EXECUTIVE SUMMARY

Across the globe, populations are migrating to cities, resulting in congestion and increased pollution. Overall we are travelling a lot less than we did 10 or 20 years ago, but the travel we are undertaking is mostly within cities. Customer experience often remains poor – intermittent or disrupted services and lack of transparency in planning routes across fragmented operators means that all too frequently consumers believe the convenience of driving their own cars outweighs the perceived decrease in costs of using public transport.

Within the transport industry everyone is talking about Mobility as a Service (MaaS) – solutions that integrate different existing transport providers to provide a near seamless door-to-door experience for consumers. It is now generally agreed that this is the inevitable direction of travel to address the mobility, congestion and pollution issues. In this White Paper, we describe the MaaS evolution and look at the opportunity it creates for innovative Payment Service Providers (PSPs).

The potential size of the MaaS market is enormous – the Market Research Future report on MaaS1 estimates the size of the market by 2023 at $254 billion with major players such as Uber and Google looking to address the market. Even allowing for the fragmented nature of payments across this market a total value of in excess of $1 billion is not unreasonable for the MaaS Payments market.

The existing transport operators use a variety of payment methods, dependent on their specific business models. For instance, not all payment methods are fit for purpose in the high throughput stations involved in urban centres. For MaaS providers this is an issue – how do they provide a seamless payment experience for their customers when they are traversing a range of different transport providers, each of whom have different payment options?

Increasingly, across all industries, payment is being considered as a service in its own right, best dealt with by organisations that specialise in the area. This paper outlines the generic architecture and requirements associated with such a decoupled infrastructure allowing MaaS operators to focus on their core applications, while offering their customers access to the payment options that best suit their needs.

We conclude that, in line with other industries, we expect to see the market for MaaS moving to an architecture where payments are no longer coupled into the business applications. The rapidly changing nature of payments, particularly in respect of customers taking control through mobile applications, means that it is no longer possible to make assumptions about what type of payment instrument customers will have. To support this move there needs to be a new type of PSP which allows MaaS Providers to isolate themselves from the changes to the financial ecosystem, while providing access to the widest range of payment instruments.

Consult Hyperion has enviable expertise in both mobility solutions and the new wave of payment services. We continue to support customers in both markets looking to develop new services and extend existing ones, across the globe.

1) https://www.marketresearchfuture.com/reports/mobility-as-a-service-market-3109
# CONTENTS

1 INTRODUCTION  3

2 THE MOVE TOWARDS MAAS  4
  2.1 Introduction  4
  2.2 The ecosystem  5
  2.3 Integration is key  6
  2.4 Case study 1: Transport for London  7
  2.5 Case study 2: Whim  7
  2.6 Payment Considerations  8

3 THE NEW PAYMENT LANDSCAPE  8
  3.1 Evolution of payment instruments  8
  3.2 Consumer payment trends  9

4 THE MOBILITY PAYMENT SERVICE PROVIDER  10
  4.1 How might a PSP be used by MaaS?  10
  4.2 Impact of the M-PSP on the MaaS Provider  11
  4.3 Architecture  11

5 CONCLUSIONS  13

APPENDIX A: SOME MAAS PAYMENT REQUIREMENTS  14
1. INTRODUCTION

Consumer expectations are changing. As smartphones become pervasive, the expectations of consumers wanting, and relying on, immediate information to serve their needs increases. Urban travel information is no exception to this. Increasingly, young people do not want to own a car, but they need to travel to be part of society.

Across the globe, populations are migrating to cities resulting in congestion and increased pollution. Overall we are travelling a lot less than we did just 10 or 20 years ago, but the travel we are undertaking is mostly within cities. Customer experience often remains poor – services are intermittent or disrupted and there is a lack of transparency in planning routes across fragmented operators.

