Future bus transport contracts under a mobility as a service (MaaS) regime in the digital age: are they likely to change?

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ABSTRACT

The digital age has opened up new opportunities to improve the customer experience in using public transport. Specifically, we see the role of smart technology in the hands of customers as the new rubric to deliver services that are individualised to the needs and preferences of current and future public transport users. This frontline of service delivery has become known as mobility as a service (MaaS) whereby an individual can book a service delivered through a range of possible modes of transport. Variations are bus-based options that include smart bookable 'point-via-point-to-point' services that offer options on travel times and fares as well as the continuation of conventional bus services where the market for smart MaaS is difficult or inappropriate to provide (e.g., contracted (often free) school bus services). This paper presents a number of positions that could potentially represent future contexts in which bus services might be offered, recognising that a hybrid multi-modal state of affairs may be the most appealing new contract setting, enabling the design of contracts to be driven by the mode-neutral customer experience, and the growing opportunity to focus on MaaS. We suggest that the adrenal rush for mobility services, however, may not deliver the full solution that supporters are suggesting.

1. Introduction

> *"The mobility systems of the future are likely to be very different from what exists in most of the world today. The individual traveler is at the heart of this evolution, so consumers will need to be open to adopting new technologies and services. However, both the public and private sectors will have roles to play in paving the way."* (Hannon et al. 2016)

A number of transport summits in recent years (e.g., Transport for NSW 2016) have looked to the future of transport as informed by autonomous vehicles, big data analytics, internet of things, disruptive technologies, and customer service in the digital age. Closely connected to these developments is the likely new context in which public transport services might be provided, facilitated by this new digital age with smartphone apps for easy access to bookable and turn up and use services, including driverless vehicles of all types (cars, taxis, buses, trains) in which 'mobility as a service' (MaaS) comes to the fore with no need for individuals to own a car, and with regulatory reform (and contracts) that supports a customer-

focussed MaaS model in which point-to-point transport can be provided via smart technology. The case for single mode regulation will need to be reconsidered when the provision of mobility services is drawn from many modal offerings. These offerings will include the shared economy typified by car clubs, lift share (such as BlaBlaCar), the 'car next door' and various manifestations of taxis (and buses of varying sizes), with different notions of collective or individual ownership.

MaaS as defined in https://en.wikipedia.org/wiki/Mobility_as_a_service_(transport), 'combines transport services from public and private transport providers through a unified gateway that creates and manages the trip, which users can pay for with a single account'. Users can pay per trip or a monthly fee for a limited distance. The key concept behind MaaS is to offer travellers mobility solutions based on their travel needs[1]. Fishman summarises these options graphically in Figure 1.

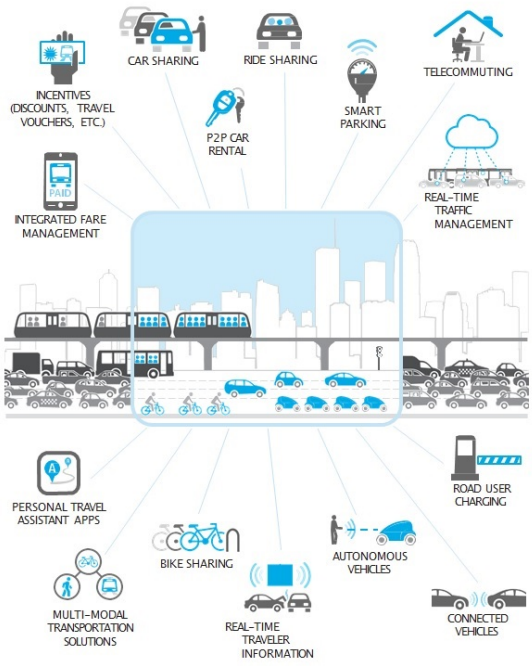

Figure 1 Future mobility options (Fishman 2012)

This paper is a think piece[2], raising issues that need considering as we move forward that are focussed primarily on future bus contracts in the presence of MaaS. In order to place this into context, we synthesise the issues that MaaS brings up in the market for servicing customers. Through having a better understanding of what MaaS is, and might be in the future, we can start to see the types of issues that might impact on the future structure of existing bus contracts, and indeed if we even need mode specific contracts that might, in time, be replaced with mobility contracts. The questioning of the future of bus-specific contracts as currently specified in the presence of a scaled up MaaS is thus the real intent of

[1] The Mobility as a Service (MaaS) Alliance has been established in 2016 as a public-private partnership dedicated to creating the foundations for a common approach to MaaS, unlocking the economies of scale needed for successful implementation and take-up of MaaS in Europe and beyond. http://maas-alliance.eu/

[2] In part motivated by the many workshops the author has attended in the last 12 months on the growing interest in MaaS.

the paper, designed in part to get service providers and regulators thinking ahead on what this might mean for future regulations and contract design.

The paper is structured as follows. The next section focuses on some examples of recent implementation and/or planning for MaaS schemes in a number of countries. This is followed by a discussion on what MaaS might mean for future public transport contracts, given future service delivery options in the new digital age. One of the central issues of MaaS is the move to greater (more efficient) use of cars, be they autonomous or with a driver, and what this might mean not only for conventional public transport but also congestion of the road network. It is unclear which way this debate will go, and indeed whether congestion will reduce or increase. The next section provides initial thoughts on the opportunity (or not) to reduce traffic congestion under MaaS, and especially when and if MaaS is scaled up. The scalability of Maas is an intriguing and unclear matter. A number of key ideas and future research suggestions are presented in the concluding section.

