Intelligent Transport Systems Technology Action Plan 2014–18

Transport in the digital age

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CONTENTS

FOREWORD

In November 2013 I released, for public consultation, a draft Action Plan setting out the government's proposed work programme on intelligent transport systems in New Zealand. This was well received by the Intelligent Transport Systems sector.

I am pleased to release the final Action Plan, which has been refined to take into account submitter comments where appropriate. Submitters supported the government taking a stronger leadership role and this Action Plan is the first step in this process.

Part of the Digital Age, intelligent transport systems — which use sensors, computing and communication technologies — are becoming integral to transport in New Zealand and around the world. They play a major role in making travel safer and more efficient. Intelligent Transport Systems technologies are new and evolving tools that will help the government achieve its transport objectives.

Examples are numerous. Some of these technologies, such as traffic control systems, will be acquired by government agencies or local government. However, other technologies, such as advanced driver assistance, vehicle monitoring systems and integrated electronic ticketing will be used by consumers because of the benefits they bring. Many companies now use supply chain management systems to track and manage freight shipments and vehicles. The government has a different role to play here — one of setting standards and ensuring open technology markets.

The development of new technologies is rapid. We are likely to see many new and exciting transport applications in the future. Some may even be transformational. For example, vehicles of the future may be so well equipped that that they are almost impossible to crash. If so, it could lead to large reductions in the road toll.

The rise in ownership of smart phones also presents major opportunities in getting high quality information to travelers.

We are well placed as a nation to capitalise on the benefits that Intelligent Transport Systems will bring. New Zealand has a history of being early adopters of technology. For example, the use of refrigerated shipping underpinned the development of our pastoral economy while New Zealand has been a pioneer in aspects of aviation.

The government is ready to play its part. In particular we need to provide the sector with a clear understanding of our strategic direction and priorities. This will include continually identifying what barriers exist to the introduction of new transport technologies to New Zealand, and, where appropriate, how the government can help to minimise them.

This Action Plan sets out the government's work programme to encourage the continued deployment of Intelligent Transport Systems in New Zealand over the next four years.

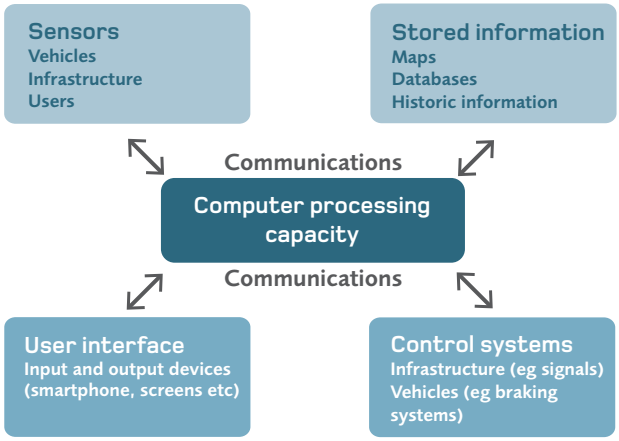
Hon Gerry Brownlee
Minister of Transport

1 INTRODUCTION

1.1 Intelligent Transport Systems Technology Action Plan

Intelligent transport systems (ITS) are those in which information, data processing, communication, and sensor technologies are applied to vehicles (including trains, aircraft and ships), infrastructure, operating and management systems, to provide benefits for transport service users (see Figure 1).

Figure 1: ITS components



ITS technologies are tools that vehicle owners, funders and policy makers can use to make transport systems across all modes of transport safer, more efficient, more resilient, and more sustainable. ITS technologies are already widely used across all modes of transport and are developing at a rapid pace.

For the purposes of this document, ITS technologies can be broken into three broad areas.

1. Those provided and controlled by central and local government such as air traffic control systems, variable message signs on motorways, traffic management systems, and operations centres.
2. Those provided by the private sector and which the government has limited direct control over, such as vehicle safety and navigation systems, and advanced vehicle control systems.
3. User-innovated ITS, based on crowd-sourcing of information, open data and user generated data.

The government is aware of the many benefits ITS technologies offer and wants to ensure that ITS technologies can be used safely, efficiently and effectively in New Zealand. To this end, the government has produced this Action Plan to give the ITS sector an understanding of the government's objectives for New Zealand's transport system and how ITS can contribute to meeting these objectives. The Action Plan will also help the government to enable ITS technologies to enhance the operation, use and experience of the transport system.

This Action Plan contains 42 actions. The government thinks these will ensure ITS technologies can contribute to its objectives for all modes of New Zealand's transport system. The Action Plan does not discuss in any detail investment assessments or decisions. These are made by the responsible parties, for example Airways New Zealand, Land Information New Zealand (LINZ), the NZ Transport Agency, and the private sector.

Many of the technologies implemented by the private sector will rely on guidance from documents such as this to determine priorities.

The Action Plan outlines a program of government ITS-related work over the period 2014-18. The Plan will be reviewed in 2016.

2 STRATEGIC CONTEXT

2.1 The government's economic growth and transport objectives

The government is committed to growing the New Zealand economy and increasing the wellbeing of all New Zealanders.

Our economy is reliant on trade in goods and services, such as tourism. A safe and efficient transport network is essential for delivering these goods and services. The government has adopted a Business Growth Agenda target to lift exports from 30 to 40 percent of gross domestic product by 2025. However New Zealand's relative geographical isolation puts us at a competitive disadvantage in exporting when compared to many other countries. To compete effectively in the global market, we need all aspects of the supply chain, including transport, to be as efficient as possible. Intelligent transport systems are already contributing to improved efficiency of supply chains in New Zealand and around the world. An example of this is real time tracking of vehicle performance and use of accurate maps and location data to plan delivery routes for the freight sector, these have resulted in fuel savings of up to 15 percent.

The National Infrastructure Plan 2011 sets out the government's plans for infrastructure, including transport infrastructure. The National Infrastructure Plan emphasises the importance of having infrastructure capable of supporting economic and social activity, but also the need for infrastructure to operate efficiently, and the importance of managing demand and ensuring value for money when investing in new or upgraded infrastructure. Investment in ITS can sometimes help in postponing the need for more expensive physical expansion of transport infrastructure capacity.

The government is also concerned about the safety of the transport system. As well as the trauma and personal tragedy experienced by those involved, the social cost of road crashes is estimated at $3.1 billion each year. The government's Safer Journeys strategy and action plan sets out our aims and a programme for improving road safety. In parallel with government actions, the introduction by vehicle manufacturers of advanced driver assistance systems such as land lane departure warning will over time contribute to increased vehicle safety and efficiency.

The NZ Energy Efficiency and Conservation Strategy 2011-16 has a target for making road vehicles entering the fleet more fuel efficient and has also made an economy-wide commitment to reduce greenhouse gas emissions by five percent from 1990 levels by 2020, and by 50 percent by 2050. We expect ITS technologies to assist in meeting these targets by improving the efficiency of the transport sector.

The government's Better Public Services programme has adopted as one of its 10 key results areas a target that 'New Zealanders can complete their transactions with the government easily in a digital environment' and has published an Information and Communication Technology Strategy and Action Plan to 2017. This identifies the transport sector as a pilot for moving towards greater integration in electronic service design and delivery. Some ITS technologies involve customers interacting electronically with government departments and agencies, and many actions in this Action Plan are consistent with the government's wider goals for better public services.

The introduction of ITS technologies also brings a number of challenges for policy makers. These challenges include understanding public versus private benefits, ensuring the privacy and security of individuals' information is maintained, and making changes to the regulatory environment. This Action Plan proposes a number of actions to address these challenges.

The government has set out an overall objective for the New Zealand transport system in *Connecting New Zealand*. The *Connecting New Zealand* objective recognises the key role the transport system, assisted by ITS, has in meeting the government's broader goals.

Government's overall objective for transport

The government's overall objective for the transport system is for an effective, efficient, safe, secure, accessible and resilient transport system that supports growth of our country's economy in order to deliver greater prosperity, security and opportunities for all New Zealanders.

The three key areas of government focus for achieving the objective are:

- Economic growth and productivity
- Value for money
- Road safety

2.2 Transport outcomes and the role of ITS

To support the government's overall transport objective, government transport agencies have adopted four long-term goals for transport in New Zealand (Figure 2). ITS technologies, enabling the provision of real-time information and real-time supply chain management for example, allow some of the key problems facing the transport sector to be addressed.

Actions in this Plan will, among other things, identify regulatory and other impediments to the continued deployment of ITS in New Zealand. The release of this Action Plan is the first step in a government programme that will allow the selection and deployment of ITS technologies in a safe and efficient manner.

This Action Plan is not intended to identify any particular ITS technology as the solution to a transport problem. Rather we recognise ITS technologies are tools which can be used to contribute to the government's transport objectives.

The identification of ITS technologies to address specific issues is done in more detailed strategic documents such as the National Air Navigation Plan, and the Safer Journeys Action Plan.

