



Mobility as a Service

A New Ambition for Public
Transport Authorities

Discussion Paper

184
Roundtable

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Introduction

The concept of Mobility as a Service (MaaS) emerged in Finland some years ago, as a by-product of the new mobility services, themselves resulting from the digital revolution. MaaS is based on the idea of accessing via a single medium – a smartphone – a variety of mobility services, including public transport (PT) and shared mobility services. The concept underlying MaaS is that, in the near future, urban mobility has to become fully multimodal in order to reduce the external costs of urban mobility. Access to a wide range of mobility services will be coordinated or even integrated between various mobility service providers; but due to the variety of urban contexts, MaaS has many different meanings and variants. In many cities, MaaS remains a fuzzy concept, a tagline, having, until now, few impacts on mobility patterns.

In the second quarter of 2019, two reports on the future development of MaaS were published by key stakeholders involved in the area of urban mobility: the International Association of Public Transport (UITP, 2019) and the European Metropolitan Transport Authorities (EMTA, 2019). In September 2019, the Centre on Regulation in Europe (CERRE) published a report on MaaS and the regulatory challenges of shared mobility (Crozet, Santos and Coldefy, 2019)¹. All those reports underline the fact that MaaS is a promising innovation, but still in its infancy.

MaaS must not be developed for its own sake, but for public urban mobility policies to achieve their main objectives. Among the Sustainable Development Goals (SDG) agreed upon by the United Nations General Assembly (United Nations, 2019), three of them are especially relevant to urban mobility: SDG11, which aims at making cities inclusive, safe, resilient and sustainable; SDG13, which aims to combat climate change; and SDG3, which aims to ensure healthy lives and promote well-being for all ages. Public transport is one of the major levers for mobility to contribute to making cities safer, more resilient, more inclusive and better able to face the risks of climate change.

The transition to maturity of MaaS, therefore, requires clarification of the place that public transport must occupy in the range of mobility services, and the future role of Public Transport Authorities (PTAs).

The first part of this paper explains why PT has been ignored by the new mobility providers and explores possibilities for the role of PT in a MaaS ecosystem, in relation to the new mobility services. Originally, shared mobility was often presented as a substitute for PT, but things are changing, and this Roundtable is concrete evidence that the new mobility services are complementary to PT. Consequently, PTAs are now at the heart of a more concrete and efficient implementation of MaaS.

The second part of this paper details the new roles of PTAs. In order to address the issues of MaaS, the PTAs have to nourish new ambitions and to become Multimodal Mobility Authorities (MMA). They must not only manage PT but also seize the opportunities offered by the digital revolution to propose a wider spectrum of mobility services. However, in order to achieve the generic goal of sustainable urban mobility, the objective can no longer be to develop all the vectors of urban mobility.

Digital revolution and MaaS: What is the future role for public transport?

Bus, tram, underground and suburban rail networks can be set up by public or private initiatives. But from an urban economics point of view, PT falls into the broader category of public goods. As a network industry, PT is characterised by increasing returns. It, therefore, features natural monopolies, or more specifically local monopolies requiring government policy upstream from service provision to determine routes, types of service, frequency and other details. Such public policy is particularly necessary because of the social considerations involved: PT is often the only reliable means of medium-distance transport for those on low incomes. PT is also necessary for environmental reasons. PT does less harm per passenger, or per passenger-kilometre, than private cars.

Consequently, in urban areas, public policies have long sought to develop public transport on the one hand, and on the other to reduce the market share of the private car. Faced with this double objective, the development of new mobility services has raised many hopes. Will the digital revolution, which is already manifesting itself in applications dedicated to mobility, and which will soon supply autonomous vehicles, not completely change the situation?

The most radical transformation, offered today by digital platforms and tomorrow by autonomous vehicles, is more collective use of cars. Given that increasing the load factor of cars is one approach to reducing the external costs of urban mobility, then the sharing of vehicles via digital platforms is an exciting solution. But shared mobility is a challenge for PT because it is based on new business models mixing private and public initiatives, private and public financing, private and public ownership of vehicles. The current business model of PT depends heavily on public subsidies. PT is expensive and the fares charged to users generally cover only a small share of the overall cost. Will it be different, or not, with the development of shared mobility?

Studies conducted by the International Transport Forum in Lisbon, Dublin, Auckland or Helsinki, have shown that shared mobility can greatly reduce congestion and pollution, and even travel times, provided this shared mobility primarily replaces individual vehicles and even some PT, such as buses. But some doubts remain about the capacity of shared mobility to become a substitute for PT. Shared mobility is probably more a complement for public transit than a pure substitute - but even as a complement, it is a challenge for PT. The next section considers the conditions under which new mobility services could be a substitute for traditional PT in the future and the scenario where they complement each other.

New mobility services as a substitute for public transport?

Is shared mobility not a way to rethink the organisation of public transport? To finally provide commuters with seamless mobility? This prospect was revived by the announcement of the imminent arrival on the market of autonomous cars, capable of transporting, without a driver, more passengers on any urban route (see Box 1).

The digital revolution and the dream of a “seamless” mobility

The digital revolution seems able to offer new options, both for commuters and for mobility providers. Door-to-door mobility would become accessible to everyone, even in the dead of night. Those who advocate such innovations explain that digitisation is able to reduce traffic congestion dramatically, thus opening up more space for pedestrians and cyclists. Digital technology can contribute to implementing MaaS as a new deal for urban mobility, as it allows for inter-modality by going beyond boundaries between modes and organisations. Digitisation is also a way for private actors to contribute to public policy in the domain of urban mobility.

This new deal in urban mobility has indeed manifested itself through the appearance of new mobility services offered to residents of large cities by private operators. These provide residents with a new service that can be booked via a digital application. UBER is the best-known example of these new services, but it is far from alone. Other companies, such as Lyft or Didi, have also developed, in a few years, a global network that has changed habits in the taxi profession. Today, these three companies have multi-billion dollar sales and have been listed, or are considering listing. Note, however, that companies like UBER or Lyft have yet to make a profit. Their activity continues thanks to successive fundraisers. The same is true for most companies that have launched shared mobility services. Their business models are very fragile, bankruptcies are numerous and market exits are almost as numerous as entries. Many examples illustrate the difficulties encountered by different kinds of shared mobility services.

- Car sharing (Autolib, Zipcar, etc.) remains a niche activity, aimed at an affluent and qualified population. Its impact on motorisation rates and car traffic is very low; even negative (Clewlow and Mishra, 2017; Erhardt et al., 2019).
- Motorbikes, bicycles and free-floating scooters, after success in popularity, quickly encounter problems of vandalism and co-existing with other users of public space. At best, it is a niche activity (Nikitas, 2019).
- Carpooling has shown its possibilities for long distance with Blablacar, the profitability of which remains uncertain. For the short distance, however, it is sometimes necessary to subsidise drivers and passengers! As B2C services are struggling to develop, Karos or Klaxit companies fall back on corporate travel plans (B2B).

The fragility of the business models of shared mobility is a puzzle for PTAs. For instance, up to what extent must they support those private initiatives? It is particularly an issue when the new services are directly competing with public supply.

It is also a puzzle for the new entrants. The main difficulty is that of critical mass. To survive, they must quickly find customers so that the fleet of vehicles is used intensively. However, this objective is difficult to achieve for many reasons.

The first is that users have to pay for the service. The business models of the new mobility services fall into the B2C category. This is why they were originally so attractive. While public transport needs significant public subsidies, the new mobility providers seemed capable of revolutionising the sector at no cost to the community.

