Sustainable Built Environment National Research Centre AUSTRALIA

Introducing the 'FreightSync Roadmap' A Pathway to Linking Freight Vehicles and Transport Systems

Final Research Report - Milestone 2

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EXECUTIVE SUMMARY

According to study in 2014 by Ernst and Young rising congestion levels and urban encroachment are reducing the efficiency of the freight sector and considering that the level of congestion on metropolitan roads is likely to continue to grow in the coming decades, this presents an issue. The study points out that "*much of the infrastructure used by the freight sector is shared [with other road or rail users], and conflicts around access and use are not efficiently managed or addressed*". The study considered the potential for investment in dedicated freight infrastructure, such as the privately funded railway lines currently used to transport coal and iron ore, but found that either dedicated railways or roadways are unlikely to be economically viable without allowing for mixed use given upfront costs.[1] This then raises the question of how the movement of freight can be made more efficient, particularly within metro areas, whilst being embedded in the wider transport system. According to the National Freight and Supply Chain Strategy a key element will be to "*develop an evidence-based view of key freight flows and supply chains and their comparative performance to drive improved government and industry decision-making, investment and operations*."[2]

Given the high value of freight, with Infrastructure Australia estimating that transport and logistics contributes 14.5 per cent of GDP,[3] there has been much work done to investigate ways to increase the efficiency of freight movement. However, on the whole, limited technical capacity of both the freight sector and the transport system itself has meant that such efforts are yet to demonstrate meaningful improvements. Early approaches have involved freight vehicles being equipped with GPS guidance systems that can provide information to the driver on the level of congestion along potential routes. More recently private companies are offering tracking and analytics services to monitor vehicle location to ensure the use of approved routes and monitor driver behaviour, such as hash breaking or exceeding speed limits. Although such passive approaches stand to deliver some benefits they are ultimately restricted by the fact that there is no direct interaction with the transport system. According to Michael Lopresti, Main Roads Western Australia SCATS and SVD Area Manager, when considering how to achieve greater benefits, "*It will be particularly interesting to see how technology can provide the opportunity to locate and identify heavy vehicle freight movement in order to manage cycle times and offsets accordingly. This is very likely to deliver tangible benefits to freight operators while improving conditions for all road users, however the cost and benefits of developing such a system is yet to be well understood*".[4]

More recent efforts have been focused on investigating the potential for freight vehicles to interact directly with traffic lights in order to gain priority signalling at intersections, using similar technology to that used by emergency vehicles. The intention is to avoid freight vehicles within the vicinity of a particular intersection having to stop by recognising its presence and allowing an extended green signal, hence avoiding the slow acceleration on the next green signal that slows overall traffic.[5] Early trials based on simulations have shown that there is potential for improvement at the intersection level.[6] However it is not clear if this translates into reduced overall trip times, as it may be the case that *ad hoc* responses by individual traffic lights due to last minute notifications from trucks will have a detrimental

[1] EY (2014) A study of the potential for dedicated freight infrastructure in Australia, Report to the Australian Government, Ernst & Young.
[2] TIC (2019) National Freight and Supply Chain Strategy, National Action Plan, Transport and Infrastructure Council, Commonwealth of Australia.
[3] IA (2018) Australia's growing freight task: Challenges and opportunities, Infrastructure Australia, 31 October 2018.
[4] Lopresti, M., *Pers Comms*, 17 April 2020.
[5] Kari D., Wu G., Barth, M. (2014). Eco-friendly freight signal priority using connected vehicle technology, IEEE Intelligent Vehicles Symposium; Ioannou, P. (2015) Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow, University of Southern California.
[6] Zhao, Y. and Petros, I. (2016) A traffic light signal control system with truck priority, IFAC-PapersOnLine, vol. 49, no. 3, pp. 377-382, May 2016.

impact on the effectiveness of system wide signalling. Hence unlike the movement of a small number of emergency vehicles across an entire city this approach may not deliver benefits when applied to many freight vehicles moving all across a transport network, calling for a more dynamic approach, one that will involve new forms of data exchange and the use of advanced analytics.

According to Dom Thatcher, a senior logistics officer for Fremantle Ports, people often over-estimate the value of their own data and under-estimate the value of pooled data.[7] This is reinforced by findings of a 2019 study as part of the iMOVE CRC that highlights that although data is a unique commodity that can be used by multiple platforms along a supply chain, it is when this data is brought together an analysed that the real value is created. When considering the potential for increased government involvement in data collection and handling on behalf of taxpayers for the wider good of the transport sector the report pointed out that "*it has long been accepted in Australia that there is a role for all levels of government to collect, analyse and disseminate data. For one thing, governments play an indispensable role in national economic management and could not effectively do this without data*".[8]

A number of government agencies, industry bodies and research institutions are producing public freight related datasets, however these often focus on highly aggregated historic data rather than real item tracking data held by freight and logistics companies. Such data, including vehicle classification, current location, and intended destination for both general and restricted access vehicles would be of great benefit to traffic management if exchanged in an appropriate way for mutual benefit. According to CISCO, "*While it is perfectly reasonable for individual transport mode operators to be exclusively focused on the benefits that digitisation will bring to their domain, there is significant value that will be missed if the opportunities that transportation Data Exchanges bring are not realised*."[9] The inability to synchronise the location and destination of freight vehicles in real time with the transport system means that still today freight vehicles are effectively invisible to the system and are left to use third party apps in order to navigate traffic. However before such exchange can be possible a number of concerns need to be addressed such as what real value will this create for companies, who will have access to the data, and how will it be used. For instance can the data be limited to use only by the transport system or will it be open to use by enforcement agencies to issue speeding fines or other infringements?

> *The goal of the FreightSync Roadmap is to achieve the seamless exchange of data between freight vehicles and transport systems in such a way as to deliver mutual benefit while ensuring the data is only used for agreed purposes.*

The purpose of the 'FreightSync Roadmap' is to provide a pathway that outlines key steps involved in transitioning from the current situation where freight vehicles are largely invisible to traffic management, to a situation where the entire transport network is managed with full view of freight (and other heavy vehicles) allowing benefits to be created well beyond *ad hoc* responses, such as trucks being detected at particular intersections. This will included a staged pathway to investigate and respond to stakeholder concerns, opportunities and challenges related to data exchange and explore options to provide robust solutions working collaboratively with stakeholders. The intention of the FreightSync Roadmap is to inform and streamline collaborative efforts to accelerate progress to achieve this goal.

