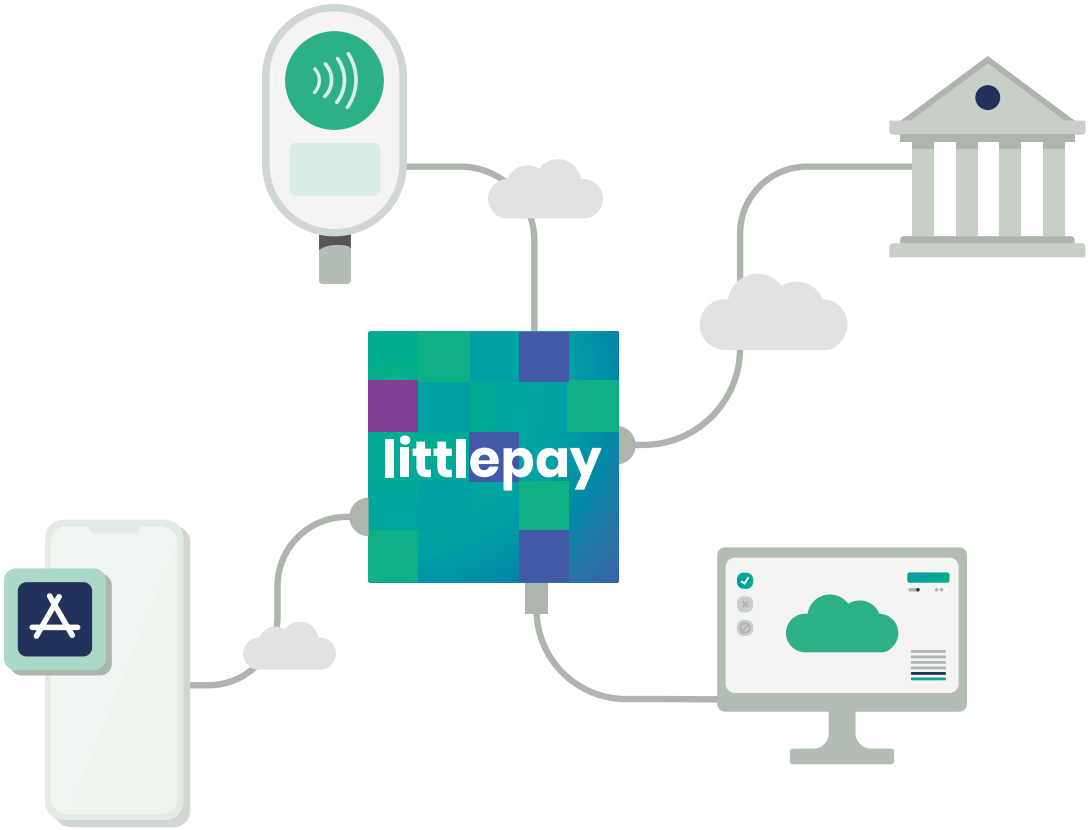
Modular v. Vertically Integrated

Modularity and agility go hand in hand. You could say the former is a prerequisite for the latter. You simply cannot be agile while dependent on the delivery of a fully vertically integrated solution by a single vendor.

In the same way that you don't need to throw out your monitor and keyboard when you upgrade your laptop, a modular ticketing system gives transit agencies the flexibility to upgrade and future proof their solutions in a lower risk way.

Government RFP documentation and selection processes were designed in an era of bespoke systems that were built from the ground up. As Conway's law predicts, the RFP process will bias the outcome in favour of legacy vertically integrated systems.

Avoiding a monolithic system, and drive towards modularity requires upfront design decisions regarding the architecture and interfaces of the system. This in turn needs to be reflected in the tender process to attract vendors who can work in an agile and collaborative model.



Consultants v. Practitioners

Consultants can play a helpful and important role in supporting a government agency through a procurement process. But every consultant brings to the table their own experiences and biases. If you hire consultants with prior experience working for large vertically integrated systems, you're likely to get a process and solution that points you in that direction.

Consultants love complexity and transit ticketing and payments is a complex domain. Another iteration of Conway's law might say "The complexity of your system is proportional to the number of consultants involved in the design".

We've seen too many procurements and deployments fail based on the complexity of requirements by consultants who are too far removed from today's practices. A classic example was the expensively aborted project ABBOT (which had several failed iterations).

ABBOT was an attempt to create a regional government-owned platform that could unify multiple ticketing systems to provide passengers with multi-modal ticketing. With hundreds of requirements detailed in the minutia, this project was always bound to implode on the weight of its own complexity. By focusing on requirements, vendors scramble to comply with requests, often underestimating the time and cost of delivery.

In our experience, effective and constructive engagements with consultants occur when the transit agency has a clear understanding of the outcomes it wants to achieve. This understanding is gained through early engagement with practitioners in the industry. By focusing on outcomes instead of requirements, we can understand what various systems and approaches can offer, and move with more agility.

The good consultants will be open minded and focused on higher-level outcomes, giving practitioners the freedom to come up with different innovative solutions to address these.

Structuring a procurement process

Now that we understand some of the trade-offs, here are some of our learnings from the more successful deployments we've encountered.

Learn what's possible

With the introduction of cloud based SaaS and modular services, transit ticketing has evolved greatly over the past decade. Options are increasing as new innovative vendors enter the market.

When Costa Rica's central bank set out to bring contactless nationally across the transit network, they engaged industry ticketing vendors and the card networks over a 12-month period, to determine the approach they wished to adopt. This provided great clarity in the tender process, and allowed Littepay to deliver a national open-loop solution within a year of commencing the project.

