AP-R413-12

AUSTROADS RESEARCH REPORT

Cooperative ITS Strategic Plan

Austroads

Cooperative ITS Strategic Plan

Cooperative ITS Strategic Plan

Published August 2012

© Austroads Ltd 2012

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*,
no part may be reproduced by any process without the prior written permission of Austroads.

Cooperative ITS Strategic Plan

ISBN 978-1-921991-40-0

Austroads Project No. NT1632

Austroads Publication No. AP–R413-12

Project Manager

Geoffrey McDonald
Department of Transport and Main Roads Queensland

Prepared by

David Green, John Gaffney and Paul Bennett
ARRB Group

Published by Austroads Ltd
Level 9, Robell House
287 Elizabeth Street
Sydney NSW 2000 Australia
Phone: +61 2 9264 7088
Fax: +61 2 9264 1657
Email: austroads@austroads.com.au
www.austroads.com.au

Austroads believes this publication to be correct at the time of printing and does not accept responsibility for any consequences arising from the use of information herein. Readers should rely on their own skill and judgement to apply information to particular issues.

Cooperative ITS Strategic Plan

Austroads

Sydney 2012

About Austroads

Austroads' purpose is to:

- promote improved Australian and New Zealand transport outcomes
- provide expert technical input to national policy development on road and road transport issues
- promote improved practice and capability by road agencies.
- promote consistency in road and road agency operations.

Austroads membership comprises the six state and two territory road transport and traffic authorities, the Commonwealth Department of Infrastructure and Transport, the Australian Local Government Association, and NZ Transport Agency. Austroads is governed by a Board consisting of the chief executive officer (or an alternative senior executive officer) of each of its eleven member organisations:

- Roads and Maritime Services New South Wales
- Roads Corporation Victoria
- Department of Transport and Main Roads Queensland
- Main Roads Western Australia
- Department of Planning, Transport and Infrastructure South Australia
- Department of Infrastructure, Energy and Resources Tasmania
- Department of Lands and Planning Northern Territory
- Department of Territory and Municipal Services Australian Capital Territory
- Commonwealth Department of Infrastructure and Transport
- Australian Local Government Association
- New Zealand Transport Agency.

The success of Austroads is derived from the collaboration of member organisations and others in the road industry. It aims to be the Australasian leader in providing high quality information, advice and fostering research in the road transport sector.

CONTENTS

TABLES

FIGURES

SUMMARY

Cooperative Intelligent Transport Systems (C-ITS) is an emerging platform that can be applied to motor vehicles and roadside infrastructure to enable direct two-way communication between them, as demonstrated in Figure 2.1 on page 3 of this document. C-ITS also has the potential to interface to portable personal devices (used by vulnerable road users, such as pedestrians and bicycle riders).

Because C-ITS enables connectivity between road users through wireless communication, it can provide real-time information about the road environment (such as potential incidents, threats and hazards) with an increased time horizon and awareness distance that is beyond both what in-vehicle technologies (such as radars and cameras) and the driver can visualise. In this sense, C-ITS has the potential to deliver significant safety outcomes.

In addition to safety, C-ITS can also provide significant improvements to the efficient transport of people and goods, and improve environmental performance of the transport system, thereby providing significant benefits and outcomes to both road users and road operators.

Substantial work has been undertaken in the domain of C-ITS internationally, primarily in the regions of Europe, the USA, Japan and South Korea, with these regions looking at deploying by between 2016 and 2020 (subject to developments in these regions) and with Japan already having deployed vehicles with basic C-ITS functionality. There is now increasing recognition of the need for Australia to accelerate its involvement in C-ITS if it is to adopt C-ITS and take advantage of its potential benefits and outcomes.

Australia needs to be prepared for the advent of C-ITS equipped vehicles. The adoption and deployment of a harmonised C-ITS platform along with its applications in Australia would be best guided by a strategic plan, such as contained in this document, that provides a general overview of the necessary tasks to be undertaken to facilitate the effective deployment of C-ITS equipped vehicles as soon as they become available internationally. Although this Strategic Plan is written from a government perspective, successful C-ITS deployment will require a substantial collaborative effort between governments, industry and users, with the quantifiable benefits of C-ITS being proportional to its uptake by the community.

This Strategic Plan identifies a series of tasks to be undertaken across the six areas of policy requirements, international and national engagement, technical requirements, platform deployment requirements, trials and demonstrations, and marketing and communications.

The successful delivery of C-ITS would largely depend on the level to which Australia engages and contributes to the international agenda, the extent of specialist expertise and resources brought to bear through effective leadership and management, and the extent and pace that effective communication strategies inform and encourage consumers to adopt this new technology.

While this Strategic Plan focuses on Australia, information will be shared with Austroads member New Zealand. Also, New Zealand is willing to share their knowledge and contribute to the Austroads C-ITS strategy. New Zealand has independently been undertaking their own investigations. However, in the implementation of this Strategic Plan it is likely that national differences will be identified. Where significant differences between the countries are identified, New Zealand will develop their own solution for implementation.

ACKNOWLEDGEMENTS

The authors of this report would like to acknowledge the contribution of the Cooperative ITS Steering Committee, the Cooperative ITS Industry Reference Group, Anthony Ockwell and Lindsay Jacob to this report.

1 INTRODUCTION

Despite the significant gains in road safety achieved in Australia since 1970, the National Road Safety Strategy 2011–2020 (Australian Transport Council 2011) raised concern that the rate of progress has slowed in recent years. Between 2004 and 2009, the average annual reduction in road fatality numbers was less than two per cent. Hospital admissions data for this period also point to little, if any, national improvement in the number of people who were seriously injured in road crashes. There is evidence that Australia's relative road safety performance internationally has slipped in recent times; for example, in terms of the average annual decrease in fatality numbers, Australia's ranking among Organisation for Economic Cooperation and Development (OECD) countries has fallen over the past decade (Australian Transport Council 2011).

Further, while the Standing Council on Transport and Infrastructure (SCOTI) endorsed a target in the National Road Safety Strategy 2001–2010 (Australian Transport Council c.2001) to reduce the annual road fatality rate by at least 40 per cent over the 10-year period to the end of 2010 from 9.3 deaths to no more than 5.6 deaths per 100 000, the 40 per cent reduction target was not realised. The revised Strategy document has highlighted some of the major systemic problems on our roads, such as the frequent occurrence of three basic crash types: run-off-road, intersection and head-on crashes (Australian Transport Council 2011), and the need to develop mechanisms to address these crash types in order to reduce the fatality rate on Australian roads.

Cooperative Intelligent Transport Systems (C-ITS) have the capacity to connect road users in their vehicles to each other and to their road environment through real-time information exchange about their road environment, such as potential incidents or threats and hazards. As such it has the potential to make a substantial contribution to road safety and subsequently reduce the crash rate on Australian roads, with Austroads (2011a) estimating that with a 100% market uptake of the technology in vehicles across Australian jurisdictions, the current total of approximately 29 000 annual serious casualties (fatalities and serious injuries) could be reduced to between 18 500 and 21 500 (a reduction of 25–35%). It is the potential safety outcomes achieved through peer-to-peer vehicle-to-vehicle (V2V) communications that are the main impetus for governments in Australia wanting to deploy C-ITS.

Besides potentially delivering applications to improve safety, C-ITS may deliver applications to improve the productivity, efficiency and environmental outcomes of the road system, and to provide services to all road users and operators.

Austroads and its members have identified the potential broader benefits of C-ITS for the Australian road transport sector and, as such, in recent years have funded several projects in C-ITS (Austroads 2011a, 2011b). The purpose of the current Austroads project (NT1632) is to progress Australia on the journey for the deployment of C-ITS. One of the aims of NT1632 is to develop a strategic plan for C-ITS. This report provides the background to C-ITS and provides a roadmap for its deployment. The structure of the report is as follows:

- Overview of C-ITS – This section provides a definition of C-ITS and answers the questions: 'who', 'what' and 'how' (Section 2)
- Types of C-ITS applications – This section discusses the type of C-ITS applications, including safety, efficiency, etc. (Section 3)
- International development in C-ITS – This section discusses the development in C-ITS in the key international areas of Europe, the USA, Japan and South Korea (Section 4)
- Mission, vision, objectives and guiding principles of the C-ITS strategic plan (Section 5)

- Key areas for government decision (Section 6)
- C-ITS – The path to deployment – This section discusses the path that needs to be taken to enable C-ITS deployment (Section 7)
- Conclusion (Section 8)
- Appendix A lists the 32 use cases identified as likely C-ITS applications by the European Telecommunications Standards Institute (ETSI)
- Appendix B provides brief details on the US trials of vehicle-to-vehicle C-ITS applications
- The tasks required to be undertaken in order to deploy C-ITS in Australia are listed in Appendix C
- The skills sets required to deploy C-ITS in Australia are identified in Appendix D.

This report is prepared with the following context:

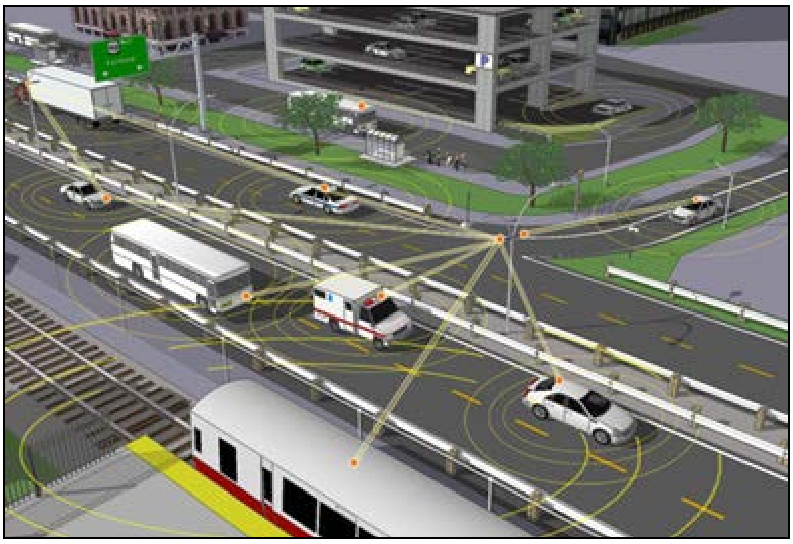
- While it is acknowledged that C-ITS applications would most likely extend to other non-road-based transport in the future, the focus of this document is to provide a strategic plan for the initial deployment of C-ITS applications to road-based transport (including where road-based transport interacts with non-road-based transport such as trains)
- This document has been written from governments' perspective, acknowledging that the deployment of C-ITS in Australia would require a three-way partnership between governments (public), the industry (private) and users
- While this strategic plan focuses on Australia, information will be shared with Austroads member New Zealand. Also, New Zealand is willing to share their knowledge and contribute to the Austroads C-ITS project. New Zealand has independently been investigating the potential of C-ITS and are entering into consultation with respect to securing the 5.9 GHz spectrum for C-ITS. However, in the implementation of this plan it is likely that national differences will be identified, especially in key areas such as radio spectrum management, vehicle fleets (New Zealand has a significant reliance on second-hand imported vehicles from Japan), policies, regulations and road rules relevant to C-ITS. Where significant differences between the countries are identified, New Zealand will develop their own solution for implementation
- As C-ITS requires a broad range of technologies and offers a broad range of road user and road operator benefits C-ITS deployment in Australia (and hence this strategy) tie back to other government information and communication technologies (ICT), road safety and road operation strategies, policy frameworks and papers, such as:
  - National Digital Economy Strategy
  - National Broadband Network Strategy
  - Policy Framework for Intelligent Transport Systems in Australia
  - National Intelligent Transport Systems Strategy
  - National Road Safety Strategy
  - Council of Australian Governments (COAG) Urban Congestion Review
  - Australian Strategic Transportation Agenda for Research and Technology (ASTART).

