Government access to vehicle-generated data

May 2020

Discussion paper

National Transport Commission

Report outline

Title	Government access to vehicle-generated data discussion paper
Type of report	Discussion paper
Purpose	For public consultation
Abstract	This paper *examines* opportunities that governments and the community may derive from enhanced access to vehicle-generated data. The paper *considers* the costs, benefits, issues and barriers of access. The paper *identifies* three problems that need to be addressed to achieve access to and use of vehicle-generated data and *proposes* a range of options to address these problems.
Submission details	The NTC will accept submissions online until Friday 3 July 2020 at **www.ntc.gov.au**
Attribution	This work should be attributed as follows, Source: National Transport Commission, *Government access to vehicle-generated data: discussion paper*, NTC, Melbourne. If you have adapted, modified or transformed this work in anyway, please use the following, Source: based on National Transport Commission, *Government access to vehicle-generated data: discussion paper*, NTC, Melbourne.
Key words	Vehicle-generated data, government access, use cases, road safety, infrastructure planning, network efficiency, asset maintenance, automated vehicles, V2X, connected vehicles
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Have your say

What to submit

Any individual or organisation can make a submission to the NTC. We would benefit from hearing from the following organisations as part of this consultation:

- light and heavy vehicle manufacturers and importers (road transport) and automated driving system entities
- suppliers of connected vehicle systems, data aggregators and information service providers
- privacy groups and agencies
- telecommunications providers
- transport user groups, including motoring organisations
- government agencies at the Commonwealth, state and territory and local government levels
- government-associated entities such as Austroads and Transport Certification Australia.

The discussion paper includes 19 questions that we are seeking your feedback on. You do not need to answer all the questions. You may answer as many or as few questions as you like.

When to submit

We are seeking submissions on this discussion paper by Friday 3 July 2020.

How to submit

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

Making a submission

Visit **www.ntc.gov.au** and select 'Have your say' on the homepage.

Register you interest for an online meeting or tell us how you would like to be involved by emailing **automatedvehicles@ntc.gov.au**.

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

Publishing your submission

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

The *Freedom of Information Act 1982* (Cwlth) applies to the NTC.

Contents

Glossary

Term	Definition
Aggregated data	Raw data gathered and expressed in a summary form for statistical analysis.
Automated driving system	The hardware and software that are collectively capable of performing the entire dynamic driving task (steering, accelerating, braking and monitoring the driving environment) on a sustained basis.
Automated driving system entity	The legal entity responsible for the automated driving system. This could be the manufacturer, operator or legal owner of the vehicle, or another entity seeking to bring the technology to market in Australia.
Automated vehicle	A vehicle with SAE levels 3–5 automation. It is a vehicle that has an automated driving system, which means that it is capable of performing the entire dynamic driving task on a sustained basis without human input. It is distinct from vehicles with automated features to assist a driver (SAE levels 1–2), which still require a human driver to perform part of the dynamic driving task. The NTC's automated vehicle work program adopts the taxonomy of SAE International Standard J3016. SAE J3016 provides a broadly accepted, common set of definitions and has not as yet been superseded by any other international standards.
Connected vehicle	Any 'smart vehicle' with wireless connectivity to the internet, local network, 'the cloud', other vehicles, personal communication devices, roadside infrastructure or control centres for real-time communication or exchange of data. This could include embedded systems within the vehicle, tethered connectivity or telematics systems fitted in the aftermarket.
Cooperative intelligent transport system (C-ITS)	A technology platform that enables components of the transport network (vehicles, roads and infrastructure) to wirelessly communicate and share real-time information including data on vehicle movements, traffic signs and road conditions.
De-identified data	Data from which the personal identifiers have been removed. It covers both information that cannot be re-identified and pseudonymised information (the removal of individual identifiers). When data is pseudonymised it is most likely still identifiable when combined with other data.

Dynamic driving task	All the operational and tactical functions required to operate a vehicle in on-road traffic. This includes steering, acceleration and deceleration, object and event detection and response, maneuver planning and enhancing conspicuity through lighting signalling, etc. The dynamic driving task excludes strategic functions like trip planning, such as where and when to travel and route selections.
Personal information	Broadly means information about a reasonably identifiable individual.
Sensitive information	Broadly, it refers to certain types of information about the individual – for example, their race or ethnic origin, sexual orientation, political opinions or health information.[1] The collection, use or disclosure of sensitive information may need to meet higher standards than other types of information.
V2I	Vehicle-to-infrastructure communication. The wireless exchange of data messages (for example, about road conditions) between vehicles and roadside infrastructure over short-range or ad hoc networks.
V2V	Vehicle-to-vehicle communication. The wireless exchange of data messages (for example, about vehicle movements) between vehicles.
V2X	Vehicle-to-anything. The passing of information from a vehicle to any entity that may affect the vehicle, and vice versa.
V2N	Vehicle-to-network. Wireless exchange of data over private networks such as 3G, 4G LTE or 5G networks. These can enable cloud services, remote application servers or remote data stores.
Vehicle-generated data	Any data generated by the vehicle itself about the vehicle, the road environment or the use of the vehicle.

[1] For states and territories that have a sensitive information category, many exclude biometric and genetic information, and some exclude health information. For example, NSW legislation does not include a sensitive information category, and in Victoria sensitive information only includes information that is also personal information. Some states, for example NSW, also have distinct legislation that governs health information.

Executive summary

Vehicles are increasingly capturing a range of useful data about the road environment, the vehicle itself and the way it is used. The vehicle industry is also rapidly expanding the capability of vehicles to connect and share data. This could provide a new opportunity for governments to improve their transportation systems through access to and use of this new data. If government access is not considered in a nationally consistent way, governments risk creating a fragmented, overly burdensome or low-access data environment.

Australia's transport agencies have identified that this new data will be important for operating more dynamic and responsive transportation systems. This new vehicle-generated data has the potential to improve road safety, optimise the road network and better inform network planning. For this report we have defined vehicle-generated data as any data generated by a vehicle that produces information about the vehicle, the environment around the vehicle or the use of the vehicle.

The purpose of this project is to develop policy options for government access to and use of vehicle-generated data for the purposes of road safety, network operations, investment, maintenance and planning.

The purpose of this discussion paper is to:

- discuss our understanding of key issues and challenges arising from government access to vehicle-generated data
- seek views on the opportunity statement and problem statements contained in this paper
- seek views on options that could address these problems.

What are the opportunities and benefits?

Improved road safety has been identified as a key need that could be addressed through greater access to vehicle-generated data. For example, sharing and reporting of traffic safety events could use vehicles to detect and warn occupants about dangerous road conditions, allowing transport agencies to respond more rapidly to incidents. It is also the area with the highest willingness among vehicle manufacturers to share data. Unlike other types of data such as vehicle movement data, this data is unique to the vehicle and cannot be as easily replicated from other data sources.

To better understand the needs of transport agencies and industry, we hosted several co-design workshops. The workshops generated 23 use cases identifying different potential uses for vehicle-generated data. Transport agencies identified significant potential benefits for road safety, network planning and optimisation. Transport agencies saw that this data could better inform decision making and reduce road trauma.

However, the detailed benefits and costs of these use cases are still unknown. We also found that further data requirement and business case development is needed on priority uses for vehicle-generated data. Further collaboration between industry and government to better understand the potential benefits and costs would be highly beneficial to achieve this and is strongly supported by stakeholders.

Australia does not lag significantly behind international jurisdictions in government access to vehicle-generated data; however, there are early international collaboration efforts that Australia can learn from. Key among these is the European Union's memorandum of understanding between government and industry on the exchange of vehicle-generated data to support eight safety-related use cases.

What are the barriers and gaps?

Vehicle-generated data can be costly to generate, carry, store and use, and can reveal sensitive information about users and businesses. Much of this data is not stored, broadcast or shared. There is currently a low market penetration of vehicles that can share this data. The key barriers to government access include:

- There is no compelling reason or incentive for generators of vehicle-generated data to provide this information to transport agencies (with the exception of the road access, safety and productivity benefits provided to heavy vehicle operators through regulatory telematics).
- There are trust, cost and operational barriers to the exchange of vehicle-generated data and, outside of heavy vehicles, there is no data access framework to address these issues.
- In comparison with international markets, there are currently fewer vehicles capable of capturing and communicating vehicle-generated data on Australia's roads, with only market-based mechanisms to encourage uptake.

What are the opportunities and problems?

We have identified one key opportunity for government to access vehicle-generated data:

1. There is an opportunity for stakeholder collaboration on exchange or sharing of vehicle-data for road safety purposes to understand:
   - what vehicle-generated data can be used to support road safety in Australia
   - what an appropriate framework and forum might look like to support such an exchange.

We have identified three problems that will we need to overcome to create wider government access:

1. Vehicle-generated data is currently not provided to transport agencies for purposes that may have publicly beneficial outcomes. This could be due to current vehicle capabilities and/or a lack of incentive or reason for industry and road users to provide the data (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance scheme under the Heavy Vehicle National Law).

2. There is a lack of a data access framework to provide the necessary trust, data exchange systems, data standards/definitions, understanding of data needs and governance to establish data access and use (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance scheme).

3. The level of uptake and penetration of connectivity across the Australian vehicle fleet may delay the benefits of vehicle-generated data, particularly related to safety-critical events.

What are we proposing to address the opportunity and problems?

Recognising that vehicle-generated data is still at the nascent stage of development in Australia and that stakeholders remain unclear on priorities, there is an opportunity for governments to adopt a new policy approach. We propose that a new collaboration between industry and governments begin with a focus on road safety data as the priority and common mission. This approach is in line with the European Union's approach and has early consensus from industry and government. We propose:

> For future development on government access to vehicle-generated data, road safety is the priority for exchanging vehicle-generated data between industry and government. Industry and government should collaborate on identifying opportunities for exchanging road safety data and adopt a principle of non-commercial sharing or exchange.

We have identified three options to address problems 1 and 2, which are:

- Option 1: Rely on existing arrangements between government and industry, with no changes to existing legislation or frameworks.
- Option 2: Establish a data exchange partnership between industry and government that will identify opportunities for exchanging vehicle-generated data as well as develop standards and consider proof of concept.
- Option 3: Introduce new legislation requiring industry to collect, store and retain vehicle-generated data while providing access to government.

The NTC's preliminary preferred option is **option 2**. We believe this option can provide the best opportunity for government to better understand how to maximise the potential benefits and opportunities of vehicle-generated data while actively collaborating with industry. This option has received general early support from government and industry.

To address problem 3 – a lack of stimulus to bring forward vehicle connectivity – we are proposing that the Commonwealth considers the costs, benefits and system requirements to require vehicles to send automated crash notification system messages and have these received and actioned. Europe has achieved this through introducing its eCall system. This would bind all vehicles to a capability to send data messages over private networks. This proposal could be enacted through the Commonwealth government considering adoption of international standards into an Australian Design Rule (with consequential amendments to the relevant state and territory in-service vehicle standards) and infrastructure and capability to receive and use emergency notification messages. This would result in a significant increase in the fleet penetration of connected vehicles in Australia.

What happens next?

We are seeking submissions on this paper by Friday 3 July 2020. We will use your feedback to develop recommendations for transport and infrastructure ministers to consider at the November 2020 Transport and Infrastructure Council meeting.

List of questions

1 About this project

Key points

- The Transport and Infrastructure Council tasked the National Transport Commission to develop policy options for government access to and use of vehicle-generated data for the purposes of network operations, investment, maintenance, planning and road safety.
- This project will analyse the challenges and barriers to government access to vehicle-generated data while and examine potential options to address these challenges.
- We are seeking your feedback on:
  - whether we have accurately captured the challenges, opportunities and problems of government access to vehicle-generated data
  - options to address opportunities and challenges.

1.1 Purpose of this project

At the November 2019 meeting of the Transport and Infrastructure Council, the council asked the NTC to:

> *Develop policy options for government access and use of vehicle-generated data for the purposes of network operations, investment, maintenance, planning and road safety.*

This project will consult with stakeholders to develop a range of policy options for considering government access to vehicle-generated data.

1.2 Purpose of this discussion paper

The purpose of this discussion paper is to:

- outline current problems and opportunities relating to government access to vehicle-generated data including:
  - the opportunity to enhance road safety outcomes through the exchange of safety-related data between government agencies and industry
  - the current lack of incentive to exchange data with governments
  - the current lack of trust in exchanging data
- provide a summary of the key issues and an overview of Australian and international developments for government access to vehicle-generated data
- provide an outline of priority use cases for government access to vehicle-generated data
- provide options to enhance government access to vehicle-generated data and to seek views on these options
- seek stakeholder views on the options presented and responses to specific consultation questions where more information and analysis is desired.

1.3 About the National Transport Commission

We lead national land transport reform in support of Australian governments to improve safety, productivity, environmental outcomes and regulatory efficiency.

We are a key contributor to the national reform agenda with accountability to the Transport and Infrastructure Council and its advisory body, the Transport and Infrastructure Senior Officials' Committee.

1.4 Project mandate

At its August 2019 meeting, the Transport and Infrastructure Council agreed that:

> *... the NTC should work with jurisdictions, the Commonwealth and Austroads to analyse future government access and use of Cooperative-Intelligent Transport Systems [C-ITS] and automated vehicle data, including for network efficiency, infrastructure investment and road safety.*

The NTC previously discussed vehicle-generated data in our policy paper *Regulating government access to C-ITS and automated vehicle data*, but that paper focused on user privacy. How governments may access vehicle-generated data has not to date been publicly discussed, meaning the positions of most stakeholders remains unknown. In submissions to our discussion paper on *Regulating government access to C-ITS and automated vehicle data*, one state transport agency argued that:

> *The most significant issue with the current information access framework for government collection is that it does not authorise the collection, use and disclosure of CAV [connected and automated vehicle] data for legitimate government use cases.*[2]

In consultation with states and territories we refined the scope and project purpose. The scope will include all vehicle-generated data rather than just C-ITS and automated vehicle data. By considering data needs in this way, we are not focusing on longer term solutions such as C-ITS exclusively and can consider data needs from current and near-market vehicle systems.

The redefined project purpose was noted at the November 2019 council meeting as:

> *Develop policy options for government access and use of vehicle-generated data for the purposes of network operations, investment, maintenance, planning and road safety.*

1.5 Project benefits and expected outcomes

It is expected that this project will deliver the following benefits and outcomes:

Benefits	Expected outcomes
An understanding of the opportunities, challenges, risks, barriers and options to	Transport ministers will understand the challenges, risks, barriers and options for

[2] See: https://www.ntc.gov.au/submission_data/92

Benefits	Expected outcomes
achieving access to a range of data types	how transport agencies can best access vehicle-generated data
Opportunities identified to reduce potential costs to industry and jurisdictions for access to vehicle-generated data	Reduced costs to industry and jurisdictions for access to vehicle-generated data due to the removal of barriers, and through increased national consistency
In the longer term, enhanced public benefits from using vehicle-generated data across road safety, congestion, government investment, asset utilisation and reduced emissions	Net public benefits from enhanced access to vehicle-generated data

1.6 Links to other projects

This project includes linkages with projects by the NTC and Austroads.

1.6.1 Austroads Future Vehicles and Technologies program

The Future Vehicles and Technologies program supports Austroads' member organisations to deliver an improved road transport network, leveraging the benefits of emerging technologies while minimising some of the risks inevitably faced during a period of such rapid change. The Austroads project on defining future vehicles includes future forecasts for C-ITS technology market penetration in Australia, which this discussion paper references in chapter 2.

Austroads is also seeking to understand how road and transport agency operations can make data related to the safe operation of connected and automated vehicles available. The project, called Road Authority Data for Connected and Automated Vehicles, will make guidelines available on data such as roadworks, speed zones and traffic signals.

1.6.2 NTC automated vehicle reform

The NTC is currently developing an end-to-end regulatory framework for automated vehicles. Future work will consider access to data from automated vehicles for compliance and enforcement purposes to support in-service safety obligations. As part of this work, we will consider access to automated vehicle data by insurers to assess liability for insurance purposes.

1.6.3 NTC Heavy Vehicle National Law review

The NTC is currently reviewing the Heavy Vehicle National Law from a first-principles perspective. As part of the review, we will consider the role of technology as primary data generator to underpin compliance, enforcement and assurance activities. We will take an outcome-focused approach in the new law and avoid prescribing particular technologies. Consultation has indicated that the sharing of de-identified and aggregated data should be facilitated and encouraged through a clear data framework. The data framework would provide clarity and certainty to operators, government, regulators and technology providers about the permitted collection and use of data.

1.6.4 Freight data hub

The Department of Infrastructure, Transport, Cities and Regional Development is currently consulting on the design of the National Freight Data Hub. The purpose of the Freight Data Hub will be to enhance access to freight data across all modes to:

- support day-to-day operations
- improve infrastructure and transport network investment decisions
- enable end-to-end performance evaluation of Australia's freight system.

The project will consider how stakeholders will be able to access and share freight data.

1.7 Project scope

1.7.1 Scope inclusion items

The following is in scope for this project:

- access to data generated by vehicles, including automated vehicles, from vehicle-generated sources that can be consumed by transport agencies
- data sourced from vehicles through a range of technology means including:
  - data broadcast from a vehicle over broadcast one-to-any channels
  - data provided by a vehicle over private wireless networks
  - data that can only be accessed by physical connection to the vehicle
- both technical data and personal data (if needed)
- aggregated data (information) and disaggregated/raw data
- data for the purposes of network operations, investment, maintenance, planning and road safety (data categories outlined in Appendix B)
- heavy and light vehicle data, as well as data from aftermarket devices
- all levels of Australian governments (Commonwealth, state/territory, local)
- road safety data for compliance and enforcement.

1.7.2 Scope exclusion items

This project will not examine automated vehicle data for safety, enforcement and insurance purposes – this will be considered as part of the NTC's in-service safety reforms. Additional out-of-scope items include:

- data from personal devices (phones) or other data collection methods such as automated licence plates, phone data tracking, bluetooth/wi-fi sensing of devices or vehicles
- data for other government agencies such as vehicle recall for the Australian Competition and Consumer Commission and cybersecurity agencies
- other third-party uses of in-vehicle data such as access to data for repairers, insurance and service providers
- vehicle data generated from rail and on-road public transport vehicles
- data from e-bikes, scooters or other vehicles not covered by the *Road Vehicle Standards Act 2018*

- other existing regulated telematics systems, taxis and alcohol interlocks.

1.7.3 Data ownership

We note that privacy law concepts focus on the collection, use, access and disclosure of personal information and the rights of data subjects in relation to that information, not the concept of data ownership.

Our initial literature review suggests that whoever retains the right to 'limit access to, use, and destroy data' are likely the closest proxies to ownership of vehicle-generated data (Zhang, 2018). This is likely to be the vehicle manufacturer, a telematics service provider that collects the data from a vehicle and can prevent or control access by third parties including transport agencies.

This project assumes that government access to data provided over private networks will need to be negotiated through a vehicle manufacturer or providers of a telematics service as the 'gatekeeper' to accessing vehicle-generated data. In the absence of any law, ownership is governed by common law and the agreements made when buying a new vehicle or engaging a vehicle data service.

Data collected by transport agencies such as vehicle-to-everything (V2X) messages at the roadside, conversely, would be 'owned' by transport agencies.

Many vehicle manufacturers are constructing their systems so they are the sole end point for collecting vehicle data. Some stakeholders and literature consider whether changes to this to enable consumers to determine where their data goes may create an open digital market that benefits all users of data, including governments (Kerber, 2019). While we appreciate that this discussion could be a separate pathway to achieving this goal, it is not within the scope of this project or the NTC's remit. Granting consumers greater control of their own data is broadly being considered as part of the Australian Government's development of the Consumer Data Right (Australian Competition and Consumer Commission, 2020).[3]

Transport agencies collecting and storing data directly from roadside equipment are most likely the owners of that data.

1.7.4 Government open data policies

Transport agencies, as part of their broader government open data policies, provide access to third parties through 'creative commons' licensing with no or limited fees. These policies typically envisage creating greater value from publicly held information than transport agencies are capable of achieving on their own (Victorian Government, 2019).

It is partly this tension between government open data policy and commercial pressures to profit from data captured that is motivating some stakeholder views. Where transport agencies need to invest significantly to provide more timely, accurate and real-time data for the new private sector transport technology needs of the coming years, there is a question about what should be returned. Some transport agency stakeholders are considering if a

[3] The Consumer Data Right, while first starting with banking, energy and telecommunications, will be rolled out into different sectors.

data access right should be made a condition of accessing road networks (Austroads, 2018b).

This project does not consider whether government open data policy should be changed and fees and reciprocation added, but whether government should or can access the data it desires for transport planning, operational and safety purposes.

1.8 Problems and opportunities we are addressing

Vehicle-generated data is creating opportunities for transport agencies to create public value by enhancing network operations, investment, maintenance, planning and road safety. Australia's transport agencies are seeking to understand how they may access and create value from this data without raising commercial, privacy or security issues or disincentives to deploying technology.

Many transport agencies consider access to data as critical to their future operations. Without data they may be unable to make properly informed decisions. New and emerging technologies such as connected and automated vehicles could disrupt existing travel patterns and vehicle use. Data from the same vehicles could allow more dynamic responses to these changes.

While there is an opportunity to enhance decision making and allow more dynamic responses, the use of vehicle-generated data remains uncertain. Fundamental questions as to what data transport agencies desire, and whether this data can be meaningfully 'refined' into new insights, remain. A national view on transport agency data needs will reduce the likelihood of gaps or duplication of requests to generators of vehicle data.

