Automated Vehicles: Perspectives from Canadian vehicle OEMs

CCMTA Annual Meeting

Toronto, ON

May 25, 2014

Overview

1. **Our membership**
2. **Automated vs. autonomous vehicles**
   - Levels of automation
3. **Technology**
   - Sensor-based
   - Connectivity-based
   - Converged
4. **AV technology deployment: potential implications**
5. **AV pilot programs: OEMs' recommendations**

Our membership

Canadian Vehicle Manufacturers' Association (CVMA)

The Canadian Vehicle Manufacturers' Association is the industry association that has represented Canada's leading manufacturers of light and heavy duty motor vehicles for more than 85 years. Its membership includes Chrysler Canada Inc.; Ford Motor Company of Canada, Limited and General Motors of Canada Limited. Collectively its members account for 62% of vehicles produced in Canada; operate 5 vehicle assembly plants, each having a 9:1 job multiplier, as well as a number of engine and components plants; and, over 1,300 dealerships. 115,000 jobs are directly tied to vehicle assembly in Canada. Direct and indirect jobs associated with vehicle manufacturing are estimated at over 500,000 across Canada.

CHRYSLER Ford GM CANADA

Global Automakers of Canada (GAC)

Global Automakers is the national association representing the interests of 14 international manufacturers of light duty vehicles (LDVs). In 2013, our members sold 55.4% of all new vehicles in the Canadian market. Over 54% of our companies' Canadian sales were assembled in the North American Free Trade Agreement (NAFTA) region. Roughly 20% of those sales were manufactured at Honda and Toyota's affiliated Ontario assembly operations which accounted for roughly one-third of Canada's total LDV production in 2013. 11 of our 14 members currently assemble vehicles in the broader NAFTA region and, taken together, our companies support over 77,000 direct and indirect Canadian jobs as well as 60% of Canada's 3,492 new vehicle dealers.

BMW HONDA The Power of Dreams HYUNDAI JAGUAR LAND ROVER KIA mazda Mercedes-Benz MITSUBISHI MOTORS NISSAN

PORSCHE SUBARU TOYOTA VOLVO

Associates: Ferrari ISUZU DENSO

Automated vs. autonomous vehicles (AVs)

Terminology related to Automated Vehicles (AVs) and Advanced Driver Assist Systems (ADAS)

Our members and the broader automotive engineering community do not use the terms “autonomous” or “self-driving” to describe driving automation.

“Autonomous” is generally used to refer to systems of governance, or participants therein, in which context it means “having the power or right to govern itself” (see, for example, the Merriam-Webster dictionary).

Thus, using the terms “autonomous” or “self-driving” incorrectly implies that an automation system is capable of independently changing the rules by which it operates, which is not the case.

The preferred term is “automated”.

Levels of automation

The **Society of Automotive Engineers (SAE International) On-road Vehicle Standards Committee** has published nomenclature and definitions. Information document J3016 (JAN:2014) describes six (6) levels of automation (**NHTSA** has published a 5-level hierarchy describing the continuum between conventional, fully human driven vehicles and AVs):

Level 0 – No automation
Level 1 – Driver assistance
Level 2 – Partial automation
Level 3 – Conditional automation
Level 4 – High automation
Level 5 – Full automation

Levels 0-2: Systems that are already in production, **not** "automated vehicle technology".
Level 1, 2: Systems only automate a portion of the dynamic driving task during engagement; require the driver to perform the remainder of the dynamic driving task while engaged.
Level 3-5: Systems are referred to as "automated driving systems," as they are capable of performing the complete driving task under some or all conditions.

NHTSA Preliminary Statement of Policy Concerning Automated Vehicles, 2013 http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf

Summary of Levels of Driving Automation for On-Road Vehicles

This table summarizes SAE International's levels of *driving* automation for on-road vehicles. Information Report J3016 provides full definitions for these levels and for the italicized terms used therein. The levels are descriptive rather than normative and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. "System" refers to the driver assistance system, combination of driver assistance systems, or *automated driving system*, as appropriate.

The table also shows how SAE's levels definitively correspond to those developed by the Germany Federal Highway Research Institute (BASt) and approximately correspond to those described by the US National Highway Traffic Safety Administration (NHTSA) in its "Preliminary Statement of Policy Concerning Automated Vehicles" of May 30, 2013.