[7] Thatcher, D., *Pers Comms*, 13 March 2020.
[8] Karl, C. and Branigan, J. (2019) DIRDC Freight Data Requirements Study - Institutional Arrangements, A report to the DIRDC, iMOVE CRC.
[9] CISCO (2018) Towards a Multimodal Transportation Data Framework, Public White Paper, CISCO.

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Part 1: Introduction

1.1 What is a Roadmap?

For the purposes of this report a 'Roadmap' is assumed to be a strategic pathway to guide implementation of a series of concurrent activities that are divided into a set of stages in order to deliver preferred outcomes. Having said that, a Roadmap is not intended to be a perfect prediction of how to achieve the associated outcomes in the future, but rather as in this case, a Roadmap is considered to provide a guide to inform agile efforts to navigate a changing landscape over time that will affect the direction and pace of the process in order to maintain progress. Typically a strategy roadmap may include an indication of: what is likely to be needed to reach each destination; what is available when you get there; how long it will take; what resources are needed; who is involved; what the likely terrain will be; and what are the likely obstacles to be faced. In addition, for the purpose of this report a 'Roadmap' is not a strategy or work plan, but rather is intended to provide a pathway to reach a set of preferred destinations. Hence the interpretation adopted in this report is that a Roadmap can be expected to focus on what steps should to be taken, what questions should be asked, who should be involved, and what could be achieved along the way as efforts combine to reach the end goal.

1.2 Why is a Roadmap needed?

The reason a Roadmap is needed in order to support and accelerate efforts to link freight data and transport systems is due to the fact that although tracking technology is now widely available the combination of the technology and analytics needed to harness the data to improve traffic management is in its early stages of development and trust will need to be established through novel collaborative deployment initiates. This means that there will be a need for new partnerships between the freight industry and transport agencies that may call for the nomination or creation of new intermediaries or supporting systems. Given the Roadmap stands to benefit both the freight sector and the transport agencies there needs to be strong buy-in from the early stages to ensure that key issues are resolved, such as access and privacy, with the associated initiatives needing to be well informed and strategically deployed.

1.3 What does the term 'FreightSync' mean?

The exchange of data between freight operators and traffic agencies stands to deliver a number of benefits, such as: improved transport planning and traffic management and increased efficiency of freight operations.

> *The term 'FrieghtSync' has been chosen to describe the private exchange in real-time of specific data between freight operators and transport systems for mutual benefit.*

As such this functionality is intended to compliment efforts to collect and aggregate historic data on freight vehicles to inform planning and longer term infrastructure decisions, such as the National Freight Data Hub. For instance, once real-time data from freight vehicles has been used to inform the traffic management system, and vice versa, this data can be de-identified and aggregated as an input to such historic data sets and to update performance evaluation assumptions. An important consideration is how to deal with data security to ensure that firstly the data being exchanged is secure, but also that it is only being used for purposes that have received consent. According to a study by the Australian Government "*... despite agreement that 'data is the new oil', and that interoperability was important for the industry, barriers to information sharing arising from competitive concerns were conceded by road* *transport groups. A further comment made in consultations was that even where good data was collected, it was often not analysed to a sufficient extent*." [10] Hence this report provides a pathway to work collaboratively to achieve freight synchronisation with the transport system, namely, the 'FreightSync Roadmap'.

1.4 What is the value of a FreightSync approach?

It is important when considering a change to the way industry operates to clearly understand the associated benefits and beneficiaries. For instance when considering the exchange of data between freight operators and the transport system there are a range of potential benefits for freight operators, transport management, and transport planning, namely:

- *Likely benefits for Freight Operators*: A key question for participants considering data exchange is clarity on what benefits can be expected. Currently freight operators navigate the transport system much like any other road user, namely through the use of third party traffic applications that provide an indication of the level of congestion and expected trip times. This approach provides benefits to freight operators as it allows areas of high congestion to be avoided and trip times to be compared to job requirements. However such a passive approach misses the opportunity to interact with the traffic management system directly, along with missing out on a range of future benefits from aggregating data to establish authenticity, providence and to reduce transaction time and costs (as others are now doing). Given freight vehicles influence vehicle flow rates, the more the transport system knows about their movements the better it can manage traffic. In short the benefit of appropriately exchanging data with transport agencies is that both daily traffic conditions and longer term transport planning outcomes will be improved, such as:
    a) *Improved Traffic and Transport Planning Outcomes*: Providing access to information of freight vehicles, such as classification, location and destination, can improve traffic flow conditions across the network, such as via responsive signalling to manage cycle times and offsets, and other adaptive traffic management methods. Such data will allow traffic management systems to understand both current and near future behaviour of freight vehicles allowing for tailored traffic responses and even direct communication with freight vehicles on preferred routes and timings. Along with short term traffic management benefits, in the longer term data exchange can improve transport planning decisions and associated investments by providing much better data than is currently available.
    b) *Direct Benefits to Operators*: Apart from benefits to traffic management such a system of data exchange may underpin a range of other benefits, such as: automated clearance for road access for various vehicle classification types; improved vehicle flow at loading points; informing freight forwarders of anticipated level of *driver* promptness; consistency across state borders; and linking freight tracking with container parks, rail services, and port stevedores to improve synchronisation.
    c) *Positioning for Future Benefits*: Such a system of data exchange would position the sector well to take advantage of a range of future digital productivity options. For instance, as outlined in SBEnrc 'Project 1.64: Exploring the Potential for Artificial Intelligence and Blockchain to Enhance

[10] DIRDC (2018) Inquiry into National Freight and Supply Chain Priorities, Australian Government, Canberra, ACT.

Transport'[11], using emerging digital distributed ledgers, such as Blockchains, to deliver new value to the logistics sector, such as:

- *Verifying Authenticity*: The ability to provide access to secured proof of origin and sourcing evidence for a range of high-value goods, *such* as wine and other exports.
- *Establishing Provenance*: The ability to track the movement of freight from initial pick up to final delivery and provide customers with origin *information*, and if it has been sold already.
- *Streamlining Transactions*: The ability to have multiple transactions on one permissioned database to share customs releases, *commercial* invoices, cargo lists, broker loads, etc.

Furthermore, once established such systems would provide a rich pool of information for new applications of Artificial Intelligence to optimise freight routes, staging and storage of freight, and inform the potential for sharing of facilities and avoiding running empty.