2 OVERVIEW OF C-ITS

This section provides a brief overview of C-ITS, which includes: outlining what is C-ITS, who is C-ITS for, what are the benefits of C-ITS applications, how would C-ITS be deployed, and connectivity through wireless communications.

2.1 What is C-ITS?

C-ITS is a new form of intelligent transport system (ITS) that enables communication and real-time information sharing between vehicles and roadside infrastructure (as indicated in Figure 2.1) as well as wireless consumer devices, in order to improve safety, productivity, efficiency and environmental outcomes of the road system, and to provide services to all road users and operators through giving advice or facilitating actions.



Source: Andersen and McKeever (2011).

Figure 2.1: C-ITS – wireless connection between vehicles and roadside infrastructure

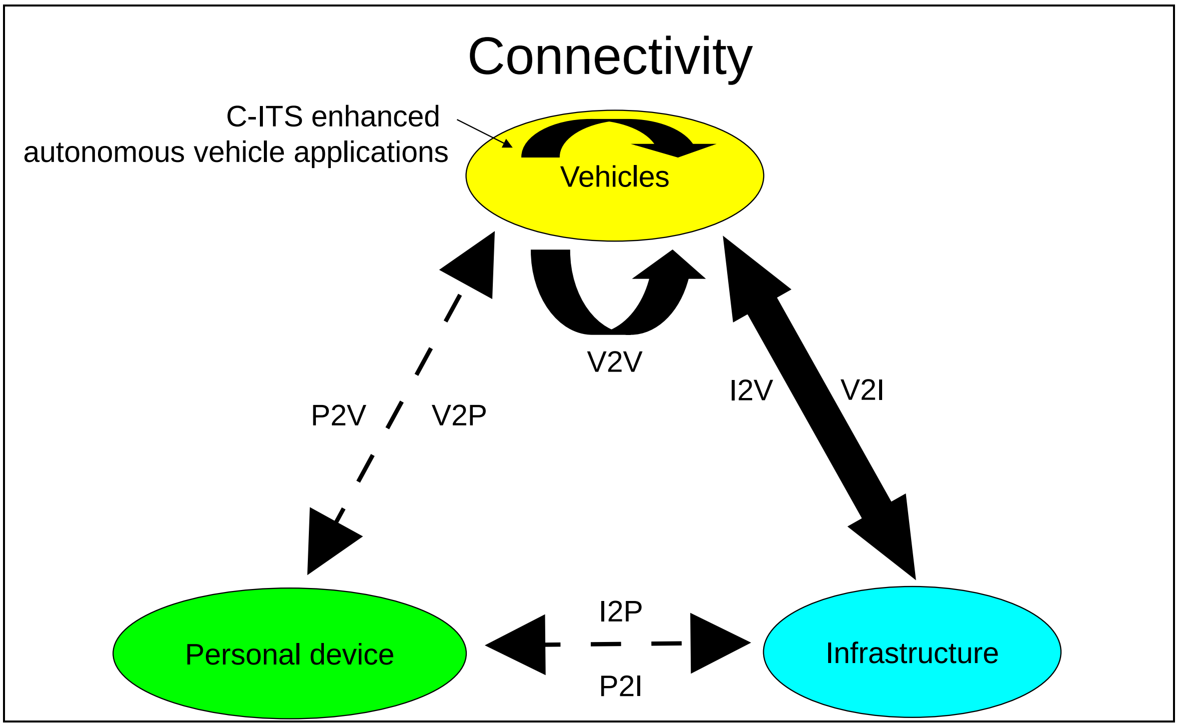
This strategic plan focuses on future C-ITS applications that will enable vehicles to connect to various other entities within its environment. In this sense, C-ITS is an enhancement of existing in-vehicle telematics applications such as those listed below that enable information exchange between vehicles and infrastructure:

- Transport Certification Australia's (TCA's) Intelligent Access Program (IAP)
- the provision of routing and congestion information to vehicles via applications such as SUNA Traffic
- electronic toll collection (ETC)
- private fleet management systems.

The definition of 'cooperative' in Cooperative ITS refers to the provision of connectivity (through wireless communication) primarily between:

- vehicles (V2V)
- vehicles and roadside infrastructure (V2I)
- roadside infrastructure and vehicles (I2V).

C-ITS may evolve to include connectivity with travellers such as pedestrians and bicycle riders, through the use of a portable personal device. The concept of connectivity in C-ITS is illustrated in Figure 2.2, which was developed by the project team.

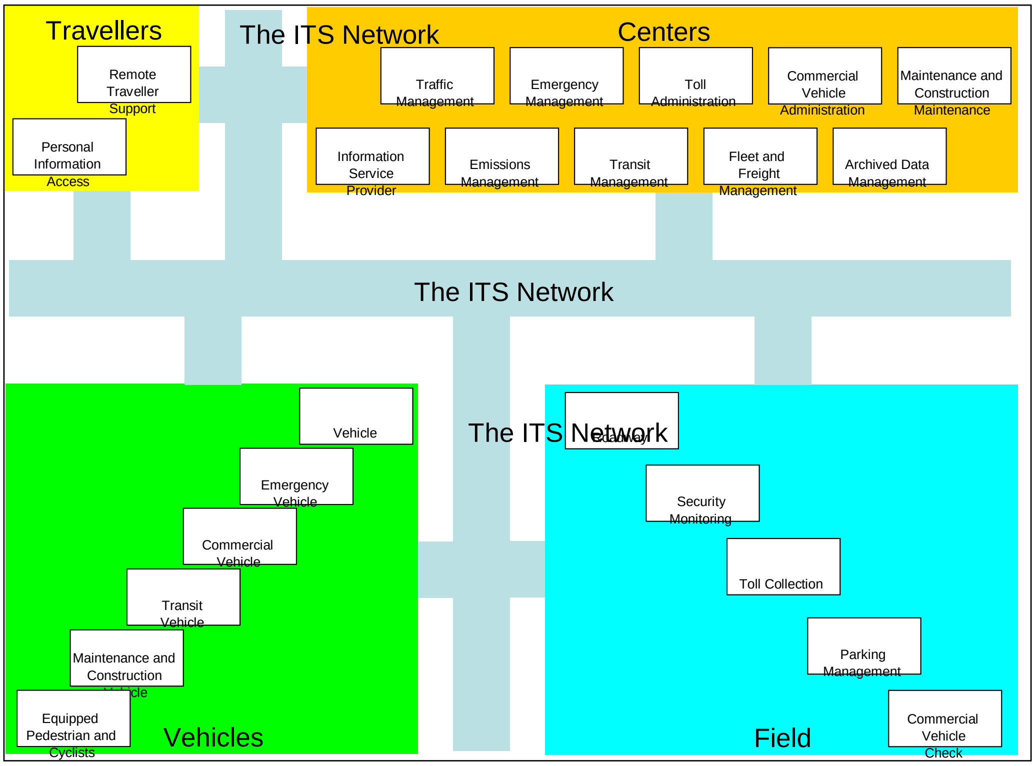


Notes:

1 Infrastructure may refer to both field infrastructure and central infrastructure.
2 Although at this stage the main focus of C-ITS is the connection between vehicles and between vehicles and infrastructure, C-ITS may evolve to extend connectivity to travellers such as pedestrians and bicycle riders through the use of a portable personal device.

Figure 2.2: C-ITS connectivity areas

C-ITS represents the next significant technological breakthrough in the evolution of Intelligent Transport Systems (ITS) in that it enables efficient V2V and V2I communication and enhances the data exchange between four ITS entities: travellers (e.g. pedestrians and bicycle riders), centres (e.g. traffic management and traffic support centres such as emergency vehicles), vehicles (e.g. trucks, buses, trains, trams, cars, motorcycles) and field devices (e.g. various ITS devices installed along the road network), as shown in Figure 2.3.



Source: Adapted from Research and Innovation Technology Administration (2007).

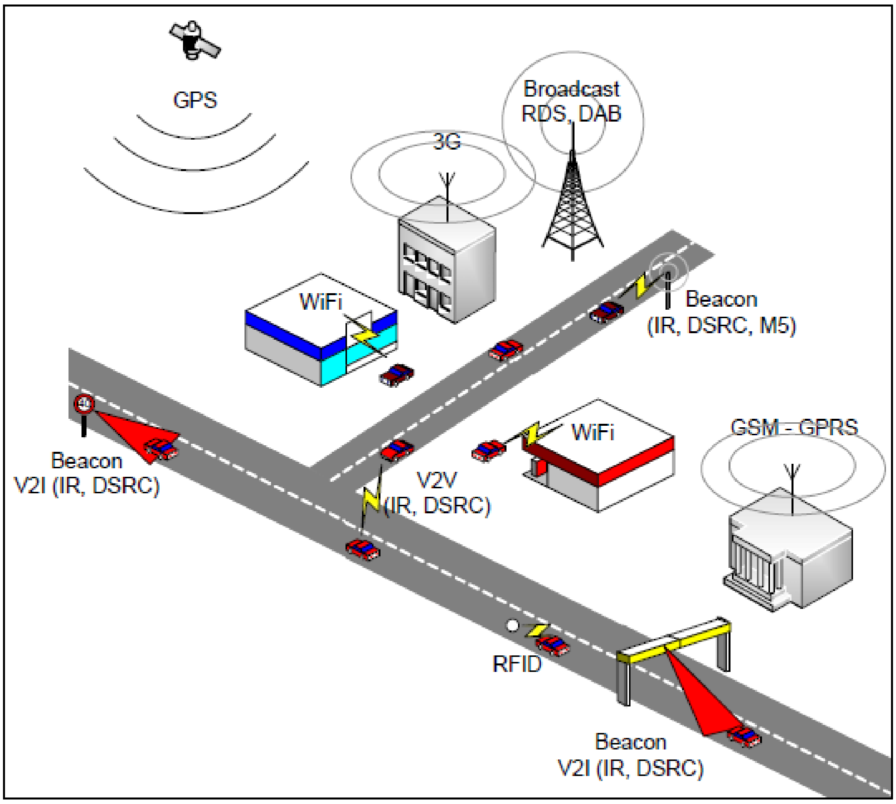
Figure 2.3: C-ITS technology architecture showing the communication linkages between typical users grouped into the four like-minded areas of travellers, centres, vehicles and field

As a result of C-ITS, communication can be directed in a more targeted manner at specific vehicle types and locations with resultant actions taken by the vehicle's on-board advanced driver assistance system (ADAS) (e.g. for safety applications) or messages sent directly to vehicles from service centres via backhaul systems (e.g. for reducing response times for incident management).

As C-ITS provides assistance to the driver, it may be classified as part of the modern vehicle's ADAS. However, C-ITS extends traditional ADAS beyond the internal environment of the vehicle's sensors by expanding the information, time and capacity to respond to events by using wireless communication media in order to obtain advice about the external environment.

2.2 C-ITS Communication Mediums

The C-ITS platform would use various communication mediums depending on the C-ITS application to be delivered (as indicated in Figure 2.4). For example, vehicle-to-vehicle (V2V) and/or vehicle-to-infrastructure (V2I) safety applications require low latency, highly reliable and free communication mediums. The primary communication means of these applications would be Dedicated Short Range Communications (DSRC) via the 5.9 GHz radio band. As such, 5.9 GHz is critical for the objectives of C-ITS to be achieved. It is recognised that C-ITS will need to address the interaction and interfacing between 5.9 GHz and other rapidly evolving communication mediums such as cellular networks (e.g. 2G, 3G, 4G, WiMax and Long Term Evolution networks) and private microwave and fibre networks, etc.



Source: Austroads (2010).

