



# TTC AV Strategy and Plan

Denton's 2<sup>nd</sup> Annual Canadian Smart Cities Virtual Summit

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November 12, 2021

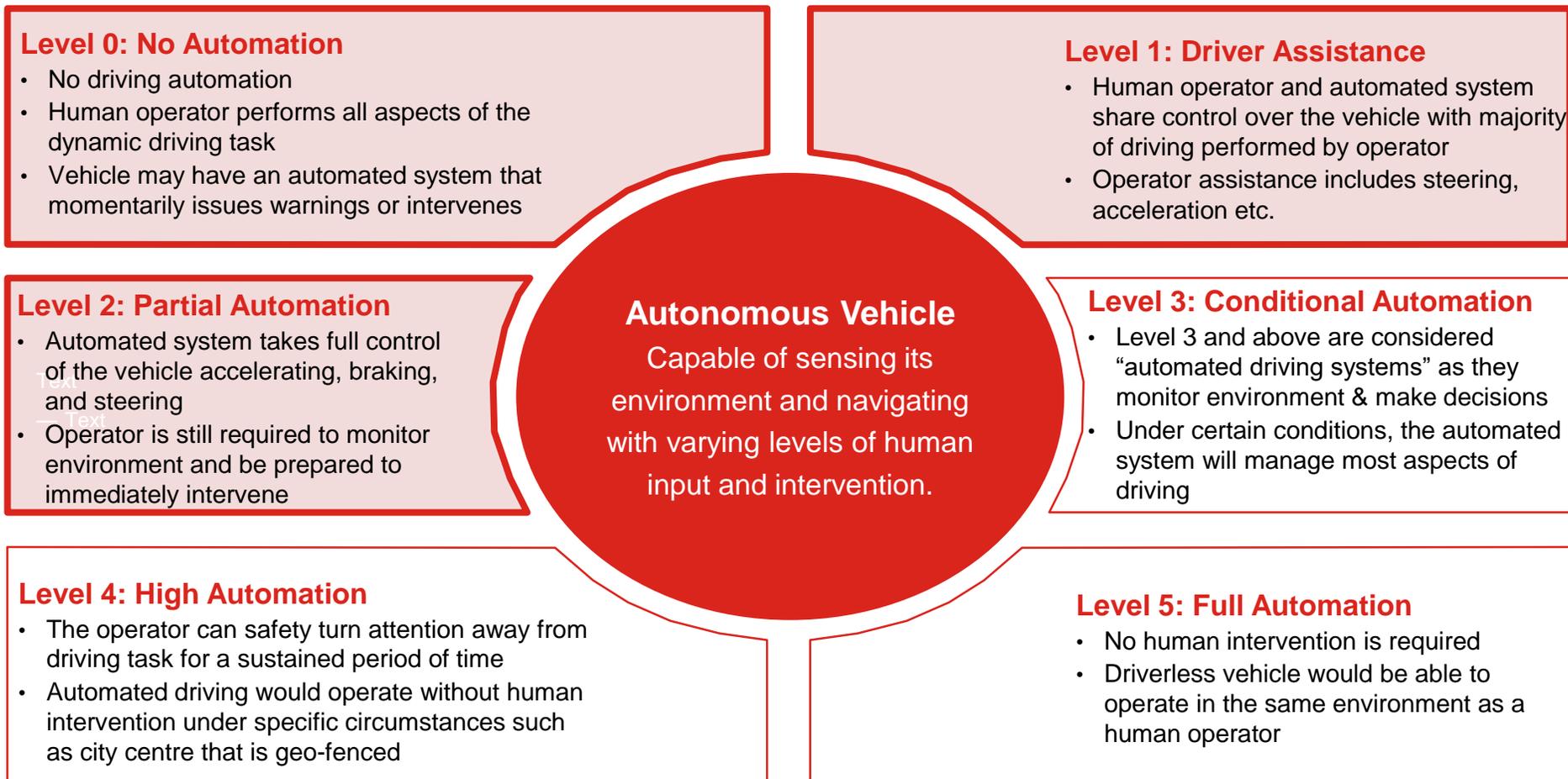


# | Agenda

- 1. TTC AV Strategy and Plan**
- 2. West Rouge Automated Shuttle Trial**

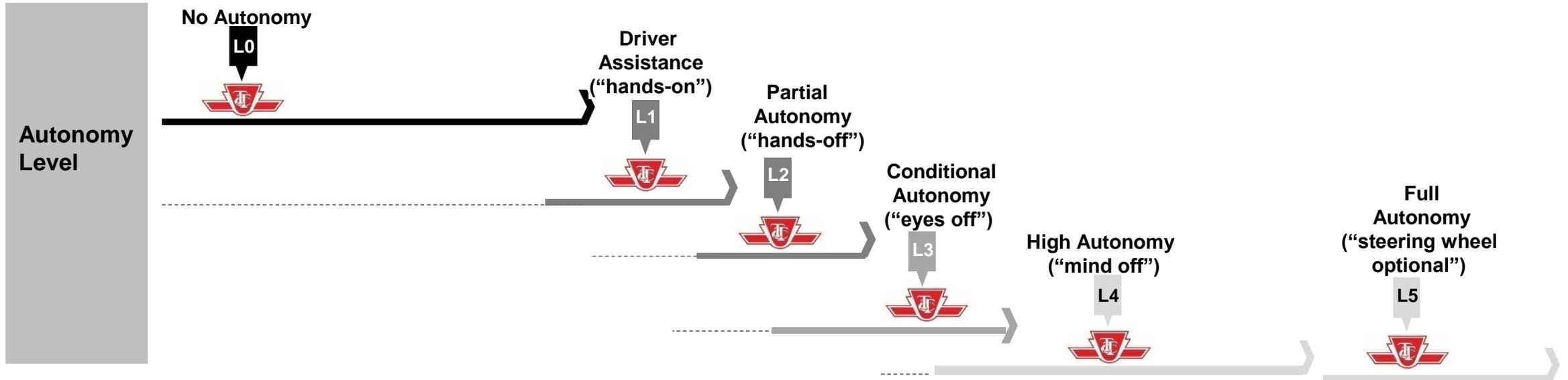


# Overview: What is AV Technology



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## Gradual rollout of the 'levels of automation'



Short-Term Potential Benefits	
❖ <b>Safety (L1-L5):</b> AV tech can <b>reduce the number of collisions caused by human error</b> by aiding drivers	❖ <b>Ride Comfort, Fuel Cost and Pollution (L2-L5):</b> AV technology can assist with improving overall driver performance – minimize hard acceleration and breaking, which <b>improves rider comfort</b> , reduces fuel consumption, <b>lowers fuel cost</b> , and <b>reduces GHG emissions</b> .