2. A Brief Overview of MaaS in Practice

The opportunities for public transport to match customer expectation under a MaaS model are exciting (see Hietanen 2014, Transport Systems Catapult 2015, Kamargianni et al., 2015, and Martin 2016), but also disruptive in terms of current practices centred around mode-specific contracts, protected service areas and often under-utilised bus capacity (it being well known how often buses move 'fresh air' plus the driver but no passengers). Has the time arrived for the digital age to provide the much needed technological spur for the take-off into the new MaaS era? In New South Wales (NSW), for example, this is clearly influenced by the Uber experience and the 2016 legalisation[3] of their taxi-like services with an emphasis on high quality point-to-point customer service bookable through smart palm-based technology. 'Uberisation' of public transport might now be the catch cry to get us all thinking about future states involving all modes of transport[4]. Many of the MaaS initiatives are, however, not new and are similar in intent, in respect of customer service, to flexible transport services including demand responsive transit. What is different today is the ability to bring such flexible options direct to any interested user via the digital app capability available on smartphones. This provides a more efficient way to service mobility needs that is available to all, albeit under certain pricing and service level conditions.

With such a large amount of capacity provided, and often with excess under-utilisation (partly a consequence of non-permissable passenger pick up in areas outside of contract areas, such as the return trip from the contract neutral central business district of Sydney), especially in the off peaks, but a recognition that existing assets may not be the best fit in delivering point-to-point MaaS (which might benefit by a mix of vehicle types –including cars, small buses, large buses etc.), if there is a desire by government to relax the modal regulatory regime to accommodate mixed-mode opportunities offered by one or more service

[3] In contrast, the Queensland Government on 21 April 2016 rejected legalisation of Uber styled services. The Katter's Australian Party's private member's Bill, passed by the Queensland Parliament with Opposition support, allows transport inspectors to fine Uber drivers up to $2,356, while administrators can be fined up to $23,560. Paid ridesharing remains illegal in Queensland under current taxi regulations, but the government is reviewing those regulations.

[4] The word Uber has Germantic heritage and refers to 'being a superlative example of its kind or class'.

providers, then we are very likely see a huge change in the services available to customers. This NSW 2016 legislation permitting Uber services also allows any new player to enter the market as long as their vehicle (which includes mini-buses) has a capacity not exceeding 12 seats. The recent move to a multimodal public transport contract offered in Newcastle, Australia, involving conventional timetabled (and some school contracted) buses, trains and ferries (awarded in December 2016 to Keolis Downer) is a good sign of the willingness of a regulatory setting to accommodate such a plan in Australia, but whether it will relax the mix of modes in the new contract environment is more of a challenge.

MaaS initiatives are growing very fast throughout the world, especially in Europe. Kamargianni et al. (2015) identify a number of existing travel services/initiatives where citizens are offered a form of monthly subscription payment (MOBIB[5] in Brussels, HANNOVERmobil[6], EMMA in Montpellier, SMILE[7] in Vienna, and Moovel[8] in Germany). These typically include a fixed monthly subscription for unlimited public transport use (costing slightly more than a PT monthly pass) and discounted pay-as-you-go rates on usage of all other modes such as car and bike sharing and taxi. Customers receive an integrated mobility bill at the end of each month that includes the basic cost as well as taxi and car/bike sharing usage fees. These are typically provided through an app or through purchase of a smartcard ticket. These on-demand services are not included in advance in the subscription package, but are charged separately at a discounted rate after use. The creation of tailored subscription mobility packages which include pre-payment of all selected modes in advance, is a very recent idea with only one current example of a project testing the concept. The UbiGo trial[9] in Sweden involved 70 households in Gothenburg with 190 users between Nov 2013 and April 2014. They agreed to pay for a “transportation smorgasbord” that included car-sharing, rental car, taxi, public transport and bicycles in one app, paid at once. A flexible monthly fee (average 140€/month) allowed users to choose, in advance, the bundles of transport provision which they felt best met their needs. Advantages stated were that it became easier to pay for the travel and that the service gave them access to more modes of travel. Disadvantages were that it was difficult to choose the level of subscription (initially) and there were problems with the driver’s knowledge of the UbiGo service (app-tickets). All households in the pilot continued using the service and buying packages after the trial ended. Interestingly, there were considerable unused travel allocations each month. On average, 86% of the monthly PT services purchased through monthly subscription were utilised, while 69% of the car services purchased through the monthly subscriptions were utilised. The pilot project ended in 2014, but UbiGo says that it planned to re-launch somewhere in Sweden after late 2016 or early 2017, in co-operation with Ericsson.

One of the most interesting but unsuccessful trials was in Kutsuplus, a city-run “mobility on demand” transit service in Helsinki[10]. WiFi-equipped minibuses roamed the city's downtown core and a dispatch system would direct buses to passengers and dynamically update routes on the fly to pick up more passengers. Pickup points were typically the nearest city bus stop, usually only a few minutes walk, and payment was arranged through an app - no fumbling

[5] http://www.mobib.be/mobib-card_EN.htm
[6] www.gvh.de/service/rad---auto---carsharing/hannovermobil
[7] www.smile---einfachmobil.at
[8] www.moovel.com
[9] https://tapahtumat.tekes.fi/uploads/ddb30435/Arby_Hans-8909.pdf
[10] https://nextcity.org/features/view/helsinki-kutsuplus-on-demand-transportation-mobility-next-uber

with transit cards or cash needed[11]. On the last day of 2015, Helsinki Regional Transport cancelled the Kutsuplus pilot program. There are a few suggested reasons as to why it failed. First, with a budget of about 3.2 million euros, the service was unable to get more than 15 buses running at a time (this is the scalability requirement). (HSL - Helsinki Regional Transport - planned to have 100 by 2017, and 2,000 by the year 2020.) By the end of 2015, the 15 buses were operating for longer hours and serving more people, but it was not enough for Helsinki, which has a metro, 15 tram lines and a large bus system. Combined, Helsinki's public transport network provides about 1.2 million rides daily. Just as critically, a limited schedule means fewer fare-paying riders and fewer fares means more money from the city is needed to offset the expenses of each trip. As of December 2014, Kutsuplus' subsidy per trip was around 20 euros, an improvement over the 40 euro-per-trip subsidy needed 12 months earlier, but still not a great deal for the city. The CEO suggested that Kutsuplus would have been much more successful if there had been more vehicles … [in] the pilot program, but he also believed that the challenge in transportation technology is not the technology in itself, but how the business around it is managed. It appears that Kutsuplus may have tried to do too much, too soon, without a solid financial backing. But it was not likely to be just economics that killed Kutsuplus. In a city with a large population of commuters who travel downtown each day from outlying suburbs, its service area only included the city centre and rides could not be pre-ordered more than 45 minutes in advance.