Oversharing and undersharing of data can create problems. Oversharing data from a vehicle that is personal or of a perceived personal nature will see users opt-out of providing their data. Undersharing of data is likely to see transport agencies operating networks and systems not fully utilised.

The vehicle industry is also reluctant to share data with governments due to concerns over the breadth of purposes it could be used for, particularly because many agencies hold roles both as regulators and transport system operators. Industry reluctance is founded on valid concerns of government use of data detrimentally impacting on them or their customers. This could include enforcement or compliance action, inadvertent release of commercial intellectual property and customer privacy.

Generators of vehicle-generated data are aware of the high commercial value of data and are preparing market-based services in response to transport agency business needs. Determining the willingness to more openly provide access to this data will lead to a greater understanding between participants. There is early indication from industry of a willingness to exchange data for road safety-related purposes (European Automobile Manufacturers' Association, 2016). Governments have indicated interest in exchanging data for system optimisation and improved safety and environmental outcomes. We note upfront in this project the willingness of the European vehicle industry to provide public access to some road-safety-related data.

Australia risks creating a fragmented data approach if a national view of government access to vehicle-generated data needs is not developed and risks creating an overly burdensome environment of data sharing if demand for data is not well planned.

Current problems identified by stakeholders include:

- a lack of incentive or compelling reason to share or exchange data with governments
- lack of trust in exchanging data between parties
- lack of clarity and alignment on government priorities
- the high cost of systems, data collection, data storage and data analytics to manage data
- low deployment rates of connected vehicles with embedded connectivity in Australia.

Currently there is no framework in place that addresses these issues for all vehicles. We have developed one opportunity statement and three problem statements reflecting the opportunity to be seized and problems to be addressed.

Opportunity statement

There is an opportunity for stakeholder collaboration on exchange or sharing of vehicle data for road safety purposes to understand:

- what vehicle-generated data can be used to support road safety in Australia
- what an appropriate framework and forum might look like to support such an exchange.

Problem statements

1. Vehicle-generated data is currently not provided to transport agencies for purposes that may have publicly beneficial outcomes. This is due to current vehicle capabilities or a lack of incentive or reason for industry and road users to provide the data (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance schemes).
2. There is a lack of a data access framework to provide the necessary trust, data exchange systems, data standards/definitions, understanding of data needs, and governance to establish data access and use (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance schemes).
3. The level of uptake and penetration of connectivity across the Australian vehicle fleet may delay the benefits of vehicle-generated data, particularly related to safety-critical events.

Question 1: Do our problem and opportunity statements accurately define the key problems to be addressed, and do they capture the breadth of problems that would need to be addressed?

1.9 Approach

The NTC undertook a co-design approach to inform the evidence base of this discussion paper. Co-design seeks to build in stakeholder needs earlier into project phases. It enables stakeholders to hear directly from each other and to generate solutions to problems that the NTC may not have considered.

We engaged Arcadis to run a series of co-design workshops with government and industry stakeholders in Sydney and Melbourne. Because the Queensland Department of Transport and Main Roads is most clear on its desire to access vehicle-generated data, a government-only workshop was held in Brisbane.

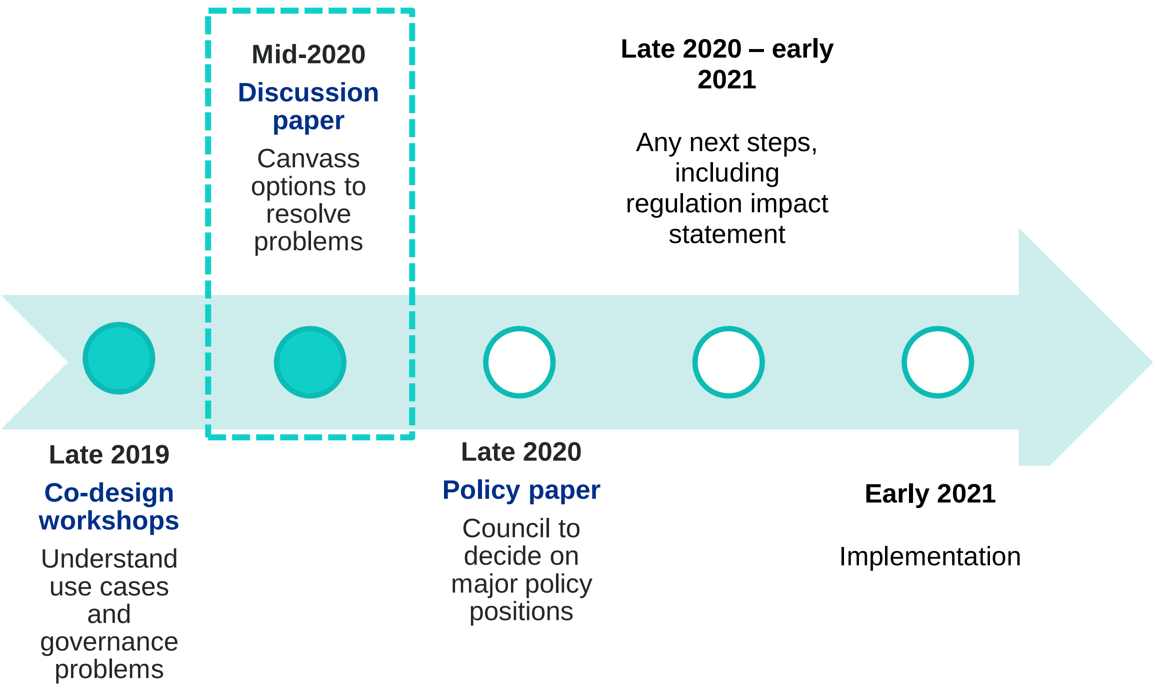
The purpose of the workshops was to better understand the data needs of transport agencies and the kind of data that industry is capable of producing, storing and processing. During the workshops, participants developed use cases on government access to vehicle-generated data. These use cases illustrate potential benefits, barriers and challenges for government vehicle-generated data. Both industry and government presented their knowledge and insight to stakeholders.

The result of these workshops was 23 use cases for road safety, network operations, planning, transport asset management, research, compliance and enforcement and the private sector. The most commonly held view from workshop participants is that safety-related use cases are the most important to prioritise followed by planning and network optimisation. These use cases and further results will be discussed throughout this discussion paper.

A second workshop was held on data governance – or the rules for how stakeholders would interact around access to vehicle-generated data. This was an opportunity to test options and solutions to breaking the barriers to data exchange.

This is the second stage of policy development for government access to vehicle-generated data. This follows from an initial literature review and co-design workshops with key industry and government stakeholders further discussed in section 1.6. We will consider submissions to this discussion paper to put forward a preferred option to transport and infrastructure ministers in late 2020 (see timeline in Figure 1).

Figure 1. Timeline for project implementation



2 Consultation

Key points

- Any individual or organisation can make a submission to the NTC.
- We are seeking submissions on the paper by Friday 3 July 2020.

2.1 How to submit

Any individual or organisation can make a submission to the NTC. The discussion paper includes 19 questions that we are seeking your feedback on. You do not need to answer all the questions. You may answer as many or as few as you like.

Making a submission

Visit **www.ntc.gov.au** and select ‘Have your say’ on the homepage.

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The *Freedom of Information Act 1982* (Cwlth) applies to the NTC.

2.2 Questions to consider

3 Background on vehicle-generated data

Key points

- Vehicle-generated data is any data generated by the vehicle itself and is about the vehicle, the road environment or the use of the vehicle. This includes data from the event data recorder, location data, technical data, driver data and sensor data. Much of this data is not stored, broadcast or shared. There is currently a low market penetration of vehicles that can share this data.
- The government could access connected vehicle data in several ways. It could receive V2X broadcast or unicast data through roadside infrastructure. It could also enter into commercial arrangements, partnerships or agreements with industry to access the data it collects.
- Current data access frameworks are limited to telematics within the heavy vehicle industry.
- The European Union is currently undertaking a 'proof of concept' for sharing road-safety data between government and industry.

3.1 Purpose of this chapter

The purpose of this chapter is to provide an understanding of what we mean by vehicle-generated data and to provide an overview of relevant Australian and international developments.

3.2 What we mean by 'vehicle-generated data'

3.2.1 We have defined a new term for vehicle-generated data

We have adapted the term 'vehicle-generated data' for this project to capture the idea of data generated by vehicles that is not linked to any specific technology or communications platform. Vehicle-generated data may have a different definition depending on where the term is used, and it is important to define what is meant by this term.

Vehicle-generated data is substantially different from data collected by other forms of modern transport data collection such as roadside data collection devices. Such transport data collection systems sense the presence of a vehicle, or a device, but do not interact with any of the vehicle's systems.

For the purposes of this discussion paper vehicle-generated data is not limited to C-ITS (from here on referred to as 'V2X') and automated vehicle data.

Vehicle-generated data definition

For the purpose of this project:

- Vehicle-generated data is any data generated by the vehicle itself that is about the vehicle, the road environment or the use of the vehicle.

It should not include data generated by drivers such as address books and audio inputs to vehicles – this is a user's data. Further terms relating to data may be found in the Glossary.

Our view on the type of data vehicles could generate includes the following.

Categorisation of vehicle-generated data*

- **Movement/location data:** Precise geographic location of vehicle (location, timestamp, heading).
- **Events/actions:** Operational functioning of the vehicle including, but not limited to, anti-lock braking systems (ABS), electronic stability control (ESC) sensor activation, windscreen wiper or hazard light activation.
- **Driving behaviour:** Information about either the physical state of the driver (for example, eye movement) or how a person drives a vehicle (speed, acceleration, seatbelt status, harsh braking, lane departure events). This information may be directly from a vehicle's systems or derived information.
- **Crash analysis:** Data stored and recorded on either the event data recorder (EDR) or data storage system for automated driving (DSSAD) for road safety and user information purposes. This could also include other sensor data not currently stored on board but stored remotely by vehicle data servers.
- **Crash response:** Crash data messages triggered by airbag deployments and sent to public authorities for emergency crash response (eCall – or automated crash notification systems)
- **Asset sensing:** Data about how the car perceives its remote environment including infrastructure and other road users. For example, radar/LIDAR/machine vision, tyre pressure or information packets derived from this data. This could be used to indicate potholes or road surface deterioration.
- **V2X messages:** Data packets generated by vehicles in a structured format that can be consumed by other vehicles or devices, or infrastructure. Primarily the:
  - cooperative awareness message (CAM) – location data
  - decentralised event notification message (DENM) – hazard warnings
  - signal request message (SRM) – request for a green light
  - signal phase and timing, MAP (road geometry messages), vehicle signage.
- **Automated driving:** It is unclear what data would be produced specifically by automated driving systems, or how this would be reported. We speculate that it could include safety reporting obligation requirements, vehicle handover requests or data relating to the vehicle's operational design domain.[4]

***** This data categorisation was developed from the data categorisation presented in 'Who owns your smart car data' (Zhang, 2018), with further development by the NTC in consultation with other data practitioners.

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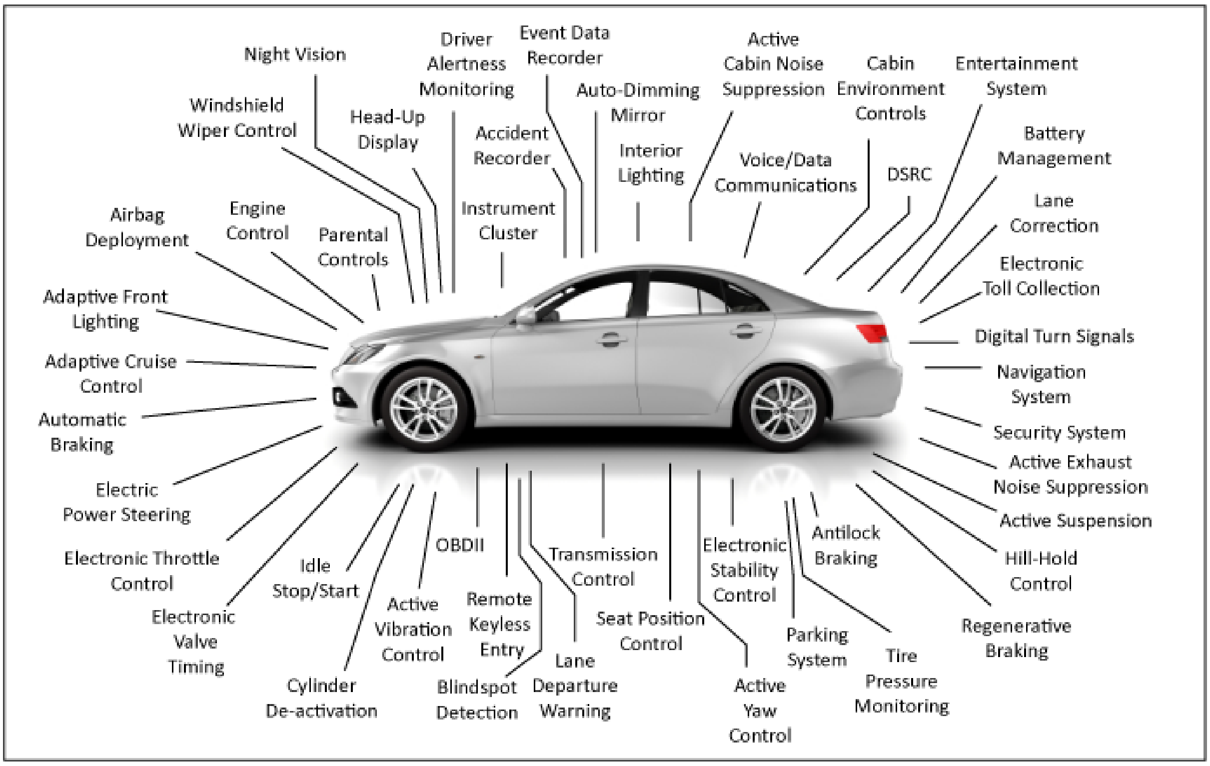
[4] These safety obligations will most likely be in line with first-supply safety criteria as outlined in the NTC's *In-service safety for automated vehicles consultation regulation impact statement*.

More information on the types of categories of data is provided in chapter 6.

3.2.2 What data can be shared outside the vehicle?

Vehicles have the capability to produce significant amounts of data – up to four terabytes of data each day (Krzanich, 2016). While this provides an upper bound to the capabilities of a vehicle, a more realistic expectation will need to be set around what can actually be viably *shared* from the vehicle. Figure 2 illustrates the many different sources of data from a vehicle, which is expected to grow in future years (Turner, 2018).

Figure 2. Sources of vehicle-generated data



Source: The Clemson University Vehicular Electronics Library

More terms related to data can be found in the Glossary.

Much of the data generated by a vehicle is likely to be generated and consumed within the local vehicle systems and never stored or communicated externally. For example, a frontal camera system may scan much of the road environment; however, only very limited data will be processed by the camera, and much of that will be discarded once it has been used in an advanced driver-assistance system.

Each vehicle may be able to create a 'digital exhaust' driven by its internal electronic control units and sensors. However, only a portion of it will be available for sharing. The sharing of data outside of the vehicle incurs costs of data carriage, storage and analytics. High costs of storage and transmission are likely to inhibit data sharing. We have heard frequently through this project that it is likely that only small packets of information derived from vehicle sensors or systems could be cost-effectively shared.

3.2.3 Monetising vehicle-generated data

The value of the data means there is a potential for vehicle data to provide new sources of revenue. McKinsey & Company estimates that the overall revenue pool from car data monetisation at a global scale might add up to USD450–750 billion by 2030 (McKinsey & Company, 2016). Business ventures such as HERE Technologies, an information service provider, are partly owned by large automotive companies. Vehicle data is already included as part of its service offerings.

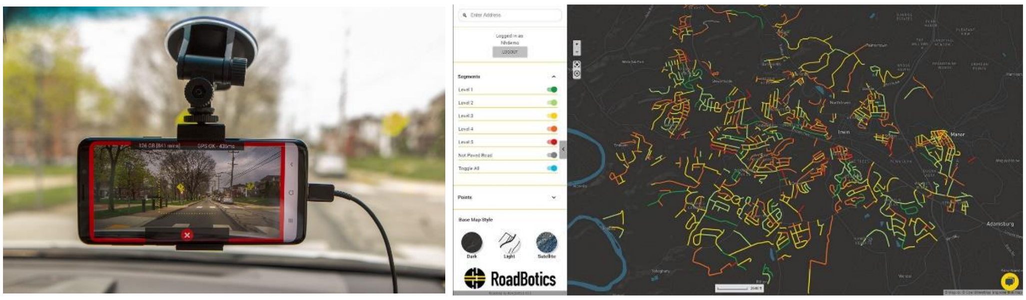
Vehicle monetisation use cases can include concierge services, remote vehicle diagnostics, vehicle breakdown services, pay-as-you-drive insurance and live traffic data (McKinsey & Company, 2016).

While monetisation of data adds barriers to access, there are two further key points to consider from data monetisation for government access:

- The value of commercial incentives will drive the development of more innovative products and services for transport agencies and the community.
- Many of the technologies that generate vehicle data are linked to features that have been added to vehicles to increase their safety and efficiency. Technologies including forward-facing cameras and radars can enable automated braking or speed-assistance systems as an example. But they also enable the vehicle industry to seek to commercialise data from these sensors. This increase is an incentive to deploy more safety equipment on-board the vehicle.

Case study: Roadbotics

Roadbotics are a recent spin-off from Carnegie-Mellon University's Robotics Institute. Roadbotics offer a service that collects data from forward-facing cameras (currently from mobile phones) to collect data about road surface conditions through small vehicle fleets. This is an example of commercial incentives driving innovation for transport agencies.



Source: Roadbotics

The collection of data allows Roadbotics to offer commercial services to road authorities including map-based visualisation of road conditions. Their value proposition is that they can create road condition information more rapidly than existing road data collection services. A similar service is offered in Australia through Fulton Hogan.

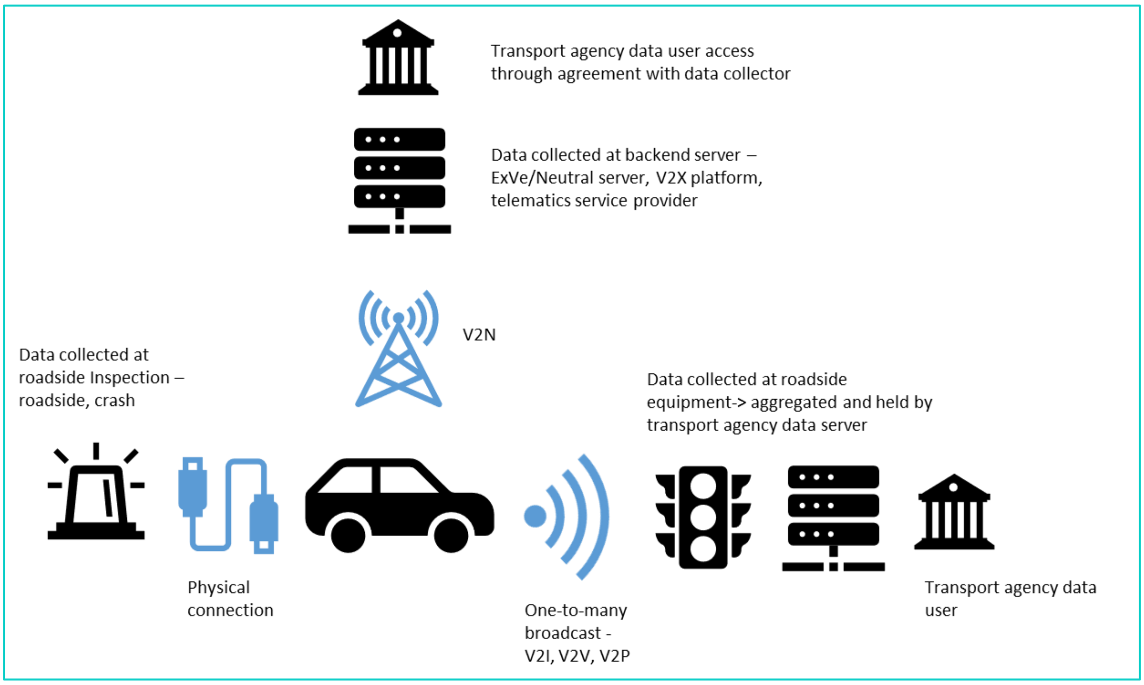
While Roadbotics currently uses mobile phones to capture data, the German car brand Mini has previously invested in the start-up, and there is the potential that data could be captured passively through vehicle frontal cameras in the future.

3.2.4 How governments may access vehicle-generated data

There are different ways in which governments may access vehicle-generated data (see Figure 3). Broadly speaking, it can be:

- received via an ad hoc broadcast or unicast of messages such as through V2X systems
- sent via a private cellular network – often referred to as a V2N
- accessed by physical connection to the vehicle such as the on-board diagnostics port – this may include the EDR or proposed driver state system for automated driving through on-board access.

Figure 3. Current access methods for governments



Data broadcast or unicast over ad hoc networks

Cooperative systems, often referred to as V2X, deliver low-latency safety messages directly from vehicles that conform to strict sets of interoperability standards (referred to as the CAM and DENM). These messages contain small packets of information primarily about the location of the vehicle. They also include some limited vehicle hazard data such as emergency brake activation and traffic signal priority requests. These are the primary data points of interest to governments.