- *Likely benefits for Traffic Management:* Live data on freight vehicles can be beneficial to traffic management systems in a number of ways, including:
  a) *Improved Signalling*: Improving signalling to account for the presence of freight vehicles across the network (rather than at an intersection by intersection basis) allowing improved network capacity by pre-empting increases in freight vehicle frequency.
  b) *Vehicle Communication*: Informing freight vehicles of preferred routes to encourage use of parts of the transport network with lower congestion levels, this may also include providing freight vehicles with target speeds to reduce likelihood of meeting a red light.
  c) *Enhanced Safety*: Alerting inappropriate road use by restricted access vehicles to increase safety, providing the location and progress of dangerous goods movement, and informing the designation of gazetted routes and timings based on actual freight movements.
  d) *Real-time Monitoring:* Identifying trouble spots with intersections or bottlenecks in traffic flow that may warrant investigation and intervention, and allowing monitoring of actual bridge crossings to compare to strength assumptions of bridges.
  e) *Predictive Analysis*: Inferring driving patterns of vehicles to include typical acceleration speeds, breaking distances, etc. to predict future behaviours, and informing predictive analytics by comparing real-time conditions to historic data to predict the likelihood of congestion events.
  f) *Streamline Data*: The benefit of such as system would be to streamline access to data and reduce duplication with the data observatory aggregating and curating the data.
- *Likely benefits for Transport Planning*: Building a database of tracking data on freight vehicles will be a valuable source of information to create a record that shows where the freight load is being transported across the transport system. Such high levels of detail on freight vehicle movement will provide a much clearer view of vehicle behaviours and can generate a range of benefits. This type of data is typically gathered using periodic surveys that may not be repeated for a number of years, or by making assumptions, such as the percentage of freight and other heavy vehicles in traffic flows, with both options proving little indication of time of use patterns. Having a real time stream of such data can allow a comparison between the quality of the road system and the quantity of freight carried at particular times (especially high value freight) which can influence decisions as to where to invest in infrastructure betterment and upgrades.

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[11] Hargroves, K., Stantic, B. and Allen, D. (2020) Exploring the Potential for Artificial Intelligence and Blockchain to Enhance Transport – Final Industry Report', Sustainable Built Environment National Research Centre (SBEnrc), Australia.

1.5 How could a FreightSync System function?

Given the goal of the FreightSync Roadmap is to "*achieve the seamless and controlled exchange of data between freight vehicles and transport system in such a way as to deliver mutual benefit*", this will require both improvements in the way data is exchanged along with enhancing the way data is used. Hence the FreightSync Roadmap focuses on both developing an appropriate framework for the exchange of data, and increasing the capacity of freight operators and traffic managers to harness the data for mutual benefit.

1) *The appropriate exchange of data:* In order to implement the FreightSync Roadmap a critical issue to overcome is to ensure that data exchanged between freight operators and the transport system is secure and can only be used for the expressed purpose, such as though the use of trusted third party. In order to demonstrate the value of data exchange initial efforts need to be able to harness the data to show early benefits and this will be very unlikely if protections are not put in place, much like the protections afforded by Transport Certification Australia (TCA). TCA is an independent not-for-profit entity that has government oversight and ownership that is tasked with providing assurance services. TCA receives data from freight operators to assess compliance for various government agencies with the data provided under consent agreements that prohibit used for any other purpose unless as part of a legal requirement such as a court order. This trusted third party role is a critical part of the compliance process as it allows government agencies to confirm non-compliance without receiving access to the data which may be used for other purposes such as enforcement.

   For the purpose of the FreightSync Roadmap we refer to the trusted third party as a 'Freight Observatory', which is described by the Australian Government as an entity that is tasked to, "*…collect, analyse and publish freight performance data for all freight modes and supply chains to better inform decision making and investment, with appropriate governance arrangements and the potential for this function to be held by an independent body that has industry confidence*." [12]

2) *The increase in technical capacity*: It is important to understand that the deployment of on-board technologies in freight vehicles is not uniform. Larger freight operators that carry an estimated 80 percent of freight and represent say 10-12 percent of the 42,000 road freight companies in Australia [13] are likely to be well equipped, however the remainder are typically reliant on mobile devices to access traffic information. Hence if the intension of the FreightSync Roadmap is for data to eventually be collected from all freight vehicles, a staged approach is needed to first work with the companies with such technologies to demonstrate the early value that can be created, and then expand to all other vehicles on-board devices that may be embedded in government provided licence plates for instance. Along with the focus on freight vehicles the need to increase the technical capacity of transport systems must also be considered. Such systems are likely to not yet be equip to process real time tracking and destination data from heavy vehicles and use this to inform traffic management or transport planning, although a number of transport agencies have developed programs in this area.

[12] DIRDC (2018), Inquiry into National Freight and Supply Chain Priorities, Report, Department of infrastructure, Regional Development and Cities, Canberra, ACT.
[13] NTC (2016) Who Moves What Where - Freight and Passenger Transport in Australia, National Transport Commission.

Considering this the Freight Sync Roadmap has three main stakeholders each with a different data role, as shown in Figure A.

Figure A: FreightSync Data Exchange Flow Chart

The first set of stakeholders are the freight operators (and service providers) that will be tasked with collecting data on freight vehicles and receiving data from the traffic management system, the second is the trusted 'Freight Observatory' that will be tasked with curating data from multiple freight operators (potentially through service providers) and making it available under agreed conditions to the transport system, and thirdly the transport agencies that will undertake data analytics and modelling to improve the overall transport system and provide direct guidance to freight operators.

1.6 What are likely enablers and disablers to data exchange?

When considering the implementation of the FreightSync Roadmap in order to create a platform for effective data exchange between freight operators and transport agencies it will be important to understand the current level of enablers and disablers to inform pilot projects. The following is an initial list of such factors:

Disablers

- *Lack of trust between private sector and government agencies:* When considering data exchange there is a concern that data provided to government agencies may be used for additional purposes other than the agreed upon purpose, such as additional enforcement efforts.
- *Lack of 'evidence-based view of key freight flows and supply chains'*: According to the National Freight and Supply Chain Strategy such a view can allow consideration of "comparative performance to drive improved government and industry decision-making, investment and operations." [14]
- *Limited current capacity to utilise real-time data*: There is currently limited technical capacity of both the freight sector and the transport system to harness real time data and investment in such systems needs to be carefully targeted.
- *Risk of Hacking*: The risk of hacking or inappropriate access affecting competitive advantage or reputation of specific freight operators or allowing identity fraud.
- *A lack of clarity around the responsibility for the system*: It is not clear who would be responsible for a freight observatory and how it would be funded.