If there are fewer users than expected, it is also because they have other options for getting around, foremost among which is the private car. In many cities, especially outside the hyper-centre, it remains the most used means of transport. However, once you have an automobile, its marginal cost is relatively low. Thus, in France today the total cost of a journey by private car is EUR 0.25 to EUR 0.30 per kilometre, but in this set, the fuel accounts for only EUR 0.06 or EUR 0.07. However, a taxi ride costs around EUR 2.5

per kilometre and, in Paris, a trip by electric scooter costs EUR 1 or EUR 2 per kilometre (Crozet, Santos and Coldefy, 2019; pp. 43).

The other problem is that of competition between modes of transport for the uses of space. The free-floating, self-service bicycle systems (Ofo, Mobibike, etc.) seemed to have a bright future. In a few months, they flourished in hundreds of cities but they very often disappeared almost as quickly because of various problems (vandalism, premature wear of vehicles, financial losses...), but also because the authorities in charge of the road network very quickly wanted to regulate the use of public space. In many cases, they often set up a public self-service bicycle system themselves.

More generally, the new entrants are creating a new deal in the relation between the PTA and the PT operating company. Instead of a single contract between two partners, the development of MaaS is leading to different contracts with different operators potentially in competition. How to define the optimal market share of each operator? It depends on the capability of new entrants to reach critical mass.

How to reach the critical mass?

The condition for success for new mobility services is to reach critical mass. When it has been achieved, they can consider replacing public transport. This has been shown by the International Transport Forum, in studies carried out in several cities (Lisbon, Helsinki, Dublin, Auckland, etc.). They wanted to see to what extent carpooling could replace public transport and the private car. Table 1 summarises the result of this study in the specific case of the city of Lyon.

Table 1. Shared-mobility simulations: scenarios tested in Lyon

Scenario number	Bus	Car	Rail, LRT	Shared mobility modes
1	100% Replacement	100% of trips replaced	Keep	Shared taxi, taxi-bus and carpooling
2	100% Replacement	20% of trips replaced	Keep	Shared taxi, taxi-bus and carpooling
3	Keep trips where Bus with headway <5 min	20% of trips replaced	Keep	Shared taxi, taxi-bus and carpooling
4	Keep	100% of trips replaced that prefer carpooling. carpooling corridors	Keep	Carpooling
5	100% Replacement	Low Emissions Zone (LEZ) with all private car traffic constrained within LEZ, 20% of car users affected by LEZ restrictions use the shared modes from the origin	Keep	Shared taxi, taxi-bus and carpooling

Source: ITF (2020).

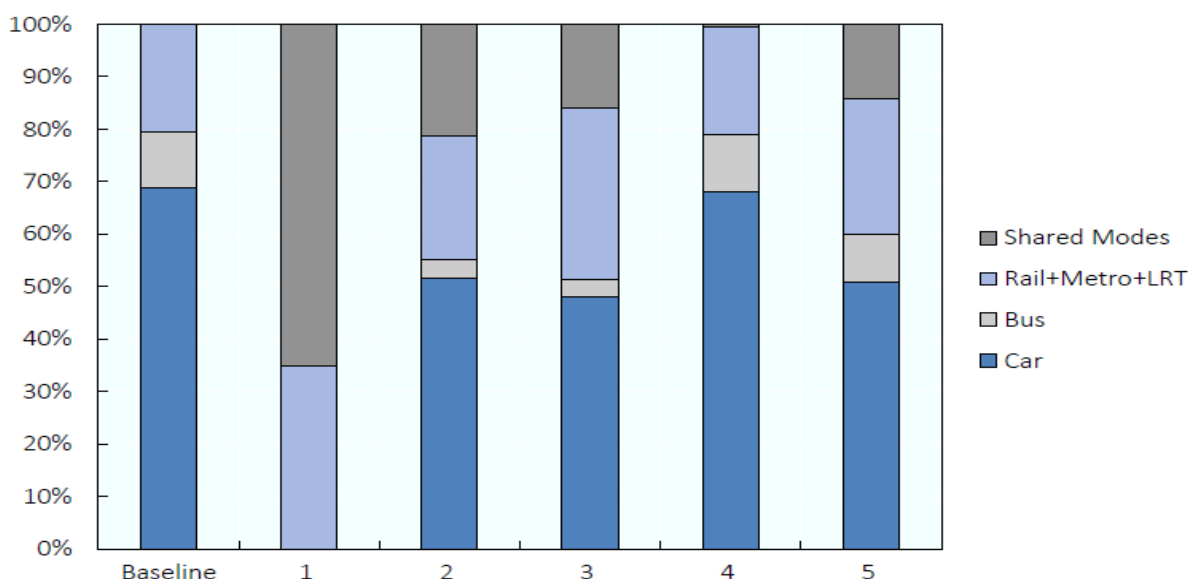
Five scenarios were tested, all retaining heavy public transport such as the train, metro and trams. Going further, the first two scenarios envisage the complete abolition of bus lines and even the private car in scenario 1. In scenario 2, the buses are also fully replaced but only 20% of trips by car are transferred to shared taxi, taxi-buses and carpooling.

The results are presented in Figure 1. With scenario 1, shared mobility effectively presents itself as a powerful substitute for both buses and the private car: it captures more than two-thirds of motorised trips.

In scenario 2, however, it attracts only 20% of traffic because as long as travel by private car is possible, the latter retains a significant market share (50%). Such a result informs us about the conditions necessary for an effective substitution of public transport by shared mobility.

The first concerns the acceptability of the measure. In scenario 1, shared mobility develops because there is no other option even though it can involve significant costs for commuters (uncertainty of travel time, waiting, discomfort, etc.). It is therefore a very restrictive measure, which could be considered as a deterioration in the quality of mobility services. There is a great risk that the result could be far removed from the seamless mobility mentioned above unless the information and ticketing system is efficient enough to make the constraints of shared mobility acceptable. This is the challenge of MaaS! It is not enough to offer new mobility services; they must be integrated into a global offer and demonstrate their usefulness.

Figure 1. Modal split in different scenarios



Source: ITF (2020).

The second condition follows from the first. When there is a choice of multiple mobility services, commuters opt for the one with the lowest overall cost. However, shared mobility involves specific costs linked to the great diversity of itineraries and personal activity programmes. The result, widely observed in the cities where carpooling is currently offered, is that while shared mobility is only one option among others, its market share remains very modest.

We come to a major observation: multimodality is often presented as a solution, whereas for commuters it is, primarily, a problem because of the change in the mode of transport and the uncertainty that can accompany it. In order to take account of these hidden costs of multimodality, Reck and Axhausen (2019) developed a case study using block-group level origin-destination commuting trip information. They constructed public transport travel times, including access/egress walking times and intermediate wait times, and then constructed first- and last-mile ridesharing car trips from the origin to the first public transport station used, and from the last public transport station to the destination. They find that a first and last mile ridesourcing feeder service leads to average travel time savings of 15.7 minutes. However, transfer penalties of five, ten and 15 minutes diminish travel time savings by 54%, 82% and 95%,

respectively. The relevance of these services is therefore limited. This is why it is more relevant, in the medium term, to consider the new mobility services as a complement to public transport.

Box 1. The autonomous vehicle, which services, which horizons?

The digitisation of the economy has changed many business models. The proliferation of digital devices and platforms enable almost everybody to be a part of this revolution. At each stage of this revolution, new business models were born.

The first wave of the digital revolution appeared with the spread of the internet and the possibility of exchanging, at virtually zero cost, digitised data (text, image, music, film, etc.). Information has become the basis of an important business (Google, Facebook) and the entertainment industry has been profoundly transformed (books, music, films ...).

