MaaS ALLIANCE

endava

# WHY PAYMENTS ARE THE KEY TO MOVING MAAS FORWARD

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## Introduction

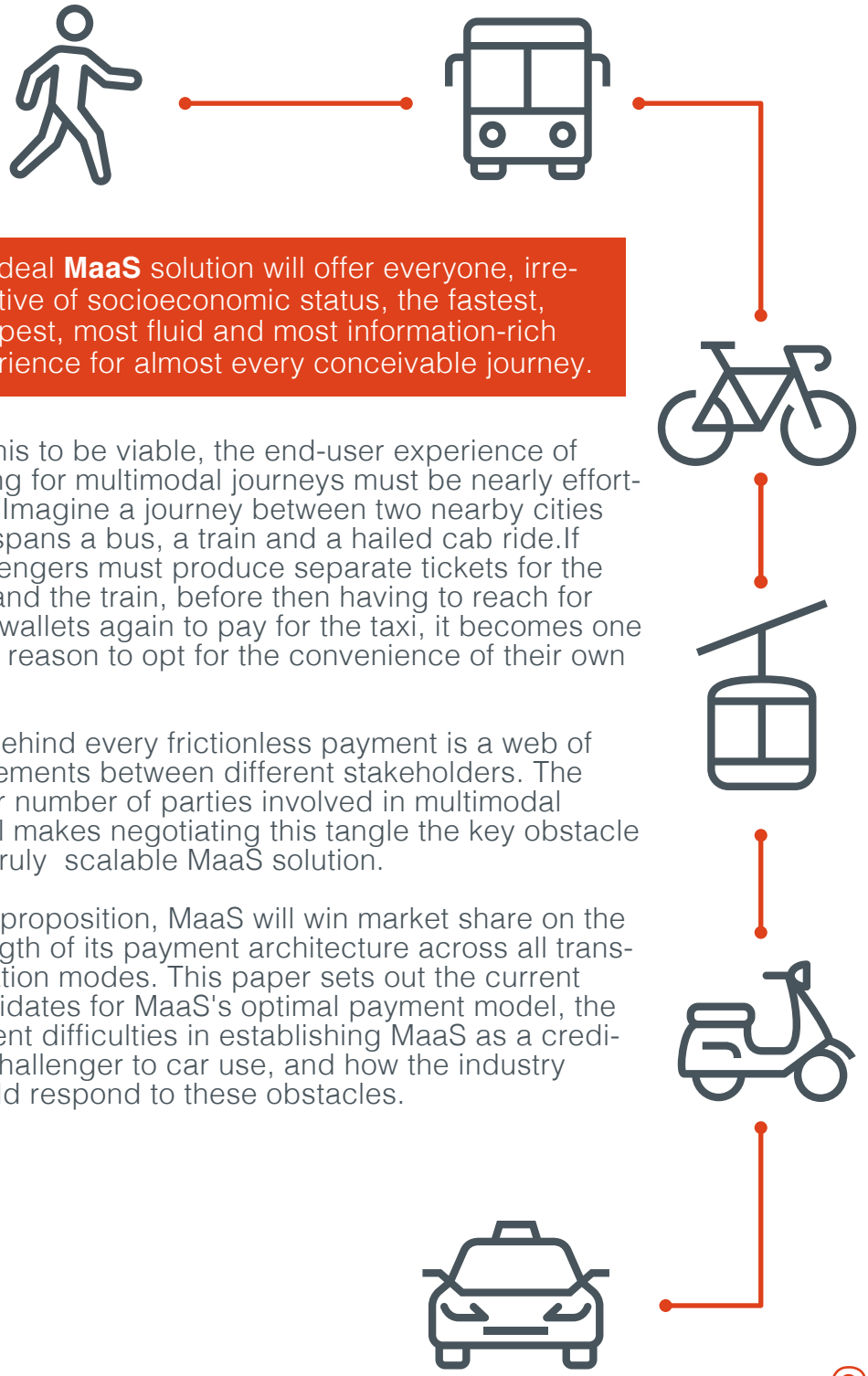
Despite ecological impacts, rising congestion, spiralling fuel costs, and the best efforts of transport planners, the private automobile remains the developed world's favoured mode of transport. Beyond design, comfort, or the subjective thrill of the open road,the enduring appeal of the car lies in the simplicity and freedom it offers to get around.

Overturning this preference and reducing the number of cars on the road is a priority for many cities, public transit authorities, businesses and NGOs. Yet any greener transportation service for getting people from A to B will have to emulate the frictionless experience that makes the car so popular for daily commuters.

