A Framework for the New Mobility Industry in Metro Vancouver

Contents

Executive Summary

The New Mobility Services (NMS) industry is growing rapidly throughout the world, providing enormous opportunities to companies and individuals. At the same time NMS poses new challenges to cities. One such challenge is how to structure the industry. If Metro Vancouver takes a free-market approach, large companies may form walled gardens, providing all mobility options within a city through a single monopolistic platform.

Walled gardens are problematic for a city as its residents will depend on one service provider for all of their transportation needs. This would make residents vulnerable to one corporation's pricing, data regulation, and investment strategies. The company that controls the dominant platform can decide which services will be discontinued and which users to accept, leaving users without an outside option if the monopolist fails to serve their needs.

Recent mergers and acquisitions, such as Uber's acquisition of bikeshare startup Jump, show the formation of potential monopolies. Policy makers are increasingly concerned that a large corporation will monopolize their city if the NMS industry is left unregulated.

With ride-hailing soon to be introduced into Metro Vancouver, this is the ideal time to lay out the regulatory framework that will ensure a healthy and competitive NMS market.

We evaluate five policy options, considering their effects on the NMS industry itself, public transport, the taxi industry, businesses, and individuals:

1. Unregulated market
2. Mandatory open data
3. Mid-layer as public utility
4. Exclusive contract with an aggregator
5. Caps on operators

To preview our results, our economic analysis shows that option 3 will best serve Vancouver residents as it provides the benefits of market competition while guarding against the formation of monopolies in the new mobility space. Furthermore, it involves creating a new public utility that will gather and disseminate the valuable data generated by the NMS industry, providing cities with information for setting policy.

Option 1, an unregulated market, is undesirable because strong network effects will lead to walled gardens.

With option 2, mandatory open data, we arrive at a simple yet powerful change to regulation: **no real-time data-sharing means no business license** granted to the operator. Aggregator apps, drawing on data made available by operators, can make the NMS market more competitive, inhibiting the formation of a walled garden. An aggregator app provides route-planning, booking, and payment services for a wide array of transportation options. A competitive NMS market will lower transportation costs and ensure innovative services for the city. On the supply side, option 2 levels the playing field for all providers and allows existing operators and new innovative firms to compete against larger corporations. This policy would foster competitive markets for both aggregators and operators.

Option 3 includes the open data requirement and adds an essential feature: a mid-layer, or computer reservation system (CRS) to gather information, provide oversight, and act as a central clearinghouse for data requests. The mid-layer is an intermediary between operators and aggregators that can be run as a public utility.

TransLink can contract with a developer to design and manage the CRS. There are several advantages to adding a mid-layer. By taking data on all available vehicles from operators and disseminating that data to all aggregators, a CRS eliminates duplicate requests. In its position as the central data clearinghouse, the CRS can request additional data from operators. This can be data on the whole moving fleet of an operator instead of only available vehicles. TransLink can use this data for audit, planning, and congestion pricing. This data can also be shared with third parties for carbon offsets, research, and other purposes.

Options 4 and 5 are strategies taken by other cities. Option 4 involves an exclusive contract between the city and a single aggregator app. This option has been tried in cities including LA, Denver, and Dallas. The intent is to give cities more control of the aggregator space. However, without competitive pressure in the aggregator space there is less incentive to provide an innovative service. This strategy also creates a single point of failure: if there is a problem with the app, all individuals using it are left stranded. We believe that cities can gain the advantages of control by running a CRS, without losing the advantages of competition among aggregators.

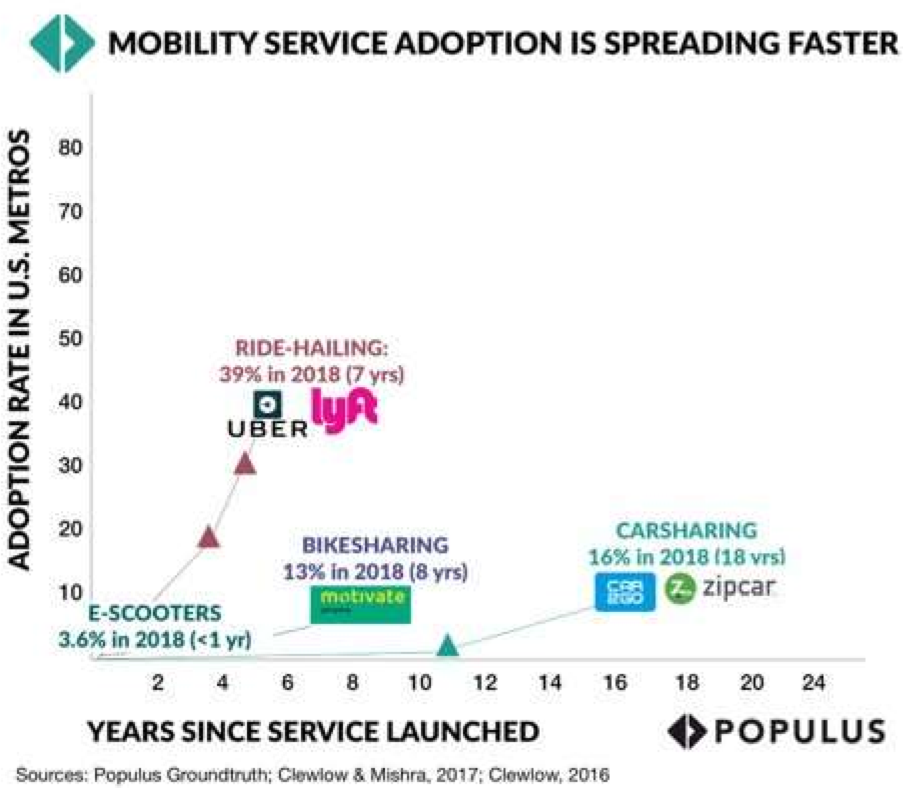
As for option 5, New York City has introduced ride-hailing vehicle caps to curb congestion. Many leading economists agree that caps are an improper measure to tackle congestion. Limiting these services decreases their benefits along with their costs, ultimately reducing people's choices as surely as a monopoly would.