Figure 2: How ITS can contribute to the government's four long-term goals for the transport system in NZ

The government's four long-term goals for the transport system in New Zealand			
Effective Moves people and freight where they need to go in a timely manner	**Efficient** Delivers the right infrastructure and services to the right level at the best cost	**Resilient** Meets future needs and endures shocks	**Safe and responsible** Reduces the harms from transport
Examples of how ITS can contribute to the government's long-term goals			
Real-time information provided by ITS systems improves the reliability of the network, reduces journey times and cost, and keeps users informed of the best mode of transport to use.	By offering new ways to manage demand for transport services, ITS helps us to use our existing infrastructure more efficiently. Detailed information on the use of transport systems or transport routes can remove or defer the need for future transport investments. More efficient use of vehicles will reduce fuel use.	ITS provides real-time information about the state of transport systems. This allows network operators to manage the network and keep users informed when shocks such as crashes and natural disasters occur.	ITS technologies have a major impact on the safety of transport by reducing the severity and number of crashes in all modes of transport. Some technologies can also reduce emissions by smoothing traffic flow, and improve the efficiency of supply chains by providing operators with real-time information on their driving efficiency.

2.3 The central government participants in ITS

The central government transport agencies and state-owned enterprises all have a role to play in facilitating the continued deployment of ITS technologies in New Zealand. The technologies themselves, and which ones are deployed, are for the market to determine.

The central government participants include the Ministry of Transport, the NZ Transport Agency, KiwiRail, Maritime New Zealand, the Civil Aviation Authority, the Aviation Security Service, Airways New Zealand, Land Information New Zealand, and MetService. Other government departments and agencies, such as the New Zealand Police and the New Zealand Customs Service, are involved in specific aspects of ITS. This Action Plan is designed to include actions across the different government departments and agencies, who will continue to work closely together.

2.4 Other key participants

Local government, vehicle manufacturers, technology providers and transport users all have major roles to play in increasing the uptake of ITS technologies. ITS New Zealand, as a sector representative and a participant in the international ITS community, also has an important role. A key part of the government's work will be drawing these groups together and working with them to ensure ITS delivers the maximum possible benefit to New Zealand.

3 THE GOVERNMENT'S APPROACH TO INTELLIGENT TRANSPORT SYSTEMS IN THE TRANSPORT SYSTEM

3.1 Statement of government commitment

The government recognises the great potential of ITS technology to contribute to the achievement of the government's desired transport outcomes, and has already made significant investments in ITS in all modes. The government will encourage and support the further development and deployment of ITS to ensure these benefits are realised for New Zealanders as quickly as possible, where they support transport outcomes and it is cost-effective to do so.

3.2 The role of government

Some technologies, (particularly features to make vehicles safer and more convenient for operators), are designed and marketed by manufacturers, and their uptake is driven by consumer demand. Where this is the case, there may be little reason for the government to be involved. However there are a number of areas where the government has an essential role to play in the advancement of ITS technologies.

The government's role

- **Strategic leadership, direction setting and collaboration.**
  Feedback from the sector has clearly identified the need for the government to provide strategic leadership, working collaboratively across the ITS and transport sectors, and across central and local government.
- **Providing a supportive regulatory environment.**
  For example:
  - > Removing unnecessary regulatory barriers to ITS deployment
  - > Ensuring open markets — in some cases by regulating on issues such as standards
  - > Speeding up deployment — for example, by mandating certain ITS features where there is a clear public benefit
  - > Managing safety risks of new technology
- **Funding and procuring infrastructure or services.**

For example:

- > ITS solutions — such as air navigation or traffic management infrastructure
- > Providing building blocks necessary for ITS solutions, but with wider applications — such as enhancing Global Navigation Satellite System (GNSS)[1] coverage and three dimensional digital mapping
- > Facilitating or piloting technologies

- **Using the information and opportunities provided by ITS systems.**

For example, in planning and operating the transport networks for which central or local government or other agencies are responsible.

- > **Influencing -** The government is often best placed to influence others within and outside New Zealand — for example, the developers of international standards that have a major impact on New Zealand.
- > **Informing and validating -** The government has a role informing users about developments relevant to the ITS field to encourage uptake of technologies with clear public benefit.

3.3 The government's approach

The following list provides guidance on the government's approach to ITS:

1. The government's involvement in ITS will prioritise those technological solutions that best support the four transport objectives, across all modes. In particular, it seeks to enable cost-effective solutions that will bring transformational benefits in the medium to long term.
2. The government will encourage sector-led ITS development and investment. The government will focus its actions on enabling such investment, but will not get involved where it is not necessary to do so.
3. The government will take a leadership and coordination role within the ITS and transport sectors, working with all relevant agencies and interests to develop a clear strategic direction for ITS as an integrated part of New Zealand's transport system.
4. The government will operate in a coordinated way across different government departments and agencies, recognising many of the issues relevant to ITS also apply in other sectors.
5. Government regulation in the area of ITS will focus on removing unwarranted barriers to ITS deployment, ensuring open markets and accelerating the uptake of ITS technologies where there is a clear public benefit.
6. Where the government is itself an investor, it will do so on the basis of achieving value for money over the long term. Investments across all modes of transport will be focused on achieving the government's transport objectives. Decisions on whether to procure systems and hardware or services will also be driven by value-for-money considerations.

[1] The most well known of the systems is the US Global Positioning System (GPS)

4 GOVERNMENT ACTIONS FOR 2014–18

The following actions to be undertaken by government transport agencies relate to specific ITS systems and applications; some to the building blocks of ITS systems, several of which have applications outside ITS; and in some cases to more general issues facing the ITS sector. The actions were developed following workshops with government and private sector ITS stakeholders and were refined following consultation on the Draft Action Plan.

The actions highlighted in blue are those considered to be strategically important for the continued deployment of ITS technologies into New Zealand.

4.1 Leadership, strategic direction, and collaboration

During the development of this Action Plan stakeholders noted a desire for the government to take a stronger leadership role in the deployment of ITS. To date government and transport agency collaboration with ITS stakeholders has been sporadic. If the government and New Zealand are to realise the long-term benefits of ITS technologies, government agencies will need to more actively engage with the ITS sector.

Much ITS technology is likely to be developed and introduced commercially, driven by consumer demand. Nevertheless, the government is a major player in the ITS sector as regulator, and through various government agencies and State-owned enterprises, as the owner and operator of the State highway network, the rail network and the air traffic control system. Given the role of the government, it is important to develop a clear strategic direction for ITS in New Zealand and to clarify priorities for government regulation and investment.

A number of branches of government are involved in different aspects of ITS — as regulators, funders and users of ITS systems and information. Stakeholders have also requested that the government be more joined up in this work. The government has stepped up to the leadership challenge and worked closely with the sector in the development of this Action Plan.

The following actions will help the government develop its leadership role and provide strategic direction to the sector.

Government actions to develop its sector leadership role	Target date
The Ministry of Transport will establish an ITS Leadership Forum with government, ITS stakeholders, and multi-modal end user representatives. The Forum will take a long-term view and develop a strategic vision for the use of specific ITS policies in New Zealand.	2014, then ongoing
The Ministry of Transport will establish a whole-of-government ITS technology working group to ensure ongoing co-ordination of actions across central government.	2014, then ongoing
The Civil Aviation Authority will work with Airways NZ and other stakeholders to finalise and implement the National Air Navigation Plan, which outlines ITS priorities in airspace and air navigation, including for system investment and airspace management.	2014, then ongoing
The NZ Transport Agency will publish an ITS framework to inform the sector on its approach to developing ITS systems for land transport, including network operations, maximising the return from transport assets, and shaping smart transport choices.	2014

4.2 Investment

Central government owns and operates the State highway network, the rail network and the air traffic control system, through the NZ Transport Agency, KiwiRail and Airways New Zealand respectively. Furthermore, the government has significant interests in other key transport assets, including a majority shareholding in Air New Zealand, joint venture ownership of six airports, and shareholdings in four corporatised airports. Through the National Land Transport Programme, the government also co-funds the development and operation of local roads, walking and cycling facilities such as cycleways, and public transport, working with the relevant local authorities.

Through the operation of these assets, central and local government already make extensive use of ITS technologies to monitor the performance of the network and network assets, and improve the efficiency and effectiveness of their operation. Information gathered from ITS is also used for the ongoing process of predicting future demand and planning the development of the network.

The government, through its agencies, makes strategic decisions in relation to investment in ITS. These include:

- the overall level of government funding for ITS
- the specific outcomes ITS solutions will need to deliver
- whether the government will procure physical infrastructure or ITS services from a third-party provider
- the setting of standards for ITS and its related infrastructure
- how infrastructure investment decisions, specifications and standards are coordinated across different government and non-government players to achieve the maximum overall benefit

For the private sector, having a clear understanding of the government's priorities for future investment is essential, as this will allow the private sector to plan accordingly, and, where necessary, research and develop new products.

Government actions on investment in ITS technology	Target date
The Ministry of Transport will provide policy about the role of ITS technologies in contributing to transport objectives in the next Government Policy Statement on Land Transport.	2014
The NZ Transport Agency, as the major investor in land-based ITS, will publish planning and investment signals that will inform suppliers about its future approach to delivery of ITS infrastructure and services.	2014

4.3 Regulatory review

A number of regulatory barriers to the cost-effective implementation of ITS in New Zealand have already been identified. Barriers not only limit or prevent the immediate benefits that could be provided by some ITS solutions, but also deter ITS developers from investing in research and development. The government's immediate focus will be to ensure transport rules and regulations are designed and implemented in a way that enables the development of ITS in New Zealand, while still ensuring appropriate safeguards are in place.