Within the transport industry, everyone is talking about MaaS and seems to agree that it is the inevitable ‘direction of travel’ to address the mobility, congestion and pollution issues described above. But what is meant by MaaS? There is no single agreed definition, but consensus seems to be emerging. For us, the definition of MaaS must include:

- Customer-centricity, probably using a mobile app to provide convenient access while on the move;
- Real time availability of information to allow journey planning and management, including being informed about disruptions, and support for re-planning;
- Journey choices seamlessly integrating public and private transport modes to provide the door-to-door planning and assistance;
- On-demand options, not just pre-booked journeys;
- Integrated payment for the mobility services using mechanisms that suit the customer.

In wealthy countries, consumers spend on average around €500 per month on transport, whereas, for mobile phones, the average revenue per user (ARPU) is less than €30. It’s clear that the potential MaaS market is significantly greater than the trillion-dollar global market for mobile².

To obtain the full benefit of MaaS the end-to-end experience needs to reduce friction for the customer, which includes how they pay for the service. As is the case with all consumer retail propositions, the customer does not go shopping for the pleasure of paying but, all too often, payment for mobility services targets the needs of the Transport Operator rather than those of the consumer. Payment should be seamless, frictionless and multi-modal – the consumer should be able to pay for the services they need using the payment methods they prefer.

Historically, many industries, including mass transit, have seen payment methods directly integrated into their software applications. This has left organisations with inflexible software that is difficult and expensive to adapt as payment methods in common use change and new payment methods have been introduced. These changes to payment methods are not under the control of the transport industry and, worse, this distracts Transport Operators from focusing on their core business applications, to the detriment of their customers.

Increasingly, across all industries, payment is being recognised as a service in its own right, best dealt with by Payment Service Providers (PSPs) – organisations that specialise in the area. This paper outlines the generic architecture and requirements associated with such a decoupled infrastructure allowing Transport Operators to focus on their core business, while offering their customers access to the payment options that best suit their needs (see Figure 1).

Payment services themselves are a barrier to MaaS take up – without the flexibility required MaaS providers will need to subject their customers to a patchwork of different payment services. However, the prize for the PSPs that structure their businesses correctly and offer the services, APIs and flexibility that MaaS providers need is enormous. With an estimated MaaS market size of $250 billion by 2023 even a conservative estimate of the payment solution value would be well in excess of a billion dollars.

2. THE MOVE TOWARDS MAAS

2.1 Introduction

In this section we discuss what the move towards MaaS actually means. Who are the key players and what are the main issues? One thing that is clear is that not all MaaS providers are the same, and we outline a couple of differing examples from the UK. Arising from this is the recognition that the payment services needed to support MaaS providers are multi-factored – not all payment services will be required by all providers.
The following key actors are needed in the MaaS ecosystem (see Figure 2):

- **MaaS Customer**: We need to make the MaaS offer attractive and easy to use if we are to achieve the desired modal shift away from private cars.

- **MaaS Provider**: The MaaS Provider runs the MaaS scheme, cutting deals with the other actors, making an aggregated offer to the customers and providing them convenient means to use the service, such as a mobile app. A MaaS Provider is to mobility what Netflix is to movies and Spotify is to music.

- **Data Provider**: There are many data sources including routes, fares and timetables which the MaaS Provider must collate and structure in such a way as to be useful to customers. So, there is a role for a Data Provider, assuming that the MaaS Provider does not consider this a core strength of its own.

- **Transport Operator**: The role encompasses the traditional public transport modes (bus, train, metro, tram, ferry) as well as taxi, car hire, car share and bike hire.

- **Local Transport Authorities**: These governmental bodies have the power to intervene in the mobility ecosystem through regulation and in some instances also act as a transport operator (e.g. local tram or metro) or data provider.
2.3 Integration is key

As discussed, customers are seeking a seamless experience as they travel from door-to-door, all facilitated through a single mobile app. Achieving seamlessness is all about ensuring that the various parties are tightly integrated; lack of integration leads to lack of uptake.

As the industry migrates towards MaaS and new players appear, there seem to be various approaches which can be compared by the level of integration they offer. Overall, integration can be thought of as comprising the following (see Figure 3):

- **Modal integration**: All the transport modes that customers need to replace the private car door-to-door experience are available and their availability and routes work in concert. E.g. Bus, train, metro, tram, ferry, river bus, taxi, car hire, car share, bike hire, and pedestrian route planning.

