National Transport Commission
http://www.ntc.gov.au/submissions/

July 9 2018

To Paul Retter, Chief Executive, National Transport Commission

Consultation Regulation Impact Statement (RIS) on Australia's approach to a safety assurance system for automated vehicles request for submissions

We applaud the directive of Australian state and federal governments in tasking the NTC to undertake this vital consultation on the potential regulatory impacts in determining safety assurances for connected and automated vehicles.

We were pleased to be able provide some support to NTC in their exhaustive engagement program recently by offering our members and the wider community an opportunity to join a webinar with Project Director Marcus Burke and Project Manager Rahila David. For those unable to attend the comprehensive workshops held around the country this lunchtime session was a chance to hear about this important work and engage in a question and answer session in real time.

Multiple attendees wrote to ITS Australia to thank the NTC for their input on what was agreed is a very complex subject matter.

This is an important piece of work on an area of huge importance to our members and the future of transport in Australia, and ITS Australia are pleased to submit the following information to the consultation process for consideration.

ITS Australia Background

ITS Australia is the peak group representing over 100 public and private organisations delivering on transport solutions and technology improving Australia's road and transport networks, and promotes the development and deployment of advanced technologies to deliver safer, more efficient and sustainable transport across all public and private modes – air, sea, road and rail.

Established in 1992, ITS Australia is an independent not-for-profit incorporated membership organisation representing ITS suppliers, government authorities, academia and transport businesses and users. Affiliated with peak ITS organisations around the world, ITS Australia is a major contributor to the development of the industry.

As set out in the Strategic Plan 2018-2021 our vision is to shape future transport to be safe, efficient and environmentally sustainable through the implementation of Intelligent Transport Systems. Our mission is to:

- Advocate for, and inform discussion about, ITS;
- Facilitate collaboration and partnering amongst industry, government and researchers;
- Support research, development and the deployment of ITS technologies;
- Influence and guide the successful development of the ITS industry.

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ITS Australia statement on Connected and Automated Vehicles for consideration

Overseen by the ITS Australia Policy Committee and endorsed by the ITS Australia Board a statement on connected and automated vehicles has been prepared following the recent publication of a similar statement published by the Institute of Transportation Engineers.

Acknowledging their work, ITS Australia drafted the following statement to reflect our position of the importance of this technology and the need for government to play a strong role in its development and deployment.

Conclusion

ITS Australia commends the NTC and government in looking to gain a better understanding of this important once-in-a-generation opportunity, and are keenly interested in engaging with government and industry to support pathways to regulatory changes that pave the way for safe mainstream deployment of this technology in vehicles and infrastructure.

The ITS Australia statement on Connected and Automated Vehicles is also included in this submission and for your consideration we have also attached the full chapter on Pathways to Connected Autonomous Vehicles from our *Shaping Future Transport* report.

ITS Australia thank NTC for the opportunity to contribute to the RIS consultation and to update our members on Australia's proposed approach to a safety assurance system for automated vehicles. We look forward to the opportunity to continue to engage on activities such as this that support a pathway for appropriate deployment of advanced transport technology in Australia.

Yours sincerely,

Susan Harris

Susan Harris
Chief Executive Officer

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ITS Australia Statement on Connected and Automated Vehicles

ITS Australia supports the advancement of connected and automated vehicle technology and see the appropriate deployment of the technology as a pathway to provide safer, more efficient and more sustainable transport.

Safety needs to be the foundation on which any development of Connected and Automated Vehicles (CAV rests. We are optimistic about the innovation and expertise in our industry and the functionality that will be available to the wider community.

These technologies have the potential to revolutionise transport in a way not seen since the mass-production of the private vehicle more than 100 years ago and to save thousands of lives.

A strong government role will be critical to ensure that the deployment of CAV is guided to improve the quality of life for citizens. Governments need to provide strong regulatory oversight to give the public confidence in CAV testing and deployment as well as support connectivity and access to governments' real time data systems.

To that end we are strongly supportive of existing and emerging pilots and trials underway and proposed around the country, building a collaborative and transparent understanding of the challenges and opportunities these technologies offer, and ensuring that public safety is always the key consideration.

Government should also play a key role in working with the private sector to facilitate deployment and remove unnecessary regulatory barriers to enhance the widespread deployment of proven technologies. Ensuring all elements are safely assessed and fully tested in controlled pilots and trials before publicly deployed.

ITS Australia is a membership based peak body representing Australian industry, government and research organisations in promoting Intelligent Transport Systems initiatives. We are a Not for Profit association and serve the interests of our members in Australia and globally. We represent the Australian ITS sector within Australia and Australian ITS interests internationally.

As such we recognise the importance of these technologies and work with our members and the wider community to ensure safe and responsible development and deployment of these potentially life-changing transport innovations.

To build understanding, and collaborative approaches, and work towards broad community consensus we support the following key messages while appreciating that our position will evolve as both these technologies and the market mature.

