



Clarifying control of automated vehicles
Policy paper
November 2017



National Transport Commission

Report outline

Title	Clarifying control of automated vehicles
Type of report	Policy paper
Purpose	Recommendations approved by the Transport and Infrastructure Council – November 2017
Abstract	This policy paper supports the national enforcement guidelines for automated vehicles. This paper explains the assumptions and objectives of the guidelines, who has responsibility for compliance with road traffic laws and the indicators of <i>proper control</i> for vehicles operating at different levels of automation.
Key words	Vehicle with automated functions, automated driving system, Australian road rules, enforcement, safety, SAE International Standard J3016 'Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles'
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Foreword

Vehicles with automated functions are already on our roads, and their numbers will only increase in the years to come. While offering the possibility of fundamentally changing how transport is provided and unlocking a range of benefits, diverse automated vehicle technologies are also challenging traditional concepts of *control* and *proper control* in the road traffic laws. The role of the driver and their control of the vehicle is fundamental to road safety legislation. As such, the market needs certainty about both who is responsible for compliance with road traffic laws and what is necessary in order to be compliant.

A lack of clarity around responsibility presents a number of challenges to the deployment of vehicles with automated functions in Australia. Uncertainty could create barriers to entry, disrupt effective and efficient enforcement of road traffic laws and, where control is interpreted differently across jurisdictions, create consumer uncertainty.

To address these challenges, in 2017 the National Transport Commission undertook a project to develop national enforcement guidelines to ensure police are able to apply road traffic laws to vehicles with automated functions in a nationally consistent manner.

The policy directions and recommendations in this paper inform the first iteration of the guidelines. The guidelines are a dynamic document that will be updated as automated vehicle technologies and international developments evolve.

The policy directions and recommendations set out in this paper reflect our extensive research, analysis and consultation with a range of stakeholders. We received more than 35 submissions to the discussion paper, including from state and territory governments, police, industry bodies, law firms, academics, technology developers and automobile clubs. The national enforcement guidelines themselves have similarly greatly benefitted from contributions from our stakeholders, including police agencies that will now incorporate the guidelines in operational policies and procedures.

The National Transport Commission's overall goal is to have end-to-end regulation in place by 2020 to support the safe, commercial deployment of automated vehicles at all levels of automation. The national enforcement guidelines represent just one aspect of this overall goal. In May 2017 we released automated vehicle trial guidelines and are currently working towards developing a safety assurance system and changing driving laws to support automated vehicles, both of which are expected to be delivered and implemented by 2020. While the guidelines are operable and relevant right now, any future reforms to the regulatory landscape for vehicles with automated functions will inevitably impact on them.

I would like to acknowledge the valuable input provided by stakeholders in informing this policy paper and the national enforcement guidelines, particularly that provided by police agencies. I encourage government, industry and consumer groups to continue to work with us on other projects that make up the National Transport Commission's automated vehicle regulatory reform agenda.



David Anderson PSM
Chairman and Commissioner

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Executive summary

Traditional concepts of *control* and *proper control* in the Australian Road Rules and other traffic laws are being challenged by vehicles with progressively automated functions entering the market. These automated vehicles are doing more of the driving, with humans monitoring the vehicle and acting as the fall-back.

A number of vehicles with automated functions are already on our roads, including vehicles with driver assistance, partial automation and parking assistance. More vehicles with automated functions are expected to be progressively introduced in the next few years.

As a result, in November 2016 the Transport and Infrastructure Council asked the National Transport Commission (NTC) to develop national enforcement guidelines to clarify regulatory concepts of *control* and *proper control* for vehicles with automated functions.

The purpose of this policy paper is to outline the rationale behind the first iteration of the national enforcement guidelines including:

- the assumptions and objectives
- the justification for maintaining (in the interim) the existing policy position that the human driver remains responsible for a vehicle with conditional automation for the purposes of road traffic law enforcement
- the policy directions relating to the indicators of *proper control* for vehicles operating at different levels of automation.

In developing this policy paper, the NTC has reviewed submissions provided by a range of stakeholders including state and territory governments, police, industry bodies, law firms, academics, technology developers and automobile clubs. The NTC received 30 public submissions as well as submissions provided on a confidential basis. The insights of stakeholders in this latter category have been de-identified.

This policy paper should be read in conjunction with the national enforcement guidelines. The guidelines are intended to be incorporated into police operational procedures.

Objectives of the project

Many of our transport laws, including the Australian Road Rules, are based on the principle that the driver is in control of the vehicle. The Australian Road Rules have a performance-based requirement that a driver exercises *proper control* of the vehicle.

National enforcement guidelines are needed to clarify the concepts of *control* and *proper control* in the road rules, which are being challenged by emerging technologies that are doing more of the driving, with humans monitoring the vehicle and acting as the fall-back.

In November 2016 the Transport and Infrastructure Council agreed to recommendations 3 and 4 in the NTC's policy paper, *Regulatory reforms for automated road vehicles*.¹

Ministers agreed that the NTC should develop national enforcement guidelines that address four key issues:

1. who is in control of, and therefore legally responsible for, an automated vehicle

¹ Available at: [http://www.ntc.gov.au/Media/Reports/\(32685218-7895-0E7C-ECF6-551177684E27\).pdf](http://www.ntc.gov.au/Media/Reports/(32685218-7895-0E7C-ECF6-551177684E27).pdf) (accessed 31/07/2017).

2. application of the *proper control* test to the human driver at different levels of automation
3. application of the *proper control* test to the automated driving system (ADS)² when it is engaged
4. enforcement interaction with automated vehicles.

The national enforcement guidelines address these key issues. They have been drafted for immediate use and are intended to work within current legislation to:

- provide guidance about how the requirement of *proper control* in Australian Road Rule 297 should apply to vehicles with automated functions
- confirm that the human driver is responsible for compliance with road traffic laws when a vehicle has conditional automation engaged at a point in time.

Objectives of the national enforcement guidelines

The national enforcement guidelines have been developed to:

- support road safety outcomes
- be consistently adopted by all states and territories
- be technology-neutral
- provide police with clear guidance about how Road Rule 297 and the requirement of *proper control* should apply to vehicles with automated functions
- confirm that the human driver is responsible for complying with road traffic laws when a vehicle has conditional automation engaged at a point in time
- be updated and kept relevant to ensure they reflect judicial interpretations of control, changes in legislation and developing technology
- have regard to all levels of driving automation in the longer term
- assist road transport agencies when considering the consequences of granting exemptions from traffic laws
- not affect current rules for drivers of non-automated vehicles.

In addition to clarifying and guiding the application of the existing law for police, the guidelines may also provide other agencies with policy guidance.

Recommendations

The Transport and Infrastructure Council has approved the following recommendations:

That the Transport and Infrastructure Council agrees to adopt national enforcement guidelines that:

- 1) give effect to the existing policy position that the human driver remains responsible for a vehicle with conditional automation (Level 3) for the purposes of road traffic law enforcement. This policy position and the national enforcement guidelines will be reviewed after amendments to driving laws to recognise ADS entities.
- 2) provide indicators of *proper control* for human drivers of vehicles with automated

² The 'automated driving system' is defined in section 1.5.

driving functions.

That the Council agrees to review the national enforcement guidelines, including the policy position that the human driver remains responsible for a vehicle with conditional automation, after amendments to the driving laws to recognise ADS entities.

Findings on key issues

1. Who is in control?

Human drivers will continue to be in control of vehicles with no automation, driver assistance and partial automation. In relation to vehicles with conditional automation, the national enforcement guidelines provide that the human is in control even when the ADS is engaged in the dynamic driving task. This is reflected in the extract from the guidelines in Table 1.

There has been strong support for maintaining this existing policy position for vehicles with conditional automation in the interim. A number of stakeholders supported this position on the basis that it will be reviewed after amendments to the road traffic laws recognising the ADS and ADS entity and an end-to-end regulatory regime, including a safety assurance system, are implemented. The NTC is examining these matters as part of separate reform projects.

International developments on the issue of control are not consistent. Noting that control has to be determined in accordance with the current law, until road traffic laws are amended to recognise the ADS and ADS entity, the human driver must remain in control of the vehicle. The NTC notes that these findings are confined to responsibility for road traffic offences and do not extend to civil liability or responsibility for a crash or road trauma.

This interim position also reflects a cautious approach while the safety of vehicles that require human intervention and feedback is validated. It will be reviewed periodically, including following current reforms and the implementation of a safety assurance system.

Feedback from stakeholders also indicated strong support for introducing obligations on the human driver as supervisor of the ADS if and when the ADS is determined to be in control of a vehicle operating at conditional automation. The introduction of such obligations will be reconsidered if and when the ADS can legally be in control of a vehicle.

Table 1: Responsibility by level of driving automation

Level of automation ³	Who is undertaking the driving task?	Responsibility for compliance with road traffic laws (who is in control?)
When there is no driving automation system engaged at a point in time	Human driven The human driver performs the entire driving task.	Human in control and responsible for compliance with road traffic laws The human driver performs the entire driving task although there may be active safety systems (that warn or intervene during a high-risk event or manoeuvre).
Level 1 – driver assistance (steering or braking and acceleration control)	Human driven The human driver performs the majority of the driving task.	Human in control and responsible for compliance with road traffic laws The human driver is required to perform all or part of the driving task.
Level 2 – partial automation (steering, acceleration and braking control)	Human driven The driving automation system cannot perform the entire driving task for a sustained period without a human in the loop to monitor the system.	Human in control and responsible for compliance with road traffic laws The human driver is required to perform all or part of the driving task.
Level 2 – partial automation (parking assistance – driver remains in driver’s seat)	Driving task shared between the system and the human driver The driving automation system performs the parking task, and the driver is responsible for object detection and intervenes if an obstacle enters the vehicle’s path.	Human in control and responsible for compliance with road traffic laws The human driver is required to perform all or part of the driving task.
Level 3 – conditional automation	System capable of operating the vehicle The ADS can perform the entire driving task for a sustained period without a human monitoring the system, but the human is expected to intervene with the driving task if requested or if there is an evident vehicle system failure.	Human in control and responsible for compliance with road traffic laws The ADS entity is not currently recognised in legislation and therefore cannot be in control. The human driver is not required to perform any of the driving task while the ADS is engaged but has a fallback role.

2. Examples of behaviours that indicate *proper control*

The indicators of *proper control* seek to achieve a balance between:

- being outcomes-based and aligned with what technology is capable of
- being tangible and observable behaviour for police.

The indicator of having at least one hand on the steering wheel will not apply to automated parking assistance features or vehicles operating at conditional automation when the automated function is properly engaged, but new indicators of *proper control* relating to alertness and readiness to intervene should be introduced.

³ The national enforcement guidelines adopt the levels of driving automation in SAE International Standard J3016, *Taxonomy and Definitions of Terms Relates to Driving Automation Systems for On-Road Motor Vehicles*. These levels have been summarised in Table 3 in section 3.2.

There has been broad agreement that the human driver does not need to have a hand on the steering wheel in a self-parking operation or when conditional automation is engaged. The examples of behaviours that indicate *proper control* are outlined in the extract from the guidelines in Table 2.

Table 2: Examples of behaviours that indicate *proper control*

Level of automation	At least one hand on the steering wheel	Seated in the driver's seat	Alert enough to resume the entire driving task if requested or if there is an evident vehicle system failure (e.g. eyes open, checking the external environment)	Not reading or viewing a device or thing unrelated to navigation or driving (existing restrictions on mobile phones and visual display units continue to apply)
When there is no driving automation system engaged at a point in time	Yes	Yes	N/A The driver is always responsible for the entire driving task.	Yes The driver must not engage in any activity other than driving.
Level 1 – driver assistance (steering or braking and acceleration control)	Yes	Yes	Yes	Yes The driver must not engage in any activity other than driving.
Level 2 – partial automation (steering, acceleration and braking control)	Yes	Yes	Yes	Yes The driver must not engage in any activity other than driving.
Level 2 – partial automation (parking assistance – driver remains in driver seat)	No	Yes	Yes	Yes The driver must not engage in any activity other than supervising the system.
Level 3 – conditional automation	No	Yes	Yes	Yes While not driving, the human driver must not engage in activities that prevent him or her from responding to takeover demands, are not in line with the intended use of the automated driving function or are prohibited by law.

Table 2 should be read in conjunction with the following **principles**:

- Where a vehicle is capable of more than one level of automation, the relevant indicators are those that apply to the level of automation engaged.
- Drivers must comply with road traffic laws unless they have an exemption, including prohibitions on use of visual display units and mobile phones.

- Drivers should comply with the manufacturer's requirements for the operation of the vehicle, unless they conflict with a relevant road traffic law.
- Drivers should adapt their behaviour based on the degree to which their vehicle's automated functions are being used at any given moment based on the designed and given capabilities and limitations of the system.
- Drivers should adapt their behaviour depending on the road conditions.

3. Applying *proper control* to the automated driving system

The driver must have *proper control* of the vehicle whether the driver is a human driver or the ADS.

The current national enforcement guidelines will only apply to the human driver and not to the ADS. The guidelines will be updated when the ADS and the ADS entity are recognised in legislation and a safety assurance system is implemented. This will ensure the guidelines only have regard to current law and do not engage in the interpretation of theoretical entities and obligations.

4. Enforcement interaction with automated vehicles

Enforcement agency interaction with automated vehicles should be considered as part of the development of an end-to-end regulatory regime, including a safety assurance system, and options for this interaction should be further explored as part of the NTC's project to regulate government access to data, scheduled to commence in late 2017.