- **Ticketing integration**: One customer medium can be used on all modes (e.g. a barcode, transit smart card, a bank card, or a mobile app) as proof of ‘authority to travel’.

- **Payment integration**: Multiple payment instruments are available based on the customer’s dynamic preferences, changes in the financial ecosystem and the transport mode. Includes pre-purchased ticket if necessary and pay as you go (PAYG).

- **Journey planning integration**: A single interface can be used to access all the information needed, e.g. information about the transport modes such as fares, timetables, routes, live disruptions.

- **Tailored packages**: Packages of pre-paid mobility tailored to each customer’s requirements in a similar way that Netflix and Spotify do today for films and music respectively.

![Figure 3: Integration aspects evolving towards MaaS](image-url)

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Mode

<table>
<thead>
<tr>
<th>Single mode</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper tickets and transit tokens</td>
<td>Integration</td>
</tr>
<tr>
<td>Cash or prepaid accounts</td>
<td>Integration</td>
</tr>
<tr>
<td>Planning journeys by phone or using paper timetables</td>
<td>Integration</td>
</tr>
</tbody>
</table>
2.4 Case study 1: Transport for London

Transport for London (TfL) is often cited as a case study for smart ticketing due to high levels of innovation and success. Its advantage over many Local Transport Authorities is that it controls all Transport Operators within its domain and can therefore make the multi-modal, multi-operator customer experience seamless and simple to understand. This is done through fares simplification and providing fair price promise ‘capping’ so that customers can pay as they go and (mostly) do not need to even think about tariffs and purchasing tickets in advance.

TfL currently has two alternative payment and ticketing offers across its transport modes:

- The Oyster Card as the customer identifier with pre-paid accounts; and
- Contactless bank cards, and the payment network with bank accounts.

TfL is a mobility provider, but not so much of a MaaS Provider. TfL shares some data to allow third parties such as City Mapper and Google to provide travel planner apps. But the TfL mobile app is aimed at managing your Oyster card, season tickets, pre-paid account and viewing bank card journey history and payments; it does not yet include journey planning and the like that a customer needs for the integrated MaaS experience.

The modes of transport that can be paid for using TfL’s payment mechanisms (pre-paid Oyster or PAYG bank card accounts with capping) do not include taxi, cycle hire, car hire or car sharing and they do not offer any mobility packages tailored to customer needs.

Recently, City Mapper launched a MaaS offering in London using a prepaid Mastercard. This works because all TfL modes accept open-loop payments. However, TfL had previously stated that they will not provide a cut of fares to MaaS Providers, so it will be interesting to see how this plays out.

2.5 Case study 2: Whim

MaaS Global has arrived in the UK from Finland and have launched in the West Midlands region. They are a start-up MaaS Provider that has been operating since 2016 in Helsinki. They have a mobile app called Whim, which:

- Plans to offer public transport modes, taxi, car hire and cycle hire when the agreements are in place in your region.
- Contains a journey planner, allowing customers to enter their start and end points and choose a single mode of transport which can be paid for through the app.
- Allows the customer to either subscribe to packages of mobility on a monthly payment basis or to pay for each journey at the point of booking or, if the cost is not known, at the point of completion of the journey (e.g. taxi).
- Has a single card-on-file payment mechanism using credit or debit bank cards.
- Allows purchased tickets to be stored in the app as 2-D barcodes, which may be displayed for inspection purposes.
Unlike TfL, MaaS Global is not a Transport Operator in its own right and so does not have automatic access to transport operators within the region. Negotiation of a deal with each new operator is necessary for them to achieve the levels of integrations needed for true MaaS. Therefore, it makes sense for them to target transport authorities such as Transport for West Midlands (TfWM) that can potentially bring more than one mode of public transport to the table. But the problem of integration persists if the transport operator does not choose to accept visual inspection or 2-D barcodes as tickets, for example in London on TfL modes.