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Key messages:

1. **More than 1,200 people die and over 30,000 people are seriously injured each year on Australia's roads. The only long-term goal we can have is for zero fatal and serious injuries.**
    - We believe we will only get to zero fatalities and serious injuries through CAV technology.
2. **Technology can save lives today.**
    - We support the early adoption of advanced driver assistance technologies— lane keeping, blind spot warning, adaptive cruise control, automatic braking — should be on all new vehicles.
3. **Performance based regulation with safety systems validated by manufacturers is essential.**
    - New technologies must be evaluated in real-world conditions, but only after they have been fully tested in off-the-road environments. We support controlled and transparent pilots and trials, with government oversight, of tried technologies.
4. **Cooperative systems achieved through communication between vehicles, infrastructure, and other users will provide an enhanced layer of safety and must be pursued.**
    - This ability to communicate will be essential for extending the range of vehicle-based sensing, and delivering maximum safety benefits with high levels of automation.
    - Initially additional research and testing is needed concerning the driver's ability to remain vigilant and take over the driving task when required with the current levels of new technologies which have low levels of automation.
    - As increasing levels of automation are achieved these systems will fully automate the driving task under most conditions, but do not preclude the vehicle being operated by a human driver in unusual or emergency situations.

Acknowledgement

ITS Australia would like to acknowledge that this statement builds on the work of the Institute of Transportation Engineers, adopted for the Australian context.

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2. PATHWAYS TO CONNECTED AUTONOMY

2.1 BACKGROUND

Automated vehicles attract keen media attention. Indeed, for popular broadcasters, ITS and automated vehicles are often synonymous. While such vehicles were showcased at the Congress, they represent one part of a much richer menu of computerised intelligence supporting travel by vehicles.

This section brings together two technology dimensions on which assisted or automated vehicles depend: information and decision making to 'drive' a vehicle, and technology to provide information to and connections between vehicles and their environment. The development of electric vehicles is a key contributing technology. Electrification of vehicle propulsion will contribute an enabling building block for connectivity and autonomy.

There are various predictions with regards to the timeline for introduction of autonomous vehicles. A fully human driver free system (no driver in any vehicle) may be a long way off but a single vehicle operating without a driver is likely to be much closer, even if restricted to certain operational modes and areas. Driver assistance and automated intervention are already present in road and rail vehicles. This section of the report explores the journey towards connected autonomy and the opportunities for Australia.

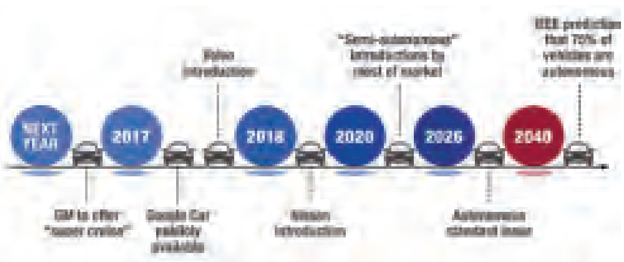

Figure 1. Anticipated timelines for introduction of CAV, Brian Burkhard, Jacobs Engineering (23rd World Congress, Technical Session 51)

Within the vehicle, assistance or automation involve a number of elements, including navigation and positioning, management of the vehicle, interaction with the roadside and with other vehicles, and decisions about speed and other tasks. Five levels of vehicle automation have been identified by SAE, and is now widely accepted that progresses from Level 0 (no assistance to the driver) to Level 5 (full autonomy).[3]

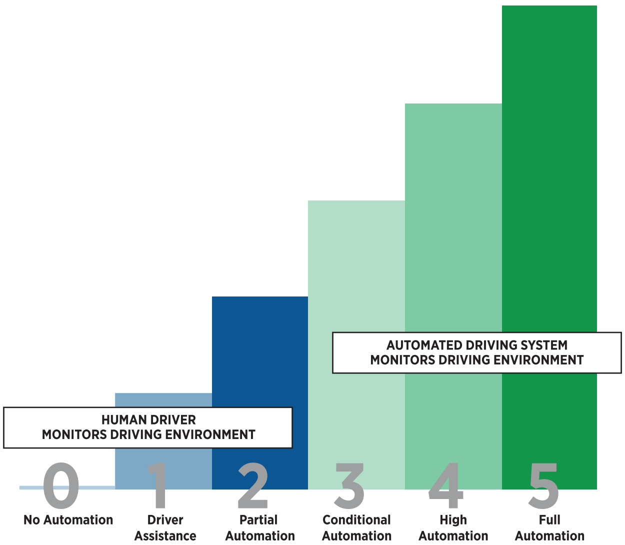

Figure 2. Levels of Driving Automation, Society of Automotive Engineers Australasia (SAE-A)[4]

When the vehicle's systems are connected with the environment an additional layer of benefits enhancing network management and relieving congestion can be achieved. Vehicle-to-Vehicle (V2V) communications enable nearby vehicles to inform each other of changes to their path or speed, preventing collisions and allowing optimal road use. Vehicle-to-Infrastructure (V2I) communications allow vehicles to interact with network infrastructure such as intersection management. "Vehicle to everything" (V2X) communications broaden the scope to include other entities, including pedestrians and devices.

[3] Level summary: 0 – full driver control. 1 – a specific function can be automated. 2 - at least one driver assistance system of "both steering and acceleration/ deceleration using information about the driving environment" is automated. 3 - safety-critical functions are controlled by the vehicle. 4 - vehicles are designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. 5 – fully autonomous, where the vehicle performance equals or exceeds that of a human driver in every driving scenario.

[4] https://www.sae.org/misc/pdfs/automated_driving.pdf

Cooperative ITS (C-ITS) brings communications models together to support driver assistance and full vehicle automation.

Connected autonomy is intended to deliver a number of benefits.

SAFETY

Driver assistance reduces the risk of crashes and therefore fatalities, injuries and loss. This benefit is incremental in that the safety benefits increase with each further step towards full automation and as the proportion of vehicles equipped increases.