The national enforcement guidelines provide practical guidance to assist officers in interacting with drivers who are operating vehicles with automated functions. This guidance provides there is no onus on officers to determine whether a vehicle has a level of automation engaged at a point in time and that the onus is on human drivers to provide evidence that an automated function is engaged and the level of automation engaged.

1 Context

Key points

- The National Transport Commission has developed national enforcement guidelines that clarify regulatory concepts of *control* and *proper control* for vehicles operating at partial, conditional, high and full automation.
- The national enforcement guidelines have been drafted for immediate use and are intended to work within current legislation to:
 - provide guidance about how the requirement of *proper control* in Australian Road Rule 297 should apply to vehicles with automated functions
 - confirm that the human driver is responsible for complying with road traffic laws when a vehicle has conditional automation engaged at a point in time.

1.1 Objectives

Many of our transport laws, including the road rules, are based on the principle that the driver is in control of the vehicle. The development of automated driving system (ADS) technology, which can take over some or all of the driving task depending on the vehicle's level of automation, challenges regulatory concepts of *control* and *proper control*.

Transport ministers in Australia have agreed that the National Transport Commission (NTC) should develop national enforcement guidelines that address four key issues:

1. who is in control of, and therefore legally responsible for, an automated vehicle
2. application of the *proper control* test to the human driver at different levels of automation
3. application of the *proper control* test to the ADS when it is engaged
4. enforcement interaction with automated vehicles.

This policy paper should be read in conjunction with the national enforcement guidelines. The guidelines are intended to be incorporated into police operational procedures.

We have developed this paper to provide policy directions and recommendations to transport ministers in relation to these key issues. The policy directions and recommendations are grouped into five themes:

- **Chapter 2:** Assumptions and objectives
- **Chapter 3:** SAE levels of driving automation
- **Chapter 4:** Who is in control of the vehicle at each level of automation?
- **Chapter 5:** What constitutes *proper control* for each level of automation?
- **Chapter 6:** How will enforcement officers know what level of automation is engaged at a particular time?

1.2 About the NTC

The NTC is an independent statutory body charged with improving the productivity, safety and environmental performance of Australia's road, rail and intermodal transport systems. As an independent statutory body, we develop and submit reform recommendations for approval to the Transport and Infrastructure Council, which comprises Commonwealth, state and territory transport, infrastructure and planning ministers.

Automated vehicles are an important part of our work program because they are expected to have a significant impact on transport networks. Our work in this area began in 2015 after the Transport and Infrastructure Council asked us to identify regulatory barriers to safely introducing more automated road and rail vehicles in Australia.

1.3 Consultation

In April 2017 the NTC published a discussion paper⁴ outlining the key issues, discussing potential options to address the identified issues and seeking stakeholder feedback in relation to the options and issues.

We received 30 public submissions as well as submissions provided on a confidential basis.⁵ Stakeholders who made submissions included state and territory governments, police, industry bodies, law firms, academics, technology developers and automobile clubs. Based on stakeholder feedback to the discussion paper, this policy paper, together with the national enforcement guidelines, were developed and submitted to the Transport and Infrastructure Council in November 2017.

1.4 Background

1.4.1 Project mandate

In November 2016 the Transport and Infrastructure Council agreed to recommendations 3 and 4 in the NTC's policy paper, *Regulatory reforms for automated road vehicles*.⁶

Recommendation 3: That the NTC develops national enforcement guidelines that clarify regulatory concepts of *control* and *proper control* for partial, conditional, highly and fully automated vehicles. That the NTC should develop guidelines that have regard to international standards and best practice and in collaboration with state and territory road, transport and police agencies and public prosecutors.

Recommendation 4: That Australian transport ministers agree to reaffirm the existing policy position that:

- The human driver remains in full legal control of a vehicle that is partially or conditionally automated, unless or until a new position is developed and agreed (in alignment with recommendation 3).
- The human driver of a partially or conditionally automated vehicle should only undertake non-driving tasks currently permitted by the road rules and existing enforcement policies and guidelines, unless or until a new position is developed and agreed (in alignment with recommendation 3), or an exemption is provided by a road agency.

Recommendation 4 provided a clear interim policy position that the human driver remains in control of his or her vehicle until new guidelines are developed or exemptions are provided. This was intended to provide immediate clarity to manufacturers, drivers and

⁴ *Clarifying control of automated vehicles – Discussion paper* (April 2017), available at: [http://www.ntc.gov.au/Media/Reports/\(7995F420-95ED-216A-5C6D-F79655DE9963\).pdf](http://www.ntc.gov.au/Media/Reports/(7995F420-95ED-216A-5C6D-F79655DE9963).pdf) (accessed 31/07/2017).

⁵ A list of stakeholders who made a public submission is provided at Appendix B.

⁶ Available at: [http://www.ntc.gov.au/Media/Reports/\(32685218-7895-0E7C-ECF6-551177684E27\).pdf](http://www.ntc.gov.au/Media/Reports/(32685218-7895-0E7C-ECF6-551177684E27).pdf) (accessed 31/07/2017).

enforcement agencies on the issues of control and legal responsibility for vehicles with partial and conditional automation.

1.4.2 What are the problems being addressed?

Australia's road traffic laws are based on the principle that the driver is in control of the vehicle. In the Australian Road Rules, *drive* is defined to include 'be in control of'. The road rules have a performance-based requirement that a driver exercises *proper control* of the vehicle. Road Rule 297(1) provides as follows:

A driver must not drive a vehicle unless the driver has proper control.

These concepts of *control* and *proper control* are challenged by emerging technologies that are doing more of the driving, with humans monitoring the vehicle and acting as the fall-back.

Unless responsibility for a vehicle with automated functions is clarified in relation to levels of driving automation, there is a risk that:

- technologies with potentially significant safety, mobility and productivity benefits will not be introduced in Australia
- technologies are introduced but enforcement agencies interpret control differently across jurisdictions
- there is legal and consumer uncertainty about who is in control and what constitutes legal behaviour of a human driver in different vehicles
- drivers do not act in a safe and appropriate way.

For example, if a vehicle with automated functions were to breach a road traffic law, there is a risk that in one state the enforcement agency would hold the ADS entity responsible, while in another state the human driver or owner of the vehicle would be held responsible. Another example is the interpretation of what it means for a driver to have *proper control* of the vehicle: a human driver of a vehicle with automated functions could be fined for not having a hand on the steering wheel in one state but not in another.

At this stage, guidelines are needed to assist in applying current law to vehicles with automated functions. As discussed in section 1.6.3 below, in the longer term the guidelines are likely to be updated when an end-to-end regulatory regime, including a safety assurance system, is developed and reforms to establish legal obligations for ADS entities are introduced.

1.5 Key terms used in this paper

Automated driving system means the hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis. It is a type of driving automation system used in vehicles operating in conditional, high and full automation mode.

Automated driving system entity means the legal entity responsible for the ADS. This could be the manufacturer, operator or legal owner of the vehicle, or another entity.

Safety assurance system means a regulatory mechanism to provide oversight of the safety performance of an automated vehicle to assure it can operate safely on the network.

Levels of driving automation:

- **Partial automation** means the driving automation system may take control of steering, acceleration and braking in defined circumstances but that the human

driver must continue to monitor the driving environment and the driving task, and intervene if required.

- **Conditional automation** means the system drives the vehicle for sustained periods of time. The human driver does not have to monitor the driving environment or the ADS but must be receptive to any system failures and intervene if requested and be the fall-back for the dynamic driving task.
- **High automation** means the system drives the vehicle for sustained periods of time in some situations, or all of the time in defined places and conditions, and no human driver is required to monitor the driving environment and the driving task, or to intervene, when the system is driving the vehicle.
- **Full automation** means all aspects of the driving task and monitoring of the driving environment and the dynamic driving task are to be undertaken by the vehicle system. The vehicle can operate in automated driving mode on all roads at all times.

1.6 Scope of the national enforcement guidelines

The national enforcement guidelines have been drafted for immediate use and are intended to work within current legislation to:

- provide guidance about how the requirement of *proper control* in Australian Road Rule 297 should apply to vehicles with automated functions
- confirm that the human driver is responsible for complying with road traffic laws when a vehicle has conditional automation engaged at a point in time.

The primary audience for the guidelines is police. The guidelines may also provide other agencies with policy guidance.

1.6.1 Matters in scope

The guidelines are limited to current road traffic laws.

In relation to *proper control* in Road Rule 297, the guidelines provide examples of behaviours that indicate *proper control* for the following:

- vehicles that do not have any level of automation engaged at a point in time
- vehicles with driver assistance (Level 1) and partial automation (Level 2) where the human driver performs part of the dynamic driving task
- vehicles with conditional automation (Level 3) where the human driver must be ready to respond to vehicle system failures and requests to take over the driving task.

1.6.2 Matters out of scope

The guidelines **do not** cover civil liability or criminal responsibility for a crash or road trauma.

These guidelines **do not** currently provide examples of behaviours that indicate *proper control* for the following:

- vehicles operating at high automation (Level 4) because these vehicles are not anticipated to be commercially released on the market until 2020
- vehicles operating at full automation (Level 5) because these vehicles are not anticipated to be commercially released on the market for the foreseeable future

- vehicles and automated features that cannot operate on public roads without a permit or exemption(s) from the road traffic laws.

The reasons for excluding these vehicles and automated features from the national enforcement guidelines are discussed in more detail in the sections of this policy paper that follow.

In addition, legislative amendments are outside the scope of this project including:

- amendments to the road rules such as mobile phone use while driving
- amendments to any other laws that may be warranted such as amendments to Western Australian road rules that require a driver to be seated behind the steering wheel
- legislation to enable specific automated applications such as remote control parking.

Legislative amendments will be addressed in other NTC projects.

1.6.3 Interaction with other NTC projects

The national enforcement guidelines will be updated as the NTC's work on a safety assurance system is progressed. The safety assurance system is likely to apply to vehicles with conditional automation as well as vehicles with high and full automation. Critically, the safety assurance system could provide an administrative process to ensure enforcement officers have accurate real-time information about a vehicle's automated functionality and the level of automation engaged at a given time. It could also ensure vehicles with conditional automation have systems that ensure drivers are ready to take back control when necessary and can operate safely without the driver having at least one hand on the steering wheel.

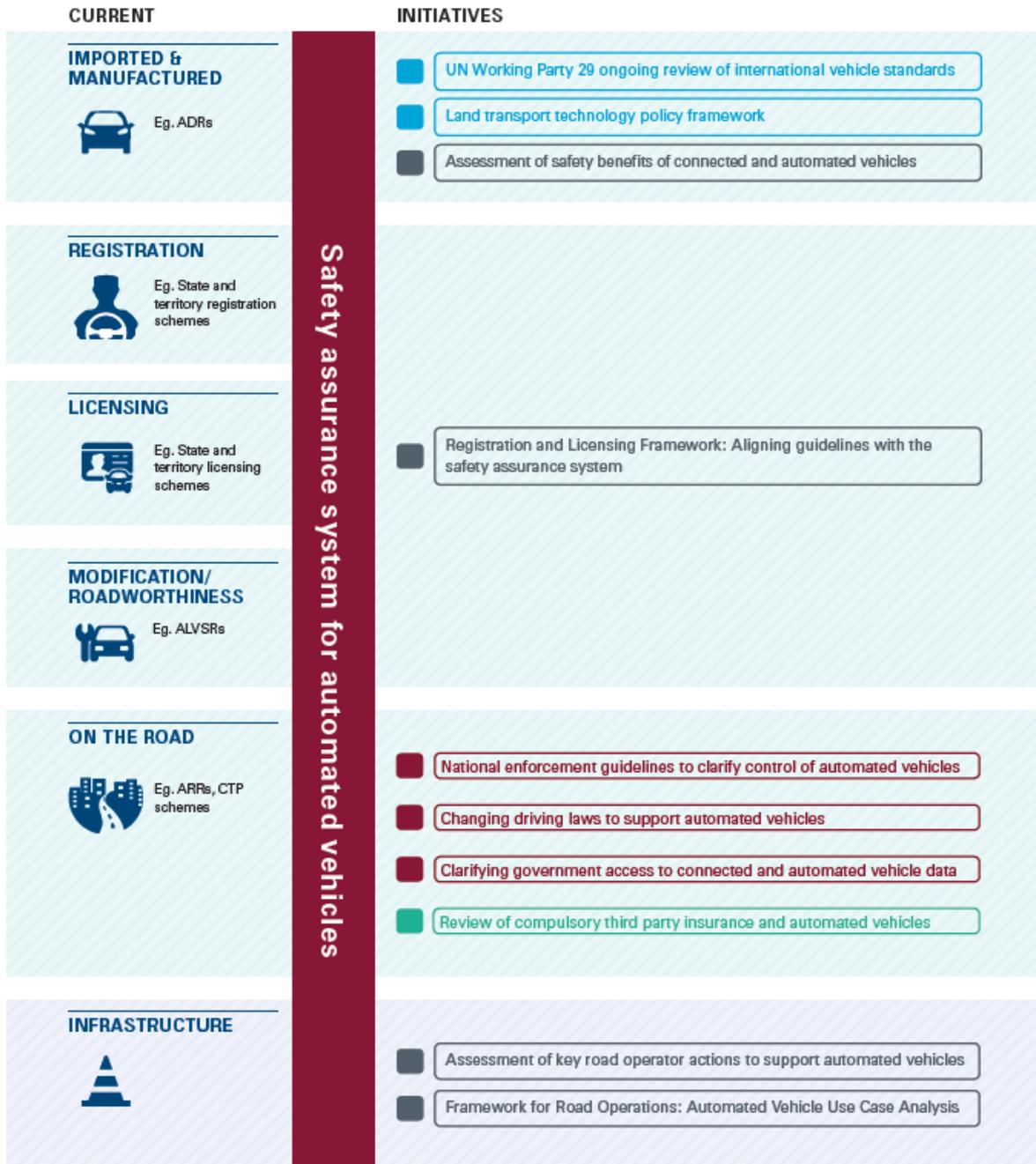
The national enforcement guidelines will also be affected by the reforms to establish legal obligations for ADS entities, which could result in amendments to the definition of *driver* in the Australian Road Rules and other laws, to the effect that the definition is expanded to include the ADS entity (the NTC's project to change driving laws to support automated vehicles).

