6. INTEGRATED MOBILITY

The City of Toronto will encourage the adoption of driving automation systems that further integrate space-efficient and active modes of travel, and better manage all traffic impacts from the movement of goods.

When human transportation technology changed over a century ago, our streets and infrastructure changed with it. Urban planning and transportation engineering reoriented our cities almost exclusively toward the automobile. With the legacy – and consequences – of those planning choices now apparent, planners have been developing a new vision for our streets – integrated mobility. Integrated mobility is the ability for people to move easily from place to place according to their own needs. This means taking a transit-centric approach which connects all modes of travel including active transportation and automobile travel, enabling door-to-door and seamless mobility throughout the city, that is accessible to everyone.[88]

Even in an automated future, high-capacity transit will likely remain the most efficient use of urban space and the most affordable and sustainable method of transportation for users.[89] A single travel lane can carry at most 1,600 people per hour in a private vehicles, while an on-street bus lane can carry up to 8,000 people per hour, and an on-street transit way (bus or rail) can carry up to 25,000 people per hour.[90] To serve the City of Toronto's mobility goals, transit, alongside space-efficient and active modes, must remain a top priority in the City's approach to this emerging technology.

Guiding Policies and Strategies:

Toronto Complete Streets Guidelines (2017):

Streets for People - Safe, Accessible, Choices, Transportation, Networks, Connectivity, Healthy, Resilient

- *Streets should enhance human and environmental health by providing a range of safe, inviting and attractive choices for mobility and integrate all modes into a seamless network.*

Streets for Prosperity - Economic Vitality, Social Equity, Flexible, Cost Effective

- *Streets should also be flexible and have the ability to change over time, adapting to needs, preferences and technologies. Streets are not static, and should be cost effective to build, operate and maintain in all seasons.*

Toronto Official Plan (2015):[2]

City streets are significant public open spaces which connect people and places and support the development of sustainable, economically vibrant and complete communities.

- *balance the needs and priorities of the various users and uses within the right-of-way*
- *improve the quality and convenience of active transportation options within all communities by giving full consideration to the needs of pedestrians, cyclists, and public transit users*
- *increase transit priority throughout the City by giving buses and streetcars priority at signalized intersections and by introducing other priority measures*

Toronto Transit Commission's 5-Year Corporate Plan:[91]

> *Mission: To provide a reliable, efficient and integrated bus, streetcar and subway network that draws its high standards of customer care from our rich traditions of safety, service and courtesy.*

Summary of Goals and Tactics

Goals	Tactics	Key performance indicators
6.1 Increase Space Efficiency - In 2050, the City will have harnessed the widespread adoption of automated vehicles to ensure a greater proportion of intraurban travel will be by more space-efficient and active modes of travel.	6.1.1 Transit Priority 6.1.2 Active Transportation Priority 6.1.3 High-Occupancy AV Priority 6.1.4 Urban Goods Movement	Throughput in persons per hour per unit area of public right-of-way Percentage change in mode share for: • Active transportation • Transit • 2+ occupant vehicles • Combined-purpose vehicles Urban Goods Movement KPI TBD based on completion of Goods Movement Strategy
6.2 Design Smart Streets - In 2050, the City will have harnessed the widespread adoption of automated vehicles to ensure the design of city streets is optimized to meet dynamic daily needs.	6.2.1 Street Design 6.2.2 Road Classification & Use 6.2.3 Flexible Curbs	Number of flexible curbside hours per 100m
6.3 Increase System Seamlessness - In 2050, the City will have harnessed the widespread adoption of automated vehicles to ensure that Toronto's transportation system is seamless to the user.	6.3.1 Transit-Centric Mobility-as-a-Service (MaaS) 6.3.2 Microtransit	Percentage of ridership satisfied with system seamlessness

6.1 Increase Space Efficiency

In 2050, the City will have harnessed the widespread adoption of automated vehicles to ensure a greater proportion of intraurban travel will be by more space-efficient and active modes of travel.

6.1.1 Transit Priority

Proposed Tactic: Develop and implement a mechanism to increase the ability to provide transit priority with AVs.

Transit priority provides municipalities with a cost-efficient way to reduce transit delay, improve service reliability, and prioritize the use of transit vehicles.[92] Automated and connected vehicles provide an added benefit to this solution by allowing vehicle-to-vehicle and vehicle-to-infrastructure communication that can:

- Reduce the likelihood of collisions at intersections;
- Increase the reliability of transit movements and schedules; and
- Increase the availability of information for performance measurement.