The second wave of the digital revolution involved the sale of services such as airline tickets, vacation stays and hotel rooms. Carpool services like Blablacar fall into this category called "transaction platforms" which are only intermediaries between service providers and seekers. It is different when new mobility services (carsharing, bike-sharing) are offered via a platform set up by the service provider. The latter requires that not only the platform, but also the service, must be a success with its customers. This is the origin of the fragility of business models based on a B2C logic.

The coming third wave of the digital revolution is the Internet of Things (IoT), which includes autonomous vehicles. It is an old idea. The EU funded related research in 1987 through a research programme called Prometheus. In 1995, a driverless car was tested on German motorways. But interest ignited when, in the years 2007-2009, Uber, then Google and others announced that they were going to invest significant sums in such projects. However, putting aside the technical prowess represented by the autonomous vehicle, it is necessary to question the services it could provide, and with what impact for the community.

The first type of service, which explains UBER's interest, is to reduce driving costs and therefore make the services of future "robo-taxis" more affordable. But it is important to remember that the latter only have a real interest if they are shared. Multiplying robot taxis with a single passenger on board would only increase traffic congestion.

It would be different if they were autonomous minibuses that could replace private vehicles (see the simulation for Lyon above) or traditional buses (see the simulation for the Paris region below). If such a service could be set up, with the public subsidies generally allocated to public transport, it would be possible to envisage a sharp reduction in the ownership of cars by households. For this reason, car manufacturers are considering the possibility of seeing the value chain totally transformed in their sector. They should then transform themselves into vehicle suppliers to mobility providers, or even become service providers themselves. Attempts have been made in this direction. For the time being, they face the fragility of the business models mentioned above.

As for autonomous vehicles, although significant progress has been made, hopes for rapid commercialisation have been dashed. In November 2018, John Krafcik, head of Waymo, the self-driving car unit of Google parent company Alphabet said that decades would be necessary before autonomous cars (level 5) are widespread on the roads, and even then, they would not be able to drive themselves in certain conditions.

New mobility services as a complement to public transport

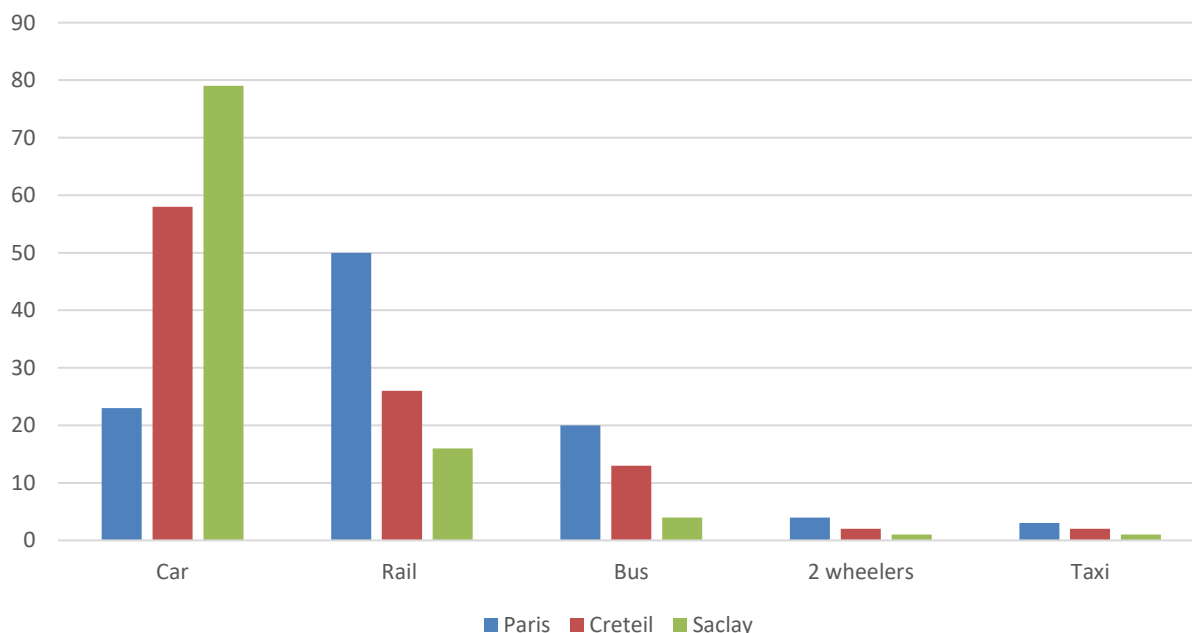
Public transport is, and will remain in the coming years, the backbone of urban mobility. In the distant future, the new mobility services based on autonomous vehicles should therefore not be seen as competitors of public transport, but as an opportunity to enrich the range of services offered to the population. With a near horizon, shared mobility already has an important role to play in complementing public transport by supplying first- and last-mile connectivity, and by serving areas where public transport is not financially viable. In addition, in partnership with local authorities, shared mobility providers may have a role in supplying services to the elderly, disabled, or those on low incomes. On a more distant horizon, the arrival of autonomous vehicles could further change the modal roles in a MaaS ecosystem.

Public transport and the distant horizon of the autonomous vehicle

Let us start by placing ourselves on a distant horizon, that of autonomous vehicles. Could their entering into general circulation translate into a paradigm shift?

An answer to this question was given for the Paris region by a case study (Hanouille and Nadal, 2019) that considered different types of autonomous vehicle services, subsidised and integrated into the public transport offer (robo-taxis, shared-vans). The objective of this research was to explore a variety of situations. To this end, it targeted three zones of varying densities: the city of Paris (21 000 inhabitants/km²), the Créteil zone (6 000 inhabitants/km²) in the inner suburbs and the Saclay zone (1 700 inhabitants/km²) in the outer suburbs. As Figure 2 shows the contrast in modal shares of trips. Public transport (rail and bus) attracts 70% of traffic in Paris, but less than 40% in Créteil and less than 20% in Saclay. Two wheels and taxis occupy a marginal place.

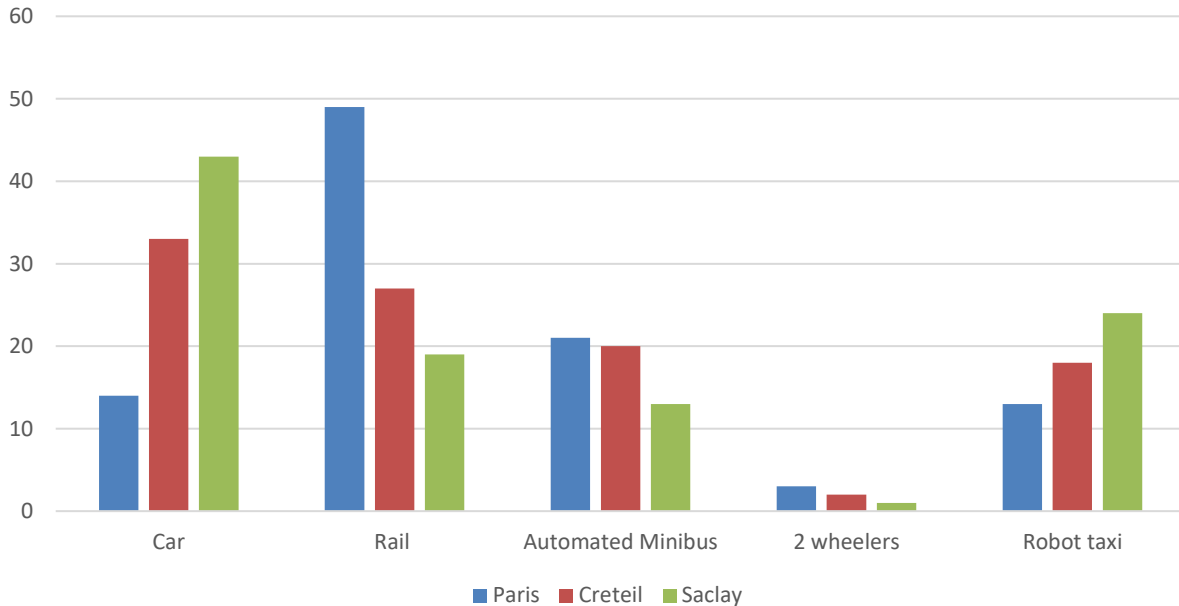
Figure 2. Modal share in three different subparts of Ile-de-France



Source: Hanouille and Nadal (2019).