The government is currently reviewing other key pieces of transport legislation including the Civil Aviation Act and the Land Transport Act. As part of these reviews, transport agencies will consider whether there are opportunities to future-proof the legislation for likely ITS developments. It is not always possible, however, to anticipate future needs. It is therefore important that the government is flexible and able to respond quickly to ensure ITS technologies which offer significant benefits are able to be put in place as soon as possible. The existing transport rules development process is being revised to speed up rule-making, which will support this objective.

The Ministry of Transport and the NZ Transport Agency are also developing a vehicle standards map, as part of the Safer Journeys Action Plan for 2013-15. The map will identify existing and forthcoming vehicle technologies that could improve safety or efficiency, such as autonomous emergency braking or eCall, and will highlight relevant research or international standards. Where possible, the map will also indicate technologies the government might encourage the uptake of, by advertising, incentives or even legislation.

Civil Aviation Rules will be amended to enable the technology changes required to implement the National Air Navigation Plan. The introduction of remotely piloted aircraft systems used for survey and other non-military purposes will require new rules to clarify how they can be safely operated in New Zealand's airspace.

Government actions on regulatory change	Target date
The Ministry of Transport, in conjunction with transport agencies, will scan all transport legislation to identify unnecessary barriers to the continued deployment of ITS technologies in New Zealand. The review will also consider the need to review legislation in light of the increasing introduction of advanced driver assistance systems (ADAS) and semiautonomous vehicles.	2015
As set out in the Safer Journeys Action Plan 2013-15, the Ministry of Transport and the NZ Transport Agency will develop a (road) vehicle standards map, and a land transport rule to mandate electronic stability control.	2014
The Ministry of Transport and the Civil Aviation Authority will develop aviation rules to enable changes related to ITS that are required to implement the National Air Navigation Plan.	2015, then ongoing
The Ministry of Transport and the Civil Aviation Authority will develop aviation rules on remotely piloted aircraft systems.	2015, then ongoing

4.4 Data collection, sharing, security and privacy

Data collection and sharing

ITS technologies are is based on information processing. Some of the most promising new technologies are no more than new ways to analyse data using sophisticated statistical techniques and high speed processing power.

Government agencies already collect a great deal of information about transport, and ITS technologies will increase both the amount and usefulness of this data. Transport sector workshops held by the Ministry of Transport found much enthusiasm for greater data sharing between agencies and with the public and private sector.

The revolution in the amount of data available to improve the efficiency of the transport network has been led by the development of low-cost sensors and the proliferation of mobile information processing devices (such as smart phones). We are only beginning to discover the ways in which this data can be used. For example, there has been some investment in the rebuilding of Christchurch as a 'smart' or 'sensing' city, studded with sensors to monitor infrastructure, transport and other sources of information to enable more efficient uses of energy and resources.

The government is committed to open access to the data it collects, where this is cost-effective and consistent with privacy and commercial propriety. The challenge is to determine what data should be collected, and how to make it available in a form that meets the needs of the transport sector and encourages its innovative, productive use. This will involve consideration of standards and protocols to enable data to be shared. It will also require the coordination of data sources and, possibly, the 'warehousing' of data.

Open source standards for sharing transport system data are preferred, to encourage third parties to develop applications that benefit transport users and other stakeholders. For example, the General Transit Feed Specification (GTFS) defines a common format for public transportation schedules and associated geographic information. GTFS 'feeds' enable public transit agencies to publish their transit data and developers to write applications that use that data in an interoperable way. Some NZ public transport agencies already provide data in the GTFS format, but it is not yet universal.

In June 2013 the Government Information and Communications Technology (ICT) Strategy and Action Plan to 2017 was released. This is a plan to better integrate the government's electronic services and information handling through sharing resources and capability between departments. The result will be a strong emphasis on online services and single access points for individuals and businesses. The transport agencies are part of a pilot for the new operating model and approach.

Security

The collection and storage of data carries with it a responsibility to ensure data is secure. Data security involves protecting data from inappropriate access, but also maintaining the integrity of data and the robustness and resilience of the systems that process it. As transport becomes increasingly dependent on data processing, it becomes vulnerable to accidents and even malicious attacks. Valuable data, whether personal or commercial, needs strong security policies and techniques to protect it.

Data security is also a priority of the government's ICT strategy. In particular, privacy protection will be designed into systems that contain personal information, rather than relying on restricting access to the systems. The NZ Transport Agency (supported by Maritime New Zealand) is setting up a Security Centre of Expertise. The Centre will be built on the NZ Transport Agency's existing expertise with information and communications technology security. It is intended that it will also be a resource for other agencies.

Privacy of personal information

Much of the data produced or used by ITS technologies is about people and their behaviour, and so raises issues concerning privacy. Moreover, the power of data analysis is such that even apparently trivial data can be used to discern statistical patterns that reveal much richer personal information. For example, without appropriate safeguards,

the collection of data about vehicle movements, which could be so useful for network management and safety, could amount to surveillance. It is important systems are designed so information is not collected or stored unnecessarily. Where information is collected, there should be clear protocols governing its use.

Individuals, groups and corporations have a strong interest in the privacy of information about themselves. However, taking account of privacy should not be seen as an obstacle to the benefits of ITS; it is essential to realising these benefits. The greatest value will be achieved if privacy is considered at the outset of ITS design.

In New Zealand, the legal principles governing the collection and use of personal information are contained in the Privacy Act 1993. These principles require that personal information be collected only for clearly specified purposes and that people are made aware of the collection and its purpose. Most importantly, personal information must not be used for purposes other than for which it was collected, and must be available to its subjects on request.

The Office of the Privacy Commissioner has helpful guidelines available for people or organisations dealing with personal information.

Government actions on data collection, sharing, security and privacy	Target date
The ITS Leadership Forum will establish a working group to look at what transport-related information the government and other agencies are collecting, how to share it, what information should be publicly available and how to protect privacy.	2015
The NZ Transport Agency (supported by Maritime New Zealand) will set up a Data Security Centre of Expertise.	2014
The transport agencies will form a 'cluster' to pilot the government's ICT strategy by sharing capability and resources in information management, assurance and investment planning.	2014

4.5 Standards

For ITS to work effectively it will be important New Zealand adopts standards that ensure the widest range of technologies can be used in New Zealand. In some cases, these standards may need to be set in law. In other cases uptake will be voluntary.

Some standards are developed in New Zealand. For example, in the area of integrated ticketing and the use of smart cards, the NZ Transport Agency has successfully developed a national standard which is being used for all new smart card systems on public transport, and will eventually apply to all such systems.

In general, however, New Zealand looks to international bodies such as the International Organisation for Standardisation (ISO) to set the standards. The Ministry of Transport has already successfully worked with Standards New Zealand and ITS New Zealand so ITS New Zealand can become part of what is known formally as ISO TC 204 Intelligent Transport Systems[2]. This Technical Committee is setting standards for many aspects of ITS. The ability to access these standards quickly and cost-effectively through a neutral organisation such as ITS New Zealand (and also to have the option to be part of the process of developing the standards) will be of great importance for many New Zealand organisations.

In some cases the transport agencies may not have the level of technical expertise to be actively engaged in development of standards in processes such as ISO TC 204. It is likely the Ministry's role in that process would be in ensuring any contributions from New Zealand participants represent a consensus view. It is also likely the necessary expertise will be in government agencies that have not traditionally had a role in the transport sector. The planned ITS Leadership Forum and working groups will therefore be important to ensure appropriate engagement.

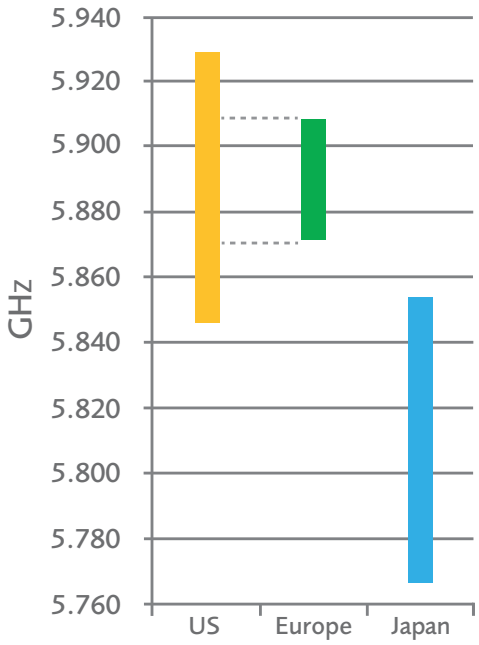
New Zealand is also working with other international organisations such as the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) who are responsible respectively for aviation and maritime related standards. The Ministry of Business Innovation and Employment's (MBIE) Radio Spectrum Management team also has a role in developing and implementing standards for communications technologies.

Radio spectrum allocation and standards

An example of a standard likely to be set in law is the communication frequency used in what is known as 'Cooperative Intelligent Transport Systems' (or C-ITS). C-ITS is a rapidly developing part of ITS built around technology that enables vehicles and infrastructure to communicate directly with each other. Although similar in concept to existing internet wireless connections, the new C-ITS technology will be much faster and more secure.

Radio spectrum will also need to be allocated to ensure sensor technologies used by advanced driver assistance systems, (and eventually by autonomous vehicles), do not cause and are not subject to interference.