In many geographies, public transit options may only cover a small portion of riders' desired journeys, with further alternative means needed (walking, taxi, bikeshare) to reach their final destination. These coverage gaps force customers to pre-plan journeys extensively, with the constant risk of disruption and delay. This is the space that Mobility as a Service (MaaS) must fill.

**Mobility as a Service'**, or **'MaaS'**, is an all-encompassing term for efforts to enable fast, cohesive travel experiences for every journey by using open data on transit and roads. In the words of industry body MaaS Alliance, Mobility as a Service **'integrates various forms of transport and transport-related services into a single, comprehensive, and on-demand mobility service'.**

To be successful, these platforms must provide aggregated access on demand to a range of transport modes from one digital interface, covering the maximum amount of ground. This allows users to plan and pay for journeys as packages of rail, bus, scooter, bike, taxi, car rental, and ridesharing options.



The ideal **MaaS** solution will offer everyone, irrespective of socioeconomic status, the fastest, cheapest, most fluid and most information-rich experience for almost every conceivable journey.

For this to be viable, the end-user experience of paying for multimodal journeys must be nearly effortless. Imagine a journey between two nearby cities that spans a bus, a train and a hailed cab ride.If passengers must produce separate tickets for the bus and the train, before then having to reach for their wallets again to pay for the taxi, it becomes one more reason to opt for the convenience of their own car.

Yet behind every frictionless payment is a web of agreements between different stakeholders. The sheer number of parties involved in multimodal travel makes negotiating this tangle the key obstacle to a truly scalable MaaS solution.

As a proposition, MaaS will win market share on the strength of its payment architecture across all transportation modes. This paper sets out the current candidates for MaaS's optimal payment model, the present difficulties in establishing MaaS as a credible challenger to car use, and how the industry should respond to these obstacles.

CHAPTER ONE:

# HOW CAN WE PAY FOR MAAS?

Broadly speaking, we can identify four distinct payment models with a track record of application in the field of public mobility.

Each will have its own benefits and drawbacks in the context of an integrated MaaS platform. These should be understood according to their impact on the demand side, as well as on supply-side stakeholders whose cooperation will make any MaaS proposition possible.

# 1. CLOSED-LOOP PREPAYMENT

Prepayment has been the default way of accessing public transport systems from their very beginnings. Buying a ticket before boarding a train or bus is a familiar experience to almost everyone.

In the 1990s, smart cards began to replace paper tickets as the preferred prepayment method in many jurisdictions.- Customers digitally load a chosen amount of money onto these cards to spend on travel. Alternatively, they might purchase and load a season ticket that allows unlimited travel on the network within a certain timeframe.

We can refer to this as a closed-loop payment system, as the values involved can only be redeemed in transactions between the customer and a single ecosystem. These card-centric solutions are limited in functionality and are proprietary to each transit implementation.

In a MaaS framework, customers could pay for each leg of a multimodal journey with a single smartcard. As an example, Los Angeles is looking to upgrade its Metro services through the TAPforce system. This account-based system integrates with the legacy closed-loop TAP card for use on rail and bus services across Los Angeles County, plus some bike hire options. The Metro authority hopes to extend the card's uses to cover ridesharing apps like Uber or Lyft, Electric Vehicle (EV) hire, plus other micromobility providers.

## *Benefits of closed-loop prepayment*

One major benefit to passengers of a prepayment model in MaaS is its familiarity. Transit users are already primed to pay in this way. This collective muscle memory reduces the need for public information campaigns about how to interact with the service.

For operators, a closed-loop system does not pose any credit risk. It facilitates easy, instant flows of cash paid directly for services yet to be rendered. It also allows them to forecast demand in the immediate term. For instance, if an operator saw a surge of balance top-ups in the days leading up to a large event, that would act as a clear signal to ramp up services.

Closed-loop card systems also allow for easy implementation of concessionary fares for certain groups, like older people, students and children. They also do not exclude the unbanked from access.

## *Drawbacks of closed-loop prepayment*

Other than the cost to the issuer of manufacturing the card, the negatives of a prepay model fall mostly on the demand side. Making access to travel dependent on a physical token like tickets or smartcards means that these objects themselves become valuable. If they are lost, stolen or damaged, the user suffers a blow to their ability to get around. This disproportionately hits the economically disadvantaged, who will endure a higher proportional cost to replace their passes.

Many closed-loop systems also create extra friction by requiring riders to top-up funds at ticket vending machines or offices.

Prepaid models also penalise end-users through a phenomenon known as breakage. This refers to the amount of value that ends up unredeemed on closed-loop systems like gift cards and travel passes. For instance, in 2018 it was estimated that **£321m** worth of unclaimed value is sitting on dormant Oyster cards. This represents a major cumulative loss of money for London's transport users, with lower-income passengers comparatively bearing the brunt.