Enablers

- *Precedent for consent based data exchange*: Transport Certification Australia (TCA) provides an example of an existing framework that has the ability to receive data from freight operators and provide responses to government agencies as per strict consent agreements.

[14] TIC (2019) National Freight and Supply Chain Strategy, National Action Plan, Transport and Infrastructure Council, Commonwealth of Australia.

- *Existing Structures*: The TCA also administers the 'National Telematics Framework' which at its core is a platform for telematics related technology, applications and data queries, that can be managed by TCA as a trusted third party.
- *Emerging Technologies*: The emergence of advanced technologies such as the 5G network, Blockchain, and Artificial Intelligence, along with the proliferation of mobile devices provides a never before experienced level of technical support for data exchange and analytics.
- *High Value of Freight*: Given the high value of freight, contributing nearly 15 per cent of GDP, any efforts that lead to reduced trip times and a more streamlined supply chain will deliver sizable benefits (unlike say public transport vehicles that are often deemed to be of low value).
- *Databases are being created*: A number of government agencies, industry bodies and research institutions are producing public freight related datasets, however these often focus on highly aggregated historic data rather than real item tracking data held by freight and logistics companies.

1.7 What is the potential for wider application?

Many of the benefits available when the transport system can understand in real time how freight vehicles are utilising the transport network are also relevant to other large and heavy vehicles such as buses, shuttles, garbage trucks, cement trucks, etc. Hence should the FreightSync Roadmap lead to the deployment of such technologies it could be made available for wider application. This is of particular interest given that due to excessive congestion issues many cities around the word are now seeking to shift away from private vehicle dominant transport infrastructure to shared rapid-transit corridors serviced by bus and shuttle services.[15] Such a system would also benefit from having real time exchange of such vehicles with the traffic management system. In addition to other applications there is the potential to integrate with new functionality such as digital distributed ledgers that are increasingly being used to track freight to not only significantly reduce transaction costs but to provide a trusted source of authenticity and providence.[16]

[15] Newman, P., Hargroves, K., Davies-Slate, S., Conley, D., Verschuer, M., Mouritz, M. and Yangka, D. (2019) The Trackless Tram: Is It the Transit and City Shaping Catalyst We Have Been Waiting for? *Journal of Transportation Technologies*, 9, 31-55.
[16] Hargroves, K., Stantic, B. and Allen, D. (2020) Exploring the Potential for Artificial Intelligence and Blockchain to Enhance Transport, Sustainable Built Environment National Research Centre (SBEnrc), Australia.

Part 2: FreightSync Operational Considerations

2.1 How can consistency be achieved?

When considering the development of a new approach that is set to involve multiple stakeholders, in this case numerous freight operators, some form of freight observatory, and transport agencies, it is important not to re-invent the wheel and identify existing language and frameworks that can form part of the supporting structure. This is important as such language and frameworks are likely to be already familiar or adopted by the various stakeholders and rather than building a new structure it is more effective to adopt elements of existing structures. Hence a consistent set of language and frameworks is needed for each of the functions, namely: ***data collection*** by freight operators, ***data curation*** by a data exchange platform, or a 'Freight Observatory', and ***data analytics*** by a transport agency, as shown in Figure B. In the case of data collection there are a number of existing frameworks that stand to provide elements of the FreightSync Roadmap, such as "*ISO 15638-22:2019: Intelligent Transport Systems - Framework for collaborative telematics applications for regulated commercial freight vehicles*" which is focused on the transfer of data from freight vehicles and roadside monitoring equipment and sensors.

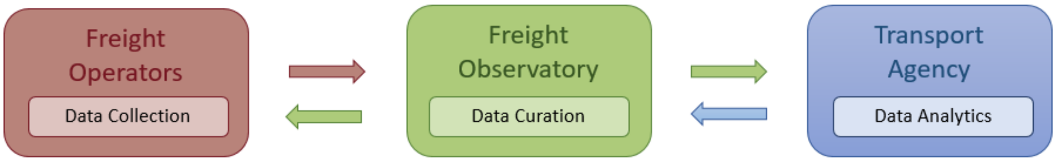

Figure B: FreightSync Data Exchange and Functionality Flow Chart

When considering existing frameworks for the role of the freight observatory that has the ability to receive data from freight operators for pre-approved uses involving government agencies a leading example, as mentioned previously, is Transport Certification Australia (TCA). One of the roles of TCA is to administer the 'Intelligent Access Program' where high risk freight vehicles are monitored for breaches of non-compliance, such as the roads used by restricted access vehicles. The TCA plays a key role here in that it can receive tracking and other information from freight vehicles and use it to investigate requests from government agencies to confirm non-compliance. This is facilitated through consent agreements with freight operators where the use of the data provided to TCA is strictly controlled, unless the data is requested by a court order. Data collected by the TCA includes location, speed, time and identity, and this is used to investigate compliance with a range of conditions of access set by road managers and regulators, with the option to manually submit data through a user interface.

Another key framework administered by the TCA is the 'National Telematics Framework' which is described as a "*digital business platform consisting of infrastructure and rules that support an open marketplace of telematics and related intelligent technology providers*". As such this may provide a valuable supporting framework that may help to underpin the entire FreightSync Roadmap by adopting a standardised national platform that supports a range of applications and assurance levels and is already used by the freight sector. At its core the National Telematics Framework provides a central platform for telematics related technology, applications and data queries to be managed by TCA as a trusted third party. This is done by brokering the interactions between a set of approved service 'Providers' (including suppliers of telematics, vehicle manufactures and other technologies providers), with both 'Producers' (such as government agencies or industry bodies that produce policy or programs and may seek assurance), and 'Consumers' who purchase offerings from the providers via the platform in order to "*deliver consistency and confidence to all stakeholders*", as shown in Figure C.