Long-Term Potential Opportunities	
❖ <b>Increased access to public transit (L5):</b> AVs may assist with <b>addressing the first/last mile access problem</b>	❖ <b>Efficient fleet utilization (L1-L5):</b> In high-ridership corridors, the use of high-capacity, interconnected AVs can <b>reduce vehicles on the road</b> . In low-ridership corridors, <b>autonomous shuttles</b> can be <b>used in conjunction with other methods</b> to provide <b>on-demand service</b> .
❖ <b>Innovative/ efficient service models (L4-L5):</b> AVs can <b>drive innovative service models</b> .	



# TTC AV Strategy



Safety and Security is the cornerstone to the TTC's Corporate Plan to ensure the safety and security of customers and employees alike.

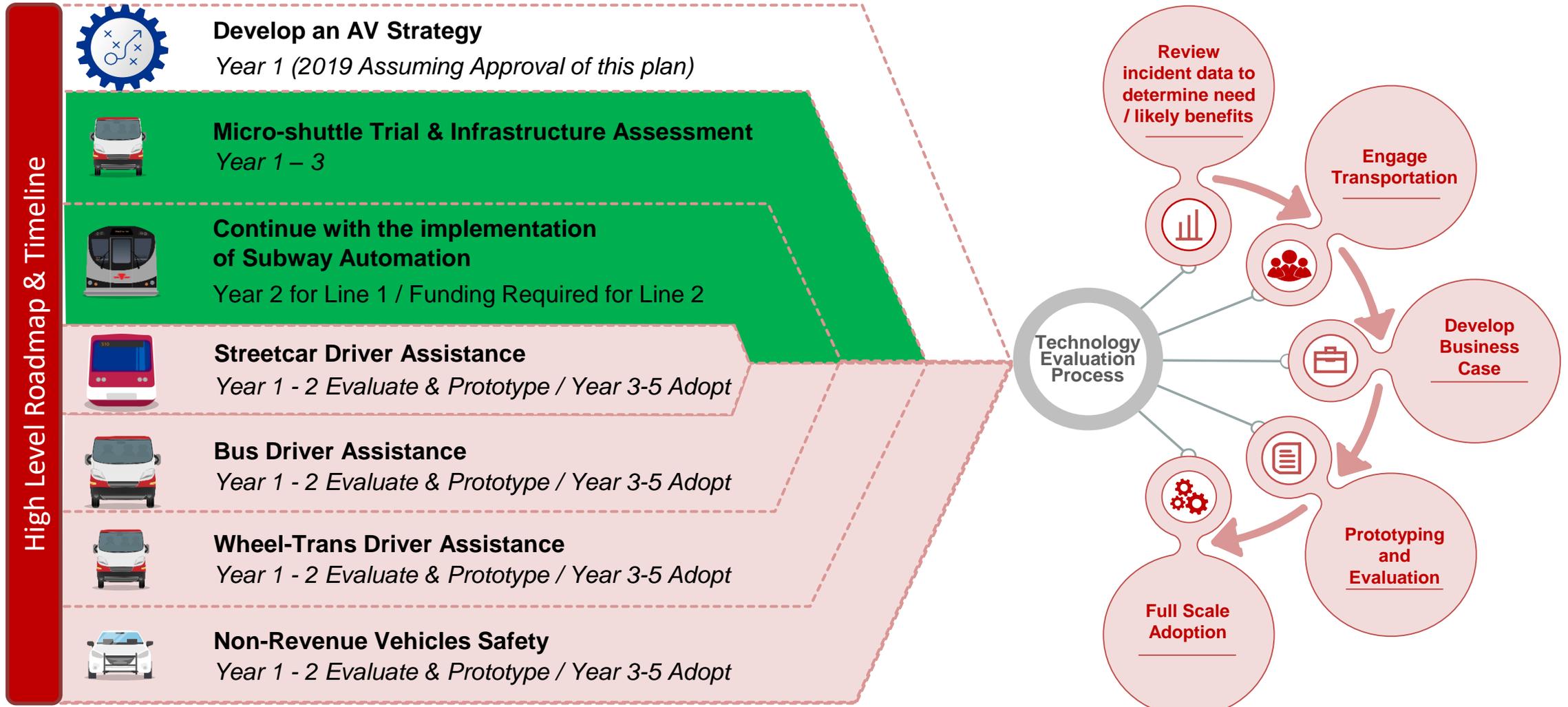
Autonomous vehicle technology can help the TTC achieve its corporate objectives and plans particularly as it pertains to safety and efficiency of its vehicle operations.

TTC has been involved in a variety of initiatives such as City of Toronto's inter-divisional AV working group, the implementation of Automated Train Control, and has received funding with the City of Toronto test autonomous shuttles

TTC AV Strategy over the next 5 years:

- 1 **Continue Subway ATC**
- 2 **Evaluate, Test, and Implement Safety Enhancements** (streetcars, buses, wheel-trans and non-revenue)
- 3 **Explore the role of AVs in micro-transit** through opportunities such as the West Rouge Automated Shuttle trial
- 4 **Continue Improve understanding of AV technology** particularly as it pertains to mass transit