These messages can be broadcast by the vehicle via dedicated short-range communications or C-V2X and may be received by government through roadside equipment and infrastructure. This can be done by installing roadside C-ITS infrastructure, as is the case in the C-ITS pilot in Queensland (Queensland Government, 2019b). There is also a similar trial in Victoria using cellular infrastructure connecting vehicles to one another and to traffic management centres (Webster, 2019).

Data provided via private or cellular data networks

Data generated by a vehicle may also be directly transmitted to a server, telematics provider or central platform or server for V2X data. Data sent over private networks could include data from embedded vehicle systems or eSIM, data from aftermarket telematics devices or V2X data sent via cellular networks.

Depending on the type of vehicle connectivity system and its access to the vehicle’s internal network, different levels of data from the vehicle can be extracted.

Data provided from embedded vehicle systems available to original equipment manufacturers may include almost all data captured in a vehicle. This could include location data, driver data, vehicle technical/safety data and sensor data. The European vehicle industry outlines that vehicle-generated data could include (European Automobile Manufacturers' Association, 2016, p. 2):

> *The data that can be made available is 'vehicle generated data' or 'operating data'. It excludes data imported by vehicle users (e.g. mobile phone contact list, selected destinations for navigation) and data received from external sources (e.g. information transmitted by roadside units, other vehicles or vulnerable road users).*
>
> *Vehicle generated data is created within vehicle control units and helps ensure the safe operation of the vehicle, checks its proper functioning, identifies and corrects errors and refines and optimises vehicle functions.*
>
> *It also documents the system status for certain events (e.g. component malfunction, airbag deployment, stability control) and records the relevant information for the function (e.g. number of revolutions, acceleration, speed, air temperature, fuel level or brake pad wear). This operating data varies according to manufacturer, vehicle type and equipment.*

Aftermarket telematics devices may also capture data such as location. Depending on the system available aftermarket telematics may also capture some data from the vehicle's engine system (via the on-board diagnostics port) or from additional sensors such as accelerometers. This may include data such as when the vehicle has engaged heavy braking. Transport Certification Australia has outlined that the following data is available through regulatory telematics (Gordon, 2019):

- position or location (latitude, longitude)
- time (time, date)
- vehicle type
- enrolment (for example, the scheme the vehicle is monitored under)
- speed
- mass
- fatigue events
- alarms (including tampering and malfunctions).

In either case, data is stored by an original equipment manufacturer server or telematics provider server and aggregated into different datasets, potentially for a variety of purposes.

Emissions, crash/event/liability data accessed through physical interface on the vehicle

Data relating to crashes and events is stored in some vehicles within an EDR. Such data is collected continually but only retained and stored in the event of a crash when the airbag is deployed (up to five seconds either side of the event). This data may be given to an enforcement agency (such as police) voluntarily or obtained by an enforcement agency using any coercive powers available to it under the law.

A physical interface to the vehicle – the on-board diagnostics port – enables access to certain limited engine and emissions data used for checking exhaust emissions system compliance.

3.3 What vehicle-generated data could governments access now and in the short term?

To understand what data is currently available through existing collection and access powers, we have reviewed current collection powers (Vaile, et al., 2018). Table 1 outlines key examples of how governments in Australia currently are able to access vehicle-generated data.

From the table a few clear conclusions can be drawn:

- Where governments have accessed data to date, this has been achieved through regulatory mechanisms that compel access to data, with some limited exceptions.
- Governments typically opt to place higher data requirements on higher risk and more highly used vehicles such as those used in commercial services, rather than on private vehicles. This most likely reflects the greater ability to create an incentive for data access and the reduced sensitivities to accessing data from commercial drivers compared with privately owned and operated vehicles.
- Access to data is usually placed on narrow cohorts of vehicles such as restricted access vehicles, which require additional permission to access vehicle networks. In this sense, access to data has been as a condition of access.
- Access is typically limited in scope for the purposes the Transport and Infrastructure Council tasked the NTC to investigate. Under a ‘business as usual’ or ‘no intervention’ scenario, current regulatory access arrangements would only provide limited access, and market-based access would be needed to meet most of the purposes we have been asked to consider.
- A wide range of powers have been created to access vehicle data. However, these have been developed based on the access need and to the cohort of vehicles it would apply. By contrast, a general authorisation power or access right has not yet been developed.

Question 2: In our table, have we accurately captured all the regulatory and legislative mechanisms government could currently use to access vehicle-generated data?

Table 1. Examples of current Australian Government access to vehicle-generated data

Table key: No access likely; Some access but limited in scope; Broad access for purposes

Regulatory access and use	Connection to vehicle	**General access vehicle** (typically light/heavy passenger, commercial, within normal mass and dimension limits)	**Ride-hailing or point-to-point vehicles** (transport network companies such as Uber)	**Restricted access vehicles** (requiring a permit/notice to access road networks)
Heavy Vehicle National Law and state and territory vehicle law (e.g. condition on notices or permits)	V2N	No government access	No government access	- Location, mass, fatigue data for safety, compliance and asset management purposes - Historical data
Commercial Passenger Vehicle Regulations (example used – Victoria)	V2N	No government access	- Origin/destination for levy purposes - Limited to historical data on request	No government access
Radiocommunications (Intelligent Transport Systems) Class License 2017	V2I, V2V, V2P	- CAM, DENM, traffic signal request - Use for transport purposes such safety and network efficiency - Limited to where vehicles are equipped and where transport agencies fitted devices to collect messages		
Telecommunications (Interception and Access) Act 1979	V2N	- Most vehicle data, obtained by warrant for law enforcement purposes - Limited to where reasonable suspicion is identified		
Data via a warrant (e.g. s 128 of the *Road Safety Act 1986* (Vic))	Physical	- Crash data available through EDRs (where fitted) for safety and legal information purposes - Limited to crashed vehicle locations		
Australian Design Rule 79/01 (on board diagnostics port)	Physical	- On-board diagnostics emissions data for vehicle emissions purposes - Limited to intercept points such as inspections or tests		

It is likely that current access will be supplemented by requirements developed through the United Nations forum for harmonisation of vehicle standards – Working Party 29. Commonwealth government policy is to align Australian Design Rules with international standards. This means that any international proposals are likely to eventually come into Australian law.

There are currently United Nations proposals which if adopted in Australia would permit governments to access crash data from vehicles which is illustrated in Table 2.

Table 1. United Nations current and future proposals

Proposal	Data available, when it will be available, access method
Safety data – EDR Purpose – legal information for safety and liability purposes	**Data stored/available**: Crash information, brake/throttle/steering inputs **When:** Proposed on light vehicles by 2022 and all new vehicles of categories (heavy and bus) by 2026 **Access method**: Physical connection to vehicle, at crash location.
DSSAD – legal information for safety and liability purposes	**Data stored/available:** Automated driving system activation – deactivation, transition demand, emergency maneuver **When:** Proposed new international definition by 2020 through United Nations Working Party 29. Implementation unknown **Access method:** Unclear, may be on-board or off-board (data server) access

Question 3: Are there other major local or international jurisdictional developments providing further access powers or arrangements for vehicle-generated data?

3.4 Vehicle-generated data use for crash causation and liability

Some vehicles in Australia are fitted with EDRs, and currently some enforcement agencies may seek EDR access to the data via a warrant.

There are some barriers to this process, with some jurisdictions noting that it can be difficult for enforcement agencies to obtain the data from manufacturers when the data is located overseas. Jurisdictions also note issues with accessing the electronic interface and that some manufacturers do not allow access to data for crash investigations.

Access to crash data was not a focus of our workshops given the breadth of stakeholders involved. We note that this will remain a key priority for enforcement agencies.

As outlined in **Table 1** it is likely that enforcement agencies will have improved access in the future to crash-generated data. This will require adoption of United Nations proposals by the Commonwealth government through adoption in the Australian Design Rules.

3.5 What data about automated vehicles is unique?

For the purpose of the discussion we refer to automated vehicles as those that are capable of completing the dynamic driving task (Society of Automotive Engineers level 3 and above).

We do not consider automated vehicles distinct from existing vehicles for the purposes that the Transport and Infrastructure Council has tasked us to investigate, with the exception of data related to the performance of automated driving systems in-service. These opportunities could be:

- the DSSAD
- safety reporting obligations (such as those in California (State of California Department of Motor Vehicles, 2020))

For all other data needs, vehicles will have similar features, sensors and communication systems likely to be common for automated vehicles and those with advanced driver assistance, albeit with greater capability at higher levels.

3.5.1 Cybersecurity risks increase as vehicle automation increases

Government access opportunities may be more difficult to establish for highly automated vehicles as industry becomes less willing to provide access. In our discussions with several developers of these vehicles, it is apparent that, in the initial stages of deployment, connectivity may be very limited and only provide interfaces with trusted services such as a 'remote operating centre' (Davies, 2017). These concerns appear to be based on cybersecurity risks that are opened by increasing the number of interfaces or 'attack surfaces' to the vehicle (Pegoraro, 2018).

In our early consultations one developer commented that current data exchange with their vehicles is through physical handling of hard disk drives in and out of the vehicle. Data connection to the vehicle in operation may only occur through a network connection to a remote operational centre. Discussions acknowledged that the benefits of third-party connectivity are being considered and may be explored once an initial safety system for the vehicle has been established.

We note this as a clear risk for transport agencies in Australia. Focusing too early on automated vehicle data at the exclusion of current opportunities for access may delay the benefits of data for their communities.

3.5.2 Data storage systems for automated driving

What is unique is the potential for vehicle-generated data to denote the status of the driver and the automated driving system, which may help with clarifying legal liability for either insurance or road safety enforcement purposes. We refer to the DSSAD for this purpose (UNECE, 2019).

3.5.3 Safety reporting requirements

Many international regulatory agencies are also considering mandatory reporting requirements for operators of automated vehicles to determine overarching on-road safety performance. California's requirement for disengagement data is an example of this approach (State of California Department of Motor Vehicles, 2020).

3.6 Potential timeline for introducing connected vehicles

3.6.1 Embedded systems

Vehicles equipped with their own native or embedded connectivity system providing services that use vehicle-generated data have existed for many years. Early examples include General Motors' OnStar telematics service providing remote diagnostic services. This service first entered the market in 1996 and continues in the United States but will be discontinued in Vauxhall vehicles (Fleet News, 2018).

Toyota Australia and General Motors were early adopters of vehicle telematics in Australia by providing the option to include a system run by Intellematics in the early 2000s. This system provided remote security, safety and data services to vehicles but was removed from service.

More recently several local vehicle importers have announced deploying embedded connected vehicle systems in Australia including:

- The parent companies from these brands feature data servers that make data publicly accessible such as BMWCarData (BMW Group, 2020).
- Ford Australia has recently announced that all new Ford Ranger models released in Australia in 2020 will feature embedded vehicle connectivity technology (Ford Australia, 2020).
- Volvo UK announced that it will add 'big data' to every new car sold in the United Kingdom from 2020, which will include a SIM with 100 GB in the initial year of purchase with features such as 'Real Time Traffic Information' (Volvo, 2019).

Case study: Tesla connectivity

While connectivity is new a feature in many traditional vehicle brands, Tesla is a unique case study because it has embedded connectivity in almost all of its models. Tesla vehicles feature telematics data (V2N) transmitted to its server. Most data is not stored on the vehicle. The data captured by Tesla is reported to be significantly ahead of other vehicle brands and automated driving system developers (Forbes, 2019). Some of the estimates as to the scale of this data include:

- Approximately 800,000 Tesla vehicles have been sold globally.
- Tesla vehicles have driven 16 billion miles, of which approximately two billion are considered to have been driven in an ‘autopilot’ mode.
- Unlike the data captured in EDRs, Tesla captures richer data from the vehicle’s cameras and radar systems, which is used to ‘train’ Tesla’s automated driving features.

What makes this case study interesting is that accessing this data has proven to be very challenging for government agencies and individuals. Tesla owners have reported that information relevant to potential legal proceedings could be stored on remote servers, but they have not been able to access it, only the data stored on board the vehicle’s EDRs. Some data has been made available for fatal crash investigations but only reportedly through court orders (Mitchell, 2020).

Other data that Tesla may collect could also be of interest to transport agencies, including information about deteriorated road conditions such as pavement markings, signs or potholes (Lambert, 2020).

Case study: Current state of connected vehicle data field capability

To assist our project, the Federal Chamber of Automotive Industries (FCAI) conducted a survey of 15 vehicle brands as well as reviewing published announcements, with the following results. We note this survey was limited in scope but it provides a useful guide to the state of deployment in Australia. The study did not include infotainment-based connectivity.

As part of discussions, the FCAI indicated that they expected connectivity will grow rapidly in the next 12–24 months and will be driven by new consumer offerings such as concierge, security and driver data services. FCAI expects connectivity will precede vehicle automation in its deployment in the Australian market.

No. of brands surveyed	Market share	2019 sales	Connected vehicles
15	71%	760,000	72,000

Connected vehicles surveyed: 9.6%

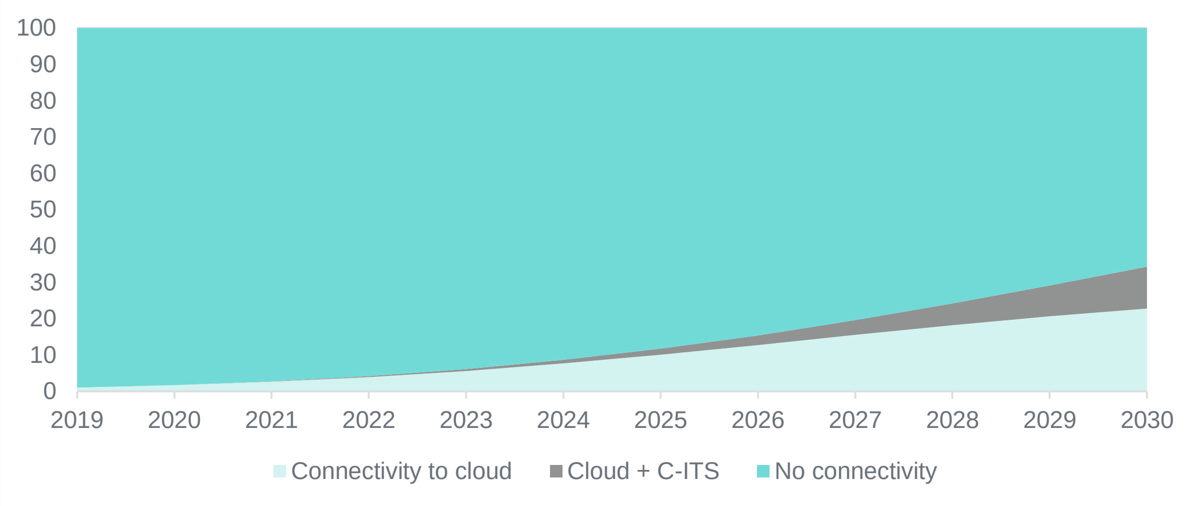
- Time Stamp 9.6%, GPS 9.6%
- Airbag 4%
- Hazard 1%,
- Door Lock 1%
- ABS event 0%, windscreen wiper activation 0%, ESC event 0%, TRC event 0%

Austroads identified that, in 2019, 7 per cent of newly sold vehicles were fitted with some form of connectivity to the cloud that is embedded in the vehicle (Austroads, 2020) . The report also forecasts growth in cooperative and embedded systems. Austroads estimates that approximately 1 per cent of the Australian fleet is equipped with some form of connectivity. No new vehicles in the Australian market are considered to be equipped with C-ITS-capable technology. C-ITS-equipped vehicles are forecast to make up around 12 per cent of the fleet by 2030.

IHS Markit forecast that by 2023 approximately 69 per cent of new vehicles globally will be fitted with connectivity (IHS, 2018). By 2030 it is estimated that 40 per cent of new cars and SUVs will be fitted with C-ITS, with fleet penetration at a little over 10 per cent (Austroads, 2020).

Figure 4 shows forecast Australian penetration rates to 2030.

Figure 4. Predicted percentage of car and SUV fleet with connectivity features to 2030



Source: Austroads

The forecast rates shown in Figure 4 do not consider the change or introduction of any new regulation that may have an impact. Austroads estimates that the vehicle fleet penetration rate for highly automated vehicles will be approximately 4 per cent in 2030.

Cooperative systems

Cooperative systems, often referred to as V2X (vehicle-to-anything), are also likely to appear in the coming years. Several vehicle brands are signalling future fitment of cooperative systems; however, most remain in proof of concept or trial phases. For example, Ford US has announced that fitment will commence from 2022 based on C-V2X cooperative systems (Stevens, 2019). However, the rollout for cooperative systems is less clear, with international government and industry disagreement over standards for adopting this technology. For example, Volkswagen recently announced its decision to deploy cooperative systems based on a separate set of vehicle standards known as ITS-G5 (or wi-fi) (Shankland, 2019).

Tethered systems

Depending on the vehicle manufacturer's implementation, connectivity may also be applied to vehicles via tethered phone devices. Tethered systems include Android Auto and Apple Car Play, which connect a vehicle's infotainment system to a nomadic mobile phone device. We understand that tethered systems do not offer integration with the full range of vehicle technical systems such as the vehicle's technical network or sensors but may have access to the vehicle's location and some infotainment settings (Wright, 2020). Notwithstanding a lack of full integration there is likely to be significant volumes of location data generated through these services in the current deployed vehicle fleet, which is useful for planning and network operations purposes.

3.6.2 Mobile phone application data

Similarly, mobile phone application location data is used by many commercial passenger service vehicles (Uber is an example). While not within scope of this project, we note that these companies have previously offered access to aggregated data on average travel times and speed in many Australian cities via a web interface (called 'Uber Movement', which is currently not active). Some transport agencies purchase such data from Google and other companies to use for network planning.

3.6.3 Aftermarket telematics

Aftermarket commercial telematics are available in the new light vehicle market as an additional, optional fitment by fleets. These are often supplied by vehicle manufacturers such as Toyota (Toyota, 2020). In heavy vehicle fleets, these have become common for a range of commercial purposes. Aftermarket systems are not integrated with the vehicle's sensor or technical network so are limited in the scope of data they produce. In current fleets, aftermarket telematics are capable of generating useful information about the vehicle's location and engine diagnostics and can be linked with additional aftermarket sensors that measure vehicle acceleration, driver fatigue and vehicle mass.

Some aftermarket telematics systems can replicate the capabilities of embedded vehicle systems. Mobileye is a supplier of advanced driving systems and chipsets to the automotive industry. It offers an aftermarket telematics service that can capture data from vehicle warning systems such as lane departure, over-speed and vulnerable road users detection systems (BusinessWire, 2020).

Summary

Connectivity options in vehicles remain broad, without any apparent consensus from industry on adopting one preferred solution. While some technology is currently available, connectivity of vehicles in Australia remains low. Depending on the purpose data is being used for by industry, connectivity solutions appear to remain fit for purpose. This has implications for governments because, depending on the purposes for which data is desired, the availability of connectivity solutions, and therefore data availability, may vary significantly.

Question 4: Do you agree with our assumptions on the currently low uptake and limited availability of technology that supports the generation of vehicle data and that there are few and limited current government access arrangements for vehicle-generated data?

3.7 Relevant developments in Australia for vehicle-generated data

Regulatory developments to date in Australia are limited to the heavy vehicle industry.

3.7.1 National Telematics Framework and regulatory telematics

The National Telematics Framework (NTF) is administered by Transport Certification Australia. The telematics framework covers some key data governance principles including:

- defining and separating the roles and functions of participants in a data exchange system
- separating the purposes for use of similar data (such as location data) for compliance, enforcement and road management functions
- facilitating trust among users within the system by separating providers of data (drivers, fleets) from developers of regulatory tools (transport agencies)
- a data dictionary to facilitate and reduce the cost of data exchange between key system participants

- principles for establishing new regulatory tools from compliance and enforcement data.

However, transport agencies are increasingly interested in use of data, not for compliance purposes but for improved performance of transport networks. Transport Certification Australia's (TCA) Road Infrastructure Manager application (TCA, 2020) is an example of a level 1 application that is being increasingly used in notices and permits required for network access. Data is used only to provide reports on road usage so that improved network planning and maintenance decisions can be made.

TCA has also developed a telematics data exchange platform primarily for heavy vehicles that acts as an intermediary between transport agencies, vehicles and transport operators to facilitate data exchange while supporting privacy obligations.