Figure 3: Radio spectrum allocation



Communication between C-ITS vehicles and infrastructure will depend on access to internationally harmonised radio spectrum. Currently the US, the European Union and Japan are standards setters in this area. Unfortunately, each of these jurisdictions is proposing to use a different part of the radio spectrum and different communication protocols. Ideally, all vehicles in a fleet should operate to the same standard, so New Zealand will need to select one of these frequency ranges. Figure 3 shows the proposed spectrum allocation for C-ITS vehicles in the US, the EU, and Japan. They are in the 5.8 and 5.9 GHz range.

MBIE is responsible for providing policy advice to government on the allocation of New Zealand's radio spectrum. MBIE has not formally reserved the 5.9 GHz frequency for C-ITS use, but it is available and MBIE is monitoring demand for its use.

[2] http://www.iso.org/iso/iso_technical_committee?commid=54706

The 5.8GHz frequency range being used in Japanese vehicles can be used legally in New Zealand as this range has been allocated for public use. Because the frequency has been allocated for public use it cannot be reserved for use by the transport sector, which means it cannot be protected from sources of interference. The 5.8 GHz range is already being used for devices such as cordless phones and wireless internet modems.

C-ITS cannot sustain different standards, so we will have to choose which standards to support. Diverging standards could lead to vehicles entering New Zealand with equipment that will not work because it relies on other technology that is not present. Or, if vehicles contain technology we do not permit, it may have to be decommissioned, effectively rendering the vehicles 'unintelligent' and little better than our current vehicles. Of more concern, the technology may be subject to potentially dangerous interference from other users if left active.

Australia has proposed adopting the 5.9GHz range allocated in the EU for C-ITS. Most new vehicles offered in New Zealand are built to Australian[3] or European standards, so there is good reason for us to adopt the same C-ITS frequency range as Australia. It is recognised that choosing a C ITS frequency range at this time may potentially limit future options around the import of Japanese used vehicles. However, it is necessary to give an indication to allow planning by vehicle importers and potential roadside infrastructure providers.

Because used Japanese vehicles are generally not imported until they are seven or eight years old, there will be time to consider issues of compatibility further. There is also a reasonable expectation there will be a technical solution to the issue of divergent standards by the time any importation of Japanese C-ITS equipped vehicles is likely to become common.

Other frequencies are also expected to have to be formally allocated. For example radar technologies used by, among things, emergency braking systems are expected to require use of frequencies in the 79GHz range. The standards required for the radar to operate in an interference free manner have not been finalized in this range at an international level.

In addition to the protection of spectrum used by land transport, there is also a need to protect spectrum used by the aviation sector — for new technologies like automatic dependent surveillance-broadcast and satellite or ground based augmentation navigation systems — so other systems, (such as mobile phones), do not encroach on them.

Incompatibility between standards for ITS, especially for C-ITS, is likely to have much greater implications for New Zealand than many other countries where most vehicles are built to only one jurisdiction's standard. Ideally, if there is to be a divergence in standards for C-ITS, devices should be sufficiently smart to know where they are and adapt to local conditions. As an example of this, most cell phones now work in many countries without the owner needing to make any changes. There will be a role for the New Zealand government to work through international forums and potentially through standard setting bodies, to promote compatibility between technologies from different jurisdictions.

In addition to setting standards for C-ITS, there are many other technical standards for all aspects of ITS where government guidance or regulation may be required. The issue for those setting the standards will be to ensure maximum interoperability of technology. The standards will also need to be technically relevant to New Zealand's particular conditions. The ITS Leadership Forum and its working groups will identify other standards that may impact on the use of ITS technologies in New Zealand.

Government actions on standards	Target date
Subject to international agreement on the appropriate frequency allocation and standards, the Ministry of Business, Innovation and Employment will allocate radio spectrum for ITS applications.	When international agreement is reached
The Ministry of Transport will work with ITS New Zealand to take part in international standard development processes, such as through the ISO TC 204 national committee.	2014, then ongoing
Government agencies will strongly promote harmonisation, open standards and interoperability of technologies at an international level.	2014, then ongoing
Transport agencies will explore the use of international standards in New Zealand to ensure compatibility with the widest range of technologies.	2014, then ongoing

[3] Australian vehicle standards are usually European standards, but may have different implementation dates.

4.6 Active network management

Improvements in technology (including ITS) are helping transport system operators to maximise the efficient operation of their services. Operators are now able to monitor and control dispersed network operations from centralised control centres.

Technological developments have, for example, allowed Airways NZ and KiwiRail to control their New Zealand-wide operations from single central control centres. The NZ Transport Agency has three Transport Operations Centres which monitor and manage the land transport network on the state highways and in our three major urban areas. These centres are operated in cooperation with local agencies. The centres provide travelers with real-time, (or near real-time), information on congestion, speed limits and road works, through variable message signs and smart phone applications.

The centres are also able to use information such as forecast storm events, major sporting events, or concerts to plan for, (and reduce the impact of), the event as much as possible.

In the future, as well as providing information about delays, it will be possible to provide comparisons of time taken, and the cost involved, for each mode of transport (public, private motorised and non-motorised, ride sharing) to reach a destination. This information will allow people to use the most convenient, least cost means of travel for their journey.

As well as network information supplied by the network operator, smartphone applications are available that make use of crowd sourced data to provide network information to users. Applications have been developed to provide real-time information on the condition of transport infrastructure to network operators.

The centralisation of operations centres can, however, present risk management problems. Given the importance of the operation centres, resilience needs to be considered and planned for during their development.

It is important the loss of any one centre does not affect the operation of the transport network. To this end the Action Plan recommends that the owners of key network control centres will ensure there is adequate backup to enable continuity and reliability of services to their users.

A key decision for the future of active network management and demand management will be the type of technology used to collect network condition and usage data. Low-priced sensors connected by wireless technologies are being developed that can deliver new information to network managers. These sensors offer the potential for a wealth of real or near real-time information to be available to operators, service providers and transport users.

Equally, mobile phone positioning and crowd sourced data offer a rich source of information on network flows, congestion levels, and the provision of services. This data complements the information provided by system operators. For crowd sourced services personal data will need to be anonymised before being shared.

For airlines operating in New Zealand, the collaborative flow management tools introduced by Airways NZ are already reducing delays in the air and cutting fuel costs and emissions. The new National Air Navigation Plan will present a comprehensive modernisation pathway for the next 10 years that conforms to global standards set through the International Civil Aviation Organisation.

The central control centre operated by Airways NZ is likely to have an increasingly comprehensive picture of air traffic throughout New Zealand. The use of technology such as 'multilateration' is already being introduced in the southern South Island. Of particular note is a likely move away from the current reliance on ground-based radar and navigation systems to systems that use satellite navigation (GNSS) such as satellite based augmentation systems (SBAS) and automatic dependent surveillance - broadcast systems fitted to aircraft by fleet operators.

Government actions on network management	Target date
Owners of key network control centres will work to improve the functionality of the centres, including ensuring that there is adequate backup to enable continuity and reliability of services to their users.	2015, then ongoing

4.7 Positioning systems

Accurate real-time positioning is a key requirement of many ITS technologies in all modes of transport. In particular, safety-of-life ITS applications impose strict requirements that are not always available in mass-market grade global navigation satellite systems (GNSS) positioning. The required navigation performance parameters for potential ITS safety applications are:

- **Accuracy:** the closeness of the measurements to the true position value
- **Integrity:** the level of trust that can be placed in a navigation system
- **Continuity:** the reliability of the position data provided by a navigation system
- **Availability:** the likelihood that the proceeding three parameters meet the requirements of a given technology
- **Interoperability:** the ability of systems to operate using location data from more than one source
- **Timeliness:** the ability to deliver location data to navigation systems in real-time or at a rate that ensures the system operates in a safe manner.

Mapping and location data in New Zealand is accurate enough for navigation systems to determine a vehicle's current position on a map. However it is not accurate enough to exactly represent the geometry of the road and identify which lane the vehicle is travelling in. Therefore, in New Zealand, standalone GNSS may not be suitable for some of the emerging ITS safety and fuel efficiency applications that rely on precise location data.

The reliability and accuracy of GNSS positioning can be improved through the provision of real-time positioning services. These services provide GNSS receivers with corrections that enhance the accuracy of resulting positions.

The corrections are calculated from continuously operating reference station networks (such as the Land Information New Zealand PositioNZ network) and transmitted to users via terrestrial or satellite communications systems.

Real-time positioning services have been implemented that provide augmentation from space or terrestrially transmitted corrections. However, to be economically viable the deployment of a satellite-based augmentation system would most likely need to be done in cooperation with Australia.

These services are currently provided to assist aircraft landing on the approaches into Queenstown airport (known as Performance Based Navigation, PBN). Commercial services providing centimetre-level positioning for terrestrial users are available in some major urban centres of New Zealand.

GNSS signals are weak in relation to other radio transmissions and satellites are not always visible, thereby limiting their utility in some ITS applications. The following are particular concerns:

- without augmentation GNSS signals are not accurate enough for some ITS applications, such as landing aircraft
- restricted sky visibility near tall buildings or in areas with mountainous topography can limit the number of satellites that can be observed from a given constellation
- GNSS signals can be subject to unintentional or malicious jamming/spoofing that affects the ability to determine a reliable position — such interference may not be immediately determinable to the users of GNSS equipment.

Government actions on GNSS systems	Target date
The Ministry of Transport and LINZ, in conjunction with the CAA and Airways, will monitor international developments and study the costs and benefits of providing a national real-time positioning service that could improve Required Navigation Performance.[4, 5]	2018
LINZ will consider options for investment in a national real-time positioning service to support ITS and non-ITS applications.	Ongoing

[4] Required Navigation Performance allows aircraft to fly precisely along a predefined route using onboard navigation systems and the Global Navigation Satellite System — resulting in improved efficiency, capacity and environmental performance for the global air transportation system.