# TTC AV Timeline & Approach

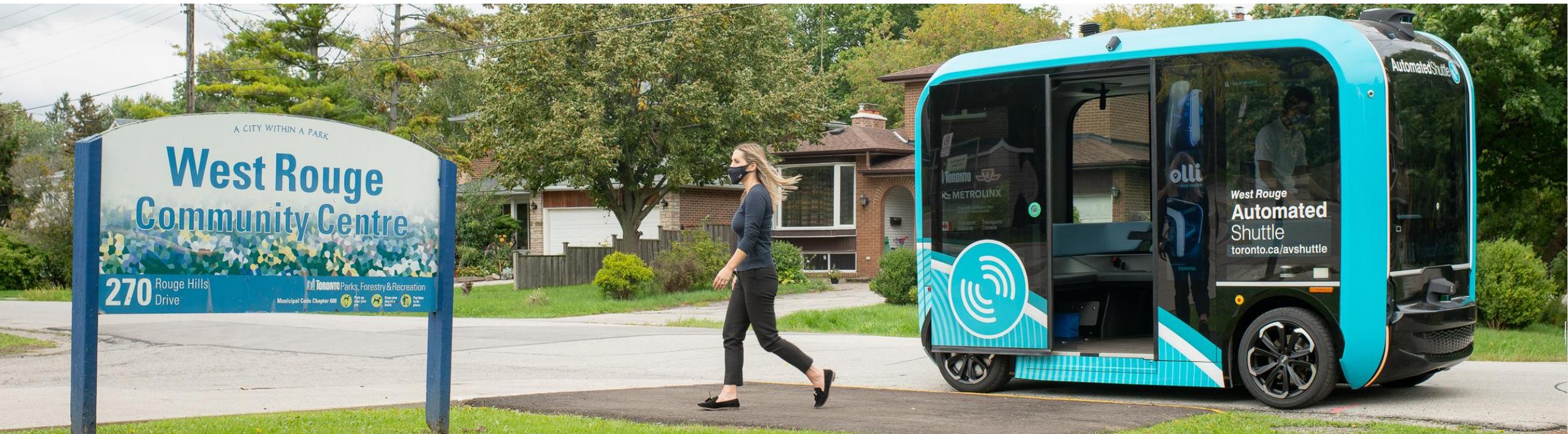




# West Rouge Automated Shuttle Trial

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# | Agenda

## Overview

- Trial Project Objectives
- Trial Project Concept
- Trial Service Plan
- Olli 2.0 Vehicle Information
- Olli 2.0 Interior
- Accessibility Features
- Safety & Testing
- Stop Locations
- Infrastructure Changes
- Vehicle & Stop Branding
- TTC Communications Plan

# Trial Project Objectives

Capacity building & learning for  
the City, TTC, and Metrolinx

To **increase understanding and knowledge** of:

- The technical requirements to operate an automated shuttle
- The administrative requirements to deliver service through an automated shuttle
- The interaction of an automated shuttle in the transit and transportation system
- Human response to an automated shuttle
- The value of an automated shuttle service in the transit and transportation systems

Further, to:

- Increase **public support** for the use of innovation in the public transit system
- Develop a plan to **increase the attractiveness of Toronto** for investment in the development and export of automated transit vehicle technology
- **Provide leadership** in automated vehicle preparedness at the municipal level through knowledge transfer and exchange

# Trial Project Concept



Free weekday peak hour service to GO Station



Free weekend service GO Station to Rouge National Park and West Rouge Community Centre



Schedule aligned to GO Train connections



Fixed route and fixed stops



Operator (AutoGuardian by SmartCone)



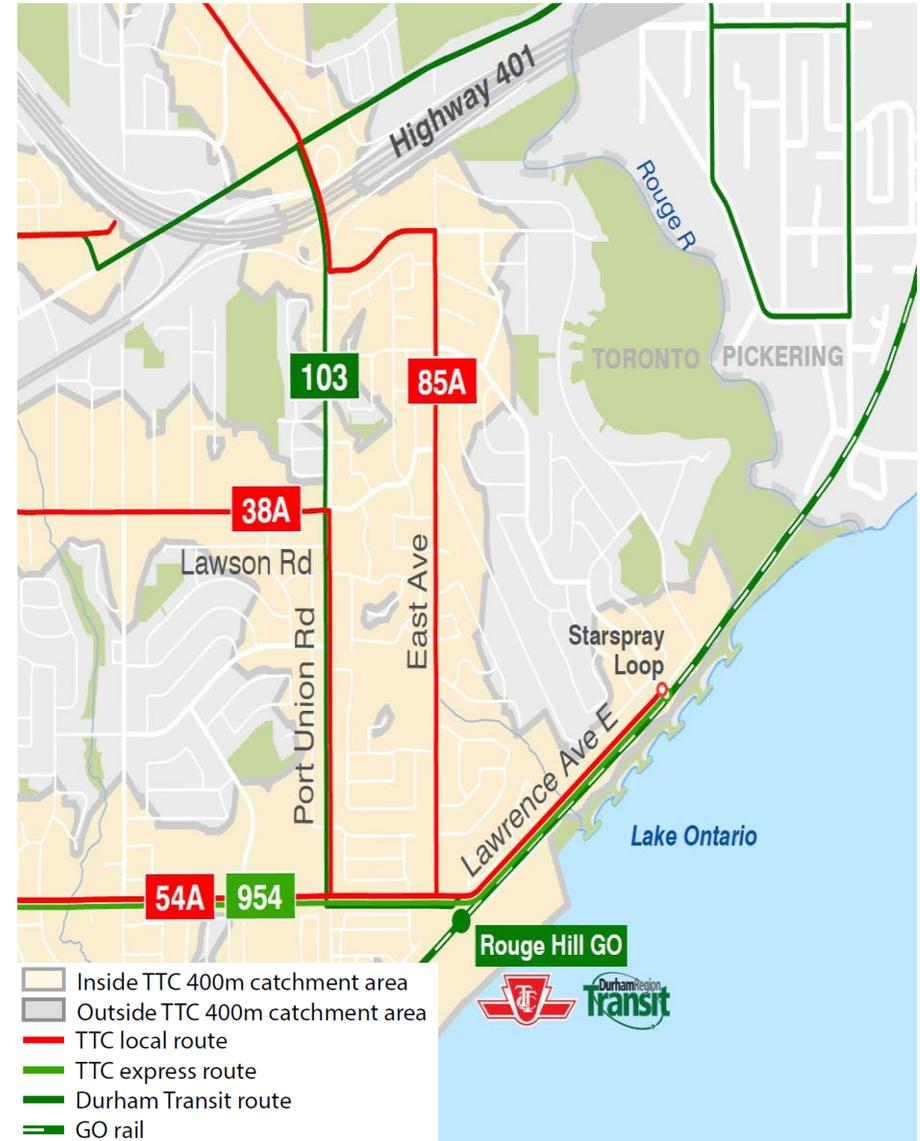
Ride booking service



# Trial Service Plan

## Selected Trial Area

- Potential transit riders outside of the existing TTC 400m service area
- Close proximity to a major transit hub (GO / TTC / Durham Region Transit)
- Many Rouge Hill GO Station users currently drive to the station