In promoting a transit-centric approach at the City of Toronto, improving transit priority through technology will not only increase the reliability of the service, but it will incentivize the use of automated transit that receives priority in traffic, as opposed to private AVs.

Proposed progress to 2022: Research and learn about AV technology potential to provide transit priority and isolate corridors for potential integration. Coordinate with the Toronto Transit Commission to ensure that work on transit priority for Toronto's surface transit network is considered in the development of this Tactic. Incorporate policy options based on stakeholder input into a white paper for 2022.

6.1.2 Active Transportation Priority

Proposed Tactic: Develop and implement corridors and zones dedicated to walking and biking in conjunction with AV infrastructure upgrades.

Municipalities and transit agencies have the opportunity to leverage the emergence of AVs to improve the lives of urban residents; however, this requires proactive urban policy, with a focus on reducing the amount of motor vehicle travel, supporting high occupancy trips via transit, and making safe spaces for walking and cycling. NACTO's Blueprint for Autonomous Urbanism supports rebalancing the right-of-way through AVs, by moving more people in fewer vehicles on less-congested streets. This way, space can be used more efficiently towards active, sustainable modes, and technology can help manage the public realm dynamically. [79]

Proposed progress to 2022: Study the potential impacts to active transportation with the introduction of private and public automated vehicles. Generate policy options to be included in a white paper for 2022 that will address how walking and biking will remain a priority alongside AV infrastructure upgrades.

6.1.3 High-Occupancy AV Priority

Proposed Tactic: Develop and implement policies to give high-occupant vehicles priority in planning and infrastructure for AVs.

High occupancy vehicle (HOV) lanes are lanes reserved for vehicles carrying at least two people, with the goal of moving a higher number of people with fewer vehicles. However, effectively enforcing occupancy requirements in HOV lanes presents a challenge in that it is difficult to consistently count the number of passengers in a vehicle.

While automatic passenger counting infrastructure could mitigate this problem for the vehicle fleet at large, AVs could provide another avenue through which to ensure that HOV lanes are used only by vehicles with two or more occupants. By sharing onboard passenger count data obtained through sensors embedded in the AV, these vehicles could automatically be granted or denied access to HOV lanes based on how many people they are carrying.[79]

Proposed progress to 2022: Coordinate the development of HOV priority for AVs with the City's existing work on high-occupant vehicles. Explore options to implement policies for planning and infrastructure that consider AVs, and isolate a preferred solution based on the City's intended HOV goals.

6.1.4 Urban Goods Movement

Proposed Tactic: Develop and implement a policy and mechanism to manage urban goods movement in automated vehicles, including non-passenger AVs.

AV technologies could have a large impact on both public and private urban goods movement.[93] The use of automation to deliver directly to a customer's door could increase the reliability of the delivery, lessen traffic congestion, reduce the costs associated with parking, labour, and fuel, reduce emissions, and increase productivity substantially with the opportunity for uninterrupted operations.[94] Non-passenger AVs such as sidewalk delivery robots have been pitched as an urban 'last-mile' logistics solution for e-commerce. Companies such as Amazon, FedEx, and Domino's, are looking to sidewalk bots as a method of last-mile delivery, to reduce costs and improve efficiency.[95]

In addition to the benefits outlined above, automated urban goods movement may place more demands on curb space, cause difficulty managing truck movements, and impact other modes of transportation. Sidewalk delivery robots would need to be capable of navigating encounters with pedestrians and deal with crosswalks and streets with the added difficulty of moving through public spaces like sidewalks, footpaths, and bicycle lanes.[96]

Proposed progress to 2022: Coordinate the management of urban goods movement in AVs with the City's Goods Movement Strategy. Consult with relevant stakeholders on potential issues, priority concerns and opportunities, and the City's role in its development.

6.2 Design Smart Streets

In 2050, the City will have harnessed the widespread adoption of AVs to ensure the design of city streets is optimized to meet dynamic daily needs.

6.2.1 Street Design

Proposed Tactic: Develop and implement a new standard for street design that addresses the unique needs and challenges of AVs.

The introduction of AVs creates opportunities to rethink how we design our streets. With proper planning, cities can leverage AVs as a means of enhancing the public realm and transportation system, to achieve broader goals of equity, environmental sustainability, safety, and a multimodal environment.[79] New street design measures could include reducing speed limits, reducing lane widths, and planning for dynamic street and curbside management from the start.[79]

The City of Toronto recognizes the need to develop a new standard for street design that addresses the unique needs and challenges of AVs.