What would happen in these different zones after 15 years of deployment of different autonomous vehicle services? The answer is summarised in Figure 3.

Figure 3. T+15: Modal share in three different subparts of Ile-de-France



Source: Hanouille and Nadal (2019).

The results of this case study should be viewed with caution. They are not trying to predict the future but to help us understand the conditions under which the autonomous vehicle could be included in the range of public transport offers.

- The first condition is that it will take time for things to change. Behaviours are changing slowly; the new autonomous bus or robot-taxi services will need several years to be operational.
- The second condition is that the supply of new services must be diversified and adapted to very varied travel demands, especially in sparsely populated areas. For this, public subsidies are necessary, sometimes in significant proportions.
- The third is that the different services must be integrated for the load shifts to be acceptable. Rail transport, in particular, will only retain its market share if “mass feeders” supply it, for example, shuttle buses running on autonomous minibuses.
- The fourth condition is that the information, ticketing and pricing system must be very efficient in order to make multimodality attractive. It is a central objective of MaaS.

A near horizon for MaaS?

This last remark helps us to understand that even if the horizon of the autonomous vehicle is far off, this is not the case for MaaS. It is expected in the near future to initiate the transition to multimodality. This is particularly the case for the new mobility services that already exist and can already become complements to public transport, such as ride hailing services, which can offer an example of how new mobility can be adopted into the mobility provision of a city or region.

For instance, PTAs in the US and Canada are exploring ways in which they can partner with new mobility providers to provide first mile/last mile rides, especially in areas not well-served by public transport. Ride hailing is also an option to offer transport-on-demand for the elderly and the disabled (McMahon, 2018). Uber is running an on-demand paratransit pilot scheme with the Massachusetts Bay Transit Authority (Uber, 2019) and rides from Innisfil, Ontario, a small town about an hour from Toronto, to key destinations such as the town hall and the employment centre (Schaller, 2018). The City of Arlington, Texas, has also collaborated with Via to provide on-demand trips in a zone within the city (Schaller, 2018).

Ride hailing can also serve as a complementary mode for commuter rail services. Clewlow and Mishra (2017) observed an average net increase of 3% in use of rail in Boston, Chicago, Los Angeles, New York, San Francisco/Bay Area, Seattle, and Washington, D.C, when ride hailing was used to reach rail stations. Hence, some commuters can switch from the private car to public transport by using first- and last-mile connections to public transport stations (Erhardt et al., 2019; p. 1). In London, a night service running between 12:30 am and 5:30 am on weekends was introduced along the Central and Victoria underground lines in August 2016.

Murphy, Karner and Accuardi (2019) report the lessons from Pinellas County, Florida, which has the longest operating ridesourcing partnership (with Uber) to provide subsidised first- and last-mile connections to public transport stops, known as PSTA Direct Connect. One of their conclusions is that, while successful at cutting costs overall, there were a number of other costs (including per-ride reimbursements to service providers, transfer discounts provided to riders, among others) that are likely to “limit scalability beyond very low performing routes” (p. 3).

In areas where public transport is not profitable or where demand is so sporadic that frequency can only be low, ridesourcing can also provide services to the elderly, and the disabled, and if the local authority pays for or subsidises the trips, to lower-income groups without access to private or public transport. Laguna Beach, California, for example, has partnered with Uber to supplement public transport for the elderly and the disabled and the public transport agency in Las Vegas, Nevada, has partnered with Lyft, to provide on-demand paratransit services (Schaller, 2018).

Finally, whether the horizon is far or near, new mobility services can only develop if they benefit from public subsidies. This will be the case in a few years (decades?) for autonomous vehicles. This is already the case for the services offered as targeted supplements to public transport. This means that the business models of the new mobility providers cannot be based on a business-to-customer (B2C) principle. This was the hypothesis adopted in the logic of substitution for public transport. But in a situation of complementarity, business models must move towards business-to-government (B2G). It is no coincidence that Uber became a member of the International Union of Public Transport (UITP), an association that brings together companies, private or public, operating public transport networks.

The transition from B2C to B2G allows us to understand why PTAs are now at the heart of the implementation of MaaS. Since the end-user is the main target of MaaS, it is more accurate to speak of B2G2C. The implementation of MaaS has two distinct, though linked, components. The first corresponds to the implementation of new mobility services and what role they, and PT, play in serving the mobility needs of the population. The second corresponds to their integration into a global offer easily accessible for commuters. This is the major challenge of MaaS for the PTAs.

MaaS and open data: The new roles of public transport authorities

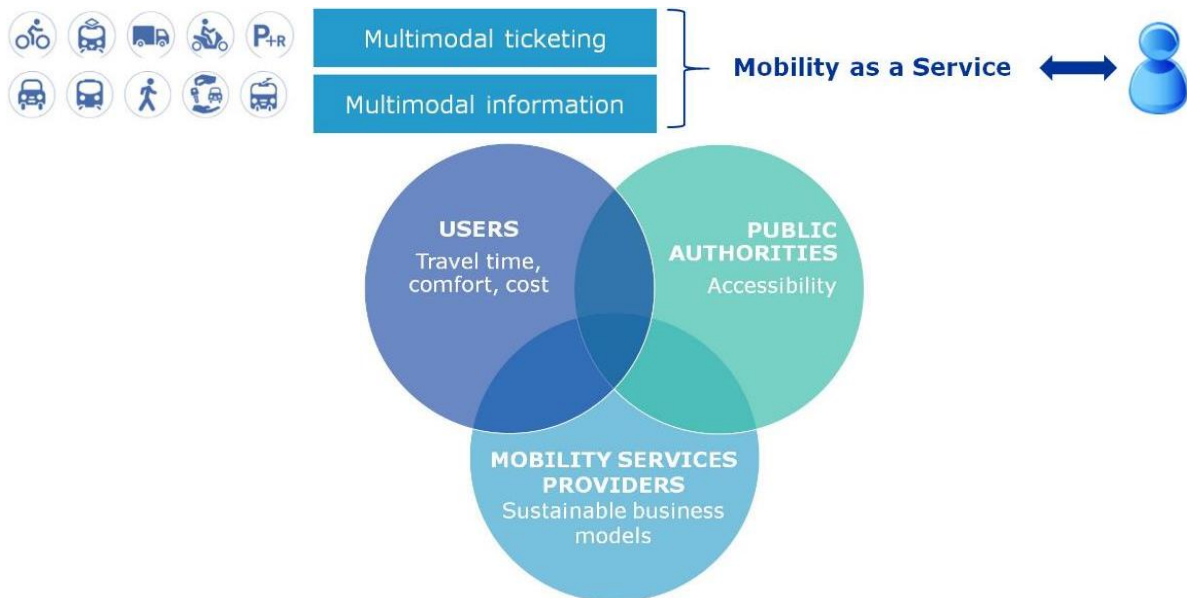
Mobility in urban areas is frequently based on a division of labour between public and private actors, and between public and individual transport. Both are managed independently. Clear borders exist, for example, between public transport vehicles and individual cars, and cars are often opposed to the soft modes like cycling and walking, with two-wheeled motorised vehicles occupying an intermediate position. With these categories, the roles of each actor are clearly defined. A PTA deals with the organisation of public transport. Another public entity is in charge of the management of roads. Users of the latter, including motorists and cyclists, use their own vehicle for free. Urban tolling remains an exception. With the development of shared mobility, the frontier between public and private transport is blurring.