While the guidelines are operable and relevant independently of any reforms, they will need to be updated when reforms are delivered and implemented. Figure 1 shows the existing end-to-end regulatory process and the projects underway at each stage to prepare for more vehicles with automated functions.

Figure 1: End-to-end regulatory process and projects

Creating an end-to-end post-trial regulatory system

- NTC
- Federal
- Austroads
- States and territories



ADRs = Australian Design Rules; ALVSRs = Australian Light Vehicle Standards Rules; ARRs = Australian Road Rules; CTP = compulsory third party insurance

2 Assumptions and objectives

Key points

- The national enforcement guidelines reflect the current law and will be reviewed and updated to reflect any changes in legislation.
- The guidelines assume there is a legal entity responsible at all times, but that responsibility could shift between parties, and that road traffic laws will primarily be enforced by way of roadside enforcement for the foreseeable future.
- The national enforcement guidelines provide police with guidance about how the requirement of *proper control* should apply to vehicles with automated functions.
- The guidelines should be adopted nationally, be technology-neutral, support road safety outcomes and assist with granting exemptions from road traffic laws.

2.1 Assumptions and objectives outlined in the discussion paper

2.1.1 Assumptions

In the April 2017 discussion paper, the NTC suggested that the following assumptions should underpin the guidelines:

- The national enforcement guidelines will reflect current law.
- The national enforcement guidelines will be reviewed and updated when the ADS and the ADS entity are recognised in legislation and an end-to-end regulatory regime, including a safety assurance system, is implemented.
- There must always be a legal entity responsible for a vehicle operating on a public road or public access area where the road rules apply.
- There can only be one legal entity responsible at one time, but responsibility could shift between parties.
- Enforcement of road rules and traffic laws will continue to be primarily based on roadside enforcement for the foreseeable future.

These assumptions were based on submissions to the NTC's initial discussion paper of May 2016 and international developments. We sought feedback on whether any of these assumptions required further clarification or refinement.

2.1.2 Objectives

Based on the policy principles contained in the *National Policy Framework for Land Transport Technology*, public submissions to the May 2016 discussion paper and stakeholder workshops, the NTC developed proposed objectives for developing national enforcement guidelines.

The objectives outlined in the April 2017 discussion paper suggested that the national enforcement guidelines should:

- provide enforcement agencies with clear guidance about how Road Rule 297 should apply to automated vehicles
- be consistently adopted by all states and territories
- be principles-based and technology-neutral

- support road safety outcomes
- support innovation
- be updated and kept relevant as the capability of automated vehicles develops
- have regard to all levels of driving automation
- assist road transport agencies when considering the consequences of granting exemptions from traffic laws
- not affect current rules for drivers of non-automated vehicles.

We sought feedback on whether any of these objectives required further clarification or refinement.

2.2 Feedback from the discussion paper

The majority of stakeholders agreed with the assumptions and objectives underpinning the NTC's work to develop national enforcement guidelines.

While agreeing with the assumptions and objectives, the WA Transport Portfolio noted that when the law is changed there may no longer be a need for guidelines and suggested amending the assumption to simply state there should be regular reviews. Similarly, the Northern Territory Department of Infrastructure, Planning and Logistics (DIPL NT) noted that the relevance of Road Rule 297 may decrease with increasing vehicle automation, and the Australian Trucking Association (ATA) suggested that the NTC review changes in automated vehicle technologies every 12 months.

Tim Connors suggested there should be shared responsibility between the human operator (who made the choice to operate an automated vehicle) and the ADS entity.

NatRoad supported the identified objectives but noted that supporting road safety outcomes should be the primary objective of the guidelines. In noting this, NatRoad acknowledged that the NTC will be developing a national performance-based assurance regime and suggested that this regime be integrated with the national enforcement guidelines as part of an end-to-end regulatory regime.

While agreeing in principle with the assumptions and objectives, Queensland's Department of Transport and Main Roads (TMR) noted that a number of other road rules are also applicable, especially when considering who is driving a vehicle with high automation and who is responsible when an infringement needs to be issued or a crash occurs.

Some stakeholders raised the need for legislative amendment:

- While supporting the assumption that the enforcement guidelines should reflect current law, TMR suggested that current laws need to be amended prior to vehicles operating at SAE Level 3 or above being on the roads. If such amendments are not made, the human driver will be left responsible for the driving task being undertaken by an ADS.
- While supporting the assumptions and acknowledging that legislative amendments are outside the scope of the current project, Robert Bosch (Australia) Pty Ltd (Bosch) noted that in order for the guidelines to be truly effective it is necessary to recognise an ADS as a legal entity.
- Australia & New Zealand Driverless Vehicle Initiative (ADVI) noted that there should be a review of Road Rule 297 itself.

Insurance Australia Group (IAG) and the WA Insurance Commission were concerned that changes to the definition of *control* has broader implications that are not in scope for the purposes of the NTC's 'clarifying control for automated vehicles' project. IAG argued that it is relevant to consider both transport regulation and liability implications in parallel and

that a joint government and insurance industry initiative should be undertaken to consider liability and coverage.

One police agency raised concerns that the indicators of *proper control* are specific and operational, which is inconsistent with the objective that the guidelines be 'principles-based'. The police agency also noted it is not clear why the 'support innovation' objective has been included.

Brady, Burns and Tranter suggested that the road rules should be reformed to focus on road users rather than drivers, which would make the concept of *control* unnecessary. Owen Hayford noted that any attempt to define *proper control* would face issues as technology continues to evolve. Owen Hayford suggested that the words *proper control* should be given their ordinary meaning and be interpreted depending on the capabilities of the vehicle and other relevant circumstances. However, he considered there is a need to amend the road rules and certain other laws to remove the need for a human driver.

2.3 Conclusions

Noting the broad agreement by stakeholders with the **assumptions**, the NTC has applied the assumptions outlined in the April 2017 discussion paper in developing the national enforcement guidelines. The NTC considers that the assumptions as currently drafted are sufficiently flexible to accommodate stakeholder feedback.

While there was broad agreement by stakeholders about the **objectives** of the national enforcement guidelines, the NTC has made some amendments based on stakeholder feedback. The NTC considers it is appropriate to broaden the objectives to take into account concerns about restricting the scope of the guidelines to only cover the application of Road Rule 297. As such, the relevant objective has been amended and divided into two objectives as follows:

- provide police with clear guidance about how Road Rule 297 and the requirement of *proper control* should apply to vehicles with automated functions
- confirm that the human driver is responsible for compliance with road traffic laws when a vehicle has conditional automation engaged at a point in time.

Noting concerns raised by stakeholders about the effectiveness of the guidelines prior to the recognition of an ADS and an ADS entity and for the reasons discussed in the sections of this policy paper that follow, the national enforcement guidelines will not, at this stage, provide guidelines for the following vehicles and automated features:

- vehicles operating at high automation (Level 4) and full automation (Level 5)
- vehicles and automated features that cannot operate on public roads without an exemption or permit (for example, remote parking assistance features).

As such, the objective 'have regard to all levels of driving automation' has been amended to read as follows:

- have regard to all levels of driving automation in the longer term.

Based on stakeholder feedback, the NTC has removed the objectives of 'principles-based' and 'support innovation':

- The NTC received feedback that behaviours indicating *proper control* need to be practical, tangible and observable, which the NTC acknowledges is inconsistent with the objective that the guidelines be 'principles-based'.
- The underpinning rationale for the 'support innovation' objective was that the guidelines should not favour a particular technology or brand. This is already covered by the objective that the guidelines be 'technology-neutral'.

The NTC understands that legislative amendment is necessary to recognise the ADS and the ADS entity as the driver (and to remove the need for a human driver). This will be progressed in our project to change driving laws to support automated vehicles. The suggestions from stakeholders about specific approaches will be considered in developing the discussion paper for that project. However, the NTC considers that guidelines are necessary at this stage because, in the absence of legislative amendments and judicial interpretation, there is uncertainty around enforcing compliance with the road traffic laws in relation to vehicles with automated functions.

The NTC notes that the national enforcement guidelines do not attempt to change the definition of *control* or *proper control* in the road rules. Rather, they provide guidance on who is in control under the current law and examples of behaviours indicating *proper control* for the purposes of road traffic law enforcement. The guidelines are also explicitly limited to current road traffic laws and do not extend to civil liability in the context of a crash investigation and allocation of fault.

On the issue of liability, we will work closely with state and territory governments when they undertake reviews of compulsory third party and national injury insurance schemes, particularly to ensure any reforms are as nationally consistent as possible.

Policy direction: The following **assumptions** should be applied in developing the national enforcement guidelines:

- The national enforcement guidelines will reflect current law.
- The national enforcement guidelines will be reviewed and updated when the ADS and the ADS entity are recognised in legislation and an end-to-end regulatory regime, including a safety assurance system, is implemented.
- There must always be a legal entity responsible for a vehicle operating on a public road or public access area where the road rules apply.
- There can only be one legal entity responsible at one time, but responsibility could shift between parties.
- Enforcement of road rules and traffic laws will continue to be primarily based on roadside enforcement for the foreseeable future.

Policy direction: The **objectives** underpinning the national enforcement guidelines are that the guidelines should:

- support road safety outcomes
- be consistently adopted by all states and territories
- be technology-neutral
- provide police with clear guidance about how Road Rule 297 and the requirement of *proper control* should apply to vehicles with automated functions
- confirm that the human driver is responsible for compliance with road traffic laws when a vehicle has conditional automation engaged at a point in time
- be updated and kept relevant to ensure they reflect judicial interpretations of control, changes in legislation and developing technology
- have regard to all levels of driving automation in the longer term
- assist road transport agencies when considering the consequences of granting exemptions from traffic laws

- not affect current rules for drivers of non-automated vehicles.

In addition to clarifying and guiding the application of the existing law for police, the guidelines may also provide other agencies with policy guidance.

3 SAE levels of driving automation

Key points

- The national enforcement guidelines adopt the levels of driving automation set out in SAE International Standard J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*.
- The levels of driving automation have been grouped according to whether the human will have to drive or monitor the operation of the vehicle at any time during the journey.

3.1 Driving automation is based on who or what performs part or all of the dynamic driving task

In November 2016 the Transport and Infrastructure Council agreed to adopt the SAE International Standard J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* (SAE J3016), when it is relevant to classify a vehicle based on the level of driving automation. SAE J3016 has six levels of driving automation from no automation (Level 0) to full automation (Level 5). These levels are descriptive rather than normative and technical rather than legal. As such, the levels provide a technical description of the capability of the system at each level of automation but do not prescribe a particular policy position because this requires consideration of other factors such as safety. The levels also do not imply a particular order of market introduction and recognise that one vehicle could be equipped to operate at multiple levels.

The definitions indicate minimum rather than maximum system capabilities for each level. Importantly, SAE J3016 is technology and application neutral. This is appropriate from a legal and policy perspective. The issues of control centre on what requirements are placed on the human driver (driving, supervising, intervening and so forth) rather than a specific automated driving activity (such as self-park, platooning and autopilot).

In the April 2017 discussion paper, we sought feedback on whether the national enforcement guidelines should clarify issues of *control* and *proper control* based on SAE J3016 and whether other approaches should be considered.

3.1.1 Feedback from the discussion paper

The majority of government and industry stakeholders supported clarifying issues of *control* and *proper control* based on SAE J3016.

A number of stakeholders noted the importance of being consistent with international approaches and technology-neutral, which is achieved by relying on SAE J3016:

- The Federal Chamber of Automotive Industries (FCAI) supported the guidelines being based on SAE J3016 because it is currently a widely used and comprehensive set of definitions. FCAI noted that the guidelines should be reviewed to ensure consistency with UN Regulation No. 79 (UN R79)⁷ and the Vienna Convention to allow new vehicle technology to be introduced into Australia.

⁷ UN Regulation No. 79 is an international standard that provides uniform provisions concerning the approval of vehicles in regard to steering equipment.

- TMR agreed that issues of *control* and *proper control* should be based on SAE J3016 and not specific automated applications or technologies. TMR noted the importance of maintaining consistency with larger, international markets to facilitate the use of automated vehicle technology in Australia.
- GHD Advisory (GHD), the Royal Automobile Club of Victoria (RACV) and the Motorcycle Council of NSW similarly noted that SAE J3016 is supported internationally, and international consistency is necessary; otherwise, there is a risk of delayed introduction and adverse effects on safety and economic wellbeing.

Some stakeholders noted SAE J3016 may become less relevant as technology and international standards develop:

- Bosch agreed that SAE J3016 currently provides a well-informed benchmark but noted the importance of being able to react quickly as technology goes to market.
- While the Truck Industry Council (TIC) supported the use of the SAE J3016, TIC considered that continued review of the use of SAE J3016 is required as automated driving technologies evolve and more appropriate international standards are developed.
- The WA Transport Portfolio and IAG cautioned there might be meaningful differences between vehicles that fall within a particular level.⁸
- While agreeing in general that the national enforcement guidelines could be based on SAE J3016 because this would be consistent with international approaches, one government agency noted that the levels of automation available in future markets may not strictly conform to the SAE levels.