Another two pilots are planned in the near future or recently launched in Helsinki and Berlin. MaaS Global in Helsinki[12] launched its transport subscription service through the Whim app in late 2016[13]. Whim, has completed pilot testing, and comprises of a smartphone app that lets the user tailor their own monthly transport plan, setting how many miles of Uber or taxi travel they want, how many train and bus journeys, number of hours of car hire or car-club rental and other parameters that each affect the total monthly price. Several options are being proposed or assessed at present:

- *Move on a Whim* - Pay as you go to access all the different MaaS options. Allows users to test out the service with zero commitment.
- *Monthly Mobility* - Unlimited local public transport and bike share use, with a monthly quota of points to use freely on taxis, rental cars, long-distance trains and value-added services. Users can earn extra points by making smart travel choices.
- *Ultimate Freedom* - Travel in style on any mode of transport you like, from every kind of public transport to local taxis and rental cars. Earn extra points by opting for public transport and use them on life enhancing perks like value added services or a Tesla for the weekend.[14]

[11] One user said '"If you go to [an] edge area, and make a … trip at 6 a.m., you may be alone in the vehicle. But on a lively day, a 10-trip combination is typical, with three to four passengers in the vehicle at the same time," he says. He adds that when a bus did only have one passenger, at least the next rider was usually nearby. A taxi would often instead drive, empty, back to the nearest taxi stand. "Even with 15 vehicles only, we reached higher efficiency than taxi," he says. "On lively days some three to four trips per vehicular hour."

[12] https://maas.global/

[13] See https://eu-smartcities.eu/content/finland-launches-whim-app-new-all-inclusive-mobility-service

[14] Some of these applications and evidence are drawn from a literature review in a report by Steve Wright and John Nelson (2016) as part of a larger study being undertaken by the Institute of Transport and Logistics Studies on MaaS: a future direction for community transport? This material is used with permission.

3. What might MaaS mean for Future Bus Contracts?

So where might we start in considering what the MaaS movement might mean for existing bus contracts? The first point is to recognise that the existing model for delivering public transport services (especially the way contracts are designed – see for example Hensher 2015) may in itself be a constraint on the ability of public transport to fulfil a more useful role in point-to-point mobility as a service. Imagine a metropolitan world in which we no longer have geographic contract areas for bus services, but a model in which operators run their business in a way that gives them the flexibility to provide (if they so wish) traditional timetabled services along specific routes (with designated bus stops), but also a bookable system using smart technology that provides flexible point-to-point services, be they from home to a rail station, or even longer distances from home to work (the latter is like the old subscription bus service in some countries before the digital booking era). Operators will use this digital platform to compete for business and develop many ways to incentivise users to stay with them (e.g., loyalty programs, fare discounts for multi-riding, discounts on products from various stores etc.). Prior to the onslaught of digital apps, this would be referred to as an agency approach whereby demand and supply are matched by an informed agency in the middle.

What is exciting about this future prospect is that there are many smart bus operators in various jurisdictions throughout the world[15], and they can be part of this journey, make profits and take pressure off of the funds currently provided by government, resulting in a significant improvement in value for money to the tax payer, something that has been somewhat alien for many years in this very fragmented and protected sector in a number of jurisdictions throughout the world. While bus operators are often encouraged to be innovative and to grow patronage (e.g., with profit sharing above a threshold rate of patronage growth), the contracting regimes in place often have limited incentives to do so, which together with the difficulties in attracting patronage in a market often dominated by the car (which is seen as the preferred mode at present), result in bus operators struggling to build patronage even under attractive incentives. Indeed, these new service mobility models are expected to make the need to use a car owned by a traveller significantly reduced, even if the substitute is a point-to-point[16] serviced car operated by the smart multimodal transport MaaS provider.

The entrepreneurial zeal may not be something to whet the appetites of all existing bus operators, but we could expect that quite a few will relish the opportunity, including undertaking a service broker role across all modal service provisions, while others might just decide to call it a day. In addition, new service providers (or brokers) are likely to enter the new MaaS space. The same arguments might be put for rail; however the focus is likely to be on rail operators moving into the point-to-point space as a way of gaining patrons for the rail network through a single point-to-point service offered by the refreshed multimodal (door to door) rail enterprise[17]. Whether the rail enterprise does this through a partnership with other

[15] As shown for example in the innovations offered through tendered bus contracts in Singapore and a number of rail operations in Japan, UK and Australia. There are also many overly conservative bus operators who will fail to see the opportunities to participate in the multi-modal space.

[16] Under Maas, to be point-to-point the car has to be non-private car.

[17] I acknowledge discussions on this matter with Andrew Lezala, CEO of Melbourne Metropolitan Trains. The focus is on partnering with Uber for the 'first and last mile'.

MaaS providers, or themselves, as a first and last mile strategic partnership should be entirely up to them.

These comments set a future in which existing uni-modal urban bus services, as currently structured and contracted, might have reached their useful shelf life. But if is this so, under what conditions might such a significantly disruptive future be limited to some aspects of traditional service delivery? We explore this below, and suggest that the smart technology age, supported by an emphasis on MaaS, has much merit, but is unlikely to be a panacea for all bus service provision. There are many features of the new digital age (see Global Mass Transit Report 2014, Zielinski 2011) inspired model of service provision that will not or should not replace the existing ways in which buses are used to service some of the existing user segments – the main change will unambiguously be in the way in which provision of real-time passenger information tailored to a specific mode can improve the traveller experience, including its efficient connectivity to other modes.

We are, however, particularly interested in how we might mould a mixture of 'Uber' type point-to-point services with existing bus services, to deliver a hybrid multimodal service model, and what this will mean for future bus contracts. 'Uberisation'/digital technology is about providing more service points in the spectrum between buses and conventional taxis. If conventional regulated taxis are at the far right of the spectrum, Uber X (or similar) would be just to left, Uber pool (or a similar car point-via-point(s) to point)[18] next left, and then there is a large gap with conventional bus services at the other end of the spectrum[19]. What might be the options that fit within this gap? It is the far left, however, of the spectrum (i.e., mass transit) that is of special interest in terms of its impact on contract design, and also is of interest in the broader context of congestion on the roads.