Breakage is advantageous to transport operators, providing them with revenue without the corresponding pressure on services. Yet it also means that a prepaid payment model cannot entirely meet MaaS's promise to provide an inclusive mode of transport that does not discriminate on the basis of socioeconomic status.

While prepayment's downsides mainly land on users, operators are also hit by the costs of capital expenditure. Closed-loop payment systems typically require bespoke acceptance infrastructure. This is expensive to design and engineer, while also being liable to obsolescence.

# 2. OPEN-LOOP PAY AS YOU GO

A mature MaaS platform should be able to facilitate all travel patterns, from unscheduled trips to regular commutes. This is the basis of a pay as you go (PAYG) model. PAYG charges users only for the journeys they have undertaken, taking the money directly from their accounts. Transportation agencies have developed mechanisms that allow riders to pay for flat-fare transactions on a bus, as well as distance-based zones in the subway/tube.

While many transport networks advertise a PAYG model that takes payment via closed-loop cards, we will exclude them for the purpose of this paper. Our focus here is on the unmediated transactions made possible by bankcard technology and mobile devices enabled with near-field-communication (NFC).

We will refer to payments made using contactless debit and credit cards, or through virtual mobile wallets like Apple Pay, as open-loop cards. This means that their use is not limited to any specific transaction partner.

This payment model was first pioneered by Transport for London (TfL) in 2012 on its bus network. It is now in operation on many cities' public transport networks, from megacities like New York and Bangkok to smaller metropolises like Tbilisi in Georgia.

In a true MaaS context, open-loop cards would aggregate all the different legs of an end-to-end journey into a single payment. No notable use case currently exists for this. However, the Netherlands' planned nationwide OVpay system, which would allow open-loop payments on all the nation's bus, train and tram services, is the closest analogue in the pipeline.

It is possible to envision a MaaS service offering open-loop payment through a mobile payment method integrated into the journey planning app. This might either be charged per leg or as an aggregated total at the end of the journey.

## *Benefits of open-loop PAYG*

Open-loop payments have proved very popular among customers in the geographies they have been introduced to. In New York City, almost **40% of journeys** are now paid for using the Metropolitan Transit Authority's (MTA) OMNY open-loop service, despite the system still not having been fully rolled out across the network.

The tap-in action of a phone, debit card or QR code against a reader mimics that of the closed-loop systems passengers are already accustomed to. It also creates a virtually frictionless experience, removing any need to purchase and pre-load a travel pass. The items the passenger probably already has in their pocket – a contactless bank card and/or compatible smartphone – are all they need to travel.

In a MaaS context, this broadens the inclusivity of any potential platform. There would be no upfront cost or commitment that might deter hesitant customers or those with casual travel patterns.

Open-loop PAYG also offers benefits to service providers. They are spared the expense of designing, manufacturing and maintaining their own closed-loop cards, while still benefiting from that model's lack of credit risk.

Similarly, the acceptance infrastructure need only incorporate widely available NFC-enabled technologies. This reduces reliance on bespoke solutions and allows infrastructure to be reused, saving costs and creating economies of scale.

## *Drawbacks of open-loop PAYG*

The negatives of open-loop systems mainly fall on the supply side in the form of high implementation costs.

Facilitating open-loop payments requires re-engineering or replacing all fare collection infrastructure across transit networks. Open-loop systems typically require new hardware at the gates and buses, plus telecommunications and enhancements in the back office.

For most agencies, this will pose higher implementation costs than updating the functionality of a traditional closed-loop system. This is an expensive capital project that local treasuries may be reluctant to sign off on until existing infrastructure becomes obsolete.

In a true MaaS context, validating payments would most likely involve app-based release methods, issued to the user's device upon payment from a digital wallet. This would add friction and impact accessibility by requiring passengers to carry smartphones with specific apps downloaded.

To ensure frictionless journeys, all these physical elements would need to be interconnected in real-time to the transportation agency's back-office infrastructure, and then to international card networks.

The costs of open-loop PAYG for the operator also apply in the form of processing fees on transactions. Given the typically small transactions involved in PAYG journeys, in US jurisdictions this can cost the operator a not-insignificant percentage of each fare. The cumulative cost could complicate the business case for an all-inclusive MaaS proposition.

Open-loop systems also add a layer of complication to the process of offering concessionary fares to groups such as the elderly and disabled. While these can be easily assigned to bespoke, closed-loop cards, in most jurisdictions they are not commonly linked to customers' bank cards. The age verification credentials built into payment cards in some nations indicate how this challenge could eventually be overcome.