Introduction

This paper analyses policies to structure the NMS industry in the Metro individuals with transportation options such as ride hailing, ride sharing, bike shares, scooters, and microtransit. We aim to inform policy decisions so they can be maximally beneficial to the public as a whole.

As of 2017, the Shared Mobility Market (ride-hailing, bike-sharing, ride-sharing, carsharing) was valued at USD $104.95 billion and expected to grow by 25% between 2018 and 2025[1]. Adoption of NMS in US metropolitan areas has been increasing over the past decade, as Figure 1 shows.

Figure 1: Adoption of New Mobility Services Since Their Introduction



Adoption of New Mobility Services has accelerated in the past decade, with ride-hailing very quickly being taken up by users.

Vancouver's status quo

At the time of our research, there are a number of carsharing options available in Vancouver: Car2go, Evo, Zipcar and Modo. There is currently one bikeshare provider in downtown Vancouver, Mobi, which launched 2016, subsidized by the city. Ride-hailing services in Vancouver are only offered by the taxi industry, but Uber and Lyft are already taking measures for their anticipated service applications in

[1] Shared Mobility Market Size, Share & Trends Analysis Report (Jan. 2019). Retrieved from https://www.grandviewresearch.com/industry-analysis/shared-mobility-market

September 2019[2]. We can expect the arrival of either of these companies to have a large effect on the urban mobility landscape in Vancouver. With many NMS solutions on the rise, this is the ideal time to plan and prepare an optimal environment for the Shared Mobility Market in the Greater Vancouver Area. To judge which policy is a best fit, it is necessary to determine the affected stakeholder groups:

- *New Mobility Industry:* The industry itself has a strong interest in how it is to be regulated, but what benefits the industry may not be in the best interest of others, particularly if these benefits are achieved through monopolization.
- *Taxi Industry:* The taxi industry has already seen disruptions in anticipation of other ride-hailing operators' entry into the market: from a high of CAD $1 million, the value of a license had dropped to about CAD $200,000 by 2016[3]. Early 2019, a few taxi operators came together to join the app Kater. With Kater, users can book taxi rides through an app, making taxi operators practically equivalent services to Uber and Lyft. Through services like Kater and UberTaxi, taxis are becoming integrated into New Mobility.
- *Public Transit:* As the major mobility provider in Vancouver, public transit will see effects from any kind of development in the NMS market. Some policy options may benefit public transport usage more than others. It remains a highly location- and service-dependent question whether ride-hailing can be a substitute or complement to transit. Ride-hailing has been shown to act as substitute for bus and light rail services, while it is complementary to commuter rail (Clewlow & Mishra, 2017).
- *Businesses:* Businesses in Vancouver depend on their accessibility. Easy access to mobility services and low congestion rates can convince more customers to make their way to a business location. Better and more affordable transportation options also broaden the labour market by allowing workers to reach more employers within a reasonable commute time, making the market more efficient.
- *Everyone in Vancouver who needs to get places:* Everyone living in or visiting Vancouver is a potential user of mobility services and thereby affected by any policy decision regarding NMS. This group outnumbers the rest, and so their welfare must be the primary concern of any policy.

These stakeholders may have complementary or opposed interests along any given dimension. Therefore, any policy will need to balance their competing interests to maximally benefit the public as a whole.

Policy options

We will compare five policy options. Some of these are mutually exclusive, while others may be adopted concurrently:

1. Unregulated market
2. Mandatory open data
3. Mid-layer as public utility
4. Exclusive contract with an aggregator
5. Caps on operators

[2] Nathan Caddell, (July 2018). A year early, Uber and Lyft are already battling over Vancouver. Retrieved from https://www.bcbusiness.ca/A-year-early-Uber-and-Lyft-are-already-battling-over-Vancouver

[3] Jeff Lee (Jan. 2016). Even before Uber arrives in B.C., it has the taxi industry in disarray. Retrieved from http://www.vancouversun.com/news/even+before+uber+arrives+taxi+industry+disarray/11755601/story.html

Open API

An Application Programming Interface, or API, allows backend access to the data and functionality of a system. While private APIs allow businesses to open their backend functionality for specific developers or contractors, open APIs are designed to be accessible to a wide array of users, often ones who are completely external to the business. Open APIs and data sharing can go hand in hand when the API allows third party users to collect real time data from the organization. For example, if Uber were to adopt an open API, aggregator apps could collect real time data on the location and pricing of Uber cars in a particular area and display it to app users.

We first look into a baseline scenario, (1) an unregulated market: We ask what can be expected for all stakeholders if the NMS industry is allowed to grow without oversight.

In policy option (2) we introduce our proposal for open data sharing: no data sharing means no business licence for NMS operators. Operators can share their data in real time through an API, or Application Programming Interface, enabling aggregator apps to display all NMS providers alongside public transit through TransLink's GTFS feed. We show how such a policy will affect the degree of competition in the NMS industry and if and how that can be beneficial for all stakeholders.

Option (3) is our main proposal: TransLink should coordinate the development of a Computer Reservation System (CRS) or mid-layer as a public utility. Operators send their data on available devices and pricing to the CRS, which then relays the information to aggregators. This has benefits in coordinating fair data sharing between operators and aggregators and it makes their communication more efficient. In addition, it greatly increases the amount of mobility data available to TransLink. The CRS could request data on the whole fleet of operators' vehicles instead of only available devices, using the additional data for audit, planning, research and third-party business applications.

