TWO DECADES OF INTELLIGENT ACCESS IN ITS BIRTHPLACE OF AUSTRALIA – WHERE WE'VE BEEN AND WHERE WE'RE GOING

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Abstract

This paper provides a historical overview of Intelligent Access reforms in Australia, and how they have contributed to the realisation of improved productivity, safety and environmental outcomes over the last two decades.

The political, economic, social, technical, environmental and legal (PESTEL) method will be used as the basis for the paper to demonstrate how each of these elements, when managed strategically in a complex stakeholder environment, have contributed to successful road transport reforms enabled through Intelligent Access.

These reforms have underpinned Australia's international competitiveness in road transport and contributed to Australia's economic performance with its trading partners.

Reference will be made to academic concepts, such as the Overton Window, to demonstrate how the level of discourse around Intelligent Access has evolved over the last two decades, and how this has been influenced by a range of actors to broaden its use in ways not originally contemplated, or not considered to be in the acceptable range of policy discourse (in the context of the Overton Window).

The paper provides insights into the current and emerging influences which are continuing to shape the future of Intelligent Access.

Keywords: Telematics, intelligent access, primary produce, productivity, local road access, supply chain resilience

1. Background

First conceived as a concept in Australia in the mid-1990s, Intelligent Access was recognised as a way to advance productivity, safety and efficiency reforms in Australia utilising emerging in-vehicle technologies, including the Global Navigation Satellite System (GNSS) and the Global System for Mobile communications (GSM). Digital technologies were recognised as a way to provide greater access to road networks without significant public investment, providing heavy vehicle operators agreeing to the remote monitoring of vehicles and loads for compliance with their conditions of approval.

Intelligent Access has attracted interest from other regions globally as an enabler to support policy developments which improve the productivity, safety and environmental performance of road freight transport. This has led to Intelligent Access being the subject of numerous papers at HVTT fora. (At HVTT16 there were seven papers on the subject of Intelligent Access, while an additional three papers included references to Intelligent Access as a way to improve road transport outcomes). Notably, these HVTT papers highlighted how Intelligent Access was being adapted to meet local policy environments, legislative parameters and stakeholder issues while retaining core principles from Australia. Walker et al. (2021) at HVTT16 found that PESTEL influences were leading to the adaptation of Intelligent Access to cater for different environments and policy arenas.

Influences have led to an evolution of Intelligent Access in its birthplace of Australia. Since its inception, the concept of Intelligent Access has been shaped and influenced by a range of factors, resulting in key developments and milestones that have, when combined, charted the course for the evolution of Intelligent Access over this period.

This paper will seek to highlight the multi-disciplinary influences which have led to the evolution of Intelligent Access using the political, economic, social, technical, environmental and legal (PESTEL) method. The paper will also analyse the implications of these influences using the concept of the Overton Window and provide insights into current and emerging developments involving Intelligent Access, .

2. Analysis of Intelligent Access developments in the context of PESTEL influences

As explained by Carvalho de Sousa and Arturo Castañeda-Ayarza (2022), the PESTEL framework is a "strategic analysis tool and an acronym for the defined segments of the macro-environment: political, economic, social, technological, environmental and legal. A PESTEL analysis is a tool used to gain a macro picture of an industry environment (The University of Sydney 2023). Although a PESTEL analysis is typically used for strategic analysis and planning purposes, it can provide useful insights into the contributing factors which have led to prior developments, and the external influences which led to those outcomes. Table 1 provides a summary of key milestones for Intelligent Access, accompanied by the PESTEL influences which have contributed to the development or the milestone being realised.

For the sake of simplicity and to aid the reader, three primary PESTEL influences are shaded for the majority of each development/milestone. This is despite, in some cases, other influences having contributed to the developments or milestones. Accompanied with the selection of these primary influences in Table 1 is commentary to provide context to the PESTEL analysis.