The challenge will be for the small MaaS Provider, such as MaaS Global, to find a way to convince the Transport Operators to work with them. Like Netflix and Spotify, they will need a critical mass before they will start to make money. It seems likely that much larger organisations, such as Google, will step in and take the MaaS Provider role and provide it uniformly across the globe. They already have other parts of the solution in place such as Data Provision and, more recently, tickets sales as demonstrated by their work with ITSO on Mobile in the UK.

2.6 Payment considerations

As we can see, not all MaaS Providers are the same and different transport modalities come with legacy payment methods. Yet to provide a seamless travel experience the MaaS Provider somehow needs to provide an integrated payment experience regardless of the underlying Transport Operator models. In the next sections we look at how specialised Payment Service Providers might approach such a challenge.

3. THE NEW PAYMENT LANDSCAPE

Different industries have different requirements for payments and not all payment methods are suitable for all. However, the general principle for businesses is that they should offer the payment options that their customers want rather than forcing them to accept specific payment methods and that payment should be as frictionless as possible.

Historically this has been relatively easy as the only common methods of payment were cash and cards and some closed-loop pre-paid options such as transit operator cards. Now, particularly for online payments, new alternative payment methods are being adopted and closed-loop solutions where scarce cash has to be pre-allocated are increasingly less favoured.

3.1 Evolution of payment instruments

In a face-to-face environment the main payment methods employed are cash or open loop payment cards (e.g. Visa, Mastercard). The pervasiveness of these methods is due to widespread and common acceptance, either as part of a cultural norm or because of the availability of acceptance infrastructures. Mobile payment instruments such as ApplePay or Google Pay are simply proxies for cards, and use the existing infrastructure: they are open loop payment cards presented in a different form factor. Although changes are afoot in the world of face to face payments – particularly with larger retailers trying to remove the friction associated with checkout – the focus on cash (or pre-paid in the mass transit sector) and cards is unlikely to change in the foreseeable future.
In an online environment, the payment methods employed are much more diverse and continue to change rapidly. Although cards are pervasive and widely used they are not accepted in all cultures. Where they are accepted online card payments are associated with security issues as a result of originally being designed for the face to face environment.

As a result of these issues we have seen a variety of new types of payment solution made available for on-line payments. PayPal is the best known of these “alternative” payment methods but there are many country-specific payment instruments in other territories – e.g. M-Pesa in Kenya, Paytm in India, iDeal in the Netherlands, Klarna in Sweden and Sofort in Germany.

In addition, the European Union has recently launched its PSD2 Open Banking regulation which allows for direct payments using open APIs from consumer bank accounts to merchant accounts without the use of a proxy such as a card. Open Banking initiatives, whilst led from the EU, are also happening elsewhere in the world. This is likely to be an increasing trend. Open Banking is, at least in theory, more secure than card payments in an online environment and we would expect to see slow but steady growth in this area.

### 3.2 Consumer payment trends

The nature of payments is changing. Consumers want flexibility and simplicity in their payment choices. They do not want to repeatedly provide their payment details to multiple parties and would prefer that payments are as frictionless and invisible as possible. The traditional mass transit payment approach of dictating to customers how they should pay and requiring them to use prepaid accounts and cards is not really suitable for a world where customers are used to paying for services and access on demand. They are also not suitable for visitors who just want to turn up and travel.

In addition, preferred funding sources may be dynamically allocated. Today’s online consumers typically have the choice between debit card and credit cards, but in future third-parties may be able to offer mixed payment choices. For instance, Open Banking allows third-parties to inspect the consumer’s payment accounts and to set up funding preferences as a mix of credit or debit. Given access to account details we would expect to see vendors offering short term or long term loans for specific purposes – season tickets for travel, for instance.

To address this, in the rest of this paper we describe the requirements for a new payment intermediary, specialising in payments and providing MaaS Providers with the payment services they require. These Mobility Payment Service Providers (M-PSPs) will isolate the MaaS Providers from the payments infrastructure and provide the services the transport industry needs to service the needs of consumers.
4. THE MOBILITY PAYMENT SERVICE PROVIDER

Many industries have either had to introduce payments or have had to decouple their core applications from their payment applications. In doing so a new class of intermediary has been introduced – the Payment Service Provider (PSP). The main role of the PSP is to provide the business application with a decoupled interface into the core payments infrastructure provided by banks and other payment intermediaries, to isolate them from the constant change that is occurring there.

