Transportation Technology and New Mobility Options

City of Guelph Transportation Master Plan

Background Paper Series

Transportation Master Plan

City of Guelph

Making a Difference

Guelph Transportation Master Plan

Moving Guelph Forward

Guelph is growing and how we move around our city is changing. As a result, we are exploring transportation options to make our city move better in every way. Through the Transportation Master Plan (TMP) update, we will review all of the ways we move: walking, cycling, riding transit, driving, trucking, and using trains. Our goal is to ensure that we offer diverse travel options, have appropriate transportation capacity, and maintain a high quality of life for both existing and future residents and workers.

The updated TMP will look at transportation planning in Guelph beyond 2031. The main objectives of this update are:

- To ensure that the new plan builds upon current policies, including the Official Plan and other master plans that have been approved since 2005;
- To recommend new policies and guidelines that reflect the vision for our community and balance mobility, environment, and efficiency, while prioritizing safety and access for all travellers; and
- To explore how new, evolving technologies and travel services will shape the future of transportation in Guelph.

This paper is part of a series of background papers intended to communicate information, key trends, and concepts. These will form the foundation of and set the strategic direction for our updated TMP. The papers are intended to support conversations in the community and within City Hall about how we plan for the future of mobility.

The series includes the following papers, which are all available at **guelph.ca/tmp**:

- **Transportation Technology and New Mobility Options**
- **The Changing Transportation System User**
- **Transportation and Building 21st Century Cities**
- **Road Safety**
- **Network Planning**
- **Transportation System Resilience**

Each of the background papers opens with an introductory primer on the topic before it examines key global trends, considers how these topics and trends are currently addressed in Guelph, and concludes with an analysis of the implications of that topic on planning Guelph's future transportation system.

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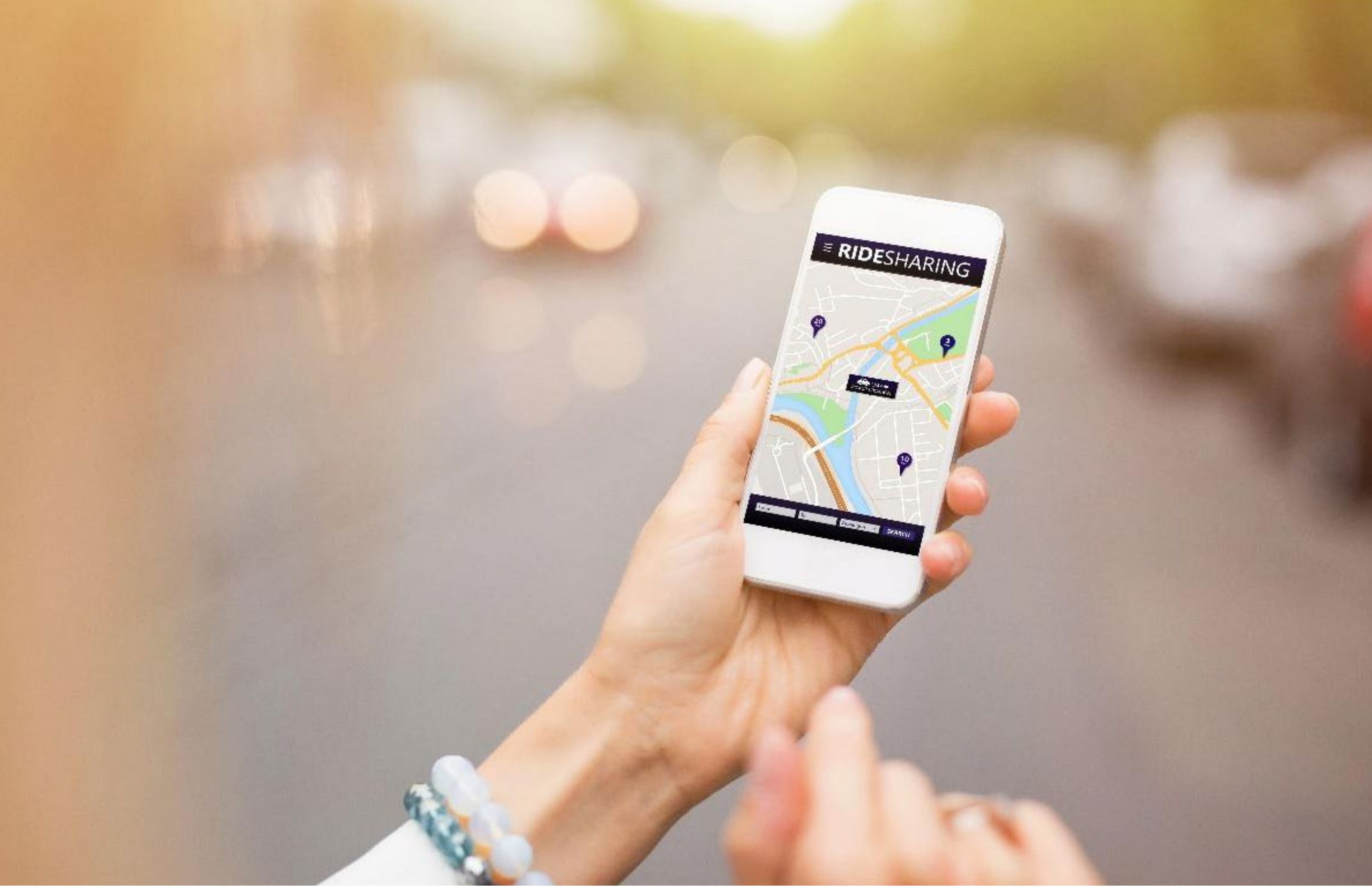


New Mobility: A Primer

Over the last few decades, amidst the rapid evolution of digital technologies and ever-improving connectivity, new transportation-related innovations have emerged at an unprecedented rate. These innovations are changing how we move, shaking up the transportation sector, and reshaping our cities.

Understanding the changes in how people and goods move in urban environments is critical to forecasting what transportation will look like in the future and knowing what we should plan for. This paper discusses a number of new and emerging technology-driven changes to mobility that exist in communities today or are on the horizon.

Specifically, the paper covers:

- Ride-hailing
- Microtransit
- Micromobility
- Mobility-as-a-Service (MaaS)
- E-commerce
- Electrification
- Self-driving Technology
- Connected Mobility

Starting with an introduction of each of these technologies and new approaches, this paper discusses how they are being implemented around the world and outlines what is already present in Guelph today. The paper concludes with some key takeaways about new mobility and how it will affect transportation plans for the future.

Ride-hailing

Ride-hailing is an on-demand service offered by transportation network companies (TNCs). Since the early 2010's, TNCs have been springing up in cities and allowing individuals to use their own car to transport passengers for a fare that is often cheaper than a traditional taxi service. Ride-hailing services are typically booked and paid for via an app that also allows both drivers and passengers to rate each other.