MOBILITY

Autonomous vehicles, and advanced driver assistance, offer increased mobility. They not only provide access to travel for those not able to drive and change the demand for parking, but more broadly enable changes in the structure of travel. Such ideas as pools of self-driving cars in a sharing economy will become viable as autonomous vehicles enter the road systems.

EFFICIENCIES

Drivers may become 'freed up' from the driving task and therefore able to perform other tasks. However, as time on the road may become more productive, as drivers are relieved of the cost of travel, it has the potential to increase traffic and congestion.

Connected, assisted and, particularly, fully autonomous vehicles can operate significantly more efficiently. Platooning of vehicles enables very short headways that would increase the likelihood of crashes in traditional vehicles while interaction with traffic signals potentially enables junction management to be optimised, saving fuel and time.

Vehicles connected to each other enable a more efficient, coordinated and safer use of the available road space. Vehicles connected to the infrastructure will provide more information to the control systems that monitor and optimise the road network.

Some of this is underpinned by the dramatic impact automation will have on the costs of travel. There is an avoidable and significant cost where a driver's main task is to control the vehicle (buses and trucks, for instance) and when occupied vehicles spend time on congested roads. These costs will be reduced and may be eliminated by connected autonomy.

Together, these technologies will reduce the resistance to travel, or travel friction, making new journeys viable and reducing the cost of journeys.

This will progressively reduce the costs of travel-related economic activity and deliver social benefits across society.

Unlike some other topics in this report, the end point for this one (a network of self-drive, connected vehicles) is easier to visualise than the steps leading to it. This section explores the pathway to connected autonomy.

2.2 KEY CONGRESS MESSAGES

'The three big technology topics of connectivity, electrification and automation will change the automobile and its place in society as never before. All vehicles will be connected, will increasingly be electric and will become more automated over time. Embracing this transition is also an absolute necessity due to the convergence of a number of influential megatrends: specifically changing demographics, increasing urbanisation, energy and climate risks and the exponential increase in the number of connected devices.'

Gavin Smith, President, Robert Bosch Australia

The timeline to the technical availability of connected autonomy can be predicted with some confidence, even if adoption cannot be forecast so precisely.

The development of this technology is now at a very exciting stage. Many of the problems now being addressed are about sensing the environment and much experimentation and testing has now been done and was shared at the Congress. What was a novelty is now not only real, but has both importance and urgency.

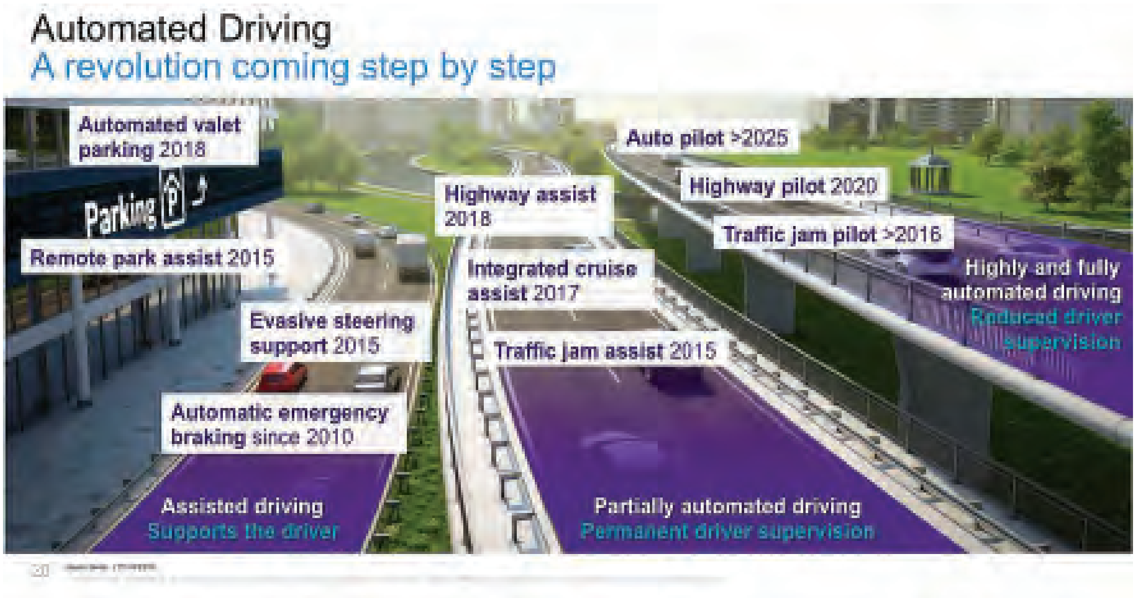

Figure 3. Indicative timeline to automated driving, Gavin Smith, Robert Bosch Australia (23rd World Congress, Plenary Session 1)

'Safer vehicles are the fourth pillar of safe systems. The other three pillars are essential to achieve a zero road toll but we know that the real key to success is making the vehicles on our roads safer. There is no doubt that will come through automated vehicles.'

Doug Fryer, Assistant Commissioner, Road Policing Command, Victoria Police

The critical interdependence of automation and connectivity was a common theme. While public attention is on autonomy and automation, less is said in the media about connectivity, and this is a critical part of the safety and efficiency outcomes.

'The convergence of connected and autonomous vehicles is the right approach. In the US we see this as primarily a safety issue. USDOT has said 80% of vehicle crashes can be avoided by using connected technology, nothing to do with automation. I would like to see Australia viewing it this way too, a huge safety opportunity in its own right.'

