# Report outline

<table>
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<th>Clarifying control of automated vehicles</th>
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<tr>
<td>Abstract</td>
<td>This paper outlines the rationale for national enforcement guidelines to clarify how regulatory concepts of control and proper control in the Australian Road Rules should apply to automated vehicles. The paper explores options in relation to vehicles operating with partial, conditional, high or full automation.</td>
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<td>Att: Automated Vehicle Team</td>
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Executive summary

Vehicle manufacturers and technology providers are developing a wide range of automated applications that we expect to see on our roads within the next few years. These include systems that assist a vehicle to keep within a lane or to overtake safely, to systems that undertake the complete driving task within specific conditions.

Automated vehicles are expected to challenge existing concepts of a driver being in control of his or her vehicle and the enforcement of road rules and other traffic laws. From an enforcement perspective, there are four key issues:

- **Issue 1: Who is in control?** It is currently unclear who should be responsible for an automated vehicle if the driving task is undertaken by an automated driving system, but a human is the fallback and must be receptive to system errors and intervene if requested.

- **Issue 2: What will it mean to have proper control of an automated vehicle?** The road rules require a driver to have proper control of the vehicle. Police currently interpret proper control to mean that the driver is in the driver’s seat and has at least one hand on the steering wheel. This may need to be updated to recognise automated functions and different safety-related behaviours required from human drivers.

- **Issue 3: How should proper control apply to the automated driving system?** It is currently unclear whether it is appropriate or relevant to apply the proper control test to an automated driving system when the automated function is engaged.

- **Issue 4: How do enforcement agencies interact with automated vehicles?** There is no single automated vehicle or automated driving technology being developed, and it remains to be seen how enforcement agencies will interact with automated vehicles and know what level of automation is engaged at a particular time.

For these reasons, 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 automated vehicles.

Addressing these issues in a nationally consistent approach will provide enforcement agencies, industry and consumers with greater certainty about how road rules and other traffic laws apply to automated vehicles. National enforcement guidelines may also provide direction for insurers and help address issues of liability on a case-by-case basis.

Issues and options

We welcome feedback on any of the issues and options raised below, and we encourage organisations and individuals to make a submission. Preferred options have been identified for discussion purposes and are preliminary views only.

Who is in control of an automated vehicle?

<table>
<thead>
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<th>Options</th>
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<tbody>
<tr>
<td>1. That the national enforcement guidelines provide that the <strong>human driver</strong> is in control of a vehicle operating at conditional automation, even when the automated driving system is engaged in and is performing the dynamic driving task.</td>
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<tr>
<td>2. That the national enforcement guidelines provide that the <strong>automated driving system</strong> is in control of a vehicle operating at conditional automation when 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.</td>
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**Preferred option:** option 1
We are concerned that if the human driver is not considered to be in control, he or she may engage in unsafe behaviours while the automated driving system is engaged. We are also concerned that the road traffic laws are not yet in a state of readiness to accommodate automated vehicles operated by an automated driving system.

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

**Options**

1. No change to the current interpretation of proper control.

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 2 on page 34) should be introduced. The indicators of proper control should be reviewed as further reforms are made and the technology develops.

   **Preferred option:** option 2

If a human driver is not required to undertake the driving task for a sustained period of time, then the driver does not have responsibility to steer the vehicle and therefore there should not be a requirement for a human driver to have at least one hand on the steering wheel when the automated function is engaged.

We further suggest that additional examples of indicators applicable to automated vehicles should be included in the national enforcement guidelines that reflect the cognitive requirements of the human, such as readiness to intervene and alertness.

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

A key assumption in this discussion paper is that the national enforcement guidelines should:

- reflect current law
- be reviewed and updated when the automated driving system and the automated driving system entity are recognised in legislation and an agreed approach to safety assurance is implemented.

Therefore, we propose that the first iteration of the guidelines does not have regard to the application of proper control to the automated driving system but that the guidelines are updated to do so when the automated driving system and the automated driving system 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.

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

There are a range of technology solutions that could be developed by vehicle manufacturers to help enforcement agencies interact with automated vehicles and know what level of automation is engaged at a particular time.

We propose that the guidelines should not specify how enforcement officers interact with automated vehicles until the technology 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 interact with automated vehicles. Options to facilitate enforcement agency interaction with automated vehicles should also be included as a key objective in the NTC project to regulate government access to data (2017–18).
What national guidelines could look like

Adopting the preliminary approach proposed by the NTC, the national enforcement guidelines would include the following elements:

<table>
<thead>
<tr>
<th>Level of driving automation</th>
<th>Who is in control</th>
<th>Examples of indicators of proper control</th>
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<tbody>
<tr>
<td></td>
<td>At least one hand on the steering wheel</td>
<td>Seated in driver’s seat</td>
</tr>
<tr>
<td>Driver assistance (Level 1)</td>
<td>Human driver</td>
<td>Yes</td>
</tr>
<tr>
<td>Partial (Level 2)</td>
<td>Human driver</td>
<td>Yes</td>
</tr>
<tr>
<td>Conditional (Level 3)</td>
<td>Human driver</td>
<td>No</td>
</tr>
<tr>
<td>High (Level 4)</td>
<td>Automated driving system</td>
<td>No</td>
</tr>
<tr>
<td>Full (Level 5)</td>
<td>Automated driving system</td>
<td>N/A</td>
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Consultation questions

1. Do you agree with the assumptions and objectives underpinning the NTC’s work to develop national enforcement guidelines? If not, what other assumptions or objectives should be considered?

2. Do you agree that national enforcement guidelines should clarify issues of control and proper control based on SAE International Standard J3016 Levels of Driving Automation? If not, what other approach should be considered?

3. For the purposes of enforcing proper control, is there value in grouping levels of driving automation according to whether vehicles are capable of automated operation?

4. Do you agree that the human driver should remain in control of a vehicle with partial or conditional automation, and that the automated driving system should be in control of a vehicle operating at high or full automation? If not, why?

5. In the event that the automated driving system is determined to be in control of a vehicle operating with conditional automation, should road traffic laws introduce obligations on the human driver as supervisor of the automated driving system?

6. Do you agree with the suggested indicators of proper control for each level of driving automation (outlined in Table 2 on page 34 of this paper)? Are there any other indicators that should be included in the guidelines?
7. Should special consideration be given to automated parking functions that are partially automated and can only operate without the driver holding the steering wheel?

8. Should the national enforcement guidelines also clarify the application of due care and attention offences to automated vehicles? If so, what behaviours usually penalised under these offences require clarification when applied to automated vehicles?

9. Do you agree that the guidelines should not apply the proper control test to the automated driving system until the automated driving system and automated driving system entity are recognised in legislation? If not, what alternative approach should be considered?

10. Do you agree that the guidelines should only specify enforcement agency interaction with automated vehicles once the technology capability of automated vehicles is more developed and enforcement practices implemented in overseas jurisdictions? If not, what alternative approach should be considered?

**Who we are**

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.

**Next steps**

Submissions to this discussion paper close on **Friday, 2 June 2017**.

Based on feedback to this paper, we will report back to the Transport and Infrastructure Council in November 2017 with proposed national enforcement guidelines that will adopt a preferred option on each of the key issues.

Subject to feedback from the Transport and Infrastructure Council, we plan to finalise national enforcement guidelines in late 2017.
1. Context

Key points
- The NTC proposes that:
  - national enforcement guidelines provide that the human driver is in control of a vehicle with conditional automation, even when the automated driving system is engaged in the dynamic driving task
  - interpretation of proper control is amended to allow the human driver to not have a hand on the steering wheel when a vehicle is operating at conditional or high automation, but introducing new indicators of proper control related to alertness and readiness to intervene
  - guidelines do not have regard to the application of proper control to the automated driving system for high levels of automation, but that the guidelines are updated to do so when the automated driving system entity is recognised in the road rules
  - technology solutions to assist enforcement agencies to interact with automated vehicles and to access relevant information should be included as part of the NTC’s future project to regulate government access to automated vehicle data (scheduled to commence in FY 2017–18).

1.1 Objectives

Many of our transport laws, including the Australian Road Rules and obligations in the Heavy Vehicle National Law, are based on the principle that the driver is in control of the vehicle. This approach is underpinned by international convention and common law. The introduction of automated driving systems, which can take over some or all of the driving task depending on a vehicle’s level of automation, challenges regulatory concepts of control and proper control.

Transport ministers in Australia have agreed that the NTC should develop national enforcement guidelines that address four questions:

1. Who is in control, and therefore legally responsible, of an automated vehicle – the human driver or the entity responsible for the automated driving system?

2. How should the proper control test apply to the human driver in vehicles at different levels of automation?

3. How should the proper control test apply to the automated driving system when it is engaged?

4. How will enforcement officers interact with automated vehicles and know what level of automation is engaged at a particular time?

We have developed this discussion paper to assist readers to understand these issues and to help reach an agreed position that can be adopted in national enforcement guidelines.

This paper:
- explains why the NTC is doing this work and defines the scope of the project
- explains the impact of recent changes to SAE International Standard J3016 Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles
- discusses who could be in control of the vehicle at each level of driving automation
- discusses what could constitute proper control for each level of automation.
Appendix A contains a glossary of technical terms used throughout this paper.

1.2 Background

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*.

**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 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.

This discussion paper is the first step in completing recommendation 3 and the development of national enforcement guidelines. Based on your feedback to this paper, we will submit draft national enforcement guidelines to the Transport and Infrastructure Council in November 2017.

Recommendation 4 provides 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 is intended to provide immediate clarity to manufacturers, drivers and enforcement agencies on the issues of control and legal responsibility for partially and conditionally automated vehicles.

1.3 What are the problems being addressed?

Unless control and responsibility for an automated vehicle 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. Or there is a risk that the technologies are introduced but enforcement agencies interpret control differently across jurisdictions and there is legal and consumer uncertainty about who is in control and what constitutes legal behaviour of a human driver in different vehicles.