Proposed progress to 2022: Study the unique needs and challenges of AVs on Toronto's street design. Consult with stakeholders on potential issues and opportunities.

6.2.2 Road Classification & Use

Proposed Tactic: Develop and implement a policy to increase the role of local streets as facilitators of vehicular access to buildings.

The City of Toronto's Road Classification System ensures that the street network performs most efficiently and safely from both a traffic operations and road safety perspective. This system divides Toronto's streets into local roads, collector roads, minor arterial roads, major arterial roads, and expressways based on their use and characteristics.[97]

Local roads provide access to property, with low traffic speeds, generally no bus routes, less than 2,500 vehicles per day, and dedicated sections for both cyclists and pedestrians. As AVs bring a risk of increased vehicular and curb use, the City will look into developing a policy to increase the role of these streets as facilitators of vehicular access to large buildings, particularly in high-density urban areas.[97] Access lanes could provide space for pick-ups, drop-offs, and deliveries – and could be "fully traversable" with restricted access at other times of day.[79]

Proposed progress to 2022: Study potential opportunities and issues with using local streets as a facilitator for vehicular access to buildings.

6.2.3 Flexible Curbs

Proposed Tactic: Develop and implement a mechanism to optimize the use of curbside space by AVs over the course of a day.

In the future, the curb may be able to be more responsive and flexible – rather than fixed – as AV technologies are introduced. Curbside space has the potential to host a variety of different programs and activities that can vary throughout the day or the time of year. NACTO's Blueprint outlines several curb elements that can be layered atop one another: vendors, public seating, digital infrastructure, freight loading, green infrastructure, delivery lockers, market, pick-up/drop-off zones, and transit stops.[79]

In addition to incorporating flexible curbside uses, the City can also "code the curb" to monitor the amount of time a vehicle uses it, and account for and broadcast any availability of curb space to connected AVs. Through coded incentives and deterrents, the City could better manage the use and availability of its curbside space.[79]

Proposed progress to 2022: Create policy options to optimize the use of the curb for AVs over the course of a day - to be included in a white paper for 2022.

6.3 Increase System Seamlessness

In 2050, the City will have harnessed the widespread adoption of AVs to ensure that Toronto's transportation system is seamless to the user.

6.3.1 Transit-Centric Mobility-as-a-Service (MaaS)

Proposed Tactic: Develop and implement a policy to support a coordinated transportation system to achieve seamless mobility centred on public transit.

AVs and MaaS are often referenced in connection with one another, as highly automated vehicles allow for the flexibility and integration required of MaaS. As cars gain the ability to "drive for themselves," ride-hailing and journey-planning through a mobility platform becomes much more convenient.[98] The City will aim to be ahead of this revolution, and begin thinking about how to support a coordinated transportation system to achieve seamless mobility centred specifically on public transit. If there is ease of access to our transit services, the experience for the user will just be improved that much more.

Proposed progress to 2022: Coordinate the development of Mobility-as-a-Service in relation to AVs with the City's existing work on MaaS, and fare integration in general. Consult with relevant stakeholders on potential issues, priority concerns and opportunities, and the City's role in its development.

6.3.2 Microtransit

Proposed Tactic: Develop and implement a policy regarding the integration of automated microtransit into the transit system.

Microtransit consists of shared public or private sector transportation operating either as fixed routes or on-demand via mobile apps.[99] By using 'right-sized' vehicles – either small commuter shuttles or shared fleet vehicles – the microtransit model could address the challenge of first and last-mile connections to transit hubs, while improving mobility to areas that conventional transit cannot serve efficiently.

In 2018, the City of Toronto – in partnership with the TTC and Metrolinx – submitted a successful funding proposal to Transport Canada to operate a pilot project with an automated transit shuttle. The purpose of the project is to test the shuttle technology's ability to meet an existing unmet need in public transit, such as filling the lower-demand "last mile" gap. This pilot represents a first step in evaluating the viability of integrating microtransit into the transit system. If successful, automated shuttles and shared AV fleets could significantly improve the viability of the microtransit model by making it more cost-effective to offer service to more people.

Proposed progress to 2022: Evaluate the success of the Minding the Gap automated shuttle pilot project, which will run from 2020-2021.

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