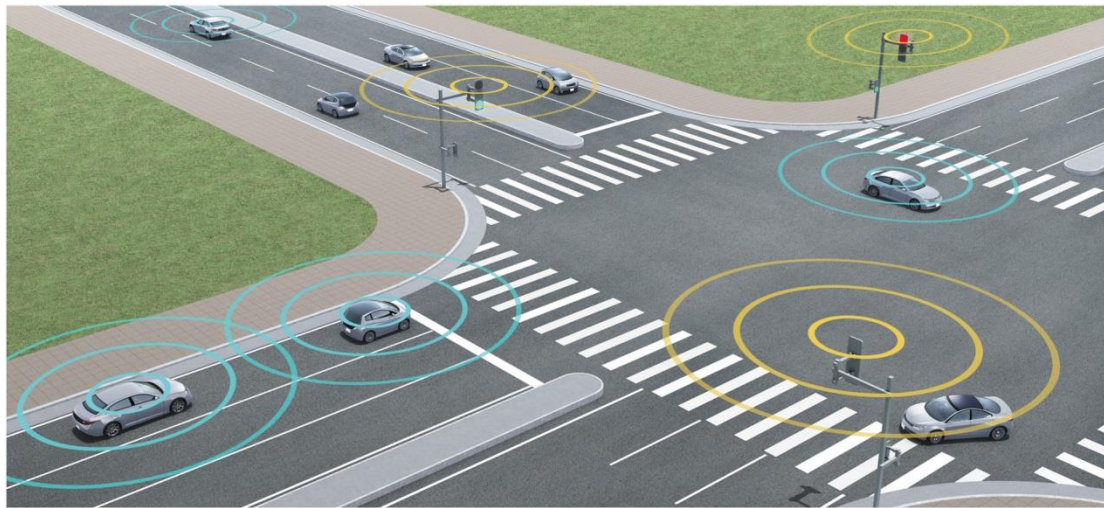


The role of connectivity with vehicle automation



Source: Denso

Stuart Ballingall
Project Director Cooperative ITS, Austroads

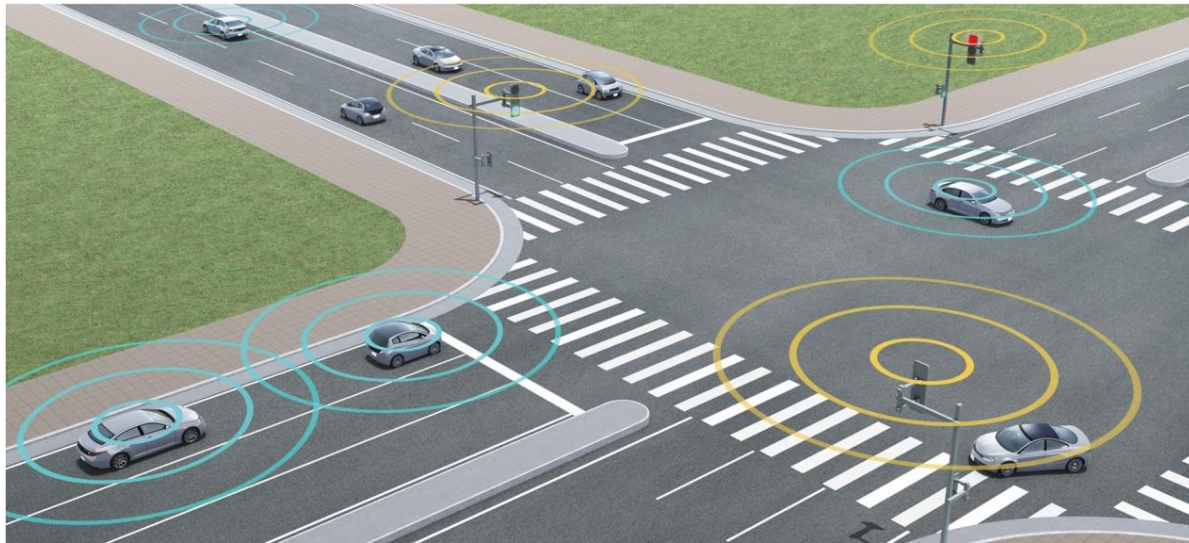
ITE-ANZ seminar on Automated Vehicles
16 March 2015, Melbourne