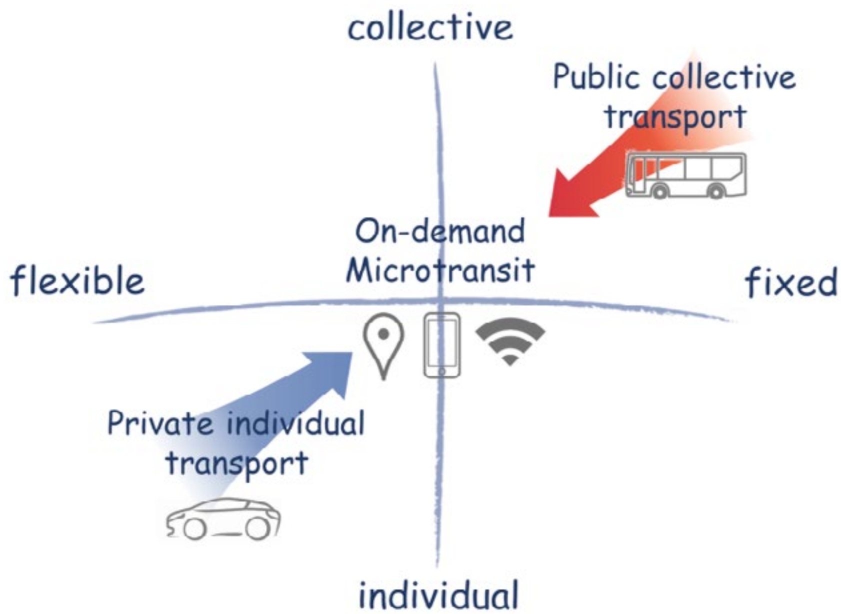
Uber and Lyft are the most well known TNCs but there are many other companies offering ride-sharing services. Smaller TNCs often tend to be limited to a specific local geography.

Microtransit

Microtransit - also known as "dynamic transit" – is a demand-responsive public transit service that uses smaller vehicles (e.g. vans, minibuses, etc.) than would be expected with a conventional service. Microtransit can offer on-demand or a form of fixed-schedule services with either dynamic or fixed routing. Within its service area, microtransit may provide door-to-door service or it may have predetermined stops and only serve the stops where a trip request is made. The scheduling, dispatch, software, and operational aspects of microtransit can be operated by the public transit system, by a third-party service provider, or through a partnership between a local transit system and a private company.

With these attributes, the microtransit model combines some of the flexibility of single user transportation with attributes of a conventional public transit service. This unique role presents great opportunities to fill in gaps in the traditional transit network.

Figure 1: Visual representation of the on-demand microtransit model[1]



1 Reproduced from Smart Circle, "The rise of the Mircrotransit movement.". https://www.smart-circle.org/blog/microtransit/

The cost-effectiveness of microtransit is dependent on its service area. Though microtransit is more convenient for the rider than conventional transit service, it can also cost significantly more to serve the same number of riders with microtransit. The microtransit model is often most economical in smaller low-density service areas where potential riders are spread far apart from each other, making it challenging to offer an efficient and convenient fixed-route service.

Micromobility

Micromobility refers to the use of light vehicles that can carry one or two passengers at a time, such as bicycles, scooters, and even small vehicles. Micromobility can be human-powered or powered by an electric motor. Users typically start their trip upon coming across an available device and can end their trips anywhere within a geo-fenced area, leaving the shared device avialable for the next user. Access to micromobility devices is often facilitated through a smartphone app, which allows users to locate available devices, commence or terminate their trip, and pay for the service. These innovations can provide relatively low-cost and convenient options for short trips, making them especially attractive within urban centres.

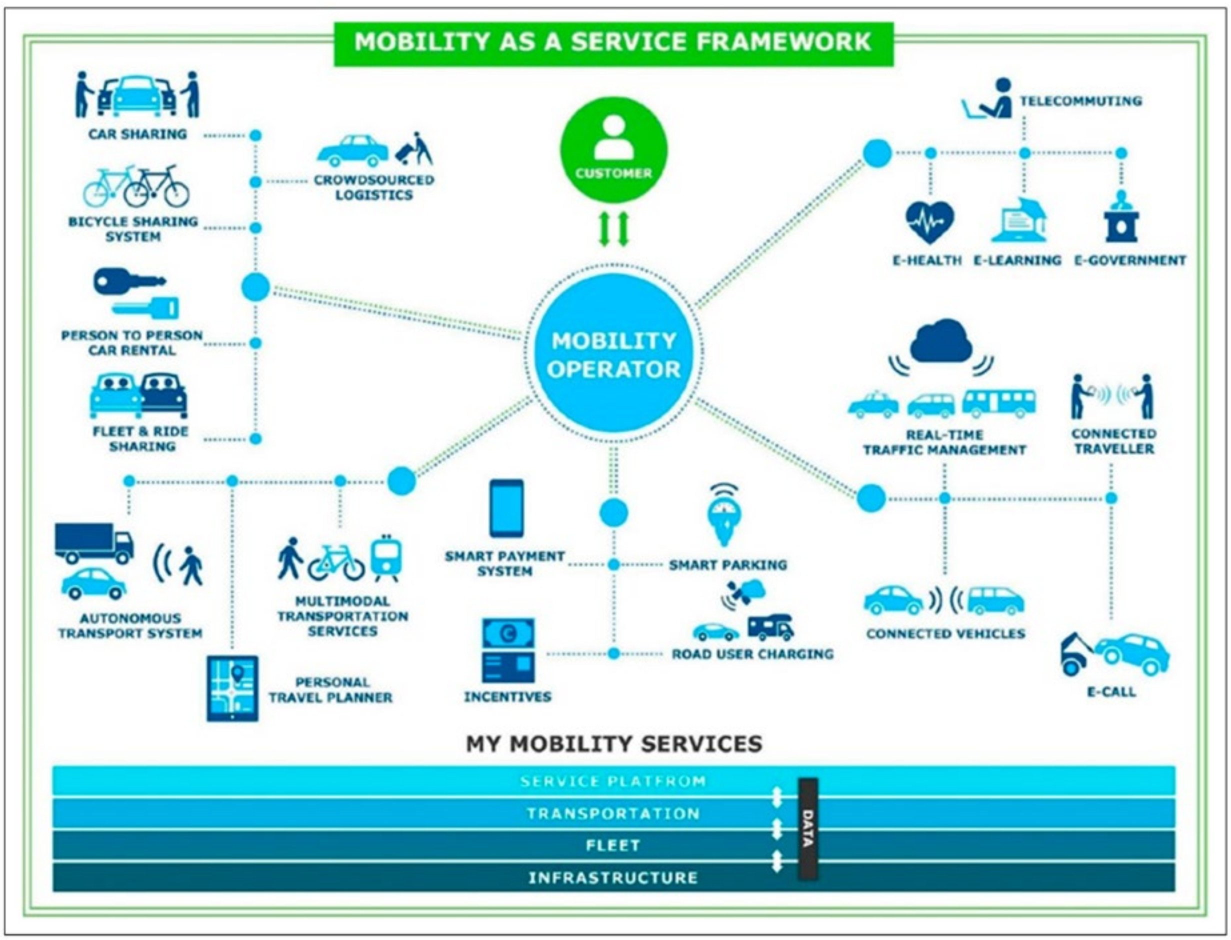
Mobility-as-a-Service

Mobility-as-a-Service (MaaS) is an emerging user-oriented philosophy that takes advantage of digital platforms and real-time data to get a user of the service from point A to point B in the most convenient and personalized way possible for one single fee.