For example, if an automated vehicle were to breach a road traffic law, there is a risk that in one state the enforcement agency would hold the automated driving system 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 an automated vehicle could be fined for not having a hand on the steering wheel in one state but not in another.

The legal ambiguity relates to vehicles capable of conditional automation where the human driver is not performing any of the driving task of steering, acceleration and braking, or monitoring the driving environment for defined activities, but is the fallback if something goes wrong, and must be receptive to system failures and be ready to resume driving. This complexity is illustrated in Figure 1.

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The issue of control relates to both light and heavy vehicles. For passenger transport services and heavy vehicles, clarification of who is in control will be important not only for compliance with road rules and other traffic laws but will be essential in determining specific offences where a driver may be infringed or prosecuted in addition to the vehicle operator or other parties in the supply chain.

**Figure 1**: Where issues of control remain to be clarified

It should be noted, however, that, as of April 2017, the NTC is not aware of any vehicle manufacturers or technology providers developing or commercialising vehicles with conditional automation. Because of the potential safety risks of requiring a human driver to intervene and be the fallback, some manufacturers have told us that they are aiming to progress from vehicles with partial automation to vehicles with high automation.

### 1.4 Why ministers agreed to adopt enforcement guidelines

The Australian Road Rules have a performance-based requirement that a driver exercises *proper control* of the vehicle:

A driver must not drive a vehicle unless the driver has proper control (Rule 297(1)).

Western Australia is the only jurisdiction that has legislated a requirement to sit behind the steering wheel. In all other Australian states and territories, Road Rule 297 does not specify what *proper control* means, and no road rule in any jurisdiction explicitly addresses automated vehicles. However, Road Rule 297 has been consistently interpreted by enforcement agencies in Australia as meaning that:

1. Only a human driver can be in control of a vehicle.

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3 Section 263 of the *Road Traffic Code 2000* (WA).
2. The human driver does not have *proper control* unless he or she is sitting in the driver’s seat with at least one hand on the steering wheel.

The intent of Road Rule 297 – that the vehicle is properly controlled – may remain relevant to automated vehicles. The key issue is that the current interpretation of Road Rule 297 does not contemplate automated vehicles that could feasibly operate safely without a human driver keeping at least one hand on the steering wheel, or potentially even sitting in a driver’s seat.

In feedback to the NTC discussion paper *Regulatory options for automated vehicles*, stakeholders largely agreed that at this early stage in the development of automated vehicle technology it is appropriate that regulatory concepts of *control* and *proper control* are addressed in national enforcement guidelines rather than in amendments to the road rules.\(^4\)

With increasingly automated vehicles due on the Australian market within the next few years, existing enforcement guidance needs to be updated to address automated vehicles and the application of Road Rule 297. Given the range of automated applications and the levels of automation that are possible, a national approach will give the consistency that will provide the greatest benefits to manufacturers, drivers, owners and operators. National guidelines will assist police agencies by reducing the costs of developing and updating their own guidance material.

However, in the longer term it may be beneficial to amend the road rules to clarify issues of control once the technology has become more settled and the safety of automated vehicles better measured and understood.

The regulatory challenge is to ensure that requirements for a driver to have *proper control* continue to be as performance-based as possible. We need to continue to ensure that we do not build-in prescriptive requirements that diminish the law’s capacity to target unsafe behaviours, or which will become quickly outdated as the technology develops.

### 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 with conditional, high and full automation mode.

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

- **Conditional automation** means that the 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 any system failures and intervene if requested and be the fallback for the dynamic driving task.

- **Full automation** means that 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.

- **High automation** means that 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.

- **Partial automation** means that the automated driving 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.

- **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. It could operate through the introduction of automated vehicle registration or the accreditation or licensing of the automated driving system entity.

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The levels of driving automation defined above are based on SAE International Standard J3016, *Levels of Driving Automation*.

### 1.6 Assumptions adopted in this paper

This discussion paper is underpinned by the following assumptions:

- The national enforcement guidelines will reflect current law.
- The national enforcement guidelines will be reviewed and updated when the automated driving system and the automated driving system entity are recognised in legislation and 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 are based on previous submissions to the NTC discussion paper and international convention. We welcome feedback on whether any of these assumptions require further clarification or refinement.

### 1.7 Objectives of the national enforcement guidelines

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

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.

Subject to ministerial approval in November 2017, the national enforcement guidelines should be embedded in enforcement procedures from early 2018. This will be before the finalisation of driver reforms and the implementation of a safety assurance system for automated vehicles. While the guidelines should be operable and relevant independently of these reforms, they should be updated when these reforms are delivered.

We welcome feedback on whether any of these objectives require further clarification or refinement.

**Consultation question**

**Question 1:** Do you agree with the assumptions and objectives underpinning the NTC’s work to develop national enforcement guidelines? If not, what other assumptions or objectives should be considered?

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1.8 Scope of the national enforcement guidelines

The scope of this project is to clarify the application of regulatory concepts in Road Rule 297 of control and proper control in relation to automated vehicles. The primary audience for the guidelines is enforcement agencies; however, the guidelines may provide additional certainty for vehicle manufacturers, insurers and consumers.

The national enforcement guidelines are intended to work within current legislation. This means that any legislative amendments are out of scope, 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.

Interaction with development of a safety assurance system

As part of the council’s roadmap for reform to prepare for automated vehicles, from 2017 the NTC will develop a national performance-based assurance regime designed to ensure the safe operation of automated vehicles (recommendation 5 in the NTC policy paper, see Appendix B).

One suggested approach draws on aviation, rail and systems engineering best practice and would allow applicants to submit an automated vehicle for assessment against safety, security and data performance criteria. Our aim is to ensure the safety assurance system is sufficiently technology-neutral to allow the deployment of safe technologies unheard of today, and that it is capable of ensuring the continuing technical integrity of the automated driving system.

Transport ministers have asked us to consider the application of a safety assurance system to vehicles with conditional automation, as well vehicles that can operate in high or full automation. Should the safety assurance system include vehicles with conditional automation, then governments would have an additional regulatory mechanism to ensure they are operating safely. If not, the interpretation of Road Rule 297 to vehicles with conditional automation will be critical as it could be one of the few safeguards to ensure such vehicles are operated safely.

The safety assurance system could provide a mechanism for ensuring that enforcement officers have accurate real-time information about a vehicle’s automated functionality and whether the automated driving system is engaged at a given time. The safety assurance system could also provide enforcement agencies with a mechanism for ensuring that a specific technology or application can operate safely without the driver having at least one hand on the steering wheel.

It is important that the national enforcement guidelines and the safety assurance system are consistent. The guidelines should be reviewed and updated when the safety assurance system is implemented.

Interaction with driver reforms

In addition to developing a safety assurance system, the NTC has recently commenced a two-year project to develop reforms to establish legal obligations for automated driving system entities (recommendation 6 in the NTC policy paper, see Appendix B).

The driver reform project could result in amendments to the definition of driver in the road rules, to the effect that the definition is expanded to include the automated driving system entity. One option canvassed in our 2016 discussion paper was that relevant laws would be amended to the effect that:

1. ‘Driver’ means a human driver or, if an automated driving system is engaged, the automated driving system, and the automated driving system entity responsible for the actions of the automated driving system.

2. ‘Automated driving system entity’ means the entity that is responsible for the automated functions of the vehicle and approved by the relevant authority to operate the automated driving system.
Under such an approach, the driver reforms would clarify that the legal responsibilities for an automated vehicle can be transferred to an automated driving system entity.

As we discuss in section 3, control is intrinsically linked to driver in Road Rule 297⁶ – and the driver is clearly assumed to be a human in the road rules and traffic laws (because the driver must have a line of sight, a lap, a hand and so forth). Therefore it is arguable that it would not be possible to interpret a non-human as having control of a vehicle, at any level of automated driving, unless or until the definition of driver is expanded to include the automated driving system. The national enforcement guidelines provide an opportunity to confirm this position, as well as reviewing the meaning of proper control.

In this regard, the driver reforms and the national enforcement guidelines are complementary. The driver reforms will clarify that an automated driving system entity can be legally responsible for an automated vehicle when the automated driving system is engaged – the national enforcement guidelines will clarify a current position on who is in control (particularly for vehicles with conditional automation) and update the indicators of proper control.

It is important that the national enforcement guidelines and the driver reforms are consistent. The guidelines should be reviewed and updated when road rules and other relevant laws recognise that an automated driving system may be a legal driver.

⁶ See also Road Rule 348: a driver doing or not doing something is a reference to the driver causing the driver’s vehicle to do or not to do the thing. This directly connects the vehicle’s movements to the actions of the human driver.
# 2 Consultation

## Key points
- Any individual or organisation can make a submission to the NTC.
- We are seeking submissions on this discussion paper by **Friday, 2 June 2017**.

We encourage you to make a submission. Your views on control of automated vehicles and the application of the *proper control* rule to automated vehicles will be essential in the development of policy findings and recommendations for the Transport and Infrastructure Council in November 2017.

## 2.1 Consultation questions

1. Do you agree with the assumptions and objectives underpinning the NTC’s work to develop national enforcement guidelines? If not, what other assumptions or objectives should be considered?

2. Do you agree that national enforcement guidelines should clarify issues of *control* and *proper control* based on SAE International Standard J3016 *Levels of Driving Automation*? If not, what other approach should be considered?

3. For the purposes of enforcing *proper control*, is there value in grouping levels of driving automation according to whether vehicles are capable of automated operation?

4. Do you agree that the human driver should remain in control of a vehicle with partial or conditional automation, and that the automated driving system should be in control of a vehicle operating at high or full automation? If not, why?

5. In the event that the automated driving system is determined to be in control of a vehicle operating with conditional automation, should road traffic laws introduce obligations on the human driver as supervisor of the automated driving system?

6. Do you agree with the suggested indicators of *proper control* for each level of driving automation (outlined in Table 2 on page 34 of this paper)? Are there any other indicators that should be included in the guidelines?