Figure 2.4: C-ITS communications mediums

2.3 Who is C-ITS for?

In the short- to medium-term, C-ITS is for all road-based transport modes, including vehicles, users and managers. In the long-term, after C-ITS and some of its applications have been deployed and have been operational for road-based transport, C-ITS may expand to non-road-based transport modes, vehicles, commercial operations (e.g. private parking operators), infotainment operators, users and managers, in order to enhance the operation of non-road-based transport, provide enhanced services to consumers and to provide interoperability between road and non-road-based transport services.

2.4 What will be the Level of Benefits from C-ITS Applications?

By combining the data from various infrastructure and vehicle-based sensors, C-ITS offers the unique opportunity to deliver new and evolved applications based on processed data with unprecedented levels of accuracy and reliability, as presented by the project team in Figure 2.5.

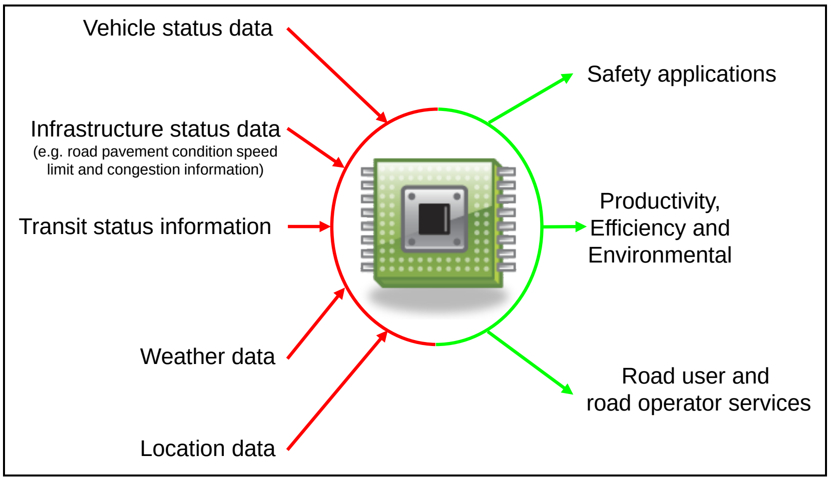


Figure 2.5: C-ITS: examples of data in, information out, and the resultant type of applications

Through the seamless linking of road users (vehicles, pedestrians, cyclists) with the road environment, C-ITS enables the time and spatial horizon given to vehicles and drivers to be increased beyond what the driver could naturally see. The increased time and spatial horizon enables information about threats, hazards and road conditions to be relayed to the driver potentially earlier than what the driver could have become aware of naturally, enabling ADAS to implement response systems (depending on what actions the ADAS is designed to undertake) and allowing the driver more time to take appropriate remedial action.

Therefore, the development and orderly deployment of C-ITS applications in Australia has the capacity to achieve the measures listed below and, in doing so, contribute to addressing a number of Australia's transport network challenges, needs, targets and visions as identified in documentation such as the National Road Safety Strategy for 2011–2020, Policy Framework for Intelligent Transport Systems in Australia, Council of Australian Governments Urban Congestion Review, National Digital Economy Strategy, National Broadband Network Strategy, National Intelligent Transport Systems Strategy and the Australian Strategic Transportation Agenda for Research and Technology (ASTART). These measures are to:

- reduce the numbers of fatalities and injuries through the introduction of active road safety systems, such as collision avoidance and improved incident response times (clear pathways for emergency vehicles)
- reduce costs associated with road crashes, given that C-ITS has the potential to significantly reduce crashes (noting that a 1% reduction in road crashes would result in an annual saving of $180 million per annum based on 2005 figures (Austroads 2009))
- reduce delay times and vehicle operating costs arising from the incidence of congestion
- improve the productivity of infrastructure use, and hence reduce the costs associated with infrastructure provision and management and increase transport system efficiency
- reduce the negative impacts of transport on the environment.

A quantifiable measure of the aforementioned benefits of C-ITS would be largely dependent on:

- the penetration rate of C-ITS equipped vehicles
- the share of vehicle kilometres of C-ITS equipped vehicles, noting that the share of vehicle kilometres of C-ITS equipped vehicles is more important than the number of vehicles (or proportion of vehicles) equipped with C-ITS in terms of maximising safety and traffic impacts

- the number of C-ITS applications and services deployed.

Whilst no one single C-ITS application is likely to justify the introduction of C-ITS by itself, it would be the accumulative benefits of several applications that would provide a positive return to the community.

C-ITS is being developed as a platform where more and more services and applications can be deployed and upgraded over time. In fact, the C-ITS platform would be like the development of the Internet and smart phones where the benefits derived to the community are a function of the number of services available, their usefulness and their usage.

2.5 How C-ITS is Envisaged to be Deployed?

The successful deployment of C-ITS will require a three-way partnership between road users, the industry and governments. Figure 2.6 illustrates the relationships and key activities within the three-way partnership and highlights the activities where effort would be required to ensure that C-ITS can be successfully delivered in Australia.

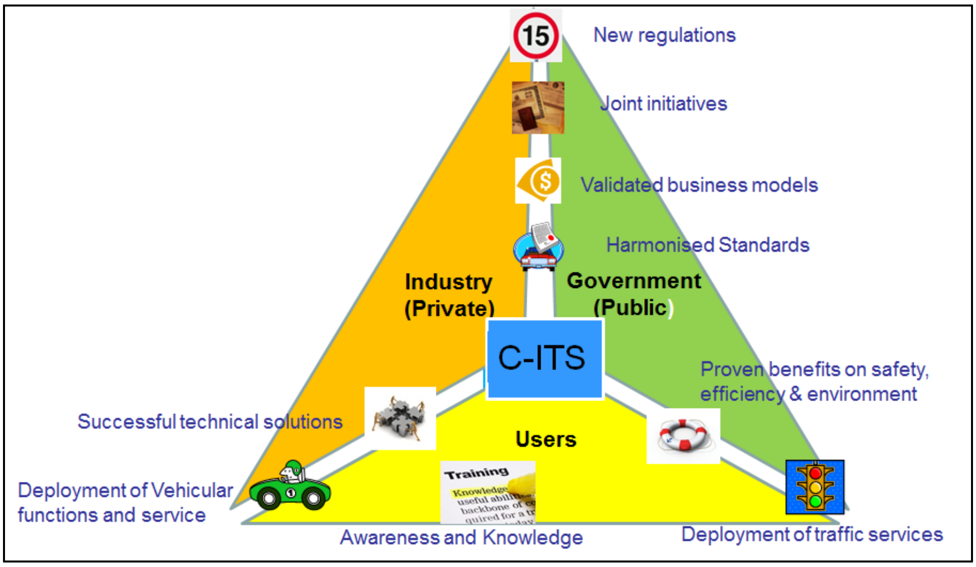


Figure 2.6: The three-way partnership between road users, the industry and governments required for the deployment of C-ITS

The primary roles of governments, the industry and users in the deployment of C-ITS are envisaged to be as follows:

- Government would establish policy and develop the regulatory enablers for C-ITS to be deployed. A key role for governments is the management of the radio spectrum component of C-ITS, the dedicated short range communications (DSRC) component, including the administration of licences and certification of C-ITS devices. This is considered a key role of governments as there is an underlying public safety requirement similar to the current vehicle Australian Design Rules (ADRs). In this context, 'governments' generically refers to federal, state, and local government departments, agencies and statutory authorities working in partnership

- Industry would bring to market various C-ITS applications (largely driven globally) for consumers to take up, with local industry playing a key role in adapting and deploying these C-ITS applications into the Australian market. Industry would also play a key role in managing and operating various components of C-ITS, as well as market C-ITS to the community in order to encourage its take up. In this context, 'the industry' generically refers to vehicle manufacturers, researchers, equipment manufacturers, telecommunication organisations, etc.
- The success of C-ITS will depend on user uptake. For C-ITS to provide measurable improvements in areas such as road safety, productivity, efficiency and environment, a significant share of the total vehicle kilometres travelled (VKT) on Australia's roads will need to be made by C-ITS equipped vehicles. Users will need to be informed of C-ITS applications in terms of their capabilities, benefits and effects on driver behaviour when making decisions to purchase C-ITS equipped vehicles or after-market C-ITS devices and applications.

In order for C-ITS to be deployed, governments and the industry would need to work together. Technically, C-ITS would be deployed:

- through the collection and distribution of real-time information about the road environment, road users and vehicles
- through specifically tailored applications and services that inform vehicles and drivers about road and traffic conditions, events, threats and potential hazards
- by harnessing proven information and communication technology (ICT), including wireless communications and positioning data
- on a national harmonised platform(s) using open standards accessible to multiple vendors
- utilising in-vehicle, roadside and portable devices.

In summary, C-ITS will enable communication and real-time information sharing between vehicles, roadside infrastructure and wireless consumer devices, and has the potential to provide a myriad of applications, including delivering safety outcomes. It will utilise a variety of communication mediums, but the primary communication medium utilised by C-ITS for the purpose of delivering safety outcomes is dedicated short range communications to be delivered via the radio spectrum (5.9 GHz is proposed for Australia). The successful deployment of C-ITS in Australia will require a collaborative effort between governments, the industry and users.

3 TYPES OF C-ITS APPLICATIONS

As discussed in Section 2, C-ITS has the potential to provide safety applications, productivity, efficiency and environmental applications, in addition to the provision of road user and road operator services as discussed in the following section.

Europe has undertaken trials on a wide range of C-ITS applications and services. As of 2011, the European Telecommunications Standards Institute (ETSI) had compiled a list of 32 potential applications ('use cases') of which it is likely that a subset would be selected to be deployed within the initial period after the complete standardisation of the C-ITS platform (the 32 ETSI use cases are listed in Appendix A). The USA has also undertaken trials on a wide range of applications and have now finalised a list of five safety applications for large-scale consumer acceptance testing. Developments in Europe and the USA are discussed in further detail in Section 4. As Australia is positioning itself to be an early adopter of developments undertaken internationally in the C-ITS space, applications deployed in Australia would be based on those applications deployed internationally, at least in the initial deployment period. Following that, Australia could evolve into a position where it could influence the development of applications to be deployed on the standardised platform that address specific areas of interest to Australia and may also be relevant to other international regions.

3.1 Safety Applications

By communicating information between vehicles via C-ITS within a shared environment, a vehicle is able to have a 360-degree awareness of its environment, beyond what is capable through the use of radars and sensors. Through this awareness, the vehicle is able to inform its operator of hazards and situations that the driver may not be aware of.

Advanced C-ITS safety applications in the future are likely to see further integration with the vehicle's Advance Driver Assistance System (ADAS) such that it can pre-arm the vehicle's crash response systems, enabling the vehicle to be more prepared for a crash and thereby reducing the severity of the crash on its occupants.

In the future, following integration with other wireless technologies, the C-ITS system could also be extended to other users of the road system, such as bicycles, pedestrians and trains, to enhance the safety of the interactions between vehicles and these other subjects.

Due to the relatively low cost of an Original Equipment Manufacturer (OEM) C-ITS unit in a new vehicle, C-ITS has the potential to deliver affordable safety benefits across the entire vehicle market including the low end vehicle market, which may have missed out on the safety benefits achieved through other more expensive systems based on radars and cameras. In addition, C-ITS applications have the potential to be deployed as aftermarket devices that may be able to be retrofitted to compatible existing vehicles, enabling the deployment of C-ITS to further extend beyond just those OEM C-ITS equipped vehicles and increase the percentage of C-ITS equipped vehicles on the road. C-ITS may not necessarily replace other vehicle safety systems (such as camera and radar-based technologies) but may be used as an additional technology to enhance the delivery of vehicle safety applications.

