MEMO

To: Rapid Transit Implementation Working Group

From: Jennie Ramsay, P.Eng.
Project Director
Rapid Transit Implementation

Date: February 15, 2019

Re: **RTIWG February 21, 2019 Meeting Agenda**
Autonomous Vehicle and Ridesharing Expert Panel

Introduction

The contents of this memo contain background information on the Council-directed request to engage with an autonomous vehicle and ridesharing expert. The adopted Council amendment on December 18, 2018 is as follows:

> **That an expert in the field of autonomous vehicles and ridesharing be engaged to speak to the Rapid Transit Implementation Working Group (RTIWG) in the first quarter of 2018 about the coming smart transit technologies and the likely timelines for their commercialization.**

From this resolution and in concert with a previous June 12, 2018 Council direction to develop a Connected and Autonomous Vehicle Strategic Plan, staff have assembled a three-speaker panel to both address the Rapid Transit Implementation Working Group (RTIWG) inquiries and the City of London's related project.

Expert Panel Format

The Expert Panel will be moderated by Jon Kostyniuk and will include the following components discussed further below:

- Individual expert introductions and subject matter background (approximately 20-30 minutes);
- Moderated discussion panel (approximately 25-30 minutes); and
- General questions from RTIWG chair and members.

Speaker Biographies

Barrie Kirk, B.Sc., P.Eng. is the Executive Director of the Canadian Automated Vehicles Centre of Excellence (CAVCOE). He is a well-known consultant, speaker, and broadcaster on automated vehicles, and has advised many public and private sector organizations on planning for the AV era. Barrie and CAVCOE are now starting their third AV research project for the City of Toronto. His other roles include the Board of Directors of Unmanned Systems Canada, the Automotive Advisory Board of Centennial College, and the Canadian Advisory Committee for ISO TC204. Prior to this, he worked in the technology industries in Canada, the US, and the UK, including senior management positions in Ottawa-area companies. Barrie received a B.Sc. (Honours) in Electrical Engineering from Coventry University, UK and is a Professional Engineer.

Edwin Olson, Ph.D. is an Associate Professor of Computer Science and Electrical Engineering at the University of Michigan, and co-founder/CEO of May Mobility, Inc., which develops self-driving shuttles. He earned his Ph.D. from MIT in 2008 for work in robot mapping. He has worked on autonomous vehicles for over a decade, including work on the 2007 DARPA Urban Challenge, vehicles for Ford and Toyota Research Institute, and now May Mobility. His academic research includes work on perception, planning, and mapping. He was awarded a DARPA Young Faculty Award, named one of Popular Science's "Brilliant 10", and was winner of the 2010 MAGIC robotics competition. He is perhaps best known for his work on AprilTags, SLAM using MaxMixtures and SGD, and Multi-Policy Decision Making.

Dr. Amer Shalaby, Ph.D., P.Eng. is a Professor of Transportation Engineering and Planning at the University of Toronto and Associate Director of the iCity Centre for Automated and Transformative Transportation Systems. He is specialized in urban transit planning and operations, intelligent transportation systems, and transportation planning for large-scale events and mega cities. His research program has been sponsored by numerous public agencies and private companies in Canada, the US, and internationally. Dr. Shalaby has also led consulting projects for many clients in Canada and internationally, and he has offered short courses on public transit planning and modelling to the professional community since 2008. Dr. Shalaby is an appointed member of two transit technical committees of the TRB, he serves as associate editor of the Canadian Journal of Civil Engineering and he sits on the editorial board of two international journals. Dr. Shalaby has also served on expert and advisory panels of several transit projects in Canada and internationally. Between 2008 and 2010, Professor Shalaby held an honorary appointment of a visiting scholar at Carnegie Mellon University.