One current open-loop implementation, introduced by Stockholm's SL agency, requires customers to authenticate themselves to their banks and formally request discounts. However, TfL is currently pursuing an account-based solution to this problem that may soon provide a workable use case for rolling out open-loop concessions at scale.

Services operating entirely on an open-loop PAYG principle requires the rider to have access to some type of credit, debit or prepaid product. This will impact the unbanked population, creating an accessibility problem that only external actors like financial institutions can ameliorate.

# 3. SUBSCRIPTION

**A recent report has predicted that, by 2027, 65% of global MaaS revenue will be generated through subscriptions.**

This forecast envisions a flat, monthly fee as the dominant payment model for multi-modal travel. Users would be charged via direct debits or automatically-renewing mobile wallet payments, which would provide unlimited access to all modes of transport.

This is very similar to one option provided by MaaS Global's Whim app, first launched in Finland and currently available in other regions throughout Europe, plus Greater Tokyo. In Helsinki, Whim's 30-day season ticket incorporates bus, tram, commuter rail and ferry, plus reduced prices for e-Scooters, taxis and rental cars.

## *Benefits of subscription*

By consolidating access to all these transport modes together into a single, regular charge, subscriptions give customers peace of mind about the true costs of their travel. The bundle may also present cost savings for the user over ad hoc travel at the same frequency.

Subscriptions chime with demonstrated consumer preferences. Billions of consumers across the world commit to pay monthly to access services as disparate as entertainment, food and software. This has clear precedents in a mobility context in the form of season tickets. Subscription-based MaaS could be marketed as something both intriguingly new and reassuringly familiar.

For transit operators, widespread take-up of app-based subscriptions handled by third parties would remove much of the administrative burden of issuing tickets. The higher transaction values may also represent cashflow and accounting benefits.

## *Drawbacks of subscription*

A subscription may be consumers' payment method of choice for small monthly outlays like a Netflix account. Yet this may not necessarily be the case for larger, non-discretionary expenses. A monthly travel pass covering all modes of transport within a particular city or region could very feasibly exceed $150. This may be too large a commitment for curious or hesitant customers, particularly those on low incomes.

This is particularly pertinent in the post-pandemic era. The shift brought about by Covid-19 public health measures to location-independent work is looking increasingly permanent. As of 2022, **84%** of UK employees who had to work from home during the pandemic plan to continue dividing their time between their homes and their workplaces. This has an obvious knock-on effect on their transport patterns.

An all-in-one subscription at this price point will appeal most to those who are required, or choose, to travel to work every day. It may still represent a cost saving for more occasional transport users. But it will present MaaS platforms with an extra marketing challenge in justifying this value.

For providers of individual services in the MaaS chain, the number of people buying bundled subscriptions does not provide a useful forecast of demand.

For the MaaS platform to offer a competitive aggregated charge, they may have to ask the various service providers to accept a lower fare-per-journey than they would normally do. This can limit the viability of MaaS projects.

# 4. POST-PAYMENT

Perhaps the least-spotted payment model in public transportation is invoicing in account-based ticketing arrears. However, this is not unheard of in the world of B2B mobility.

The most pertinent example is the accounts that companies will often hold with favoured minicab firms, where employees are given a code linked to that account to quote. The journeys undertaken during this period will then be itemised and their cost invoiced to that company's account at the end of a given period.

This is not a model commonly employed in the current batch of nascent MaaS products.

## *Benefits of post-payment*

For customers, a post-payment model for MaaS would offer the least friction. Passengers would not even need to think about the cost of their journeys until long after they are complete.

This may provide a psychological incentive to travel frequently. More intense travel patterns would have obvious positive financial implications for MaaS platforms and transit providers.


## *Drawbacks of post-payment*

The biggest obstacle to a viable mass-market post-payment model for MaaS is the credit risk it poses to the various operators. This risk is exacerbated by the psychological incentives described above that a post-pay model presents.

Transit agencies will need to ensure cards/devices are validated for authenticity at the point of entry and then route transactions in real-time to the card issuer. This ensures payments are authorised and minimises transaction risk for future journeys.

The transit agency will also need to manually recover outstanding debts with the transit rider. This is known as transit debt recovery, and is a prerequisite for granting riders access to future rides.

With cost aggregation already whittling down providers' margins, even a small proportion of frequent, insolvent customers can collapse the MaaS business model.

CHAPTER TWO:

# WHAT CHALLENGES DOES MAAS FACE?

MaaS is an ambitious proposal. The path to overturning a century of private car dominance will always be beset with challenges. Finding a successful payment model ranks high among them.