MaaS leverages modern transportation options to optimize personal mobility. When planning a route, MaaS platforms can link transit, ride-hailing, car-sharing, micromobility, walking, and more to create one seamless trip for the user of this service.

MaaS also prioritizes user preference: MaaS platforms often allow users to influence route planning by indicating their preferred trip attributes such as modes of travel or their preference for trade-offs between the number of transfers and travel time. MaaS's combination of trip planning, booking, and payment in one location is a key factor of its convenience.

Figure 2: Illustration of Mobility-as-a-Service[2]



2 Reproduced from Kivimäki, M. "MaaS-Finland on the leading edge," Mobility as A Service Seminar and Networking Event, Ministry of Transport and Communications: Ventaa, Finland, 2014

Delivery Services

Since the early 2000s, the ever-increasing convenience and choice provided by online shopping has driven major changes in how we buy things. Today, it is easy to purchase a wide variety of things online, from clothes and furniture to groceries and meals from your favourite restaurant. The growing popularity of online shopping has resulted in customers being increasingly reliant on last-mile home delivery services to get their purchases to their doorstep.

Courier network service companies have emerged to meet some of these new delivery demands. These services use online apps or platforms to facilitate deliveries, which are often done by individuals using their personal vehicle or bicycle. The use of courier network services helps improve delivery efficiency by reducing the number of individual trips and the number of large vehicles required.

The growing options and convenience offered by delivery services improve the comfort and quality of life for many people. But as more individual packages are being delivered to more homes at a more frequent rate, an increasing number of delivery service vehicles are competing with other street users for short-term parking space and curb access. The demand-responsive nature of courier network service fleets also makes it challenging for professionals to forecast (and thus plan for) how many of them will be on the streets on any given day.

Electrification

Electrification refers to the process of shifting vehicle propulsion systems from fossil fuels to electricity. Driving personal electric vehicles (EVs) allows individuals to enjoy the convenience and comfort of a personal car while reducing their environmental impact. Some people group hybrid vehicles (i.e. vehicles that use two or more distinct types of power, such as both internal combustion and electric motors) under the EV umbrella. However, within the context of this paper, EVs refer to vehicles that run fully on electric energy and are either battery-powered (BEVs) or plug-in (PEVs).

A shift to EVs will reduce greenhouse gas emissions, improve air quality, and reduce transportation-related noise in urban centres. However, moving all existing drivers to EVs will not reduce traffic congestion. Electrification also still has major hurdles to overcome in the next decades. Since range between charges continues to be a major limiting factor for EVs, large-scale adoption of EVs would require significantly more public chargers than exist today. And although AVs are becoming more affordable, high up-front costs are still a barrier for many potential EV owners.

Note that electrification goes beyond cars. Buses, trains, and goods movement vehicles are also seeing increasing numbers of electric options, which offers opportunities to reduce environmental impacts from the public transit and commercial transportation sectors. Electrification is also occurring in smaller personal mobility devices, with the growing popularity of electric bikes (e-bikes) and electric scooters (e-scooters). Electrification of personal mobility devices minimizes the physical effort required to move, making them more accessible for some people with reduced mobility.

Self-driving Technology

With ongoing advancements in self-driving technologies, we are steadily nearing a world with autonomous vehicles (AVs) on our roads, which will include cars, transit, and commercial vehicles. Although fully automated vehicles are still a future technology, each year introduces a wider range of automated functions to assist drivers. These include lane keeping assist, adaptive cruise control, and self-parking.

Driving automation systems encompass a range of features that perform part of or the entire task of driving. The Society of Automotive Engineers (SAR), a globally active engineering association, describes six levels of driver assistance technology, as shown in **Table 1**. In this classification, Level 0 refers to no automation while Level 5 refers to full automation under all conditions. With existing technologies that are available to the public, some vehicles today operate within the middle levels of automation.

Table 1: Summary of Levels of Vehicle Automation[3]

Levels of Automation	Who Does What and When
Level 0	The human driver does all the driving.
Level 1	An advanced driver assistance system on the vehicle can sometimes assist the human driver with steering or braking/accelerating, but not both simultaneously.
Level 2	An advanced driver assistance system on the vehicle can control both steering and braking/accelerating simultaneously by itself under some circumstances. The human driver must continue to pay full attention (i.e. "monitor the driving environment") at all times and perform the rest of the driving tasks.
Level 3	An automated driving system (ADS) in the vehicle can perform all aspects of driving tasks by itself under some circumstances. In those circumstances, the human driver must be ready to take back control at any time when the ADS requests the human driver to do so. In all other circumstances, the human driver performs the driving task.
Level 4	An automated driving system on the vehicle can perform all driving tasks and monitor the driving environment (essentially, do all the driving) by itself under certain circumstances. The human need not pay attention in those circumstances.
Level 5	An automated driving system on the vehicle can do all of the driving in all circumstances. The human occupants are just passengers and never need to be involved in driving.

AVs require a suite of technologies to operate autonomously. While some of these exist today, many others are at various stages of testing and development. **Figure 3** summarizes the technologies that AVs require.