Transport for NSW, perhaps the most technologically advanced and capable agency we've dealt with, are currently undertaking a 2 part process to learn what's possible from industry practitioners, before the tender for Sydney Metro system. The first part was an 'Industry Sounding' where they put forward a proposed approach and asked the industry to comment on the approach. The next stage was an RFI which further refined their thinking prior to finalising the RFP documentation.

Hire the right consultants for the right job

If you're not sure where to start, talk to us first. We'll give you some pointers and a few options and you can then make a more informed decision.

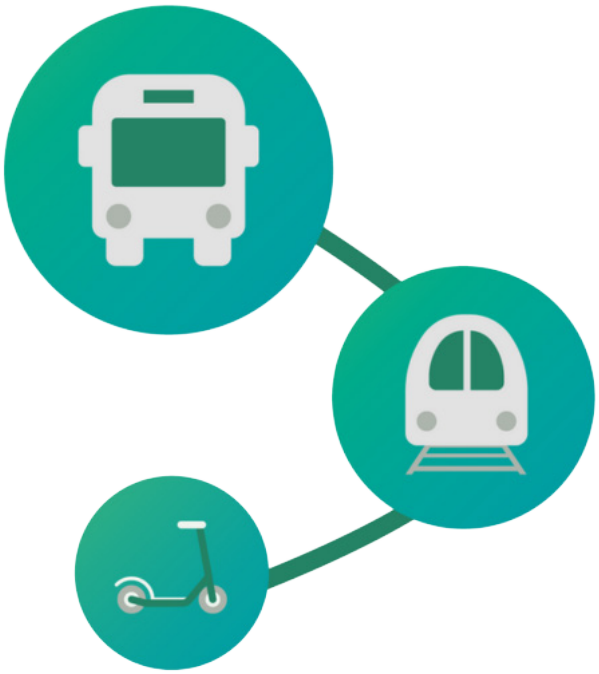
Pilot

Modular systems give you a chance to pilot some of the components of the system in a live environment, giving you valuable data to refine your final tender requirements and outcomes.

Littlepay has integrated and certified with a wide range of hardware vendors that can be quickly deployed at very low cost to achieve this outcome.

In Helsinki, we ran a contactless open loop initial pilot using validators from two different vendors well in advance of the final hardware procurement, uncovering a range of additional considerations that were included in the tender.

In California, Littlepay ran small scale pilots in two cities for a simple flat fare deployment prior to the broader Cal-ITP procurement, giving valuable feedback and proof points regarding the performance of various devices relative to their promise.



Build in optionality

The Cal-ITP run procurement for California's ticketing system introduced the innovative concept of a 'vendor panel' or framework to their process. Instead of having a single vendor in a 'winner takes it all' decision, they evaluated bidder responses and pricing, and approved a number of vendor offerings. Individual city agencies could then select from this panel at their own discretion, with pre-agreed commercial terms.

That is, a transit agency in California can select one of 3 device vendors, and one of 4 different back-offices without having to go through a new tendering process. This concept could have much broader applicability in larger agency tenders, which may need a range of different hardware for different use cases.

Again, this comes back to modularity and the initial design of the solution allowing for this 'plug and play' approach to building an overall system.

Parcel your tender and let vendors bid on multiple lots

Breaking up the procurement into separate lots allows for greater competition while retaining the flexibility of having both specialist best-of-breed applications, as well as fully integrated solutions.

Separate procurement lots for hardware (front office), payments (middle office), ticketing (back office), and System Integration (consulting) are logical. This approach allows for greater competition as smaller specialist vendors can bid on individual components, while also giving ample opportunity for large integrators to propose fully vertically integrated solutions by combining lots.

Do real reference checks to quality vendors

A common pitfall we've seen in a number of tenders is inadequate reference checking in the qualification round. There have been many instances of vendors claiming 'qualifications' in having previously deployed certain solutions, being awarded the tender on this basis, and then revealing that they don't have production ready systems, or that the deployments are not actually live yet, or that they were referring to something totally different. Being able to process a payment in the retail context is not the same as open payments for transit.

An example of this is in the recent tender process in Melbourne, where references cited are now being disputed. Reference checking should be robust, very specific and validated. This is the work consultants should be able to do.

Scoring Respondents

We've seen a few tenders which have been won by the barest of margins, with a few thousand dollars on price being the determining factor between two vastly different solutions. It can only be the result of a poorly designed scoring system when the results do not show clearer separation between two very different systems.

You can have more flexibility in your decision making by:

- Adding more qualitative factors to the scoring
  - Allocating points to a demo, or a pilot is an example of a qualitative scoring round
- Not overweighting one factor over all others.
  - We've seen Total Cost weighted at 80% in some tenders, which creates a likelihood that an inferior and cheap solution wins on points.

Don't over commit

In a fast moving world, where new technologies are emerging, and modular flexible solutions allow for flexibility, there's no reason for a tender to be awarded for an excessively long term.

Ten to fifteen year contracts to a single vendor puts the transit agency in a difficult position if technologies change. This is a legacy from the bespoke-build days where hugely expensive systems needed long periods to recover costs.

Contracts for more modular solutions like those in Helsinki and California are for 3-4 years. This is a good benchmark for components that don't require heavy capex commitments for bespoke solutions.

To explore how Littlepay can modernise your fare collection systems and streamline operations, book a consultation with our experts today.