Autonomous Vehicle and Ridesharing Background Information

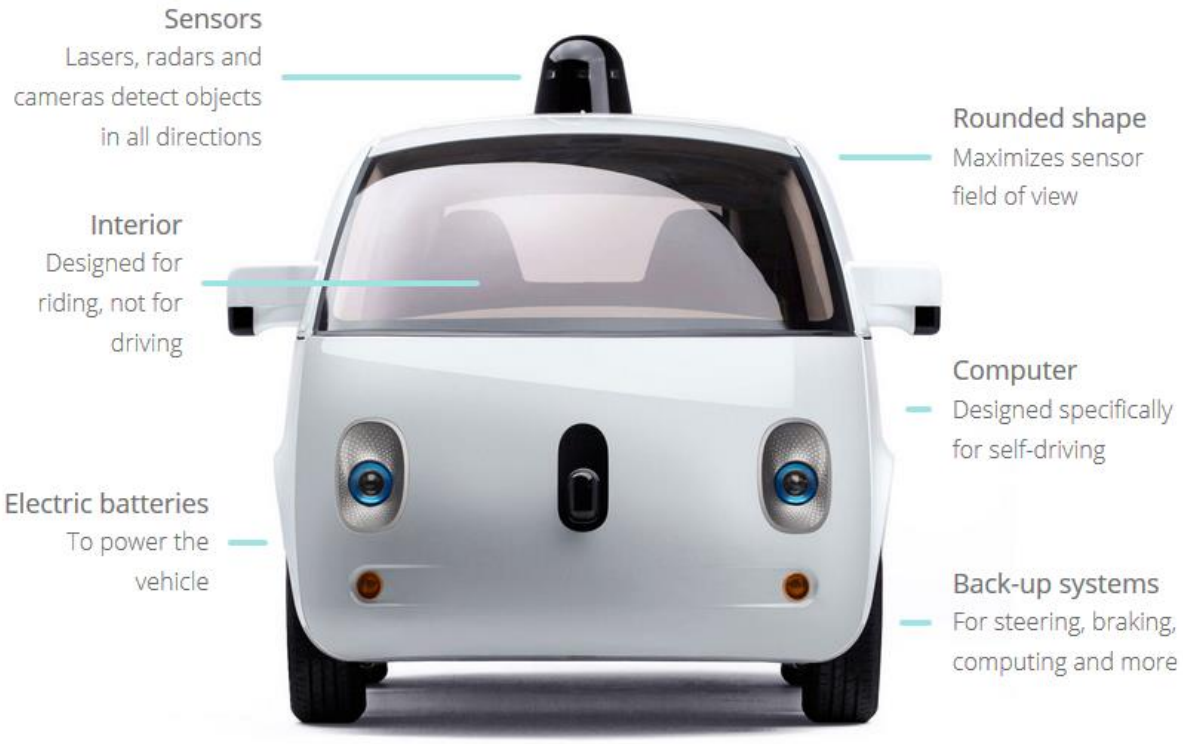
Autonomous Vehicles (AVs)

*D*riverless or self-driving vehicles that are capable of detecting the surrounding environment in order to safely navigate a transportation system.

Generally, autonomous vehicles detect the surrounding environment using:

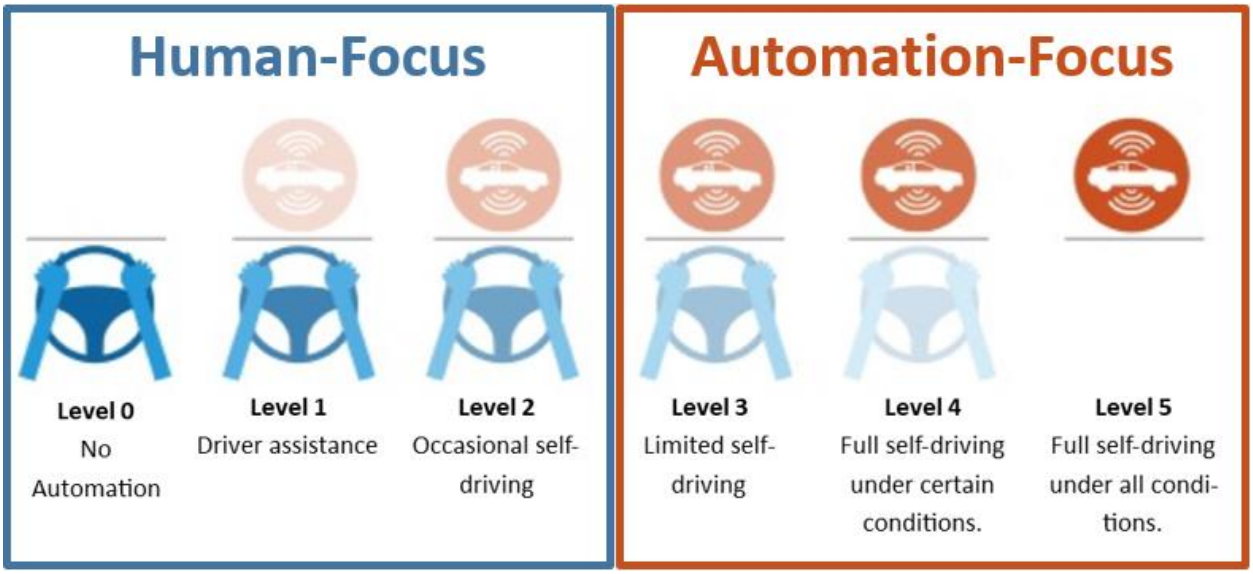
- A variety of sensors;
- A Global Positioning System (GPS); and
- Computer algorithms based on Artificial Intelligence (AI).