# Trial Service Plan

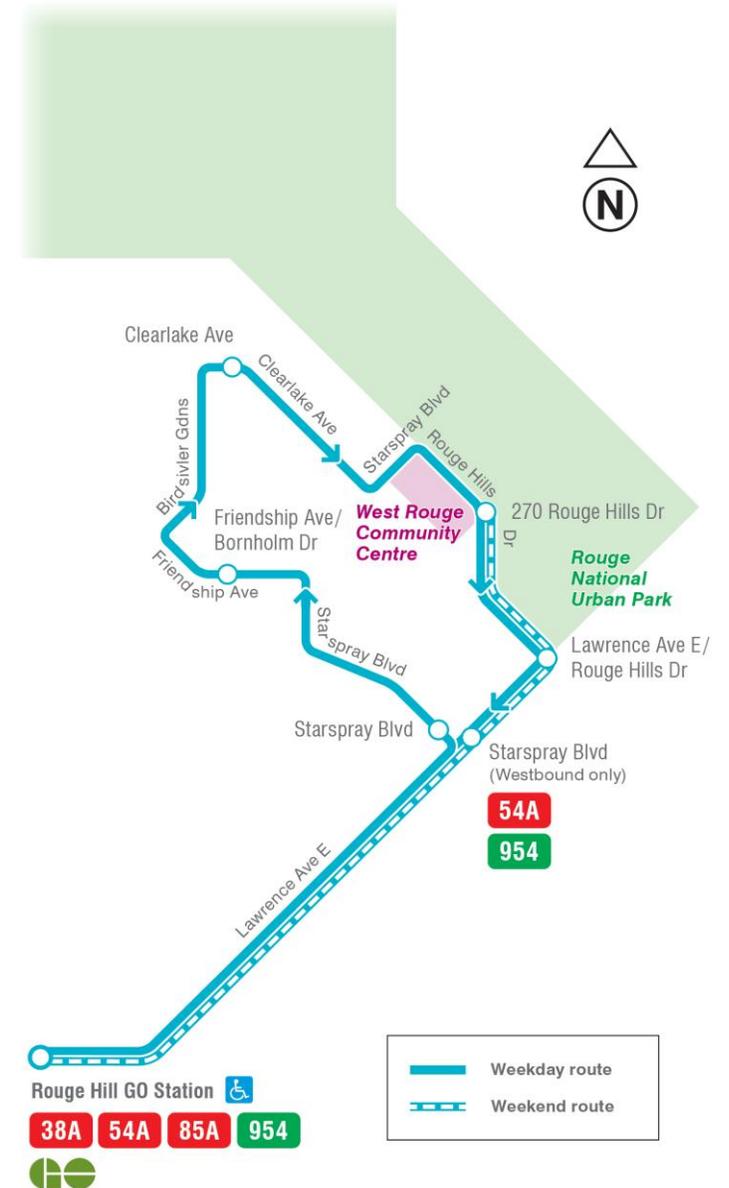
- **Weekday Service:**

- Every 30 minutes
- 6 a.m. to 9 a.m. and 3:30 p.m. to 6:30 p.m.
- Aligned with GO schedules

- **Weekend Service:**

- Every 30 minutes
- 11:30 a.m. to 1:30 p.m. and 3:30 p.m. to 5:30 p.m.
- Aligned with GO schedules

- Free for passengers
- Advanced booking is required
- All stops are accessible
- Service expected to launch late-October/Mid-November

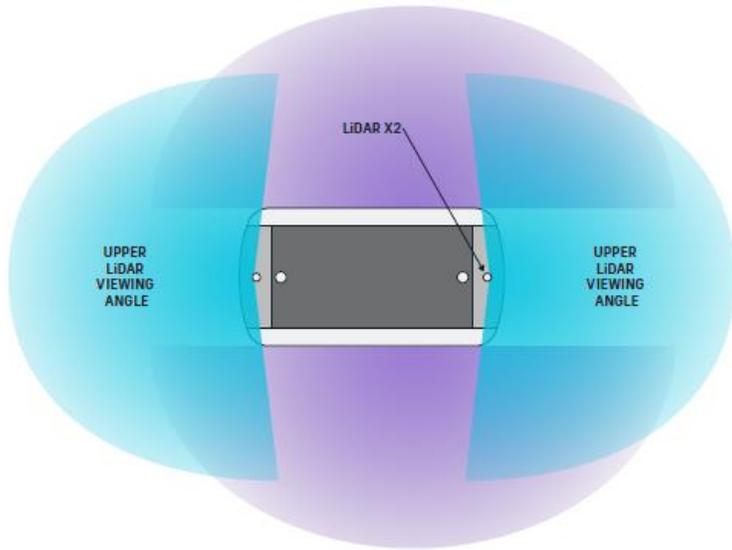


# AV Shuttle - Olli 2.0 – Vehicle Information

- Low-speed (20 km/h) in automated mode; capable of up to 40 km/h when operated by an attendant in manual mode (to/from storage location)
- Fully accessible
- Mostly self-driving vehicle (a human attendant will always be on board during the trial to take over driving if needed)
- Electric (zero-emissions)
- Guided by sensors using Light Detection and Ranging (LiDAR) and Radio Detection and Ranging (Radar)
- Equipped with cameras both inside and outside (for liability and learning purposes) but are blurred to protect individual privacy