Peter Sweatman, Principal, CAVita

Research by the US DOT states that V2V and V2I could reduce the millions of crashes that occur each year by as much as 80%, saving lives and reducing injuries. The deployment of C-ITS depends upon clear business cases being made, particularly around safety.

'Right here, right now we have level 2 technologies which can save lives but are not mandated in Australia yet we know that if every vehicle on the roads today had this technology, we'd be saving thousands of lives in the future.'

Samantha Cockfield, Senior Manager of Road Safety, Transport Accident Commission, Australia

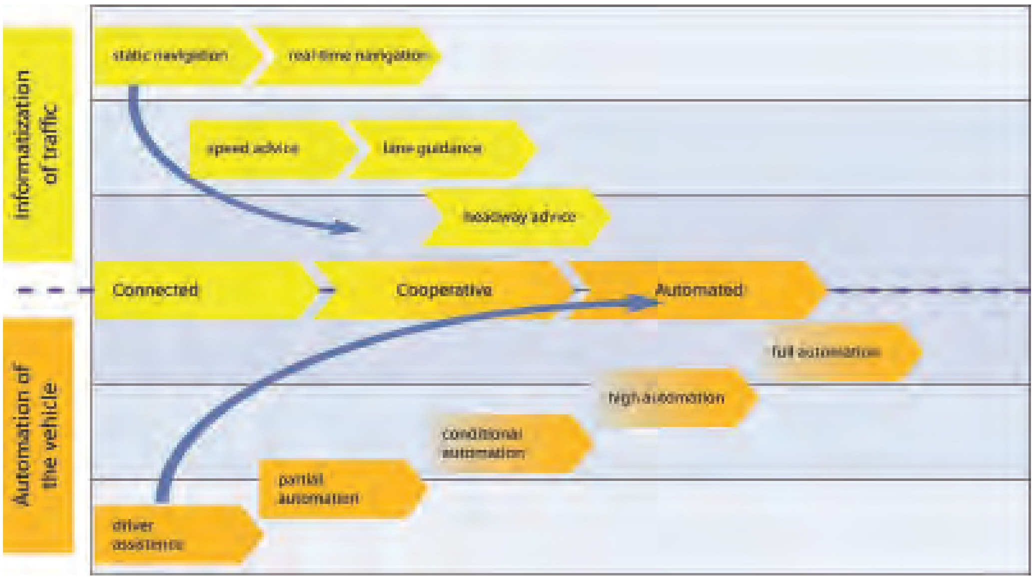

Figure 4. Indicative convergence of automation and connectivity, Wolfgang Hoefs, DG CONNECT (23rd World Congress, Plenary Session 1)

A number of people remarked on the significant change in how development is occurring. Early development was typified by defence department funded or localised research, with a focus on individual vehicle performance. Now, research is more commercial, with car makers and information systems enterprises like Google leading the research. At the same time, regulators are supporting data gathering and reporting.

'We are starting to see what is good what's bad what's ugly about these systems: where these systems can come out quickly and where they can provide help early on, but importantly we now have more open reporting in many cases. A very good example is the Department of Motor Vehicles in California where you not only have to report accidents involving these vehicles but also takeovers [where the vehicle takes over control from the driver], so we can get data to see where weaknesses are in these systems.'

Christopher Mentzer, Manager R&D, Southwest Research Institute, United States

A number of sessions explored the complex area of liability and responsibility with the growing availability of assistance and the ultimate achievement of full autonomy.

'Some people think it is fanciful that fully automated vehicles will ever come – I think it is just a matter of time. So what does legislative and regulatory change look like for us? It is going to be tricky. Who will have accountability and responsibility for a vehicle and for vehicle movement? The manufacturer? The technician? The owner? For us the definition of what 'driving' and 'in charge' is by legislation and laws is really quite tricky because at the moment it is clear that it refers to a human.'

Doug Fryer, Assistant Commissioner, Road Policing Command, Victoria Police

Autonomy is not the central or end point. Connectivity is the key and, while vehicle equipment is guided by individual purchasing decisions and how they influence manufacturers, implementation of connectedness requires investment by government and society more broadly.

'All businesses, all people make an economic, a mobility and a safety choice in transportation. The more we give them good information, the better those choices will be, and choice is the most powerful piece in transportation, not regulation and enforcement. That has to do with getting good information in their hands.'

Paul Trombino III Director, Iowa Department of Transportation

Others highlighted additional benefits. In Australia, congestion and efficiency of infrastructure are also well recognised outcomes. Wolfgang Hoefs, Head of Sector, Directorate General CONNECT, European Commission emphasised the importance of other societal, personal and productivity benefits, noting how important it is that the hoped-for benefits are both quantified and verified so that appropriate investment occurs. From a business perspective, commercial access to data, within essential data protection constraints, will create real value.

'What needs to be done is a good verification of these societal benefits because we need a good justification for any private or public investment into these solutions… When we talk about climate change, even there, automated driving might play a role.'

Wolfgang Hoefs, Head of Sector, DG Connect, European Commission

2.3 AUSTRALIAN CONSIDERATIONS

Australia is amongst the world leaders in key aspects of connected and autonomous vehicles. The country combines high level technical expertise with regulatory support, critical infrastructure and an environment that is suited to testing.

'Melbourne, rated as one of the world's most liveable cities, achieved a perfect score of 100 for infrastructure, highlighting the importance placed by successive Victorian State governments on an integrated, intelligent transport systems network. The Victorian government clearly appreciates the importance of mobility in maintaining this position and has partnered with Bosch to engineer, build and evaluate what I would describe as an aspirational automated vehicle.'