To take advantage of the potential role of aftermarket safety technologies, a Strategic Plan is required to ensure that such 'add-ons' are interoperable with other C-ITS systems with strict compliance in terms of a nationally harmonised platform(s) for deployment, standards, protocols and user interface.

Austroads (2011a) estimates that hypothetically with a 100% market uptake of C-ITS technology in vehicles, serious casualty crashes could be reduced by 25 to 35%. This could result in significant cost savings to the economy given that a 1% reduction in road crashes would result in an annual saving of $180 million per annum (based on 2005 figures) (Austroads 2009).

3.2 Productivity Efficiency and Environmental Applications

The C-ITS system has the potential to obtain valuable traffic flow information from thousands of equipped vehicles at any particular time. This information can help transport managers monitor and respond to the information provided, so as to better manage the transportation system's performance through adjusting traffic and motorway ramps signals, dispatching emergency services, providing real-time traveller information into the vehicle to reroute traffic around congested locations or incidents, etc. Through acting on the information provided, it is expected that systems and procedures could be developed and implemented in order to help reduce the occurrence and length of flow breakdown on the road network. C-ITS services and applications would assemble real-time vehicle data to develop enhanced real-time congestion maps (far superior to the maps available today due to increased sample size and reduced latency, etc.) that would enable vehicles to make better utilisation of the road network, thus improving productivity and efficiency.

Additionally, the use of the equipped vehicles as probes will offer rich road condition information to support weather warnings, asset management and road repairs planning, including dispatch of maintenance crews for emergency works.

Through the provision of productivity and efficiency applications C-ITS has the potential to reduce emissions by enabling road users to make more informed decisions about their driving habits, which can reduce the environmental impact of their trip. Also, some environmental applications are being investigated that will reduce fuel consumption and emissions by advising vehicles when to switch motors off when waiting at traffic signals.

3.3 Road User and Road Operator Services

C-ITS has the potential to offer additional beneficial services to both the road user and the road operator. Such services include an automated emergency call service (eCall), an automated vehicle breakdown call service (bCall), improved freight and fleet productivity through improved compliance with regulation enabling route access by higher productivity vehicles and enhanced logistics, and car park location guidance systems. These would build on existing ITS applications through integration of legacy systems such as Transport Certification Australia's (TCA's) Intelligent Access Program (IAP).

In summary, the C-ITS platform is being designed to be used for real-time information exchange between vehicles and infrastructure, and possibly in the future expanded to include portable personal devices. It can make a substantial contribution to not only safety, but also to the efficient transport of people and goods, whilst providing enhanced road user and road operator services. The potential benefits of the wide range of applications achievable through C-ITS are considered to outweigh the cost of deploying it in Australia.

4 INTERNATIONAL DEVELOPMENTS IN C-ITS

Over the past five to ten years, significant advancements have been made internationally in the development of C-ITS, with Europe, the USA, Japan and South Korea well on the path to seeing the initial deployment between 2016 and 2020 (subject to developments in these regions). In addition to work undertaken within these regions, one of the key developments is the move towards the potential development of a single C-ITS global platform. This is reflected in agreements being signed between Europe, the USA, and Japan, to collaborate on C-ITS research with a view to harmonisation.

The developments undertaken in C-ITS internationally are critical to the deployment of C-ITS in Australia, and therefore, it is important that Australia observe and participate where possible in international C-ITS developments to maximise benefits to the transport system and potentially influence some aspects of the C-ITS technologies developed internationally. This section briefly discusses where the key international regions working on C-ITS were at as of 2011.

4.1 Europe

Europe has been undertaking a large and focused effort in C-ITS since around 2006 as outlined in European C-ITS project websites such as CVIS (n.d.). In 2010, the European Commission prepared the ITS Action Plan and Directive 2010/40/EU (European Commission 2011) that encompasses C-ITS and has also defined a timeframe under the European Commission Mandate M/453 to develop a set of standards, specifications and guidelines to support European community-wide implementation and deployment of C-ITS.

The emerging European terms for C-ITS tends to be V2X or C2X (where X refers to a variable unit such as vehicle, infrastructure or roadside unit and C refers to car). For the purpose of the European discussion, V2X and/or C2X would be referred to as C-ITS.

The C-ITS effort in Europe has been largely delivered through projects funded by:

- individual European countries
- European vehicle manufacturers and other relevant organisations interested in C-ITS
- projects funded through the European Union’s Framework Programmes.

Europe has developed a roadmap in which it plans to address several challenge areas on its path to being ready for deployment between 2016 and 2020.

It is likely that the deployment of C-ITS in Europe would evolve from vehicle manufacturers and/or individual European countries with other vehicle manufacturers and/or European countries following the lead, rather than a collective European deployment.

Considerable research and development with respect to C-ITS has been done, and European vehicle manufacturers and countries are starting (as of 2011) to transition their focus to the deployment stage of C-ITS. The European Telecommunications Standards Institute (ETSI) have developed a list of 32 applications (‘use cases’) of which it is likely that a subset would be selected to be deployed within the initial period. The 32 applications are listed in Appendix A.

4.2 USA

The US federal government through the Intelligent Transport Systems (ITS), Joint Program Office of the US Department of Transport, Research and Innovation Technology Administration (RITA) (Research and Innovation Technology Administration n.d.) has been working on C-ITS in collaboration with the vehicle and other key industry players and organisations as well as state and local road authorities for some time prior to 2011. In 2003, the US Department of Transport (US DOT) launched the program currently known as the Connected Vehicle program (formerly Intellidrive and prior to that known as the Vehicle-Infrastructure Integration (VII) Program) to define and undertake tasks to implement the full suite of applications that comprise the program.

Since its launch, the RITA program has seen the development of a:

- defined set of overarching principles on which the program is based upon
- strategic plan
- research program around safety, mobility, environment and C-ITS policy
- road map that outlines the key challenges and areas to be addressed, in addition to milestones to achieve and decisions to make to enable deployment of C-ITS.

The US is working towards the deployment of C-ITS vehicles between 2016 and 2020. The actual deployment of C-ITS vehicles in the US will be influenced by developments in the US (as well as internationally) and market forces. These influences could see deployment occurring early or later in the period between 2016 and 2020 and even possibly after this period.

The initial C-ITS applications deployed in the US are likely to be V2V applications that can be deployed using current (as of 2011) technology and infrastructure (e.g. positioning technology and mapping). In 2011/12 the US will be undertaking driver clinics and model deployment trials principally around five V2V applications. Brief details of these driver clinics and model deployments are contained in Appendix B. It is considered that the outcome of this would largely influence the applications deployed in the USA in the initial stages, with applications expanding beyond the initial set as the technology and its deployment evolves.

Connected-vehicle technology will be put to the test in 2012 in an extensive road safety field trial on the streets and highways of Ann Arbor, Michigan. The University of Michigan Transportation Research Institute (UMTRI) will conduct the Safety Pilot Model Deployment, with $14.9 million in support from the US Department of Transportation (USDOT) and an additional $3.7 million in cost-share commitments, to evaluate the effectiveness of connected-vehicle technology in preventing crashes.

The Model Deployment will include the installation of wireless devices in up to 2850 vehicles, enabling communication with other instrumented vehicles and roadside equipment. It will take place from August 2012 to August 2013. Drivers using cars, trucks, and transit vehicles will be recruited from Ann Arbor and the surrounding communities.

The model deployment is being designed such that the number of interactions between equipped vehicles is maximised, thereby providing an ideal opportunity to test the robustness of vehicle-to-vehicle and vehicle-to-infrastructure connectivity as well as drivers' responses to these systems in a real-world environment.

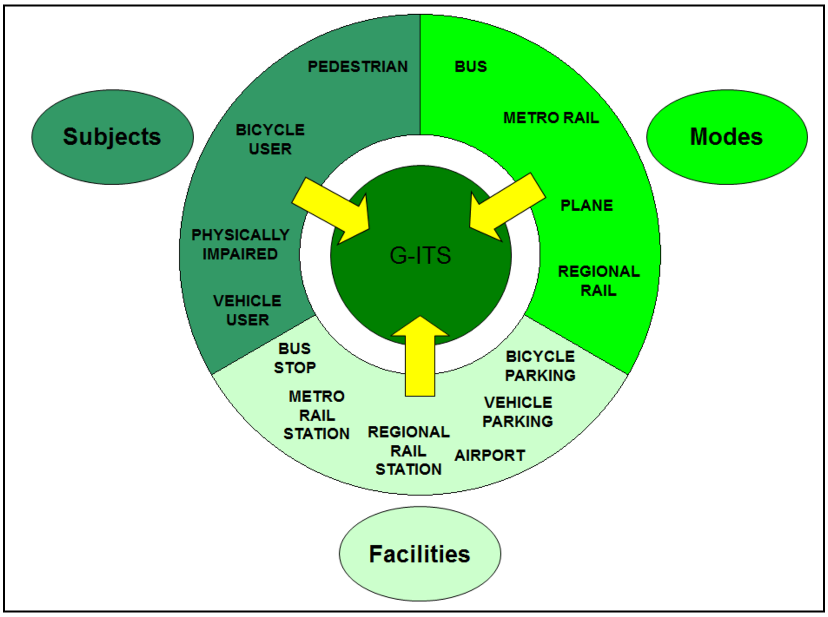
During the model deployment, drivers of a subset of the instrumented vehicles will be alerted to impending dangers in real-time so that they can take action to avoid crashes. Data will be collected from vehicles and roadside equipment in order to understand how motorists respond to safety messages in the real world and how effectively the roadside equipment operates.

4.3 Asia – Japan and South Korea

Japan has been working on a comprehensive ITS Plan since 1996 and has identified several ITS radio systems to achieve their ITS objectives through the use of C-ITS. Japan has begun deploying its ITS radio systems across the road network. Evidence of this is through the deployment of the SmartWay project using dedicated short range communication (DSRC), which commenced in 2007. The SmartWay project is a cooperative vehicle-highway system project primarily using V2I technology (or Vehicle to Road (V2R) as referred to in Japan) and providing and/or proposing to provide wide area travel time traffic information, safety information, miscellaneous service information and fee collection. According to ITS Japan's Chairman, Hiroyuki Watanabe, SmartWay has shown that the system can reduce the number of accidents on blind corners by 70 % (ITS international 2010). Japan also has a Driving Safety Support System (DSSS) deployment delivering safety initiatives to urban roads via I2V using infra-red (IR). Because of spectrum availability, Japan is developing V2V communication system in the 700MHz band to deliver similar functionality as V2V in the 5.9 GHz band.

Considerable work and development has been undertaken in South Korea with the development of the concept of the Green Intelli Travel Society (G-ITS) model. The G-ITS model somewhat mirrors other C-ITS international business directions. However, it has a strong focus on the need to maintain multimodal connectivity and identifies the use of the personal (wireless) devices as being the key to the future.

The South Korean model sees the public and private sectors playing significant roles in providing benefits and services to the users. This is indicated in Figure 4.1.



Source: Lee (2011).

Figure 4.1: South Korea's Green Intelli Travel Society (G-ITS) model

In summary, substantial work has been undertaken in the domain of C-ITS internationally, primarily in the regions of Europe, the USA, Japan and South Korea, with these regions looking at deploying C-ITS between 2016 and 2020 (subject to developments in these regions) and with Japan having already deployed vehicles with basic C-ITS functionality. There is now increasing recognition of the need for Australia's involvement in C-ITS if it is to take advantage of international developments in this area. Governments need to actively work in collaboration with the industry to enable the deployment of the internationally developed C-ITS platform into Australia.

5 MISSION, VISION, OBJECTIVES AND GUIDING PRINCIPLES OF THE C-ITS STRATEGIC PLAN

This section provides some high level statements developed that will serve as a focus for guiding activities and effort, as well as serve as a useful guide in shaping the direction that C-ITS in Australia will follow.