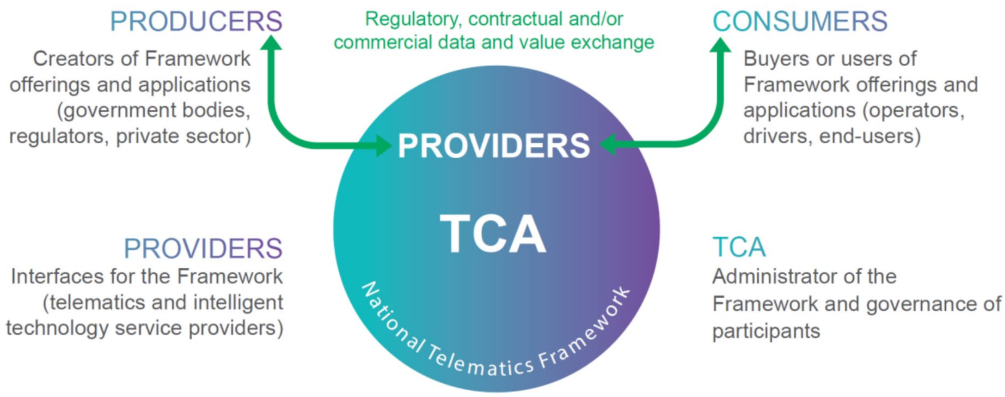

Figure C: The Transport Certification Australia National Telematics Framework Ecosystem.
Source: Transport Certification Australia (TCA, 2018[17])

Although Transport Certification Australia has a focus on investigating compliance on behalf of government agencies, given it also protects the privacy of freight operators it is of particular interest for the FreightSync Roadmap, and in particular the National Telematics Framework:

1. Provides a 'Telematics Data Dictionary' that sets a common understanding of data types, formats and definitions. (*This will be of particular interest given it stands to provide a basis for a consistent set of language that may be added to from other standard language sets or by specific terms associated with the FreightSync Roadmap.*)
2. Describes the standard methods and mechanisms for the transfer of telematics data between entities. (*This will be particularly important to support the exchange of data between private freight operators and government agencies involved in traffic management.*)
3. As previously mentioned, offers governance frameworks to manage privacy requirements, to ensure the use of data collected through telematics and related technologies is used only for disclosed purposes. (*This will be a very important aspect of any efforts to share real-time data between the private sector and government and vice versa given the potential for its unintended use to be detrimental to freight operators.*)

2.2 What type of data is involved?

For the purpose of this report consider that there are two categories of data on freight vehicles, firstly data that is suitable for public use (such as averages and trends), and secondly data that is not suitable for public use (such as real time location and intended destination of particular trucks). It is likely that the first category is suitable for curation by a government agency for use by researchers, companies and government agencies, as according to an inquiry by the Productivity Commission in 2017, "*the emphasis for government agencies in handling data should be on making data available at a 'fit for release' standard in a timely manner. Beyond this, agencies should only transform data beyond the basic level if there is a clearly identified public interest purpose or legislative requirement for the agency to undertake additional transformation*".[18]

However it is the latter category, that of data not suitable for public use, that is the focus of this report as it is not clear how to best curate and analyse this data in order to allow it to be synchronised with the transport system for mutual benefit. This approach is more in line with the concept of a 'Trade

[17] TCA (2018) National Telematics Framework: A Digital Business platform, Transport Certification Australia Limited.
[18] PC (2017) Data Availability and Use, Report No. 82, Productivity Commission, Canberra

Community System' which according to Price Waterhouse Coopers, "*is a platform where participants in the supply chain can share information securely in order to drive productivity and service innovation through trusted end-to-end visibility of the supply chain*".[19] However sit is not clear how such as system maintains data security and ensures appropriate use of the data, such as the role of the freight observatory or the use of a distributed ledger to provide trust without the control of an intermediary entity.

It is the intent of the FreightSync Roadmap to provide a pathway to navigate this new territory and identify a suitable way forward to deliver the mutual benefits, and it is likely that the following core data will be involved, subject to investigation as part of the first stage of implementation:

1. *Vehicle Classification*: According to the National Heavy Vehicle Regulator, a heavy vehicle is classified as either a 'General Access Vehicle' if it complies with specific mass and dimension requirements, and therefore does not require a notice or permit to operate on the road network, or it is a 'Restricted Access Vehicle' that does not comply and is required to operate under a notice, permit, or higher mass limits and can generally only access certain parts of the road network. The classification will inform assumptions by the transport agency around anticipated dimensions such as height, width and length along with the maximum weight without identifying the particular vehicle. The footprint of the vehicle is important for traffic management as it will have queuing and signalling implications.

2. *Location*: Data on the location of freight vehicles can be sourced in a number of ways using either on-board, roadside, or remote technologies.[20] This data can be used to create updated historic data sets of overall freight vehicle movements along with providing real-time locations. To reduce concerns the release of real time data may be restricted to a notification when the truck arrives at an intersection along the route to the nominated destination (or a geo-fenced portion of the route) rather than along the entire trip (which may give access to acceleration, speed, braking data that may not be part of the consent agreement). In this case the traffic system knows that a truck is at a specific set of lights now and it is heading to a set destination, so it can select a likely route based on roads that can be used and traffic conditions and then verify as it moves progressively from intersection to intersection, the system does not need to know where the truck is at all times nor who is driving or who the truck belongs to.

3. *Intended Destination*: A key item of data is the intended destination of the vehicle. The previous two items of data will provide benefits however without knowing the destination the system is restricted to ad hoc responses at an intersection by intersection level rather than being able to see the intended routes of vehicles and finding a traffic management solution that delivers optimal benefits to both freight operators and other road users. This also provides the potential for the traffic management system to provide routing suggestions to freight vehicles that, for instance, allow greater preferential signalling, depending on time of day traffic conditions. This would also allow real-time diversion of freight vehicles if required to respond to incidents. This data is often not digitally available and a dedicated interface may need to be provided.

Complimentary data sets may include data from empty container parks on vacancy, stevedore from Ports, and even data on stress levels on bridges and other infrastructure.

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[19] PwC (2018) Proof of Concept for a National Trade Community System, TCS Pilot Proposal, Pricewaterhouse Coopers, Melbourne, Victoria.

[20] For more details see: Hargroves, K., Tze Wei Yeo, J. and Loxton, R. (2020) Review of Options to Link Freight Vehicle Data with Traffic Management Systems, Sustainable Built Environment National Research Centre (SBEnrc), Curtin University.

It is important to consider how often the data is needed as this has real implications for its cost and its usability. For instance a High Resolution Record is considered to be recorded every second, however it is more typical to see polling periods of between 30 seconds and 5 minutes. Also it is typical to see what is referred to as 'event based polling' where data is only collected when a particular event occurs. It is likely ultra-low latency data will be needed for safety however low latency can be used for traffic management, and medium latency may be sufficient for transport planning.