4. Future Service Delivery Options in the New Digital Age

Maas opens up opportunities for greater customer service and potential reductions in public subsidy for public transport services, many of which are currently inefficient in terms of cost and network effectiveness[20]. MaaS has the very real opportunity to match customer needs more closely to service supply and to reveal the real contribution of conventional public transport services; however, how much of this can be achieved through market forces compared to government regulatory settings is something that we learn more about as new MaaS initiatives enter the market to compete and are tested over longer periods. What is of

[18] RydHero is a new initiative in Australia specialising in a bookable system to take children safely to and from school. The cost is $15 for the first child for a distance up to 5 kms ($5 per extra child) and then a cost based on distance ($1/km) and time. See https://rydhero.com.au/. In the USA tots2Teens was launched in late 2015. Tots2Teens has grown significantly with four vans and drivers, and it transports 43 children to 23 locations in Bettendorf, Davenport and Pleasant Valley, Iowa.

[19] We could broaden and generalise this even more in terms of existing bus services which are currently fixed on a number of dimensions, and that disruption and increasing flexibility could be induced in all dimensions to a different degree giving rise to a whole plethora of different outcomes.

[20] In Australia, the greatest component of the bus subsidy is linked to school children. The existing school bus subsidy scheme involves free public transport. Overall, the farebox recovers around 30-40 percent of the costs of regular bus services in NSW (which includes the school bus subsidy scheme). A challenge for competitive mobility service providers in the school market in particular is the cost to the student (or their household) and the extent to which government believes that these services might be substitutes for conventional bus services and eligible also for public subsidy. This is unlikely to occur if there is no significant saving in the subsidy paid out under current bus contracts.

especial interest is the extent to which providers of conventional public transport will join the MaaS bandwagon as a way of complementing or indeed competing with their existing service provision. I have referred to this as the 3Bs future – Budgets, Bundles and Brokers. The roles of existing public transport providers might change as they see opportunities to be brokers for multi-modal bundles of services (like Telco plans or packages), in which they may no longer deliver services themselves (or this becomes a totally separate business), but act as a broker, which may still require some public subsidy in some service components that cannot be commercial under the MaaS banner. The amount of subsidy is an unknown, but an important question currently being asked by regulators, with the supplementary question of whether the amount of public subsidy currently paid out for conventional public transport services will no longer be required as some services are replaced with MaaS services. Whether this will result in a net reduction in public subsidy, or not, is a topic for ongoing research.

The MaaS landscape is almost certainly to require revised regulations, for many reasons including a consideration of an outcome which might be too much service at too high a price. However there is a caveat – with such a variety of mobility service opportunities under MaaS (specifically with a purchased package where bus, train, bicycle, case pooling, point to point taxi like services etc.), that the market choices are likely to be such that price exploitation is less likely to occur, especially with many plans on offer from different mobility service providers. Clearly, a regulatory regime will need to monitor this in order to avoid the classic monopolistic competition outcome for the taxi industry, or the oligopolistic outcome for other modal sectors such as the bus industry.

A starting position is a consideration of the conditions under which point-to-point MaaS, supported by smart booking technology, can be provided as a substitute for conventional urban bus services, where the latter are typically offered under an areawide contract that is either competitively tendered or negotiated (exceptions being route based tendered contracts as in London, for example) – see Hensher (2017) for an overview of the various procurement models. Existing contracts in many geographical jurisdictions provide regular public transport services (timetabled), contracted school runs (also timetabled) and charter services. The question of interest is whether some of these services might be better delivered by point-to-point smart booking transport or whether the nature of transport service required makes the new digital inspired smart MaaS an inappropriate substitute? This issue is being investigated by Hensher et al. (2017) since it will provide important information on preference substitution for various MaaS plans, some of which will include within the plan some amount of continued use of conventional bus services which can be identified as a maintenance of bus trips by conventional bus or a reduction.

The majority of the literature on MaaS appears to focus on a changing role for the car[21] (see the selected set of URLs in the reference list), becoming a vehicle that is used but not owned, with cars available to be booked for a point-to-point trip, with or without a driver in the future as autonomous vehicles come on stream in volume. Just because the technology is

[21] A commonly heard concern with offering a car without a driver is how it gets to the customer and how it gets back. While it is not such a problem in the inner suburbs, there is a difficulty in outer suburbs where MaaS really holds potential. The hire car proposition on weekends also faces this problem (not an improvement on the existing regime), and is thus unlikely to incentivise people to get rid of their cars. Car club schemes in operation at present also face this problem as they only work with the density in inner suburbs (where fixed route transit works really well anyway).

available at present in small scale does not suggest that it can be scalable to dominate all bus market segments. Specifically, we can reasonably see a case for very thin demand contexts such as late evening bus services in suburbia where there are few if any individuals using the buses, to have a point-to-point (or even point-via-point-to-point) bookable service by car that can be offered by any of a number of service providers, including incumbent bus operators[22]. There remains however the matter of the price compared to a regular bus fare and the extent to which government sees merit in subsidy support regardless of whether curtailed bus services were subsidised[23]. Although subtle, this may risk the point of MaaS which is that the individual demands are met by a service and not that a service exists for an individual to take advantage of.

With a competitive spatially local market for such MaaS, the travel times and fares can be structured to win business (including strategies and incentives to retain business for repeat travel), although we anticipate that fares will be higher than those offered by conventional bus services. This initiative could remove the need for some conventional bus services, and whereas it would not necessarily save on buses, it would be expected to reduce labour and maintenance avoidable costs. The point (and via point) to point car based service, if managed well, can also provide an opportunity for a bus business to grow patronage that previously used a car (be in park and ride or kiss and ride) or walked from the station to home etc. This then becomes a way of increasing the viability of a bus operator, as well as reducing the amount of money paid by government (maybe not to a great extent) through typically gross cost contracts to a bus operator.