Table 1 – Intelligent Access milestones and PESTEL influences

#	Year	Development/Milestone	PESTEL influences
1	1993	**GSM network becomes available** The first digital mobile phone networks, using the Global System for Mobile communication (GSM), became available in Australia (Telstra 2016).	P **E** **S** **T** E L The introduction of digital telecommunication networks offered features such as packet data and digital encryption which led to the widespread use of digitally connected, wireless devices and online services.
2	1996	**Global Positioning System (GPS) accuracy is improved** In 1996, the then United States President, Bill Clinton, issued a policy directive which led to 'selective availability' being discontinued on May 2, 2000.	**P** E **S** **T** E L The availability of non-degraded GPS signals led to the widespread consumer use of GPS-enabled technologies.
3	1998	**The Intelligent Access Project commences in Australia** The first trials of the 'Intelligent Access Project' commenced operation.	P **E** S **T** E **L** The Australian jurisdiction of Tasmania led trials of the Intelligent Access Project to improve the management of logging vehicles, performing an initial assessment of the economic, technical and legal opportunities that could be derived from Intelligent Access (combining the use of GPS and GSM technologies).
4	2000	**New technologies earmarked for route compliance** The former National Road Transport Commission (NRTC) noted that the transport industry was embracing technological approaches for fleet and driver management. The NRTC also noted that these technologies may offer a simple low-cost and credible method for operators to confirm compliance with special route requirements, which all jurisdictions could support (NRTC 2000).	P **E** S **T** E **L** A micro-economic reform agenda to improve the productivity of road freight transport in Australia – and to continue to improve the economic prosperity of the Australian economy and society – led to new ways of approaching the use of new and innovative vehicles which could improve productivity, while enhancing road infrastructure management and safety. The outcomes of these micro-economic reforms led to the introduction of technology-based reforms for road freight transport, including Performance Based Standards (PBS) and Intelligent Access in Australia. It also led to the establishment of the National Heavy Vehicle Regulator (NHVR).

Table 1 – Intelligent Access milestones and PESTEL influences (cont'd)

#	Year	Development/Milestone	PESTEL influences
5	2001	**Intelligent Access trials in other Australian jurisdictions** Trials of Intelligent Access commenced operation in New South Wales and Queensland.	P **E** **S** **T** E L Improved economic outcomes (i.e. heavy vehicle productivity) drove the first trials of Intelligent Access. Notably, stakeholders from the road transport industry promoted the early trials of Intelligent Access by advocating for improved economic *and* societal benefits through the use of technology.
6	2002	**National Intelligent Access Project established** National project established through Austroads, the national association of road transport agencies.	P **E** S **T** E **L** The establishment of a national project for Intelligent Access recognised that multiple disciplines needed to be brought together to deliver such a significant reform to road transport, with a focus on economic, technical and legal dimensions.
7	2003	**Intelligent Access was deemed to be feasible** Austroads found that Intelligent Access was feasible, and it was recommended that a staged roll-out commence.	**P** **E** **S** **T** **E** **L** The feasibility study found that Intelligent Access was technically viable and – with a supporting legal framework with an emphasis on establishing safeguards and protections to manage privacy and surveillance – had the potential to generate significant benefits by improving road safety, reducing infrastructure wear, reducing environmental effects, better managing public perceptions and expectations of heavy vehicle movements, and optimising road freight policy and operations tasks, including optimisation of the on-road enforcement activities (Austroads 2003).
8	2005	**Improved economic outcomes through Intelligent Access** The National Transport Commission (NTC) released a Regulatory Impact Statement (RIS) for Intelligent Access (NTC 2005).	P **E** S T **E** **L** The RIS for Intelligent Access projected improved economic outcomes through the introduction of enabling legislation. Improved environmental outcomes were also foreshadowed. The benefits of Intelligent Access were found to be greater than the costs.

Table 1 – Intelligent Access milestones and PESTEL influences (cont'd)

#	Year	Development/Milestone	PESTEL influences
9	2005	**Enabling legislation prepared** The NTC drafted national model legislation for passage through the parliaments of individual jurisdictions within Australia.	**P** E **S** T E **L** The passage of the national model legislation through individual jurisdictional parliaments occurred between 2006 and 2009. Legislation for Intelligent Access was later incorporated into the Heavy Vehicle National Law (HVNL), which was passed in 2013. The passage of law represented the outcome of a political, social and legal process.
10	2005	**Intelligent Access implemented** A cohesive package of enabling arrangements was established under the direction of Australia's road and transport agencies. This included funding and resources necessary to give effect to implementation plans (Austroads 2004).	**P** **E** **S** **T** **E** **L** All PESTEL influences led to the implementation of Intelligent Access, laying the foundations for all subsequent policy, legislative, technical, and operational developments which followed in subsequent periods.
11	2005	**Inaugural policy use of Intelligent Access established** A major funding agreement between the Australian Government and two Australian jurisdictions (New South Wales and Queensland) created the first policy use of Intelligent Access.	**P** **E** **S** **T** **E** **L** All PESTEL influences led to the inaugural use of Intelligent Access in Australia. At its core was an appreciation that new ways of managing heavy vehicle access were required to deliver improved productivity outcomes (see items 4 and 8).
12	2005	**TCA established** Transport Certification Australia (TCA) was established by Australian road agencies to administer the Intelligent Access Program (IAP) and other related technology applications to improve road management outcomes in a nationally consistent manner.	P E **S** **T** E **L** The creation of TCA foreshadowed the need for a national entity to lead and be the focal point for Intelligent Access, and in time, to enable the introduction of other transport reforms which rely on technology and data to improve public and social outcomes.
13	2008	**Intelligent Access endorsed as preferred approach** The former Australian Transport Council (ATC) of Ministers endorsed Intelligent Access as a preferred compliance and vehicle management solution and agreed that it could be used (as appropriate) to provide assurance over heavy vehicle access management.	**P** **E** S T E **L** Intelligent Access was recognised by Australian transport ministers as the preferred technological approach to manage compliance with and enforcement of heavy vehicle regulations. This was an outcome of the political process, micro-economic reform and legislative reform.