3 National Highway Traffic Safety Administration, US Department of Transportation, *Automated Vehicles for Safety*. https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

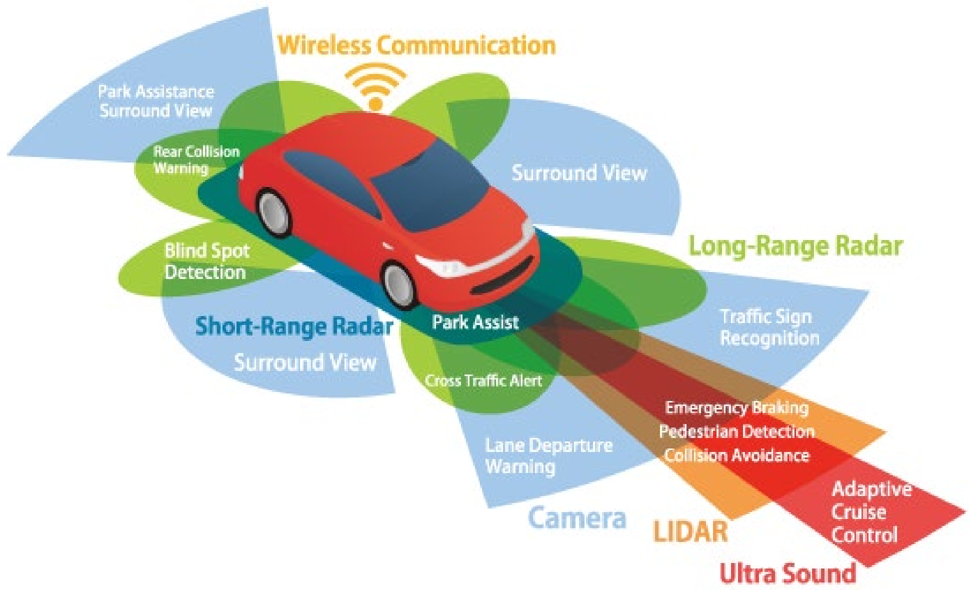


Figure 3: Illustration demonstrating self-driving car technology[4]

Connected Mobility

We are living in an increasingly connected world. The past decade has seen a rise of "smart" versions of many everyday objects like watches, thermostats, or doorbells. These connected devices share data with other devices to offer additional convenient features to everyday life. This system of connection to and between everyday items via the internet is referred to as the Internet of Things (IoT).

IoT encompasses more than just household objects. Increased connectivity within the transportation network has the potential to transform the way we move. Today's wireless networks have the abilities to connect cars, buses, scooters, trucks, trains, traffic signals, cell phones, and other mobility technologies to each other, increasing communication between these objects and devices.

Connected mobility has the potential to reduce collisions, improve safety, improve roadway efficiency, and provide continuous real-time data to travellers.

Network connectivity in transportation can be used to:

- Implement dynamic speed limits;
- Manage parking;
- Implement congestion pricing;
- Manage traffic incidents;
- Provide transit priority in response to real-time conditions; and/or
- Adjust traffic signals in real time.

Connectivity of individual vehicles to a larger network will also likely be a key feature in AV fleets to enable safe and efficient movement as well as to serve as a back-up mechanism if individual vehicles fail.

Adding more devices to the IoT allows for greater interaction between devices and generates larger amounts of data, which can help better inform important societal decisions. However, the ever-growing volume of new data requires protection and careful management to ensure that people's privacy and personal information are not being exploited.

4 Landmark Dividend, "Self-Driving Car Technology: How Do Self-Driving Cars Work?" https://www.landmarkdividend.com/self-driving-car/

New Mobility Trends

Many of these innovative approaches to daily travel introduced in the previous section are already being implemented in communities across the world. This section outlines some implementation case studies and corresponding key takeaways from each one.

Ride-hailing

Today, various ride-hailing services are available on all inhabited continents. However, the introduction of these services have often posed challenges for a variety of communities. Transportation network companies (TNCs) have often arrived in cities on their own schedule, leaving municipalities scrambling to draft new regulations, construct supporting infrastructure, and ensure fair competition for the local taxi industry. Several Canadian cities, including Calgary, Edmonton, Vancouver, and Winnipeg, banned TNCs outright until they could draft up rules and frameworks for how these new companies could operate within their municipality.

In addition to ride-hailing, some TNCs now offer ride-sharing services such as UberPool and Lyft Shared in select cities. Ride-sharing services optimize a single trip by completing pick-ups and drop-offs for multiple passengers traveling in the same general direction. Since it reduces the convenience of an individual rider by increasing their trip length, ride-sharing trips have cheaper fares than individualized ride-hailing trips. Ride-sharing services are considered to be a form of *microtransit* by some people.

Microtransit

Microtransit services have been appearing in cities around the world. These include dedicated on-demand shuttles or minivans and ride-sharing services offered by TNCs, as described previously. The Town of Innisfil in Ontario currently provides its entire "public transit" service through a contract with Uber. Meanwhile, Calgary Transit has been piloting the use of minibuses to provide on-demand service in select neighbourhoods with low population densities or low ridership levels since 2019. Calgary Transit's service connects riders in these neighbourhoods to nearby transit hubs, using the same fare that applies for the rest of the system.

A challenge for many communities is figuring out how microtransit can be integrated with conventional public transit service so that microtransit supports conventional service rather than competes with it. Riders typically enjoy the convenience of an on-demand microtransit service. However, if the service's popularity causes ridership to grow significantly, it may become more cost effective to switch to a fixed route service. This switch may cause a backlash from riders who have grown accustomed to on-demand service. Microtransit may also require higher fares to cover the operational costs of an on-demand service but having different fares within the same transit system may create a confusing experience or contribute to inequity for different users.

Micromobility

Over the last few years, micromobility devices have popped up in cities across the world, typically during the warmer months of the year. While some people celebrate the utility of these devices, others raise concerns about the nuisances they may cause. Dockless bikes and scooters offer riders convenience and improved first mile/last mile connectivity. However, residents of many communities express their dissatisfaction over micromobility devices being carelessly operated on sidewalks or left scattered across the city.

Despite some concerns, the use of micromobility is growing in popularity. In a review of 84 million shared micromobility trips from across the United States of America (USA), the National Association of City Transportation Officials (NACTO) found that the number of trips taken in 2018 were more than double the number taken in 2017. The same study found that most micromobility trips were 4 kilometres (km) or shorter in length and 25 minutes or shorter in duration. Additionally, NACTO's study found that within micromobility, bikesharing was used more often for commuting purposes, first mile/last mile connections, and social trips while scooter-sharing was used more often for recreational or exercise purposes. [5]

5 National Association of City Transportation Officials (NACTO), 2019, *Shared Micromobility in the US*. https://nacto.org/wp-content/uploads/2019/04/NACTO_Shared-Micromobility-in-2018_Web.pdf

Municipalities that offer micromobility services are taking one of three different approaches:

1. **Keeping these services privately owned and operated**
    - BIXI Montreal, a bike-sharing service, is owned and operated by the City of Montreal
    - Bike Share Toronto is owned and operated by the Toronto Parking Authority
2. **Enabling third-party providers to operate micromobility services within their jurisdiction**
    - Private providers Lime, Bird, and Roll operate their e-scooters in Calgary and Ottawa during the summer months
3. **Building public-private partnerships for ownership and operation of these services**
    - The Sobi bike-share service in Hamilton received capital investments from Metrolinx and the City of Hamilton but is owned and operated by Social Bicycles
    - The Mobi bike-share service in Vancouver received capital investments from the City of Vancouver but is owned and operated by Vancouver Bike Share

Regardless of the ownership and cooperation model used, municipalities usually have to update their regulations and policies to accommodate these new services prior to introducing them.