This chapter will focus on the biggest obstacles and potential pitfalls that successful MaaS propositions must solve for.

# 1 INTEROPERABILITY

We can think of MaaS as a glue joining up disparate modes of transport into a single offering. In payment terms, this requires ensuring that money flows so that each correct recipient always get paid.

**A huge difficulty in creating a unified payment experience lies in the variations between transport modes' pre-existing payment architectures.**

A local bus service may have a very different way of taking payments than Uber will maintain for their bike hire service.

A MaaS platform must mediate between them to make sure they each get their cut. This means acting as a clearing house to validate each journey leg and automatically divert fares to the right providers. The legal and contractual frameworks required impose another layer of complication on taking a MaaS product to market.

Interoperability problems apply between geographical jurisdictions as well as between providers. For MaaS to present an attractive alternative to car ownership, it should work at the regional level, rather than only within a city or town. MaaS leaders should view themselves as trailblazers in the creation of Smart Corridors – economically-integrated regions through which people can roam freely thanks to data-driven mobility solutions.

This is particularly salient in the densely populated areas of Europe within the visa-free Schengen Zone, where travel between cities, states and across national borders is commonplace. In North America, multi-state (and multinational) regions like the Pacific Northwest and the New York City metropolitan area are fertile ground for this flavour of innovation.

The problem comes in setting standards for fare collection that are acceptable to transit authorities and private providers in each municipality, federal state or nation. If one city has rolled out open-loop PAYG readers across its network, while another can only process its own closed-loop smartcards, inelegant workarounds must be found that will make the user experience that bit less seamless.

Clearing complications can arise when transportation agencies within a corridor use multiple financial institutions to authorise and capture payments. For transactions to be efficiently cleared through a common financial institution, protocols must be standardised for both open and closed loop payments.

When operating in multiple jurisdictions, MaaS platforms must also harmonise different tax codes when setting integrated fares. This can be very complicated to handle at scale.

There are reasons for optimism here. Passengers in Finland's capital, Helsinki, can now buy app-based, multi-modal transport tickets that are also valid in Tallinn, the Estonian capital only a short distance away across the Baltic Sea. This marks a resolution of a previous dispute over cross-border ticket sales that was referred to the Finnish Competition and Consumer Authority in 2020. Consultations on a MaaS project connecting the three Benelux nations are also underway.

# 2. DISPUTES

Transport services don't always run the way they should. Trains get held up, buses break down, taxis fail to arrive. When this happens, individual transport operators can easily reimburse passengers. This is a straightforward process in conventional transit. But it is orders of magnitude more complex in a MaaS context.

As an edge case, let's imagine a multi-modal journey to an airport that goes wrong at every point. A MaaS journey planner instructs a customer to hire an e-bike to get to a bus stop, where they catch a bus to the central train station to board a service to the airport. However, battery issues on the e-bike slow the customer down, causing them to miss their planned bus. The next one then arrives five minutes late, leaving them late for the train. Another train is scheduled to set off shortly after but is cancelled. Thanks to this chain of service failures, the passenger misses their flight, yet is still charged an aggregated fare.

The customer has a legitimate case for a refund here. But when their poor experience has been sold to them as one journey, the question emerges of who should be held liable. Is it the e-bike service who didn't maintain their fleet properly, or the bus operator for their vehicle's late arrival? Should the train company foot the bill on account of the cancelled service? Or maybe the MaaS platform is at fault for recommending that journey in the first place. If all parties are on the hook, how is that cost then divided between them?

Arbitrating on a case-by-case basis is not an option for a MaaS product with ambitions to scale. That means any such platform will require all parties to sign up to an agreed protocol for what to do when a customer disputes a charge. This can only be arrived at by extensive negotiation. This may limit buy-in among the patchwork of service providers upon whose participation a truly frictionless mobility solution depends.

# 3. PRIVACY AND SECURITY

All potential MaaS models we have discussed work by tracking customers' movements (and their payment tokens) across different transport modes. That requires Application Programming Interfaces (APIs) authorised to collect a range of data types, from geolocation to payment credentials.

MaaS platforms have a responsibility to store only the bare minimum of personal data needed to process and charge trips. They must inform their customers about the uses of their data. Compliance with local data regulation like GDPR is obviously essential.

When it comes to processing and managing payment data for open loop cards, MaaS platforms must strictly adhere to PCI-DSS standards. These codes help agencies properly and securely store or transmit card information. PCI compliance guards against fraudulent activity and data breaches by keeping the cardholder's sensitive financial information secure.