Table 1 – Intelligent Access milestones and PESTEL influences (cont'd)

#	Year	Development/Milestone	PESTEL influences
14	2011	**Identifying roadblocks in adopting Intelligent Access** A Root and Branch Analysis of Intelligent Access is undertaken in conjunction with Australia's road and transport agencies (TCA 2011).	**P** **E** S **T** E L The report considered the causes of the slower-than-anticipated roll-out and take-up of Intelligent Access and mapped out possible scenarios for addressing this going forward, taking into account political, economic and technical dimensions.
15	2013	**Entry Options and Flexible Pricing** In response to a request from one of Australia's transport ministers, TCA established the Entry Options initiative and Flexible Pricing (to reduce the costs of Intelligent Access to transport operators who had an infrequent or occasional need for the use of Intelligent Access).	**P** **E** S **T** E L The introduction of Entry Options and Flexible Pricing options represented the culmination of public advocacy by key stakeholders within the transport industry to make Intelligent Access more accessible and cost-effective. Entry Options responded to perceived technical barriers associated with the use of existing telematics devices, and Flexible Pricing responded to perceived cost (economic) issues.
16	2014	**Review of Intelligent Access** Under the direction of Australia's transport ministers, the NTC led a review of Intelligent Access to evaluate whether the implementation of Intelligent Access achieved the intended outcomes specified in the original proposal for the program in 2005 (see item 8). The review was informed by a report on the operational performance of Intelligent Access (TCA 2013).	**P** **E** S **T** E L Certain stakeholders within the transport industry called for the NTC to lead a review of Intelligent Access. Concerns were raised by some that the projected benefits were not being realised and that the costs of Intelligent Access were greater than the benefits. There were also concerns that the technical performance requirements of Intelligent Access were too stringent, leading to greater costs to transport operators (which were addressed by the work on the Entry Options initiative and Flexible Pricing). Despite concerns over cost, the review found that Intelligent Access had generated benefits to the value of AU$280M to transport operators, and AU$107M to governments during the first five years of operation, and that the complexity of Intelligent Access was being well managed.
17	2017	**Review of Regulatory Telematics** Under the direction of Australia's senior transport officials, the NTC led a review of regulatory telematics (including Intelligent Access) to assess current adoption rates by the road transport industry, identify barriers to adoption, and review governance and legislative arrangements. The review was informed by a report on the evolution of the National Telematics Framework and the expanded use of telematics (TCA 2017).	P **E** **S** **T** E L The review of regulatory telematics was prompted by the emergence of new forms of telematics and digital technologies which could improve the safe and efficient use of vehicles and support future public policy reform. One of the recommendations from the review was for TCA to lead the work on the development of a business case to improve Intelligent Access arrangements based on emerging needs.

Table 1 – Intelligent Access milestones and PESTEL influences (cont'd)

#	Year	Development/Milestone	PESTEL influences
18	2018	**Business case to improve Intelligent Access arrangements** The package of improvements to Intelligent Access arrangements in Australia was approved by Australia's transport ministers. The package included 16 separate (but inter-related) initiatives responding to the needs of road infrastructure managers, regulators, telematics providers, transport operators and drivers.	P **E** **S** **T** E L A structured process of engagement led by TCA revealed that each stakeholder had different but complementary needs and expectations from the use of Intelligent Access. A stakeholder report informed a package of initiatives to evolve the use of Intelligent Access arrangements presented to Australia's Transport Ministers (TCA 2018).
19	2020	**New variants of Intelligent Access introduced** New variants of Intelligent Access– the Road Infrastructure Management (RIM) application and the Telematics Monitoring Application (TMA) – commenced operation, providing options to policy makers considering Intelligent Access.	P **E** S **T** E **L** The availability of lower-cost, more flexible variants of Intelligent Access broadened the policy options available to Australia's road and transport agencies to improve economic outcomes, by allowing Intelligent Access to be considered for a broader range of vehicle types. This expanded its use and with it, the volume of data able to be collected through Intelligent Access arrangements.
20	2020	**TCA introduced data-driven services** TCA launched data-driven services through the Telematics Analytics Platform (TAP), providing a secure, online service to provide users with access analysis and visualisations of data collected from vehicles participating in Intelligent Access arrangements (see Table 2 for more information).	P **E** **S** **T** E L The provision of data services through TAP has responded to an unmet stakeholder need to have access to data analysis and visualisations. This has had the effect of increasing stakeholder awareness of Intelligent Access, and has created a cohort of practitioners who use TAP to gain insights into heavy vehicle use on the road network. This has also helped inform future policy developments which can benefit from Intelligent Access.
21	2021	**First transport operator certified for Intelligent Access** The improvements made to Intelligent Access arrangements (see item 17) introduced new mechanisms to allow transport operators to obtain certification for technologies already used in their vehicles (see Table 2 for more information).	P **E** **S** **T** E L The certification of transport operators for Intelligent Access removed a critical impediment which had led to public criticisms of Intelligent Access. Enabling transport operators to use existing technologies, and to leverage existing investments in those technologies, removed barriers to entry and increased the economic benefit of Intelligent Access.