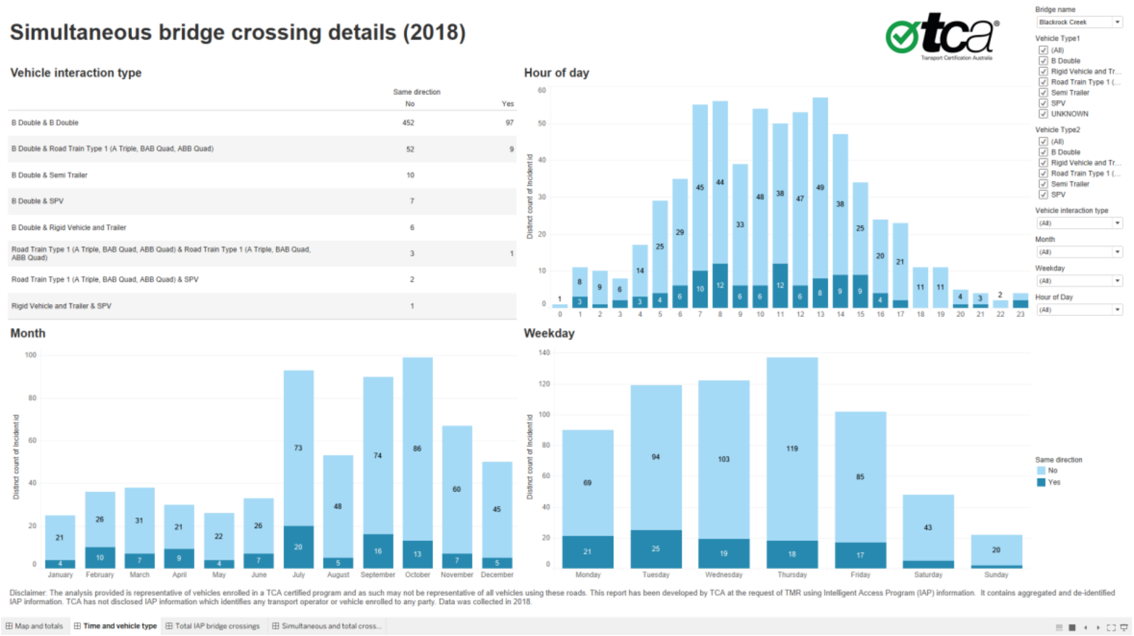
The framework has also facilitated the voluntary exchange of data between heavy vehicle and transport agency participants. Examples given by TCA include where dangerous goods have provided vehicle movement data used to highlight network planning challenges with moving dangerous goods.

Case study: TCA providing bridge cross-analysis through data from the National Telematics Framework

TCA is using data received through the NTF to help road managers to build, maintain and operate the roads more safely.

Analysis of bridge use by heavy vehicles is a key area of focus. Analysis supports road managers in better planning maintenance, targeting enforcement, managing access for heavy vehicles and working with local government and state road managers to better plan across the network and support safer travel. Analysis of such data can provide information to road managers on the frequency of bridges crossed by trucks and the type of truck crossing the bridge. This supports better bridge management and maintenance.

This analysis is possible because of the NTF – the business rules and data standardisation protocols – allows TCA to ingest data from lots of different service providers, transport operators and vehicles and to transform it into useful analysis for road managers and the public.



Source: TCA presentation

3.7.2 What can be learned from Australia's experience with heavy vehicle telematics?

There are two key learnings to consider for exchanging data between transport agencies and generators of vehicle data.

- *An appropriate incentive is needed.* In the case of heavy vehicle telematics, incentives include:
  - a regulatory requirement to comply with conditions of a notice, permit or law
  - allowing vehicles to have expanded road access or to operate at higher mass limits
  - building on the goodwill of industry to contribute to planning (reducing impacts on infrastructure), network efficiency or safety goals of the community.
- *Establishing trust and reducing the cost of exchange.* Given the reluctance of the vehicle industry to provide access to raw data:
  - separating the capture and management of vehicle-generated data from government agencies with enforcement powers through the use of a 'safe harbour' so that only reports or aggregated data are shared with government for some purposes
  - enabling a nationally consistent approach through a central data definition and platform for exchange
  - standards that are neutral technology or vehicle type.

Case study: NSW Telematics

The Transport for New South Wales website provides an interactive telematics visualisation showing a wide range of data on freight movements, performance and heavy vehicle counts on roads in New South Wales. The maps present aggregated, de-identified position data generated by vehicles monitored through the IAP and other telematics programs. The data currently covers heavy vehicles enrolled in the IAP. It provides valuable insights into the movement of freight vehicles across New South Wales.

The telematics data is made available through TCA – the Australian entity responsible for administering the IAP and other applications of the NTF.

TCA performs a ‘critical, independent role’ between industry and government in collecting, de-identifying and aggregating telematics data. This provides certainty to stakeholders that transport operator and vehicle-specific data is protected from disclosure to other parties, commercially sensitive information is securely managed, and privacy-by-design principles are upheld.

The NSW Freight Data Hub provides industry and the community with transparent information on the movement of monitored vehicles. This data already allows analysis of vehicle movements by vehicle type/combination, time of year/season and looking at key freight routes as well as lower order roads.

The information available is gradually increasing, and TCA and Transport for New South Wales are exploring other types of data analysis and other ways of sharing data with industry and the community. Examples of potential data analysis includes average speed of particular routes by time of day (to help trip scheduling and planning), contributing to the geographic analysis and estimation of transport emissions, and movements in key supply chains.

3.7.3 Use of Telematics data for compliance and enforcement purposes

The NTC’s Review of Regulatory Telematics outlines principles for developing compliance and enforcement applications from telematics data (National Transport Commission, 2018). The principles note that for *research and planning purposes* de-identified data and aggregated data should be used. Information derived from telematics data must only be accessed for the purposes for which it is collected, and any data collected should also be clearly outlined unless a warrant is obtained.

3.7.4 Privacy principles for government access to C-ITS and automated vehicle data

Our previous project on this topic includes privacy principles for government access to C-ITS and automated vehicle data (National Transport Commission, 2019b). The key principles are that policy frameworks should:

- be consistent with, and informed by, existing and emerging Australian and international privacy and data access frameworks
- align government entities’ approach to managing C-ITS and automated vehicle data with the objectives underlying existing concepts of personal information

- specify the C-ITS and automated vehicle data covered, the purposes for which the data can be used and the parties to whom the purpose limitations apply while not impeding access to data with a warrant or court order authorising a different use
- recognise the importance of notifying users in plain English about government collection, use, disclosure and storage of C-ITS and automated vehicle data.

3.8 Relevant international developments for vehicle-generated data

The United States and the European Union are developing regulations and opportunities for data exchange. However, both jurisdictions are delaying the widespread adoption of cooperative systems in new vehicles.

3.8.1 Trials and proofs of concept

Data exchange between the vehicle industry and transport agencies is in its early stages in key jurisdictions (Europe, Japan and the United States). While there are many projects, some of the proof of concept projects or trials have we have identified include:

- the European Union's Data Taskforce and its Data for Road Safety Proof of Concept (Data for Road Safety, 2020a)
- Toyota data exchange with local municipalities in Japan for road maintenance data (Toyota, 2018)
- the NordicWay project, which includes Scania and Volvo providing road hazard warnings through cloud data exchanges (Norwegian Public Roads Administration, 2020).

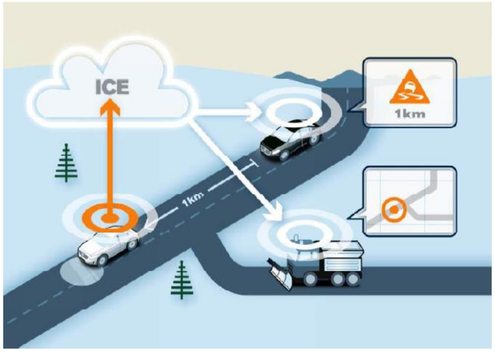
Access to vehicle-generated data in these jurisdictions demonstrates a willingness in the vehicle industry to exchange some data with transport agencies. While Australia has not run trials as seen in other countries, no country has a fully implemented solution, with the possible exception of Sweden outlined below.

Case study: Volvo sharing of safety data

Volvo is an early adopter of vehicle connectivity in Europe. Since 2014, Volvo vehicles have been sharing slippery road warning and hazard light warnings between other Volvo vehicles and the Swedish and Norwegian road traffic authorities via cloud-to-cloud data exchanges. More recent developments in sharing of safety-related traffic data by Volvo include:

- In 2018, this work has expanded to include Scania trucks.
- In 2019, it expanded to include all Volvo models.
- More recently, Volvo has starting sharing safety-related data with other vehicle brands and national traffic authorities through the European Union's data task force (Data for Road Safety, 2020a).

Data collected and shared by Volvo is either de-identified or aggregated so the initiative will comply with the European General Data Protection Regulation (GDPR).



Source: D.Pickett, Volvo Australia

3.8.2 Developments in the United States

The United States Department of Transportation is taking an approach of first facilitating data access from transport agencies with a view to a response by the vehicle industry (United States Department of Transportation, 2019). The department's publication of the Work Zone Data Exchange is an example of government facilitation. It aims to reduce costs for data exchange by harmonising approaches to work zone data dictionaries. It also recognises the need for government agencies to stimulate access to vehicle-generated data through the concept of 'exchange'. The state transport agency's own data plays a key role in providing data to vehicles, and there is a benefit in vehicles receiving data from transport agencies.

By contrast, American state governments have been stronger in mandating open access to vehicle-generated data (for example, the Massachusetts House Bill 293) (Commonwealth of Massachusetts, 2019). Industry has indicated a reluctance to participate in this environment.

The Massachusetts House Bill is an example of a broader campaign to ensure open access to vehicle data for third parties and began in discussions in American 'Right to Repair' campaigns. Automotive aftermarket participants, such as vehicle breakdown and service/repairers, contend that without access to vehicle data they will be locked out of future business opportunities (Auto care association, 2019). Likewise, some believe open vehicle access is a key to ensuring all third parties including services for traffic data and cooperative systems have open access (FIGIEFA, 2019).

3.8.3 Developments in the European Union

eCall

The European Union has introduced the mandatory inclusion of eCall in new vehicles, an in-vehicle system that contacts emergency services in the event of airbag deployment (European Commission, 2020b). The eCall mandate applies to all new light passenger vehicles from March 2018. The eCall mandate is significant for Australia because it binds a common communications technology to all new vehicles delivered to that market (Heero Pilot, 2020). Estimates are that all European vehicles will have this capability by 2035. The basic operation of an eCall system is as follows (see also Figure 5):

- *Emergency call:* An emergency or eCall is activated automatically as soon as the vehicle's sensors have detected a serious crash. In Europe, the system dials the European emergency number 112 or a privately operated call centre.
- *Positioning:* It establishes a telephone link with the appropriate emergency call centre and sends details of the accident including the location.
- *Public safety answering point:* Once an eCall message is received at a public safety answering point, operators can then dispatch appropriate assistance.
- *Quicker help:* The European Union estimates eCall can speed up emergency response time by 40 per cent in urban areas and 50 per cent in the countryside. It can reduce the number of fatalities by at least 4 per cent and the number of severe injuries by 6 per cent (European Commission, 2020).

Safety-related traffic data

The European Union has also implemented Delegated Regulation 886/2013. This regulation sets out the procedures for providing, where possible, road-safety-related traffic information free of charge to users. The regulation sets out eight use cases for which data must be provided to end users by vehicle brands and European member states.

The eight key use cases are:

- temporary slippery road
- animals, people, obstacles, debris on the road
- unprotected accident area
- short-term roadworks
- reduced visibility
- wrong-way driver
- unmanaged blockage of a road
- exceptional weather conditions.

The regulation sets the context for the European Union's Data for Road Safety Proof of Concept. A feature of this proof of concept is that data exchanged under the eight use cases is done under the principle of 'reciprocity'. This means that to become a participant in the proof of concept, data must be exchanged both ways between parties. If only one party is providing data then financial compensation must be provided (Data for Road Safety, 2020b).

General Data Protection Regulation

The relevant legal frameworks for collection, use and disclosure of personal information in the European Union is broadly governed by the GDPR and the Law Enforcement Directive. The GDPR states that anyone seeking to process a user's personal information must obtain their consent (European Union, 2020). It is not currently clear what vehicle-generated data would be considered as 'personal information', but unique identifiers such as vehicle identification numbers (VINs) are being categorised as personal information. As the GDPR extends its rights to European Union citizens when abroad, some vehicle industry participants indicated to us that they are designing connected vehicle services for Australia on an opt-in or opt-out basis to ensure they are GDPR compliant.

Extended vehicle concept

The European Vehicle industry has outlined its view that access to vehicle-generated data by third parties, including transport agencies (outside of C-ITS messaged to roadside infrastructure – V2I), will be delivered through the 'extended vehicle concept' (ExVe). ExVe is intended to reduce 'attack surfaces' to the vehicle by 'extending' the vehicle onto the vehicle manufacturer's server and controlling access only through this server.

The ExVe aims to reduce interfaces to the vehicle to only those required by law (such as the OBD-II interface, or any ad hoc networks such as cooperative V2X systems), or those that connect to the vehicle manufacturer's server or a neutral server. The European vehicle industry argues it is the best way to secure vehicle-generated data while maintaining user privacy (Car Data Facts, 2019). ExVe has now been formed as a series of ISO standards (ISO20077, 20078) (ISO, 2020).

However, the ExVe approach also limits who can access data from the vehicle and is seen by some stakeholders as anti-competitive. A European Commission report found that ExVe will become the de facto standard for third parties to interface with vehicle-generated data unless legislation is created to provide other technological or regulatory mechanisms to open access (European Commission, 2017).

A key aspect of the ExVe is its neutral server, which enables entities other than the vehicle manufacturer (including governments) to access data directly from vehicle manufacturers. The ExVe and neutral server is used in the European Union's Data for Road Safety Proof of Concept and has embedded it as a key government access mechanism.

The Right to Repair campaigns (Right to Repair, 2020) are seeking to dispute the manufacturer's right to control access by creating open interfaces such as the 'Secure Vehicle Interface' or 'Neutral Vehicle Platform' (European Commission, 2017). Third-party access to data is an ongoing issue in Europe.

Given its establishment in Europe it is likely that Australia will adopt ExVe, with governments gaining access to data through concepts such as a neutral servers.

Question 5: What issues do you believe will be created if ExVe is adopted and that would need to be considered in Australia?

4 Potential uses for vehicle-generated data

Key points

- Transport agency data needs are broad, are not yet mature, and their potential benefits are not fully understood.
- The generators of vehicle data are not yet clear on how vehicles may best provide potential benefits for vehicle-generated data.
- Stakeholders generally support road safety use cases as the highest priority to commencing vehicle data access, with a higher willingness to potentially exchange data on non-commercial terms. However, the detail of how these use cases would operate in practice still remains to be seen.
- Barriers to accessing vehicle-generated data include costs, clarity and alignment on purpose, the commercial value of data, data privacy, and transport agency capabilities to ingest and use data.

4.1 Purpose of this chapter

The purpose of this chapter is to:

- provide an overview of the key priorities Australian stakeholders have identified for government access to and use of vehicle-generated data through NTC workshops
- propose priorities for government access to vehicle-generated data
- summarise workshop participant feedback on the feasibility, key challenges, barriers, enablers and benefits of the identified use cases.

4.2 There is a need to prioritise the uses of vehicle-generated data

At the outset of this project we sought to understand the viability or cost-effectiveness of access to 'all data' or completely 'open data'. We heard that transport agencies do not have the capabilities to ingest and use all datasets. Both oversharing or under sharing of data could result in non-optimal public outcomes. The cost of data oversharing will most likely be borne by consumers either through increased vehicle purchase prices and ownership costs or through increased revenue needed to operate road networks. Data access could therefore be planned around specific contexts or use cases where public benefits can be clearly demonstrated by addressing current transport agency problems, and where vehicle-generated data can address these problems.

As mentioned in section 1.9, we undertook a co-design approach to gather potential use cases. The methodology capturing and prioritising use cases was based around the following key points:

- transport agencies identifying their key problems and business needs across the areas of road safety, network operations, investment, planning and transport asset maintenance
- transport agencies identifying the data they use to manage these problems now, and the major gaps within this data

- vehicle industry stakeholders identifying what data may be currently captured from vehicles (or in the future) that may address these problems
- all stakeholders identifying the major gaps and barriers to creating an exchange of this data and potential solutions to address those gaps and barriers.

4.3 What are the business needs we have heard?

4.3.1 Workshop presentations

Two transport agency presentations highlighted the challenges of collecting agency-wide views and the difficulties in prioritising business needs. Themes raised included:

- asset management – issue identification to assist with maintenance of road infrastructure (potholes, damage to barriers, signage, line markings, etc.)
- network operation/optimisation – real-time aggregated information to identify network disruptions to assist with traffic management, incidence response, determine alternative route options and help inform future planning
- road safety – vehicle crash notification, trigger of automatic electronic braking (AEB)/ESC/lane keeping events, emergency braking/evasive manoeuvre events, distraction/fatigue, hotspots of near-misses.

The presentations made clear that transport agencies had not yet decided which data business need could be prioritised. A key focus of both presentations was the need for more collaboration and engagement with industry to further refine data needs. Both noted the tension between open sharing of data and commercialisation of data. The presentations made clear that more work is required to define agency positions on data needs.

4.3.2 Business needs outputs

Participants developed 23 distinct use cases. These have been grouped into the following key business areas:

- road safety – real-time events, conditions and hazards
- road safety – research
- network operations
- future network planning
- transport asset management
- road asset inventory
- freight policy and planning.

For each use case workshop, participants also identified:

- the key outcomes each use case would deliver
- the unique value proposition (why vehicle-generated data and not other data)
- core data attributes
- feasibility
- challenges
- enablers
- benefits.

In Appendix B, we have provided a table containing, at a high level, the purposes, use cases, information required for, and underlying data.

Through our consultation in developing this discussion paper, we did not observe a desire from transport agencies to use data from vehicles for targeted, individual enforcement or surveillance purposes. Queensland’s Department of Transport and Main Roads outlined a principle that it ‘desires access to information or aggregated data to provide insights and analytics’.

For data for compliance purposes, access is aligned to needs for road safety *safe systems* approaches. Aggregated data to identify areas of undesirable behaviour – such as roads with high incidence of driver fatigue or speed behaviours – may be used to make changes to roadway design and safety infrastructure countermeasures but also more visible police presences to deter high-risk behaviours. Using the data in this way appears to align with the NTC’s original intent.

4.3.3 Road safety real-time events, conditions and hazards

This group of use cases focuses on temporary conditions, events and on-road hazards that could lead to further road safety problems or disruption to the real-time performance of road networks. Examples include vehicle crashes and breakdown incidents, slippery roads warnings and roadworks. Participants identified the current challenge of sourcing reliable real-time event information in areas where current roadside information systems may not be present such as on regional and rural roads.

The use case below is unique in that it focuses on vehicle data that can only be sourced through the vehicle’s technical systems. Other sources like location information could not provide the same data for this use case.

<table>
<tr>
<td rowspan="3">Road safety – real-time events, conditions and hazards

Crash detection (high)

Detect environmental conditions and hazards (moderate)

Detect crash/breakdown (high)

Safety – identification of road safety events (high)</td>
<td><u>Outcomes</u>
Detect events and hazards in near real time
Prevent secondary incidents
Improved network performance from reduced incident clearance times
Provide data back to road users</td>
<td><u>Unique value proposition</u>
Vehicle technical data that cannot be sourced from other sources such as closed-circuit television (CCTV), crowd sources, weather services or other probes
Technical data such as airbag, hazard lights, ESC event</td>
</tr>
<tr>
<td><u>Core data attributes</u>
Location
Event ID / incident type
Timestamp
Airbag, hazard light, windscreen wiper status, door lock status, ABS/ESC/traction control event</td>
<td><u>Feasibility/challenges</u>
Near-term implementation is possible on newer vehicles
Telco coverage on remote road networks
Maintenance of service through vehicle life</td>
</tr>
<tr>
<td><u>Enablers</u></td>
<td><u>Benefits</u></td>
</tr>
</table>

<table>
<tr><td>Future data for road safety (high)</td><td>Standardisation of data attributes e.g. Sensoris
Agency capability – systems, storage, analytics, staff capability
Connected vehicle adoption – need market stimulation</td><td>Road safety – fewer end-of-queue crashes
Reduced network delays
Faster emergency response, particularly in rural Australia
Reduced insurance claims</td></tr>
</table>

4.3.4 Road safety – research

This group of use cases focused on aggregated data that could highlight longer term trends in the operation of road infrastructure or driver performance on the network. By aggregating and post-processing incidents of relating to driver behaviour (ESC events, heavy braking events, lane departure warning events, driver fatigue, near-misses, pedestrian near-misses, crashes) information could be provided on high-risk road safety issues.

Many participants highlighted the high proportion of fatal and serious injuries on Australia's rural road network and the benefits of focusing data collection in these areas.

Transport agencies could use this data to better prioritise road safety treatment programs such as infrastructure interventions, compliance and enforcement programs, or driver education and training. State government insurers may also have an interest in this data for regulatory functions.

Unlike road safety real-time events, participants for these use cases noted that a 'sampled' approach using a captive fleet for data collection may be all that is required to achieve value from the use case.

<table>
<tr><td rowspan="3">Road safety – research

Safety at high-risk intersections and black spots (high)

Safety – identification of vulnerable road users (medium)

Road safety black spots (high)

Regional road safety (high)

Driver safety – metrics for behaviour (moderate)</td><td><u>Outcomes</u>
Reduced road trauma
Regional road network defects
Identifying highly vulnerable road user risk areas
Identifying high-risk intersections</td><td><u>Unique value proposition</u>
Fulfils a gap where driver behaviour data could be used to prioritise treatments
Data in regional areas where coverage of data collection is limited</td></tr>
<tr><td><u>Core data attributes</u>
Processed data of driver behaviour incidents (speed, fatigue, heavy braking)
Processed data from sensors (AEB pedestrian events, ABS events, lane keeping events)</td><td><u>Feasibility/challenges</u>
Could be captured through a sample fleet of vehicles – not all vehicles need to be connected
Cost of data collection will be high</td></tr>
<tr><td><u>Enablers</u>
Government business case for data collection
Telco network coverage
User consent to provide data and driver education campaigns</td><td><u>Benefits</u>
Reduced trauma costs
Optimised treatment of road infrastructure safety defects
Enhanced understanding of driver behaviour</td></tr>
</table>

4.3.5 Network operations

This group of use cases focused primarily on using derived information from vehicle location data (for example, travel time, network or road segment speed) to make real-time operational decisions such as incident response or optimisation of network signals. This would result in reduced congestion and hence reduced travel times for the public.