Another government agency stated that while SAE J3016 can be used as a starting point, it has effectively been superseded by guidance from United Nations Working Party 29 (WP.29),⁹ which sets international standards for road vehicles. Australia, as a Contracting Party, would be expected to align any future regulatory framework with such standards. The government agency noted that SAE J3016 does not provide enough practical guidance for regulatory purposes, and WP.29 further develops SAE J3016 by, for example, imposing additional safety requirements for vehicles with conditional automation.

IAG raised concerns that SAE J3016 does not assist with defining how the handover of control from the human to the ADS or vice versa should occur. IAG noted that *control* may become a fluid concept that cannot be applied according to the SAE J3016 levels.

3.1.2 Conclusions

Feedback from stakeholders generally expressed support for clarifying issues of *control* and *proper control* based on SAE J3016, with many recognising that SAE J3016 provides a comprehensive set of definitions and is supported internationally. As technology and international standards develop, the reliance on SAE J3016 may need to be reconsidered. However, SAE J3016 is technology and application neutral, therefore developments in technology would not necessarily decrease its relevance. In addition, SAE J3016 itself will continue to be reviewed.

In response to concerns about *control* being a fluid concept that cannot be applied according to the SAE J3016 levels, the NTC notes that SAE J3016 recognises that vehicles may not always be operating at the highest level of automation they are capable

⁸ As an example, the NTC notes that Level 2 automation includes both parking assistance features and vehicles with adaptive cruise control, lane-keeping assist and automatic emergency braking. There may be meaningful differences between these vehicle features, including different indicators of proper control.

⁹ WP.29 is discussed in detail in section 5.2.1.

of operating at, and there could be a handover of control from the human to the ADS or vice versa multiple times throughout the journey.

The NTC recognises that SAE J3016 does not currently define how this handover of control should occur, which is a limitation of the SAE J3016 levels. However, handover of control may be something that depends on the technology itself and what the manufacturer considers to be an appropriate handover process. This issue will be considered in more detail once the ADS and ADS entity are recognised in legislation (that is, when the ADS can be considered as being in control under the road traffic laws) and an end-to-end regulatory regime, including a safety assurance system, is implemented.

While the NTC recognises that international standards for vehicles with automated functions are currently being developed, including by WP.29, these are currently in draft form and have not been settled or agreed. In addition, as discussed in section 4.2.1, international developments are not consistent. As such, the NTC considers that SAE J3016 has not at this stage been superseded by other international developments or guidance.

Policy direction: To ensure the national enforcement guidelines are consistent with international approaches, the guidelines should adopt the levels of driving automation set out in SAE International Standard J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*.

3.2 Applying SAE levels based on the interaction expected of the human driver

The SAE J3016 levels of driving automation are based on the diminishing role of the human driver in performing the driving task. Not every vehicle with automated functions will need a human driver at some point in the journey, and the requirement for a driver to have *proper control* of his or her vehicle is expected to be challenged by vehicles with automated functions.

Therefore, as outlined in the April 2017 discussion paper, it may be useful to think about the SAE J3016 levels of driving automation grouped according to whether a human is expected to undertake the driving task during a journey in the following way:

- **human-driven vehicles:** driver assistance and vehicles with partial automation
- **vehicles capable of automated operation:** vehicles with conditional automation and some vehicles with high automation
- **vehicles with dedicated automation:** some vehicles with high automation and vehicles with full automation that do not have controls for human driving.

In the April 2017 discussion paper we sought feedback on whether, for the purposes of enforcing *proper control*, there is value in grouping levels of driving automation according to whether vehicles are capable of automated operation.

Table 3 outlines an adaption of the SAE levels of driving automation grouped according to the interaction expected of the human driver, which could determine the enforcement response to behaviours that could be safe in some vehicles with automated functions but not in others.

Table 3: Summary of the levels of driving automation by expectations on the human driver

SAE J3016 level	Description
Human-driven vehicles	
Level 0 – No automation	The entire driving task is performed by the human driver, even when enhanced by active safety systems. ¹⁰
Level 1 – Driver assistance	The driving automation system ¹¹ may take control of steering or acceleration and braking (speed), but the human driver is responsible for the rest of the driving task.
Level 2 – Partial automation¹²	The driving automation system may take control of all of the steering, acceleration and braking in defined circumstances, but the human driver must continue to monitor the driving environment and the driving task, and intervene if required.
Vehicles capable of automated operation	
Level 3 – Conditional automation	The ADS drives the vehicle for sustained periods of time. The human driver does not have to monitor the driving environment or the ADS but must be receptive to any system failures and intervene if requested and be the fall-back driver for the dynamic driving task.
Level ‘4a’ – High automation	The ADS drives the vehicle for <i>sustained periods of time in some situations</i> , and no human driver is required to monitor the driving environment and the driving task, or to intervene, when the ADS is driving the vehicle. In other situations, a lower level of automation may be engaged.
Vehicles with dedicated automation	
Level ‘4b’ – High automation	The ADS drives the vehicle <i>all of the time in defined places and conditions</i> , and no human driver is required to monitor the driving environment and the driving task, or to intervene, when the ADS is driving the vehicle.
Level 5 – Full automation	All aspects of the driving task and monitoring of the driving environment and driving task are undertaken by the ADS. The vehicle can operate in automated driving mode on all roads at all times.

3.2.1 Feedback from the discussion paper

The majority of government and industry stakeholders supported grouping levels of driving automation according to whether vehicles are capable of automated operation and the interaction expected of the human driver:

- The WA Insurance Commission, ADVI, QBE and NatRoad considered that grouping levels of driving automation in this way would be valuable, including for the purposes of educating consumers, because information would be presented in a human-centred, rather than a technology-centred, way and the overall dynamic driving task would be considered.

¹⁰ *Active safety systems* are vehicle systems that sense and monitor conditions inside and outside the vehicle for the purpose of identifying perceived present and potential dangers.

¹¹ The *driving automation system* means the hardware and software that are collectively capable of performing *part or all of the dynamic driving task* on a sustained basis.

¹² Level 2 automation also covers automated parking assistance features. Automated parking assistance features are discussed in detail in section 6.3.

- Both VicRoads and Austroads noted the complexity of SAE J3016, which could make it difficult for enforcement officers and members of the public to adhere to guidelines. Therefore, a more user-focused approach that considers a vehicle's potential to be driven by a human driver would be beneficial.
- The RACV supported the approach so long as the groups are in line with international standards and best practice.
- One government agency agreed that the SAE J3016 levels should be regrouped in this way because this would help the human driver to understand the behaviour he or she needs to exhibit when not in control if he or she may at some stage be expected to resume control.
- Another government agency considered that SAE J3016 is not suitable to set requirements against and, therefore, it may be simpler to describe the levels of automation based on the roles of the human driver and the ADS.
- IAG noted that enforcement guidelines need to be human-centred rather than from the vehicle's perspective.

DIPL NT noted that, in relation to Level 4 automation, the level of human control required can range from never required at all, to taking full control of the vehicle when required or desired. As such, DIPL NT suggested further differentiation of levels of automation within the SAE levels may be appropriate. As an example, DIPL NT suggested that Level 4 could be categorised into two separate levels:

- Level 4a – potential for human to take control because there is a driver's seat, steering wheel and pedals
- Level 4b – no potential for human control because there is no driver's seat, steering wheel or pedals.

Noting the potential increase in complexity, DIPL NT suggested that such separation should only go as far as defining major control variances within SAE levels themselves, rather than attempting to define all different scenarios.

Some stakeholders did not support grouping levels of driving automation as proposed:

- The FCAI recommended that the automated steering functions included in UN R79 be used for grouping and that prior to introducing any grouping the NTC should confirm the final categorisations in UN R79 that come from WP.29.
- The Motorcycle Council of NSW noted that grouping could cause issues as SAE J3016 is further developed and could prove irrelevant over time.

3.2.2 Conclusions

Stakeholder feedback expressed strong support for grouping the SAE J3016 levels according to the requirements on the human driver in performing the driving task and the vehicle's capability of automated operation. Table 3 (above) outlines the suggested grouping of levels and highlights a split of Level 4 automation into two separate levels: vehicles at Level 4a automation where the ADS drives the vehicle for sustained periods in some situations (being a vehicle capable of automated operation); and vehicles at Level 4b automation where the ADS drives the vehicle at all times in particular situations (being a vehicle with dedicated automation). Such an approach recognises stakeholder feedback that differentiation within the SAE levels may be appropriate and that the human driver makes decisions relating to the driving task even where a vehicle is operating at Level 4 automation. However, this is not immediately relevant to the national enforcement guidelines themselves because the guidelines do not currently cover vehicles operating at Level 4 automation.

To address stakeholder concerns about the technical complexity of SAE J3016 and its focus on the vehicle rather than being human-centred, the national enforcement guidelines include a more simplified description for each level of automation and provide clarity around who is undertaking the driving task, including the role of the human driver and the ADS. This approach is reflected in Table 3. The NTC considers it is more relevant to clarify the SAE J3016 levels according to the role of the human driver, rather than by the technical functionality outlined in UN R79. The relevance of UN R79 can be reassessed as it evolves over time.

Policy direction: To ensure the national enforcement guidelines provide clarity around the role of the human driver at each level of automation, the guidelines should group the SAE J3016 levels depending on whether the human will have to drive or monitor the operation of the vehicle at any time during the journey.

4 Who is in control of the vehicle at each level of automation?

Key points

- The human driver remains in control of vehicles operating at partial automation because he or she must supervise the driving environment and perform some of the driving task.
- Once it is recognised in legislation, the ADS entity is likely to be in control of and responsible for vehicles operating at high or full automation because the ADS performs the entire driving task and there is no human fall-back.
- There is no international consensus around who is in control of a vehicle operating at conditional automation.
- The national enforcement guidelines reaffirm that, as an interim position, the human driver remains in control of and responsible for a vehicle operating at conditional automation. This interim position will be reviewed once road traffic laws are amended to recognise the ADS and the ADS entity.

4.1 What constitutes control of a vehicle?

The regulatory concept of control is important because the person in control of a vehicle is responsible for the actions of that vehicle. To have effective administration of the road traffic laws and law enforcement, the person who is responsible for the vehicle must be a legal person – that is, an individual or corporation.

The emergence of vehicles with automated functions introduces the possibility that a vehicle's driving task may be undertaken by an ADS. This raises the question of whether the human driver or the ADS entity is responsible for the actions of the vehicle when both the driver and the ADS entity may have essential roles to ensure its safe operation.

State and territory laws have not applied concepts of control to vehicles with automated functions or placed parameters around the concept of control that could constitute a barrier to automated vehicle applications.¹³

Because control is not defined in the road rules, it is necessary to consider its ordinary meaning. According to the Macquarie Dictionary, *control* means 'to exercise restraint or direction over; dominate; command'. In the Cambridge Dictionary *control* means 'to order, limit, or rule something, or someone's actions or behaviour', and in the Oxford Dictionary, *control* means 'the ability to manage a machine, vehicle or other moving object'.

There is a significant body of judicial interpretation of the concept of driving and control. The Victorian Supreme Court of Appeal decision of *Tink v Francis* [1983] 2 VR 17 considered the matter of who has responsibility for the primary controls of the vehicle and established that the term *drive* includes having some control of the propulsive force that will cause the vehicle to move. The concept of driving was also summarised in

¹³ The exception is Regulation 263 of the *Road Traffic Code 2000 (WA)*, which specifies that a person shall not drive a vehicle unless 'he or she is in such a position behind the steering wheel that he or she has full control over the vehicle'. This establishes an additional requirement of control; however, the clause 'in such a position' is not further defined, and what actions the driver must be undertaking when behind the steering wheel are not prescribed.

Damasoliotis v TAC [1998] VCAT 289 as comprising control over at least three elements of the vehicle, being steering, braking and propulsion (which could include ignition, gear selection and acceleration). It is also clear in the road rules and the case law that only one entity can be in control of a vehicle at any one time.

4.2 Who is in control of an automated vehicle?

State and territory traffic laws generally define the driver in relation to control of the steering, movement or propulsion of the vehicle.¹⁴ Further, Road Rule 348 provides that: 'if the context permits, a reference in the [road rules] to a driver doing or not doing something is a reference to the driver causing the driver's vehicle to do or not do a thing'. None of these laws have regard to a vehicle where a human has indirect control of steering, movement or propulsion, or whether a human can in fact still be a driver if they are not directly undertaking the driving task. It is clear that current legislation has not been drafted with vehicles with automated functions in mind, but we must apply the regulatory concept of control to emerging technologies.

The national enforcement guidelines are intended to work within current legislation. As such, until legislative amendments are made to recognise the ADS and ADS entity, the human driver must be considered in control of and responsible for vehicles operating at all levels of automation.

In the April 2017 discussion paper, the NTC suggested the following:

- The human driver remains in control of a vehicle without automated functions (Level 0) and a vehicle with driver assistance (Level 1) because the driver performs either the entire dynamic driving task or the majority of the dynamic driving task.
- The human driver remains in control of a vehicle with partial automation (Level 2) because the automated functions are limited to lateral and longitudinal vehicle motion control and the driver is expected to supervise these functions and perform the remainder of the dynamic driving task (object and event detection and response).
- The ADS entity would be in control of a vehicle operating at high (Level 4) or full (Level 5) automation. When the ADS is engaged, it performs the entire dynamic driving task as well as the fall-back function, and a human driver is not required, at least for a defined period.
- As an interim position (pending further work on legislative change to the definition of *drive* and the development of a safety assurance system) the human driver remains in control of a vehicle with conditional (Level 3) automation.