With countless successful apps out there with similar responsibilities, these aspects of privacy should not represent an insurmountable challenge. The bigger problem is ensuring rider anonymity in a system that relies on digital payments made from personal bank accounts. The multi-stakeholder nature of MaaS once again compounds this issue.

For all parts of the multimodal chain to slot together, the MaaS platform will need to share some data on each individual user with its partner mobility providers, both public and private. This requires a centrally agreed standard for data sharing that each party sees as in its interests. However, data policy may not be front of mind for transport providers who rely on legacy payment systems.

Even more important than data privacy is data security. Any app that can take customers' payments becomes the custodian of highly sensitive data. A scaled-up, well-adopted MaaS app will present a valuable target for cybercriminals. This means they must have particularly stringent measures in place to protect their users' payment credentials against hacking attacks.

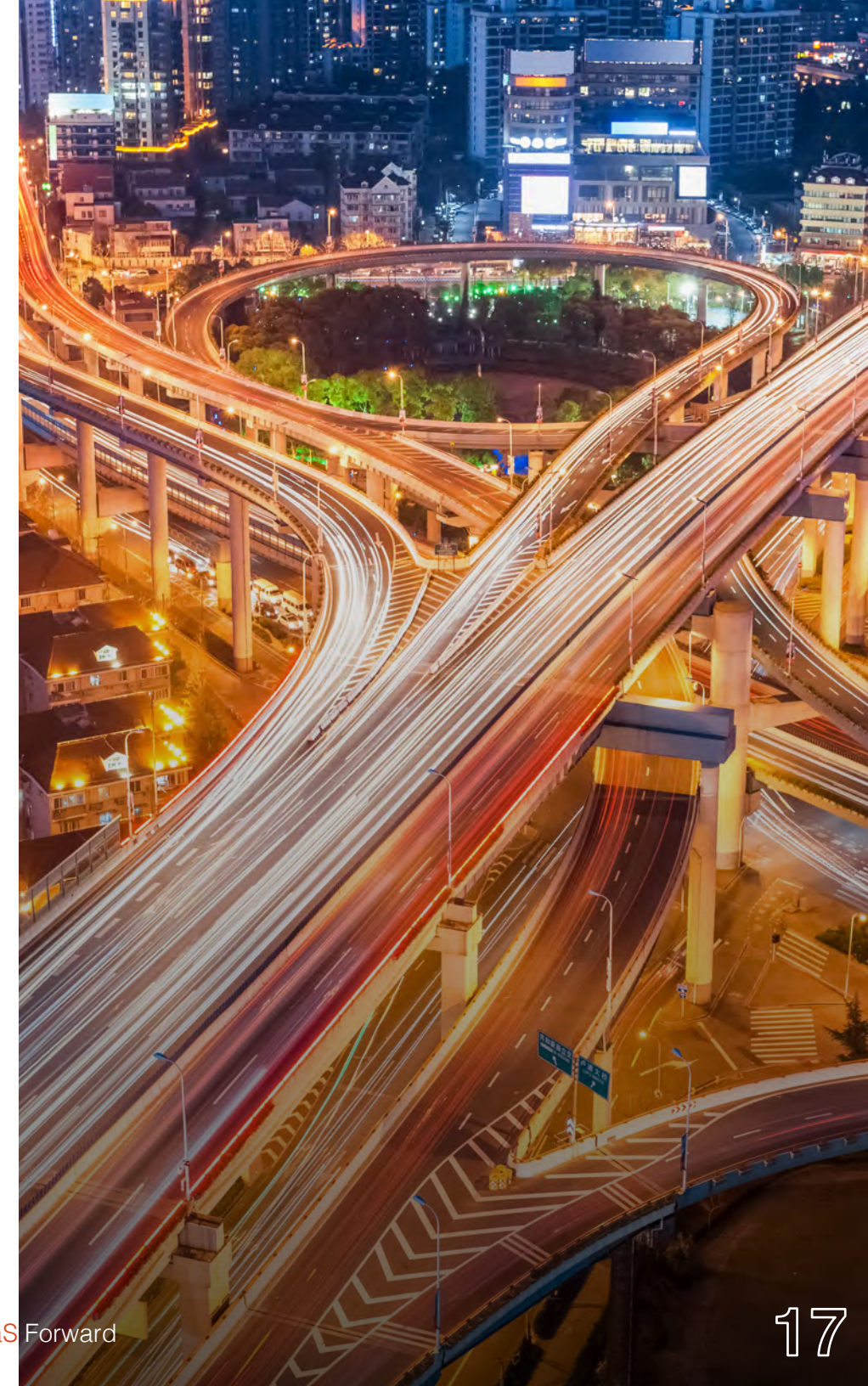
What's more, there can be no weak links. MaaS functions as a data ecosystem, and every stakeholder involved must adopt similarly watertight cybersecurity policies. The nightmare scenario for any MaaS platform is a data breach that spills its users' payment details out onto the public domain. This makes investment into cybersecurity a key criterion for participation in a MaaS project, potentially limiting its appeal to prospective partners.