Gavin Smith, President, Robert Bosch Australia

The Bosch demonstration at the Congress was the most highly automated vehicle to operate on Australian roads to date. It is a result of considerable local work, driven particularly by the opportunity to demonstrate the capabilities at the Congress. The Bosch trial is especially significant because it is independent of any particular vehicle manufacturer. Bosch and the Victorian government have committed funds to continue this work, which is progressively building a centre of excellence in Australia. It is hoped that this will contribute to global development of vehicle automation and connectivity rather than purely create a standalone automated vehicle.

'Australia is not directly driving the development in pure automation and so the interest in Australia is to see implementation in a way that is as beneficial as can be, which means a degree of convergence between connected and automated.'

Andrew Somers, Transoptim Consulting

Australia has significant players in the connected and autonomous vehicle industry. As demonstrated at the Congress, Cohda Wireless technology, for instance, provides navigation technology that allows vehicle positioning where GPS is not available.

'GM, Ford and Toyota have committed to retaining vehicle development skills in Australia following the ending of local car manufacture in Australia. These skills are available and, in many cases, well suited to intelligent transport systems.'

Peter Sweatman, Principal, CAVita

Another critical element of the mix in Australia is the involvement of government. Government not only funds much of the large scale implementation of transport infrastructure, but also provides much seed funding for trials and for research. Local expertise provides someone Government can talk to in Australia to inform government thinking, both from a technical and policy viewpoint. While the Australian social and natural environment has a unique combination of features, local standards must harmonise internationally.

'Australia is a technology taker in the sense that we don't dictate what happens in design, although some of the design will be done here. The challenge for us is to get proliferation of the technologies across the vehicle fleet. Australia needs vehicle manufacturers to make that technology more available across their ranges and for governments, mandated through the ADR system, to recognise that this technology should be available.'

Brian Negus, General Manager Public Policy, RACV and President ITS Australia

Australian business and governments are in any case at the leading edge of some significant elements of connected autonomy. The mines sector already deploys off road vehicles that are remote controlled and semi-autonomous. Similarly, Australian ports and others have vehicles which employ a level of automation that is not yet permitted on public roads. Driverless trains are being specified for the Sydney metro.

In 2015, South Australia conducted the first on-road trial of autonomous vehicles in the Southern Hemisphere and in 2016, at the ITS World Congress, Australia's most advanced highly automated vehicle was unveiled and demonstrated in mixed traffic. A 'hands-off' demonstration was provided to delegates on a designated section of the roadway. There is also progress with trials of highly automated vehicles on Australian roads:

STATE	CURRENT CONNECTED AND AUTOMATED VEHICLE INITIATIVES
New South Wales	• **Cooperative Intelligent Transport Initiative (CITI)** trial of heavy vehicle safety applications using Cooperative ITS. • **Heavy Vehicle Priority Project** trial of applications to provide heavy vehicle priority at signalised intersections. • **Smart Innovation Centre** announced in 2016, planned to be a R&D hub for emerging transport technologies, including CAVs.
Northern Territory	• **Autonomous Passenger Vehicle** trial commenced 2016, transporting people at Darwin Waterfront, Australia's first fully operational autonomous vehicle transport trial.
Queensland	• **Cooperative and Automated Vehicle Initiative (CAVI)** incorporates two main projects – a large scale pilot of Cooperative ITS in Ipswich, and a smaller pilot of cooperative and highly automated vehicles driven on selected roads.
South Australia	**Future Mobility Lab Fund** a $10M program over three years for development, testing and demonstrations of CAV technology, connected V2V and V2I pilots and demonstrations, and research and development.
Victoria	• **Bosch Highly Automated Driving Vehicle** partnership with Transport Accident Commission (TAC) and VicRoads. • **Eastlink Driver Assisted Technology** – partnership with Victorian Government, Australian Road Research Board and La Trobe University to test network and driver assisted vehicles • **ITS Grants Program** includes project trialling CAVs in highway scenarios, C-ITS to support tram priority, and in-vehicle connected vehicle services using cellular communications. • **Road Safety Action Plan** includes $10M action to trial connected and automated vehicle technologies. • **Transurban CityLink automated vehicles** – trial of how automated vehicles interact with Australian road infrastructure • **University of Melbourne** – world first urban test bed for multimodal connected transport on a large scale in a complex urban environment
Western Australia	• **Autonomous Heavy Vehicle Platooning Trial** Main Roads WA is partnering with industry to launch a trial of autonomous heavy vehicle platooning. • **RAC Intellibus** with the support of the WA State Government, RAC is trialling a fully driverless, fully electric shuttle bus in South Perth.

Many aspects of the local environment mean that Australians must solve problems that are not present or are unusual overseas. Road trauma is significantly worse on rural roads in Australia than in cities. While this is true in other countries (54% of all fatalities in the USA were on rural roads in 2012, though only 19% of the population was rural), the combination of Australian road conditions and other road safety improvements mean it has a higher profile in Australia. The Chief Executive of VicRoads put it eloquently in an Executive Session:

'We've been spectacularly successful in reducing road trauma in our cities… But you are four times more likely to die on the road if you live in the country than if you live in the city. Very narrow shoulders, beautiful Australian gum trees within metres of the side of the road, variable conditions, variable road surfaces and always sharing the roads with other cars and trucks. Most of our accidents are just veering off to the right hand side of the road and either having a head-on or clearing up one of those trees.'