[5] Opportunities for regional cooperation with Australia will be explored.

4.8 Geospatial mapping

Many ITS systems, particularly those that use GNSS positioning, are reliant on accurate three-dimensional digital geospatial information such as topographical maps. The accuracy of the data determines what it can be used for. As noted in the previous section, systems that use geospatial information to position a vehicle for safety, (such as speed management), need to be highly accurate. Conversely, positioning a vehicle for route planning requires less precision. Accurate charts of the sea bed are needed for maritime navigation. Geospatial information has a number of other important uses outside the transport sector. It is used in emergency response, hazard management, urban planning, environmental monitoring, precision agriculture, land-use analysis and much more. The New Zealand Geospatial Strategy and associated documents seek to guide the establishment of geospatial foundations that will enable other infrastructure, like ITS, to more easily and consistently achieve desired national outcomes.

Commercial shipping relies on accurate navigational charts. Accurate, modern charts allow for the planning of the most direct routes between ports, reducing fuel consumption and the carbon footprint, reducing the number of pilots required, and enabling economic benefits by allowing the use of deeper draught vessels to carry a greater volume of cargo. These factors in turn reduce the costs of commercial shipping operators, and encourage more commercial operators to enter the market.

Most marine accidents are the result of human error. The introduction of a mandatory Electronic Chart Display and Information System (ECDIS) by the International Maritime Organization in certain classes of vessels, (particularly passenger vessels, tankers and other larger ships) is designed to significantly reduce the margin for human error, thus reducing the likelihood of accidents.

Electronic navigational charts, when used with ECDIS, integrate with other navigational systems and give mariners access to a wide range of safety data. ECDIS enables mariners to digitally layer charting information with other information to aid safe navigation, such as from GNSS, radar, depth sounders and Automatic Identification Systems (AIS). It may also display additional navigation-related information, such as sailing directions.

Maritime New Zealand intends to review Rule Part 25 and Part 45 with a view to bringing New Zealand law into line with the international standards for ECDIS, as found in the Safety of Life at Sea (SOLAS) Convention.

Currently geospatial data is managed and maintained by many different government agencies and commercial providers. Land Information NZ is working with other agencies to increase the productive use of location-based information. Improved coordination and access to this geospatial information will lead to efficiency gains across government and growth in the economy.

ITS systems (including those used by heavy vehicles) are available that rely on maps that are very accurate in three dimensions. It is now possible for the automatic transmission unit in some vehicles to calculate when to shift gear using sensor data and topographical route information. These units shift to the most economical gear for the terrain before an operator would. This reduces fuel use and vehicle wear. Research in the US indicates that such systems, if used in the light vehicle fleet, could reduce fuel consumption by 5 to 15 percent.

Currently the road network datasets held by government and commercial service providers, capture different levels of information with various degrees of accuracy. For example, some have details of legal roads, whereas others include information such as legal speed limits, or the centre-line of the road. As far as possible, government datasets should be consistent and be kept updated as new roads and other features are built or amended or as natural conditions change. This is a considerable expense and currently involves duplicating effort.

The government will focus its actions over the next two years on developing a business case for a coordinated approach to collecting, purchasing and maintaining road network data, which will lead to savings and efficiencies. This will need to consider what information is required, to what level of accuracy, who is best placed to provide this information, on what basis this information should be made available to other parties, and how the maps will be kept updated. The government has committed $300,000 seed funding to develop this business case.

Government action on geospatial mapping	Target date
The NZ Transport Agency and Land Information New Zealand, in consultation with road controlling authorities, will develop a business case for a coordinated, authoritative national land transport network dataset. This could include a centrally managed road speed limit map for New Zealand.	2015
Land Information New Zealand, the Ministry of Transport, and Maritime New Zealand will develop amendments to Maritime Rule Part 25 and Part 45 to give effect to the International Maritime Organisation requirements for the installation of the Electronic Chart Display and Information System.	2015

4.9 Charging and payment systems

ITS technologies can provide more efficient, convenient and cost-effective methods of charging and paying for transport services than paper-based systems. This is consistent with the wider consumer trend towards electronic payments.

The NZ Transport Agency has introduced electronic tolling as part of the Northern Gateway Toll Road, and has also worked closely with Auckland Transport in establishing the Auckland Integrated Fares and Ticketing Scheme, which allows payment for public transport based on smartcards. In New Zealand road user charges licences are able to be purchased using an electronic system (eRUC). In aviation, electronic ticketing has been the norm for some years.

Although New Zealand has been relatively progressive in using electronic charging in transport, there are likely to be exciting new opportunities in the future. Charging systems that are being developed and implemented internationally are becoming more sophisticated, reliable and cost-effective.

The government made a commitment in the National Infrastructure Plan 2011 to increase understanding of, and encourage debate on, the use of demand management and pricing in infrastructure sectors such as transport (for example, paying less to use roads off peak). A key part of doing so will be to consider the capability, reliability, and costs and benefits of technology that might be used and to look for examples of it being used internationally.

The government also intends to explore the merits of an experimental, voluntary scheme that would allow differential RUC charges to be applied on certain key routes in congested areas. In concept, heavy goods vehicle operators that use the eRUC system could be offered the opportunity to pay lower road user charges, or receive a rebate, for using such routes during off-peak periods, but conversely could pay additional charges at peak times. Such a scheme would have legal and funding implications that need to be explored and may only be appropriate for very specific parts of the network where congestion is a major concern.

Government actions on charging and payment systems	Target date
The Ministry of Transport, working with the NZ Transport Agency, will investigate the merits of a trial of electronic road user charging in heavy vehicles that applies differential charges on defined routes through congested areas.	2016
The Ministry of Transport, in conjunction with the NZ Transport Agency, will coordinate research on how technology is being used internationally to support charging systems for road use, and project the likely development of these technologies in the future. The research will include an evaluation of the reliability, security, costs and benefits of such systems.	2016
The NZ Transport Agency will work with Greater Wellington Regional Council and other regions on the introduction of a national smart card-based integrated fares and ticketing scheme.	2016

4.10 Enabling compliance and targeted enforcement

Most people are willing to comply with transport regulations, and know how to, while others need some intervention to ensure compliance.

ITS has the potential to provide transport users with simpler, more cost-effective options for ensuring they are compliant with transport regulations. Examples include:

- electronic logbooks that provide an alternative to paper-based systems and a simpler, more efficient means for commercial drivers to log work details. This assists the operator in complying with record keeping requirements, and also provides a useful tool to help manage staff work and rest hours.
- intelligent speed assistance or adaptation (ISA) that can help drivers comply with speed laws. This can be done through an advisory system, where the driver is warned they are approaching or exceeding the speed limit, or through a system which actually intervenes to over-ride the driver's inputs and automatically reduce the vehicle's speed to the posted limit.
- extending the use of technologies that provide simple and fast methods to pay for use of public transport and toll roads
- simplifying applications for and approval of overweight vehicle permits, thereby reducing the time and cost burden faced by transport operators
- improving the efficiency of the RUC refund processes, and the electronic display of vehicle compliance documentation

ITS also has a role to play through assisting enforcement agencies to better target enforcement actions, particularly at users who are actively avoiding their regulatory obligations. For example, automated high-speed weigh-in-motion can assist Police in targeting heavy vehicles known to be over their maximum legal weight, and can help avoid the need to randomly stop all heavy vehicles.

Internationally, use of ITS technology for enforcement purposes has led to some concerns about privacy and sharing of information. These concerns must be adequately addressed to ensure we do not miss out on beneficial technologies. Section 4.4 outlines some of the issues and legislative principles relating to the use of personal data.

Government actions on compliance and enforcement systems	Target date
The NZ Transport Agency, in conjunction with the Ministry of Transport and Police, will investigate technology to simplify applications for, and approval of, overweight vehicle permits, improve the efficiency of the RUC refund processes, and the electronic display of vehicle compliance documentation.	2015
The NZ Transport Agency and the Ministry of Transport will consider the opportunities and barriers to faster adoption of Intelligent Speed Assistance technology and simplified payment technologies.	2015
As set out in the Safer Journeys Action Plan 2013-15, a multi-agency task force will pursue options for expanding the use of, and optimising investment in, automated weight and speed enforcement technologies.	2015
NZ Transport Agency and the Ministry of Transport, in conjunction with KiwiRail, will monitor overseas technology trials to improve railway crossing safety.	Ongoing

4.11 Passenger and cargo facilitation and security

For many aspects of supply-chain management the role of government in the introduction of ITS is limited, and the industry will develop its own solutions. However a key aspect of ensuring the efficiency and effectiveness of international transport is the border processing of goods and passengers by government agencies at air and sea ports. ITS technology has a useful role to play in this area and a number of initiatives are underway.

After successful trials, the New Zealand Customs Service and Biosecurity New Zealand have introduced the first stage of a Joint Border Management System, replacing the need for duplicated requests for information from shippers, thereby facilitating legitimate trade and travel.