CHAPTER THREE:

# HOW CAN MAAS MOVE FORWARD?

This lattice of limiting factors has, so far, kept MaaS a relatively niche concern. To grow, MaaS leaders must collaborate with the wider payments industry in order to answer these challenges.

In this chapter, we will explore two viable avenues for developing MaaS payment solutions that solve for these challenges.



# 1. HARMONISE DATA MODELS

Making a wealth of travel modes available through one app will require a lot of data sharing between multiple stakeholders. This cannot happen without some agreed standards that ensure all data can be processed and read by all parties.

Practically, this will involve evolving what the Open & Agile Smart Cities (OASC) network has defined as a Minimal Interoperability Mechanism (MIM) - the set of practical capabilities that will guarantee data compatibility.

In a payments context, this shared data model may consist of rules for what types of payment credentials can be stored and exchanged between participants. These standards would then enable the creation of custom APIs that convert this data into a frictionless payment experience for the end user.

**For MaaS schemes to be rolled out and scaled up at speed globally, this data model should be centrally and freely available to all.**

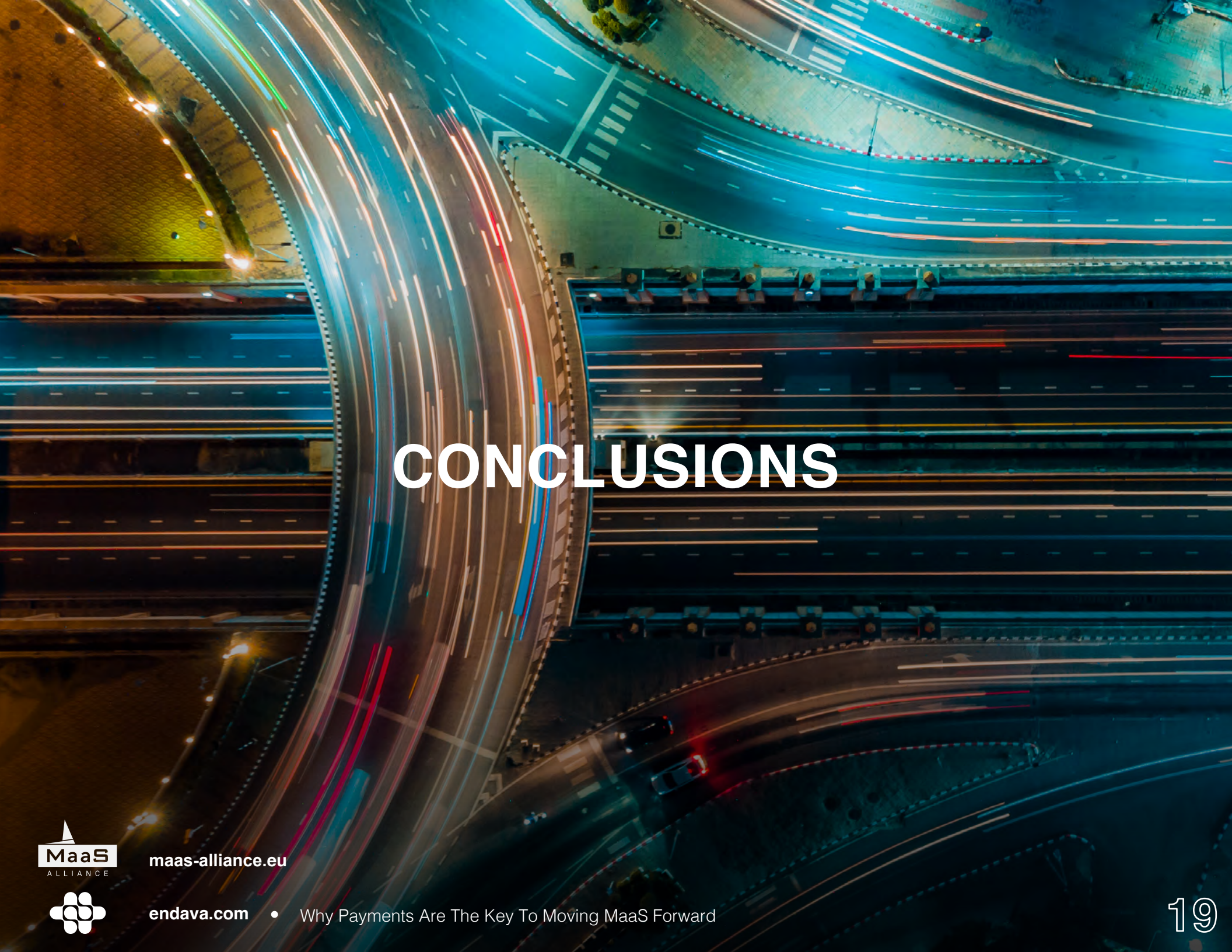
# 2. CREATE A REFERENCE ARCHITECTURE

While many mobility products have been brought to market, the MaaS sector has still failed to produce a high-profile 'killer app' that offers a seamless payments experience. This may only be possible with an easily replicable schema for how the system's generic components should be integrated.

A reference architecture could serve as a template for functional payment information exchange between the ecosystem's stakeholders. These currently include jurisdictional authorities, public transport operators, ride-hailing services, micromobility providers, card payment systems and the end user, with the MaaS app serving as a data broker. In time, this array of parties may well expand to include hotels, airlines and insurers, plus retail and entertainment providers.

This model would outline how the system would achieve its basic purpose: solving for a frictionless payment experience across a multimodal journey. The reference architecture should incorporate the types of data to be exchanged, the standards for sharing them, the APIs facilitating these shares, the protocol for settling disputes and the digital infrastructure on which it all happens.

The power of such a model should not be understated. A viable reference architecture for payments in MaaS, especially if buttressed by a proof of concept, would help entrepreneurs bring MaaS solutions to market at greater speed, in every geography.



# CONCLUSIONS


## The key to unlocking MaaS's potential as a rival to car ownership is standardisation.

Currently, no consensus exists as to the appropriate way to take payments for MaaS, let alone for how disputes and chargebacks might be handled. This means that a patchwork of MaaS services now exist, each offering different features and experiences.

Until a standard set of protocols can be drawn up for the payment model, data model and system architecture behind an integrated, multimodal journey, MaaS will struggle to define its identity to consumers.