The concept of MaaS calls into question this division of tasks between public and private transport but also between different managers of different transport infrastructures (road, rail...). The implementation of MaaS therefore requires that PTAs be entrusted with new missions. They must promote multimodality, and not just public transport. For this, the question of data and digital platforms becomes crucial. A prime example of the role of data is the issue of information and ticketing. As presented in Figure 4, multimodality refers to different visions:

- a user-centric vision: ease users' life, combine different modes
- a vision centred on new mobility services providers: attract more users, lower commercial costs
- a vision centred on public authorities: as mobility providers (public transit) but also as public mobility regulators.

Those three approaches have to be combined for a successful implementation of MaaS.

Figure 4. Multimodal information and ticketing: The first stages of MaaS implementation



Source: Crozet, Santos and Coldefy (2019; pp. 37).

From public transport authorities to multimodal mobility authorities

The regulation of urban mobility faces new challenges that concern its very organisation. Today, regulation is most often fragmented, as are the vectors of mobility. Thus, organisations in charge of public transport are often different from those managing roads and public spaces in general. The establishment of MaaS calls into question this division of labour between different public authorities. PTAs need to expand their scope and transform themselves into multimodal mobility authorities (MMA). This implies modifying the scope, skills and funding of these agencies so that they best combine the components of the various urban mobility services.

The requirements of multimodal urban mobility

When it comes to multimodality, the prospect of seamless mobility is often mentioned. Implicitly, this objective means that when a mode change is necessary, it represents a cost for the user. It is essential to remember this because it is the very justification of MaaS.

As we have shown, faced with the development of new mobility services, the transport authorities must make a strategic choice between two visions of the future of urban mobility.

- Either they think that new mobility services will remain marginal and sometimes limited to a few gadgets. Therefore, they can then continue to focus solely on public transport in the traditional sense of the term while striving to limit the place of private cars. This would be tantamount to prolonging the current situation characterised by a high modal share of passenger cars, particularly in the peripheries.
- Or they consider that, despite its current limitations, MaaS will ultimately result in profound changes. The main novelty is not carsharing or ride hailing of free-floating supplies. The very changes today affect the mobility services themselves less than the data collection, the information to commuters and the ticketing. These activities may appear as secondary but they are actually central to a mobility orientation perspective. It is therefore crucial that mobility authorities also broaden their range of activities.

If new mobility services have to be combined with the old ones, then public authorities have to address new issues. On the one hand, this entails a resolute commitment to the digital revolution. On the other hand, it entails becoming aware of their central role in optimising mobility services. Unless following the status quo approach, in which case the result is clear. Mobility authorities will have to show ambition. In the old world of urban mobility, neither commuters nor mobility providers planned the development of public transport. In the new world of MaaS, it is not them either, but the authorities, which must define the way to develop multimodality.

In order to reach this goal, the new MMA must intervene, one way or another, in the uses of roads, sidewalks and pedestrian zones, especially as bicycles and free-floating electric scooters are more and more successful. By different means, public policies must favour modes of transport that optimise the use of public space, and not those that offer individuals infinitesimal time savings, because public space is the rarest resource.

The scarcity of public space in urban areas has to be underlined because the aim of MaaS is not to reduce but to broaden the mobility options available to the inhabitants of a city. As indicated in the first part, the new mobility services must be understood more in terms of “addition” than in terms of “substitution” as we can see with some examples.

Self-service bicycles and scooters, carsharing or carpooling services offer an extension of the range of available options for mobility. This is how “smart card” projects are presented to the inhabitants of a city, providing them with a single information and payment medium for public transport, carpooling or even taxis. The goal is to enrich the universe of choice, by unifying access to information and payment for travel for all modes of transport. The logical consequence of MaaS is therefore a tendency to increase mobility. As more options are offered, it is highly likely that the number of trips will increase. Such traffic growth has been observed in some US cities after the development of ride hailing (Schaller, 2018). This raises, however, a number of problems for transport authorities.

There is, for instance, risk of developing mobility leading to increased congestion or pollutant emissions or other unintended negative effects. It is therefore logical that public authorities should regulate certain mobility services. This is the case today for electric scooters that pose problems in various cities: anarchic occupation of public spaces, traffic accidents, etc. We can also mention here some services like ride hailing that could increase congestion. As shown by some studies (Schaller, 2018) the development of such services can lead to a modal shift from PT to an increase of road traffic. Consequently, if the public authorities allow the new mobility services to develop without managing the use of road space, they risk accentuating conflicts of use and ultimately worsening the situation in cities, which are often marked by heavy traffic congestion. It is therefore important that, as in London or Oslo, the same authority be in charge of public transport and the regulation of road traffic. Pricing is also a way to regulate the latter and to find solutions to another problem, that of financing multimodality.

Funding issues are also central to the development of MaaS, which needs more public funds. Such an assertion is based on two observations.

The first one is the weakness of business models of new mobility services. As explained before, the majority of new mobility providers are not profitable. If they are part of a pure B2C model, their commercial revenues are not enough to cover their costs. This is the case of short-distance ridesharing, which cannot reach the critical mass necessary for its development. Local public authorities are asked to partially finance some specific services that could not be provided by users alone. But the question is then: how to find the necessary funds?

The second one is that funding for new mobility services is not difficult to find in the case of services of a limited scale. This has been observed in the case of self-service bikes. Their installation involves little initial investment and often they have been indirectly financed by advertising revenues. This type of financial package has been a solution for public authorities. But it cannot be reproduced identically if the goal is to embody the ambitions of MaaS, that is to say, at the same time, the entry into the era of digitalisation of the collection of data, information and online sales; and the integration of new mobility services into the public offer.

MaaS: From a bottom-up to a top-down process

At first glance, MaaS can be presented as a bottom-up process. Innovations have been proposed locally by actors who were not initially part of the mobility world. The new giants of the internet and mobility services, therefore, have such a clear strategy of integration: to master the two components of MaaS - providing new and old mobility services thanks to a platform that integrates information (location, route choice, mode choice...) and ticketing. If they succeed in this project, they will be able to offer public authorities "turnkey" solutions.

To do so, they must integrate the main building blocks of the urban mobility system. From their point of view, MaaS represents the culmination of this rationale of integration. Starting with the dissemination of

information in real time (first wave of the digital revolution) and then positioning themselves on ticketing and transport services (second wave of the digital revolution), they present themselves as integrators. The aim is eventually to offer a complete range of urban mobility services. The development of autonomous vehicles (third wave of the digital revolution) is considered, in the long run, a central part of this strategy, as it would lead to a total rethinking of transport itself. For instance, in the ITF's studies done in Lisbon or Lyon, a revolution is required in the regulation of mobility since using individual cars is forbidden. Therefore, PTAs have to create a fully new concept of public transport based on a fully new (private or public?) fleet of vehicles. But the autonomous vehicle is far from being operational.