7. Should special consideration be given to automated parking functions that are partially automated and can only operate without the driver holding the steering wheel?

8. Should the national enforcement guidelines also clarify the application of due care and attention offences to automated vehicles? If so, what behaviours usually penalised under these offences require clarification when applied to automated vehicles?

9. Do you agree that the guidelines should not apply the *proper control* test to the automated driving system until the automated driving system and automated driving system entity are recognised in legislation? If not, what alternative approach should be considered?

10. Do you agree that the guidelines should only specify enforcement agency interaction with automated vehicles once the technology capability of automated vehicles is more developed and enforcement practices implemented in overseas jurisdictions? If not, what alternative approach should be considered?
Consultation questions are provided as a guide only. You do not have to answer every question and you are welcome to provide us with feedback on any aspect of this discussion paper.

You may wish to consider:

- Is the definition of the problem accurate?
- What are likely to be the costs and operational impacts of the potential solutions for businesses and other organisations?
- What are likely to be the costs and operational impacts of the potential solutions for the broader community?

### 2.2 When to submit

We are seeking submissions on this discussion paper by **Friday, 2 June 2017**.

### 2.3 How to submit

Any individual or organisation can make a submission to the NTC.

To make an online submission, please visit www.ntc.gov.au and select ‘Submissions’ from the top navigation menu. Or post your comments to:

Att: Automated Vehicle Team  
National Transport Commission  
Level 15/628 Bourke Street  
Melbourne VIC 3000  
Australia

Where possible, you should provide evidence, such as data and documents, to support your views.

Unless you clearly ask us not to, we will publish all submissions online. However, we will not publish submissions that contain defamatory or offensive content.

The *Freedom of Information Act 1982* (Cwlth) applies to the NTC.
3  SAE levels of driving automation

Key points

- SAE International Standard J3016 is used to describe and understand the different levels of driving automation.
- Recent changes to SAE International Standard J3016 provide that in a vehicle operating at conditional automation, the human driver is not required to monitor the automated driving system but must be receptive to system failures and must be the fallback if required. This potentially weakens the argument that the human driver of a vehicle with conditional automation is in control of the vehicle.

3.1  Driving automation is based on the role of the human driver

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*, when it is relevant to classify an automated vehicle based on the level of driving automation. It was further agreed that the standard should not be replicated in legislation and the prioritisation of the SAE International Standard J3016 should be reviewed if other international standards are adopted.\(^7\)

The SAE International Standard has six levels of driving automation from no automation (level 0) to full automation (level 5). Figure 2 reproduces the SAE International Standard, which is based on distinguishing whether the human driver undertakes some or all of the dynamic driving task (levels 0–2) or the automated driving system undertakes the entire dynamic driving task (levels 3–5).

Based on SAE International Standard J3016, the ‘dynamic driving task’ includes the operational (steering, braking, accelerating, monitoring the vehicle and roadway) and tactical aspects of the driving task (such as responding to events and determining when to change lanes, turn or use signals) but not the strategic aspect of the driving task (such as determining destinations and waypoints).

SAE International Standard J3016 states that these levels are descriptive rather than normative and technical rather than legal. They imply no particular order of market introduction. The definitions indicate minimum rather than maximum system capabilities for each level. A particular vehicle may have multiple driving automation features, such that it could operate at different levels depending upon the features that are engaged.

Importantly, the SAE International Standard 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).

Parking technologies provide an example of how challenging it would be to resolve issues of control taking an application- or technology-specific approach. First, the terminology for different applications are not standardised. What one manufacturer refers to as ‘remote parking pilot’ another manufacturer calls ‘summon’. Second, parking technologies have widely different requirements placed on the human driver – some applications require the driver to be in the driver’s seat and to supervise the automated parking operation, other applications allow the driver to be standing outside (but in close proximity) to the vehicle and to supervise the automated parking operation holding a remote ‘over-ride’ device, while the most advanced applications will not require any human supervision and the vehicle is effectively ‘self-driving’ during the automated parking operation.

For these reasons, the national enforcement guidelines could clarify issues of control based on the SAE levels – not specific automated vehicle applications or technologies.

This approach will possibly generate roadside enforcement challenges that are discussed in section 4.

**Figure 2:** Levels of driver automation defined in SAE International Standard J3016 2016-09

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Narrative definition</th>
<th>DDT</th>
<th>ODD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Driving Automation</td>
<td>The performance by the driver of the entire DDT, even when enhanced by active safety systems.</td>
<td>Driver</td>
<td>Driver</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>The sustained and ODD-specific execution by a driving automation system of either the lateral or the longitudinal vehicle motion control subtask of the DDT that the driver performs the remainder of the DDT.</td>
<td>Driver and System</td>
<td>Driver</td>
</tr>
<tr>
<td>2</td>
<td>Partial Driving Automation</td>
<td>The sustained and ODD-specific execution by a driving automation system of both the lateral and longitudinal vehicle motion control subtasks of the DDT with the expectation that the driver completes the OEDR subtask and supervises the driving automation system.</td>
<td>System</td>
<td>Driver</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Driving Automation</td>
<td>The sustained and ODD-specific performance by an ADS of the entire DDT with the expectation that the DDT fallback-ready user is receptive to ADS-issued requests to intervene, as well as to DDT performance-relevant system failures in other vehicle systems, and will respond appropriately.</td>
<td>System</td>
<td>Fallback-ready user (becomes the driver during fallback)</td>
</tr>
<tr>
<td>4</td>
<td>High Driving Automation</td>
<td>The sustained and ODD-specific performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will respond to a request to intervene. In this level, the human driver (if any) has no role while the automated driving system is engaged.</td>
<td>System</td>
<td>System</td>
</tr>
<tr>
<td>5</td>
<td>Full Driving Automation</td>
<td>The sustained and unconditional (i.e., not ODD-specific) performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will respond to a request to intervene. In this level, the human driver (if any) has no role while the automated driving system is engaged.</td>
<td>System</td>
<td>System</td>
</tr>
</tbody>
</table>

### 3.2 Recent revisions to SAE International Standard J3016

In September 2016 the SAE Technical Standards Board published a revision of SAE International Standard J3016. These revisions, while substantial, preserve the original SAE J3016 level names, numbers and functional distinctions, as well as the supporting terms.

The initial version of the standard (J3016 2013-01) described the levels of automation in relation to whether the human driver or the automated driving system monitors the driving environment. Now the levels are described in terms of who or what performs part or all of the dynamic driving task:

- In a vehicle operating at partial automation (level 2), the role of the human is to perform non-automated driving tasks and supervise the automated function.
- In a conditionally automated vehicle (level 3), the role of the human is to be receptive to requests to intervene issued by the automated driving system, or to performance-relevant system failures in the vehicle, and to respond appropriately.
- In a vehicle operating at high or full automation (levels 4 and 5), the human driver (if any) has no role while the automated driving system is engaged.

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Therefore, in the event that a vehicle is operating at high or full automation, and can no longer operate in automated mode safely, the automated driving system (not the human driver) will bring the vehicle to a minimal risk condition to avoid a crash. This **non-intervention by a human driver is the key difference between a vehicle operating at conditional, high or full automation** and means that in a vehicle operating at high or full automation there is no safety requirement for the human driver to be receptive to system failures.

Table 1 illustrates the key differences between the different levels of driving automation. Emboldened terms are explained in the glossary at Appendix A.

<table>
<thead>
<tr>
<th>SAE level</th>
<th>Name</th>
<th>Revised SAE descriptions</th>
<th>Driver or user’s role</th>
</tr>
</thead>
</table>
| Level 2  | Partial automation | The sustained and **operational design domain**-specific execution by a driving automation system of both the lateral and longitudinal vehicle motion control of the **dynamic driving task** subtasks, with the expectation that the driver completes the **object and event detection and response** subtask and supervises the driving automation system | • Completes driving task  
• Supervises automated system                                                                                                                                                                                                                                                                                                                                                      |
| Level 3  | Conditional automation | The sustained and **operational design domain**-specific performance by an automated driving system of the entire **dynamic driving task** – with the expectation that the fallback-ready user is receptive to system-issued requests to intervene, as well as to **dynamic driving task** performance-relevant **system failures** in other vehicle systems, and will respond appropriately | • Receptive to system failures  
• Receptive to requests to intervene  
• Fallback                                                                                                                                                                                                                                                                                                                                                                         |
| Level 4  | High automation   | The sustained and **operational design domain**-specific performance by an automated driving system of the entire **dynamic driving task** – and fallback without any expectation that a user will respond to a request to intervene                                                                 | • No tasks or role while the automated driving system is engaged                                                                                                                                                                                                                                                                                                                      |
| Level 5  | Full automation   | The sustained and unconditional (not **operational design domain**-specific) performance by an automated driving system of the entire **dynamic driving task** – and fallback without any expectation that a user will respond to a request to intervene                                                                                                                               | • No tasks or role                                                                                                                                                                                                                                                                                                                                                                       |

**Readiness to drive**

In addition to the issues related to control, it is noted that there are likely to be additional complexities related to the regulation of ‘soon-to-be’ drivers in vehicles with conditional automation. That is, 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 automated driving system 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 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.

Vehicles operating at high automation are illustrative of this additional complexity. There are effectively two types of vehicles operating at high automation:

- a vehicle that is fully automated but is limited in where it can operate (such as the Navya or EasyMile low-speed passenger shuttle)
- a vehicle that is fully automated on some roads or some types of driving but can drive everywhere at a lower level of automation (such as the Volvo ‘Drive Me’ prototype being trialled in Gothenburg this year).²

In the first example there are not likely to be any legal requirements for a human occupant. Except for trialling operations, there is an expectation that humans (if any) would only be passengers in these vehicles.

In the second example of a vehicle operating at high automation, it is likely that the human driver would continue to have to meet current safety laws relating to drink- and drug-driving because the human driver may drive the vehicle at some point in the journey, such as when the vehicle leaves the motorway and moves into local traffic. It remains to be seen what alertness and ‘readiness to drive’ we would expect from these humans if:

- they are not driving the vehicle and therefore current driving laws may not apply
- a failure to not take back control of a vehicle operating at high automation in a safe and timely manner should result in a safe stop manoeuvred by the automated driving system and therefore may constitute a low safety risk.