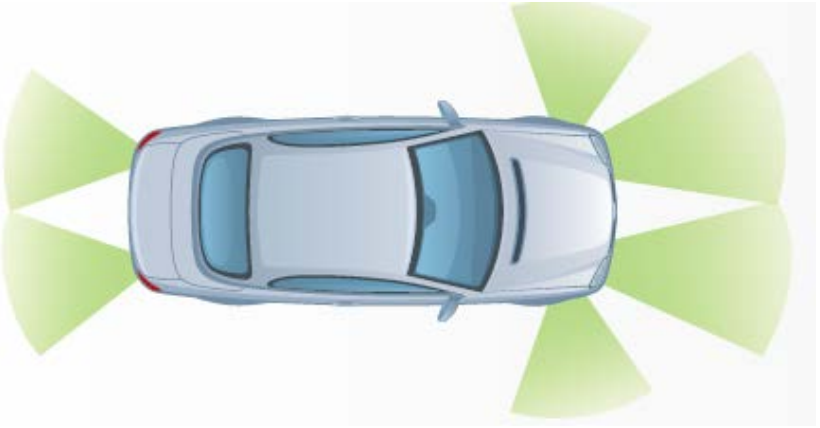
Level	Name	Narrative definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Fallback performance of *dynamic driving task*	System capability (*driving modes*)	BASt level	NHTSA level
***Human driver* monitors the driving environment**								
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a	Driver only	0
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes	Partially automated	2
***Automated driving system* ("system") monitors the driving environment**								
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes	Highly automated	3
4	**High Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes	Fully automated	3/4
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**	-	

The Center for Internet and Society at Stanford Law School , December 2013 http://cyberlaw.stanford.edu/blog/2013/12/sae-levels-driving-automation

Technology: Sensor-based

Sensor-Based Systems

- Employs a “sense-plan-act” design using a suite of sensors to gather raw data, algorithms interpret the data and makes plans about the vehicle’s actions, and plans are converted into actionable commands to the vehicle’s control system
- Light Detection and Ranging (LiDAR)
- Radio detection and ranging (radar)
- Cameras
- Ultrasonic sensors
- Infrared systems
- Combined Systems



Limitations

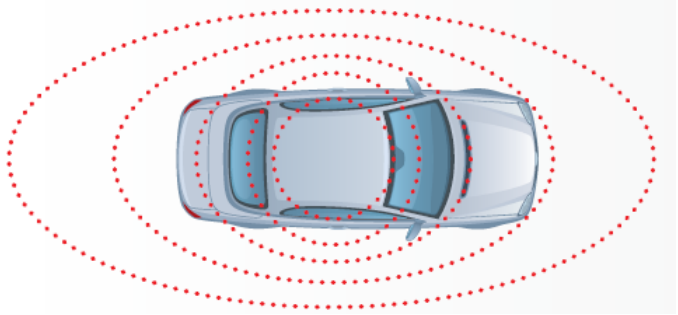
- Cannot yet address all road/traffic objects and events with sufficient reliability
- Not cost-effective for mass market adoption (i.e.: the Google LIDAR system cost ~ $70,000)
- Further development of 360 degree environmental mapping capability required

Rand Corporation, *Autonomous Vehicle Technology, A Guide for Policy Makers*, 2014, http://www.rand.org/pubs/research_reports/RR443-1.html
KPMG and CAR, *Self-driving cars: The next revolution, 2012,* http://cargroup.org/?module=Publications&event=View&pubID=87

Technology: Connectivity-based

Connectivity Vehicle Systems

- Uses wireless technologies to communicate in **real-time** from vehicle to vehicle (V2V) and between vehicle to infrastructure (V2I), collectively V2X, the "connected car"
- Dedicated Short-Range communications (**DSRC**): Currently the leading wireless medium for V2V safety communications (only wireless protocol with sufficiently low latency to do real-time safety-related warnings)
- Commercial wireless services, GSM, 4LTE for mobility, productivity and convenience
- Bluetooth
- Wi-Fi



Limitations

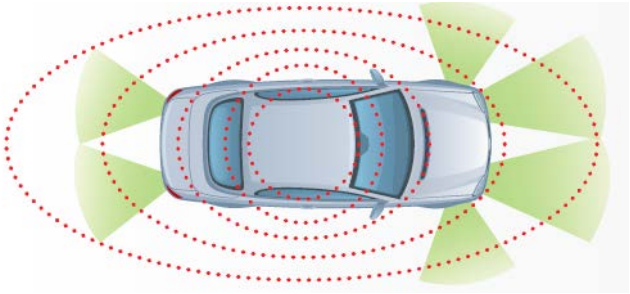
- Governance and institutional issues remain unresolved (rules of use and access, privacy, security, liability, etc.)
- DSRC-based V2I will require significant infrastructure investment
- V2V requires high market penetration to delivery value reliably