Overview

- Define cooperative systems
- Define levels of vehicle automation
- Convergence of cooperative & automated systems
- Examples of cooperative automation

Cooperative ITS

C-ITS refers to the use of wireless communications between vehicles, infrastructure, centres and personal devices, which enable systems that cooperatively work together to deliver safety, efficiency and environmental outcomes beyond what standalone systems can achieve

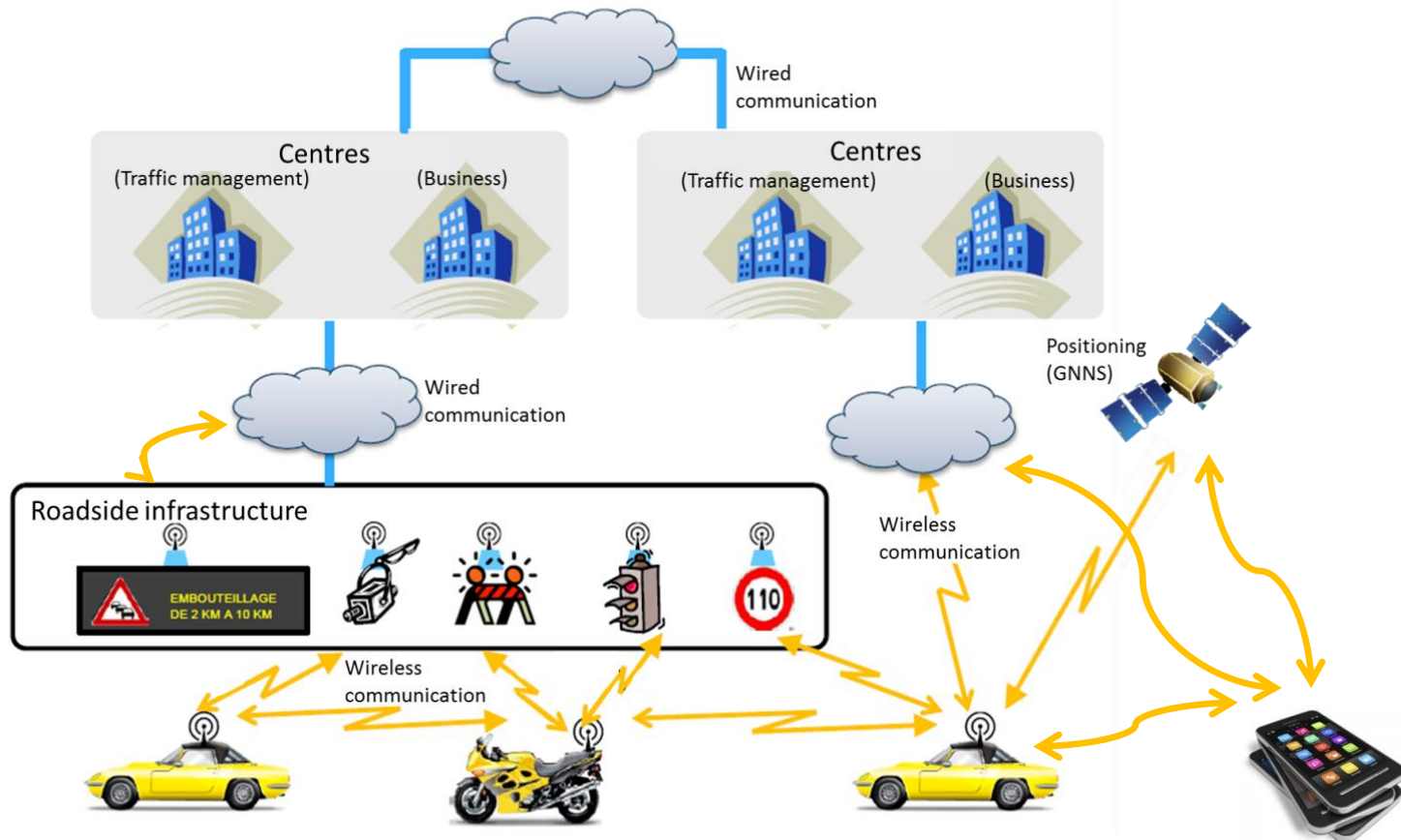


Source: Denso

Cooperative ITS

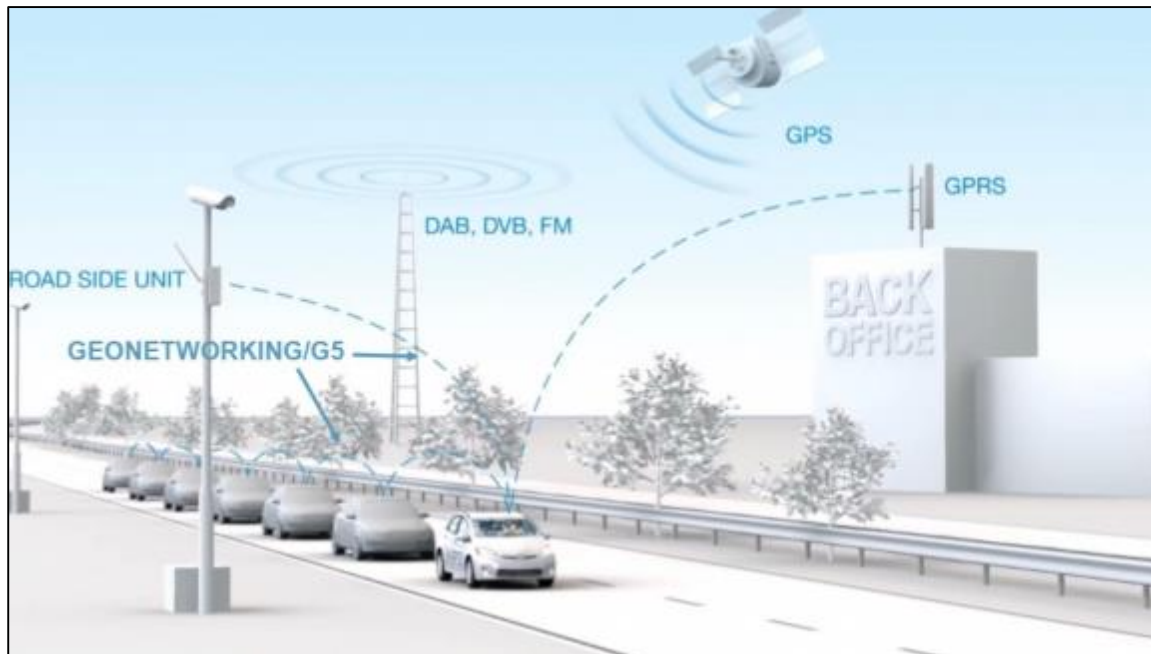
Interoperability between:

- Vehicles
- Infrastructure
- Centres
- Personal Devices



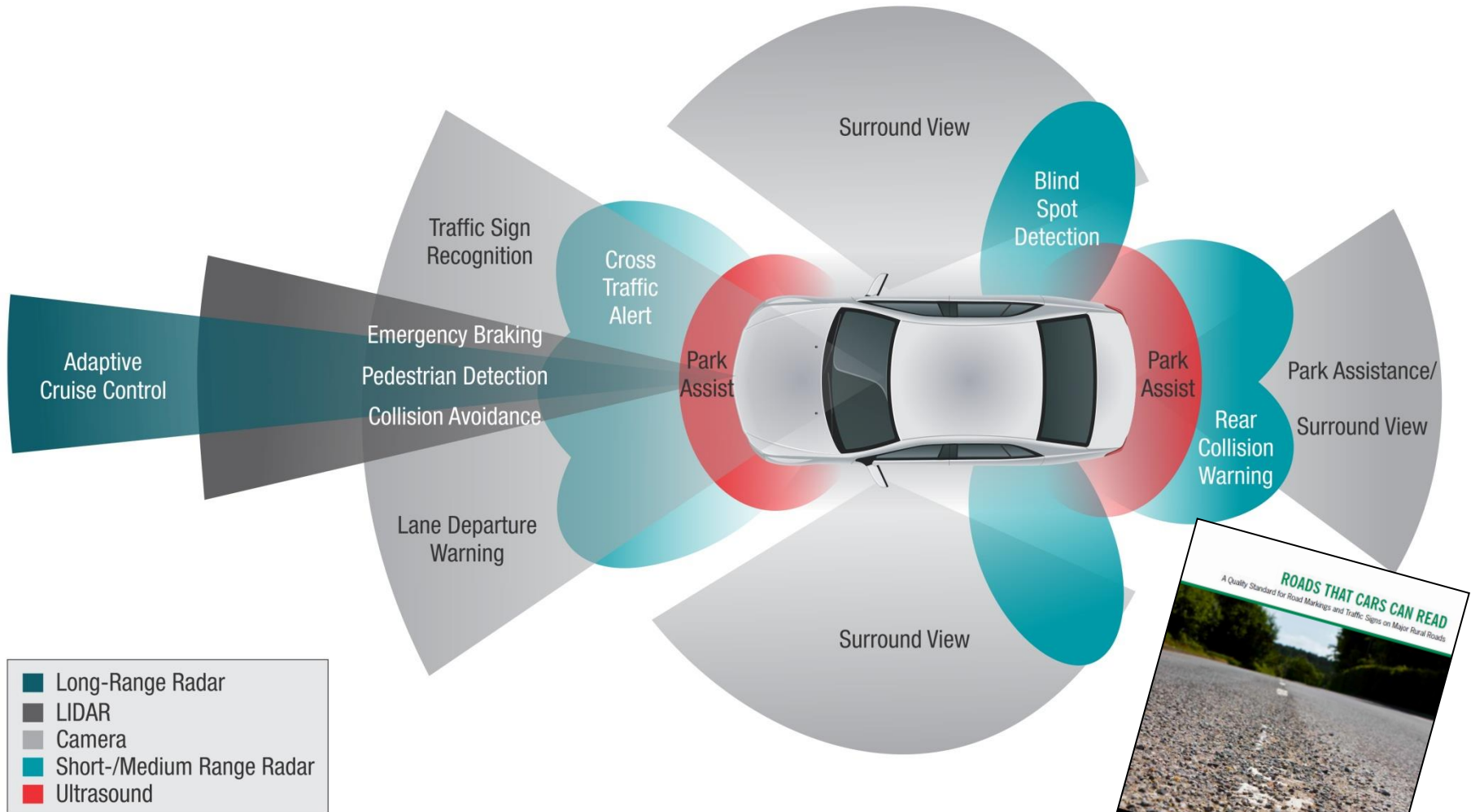
Wireless Communications

- Cellular networks (3G, 4G LTE, 5G)
- Wide area radio broadcast (eg. DAB+, analogue)
- Dedicated Short Range Communications (DSRC)
- Wireless LAN (eg. WiFi) and Bluetooth
- Satellite (eg. GNSS for absolute positioning, timing)



Source: ETSI



















Vehicle Sensors



Source: e2e.ti.com



Levels of driving automation (SAE)