Mobility-as-a-Service

Whim is a successful Mobility-as-a-Service (MaaS) platform that currently operates in Helsinki, Finland. Instead of paying for a car or a bus pass, Whim users pay for a monthly plan that offers them access to a wide variety of transportation options including rental cars, taxis, bike-share, and public transit all in one app. In addition to Whim, MaaS platform pilots are also being carried out in other European cities including Amsterdam, Madrid, Vienna, Zurich, Birmingham, Amsterdam, Munich, and Berlin. So far, implementation of MaaS platform pilots has been generally limited to dense urban centres.

In North America, the free Transit app is integrated with ride-hailing, car-sharing, and microtransit in supported regions. The free app offers users route planning services based on real-time public transit data. When offering suggested routes, it also presents options that combine transit with cycling or shared modes and displays the estimated cost for the overall trip. The app is linked to other provider platforms, making it easier for a user to pay for all legs of a multimodal trip.

So far, MaaS platform providers have been private entities. But public-private partnerships may be the key to the success and more widespread implementation of MaaS platforms. Municipalities alone do not operate the wide variety of transportation options that would make a MaaS platform successful. But at the same time, individual private service providers may not always see the benefit of partnering with each other to develop and maintain a MaaS platform without additional incentives. Furthermore, full privatization of MaaS platforms can create issues as communities become more dependent on them since private corporations are not held accountable to the general public.

Delivery Services

Today, e-commerce is a massive global industry. By 2021, e-commerce sales are expected to account for 17.5 per cent of total global retail sales.[6] Our changing shopping habits are reducing the number of trips individuals make to traditional brick and mortar retail while also increasing the number of trips made by delivery bicycles and vehicles on shorter schedules. Delivery vehicles and bicycles have to make frequent curbside stops for short to medium lengths of time. The impacts of this are seen in many municipalities, where curbside space is at an increasing minimum, particularly in downtown environments. Limited opportunities for parking are resulting in more delinquent behaviour by some delivery drivers that impedes the flows of pedestrian, cyclist, and/or vehicle traffic.

A growing number of municipalities across North America and around the world are developing ways to manage curb space. Both the Institute of Transportation Engineers (ITE) and the National Association of City Transportation Officials (NACTO) have published guidance for curb space management in recent years. These include the *Curbside Management Practitioners Guide* and *Curb Appeal: Curbside Management Strategies for Improving Transit Mobility*, respectively. Common tools for curb space management used by some municipalities include:

- The reallocation of curb space for specific uses like bike lanes and bus stops;
- Using automated enforcement;
- Flexible parking pricing according to actual usage; and
- Dedicated loading areas and regulations on delivery times.

Technology is also being harnessed to analyze data and map curbside activity in order to identify where and when parking and loading is available. Some new platforms and apps use real-time data to help drivers find long-term parking, delivery vehicles find short-term parking, or cities better understand and manage their curbside demands.

Meanwhile, shipping and logistics companies are constantly developing more efficient ways to deliver products. The impacts of emerging innovations like large-scale drone deliveries on the transportation network are still unknown but are anticipated to further change transportation in cities.

6 Statista, 2020, “E-commerce share of total global retail sales from 2015 to 2023.” https://www.statista.com/statistics/534123/e-commerce-share-of-retail-sales-worldwide/

Electrification

Sales of personal electric vehicles (EVs) are growing. In Canada, sales of both plug-in and battery-powered EVs have risen exponentially over the last few years, from 3,254 units sold in 2013 to 34,357 units sold in 2018.[7] A similar trend is seen worldwide: Deloitte reports that 2018 was a record year for EV sales, with two million units sold around the world, and forecasts that an additional 21 million EVs will be on the road globally by 2030.[8]

To support EV usage, governments are constructing more public charging stations and offering incentives for the purchase of EVs or investment in EV infrastructure. Since 2019, Transport Canada has offered a $2,500 to $5,000 rebate for the purchase of eligible zero-emissions vehicles (ZEVs), which include EVs. Provincial governments in British Columbia and Quebec also offer additional rebates for the purchase of new or used EVs and for the installation of personal charging stations. In Ontario, vehicles with a green license plate (obtained during registration of eligible vehicles like EVs) are permitted to use High Occupancy Vehicle (HOV) lanes on provincial highways even if there is only one person in the car.

EV technologies are also continuously improving and offering further ranges of travel between charges. However, EV drivers continue to be limited by the range of their vehicles. Electric charging stations are not nearly as widely available as gas stations. And when chargers are available, users cannot expect to fully "refuel" their EV in a short period of time as they would with a 5-minute stop at the gas station. Even the fastest EV chargers today take about an hour to fully charge a car and most public charging stations do not offer the fastest available chargers.

There are three levels of EV charging stations:

Level 1 – These are the lowest voltage charging stations. Level 1 chargers are essentially standard wall outlets. They take many hours to fully charge a car and are most suited for post-commute overnight parking.

Level 2 – There are most commonly available as public chargers today. They have relatively higher voltages but still take several hours to fully charge an electric car.

Level 3 – There charging stations offer the highest voltage and can typically fully charge a car in an hour or less. However, these are not commonly available as public chargers. Additionally, not every EV on the road today is compatible with a Level 3 charging station.

7 FleetCarma, 2018, "Electric vehicles sales update Q3 2018, Canada." https://www.fleetcarma.com/electric-vehicles-sales-update-q3-2018-canada/

8 Deloitte, 2019, "21 million more electric vehicles expected worldwide by 2030." https://www2.deloitte.com/uk/en/pages/press-releases/articles/21-million-more-electric-vehicles-expected-worldwide-by-2030.html

Self-driving Technology

While autonomous technology is evolving rapidly, autonomous vehicles (AVs) are not yet ready for widespread implementation. Fully autonomous vehicles do not currently operate on public roads anywhere, with the exception of some small-scale pilots within narrowly-defined areas, usually in warm climates and with predictable geography. As a result, there is still considerable uncertainty about how AVs will affect travel demands, mode shares, the allocation of road space, or demands for parking.

Among transportation professionals, there has been significant effort to predict the impacts of self-driving technologies before they become mainstream. Informed hypotheses can help communities prepare so that the potential benefits of AVs are maximized while the unintended consequences are minimized.

The following are some current trends and possible scenarios of a future with AVs.

Safety and security: AVs have the possibility to dramatically improve road safety as they eliminate driver error and reaction time. In theory, AVs could dramatically reduce car-related fatalities and injuries since human drivers would no longer be in control. However, the algorithms and programs that will run these vehicles will be developed by humans and thus incorporate the biases and moral perspectives of their creators. When AVs may be forced to respond to impossible choices such as hitting a pedestrian to avoid a head-on collision against hitting the oncoming vehicle and injuring the car passenger, their response will depend on the input of their programming.