John Merritt, Chief Executive, VicRoads

Research presented at the Congress supported the particular issue of rural roads.

'Several factors contribute to the disparity between rural and urban crash fatality rates. Rural communities have vehicles which move at higher speeds over varying grades and unique terrain which can contribute to the likelihood of crashes. Rural motorists may become tired or inattentive due to infrequent traffic on trunk roads, long traveling distances, a lack of visual stimulus and fail to notice stop signs or rail crossing signs.'

Mike Haldane, Vice President, and Jeremy Neuman, Senior Embedded Firmware Engineer, Global Traffic Technologies

This issue alone makes it essential that Australian research and development continues, avoiding the risk that the urban problems are resolved, but rural ones are left unsolved.

2.4 INITIATIVES, OPPORTUNITIES AND BENEFITS

VEHICLE SAFETY

Driver fatigue is a significant contributor to crashes. Advances in technology have permitted the development and fitment of continuous driver fatigue monitoring systems in vehicles. Real-time feedback on the incidence of fatigue events in three long-haul trucking companies in South Africa has been used to significantly reduce the incidence of fatigue events.

The CITI project is a test bed for Dedicated Short Range Communication in the Illawarra area. This connects sixty vehicles, three signalised intersections and three other sites, using Cohda Wireless equipment. The installation alerts drivers to speed restrictions and phase changes at traffic lights. It also gathers information from passing, equipped vehicles, demonstrating the viability of the technology.

SOFTWARE AND CONSUMER APPS

Business and academic research continues to test the application of computer and mobile software to enable better analysis of data and big data. GPS and access to a speed limit database can tell a consumer app what the applicable speed limit is, allowing drivers to drive at an appropriate speed. Since excessive speed contributes to 40 of fatal crashes in NSW, Transport for NSW released its own free smartphone Intelligent Speed Adaptation application in 2014 – a world first.

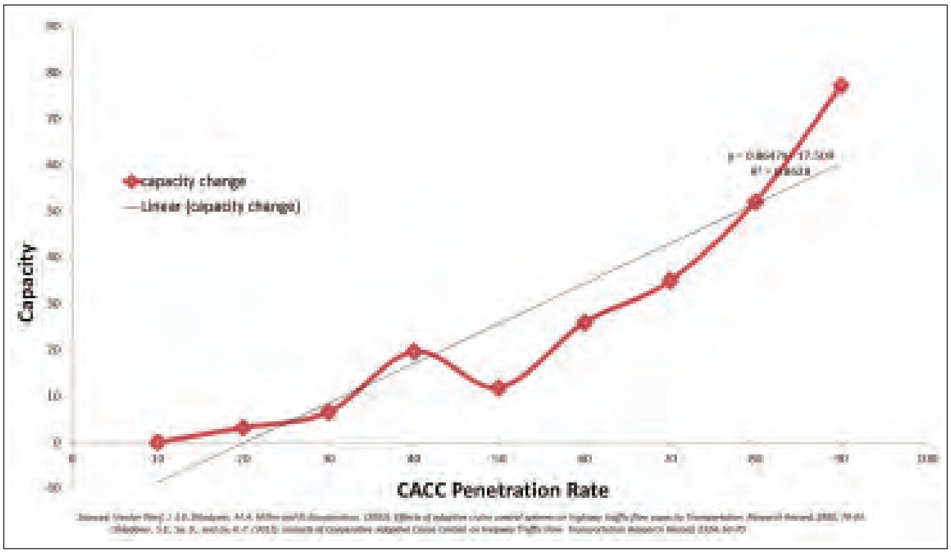

Figure 5. Example mobile device screen showing vehicle exceeding speed limit, John Wall, Transport for New South Wales (23rd World Congress, Technical Session 27)

Figure 6. Impact of Cooperative Adaptive Cruise Control (CAAC) on road capacity as adoption of CAAC increases, Joshua Auld, Argonne National Laboratory (23rd World Congress, Scientific Session 10)

ROAD CAPACITY

Connected and automated vehicle technologies are likely to have significant impacts not only on how vehicles operate within the transportation system, but may also drive changes in travel behaviour and the dynamics of traffic flow. For example, connected vehicles will be able to operate more closely together (shorter headway), allowing more vehicles to fit on a road, but more trips may result from the other improvements that flow from ITS. Some work described at the Congress will support the analysis and measurement tasks that are so critical to planning and to support investment proposals. Such work seeks to balance a variety of factors to arrive at a net impact, without which capacity planning is impossible. One example of such work is a simulation model showing the impact of headway reduction highlight the dramatic impact of cooperative adaptive cruise control on road capacity.

SUPPORTING AND ENABLING INFRASTRUCTURE

Enablers being pursued by automotive manufacturers include fleet connectivity, embedded telematics, GPS accuracy, tamper-evident devices, as well as the required backhaul network (transporting communication data between end users and the central network and infrastructure).

Simple detection systems, connected into an intelligent system that potentially connects to the vehicle, could make highly dangerous rural junctions safer. A trial in Michigan is deploying a Rural Intersection Conflict Warning System to deliver this.