Option (4) does not include an open data policy; instead, it examines the possibility of an exclusive contract between TransLink and a single aggregator app. Under this policy, TransLink would contract with an app developer to create a single aggregator for Metro Vancouver, with each operator requiring a bi-lateral contract to feed data to the app. Other cities, including LA, Denver, and Dallas, have adopted this policy for the greater control it provides. However, they have run into problems that we discuss below.

Option (5) considers a policy adopted by New York City to tackle congestion issues: caps. Their intent is quite intuitive, but they come with undesirable consequences, which we discuss below.

We start with a discussion of our baseline scenario: laissez faire.

Aggregator Apps and Mobility as a Service

Mobility as a Service (MaaS) refers to the integration of multiple transportation options into a single, on-demand service. An aggregator is an app providing mobility as a service. Aggregators can provide route-planning, booking, and payment services for a wide array of transportation options. They allow users easy comparison between different modes and providers. However, aggregators are limited by the API access provided by operators: without API access there can be no aggregators, and with read-only access, aggregators cannot provide booking and payment.

Policy option 1: Unregulated Market

This section discusses what to expect if we let Vancouver's new mobility market develop freely as it has in many other cities without open data policies, caps, or outright bans on these services. The NMS industry has specific features that make it prone to monopolization and the development of walled gardens.

Why do walled gardens emerge in an unregulated mobility market?

Network Effects

The NMS industry is likely to become a winner-take-all market because it features strong network effects. Stated simply, when an operator becomes more appealing to users as its userbase increases, this is a network effect. We see a strong example of network effects in the social media market: People use Facebook because their friends are on Facebook. The more users join Facebook, the more incentive there is to join.

Multi-sided platforms feature a particular structure of network effects. A multi-sided platform is a firm that connects multiple types of users, e.g. buyers and sellers. Ride-hailing companies are two-sided platforms, with riders and drivers being the two sides. In that case, we can distinguish two kinds of network effects: direct and indirect.

For example, if more started driving for a ride-hailing app, the effect on other drivers would be the direct network effect, while the effect on riders would be the indirect network effect.

Walled Gardens

The idea of walled gardens originated in the tech sector, referring to proprietary environments that allowed a monopoly-like service provider to lock in their customers, while limiting the information and options they receive. David Zipper has applied the concept to mobility (2018). Here, a walled garden would be one company that provides multiple mobility services and also displays all the possible options of getting to a destination. There is incentive for walled gardens to skew what they show so that users choose a more expensive option. Such digital monopolies benefit from locking in their customers. When an end-user is unable to easily switch to another platform, i.e. to vote with their feet, they are also more susceptible to exploitative practices such as excessive pricing or data misuse (Van Gorp & Honnefelder, 2015).

In the case of ride-hailing, we can discern positive and negative direct effects, and purely positive indirect effects.

Positive indirect effects: More riders mean less waiting time for drivers, and vice-versa.

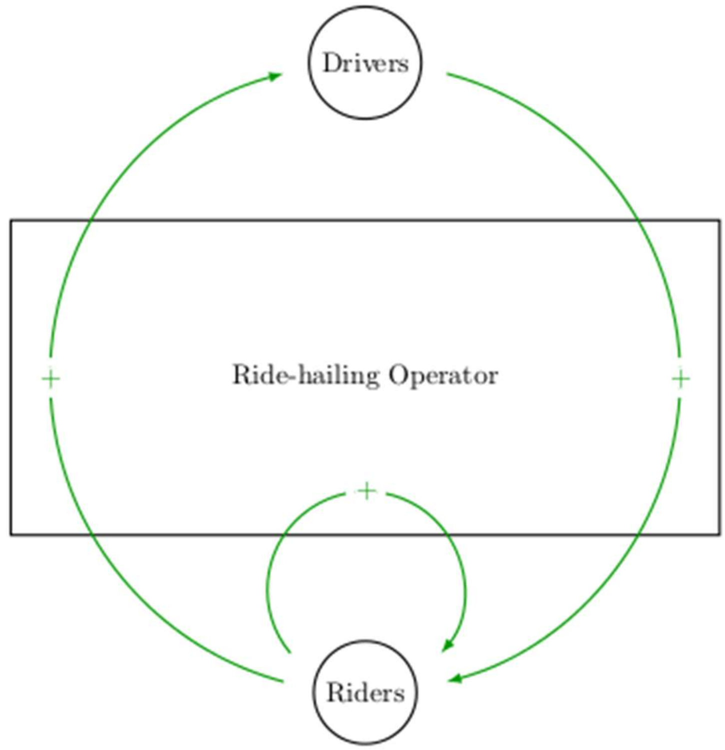
Negative direct effects: More drivers imply that each existing driver must wait longer to find a fare. More riders can lead to longer wait times, higher prices, or both. Surge pricing is an example of a negative direct network effect: a sudden spike in the number of riders forces the operator to raise prices temporarily.

Positive direct effects: The data snowball effect is one particular positive network effect (Carballa Smichovski, 2018). With more users, more data can be collected, leading to an improved service. A large userbase allows a platform to continuously run experiments to improve its algorithms. Past a certain threshold of users, it becomes impossible for competitors to maintain the same quality of service; they cannot obtain enough users to generate the necessary data.

The positive network effects in New Mobility are likely to overwhelm the negative ones, leading large competitors to grow until one captures the entire market.