Table 1 – Intelligent Access milestones and PESTEL influences (cont'd)

#	Year	Development/Milestone	PESTEL influences
22	2022	**Smart On-Board Mass introduced** Smart On-Board Mass (Smart OBM) systems enabled the digital collection of axle mass measurements to be combined with Intelligent Access data.	P **E** S **T** **E** L Smart OBM was conditioned as an operating requirement for heavier, higher productivity freight vehicles in four Australian jurisdictions. The assurance provided by Smart OBM enabled road infrastructure managers to grant access to parts of the road network that would otherwise not be accessible. Smart OBM enabled transport operators to run fewer trucks for a given volume of freight, improving environmental outcomes.
23	2023	**Industry-led data sharing initiatives commenced** Industry associations and their members have partnered with TCA to voluntarily share telematics data under transparent consent arrangements. Data received by TCA is anonymised, aggregated and visualised by TCA through TAP (see Table 2 for more information).	P **E** **S** T **E** L Industry-led data sharing initiatives are helping sectors within the transport industry to gain a macro-view of the vehicle movements in their sector, establish an evidence base to support discussions with road managers and other government authorities and demonstrate the economic value of their sector and their social licence to operate.
24	2023	**Intelligent Access used to support the introduction of battery-electric heavy vehicles** Australian road and transport agencies are adopting the use of Intelligent Access with Smart OBM systems for battery electric heavy vehicles operating on Australian road networks.	P **E** **S** T **E** L Intelligent Access and Smart OBM enable the collection of data from battery electric vehicles to evaluate the impact of higher axle weights on road and bridge infrastructure. It responds to the emergence of economic, social and environmental influences to introduce battery-electric heavy vehicles on the Australian road network.

Table 1 serves to highlight that the development, implementation, operation, evolution and enhancement of Intelligent Access in Australia has been directly influenced (and continues to be influenced) by an interaction of different factors. As highlighted by Eastough (2014), the success of the (PESTEL) technique in identifying relevant issues and trends is contingent on access to and engagement with a diverse pool of people who are willing to share relevant ideas and expertise. The success of Intelligent Access arrangements in Australia can be attributed to the willingness of different stakeholders to share ideas and expertise, coupled with the adaptiveness and agility of all the actors involved in the operation and use of Intelligent Access, including TCA, service providers, road and transport agencies, regulators and transport operators.

The cumulative impact of these interactions can be demonstrated through the evolution of Intelligent Access, which reflects sustained developments in policy thinking. These shifts can be understood with reference to the Overton Window.

3. The Overton Window

According to Romloll (2023), “the Overton window is a political theory that refers to the range of acceptable policy options at a given time. It is a concept that can help individuals and organizations understand the political landscape and shape public opinion to achieve their policy goals. By understanding the political landscape, building public support, and engaging with decision-makers, it is possible to move the Overton Window and bring previously unacceptable policy options within the range of what is considered feasible.”

Lehman (2010) describes the Overton Window as a model for understanding how ideas in society change over time and influence politics. “At any one time, some group of adjacent policies along the freedom spectrum fall into a window of political possibility…Policies outside the window, either higher or lower, are politically unacceptable at the moment. If you shift the position or size of the window, you change what is politically possible” (Lehman 2010).

The Overton Window is graphically depicted in Image 1.

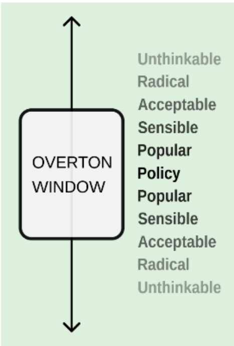

Image 1 – Overton Window and policy options

The Overton Window can be used to understand how the evolution of Intelligent Access has been led by shifts in policy thinking, and how policy positions which were previously beyond the realms of acceptability are now considered not only sensible, but popular.