As with any connected digital technology, cybersecurity is a major consideration for AVs. Relinquishing driver control to software makes car occupants susceptible to hacker overrides. With the current rise of software security breaches, individual AVs or AV fleets will need to be designed and operated in a way that ensures the security of their operations and the safety of their occupants. Actors with nefarious motives should not be able to completely shut down the transportation network of a given community or compromise the safety of users.

Finally, AVs will not conquer our roads overnight. From the perspective of road safety, the most challenging period for AV deployment will likely occur during the transition to widespread adoption, when there is a mixture of fully-autonomous vehicles and vehicles still driven by humans on the roads. During this transitional period, the mindset and priorities of the different groups of vehicle operators may not be aligned with each other. And if human drivers are not accustomed to sharing roads with AVs, misunderstanding of intention and unintended conflicts may arise.

Environment: It is likely that all AVs will be electrically powered when the industry reaches full automation. If this turns out to be true, AVs would help eliminate greenhouse gas (GHG) emissions and pollution associated with driving. However, the electrification of AVs may require more charging stations and more frequent charging since some of their power will be consumed by additional hardware and software. Otherwise, the cars may need to be powered by a combination of electric power and other fuels, which may lessen the environmental benefit.

Private vs. shared ownership: There are two distinct visions for a wide-scale deployment of AVs. In the first scenario, today's cars owners become tomorrow's AV owners, largely replicating the current model of personal vehicle ownership. In this future, the number of vehicles on the road networks stays the same or increases as more people invest in AVs due to their convenience. As a result, congestion will not be eased by the arrival of AVs and demand for parking at major destinations will increase dramatically. If parking is unavailable, empty AVs may travel home until they are recalled by their owner or be forced to continuously circle on roads while waiting for their owners. This will put more vehicles on the road outside of peak periods of travel and increase the annual number of vehicle-kilometres-travelled (VKT) on our roads.

Alternatively, shared mobility and AV technology could converge to create a model where personal ownership of AVs is minimized. Fleets of AVs could be owned by private (e.g. TNCs) or public entities who offer on-demand AV service through ride-hailing or ride-sharing. This version of the future will not require as much parking as the first scenario though fleets will require dedicated garage and maintenance facilities. Additionally, this version of the future doesn't prohibit people from experiencing the benefits of AVs if they cannot or choose not to purchase a personal AV. However, shared mobility is ultimately less convenient than private ownership and availability of AVs for everyone who needs a ride would fluctuate with demand.

Public perception: Today, nearly 50 per cent of people still believe that fully self-driving cars will not be safe and less than 50per cent of people think that "travelling in a fully self-driving car will be a positive experience."[9] But societal attitudes may adjust as AVs become more sophisticated and as more people embrace autonomous technologies. With full automation, people's attention will no longer be required to operate a vehicle. This can turn commutes into useful time during which commuters can work, carry out recreational activities, or even nap. These added opportunities during commutes may change public perception towards AVs. They can also have a significant impact on how and when people travel as well as where they decide to live.

Preparing with policy: Municipal, provincial, state, and federal governments around the world are actively developing policies and regulatory frameworks to accommodate AVs by considering the various possible future scenarios. At the start of 2019, Transport Canada released two documents: *Canada's Safety Framework for Automated and Connected Vehicles and Safety Assessment for Automated Driving Systems in Canada*. The release of these reports signaled federal support for the acceleration of a safe introduction of automated and connected vehicles on Canadian roads.

In Canada, Ontario is leading the way on regulatory framework for and testing of AV technologies. In January 2019, the Ontario Government expanded the rules of Ontario's 10-year Automated Vehicle Pilot Program (originally launched in 2016). The expansion allows cars equipped with Society of Automotive Engineers (SAE) Level 3 technology to operate on public roads in the province provided that there is a passenger on board who can take control of the vehicle if required. It also allows for testing of completely driverless AVs under strict conditions.

Many municipal governments are also completing studies to understand how AVs will affect travel in their communities and what infrastructure needs to be in place when AVs arrive to maximize their benefits:

- The City of Calgary has recently completed a *Future of Transportation in Calgary* report that looks at the possible impacts, opportunities, and risks of various new mobility technologies including AVs.
- The City of Ottawa has invested in test track facilities for autonomous vehicle technologies.
- The City of Toronto has developed an *Automated Vehicles Tactical Plan* that contains detailed policies, actions, and measurable objectives for the City to 2022. It also compiles a detailed list of knowledge gaps and direction to complete further research in anticipation of AV deployment.

9 Deloitte, 2019, *2019 Global Automotive Consumer Study*. https://www2.deloitte.com/us/en/pages/manufacturing/articles/automotive-trends-millennials-consumer-study.html

A driverless shuttle at the University of Michigan's Mcity Test facility in Ann Arbor MI. Source: University of Michigan

Connected Mobility

Computer control of traffic signals allows many municipalities to set traffic signal timing plans that change by time of day to accommodate different traffic patterns or demands. Traffic engineers also use preemption, a practice that temporarily manipulates traffic signal timing plans that are already in effect. This practice can help enable priority for emergency vehicles, certain movements, or certain modes. Existing traffic signal technologies can now be augmented by in-system detection of traffic volumes and patterns that set up optimal signal timing when coordinated with other real-time data from across the city.

As technology becomes more sophisticated, cities are also experimenting with more elements of connected transportation network:

- Many cities already have transit vehicles that communicate with each other. In Canada, examples of this include TransLink's driverless Skytrains in Vancouver and automatic train control in the Toronto Transit Commission (TTC's) subway system.
- Recently, the City of Vancouver and the City of Edmonton held pilot programs in partnership with academia and industry to experiment with different connected mobility technologies. These pilots were completed on test roads and in laboratory test environments, using sensors in roads to collect and analyze data. Test vehicles in these trials also used wireless internet to share information and communicate with each other through a central communications hub.
- The City of Ottawa's test track facilities for autonomous vehicle technologies also support studies and testing of connected mobility technologies like traffic signal coordination.
- At a demonstration lab in Vienna and through a pilot study in Germany, vehicles are being connected to road infrastructure and traffic control centers to manage congestion in real-time.

While very beneficial to municipalities for transportation system management, connected mobility technologies are also helpful to individual users of a transportation system. Ever more powerful traveller information systems like Google Maps are helping travelers optimize their routes and avoid congestion. And car manufacturers are continuously integrating car to car communication and other connected features into new car models. For example, General Motors (GM) is equipping new models with technology that enables communication with other similar models to help to detect potential upcoming hazards, like slippery roads.

The proliferation of fifth generation (5G) mobile networks, is anticipated to be a key driver in the advancement of connected mobility technology as it will provide the necessary cellular bandwidth and internet speed for more and better connection.