This invites the question of who will set these standards. MaaS entrepreneurs may reasonably see themselves as in the mobility business, rather than the payments space. Lacking either the domain expertise or the will to define the right mechanisms, MaaS natives may defer to their counterparts in the payments world.

Building ecosystems of interoperability that allow competitors to cooperate is the bread and butter of international payment schemes like Visa or Mastercard. After all, these vast systems run on stress-tested reference architectures and common data models, with well-established protocols for resolving disputed charges. When it comes to validating the two credentials at the heart of every leg of every journey – who is paying and whether they can pay – it is hard to think who would be better placed to do so than the big card networks.

Whoever steps up to take the initiative will be seizing a major opportunity. By putting their services at the core of a feasible blueprint for future travel patterns, card issuers and payment gateway providers can secure enduring market share in transport and mobility.

# ABOUT THE AUTHORS..

## NICK TELFORD-REED

Nick is a passionate and award-winning technology innovator with a commitment to generating great customer experiences. For nearly two decades, he has worked to develop compelling visions of the future, and to build strategies to help businesses achieve their goals.

Beginning his career in start-ups, Nick has led engineering and product teams through divestments and acquisitions, has crossed the chasm from challenger organisation to incumbent world leader and has consistently built process and capability on-shore, near-shore and off-shore with the aim of delivering agile technology and product organisations. In 2018, his team won Best Mobile Payment Initiative at the Cards and Payments Awards.

At the World Wide Web Consortium, Nick led a global initiative to develop a common standard for making and taking payments over the open web, working with stakeholders like Google, Microsoft, Apple, Facebook, Alibaba, Visa, and Mastercard.

## BRIAN ESTEP

Counter Narcotics Officer (Veteran) to Software Engineer/Architect to Business Leader. That's the professional path I have taken to date. It's been a wonderful and rewarding road and I am forever grateful for all the help I've had along the way. The key to success for me has always been empowering others to succeed, whether my clients, my team, my peers or my leaders.

That continues to be my guiding principle. As global Mobility leader at Endava, my biggest reward is seeing you succeed in your Digital and Technology goals.

I love this industry for how it leverages technology to inclusively, accessibly and sustainably improve people's lives.

# ABOUT ENDAVA..

We deliver next-gen tech solutions that empower clients across a dozen industries to unlock new value. The specialist consultants, strategists and engineers in our Mobility team help automotive, logistics, aviation and public transport leaders deliver market-leading digital experiences.

Let's talk about how we can help you seize the most important opportunities for growth.

*Get in touch at contactus@endava.com*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