4. How policy developments shifted the Overton Window for Intelligent Access

A founding concept which drove the initial policy development and implementation of Intelligent Access was to use digital technology and data to provide strong assurances that ‘the right truck is on the right road’. Using a combination of GNSS, GSM and other Information and Communication Technologies (ICT), the original IAP was designed to identify and report on situations where a vehicle has travelled on parts of the road network where permission had not been granted.

This approach, which can be referred to as exception-based reporting helped manage infrastructure and safety risks by managing compliance with road transport law.
As mentioned in Table 1 (item #13), Australia’s transport ministers recognised Intelligent Access as “a preferred compliance and vehicle management solution, and that it could be used as a compliance tool to provide greater compliance assurance in relation to the road freight sector for use as appropriate.” Intelligent Access was also identified as an enabler to improve road safety (Koniditsiotis et al. 2010).

As highlighted by Hill and Gordon (2021), data availability limitations inherent to the design of the IAP would move from being viewed as a positive (because of its privacy-by-design approach) to a negative by road infrastructure managers and industry (because it necessarily constrained the utility of data for planning and investment purposes). The introduction of new variants of Intelligent Access, specifically RIM and TMA, explicitly responded to stakeholders' changing needs and demands while maintaining privacy-by-design principles, albeit through different methods.

Specific examples of how policy developments in the context of Intelligent Access have shifted the Overton Window are presented in Table 2. In each case, what was once considered to be an unthinkable policy position is now widely accepted. Furthermore, this has led to a stronger level of support from transport operators who once opposed policies on the use of Intelligent Access.

Table 2 – How Intelligent Access policy developments have shifted the Overton Window

	>> Shift in the Overton Window >>		
Policy principle	**Prior policy position**	**Current policy position**	**Implications**
Transport operator systems certified for Intelligent Access	Transport operators *were not* able to use their existing telematics systems for Intelligent Access. A key policy foundation of Intelligent Access, when first introduced in the form of the IAP, was that the data collected could be used for compliance and enforcement purposes. To achieve this, defined separations of legal, technical and business roles and responsibilities were enshrined within the IAP operating model. This meant that the IAP service providers needed to be separate from transport operators. Nor could there be any conflicts of interest between service providers and transport operators.	Transport operators *are using* their existing telematics systems for Intelligent Access. The introduction of newer variants of Intelligent Access applications (namely RIM and TMA) has enabled the primary purpose of collecting data through Intelligent Access arrangements to move away from the exclusive purpose of compliance and enforcement. Although data collected through TMA can be used for compliance management, it cannot be used for penalties and prosecutions. This has removed the need to maintain a strict separation between a service provider and a transport operator. It means that prior investments in telematics and other technologies by transport operators can be certified and recognised for Intelligent Access.	Transport operators are now having their systems certified by TCA to provide Intelligent Access applications to vehicles in their fleet. In addition, transport operators who have developed their own on-board mass measurement technologies are obtaining approval from TCA to have these recognised as Smart OBM systems – for use in schemes where it is a requirement.

Table 2 – How Intelligent Access policy developments have shifted the Overton Window (cont'd)

	>> Shift in the Overton Window >>		
Policy principle	**Previous policy position**	**Current policy position**	**Implications**
Industry-led data sharing initiatives	Voluntary data sharing arrangements *were not* administered within Intelligent Access arrangements. This led to ad-hoc, commercial arrangements between technology providers, road and transport agencies, and regulators.	Voluntary data sharing arrangements *are being* administered within the Intelligent Access environment. Industry-led data sharing initiatives draw upon, and derive benefits from, core policy features which underpin Intelligent Access and the National Telematics Framework. These include: • Standardised data collection and transfer processes • Standardised consent mechanisms (legal agreements) • Data governance and protection arrangements administered by TCA to the same standard as Intelligent Access schemes.	TCA now partners with specific sectors of the transport industry that voluntarily share data with TCA for analysis and reporting to transport operators within that sector. As these operators' vehicles <u>are not</u> participating in schemes established by policy makers, this is having the effect of increasing the number of vehicles sharing vehicle data with TCA. When anonymised and aggregated, this increases the total number of vehicles which are contributing to the pool of Intelligent Access information. This improves the statistical confidence of the data pool, and the quality of planning and investment decisions which can be made by road infrastructure managers.
TCA is now a provider of services within the value chain	TCA *was not* part of the value chain for the provision of data services. TCA was the government-appointed certifier and auditor of service providers who offered Intelligent Access to transport operators. Besides its certification and audit functions, TCA managed the structured interaction of road and transport agencies, service providers and transport operators to deliver improved road outcomes through the National Telematics Framework. Apart from ad-hoc requests for TCA to analyse Intelligent Access data for 'research purposes' – as permitted under the HVNL – TCA's role was not to be a provider of data-driven services.	TCA *is now* part of the value chain for the provision of data services – to a growing portfolio of end-users, including road infrastructure managers, regulators, other government agencies, local governments, peak industry bodies, universities and other community members. These data services are augmented with TCA's other functions and services, including type-approval of hardware, and the certification and audit of Intelligent Access service providers.	TCA's role has expanded to be more than just an administrator of Intelligent Access arrangements. TCA now forms part of the value chain in the provision of data services. This has strategic implications for TCA's role and function, which is being contemplated as part of a new, national Technology and Data Framework which is being progressed as part of the current review of the HVNL.