Smart Gate Plus

Starting in December 2009, the New Zealand Customs Service introduced SmartGate, a biometric self- processing system at major New Zealand airports. At special kiosks, SmartGate reads a microchip embedded in passports and uses stored biometric data and photo- matching technology to validate passports and travelers to provide accurate and fast automated clearance. It has reduced the time New Zealand and Australian passport holders take to proceed through processing. It is planned to extend the system to a wider range of nationalities, and a second generation, called 'SmartGate Plus', which eliminates the need for a separate kiosk, is being trialled at Auckland Airport.

Staff are being freed up to work on a more risk-focussed, intelligence-driven basis. The goal is to process three million passengers annually through SmartGate by mid 2015.

The Ministry for Primary Industries is trialling the trans-Tasman transfer of X-ray images of passenger baggage taken in Australia for aviation security purposes to enable biosecurity checks to be made prior to a flight arriving in New Zealand.

The Aviation Security Service continues to monitor new technology developments with a view to upgrading its baggage and passenger screening technology.

Government actions on border facilitation and security	Target date
Customs will introduce the next generation of SmartGate technology.	Ongoing
Border agencies will investigate streamlining the collection of passenger departure information.	2014, then ongoing
The Ministry for Primary Industries will complete the trial of the trans-Tasman transfer of aviation security X-ray images of passenger baggage for biosecurity purposes.	2014

4.12 Developing technology skills and exports

To maximise the potential of ITS, New Zealand needs a workforce that understands how it is applied, and is able to install, maintain and operate the new technology. Education, training and licensing systems need to continually adapt to take into account technological developments.

The New Zealand Qualifications Authority, industry training organisations such as Motor Industry Training Organisation and ServicesIQ, and engineering schools have important roles to play in achieving this. For example, Masters-level programmes in transport studies are offered at the Engineering Schools of Auckland and Canterbury Universities (developed with the assistance of the NZ Transport Agency), as well as at Lincoln University. Continuous professional development through organisations such as the Institution of Professional Engineers New Zealand Transportation Group will also be important.

The supply of skilled workforce will also need to be monitored. In some areas, such as aviation (avionics) and maritime engineering, an aging workforce poses particular challenges. Airways, Air New Zealand and the Royal NZ Air Force are responding to these challenges through their training activities.

Simulators will play an increasing role in training operators to use new technology. Simulators are already in use, not only for flight training but also air and maritime traffic control and ship operations. These simulators are required to meet standards and will need to be kept up to date with changes as systems become increasingly automated.

While in many cases New Zealand will be an ITS technology taker from the rest of the world, there are market niches where New Zealand firms are developing products and services. For example, New Zealand-based firms are active in developing an air traffic control simulator, an air traffic control charging system, weather presentation for television stations, satellite navigation systems, and the satellite tracking of aircraft.

Government agencies such as Callaghan Innovation, which has an interest in sensor technology and unmanned aerial vehicles, and New Zealand Trade and Enterprise, which has identified aviation as a priority industry sector, are available to assist firms working in ITS to develop their products and export them.

Government actions on developing technology skills and exports	Target date
Government agencies will audit ITS skill requirements and availability, and will report to the proposed ITS Leadership Forum by 2015 with recommendations for supporting the development of these systems in New Zealand, and ways to identify shortcomings.	2015
Government agencies will assist developing the export potential of ITS products and services, and promoting them internationally.	Ongoing

4.13 Research and evaluation

As the largest investor in infrastructure in New Zealand, the government has a role to play in monitoring international developments in ITS technologies and their applicability to the New Zealand transport system. There has been significant support from stakeholders for the government to undertake this role.

Some developments that show promise overseas may have less potential here. For example, trials have demonstrated the technical feasibility of platoons of trucks using ITS to follow within metres of each other to conserve fuel. Such a strategy may be suitable for motorways with a dedicated freight lane, but a line of tightly spaced truck-and-trailer units on New Zealand's narrow two-lane State highways could delay or obstruct other vehicles.

Our geography also means that we lack practical alternative routes for parts of our State highway network. There may be less ability to benefit from congestion information than in other nations.

The government can also facilitate 'proof of concept' demonstration trials of ITS technologies to ensure that the technologies can operate in New Zealand conditions, and publicise them to potential users.

Other technologies that may be of benefit include:

- Real-time travel alerts provided to in-vehicle navigation systems
- Weigh-in-motion sensors and built in weighing systems for heavy vehicles
- Advanced navigation systems in the marine and aviation sectors
- Automated emergency calling systems for vehicles such as eCall

Where there is a clear benefit to New Zealand, the government may also facilitate or fund research and development of ITS technologies with universities, other research centres, or industry groups.

Government actions research and evaluation	Target date
The proposed ITS Leadership Forum will monitor international ITS technology developments and seek regular updates from the sector.	2014, then ongoing
Government agencies will determine priorities for testing ITS technologies that are likely to solve New Zealand transport problems.	Ongoing
The Ministry of Transport and the NZ Transport Agency will use the Transport Research Hub to coordinate and leverage research activity around ITS technology and technology systems.	2014, then ongoing

4.14 Promoting New Zealand internationally as a test-bed for new technologies

As well as carrying out research and evaluation testing of ITS technologies itself, the government intends to build on our reputation as a good place for international companies to undertake large-scale or long-term testing of technology. This is based on some distinctive aspects of New Zealand such as our appetite for new technology, our relatively small but well-educated population, our flexible regulatory environment, and our diverse landscape and climate.

For example, in the 1980s banks trialled and then rolled out EFTPOS payments systems in New Zealand. More recently, New Zealand has been used by some vehicle manufacturers to test new vehicle models and technologies. There is a winter testing facility in the South Island that is used during the northern hemisphere summer.

With a view to facilitating the testing of ITS technology in New Zealand, the government is reviewing transport legislation to determine what, if any, changes would need to be made to allow this to be done safely.

There are currently no specific laws to enable the testing of vehicles equipped with experimental ITS technologies. In most cases there are unlikely to be any laws that would prevent it. However, the NZ Transport Agency has sufficient general powers to place conditions on the testing of such vehicles to ensure public safety if necessary.

It is, for example, currently legal in New Zealand for testing of driverless vehicles to take place on public roads, provided the vehicle meets relevant standards and a competent person is in the vehicle who can take control if required. Testing of this kind poses no specific legal issues and could potentially commence immediately without further government intervention. Nevertheless, there will be benefits in reviewing and clarifying the regulations around the testing of such vehicles where no drivers are present. It is proposed to develop a specific Rule to manage testing. Such a Rule would be intended to bring the existing controls, including those that currently rely on more general powers, into one document. It would make the control explicit and clarify the current legal situation around testing.

Internationally there is a great deal of thought being given to what laws will be necessary for the general operation of driverless vehicles. Their widespread operation will pose complex legal challenges, especially to determine liability in the event of any accident. It is not proposed that the New Zealand government will explicitly look at these legal issues at this time. Rather, the government will continue to monitor international developments and draw on this knowledge once international thinking has developed further and it is clearer if or when these vehicles will be commercially available.

Technologies being tested in New Zealand that use wireless communication systems must comply with radio licencing rules under the Radiocommunications Act 1989. MBIE is open to granting test licences where possible. There is usually a low cost for test liscenees compared to many overseas jurisdictions.

Government actions to promote New Zealand internationally as a test-bed for new technologies	Target date
The Ministry of Transport, in conjunction with the NZ Transport Agency, will review transport legislation to clarify the legality of testing driverless cars in New Zealand. This will specifically consider the issues of liability associated with testing, but will not consider liability for general use.	2015
The government will use all available channels, including our relationships with vehicle manufacturers and technology developers, and our presence at ITS World Congresses, APEC and other international forums, to promote New Zealand as a receptive test-bed for new technologies.	2014, then ongoing
The government will review legislation to determine what, if any, changes would need to be made to allow the safe testing of other new ITS technologies in New Zealand.	2014, then ongoing

4.15 User interfaces and the challenge of new technologies

As vehicle functions are automated and new functions become available, skills that were once essential may be rarely needed, while new skills become necessary. There can be problems during transitional phases, where there is a mix of old and new technology.

Technologies can also develop faster than public attitudes and regulation can keep pace. Furthermore, some technology may be introduced before it is fully mature. If it does not always function as intended, or in every situation, humans will still need to be able to intervene. This is an issue for the aviation sector, where pilots need to develop new monitoring skills for automated functions, while at the same time maintaining proficiency in core flying skills.

The mix of old and new technologies also raises practical issues. For example, the current driver licence test requires people to carry out a parallel park. Should an applicant be able to use an automated parking function on the vehicle as part of the test? This raises similar issues as those that arose previously with manual and automatic transmissions.

The new driver aids that are appearing on cars, such as lane departure avoidance and brake assist, do raise the possibility that drivers who depend on them could get into trouble if they use vehicles that do not have them.

It is unclear how much of a risk this is, but the fast growing field of research into what is known as the 'human-machine interface' (HMI) could reveal ways to reduce it. One approach, which is used for electronic stability control (ESC) on cars, is for the electronic assistance to be slightly less effective than is actually possible, to ensure the driver is aware that they are exceeding the limits of the vehicle.

Development of the human-machine interface will create opportunities to better match the means of accessing technology to the needs of individual users. For example, in-vehicle displays may soon be completely configurable, to display information in the way the operator prefers. Increased flexibility will especially benefit the elderly or disabled, who might be excluded by one-size-fits-all interfaces.