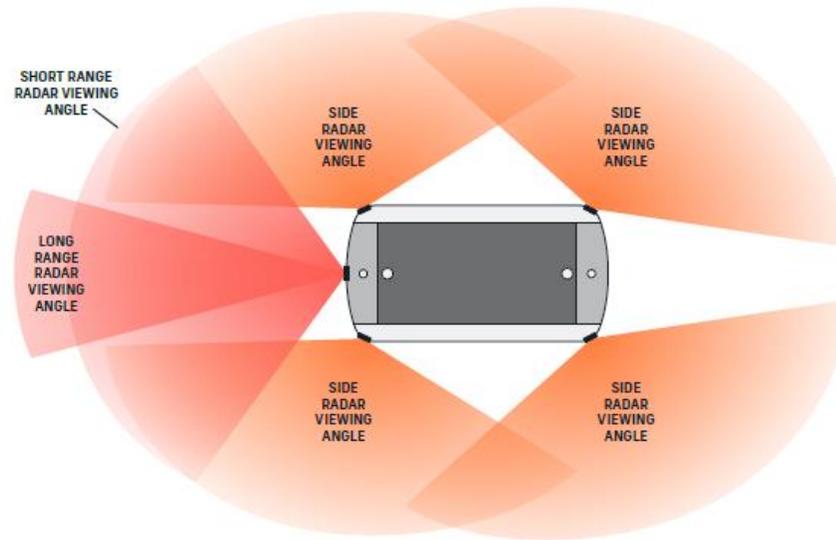


# AV Shuttle - Olli 2.0 – Vehicle Information



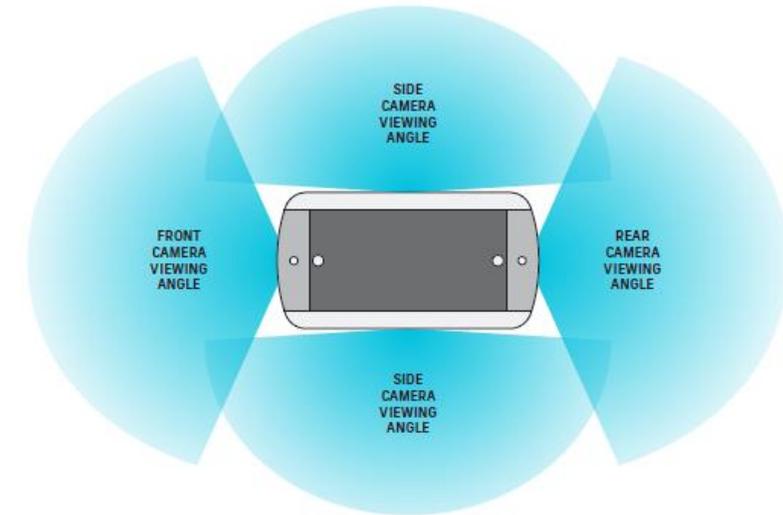
## Olli LiDARs

- Direct measurement of range and direction
- Not affected by lighting conditions
- Degraded by dust or fog



## Olli Radars

- Direct measurement of range
- Direct measurement of relative velocity
- Not affected by lighting conditions
- Less sensitive to dust or fog



## Olli Cameras

- High Resolution
- Direct measurement of color and direction
- Sensitive to lighting conditions
- Sensitive to dust or fog



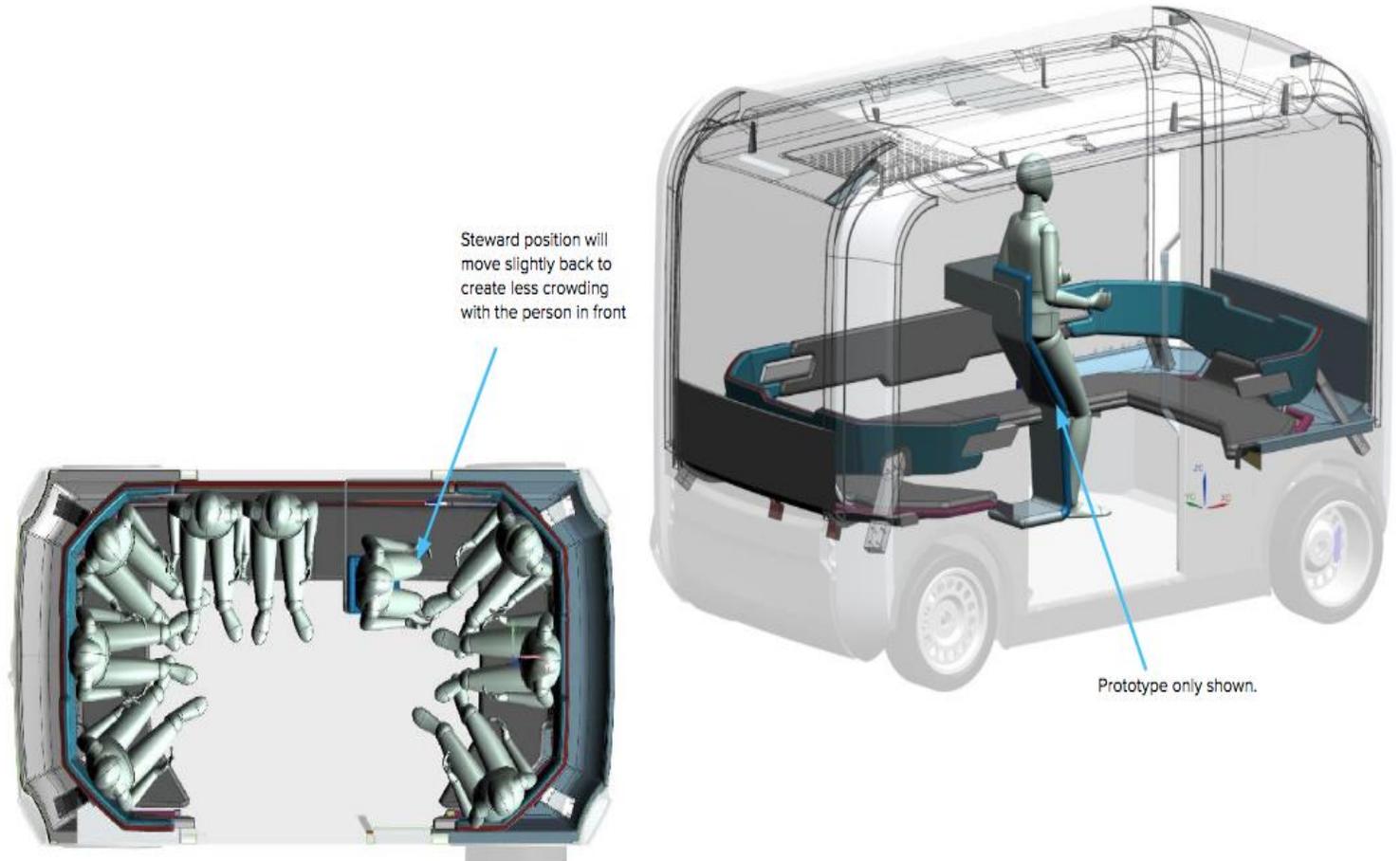
# AV Shuttle - Olli 2.0 – Vehicle Information

- The shuttle operates only in predetermined mapped routes. If the shuttle is placed outside the predetermined route, the autonomous mode does not engage.
- The shuttle confirms all Operational Design Domain (ODD) limits and functionality such as ability to stop the shuttle or initiate an emergency stop, top speed limitation, autonomous mode restriction to pre-defined route on designated roadways only.
- The shuttle sensors are capable of detecting various objects such as:
  - vehicles
  - pedestrians
  - small animals
  - large tree branches or other obstructions or inclusions in its path