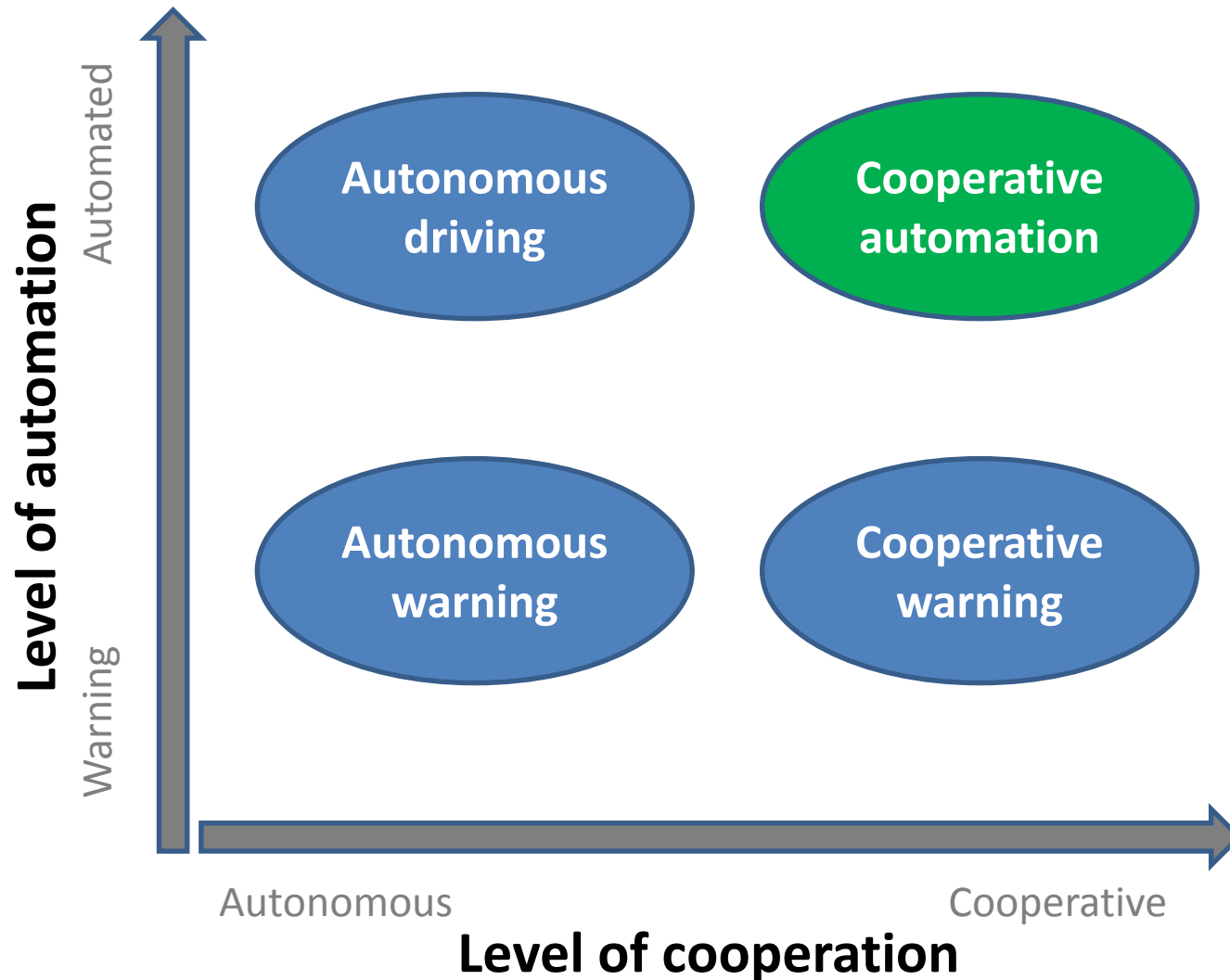
	SAE Level	Name	Description	Steering, acceleration, deceleration	Monitoring driving environment	Fallback performance of dynamic driving task	System capability (driving modes)
Human driver monitors driving environment	0	No automation	Full time performance of the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems				
	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				Some driving modes
	2	Partial automation	The driving mode specific execution by one or more driving 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				Some driving modes
Automated driving 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				Some driving modes
	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				Some driving modes
	5	Full automation	The full time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environment conditions that can be managed by a human driver				All driving modes

Source: International Transport Forum (ITF) representation of SAE automation levels

Automated vehicles



Convergence of cooperation & automation



Examples of Cooperative Automation

- **Vehicle platooning** – critical for following vehicles
- **Signalised intersections** – redundancy to onboard sensors, and green wave, vehicle prioritisation, etc
- **Dynamic navigation** – road closures, congestion, lane use, permitted road access, etc
- **Speed zones** – including variable, temporary, unsigned
- **Absolute positioning & timing** – likely from GNSS
- **eCall** – automated comms in the event of a crash
- **Software fixes & updated** – incl. safety, security, map updates, etc.

Thank you

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