If we add to this the observations we have previously mentioned on the two key rarities of public space, on the one hand, and of public funds on the other, it goes without saying that the digital revolution alone cannot ensure the development of MaaS. To approach things solely from the point of view of technology overlooks the collective dimensions of urban mobility. In the face of the business models of new mobility providers, there are social and societal objectives of public policies. The question is not only one of technical progress stemming from the digital revolution; it is how to put this technological progress at the service of a more sustainable urban mobility.

The foundation of this approach is the idea that urban mobility does not fall into the same category as hotel or housing reservations. In this field, companies like Booking.com or Airbnb soon found themselves in a natural monopoly position because they were the first ones to reach a critical mass of suppliers and customers on their platforms. We find here the result of the "superstar effect" (Sherwin Rosen) or the phenomenon of the "winner takes all". But it is not the same for urban mobility. There is no global, natural monopoly on urban mobility. Partial natural monopolies may exist for certain services such as public transport. It is for this very reason that they are under the supervision of public authorities. These monopolies can be challenged by the arrival of new players. This is the case for self-service bicycles set up by public authorities, which are now in competition with free-floating private services of the same type. However, we know that these private operators have encountered great difficulties as illustrated by the resounding bankruptcy of OFO, an ephemeral giant of this type of service.

Urban mobility is therefore composed of different building blocks but no actor has a monopoly on assembling these blocks, except perhaps public mobility authorities. Acting as an aggregator, MMA must control the use of space and organise the financing of the system. By this rationale of aggregation, the public authority is therefore in the position of the buyer of mobility services. Given the societal objectives it has set for itself, it must choose which mobility services must be provided for the population. On this basis, it decides which partners will be chosen, and under what conditions.

This is true for transportation services, old and new. For this purpose, PTAs may allow competition in the market to operate between different operators, for example for taxis. But it can also organise competition for the market by launching tenders for the provision of special services such as buses, subways or self-service bicycles. The same rationale of aggregation must apply in terms of information, route calculations or ticketing. Market competition is an acceptable information solution, but that does not mean that all public data is open access while private data is not. In the same way, the opening of online sales to other partners must be included in data sharing.

Let us not forget that, in terms of access to information, MaaS' main goal is multimodality, bridging the gap between regular users of cars and those who use public transport. The world of commuters is now partitioned and this is reflected in the uses of digital platforms. Motorists are always connected to real-time information via applications that give insight on congestion and the best routes to follow. In parallel, public transit users use platforms dedicated to public transport. There is not a strong social demand for merging the two kinds of platforms for now, because each category of user has its own routine. The aim

of MaaS is to offer commuters the opportunity to escape their routines, by learning about other options for optimising their schedules.

It is mainly for this reason that mobility authorities must take over the management of road networks. This way, they could act more effectively on vehicle flows. In addition, increasing constraints on the use of the automobile will be more easily accepted if alternative options are available and accessible online. From this perspective, the regulation of platforms and databases is crucial. This is a new but strategic mission for MMAs.

Open data and digital platforms: The role of multimodal mobility authorities

The issue of data is crucial because the new mobility actors are not just small start-up companies offering ridesharing or innovative companies in taxi services. The well-known “GAFA”² are also involved in the digitisation of mobility. With the real-time tracking of their customers, companies providing mobile phone applications now have more comprehensive databases than those held by PTAs. Consequently, they can offer a relevant set of information to commuters but also on commuters’ behaviours. This is a typical case of a two-sided market, where platform managers can modify the value chain, by their strategic positioning, in their favour. Many transport authorities are concerned about such a scenario. For instance, IDFM (Ile-de-France Mobility), the PTA in charge of Paris-Region, worries about the fact that many new entrants³ are offering apps competing with Vianavigo, the IDFM’s app. The main risk could be the integration of a ticketing system within the private apps. But their fears are probably exaggerated because there are regulatory options to avoid the marginalisation of PTAs. In order to address the regulation issues, they should display their ambitions (see Box 2) rather than their worries.

Box 2. MaaS and MMA, three different pioneer cities

Some pioneer cities have already embarked on the transition from PTA to MMA. The development of a MaaS application is central in the promotion of multimodality and less car dependency. But it is now obvious that public transport remains the backbone of urban mobility (Ramboll 2019). It does not seem conceivable to propose a MaaS offer that does not include all public transport. This becomes clear when we compare the three pioneer cities of Helsinki, Vienna and Oslo.

In a comparative study, in particular, on the cases of Helsinki and Vienna (CEREMA, 2019) it was shown that in these cities all local and regional public transport (buses, trams, metros, regional trains...) are systematically accessible via the MaaS application. In these urban regions, all public transport has been integrated for a long time within the same transport network, both for information and ticketing. The comparison between the pioneer cities is interesting because it confirms there are different forms of development of MaaS and multimodality (see Box 3).

Helsinki illustrates the bottom-up model of integration carried out by a private actor (MaaS Global) offering its own application (Whim) which is now also available in other cities.

In Vienna, the MaaS WienMobil service is offered by the transport operator, Wiener Linien. But MaaS in Vienna is not only an example of integration by the public transport operator. It is also an example of the top-down aggregation process. The local authority sets up a platform into which data from the various

mobility services (timetables, route choice, ticketing...) are integrated. In Vienna, the open public platform was developed by a subsidiary company of two public entities.

The Oslo case is interesting for the key role played there by RUTER, the transport authority whose main objective is to reduce car traffic. In Oslo, public transit and roads are the responsibility of the same deputy mayor, although at a lower administrative level, they are still managed by two separate entities. In Oslo, there is also a congestion charge, the revenue from which covers about 20% of the costs of the public transport system. Many traffic restrictions have been put in place, in particular to limit the circulation of vehicles equipped with internal combustion engines. There, the management of public space prioritises the circulation of pedestrians, bicycles and public transport. The result is that car traffic is particularly reduced in Oslo compared to European conurbations of the same size (Tennøy and Hagen, 2019).

Multimodality and the economics of platforms

The fears aroused by GAFAs in the field of urban mobility are linked to the idea that these giant companies have the technical and financial means to gradually expand their offer of mobility services. With the help of travellers (location, choice of a mode of transport and a route), precise information on travel times, frequency or timetables of public transport as well as the sale of transport tickets could be added. Such a scenario is likely, as European legislation is geared towards opening up data and sales channels so that competition encourages players to improve their services and their performance. How does this pose a threat to public transportation and PTAs?

To answer this question, a theoretical detour is necessary to understand the economics of digital platforms (Rysman, 2009). Economic analysis of two-sided, or multi-sided, markets has shown that in market economies, digital platforms pose two types of questions.

The first concerns anti-trust measures and the control of monopolies. To develop, a platform must reach a critical size. This is the condition for the realisation of the network effects which are the *raison d'être* of the platforms. The maximisation of network effects therefore risks leading to the presence of a single platform, which will find itself in a position of quasi-monopoly. This is the case today for the social network "Facebook", for the search engine "Google" or for online sales (Amazon).

The second question is that of the regulation of these platforms. How to avoid their market power leading to a sub-optimal situation, in terms of pricing, market entry or diffusion of innovations. GAFAs are sometimes presented as a factor of inertia because they have the means to buy out potential competitors and their innovations.

How does the question of monopolies and their regulation arise in the area of personal mobility, especially in urban areas? The question is important because the transport authorities also have a regulatory role insofar as they determine certain rules of the game.