In the event that the automated driving system is found to be in control of a vehicle operating at conditional automation, regulating humans to ensure readiness to drive will also be a challenge for these vehicles.

Applying SAE levels to enforcement of proper control and readiness to drive

Not every automated vehicle will need a human driver at some point in the journey. Furthermore, section 5 discusses how Road Rule 297 and the requirement for a driver to have proper control of his or her vehicle is expected to be challenged by automated vehicles. The indicators of what constitutes proper control may be updated. If so, it may be useful to think about the SAE levels of driving automation in a different way, grouped according to whether a human is expected to undertake the driving task during a journey.

For discussion purposes, we could regroup SAE levels of driving automation 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 vehicle with full automation that do not have controls for human driving.

Thought of in this way, the SAE levels of driving automation are grouped according to the human interaction expected of the driver, which could determine the enforcement response to behaviours that could be safe in some automated vehicles but not in others.

We are seeking feedback on the issues raised in this section and the following questions:

Consultation questions

**Question 2:** Do you agree that national enforcement guidelines should clarify issues of control and proper control based on SAE International Standard J3016 Levels of Driving Automation? If not, what other approach should be considered?

**Question 3:** For the purposes of enforcing proper control, is there value in grouping levels of driving automation according to whether vehicles are capable of automated operation?
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.

- The automated driving system entity is likely to be in control of vehicles operating at high or full automation because the automated driving system performs the entire driving task and there is no human fallback.

- The legal concept of control will be challenged by vehicles operating at conditional automation that do not require the human to drive or supervise the environment at all times, but to be the fallback if anything goes wrong and to be receptive to system failures.

- Until the safety performance of vehicles with conditional automation is better understood, the NTC suggests that the national enforcement guidelines should reaffirm that the human driver remains in control of a vehicle operating at conditional automation.

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

In this section we:

- summarise the treatment of control in international conventions, Australian legislation and common law
- consider how the regulatory concept of control is challenged by automated vehicles.

Control in current laws

Many elements of road transport regulation are based on the principle that the driver is in control of the vehicle. This principle is derived from article 8.5 of the 1949 Geneva Convention on Road Traffic, which states that:

Drivers shall at all times be able to control their vehicles or guide their animals.

The meaning of driver in article 4 of the Geneva Convention is also defined in relation to the person who has control of the vehicle:

‘Driver’ means any person who drives a vehicle, including cycles, or guides draught, pack or saddle animals or herds or flocks on a road, or who is in actual physical control of the same…

The same principle is incorporated into the 1968 Vienna Convention on Road Traffic, but Australia is not a signatory to the Vienna Convention.
The principle that the driver is in control of the vehicle is reflected in the Australian Road Rules and state and territory traffic laws. The road rules also define the term drive to include be in control of the vehicle.

Road Rule 297 provides the following three offence provisions:

1. A driver must not drive a vehicle unless the driver has proper control of the vehicle.
2. A driver must not drive a vehicle if a person or an animal is in the driver’s lap.
3. A driver must not drive a motor vehicle unless the driver has a clear view of the road, and traffic, ahead, behind and to each side of the driver.

State and territory laws have not defined control or placed parameters around the concept of control that could constitute a barrier to automated vehicle applications. The exception is Western Australian law, 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.

Because control is not defined, the dictionary meaning will apply. 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 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 should include the notion involving some control of the propulsive force which will cause the vehicle to move. The concept of driving was also summarised in 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 implicit in the road rules and case law that only one entity can be in control of a vehicle at any one time.

**Applying the regulatory concept of control to automated vehicles**

State and territory traffic laws generally define the driver in relation to control of the steering, movement or propulsion of the vehicle. Further, Road Rule 348 clarifies that a driver doing or not doing something is a reference to the driver causing the 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, and 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 automated vehicles in mind, but we must apply the regulatory concept of control to emerging technologies. This means considering whether the interpretation of control could be restricted to mean the physical management of the vehicle’s steering, propulsion and braking, or broad enough to include the latent ability to do so.

In other words, can a human still be in control if the vehicle is being operated through an agent (the automated driving system) and where the human must be receptive to system failures and be the fallback if something goes wrong?

To date the judicial interpretation has considered circumstances in which a human’s direct actions, sometimes assisted by other people (for example, pushing the vehicle), may or may not be considered to be controlling a vehicle. Even though we have had electronic systems assisting human driving for some years, the NTC is not aware of cases that have addressed the issue of

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11 Subsection 263(1) of the Road Traffic Code 2000 (WA).
12 Examples include the definition of ‘drive’ in section 4 of the Road Transport Act 2013 (NSW) and section 5 of the Road Traffic Act 1961 (SA).
whether a driver is in control by virtue of causing the vehicle to do or not to do something through a non-human agency.

A court may find that a driver with a vehicle operating at partial automation who is supervising the vehicle system that is operating the steering, acceleration and deceleration while undertaking the remainder of the dynamic driving task him or herself is in control of the vehicle. It is unclear whether a court would make a similar finding in the case of a vehicle with conditional automation that undertakes all the dynamic driving task and only requires the human driver to be receptive to system failures and to intervene if requested.

On the one hand, to be receptive to system failures and to intervene if requested may not be equal to the dictionary meaning of ruling something or exercising direction over it. On the other hand, to control a thing could also mean the ability to command or to manage that thing. Could the latent ability to manage the vehicle constitute control of it? Alternatively, perhaps in a vehicle with conditional automation, the human driver does not have active control of the vehicle, but because the human driver has obligations to be receptive to system failures and is the fallback, is it appropriate that the human driver is legally responsible for the actions of the vehicle?

Furthermore, there is a small but potentially important difference between the Geneva Convention and the Australian Road Rules. The Convention states that the driver must be able to control the vehicle. This lends itself well to the concept of latent control. Compare this with Road Rule 297, which states that a driver must have control of the vehicle.

In summary, control is not defined or prescribed in the road rules. Analysis of common law and dictionary definitions suggests that control could be interpreted as something that is exercised in the present time, or something that is capable of being exercised through an agent or happening at a future time. It is this ambiguity in relation to control that could have a significant impact on enforcement and driver liability. This is discussed in section 4.2.

### 4.2 Who is in control of an automated vehicle?

The levels of driving automation clearly demarcate control of vehicles operating at partial, high or full automation. Who is in control of a vehicle with conditional automation requires further discussion and agreement.

#### Levels of driving automation where control is clear

The human driver remains in control of a vehicle that is partially automated 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).

This approach is consistent with international aviation practice regarding autopilot. In aviation, an autopilot is a system used to control the trajectory of an aircraft without constant ‘hands-on’ control by a human operator being required. Autopilots do not replace a human operator but assist them in controlling the aircraft, allowing them to focus on broader aspects of operation such as monitoring the trajectory, weather and systems.¹³

The human pilot therefore has two distinct roles: pilot flying and – when autopilot is engaged – pilot monitoring. Guidance issued by the US Federal Aviation Authority is clear that the human pilot has overarching responsibility for flying the aircraft ‘even when the aircraft is under autopilot control’.¹⁴

A different situation applies to vehicles operating at high or full automation. When the automated driving system is engaged, it performs the entire dynamic driving task as well as the fallback function. A human driver is not required for a defined period and therefore the automated driving system entity would be in control of the vehicle.

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¹³ US Federal Aviation Administration, *Automated Flight Controls*.

¹⁴ See the US Federal Aviation Administration website: [https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/media/2015/SAFO15011.pdf](https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/media/2015/SAFO15011.pdf)
Vehicles with conditional automation

An issue for further discussion and agreement is whether the human driver or automated driving system of a vehicle with conditional automation should be considered to be in control while the vehicle is operating at a conditional level of automation. As discussed in section 3, when a vehicle is engaged with conditional automation the automated driving system performs all of the driving task and the human driver is not required to monitor the external environment or the operation of the automated driving system. However, the driver must be receptive to requests to intervene and to be receptive to any evident vehicle system failures related to the dynamic driving task, and to respond appropriately.

The box below is adapted from our 2016 Regulatory options for automated vehicles: discussion paper, taking account of the recent revisions to SAE International Standard J3016. It illustrates the complexity of determining control in a vehicle that is conditionally automated.

Who controls the vehicle?

Ken drives a vehicle that has a conditionally automated function. When the vehicle is on automated mode Ken is not undertaking the driving task and his responsibilities are clearly outlined in the driver’s manual:

… the driver must be receptive to requests by the vehicle system to intervene, as well as to any driving failures of the vehicle, and respond appropriately.

Ken has instigated the automated mode and the vehicle is operating in the traffic. Because he is only required to intervene if requested or if something goes wrong, Ken is not looking out the windscreen and watching what is happening on the road.

The vehicle is experiencing technical difficulties, and a message is generated on the dashboard stating that the sensors are not fully functioning. Ken doesn’t notice the message.

The vehicle fails to stop at a traffic light.

Who was in control of the vehicle at the time of the offence?

- Ken might argue that he wasn’t in control of the vehicle because he wasn’t even required to observe that there was a traffic light. He is not driving the vehicle.

- The manufacturer might argue that Ken has responsibility for the vehicle because the failure to stop was caused by a system failure that was reported on the dashboard and which he didn’t respond to.

The proposed approach in the United States

To assist with the discussion, in this section we canvass the proposed approach to vehicles with conditional automation being considered in the United States. 15


The policy states:

There is a clear technical distinction between HAV systems (those classified as SAE Level 3, Level 4, and Level 5) and lower levels of automation (SAE Levels 2 and below) based on whether the automated system relies on the human driver when engaged and operating. (p. 32)

It also explains that in level 3–5 automated vehicles there is no human driver at all or the human

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15 Other jurisdictions, including the European Union, do not have a settled position on issues of control. The SAE International Standard J3016 does not address the legal consequences of its taxonomy, stating that issues of control are to be determined in each jurisdiction.
driver can give control to the HAV system and is not expected to perform any driving-related tasks for a defined period of time (p. 12).