The following figure serves as illustration for network effects in ride-hailing:

Figure 2: Network effects for a ride-hailing operator



For a ride-hailing operator, riders and drivers interact through the operator's platform. Long arrows indicate the positive indirect network externalities: new drivers reduce waiting times for riders while new riders increase drivers' likelihood of finding a rider close by, thereby reducing deadheading as well as reducing marginal costs and increasing environmental benefits. The direct positive effect of riders on other riders represents the data snowball effect.

Switching Costs

We've explained why network effects can cause large operators to grow, but there is another key feature of this market that makes the growth of large firms anti-competitive: switching costs.

For the customer, it is less costly to use one service provider compared to multi-homing, i.e. flipping through multiple apps and coordinating among various systems. This is particularly pronounced for trips that use multiple modes of transportation, as there are a large number of route options that have to be manually compared and understood by the user. For instance, imagine someone trying to get to Stanley Park from New Westminster. They might have some idea that they should take the Expo line downtown then switch to another mode of transportation for the last leg of the journey. But should they stop at Burrard or Waterfront? It would depend on what vehicles are available near those stations. The user might need to check multiple apps to see whether there's a bike or scooter available at both Burrard and Waterfront, comparing the distances from each to their final destination.

This scenario illustrates what are called "non-monetary switching costs" in the economics literature. Learning the UI of a new provider, registering into the respective payment system and gaining a reputation of being an acceptable consumer are a few prime examples of such non-monetary switching costs. Consider a consumer booking a trip home, having taken many rides on Uber and received positive passenger ratings, and without even having the Lyft app installed. They are far more likely to book their trip home on Uber rather than Lyft, even if Lyft offered a lower price for this particular ride. Users rationally minimize switching costs by exclusively using one or two NMS apps. This allows each NMS operator some market power over users who only use their app, effectively granting them a local monopoly over these users (Srnicek, 2016).

Figure 3: China's Bicycle Graveyards

The bicycle graveyards in Xiamen, Fujian show the aftermath of a game for bicycle-monopoly. Many entered the market at first, but only very few survive today. Source: Reuters[4]

High Entry Costs

The network effects that help a provider grow large in this industry are also a reason for why it is hard to start an innovative service from scratch: *one needs a large user base to attract more users*. For a new firm entering the NMS market a lot of advertising effort is necessary to overcome the hurdle of starting with zero users. Similarly, the data snowball effect means that new entrants will lack the data necessary to provide the same quality of service as established firms, even if they have new ideas that would thrive with a large enough userbase.

In the end there were walled gardens...

The structure of the NMS industry just described is also referred to as winner-take-all market structure. It leads to the creation of walled gardens, where one single platform is able to lock customers into their proprietary environment.

We are seeing the early stages of this in transportation already, as Uber has purchased shared bicycles and scooters, and announced their goal of being the "Amazon of transportation"[5]. Uber's behaviour in Asia is

[4] Alan Taylor, (March 2018). The Bike-Share Oversupply in China: Huge Piles of Abandoned and Broken Bicycles. Retrieved from https://www.theatlantic.com/photo/2018/03/bike-share-oversupply-in-china-huge-piles-of-abandoned-and-broken-bicycles/556268/#img01

[5] Olivia Zaleski, (April 2019). Uber Readies Its Pitch as the Amazon of Transportation. Retrieved from https://www.bloomberg.com/news/articles/2019-04-13/uber-is-said-to-ready-its-pitch-as-the-amazon-of-transportation

another example of their strive for monopoly power: the firm recently lost a prolonged price war in China against competitor Didi, reportedly after having spent USD $1.5 billion trying to win the market. After a similarly costly price war with Grab in Southeast Asia, Uber settled by leaving the region and selling its business to the competitor, but also acquiring 27.5% of Grab[6].

Walled gardens and monopolization are problematic for a city as its residents will depend on one service provider for all of their transportation needs, making them vulnerable to that corporation's pricing, data regulation, and investment strategies. Whoever runs the walled garden can decide which service will be discontinued, and also which users to accept, leaving users without an outside option if the monopolist fails to serve their needs.

Walled gardens are also more difficult to regulate than a collection of small players in a competitive market. It is difficult to get the support needed to pass legislation and regulations when the walled garden is integrated into the everyday lives of society. Users can be resistant to regulations on a service they deem to be convenient and essential to their daily lives[7] (Van Gorp & Honnefelder, 2015).

Could aggregators foster competitiveness and prevent monopolization?

Aggregator apps have the potential to mitigate the anti-competitive features of the NMS market by reducing switching costs for users. To the extent that aggregators have strong user bases, new competitors can gain access to a large share of the market simply by connecting to one or more aggregators.

However, in an unregulated market, aggregators depend on bi-lateral contracts with each operator in order to access their data. Uber and Lyft used to be friendly towards open data, but moved away from this position in 2018. It used to be possible to book Uber rides through Google maps, but as Uber noticed that building a walled garden is more profitable, they silently discontinued their contract with Google.

The pro-competitive nature of aggregators makes them appealing from a public policy standpoint while simultaneously making them unappealing to the companies whose consent they require in order to function. This is what motivates our second policy proposal.

Policy Proposal 2: Mandatory Open API

We propose a simple yet powerful policy to protect competitiveness within the New Mobility space: *No data sharing, no business license.*

By requiring an open API from all New Mobility operators, policy makers can unleash the full potential of aggregator apps. Open APIs put the conditions in place for aggregators that give individuals access to all their mobility options at fair prices, since users will be more price sensitive when they can easily compare competitors.