Several of the emerging transportation technologies and options discussed in this paper have already made their way to Guelph. This section provides an overview of the options that are available today and the roles they play in our existing transportation system.

New Mobility in Guelph Today

Ride-hailing

In 2015, Guelph's City Council approved ride-hailing operations under a set of predetermined rules and conditions. The rules include criminal background checks, having $3-million insurance for each vehicle, annual safety checks for vehicles, and inability to accept street hails or cash fares like regular taxis.

Today, Uber operates in Guelph. Guelph falls within Uber's southwestern Ontario service area, which also includes London, Waterloo Region, and Hamilton.

Microtransit

There is currently no microtransit service being offered in Guelph. However, Guelph Transit is currently using elements of microtransit for Transit Mobility Services, its accessible transit service. For this service, Guelph Transit has partnered with a third-party technology provider for automated dispatch and routing to make the service more efficient.

Just outside of the city, Wellington County is currently piloting *RIDE WELL,* a publicly funded county-wide on-demand rural transit service. RIDE WELL uses full-time drivers and dedicated vehicles to provide door-to-door service to and from any address in the County. RIDE WELL also provides door-to-door service to and from any address in the City of Guelph provided that the trip starts or ends in Wellington County. Trips can be booked via an app, website, or toll-free number. The on-demand service optimizes routing to get as many people to their destinations with as few vehicles and trips as possible.

Micromobility

There are currently no shared micromobility platforms or services operating within Guelph

Mobility-as-a-Service

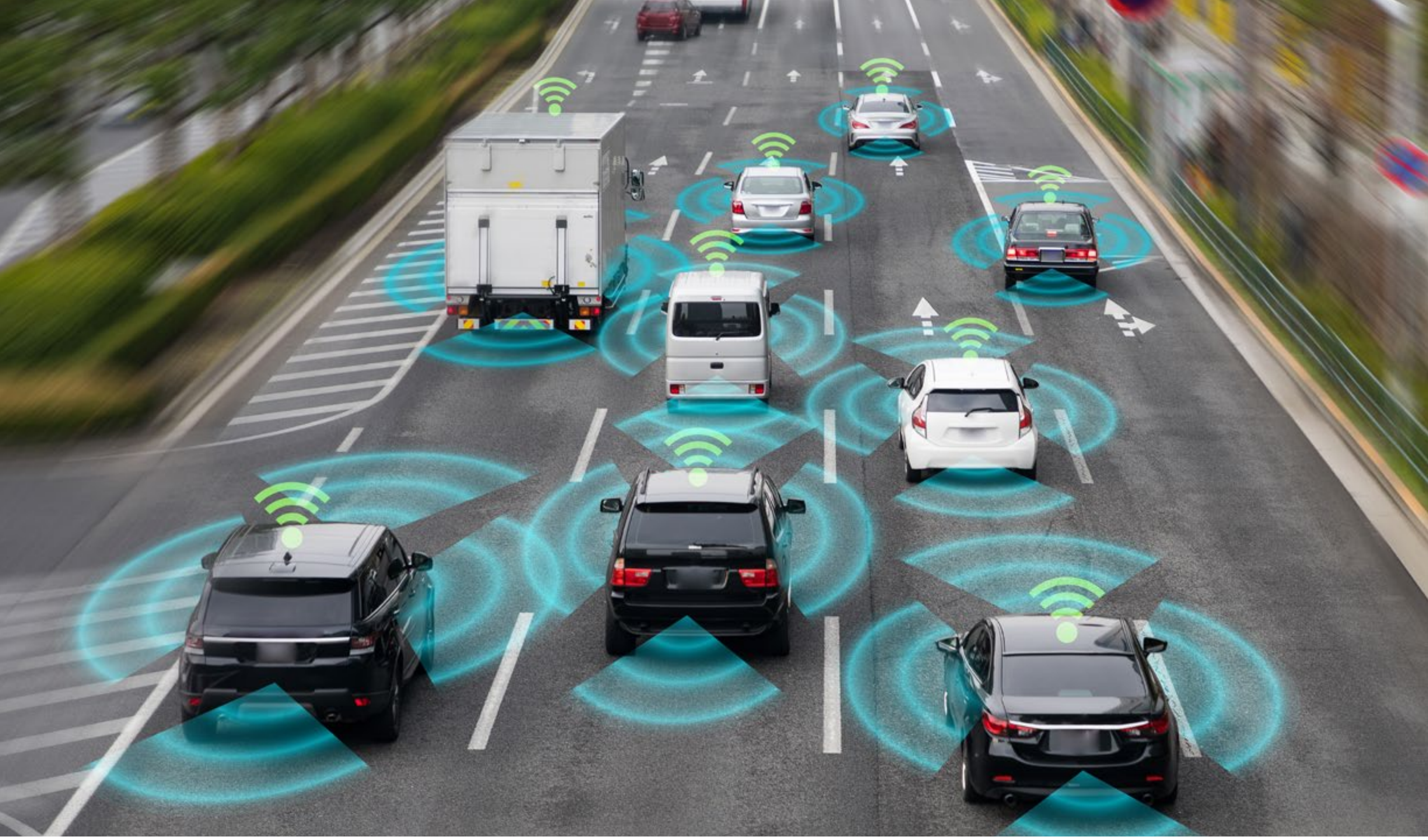
There are currently no services using the MaaS philosophy being offered in Guelph.

Delivery Services

Like other cities, Guelph has experienced the increased popularity of courier network services, increased delivery truck traffic within the city, and a resulting increased demand for curb space, particularly in downtown. The City anticipates that if current trends continue, increased demands for short-stay loading will have to be rationalized with other demands for curb space.

Electrification

Guelph's *Community Energy Initiative* (CEI) - the City's ambitious plan for reducing energy use and GHG emissions - was first set up in 2007. In 2018, CEI set a target of having Guelph produce net zero carbon emissions by 2050. The CEI task force provided 20 potential actions for the City to help Guelph achieve this target.



The list of actions included electrification of transit, electrification of the municipal fleet, and encouraged/incentivized electrification of personal vehicles.

In 2012, Guelph was one of the first Canadian communities to install an electric vehicle charging station. Today, there are over 20 public charging ports within 15 kilometres (km) of the city. In 2016, Guelph also had 10 per cent more battery electric vehicles (including hybrids) than the provincial average.

In January 2020, Guelph Transit announced that it will replace 35 older diesel buses with electric buses, add 30 brand new electric buses to their fleet, install on-route charging infrastructure, and construct a new bus storage and maintenance facility with electric charging stations.

Self-driving Technology

Like in the rest of the country, no fully autonomous vehicles operate on public roads in Guelph today.