Participants in these discussions debated whether vehicle-generated data is absolutely required to achieve value from this use case, or if other sources of traffic information (such as roadside information systems or existing crowd sourced data) could be ingested and used instead. Participants consider vehicle-generated data able to enhance other sources by providing richer data on lane-level data (traffic incidents that occur only in one lane) or traffic signal status to further optimise traffic flow.

Participants noted the likely slow penetration of connected vehicles into the fleet, making the value from using connected vehicle data a longer term proposition.

<table>
<tr>
<td rowspan="3">Network operations

Network congestion (high)

Real-time network optimisation (high)

Network speed data – variability and efficiency (low)

Traffic flow optimisation (low)

Improving network optimisation and traffic management (high)

Green wave (medium)</td>
<td><u>Outcomes</u>
Optimised traffic signal network
Reduced customer journey times
Real-time traffic management</td>
<td><u>Unique value proposition</u>
Some data could be sourced through existing third-party probe sources, CCTV and road sensors
Could be enhanced with data about vehicle type, vehicle route and number of occupants</td>
</tr>
<tr>
<td><u>Core data attributes</u>
Location
Timestamp
Speed and heading
Vehicle type
Could include traffic signal status</td>
<td><u>Feasibility/challenges</u>
Platform to ingest data and provide insights
Low current penetration of connected vehicles
Agency capability and preparedness to ingest and use data
User privacy to be addressed</td>
</tr>
<tr>
<td><u>Enablers</u>
Business case to fund collection of data
Public awareness and education
Standardised interface
Regulation to encourage sharing of data</td>
<td><u>Benefits</u>
Reduced journey times
Delayed infrastructure spending
Better informed traffic management decision making</td>
</tr>
</table>

4.3.6 Future transport network planning

This group of use cases focused on aggregated or derived information from location data such as vehicle origins/destination, route preferences and traffic volumes.

Workshop participants envisaged that this data would be used to supplement or replace existing network planning data from traditional sources such as travel time and route studies or roadside information systems. This information supports investment decisions and improved network strategies. The end result would be more efficient use of public money on transport infrastructure.

In the longer term, using vehicle-generated data may be better than traditional studies due to increased network coverage and knowing the planned vehicle route, vehicle type and number of occupants. Participants noted that while some insights can be achieved with low vehicle penetration, many uses will require a larger connected vehicle fleet.

Again, participants debated whether vehicle-generated data was essential for this use case or if other existing sources of data could be used.

<table>
<tr>
<td rowspan="3">Future transport network planning

Future planning decisions (high)

Infrastructure planning (low)

Planning of future transport networks (low)</td>
<td><u>Outcomes</u>
Improved investment and operation decision making
Reliable estimates of potential and future traffic volumes and travel times</td>
<td><u>Unique value proposition</u>
Some data could be sourced through existing sources
Vehicle-generated data provide increased granularity and coverage
Data could be enriched – vehicle type, vehicle route, lane level and number of occupants</td>
</tr>
<tr>
<td><u>Core data attributes</u>
Location data and timestamp
Derived information including origin/destination, routes and volume
Vehicle type
Number of vehicle occupants</td>
<td><u>Feasibility/challenges</u>
User privacy needs to be addressed
Cost of data collection, storing and analysis
Some data not currently collected in vehicles such as vehicle type</td>
</tr>
<tr>
<td><u>Enablers</u>
Standardisation of data collection
Larger connected vehicle fleet required
Privacy of users addressed</td>
<td><u>Benefits</u>
Improved investment decision making
Justify where increased network capacity or operational changes are required</td>
</tr>
</table>

4.3.7 Freight planning

This group of use cases focused on expanding existing data capture from heavy vehicle telematics systems. It was envisaged in these use cases that there would be an exchange of data for regulatory access to road networks. Unlike many other use cases, it was envisaged that this would focus on retrofit systems, as well as embedded vehicle systems. These use-cases may be relevant to the Commonwealth's development of the Freight Data Hub.

The key benefits of this use case are described as more efficient planning of freight networks and enhanced management of transport assets by better understanding asset loads and wear.

<table>
<tr>
<td rowspan="3">Freight planning

Access to the network (high)

Transport asset management (medium)</td>
<td><u>Outcomes</u>
Heavy vehicle impacts on road assets are understood such as pavement and bridge wear
Assets are more dynamically managed</td>
<td><u>Unique value proposition</u>
Telematics and IAP data with enhancements for on-board mass
Some vehicle-generated data such as heavy braking events</td>
</tr>
<tr>
<td><u>Core data attributes</u>
Vehicle movements and routes
Mass per axle and tyre pressure
Location data
Hard braking and driver behaviour
Lane use</td>
<td><u>Feasibility/challenges</u>
Short-term feasibility is low
Requires uptake of technology
Cost to retrofit technology</td>
</tr>
<tr>
<td><u>Enablers</u>
Incentives to offset cost of implementation
Access to data requirement – regulation</td>
<td><u>Benefits</u>
Increased productivity
Reduced cost of goods
Targeted infrastructure investment
Safety and environment</td>
</tr>
</table>

4.3.8 Transport asset inventory

Transport asset inventories were the focus of only one group in our workshops. This use case aims to use vehicle sensors to detect changes in the road network such as potholes or traffic sign changes. Participants noted that this data could be captured by embedded systems within the vehicle or from aftermarket devices that can capture and report changes.

Participants also noted that only a small fleet of vehicles is required to sample and capture the changes across the network.

This data would supplement state transport agency asset surveillance systems. However, new capabilities would be required to define data needs and to build new tools to respond to the volume of new data available. Participants noted that this data would be used to better target maintenance programs or to respond more rapidly to emerging road degradation issues.

<table>
<tr><td rowspan="3">Asset awareness and inventory

Road asset inventory (low)</td><td><u>Outcomes</u>
Real-time infrastructure information on location and specific assets
Enhanced road safety
Reduced asset inspection costs
Asset conditions</td><td><u>Unique value proposition</u>
Vehicle sensor data used to identify defects, usage or changes on the road network
Can be captured through existing surveillance techniques</td></tr>
<tr><td><u>Core data attributes</u>
Location
Traffic sign changes
Pothole detection
Heavy braking incidents</td><td><u>Feasibility/challenges</u>
Cost of data collection, storage, analytics and reporting
Business case needed to justify costs
Short-term low feasibility, with low numbers of connected vehicles</td></tr>
<tr><td><u>Enablers</u>
Relevant data could be captured through a sample vehicle fleet – either aftermarket or embedded in vehicle
Transport agency capability to create insights from data would need further development</td><td><u>Benefits</u>
Targeted maintenance
Reduced response times to asset maintenance issues
Enhanced safety through improved roadway condition</td></tr>
</table>

4.3.9 Methodology limitations

Through our workshops we have for the first time attempted to gain a national collective view of Australian transport agency data needs and the potential for vehicles to provide solutions. However, we recognise that the use cases captured represent the views of many data practitioners within transport agencies, and in many cases the use cases may represent individual needs rather than an agency-wide view or collective national view.

It would therefore be unwise to consider this a final or comprehensive view of Australian transport agency data needs. It should be understood as foundational understanding of what transport agencies' business needs and priorities may be.

4.4 Benefits of vehicle-generated data

Transport agencies see a range of potential benefits and are optimistic about how data will be used to generate new services and make better decisions. Likewise, industry participants acknowledge the public benefits that may be achieved and, in many cases, see alignment with their corporate objectives around safety, mobility and environmental outcomes.

There are already uses for vehicle-generated data. For heavy vehicles TCA is using data from IAP to better inform road asset maintenance. As described in section 3.8.3 the European Union is trialling a range of potential benefits such as providing hazard warnings to users.

We have not attempted to quantify the benefits of vehicle-generated data because the scope and use of data is too broad at this stage and the definition of needs not clarified. Nonetheless, the benefit of increased access, whether through commercial access or through policy measures to create access, is likely to be considerable and worth pursuing.

4.4.1 How the potential benefits of vehicle-generated data could be achieved

Industry and government hold misaligning views about how vehicle-generated data could lead to realising actual benefits – the difference between potential benefits and proven value that can be delivered. To achieve a benefit, the addition of vehicle-generated data alone is unlikely to solve any problems without further investment in capabilities, systems, tools and investments to respond and create behavioural change. An example of how a benefit may be yielded is provided in Table 3.

Table 3. Potential benefits of vehicle-generated data

Purpose	Vehicle-generated data	Use of data	Behavioral response by transport agency	Economic and community value achieved
Maintenance of transport assets	Suspension vibration data	Tools to detect early pavement degradation before more costly damage occurs Tools to create stronger business cases for funding	Better decision making on maintenance investments Greater investment in maintenance services	Better and safer roads Better targeting of opportunities for continued road maintenance programs Higher quality roads

Convincing all stakeholders of the benefit of data access will require visible and tangible benefits to be demonstrated. Proving the value of access may require trials or proof of concepts to be established before wider deployment is considered.

5 Challenges, issues and barriers to government use of vehicle-generated data

Key points

The key issues identified by our research and stakeholders were:

- transport agency capabilities to ingest and use data
- data not captured or stored
- willingness to share data
- user privacy and sensitive data
- costs to industry and governments
- privacy and managing consent (user opt-in/opt-out)
- lack of agreement on data standards
- assurance of devices and data
- low penetration of connected vehicles in Australia.

5.1 Purpose of this chapter

The purpose of this chapter is to discuss the key challenges, issues and barriers to government access to vehicle-generated data including:

- transport agencies' capabilities to ingest vehicle-generated data to develop meaningful information
- potential impacts on user privacy and the handling and protection of vehicle-generated data
- potentially useful data not currently being captured or stored by vehicles
- no current agreed standards for exchanging vehicle-generated data
- potential commercial sensitivities and willingness to share data
- low penetration of connected vehicles in Australia.

5.2 The key challenges and barriers

5.2.1 Transport agencies have limited capability to ingest data and develop meaningful information, insights and services

A significant stream of data would flow to government agencies if they could access all vehicle-generated data. However, a key theme across most use cases emerged from transport agencies' lack of capabilities across ingestion systems, staff capabilities and analytical tools. Workshop participants raised capabilities to ingest and make meaningful insights from data as a challenge across a range of use cases. A significant stream of data would flow if all data generated could be accessible.

Many use cases highlighted that transport agencies are not at a point where they can meaningfully use all vehicle-generated data. Practitioners with experience in working with large datasets noted the challenge of building the 'data refinery', a challenge each transport agency will face. There is a serious question for transport agencies in their ability to ingest the 'fire hose' of data if it was switched on tomorrow. Agencies may be unable to make analytics, tools, visuals and reports leading to further behavioural changes in operations, investments and incident responses.

Some Australian transport agencies are addressing these challenges through pilot projects. The Queensland Transport and Main Roads Pilot: the Connected and Automated Vehicle Initiative (CAVI) sets out a key purpose of agency change management, which is to: *consider the capabilities and resources required to support widespread deployment of these vehicles on our roads* (Queensland Government, 2019a). Queensland Transport and Main Roads' presentation in our workshops outlined data analytics capabilities as being a key strategic goal of the organisation.

Case study: New South Wales C-ITS data[5]

As part of its C-ITS trials, Transport for New South Wales has collected more than six billion records from vehicle-generated messages including, location, harsh braking events and speed warnings produced by the 60 trucks, 11 public buses, 52 light vehicles and one motorcycle involved in the trial.

Collecting, storing and analysing the volume of raw data has proven challenging. Analysing the data required new capabilities and systems to be developed across storage, analytics platforms and staffing to work with the massive datasets.

Notwithstanding the challenges, some new insights have been derived from the accelerometer data (harsh braking events), which have been used to develop predictive high-risk intersection location models. Previously, high-risk intersection analytics had focused on trailing indicators such as fatal and serious injury density.

A key challenge facing Australia is the problem of handling the many stakeholders involved in data. This problem is often described as 'many to many'. On the government side of exchange, there are approximately 500 government entities across Commonwealth, state/territory and local governments. On the industry side, there is a distributed range of vehicle industry participants across light vehicle brands, aftermarket telematics providers and heavy vehicle operators.

To address these challenges, some consultation participants suggested that new capabilities be built at the national level with a single point to ingest data and provide analytics reporting to state/territory and local government transport agencies. There may be some benefits from centralising capabilities. Centralised or national interfaces are used for telematics data through TCA and registration and licensing data through Austroads and its NEVDIS function. Similarly, the European Union has established National Access Points under European law as a mechanism for 'accessing, exchanging and re-using transport related data' (European Commission, 2020a).

[5] Information in this case study is from email correspondence with Transport for New South Wales.

Austroads previously explored the question of whether a national data aggregator is needed for connected and automated vehicle data (Austroads, 2018b). Concerns were outlined around the value of a national aggregator and the potential latency it may introduce to any data exchange. From the stakeholder interviews conducted in that project, participants noted the need for an entity to advocate for good standards and practices.

We have not formed a view on whether a national capability to ingest, store and analyse data is desirable but instead seek views from stakeholders.

5.2.2 In some cases, vehicle-generated data is not unique

Vehicle-generated data is just one of many ways of generating meaningful information about transport networks. Mechanisms for transport data collection include (Transport Systems Catapult, 2015):

- manual collection (traffic counts, surveys, interviews)
- overt crowd sourcing (digital social media survey, car parking data)
- covert crowd sourcing (crowd sourcing from social media, traffic speed data from mobile phone movements, running and cycling data from physical activity applications such as Strava)
- sensor-derived data (traffic counts and speeds from operational technology such as CCTV and inground loops)
- service provider data (from commercial services).

There are existing systems such as operational technology at roadside capture (inground sensors, CCTV, bluetooth) and surveys. These systems are already deployed and provide proven, low-cost but incomplete methods to provide insights into transport policy and planning (Bureau of Infrastructure, Transport and Regional Economics, 2014).

Transport System Catapult further notes three emerging types of data collection (Transport Systems Catapult, 2015):

- web-connected fixed sensors (individual IP addresses or web-addressable such as bluetooth and wi-fi sensing)
- web-connected mobile sensors (including vehicle-generated data through connected vehicles)
- crowdsourcing from personal communications devices (phone application data and data sourced from telecommunications providers).

Newer data collection techniques are also being pioneered in Australia including the use of wi-fi sensing and machine vision with AI capabilities (VicRoads, 2020), which also appear promising at producing highly useful information.

Case study: AIMES Smart Intersection Pilot

The Australian Integrated Multimodal Ecosystem partnership project, established by the University of Melbourne, has piloted the sensing of wi-fi signals to create new data and insights at intersections. Wi-fi is everywhere and has a nearly 100 per cent attach rate in smartphones and laptops and is now starting to emerge in vehicles. By sensing the signals, and using advanced positioning techniques, successful validation of several use cases has been established including:

- Use Case 1: Lane Level Traffic Flow (Vehicle Passing Rate): Start-lane/end lane flow at intersections for individual vehicles
- Use Case 2: Lane Level Traffic Flow (Speed Histogram): Detect average vehicle speed per lane at short (5 min); medium (15 min) and long (hour) duration.
- Use Case 3: Lane Level Traffic Flow (Stalled Detection Queue Length): Detect and report on queue length per lane
- Use Case 4: Pedestrian traffic flow and queue length.

While wi-fi sensing does not use vehicle-generated data, and instead senses the presence wi-fi devices, this case study highlights the need to consider a range of data collection methods and consider which is optimal to resolve each problem.

Stakeholders indicated that more granular and timely location data from vehicles could enhance network operational decisions and planning. This data could improve current capabilities as well as the future capabilities of transport agencies. Generators of vehicle data noted that this information may already be available through a range of existing commercial services (namely, mobile phone location data) or existing roadside capture solutions. However, these services do not provide the type of data (such as sensor data) by vehicle technical systems or the coverage provided by a widespread vehicle fleet.

The clearest unique value identified came through where vehicle-generated data could provide value beyond simple additional location data from vehicle movements on-road. These include:

- where enriched data from vehicle technical systems could indicate driver behavioural data such as harsh braking events, lane departure warnings or other systems indicating deficiencies in the road network
- where vehicle technical systems could detect events in near *real time*
- where existing data capture from embedded roadside systems or other traditional data capture was challenging to justify – such as in dispersed rural environments (noting challenges to network connectivity).

5.2.3 Most vehicle-generated data is currently not captured or stored

Some use cases highlighted needs for data that is not currently captured or stored permanently in vehicles. Participants noted that much vehicle data is consumed within a system within the vehicle but never stored or collected. An example is vehicle frontal radar data, which could be used to determine the time or distance of near-misses at intersections. However, this is currently not captured by the vehicle and is only used to enable automated braking systems.

Only the vehicle industry is fully aware of what data may be available within vehicle systems, what is captured or stored on the vehicle, and when this may become available through the ongoing evolution of vehicle technology.

As outlined in the introduction, only 10 per cent of new light vehicles are capable of generating data, with only 4 per cent capable of producing airbag events and 1 per cent capable of generating door lock status.

5.2.4 User privacy and sensitive data impacts the potential uses of vehicle-generated data

Many use cases noted maintaining user privacy and data protection as a key challenge. A presentation from a transport agency at our workshops outlined that user privacy is 'paramount' in any data access arrangement. The challenge in defining this topic is that the level of privacy risk varies greatly depending on the use case and the richness and granularity of data required for each use case.

Location data is known to be a particularly problematic set of data given the unique challenges it presents with re-identifiability (Vaile, et al., 2018). Data analytical reconstructive methods may be used to infer the identity of the user undertaking the trip where use cases required origin and destination data (such as the origins and destinations or routes of trips).

Only some use cases appear to require personally identifiable data such as location data, while others rely on technical information produced by the vehicle's sensor or technical systems, primarily about the road environment surrounding the vehicle. In our discussions with the European Union Data Taskforce, we observed that privacy was protected through only requesting information packets that include:

- an event information descriptor (roadworks zone, wrong-way driver, etc.)
- timestamp and location for when the event occurred.

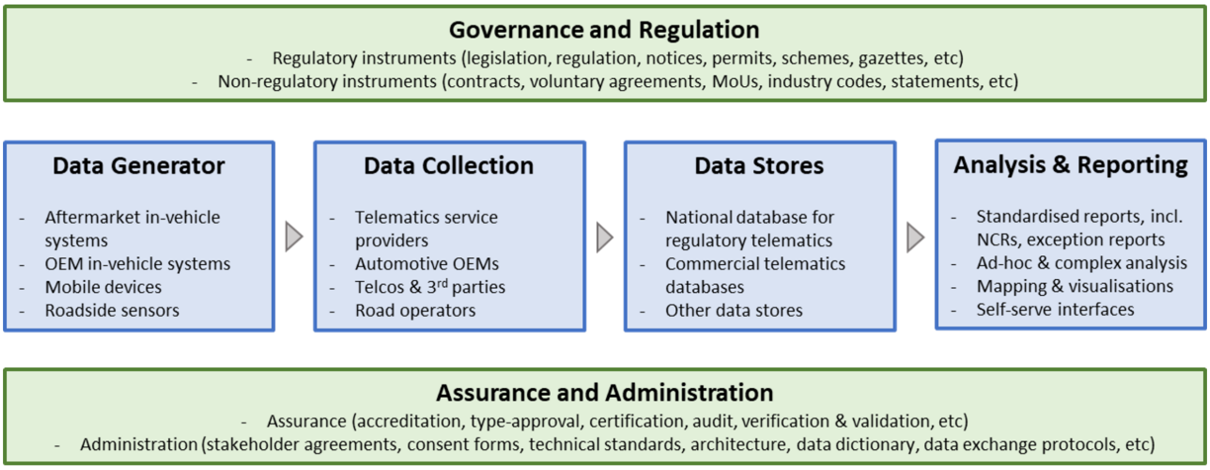
Who will hold raw data?

There are greater privacy concerns when government collects raw data than when governments access processed information or aggregated reports. At our workshops, information service providers including HERE and TomTom highlighted their existing data governance practices, which are aimed at compliance with the Australian Privacy Principles and, in the cases of international business, the GDPR. In these cases personally identifiable information such as a VIN is removed and only aggregated data or de-identified event information is provided to transport agencies. Data collectors must obtain permission for secondary purposes of data such as sharing with third parties. Under these models, transport agencies do not collect or store raw data but procure processed information and insights.

However, other models could see transport agencies directly collecting and holding raw data including location data, such as V2X messages, which can be aggregated by the transport agency itself (see C-ITS case study in section 5.2.1) to create the information and insights it needs. Government may have the capability to infer personal information from the data but will be prevented from doing so due to government legislation and policies on handling personal information.

TCA's role creates a separation of duties from policy and regulatory bodies. TCA collects and securely stores raw and sensitive data to assure industry it won't be used by government entities for purposes not agreed to. TCA acts as a 'safe harbour' for the data it collects. Access to the data is restricted by the Heavy Vehicle National Law and other regulatory instruments and agreements. TCA enables government entities to access aggregated information created from the data through standardised and ad hoc reports and other analysis and visualisation tools (see Figure 6).