[6] Jessi Hempel, (May 2018). How Grab Is Giving Uber a Run for Its Money in Southeast Asia. Retrieved from https://www.wired.com/story/ubers-grab-on-the-developing-world/

[7] Nora Young, (April 2019). No single company should have a monopoly on building smart cities, tech entrepreneur says. Retrieved from https://www.cbc.ca/radio/spark/spark-436-1.5107883/no-single-company-should-have-a-monopoly-on-building-smart-cities-tech-entrepreneur-says-1.5107889

In order for aggregators to provide their full potential, the minimal amount of data shared by operators should be the location and price matrix (e.g. rows for different user classes, columns for route type) of every available device.

Before we dive into the specifics of the data requirements under this policy, it is worthwhile to discuss the impact we expect aggregators to have on the mobility market.

What do aggregators bring to the table?

As discussed above, aggregators make the mobility space more competitive by allowing users to discover and compare all mobility options without the added friction of switching between apps. This pushes operators to compete more on the dimensions of price and quality, while also allowing new and innovative firms to gain access to a large user base as soon as they enter the market.

In addition to their pro-competitive features, aggregators also make the user experience better and can lead to more efficient route planning.

Aggregators as first- and last-mile solution for multimodal trips.

Aggregators can combine multiple modes of transportation supplied by different operators, intercomparing thousands of potential routes in a fraction of a second and offering up the fastest, cheapest, or otherwise best options. With an aggregator, planning multimodal trips is just as simple as planning a trip using only a single mode. Without an aggregator, the user has to plan out these routes manually, deciding where and when to switch between operators without the help of an algorithm.

This essential feature also increases the degree of complementarity between different forms of transportation. The arrival of Uber in a large city possibly increases transit ridership by 0.8% (Hall, Palsson, & Price, 2018). Since these cities did not have aggregator apps capable of multimodal trip planning during the time period considered in the study, we can view this as a lower bound for the likely change in transit ridership with one or more aggregators capable of multimodal planning.

Decreasing the cost of multimodal trip planning will have more benefits the more modes of transport are available in the area. Metro Vancouver has a wide array of transportation options, from busses, trains, and ferries to bike- and car-shares, with scooters and ride-hailing on the horizon. As such, it is the perfect environment for multi-modal transportation. We expect that the presence of apps to help coordinate these multi-modal trips will have a significant impact on the number of people taking them.

Long-run effects of aggregators on car ownership

In the long run, by increasing competition between NMS operators, we expect aggregators to have important implications on consumer choices as they result in lower transportation costs and more innovative services. This will allow people to substitute away from private cars. While ride-hailing and private cars both contribute to congestion, ride-hailing alleviates the demand for parking (Henao & Marshall, 2019).

The Metro Vancouver area has some of the highest land values in the world, and the prices charged for on-street parking are far too low to justify the opportunity cost of the land required for a parking spot. In a future where people have access to inexpensive transportation options that do not require parking, the municipalities of the Metro Vancouver area could (and should) reduce or eliminate the minimum parking requirements for new developments and reclaim much of the land dedicated to on-street parking to convert it to higher-value uses: larger lots with more space for housing and businesses, wider sidewalks, and bike lanes.8

Competition in aggregator space

A mandatory open API policy would allow free competition in the aggregator sector. Without the policy, few aggregator apps would be able to survive, as they would have to rely on signing bi-lateral contracts with operators who want to build their own walled garden and not be displayed on other apps. With the mandatory open API policy, aggregators will compete on the merits of their service and user experience, because all operators will be visible on all apps.

The market for aggregators is competitive, as the cost of entry is fairly low and the aggregator market lacks the strong network effects of the NMS industry; an aggregator can offer the same number of transportation options whether it has one user or one billion. As in other competitive markets, we expect the competition to produce a wide array of differentiated options serving different market segments. For example, some aggregators could be targeted to younger, more tech-savvy users, while other aggregator apps might use a simpler display or invest into accessibility options.

Major operators like Uber and Lyft may choose to enter the aggregator space. In doing this, they could prioritize their own services over those of other operators. We are not concerned about this outcome, as unbiased aggregators should outcompete such hybrid aggregator-operators by providing the options that are actually optimal in price and other relevant characteristics.

What data should be shared?

Functionality vs. privacy

There is a minimum of data sharing required in order for aggregators to be able to properly display their options. In order for aggregators to function, NMS operators will have to at least share locations and routes of available (unused) devices as well as a pricing matrix connected to every available route and device, specifying prices as function of usage of the device (e.g. minutes, distance) and who the user is (student, senior, person with disabilities, etc.).

At the same time, privacy concerns impose an upper bound on how much can be shared. We will first discuss data requirements and current standards to achieve a functioning aggregator service, and then address privacy concerns.

The open API policy can require either a "read only" API or a "read and write" API. A read-only API allows aggregators to see the current location and pricing information of any available device in real time

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[8] A possible caveat is that with real time data of routes, pricing, and location of competitors readily available, incumbent firms may have incentives to strategically disable entrants through aggressive pricing and matching their product. For example, suppose a small innovative bikeshare enters the market, with Uber already in place. With data-sharing available, Uber can track each of the new firm's device location in real time and place some of their own bikes nearby, simultaneously offering lower prices, possibly at a loss. An entrant with limited funding may not be able to withstand such aggressive pricing for too long, even if their product is better.

However, this behaviour is already observed without the existence of aggregators: around 2014, it became known that both Uber and Lyft had employees create fake accounts of each other in order to track movement and otherwise disrupt services. The existence of aggregators may make this behaviour easier, but it should not be seen as evidence that aggregators and open data are harmful to the small firm. On the contrary, without aggregators the small firm will find it difficult to exist at all.

and use this information for route planning. The read-and-write API additionally allows for booking and payment.