For school bus contracts, it is unlikely, but not impossible, that the smart point-to-point service model would apply, and since in most contexts in many countries, including Australia and the USA, school children are the backbone of their patronage, the future of point-to-point services is likely to be focussed primarily on the very small segments of the non-school children market[24]. However, as a counter argument, some social aspects may push parents into using smaller bus-like vehicles with point-to-point travel provision (a facility in the 2016 legislation which is now possible in NSW provided that the bus has a carrying capacity not exceeding 12 seats). Parents are also increasingly strongly driven by safety associated with the notion of ‘stranger danger’, including who they might meet on a bus (although this tends not to be an issue with exclusive school buses). Combined with the growing danger of getting to and from the bus stop, more specific service transport might be tempting, which reinforce a growing preference of parents to have their children only mix with other children that the parents know.

So the question then becomes – which bus-based services could be re-focussed as MaaS with some amount of improved point-to-point servicing? The substitution from bus to car sounds appealing in respect of a point-to-point experience, but it is likely to be at a higher monetary cost to users (even if a quicker journey time and elimination of transfers). The RydHero initiative in Sydney is one example of an expensive bookable car-based MaaS for

[22] This thinking is not new, and indeed has been considered for many years under various schemes including dial-a-ride, and subsidised taxis (at the equivalent bus fare). What is different is the use of smart technology to improve the ease with which such mobility service can be provided.

[23] An interesting question is whether any savings to the bus operator can be translated into few vehicles or only a reduction in labour and maintenance costs, and some administration cost reduction?

[24] Liftshare as a point-to-point activity may well be more successful in the rural setting rather than the urban setting as currently conceived.

school children (to school or other events such as sports activities) (see footnote 24, where we estimate the fare is 4 to 5 times higher than the subsidised bus fare) which needs monitoring, with an opportunity to obtain estimates of fare (price) direct and cross elasticities of demand.

If there is ride sharing (e.g., Uber pool, or RydHero pool[25]), then point-to-point may become 'point-via-point(s) to point'[26], which might still be appealing; however it starts to take on the more conventional public transport service feature in contrast to the private vehicle feature promoted by MaaS associated with 'Uberisation as Uber X or RydHero X'. Depending on the number of individuals ride sharing, a small bus (as in the Kutsuplus experiment) may be more appropriate than a car (indeed some commuters prefer the bus since it avoids the imposed intimacy of a fully occupied car with strangers). The consequence of a small bus – large bus mix in a fleet is that while it gives a better fit to market needs, it adds cost in maintenance[27] and is unlikely to reduce the number of large buses needed, which is typically in most jurisdictions determined by the peak bus requirement. Furthermore, the fares will definitely be lower than for the car solution (unless government subsidises above the bus fare, which is very unlikely).

One of the most interesting issues that follows under 'Uberisation' is the barrier imposed on MaaS by the geographically defined contract area, and restrictions associated with cross contract area servicing by an operator. Some jurisdictions in many countries already have successful cross regional services (e.g., the MetroBus services in Sydney – see Ho and Mulley 2014), and this may be an opportunity to consider the role of smaller buses and 'Uberised' cars in delivering improved point-to-point or 'point-via-point(s) to point' services that are quicker than conventional bus services. Again, this would have implications on the design of contracts, and opens up an element of competition within and between the modes. But if the fares are too high, then this initiative may not attract users out of buses (regardless of the level of enhanced service). The literature on point-to-point motorised MaaS is, as far as I can find, barren about trip costs to users who currently use conventional public transport. What may be of interest is whether a MaaS package can be designed and offered to the market under a price that is sufficiently attractive to support the occasional (or even more frequent) use of the car-based mobility options, while still supporting the majority of travel activity using conventional public transport. A successful MaaS plan, at least in the foreseeable future, is most likely to contain a mix of such offerings, and is something that is part of a number of the Scandinavian plans being trialled as well as the stated choice inquiry by Hensher et al. (2017).

A hybrid modal model which can align partially with MaaS as a mix of point-to-point and 'point-via-point(s) to point' is worth investigating in some detail, but the decline of conventional bus services is unlikely to occur for many reasons, including those set out above (and the implications of autonomous buses may add greater support for efficient bus services and hence bus-specific contracts). The implications on the design of bus contracts,

[25] For example, RydHero that transports 3 children to school over a distance of less than 5km will be $25 per ride or $50 per day. With many private schools in Australia over 5km from home, this will be much greater, and typically an additional $15 per trip per 3 students, or $80 per day or an average of $26.70 per day. This is considerably higher than the bus fare. A 24 km one way trip for 3 students is $44, so $88 per day. This is $440 per week, suggesting that it is unlikely to be used by most households.

[26] Such as existing services by coach, multi-hire taxi, and mini-bus from an airport to hotels.

[27] As is common with a variety of vehicle types which require materials and resources that are not common.

however, needs fuller consideration; but we might expect the changes to be small and at the margin, at least in the next 5 to 10 years. The focus on any future review of this matter should include establishing how bus contracts might allow for the hybrid delivery of MaaS (involving a mix of modes tailored to maximising the point-to-point delivery requirement), and the continuing provision of traditional large bus services with timetabled routes?[28]

5. Links to Reducing Traffic Congestion and Scalability

One of the highlight arguments for the MaaS model associated with point (and via point) to point 'Uberised' car services is that it 'will' significantly reduce traffic congestion on the roads, which will benefit not only car users but also road-based public transport and freight vehicles. Uber has recently been focussing on selling their product as a tool to relieve traffic congestion (as presented, for example, at the TfNSW Future Transport Summit 2016). While the arguments may have possible merit if car users switch to using such services, there is a risk that replacement of some bus-based services such as conventional timetabled or (school contracted) bus services, especially if they occur in peak periods, may have the opposite effect, with the clearest case for substitution at a time of day when congestion is unlikely to be present. The presence of growing numbers of autonomous vehicles will improve safety but not necessarily reduce traffic congestion, although it might make congestion more palatable given the opportunity to work while travelling in comfort, as well as an expected reduction in travel time variability[29].