The NHTSA provides the following guidance to the states regarding their responsibilities for regulating drivers and aspects of vehicle operations and law enforcement in its suggested framework for model state laws:

For purposes of State traffic laws that apply to drivers of vehicles (e.g., speed limits, traffic signs), States may wish to deem an HAV system that conducts the driving task and monitors the driving environment (generally SAE Levels 3-5) to be the “driver” of the vehicle. For vehicles and circumstances in which a human is primarily responsible for monitoring the driving environment (generally SAE Levels 1-2), NHTSA recommends the States consider the human to be the driver for purposes of traffic laws and enforcement. (p. 39)

By determining control based on whether the human or the automated driving system is undertaking the driving task and monitoring the driving environment, the NHTSA’s proposed approach is that the automated driving system is in control of a vehicle with conditional automation. The proposal also recognises that legislative amendments would be required to give effect to this approach.

Options

We are seeking feedback on how national enforcement guidelines should treat vehicles with conditional automation. Two options are detailed below:

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

We also welcome feedback on alternative options or an approach that incorporates elements of the options discussed here.

Option 1: The human driver is in control

Adopting this option, the human driver is in control of a vehicle operating at conditional automation. This approach is a continuation of the interim policy position approved by the Transport and Infrastructure Council.

The rationale for this option is underpinned by three factors:

1. The human driver must still be receptive to system failures and is the fallback if something goes wrong

The distinguishing element of a vehicle with conditional automation, compared with a vehicle operating at high or full automation, is that a human driver is required to perform a fallback function. The human must be seated in the driver’s seat and be sufficiently alert and skilled to take over control if requested by the automated driving system, or if there is an evident vehicle system failure that affects driving performance.

It could be argued that the requirement on the human to be ready to respond appropriately – and the inability of the automated driving system to come to a safe stop – justifies holding the human responsible for the overall safe operation of a vehicle with conditional automation, even though he or she is not engaged in the dynamic driving task.
2. It is an additional safety measure

Vehicles with conditional automation are a significant step forward in terms of technology and innovation – the automated driving system performs the entire driving task (including object detection and avoidance, steering, propulsion and braking) within a defined operational design domain. We don’t yet know that these systems are safe or how much they will need to rely on alert drivers to take back the driving task. The safest approach could therefore be to maintain the driver’s responsibility for the vehicle as a safety net in the event of a system failure.

In addition, if the human driver is not considered to be in control of a vehicle with conditional automation, it may send a signal to consumers that activities that diminish their capacity to reengage the driving task are safe when the automated driving system is engaged.

3. There are no laws in place to regulate readiness to drive

As discussed in section 3, there are currently no specific mechanisms to regulate humans to ensure readiness to drive in situations when they are in the vehicle and not yet driving but must be sufficiently alert to system failures or to take back the driving task.

The benefits of the human driver being in control include that:

- It provides certainty to authorised officers, manufacturers, technology developers and consumers about the human driver’s legal obligations and responsibilities when driving (or soon to be driving) in a vehicle with conditional automation.
- It continues the current interpretation of the law and the ministerially-approved interim policy position.
- It ensures there is a clearly identified legal entity responsible for the vehicle at all times.
- It is a cautious response to the introduction of new technologies that will perform the entire driving task for sustained periods and whose safety benefits have not yet been fully tested.
- It potentially accelerates the deployment of automated vehicles and increases the attractiveness of Australia as a preferred location for the operation of vehicles with conditional automation.
- It could incentivise the introduction of driver vigilance controls by manufacturers.
- This position can be revised depending on the outcomes of the future NTC work on the definition of driver.

The disadvantages of the human driver being in control include that:

- It could diminish the full utilisation of the technology and undermine the commercial value of level 3 functionality.
- A driver of a vehicle with conditional automation would be held responsible for traffic law noncompliance or crashes occurring while the automated driving system was engaged, even though the application was designed and sold on the basis that he or she was not expected to actively monitor the vehicle’s operation. This could be regarded as an equity issue for drivers and could be a barrier to the uptake of automated vehicles.
- The additional safety measure of maintaining the driver’s control could be redundant if the safety assurance system ensures that vehicles with conditional automation only operate on roads where it is safe to do so and with minimal reliance on driver intervention to ensure safety.
- It is inconsistent with the direction being considered by the NHTSA in the United States.

Option 2: The automated driving system is in control

Adopting this option, the automated driving system is in control of a vehicle with conditional automation while the automated driving system is engaged. The rationale for this option is based on the approach proposed by the NHTSA whereby the question of control and responsibility is based on whether the human operator or the automated system is primarily responsible for monitoring the driving environment.

The benefits of the automated driving system being in control include that:

- It recognises the important distinction in SAE International Standard J3016 between partial automation where the driver shares the dynamic driving task with the automated driving
system, and vehicles operating at conditional automation where the automated driving system performs all of the dynamic driving task.

- It places an appropriate burden of responsibility on the entity actually undertaking the driving, meaning that infringement notices and enforcement activities would be directed to the automated driving system entity rather than the human driver who is not actively driving the vehicle or monitoring the driving environment (subject to driver reforms).
- It provides additional incentive for automated vehicle manufacturers to develop safe systems for vehicles with conditional automation.
- It provides certainty to manufacturers, technology developers, enforcement agencies and consumers about how a human driver’s legal obligations and responsibilities when driving in a vehicle with conditional automation will be enforced.
- It would not have to consider or apply the proper control test to the human driver when the conditional automation is engaged.
- It could allow users to optimise the benefits of the technology by being able to undertake non-driving tasks (if safe to do so).
- It is consistent with the proposed approach being considered in the United States.

The disadvantages of the automated driving system being in control include that:

- It is unlikely to be practically implemented until driver reforms and the safety assurance system are implemented.\(^\text{16}\)
- It would become a critical enforcement issue whether the conditional automation was engaged at the time of the offence — data availability is a matter that could be addressed in the safety assurance system but may not be easily available until such a system is established.
- Governments may still seek to regulate the safe behaviour of the human driver because he or she will be the fallback. The ability to regulate the ‘fallback’ driver (or a ‘soon-to-be’ driver) is not clear under current laws.

**Human as supervisor**

In the event that the automated driving system 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 a supervisor of the automated driving system. Supervisor responsibilities in road traffic laws could seek to ensure that the human remains alert to system errors or requests to intervene.

Fully licensed supervisors of learner drivers provides a precedent for this approach. States and territory road traffic laws require a fully licensed driver to supervise a learner driver. 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.

A similar category of supervisor could be introduced for vehicles with conditional automation. Like learner drivers, the human as supervisor would not be in control of the vehicle or responsible for driving tasks while conditional automation is engaged. The obligations would exist only to ensure a safe fallback is provided should a vehicle with conditional automation have to return the driving task to the human driver.

**Conclusion**

At this preliminary stage in the development of automated vehicles, we propose that **Option 1** be adopted in the first iteration of the national enforcement guidelines; that is, that the human driver is considered to be in control of a vehicle with conditional automation.

This reflects the ministerially-approved policy position. It is an interim position pending further work on legislative change to the definition of ‘driver’ and the development of a safety assurance system. It is a cautious response recognising that the safety of vehicles that require human intervention and

\(^{16}\) Until a safety assurance system is established, there will be no readily identifiable entity (such as a manufacturer or registered owner) to be legal responsible for the actions of the automated driving system.
fallback remains to be validated. We are concerned that if the human driver is not considered to be in control, he or she may engage in unsafe behaviours while the automated driving system is engaged. We are also concerned that the road traffic laws are not yet in a state of readiness to accommodate automated vehicles operated by an automated driving system. This will require the establishment of an automated driving system entity that is legally responsible for the vehicle’s actions while the automated driving system is engaged.

However, it should be emphasised that this is a preliminary view only, and we welcome alternative views from stakeholders.

We are therefore seeking feedback on the issues raised in this section and the following questions:

**Consultation questions**

**Question 4:** Do you agree that the human driver should remain in control of a vehicle with partial or conditional automation, and that the automated driving system should be in control of a vehicle operating at high or full automation? If not, why?

**Question 5:** In the event that the automated driving system is determined to be in control of a vehicle operating with conditional automation, should road traffic laws introduce obligations on the human driver as supervisor of the automated driving system?
What constitutes *proper control* for each level of automation?

### Key points

- The current enforcement approach to Road Rule 297 does not contemplate automated vehicles that could feasibly operate safely without a human driver keeping at least one hand on the steering wheel.
- Indicators of *proper control* will vary, depending on the level of driving automation and the design capabilities of the automated vehicle.
- The NTC suggests that the national enforcement guidelines clarify that a human driver can exercise *proper control* without one hand on the steering wheel when the vehicle is in automated mode. New indicators of *proper control* should be introduced, including examples that a driver does not have *proper control* if he or she:
  - is asleep
  - has closed eyes or shows signs of drowsiness
  - is reading or viewing a device unrelated to navigation or driving.\(^\text{17}\)
- The NTC suggests that the application of *proper control* to the automated driving system should not be addressed until the automated driving system is recognised in law.

### 5.1 *Proper control* is not a prescriptive road rule

As we saw in the previous chapter, a driver must have *proper control* of the vehicle:

> A driver must not drive a vehicle unless the driver has proper control of the vehicle (Rule 297(1)).\(^\text{18}\)

The meaning of *proper control* is not further defined in the road rules,\(^\text{19}\) and the interpretation of its meaning is subject to police enforcement policy and judicial opinion, neither of which have yet occurred in relation to automated vehicles.

Based on police feedback to the NTC, police agencies generally interpret *proper control* to mean that the driver must 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:

1. observed behaviour that is unsafe – such as a vehicle swerving outside a lane
2. observed behaviour that may result in a 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
3. failure to have *proper control* is a reasonable conclusion based on the outcome of a crash or incident – that is, it can be shown that a crash was the result of the driver not properly controlling the vehicle’s steering, propulsion or braking.