Another concern with in-vehicle ITS is that extra information will be distracting for vehicle operators and create a safety risk. This may be a particular problem with systems that have not been developed as part of a package with the vehicle, such as aftermarket equipment or smart phone applications, which typically have small displays. However, given the age of our vehicle fleet, aftermarket equipment is almost certainly going to be necessary to provide technological benefits to existing vehicles. It will not always be possible to anticipate problems, and New Zealand will not have to resolve them on its own. Rather, we can expect to follow the lead of other countries, who will be addressing the same issues. It is likely though, that much of our existing knowledge around distraction, such as ensuring drivers do not take their eyes off the road for more than one or two seconds, will be relevant to new, as well as existing technologies.

Our current rules around driver distraction are set out in the Land Transport Rules. We propose to review those rules that address distraction, which refer to specific technologies, such as cellphones, televisions and reversing cameras, to see if they are fit to address the risks of distractions associated with the much wider range of technological devices available today, and which are likely to become available in the foreseeable future.

Government actions on user interfaces	Target date
Review international research on the implications of new ITS systems in relation to driver distraction and skills requirements.	2014
Review current New Zealand legislation relating to driver distraction from in-vehicle technologies.	2015

5 GOVERNMENT ACTIONS

Strategically important actions are highlighted in blue

	Government actions to develop its sector leadership role	Target date
1	The Ministry of Transport will establish an ITS Leadership Forum with government, ITS stakeholders, and multi-modal end user representatives. The Forum will take a long-term view and develop a strategic vision for the use of specific ITS policies in New Zealand.	2014, then ongoing
2	The Ministry of Transport will establish a whole-of-government ITS technology working group to co-ordinate actions across central government.	2014, then ongoing
3	The Civil Aviation Authority will work with Airways NZ and other stakeholders to finalise and implement the National Airspace and Air Navigation Plan, which outlines ITS priorities in airspace and air navigation, including for system investment and airspace management.	2014, then ongoing
4	The NZ Transport Agency will publish an ITS framework to inform the sector on its approach to developing ITS systems for land transport, including network operations, maximising the return from transport assets, and shaping smart transport choices.	2014

	Government actions on investment in ITS technology	Target date
5	The Ministry of Transport will provide policy about the role of ITS technologies in contributing to transport objectives in the next Government Policy Statement on Land Transport.	2014
6	The NZ Transport Agency, as the major investor in land-based ITS, will publish planning and investment signals that will inform suppliers about its future approach to delivery of ITS infrastructure and services.	2014

	Government actions on regulatory change	Target date
7	The Ministry of Transport, in conjunction with transport agencies, will scan all transport legislation to identify unnecessary barriers to the continued deployment of ITS technologies in New Zealand. The review will also consider the need to review legislation in light of the increasing introduction of advanced driver assistance systems (ADAS) and semiautonomous vehicles.	2015
8	As set out in the Safer Journeys Action Plan 2013-15, the Ministry of Transport and the NZ Transport Agency will develop a (road) vehicle standards map, and a land transport rule to mandate electronic stability control.	2014
9	The Ministry of Transport and the Civil Aviation Authority will develop aviation rules to enable changes related to ITS that are required to implement the National Airspace and Air Navigation Plan.	2015, then ongoing
10	The Ministry of Transport and the Civil Aviation Authority will develop aviation rules on remotely controlled aerial vehicles.	2014, then ongoing

	Government actions on data collection, sharing, security and privacy	Target date
11	The ITS Leadership Forum will establish a working group to look at what transport related information the government and other agencies are collecting, how to share it, what information should be publicly available and how to protect privacy.	2015
12	The NZ Transport Agency and Maritime NZ will set up a joint Security Centre of Expertise.	2014
13	The transport agencies will form a 'cluster' to pilot the government's ICT strategy by sharing capability and resources in information management, assurance and investment planning.	2014

	Government actions on standards	Target date
14	Subject to international agreement on the appropriate frequency allocation and standards, the Ministry of Business, Innovation and Employment will allocate radio spectrum for ITS applications.	When international agreement is reached
15	The Ministry of Transport will work with ITS New Zealand to take part in international standard development processes, such as through the ISO TC 204 committee.	2014, then ongoing
16	Government agencies will strongly promote harmonisation, open standards and interoperability of technologies at an international level.	2014, then ongoing
17	Transport agencies will explore the use of international standards in New Zealand to ensure compatibility with the widest range of technologies.	2014, then ongoing

	Government actions on network management	Target date
18	Owners of key network control centres will work to improve the functionality of the centres including ensuring that there is adequate backup to enable continuity and reliability of services to their users.	2015, then ongoing

	Government actions on GNSS systems	Target date
19	The Ministry of Transport and LINZ, in conjunction with the CAA and Airways, will monitor international developments and study the costs and benefits of providing a national real-time positioning service that could improve Required Navigation Performance.[6][7]	2018
20	LINZ will consider options for investment in a national real-time positioning service to support ITS and non-ITS applications.	Ongoing

	Government actions on geospatial mapping	Target date
21	The NZ Transport Agency and Land Information New Zealand, in consultation with road controlling authorities, will develop a business case for a coordinated, authoritative national land transport network dataset. This will include a centrally managed road speed limit map for New Zealand.	2015
22	Land Information New Zealand, the Ministry of Transport, and MNZ will develop amendments to Maritime Rules Part 25 to meet the International Maritime Organisation deadlines for the installation of the Electronic Chart Display and Information Systems.	2015

	Government actions on charging and payment systems	Target date
23	The Ministry of Transport, working with the NZ Transport Agency, will investigate the merits of a possible trial of electronic road user charging in heavy vehicles that applies differential charges on defined routes through congested areas.	2016
24	The Ministry of Transport, in conjunction with the NZ Transport Agency, will coordinate research on how technology is being used internationally to support charging systems for road use, and project the likely development of these technologies in the future. The research will include an evaluation of the reliability, security, costs and benefits of such systems.	2016
25	The NZ Transport Agency will work with Greater Wellington Regional Council and other regions on the introduction of a national smart card-based integrated fares and ticketing scheme.	2016

[6] Required Navigation Performance allows aircraft to fly precisely along a predefined route using onboard navigation systems and the Global Navigation Satellite System — resulting in improved efficiency, capacity and environmental performance for the global air transportation system.

[7] Opportunities for regional cooperation with Australia will be explored.

	Government actions on compliance and enforcement systems	Target date
26	As set out in the Safer Journeys Action Plan 2013-15, a multi-agency task force will pursue options for expanding the use of, and optimising investment in, automated weight and speed enforcement technologies	Ongoing
27	The NZ Transport Agency, in conjunction with the Ministry of Transport and Police, will investigate technology to simplify applications for, and approval of, overweight vehicle permits, improve the efficiency of the RUC refund processes, and the electronic display of vehicle compliance documentation.	2015
28	The NZ Transport Agency and the Ministry of Transport will consider the opportunities and barriers to faster adoption of Intelligent Speed Assistance technology and simplified payment technologies.	2015
29	NZ Transport Agency and the Ministry of Transport, in conjunction with KiwiRail, monitor overseas technology trials to improve railway crossing safety	2015

	Government actions on border facilitation and security	Target date
30	Customs will introduce the next generation of SmartGate technology.	Ongoing
31	Border agencies will investigate streamlining the collection of passenger departure information.	2014, then ongoing
32	The Ministry for Primary Industries will complete the trial of the trans-Tasman transfer of aviation security X-ray images of passenger baggage for biosecurity purposes.	2014

	Government actions on developing technology skills and exports	Target date
33	Government agencies will audit ITS skill requirements and availability, and will report to the proposed ITS Leadership Forum by 2015 with recommendations for supporting the development of these systems in New Zealand and ways to identify shortcomings.	2015
34	Government agencies will assist developing the export potential of ITS products and services, and promoting them internationally.	Ongoing

	Government actions on research and evaluation	Target date
35	The proposed ITS Leadership Forum will monitor international ITS technology developments and seek regular updates from the sector.	2014, then ongoing
36	Government agencies will determine priorities for testing ITS technologies that are likely to solve New Zealand transport problems.	Ongoing
37	The Ministry of Transport and the NZ Transport Agency will use the Transport Research Hub to coordinate and leverage research activity around ITS technology and technology systems	2014, then ongoing

	Government actions to promote New Zealand internationally as a test-bed for new technologies	Target date
38	The Ministry of Transport, in conjunction with the NZ Transport Agency, will review transport legislation to clarify the legality of testing driverless cars in New Zealand. This will specifically consider the issues of liability associated with testing, but will not consider liability for general use.	2015
39	The government will use all available channels, including our relationships with vehicle manufacturers and technology developers, and our presence at ITS World Congresses, the Asia Pacific Economic Cooperation and other international forums, to promote New Zealand as a receptive test-bed for new technologies.	2014, then ongoing
40	The government will review legislation to determine what, if any, changes would need to be made to allow the safe testing of other new ITS technologies in New Zealand.	2014, then ongoing

	Government actions on user interfaces	Target date
41	Review international research on the implications of new ITS systems in relation to operator distraction and skills requirements.	2014
42	Review current New Zealand legislation relating to driver distraction from in-vehicle technologies.	2015

6 EXAMPLES OF ITS SYSTEMS AND TECHNOLOGIES

Active network management

Information about traffic conditions can be used to improve the management of transport networks and optimise the movement of vehicles. Active network management systems detect traffic conditions and allow network managers to respond by adjusting controls such as traffic signals, and to advise the travelling public, police and others about incidents on the network quickly and accurately.