We sought feedback about who is in control of a vehicle at each level of automation and, in particular, a vehicle with conditional automation.

The April 2017 discussion paper also outlined two options on how the national enforcement guidelines should treat vehicles with conditional automation:

- **Option 1:** That the national enforcement guidelines provides that the **human driver** is in control of a vehicle operating at conditional automation, even when the automated driving system is engaged and performing the dynamic driving task.
- **Option 2:** That the national enforcement guidelines provide that the **automated driving system** is in control of a vehicle operating at conditional automation when

¹⁴ Examples include the definition of *drive* in s. 4 of the *Road Transport Act 2013* (NSW) and s. 5 of the *Road Traffic Act 1961* (SA).

the automated driving system is engaged in the dynamic driving task. This option would not come into effect until the automated driving system and automated driving system entity are recognised in legislation.

The NTC proposed that option 1 be adopted in the first iteration of the national enforcement guidelines. We sought feedback on the preferred option and welcomed feedback on alternative options or an approach that incorporates elements of the options.

4.2.1 International developments relating to control of a vehicle with conditional automation

International developments relating to who is in control of a vehicle operating at conditional automation are not consistent, highlighting a lack of consensus about who is in control of these vehicles. The main international developments are outlined below.

WP.1 Global Forum on Road Traffic Safety

A recent document by United Nations Working Party 1 (WP.1)¹⁵ Informal Working Group of Experts on Automated Driving (IWG-AD),¹⁶ outlining a draft common understanding of the Vienna and Geneva conventions¹⁷ regarding the use of automated driving functions, discusses automated driving functions for vehicles with conditional and high automation. In the document, WP.1 notes that an example of a Level 3 automated driving function is a Highway-Pilot, and outlines the following:

- When engaged, the automated driving function will keep the vehicle within the lane and is able to perform lane changes without confirmation by the driver.
- However, when the function is engaged, the driver is required to remain ready, willing and able to resume the dynamic driving task in response to a takeover demand.
- If the driver fails to respond to a takeover demand, the vehicle will initiate a minimal risk manoeuvre.

The requirement for the automated driving function to initiate a minimal risk manoeuvre is not strictly required of a vehicle operating at Level 3 automation, although some systems' operation at Level 3 may have the ability to do so. In any case, WP.1 still concludes that, where a vehicle is operating at Level 3 automation, the driver shall remain able to control their vehicle.

WP.29 World Forum for the harmonization of vehicle regulations

A draft by United Nations Working Party 29 (WP.29)¹⁸ outlines principles to be treated as guidelines for developing a new regulation related to ADS.¹⁹ In relation to vehicle tasks at Level 3 automation, the principles include the following:

- Generally, the ADS is automatically deactivated after requesting the driver take over the driving task with sufficient lead time. However, if the human driver does

¹⁵ WP.1 is responsible for road safety and driver requirements.

¹⁶ Informal document No. 2, Automated driving, Item 3 (c) of the provisional agenda, Seventy-fourth session of the Economic Commission for Europe Inland Transport Committee Global Forum for Road Traffic Safety, Geneva, 21–24 March 2017.

¹⁷ *Convention on Road Traffic*, Geneva, 19 September 1949 and *Convention on Road Traffic*, Vienna, 8 November 1968. Australia is a signatory to the Geneva Convention but not the Vienna Convention.

¹⁸ WP.29 is responsible for technical regulations. Three UN Agreements, adopted in 1958, 1997 and 1998, provide the legal framework allowing member countries (which includes Australia) attending the WP.29 sessions to establish regulatory instruments concerning motor vehicles and motor vehicle equipment.

¹⁹ Document No. ITS/AD-12-05-3, 'A proposal for the Definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation', ITS/AD 12th meeting, 22 June 2017, agenda item 3-2.

not take over the driving task, in certain limited circumstances the ADS will transition to, or at least initiate, the minimal risk condition.

- The system, rather than the driver, must undertake emergency braking measures.

By relying on the ADS to undertake emergency braking measures and to transition to a minimal risk condition in certain circumstances, WP.29 appears to be implying that the ADS should have control of the vehicle when Level 3 automation is engaged.

The NTC notes that the apparent difference in approach between WP.1 and WP.29 may be a result of the parties' different focuses. The focus of WP.1 in relation to using automated driving functions is on improving road safety and ensuring consistency with the Vienna and Geneva conventions, whereas the focus of WP.29 is on establishing technical standards of automated driving.

The proposed approach in the United States

In its policy document *Federal Automated Vehicle Policy: Accelerating the Next Revolution in Roadway Safety*, the United States' National Highway Traffic Safety Administration (NHTSA) explains there is a clear technical distinction between Level 3–5 highly automated vehicles (HAV) and vehicles with a lower level of automation based on whether the automated system relies on the human driver when engaged and operating.

For the purposes of traffic laws and enforcement, the NHTSA notes the following:

- For vehicles operating at Level 3–5 automation, states may wish to deem the HAV system conducting the driving task and monitoring the driving environment to be the driver of the vehicle.
- For vehicles operating at lower levels of automation, the NHTSA recommends the states consider the human to be the driver.

By determining control based on whether the human or the ADS is undertaking the driving task and monitoring the driving environment, the NHTSA's proposed approach is that the ADS is in control of a vehicle with conditional automation. The NHTSA recognises that legislative amendments would be required to give effect to this approach. As such, the NHTSA's view is premised on the driving task, rather than the human having a fall-back role.

Amendments to the German Road Traffic Act

On 21 June 2017 revisions to the German *Road Traffic Act*²⁰ allowing drivers to operate vehicles with Level 3 or Level 4 functionality entered into force. The new provisions provide that the human driver activates the automated driving function and uses it for vehicle control. Where the automated driving function is engaged, the driver may avert his or her attention from the traffic; however, the driver is obliged to immediately resume vehicle control either when prompted by the system or when the driver recognises (or must recognise) that the preconditions for automated driving mode are no longer fulfilled.

While not explicitly stated, it appears as though the human (as the driver) remains legally responsible for road traffic laws even where the automated driving function is activated. This is because the provisions appear to contemplate the human driver:

- using the automated driving function for vehicle control (rather than the automated driving function becoming the driver)
- being in a position to immediately resume vehicle control in certain circumstances.

²⁰ Available at: <https://www.gesetze-im-internet.de/stvg/> (accessed 10/08/2017).

Vehicle Technology and Aviation Bill (UK)

A new UK Vehicle Technology and Aviation Bill sets out how the liability for accidents involving vehicles with automated functions should be apportioned. This Bill is not directly relevant for the purposes of road traffic law enforcement because it only relates to civil liability.

Audi A8 Traffic Jam Pilot

In July 2017 Audi announced the release of its new Audi A8 at the Audi Summit in Barcelona. Audi stated that the A8's traffic jam pilot feature will allow the vehicle to operate at conditional automation (Level 3):

The traffic jam pilot manages starting, accelerating, steering and braking. The driver no longer needs to monitor the car permanently. They can take their hands off the steering wheel permanently and, depending on the national laws; focus on a different activity that is supported by the car, such as watching the on-board TV. As soon as the system reaches its limits, it calls on the driver to take back control of the task of driving.²¹

Audi noted that it will gradually introduce functions such as traffic jam pilot into Audi A8 production from 2018.

4.2.2 Feedback from the discussion paper

The majority of government and industry stakeholders agreed that, as an interim position, the human driver should remain in control of a vehicle with partial or conditional automation and that the ADS should be in control of a vehicle operating at high or full automation. Feedback from stakeholders mainly focused on who is in control of a vehicle with conditional automation and the options on how the national enforcement guidelines should treat vehicles with conditional automation.

In agreeing with the approach to vehicles with conditional automation, Maurice Blackburn Lawyers noted that caution must be exercised in ceding control to the autonomous system in order to ensure safety is paramount in the rollout of the technology. The FCAI agreed to the approach pending the completion of an international regulatory regime.

However, some stakeholders who supported the approach to vehicles with conditional automation reiterated that it should be an interim position based on the current situation:

- VicRoads proposed that future reforms be considered on the basis that the ADS is in control of a vehicle operating at Level 3 driving automation.
- The TIC noted that the driver must be responsible for the control of a vehicle operating at conditional automation until such time as automated driving technologies become more mature and traffic laws formally recognise and define the ADS.
- In supporting a cautious approach at this stage, the Australian Automobile Association (AAA) and Austroads stated that Australia is potentially diverging from some international jurisdictions, noting the NHTSA's policy as an example. As such, adopting a new position in the future should be considered.

Some stakeholders supported option 2 and maintained that to realise the full benefits associated with automated technology, the ADS should be considered in control of a vehicle with conditional automation, which would also align with international approaches:

²¹ See: <https://www.audi-mediacycenter.com/en/press-releases/the-new-audi-a8-future-of-the-luxury-class-9124> (accessed 10/08/2017).

- TMR suggested it would be counterintuitive to the successful introduction of the technology for the human driver to be in control of a vehicle operating under conditional automation. TMR noted that by setting an expectation that an ADS monitoring and performing the driving task is in control of a vehicle, manufacturers and technology developers will:
 - have a more certain and consistent foundation to introduce this technology into the Australian market
 - be incentivised to develop safe systems for vehicles with conditional automation and their drivers. Implementing higher standards for safe system development from commencement will ensure lower quality systems with reduced safety features are not introduced to the market.

To achieve this outcome, TMR proposed that legislative changes to the road rules be prioritised.

- The Motorcycle Council of NSW supported option 2 and noted that the developer, rather than the human driver, will know how the ADS will react in all situations, and it seems unreasonable for a human driver to be held responsible for reactions by the ADS.
- Owen Hayford noted that at Level 3 automation, the human should be the 'vehicle operator' when the ADS is driving the vehicle and the 'driver' of the vehicle when the ADS ceases to perform the entire driving task. Owen Hayford considered that the NTC's preference for option 1 appears to be largely motivated by a concern that the road rules cannot accommodate option 2 and suggested that this concern be addressed by accelerating amendments to the road rules.
- One government agency raised concerns that maintaining the human as the driver may affect an individual's motivation to purchase a conditionally automated vehicle, which in turn could slow market uptake.
- Another government agency noted option 2 is preferred because it is consistent with the approach being taken by the WP.29 and aligns with the desired policy outcome of deploying vehicles with automated functions in a safe and timely manner, allowing Australians to reap the full range of benefits associated with automated technologies. The agency argued it would be concerning if drivers could lose their licence or receive infringements based on the actions of the ADS.

Some stakeholders did not express support for either option:

- Brady, Burns and Tranter from Griffith Law School stated that the link between vehicle on-road behaviour and legal responsibility for that behaviour need not be provided by the definition of control.
- The ATA considered that further work is required before either party could be responsible for the control of vehicles operating at conditional automation. In relation to the human driver, the ATA noted that until safety risks with the possible loss of driving skills and awareness by human drivers is addressed and it is demonstrated that a human driver can safely resume control of the vehicle; the human driver cannot be designated as in control of the vehicle. In relation to the ADS being in control, the ATA noted that the ADS has not yet demonstrated the ability to apply *proper control* of a vehicle.

Poida Santh noted that, for vehicles carrying oversize loads or dangerous goods and for buses carrying passengers, the human should always be capable of taking control to respond in an emergency, irrespective of the level of automation engaged.

4.2.3 Conclusions

While the majority of stakeholders supported the human driver being in control of a vehicle operating at conditional automation, even when the ADS is engaged in and is properly performing the dynamic driving task (option 1), the NTC recognises that many stakeholders supported this as an interim position only. The NTC also recognises that some stakeholders supported option 2 as being the preferred option.

The NTC notes that there are currently no vehicles in the Australian market operating at conditional automation. However, it is likely that such vehicles will be on the market in the near future and could operate without legislative amendments, permits or exemptions. As such, the NTC considers it is important to clarify who is in control (i.e. responsible for compliance with road traffic laws) when a vehicle is operating at conditional automation based on the current law to ensure legal uncertainty does not prevent such vehicles from being introduced into the market. As an interim position, having regard to the current law, the need to take a cautious approach because the safety of vehicles that require human intervention and fall-back remains to be validated and there being no international consensus on the issue, the NTC is of the view that option 1 is the preferred option.

By maintaining the human driver remains in control, we are recognising that they have a fall-back role, and it is important that they remain awake and alert to what is happening. The safety risk of removing this human safeguard remains uncertain and unmeasured, and therefore it is too early to make this transition. In addition, there is no enforcement power or ability to hold the ADS entity responsible for the road traffic laws.

In response to stakeholder feedback that neither the human nor the ADS could be responsible for the control of vehicles with conditional automation until further work is undertaken, the NTC notes that there must always be a legal entity responsible for compliance with the road traffic laws. Therefore, a position on who is in control of a vehicle operating at conditional automation cannot be delayed.

In response to stakeholder feedback that for certain vehicle types the human should always be capable of taking control, the NTC notes that until legislative amendments are made to recognise the ADS and ADS entity, the human driver must be considered in control of and responsible for vehicles operating at all levels of automation. The question of control will be considered further once these legislative amendments are made and a safety assurance system is implemented.

Policy direction: Until road traffic laws are amended to recognise the ADS and ADS entity, the human driver must remain in control of a vehicle with partial or conditional automation. This approach recognises that control has to be determined in accordance with the current law and there must always be a legal entity responsible for a vehicle operating where the road rules apply.