In terms of platforms, for mobility services, the difficulty of reaching critical mass is more frequent than the risk of a monopoly. New mobility providers are faced with a double problem: a market that remains narrow, on the one hand, and the impossibility of reaching critical size on the other. This is the case for carpooling, free-floating electric scooters or ride hailing. However, there are a few cases of platforms that have succeeded in establishing themselves, and attracting a large number of participants. This is the case with Waze for motorists looking for the best route.

These examples show us that the question of regulation should be considered in specific terms. The main problem for the organising authorities is not to promote free and undistorted competition, but to determine how this type of platform, and this type of service, contributes or not to the objectives of urban mobility policies. Let us take a few examples.

- Motorists using Waze services are often very satisfied with the information provided to help them avoid traffic congestion as much as possible. But along the proposed routes, residents complain that traffic tends to end up on secondary roads, causing discomfort for residents. Just as, in certain American cities, the services of Lyft and Uber have led to an increase in car traffic, so too is a platform like Waze an incentive to travel by private car. Faced with such a situation, the regulation issues to be considered concern road management: size of lanes, rules of use, pricing, etc.
- A similar but reversed statement can be made for carpooling. If the objective of public policies is to increase the vehicle occupancy rate, then local public policies must offer this type of service the opportunity to develop. For this, they can create reserved highways (high occupancy lanes), set up meeting areas (park and ride), or even pay subsidies to drivers or passengers. Through such measures, they can help this type of activity to reach critical size. In this case, the main question is not to control the platforms but to know how far public policies are ready to go, or not, to reduce individual trips by car and to encourage carpooling.
- The question of sharing public space between different uses is also the key question for free-floating bicycles or scooters. Many start-ups have offered this type of service in many cities. Success has been rare, due to the fragility of the business models: inability to reach critical size, vandalism, higher than expected operating costs; but also due to the negative effects on health (accidents) and on the use of public space, in particular sidewalks, which created conflicts with pedestrians. Local public authorities, therefore, had to intervene, either to ban such services (Barcelona, Seattle...), or to supervise them by limiting the number of operators and by laying down rules on the use of roads (Paris, San Francisco, etc.).

These examples remind us that the key issue of MaaS for the organising authorities is that of multimodality. With the digital revolution, urban mobility policies can no longer be limited to the question of modal shares between public transport and the private car. They need to broaden their scope by taking into account new mobility services and how they can help, or not, to achieve sustainable urban mobility. As the new and old mobility services coexist in the same public space, the organising authorities must take charge of their regulation and the regulation of road traffic. For MaaS to be a tool for public policy, it must not be considered from a purely theoretical viewpoint, its physical component must be taken into account, and, especially, its digital component.

Multimodal mobility authorities and data governance

The issue of data governance is where the greatest concerns are expressed within the transport authorities. Especially since European legislation has made open data a general principle. The fears do not concern so much the platforms mentioned above, those of mobility providers (carsharing, ridesharing, free floating ...), as the platforms of internet giants. These typically fall into the category of two-sided markets (Rochet and Tirole, 2003) where platforms can modify value chains in their favour. This could be the case in the area of urban mobility if two types of asymmetries were evident between PTAs and digital platforms.

The first asymmetry results from the fact that the clients of these platforms (Google map, City Mapper, etc.) benefit from a "positive value", often offered free of charge, in the form of information (location,

choice of route, etc.). But by logging in, users deliver key information about their preferences to platforms, which corresponds to a “negative value”, a kind of hidden payment. As the platforms have the means to monetise this information from the other side of the market, mobility data could further increase their revenues and ultimately their market power.

The second potential asymmetry is linked to a new activity now open in many countries, the possibility for platforms to sell transport tickets. This activity competes directly with existing marketing systems implemented by public transport operators under the aegis of the PTA. This could change the purchasing practices of public transport customers, especially if the platforms decide to attract more customers to sell tickets at reduced prices. Platforms could sell tickets or subscriptions at a price lower than the purchase price thanks to the monetisation of “negative values”.

Faced with these two risks, it would be unfortunate to argue for the status quo and stick to the current situation. If the objective of MaaS is to develop multimodality in the direction desired by public policies (fewer individual cars, more public transport, more shared mobility, increased use of active modes, etc.) then the opening of data and the sale of tickets is essential. They are necessary for the development of applications that integrate different mobility services and for encouraging commuters to get out of their generally single-mode routines. But for this to be done without overly strong asymmetries appearing, regulation is necessary.

For this regulation to be effective, it must distinguish what, in open data, falls under the “front office” on the one hand and the “back office” on the other hand.

Box 3. Data governance, three main models

MaaS requires the integration of the data necessary for the operation of platforms dedicated to mobility. As we have shown, this integration can be done in a bottom-up logic through the action of one or more private actors. It can also be carried out by the public authority with a top-down aggregation. But there is an intermediate option too, where the public authority delegates this aggregation mission to the public transport operator. These three models lead to three different forms of data governance.

In the bottom-up logic, a commercial integrator contracts individually with each of the mobility providers in order to resell their services. The PTA does not take part in any agreements or in the governance of the platform. Two symmetrical risks appear in this case. Either, the private operator is in a monopoly situation and the regulatory power of the public authorities is very weak, or the private operator fails to achieve the necessary data integration and MaaS cannot really work.

In the top-down type of aggregation logic, an open public platform centralises all the data from all mobility services and makes it available to all stakeholders (see Figure 4). This architecture leaves room for different operators whether they are a technical integration company or a mobility operator. Public regulation is limited to the provision of the same level of information for all, competition remains between the different mobility providers.

A specific form of aggregation is also possible by delegation to the public transport operator. The latter benefits from the expertise of operating the most structuring mode in terms of mobility at the agglomeration level. It also has a privileged and historic link with the local community. But in this case, two risks exist: an asymmetry between the actors of mobility on the one hand and, on the other hand, a weak capacity of the public authority regarding data governance.

The front office concerns services to people. The opening of data and marketing channels should lead to various offers. In addition to the applications offered by the former mobility providers, or by the PTA itself, it is desirable that other applications should emerge, based on innovations going in the direction of seamless multimodality. If there is competition between different applications at the outset, it is possible that over time one of the three models presented in Box 3 becomes necessary. First, it is necessary to consider several options.

The back office concerns the form that the opening and provision of data will take. The technical formatting issues must first be resolved so that the data can be used by different stakeholders. Standardisation is, therefore, necessary and it is up to a national or European public authority to impose it. But the key issue is that of the symmetry of rights and duties with regard to data access.

The organising authorities must develop their skills and assert their ambitions in the back office of open data.

The vast majority of data is not critical and opening data in the way of “pure open data” is not an issue. However, some data can be more sensitive when it comes to public mobility policies. It is, therefore, necessary to ensure that their re-use is consistent with public policies: can a service using public data divert road traffic towards school areas because the parallel street is congested? Could a provider purposely direct users to its mobility service at the expense of another? At a time when the sole objective of private actors is to provide services without measuring the impact on the public interest (use of public space, safety, etc.), adequate regulation (and not necessarily hyper-regulation) of the reuse of public data is necessary. Co-operation is mandatory between public and private actors together with new, proportional forms of regulation.