Scalability is one of the critical challenges with the MaaS model linked to 'Uberised' styled mobility. Scalability relates to the quantity of services that might be accommodated by a massive shift away from car ownership and conventional large bus use towards individualised or group sharing point-to-point or 'point-via-point(s) to point' services by smart bookable (driver or driverless) cars or small buses.

The congestion argument rests, in large measure, on very strong assumptions about the replacement of car ownership with third party car use; however while it might have merit under a usage reduction associated with an owned vehicle, it is hard to see how the ownership model can be totally played out. If someone chooses to travel by themselves (and they have the right and option under the MaaS model), then we may not see the total elimination of cars owned by households or a significant reduction in congestion (although it only takes approximately a six percent drop in car use to deliver travel times aligned with school holidays in many countries which are seen by travellers as very acceptable[30]). Where are the cars coming from to service out of town travel, especially at periods of peak demand?[31]

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[28] In the Sydney context (or other jurisdictions with electronic ticketting), this review can be aided by an analysis of the tap on tap off Opal data, the electronic ticketing system, available on the public transport network.

[29] This has interesting ramifications for how much car users are willing to pay to save time. We speculate that the value of time savings will decline.

[30] This finding is reinforced from opinion surveys undertaken by the Institute of Transport and Logistics Studies, see http://sydney.edu.au/business/itls/tops

[31] What about trips out of metropolitan areas – point-to-point? People undertake many spatially disparate activities and can the mobility services model support this? Yes if there is a stock of accessible vehicles on demand that you can hire. But if everyone wants to hire on a long weekend, will there be enough vehicles? If some people retain ownership of a car, maybe they would be willing to offer it up into the Uber style mix but without a driver? However, if you have fewer cars and they do the same kilometres as several cars you have

If households do not own cars, someone has to (even if leased from manufacturers or brokers, the latter as a possible future booming business[32]), and the volumes are expected to be huge. It is not clear whether Uber-style services have plans to own cars or not[33]. Uber and the like might not necessarily be the company that owns the car on their own, but they might be aligned with a car company in owning a fleet of vehicles, and therefore have direct impact on the policies and procedures that are set in place. Organisations that have shared cars today (e.g., Go Get cars) are unlikely to be able to (or we suspect, would wish to) handle such volumes, and hence the proposition may not be scalable. Maybe individuals could retain car ownership but make their personal vehicle available to an Uber-style pool to be driven by a third party, or implement the 'car next door' which has overcome the insurance issues (see Truffer 2003)[34]? This may have some positive effects on traffic congestion, but not eliminate it. The main advantage is that the car is not parked under an Uber plan, and can be used again by another party from the destination location of a previous user; whereas under private ownership it will be parked[35]. Achieving this outcome is likely to face significant barriers – including an unwillingness to allow someone else to use a private car (damage, cleanliness etc. – even if insured), and the inflexibility the owner then has in circumstances that often arise when they need their car. The scalable proposition is challenging and complex and not well thought through, but worthy of further consideration.[36]

6. Conclusions

The adrenal rush for MaaS may not deliver the full solution that supporters are suggesting (or hinting at); however as a caveat it may be premature at this stage in the roll out of new digital-conditioned opportunities to suggest a position on the impact that the proposed model/technology could have on the delivery of services and traffic congestion. While, on the arguments developed in this paper, the MaaS model may not be a panacea for many of big ticket challenges that governments face in delivering an improved customer experience, limited capabilities in the conventional public transport space are still worth looking at, particularly given the likely increase in improved choice for customers (albeit with a wider range of travel times, costs, and risks). For example, we might imagine a future scenario whereby new services appear for people who want to get to the airport at a lower cost but want a faster more personalised/comfortable service compared to that offered by conventional 'point-via-point-to-point' mini bus services (although this does sound like an existing hire car!). A hybrid model has merit, but its capabilities are currently unclear.

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reduced parking requirements but not necessarily vehicle kilometres travelled (VKT). Back running between different drivers may actually increase VKT.

[32] This has very serious implications on vehicle insurance – who is liable when the driver does not drive? Is it the car manufacturer, the developer of the on board software that drives the car, or another agent? Insurance brokers are already working to resolve this matter.

[33] Uber has talked about buying a lot of cars including a fleet of electric cars - http://www.reuters.com/article/us-daimler-uber-idUSKCN0WK1C8, with at least 100,000 Mercedes S-Class cars, but wanting driverless vehicles. However "another source familiar with the matter said no order had been placed with Mercedes-Benz. Daimler and Uber declined to comment."

[34] BMW (through the Mini brand) had suggested a scheme to do this. Owners would get a kilometre fee for renting out their vehicle and a lower repayment fee.

[35] Although as an autonomous car it might well be taken back home without a passenger after the commute and hence will not necessarily reduce the number of car kilometres, it will raise interesting questions are how one values person travel time savings when there are no vehicle occupants. This is being investigated by the author in an ongoing project.

[36] It will be interesting to see, for example, how BlaBlaCar develops – whether it really is rideshare across all walks of life or a way of making it just less expensive travel.

One of the challenges we need to face is to identify where conventional public transport services (as defined by vehicle size and utilisation, optimal load) might be replaced or not with a broad based MaaS plan. Importantly, a subscription MaaS package can include all existing modes and configurations – it is just that the plan builds in greater choice designed to align better with customer preferences than what might be available today for a specific pricing regime. We are not suggesting that conventional public transport will disappear, but it might be expected that some of the offered services are currently best served by other modes such as car sharing.

Many of the opportunities offered through the smart technologies available under the digital rubric will work well in supporting existing transport services, but may not be a driving force to grow MaaS to the detriment of sizeable segments of conventional public transport services. Specifically, the provision of real-time passenger information increasingly is becoming a fundamental element of the service offered by transit agencies (e.g., Cebon and Samson 2011, Nelson and Mulley 2013, Zhang et al. 2011, De Borger and Fosgerau 2012).