N.B.: NHTSA recently signalled an intent to **require** DSRC in vehicles in the future

Technology: Converged systems

Converged Systems

- Convergence of communication and sensor technologies could deliver better safety, mobility and automated driving capability
- Facilitates adequate mimicking of human senses
- Reduces need for an expensive mix of sensors and reduce the need for blanket V2I investment
- Provides the necessary functional redundancy to ensure a very high degree of reliability



Implementation challenges

- **Improved positioning technology**: Not *quite* sufficiently accurate for some proximity-critical applications
- **High-resolution Mapping**: Insufficient detail to "see" the environment currently
- **Robust Human Machine Interface** (HMI): Driver hand off and take-over control solution is required
- **Standardization**: SAE J2735 and IEEE1609 in place, but additional standards are likely required in future
- **Data security and privacy protection**: Sufficiently robust security and privacy protocols are required for operation across vehicles **and** communication

AV technology deployment: Potential implications

- US- based Morgan Stanley report estimates $1.3 trillion in **potential** annual savings to the American economy, with global savings estimated at more than $4.6 trillion. We've seen no reliable Canadian-specific estimates yet.
- Effect on **Crashes**: Potential to reduce crashes by reducing driver error
- Effect on **Traffic Congestion and its Costs**: Potential to reduce the **cost** of congestion, could increase productivity, congestion implications uncertain
- Effect on **Energy and** Emissions: Potential to decrease GHG emissions
- Effect on **Land Use**: Potential willingness to live farther from work, potential for fewer parking spaces from sharing programs
- Effect on **Mobility**: Potential increase mobility for those who are currently unable or unwilling to drive
- **Costs**: Potential decrease to private costs of driving; likely to disrupt existing institutions (**insurance**, **public transit**, parking revenues, etc.)
- To realize these benefits, a significant level of activity and major research initiatives on automated technology are occuring **globally** (e.g.: U.S.-based Safety Pilot program) (http://www.its.dot.gov/safety_pilot/index.htm)

Morgan Stanley, Autonomous Cars: Self-Driving the New Auto Industry Paradigm November 6, 2013. http://www.morganstanley.com/public/11152013.html

Pilot programs for AVs: OEMs' recommendations

Our recommendations

Overall objective: Facilitate testing of automated vehicles and avoid potential barriers.

1. Any new regulatory undertakings at this time would be premature.
2. It's **too early** to discuss regulations for 'automated' vehicles (AVs) and 'connected' vehicles (CVs).
3. New **regulation(s) are not needed at this time** to facilitate the safe and effective testing or deployment of vehicles equipped with automated driving technologies and systems in Canadian provinces, save for the attendant insurance-related issues or sub-national legislative-related provisions (*Highway Traffic Act)* specific to the general operation of motor vehicles.
4. Consistent **definitions and terminology usage are critical**. The definition of 'automated' does not always mean 'self-driving' or 'driverless'. Various automated or advanced driver assist systems (ADAS) have been offered as standard/option equipment on new Canadian-specification vehicles for years.
5. OEMs have been progressing, individually and collaboratively, with programs to implement vehicle automation and ADAS in new vehicles. **Canadian vehicle OEMS are key stakeholders**.

Pilot programs for AVs: OEMs' recommendations

Our recommendations (cont'd)

6. Should CCMTA or its individual members have a reasonable basis to explore new/additional requirements **that could impact the design, production, importation, sale, registration, or operation of new vehicles**, appropriate consultation is needed with OEMs and other industry or government stakeholders, on a realistic timeframe.
7. Government-industry **pre-publication consultation** with Canadian vehicle OEMs is a reasonable expectation.
8. OEMs require **sufficient time** to adjust their business plans and processes, along with a reasonable level of **regulatory certainty** in this rapidly-evolving area of interest (moving in 3-6 month leaps and bounds).
9. Activities on automated vehicles and driving systems should be **coordinated nationally** and with bordering U.S. jurisdictions to avoid a patch-work of sub-national requirements.
10. We strongly recommend that work is coordinated on connected and automated vehicles (CAVs) **federally and through the CCMTA**.

Questions? Comments?

Thank you for your time and attention.

Contact us

170 Attwell Dr
Suite 400
Toronto, ON M9W 5Z5

Mark A. Nantais, President
Tel 416.364.9333

cvma.ca

2 Bloor St W
Suite 1804, PO Box 5
Toronto, ON M4W 3E2

David C. Adams, President
Tel 416.595.8251

globalautomakers.ca