4.1 How might a PSP be used by MaaS?

Not all PSPs are the same and many provide very limited sets of payment services. For example, many PSPs specialise in only providing access to online card payments. Although this may seem like a niche area the constant change in underlying interfaces, standards and regulations means that these PSPs provide a valuable service to retailers who do not wish to constantly invest in updating payment services (see Figure 4).

However, for the MaaS environment, the requirements for the complete MaaS Payment Service Provider (M-PSP) are going to be more complex due to the varying nature of payments in the underlying transit operators. For specific implementations the MaaS Provider will need to undertake a full discovery process to understand the requirements that their M-PSP needs to meet. See Appendix A for example requirements.

Additionally, M-PSPs may offer a range of additional services, particularly where they act as a single access point to multiple payment instruments for a single consumer. These services can include identity management, risk and fraud management and access to loyalty and rewards programs.
4.2 Impact of the M-PSP on the MaaS Provider

How does the introduction of the M-PSP impact upon the MaaS Provider? The MaaS Provider (in collaboration with the Transport Operators) will remain responsible for all mobility related requirements. A conventional PSP will not have any knowledge of transport-related information or requirements and is, for instance, not capable of calculating fares, automatically generating refund requests or managing pre-paid funds for closed loop transit schemes. The M-PSP must be capable of initiating and collecting payments triggered by the MaaS Provider, initiating and distributing refunds triggered by the MaaS Provider and collecting funds for topping up closed loop pre-paid accounts through any payment method that has been configured.

The MaaS Provider is the only entity in the architecture that understands the mobility solution and the purpose of the split architecture is to remove the complexities of the payment methods. However, a M-PSP, designed to support a mobility architecture, should be able to provide specific support to payment related requirements that are directly derived from a mobility solution. For instance, a M-PSP must be able to support requirements to check the availability of funds prior to commencing a journey and to allow the top-up and distribution of funds for a pre-paid payment instrument.

Critically, the M-PSP should not take on any requirements specific to the mobility solution. This is, and remains, the responsibility of the MaaS Provider. One of the core tasks of any architecture design phase will be to define the APIs supported by the M-PSP and to specify the integration requirements for the MaaS Provider.

4.3 Architecture

Each MaaS implementation may be slightly different and the following descriptions should only be taken as examples. Note also that the transit modes and payment methods shown are also only examples – there are significantly more of both in the real world.

Figure 5: MaaS Architecture with Shared Customer Identity
The MaaS Provider-to-M-PSP architecture can be represented at a high level as shown in Figure 5. Here the MaaS Provider "owns" the customer and manages their identity. This identity needs to be shared with the M-PSP in order that they can manage the customer preferences.

In this model the M-PSP is responsible for removing the payments process from the MaaS Provider and for holding transactional information – records of what payments have been made and when. The M-PSP will publish APIs that define the payments processes available. For instance:

- **Payment Methods Available:** identifying what payment instruments are supported by the M-PSP;
- **Check Funds Available:** allowing the MaaS Provider to determine what funds are available to the customer for travel purposes;
- **Initiate Payments:** allowing the MaaS Provider to trigger a payment on either a specific payment method or on a customer identity;
- **Payment Fulfilled:** allowing the PSP to inform the MaaS Provider that payment has been settled and funds are available;
- **Payment Statement:** allowing the MaaS Provider to retrieve all customer payment details on either a specific payment method or on a customer identity; note that under Open Banking the PSP may have access to some or all of the customer's bank account details which may also be provided under the appropriate consent.

An alternative architecture would see the M-PSP solely responsible for managing the digital identity. Note that this is often misconstrued as the MaaS Provider losing ownership of the customer – this is incorrect. It merely means that the MaaS Provider is not responsible for the complexity associated with managing the customer’s digital identity or payment processing. In addition, as recent GDPR fines have shown, companies should aim to minimise the customer data they hold in order M-PSPs can help MaaS Providers limit their GDPR exposure.
5. CONCLUSIONS

MaaS is in an early stage of development and the MaaS Provider’s current approach to payments is based on the methods used by existing, long-established transport operators. However, in a multi-modal approach to transportation there is no single payment method that is suitable for all situations.