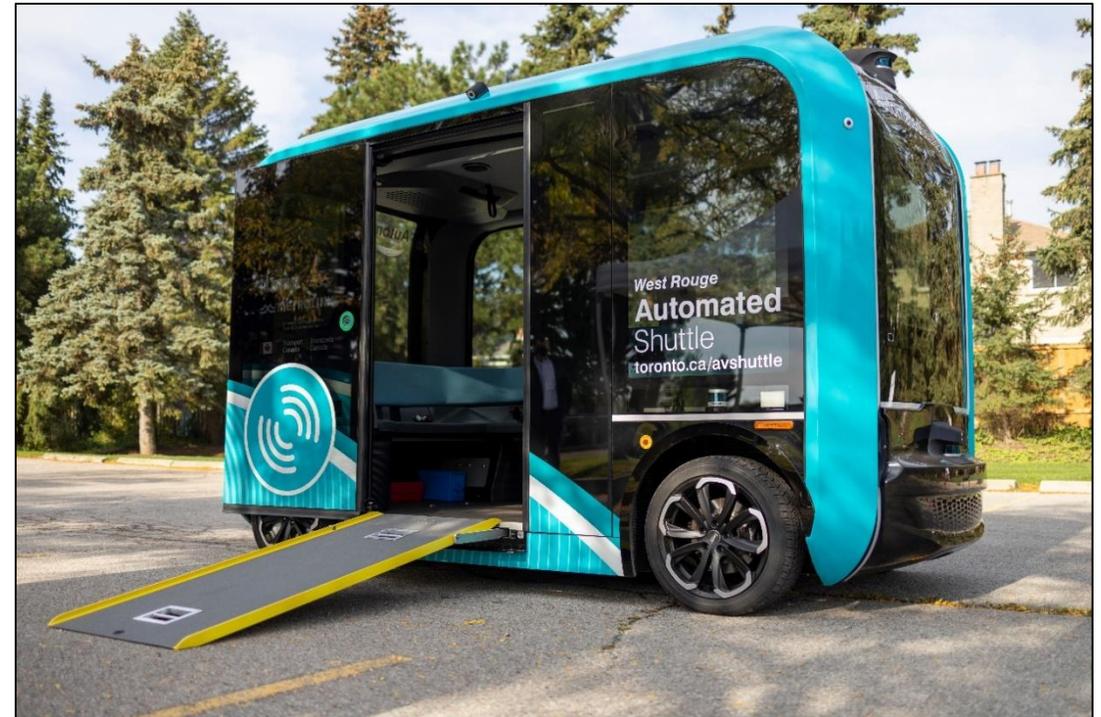
# Olli 2.0 – Interior

- During the trial, pre-booking a trip is required with a maximum capacity of five seated passengers or one passenger in a mobility device and one seated passenger
- During the trial, passengers must be from the same household - COVID-19 safety precaution



# Accessibility Features

- On-board mobility device securement
  - Due to size and passenger limitations, only one passenger with a mobility device (wheelchair, electric scooter or other of similar size) can be accommodated at a time
  - Stop announcements audible inside and outside of vehicle
  - Digital information screens inside and outside
  - Safety attendant will always be onboard to provide assistance as needed
- Access for passengers using mobility devices will be via a ramp deployed manually by the onboard safety attendant



# Safety & Testing

- Independent safety review (Peer Review) of all vehicle testing, quality control, safety procedures, onboard systems and operational procedures was produced
- Route specific review was performed identifying any irregularities or inclusions that may effect the safe operational of the shuttle
- Cyber Security assessment was performed on the shuttle and infrastructure
- Onsite first responders training was conducted
- Detailed hazard log with mitigations was produced
- Operational procedure walkthroughs performed with the operator

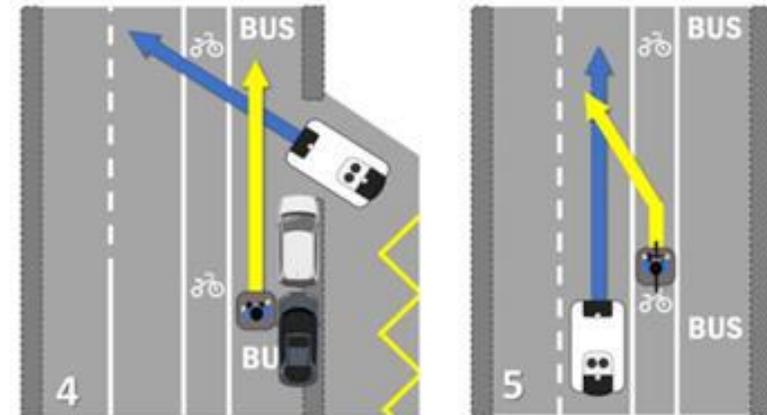
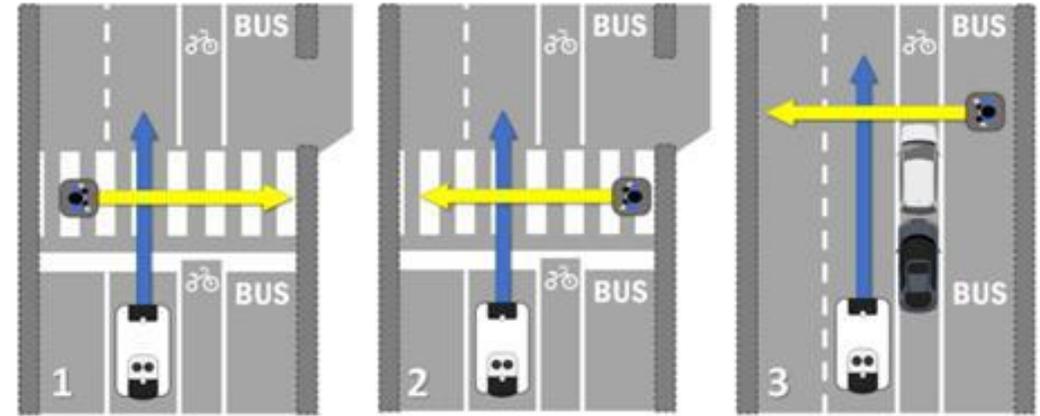


# | Safety & Testing

MTO guidelines and ISO testing guidelines for Autonomous vehicles were used

The ISO 22737 standard for Autonomous vehicles specifies:

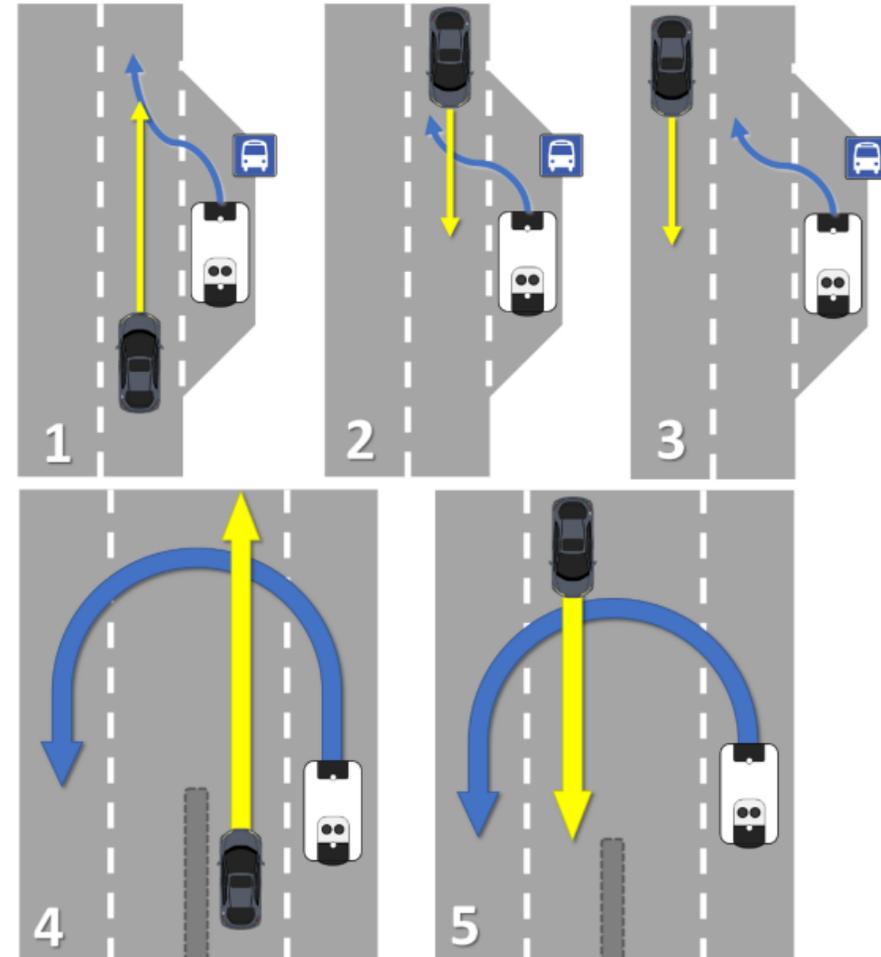
- requirements for the operational design domain
- system requirements
- minimum performance requirements
- performance test procedures
- Pass/Fail criteria



# Safety & Testing

Hazard Identification and risk assessment:

- To identify hazards and risks present in the existing shuttle operation plan.
- Verify that operational mitigations are provided through training and operating procedures.
- Assist in the identification of new operational control measures that could be used to reduce risk.
- Propose additional safety validation tests to be conducted by the Vendor
- Assess the change in risk which could result from a change in the operating strategy.



# Stop Locations



- The criteria for locating stops included:
  - appropriate spacing for transit service
  - Safety and accessible waiting area
  - user need, and community input.
  - Maximize number of customers who can access within a 5 minute walking radius