The most developed network management systems are in aviation, where they are used to control aircraft movements in controlled airspace. In maritime transport, the automatic identification system (AIS) is used to assist ship navigation.

Management of airspace and shipping networks
Air traffic control systems are already highly reliant on technology and are moving towards increased use of satellite-based technology.

The NZ Transport Agency operates three Traffic Operations Centres – in Auckland (in partnership with Auckland Transport), Wellington and Christchurch. These monitor traffic conditions and allow operators to intervene, for example by adjusting traffic signals and other devices in order to maximize the efficiency of the roading network.

Active road network management
The Auckland Joint Transport Operations Centre allows operators to adjust traffic light signals, variable speed and message signs and ramp metering in response to real-time traffic conditions monitored through cameras and other sensors.

All transport modes use weather forecasts provided by the MetService, developed with the assistance of its extensive network of sensors, including automatic weather stations, satellites, ocean buoys and its soon-to-be completed rain radar network, as well as reports from aircraft and ships.

In the future

We envisage the continued development and integration of network management systems across all modes of transport. We are also likely to see increased levels of monitoring of network conditions using cheap new sensors and data from smart phones.

Information provided to the traveller

ITS technologies can provide real-time or near real-time information, collected by sensors, to transport users and operators. This information can include traffic conditions, weather conditions, the expected arrival times for public transport services or whether the services cater for wheelchair users. Information can be provided in a number of forms including roadside displays, on websites, though dedicated radio messages, and direct to smart phones by text or other applications. This can assist travellers in making smart transport choices — when and how to travel, route etc — which in turn can increase network efficiency and help to reduce crashes.

Real time information to travelers
Variable message signs and traffic cameras provide important information on road conditions to drivers. In public transport, real time passenger information can make using public transport systems more convenient.

In the future

We are likely to see smart phones and other portable devices increasingly used both to provide information to users and integrated into the vehicle control systems. One example is the provision via 'apps' of information about how efficiently a vehicle is being driven. However, the older vehicles in New Zealand's vehicle fleet generally lack the software and access ports commonly found in other countries, potentially limiting the uptake of some technologies.

Smart phone and other mobile devices in transport
Smart phone apps are available that use satellite positioning and 3D maps to work out how efficiently a motorist is driving, and provide advice on improving efficiency.

Systems have even been developed for light aircraft where a tablet computer is inserted into the aircraft and becomes part of the instrument panel.

We may also see information increasingly being used by the vehicle itself to automate the decision making process — for example speed limits automatically communicated to the vehicle, which then adapts its maximum speed accordingly.

Advanced Driver Assistance Systems

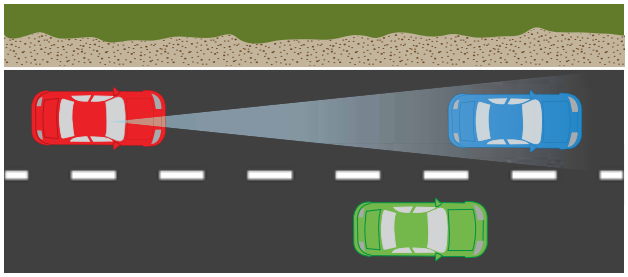
ITS technologies are already widely used in modern vehicles. Advanced Driver Assistance Systems such as Electronic Stability Control and lane departure warning systems are already having a positive effect on road safety.

Lane departure warning system
Lane departure warning systems use cameras to detect and warn the driver if they stray across road lane markings.

Collision avoidance systems use radar and lasers to detect if a collision is likely to happen. A typical system will first alert the driver, pre-tension seat belts and can apply the brakes automatically if it determines that a collision is otherwise unavoidable. As the vehicle fleet refreshes over time, we are likely to see these features becoming more widespread.

Adaptive cruise control systems, which control the speed of a vehicle and allow it to automatically keep a safe distance from the vehicle in front, are becoming common in new mid range vehicles.

Figure 4: Adaptive cruise control systems



The red car is using radar, laser, or other sensors to detect the front vehicle, adaptive cruise control then maintains a safe following distance from the blue car. Should the green car pull into the lane the red car will drop back to maintain the following distance.

In the future

We are likely to see the introduction of even more sophisticated systems such as cooperative adaptive cruise control. Under these systems, a vehicle will be able to communicate electronically with following vehicles and will inform them almost instantaneously if it brakes suddenly.

Collectively such systems will bring major safety benefits, as they may make the vehicles of the future very hard to crash. They could also bring efficiency and fuel-saving benefits, as they smooth traffic flows and potentially allow vehicles to travel in tight platoons or 'road trains', with reduced separation distances. Such platoons could allow more efficient use of road capacity and reduce fuel use due to the 'drafting' effect (in a similar way to road cyclists in a peloton). Prototypes of these technologies are already being trialled globally, although it is not clear how many of New Zealand's roads would be suitable for long trains.

Fully autonomous vehicles

Many vehicle manufacturers around the world are currently developing semi-autonomous and autonomous vehicles. These use ITS technologies to sense their surroundings and either assist the driver in responding to conditions and incidents, or control the vehicle automatically. In the most advanced cases, vehicles are being developed that do not need a driver at all. In the aviation and maritime areas, fully autonomous vehicles are already being used.

Remotely controlled or unmanned aerial vehicles (UAVs) used for military purposes have received a lot of attention. However their use for civilian purposes, such as surveying, emergency management and agriculture, is growing rapidly, and New Zealand has some world-leading companies producing UAVs. In the maritime area, unmanned vessels such as surveying submarines are also in operation. Overseas the storage and retrieval of containers in some large cargo terminals is now completely automated.

Unmanned aerial and maritime vehicles
Unmanned aerial vehicles are increasingly being used for civilian purposes such as surveying and in agriculture.

The SeaExplorer glider is an example of an autonomous submersible vehicle.

In the future

In the future, it is the use of fully autonomous or driverless vehicles that may have the greatest potential, in the long term, to revolutionise the concept of transport. Such vehicles could have profound implications for road safety and provide new opportunities for people to travel who currently are not able to (for example because of age or disability). Demographic changes in the future, with an increasing number of elderly people, will make this particularly important. They could also further increase the efficiency of the road network and reduce emissions by being programmed to drive in a highly efficient way.

Charging and payment technologies

ITS technologies provide efficient and convenient paperless systems of charging and paying for transport services.

In Auckland, the NZ Transport Agency and Auckland Transport have introduced an integrated fares and ticketing system that allows passengers to pay for public transport services using the HOP smart card. This is more convenient than using cash and saves time when a passenger gets onto a vehicle. In New Zealand and internationally, smart card ticketing systems have also been developed that also allow cardholders to pay for other transport-related services such as car parking, taxis and non-transport related goods.

Electronic tolling (E-tolling) involving automatic number plate recognition is already in use on the Northern Gateway Toll Road. E-tolling saves time and congestion because vehicles do not have to stop at toll booths. Overseas, other technologies such as radio frequency tags are increasingly being used for toll charges and the tracking of freight as it passes along the supply chain. These tags function like access cards and are detected by sensors as the vehicle passes the charge or monitoring point.

Northern Gateway Toll Road e-tolling
Tolls can be paid electronically on the Northern Gateway Toll Road by opening an account and being charged automatically based on automatic number plate recognition technology. The amount paid is less than using paper based payments, due to the reduced administration charge.

In New Zealand we have enabled heavy vehicles to pay road user charges using an electronic (eRUC) system. Road user charges are calculated using electronic distance recorders instead of mechanical hubodometers and licences are displayed electronically replacing paper labels. E-RUC provides efficiencies for road users through avoiding the need to manually calculate off-road travel and reduces time spent purchasing RUC.

In the future

We are likely to see the development internationally of more sophisticated, accurate and efficient electronic charging and payment systems, including those that calculate charges for using infrastructure based on the distance travelled and the location and time of travel. We are also likely to see smart phones integrated into payment systems to a much greater extent.

ITS and future network planning

Transport planners currently use a variety of sources to measure the volume and type of traffic using the network. This includes technology such as electromagnetic sensors in the road, through to manual traffic counts and floating car surveys. Increasingly, newer ITS technologies such as Bluetooth sensors that pick up signals from passing vehicles are being used. Information collected in this way is used in regional traffic models to predict future demand, and is an important input into decisions on the need for future infrastructure and services.

Regional models also represent a key input into land use planning – so that the design and expansion of cities can be integrated with the transport infrastructure necessary for them to function efficiently.

The Auckland Plan
The Auckland Plan was developed with input from the Auckland Regional Transport Model.

On public transport networks, smart card systems are now providing highly accurate information on demand on different routes and at different times of the day, which assists greatly in designing the network and planning future services.

Information provided by ITS systems is used to evaluate the performance of infrastructure, to ensure that target levels of service are achieved by the network operator. It is also used to monitor the post-construction performance of new infrastructure projects, to evaluate whether the impact of new infrastructure is consistent with that predicted in the planning phase.

Finally, ITS systems are starting to be used to automatically monitor specific assets such as bridges in real time, informing the asset manager when maintenance may be required. This can streamline asset management operations, reducing the need for inspections and ensuring essential maintenance is done at the right time.

In the future

We are likely to see cheap sensors and information from mobile phones providing much more information than has been available in the past. Although managing this data presents its own challenges, the benefits in ensuring that future networks are planned effectively and efficiently are likely to be very significant.