\(^{17}\) In addition to any behaviours explicitly prohibited by law, such as the use of a mobile phone while driving.

\(^{18}\) State and territory laws generally define the driver in relation to control of the steering, movement or propulsion of the vehicle.

\(^{19}\) It is noted, however, that the *proper control* rule is supplemented by other more prescriptive laws, notably Road Rule 299 and the requirement not to use a mobile phone while driving.
The third scenario is similar to safe distance requirements, such as Road Rule 126. There are no prescribed distances that are required to safely stay behind other vehicles, and the evidence of a failure to do so exists in the subsequent crash with the vehicle ahead rather than a specified distance in the road rule, which may be difficult to prove.

From a roadside enforcement perspective, police agencies generally take a more proactive approach rather than wait for a crash and interpret Road Rule 297 to mean that the driver must be in the driver’s seat and have at least one hand on the steering wheel.

The Western Australian exception

The application of the road rules in Western Australia provides an exception to the performance-based nature of the model road rules. Section 263 of the Road Traffic Code 2000 (WA) provides that the driver must be behind the steering wheel and have full control over the vehicle:

263. Drivers to have uninterrupted and undistracted views etc.
(1) A person shall not drive a vehicle, unless —
(a) he or she is in such a position behind the steering wheel [our emphasis] that he or she has full control over the vehicle; and
(b) he or she can obtain a full and uninterrupted view of the road and any traffic ahead and on each side of him or her; and
(c) he or she can obtain, in a rear-vision mirror or mirrors attached to the vehicle, a clear reflected view of every overtaking vehicle.

The current Road Traffic Code in Western Australia places an additional prescription of proper control, requiring the driver to be seated behind the steering wheel. This could limit the uptake of certain technologies that allow the driver of a vehicle with partial or conditional automation to self-park the vehicle autonomously without the driver sitting behind the steering wheel. However, there are no additional levels of prescription – such as requiring at least one hand on the steering wheel – and insofar as the national enforcement guidelines are not in conflict to Western Australia’s Road Traffic Code they could apply in that state.

Why automated vehicles are challenging the proper control rule

The current enforcement approach to Rule 297 does not contemplate automated vehicles that could feasibly operate safely without a human driver keeping at least one hand on the steering wheel, or even sitting in a driver’s seat. Without a change in the interpretation, there may be reduced uptake of automated vehicles because the full benefits of automation would not be realisable by consumers.

Behaviours related to monitoring the automated driving system and maintaining a safe level of alertness may become more relevant to Rule 297 than keeping a hand on the steering wheel.

For example, in vehicles that have conditional automation, or in a vehicle that is highly automated some of the time, the driver must remain sufficiently vigilant and alert to take back control at a point in time.

Our challenge is to ensure that indicators of proper control continue to be relevant to automated vehicles so that enforcement agencies can target unsafe behaviours.

Proper control issues the guidelines could address

The proper control rule will not apply to a human in automated vehicles where the human is not the driver – that is, in the following conditions:

- in vehicles with conditional automation when the automated function is engaged (if the automated driving system is agreed to be in control, as discussed in section 4)
- vehicles operating at high automation when the automated function is engaged
- vehicles operating at full automation.

This results in two questions that should be addressed in the national enforcement guidelines:
1. How should *proper control* apply to the human in vehicles with automated functions when the human is the driver? (see section 5.2).

2. Should *proper control* apply to the automated driving system when it is controlling the vehicle and, if so, how? (see section 5.3).

### 5.2 How should *proper control* apply to the human driver in vehicles with automated functions?

*Proper control* may mean new behaviours for human drivers in automated vehicles, particularly vehicles with conditional automation, or in vehicles that are highly automated some of the time. In these vehicles, the driver must remain sufficiently aware of the automated driving to take back the driving task at a point in time, either when the automated driving system reaches the limits of its design parameters (a highly automated vehicle) or when the automated driving system requests the driver to intervene (a vehicle with conditional automation).

*Proper control* in this situation may relate to driver alertness and driver distraction. For example, what is *proper control* if the driver is required to be receptive to a request from the automated driving system to intervene? Without a change to the road rules or an exemption, drivers could not use a mobile phone or watch a movie on an in-vehicle screen, but could they read a book, use a tablet or close their eyes? Does the enforcement response change in any way if the automated vehicle was designed by the manufacturer to safely allow humans to undertake non-driving activities by introducing vigilance controls to maintain alertness?

In the context of roadside enforcement, the following indicators are markers of *proper control* in non-automated vehicles:

- The driver has at least one hand on the steering wheel.
- The driver is positioned in the driver’s seat.

Steering is a critical element of the driving task in these vehicles and whether a driver has a hand on the wheel is observable to enforcement officers. With vehicles that are designed to control the steering, acceleration and braking, a human hand on the wheel is possibly no longer an indicator of *proper control*.

Likewise, the requirement to be seated in the driver’s seat may not be relevant to some automated functions. For example, some partially automated vehicles have the ability to park automatically, with the driver supervising the manoeuvre adjacent to the vehicle and holding an override control in the vehicle’s key fob or mobile application. These applications would breach several road rules and would not be legally possible without an exemption from these rules. However, we expect that in a vehicle with conditional automation, the requirement to remain 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 and would therefore need to be in the driver’s seat already to do so in the time available.

What does *proper control* mean in the context of supervising a vehicle or being receptive to requests to intervene? It could relate to concepts of vigilance and maintaining alertness. Therefore, the following indicators may be more relevant markers of *proper control* in automated vehicles:

- readiness to intervene in the driving task
- alertness to surroundings
- not affected by fatigue (such as drowsiness or the propensity to fall asleep)
- not reading or viewing a device unrelated to navigation or driving.\(^2\)

Unlike hands on the steering wheel, measures such as alertness and fatigue are difficult for enforcement officers to assess at the roadside. Readiness to intervene may be easier, in that it

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\(^2\) Rule 299 and Rule 300 would prevent the driver from watching a movie or using a mobile phone while holding it.
would require the driver to be in the driver's seat, awake and possibly able to respond coherently if questioned.

It should also be noted that existing indicators of *proper control* are likely to still be relevant to vehicles with partial automation (except as noted above) or vehicles with conditional automation when the vehicle is not in automated mode.

**Automated parking**

Some automated parking functions do not require a hand on the steering wheel in a partially automated application. 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.

We are seeking feedback on whether the national enforcement guidelines should consider specific indicators of *proper control* for automated parking functions, or exceptions from 'one hand on the wheel' indicators for partially automated vehicles.

**Due care and attention**

In addition to the *proper control* rule, states and territories have due care and attention offences relating 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. For example, section 83 of the *Transport Operations (Road Use Management) Act 1995* (Qld) provides that:

83. Careless driving of motor vehicles

Any person who drives a motor vehicle on a road or elsewhere without due care and attention or without reasonable consideration for other persons using the road or place is guilty of an offence.

These offences are usually non-infringeable and carry higher penalties than *proper control*, including imprisonment in some jurisdictions.

We are seeking 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 an automated vehicle. If so, we are seeking feedback on whether the national enforcement guidelines should also clarify the application of due care and attention offences to automated vehicles.

**Options**

We are seeking feedback on how national enforcement guidelines should apply the *proper control* test to the human driver in vehicles with automated functions. Two options are detailed below:

<table>
<thead>
<tr>
<th>Option 1:</th>
<th>No change to the current interpretation of <em>proper control</em>, or</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option 2:</strong></td>
<td>That the interpretation of <em>proper control</em> 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 <em>proper control</em> related to alertness and readiness to intervene (outlined in Table 2 on page 34) should be introduced. The indicators of <em>proper control</em> should be reviewed as further reforms are made and the technology develops.</td>
</tr>
</tbody>
</table>

We also welcome feedback on alternative options or an approach that incorporates elements of the options discussed here. For example, a third option may be that the national enforcement guidelines continue to require the human driver to have at least one hand on the steering wheel, but include additional requirements related to alertness and readiness to drive.

<table>
<thead>
<tr>
<th>Option 1:</th>
<th>No change to the current interpretation of <em>proper control</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adopts this option, the national enforcement guidelines would explicitly state that the interpretation of Rule 297 has not changed in light of automated vehicles. The guidelines would</td>
<td></td>
</tr>
</tbody>
</table>

 Clarifying control of automated vehicles April 2017
restate that the indicators of proper control continue to require at least one hand on the steering wheel and a human being positioned in the driver’s seat.

The guidelines could emphasise that this approach would be reviewed as the technology develops so that it is possible to identify whether the vehicle’s automated function is engaged at a particular moment, and the safety of the human driver not having at least one hand on the steering wheel can be further evaluated.

The benefits of no change include that:

- Guidelines would not pre-empt the technology and make assertions about what is safe before automated functions are developed.
- It simplifies roadside enforcement because officers would not have to know the automated function of a vehicle or whether the automated system was in operation at a given time.
- Behaviour is easy to identify and prove.

The disadvantages of no change include that:

- It could diminish the uptake of technologies that have significant safety benefits.
- It is upholding a requirement that is not relevant to the road safety of automated vehicles.
- It does not take into consideration that the safety of the technology and the human–machine interface will be evaluated as part of the safety assurance system (when introduced).
- It does not recognise that other safety-critical behaviours related to alertness and readiness to intervene are more relevant in automated vehicles than having one hand on the steering wheel.
- It would prohibit the operation of specific applications (some of which, such as self-park, are already available on the market) that allows the driver to operate the manoeuvre standing outside the vehicle or where the driver is in the driver’s seat but must have hands off the steering wheel for the manoeuvre to operate.

Option 2: That the interpretation of proper control is updated

Adopting this option, the interpretation of proper control would be updated according to the level of automation to allow the human to not have a hand on the steering wheel. Under this option, new indicators of proper control related to alertness and readiness to intervene would be introduced. These could include requirements that a driver does not have proper control if he or she is asleep, has closed eyes or shows signs of drowsiness, or is reading or viewing a device or thing unrelated to navigation or driving.