MaaS in Finland

In 2016, Helsinki became the first city with a transit authority that shared not only read-data, but also payment options. Through its partnership with the read-and-write aggregator Whim, it allowed Whim users to book rides on public transportation. Since 2018, Finnish legislation has required operators to provide their data, with two options for where to provide it: Operators are allowed to provide an open interface through their own website, or they can provide real-time information to the Finnish Transportation Agency's computer reservation system.

Read only may be restricted to planning, but will still alleviate much of the switching cost incurred by users under the status quo. Currently there exist data format standards transit agencies and mobility operators have been using that would allow a read-only API to be implemented fairly straightforwardly: GTFS and GBFS.

As for read-write, there currently exist no data standards that operators and aggregators may follow. In this case it is helpful to consider examples of successful implementations of such an option in the NMS sector: the prime one being the Finland model and a more recent implementation in New Zealand.

These show that it is not necessary for operators to openly share any additional information when going from read-only API to read-write. For aggregators to allow trip booking, the additional requirement is another line of communication that handles booking requests, cancellations, alterations and possibly customer service. This is exemplified by Whim, the read-write aggregator available in Helsinki. The aggregator implements booking communication by having the user query a booking to the aggregator, and the aggregator relaying that query to the respective operator. Whim provides its booking API openly on GitHub[9].

Data standards and ride-hailing

Open APIs can be employed in many ways. First, having operators follow a common data standard will make communication with aggregators easier; the standards available now (GTFS, GTFS-flex, GBFS) cover an important part of the NMS market, but cannot currently accommodate ride-hailing services.

[9] MaaS TSP (Transport Service Provider) Public API. Retrieved from https://github.com/maasglobal/maas-tsp-api

The issue with open APIs and ride-hailing is the dynamic nature of the service. For floating carshare apps such as car2go and Evo, GBFS provides sufficient information for the service: the location, pricing, and fuel level of a stationary, unreserved vehicle. For ride-hailing however, available cars can be on the move, and their availability will depend on the route that the rider wants to take. Knowing the location and pricing of available Uber cars is enough only if one has access to Uber's algorithm in estimating pick-up times and prices for a given route.

Data Standards

The General Transit Feed Specification (GTFS) is a commonly adopted data feed for public transport, providing fare, schedule, and route information as well as a real-time format including estimated arrival times and vehicle locations. GBFS, or General Bikeshare Feed Specification, is a standard for docked and dock-less bikeshares, showing location, pricing and battery level. This standard can also accommodate carshare services. GTFS-flex is a standard currently under development. It can incorporate demand responsive transport into a public transit authority's data feed.

A possible solution is to require ride-hailing operators to give aggregators access to their ride-request API. Aggregators can forward queries to ride-hailing operators each time they plan a route. Uber already provides a tool to integrate such services via their website[10].

Privacy

Mobility data is susceptible to misuse if not treated with care. Even without an open API policy in place, it is possible to track people's movements with concerning accuracy (Riederer, Kim, Chaintreau, Korula, & Lattanzi, 2016). With an open API policy in place, regulatory design must be careful to prevent such misuse from becoming even easier.

[10] Introduction to Ride Requests. Retrieved from https://developer.uber.com/docs/riders/ride-requests/introduction

An essential step to preserve privacy is having operators not share the license plates of available devices, so that one cannot track where a specific car disappeared from the feed and then reappeared later. Even today in Vancouver, carsharing operators car2go and Evo openly display license plates of available vehicles. A way to enhance privacy is assigning dynamic IDs to devices that would be changed during trips according to a given rule.

New Zealand

The application launched by the Transportation Agency of New Zealand streams data on available devices and pricing to end-users. Similar to Whim, booking queries are relayed via the aggregator from rider to operator without interference from the aggregator. For multi-modal trips, the aggregator just separates the users' query into multiple queries corresponding to each operator used in the trip. Their aggregator does not store data on the user side, it would be stored on the user's phone. They also anonymize the operator side. They only stream operator data based on mode and type of vehicle, with the operator anonymized. This is done as some operators are concerned that competition may learn too much about their algorithms and strategies if their data were streamed openly.

Preventing malicious compliance

Just because you require something doesn't mean you will achieve your intended result. Operators may engage in malicious compliance to keep users from adopting aggregators. They could do this in a number of ways, for instance by showing worse prices to the aggregator, charging a prohibitive price for data requests, or simply slowing down their API to make aggregators slow and clunky.

Experience from different industries applying open API policies suggests that this is indeed an issue: For example, consider travel applications like Expedia. It is unclear whether consumers are actually able to find the best offers for their flights via the aggregator; airlines and hotels can offer better prices through their own websites. Similarly, mileage programs' benefits often are only available when booking through the airline's website, not through an aggregator. It appears that withheld options as well as additional liability issues incentivize users to access an airline-operator's own application instead of the meta-platform. Such strategies encourage users to go back and forth between aggregators and operators, undoing the advantages of an aggregator.

Sound incentive design can curb malicious compliance: Hotel aggregators such as Expedia and Booking.com punish hotels that discriminate between their own website and the aggregator (Hunold, Kesler, & Laitenberger, 2018). If a hotel offers lower prices on their website, they tend to get listed lower on the aggregator.

Expedia can enforce compliance because a large number of users go to Expedia for their travel needs. However, the aggregator market for mobility services is in its infancy. Before it gains a sufficient user base, it will be vulnerable. Maliciously compliant operators may prevent aggregators from taking off. We can't predict all the possible ways a large operator could push against open data, so we simply say that regulators must be in a position to monitor them and detect attempts to undermine the aggregator space when they occur.

Our third proposal provides the platform for regulators to gather the data they need to monitor the market.