5.1 Mission Statement

To bring C-ITS to fruition in Australia so as to improve the safety, productivity and environmental outcomes of the road system, and as opportunities arise to the broader transport system.

5.2 Vision Statement

The vision is to achieve a transport system that utilises C-ITS through a nationally harmonised platform(s) that provides a safer, more productive, efficient and cost effective road-based transport system that can also provide enhanced road user and road operator services and information.

5.3 Objectives

The objectives of C-ITS and how they would be achieved are contained in Table 5.1.

Table 5.1: Objectives of C-ITS and how they would be achieved

Objectives	How the objectives of C-ITS would be achieved
Deploy C-ITS in Australia in line with international developments (i.e. between 2016 and 2020)	By keeping up-to-date with international developments in C-ITS and positioning Australia such that it is able to adopt and adapt the various requirements developed internationally that are needed to successfully deploy C-ITS and enable it to function such that the C-ITS applications and benefits can be rolled out to the Australian community.
Improve road safety	By vastly improving risk detection and its notification to vehicles and drivers through advanced driver assistance information services and applications.
Enhance mobility and access	By offering increased convenience, mode choice and access to services.
Improve transport efficiency, reliability and productivity and therefore improve the productivity of the nation through improving the productivity of its road network	By providing the efficient movement of people through enhanced public transport services, and goods through enhanced logistics and routing, and by improving the management of traffic through the use of enhanced transport network performance information. Through more efficient use of transport infrastructure and optimising freight (logistics) and public movement, the productivity of the nation can be increased, as gains in the productivity of the road network will transfer to overall productivity gains.
Improve social and environment-related transport outcomes	By providing information, system interventions and services to aid road users to reduce their energy consumption and emissions.
Improve transport network resilience	By providing systems to enable the road network to recover from a decline in traffic flow and have the road network operating at its full potential when it is required most.
Contribute to the international C-ITS arena	By being an active and valuable contributor to various international C-ITS related committees and by developing and undertaking trials, and testing of C-ITS applications and devices that are proposed to be deployed on to the global platform.

5.4 Guiding Principles

The guiding principles on the adoption of a C-ITS platform for Australia are that the C-ITS platform:

- enables the deployment of numerous applications and services by multiple vendors on nationally adopted platforms (developed internationally) that use harmonised open standards and are appropriately regulated and applied nationally
- ensures interoperability by ensuring that systems and underlying business processes have the ability to exchange data and share information continuously and reliably
- involves mandatory regulation of key elements of the platform, which would only be introduced after application of standard regulatory impact assessment processes, involving assessment of the costs and benefits of regulatory action
- requires the processing of personal data to be carried out in accordance with Australian Government and State privacy laws and legislation (this covers the general principle regarding divulgence of personal information without the driver's consent)
- ensures data exchange security and protection against unauthorised access, whether malicious or inadvertent, in order to protect the integrity of connected devices, vehicles and systems
- supports backward and forward compatibility
- is cost effective based on cost-benefit assessments
- facilitates the fast uptake of deployment, both in the vehicles and the provision of necessary infrastructure in the field
- ensures applications and services are easy and safe to use and that the applications do not interfere with the safe and reliable operation of the vehicle
- provides a path and policy that permits existing ITS (telematics) applications such as real time traffic data, electronic tolling services and the heavy goods vehicle Intelligent Access Program to be migrated to the future C-ITS platform
- ensures that C-ITS can leverage off existing and future infrastructure and communication services
- promotes effective public and private sector cooperation and collaboration in order to enable deployment and to ensure governance and institutional arrangements for C-ITS provide the essential supporting arrangements.

In summary, the mission, vision, objectives and guiding principles for the deployment of C-ITS in Australia have been identified in the strategic plan and are to be used to guide the deployment of C-ITS in Australia.

6 KEY AREAS FOR GOVERNMENT DECISIONS

This section outlines the main areas where national decisions need to be considered by governments in order to put in place a framework that is able to facilitate the introduction and effective use of C-ITS. This needs to occur collectively by the Commonwealth, States and Territories taking a national perspective.

There is a range of complex technical, policy/regulatory, socio-economic, governance and commercial challenges associated with the development of C-ITS. Unless these are addressed effectively, user demand, and hence market penetration and aggregate benefits from C-ITS will not be fully realised, the C-ITS market will be weaker, and the economic case for cooperative systems may not be sustainable. Work to address these challenges has been underway in some overseas economies for up to eight years, involving a mix of government agencies, the private sector, users and research institutions. The technical, policy and commercial environment for the deployment of C-ITS is still evolving.

Delivering the numerous activities identified in the strategic plan requires leadership and coordination in addressing the following key areas:

- Progress the six key elements required for successful development and implementation of cooperative systems, being:
  - Policy Requirements (operational and regulatory)
  - International and National Engagement (knowledge gathering and transfer)
  - Technical Requirements (architectures, standards and specifications)
  - Platform Development (applications, infrastructure, networks, commercial and operations)
  - Trials and Demonstrations (gaining hands-on experience, expertise and exposure)
  - Marketing and Communications (gaining understanding, promoting benefits and encouraging uptake).
- Nomination of a national entity to manage and administer the spectrum
- Integrate the necessary elements outlined above. This will require project teams, consultative forums and partnerships to be formed as needed to manage and progress Australia's path to C-ITS deployment.

This section discusses each of these areas and concludes that it is now time to move from the current part-time project-based approach to the next phase, which will require an increased emphasis on leadership and management by governments in partnership with industry.

6.1 Policy Requirements

A document titled 'Policy Framework for Intelligent Transport Systems in Australia' was approved by the Australian Transport and Infrastructure Senior Officials Committee (TISOC) in September 2011 and endorsed by the Standing Council on Transport and Infrastructure (SCOTI) in November 2011. The framework identifies policy principles and priority action areas. It also provides a schedule of projects being undertaken through government and industry to enable new technologies. The framework was developed to guide consistent application of the policy principles and to achieve the most cost effective implementation, integration and uptake of ITS nationally across all transport modes.

The main policy challenges in developing C-ITS have been identified in international work. These have been considered by Australian stakeholders and endorsed through a joint industry/governments exercise (as discussed in Austroads (2011b)). The key policy areas of challenge to the introduction and roll-out of C-ITS in Australia, as identified in this exercise, are listed below:

- **Dynamic and uncertain environment:** Technical innovation is rapid and multi-pronged and cooperative systems cross traditional boundaries between vehicles and infrastructure. Overseas experience suggests that bringing together stakeholders early in the development process to undertake policy, technical, operational and commercial work assists in managing uncertainty by working through the complex issues in an integrated, collaborative and coordinated approach.
- **Interoperability:** The ability of applications to communicate and work with each other (interoperability) provides the foundation to gaining maximum, sustained, long-term net benefits. The specification of adopted/adapted international standards and a nationally agreed architecture should be a key while not the sole objective in order to achieve interoperability.
- **Functions, responsibilities, liabilities and governance:** C-ITS services and applications involve a large number of stakeholders/participants, and technical, policy and commercial complexities and risks. Identifying functional responsibilities for effective service delivery is a complex but essential task. As C-ITS will be new to Australia, decisions on allocation of responsibilities within an emerging international business model will need to be agreed between stakeholders.
- **Privacy and security:** C-ITS applications generate data that is collected by both private and public agencies, and hence requires appropriate management of privacy and security of personal information. Overseas experience demonstrates that privacy and security are issues that need to be addressed from an early stage in the design, development and regulation of C-ITS applications.
- **Human-machine interface (HMI):** It is likely that by the time new and imported vehicles with C-ITS and interoperable on-board units are available in Australia, the HMI issues involved with originally-installed equipment will have been addressed. There are greater concerns with retro-fitting existing vehicles with aftermarket devices for multiple applications. However, it is important to define basic requirements of aftermarket on-board units to host retro-fitted applications that meet HMI concerns.
- **Digital mapping and positioning:** Different types of C-ITS applications require different levels of accuracy from positioning technologies and on-board digital maps. It is probable that current GPS alone could not deliver the degree of accuracy required for more stringent cooperative systems. However, if used in conjunction with other data sources and methods, sufficient accuracy could be attained. Irrespective of accuracy, it may not be prudent to rely solely on one approach. Road agencies, including local government, will be responsible for maintaining the currency of certain data for digital maps, as well as managing the provision of that data to third party providers and/or end users. This may involve a significant cultural change for many of the agencies involved.

- **Telecommunications:** Research and testing of all transmission options is underway overseas. A vehicle communication system based on wireless standard LAN 802.11p (CALM M5 standard) provides the only system that has the performance attributes necessary for safety-related cooperative systems. The process to secure sufficient bandwidth is already well-progressed in Australia and is expected to follow US and European decisions to allocate the 5.9 GHz band. Other issues being addressed include management of licences, access rules and potential interference with other users.
- **Aftermarket devices and applications:** The aftermarket sector will be important in Australia, as originally installed applications will only be available through new and originally high end vehicles, and this will be a relatively slow process for introducing the new technologies. Retro-fitting of hardware and/or software to the existing fleet could occur well before enabled new vehicles are available in sufficiently large numbers on our road system to be effective. The key area of risk is that the aftermarket sector may introduce problems not occurring in the more controlled environment of the original equipment manufacture (OEM) sector, such as impediments to interoperability and data harmonisation, privacy, security and compliance with HMI (e.g. how aftermarket applications integrate with the vehicle and driver including with any HMI in the vehicle). However, this risk can be managed by some form of regulation of the aftermarket sector, such as ensuring adherence to appropriate standards and protocols, and quality control through certification of equipment and software (as referred to in Austroads (2011b)).
- **Potential for conflict between public and private objectives:** There is a risk that advice provided by real-time commercial applications may conflict with the objectives of broader network management. This includes day-to-day management, such as the need to modify traffic flows around incidents and events. Such conflict would undermine the potential policy benefits of cooperative systems. The need for certification of commercial applications to ensure, among other things, that they do not run counter to public objectives but uphold good practice, should be considered when developing the regulatory and governance arrangements for C-ITS. It is also important that any regulatory framework does not stifle innovation. This issue highlights the importance of a collaborative approach between governments and industry, so that market developments contribute to key government objectives, and that government policy is informed by an awareness of market developments.
- **Roadworthiness:** Once vehicles with C-ITS are on the road, the issues of ongoing maintenance and roadworthiness become important to ensure that applications continue to function effectively. The responsibility for in-service vehicle roadworthiness and registration is a matter for states and territories.
- **Consumer confidence and market penetration:** Growth in market penetration needs to be based on successfully meeting the range of challenges to C-ITS. This will establish the foundation for consumer confidence and positive value propositions for users. Establishment of a marketing/awareness plan (through the development and implementation of advertising and marketing strategies highlighting the benefits to consumers of C-ITS) to aid consumer confidence and uptake would also be of value. A key issue is regulation of operators, applications, equipment, software, etc. to provide confidence to consumers that required standards of performance are to be met.

It should also be noted that the National Transport Commission (NTC) is currently (during 2011/12) undertaking research on the regulatory policy implications of C-ITS applications for a coming policy options paper. The paper will focus on the four areas of privacy, driver distraction, liability and compliance and enforcement equity.

6.2 International and National Engagement

Australia would be largely an adopter and adapter of C-ITS, with most of the in-vehicle and associated roadside devices and C-ITS applications being developed overseas through collaborative private/public initiatives and tested through joint private/public demonstrations and trials. Relevant policy issues have been identified and are being progressed through overseas work. Standards and compliance frameworks would also be largely developed overseas through global arrangements.