Figure 5. National Telematics Framework: Transport Certification Australia



Source: TCA – presented at the Data Practitioners Workshop, 12 December 2019

Question 6: Is there value in establishing a national data aggregator or trust broker? Could good data definitions, practices and cooperation between entities achieve the same outcome?

Data protection

Data protection methods could address concerns with personal and commercially sensitive information within the use cases (see Table 4). The detail of these methods needs to be worked through.

The level of risk will depend on many factors including:

- the type of data generated by vehicles for each use case (technical or personal)
- the level of aggregation of data and the type of information required to solve each problem
- data protection methods and techniques to protect personal information
- whether data will be collected directly from the vehicle by transport agencies or through a commercial entity with Australian Privacy Principle obligations already in place.

Table 4. Examples of user sensitivities to data

Use case	Vehicle-generated data	Derived information	Sensitivity to data being provided to governments	Methods to protect user privacy
Data for planning future transport networks	Location data	Trip origins and destinations Traffic volume counts	Potentially high if individual trip data can reveal the user's personal information through	Aggregation of data to postcode level

Use case	Vehicle-generated data	Derived information	Sensitivity to data being provided to governments	Methods to protect user privacy
		Vehicle travel speeds	analytical methods	Removal of first and last kilometre of travel Aggregated by data store before being provided to transport agency
Transport asset management – speed sign changes	Traffic sign recognition system events	Speed sign location has changed Speed sign limit has changed	Potentially low	Data is aggregated by data stores before information is provided to transport agencies Unique identifiers such as VIN removed

Case study: Los Angeles – Mobility Data Standard

The city of Los Angeles introduced its Mobility Data Standard (MDS) in 2018. The standard is applied as a condition of operating footpath-based shared mobility services such as scooters and share bikes. The standard, and associated application interfaces, are aimed at helping the city understand usage patterns to better plan streets and regulatory enforcement to help remove scooters left in unsafe or inconvenient locations.

The MDS provides the city with data on where each bike and scooter trip starts, the route each vehicle takes and where each trip ends in real- time on an individual trip level. While the data is anonymised, privacy advocates have criticised the ability of a transport agency to hold personally sensitive information that can be analysed from location data.

As of October 2019, Uber, which operates a dockless scooter and bike service called Jump, have threatened to sue the Los Angeles Department of Transportation (LADOT) on the grounds the standards create a violation of the Californian Electronic Communications Privacy Act. LADOT has responded by revoking permits to operate on the network. LADOT has released privacy principles that outline the data will not be available through freedom of information laws and will be securely held.

However, some believe the highly granular data is being collected for other purposes such as establishing a future model to enable the agency to control and direct access to the road network by observing and redirecting vehicle movements in real time. This approach is sometimes referred to as a 'digital twin'.

This case study highlights the distrust that can be created from data access, despite the positive intentions for the MDS (Bliss, 2019).

As we observed in our previous policy paper, *Regulating government access to C-ITS and automated vehicle data*, existing information access frameworks are unlikely to be adequate to protect privacy. Any policy approach, whether through agreement with industry or through legislation, should embed the privacy principles we have previously outlined.

Without a clearly defined national position on government priority purposes, and use cases, it is challenging to define how data should be protected.

5.2.5 Costs to industry and governments for vehicle-generated data are currently unclear

Workshop participants were unable to quantify the direct costs associated with each use case or the corresponding benefits of data access. However, participants considered that the magnitude of the problems being addressed (such as road safety and congestion) is likely to yield positive cost-benefit ratios from increased government access.

It is challenging to estimate what the cost and benefit of any intervention may be. Table 5 highlights the magnitude of some of these challenges.

Table 5. Economic challenges associated with transport problems

Transport problem	Economic scale of the problem
Road trauma	Social cost of road crashes in 2016 was $33.16 billion[6]
Network congestion	Expected to reach between $30.6 and $41.2 billion by 2030[7]
Transport asset management	Estimated benefit from access to improved maintenance from mass and location data: $5.7 billion[8]

Several industry and government presentations raised the high cost of generating, collecting, storing and analysing vehicle-generated data. Each stage incurs costs including the following.

In vehicle hardware/software:

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[6] *The cost of road crashes in Australia 2016: an overview of safety strategies*: https://www.aph.gov.au/DocumentStore.ashx?id=a37c13ee-72d4-47a9-904b-360d3e635caa

[7] *Road congestion in Australia*: https://www.aaa.asn.au/wp-content/uploads/2019/06/Road-Congestion-In-Australia-2019-v.3.pdf

[8] *Economic analysis of potential end-states for the heavy vehicle road reform*: https://www.infrastructure.gov.au/roads/heavy/files/DIRD-HVRR-reform-CBA-ncic.pdf

- V2V/P/I/X technologies (some estimated around $500 per vehicle)
- sensors, satnav systems, networks
- infotainment
- navigation
- remote services
- communication systems (SIM), etc.
- development costs.

Communication (data carriage):

- mobile data plans – could include owner subscription, gifted period and excess data costs.

Off-vehicle hardware/software:

- data centre/server
- processing costs
- communication costs to government
- third-party arrangements – branded/neutral/aggregator servers.

Transport agency costs for ingestion and use:

- hardware – servers
- analytics, reports, tools, applications
- agency capabilities, staffing, training.

Costs for each use case remain highly uncertain. Uncertainties include the following:

- *Frequency of data:* Data costs may vary significantly depending on the frequency of data provided, as this impacts the cost of communication. It will vary on how many data fields are required and the frequency of data required (for example, by millisecond, second, minute or week).
- *Level of connectivity:* Location data is becoming ubiquitous through mobile phone application and tethering. However, richer data that can access vehicle sensors will require embedded connectivity.
- *Vehicle data processing capabilities:* Data costs may depend on whether a vehicle is already capable of on-board processing or whether data needs to be processed off-board on data analytics platforms. This directly impacts the size of the data packet produced and cost of carrying over telecommunications networks.
- *Sample size:* What is the sample size that is needed to achieve the outcomes of a use case? Can the use case be achieved by a captive sample of vehicles or do all vehicles need to be connected to achieve value?
- *Vehicle capabilities:* If the vehicle is already equipped with a means of communicating data to collection points, additional data needs only add marginal costs. Many workshop participants noted costs are much smaller once a vehicle is equipped with a communications system.
- *Use of unlicensed spectrum:* Some vehicle data messages (CAM and event messages, for example) can be carried over unlicensed radio spectrum (5.9 GHz is currently allocated for this task in Australia), removing the need for data to be carried over telecommunications networks. However, transport agencies will need to build out

their own communications networks to receive the data and possess other capabilities to aggregate and analyse.

- *Level of assurance:* While our use cases and purposes did not outline the need for evidentiary-level data, we note that if assurance of data is required, this can have a significant impact on the certification of devices or technology. TCA has reported that its certified applications (such as IAP) are orders of magnitude more expensive than applications that build of existing vehicle data (such as its Road Infrastructure Manager application).
- *Transport agency capabilities:* As noted above, some doubt remains as to the ability of transport agencies to use high volumes of vehicle-generated data. Staff capabilities, systems and tools will require significant changes. New tools are emerging to help manage volumes of data.

At the start of this project we set out with a goal to be able to assess some of the costs of data access, collection and use. However, further research is required to determine this due to factors identified above.

We anticipate that in many cases that costs will be high, but that the benefits of vehicle-generated data will also be significant. Further detailed assessment is required to determine this, and this will require the cooperation and support of generators of data.

Case study: Otonomo partnering with Waycare and the Nevada Highway Patrol

The Otonomo Automotive Data Services Platform offers data from more than 18 million passenger and commercial vehicles located in the United States, Canada, Europe and Asia. Connected vehicles generate data streams from infotainment units, fuel systems, advanced driver assistance systems (ADAS) and other systems that monitor vehicle operations. The data ranges from status attributes – such as doors state, battery voltage and remaining fuel – to driving data such as distance travelled and fuel consumption to environmental data such as road signs or conditions.

One example is Otonomo partnering with Waycare and the Nevada Highway Patrol. The Nevada Highway Patrol ran a pilot program that saw a 17 per cent reduction in crashes along a portion of northbound Interstate 15 near Las Vegas, Nevada, with accidents identified up to 12 minutes faster. Extrapolating these types of results to more cities would result in billions of dollars of economic advantages as well as lives saved (Otonomo, 2019).

The Otonomo Platform makes commercial data from connected cars available for a diverse range of safety and emergency use cases (Otonomo, 2020). Real-time information like airbag deployments, hard braking, speed and location is available through the platform. Pricing structures are available based on the number of vehicles required.

Question 7: Can you provide us with more information on either the costs or benefits for government access to vehicle-generated data for the use cases listed in Appendix B?

5.2.6 There are many factors determining whether users will opt-in or opt-out of providing consent for vehicle-generated data

Many of the above factors have a bearing on whether vehicle users are likely to opt-in or out of connected vehicle services. Users may be reluctant to enable all features in a vehicle that generate data (a driver state monitor is an example).

The vehicle feature incentives and purposes of data collection must align for the end users to be willing to use such features. It must also align with the approach of transport agencies and vehicle manufacturers. If they do not align, for example if end users are uncomfortable with the level of data being collected, then the manufacturer will be less willing to collect data on behalf of a transport agency.

Some vehicle industry participants have indicated a willingness to collect data from users for transport agency purposes. However, even for de-identified or aggregated data, participants will still request consent from users. This is a 'guest-centric' approach to data collection. Consent to collect data may be based on:

- use of a connected vehicle service
- the specific purposes for which data is collected.

Factors that may influence users to opt-in will include:

- use of data by transport agencies is protected in line with privacy expectations (for example, data is not is not recombined with other data or analytics used to identify users)
- whether users can see direct value from the use of their data or understand its use for purposes for transport agencies that do not accrue directly to them (for example, improved network planning practices may take many years to become apparent)
- purposes are not directly disadvantageous to end users such as use of data for speed enforcement
- data costs – cost of mobile data transfer from the vehicle
- user education – will users understand the advantage of data being used for broader community-based purposes and contribute data?
- incentives – will direct incentives be made available to offset the costs of participation such as registration, insurance discounts or others?

Case study: Automatic numberplate recognition collection

In 2013, the privacy commissioner for New South Wales raised concerns with information about the extent to which automatic numberplate recognition (ANPR) data is being recorded and stored (Thompson & Christodoulou, 2019).

ANPR is a method of collecting licence-plate data to provide automatic alerts to officers of unregistered, uninsured and stolen vehicles. This enables police to better target enforcement efforts and ultimately achieve road safety outcomes. However, collecting large amounts of this data may enable multiple records to be built up and used for other purposes such as investigations.

Similarly, with connected vehicle data, some participants have expressed to us a concern about vehicle data messages (such as location data) being provided for the purpose of road safety research or to build regulatory applications such as detecting over-speeding events.

This may drive users to opt-out or disrupt connectivity systems, which reduces their overall commercial and community benefit.

5.3 There is a current lack of data standardisation for vehicle-generated data

Workshop participants highlighted a lack of data standardisation as a key barrier to exchanging data. Different generators of vehicle data produce data using different systems, standards and measures of analysis. For example, timescales may differ depending on devices. For sensor data, one vehicle may produce ABS wheel sensor readings at different rates to another make and model. Where this data is used for determining crash trends, it is important that data needs are clearly defined.

For real-time data produced by V2X systems, standardisation is critical to ensure messages are received and time-critical safety decisions made. Standardisation of V2X messages is already occurring in Europe. Australia's state and territory V2X pilot projects are embedding these standards. The Australian Communications and Media Authority's *Radio Communications Class License for Intelligent Transport Systems 2017* requires devices that use dedicated spectrum available for V2X (commonly referred to as 5.9 GHz) to be aligned to a set of standards for interoperability.

For data with less frequency of report (events, periodic reports), we anticipate data standardisation will remain important to ensure interoperability and reduce costs for participants. A lack of standardisation may increase costs to data exchange, as entities will have to convert their data into another format.

Standardisation across government will also decrease costs. A lack of standardisation across the many different interested government agencies it may mean a desire by governments for similar data but in different formats. There will be a cost associated with format conversion, which may increase data costs.

Some stakeholders note that standardisation can occur too early before international formats are fully developed, particularly given Australia's role as a technology receiver. In this way, standardisation could act as a barrier.

As a policy, Australia adopts vehicle standards from Europe and the United Nations such as those developed in the United Nations Working Party 29 for vehicle standards (Department of Infrastructure, Transport, Regional Development and Communications, 2018). Some stakeholders suggest that the European Union's data taskforce model or the DATEX II standards may serve as a model for adoption in Australia.

There may be purposes outside of vehicle design where international standards are not developed or followed that the Australian industry could innovate in. As discussed in section 3.7, Australia is regarded as a leader in heavy vehicle telematics and has lead standards development through for heavy vehicle telematics at the International Standards Organisation (ISO, 2012).

We anticipate that standards could act as standardisation efforts work best when data needs are clearly understood, mature and can be used to bind participants to a common approach.

Question 8: Are there relevant international standards that should be adopted for vehicle-generated data? Are there any standards that could be locally developed?

5.4 There are commercial sensitivities impacting industry's willingness to share vehicle-generated data

Commercial sensitivities raised in our workshops and research include the following:

- *Fairness:* Why vehicle-generated data and not data from mobile phones, smartphone applications or other commercially held repositories of useful data? Unbalanced requirements may favour one business model or technology over another.
- *Disincentives to generate new data:* Much of the data generated from vehicles can be considered a 'digital exhaust' created by features fitted to the vehicle to increase its safety. Revenue from sensors may be an offset of the cost of installing new safety systems. For example, LIDAR is currently considered cost prohibitive as a feature for mass market road vehicles; however, revenue from LIDAR fitment may offset some of these costs. If the return on investment from these features is lower because data sharing requirements are imposed, does this delay the introduction of these features?
- *Overall market value:* One commentator noted that while business is willing to exchange road safety data, the revenue generated from traffic data services underpins their business in Australia.
- *Competitive insights:* These could include damage to vehicle brand reputation and through revealing sensitive information to competitors such as passenger pick-up and drop-off locations if data is inadvertently released, or 'free-loading' off data provided for some purposes but utilised by other competitors (see Table 6 for examples).

Table 6. Examples of competitive insights

Use case	Vehicle-generated data	Derived information	Commercial sensitivity to data being provided to governments	Potential methods to protect commercial sensitivities
Data for planning future transport networks	Location data	Trip origins and destinations	Potentially high if individual trip data reveals competitive information about operational models	Aggregation of data to postcode level Collection of data only outside the first and last kilometre of travel Collection of data only on arterial road network

Use case	Vehicle-generated data	Derived information	Commercial sensitivity to data being provided to governments	Potential methods to protect commercial sensitivities
Road safety events – identification	Vehicle breakdown events from hazard warning lights	Recurrence of vehicle breakdowns by area	Data could be aggregated by brand to demonstrate which vehicle brand breaks down more on freeway networks Data could be consumed by other vehicle brands that do not provide equivalent data into an exchange ecosystem	Reciprocity may be required to have access to vehicle-generated data from other generators of vehicle data Use of data may need to be limited through policy outlining permitted uses

5.5 There is currently a low penetration of connected vehicles in Australia

Our use cases frequently noted that achieving value from vehicle-generated data in the short term may not be feasible due to the low fleet penetration of vehicles that generate useful data. Issues of fleet penetration include that some use-cases:

- only achieve substantial benefits if all road-based incidents and events are recorded
- require a deployed vehicle fleet to create a level of statistical significance
- may be achieved through capture by a captive or corporate vehicle fleet (for example, a road network could be sampled by a smaller number of vehicles).

Case study: HERE connected signs – the challenge of limited connected vehicle populations

HERE Road Signs is a commercial product offered in European markets. Crowdsourced sensor data from vehicle frontal camera systems is used to provide real-time traffic signage information to keep in-vehicle maps up to date with local regulations and drivers informed on the road. This same data could be consumed by transport authorities to maintain traffic sign asset registers and manage internal speed zone databases in near real time.

HERE's product has been active in Europe since 2016, where connected cars report sign change locations. Three samples are required to survey a sign change before it is reported to public authorities and other vehicles. However, the service is not active in Australia because the volume of capable vehicles is lower. HERE anticipate the service may be available in Australia in the next 12 months.

Question 9: Have we accurately described the key barriers to accessing vehicle-generated data? Are there additional barriers?

6 Prioritising vehicle-generated data opportunities and limitations

Key points

- Transport agencies are still identifying and defining their views on government access.
- We have undertaken a categorisation of data that considers potential data solutions and uses. This categorisation may be helpful to direct future work on government access to vehicle-generated data.
- Road safety is one key priority and potential future opportunity; however, there is an opportunity for further work to better determine future priorities.

6.1 Purpose of this chapter

This chapter outlines the key opportunities for access to vehicle-generated data and how they could be achieved.

6.2 Transport agencies are still identifying and defining their needs for government access

At the start of this project, we set out to understand transport agencies' data needs and which of those are their highest priorities. We believe the workshops captured a collective snapshot of purposes and potential key priorities for transport agencies.[9] This is useful for all participants to have visibility of the business needs and the problems that transport agencies are trying to address.

The results of the workshops as discussed in chapters 4 and 5 illustrate that transport agencies have not yet fully formed their views on government access to vehicle-generated data. Some reasons for this include the following:

- *Breadth of use:* Within a transport agency there are many potential data users, each with broad and differing needs, desires and potential uses for data. The Queensland Department of Transport and Main Roads indicated they had more than 500 internal stakeholders express an interest in potentially using vehicle-generated data
- *The range of connectivity options* from vehicles are broad, complex and not well understood by transport agencies. The low fleet penetration rate suggests little experience with such technology by most Australians, and it is likely the technology is not well understood by those outside the businesses providing the technology.

[9] We acknowledge that this was a limited exercise and we anticipate that further research to define value propositions from vehicle-generated data would make a more compelling case for vehicle-generated data access.

- *Existing gaps* in data are often not well understood. The unique value proposition for vehicle-generated data was often not fully considered in the use-cases. Other sources of data may be able to solve the problem of a particular use-case.
- *Use of data will evolve:* As access and use of data grows, there may be future unforeseen uses that emerge.

The result is that we are unable to clearly define what the priority data needs of transport agencies are at this stage. It also means that opportunities to use data are not well understood.

6.3 We have categorised data by types of data rather than by use case

Because we cannot at this time clearly define the priority needs of transport agencies, we undertook a different approach. We have categorised potential uses cases by data rather than transport agency priority. This approach more clearly illustrates both the capabilities and limitations of vehicle-generated data as well as the barriers and limitations to using the data.

By organising vehicle-generated data into a framework based on the use of the vehicle (events, movement, crashes) or its capability to produce data (sensors, C-ITS messages, automation), the use of data is understood without limiting the discussion to purposes or temporary business needs. These have been linked to the types of use cases discussed in chapters 4 and 5.

The following categorisations are useful in understanding this:

- uniqueness of data
- mechanism and restrictions to access vehicle-generated data
- willingness of industry to support access to data
- potential limitations on the use of data
- the likely timing and availability of data.

Through this categorisation we anticipate that stakeholder understanding of vehicle capabilities and limitations, opportunities to access data, and limitations will improve. Our analysis in chapters 4 and 5 was a top-down analysis from problem statements and uses of data through to solution. This analysis works from the bottom upwards, from potential data solutions through to potential uses.

A full analysis with evidence and reasoning for our categorisation is in Appendix C.

Table 7 shows that by considering the category of data first, the unique barriers and potential opportunities become clearer. This is in direct contrast to the approach undertaken in the workshops, which started with considering data purpose. The same data may have different purposes with the workshop approach, resulting in a narrower understanding of potential data opportunities.

The table provides a potential future approach for considering the purposes for which data could be used by government. It could inform and develop use cases by first considering availability, readiness and other opportunities and barriers. It may assist transport agencies in prioritising and developing future use cases with a clearer understanding of the limitations of vehicle-generated data. Any use case would ultimately need to have a clear purpose and a positive cost-benefit analysis.

6.4 Vehicle-generated data categorisation

Table 7 illustrates our approach to categorising data to then determine what are the potential barriers and opportunities for different types of data.

- The ‘availability’ column considers whether vehicles are capable of producing this data and are available in the fleet. The table is sorted from the nearest to longest term availability.
- The ‘readiness to use’ column considers whether governments are ready to access and use data in operations.
- The ‘industry support’ column considers industry willingness to provide data due to the commercial or personal sensitivity to the data.