# Infrastructure Changes

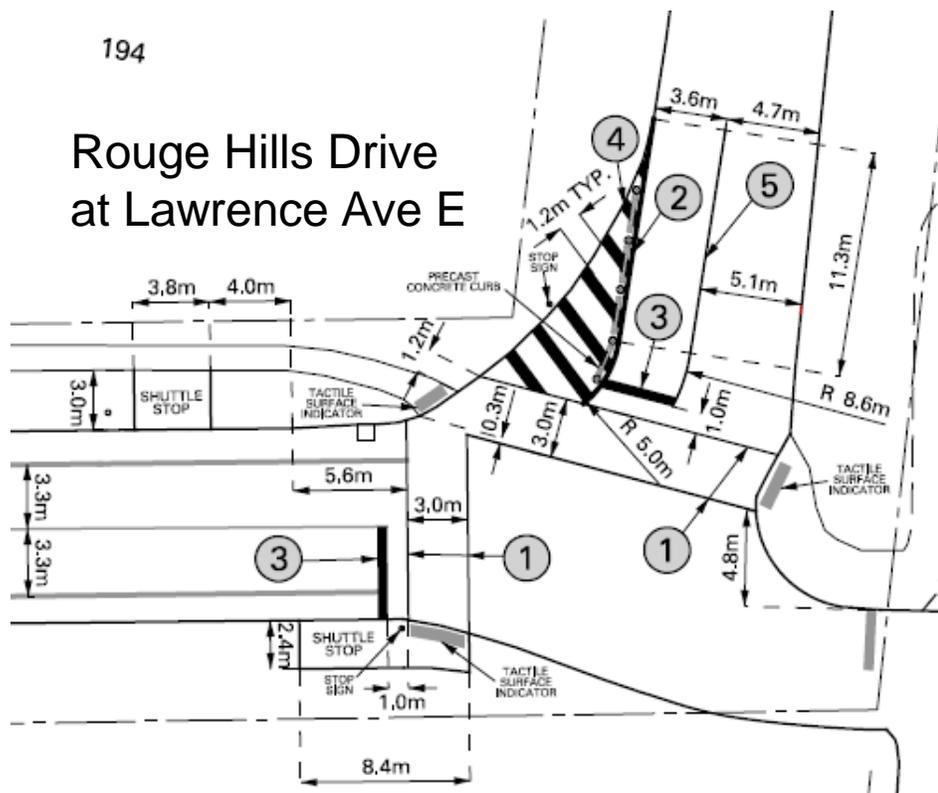


Caution Signage implemented along the route



Passing to be allowed along Lawrence

# Infrastructure Changes



Narrow intersection for shorter crossing distance



Pedestrian Crosswalks & Ramp to south-side shuttle stop

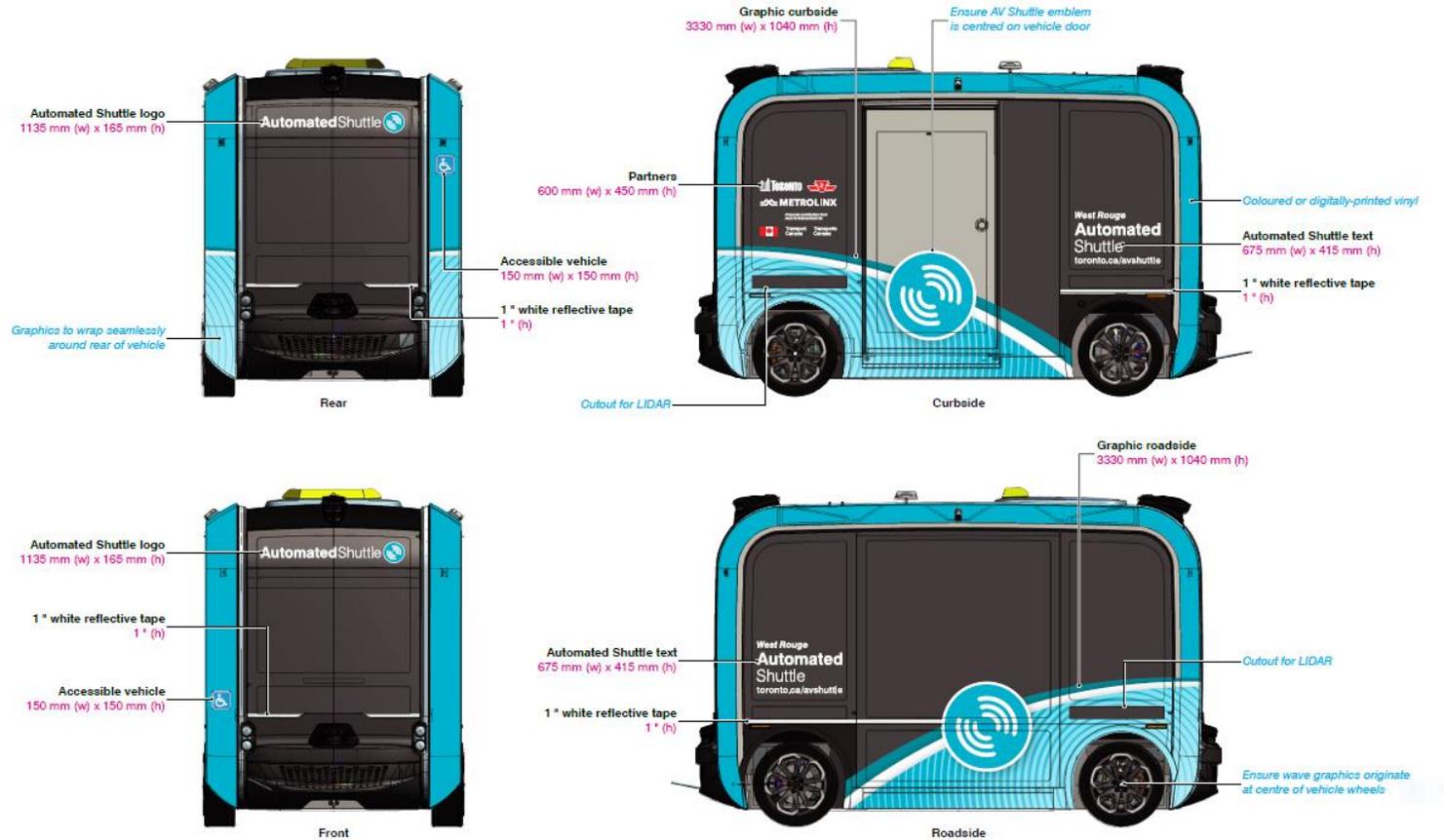


# Vehicle & Stop Branding



# Vehicle & Stop Branding

- The vehicle livery and program identity are designed to be consistent with other City transit initiatives (e.g. RapidTO, Electric Bus, Hybrid Bus)
- Use of a bright blue colour and the incorporation of reflective film gives the vehicle increased visibility, and differentiates it from other transit vehicles in the West Rouge area.
- The vehicle is clearly identified with large graphics and messaging.



 <b>Design and Wayfinding</b>	<small>DEPARTMENT</small> Design and Wayfinding, Customer Communications <small>ADDRESS</small> 1900 Yonge St, Toronto, ON M4B 1Z1	<small>PROJECT</small> AV Shuttle wrap	<b>AV Shuttle wrap</b> <small>Local Motors Oil AV Shuttle</small>	<small>SCALE</small> 1:30	<small>DATE</small> July 12, 2021	<small>DRAWING NUMBER</small> SK 1-1
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# Vehicle & Stop Branding

- Stops utilize a stop marker design consistent with those found throughout the city, for easy identification by TTC customers
- Stop markers feature the same brand elements as the vehicle livery design to differentiate them from other TTC stops in the area
- Incorporates a standard TTC -style route map, highlighting connections to other transit services

Automated Shuttle – Pilot Project

## Design for Curbside Stop Markers

Layout for standard round Stop Marker, w/ Infopost frame



Automated Shuttle Stop Marker Decal



Automated Shuttle Stop Marker Mock-up



Infopost Insert Card



Infopost Insert w/ Standard Frame



Automated Shuttle Stop Mock-up



Design and Wayfinding

DEPARTMENT  
Marketing and Customer Experience  
ADDRESS  
1900 Yonge Street, Toronto, ON M4S 1Z2

PROJECT  
Automated Shuttle - Pilot Project  
Design for Curbside Stop Markers

Automated Shuttle  
Stop Marker Components & Layouts

PREPARED BY  
HARRISON  
REVIEWED BY  
Ian Dickson

DATE  
July 22, 2021  
REVISED  
Oct 04/21 - Dra # 5

DRAWING REFERENCE  
Auto Shuttle Stops - Layout Pkg  
PAGE NUMBER  
2 of 2



# AV Shuttle - TTC Communication Plan

- TTC website
  - Home page feature
  - Dedicated landing page – linking to City of Toronto website: [Toronto.ca/AVShuttle](https://toronto.ca/AVShuttle)
  - Update the Emergency Evacuation Procedures page
- Platform video screen ads in subway stations
- Social media:
  - Twitter @TTCNotices (awareness and retweet City of Toronto posts), Facebook, Instagram, LinkedIn
  - Note: feedback from social media and customer complaints will be evaluated and shared with partners and will form part of final report
- On-board bus announcements for awareness directing customers to [ttc.ca](https://ttc.ca) on 38A Highland Creek, 54A Lawrence East, 954 Lawrence East Express and 85A Sheppard East routes
- Internal communications for employee awareness