Connected Mobility

Similar to many other municipalities, Guelph uses traffic signal preemption at select intersections for Fire Services emergency vehicles. Preemption is used to halt conflicting movements in advance of the emergency vehicle arriving at the intersection. This helps improve emergency response times and makes the roads safer for everyone. The City does not currently have any other forms of traffic signal priority measures.

This fall, the City will be piloting new traffic counting and detection technologies. These technologies will enable the City to have real-time traffic counts at select locations during all hours of the day. Having real-time traffic data will help the City make more informed operational decisions about its transportation network.

Moving Guelph Forward: New Mobility

Transportation is affected by the rapid rate of technological innovation and advancement in our society. New technologies and new mobility options are changing how people and goods move through their communities. These changes generally make life more convenient but their disruptive nature can negatively impact transportation networks that are not ready for sudden change. To embrace the future of transportation and ensure a transition that is as seamless as possible, we have to build communities that are ready for and supportive of these anticipated changes.

Based on the trends, best practices, and existing conditions outlined in this paper, the following is a list of key takeaways about emerging transportation technologies and new mobility:

- The various new and emerging mobility options such as ride-hailing, microtransit, and micromobility have the potential to improve daily transportation for many people. However, their sudden presence in a community can be disruptive. Before permitting their operation, policymakers and planners should seek to maximize their benefit without negatively affecting other modes of travel.

- With so many new and emerging options for travel, Mobility-as-a-Service (MaaS) platforms present opportunities to seamlessly integrate trips across different modes. Though growing in popularity, these platforms are still relatively rare and offered only by private entities. Support or partnerships from the public sector may help MaaS reach its full potential.

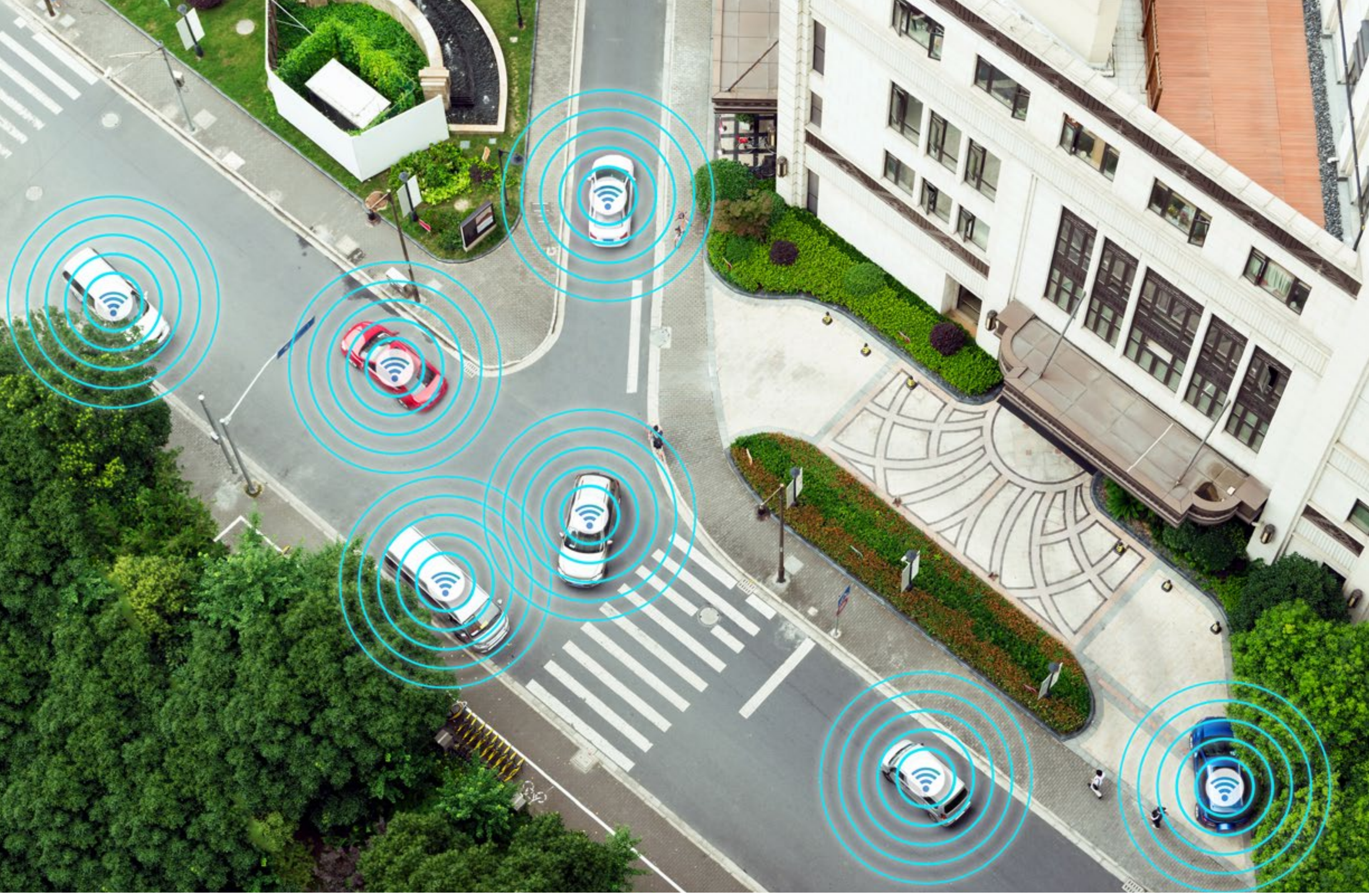
- The popularity of online shopping is constantly growing and causing personalized goods movement to become more important to communities. Effective curbside management is crucial to ensuring efficient delivery services while also preventing conflicts with other modes.

- Electrification of transportation options is critical to helping communities reach their emissions-related sustainability goals. However, electrification alone will not solve all of the other problems associated with a dependence on cars.

- Autonomous vehicles (AVs) are on the horizon but the industry has not reached full automation yet. Since the precise impacts of AVs remain unknown at this time, planning for different AV deployment scenarios is the best way to maximize their benefits when they arrive.

- Connected - or "smart" - features of transportation make travel more convenient. The data collected through these features can help decision-makers make more informed choices than ever before. But regulatory frameworks and privacy protections are needed to prevent exploitation of this data.

- The City is already implementing some new technologies and mobility options into Guelph's transportation network. However, there are still many opportunities to use transportation innovations to fill in network gaps and improve mobility in Guelph.



What do you think?

What does the future of transportation in Guelph look like? How will the movement of people and goods in Guelph change over the next several years? What should planners and policymakers do to ensure that new transportation technologies and innovations provide the most benefit to residents?

Let us know! Visit guelph.ca/tmp to learn more about the transportation topics and trends informing the development of our Transportation Master Plan and to find out how you can have your say on Moving Guelph Forward.

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Shawn Doyle, Project Manager

Mariam Bello, Project Coordinator/Primary Author

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