5. Policy developments and Intelligent Access schemes

Shifts in the Overton Window continue to inform the perceptions of Intelligent Access, and with it, are challenging preconceived limitations and constraints. In the context of Intelligent Access, new productivity and safety schemes are progressively shifting the bounds of the Overton Window. As a consequence, novel Intelligent Access arrangements are being activated in tandem with new policy developments, which may not have been contemplated previously.

The term ‘scheme’ is used for a variety of purposes across different parts of the Australian road transport regulatory environment. In the context of Intelligent Access, a scheme contains the business rules and digital conditions that give effect to a policy position using telematics.

It is important to differentiate between Intelligent Access applications and schemes. Intelligent Access applications define such things as the:

- functional and technical requirements which need to be met by service providers;
- levels of assurance provided by TCA over service providers (i.e. the extent to which service providers are overseen by TCA to ensure functional and technical requirements are satisfied, through functions such as type-approval of devices, certification of service and audit of overall service performance); and
- types of data collected, and the purpose for which data is used (the purposes for which are underpinned by the HVNL, certification agreements and tri-partite legal agreements between transport operators, service providers and TCA).

Intelligent Access schemes are the digital representation of the policy use of Intelligent Access applications to deliver improved transport outcomes. Schemes are created by policy makers within road and transport agencies and/or regulatory bodies and are underpinned by legal instruments such as notices or permits (with which transport operators need to conform).

In simple terms, an Intelligent Access *application* articulates *what* data is collected, while a *scheme* focuses on *why* data is collected. This is diagrammatically depicted in Image 2.

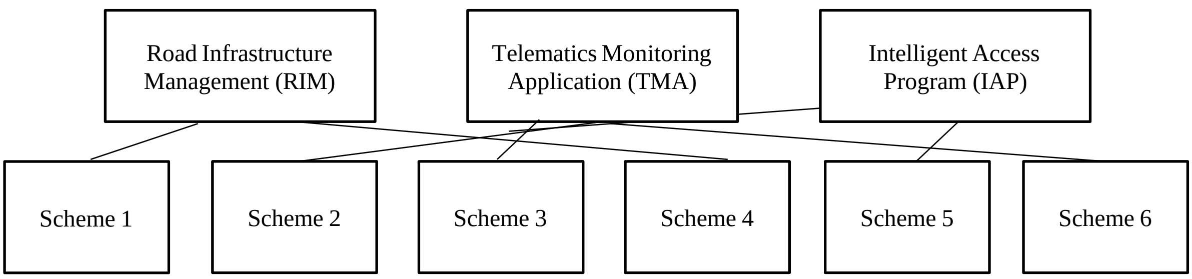

Image 2 – Relationship between applications and schemes

Intelligent Access schemes do not operate in isolation. They sit within the nexus of interrelated factors which influence the design and operation of schemes. The factors exist within a broader strategic context in which Australia’s road and transport agencies operate (TCA 2022). These relationships are illustrated in Image 3.

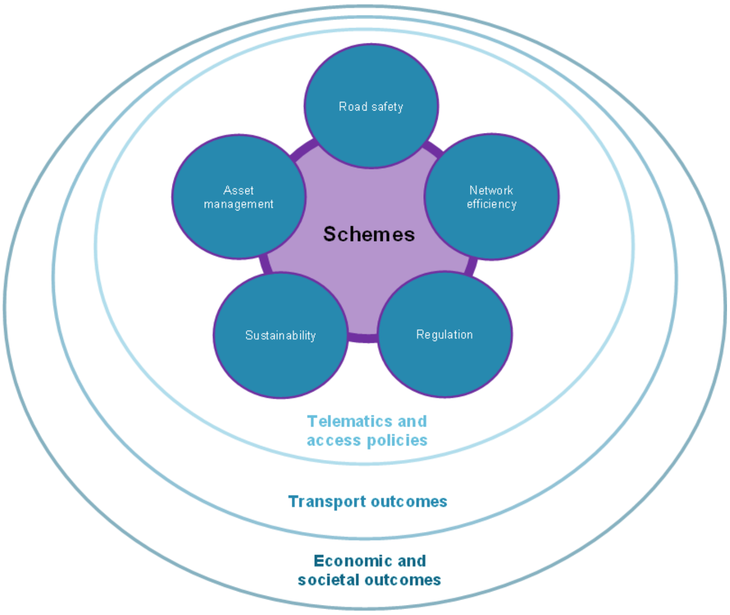

Image 3 - Scheme relationships and strategic context

As presented by Hill and Greenow (2021) at HVTT16, policy makers are adopting a risk-based approach to the use of Intelligent Access applications. Decisions about which Intelligent Access application to utilise is informed by the following key, inter-related dimensions:

- The *intended use of data* to be collected through an Intelligent Access arrangement (as an example, if policy makers seek to obtain identifiable vehicle movement data so that it can be used for direct enforcement purposes, an Intelligent Access application with a higher level of assurance will be selected)
- The *risks* to road infrastructure, road safety and other road users of specific heavy vehicle combinations and/or loads (as an example, policy makers may seek to obtain vehicle movement data from individual vehicles for the sole purpose of having TCA anonymise and aggregate data for reporting against vehicle movement patterns of specific types of vehicle and/or combinations on the road network – which can help inform road infrastructure maintenance, planning and investment)
- The *cost to industry* of obtaining Intelligent Access monitoring (policy makers will consider the financial impacts to the road transport industry of different Intelligent Access conditions, in combination with the two prior dimensions).

Schemes have traditionally relied upon vehicle position data (derived from GNSS) as the primary form of data collected by service providers for use in schemes. The emphasis on vehicle position data has been driven by two factors:

- The widespread availability and maturity of GNSS
- The historical focus of road infrastructure managers and regulators on gaining insights into vehicle movement and utilisation on the road network.

Axle mass data (derived from the use of Smart OBM systems) is now being augmented with vehicle position data through Intelligent Access schemes used in the Australian jurisdictions of Tasmania, Victoria, New South Wales and Queensland. These schemes offer richer insights into vehicle movement, vehicle load and vehicle configuration than vehicle location data can provide alone.

While other data attributes may be generated by a vehicle's telematics system, service providers offering Intelligent Access have no obligation to make this data accessible to other parties (such as TCA) and may have commercial and/or contractual considerations that restrict their ability to do so. Other types of data sought by Australia’s road and transport agencies are presented in Table 3.

Table 3 – Other types of data for inclusion in Intelligent Access arrangements

Data categories	Use case examples	Outcome areas
G-force data	Identification of high-frequency harsh braking and evasive manoeuvers. A high frequency of G-force ratings on specific segments of a road may indicate the need for interventions.	Road safety
Digital imaging and video	Management of vehicle and driver behaviour where other data types (when used in isolation) cannot deliver intended outcomes. For example, digital imaging and video can be used to validate: • Centreline travel for Oversize/Overmass (OSOM) vehicles • Low-speed travel across vulnerable structures. When used in combination with other data sources (including G-force data), digital imaging and video provides an opportunity to forensically review the behaviour of drivers before events involving hard braking or evasive manoeuvres. Digital imaging and video also offer a way to identify potential infrastructure and safety management issues on the network.	Road safety Asset management Network efficiency
Real-time data	Identification of vehicle movements in real-time, to improve network efficiency and to manage the use of higher-risk vehicles or activities.	Road safety Network efficiency

6. Vehicle Data Exchange project

TCA is currently managing a Vehicle Data Exchange project to explore how other types of data can be incorporated into Intelligent Access arrangements. The objectives of the project are to:

- identify what additional data attributes could be derived from road-based vehicles; and
- gain knowledge and experience from the engagement with vehicle manufacturers, intelligent access providers and other telematics providers as to the availability and accessibility of a broader suite of data to augment data types already collected through Intelligent Access – as defined in the TCA Telematics Data Dictionary.

During the first half of 2023, TCA consulted with stakeholders to understand the:

- type of data attributes generated by modern vehicles that can be collected and transferred; and
- willingness of stakeholders to share additional data attributes with TCA, and under what circumstances.

The outcomes of this work revealed that the type of data attributes generated by vehicles can be characterised by two key dimensions:

- The availability of data; and
- The accessibility of data.

The *availability of data* indicates whether specific types of data are commonly collected by vehicle manufacturers and technology providers. The *accessibility of data* indicates the willingness of the vehicle manufacturer or technology provider to share the data with a third party (TCA 2023). The interaction between these two dimensions is represented in Image 4.