This approach distinguishes between different levels of automated driving and considers the relevance of both existing and new indicators of proper control. The indicators would be applicable before and after driver reforms and establishment of the safety assurance system.

If this approach is adopted in the guidelines, exceptions are recommended to allow self-parking functions where the human driver takes his or her hands off the wheel, or can safely operate the manoeuvre standing outside the vehicle (subject to exemptions from relevant road rules).

Table 2 summarises how the proper control test could apply to human drivers in vehicles with automated functions under option 2.

In alignment with current enforcement practices, these indicators would only be examples of not having proper control of a vehicle – enforcement agencies would continue to make an assessment of whether a driver had proper control based on the three scenarios outlined on page 26:

1. observed behaviour that is unsafe
2. observed behaviour that may result in a safety risk
3. failure to have proper control is a reasonable conclusion based on the outcome of a crash or incident.
## Table 2: Suggested examples of indicators of proper control, by level of driving automation

<table>
<thead>
<tr>
<th>Proper control</th>
<th>Levels 0–2 Human-driven</th>
<th>Level 3 Vehicle capable of automation</th>
<th>Level 4 Vehicle capable of automation</th>
<th>Some level 4 and all level 5 Dedicated automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human in control because he or she is required to perform all or part of the driving task</td>
<td>Human in control because he or she is required to perform a fallback role</td>
<td>Human not in control but will be requested to, and may, resume control when automated driving system reaches the limits of its operational design domain</td>
<td>No human driver</td>
<td></td>
</tr>
</tbody>
</table>

### Current indicators of proper control

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Level 0–2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Some level 4 and all level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one hand on the steering wheel</td>
<td>Yes(^{21})</td>
<td>No</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Seated in the driver’s seat</td>
<td>Yes(^{22})</td>
<td>Yes</td>
<td>No(^{23})</td>
<td>NA</td>
</tr>
</tbody>
</table>

### Suggested indicators of proper control

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Level 0–2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Some level 4 and all level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not asleep</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Not have closed eyes or show signs of drowsiness</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Not reading or viewing a device or thing unrelated to navigation or driving(^{24})</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
</tbody>
</table>

The benefits of updating indicators of proper control include that:

- It recognises that safety-critical behaviours in automated vehicles are different from behaviours in conventional vehicles and matches the indicators of proper control accordingly.
- It ensures the national enforcement guidelines and the police response to automated vehicles remain relevant and outcomes-based.
- It is expected to increase consumer demand for technologies that are likely to have significant safety benefits.

---

\(^{21}\) Would not apply to self-parking operations that safely allow the human driver to stand outside of the vehicle during the self-parking manoeuvre.

\(^{22}\) Would not apply to self-parking operations that safely allow the human driver to stand outside of the vehicle during the self-parking manoeuvre.

\(^{23}\) In a highly automated vehicle the vehicle can come to a safe stop if the human driver does not resume the driving task. Therefore the soon-to-be driver does not have to be seated in the driver’s seat when the vehicle is operating in highly automated mode.

\(^{24}\) In addition to any behaviours explicitly prohibited by law such as the use of a mobile phone while driving.
• It encourages vehicle manufacturers to develop vigilance controls to ensure human drivers remain alert and ready to intervene when they are not undertaking the driving task.

The disadvantages of updating indicators of proper control include that:

• It creates complexity for consumers and enforcement agencies because there will be different expectations of proper control depending on a vehicle’s automated function.

• It will be more difficult to revert to the existing interpretation if amending the indicators proves to be unsafe or impractical.

• It requires police and drivers to know what level of automation the vehicle is operating at.

• We do not have any indication of how other countries will respond to the same issue, and Australia may be the only country to take this approach.

Conclusion

Until automated vehicles are further developed and the effectiveness of vigilance controls and the safety of the technology can be evaluated, we propose a cautious response to proper control is adopted in the national enforcement guidelines.

Unless the automated function is a remote self-park (noting that exemptions from the road rules would be required to allow this manoeuvre), the human driver should remain in the driver’s seat.

However, if the driver is not required to undertake the driving task for a sustained period of time, then the driver is not responsible for steering the vehicle and therefore there should not be a requirement for a human driver to have at least one hand on the steering wheel when the automated function is engaged.

Additional indicators applicable to automated vehicles should be included in the national enforcement guidelines that reflect the cognitive requirements of the human, such as readiness to intervene and alertness. These could include examples that a driver does not have proper control if he or she:

• is asleep

• has closed eyes or shows signs of drowsiness

• is reading or viewing a device unrelated to navigation or driving.

These indicators of proper control should be reviewed on a periodic basis as the technology develops and the human–machine interface evolves.

Consultation questions

**Question 6:** Do you agree with the suggested indicators of proper control for each level of driving automation (outlined in Table 2 on page 34 of this paper)? Are there any other indicators that should be included in the guidelines?

**Question 7:** Should special consideration be given to automated parking functions that are partially automated and can only operate without the driver holding the steering wheel?

**Question 8:** Should the national enforcement guidelines also clarify the application of due care and attention offences to automated vehicles? If so, what behaviours usually penalised under these offences require clarification when applied to automated vehicles?
5.3 How should proper control apply to the automated driving system when it is controlling the vehicle?

Legislative reforms to the definition of driver (recommendation 6 in the NTC policy paper) are intended to ensure that the automated driving system entity is explicitly recognised in road rules and other laws, and that that entity has appropriate obligations and penalties for unsafe behaviour.

A human driver can perform actions that lead them to 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 automated vehicles because an automated driving system cannot perform these unsafe and risky behaviours. If an automated driving system 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. These safety-critical events are more closely related to concepts of mismanaging safety, a failure to identify and manage risk to a required standard or, in extreme circumstances, negligence or reckless indifference.

In the event that an automated driving system entity did not maintain an automated vehicle properly, and this resulted in safety-critical failures, an infringeable offence such as proper control would arguably be a too-minor and inadequate offence that would be disproportionate to the behaviour of the automated driving system entity.

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

As discussed in section 1, until the projected reforms to recognise the automated driving system entity in the road rules and other laws are implemented, it could be argued that only a human can be the legal driver of the vehicle – in which case any treatment of the automated driving system entity and the proper control test in the national enforcement guidelines would be theoretical.

Proposed approach

A key assumption in this discussion paper is that the national enforcement guidelines should:

- reflect current law
- be reviewed and updated when the automated driving system and the automated driving system entity are recognised in legislation and a safety assurance system is implemented.

Therefore, we propose that the first iteration of the guidelines does not have regard to the application of proper control to the automated driving system but that the guidelines are updated to do so when the automated driving system and the automated driving system 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.

We welcome feedback on this proposed approach and any alternative approaches to reviewing proper control applicability to the automated driving system after the driver reforms have been implemented.

Consultation question

Question 9: Do you agree that the guidelines should not apply the proper control test to the automated driving system until the automated driving system and automated driving system entity are recognised in legislation? If not, what alternative approach should be considered?
6 How will enforcement officers know what level of automation is engaged at a particular time?

Key points

- Different indicators of proper control for different levels of automation could create a future enforcement challenge in identifying the level of automation that was engaged at a particular time.

- 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.

- The NTC proposes that options for enforcement agency interaction with automated vehicles is further explored as part of the NTC’s project to regulate government access to data, scheduled to commence in late 2017.

6.1 Enforcement of automated vehicles requires knowledge of automated functions

What is the problem?

At a roadside intercept, a driver would need to be able to demonstrate that his or her behaviour at the time was appropriate for the level of automation of the vehicle.

To consider the explanation and decide whether or not to issue an infringement notice, an enforcement officer would need evidence of the level of automation at that time.

For example, an enforcement officer may observe a driver in a vehicle turned to face the front-seat passenger without any hands on the steering wheel. The officer believes the driver may not have proper control of the vehicle and indicates the driver to pull over. The driver explains the vehicle is a level 3 automated vehicle, operating in automated highway mode and they do not need to have their hands on the steering wheel because the vehicle controls the steering and acceleration and all other aspects of the dynamic driving task.

Does the enforcement officer need to verify this statement and, if so, how?

In the event that different indicators of proper control are adopted for different levels of automation, as proposed in section 5, enforcement officers will need to know what level of automation was engaged at a particular time in order to know which indicator applies.

For example, if the human driver is agreed to be in control of a conditionally automated vehicle at all times, the indicators of proper control applicable to that driver will depend on whether or not the automated driving system is engaged. If engaged, the indicators relevant to level 3 would need to apply; if not, the level 0–2 indicators would need to apply.

How to identify what level of automation the vehicle was operating in at the moment of detection?

It will likely be necessary for an enforcement officer to be able to ascertain the level of automation a vehicle was operating in at the moment of detection if he or she is to know which indicators of proper control are applicable to the driver.
Ideally, access to the automated vehicle’s data would show this, but this data may not be retained in the absence of specific Australian Design Rules for automated vehicles or requirements imposed through the safety assurance system (discussed below). 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.

Our 2016 discussion paper suggested automated vehicle identification could be as simple as an external flashing light or electronic signal indicating when the vehicle is operating in automated mode. This would alert authorised officers that different proper control indicators apply to the driver. However, it is unlikely that such a requirement would be mandated in the near future, and an external indicator does not appear to be a feature that manufacturers are considering for their automated vehicles, other than those designed for driverless operation (such as low-speed passenger shuttles on defined routes). In addition, conditionally-automated applications may be introduced on public roads without the need for exemptions or approvals, and so there is no mechanism for requiring special identification.

Alternatively, an internal light in the vehicle’s control panel might provide this information, which might also be recorded by the vehicle’s incident recording system. Some legislatures in the United States have specified internal warning lights and crash data recorders in their automated vehicle legislation.