Recommendation: That the Transport and Infrastructure Council agrees to adopt national enforcement guidelines that:

- 1) give effect to the existing policy position that the human driver remains responsible for a vehicle with conditional automation (Level 3) for the purposes of road traffic law enforcement. This policy position and the national enforcement guidelines will be reviewed after amendments to driving laws to recognise ADS entities.

That the Council agrees to review the national enforcement guidelines, including the policy position that the human driver remains responsible for a vehicle with conditional automation, after amendments to the driving laws to recognise ADS entities.

4.3 Readiness to drive and human as supervisor

In the April 2017 discussion paper, the NTC noted that, in the event that the ADS is determined to be in control of a vehicle operating with conditional automation, further consideration should be given to introducing legal responsibilities on the human driver as supervisor of the ADS. There are currently no specific mechanisms to regulate humans to ensure their readiness to drive in situations when they are in the vehicle, not yet driving, but must be sufficiently alert to system failures or requests from the ADS to take back the driving task.

This is also an issue with vehicles with high automation where the vehicle reaches the limit of its operational design domain and alerts a human driver that they need to take over the driving task or the vehicle will come to a safe stop. If the driver chooses to take over the driving task, he or she will need to be fit and licensed to drive.

The introduction of supervisor responsibilities in road traffic laws could seek to ensure the human remains alert to system errors or requests to intervene. State and territory laws requiring a fully licensed driver to supervise a learner driver provide a precedent for this approach. While the supervisor is not undertaking the driving task, he or she has responsibilities to oversee and monitor the learner driver and therefore cannot be asleep, intoxicated or affected by drugs when undertaking the supervisory role.

4.3.1 Feedback from the discussion paper

The majority of government and industry stakeholders agreed that the road traffic laws could introduce obligations on the human driver as supervisor of the ADS at a future time:

- The Queensland Police Service (QPS) and RACV agreed that the human driver should monitor the safe operation of the vehicle and maintain a level of awareness to take immediate control when it is apparent the ADS is no longer working in a proper manner. One government agency stated that the relevant level of awareness should be interpreted with reference to the manufacturer's instructions about safe behaviours. Bosch considered that the obligations on the human driver to be vigilant should be similar to what is currently legislated.
- One police agency noted that issues relating to obeying a police direction to stop, fall-back and readiness to drive suggest that the human driver has obligations in respect of the overall driving task. The police agency suggested that, at conditional automation, obligations should be imposed on human drivers by treating automated functions as 'driver's aids' within the context of the road rules.
- Another police agency noted that, at higher levels of automation, references to 'in charge' rather than *proper control* may become more relevant for offences.
- GHD, Optalert and VicRoads considered there could be an ongoing objective measurement of the human driver's capability to perform driving tasks, with supervision possibly becoming part of the licensing regime so that additional obligations in relation to non-driving activities could be included.

The WA Transport Portfolio suggested that the human driver should be recognised as supervisor of the ADS irrespective of whether the ADS is determined to be in control of a conditionally automated vehicle.

However, TMR did not support the introduction of supervisory obligations on human drivers who are using conditionally automated driving systems where the manufacturer has determined that the driver does not need to monitor the driving task. TMR considered that introducing supervisory obligations on human drivers when an ADS is undertaking the driving task creates duplication and goes against the intention of having an autonomous system in control.

4.3.2 Conclusions

Feedback from stakeholders strongly supported the future introduction of obligations on the human driver as supervisor of the ADS (or for a reference to 'in charge' to be used as an alternative approach). Noting that such obligations on human drivers would differ from obligations on the ADS, the NTC does not consider that the introduction of supervisory obligations creates duplication.

Policy direction: The introduction of obligations on human drivers as supervisors of the ADS is being considered as part of the NTC project to change driving laws to support automated vehicles.

5 What constitutes *proper control* for each level of automation?

Key points

- The examples of behaviours that indicate *proper control* in the national enforcement guidelines include what the NTC understands to be existing indicators, being at least one hand on the steering wheel and seated in the driver's seat, and new indicators relating to alertness and readiness to intervene.
- The indicator to have at least one hand on the steering wheel does not apply to automated parking assistance features or vehicles operating at conditional automation when the automated function is properly engaged.
- At this stage, the guidelines do not provide indicators for vehicles operating at Level 4 or Level 5 automation or for vehicles and automated features that require a permit or exemption(s) to operate on public roads.
- The first iteration of the national enforcement guidelines applies the concept of *proper control* only to the human driver, and application to the ADS will not be addressed until the ADS is recognised in law.

5.1 *Proper control* is not a prescriptive road rule

Road Rule 297 provides that a driver must not drive a vehicle unless the driver has *proper control* of the vehicle.²² *Proper control* is not defined in the road rules, and its meaning is subject to police enforcement policy and judicial opinion, neither of which have yet been developed in relation to vehicles with automated functions.

Based on earlier consultation with police, the NTC understands that police agencies today generally interpret *proper control* to mean that the driver should be in the driver's seat and have at least one hand on the steering wheel. There is not a limited set of behaviours that constitute a failure to have *proper control* of the vehicle. In broad terms, a *proper control* offence may be based on three scenarios:

- observed driver behaviour that creates a potential safety risk – such as a driver observed not holding the steering wheel or a frosted windscreen impairing vision, although the vehicle is not observed performing unsafely
- observed driving behaviour that is unsafe – such as a vehicle swerving outside a lane
- a crash that was the result of the driver not properly controlling the vehicle's steering, propulsion or braking.

The *proper control* rule appears to be particularly suitable for the first scenario. The second scenario can be addressed by using the range of road rule offences that target specific unsafe behaviours. The last scenario may be best addressed by using a specific road traffic law such as drink driving, or a general offence such as driving without *due care and attention* or dangerous driving.

²² Note that Western Australia's equivalent to Road Rule 297, regulation 263 of the *Road Traffic Code 2000* (WA), also requires the driver to be seated behind the steering wheel.

The current enforcement approach to *proper control* may not contemplate vehicles with automated functions operating safely without a human driver keeping at least one hand on the steering wheel, or even sitting in a driver's seat. The indicators need to be reviewed to be relevant to vehicles with automated functions so behaviours that are proven to be safe are not penalised and unsafe behaviours can be targeted. For example, behaviours related to monitoring the ADS and maintaining a safe level of alertness may become more relevant than keeping a hand on the steering wheel.

5.2 How should *proper control* apply to the human driver in vehicles at different levels of automation?

Existing indicators of *proper control* (generally, that the driver must be in the driver's seat and have at least one hand on the steering wheel) would continue to be relevant when a vehicle is not in automated mode.

For vehicles that are designed to control the steering, acceleration and braking, a human hand on the wheel may not be an indicator of *proper control*. Likewise, being seated in the driver's seat may not be relevant to some automated functions. For example, some vehicles with partial automation have automated parking assistance features (discussed in more detail in section 5.3).

We expect that in a vehicle with conditional automation, remaining in the driver's seat will continue to be a relevant indicator of *proper control* because the driver may need to take back control within a matter of seconds if requested or if there is a system error, and would therefore need to be in the driver's seat already to do so in the time available. In the context of supervising a vehicle or being receptive to requests to intervene, *proper control* could relate to concepts of vigilance and maintaining alertness.

5.2.1 Indicators of *proper control* in the April 2017 discussion paper

The April 2017 discussion paper outlined two options on how the national enforcement guidelines should apply the *proper control* test to the human driver in vehicles with automated functions:

- **Option 1:** No change to the current interpretation of *proper control*.
- **Option 2:** That the interpretation of proper control is clarified to allow the human driver to not have a hand on the steering wheel in a self-parking operation or when an automated vehicle is in automated mode. New indicators of proper control related to alertness and readiness to intervene (outlined in Table 3 on page 34 [of the April 2017 discussion paper]) should be introduced. The indicators of proper control should be reviewed as further reforms are made and the technology develops.

We sought feedback on these options and also welcomed feedback on alternative options or an approach that incorporates elements of the options.

By way of summary, the indicators of *proper control* in the discussion paper were the following:

- at least one hand on the steering wheel
- seated in the driver's seat
- not asleep
- not have closed eyes or showing signs of drowsiness
- not reading or viewing a device or thing unrelated to navigation or driving.

The discussion paper also provided that the indicators of *proper control* would apply as follows:

- For human-driven vehicles (vehicles with Levels 0–2 automation), all indicators should be met. An exception to this was self-parking operations, which are discussed at section 5.3.
- For vehicles with conditional automation (vehicles with Level 3 automation), all indicators other than the requirement to have at least one hand on the steering wheel should be met.
- For vehicles with Level 4a automation (vehicles capable of automated operation as described in section 3.2), none of the indicators would need to be met. This is because such vehicles can come to a safe stop if the human driver does not resume the driving task.
- For vehicles with Level 4b and vehicles with Level 5 automation, both of which are vehicles with dedicated automation as described in section 3.2, the indicators would not apply because there is no human driver.

The NTC also noted that the indicators are in addition to any behaviours explicitly prohibited by law such as the use of a mobile phone while driving.

5.2.2 Feedback from the discussion paper

The majority of stakeholders supported the suggested indicators of *proper control*, with some suggesting modifications or noting concerns:

- One government agency suggested that the indicators also include the need for the human driver to have awareness of the driving environment.
- The TIC suggested adding words along the lines of ‘*or otherwise distracted from the driving task*’ to ‘*Not reading or viewing a device or thing unrelated to navigation or driving*’.
- The WA Transport Portfolio was concerned about *proper control* being defined in the negative because there are a number of things that the driver shouldn’t do.
- TMR supported the indicators in principle but did not support requirements that it considered were difficult to accurately detect or measure such as ‘showing signs of drowsiness’.
- ADVI noted that being asleep, drowsy or distracted are not the only indicators that should be considered. ADVI noted that these are driver states that will influence the degree of driver control the driver will be able to exercise when required to take back control of a vehicle.
- Owen Hayford noted that if *proper control* ends up being defined, the indicators of *proper control* should instead be that ‘the operator is sufficiently ready to take over performance of the dynamic driving task(s) being performed by the automated driving system’.

While supporting the indicators, the QPS suggested that existing interpretations of what is *proper control* may be flexible enough to suffice. The QPS provided the following example: ‘What is the exercise of control that would be expected of a reasonably prudent [person in charge/driver] of a vehicle with a level of automation to [describe the level]?’

Some stakeholders, including Optalert, VicRoads, DIPL NT, the FCAI and a policy agency, had concerns that the indicators for vehicles with Level 4 automation were too permissive for reasons including the following:

- Such vehicles are at a very early stage of development.
- The human driver may take over the driving task during the journey.
- Indicators need to distinguish between the two types of vehicles with Level 4 automation.

Conversely, the WA Transport Portfolio considered that the indicators for vehicles with Level 4 automation are too restrictive and that using a mobile phone when Level 4 automation is engaged should be allowed.²³

TMR suggested that specific indicators for vehicles with Level 4 automation should be delayed until more is known about the functionality of human-machine interfaces. ADVI similarly noted that more needs to be understood about the capabilities of driving systems operating at Level 3 automation or above before prescribing a driver state.

The Motorcycle Council of NSW proposed further dividing the SAE levels to recognise that vehicles operating at Level 1 or Level 2 automation that control lateral motion will not require the driver to have a hand on the steering wheel.

A number of stakeholders, including Maurice Blackburn Lawyers, the Law Institute of Victoria (LIV) and the Council, noted that the indicators of *proper control* would need to be updated as further reforms are made and the technology develops. GHD suggested indicators could be informed by trial results, and Bosch recommended consulting human behaviour experts.

Bosch also noted that the indicator ‘not reading or viewing a device or thing unrelated to navigation or driving’ will require detailed attention in the near future as this type of activity will represent one of the most significant advantages of automated driving. Other stakeholders shared the concern that human drivers should not be prevented from undertaking non-driving activities specifically permitted by the manufacturer, with one government agency noting that it may be useful to consider *proper control* to mean following the manufacturer’s instructions, with the indicators forming a default assumption for roadside enforcement.

IAG stated that it is pre-emptive to rely on the suggested indicators of *proper control* because more detailed research is first required on the interaction between humans and the ADS.

Owen Hayford considered it is not necessary or desirable for the meaning of *proper control* to be further defined. Brady, Burns and Tranter from Griffith Law School considered that providing indicators of *proper control* would create barriers to adoption and would immediately be subject to court decisions.

5.2.3 Conclusions

The feedback indicated strong support for the interpretation of *proper control* to be clarified and for new indicators of *proper control* related to alertness and readiness to intervene to be introduced. The feedback also provided strong support for reviewing the indicators of *proper control* as further reforms are made and the technology develops. As such, the NTC is of the view that option 2 is the preferred option.

The indicators of *proper control* in the national enforcement guidelines have been updated from those set out in the April 2017 discussion paper to take into account feedback from stakeholders. The guidelines no longer refer to the indicators ‘not asleep’ and ‘not have eyes closed or show signs of drowsiness’ and instead refer to a more positive indicator of

²³ The NTC notes that Road Rule 300 does not allow a mobile phone to be used except in certain circumstances.

'alert enough to resume the entire driving task if requested or if there is an evident system failure', with some practical, tangible and observable examples of conduct included.