Accordingly, Australia's engagement with international developments is essential. Australia needs to participate adequately and in a coordinated way in relevant standards-setting mechanisms to ensure its voice is heard and that it understands the direction and content of standards work, so it can prepare for its adoption and adaptation. It also needs to maintain a close watching brief on international technical, commercial, policy and regulatory developments. This investment has the potential – as has been seen in the development of an Australian approach thus far – to inform, and thus reduce the time and resource investment required in the preparations Australia needs to take to maximise the long-term benefits from C-ITS.

At a national level, it is imperative to continue to engage all key stakeholders, across the various key areas, whose actions would ensure the success or otherwise of the development and deployment of C-ITS applications in Australia. Information would be shared with New Zealand through Austroads.

6.3 Technical Requirements

Considerable research is underway overseas to address the key issues of system architecture, standards and specification of system requirements/protocols. The specification of system architecture for C-ITS effectively sets the scene for subsequent developments and applications. Architecture specifies at a high level the guiding road-map for system development and hence underpins the strategic plan by identifying requirements and linkages. Australia needs to participate in the development of international standards, commit to the application of the standards within an agreed national architecture and understand the functional and operational requirements of C-ITS.

6.4 Platform Development

As noted above, C-ITS applications are technically innovative and complex. Their technical aspects need to be thoroughly explored to ensure they deliver what is needed for safety and operational benefits (as documented in the ETSI use cases) and then examined in real world circumstances to deliver technically feasible and safe applications. Technical feasibility needs to cover the essential elements of cooperative systems (in-vehicle and roadside units, and communications media) and cover how packages of applications work together (interoperability), as well as the performance of individual applications. Critically, the performance of the technical systems that generate benefits from cooperative applications needs to be maximised (e.g. expansion of the spatial and temporal horizon around a vehicle within which real-time information is gathered; two-way 'smart' dialogue; high speed gathering and transformation of data into useful information; and an open technical architecture (Arndt 2009, European Telecommunications Institute 2008)).

The critical technical aspects of C-ITS that need to be addressed include:

- a nationally harmonised platform(s) with open access to ensure interoperability across applications, providing products and geographic regions

- access to the 5.9 GHz spectrum to facilitate the direct implementation of applications (in particular, safety-related applications) being developed and trialled overseas using DSRC systems
- utilisation of the global navigation satellite system (such as global positioning systems) as a key component of the in-vehicle C-ITS system
- examination and provision of complementary media, such as 3G or 4G commercial networks, to enable two-way transmission of information.

The development of a nationally harmonised platform(s) is a necessary pillar for an effective C-ITS market and for the private sector to respond to stakeholders' changing requirements as applications evolve over time. In order to address safety, C-ITS applications would require a nationally harmonised platform(s) across the entire road network to allow uniform and consistent transmission of information between vehicles and infrastructure. Further, in order to enhance transport efficiency, it is also necessary that the same platform can be extended to accommodate other applications (such as traffic management, road use by commercial vehicles, and public transport) in order to reduce congestion and increase infrastructure productivity.

6.5 Trials and Demonstrations

Undertaking real-world demonstrations and trials is critical in moving from small-scale prototypes of C-ITS applications to on-the-road deployment of large-scale systems. This can help to illuminate a number of issues for successful development and deployment of new technology/applications.

A key question for an Australian C-ITS strategy is whether the Australian market is suited for C-ITS deployment and warrants the investment. Proving the market through the undertaking of demonstrations and trials is essential for this. While the results of overseas testing would inform an Australian program of testing, especially in relation to technical feasibility and identifying key questions to test, most of the questions need to be answered in an Australian market, regulatory and governance context.

Accordingly, a targeted and realistically resourced program of domestic demonstrations and trials, with equipment complying with international standards and being informed by overseas testing methodologies and results, and Australian priorities, needs to be undertaken as an integral part of any national strategy. A program of trials needs to involve key stakeholders, not only those with technical expertise. For example, users clearly need to participate, as it is they who would need to feel confident and comfortable with new systems before they are willing to buy and use new applications. Also, policy/regulatory officials should be involved (e.g. Australian Design Rules (ADR) and compliance officials), so they can help inform and learn from exposure to new technical and operational systems. The domestic trials should leverage off international trials with effort undertaken to learn from trials undertaken internationally and to review, consider and adopt the outcomes of learnings for the deployment of C-ITS in Australia.

It is essential that the trials undertaken domestically do not conflict with international trials or results in 'orphan' platforms that are not in line with the C-ITS platform developed internationally.

6.6 Marketing and Communications

Ultimately, the level of consumer acceptance of C-ITS will determine the extent of their role in improving transport safety in Australia. While Australians have a positive track record in accepting new technologies, there are challenges to overcome in creating safety applications that are attractive to consumers.

It is essential initially that Australian policy makers understand the potential benefits of applications delivering broader public benefits. This discussion must be evidence-based, which highlights the importance of demonstration projects and trials under Australian conditions. Demonstrations and trials will do far more than test technical issues. A program of national demonstrations and trials is essential to prove the practical value of C-ITS applications as well as identifying implementation challenges.

For a wide range of potential applications, industry will be best placed to understand what will drive market uptake. It will be important for the broader deployment of C-ITS that the consumer-orientated service applications and those applications that may target broader government outcomes leverage off each other.

6.7 Leadership and Management

Strategic leadership, authority and management are required to accomplish the tasks detailed in this strategic plan. Governments need to consider the appropriate delivery mechanisms to ensure that C-ITS is deployed uniformly across the nation and to drive, coordinate and integrate development across the six areas discussed in Section 6.1 through to Section 6.6 and to manage and administer the 5.9 GHz spectrum. It is essential that key tasks (such as the allocation of radio spectrum for use by C-ITS) be undertaken early, to signal to the private sector and other key stakeholders that governments are serious about the deployment of C-ITS.

In summary, in order to enable the integrated and coordinated development and deployment of C-ITS in Australia to ensure the full realisation of the benefits (safety, productivity, efficiency and environment), the six areas identified in this section will need to be addressed.

7 C-ITS – THE PATH TO DEPLOYMENT

C-ITS will be deployed:

- on a national harmonised platform(s) using open standards accessible to multiple vendors utilising in-vehicle, roadside and portable devices
- through market driven specifically tailored applications and services that inform vehicles and drivers about road and traffic conditions, events, threats and potential hazards
- by harnessing proven information and communication technology (ICT), including wireless communications and positioning data.

This section discusses the path to C-ITS deployment in Australia.

7.1 Joint Effort

C-ITS would need to be delivered via a model that involves a joint effort between governments, the industry and users. In this case, governments establish the regulatory framework, set up the use of radio spectrum for C-ITS and put some of the systems and processes in place to enable both the governments' and the industry's objectives to be met and services to be delivered, while the industry develops their business models (through support and the provision of seed funding (possibly through a Cooperative Research Centre (CRC)) to enable C-ITS applications and devices on the global platform to be deployed in Australia. Both sectors would need to be active in keeping road users aware of the capabilities of the applications and their benefits, as well as privacy/security measures. The alternative is that governments do not facilitate appropriate conditions for industry deployment of C-ITS.

7.2 Australian Progress to Date

Governments and the industry have previously identified (in 2006) the importance of working towards being ready to adopt, adapt and deploy C-ITS in Australia and have undertaken several projects between 2006 and 2011 in the field of C-ITS, including:

- preparation of several reports on the applications, benefits and technologies underpinning C-ITS
- a submission to the Australian Communications and Media Authority (ACMA) on the planning for intelligent transport systems regarding the allocation of the 5.9 GHz band for use in dedicated short range communications (DSRC) (this has resulted in ACMA placing an embargo on the 5.9 GHz band until it is determined how C-ITS will be incorporated into the radio spectrum)
- the establishment of a C-ITS Steering Committee (commenced in 2009)
- the establishment of a C-ITS Industry Reference Group (commenced in 2010)
- the publication of an Austroads Report on the potential safety benefits of V2V collision avoidance (Austroads 2011a)
- the ongoing work on the Austroads NS1696 project 'Development of an ITS Architecture'
- representation on various international standards committees
- the preparation of a high level appraisal of key policy challenges for the introduction and roll-out of cooperative ITS in Australia

- the undertaking of trials of various C-ITS type applications and testing of technologies by universities, research centres, road agencies and the industry
- the identification of key challenge areas with the C-ITS industry reference group with respect to the deployment of C-ITS (as identified in Section 6.1)
- obtained approval for Austroads to become the interim C-ITS management entity (from 2012 through to 2014/15 initially) and to undertake the necessary C-ITS management tasks during this period.

Progressing the deployment of C-ITS in Australia would require the undertaking of tasks beyond those identified above and would require the transition from a research and planning phase to a development phase.

7.3 Moving C-ITS Forward

The deployment of C-ITS would require the continuance of the current governance structure with government and industry overseeing the delivery of tasks across the six areas.

The delivery of C-ITS to Australia would be via a phased approach, focused around the aforementioned six areas. These phases can be broadly categorised into the development and delivery phases as proposed by the project team and shown in Figure 7.1. This figure shows that governance is required to oversee that the tasks identified in the six areas are undertaken across the five phases in order to deploy and operate C-ITS.

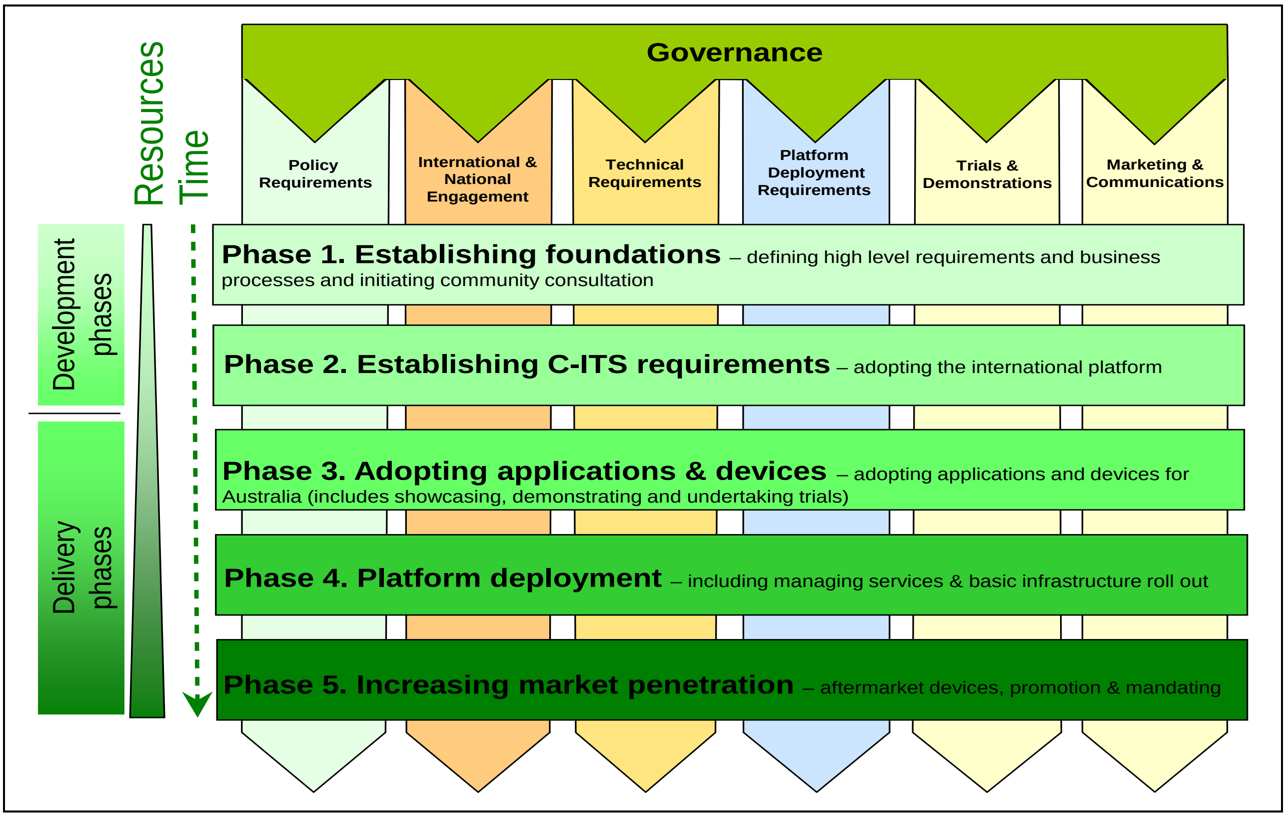


Figure 7.1: Phased approach for the delivery of C-ITS in Australia

The path to deployment of C-ITS in Australia would commence through the undertaking of development phases over the initial three years and would transition to the delivery phases by approximately the third and fourth year. This concept is represented in Figure 7.2.