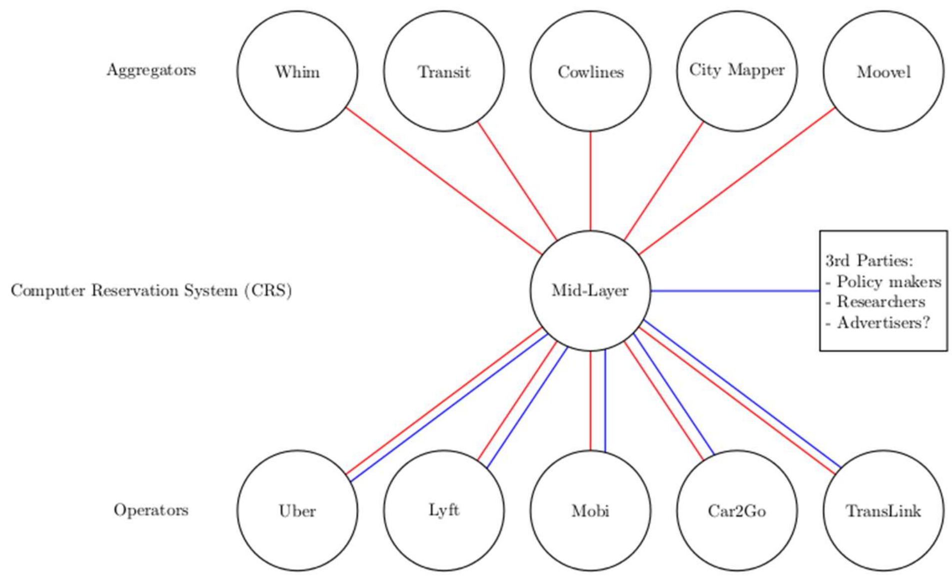
Policy Proposal 3: Mid-layer as public utility

This section discusses the benefits of introducing an intermediary communication structure between operators and aggregator apps, which we will call the mid-layer, or computer reservation system (CRS). This proposal incorporates all the features of mandatory open API, but adds this mid-layer as a central clearinghouse for data. We propose that TransLink act as enabler and manager of the mid-layer, while contracting an external developer to design and maintain it.

This position will allow TransLink to reap the benefits of control over the aggregator-operator ecosystem and its generated mobility data, while outsourcing the technically demanding task of maintaining the mid-layer infrastructure.

When data-sharing is mandatory, there is a lot of communication that will have to go on between aggregator apps and operators. An immediate effect of introducing a mid-layer is decreasing the amount of such communication by an order of magnitude. The following graphic gives intuition of the relationship between aggregators, operators and the CRS:

Figure 4: The Aggregator Ecosystem with a Computer Reservation System (CRS) as Mid-Layer



The CRS or mid-layer acts as an intermediary between operators and aggregators. As a central clearinghouse for data requests, it can reduce the cost of data sharing. It can also gather additional data (represented in blue) beyond what is necessary for the aggregators, for use by third parties such as public agencies, researchers, and possibly private businesses.

Stronger bargaining position to prevent malicious compliance

The mid-layer serves as protection against possible malicious compliance in the data-pricing dimension. Without a mid-layer, it would be at the operator's bidding how much they would ask each aggregator to pay for a data request. One can imagine Uber agreeing to share their data, but then asking $100 per request and making the aggregator service infeasible.

With a mid-layer in place, this can be prevented: even now, all NMS operators in the Vancouver area are required to pay a licensing fee. Given a projected value of the data sent to the mid-layer, its profitability can be internalized and passed on to lower the licensing fee for providers. The data passed on to aggregators can then be charged a fair price determined by the CRS.

Data is gold: The mid-layer as central data clearinghouse

The position of enabler and intermediary gives TransLink access to much more than control over shared data pricing. The mid-layer could require more data to be sent from operators than what is being fed to aggregators. For example, aggregators need only know which trips and devices are available at any given moment, whereas the mid-layer can request to see all devices and all trips taken at any point in time. This has various advantages.

This data is tremendously valuable. TransLink can use this additional database to have immediate access to audit any operator on the market, make better informed planning decisions, and implement congestion pricing. Additionally, the data can be sold to third parties to certify carbon offsets, sell ads, and do urban/transportation research.

Efficiency gain

The improved efficiency in communication from having a CRS immediately shows in figure 4: In the absence of a mid-layer, a market with, say, 10 operators and 10 aggregators would require real-time data transfer along 100 connections in the network (10 connecting each operator to all 10 aggregators). With all operators sending their data to the mid-layer, and all aggregators getting their data from this layer, there are only 20 connections to maintain (10 connecting operators to the mid-layer, 10 connecting the mid-layer to the aggregators).

Read-write with a CRS

We do not believe that there is an advantage in having the mid-layer house its own booking facility for read-write aggregators. The additional communication to be done for bookings is more of a privacy hazard than benefit in additional, useable data. The New Zealand model is a practical option, as outlined above.

We next analyse two policies that other cities have implemented: exclusive contracts with an aggregator app and caps on ride-hailing operators. They shared some of the goals we hope to achieve with a combination of open data and a mid-layer, but neither policy is ideal for reasons we will explain in the following two sections.

Policy Option 4: Exclusive Contract with One App

Some cities, such as Denver, Los Angeles, and Dallas, have opted to contract with a single firm in order to create one exclusive aggregator app for the entire city.

This policy option does not require open data. With just one aggregator, there is no need for a mid-layer. The state simply needs to require NMS operators to make their APIs available to the exclusive app.