The current examples of behaviours indicating *proper control* are the following:

- at least one hand on the steering wheel
- seated in the driver's seat
- alert enough to resume the entire driving task if requested if there is an evident vehicle system failure (for example, eyes open, checking the external environment)
- not reading or viewing a device or thing unrelated to navigation or driving.²⁴

The NTC understands stakeholder concerns about indicators of *proper control* for vehicles at Level 4 automation in particular. We recognise that vehicles operating at high automation (Level 4) are not anticipated to be commercially released on the market until 2020. Until more is known about the relevant technology, it is not appropriate to provide indicators of *proper control* for these vehicles. Vehicles operating at full automation (Level 5) are similarly a theoretical concept. As such, the national enforcement guidelines have been updated from those set out in the April 2017 discussion paper to only provide indicators of *proper control* for vehicles operating at conditional automation (Level 3) or lower.

The NTC considers that a cautious approach needs to be taken in relation to indicators of *proper control* for vehicles operating at conditional automation to recognise that vehicles requiring human fall-back are only in the early stages of development and the safety of these vehicles remains to be validated. While SAE J3016 suggests it is the system that is responsible for object detection when Level 3 automation is engaged, which may suggest that the human does not need to be aware of the surroundings, SAE J3016 is descriptive rather than normative and is a technical standard. As such, the levels provide a technical description of the capability of the system at each level of automation but do not prescribe a particular policy position because this requires consideration of other factors such as safety. Over time, as the safety of vehicles operating at conditional automation is better understood, the indicators of *proper control* could be updated to take full advantage of Level 3 capability.

Taking a similarly cautious approach to vehicles operating at Level 1 or Level 2 automation, and noting that such vehicles are human-driven, the NTC considers that having at least one hand on the steering wheel is a relevant indicator of *proper control* even where the system controls lateral motion. This is because vehicles operating at these levels of automation cannot perform the entire dynamic driving task.

Policy direction: To ensure indicators of *proper control* more accurately reflect the role of the human when a driving automation system is engaged at a point in time:

- The applicability of the existing indicators (generally, at least one hand on the steering wheel and seated in the driver's seat) should be clarified so as to not apply at certain levels of automation.
- New indicators of *proper control* relating to alertness and readiness to intervene

²⁴ Existing restrictions on mobile phones and visual display units continue to apply.

should be introduced.

Policy direction: Until such time as the safety of vehicles with automated functions is better understood, a cautious approach should be taken in determining the indicators of *proper control* at each level of automation.

Policy direction: To support an approach that reflects the current law, the national enforcement guidelines should not cover:

- vehicles operating at Level 4 or Level 5 automation
- vehicles and automated features that cannot operate on public roads without a permit or exemption(s).

Policy direction: Guidelines for vehicles operating at Level 4 or 5 automation will be considered when the relevant technology is more developed and changes to road traffic laws recognise that the driver of a vehicle could be an ADS with an entity responsible for the actions of the ADS.

Recommendation: That the Transport and Infrastructure Council agrees to adopt national enforcement guidelines that:

- 2) provide indicators of *proper control* for human drivers of vehicles with automated driving functions.

That the Council agrees to review the national enforcement guidelines after amendments to the driving laws to recognise ADS entities.

5.3 Automated parking features

Automated parking assistance features are starting to emerge. Such features allow the vehicle to undertake the entire parking task (including one or more of angle, parallel and perpendicular types of parking). Some manufacturers, such as BMW, Audi, Mercedes Benz and Tesla, are also developing a remote capability, using an app in a smartphone or the key fob, where the driver must be near, but not in, the vehicle. These include BMW's Park Assistant Plus and Mercedes Benz's Remote Parking Pilot.

The NTC notes that remote parking features are not currently being introduced into the Australian market because they cannot operate on public roads without an exemption. By way of example, Road Rule 213 (which is an offence provision) requires the driver to apply the parking brake effectively before leaving the vehicle.²⁵ Road Rule 213 cannot be complied with when the remote parking assistance feature is engaged. Tesla has reported that while its Summon function allows a vehicle to be parked remotely with no-one behind the steering wheel, at this stage the feature should only be used on private property.²⁶

Vehicles with parking assistance (with the driver remaining in the vehicle) and remote parking assistance (with the driver supervising in close proximity) are example features of Level 2 automation. When these automated parking assistance applications are engaged,

²⁵ Other relevant road rules include:

- Road Rule 264, which requires the driver to wear a seat belt
- Road Rule 297, which requires the driver to have a clear view of the road and traffic ahead, behind and to each side of the driver (with the equivalent rule in WA having additional requirements)
- Road Rule 300, which does not allow a driver to use a mobile phone unless it is being used for the purposes of a phone call or as a driver's aid, and it is securely mounted in the vehicle or is otherwise being used hands free.

²⁶ See: https://www.tesla.com/en_AU/blog/summon-your-tesla-your-phone (accessed 10/08/2017)

there must be a human driver supervising the parking function, even if this is done remotely using a hand-held control.

While there must be a human driver supervising the parking function, automated parking functions do not generally require a hand on the steering wheel when in partially automated mode. For example, vehicles available on the market today can execute self-park operations while the driver is seated behind the steering wheel, and the self-park cannot operate if the driver puts his or her hands on the steering wheel.

In the April 2017 discussion paper, the NTC sought feedback on whether special consideration should be given to automated parking functions that are partially automated and can only operate without the driver holding the steering wheel. The focus was on automated parking applications currently being developed, rather than applications in the very early stages of development (such as applications allowing the vehicle to drive itself to a car park and return on command). This latter category of automated parking features is an example of features at Level 4 automation and will be addressed in the longer term.

5.3.1 Feedback from the discussion paper

Almost all stakeholders, including government and industry, agreed indicators of *proper control* should recognise automated parking functions that operate without hands on the steering wheel because it is safe to do so and would remove barriers to consumer uptake and development of technology.

One government agency suggested that *proper control* requirements for current and future self-parking functions should reflect manufacturer's instructions, whether this requires hands on the wheel or not.

Both TMR and the WA Insurance Commission specifically supported including remote automated parking in the guidelines. The WA Insurance Commission noted that it would support road rule exemptions to allow this to occur.

The Motorcycle Council of NSW contended that parking technologies are not covered by the SAE levels of driving automation because they are not sustained activities, and ongoing discussion needs to be clear on this distinction.²⁷

The AAA and the Tasmanian Department of State Growth were concerned that focusing on specific technology applications contradicts the objective of the guidelines to be 'technology-neutral' and may result in the guidelines quickly becoming outdated as new technology develops.

NatRoad objected to consideration of automated parking for heavy vehicles because the technology has not been developed yet. Owen Hayford noted that his proposed alternative definition of *proper control* would make special consideration of this function unnecessary.

5.3.2 Conclusions

While the guidelines are technology-neutral, the NTC recognises that automated parking assistance features differ from the broader category of vehicles with Level 2 automation, particularly because self-park features currently available on the market cannot operate if the driver puts his or her hands on the steering wheel. As such, the guidelines separate out the indicators of *proper control* for parking assistance features from the indicators for the broader category of vehicles with Level 2 automation.

²⁷ The NTC notes that SAE J3016 explicitly refers to automated parking at both Levels 2 and 4.

Noting that, currently, remote parking assistance features cannot legally operate on public roads without a permit or exemption(s), the guidelines only provide indicators of *proper control* for automated parking assistance where the driver remains in the driver's seat.

Policy direction: To assist with removing barriers to development and uptake, having at least one hand on the steering wheel should not be an indicator of *proper control* where automated parking assistance features are engaged.

Policy direction: To ensure the national enforcement guidelines reflect the current law, the guidelines should not provide indicators of *proper control* for remote parking assistance features.

5.4 *Due care and attention* offences

In addition to the *proper control* rule, states and territories have *due care and attention* offences related to careless driving. A driver can have *proper control* of his or her vehicle but drive carelessly, such as a driver who weaves unsafely between traffic. Like the *proper control* rule, these offences do not target specific behaviours in legislation. These offences usually carry higher penalties than breaches of the *proper control* rule, including imprisonment in some jurisdictions.

The NTC sought feedback on the extent to which *due care and attention* offences are currently relied upon by enforcement agencies to prosecute behaviours that are unsafe in a conventional vehicle but may be safe in vehicles with automated functions. If so, we sought feedback on whether the national enforcement guidelines should also clarify the application of *due care and attention* offences to vehicles with automated functions.

5.4.1 Feedback from the discussion paper

Some stakeholders supported clarification of the application of *due care and attention* offences to vehicles with automated functions. ADVI noted that the key issue to clarify is what it means to be 'ready to intervene' when an automated vehicle requests that a driver take back control.

The WA Transport Portfolio suggested that enforcement guidelines could reinforce that *due care and attention* provisions continue to apply to vehicles operating up to Level 4 automation, but other offences would need to be developed for vehicles operating at Level 5 automation.

However, a number of stakeholders, including police agencies, considered it was not necessary for this clarification to be included in the guidelines, particularly at this stage:

- The QPS, VicRoads (reporting advice from Victoria Police) and another government agency suggested that consideration should be given to expanding or adapting offences where *due care and attention* are relevant. The QPS also suggested consideration of new offences for a person disregarding the manufacturer's instructions and failing to disengage the system.
- One police agency noted that automation up to conditional automation does not change the standard of care required of a human driver and that, for vehicles with Level 4 or Level 5 automation, there can be no prescriptive answer because the duty of care becomes a software issue.
- TMR stated that it did not, at this stage, support prescribing behaviours indicative of a lack of *due care and attention* in vehicles with automated functions.
- DIPL NT noted (based on advice from NT Police) that *due care and attention* offences are often relied upon by police and therefore guidance may be useful;

however, providing such guidance first requires the definitions of *drive* and *driver* to be reviewed.

- Owen Hayford considered clarification was unnecessary because the interpretation of what constitutes *due care and attention* will continue to evolve as vehicle technology evolves.

5.4.2 Conclusions

Feedback from stakeholders in relation to clarifying the application of *due care and attention* offences suggested that clarification is not necessary at this stage, and either new offences should be introduced or current offences need to be adapted. Based on this feedback, we have not expressly included clarification about the application of these offences in the guidelines. Some suggestions raised by stakeholders will be relevant to the NTC's project to change driving laws to support automated vehicles.

5.5 How should *proper control* apply to the automated driving system when the automated function is engaged?

A human driver can perform actions that lead to them not having *proper control* of a vehicle such as inattention, distraction and failure to properly handle the steering wheel. However, these indicators of *proper control* are not relevant to an ADS because it cannot perform these unsafe and risky behaviours. If an ADS causes a crash or incident, the safety-critical issue is likely to be the result of a system error, a technical or mechanical failure, or the vehicle operating outside its intended operational design domain.

Therefore, either the *proper control* test should not apply to an ADS (and more appropriate offences or regulatory mechanisms are used to manage safety) or the indicators of *proper control* should be adjusted to be made more relevant to vehicles with automated functions. For example, a future offence could be introduced relating to a failure to operate as designed (or as promised) in breaching a traffic law or causing a crash.

In the April 2017 discussion paper, the NTC proposed that the first iteration of the guidelines should not have regard to the application of *proper control* to the ADS, but the guidelines are updated to do so when the ADS and the ADS entity are recognised in legislation and a safety assurance system is implemented. This was to ensure the guidelines only have regard to current law and do not engage in the interpretation of theoretical entities and obligations.

5.5.1 Feedback from the discussion paper

The majority of stakeholders supported the NTC's proposal. This was on the basis that the technology is evolving, the appropriate entities are yet to be confirmed and created and a safety assurance system has not yet been implemented. For example:

- VicRoads stated that *proper control* should only apply if a human is responsible for control. If an ADS is in control of a vehicle, VicRoads suggested referring to 'in operation' rather than 'in control' and including another provision under Road Rule 297 – human behaviour if using an automated vehicle.
- DIPL NT and Bosch stated that the indicators of *proper control* that apply to human drivers would not apply to an ADS. DIPL NT suggested that the failure of an ADS to properly control a vehicle may be better dealt with by more serious offences (such as negligence), and Bosch suggested regulatory procedures designed for product or system function, rather than human function, could be followed instead.

Brady, Burns and Tranter from Griffith Law School suggested the road rules be revised to make the concept of *proper control* unnecessary, and Owen Hayford suggested making amendments to the road rules so the *proper control* test would apply to the vehicle operator rather than the ADS.

5.5.2 Conclusions

Feedback from stakeholders expressed clear support for the concept of *proper control* to apply only to the human driver, and for application to the ADS to be addressed only when the ADS is recognised in law.

Policy direction: The national enforcement guidelines should only apply the concept of *proper control* to the human driver and not to the ADS.

Policy direction: Whether *proper control* should apply to the ADS when the automated function is engaged should be reviewed when the ADS and the ADS entity are recognised in legislation and an end-to-end regulatory regime, including a safety assurance system, is implemented.

6 How will enforcement officers know what level of automation is engaged at a particular time?

Key points

- There are currently no mechanisms in place requiring vehicles to be identified as having automated functions or for enforcement officers to access information about a vehicle's automated functionality and whether the ADS is engaged at a given time.
- There is no onus on officers to determine whether a vehicle has a level of automation engaged at a point in time, although police may seek information about this for evidence-gathering purposes. The national enforcement guidelines provide practical guidance to assist officers in interacting with drivers who are operating vehicles with automated functions.
- A process for enforcement agency interaction with automated vehicles will be identified once the technological capability of vehicles with automated functions is more developed and enforcement practices are implemented in overseas jurisdictions.
- Enforcement agencies and the NTC should work closely with vehicle manufacturers to identify technology solutions to assist enforcement agencies to interact with automated vehicles, and the safety assurance system should provide an additional regulatory mechanism to manage the interaction between enforcement and automated vehicles.
- Options for enforcement agency interaction with automated vehicles should be further explored as part of the NTC's project to regulate government access to data, scheduled to commence in late 2017.