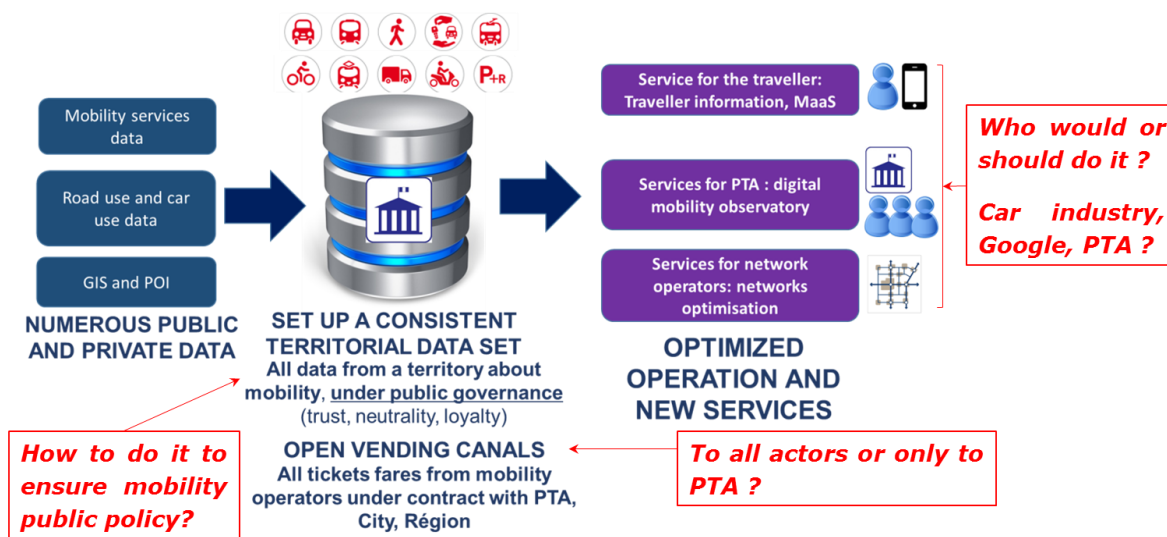
Several PTAs have led the way over the past six years, with smart licenses. In 2012, the Metropolis of Lyon, using such a license system, established the most comprehensive set of open data in Europe with a record number of more than 100 re-users. This type of license identifies re-users for sensitive data only (5% of the data) and the dialogue between the MMA and the re-users results in regulation only for cases of non-compatibility with public policies (which is not possible with open data). Thanks to this framework, many non-open data producers made their data accessible. In the end, the opening of all mobility data simply combines user service and the general interest.

The creation of a public database, under the umbrella of the MMA, allows, as shown in Figure 5, the development of MaaS while leaving room for private actors, but under the constraint of respecting the objectives defined by the community for sustainable urban mobility. Private actors contribute to the database and subject to compliance with certain rules of the game, they can reuse them. These players can have access to sales channels for transport tickets in order to offer integrated services to their customers. It is true that at the current stage of MaaS development, uncertainties remain about the type of actor capable of offering commuters integrated multimodal offers. It could be the MMA itself, or the public transport operator (see Box 2), or this or that internet giant. But it is also possible that automakers may enter such a market if they believe that selling a mobility service will be more profitable tomorrow than selling vehicles.

In such a hypothesis, data coming from vehicles becomes a particular issue. All cars in Europe will be equipped with a GPS chip and a SIM card within the next ten years (and already half of Europe’s car fleet within the next five years). This follows the obligation to set up the e-call system in new car models since 1 May 2018. While the big challenge in building alternatives to car travel lies in assessing user needs and hence knowing the mobility flows, the generalisation of connected vehicles will potentially disrupt design tools and the evaluation of public mobility policies. For the MMA and mobility operators to build adequate offers, it is necessary to have access to data from connected vehicles and driving assistants. A process to

enable this is underway under the French “General Principles Act” on mobility, which will be a genuine step towards facilitating data processing while avoiding rent-seeking data possession.

Figure 5. Territorial data set data, public objectives and private actors



Source: Crozet, Santos and Coldefy (2019).

European regulation has cleverly paved the way for widespread data opening. Public mobility authorities now have to build the framework of confidence needed to collect data at the relevant levels involved. This will include smart licenses that will allow rational regulation while maintaining a level of competition between operators.

Conclusion

MaaS and the digitalisation of urban mobility present many opportunities for local and national policy makers, PTA, citizens and mobility providers. However, disruptive innovation is also challenging public transport operators and the PTA. The development of connectivity in mobility services is leading to a renewed level playing field. Both new and old mobility providers have to contribute to some key changes, necessary to reach the goals of a sustainable urban mobility. The question of public policy objectives is key. Making cities inclusive, safe, resilient and sustainable, being able to combat climate change, ensuring healthy lives and promoting well-being for all ages is a huge challenge. To answer this question, it is not possible to stick to the separation of tasks between road network management on one side and PTA on the other. An integrated approach to the regulation of urban mobility is necessary. For PTAs to turn into Multimodal Mobility Authorities (MMA), MaaS is not a threat, even though it has emerged outside of public authorities. MaaS is an opportunity to be seized, but for this, it is necessary to take the measure of three key mutations associated with it.

The first mutation is that of multimodality. If the goal is to reduce the share of the private car, which often remains dominant outside city centres, commuters must be encouraged to abandon certain routines. The establishment of an integrated information and marketing system for travel tickets is therefore essential. To open the field of possibilities for the choice of a mode, an itinerary or a travel period, but also to make explicit the constraints that sustainable mobility implies. As such, MaaS can help with setting up pricing policies that penalise the private car and more generally the modes of transport that are most harmful to the environment.

The second change is that of managing public space. One of the main problems with the private car is the fact that, in order to circulate and park, it consumes much more public space per traveller than public transport or active modes. The transformation of PTAs into MMAs therefore presupposes that they can guide and master the different uses of public space. The distribution of the road network between the different modes of transport and traffic regulation (including by pricing) must be in the same hand as the definition of the public transport offer. The borders between these two worlds must be abolished because in urban areas public space is the scarcest resource that must be allocated according to general objectives, not in reference to some infinitesimal time savings of a minority of commuters.

The third change is that of the opening of data and the development of multimodal applications offered to commuters. In this area, too, borders must fall. Information to travellers and the sale of tickets should not remain in a monopoly situation. But for competition between mobility providers to be healthy in the “front office”, it is necessary that MMA establish clear rules of the game for the back office. For this, they must acquire new skills and present themselves as “trusted third parties” capable of offering all stakeholders the integration of data in a public database ensuring equal rights and duties for all.

In recent years, many innovations have emerged in urban mobility. But if there are many new players, they remain marginal. It is now clear that public transport will remain the backbone of urban mobility policies. To achieve their social and environmental objectives, public authorities must take advantage of MaaS, which will help them to drive the three key mutations that are: multimodality, reallocation of public spaces and the guarantee of a balanced opening of data and sales channels. The PTAs are the only ones able to take these three dimensions into account simultaneously, even if, for this, they must be creative in their cooperation with private initiatives.

Notes

1 This paper develops some recommendations of this report.

2 Google, Apple, Facebook, Amazon.

3 ViaMichelin, Google Maps, Mappy, Citymapper, Moovit, etc.

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Mobility as a Service

A New Ambition for Public Transport Authorities

This paper examines the relationship between traditional public transport and innovative mobility solutions such as Mobility as a Service (MaaS). It looks at how MaaS could change the role of public transport authorities from providing transport services to facilitating mobility, and considers how their remit and capabilities should evolve to better promote seamless multimodal transport.

All resources from the Roundtable on Integrating Public Transport into Mobility as a Service Roundtable are available at:
www.itf-oecd.org/integrating-public-transport-mobility-service-maas-roundtable.

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