Appeal depends on negotiation outcomes

Making API sharing mandatory is again a necessity to ensure all of an aggregator's benefits. The read-write aggregator offered by the transit authority in Dallas is an example of this necessity. Uber and Lyft could be convinced to have their service displayed on the app – however, users have to specify upon login which of the two providers they want to see displayed on the aggregator. That is, Uber and Lyft will never be displayed at the same time on the app. This design undoes many of the competitive benefits that are expected from having an aggregator. In the case of GoPass, the switching costs users face when comparing multiple separate apps are still there.

Fragility in the aggregator space

In principle, the competitive and pro-consumer benefits of aggregator apps could still apply to an exclusive aggregator. However, these benefits will only manifest to the extent that aggregators can attract a sufficiently large user base. With only one aggregator, policy success depends on the quality of that app.

A competitive market in the aggregator space provides a more robust set of options to consumers. If consumers can choose the best of many apps, instead of just one, they will get better service. A competitive market for aggregators will push each aggregator to innovate in order to attract users. A single monopolistic aggregator will not have this competitive pressure, and it will present a single point of failure for the entire aggregator space. *If it is mismanaged or fails for any reason, the entire aggregator space will fail with it, and leave users stranded.*

The worry that an exclusive aggregator could fail is not theoretical. The GoLA and GoDenver apps, developed by the Xerox corporation for Los Angeles and Denver, are gone. They were released to much fanfare in 2016, then quietly removed from the internet at the end of 2017. You can't download either app. Their websites are dead links. The companies responsible for making them have not responded to our emails.

While it is clear that these apps have failed, we can't be sure why. Meanwhile, competitive aggregators without exclusive contracts like Transit, Cowlines, and Moovel continue to thrive. We believe that Vancouver can achieve all of its policy goals without an exclusive app.

Policy Option 5: Caps on Operators

Every car on the road produces negative effects on other people. Cars pollute, generate congestion, take up (underpriced) parking spaces, and occasionally crash. Ride-hailing cars are much the same as private cars, except that they spend more time driving around looking for passengers, adding to pollution and congestion. On the other hand, they alleviate demand for parking. Their impact on crashes is more ambiguous: On the one hand, more driving can lead to more crashes. On the other hand, people are less likely to drive drunk if they have an easily available alternative.

Worries over the congestion caused by ride-hailing vehicles has led New York City to implement a cap on the number of ride-hailing vehicles, which went into effect February 1st, 2019.

Simple fix, complex consequences

Caps may be appealing as a quick fix, but will likely turn out to be negative in the end. In theory, a cap could work to balance out the costs of pollution and congestion if it were set at precisely the right level. A cap set too low may destroy more value than it creates.

But this discussion begs the question of whether ride-hailing vehicles are net negatives in need of a cap. It depends on how people change their behaviour in response to the cap on ride-hailing vehicles.

With ride-hailing trips made less available and more expensive by the cap, more people may choose to drive in private cars, creating a similar amount of pollution and congestion. In fact, more people may choose to continue owning private cars if they know that they cannot rely on ride-hailing for the small fraction of trips that can't be taken using public transit or other services.

New York City in particular should be wary of this policy, given its historical experience with taxi medallions. In 1937, the city decreed that there would be no more than 11,787 licenses on taxis (medallions), a number that wasn't increased until 1996. The price of these medallions rose from USD $10 to USD $1 million in the early 2000s. While this policy greatly benefitted the owners of medallions, it did so at a cost to consumers. Finally, ride-hailing destroyed the value of these medallions: by 2016, medallions sold for only USD $200,000[11]. NYC now faces a little crisis of its own creation, which was caused by an 80-year old, well-meant but ill-informed piece of legislation.

When surveyed about these caps, there was near-universal agreement among economists that they would make average residents worse off, see Figure 5.

Figure 5: Expert opinions on ride hailing/sharing caps

Source: IGM Economic Experts Panel (http://www.igmchicago.org/surveys/ride-sharing-caps-2)

There are simply better policies for dealing with the potential negative effects of ride-hailing vehicles. As we mentioned previously, a CRS gathering real-time location data from all vehicles could be used to set optimal congestion prices on those vehicles if congestion is a concern. Pollution can be addressed through taxes directly targeted at the pollution, such as BC's already-existing carbon tax.

Conclusion

The New Mobility Services industry has the potential to transform Metro Vancouver. It's important to get the regulatory environment right in order to ensure this transformation is a positive one for the city and its residents.

Many of the policies put in place when this industry is introduced may be difficult to change once a particular status quo has been established. Not only will the dominant firms have greater political power to oppose pro-competitive regulations, but even positive regulatory changes can be disruptive once people come to depend on this industry for their transportation needs.

Having reviewed five policy options Metro Vancouver can adopt, we believe that the best policy is one with an open API requirement to create competition in the aggregator space and a Computer Reservation

[11] Danielle Furfaro, (July 2016). Taxi medallion owners find their dreams dashed by Uber, Lyft. Retrieved from https://nypost.com/2016/07/05/city-lets-uber-and-lyft-cannibalize-the-american-dream/

System acting as intermediary and public utility. Aggregators are pro-competitive and pro-consumer; by allowing users to easily access and compare different mobility services, they put downward pressure on prices and draw attention to new and innovative entrants in the New Mobility space.

A CRS run as a public utility will both lower the costs of sending data and allow for data collection for public uses. The additional control the city might get through an exclusive contract with one aggregator can be achieved through control of the CRS, without sacrificing the dynamism that comes with a free market for aggregators. Furthermore, if congestion becomes an issue, there's no need to put caps on vehicles as New York City has; the data gathered using the CRS could be used to implement congestion pricing, a policy universally preferred by economists.

We believe that these policies will help make Vancouver a transportation leader among cities, with the New Mobility Services industry seamlessly integrated into the city's transportation networks.

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