Typical Autonomous Vehicle Components



Source: https://www.theurbanist.org/2016/01/07/the-good-and-the-bad-of-driverless-cars-for-cities/

All autonomous vehicles are not created equal, the Society of Autonomotive Engineers (SAE) classifies the levels of automation as follows:



The key distinction is between SAE Levels 2 and 3, where SAE Level 3 begins to focus more on the automated systems monitoring the environment and performing the entire driving task.

A short video (3:16) explaining the SAE levels of automation is found here: https://www.youtube.com/watch?v=Eq89YGbERzs

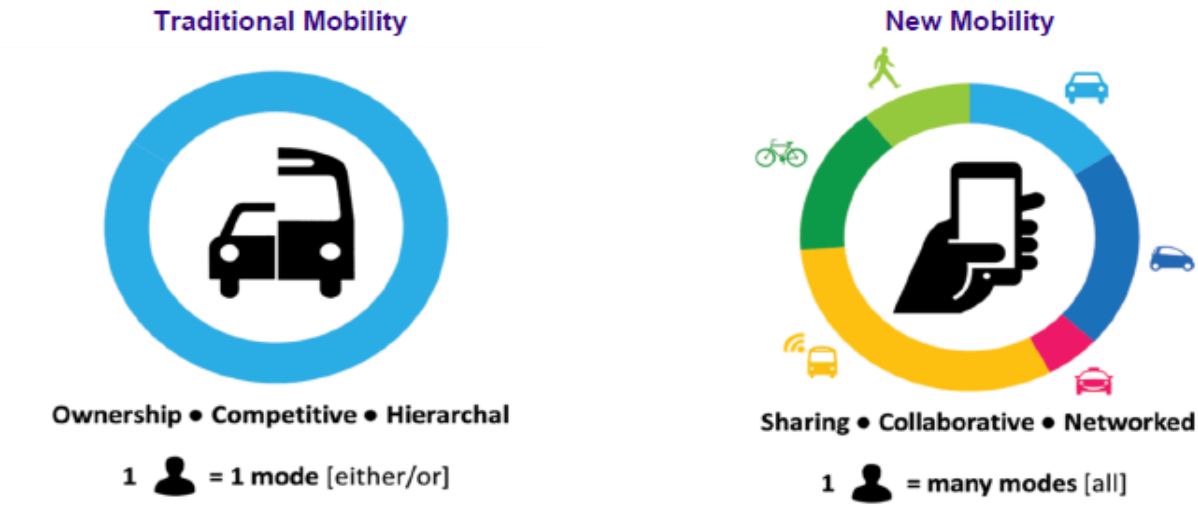
Connected Vehicles (CVs)

Autonomous vehicles may receive up to date information through connected vehicle technology, which primarily communicates through three different channels:

- **Vehicle-to-Vehicle (V2V):** Enhance situational predictability (AVs travelling together in close proximity.
- **Vehicle-to-Infrastructure (V2I):** Directly communicate the status and condition of nearby infrastructure. Includes Smart Traffic Signals and Smart Parking to manage transportation demands and to avoid congestion.
- **Vehicle-to-Everything (V2X):** A more general term for communications with the surroundings in addition to V2V and V2I, such as pedestrian/bicycle communication.

Ridesharing and Mobility-as-a-Service (MaaS)

Many companies such as Uber, Lyft, and others are developing their own autonomous vehicle products and incorporating these vehicles into their business models. These app-based transportation services target lower journey prices, increased convenience, and improved rider amenities.



Related to ridesharing is Mobility-as-a-Service (MaaS), which expands upon the ridesharing concept. MaaS describes a shift away from personally-owned modes of transportation and towards mobility solutions that are consumed as a service.

MaaS is enabled by combining transportation services from public and private transportation providers through a unified gateway (e.g. a mobile app) that creates and manages the trip, which users can pay for with a single account. Users could subscribe to various transportation service packages (similar to existing cellular phone or cable subscriptions) tailored to the needs of individuals, couples, or families.

In addition to and including ridesharing, MaaS may include services such as:

- Real-time transit and/or commuter rail schedule integration;
- Traditional taxi integration;
- Car sharing and car rental integration;
- Bicycle sharing integration; and
- Other third-party service integration.

A short video (2:10) explaining MaaS is found here:
https://www.youtube.com/watch?v=ZQieTU7_5xo