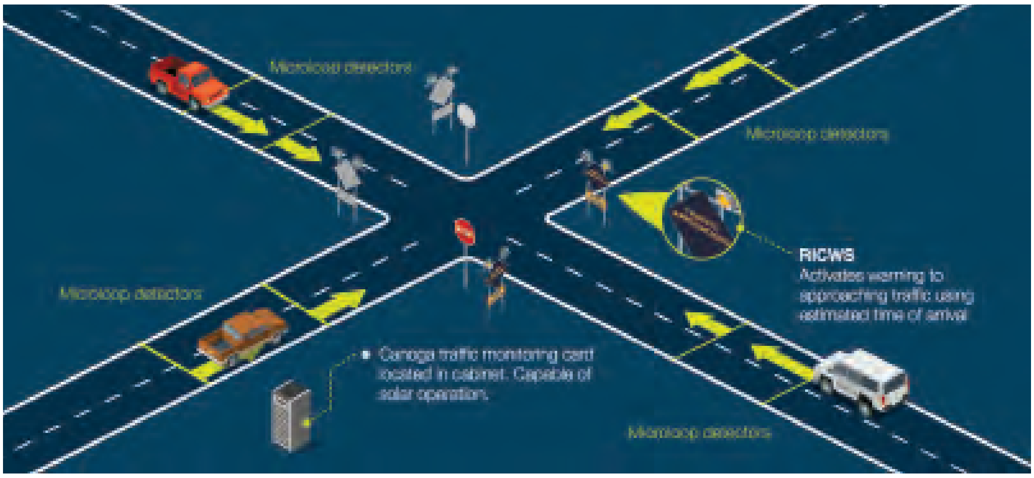

Figure 7. Michigan trial alerting drivers to potential conflict at intersection, Mike Haldane and Jeremy Neuman, Global Traffic Technologies (23rd World Congress, Commercial Session 7)

AUTONOMOUS VEHICLES

Bosch Australia demonstrated a live implementation of Australia's most advanced highly automated vehicles at the World Congress. The car had been designed to navigate roads with or without driver input and included technology to detect and avoid hazards such as pedestrians, cyclists and other vehicles.

Trials of the vehicle will be used to inform the development of regulations and infrastructure to enable similar self-driving cars to operate on Victorian roads when they become commercially available in the future.[5]

Western Australia is trialling the nation's first fully driverless, fully electric shuttle bus under plans to test automated vehicles. Internationally, trials are underway in New Zealand while in France, driverless vehicles in Lyon carry up to 15 passengers over 1.3km. A staff member is on board, but not driving and the vehicle has been authorised for road use by the Ministry.

The 2016 ITS World Congress provided the industry with an opportunity to experience the EasyMile driverless shuttle. The live demonstration showed a steering wheel was not required as one was not supplied in the vehicle.

The EZ10 has been designed to cover short distances over predefined routes in mixed use environments. Transporting 12 people (six seated and six standing) it can cater for passengers with reduced mobility. It operates autonomously following a virtual line mapped and loaded in the software of the vehicle.

[5] Victoria Government media release Victoria leads the way with self-driving vehicles 5 Oct 2016

PEDESTRIANS AND OTHER ROAD USERS

Pedestrians constitute a large proportion of road fatalities. Innovative approaches are being considered to reduce pedestrian trauma. Some of these will be predictive based on active detection by vehicles, others will engage with pedestrian 'beacons' (with present technology these are most likely to be wireless transmissions by pedestrian-carried smartphones). A typical demonstration project from Japan was presented at the Congress. In this demonstration, a combination of radar and camera scan a search area looking for and recognising pedestrians. Such systems enable warning or system intervention to avoid collision with the pedestrian.

Cyclists and pedestrians are endangered by motorized vehicles, but especially at signal controlled intersections. Another Japanese experiment uses radar to detect pedestrians and bicycles regardless of conditions at night and under bad weather so that vehicles can be alerted.

A German study proposed a protection system consisting of communication devices and an infrastructure solution. Using this, cyclists and pedestrians communicate their movement data via smartphones and a roadside unit collects the data, predicts collisions and warns (only) the affected road users via digital messages.

Figure 8. EasyMile driverless shuttle demonstrated at the 23rd World Congress

Figure 9. Conceptual collision prevention for connected vehicle and cycle with roadside radar interaction, Tim Russ, ifak (23rd World Congress, Technical Session 23)

SPATIAL AND MAPPING

Many, if not most, practical implementations require some form of mapping and location support. TomTom demonstrated a profiling tool which creates a representation of the street profile from radar surveying, allowing vehicles to establish a coarse location from GPS which is then refined by comparison of the radar model with detection from the vehicle travelling.

Work on map creation is increasingly being automated, not only for new but also for existing routes. Aisin Group demonstrated a model for automatic map creation.

Mapping is only useful to the extent that autonomous vehicles are able to interpret and utilise the information. A World Congress paper from ITS Korea and the Korean Institute of Civil Engineering and Building Technology described how to layer map and location information to best support Level 2 automation for vehicles.