6.1 The level of automation engaged is relevant to whether a driver has *proper control*

In determining whether there has been a breach of Road Rule 297, police officers must satisfy themselves that a driver of a vehicle did not have *proper control*. This may be based on observed behaviour. As a defence, a driver may need to demonstrate that his or her behaviour at the time was appropriate for the level of automation engaged.

Adopting different indicators of *proper control* for different levels of automation will require the driver to provide evidence to enforcement officers about the level of automation engaged at a particular time in order to know which indicators apply.

Under current laws it is not possible to mandate *physical signals* on vehicles with automated functions to indicate whether an automated application is engaged at a particular time. Given current practice and indications from international developments, it is unlikely that manufacturers will provide such identification.

Vehicles with automated functions could be identified by a *special number plate*. This may require changes to state and territory registration laws and would therefore be out of scope for the first iteration of the national enforcement guidelines. A vehicle may have several levels of automation, so identification by a special number plate might have limited

usefulness in enforcing different indicators for different levels of automation. It could be considered in the future for vehicles with conditional, high and full automation, including vehicles designed never to be operated by a human driver.

It is likely that legislative changes in the United States and Europe will result in manufacturers including *internal vehicle indicators* (for example, on the dashboard) to inform drivers whether or not an automated function is engaged and data recording requirements that will assist in identifying the cause of an incident or crash.

Ideally, the automated vehicle's data would show the level of automation engaged at a particular time, but this data may not be retained in the absence of specific Australian Design Rules or requirements imposed through the safety assurance system (discussed in section 6.2). Even if the relevant data about automated mode is retained, it may not be available to enforcement officers at the time of detection. The technological interface between the enforcement officer and the automated vehicle may not exist, or systems may be incompatible. In addition, there is currently no requirement in Australia for the driver or manufacturer to provide access to this data, although it may be obtained via subpoena or summons.

Noting these limitations, a human driver could demonstrate to officers that vehicle automation was engaged – and the level of automation – at a given point in time in the following ways:

- a statement made by the driver
- provision of information available to the driver about the make and model of the vehicle and its capabilities
- provision of the driver's manual, which is prepared by the manufacturer and contains a description of the vehicle's automated capabilities and how they should be used safely
- allowing visual observation of the in-vehicle dashboard screen that provides information about safe driving behaviours.

6.2 The safety assurance system can ensure enforcement agencies have the information they need

The safety assurance system for automated vehicles is expected to provide an additional mechanism to regulate the technology interface and communication between vehicles with automated functions and enforcement agencies.

The safety assurance system could include a safety criterion in relation to interaction with enforcement agencies. Under this approach a vehicle with automated functions would not be approved under the safety assurance system unless the applicant could demonstrate that enforcement officers will be able to access accurate and real-time information about a vehicle's automated functionality and whether the ADS is engaged at a given time.

In addition, vehicle registration data (including information on the National Exchange of Vehicle Data and Information Service) is likely to include fields relating to the level of driving automation, or relevant automated functions (such as traffic jam assist) as part of future changes to registration systems and processes. As such, a vehicle's registration data could also provide information about a vehicle's automated functionality. This work will be progressed as part of the safety assurance system for automated vehicles project.

Until the implementation of a safety assurance system or new Australian Design Rules, governments do not have a regulatory mechanism to compel vehicle manufacturers to have regard to interaction with enforcement agencies. Technologies are also developing at a rapid pace, and it is difficult to outline technology solutions that would not become

outdated or inhibit commercial deployment of vehicles with automated functions. The appropriate solutions may also be heavily dependent on the specific type of vehicle or technology in use. Options for enforcement agency access to data could be further explored as part of our project to develop options to regulate government access to data, scheduled to commence in late 2017.

In the April 2017 discussion paper, the NTC proposed the following:

- The national enforcement guidelines should be updated to identify a process for enforcement agency interaction with automated vehicles once the technological capability of automated vehicles is more developed and enforcement practices implemented in overseas jurisdictions.
- Enforcement agencies and the NTC should work closely with vehicle manufacturers to identify technology solutions to assist enforcement agencies to interact with automated vehicles.
- Options to facilitate enforcement agency interaction with automated vehicles should be included as a key objective in the NTC project to regulate government access to data (2017–18).
- When the safety assurance system is implemented, it should provide an additional regulatory mechanism to manage the interaction between enforcement agencies and automated vehicles.

The NTC sought feedback on this proposed approach and any alternative approaches to managing the interaction between enforcement agencies and automated vehicles. In particular, the NTC sought feedback on whether the guidelines should only specify such interaction once the technological capability is more developed and enforcement practices are implemented in overseas jurisdictions.

6.3 Feedback from the discussion paper

Almost all industry and government stakeholders agreed with the NTC's proposals. Some stakeholders commented on the proposed approach to only specify a process for enforcement agency interaction with automated vehicles once the technological capability is more developed and enforcement practices are implemented in overseas jurisdictions:

- Bosch noted that as automated driving technology develops, we may see vehicles with self-monitoring capabilities that reduce the need for enforcement agency interaction.
- One government agency noted it was important to keep a watching brief on overseas jurisdictions that are formulating and implementing enforcement practices. The government agency suggested that on-road trials could facilitate Australia participating in and potentially leading the development of enforcement agency interaction guidelines.
- Owen Hayford agreed that if guidelines are developed they do not need to specify enforcement agency interaction with automated vehicles at this point in time, and the Australian Design Rules could perhaps be amended instead.

Conversely, while supporting the need to monitor and align with international enforcement practices, ADVI suggested that Australia should not wait for these to be in place before developing its own guidelines.

While agreeing with the NTC's proposals, some stakeholders raised concerns about how the relevant laws will be enforced in the interim period and expressed reservations about vehicles with automated functions being allowed on the road beyond on-road trials:

- TMR, the WA Transport Portfolio and IAG noted that the guidance provided by SAE J3016 does not address how responsibility is to be determined by enforcement agencies, which is likely to be a challenge from a practical perspective.
- DIPL NT and the WA Transport Portfolio considered that issues relating to enforcement of relevant laws need to be resolved before vehicles with automated functions are introduced on the roads beyond on-road trials.
- The QPS noted that the NTC's approach may leave an interim period where vehicles with automated functions are present on Australian roads without guidelines relating to enforcement agency interaction. This gap may act as a disincentive to develop automated vehicle technology in Australia, and could prevent the early adoption of such technology in Australia.
- The Motorcycle Council of NSW considered there needs to be clarity about the use of vehicles operating at Level 2 automation because these vehicles are already on Australian roads.

Some stakeholders commented on the need for enforcement agencies and the NTC to work closely with vehicle manufacturers to identify technology solutions to assist enforcement agencies:

- The LIV suggested working towards possible data capture solutions and clear and objective indications of the level of automation engaged at a point of time.
- The WA Transport Portfolio similarly noted the importance of identifying methods, such as indicator lights, to alert enforcement officers of a vehicle's automated status. The WA Transport Portfolio noted this would also provide drivers with the ability to know the status of other vehicles.

QBE, ADVI and one government agency commented on the importance of collection and access to data to enable tracing of who is in control at a given point in time. The government agency noted that any vehicle with automated functions should have the software necessary to record this data. Another government agency considered the safety assurance system developed in Australia should have requirements relating to enforcement agency access to automated vehicle data (which are currently being considered by WP.29). NatRoad and Judy Oswin similarly preferred using the safety assurance system as a mechanism to manage the interaction between vehicles with automated functions and enforcement agencies.

6.4 Conclusions

The majority of feedback from stakeholders recognised it is too early to identify a process for enforcement agency interaction with automated vehicles because automated vehicle technology is not yet sufficiently developed. This is consistent with the NTC's proposed approach set out in the April 2017 discussion paper.

However, the NTC recognises concerns raised by some stakeholders about enforcement of relevant laws in the interim period. The NTC understands that vehicles operating at conditional automation may be introduced on public roads without the need for exemptions or approvals. As governments do not have a regulatory mechanism in place that requires vehicles to be identified as having a level of automation engaged or to provide relevant data, it may be difficult to enforce the road traffic laws in relation to vehicles operating at conditional automation.

In response to these concerns, the national enforcement guidelines provide practical guidance to assist officers in interacting with drivers who are operating vehicles with automated functions. This guidance notes that the onus is on human drivers to provide

evidence that a vehicle has automated functions and the level of automation engaged. There is no onus on officers to determine whether a vehicle has a level of automation engaged at a point in time, although police may seek information about this for evidence-gathering purposes.

In the short term, pending the development of the safety assurance system and new Australian Design Rules, enforcement agencies and the NTC should work closely with vehicle manufacturers to identify technology solutions to assist enforcement agencies to interact with automated vehicles.

Policy direction: The safety assurance system for automated vehicles should include safety criteria in relation to interaction with enforcement agencies.

Policy direction: Options for enforcement agency interaction with automated vehicles should be further explored as part of the NTC's project to regulate government access to data, scheduled to commence in late 2017.

Appendix A: Glossary

Term	Definition
active safety systems	Vehicle systems that sense and monitor conditions inside and outside the vehicle for the purpose of identifying perceived present and potential dangers.
automated driving system (ADS)	Hardware and software collectively capable of performing the entire dynamic driving task on a sustained basis. It is a type of driving automation system used in vehicles in conditional, high and full automation mode.
automated driving system entity	The legal entity responsible for the automated driving system. This could be the manufacturer, operator or legal owner of the vehicle, or another entity.
conditional automation	When the automated driving system drives the vehicle for sustained periods of time. The human driver does not have to monitor the driving environment or the automated driving system but must be receptive to system failures and intervene if requested and be the fall-back for the dynamic driving task.
driving automation system	Hardware or software collectively capable of performing part or all of the dynamic driving task on a sustained basis.
dynamic driving task	<p>All of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints, and including without limitation:</p> <ol style="list-style-type: none"> 1. lateral vehicle motion control via steering (operational) 2. longitudinal vehicle motion control via acceleration and deceleration (operational) 3. monitoring the driving environment via object and event detection, recognition, classification and response preparation (operational and tactical) 4. object and event response execution (operational and tactical) 5. manoeuvre planning (tactical) 6. enhancing conspicuity via lighting, signalling and gesturing, etc. (tactical).
full automation	When all aspects of the driving task and monitoring of the driving environment and the dynamic driving task are to be undertaken by the vehicle system. The vehicle can operate on all roads at all times.
high automation	When the system drives the vehicle for sustained periods of time in some situations, or all of the time in defined places, and no human driver is required to monitor the driving environment and the driving task, or to intervene, when the system is driving the vehicle.

human-machine interface	Interface between a human operator and a machine. Includes functional and ergonomic design of the interface (human factors).
object and event detection and response	The subtasks of the dynamic driving task that include monitoring the driving environment and executing an appropriate response to such objects and events.
operational design domain	The specific conditions under which a given driving automation system or feature thereof is designed to function including, but not limited to, driving modes.
partial automation	When the driving automation system may take control of steering, acceleration and braking in defined circumstances but that the human driver must continue to monitor the driving environment and the driving task, and intervene if required.
SAE	Society of Automotive Engineers
safety assurance system	An administrative process to approve automated driving systems to ensure they operate safely on public roads.
system failure	A malfunction in a driving automation system and/or other vehicle system that prevents the driving automation system from reliably sustaining dynamic driving task performance (partial or complete).

Appendix B: Submissions to the NTC discussion paper

Name of organisation	Abbreviation	Description
Australia & New Zealand Driverless Vehicle Initiative	ADVI	National peak advisory body for autonomous vehicle technology led and coordinated by the Australian Road Research Board
Australian Automobile Association	AAA	National peak body for Australia's motoring clubs
Australian Trucking Association	ATA	National peak body for the Australian trucking industry
Austroroads		The association of Australasian road transport and traffic agencies
Brady, Burns and Tranter		Mark Brady, Dr Kylie Burns and Dr Kieran Tranter (Griffith Law School)
Connors, Tim		Individual
Department of Infrastructure, Planning and Logistics (Northern Territory)	DIPL NT	Department of the government of the Northern Territory
Department of State Growth (Tasmania)		Department of the government of Tasmania
Department of Transport, Main Roads and the Public Transport Authority (WA) <i>and</i> The Insurance Commission of Western Australia	WA Transport Portfolio WA Insurance Commission	Key transport agencies of the government of Western Australia Statutory corporation of Western Australia
Department of Transport and Main Roads (Queensland)	TMR	Department of the government of Queensland
Federal Chamber of Automotive Industries	FCAI	National peak body for manufacturers and importers of light vehicles and motorcycles
GHD Advisory	GHD	Professional services company
Hayford, Owen		Individual
Insurance Australia Group	IAG	General insurance group
Judy Oswin Consulting	Judy Oswin	Individual
Law Institute of Victoria	LIV	Professional association for Victorian solicitors and lawyers
Maurice Blackburn Lawyers		Compensation and social justice law firm

Motorcycle Council of NSW		Council for New South Wales motorcycle clubs, associations and ride groups
National Roads and Motorists' Association	NRMA	Motoring club and mutual organisation
National Road Transport Association	NatRoad	Association representing road freight transport operators
Optalert		Technology developer
QBE		General insurance group
Queensland Police Service	QPS	Law enforcement agency in Queensland
Robert Bosch Australia	Bosch	A global supplier of technology and services
Royal Automobile Club of Victoria	RACV	Motoring club and mutual organisation
Santh, Poida		Individual
Telstra		Australian telecommunications and media company
Truck Industry Council	TIC	Peak body for heavy vehicle manufacturers and distributors
VicRoads		Road management agency, Victoria

The NTC also received one public anonymous submission and seven confidential submissions.