It is likely that manufacturers will provide information in the automated vehicles themselves about the automation levels, capabilities and limitations of the particular vehicle. There will at least be an owner’s manual explaining how to use the vehicle’s features. While mainly designed to inform owners, drivers and operators, it will also be useful to enforcement officers.

For example, the 2016 NHTSA *Federal Automated Vehicle Guidance* suggests that vehicle manufacturers will be expected to provide detailed descriptions of these matters:

> The ODD [operational design domain] should describe the specific operating domain(s) in which the [automated vehicle] system is designed to properly operate. The defined ODD should include the following information to define [automated vehicle] systems’ capabilities:
>
> - roadway types on which the automated vehicle is intended to operate safely
> - geographic area
> - speed range
> - environmental conditions in which the automated vehicle will operate (weather, daytime/night-time, etc.)
> - other domain constraints. (p. 27)

The NHTSA guidance further states that these matters should be provided in summary to drivers and operators in the vehicle’s owner’s manual and in a conspicuous place in the vehicle’s interior.

In the context of determining who has control of an automated vehicle at a point in time, our discussion paper suggested that technology interfaces could be developed by industry to enable enforcement agencies to identify highly automated vehicles at the roadside, and to identify whether the automated driving system was engaged.

This approach could draw on a wide range of technologies and applications. Alternatively, a highly automated vehicle could have historical data displayed on a screen that identifies who was in control of the vehicle. This data could be printed, visually observed by authorised officers or transmitted to enforcement agency systems.

Our discussion paper noted that the automated vehicle technology is largely driven by an international market, and until the development of international standards are integrated into the Australian Design Rules or incorporated into the national safety assurance system, there is no mechanism to require a technology interface between automated vehicles and enforcement agencies. Developing such an interface would remain reliant on industry cooperating with enforcement agencies.
6.2 The safety assurance system can ensure enforcement agencies have the information they need

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

As noted in section 1.8, the safety assurance system could include a safety criterion in relation to interaction with enforcement. Under this approach, an automated vehicle would not be approved by the safety assurance system unless the applicant can demonstrate that enforcement officers will be able to access accurate and real-time information about a vehicle’s automated functionality and whether the automated driving system is engaged at a given time.

Proposed approach

It is clear that, as automated vehicle technology develops and matures, enforcement agencies will require specific information about the automated vehicle to ensure enforcement is timely, appropriate and efficient.

An enforcement officer will be required to consider automation on a number of levels:

1. Is the vehicle capable of operating in an automated mode?
2. Was the vehicle operating in an automated mode at the time of a behaviour of concern being witnessed?
3. Was the level of automation and the observed behaviour consistent with the national enforcement guidelines?

The challenge of accessing this information in an enforcement context will be exacerbated by the diversity of automated vehicles and functions we expect to see, operating in a mixed environment with both conventional vehicles and other types of automated vehicles.

There are a range of technology solutions that could be developed by vehicle manufacturers to address these issues and to provide enforcement agencies with the information they need to ensure accurate and equitable roadside enforcement outcomes. 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 (recommendation 8 in the NTC policy paper, see Appendix B).

However, 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 automated vehicles. The appropriate solutions may also be heavily dependent on the specific type of automated vehicle or technology in use.

The NTC therefore proposes that:

1. Enforcement agencies and the NTC should work closely with vehicle manufacturers to identify technology solutions to assist enforcement agencies to interact with automated vehicles.
2. 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).
3. National enforcement guidelines should be updated to identify a process for enforcement agency interaction with automated vehicles once the technology capability of automated vehicles is more developed and enforcement practices implemented in overseas jurisdictions.
4. When the safety assurance system is implemented, it should provide an additional regulatory mechanism to manage the interaction between enforcement agencies and automated vehicles.

We welcome feedback on this proposed approach and any alternative approaches to managing the interaction between enforcement agencies and automated vehicles.

**Consultation question**

**Question 10:** Do you agree that the guidelines should only specify enforcement agency interaction with automated vehicles once the technology capability of automated vehicles is more developed and enforcement practices implemented in overseas jurisdictions? If not, what alternative approach should be considered?
# Appendix A: Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>automated driving system</td>
<td>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 conditional, highly and fully automated vehicles.</td>
</tr>
<tr>
<td>automated driving system entity</td>
<td>The legal entity responsible for the automated driving system. This could be the manufacturer, operator, legal owner of the vehicle or another entity.</td>
</tr>
<tr>
<td>conditional automation*</td>
<td>When an automated vehicle 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 any system failures and intervene if requested and be the fallback for the dynamic driving task.</td>
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| dynamic driving task*                         | 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:  
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); and  
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.                                                   |
| Heavy Vehicle National Law                    | National laws related to the regulation of heavy vehicles over 4.5 tonnes. Operational in all Australian states and territories except Western Australia and the Northern Territory.                                                                                                         |
| 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. |

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25 Terms marked with an asterisk are quoted from SAE International Standard J3016.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>human–machine interface</td>
<td>Interface between a human operator and a machine. Includes functional and ergonomic design of the interface (human factors). The subtasks of the dynamic driving task that include monitoring the driving environment and executing an appropriate response to such objects and events.</td>
</tr>
<tr>
<td>object detection and response*</td>
<td>The specific conditions under which a given driving automation system or feature thereof is designed to function, including, but not limited to, driving modes.</td>
</tr>
<tr>
<td>operational design domain*</td>
<td>When the automated driving 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.</td>
</tr>
<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
</tr>
<tr>
<td>safety assurance system</td>
<td>A regulatory mechanism for governments to assess the safety performance of an automated vehicle to ensure it can operate safely on the network.</td>
</tr>
<tr>
<td>system failure*</td>
<td>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).</td>
</tr>
<tr>
<td>vigilance controls</td>
<td>Human–machine interventions to assist a human operator or driver to remain sufficiently alert over a sustained period of time to undertake required tasks.</td>
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</table>
Appendix B: Recommendations approved by the Transport and Infrastructure Council

In November 2016 the Transport and Infrastructure Council approved the following recommendations, outlined in our Regulatory reforms for automated road vehicles policy paper.

<table>
<thead>
<tr>
<th>NEAR-TERM REFORMS</th>
<th>Outcomes</th>
<th>Recommended actions</th>
<th>Lead agency</th>
<th>Timeframe</th>
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</table>
|                                                                                   | Government support of on-road trials of automated vehicles for all levels of automated driving | 1. That the NTC and Austroads develop national guidelines for on-road field testing and trials of automated vehicles in Australia.  
2. That state and territory road and transport agencies and the National Heavy Vehicle Regulator (NHVR) undertake a review of current exemption powers to ensure they have sufficient powers to undertake and manage on-road trials of automated vehicles, including in relation to vehicle standards, road rules and driver licensing requirements, and to review how cross-border trials could be managed. | The NTC, in partnership with Austroads  
State and territory road and transport agencies and the NHVR to undertake reviews, and the NTC to report progress to the Transport and Infrastructure Council. | Early 2017 to May 2017  
Early 2017 to 2018                                                                 |
|                                                                                   | Certainty for industry and governments as to:                             | 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. 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. | The NTC                                                                                           | Early 2017 to November 2017          |
|                                                                                   | (1) who is in control of an automated vehicle                             | 4. That Australian transport ministers agree to reaffirm the existing policy position that:  
4.1 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).  
4.2 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. | Transport and Infrastructure Council                                                              | November 2016                        |
|                                                                                   | (2) how enforcement agencies will apply the 'proper control' requirement in the road rules to all levels of driving automation |                                                                                                                                                |                                                                                                  |                                     |
### MEDIUM-TERM REFORMS

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Recommended actions</th>
<th>Lead agency</th>
<th>Timeframe</th>
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<tr>
<td>A complete regulatory framework to support the safe commercial operation of automated vehicles</td>
<td>5. That the NTC develop a national performance-based assurance regime designed to ensure the safe operation of automated vehicles, with an initial focus on vehicles with conditional automation (level 3). An initial briefing on process and technical performance requirements to be provided to ministers in May 2017.</td>
<td>The NTC</td>
<td>Early 2017 to November 2017</td>
</tr>
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<td></td>
<td>6. That the NTC develops legislative reform options to clarify the application of current driver and driving laws to automated vehicles, and to establish legal obligations for automated driving system entities.</td>
<td>The NTC</td>
<td>Early 2017 to May 2018</td>
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<td></td>
<td>7. That state and territory governments undertake a review of compulsory third-party and national injury insurance schemes to identify any eligibility barriers to accessing these schemes by occupants of an automated vehicle, or those involved in a crash with an automated vehicle. That, subject to the review of insurance schemes, each state and territory government amends its compulsory third-party insurance schemes in close consultation with each other and industry, and that the resulting reforms are nationally consistent wherever possible.</td>
<td>States and territories to undertake reviews, and the NTC to report progress to the Transport and Infrastructure Council</td>
<td>Early 2017 to 2018</td>
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### LONG-TERM REFORM

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<tr>
<th>Outcomes</th>
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<th>Lead agency</th>
<th>Timeframe</th>
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<tbody>
<tr>
<td>A complete regulatory framework to support the safe operation of automated vehicles</td>
<td>The Commonwealth Government should continue with the current approach of engaging with the United Nations Working Party 29 and harmonising ADRs with international vehicle standards.</td>
<td>Commonwealth Department of Infrastructure and Regional Development</td>
<td>Ongoing</td>
</tr>
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<td></td>
<td>No immediate actions are required by the Transport and Infrastructure Council.</td>
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### CLARIFY THEN REFINING

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</thead>
<tbody>
<tr>
<td>Regulation of government access to automated vehicle data to achieve road safety and network efficiency outcomes, efficient enforcement of traffic laws and sufficient privacy protections for users.</td>
<td>8. That the NTC develops options to manage government access to automated vehicle data, having regard to achieving road safety and network efficiency outcomes and efficient enforcement of traffic laws, balanced with sufficient privacy protections for automated vehicle users.</td>
<td>The NTC</td>
<td>Late 2017 to November 2018</td>
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