A question of particular interest is whether the bus passenger mix today will remain or change in the future under a new MaaS model. If, in the future, the MaaS model does change the local 'public transport' market, will this service all existing groups of bus users in a way that can claim a significant improvement in service delivery, and hence the customer experience. There appear to be many bus settings which are likely to remain as the preferred way of servicing specific market segments. School services, which dominate urban, regional and rural bus service provision in many countries, are likely to have to stay as is, especially dedicated school services and possibly other services that serve a mix of school children and adults (especially the elderly and others without access to a car), unless the preference for transport school children to school by car can be translated into a MaaS option with an attractive pricing regime (something that seems limiting if the expensive RydHero service in Sydney is an indication of the MaaS model). Nevertheless, the challenge remains to explore options where the new technology can make it easier for people to get from home to conventional bus or train services (e.g., imagine a 'Mytrain' subscription service like Spotify[37] whereby a user pays a set fee for someone to shuttle them to the local train station a few kilometres away for an agreed number of trips or unlimited number of times a month). This could provide major benefits for people who are living in low density areas, and be more cost effective compared to less flexible services that are currently not fully utilised.

While the MaaS model supports ride share by many forms of transport, it appears at present to be very dependent on a revised role for the car. We have to be very careful how to accommodate true point-to-point service with multiple occupancy, since it could become 'point-to-via-point to point' services (like coaches from airports to hotels). These could also be buses (of varying sizes) deviating to deliver passengers e.g., Telebus in Victoria. For the contribution of a revised role of the bus in the presence of multimodal MaaS, will there be a sufficient change in bus patronage to or from the bus that can help in a significant way to relieve traffic congestion on the roads? The issue remains to tame the use of the car, and whether this can be achieved by focussing on who owns the car, and whether it will be driverless, all questions of great relevance. Futures involving greater access to the car as the

[37] http://pansentient.com/2011/04/spotify-technology-some-stats-and-how-spotify-works/

mode of choice in a MaaS package will be influenced by the availability of cars offered under varying regimes such as an individual still owning a car and driving it as part of a service pool, offering it up to the pool as an autonomous vehicle, or cars not owned by individuals but supplied by a broker (e.g., a vehicle manufacture) to a pool.

As the MaaS offering is scaled up, we might speculate that a plausible future is one in which the broker role will grow in importance, and especially in a setting where fewer individuals own a car or are willing to make their car available to a pool. What seems missing in the debate and discussions on a new MaaS era informed by smart technology is the role that road pricing reform must play if we are to make a real difference to congestion on the road, and what trade-offs customer are willing to make between travel time gains and the cost associated with obtaining such time benefits (as well as other attributes such as safety, convenience, comfort, transfers etc.). Whether in time, with autonomous cars, we can reduce the amount of cars on the roads and still deliver a high level of mobility, and hence reduce congestion, remains to be seen. The preference for car sharing over individualised service will be a critical factor in establishing the amount of car traffic. Historically, car sharing has not been successful, with some exceptions, but scalability remains a huge challenge. Will MaaS this time around resolve this issue? Time will tell.

The shared economy model underlying MaaS (and indeed elements of a MaaS package plan) can be seen as a way to exploit existing spare capacity (e.g., Uber's use of private cars), but there are regulatory concerns over such a model, and it is possible that MaaS will be based on dedicated vehicles. With dedicated vehicles, it is not certain that MaaS will lead to better capacity utilisation. The implications are unclear at present, and this is a theme we need to contemplate as we move forward in seeing how best MaaS might contribute to serving customers in a cost efficient and network effective manner (including implications on traffic congestion).
While many of the proposed technology-supported opportunities may not be a game changer in terms of widespread spatial improvements in congestion, they could have some meaningful impact and should be part of suite of responses to the problem. For example, benefits around localised congestion hotspots such as an airport[38] could be sizable. Effective congestion management is about applying or enabling incremental improvements and innovation to progressively get more out of the transport network. Given this, customer benefits and potential savings in procurement of services by government (the latter may not be significant) need to be investigated in more depth.

The arguments presented above suggest an open agenda on whether the new digital age of smart technology will actually be enough to resolve many of the pressing challenges associated with accessibility and mobility. What we may end up with is a large amount of ‘icing on a cake’ that is still barren of new solutions (that the customer is willing to pay for) that will make a non-marginal difference to the overall performance of the transport network and the customer experience.

Finally, there is a need for some fundamental research on many of the issues raised in this paper, including investigating the extent to which individuals would be willing to not own a car, and if they own a car, under what conditions they would be prepared to offer it up to an

[38] The airport context is fascinating given that many airports in Australia (and possibly elsewhere) make substantial revenue from parking provision and the MaaS model may make a big dent in this source of revenue?

Uber-styled pool for use by others, and how much are travellers willing to pay to improve the journey experience?

Research using stated choice experiments, with alternatives defined by various MaaS packages, is one way to investigate the potential demand for new MaaS offers (see Hensher et al., 2017). Specifically, with such a smorgasbord of potential offerings, there is value in investigating how the potential market of MaaS would change preferences for travel when they are offered a one-stop access to a range of mobility services, and how much potential users value each item included in a MaaS plan. To this end, Hensher et al., (2017) have reviewed the literature on the various MaaS models and synthesised their features into a choice experiment in which different mobility services are packaged into a plan for respondents to select, as a way of revealing their take-up and preferences for MaaS. An online survey has been conducted in Sydney in early 2017 with mixed logit models estimated to obtain willingness to pay estimates for each item packaged in a MaaS plan. As part of this study we are investigating the extent to which MaaS would change the way Sydney residents travel in the future, including the impact on car ownership, modal shift (and hence existing bus contracts) and induced travel activity.

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References

Cebon, P., and D. Samson (2011) Using real time information for transport effectiveness in cities. *City, Culture and Society,* 2, 201-210.

De Borger, B., and M. Fosgerau (2012) Information provision by regulated public transport companies. *Transportation Research Record,* 46, 492-510.

Farag, S., and G. Lyons (2012) To use or not to use? An empirical study of pre-trip public transport information for business and leisure trips and comparison with car travel *Transport Policy*, 20, 82-92.