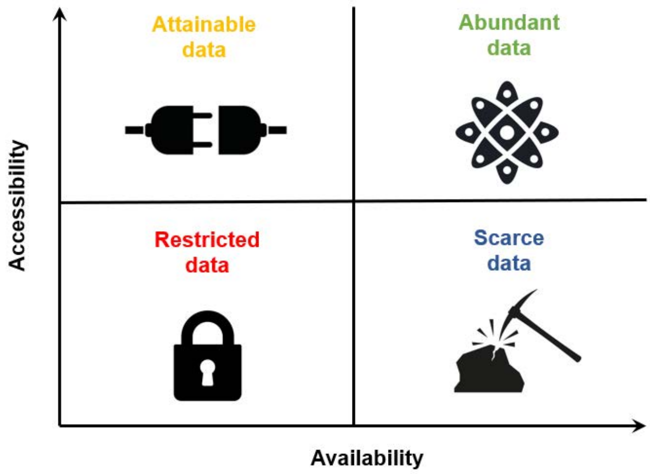

Image 4 – Interactions between availability and accessibility of new data types

7. Strategic insights and implications

The evolution of Intelligent Access will continue to be influenced by a range of political, economic, societal, technical, environmental and legal factors. Together, these factors will guide the future direction of Intelligent Access into new policy domains and operational deployments.

However, at its core, the structured interaction between different actors to give operational effect to Intelligent Access arrangements will remain a constant. Each of these actors has distinct roles and responsibilities which, when combined, enable the delivery of Intelligent Access services. This is depicted in Image 5.

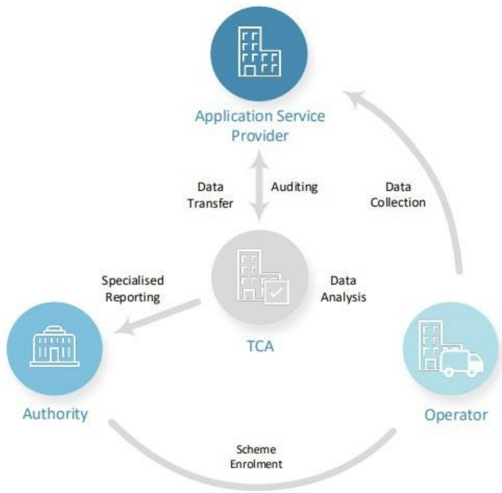

Image 5 – Intelligent Access actors and interactions

Central to these interactions is the operation of tri-partite data sharing and consent arrangements between TCA, the Application Service Providers and transport operators. These tri-partite arrangements enable transparent, structured, and standardised instruments which articulate the permitted purpose for which data is being collected, its retention, use and destruction, and underpin the operation of all applications and schemes within Australia's National Telematics Framework (TCA 2023). It is anticipated that the introduction of new data types will require an extension of these underpinnings to additional actors within Intelligent Access operating arrangements. In particular, data which is *less accessible* (as represented in Image 4) will require the consent of vehicle manufacturers or technology providers responsible for collecting these data. The inclusion of additional actors is represented in Image 6.

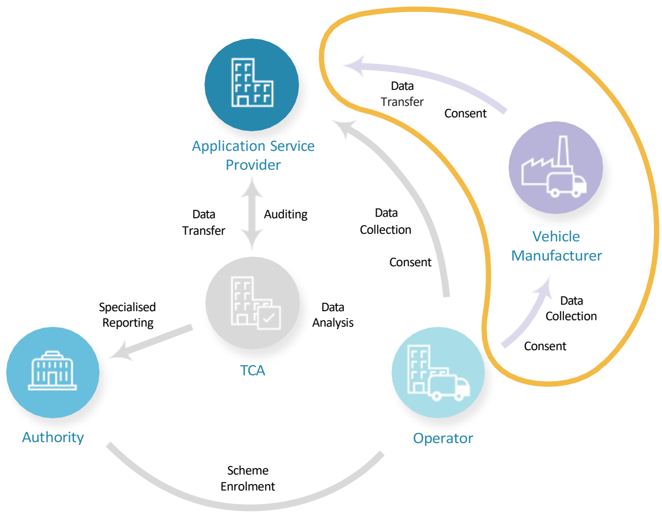

Image 6 – Introducing new actors with additional data types

8. Conclusions

This paper has highlighted the extent to which external influences across political, economic, societal, technical environmental and legal dimensions have shaped the development, implementation, operation and ongoing evolution of Intelligent Access in Australia. Intelligent Access is too often viewed through the prism of a technology initiative, without consideration of the complex interplay of other factors which are associated with any major program of reform. The lesson for other regions contemplating the introduction of Intelligent Access is to ensure all PESTEL influences are identified and proactively managed through a structured, ongoing process of engagement.

In an environment where digital technologies are disrupting traditional paradigms, and external factors are accelerating the pace of change, the need to establish operating frameworks with stakeholders that span government and industry is crucial to establishing the foundations for resilience and agility.

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