Table 7. Vehicle-generated data categorisation

Category	Source	Exchange method	Frequency	Potential uses	Unique to vehicles?	Unique to SAE3+ AV?	Availability	Readiness to use	Industry support
Vehicle movement e.g. location data (GNSS+UTC)	🚗 👤	V2N	Real time, periodic	More efficient network operations, network planning, project evaluation, investment planning, MaaS platforms	✗	✗	Current	Medium–high	Low–medium
Vehicle actions or events e.g. ABS, ESC, LKA events, airbag events, hazard light/ windscreen wiper activation	🚗	V2N	Event, periodic	Rapid incident responses, road safety network planning and evaluation, safety data for road users	✓	✗	Current to near-term	Low–medium	Medium–high
Driving behaviour e.g. speed, acceleration, harsh braking, ADAS functions use, fatigue events	🚗 👤	V2N	Event, periodic	Safe system strategic compliance activities, risk-based insurance for government price setting	✓	✗	Current to near-term	Low–medium	Low–medium
Vehicle crash analysis e.g. EDR, ACN/eCall, DSSAD, vehicle actions and sensors records	🚗	V2N, physical	Event	Crash reconstruction for enforcement, liability purposes, safety planning	✓	✗ (DSSAD will apply to AVs)	Current to near-term	Medium–high	High
Vehicle crash response e.g. ACN/eCall	🚗	V2N	Event	Rapid incident responses, road safety evaluation	✓	✗	Near-term	Low–medium	Medium–high

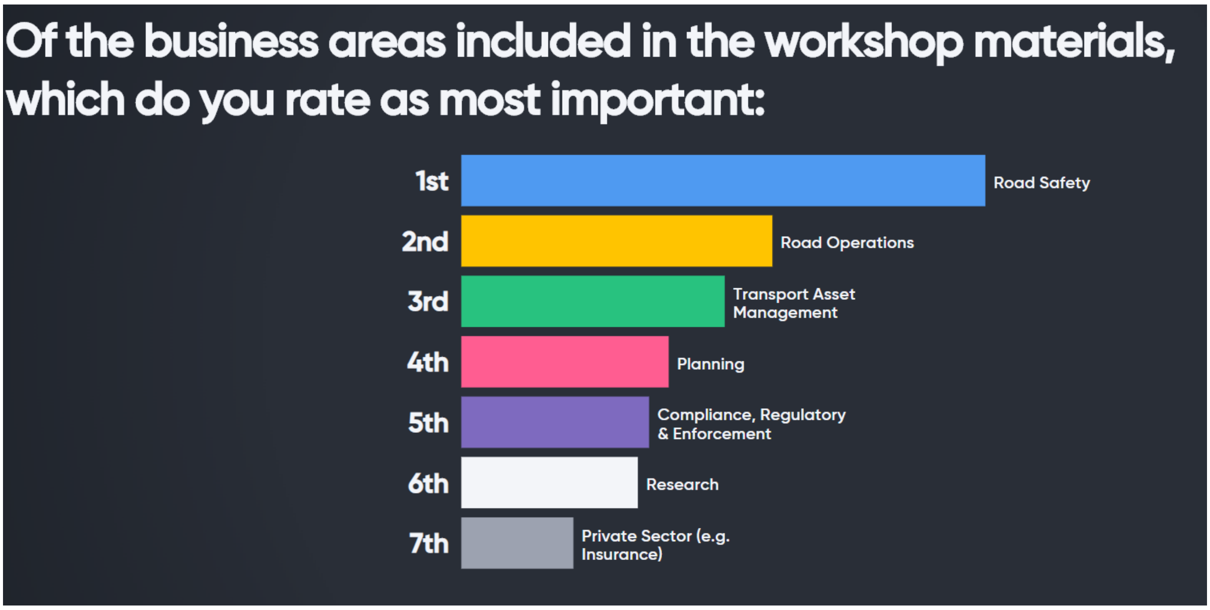
Vehicle condition e.g. OBD codes, engine status codes, battery status		V2N, physical	Event, periodic	Digital roadworthiness lodgement, electric vehicle charge point planning	✓	✗	Near-term	Low–medium	Low–medium
Asset sensing e.g. processed events from TSR systems LKA (line marking quality issues), tyre pressure/suspension, vibration, machine vision analytics (e.g. pothole detection)		V2N	Periodic	Transport asset maintenance, predicative maintenance, asset inventory, freight access policy	✓	✗	Near-term	Low–medium	Low–medium
C-ITS messages e.g. CAM, DENM, traffic signal request		V2I/P/V, V2N	Real time, periodic	Real-time network operations, road safety incident detection, traffic signal prioritisation	✓	✗	Mid- to long term	Low	Medium–high
Automated driving e.g. To be determined (TBD) safety reporting obligations, ODD, geofence change/reports, network disruptions, minimal risk manoeuvres		V2N	Periodic, event	Regulatory oversight of automated vehicle deployment by transport agencies	✓	✓	Long term	Low	TBD

6.5 What priorities did we hear?

6.5.1 Stakeholder sentiment

We asked workshop participants about their priorities to determine where transport agency business needs and industry willingness to share or exchange data may align. As illustrated in Figure 7, participants saw road safety as a potential priority for access to vehicle-generated data. Industry indicated that in limited circumstances this data may be exchanged on non-commercial terms.

Figure 6. Co-design workshop polling



Source: Arcadis – workshop live polling

Workshop presentations from government and industry participants noted road safety trends in Australia as concerning. Transport agencies continue to work towards improving road safety and reducing road trauma. However, presentations noted that road deaths have been increasing since 2015. Both generators of vehicle data and transport agencies noted the importance of achieving road safety objectives. Access to vehicle-generated data could contribute to improving road safety.

6.5.2 Why should road safety be the highest priority area?

We contend that road safety data should be the highest priority area for government access to vehicle-generated data. We have analysed each purpose based on a framework that balances both the business need they are trying to solve (impact) and the availability of solutions that are available from vehicle-generated data (effort). To help prioritise, we have identified a range of criteria to assess the impact of the use case or the effort required to achieve it. Criteria that indicate the *impact* of the use case include:

- scale of the problem and the business need
- existing alternatives / uniqueness of the data – Can the data already be sourced elsewhere? Why should the vehicle be used as the source of the data?
- if value could be achieved early or if it requires a high level of fleet connectivity.

Criteria that indicate the *effort* required to access data include:

- the willingness of industry to exchange data
- that access would require vehicles to be reconfigured for unique Australian requirements
- if access requires personal information or if aggregated/de-identified data is needed.

Our detailed analysis of each purpose against the criteria is contained in Appendix C. From our analysis, and stakeholder feedback, we consider road safety could be the logical starting point for initial access arrangements to be made for data from the light vehicle industry.

We consider road safety could be the priority for the following reasons:

- Road safety is a significant and ongoing transport problem in the Australian community – Australia is unlikely to meet its road safety targets.
- Value is achieved from knowing when and where each unique safety event occurs across road networks. A wider fleet would be more beneficial, but immediate value can be harvested.
- Industry has indicated greater willingness to exchange data for road safety purposes without commercial terms being added.
- A model for road safety data partnerships has been established in Europe that could potentially be adopted in Australia
- Road safety data is considered a public good in Europe, and this same principle should be supported in Australia.

Only de-identified, technical data is required from the vehicle, which does not require the consent of users to collect and would be difficult to combine with other data to infer personal information from.

The case study below illustrates the approach the European Union has taken for prioritising data needs.

Case study: European Data Taskforce Proof of Concept – Data for Road Safety

The European Union's Data for Road Safety Proof of Concept is a 12-month practical evaluation of how transport agencies and the vehicle industry can collaboratively exchange data for the benefit of communities. By ensuring all road users have access to safety data, a greater value is created than information remaining within the transport agency or vehicle brands.

The Data for Road Safety exchange involves four light vehicle brands (Ford, BMW, Mercedes, Volvo), one heavy vehicle brand (Scania), seven European nations and two information service providers (HERE and TomTom).

The proof of concept seeks to provide end users (vehicle drivers) with safety-related traffic information through the exchange of data from both transport agencies and vehicles across eight use cases relating to real-time traffic safety events. The data sourced from vehicles uses vehicle technical systems such as anti-lock brake events, vehicle hazard light activation and detection of roadworks signs through frontal camera systems. This provides a benefit to the drivers themselves, as well as to governments.

Data is exchanged through vehicle manufacturers' data servers and national access points operated by transport agencies.

GDPR is a key consideration of the Data for Road Safety project. Data is protected by limiting access only to event information, event locations and timestamps. Personal information such as a VIN is not provided, nor is a 'breadcrumb' trail of data about the vehicle's location produced.

A memorandum of understanding limits the use of data to the creation of 'safety-related traffic information'. A reciprocity proposal is used to ensure only those who contribute data to the exchange are able to access data produced, ensuring all stakeholders receive value.

Data costs are minimised through standardisation efforts that ensure only a light packet of data containing only the necessary information to produce 'safety-related information' is carried over telecommunications networks.

Question 10: Do you agree that *road safety data* should be considered the priority purpose for which we seek to exchange data with industry?

Question 11: What are the key data needs of transport agencies beyond those already identified?

Question 12: What further benefits from vehicle-generated data should be considered?

6.6 There are potential future priorities

To date we have not been able to establish a view of a desired minimum national data view due to:

- the range of purposes for which data is desired
- the range of stakeholders that have data needs
- the range of connectivity options from vehicles, which are broad, complex and not well understood
- existing gaps in data are often not well understood and other sources of data may be able to fill gaps
- the benefits of collecting vehicle-generated data are not yet well defined.

Through our workshops we believe we have captured a collective snapshot of purposes and refined key priorities for transport agencies. We acknowledge that this was a limited exercise, and we anticipate that further research to define value propositions from vehicle-generated data would make a more compelling case for vehicle-generated data access.

Some of the limitations of this exercise could be filled out with further research that covers:

- deeper analysis of key transport agency problems

- data gaps and challenges with old methods of data collection (sample, intrusiveness, expense, granularity, timeliness)
- data requirements (frequency, fields, accuracy, latency)
- uniqueness of the vehicle-generated data
- number of vehicles required to achieve value
- readiness of transport agencies to ingest and use data
- availability of solutions from vehicles
- greater understanding of data costs to deliver a solution from the vehicle.

At the conclusion of our workshops, we surveyed stakeholder sentiment on building an ongoing forum between industry and government to continue discussing data access. There was strong support across both industry and government participants to continue engagement. Further consultation may be required to determine the appropriate forum.

6.7 The vehicle-generated data categorisation table presents future opportunities

Table 7 assesses opportunities for access to vehicle-generated data by categorising vehicle data types by:

- when this data may be available in Australia
- the readiness of transport agencies to define data needs, access and use data
- the willingness of industry to share or exchange data.

The analysis highlights the following opportunities in the *short term*:

- build on the willingness of government and industry participants to support road safety through access to vehicle action/event data, and potentially driver behaviour data
- build on the planning of some jurisdictions to expand requirements for some restricted access vehicles types to provide movement data as a condition of road access
- introduce requirements to support crash analysis and crash event through:
  - the possible alignment of Australian Design Rules with United Nations Regulations for automatic crash notification systems (eCall)
  - the alignment of forthcoming United Nations regulations for EDRs and DSSAD for enhanced legal information.

In the *longer term*:

- In-service safety law for automated vehicles will create opportunities for new data requirements that could be applied as a condition of road access. Data requirements for compliance and enforcement purposes to ensure appropriate regulatory oversight of automated vehicle deployment will be considered in future NTC work. Other opportunities could be considered as part of future work on vehicle-generated data.
- C-ITS opportunities may emerge as international approaches to technology are settled and Australian stakeholders consider whether deployment initiatives in Australia are desirable.

Other opportunities:

- Vehicle movement data and asset sensing are likely to be the most contested areas for government access. This is because this form of vehicle-generated data is not unique to vehicles and is already being commercialised. Governments have introduced their own capabilities to access vehicle movement information through enhanced roadside technology and other uses of crowdsourced data.

- It is not clear to us at this stage that a market failure exists, with many categories of vehicle-generated data including vehicle movement and asset-sensing data. Products for such categories are available, with indications that more products are in development. We anticipate that market-based services will continue to emerge that provide enhanced products for network operational and transport planning services. Intervention in this market at this point does not appear warranted.
- Other data such as vehicle condition data remains unclear. What the data is used for will determine drivers' and road users' willingness to share.
- There could still be benefits in defining government needs, developing standards to ensure data interoperability, or looking to smaller, captive fleets to provide a 'minimum dose' of data needed to sample road networks. As an example, commercial vehicles that operate frequently on the network could present another opportunity.

6.7.1 COVID-19 – data priorities and needs

This project began in 2019 and most consultation occurred across late 2019 and early 2020. As a result, the NTC has not been able to consult on any changing priorities or needs as a result of the COVID-19 impacts on transport agencies.

COVID-19 impacts on road transport are not yet clear, but some of the following short-term changes have been observed (Australain Road Research Board, 2020):

- significant reductions in pedestrian traffic
- significant reductions in congestion – for example, an 85 per cent reduction in traffic congestion on Melbourne's Monash freeway, with only a 28 per cent reduction in vehicle movement
- no major changes to heavy vehicle movements.

Some transport agencies have also temporarily exempted or reduced requirements under transport laws – for example, the removal of heavy vehicle movement curfews on some urban networks. Data that helps evaluate and monitor the impacts of these changes on vehicle movements could be useful to transport agencies in making these policy decisions.

These changes could also increase the need to prioritise data access for heavy vehicle movements to be able to assess the impact of policy changes.

It is uncertain whether all these changes will be temporary or which may have an ongoing impact. We are interested in hearing from stakeholders on how COVID-19 is likely to affect land transport in Australia.

Question 13: We contend that a prioritised starting point should be established from which data for other purposes can be further developed. Are there other approaches that could achieve this?

Question 14: Do you agree with the analysis presented in Table 7? What other opportunities are there for vehicle-generated data, and why?

Question 15: Have priorities changed for land transport policy and for data access from vehicles with the onset of COVID-19?

7 Policy options for Australia to gain the benefits of vehicle-generated data

Key points

- This discussion paper presents several policy proposals to address the opportunities and problems discussed.
- We propose the following opportunity statement: For future development on government access to vehicle-generated data, road safety is the priority for exchanging vehicle-generated data between industry and government. Industry and government should collaborate on identifying opportunities for exchanging road safety data and adopt a principle of non-commercial sharing or exchange.
- For problem 1 and 2 we put forward the following options:
  - Option 1: Rely on existing arrangements between government and industry, with no changes to existing legislation or frameworks.
  - Option 2: Establish a data exchange partnership between industry and government that will identify opportunities for exchanging vehicle-generated data as well as develop standards and consider proof of concept.
  - Option 3: Introduce new legislation requiring industry to collect, store and retain vehicle-generated data while providing access to government.
- For problem 3 we propose that the Commonwealth government and the Australasian New Car Assessment Program undertake further work to progress the introduction of an eCall or automated emergency crash notification type service in Australia.
- At this stage, the NTC considers that option 2 provides the best opportunity for government access to vehicle-generated data.

7.1 Purpose of this chapter

The purpose of this chapter is to:

- provide a recommended policy approach to address the opportunity statement
- present options to address problem statements 1 and 2
- provide potential policy considerations to be adopted to address problem statement 3.

7.2 Recommended policy approach to increase collaboration on exchanging vehicle-generated data

Opportunity statement

There is an opportunity for stakeholder collaboration on exchange or sharing of vehicle data for road safety purposes to understand:

- what vehicle-generated data can be used to support road safety in Australia
- what an appropriate framework and forum might look like to support such an exchange.

We recognise there are many opportunities for greater access to vehicle-generated data. Participants at the workshops saw exchanging vehicle-generated data to improve road safety as a key objective that could be supported by both government and industry. Exchanging vehicle-generated data could improve the safety of road users and potentially reduce fatalities on Australian roads.

A successful exchange will require industry willingness and participation. Stakeholders note the need for a single starting point to establish trust and governance frameworks for exchanging data. As road safety will benefit road users most directly, this is the logical starting point. Importantly, industry indicates a willingness to collaborate on the exchange of data related to road safety on non-commercial terms in some circumstances. This would not preclude industry and government from exchanging data on commercial terms.

Vehicle-generated data is still at the nascent stage of development in Australia, and there is an opportunity for governments to adopt a new policy approach. We therefore propose:

> For future development on government access to vehicle-generated data, road safety is the priority for exchanging vehicle-generated data between industry and government. Industry and government should collaborate on identifying opportunities for exchanging road safety data and adopt a principle of non-commercial sharing or exchange.

This is in line with the current approach in the European Union where a proof of concept is underway on government and industry exchanging road-safety-related data. This policy approach is supported by both industry and government and complements the options put forward for the problems s. This may serve as an initial focus that is broadened out to other areas over time. It is not yet clear what kind of data would be exchanged as part of road safety. Further work will be needed to establish requirements, data standards and determining what exactly is considered road safety data.

We note that adopting a principle of non-commercial data may impact some commercial providers of data. Some information services have created new 'hazard warning' services (HERE, 2020), which offer commercial propositions for vehicle event data. However, we believe that seeking non-commercial exchange of this information would align Australia with best practice from the European Union.

Question 16: Should road safety be adopted as the priority for developing use cases for government use of vehicle-generated data? If not, what other approach should Australia take?

Question 17: Can data other than for the purposes of road safety be exchanged on non-commercial terms?

7.3 Options to improve government access to vehicle-generated data and establish standards and governance frameworks

Problem statements

1. Vehicle-generated data is currently not provided to transport agencies for purposes that may have publicly beneficial outcomes. This is due to current vehicle capabilities and/or a lack of incentive or reason for industry and road users to provide the data (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance scheme).

2. There is a lack of a data access framework to provide the necessary trust, data exchange systems, data standards/definitions, understanding of data needs and governance to establish data access and use (the exception to this being heavy vehicles enrolled in a current regulatory access or compliance scheme).

We are putting forward one set of options for both problem 1 and 2 because we believe these options can address both problem statements.

7.3.1 Option 1: No change to existing framework and legislation

This option proposes no changes to the existing government access to vehicle-generated data landscape. It is suitable for governments satisfied with existing arrangements between government and industry and that consider current access to vehicle-generated data sufficient. Access to data from EDRs will most likely increase, as will the availability of legal information for automated driving liability determination with the future adoption of international DSSAD standards.

Governments wanting to increase access can procure data from existing providers or approach industry independently to purchase solutions. This option:

- will most likely require transport agencies to each separately and internally develop use cases to further understand their needs
- will create a fragmented approach to transport agencies engaging with various businesses to enter into commercial arrangements to access various data for their needs
- may not result in any further or new access to vehicle-generated data where participants see mutual benefit
- would miss an opportunity to influence industry stakeholders to adopt a consistent approach to providing vehicle-generated data

- may result in different standards being used in different states and territories, increasing costs for governments and industry.

7.3.2 Option 2: Government and industry data exchange partnership

This option proposes creating a data exchange partnership between industry and government that will identify and develop use cases for the exchange of data between industry and government. We envisage this partnership could include the following features. These are given as an example but would need to be developed by the partner organisations.

Partnership scope and establishing overarching governance

- The partnership would develop a shared vision and principles. A memorandum of understanding would establish the terms, members and governance of the working group and include any agreed principles.
- Principles could include:
  - achieving national consistency, particularly in relation to data definitions and standards
  - minimising that amount of data needed to achieve an outcome
  - focusing on information and insights over data
  - encouraging ‘opt-in’ to services
  - protecting sensitive data – either personal or commercial.
- The partnership approach would enable parties to make requests for data, on the basis of either sharing of data, exchange of data (which could include reciprocity) or other means to provide value to stakeholders.
- The scope of the partnership would focus on data for road safety as the priority identified in this project. However, where requests for data achieve stakeholder support through providing an ‘appropriate incentive’ and an established trust mechanism, data for other purposes could be considered.

Exchange obligation

- Both industry and government parties may make requests for data, but there would be no obligation by any party to comply with any requests. A response outlining why the data request has been refused should also be provided and on what grounds it could be met.

Establishing and proving value

- Industry and government may also consider trialling the exchange of data through a proof of concept to validate the value of data exchange.
- Successful proof of concepts will further inform the development of a framework for the exchange of vehicle-generated data between government and industry.

Process and data governance

- Governance would be established by drafting legal agreements covering rights to access data. Existing agreements used in heavy vehicle telematics could be adopted as a starting point.
- Transport agencies would develop draft problem statements, underlying data requirements, assessment of alternatives and potential benefits to be discussed and further developed with industry.

Membership

Membership would be voluntary and include government and industry and an administrative entity such as TCA, which could assist in administering the exchange of data and, where desirable to stakeholders, act as a national aggregation point. It could also include other parties such as research and academic organisations, who may see other uses of data or contribute to the overall evaluation of exchanges.

Outputs

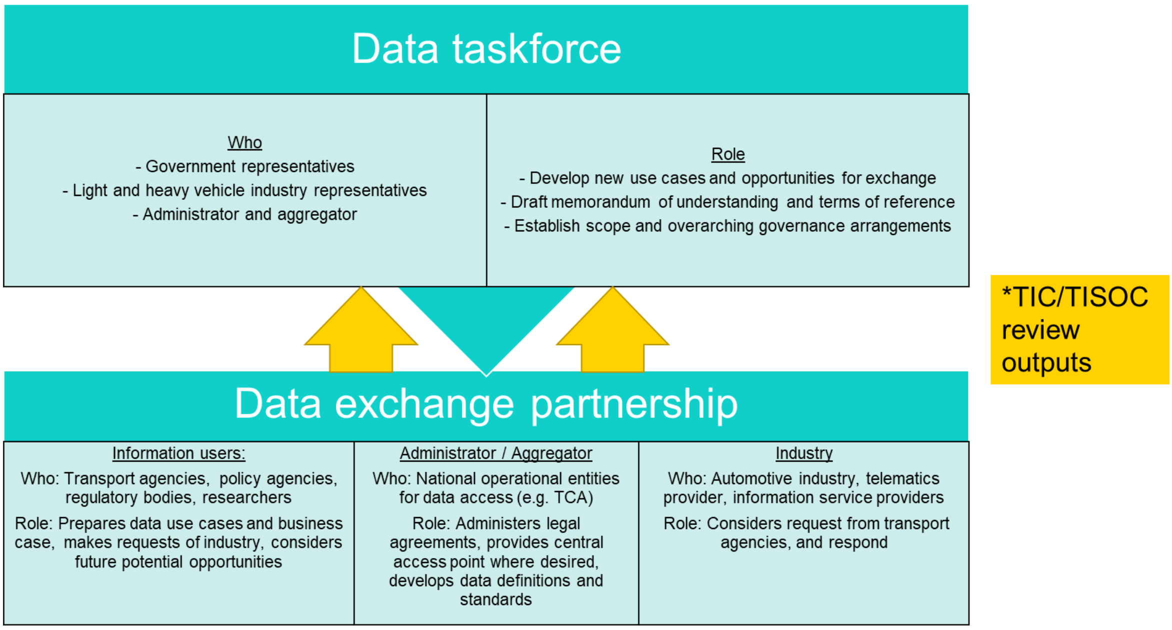
We envision that outputs could include trials as well as data exchange standards and, in time, validated use cases that could be implemented by stakeholders.