Fishman, T.D. (2012) *Digital Age Transportation: The Future of Urban Mobility*, Deloitte University Press, Deloitte Development LLC.

Global Mass Transit Report (2014*) Smartphone Applications in Transit Services: Growing Popularity*. http://www.globalmasstransit.net/archive.php?id=16210, retrieved September 22, 2015.

Hannon, E., McKerracher, C., Orlandi, I. and Ramkumar, S. (2016) An integrated perspective on the future of mobility, McKinsey Report October, http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/an-integrated-perspective-on-the-future-of-mobility?cid=other-eml-alt-mip-mck-oth-1610

Hensher, D.A. (2015) Customer service quality and benchmarking in public transport contracts, invited paper for inaugural issue of *International Journal of Quality Innovation*, 1 (1) :4 Available electronically on SpringerLink: http://www.springer.com/-/0/AU8zf6ebKhf9IB3kPrf- Open Access.

Hensher, D.A. (2017) Public service contracts – The economics of reform with special reference to the bus sector, in S. Ison and J. Cowie (eds.) *Handbook of the Principles of Transport Economics,* Routledge, UK., *Chapter 15.*

Hensher, D.A., Mulley, C.M. and Ho, C. (2017) What are the prospects for switching out of conventional transport services to mobility as a service bundles?: A stated choice investigation, paper being prepared for presentation at the *15th International Conference on Competition and Ownership of Land Passenger Transport* (Thredbo 15), Stockholm, Sweden, 13-17 August 2017.

Hietanen, S (2014) 'Mobility as a Service' – the new transport model? Eurotransport, 12 (2), 2-4. http://www.itsineurope.com/its10/media/press_clippings/ITS%20Supp_et214.pdf . Accessed July 3rd 2016

Ho C. and Mulley C. (2014) Metrobuses in Sydney: How high capacity and high frequency services are benefiting the Metropolitan fringe, *Research in Transportation Economics*, 48, 339-48

Kamargianni, M., Matyas, M., Li, W. and Schäfer, A. (2015) Feasibility Study for "Mobility as a Service" concept in London FS-MaaS Project, UCL Energy Institute, London, May.

Martin, J. (2016) Mobility as a Service (MaaS) – a new way of using ITS in public transport, *Eurotransport*, 14 (4), 2-5.

Nelson, J. D., and C. Mulley (2013) The impact of the application of new technology on public transport service provision and the passenger experience: a focus on implementation in Australia, *Research in Transportation Economics*, 39, 300-308.

Transport for NSW (2016) *Future of Transport Summit*, Australian Technology Park, Sydney, April 18-19.

Transport Systems Catapult (2015) Transport Systems Catapult (2015) Traveller Needs and UK Capability Study. Transport Systems Catapult, October. https://ts.catapult.org.uk/wp-content/uploads/2016/04/Traveller-Needs-Study.pdf

Truffer, B. (2003) User-led innovation processes: the development of professional car sharing by environmentally concerned citizens. *Innovation: The European Journal of Social Science Research,* 16 (2), 139-154.

Wright, S. and Nelson, J. (2016) *Mobility as a Service – Task 1 Landscape Scanning*, (University of Aberdeen), September.

Zhang, L., J. Q. Li, K. Zhou, S. D. Gupta, M. Li, W. B. Zhang, M. A. Miller, and J. A. Misener (2011) Traveler information tool with integrated real-time transit information and multimodal trip planning. *Transportation Research Record,* 2215, 1-10.

Zielinski, S (2011) Connecting (and Transforming) the Future of Transportation: A brief and practical primer for implementing sustainable door- to-door transportation systems in communities and regions, Sustainable Mobility and Accessibility Research and Transformation, University of Michigan, http://deepblue.lib.umich.edu/ bitstream/2027.42/69252/4/100624.pdf

URL online articles:

"The European Mobility-as-a-Service Alliance has been launched".

Kamargianni, Maria. "Feasibility Study for Mobility as a Service Concept for London". Retrieved Jun 1, 2015.

Garza, Brett De La. NextCity: Cubic's Vision for the Future of Urban Mobility". www.cubic.com. Retrieved 2016-02-29.

"Urbanomics Mobility Project Prompts Efficient Urban Growth, a Healthy Economy". www.cubic.com. Retrieved 2015-09-16.

Research, TechSci. "Global Intelligent Transportation Systems Market to Grow at a CAGR of over 10% Through 2020 Finds TechSci Research". www.prnewswire.com. Retrieved 2016-02-29.
"Car Emissions and Global Warming". Union of Concerned Scientists. Retrieved 2016-02-29.
"Ubigo home page (Swedish)". Oct 10, 2015.
"Mobility as a Service - A Proposal for Action for the Public Administration, Case Helsinki". Oct 10, 2015.
"Mobility as a Service – the new transport paradigm" (PDF). Oct 10, 2015.
"Launch of MaaS Alliance". Oct 10, 2015.
"Mobinet home page". Oct 10, 2015.
"Bicycle, Car & CarSharing". www.gvh.de. Retrieved 2016-02-29.
"Home page". Oct 10, 2015.
"Company web page". Oct 10, 2015.
"Uber CEO explains his company's highly ambitious goal to end car ownership in the world". Business Insider Australia. Retrieved 2015-11-02.
"Driving Forward - What's Beyond Self-Driving Cars? | TechWeekEurope UK"
Röhrleef, M. üstra Hannover Creating a “One Stop Mobility Shop“ for Hanover (Germany) https://www.connective-cities.net/fileStorage/Veranstaltungen/Projektwerkstatt_Cebu/Dokumente/Presentation_Mr_Roehrleef_Hanover.pdf, May 2016.
http://www.mobib.be/mobib-card_EN.htm
www.gvh.de/service/rad---auto---carsharing/hannovermobil
www.smile---einfachmobil.at
www.moovel.com
https://tapahtumat.tekes.fi/uploads/ddb30435/Arby_Hans-8909.pdf
https://maas.global/
http://www.ecartec.com/wp-content/uploads/2015/07/Siemens.pdf