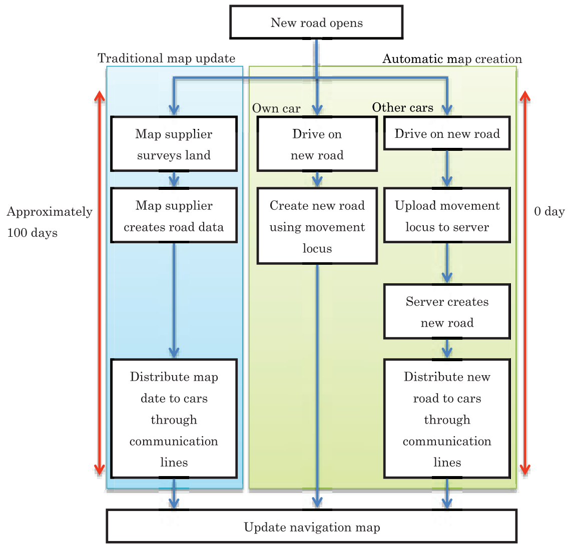

Figure 10. Comparison of traditional, delayed map updating with real time automation of map data collection exploiting connectivity with vehicles, Akira Otabe, AISIN (23rd World Congress, Technical Session 29)

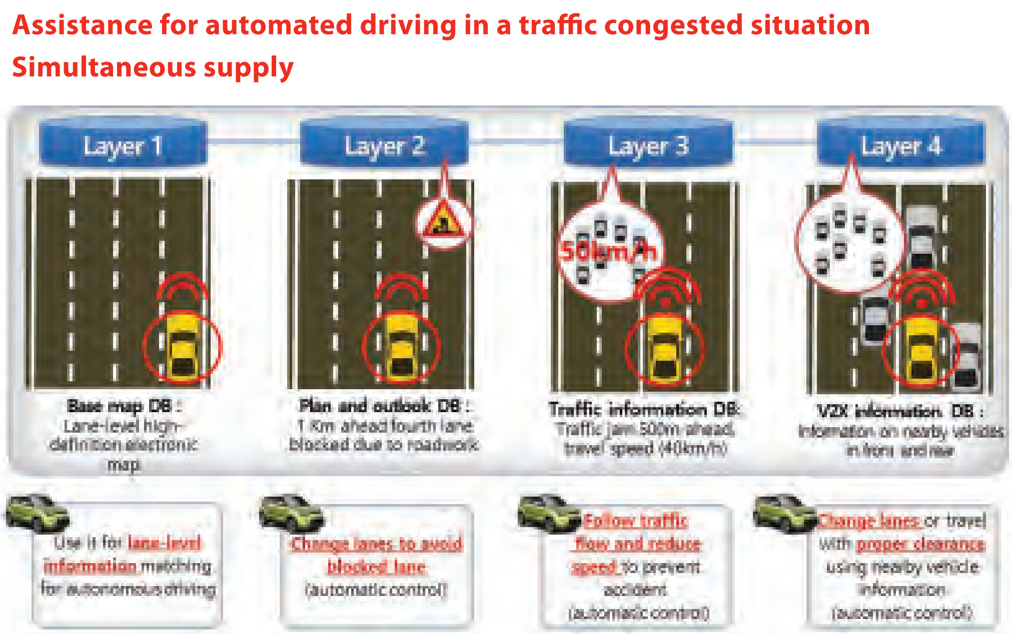

Figure 11. Consolidation of data to support progressively more sophisticated responses to congested traffic, Jiyeon Lee, ITS Korea (23rd World Congress, Technical Session 29)

GNSS/GPS precision is not yet sufficient to enable automation using this information alone. Lane positioning, stop line detection and other tasks must be performed to a higher level of accuracy. A number of solutions were presented at the Congress. One of these uses roadside infrastructure to broadcast its own, accurately known position, to enhance in-vehicle systems.

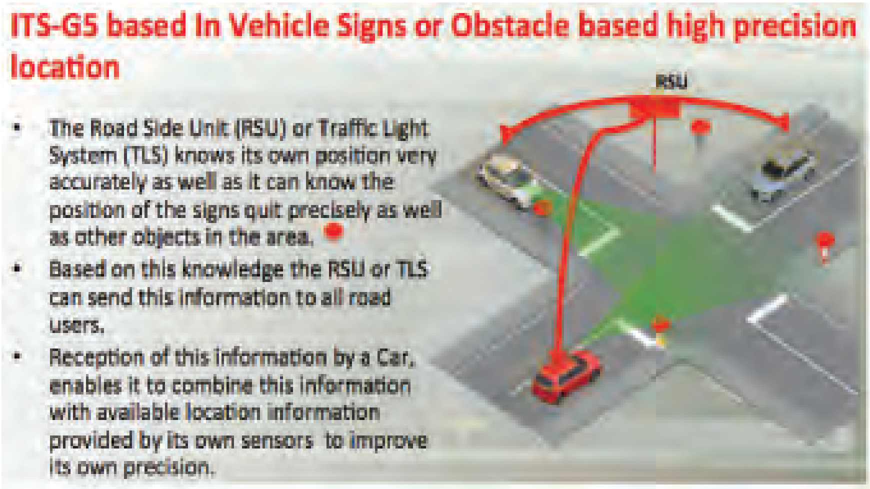

Figure 12. Enhanced GPS enabling accurate vehicle positioning, Paul Spaanderman PaulsConsulting (23rd World Congress, Technical Session 29)

2.5 CONCLUSIONS

In summary, the pursuit of automated and connected vehicles will deliver progressive and important benefits to individuals and society.

Connectivity and automation are tied closely together. Both areas of development rely on bringing many separate innovations together and integrating them in a viable and safe system.

Australian businesses make a significant contribution to connected autonomy through leading edge projects and trials. Australian governments are creating and supporting test environments through financial support and regulatory flexibility.

Many opportunities exist today and will emerge in the future for Australian businesses to develop solutions to specific problems that can be integrated into complete systems. The trial programmes that are underway[6] provide a focus for collaboration and a network of experts.

Australian business is represented in a number of connectivity projects and provides proven solutions in communications. The trials of driver assistance and automation in Australia provide a platform for these and other local businesses to maintain and grow this expertise.

[6] See Section 2.3 for list of Australian trials.