This option could result in:

- the development of use cases for government access to vehicle-generated data
- the identification of how data can be exchanged between government and industry for the purposes such as road safety, planning and network optimisation
- the development of data exchange standards to be verified by a third party such as TCA
- clearer understanding of participants positions
- greater access by government to vehicle-generated data
- access to some data on non-commercial terms but still on the basis of exchange or reciprocity
- a framework for future exchange of data between government and industry.

Figure 8 illustrates a potential governance model for such a working group.

Figure 7. Potential governance model for a data exchange working group



This option does not propose any legislative changes. The work undertaken by government and industry under this option may inform any future legislative or regulatory changes.

7.3.3 Option 3: Legislative reform

This option proposes introducing new, nationally consistent legislation that would require industry to capture, store and process vehicle-generated data, which would then be provided to road agencies.

There are many ways to draft the legislation. For example, the Act could be modelled on the *Telecommunications (Interception and Access) Amendment (Data Retention) Act 2015* (Cwlth) or the European Union's Delegated Regulation 886/2013 for providing 'Safety Related Information free of charge to end-users'.

The legislation could include:

- obligations for industry on what data is captured and how it must be provided to industry
- data standards for capturing, storing, processing and transferring data
- the purposes for which data would be used by road agencies
- the frequency of which transport agencies would request data be provided by industry
- what data road agencies must provide to industry
- how personal and sensitive data is handled by all parties.

This option could result in:

- greater access by government to vehicle-generated data
- nationally consistent data exchange standards
- access to data on non-commercial terms
- a framework for government access to vehicle-generated data
- new legislative obligations for government and industry.

7.3.4 The NTC's preferred option

The NTC's preliminary preferred option is **option 2**. The reasons for this are outlined below.

Option 1 is not the preferred option for the following reasons:

- It may not improve government's understanding of the potential uses and benefits of vehicle-generated data.
- It may not improve government and industry collaboration on vehicle-generated data.
- Government may only be able to access on a commercial basis without any improved understanding of the potential uses and benefits of vehicle-generated data. This may mean that none or only some of the potential benefits of vehicle-generated data will be realised.
- Government may not be able to clearly define the potential uses and benefits and may not know what the costs of ingesting and using such data will be.
- Industry is unlikely to know what its costs relative to potential benefits may be for providing such a service. This may result in a commercial agreement that does not accurately reflect a cost that is commensurate with potential benefits and use.

- It is unlikely that an improved trust environment between industry and government will occur with existing arrangements. Under a commercial exchange trust may be established; however, this may lead to an inconsistent approach between jurisdictions. There may be inconsistency on aspects such as data attributes, data formats, frequency of data provision and owner/user consent.

Option 2 is the preferred option for the following reasons:

- It can provide an opportunity for government and industry to collaboratively realise the benefits of vehicle-generated data for road safety and potentially other benefits.
- It can provide the best opportunity for government to better understand how to maximise the potential benefits and opportunities of vehicle-generated data, with active collaboration with industry. It will allow for both government and industry to understand the potential costs involved in government access and use to vehicle-generated data.
- There are no mandatory costs for industry and, depending on the nature of the agreement, there may be no additional costs for industry participants.
- Government and industry will work to determine privacy and other security issues with exchanging vehicle-generated data. It can establish trust between industry and government through developing an exchange framework.
- It does not get ahead of any international developments. Any international developments can inform the working group for potential opportunities.

Option 3 is not the preferred option for the following reasons:

- Without a clear understanding of the potential uses and benefits of vehicle-generated data, government will not be able to accurately legislate to capture all potential benefits.
- It is not clear to us who would be regulated for each purpose and which is the best regulatory instrument to achieve this. We anticipate any regulation will be highly dependent on the use case, as it may need to regulate specific industry sectors.
- Without a clear set of use cases, government may legislate too broadly, which may result in cumbersome regulation to industry. Legislation will most likely place more obligations on industry resulting in further regulatory compliance costs to industry. It is unclear what the cost to industry would be at this point and there is a risk that it may be a significant cost.
- Legislation may be a barrier to introducing new vehicle technology into Australia that improves road safety. By placing a requirement on industry to provide data from new technology to government, the cost of including such technology to a vehicle may outweigh any commercial benefit. Government would first need to develop a better understanding of potential use cases to avoid this issue.
- There is insufficient evidence at this stage that legislation will provide a better approach compared with a market-based solution. The market for vehicle-generated data is in its nascent stages and it is likely that there will be further innovations leading to greater availability of data at a lower cost.
- Legislation at this stage will most likely result in additional costs to industry to provide data and will require large-scale investment by government to ingest, process, store and analyse any data provided by industry through legislation. Some of these costs may also be passed on to the end user or such technology is not introduced into Australia due to the additional costs incurred during to the enactment of legislation.

- Once potential uses are better known through the trialling of vehicle-generated data technology in partnership with government, option 3 may be a potential future policy direction in that:
  - it can provide ongoing continuity of service and provision of data to government beyond an initial period of data provision as in option 2
  - it may more effectively establish trust than a voluntary agreement between industry and government and protect against data misuse
  - it may establish opt-out provisions ensuring end user privacy and prevent the use of data for compliance and enforcement provisions.

Question 18: Does the NTC's preferred approach (option 2) best address the problems we have identified? If not, what approach would better address these problems?

7.4 Proposed approaches for increasing whole-of-fleet penetration for connected vehicles

Problem

3. The level of uptake and penetration of connectivity across the Australian vehicle fleet may delay the benefits of vehicle-generated data, particularly related to safety-critical events.

Improving Australia's fleet connectivity could create an opportunity to reduce the delay of benefits from vehicle-generated data. As outlined in section 3.6, Australia's light connected vehicle fleet penetration is low, with the current number of connected vehicles estimated at less than 5 per cent of the total fleet. However, the use cases developed in our workshops (chapter 4) often highlighted the need for a wider connected vehicle fleet to derive benefits. With safety-related use cases such as real-time events, there is benefit in being able to rapidly identify all safety incidents and make faster responses.

To address this problem, the NTC proposes that the Commonwealth government considers policies that could increase fleet penetration through developing a regulation impact statement. Based on feedback and discussion from our past workshops, we propose:

- that the Commonwealth government considers policy options and infrastructure requirements for implementing eCall-like services in new vehicles as is found in the European Union
- that Australasian New Car Assessment Program (ANCAP) considers assessing eCall and Advanced eCall as part of its assessment for new vehicles entering the Australian market.

We are proposing the above for the following reasons:

- The introduction of eCall is the only regulatory opportunity outlined in chapter 6 in the short term for the increased uptake of vehicle-generated technologies in Australia.

- eCall is important because it binds all new vehicles to be fitted with installed or embedded communication devices in all vehicles, as well as requiring backend infrastructure to receive messages.
- Several vehicle industry stakeholders have called for the introduction of eCall at our workshops. This was the only regulatory measure supported by stakeholders at this time. Some vehicle industry stakeholders noted that it was challenging to justify the fitment of connectivity in Australian-delivered vehicles to their overseas parent companies.
- The introduction of eCall is in line with international standards. Apart from European Union implementation, the United Nations has developed UN-Regulation 144, requiring vehicles to:
  - fit a system capable of providing data over public mobile phone networks
  - be interoperable with public exchange points for a minimum set of data
  - include a mechanism to collect data from the vehicle in the event of a crash.
- We understand that international eCall requirements enable both the use of services that ‘triage’ calls through a private call centre or enable data to be sent directly to a public service access point such as Australia’s triple zero (000) service. We envisage that introducing eCall in Australia would not preclude either of these service options, provided that they bind connectivity to new vehicles.
- Mandatory eCall can be implemented through the Australian Design Rules, resulting in a significant increase in the fleet penetration of connected vehicles in Australia. A mandatory requirement may also mean a level playing field for industry. The mandatory inclusion of eCall in Australia would also mean that other related vehicle technology would only be an incremental cost (rather than a significant cost) to include in Australian vehicles.
- Overall we heard that such a mandatory inclusion would reduce costs for generating this data.
- We have heard that infrastructure requirements and system capabilities will need to change, in particular triple zero (000) capabilities, to allow for eCall messages to be received and actioned. These issues can be further considered by the Commonwealth.
- ANCAP has previously considered assessing eCall and Advanced eCall as part of its safety assessment but has delayed inclusion of this criteria until 2022, when it is anticipated that infrastructure may be in place to receive eCall messages (ANCAP, 2020).
- Vehicle-generated data benefits would strengthen the business case for eCall, in addition to the primary benefits of emergency services reaching crash sites more quickly.

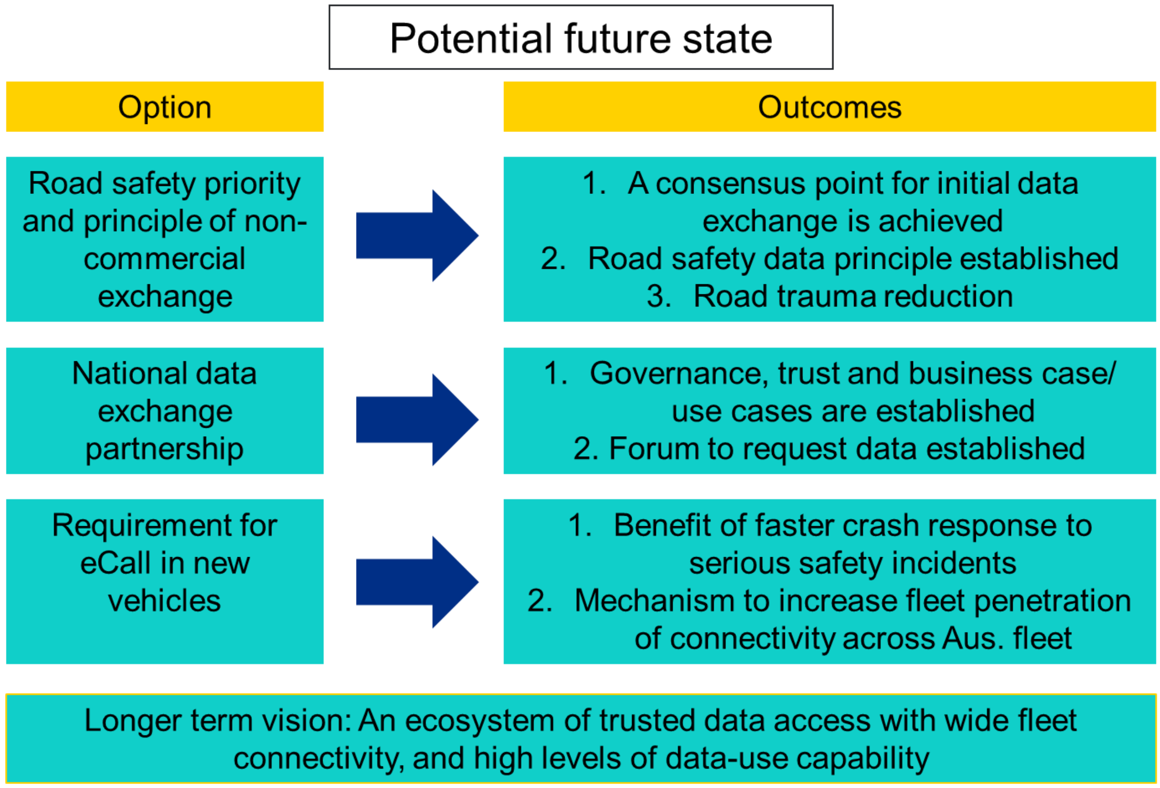
Question 19: Does the NTC’s proposed approach best address the problems we have identified? If not, what approach would better address these problems?

7.5 Conclusion

At this stage of vehicle-generated data the NTC considers option 2 best addresses the issues in problem 1 and 2. This approach will help guide further policy development and improve collaboration between industry and government on the exchange of vehicle-generated data. It may also increase access by government to vehicle-generated data.

Our proposed policy approaches for problem 3 and the opportunity statement complement our preferred option. Figure 9 illustrates the outcomes and potential future state if all recommended proposals were adopted.

Figure 8. Summary of NTC proposed options



With an initial focus on road safety, government and industry can identify new ways to maximise the potential benefits for vehicle-generated exchange data. Over time, as standards and methods of exchange are established, this partnership can look to other areas outside of road safety for further opportunities. This work would be complemented by introducing mandatory eCall requirements, increasing fleet penetration and potential data exchange opportunities with more connected vehicles on Australian roads. With greater fleet penetration, there would be more opportunities for the exchange of data and new opportunities for government access to vehicle-generated data.

Adopting all of these approaches as a package of responses could increase the adoption of vehicle-generated data technology, improve government and industry collaboration and ultimately improve road safety in Australia.

7.6 Next steps

The NTC will consult with stakeholders and review and consider all submissions in response to this discussion paper.

Based on the outcomes of this consultation, the NTC will develop recommendations and next steps to implement the recommendations for the Transport and Infrastructure Council meeting in the second half of 2020.

Appendix A Use case impact and effort analysis

	Impact			Effort		
Purpose	**Scale of the problem and business need**	**Is a vehicle needed to generate this data or could other sources be used?**	**Fleet connectivity**	**What is industry willing to exchange on a non-commercial basis?**	**Would the implementation of this use case require unique Australian requirements that present a barrier to market entry?**	**Is personal information required?**
Road safety – real-time events	✓ Was rated as a high priority by workshop participants	✓ Highly beneficial to use vehicle data from technical systems such as airbags, hazard warnings, stability control and others	✓ Value is achieved for every event reported	✓ Likely to be higher as evidenced by the European car industry policy statements[10]	✓ The model of the European Union Data Taskforce could be adopted Standards are being developed to underpin this project	✓ No – de-identified event data
Road safety – research	✓ Was rated as a high priority by workshop participants	✓ Highly beneficial to use vehicle data from technical systems such as airbags, hazard warnings, stability control and others	? A fleet of vehicles may be needed to sample the road network and provide statistically valid data	✓ Likely to be higher	? Unclear – some stakeholders indicated that this could be captured through captive vehicle fleets	✓ No – aggregated data

[10] ACEA: Access to vehicle data for third part services: https://www.acea.be/publications/article/position-paper-access-to-vehicle-data-for-third-party-services

Network operations	✓ Was highly rated by workshop participants	- As this is primarily location data derived information, it could be sourced from a range of services that provide movement data	✓ A fleet of vehicles is required to sample the road network and provide statistically valid data	- Low – this is being commercialised through information service providers	✓ Location data is not a unique Australian requirement	- Potentially yes Location data may reveal user travel patterns
Transport asset inventory and management	- Rated as a lower priority by workshop participants	✓ Likely to benefit from access to vehicle technical systems	? A fleet of vehicles is required to sample the road network and provide statistically valid data	- Likely to be low because this data is already being commercialised	- Low – we are not aware of aligned international approaches	✓ No – aggregated data only
Freight policy and planning	✓ Rated as a high priority by workshop participants	✓ Could be captured through heavy vehicle aftermarket telematics	✓ Value can already be achieved through heavy vehicle equipped fleets	? Not assessed in workshop	? Not assessed in workshop	? Aggregated info needed, but potentially yes as location data may reveal user travel patterns
Network planning	✓ Rated as a high priority by workshop participants	- As this is primarily location data derived information, it could be sourced from a range of services that provide movement data provide movement and location data	- A fleet of vehicles is required to sample the road network and provide statistically valid data	- Low – this is being commercialised through other information service providers	✓ Location data is not a unique Australian requirement	? Aggregated data needed, but potentially yes Location data may reveal user travel patterns

Appendix B Use cases generated through NTC workshops

Purpose	**Use cases**	**Typical *information* required**	**Indication of underlying *data***
Road safety – real-time events	1. Identification of road safety events 2. Future data for road safety 3. Crash detection and response 4. Detect environmental conditions/hazards 5. Detect crash/breakdown	• Real-time safety-related event and location	• Location, timestamp • Vehicle technical data including: airbag event, hazard/fog light activation, ESC/ABS event, windscreen wiper activation, roadworks event
Road safety – research	1. Safety at intersections (high risk) 2. Identification of vulnerable road user risk 3. Road safety black spots 4. Regional road safety 5. Driver safety	• Aggregated information on infrastructure and driver behavioral risk across road networks	• Vehicle technical data including: ESC/ABS events, lane departure, speed warning, fatigue events, pedestrian warning • Hard braking
Network operations	1. Network speed data (variability and efficiency) 2. Network optimisation and traffic management 3. Traffic flow optimisation 4. Congestion	• Network travel speed and performance • Segment travel speeds • Incidents/hotspots	• Location data (latitude, longitude, heading, etc.) • Vehicle type (e.g. bus or car) • Could include traffic signal status

	5. Green wave		
Future network planning	1. Planning of future transport networks 2. Combining volume and origin destination data 3. Infrastructure planning 4. (Open vehicle data)	• Origin/destinations • Travel routes • Volume • Travel times	• Location data (latitude, longitude, heading, etc.) • Number of vehicle occupants • Vehicle type
Road asset awareness and inventory	1. Road asset inventory	• Real-time asset condition information and location / changes to specific assets	• Location, timestamp • Vehicle sensor data: speed sign change, pothole detection, etc.
Freight policy and planning	1. Access to the network 2. Transport operations/productivity 3. Asset management	• Lane use • Vehicle movements and routes • Asset wear – pavement and bridge • Driver behaviour • Vehicle type, configuration, mass	• Telematics (including IAP and commercial) • Hard braking • Vehicle and axle mass • Tyre pressure • Vibration • Lane ID

Appendix C Vehicle-generated data analysis

The reasoning for our analysis is included in the table below.

Vehicle data category	Vehicle data availability	Readiness to access/use	Industry willingness to support
Vehicle movement	Vehicle movement data is currently produced and available from telematics devices, mobile phones and other devices	Transport agencies are already using data from similar sources such as mobile phones; telematics application data is also being widely used as indicated by TCA	Industry has indicated movement data has high commercial value and is likely to be personal in nature; this type of data is already being commercialised
Vehicle actions or events	While such data is created it is not generally stored or transmitted. We expect this data to be a near-term possibility based on the 'Data for Road Safety Proof of Concept' in the European Union	Transport agencies do not currently have access or use such data and may not have adequate capabilities to use it	In our workshops, industry indicated a willingness to exchange such data for real-time events
Driving behaviour	Such data is currently being captured in new model vehicles	Transport agencies do not currently have access to or use such data and may not have adequate capabilities to use it	Industry indicates some of this may impact on driver privacy; however, for the purposes of road safety there may be some willingness provided users are de-identified or data is aggregated
Vehicle crash analysis	Crash data is currently being captured in new model vehicles through on-board event data recorders	Agencies have indicated that they access to and use vehicle crash data in some circumstances	Industry indicates this data is currently shared with governments, with support for further sharing
Vehicle crash response	There are currently limited vehicles with emergency call features; industry indicates this capability may be included in more vehicles in the future	Current public infrastructure does not support emergency calls via message or other means	There was a relatively high level of support that sharing crash notification data will improve road safety

	The European eCall requirement indicates that this capability could be made available in Australia in the short term, if Australia required it		However, there are concerns over the ability of public authorities to handle messages
Vehicle condition	While some of these data types are available through on-board diagnostics reports, the access is limited and controlled by original equipment manufacturers	Transport agencies do not currently have access to or use such data	Vehicle condition data is likely to be highly valuable for aftermarket business sales and services; however, some limited purposes such as electronic roadworthy certificate lodgement may be supported
Asset sensing	Some early data on asset sensing is being captured such as processed traffic sign changes; however, this does not appear to be widespread	We are not aware of asset-sensed data being used widely at this stage	Sign change data is already being commercialised; there is likely to be less support for sharing it
C-ITS messages	Austroads research indicates that this technology is likely to be a slower penetration through the vehicle fleet	While there is some testing of C-ITS capabilities, transport agencies do not use data from C-ITS currently	Industry has indicated sharing such data would be beneficial to all parties
Automated driving	The NTC's current outlook for automated driving vehicles predicts low fleet penetration by 2030	This is an ongoing consideration by transport agencies on how such data could be used and accessed	Because it is yet unclear what data will be produced, industry does not know what its willingness to exchange will be

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List of tables and figures

Tables

Figures