The years have not been specifically identified in Figure 7.2 as the timing of when tasks are undertaken will be largely based on international developments. As of 2011, Australia views itself from a governments' perspective as approaching Year 1 and has consequently commenced work on the initial development phase 1, including:

- progressing arrangements in order to assign the 5.9 GHz spectrum in Australia for the purpose of C-ITS under a co-sharing arrangement with other existing users who cannot be relocated
- progressing work in the area of mapping and positioning to determine what is required in this space in order to deploy C-ITS in Australia, both for initial and future C-ITS applications
- progressing investigations into the entity and resources required to deploy and operate C-ITS in Australia, in both the short- and long-term.

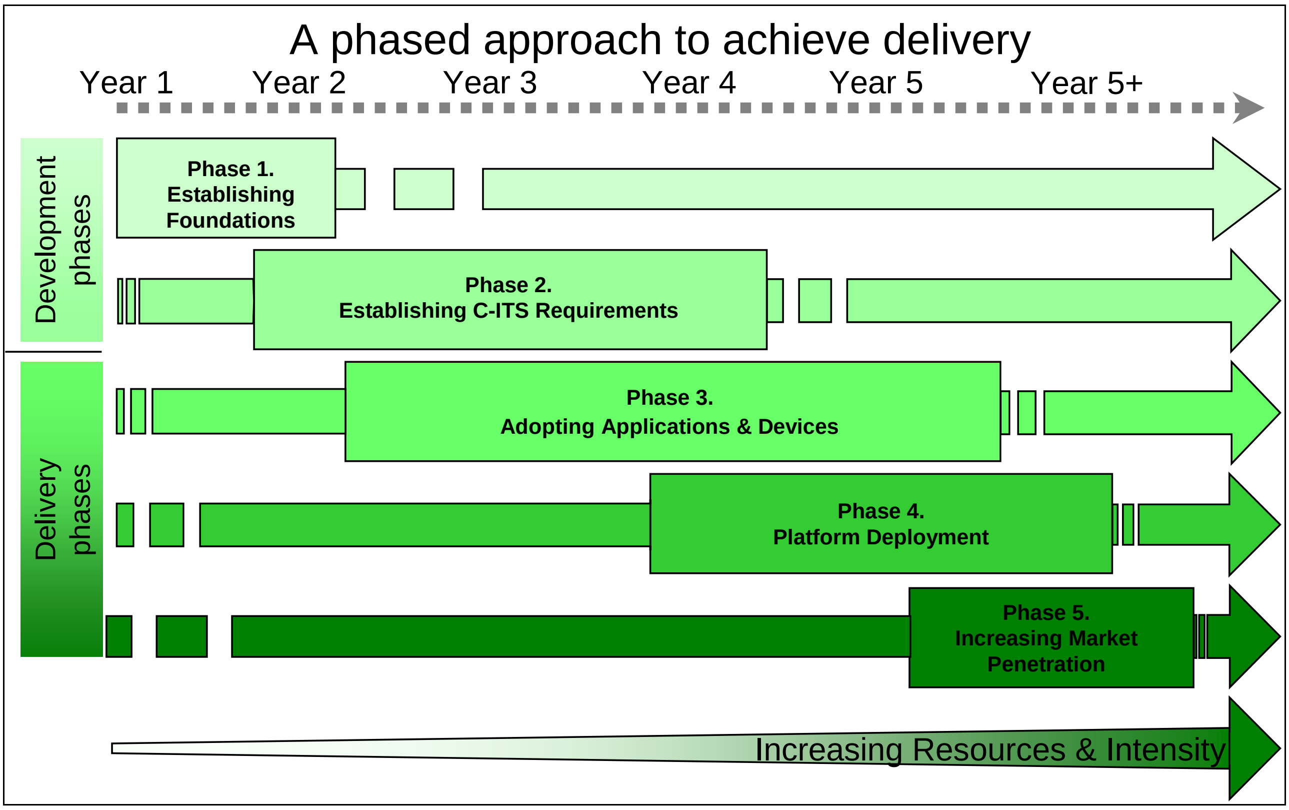


Figure 7.2: Phased approach to C-ITS delivery in Australia with respect to timeframes

7.4 Tasks to be Undertaken to Deliver C-ITS

The likely path to C-ITS deployment for Australia would follow the adoption, adaptation and implementation of the C-ITS platform developed internationally. Governments in collaboration with the industry have identified a series of tasks (across the aforementioned six areas) that would need to be undertaken in order to deliver C-ITS in Australia. The tasks to be undertaken are contained in Appendix C.

The tasks identified are based on the broad premise of Australia adopting and adapting rather than developing its own C-ITS platform. As such, many of the tasks identified would require Australia to be across international developments in order to enable the national deployment of C-ITS. This includes:

- be sufficiently across the detail of the task so as to understand what is required for Australia
- adopt, and where required adapt, the necessary requirements as developed internationally that are associated with the C-ITS task
- undertake the necessary work associated with the tasks, including liaising with industry and gaining industry input as required.

The Austroads C-ITS industry reference group indicated that governments need to put in place appropriate mechanisms to address the following key tasks to enable the motor vehicle industry to deploy C-ITS:

- allocation of the 5.9 GHz spectrum to C-ITS DSRC, including channel allocation and licensing arrangements for C-ITS devices (including both in-vehicle and roadside units)
- assignment of open standards that promote interoperability, while allowing market competition
- development of a national ITS framework, in particular a national ITS architecture
- resolution of matters related to privacy with respect to C-ITS
- provide solutions to allied aspects related to C-ITS that only governments can address, such as the provision of map data
- raising awareness with the community to generate interest and drive uptake (e.g. similar to NCAP campaigns run by government agencies)
- engagement of stakeholders through collaborative demonstration projects.

The tasks identified in Appendix C are an expansion of those identified by the industry reference group.

Progress has already been made on some of the tasks, with an embargo being placed on the 5.9 GHz band in preparation for the allocation to C-ITS DSRC to this spectrum, the Policy Framework for Intelligent Transport Systems in Australia being endorsed by the Standing Council on Transport and Infrastructure (SCOTI) and the Austroads NS1696 project 'Development of an ITS Architecture' progressing towards adopting a national ITS architecture.

The tasks in Appendix C have been prioritised based on the following two deployment models:

- **C-ITS deployment model 1:** Governments undertake a minimum effort to enable the industry to deploy C-ITS and its applications (with the applications deployed being based on market forces, which may or may not be in line with the primary objective of governments – being to deliver safety outcomes).
- **C-ITS deployment model 2:** Undertake a joint effort between governments and the industry, where governments put some of the systems and processes in place to enable both the governments' (safety and transport) and the industry's objectives to be met and services to be delivered, while the industry develops their business models (through support and encouragement from governments) to enable C-ITS applications and devices on the global platform to be deployed in Australia.

In order to progress safety, environmental and productivity outcomes, and provide road user and road operator services beyond current practice, it is recommended that model 2 be adopted. If the governments do not want to invest the resources and funds required to implement model 2, then consideration could be given to model 1. However, the outcome of model 1 may not be as desirable as that associated with model 2 and as a consequence the safety benefits of C-ITS may not be maximised.

As can be appreciated from a review of both the aforementioned tasks and the tasks outlined in Appendix C, in order to move to the chosen C-ITS deployment model, Australian Governments will need to collectively agree to the transition from the current Austroads project delivery model to a commitment over time of more full-time resources, commencing with the appointment of a full-time Project Director, with dedicated resources (as further discussed in Section 7.6). This is required if Australia is to progress to a position where C-ITS can be deployed in Australia.

7.5 C-ITS Applications of Interest to Australia

Of the C-ITS applications being developed internationally (including the 32 ETSI use cases listed in Appendix A), the applications of interest to Australia for initial trial deployment are listed below (although the applications listed below are broadly grouped into safety and network, they may also provide environmental benefits):

- Safety:
  - Intersection collision warning (ETSI UC003), motorcycle approaching warning (ETSI UC004) and collision risk warning (ETSI UC012)
  - Regulatory/contextual speed limits notification (ETSI UC018)
  - Traffic light optimal speed advisory (ETSI UC019)
  - Driver fatigue for light and heavy vehicles (to be developed and considered as an Australian addition to the 32 use cases).
- Network Efficiency:
  - Enhanced route guidance and navigation (ETSI UC021).

Australian road agencies are encouraged to prepare business cases and trials associated with the adoption and deployment of the aforementioned use cases that would be in line with the overall C-ITS platform developed internationally and adopted and adapted for Australia.

Although road agencies and others may undertake their own investigations, they are discouraged from developing applications that are not in line with the C-ITS platform developed internationally and deployed in Australia. Although they may also investigate other applications, the focus should be on those applications listed above.

7.6 Resourcing C-ITS in Australia

In order to deliver the tasks identified in this strategic plan, it is proposed that the current C-ITS Austroads project be transformed into an appropriate delivery mechanism (with appropriate technical resources) for the effective delivery of the tasks (it is noted that the first steps have been undertaken in achieving this through the appointment of Austroads as the interim C-ITS manager, as outlined in Section 7.2). In doing so, it needs to be acknowledged that many of the tasks must be undertaken in parallel by dedicated multifunctional and multidisciplinary teams who are tapped into the international scene.

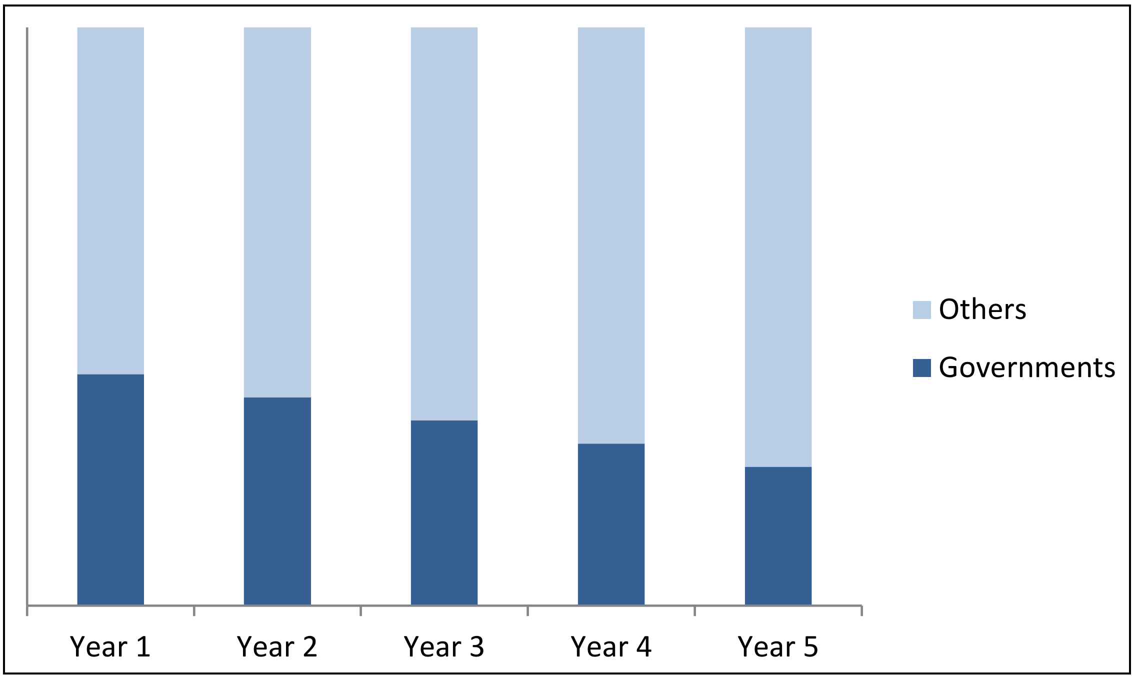
In November 2011, the Austroads Board agreed to establish Austroads as the short-term entity to secure and manage the 5.9 GHz spectrum and to lead the development of a model and roles for a permanent management entity (including determining required resources).