2.3 How can data security be ensured?

According to a study by the Productivity Commission released in 2017, "*Lack of trust by both data custodians and users in existing data access processes and protections and numerous hurdles to sharing and releasing data are choking the use and value of Australia's data. Marginal changes to existing structures and legislation will not suffice. Recommended reforms are aimed at moving from a system based on risk aversion and avoidance, to one based on transparency and confidence in data processes, treating data as an asset and not a threat*."[21]

There are a number of concerns related to the release of vehicle data by the private sector to a government agency, such as:

- Scepticism around the likelihood of seeing direct benefits from the sharing of data with government agencies.
- The risk of hacking or inappropriate access affecting competitive advantage or reputation of specific freight operators or allowing identity fraud.
- The likelihood that controls on the use of data be extended to original equipment manufacturers or service providers that may have access to such data.
- The use of acceleration and breaking data to estimate weight of vehicle and enforce exceedance of weight restrictions that is currently not monitored electronically.
- The data may be used without permission by law enforcement agencies, such as speeding violations, drive time duration restrictions, and road access violations not otherwise monitored.

Hence it is clear that as part of the FreightSync Roadmap the chosen Freight Observatory needs to consider a similar approach to that used by the TCA to provide a trusted third party broker between the freight operators and the government agencies to ensure appropriate use. This may include the use of 'consent agreements' as with the TCA approach that provides clear guidance as to how data released by freight operators can be accessed by the transport system.

2.4 What are the potential stakeholders for a Freight Observatory?

Although tracking technology is now widely available, the combination of the technology and the analytics needed to harness the data to improve traffic management is in its early stages of development. This means that there will be a need for new partnerships between the freight industry and transport agencies that may call for the nomination or creation of new intermediaries or supporting systems. Given the exchange of data stands to benefit both the freight sector and the transport agencies there needs to be strong buy-in from the early stages to ensure that key issues are resolved, such as

[21] https:/www.pc.gov.au/inquiries/completed/data-access/report/data-access-overview.pdf

access and privacy, with the associated initiatives needing to be well informed and strategically deployed. It is anticipated that obvious potential stakeholders will include:

- Transport agencies,
- Freight operators,
- Telematics companies,
- Port and Airport operators, and
- Container Park operators.

Such stakeholders have a direct interest in seeing freight movement improved with a nuber of other potential stakeholders being interested in the utility of the data, such as:

- Local Government,
- Research Organisations,
- Private companies… etc

Beyond freight vehicles there are a range of other vehicle types and associated stakeholders such as buses, shuttles, garbage trucks, cement trucks, etc.

2.5 What type of technology is needed?

Developing a synergistic data system

The selection of technology for use in data collection, curation and analytics will involve a non-linear approach given they interact with each other, for instance:

- Data requirements from the transport system will influence the selection of data collection technologies,
- The data collection technology selected will influence the data curation technology to ensure compatibility, and
- Data curation technology will need to interface with both the transport agency and freight operators.

Data collection by Freight Operators

In order to identify suitable data collection technology a range of options need to be reviewed, both located on vehicles such as GPS trackers and RFID Tags and as part of the network infrastructure, such as CCTV cameras, satellites, mobile phone towers, Wi-Fi and Bluetooth receivers and RFID readers. [22] When considering the technology to use for data collection the first step is to engage with stakeholders to identify a set of questions to guide the investigation. However before this can be undertaken the data requirements of the transport agency need to be clearly established as part of Stage 1 of the implementation of the FreightSync roadmap, raising questions such as:

- What type of data is required? (*such as data on vehicle classification, location and destination*)
- What form is the data required in? (*such as preferred format, interval, output file type, etc*)[23]

[22] For more details see: Hargroves, K., Tze Wei Yeo, J. and Loxton, R. (2020) *Review of Options to Link Freight Vehicle Data with Traffic Management Systems*, Sustainable Built Environment National Research Centre (SBEnrc), Curtin University.

[23] Hargroves, K., Stantic, B., Conley, D., Ho, D. and Grant, G. (2017) Big Data, Technology and Transport - The State of Play, A Sustainable Built Environment National Research Centre (SBEnrc) Industry Report, Curtin University and Griffith University, Australia.

Once this is established an investigation into the most appropriate data collection technology can be undertaken which may include investigating a series of questions such as:

- What is the cost of the technology and who will pay for it? (*using existing on-board technology can reduce cost but cause complications with data access*)
- At what stage of development and deployment is the technology? (*GPS is a well proven technology while Wi-Fi based detection and classification systems are in the early stages*)
- What data does the technology collect? (*such as detection of vehicle, classification of vehicle, identification of vehicle, tracking of location, speed, intended destination etc*)
- What is the latency in data collection? (*latency is the lag time, which in the case of satellites can be as much as 10 minutes, which is important if looking at intersection level detection of vehicles*)
- What is the range of the collection system? (*technologies such as Bluetooth and RFID need to be within range of a collection antenna*)
- How accurate is the data? (*GPS trackers can be accurate to a 5 metre radius in clear conditions, areal imagery can provide 80% accuracy for object classification, and video analytics can provide 92% accuracy for object classification and by reading licence plates can have 98% accurate identification*[24])
- Does it require a new device to be installed on the vehicle? (*some devices have their own power source and others need to draw power from the vehicle*)
- Does it require roadside equipment to be installed? (*such as Bluetooth receivers at intersections*)
- Does it require subscription to remote services? (*such as areal or satellite options*)
- Are there legal restrictions on the collection and use of the data? (*with the legality of options that involve reading licence plates or other identifying features needing to be established*)
- Is it a dedicated device or is the data drawn from another multiuse device? (*multiuse devices, such as telematics, may involve more data than is required by the transport system presenting access and privacy issues*)
- Who is the custodian of the data and collection infrastructure? (*data is collected by a range of third parties, including telecommunications based data, along with various government agencies*)

Data curation by a Freight Observatory

The role of the freight observatory is to curate data from freight operators or freight tracking service providers used by the operators, meaning that it is focussed on bringing data together and releasing it to the transport agency, and potentially other users, as per the consent agreements. The freight observatory may then also receive data from the transport system to provide to the freight operators to inform routing, speed and timings decisions. The process to identify appropriate data curation technology will be directly influenced by the selection of data collection technology, which in turn is influenced by the requirements of the transport agency in order to ensure compatibility. When investigating the technology appropriate for data curation a set of question will be established in collaboration with stakeholders, such as:

[24] Hargroves, K., Tze Wei Yeo, J. and Loxton, R. (2020) *Review of Options to Link Freight Vehicle Data with Traffic Management Systems*, Sustainable Built Environment National Research Centre (SBEnrc), Curtin University.