In line with other industries, we expect to see the market for MaaS moving to an architecture where payments are no longer integrated into the business applications. The rapidly changing nature of payments, particularly in respect of customers taking control through mobile applications, means that it is no longer possible to make assumptions about to what type of payment instrument customers will have access. To support this there needs to be a new type of payment service provider which allows MaaS Providers to isolate themselves from the changes to the financial ecosystem, while providing access to the widest range of payment instruments.

For example, the collision of increasing mobility ARPU in cities and the development of more secure mobile payment instruments such as those based on the Open Banking and PSD2 initiatives in the UK and the EU means that we can expect to see a wide range of new payment instruments and intermediaries arising over the next few years. To take advantage of the very large mobility market MaaS Providers will need to find ways of quickly and seamlessly supporting these payment methods. As consumers move beyond only using cash and payment cards, providing inclusive mobility services will require new ways of accepting payments.

Supporting these requirements will require a new breed of Payment Service Provider. Many of the services offered will be similar or identical to those provided to other business applications. However, MaaS provides some unique challenges and the Payment Service Providers that can adapt their solutions to the new environment will have a significant advantage in this new market.

Consult Hyperion has expertise in both mobility solutions and the new wave of payment solutions. We would be delighted to support customers in both markets looking to develop new services and extend existing ones.
APPENDIX A: SOME MAAS PAYMENT REQUIREMENTS

Here we outline a few of the key MaaS requirements around payments and shows how the introduction of an M-PSP will simplify their processes. Note that this is not intended to be a complete MaaS solution, and is merely representative of the approach.

<table>
<thead>
<tr>
<th>Source</th>
<th>Requirement</th>
<th>Impact on M-PSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer</td>
<td>I want to use payment mechanisms suited to me, not ones dictated by the MaaS Provider or the Transport Operators.</td>
<td>M-PSPs will need to offer services that translate Transport Operator payment protocols into an integrated payment experience for the consumer at the MaaS level.</td>
</tr>
<tr>
<td>Consumer</td>
<td>I want to present my concessions documentation evidence once and for it to be applied to all relevant journeys, e.g. proof of age.</td>
<td>M-PSPs or Maas Providers will need to manage the customer’s identity in a suitably anonymised way.</td>
</tr>
<tr>
<td>Consumer</td>
<td>For appropriate transport modes, I want to travel on demand, not pre-booking.</td>
<td>M-PSPs will need to manage and settle split payments using different payment instruments across Transport Providers in real-time.</td>
</tr>
<tr>
<td>Consumer</td>
<td>I want to be able to add value to my child’s or ward’s pre-paid account.</td>
<td>M-PSPs or MaaS Providers will need to manage complex account structures and link these to varying payment processes.</td>
</tr>
<tr>
<td>Consumer</td>
<td>I want rapid refunds when I am due them, e.g. due to travel disruption or cancellations; automatic delay re-pay.</td>
<td>M-PSPs must be capable of reversing any full or partial payment request across one or many Transport Operators.</td>
</tr>
<tr>
<td>Taxi driver</td>
<td>Reserve the funds at the beginning until the amount is known at the end of the journey.</td>
<td>M-PSPs must support a wide range of funds blocking and release functions as well as a variety of payment modes – pre-payment, post-payment and post-payment top-up.</td>
</tr>
<tr>
<td>MaaS Provider</td>
<td>Settlement, refunds, etc. between all parties in the MaaS ecosystem should be easy.</td>
<td>M-PSPs must be capable of managing complex split settlement processes to ensure all parties receive the funds they are entitled to.</td>
</tr>
<tr>
<td>MaaS Provider</td>
<td>Flexibility for when charges are made depending on transport mode.</td>
<td>M-PSPs need to support all payment modes. It is not sufficient to provide a sub-set of possible payment modes – e.g. card payments – when neither consumer or MaaS provider wish to use these.</td>
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</tbody>
</table>