- How will data be received from the traffic operators?
- How will data be prepared for release to the transport agency?
- What functions will the transport agency use the data for?
- How can consent agreements be enforced?
- How can data be received from the transport agency and released to the appropriate freight operator, or is this best done directly or by another trusted third party?
- What would be an ideal host and business model for the observatory? (The volume of data will be high and it may call for some form of involvement from a large scale telecommunications/data service provider.)

Data analytics by the Transport Agency

The first challenge to overcome for the transport agency will to identity the type of analytics that is suitable for the processing of data from the Freight Observatory. Hence Stage 1 of the FreightSync Roadmap will include a comparison between standard rule-based software and emerging applications of artificial intelligence and neural networks to identify the most suitable analytics technology. Once this is done a set of questions will be developed with stakeholders to inform the selection of such technology, such as:

- How well does the technology interface with current transport systems?
- Can the technology be operated in-house or is external expertise required?
- What functionality can the technology provide and can it be deployed in stages?
- What data can be shared with telematics/operators from transport agency?

Part 3: Introducing the 'FreightSync Roadmap'

3.1 The Dynamics of the FreightSync System

Taking a multi-track approach

When considering the stakeholders there are four clear tracks for implementation of the roadmap, each in turn have their own specific stakeholders and requirements along with overlapping challenges and opportunities. For instance as can be seen from Figure D there are three main tracks of implementation, namely: Freight operators focused on data collection, a freight observatory focused on data curation and the transport agency that is focused on data analytics for planning and management.

Figure D: Nodes of the FreightSync System

As such the FrieghtSync Roadmap has been designed to run along four tracks, namely:

- *Track A: Freight Operators* - with a focus on data collection and the intention so see freight operators autonomously synchronised with transport system to reduce trip times and delays.
- *Track B: Freight Observatory* - with a focus on data curation and the intention to manage an autonomous data exchange between freight operators and the transport agencies.
- *Track C: Transport Agency* - with a focus on enhancing data modelling used for transport planning and data analytics to inform traffic management in real time and for mutual benefit.

Taking a multi-stage approach

Now that the activity tracks have been identified the overall progress of implementation of the Roadmap can be staged to provide a pathway for progress, as shown in Figure E.

Figure E: Tracks of the FreightSync Roadmap

As such the FrieghtSync Roadmap has been designed to be implemented in four stages, namely:

- *Stage 1: Understand the Landscape* - is focused on understanding the landscape in which the initiatives of the roadmap will be implemented. This will include a series of general tasks such as reviewing examples, reports, strategies etc of similar efforts, along with a set of specific tasks.
- *Stage 2: Plan the Approach* - then builds on the understanding of the landscape to map out how each track will approach implementation of the Roadmap. This will include configuring and provisioning key structures and frameworks in close collaboration with stakeholders.
- *Stage 3: Deliver Early Benefits* - focuses on ideating opportunity's to deliver early benefits to demonstrate the value of the overall process. This will include consideration of specific early benefits that can be achieved with minimal investment.
- *Stage 4: Roll-Out Data Exchange* - build on from early benefits to create an automated system that collects, curates and analyses data for the mutual benefit of freight operators and transport agencies.

3.2 Presenting the FreightSync Roadmap

The FreightSync Roadmap is the combination of a set of tasks and objectives for each of the tracks over each of the stages in order to reach a set of preferred destinations, as shown in Table 1.

Table 1: The FreightSync Roadmap

	Stage 1: Understand the Landscape	*Stage 2: Plan the Approach*	*Stage 3: Deliver Early Benefits*	*Stage 4: Roll-Out Data Exchange*	*Destination*
Track A: Freight Operators - Data Collection					
Tasks	*Understand current situation, expectations and benefits*	*Map out approach to data collection and storage*	*Create initial cohort of participants with compatible systems*	*Automate active industry wide participation*	*Freight operators autonomously synchronised with transport system to reduce trip times*
Outcomes	*Identify specific risks and rewards from data exchange*	*Configure and provision data collection*	*Improved conditions on specific routes at specific times*	*Feedback from transport system*	
Track B: Freight Observatory - Data Curation					
Tasks	*Understand constraints and expectations*	*Map out approach to data exchange and privacy*	*Create value from exchange to support wider data exchange*	*Automate and expand seamless data exchange processes*	*Manage seamless data exchange between freight operators and the transport agencies*
Outcomes	*Identify preferred performance criteria and structures*	*Configure and provision data exchange platform*	*Expanded data exchange to include additional participants*	*Improved access to other heavy and shared vehicles*	
Track C: Transport Agency - Data Analytics					
Tasks	*Understand opportunities and implications*	*Map out approach to using live data in data analytics*	*Create mutual value from initial cohort of data*	*Automate real time data analytics and reporting*	*Real time synchronisation of freight vehicles with transport agencies for mutual benefit*
Outcomes	*Identify current processes that can be enhanced*	*Configure and provision real time data analytics*	*Improved outcomes to support roll-out of data exchange*	*Improved modelling, evaluation, and traffic management*	

The following tables, Tables 2-5, provide initial signposts based on a desktop review and discussion with stakeholders for each track to inform efforts to undertake the tasks, to be completed as part of Stage 1.

3.3 Signposts of the FreightSync Roadmap

Table 2: Data Collection Signpost for the FreightSync Roadmap (Freight/Telematics Operators) (Version 2.0)

Stage 1: Understand Landscape	**Task: Understand the current state of play and expectations** *i. Review examples of transport operators exchanging freight data.* *ii. Review options for tracking data collection technologies.*	*iii. Investigate potential benefits to participants from data exchange.* *iv. Identify key existing enablers and disablers to data exchange.* *v. Consider political and policy positions that affect data exchange.*	*vi. Investigate data sources and associated opportunities & constraints.* *vii. Summarise transferable findings and outcomes to inform Roadmap.* **Outcome: Identify specific challenges and benefits from data exchange**
Stage 2: Plan Approach *(To be reviewed following Stage 1)*	**Task: Map out approach to data collection and storage** *i. Identify current data needs, sources, formats and considerations.* *ii. Review existing data exchange protocols, standards and frameworks.*	*iii. Investigate requirements for data curation and data analytics.* *iv. Propose a set of standardised data collection protocols and procedures.* *v. Engage with stakeholders to review and finalise data protocols.*	*vi. Seek industry wide peer review of recommended protocols.* *vii. Outline considerations for data collection/exchange with operators.* **Outcome: Configure and provision data collection**
Stage 3: Deliver Early Benefit *(To be reviewed following Stage 1)*	**Task: Create initial cohort of participants with compatible systems** *i. Collaborate with stakeholders to identify overall goals of trial.* *ii. Explore the business case for data exchange for mutual benefit.*	*iii. Identify specific data to be exchanged to demonstrate value.* *iv. Recruit participants in initial trial of specific data exchange.* *v. Design process to implement initial trial to demonstrate early benefits.*	*vi. Measure tangible benefits from data exchange for operators.* *vii. Report on overall findings and recommendations for roll-out.* **Outcome: Improved conditions on specific routes at specific times**
Stage 4: Roll-Out Exchange *(To be reviewed following Stage 1)*	**Task: Automate active industry wide participation** *i. Review additional data types to implement real time data exchange.* *ii. Design work plans for incorporating exchange of new data types.*	*iii. Manage data management security risk and report on status.* *iv. Ensure mutual benefits are achieved by stakeholders.* *v. Remove manual intervention stages and replace with automated systems.*	*vi. Inform consideration of data exchange with other vehicle types.* *vii. Fully integrate real time data from transport management system.* **Outcome: Feedback from transport system**
Destination: Freight operators autonomously synchronised with transport system to reduce trip times.			

Table 3: Data Curation Signpost for the FreightSync Roadmap (Freight Observatory) (Version 2.0)

Stage 1: Understand Landscape	**Task: Understand expectations and constraints** *i. Review efforts to curate industry data for compatibility and control.* *ii. Identify potential stakeholders (data providers, users, and customers).*	*iii. Identify stakeholder's requirements for data, functionality, and assurance.* *iv. Identify types of service offerings and requirements (storage, etc).* *v. Identify governance framework for operation of the Observatory.*	*vi. Identify business plan options and revenue models for the Observatory.* *vii. Identify suitable options for hosting and financing the Observatory.* **Outcome: Identify preferred performance criteria and structures**
Stage 2: Plan Approach *(To be reviewed following Stage 1)*	**Task: Map out approach to data exchange and privacy** *i. Select form of Observatory and model of operation for program trial.* *ii. Engage with stakeholders to design Observatory framework.*	*iii. MOUs and consent agreements for data provision and storage.* *iv. Design functionality of data bridge to agency information systems.* *v. Design functionality of data bridge to telematics services and operators.*	*vi. Ensure robust approach to data monitoring and security.* *vii. Development of detailed business case for Observatory.* **Outcome: Configure and provision data exchange platform**
Stage 3: Deliver Early Benefit *(To be reviewed following Stage 1)*	**Task: Create value from exchange to support wider data exchange** *i. Confirm requirements of stakeholders and confirm benefits.* *ii. Select functionality to be tested in trial and assign responsibilities.*	*iii. Design process to implement initial trial to demonstrate early benefits.* *iv. Implement initial data exchange with stakeholders and fine tune.* *v. Run the trial as per the business plan with stakeholder engagement.*	*vi. Collate tangible benefits from data exchange for each stakeholder.* *vii. Report on overall findings and recommendations for roll-out.* **Outcome: Expanded data exchange to include additional participants**
Stage 4: Roll-Out Exchange *(To be reviewed following Stage 1)*	**Task: Automate and expand seamless data exchange** *i. Identity next levels of functionality and associated data requirements.* *ii. Design work plans for incorporating exchange of new functionality.*	*iii. Design data life-cycle management process and reporting mechanisms.* *iv. Implement ongoing process to review mutual benefits.* *v. Remove manual intervention stages and replace with automated systems.*	*vi. Inform consideration of data exchange with other vehicle types.* *vii. Fully automate data exchange between operators and agency.* **Outcome: Improved access to other forms of heavy and shared vehicles**
Destination: Manage an autonomous data exchange between freight operators and the transport agencies.			

Table 4: Data Analytics Signpost for the FreightSync Roadmap (Transport Agency) (Version 2.0)

Stage 1: Understand Landscape	**Task: Understand opportunities and implications** *i. Identify strategic objectives for use of freight vehicle data.* *ii. Identify lessons learned from freight and logistics data projects.*	*iii. Identify data uses and benefits for planning and traffic management.* *iv. Engage with freight industry to explore proposed benefits.* *v. Identify potential revenue models and monetization opportunities.*	*vi. Identify risk at critical points of data integration with existing systems.* *vii. Identify use cases and develop criteria for measuring benefits.* **Outcome: Identify current planning processes that can be enhanced**
Stage 2: Plan Approach *(To be reviewed following Stage 1)*	**Task: Map out approach to using live data in data analytics** *i. Identify capacity of agency technology and upgrade options.* *ii. Identify needs and processes to format, interpret and transform data.*	*iii. Collaborate with Observatory to establish data exchange protocols.* *iv. Develop project timelines with key time critical stages and targets.* *v. Develop data management risk structure with recommendations.*	*vi. Forecast expenditure to deliver data bridge to agency information systems.* *vii. Engage with approvals process to underpin implementation.* **Outcome: Configure and provision real time data analytics**
Stage 3: Deliver Early Benefit *(To be reviewed following Stage 1)*	**Task: Create mutual value from initial cohort of data** *i. Identify use cases likely to deliver early benefits using current options.* *ii. Explore the business case for data exchange for mutual benefit.*	*iii. Design process to implement initial trial to demonstrate early benefits.* *iv. Implement initial data bridge to observatory information systems.* *v. Implement data management risk recommendations.*	*vi. Measure tangible benefits for use cases across transport agency.* *vii. Report on overall findings and recommendations for roll-out.* **Outcome: Improved outcomes to support roll-out of data exchange**
Stage 4: Roll-Out Exchange *(To be reviewed following Stage 1)*	**Task: Automate real time data analytics and reporting** *i. Select additional use cases to implement real time data exchange.* *ii. Design work plans for implementation of use cases.*	*iii. Manage data management security risk and report.* *iv. Ensure mutual benefits are achieved by stakeholders.* *v. Remove manual intervention stages and replace with automated systems.*	*vi. Inform consideration of data exchange with other vehicle types.* *vii. Fully integrate real time data with transport planning processes.* **Outcome: Improved modelling, evaluation, and traffic management**
Destination: Real time synchronisation of freight vehicles with transport agencies for mutual benefit.			

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