It is anticipated that the resources required to deploy C-ITS in Australia would significantly grow each year until C-ITS platforms and applications are effectively implemented. The bulk of resources required to deploy C-ITS during the initial years are likely to come from both governments and the industry equally. Once C-ITS applications start to be deployed, the proportion of the overall resources that are required to come from governments is expected to decrease to a level where it is sufficient for the ongoing management, maintenance and increased deployment of new and improved applications and devices (this is discussed in further detail below). It is expected that the skills sets required for Australia to deploy would be broad, as indicated in the skills set matrix contained in Appendix D.

The expected trajectory of relative shares in resource commitments required in the initial stages for the implementation of the Strategic Plan is illustrated in Figure 7.3. The likely resource commitments shown in Figure 7.3 are indicative only, and seek to illustrate that in the early years of the Strategic Plan (Years 1 and 2), the focus should be on a collaborative partnership between governments and others. In this case, others include the motor vehicle industry; information, communication and technology (ICT) designers and manufacturers; C-ITS related industries (such as positioning, telematics, C-ITS software and hardware developers, and researchers, etc.); motoring organisations (such as the various state motorists' clubs – RACQ, RACV, NRMA, etc.); industry organisations (such as ITS-Australia); road safety community groups (e.g. RoadSafe Victoria); and users. These partnerships could include trials of C-ITS applications, community awareness campaigns to secure high levels of acceptance by road users, and working groups to address key issues such as privacy.

It is anticipated that the level of resourcing required will evolve over time, with specific decisions on resourcing by governments being made at appropriate times taking into account particular needs and the availability of resourcing.

Over time, it is likely that the proportion of the total resource requirements that will come from governments would decrease, with governments taking on the role of being a 'gate-keeper' of standards, management of radio spectrum, management of C-ITS devices, regulation and management of protocols for interfaces between vehicles and infrastructure. Although the proportion of the total resource requirement from governments may decrease, the actual resource commitment may grow with increased deployment of C-ITS devices (in particular, due to the potential management role associated with C-ITS devices operating on the 5.9 GHz spectrum). As the demand for C-ITS applications increases, the input required by the private sector would likely increase; however, it will be mostly funded from business applications.



Notes:

1 Others include the motor vehicle industry; information, communication and technology (ICT) designers and manufacturers; C-ITS related industries (such as positioning, telematics, C-ITS software and hardware developers and researchers, etc.); motoring organisations (such as the various state motorists' clubs – RACQ, RACV, NRMA, etc.); industry organisations (such as ITS-Australia); road safety community groups (e.g. RoadSafe Victoria); and users.

2 The trend depicted in this figure, with respect to the proportions of resource commitments, may change in the years beyond initial deployment (or year 5) and is conceptual only.

Figure 7.3: Indicative relative shares of resource commitments

In summary, deployment of C-ITS in Australia will require tasks to be undertaken across six key areas. The tasks would need be undertaken over the next five years, with many tasks being ongoing into the future. As the timeframe for the deployment of C-ITS in Australia evolves, the total resource commitment required between governments, the industry and users will grow, with the proportion of the total resources required from governments likely to decrease. Although the proportion of total resources required from governments may decrease, the actual resource commitment required from government is likely to grow relative to the potential increase in the deployment of C-ITS units.

8 CONCLUSIONS

C-ITS has the potential to revolutionise the road transport sector as it is known. It has the potential to provide significant benefits and outcomes to both road users and road operators through the provision of new types of applications and services that specifically provide enhanced safety, productivity, efficiency and environmental outcomes, together with a myriad of road user and road operator services to motorists.

A great deal of work has been undertaken internationally with respect to the development of C-ITS. It is expected that C-ITS equipped vehicles would be available through large-scale production to the Australian market between 2016 and 2020 (subject to international developments). If Australia is to maximise the benefits from the C-ITS initiative, it needs to undertake of series of tasks that would enable the deployment of C-ITS equipped vehicles into the Australian market place as soon as they become available internationally.

This document outlines a series of tasks that need to be undertaken to enable the deployment across six areas (including policy requirements, international and national engagement, technical requirements, platform development, trials and demonstrations, and marketing and communications). The successful deployment of C-ITS equipped vehicles in Australia would be undertaken through a collaborative effort between governments, the industry and users. It is noted that the strategic plan (including the defined tasks) is a living document requiring regular reviews and amendments based on the emerging developments of C-ITS, nationally and internationally.

In order to deliver the tasks identified in this strategic plan, it is proposed that the current C-ITS Austroads project be transformed into an appropriate delivery mechanism for the effective delivery of the tasks. In doing so, it needs to be acknowledged that many of the tasks must be undertaken in parallel by dedicated multifunctional and multidisciplinary teams who are tapped into the international scene.

The Australian C-ITS program is primarily about establishing the expertise and knowledge to set up the necessary preconditions, these being: technical, policy, and management regimes to enable the global C-ITS platform to operate successfully in Australia so that the vehicle industry can deploy C-ITS equipped vehicles and applications. Where considered appropriate, Australia should also provide direct input into international processes, decisions and standards that may affect C-ITS operations in Australia.

It is anticipated that the size of the resources required by governments, the vehicle industry and other stakeholders to deploy C-ITS in Australia would grow each year with the proportion of the total resources required from governments likely to decrease over time. Although the proportion of total resources required from governments may decrease, the actual resource commitment required from governments is likely to grow relative to the potential increase in the deployment of C-ITS units. In this sense, ongoing resources after the C-ITS platforms and applications have been effectively deployed would need to be tailored to the ongoing management of ongoing activities (e.g. management of radio spectrum), maintenance and increased deployment of new and improved applications and devices. Plans are already underway for Austroads to act as the interim entity for the management of ongoing C-ITS activities while a model and roles for a permanent entity is being developed.

Implementing C-ITS in Australia would be a substantial task and could well be one of the most significant transportation programs undertaken with respect to road-based transport over the coming decade. It would require the cooperation of the industry (in particular, the vehicle industry), governments, transport operators, research institutions, universities and supporting organisations.

The strategic plan will enable Australia to be:

- aware of the direction needed to be taken in order to deploy C-ITS in Australia
- in a position to develop a C-ITS architecture to be incorporated into the ITS architecture being developed for Australia under Austroads project NS1696
- able to overcome barriers to the deployment of C-ITS.

The strategic plan is required in order to enable governments to:

- set the direction and provide leadership to maximise the return to the Australian community
- address policy, legal, institutional and technical issues and challenges on a national basis in a strategic manner
- adopt and leverage off work undertaken internationally
- provide a nationally harmonised platform(s) that is consistent with key international developments so that the industry can deploy devices and applications built overseas into the Australian market
- deliver safety, productivity and environmental outcomes, and provide additional services to the road user and road operator
- prioritise projects and tasks to enable Australia to be well placed to reap early the benefits of this new technology by being prepared and ready for a phased introduction of C-ITS
- focus effort, resources and expenditure on priority projects.

Successful C-ITS delivery would depend on the level to which Australia engages and contributes to the international agenda, the extent of specialist expertise and resources brought to bear through effective leadership and management, and the extent and pace that effective communication strategies inform and encourage consumers to adopt this new technology.

REFERENCES

Andersen, C & McKeever, B 2011, *V2I for safety: roadmap, accomplishments and constraints*, US Department of Transportation, Washington, DC, 19 ppt. slides, viewed 30 September 2011, <http://www.its.dot.gov/presentations/L_V2I_Safety2011_files/frame.htm>.

Arndt, M 2009, 'Towards a pan European architecture for cooperative systems: status on standardization', *ITS world congress and exhibition on intelligent transport systems and services, 16th, Stockholm, Sweden*, ITS America, Washington, DC, USA, 12 ppt. slides, viewed 4 October 2011, <http://www.etsi.org/WebSite/document/Technologies/ETSIpresentations/SIS17_Arndt.pdf>.

Australian Transport Council c.2001, *The national road safety strategy: 2001-2010*, Australian Transport Safety Bureau, Canberra, ACT.

Australian Transport Council 2011, *National road safety strategy 2011-2020*, ATC, Canberra, ACT.

Austroads 2009, *Austroads' submission on the Australian Communications and Media Authority's discussion paper: 'Planning for intelligent transport systems'*, Australian Communications and Media Authority, Canberra, ACT, viewed 12 August 2010, <http://www.acma.gov.au/webwr/_assets/main/lib311208/austroads_ifc27-09.pdf>.

Austroads 2010, *Defining applicability of international standards for intelligent transport systems (ITS): final report*, AP-R368/10, Austroads, Sydney, NSW.

Austroads 2011a, *Evaluation of the potential safety benefits of collision avoidance technologies through vehicle to vehicle dedicated short range communications (DSRC) in Australia*, AP-R375/11, Austroads, Sydney, NSW.

Austroads 2011b, *Examination of major policy issues relating to introduction of cooperative ITS to Australia*, AP-R383/11, Austroads, Sydney, NSW.

Council of Australian Governments 2006, *Review of urban congestion: trends, impacts and solutions*, Bureau of Transport and Regional Economics (BITRE), Canberra, ACT.

CVIS n.d., *CVIS: Cooperative Vehicle Infrastructure Systems*, homepage, CVIS, Ertico ITS, Brussels, Belgium, viewed 4 October 2011, <http://www.cvisproject.org/>.

Drive C2X n.d., *Road to market*, Drive C2X: Accelerate cooperative mobility project website, European Commission Information Society, viewed 29 September 2011, <http://www.drive-c2x.eu/road-to-market>.

European Commission 2011, *Intelligent transport systems: action plan and directive*, European Commission, Brussels, Belgium, viewed 5 October 2011, <http://ec.europa.eu/transport/its/road/action_plan/action_plan_en.htm>.

European Telecommunications Standards Institute 2008, *Achieving technical interoperability: the ETSI approach*, white paper no. 3, ETSI, Sophia Antipolis, France.

European Telecommunications Standards Institute 2010, *Intelligent transport systems (ITS); vehicular communications; basic set of applications; part 1: functional requirements*, ETSI TS 102 637-1 V1.1.1 (2010-09), ETSI, Sophia Antipolis, France.

ITS International 2010, 'Cooperative mindset', *ITS International* ,10 March 2010, Route One Publishing, Kent, UK, viewed 12 December 2012, <http://www.itsinternational.com/features/article.cfm?recordID=4176>.

Lee, S 2011, *Study on the 'collecting & providing services of vehicle information' in Korea, ETSI TC ITS Workshop, 3rd, Venice, Italy*, ETSI, Sophia Antipolis, France, viewed 5 April 2011, <http://docbox.etsi.org/Workshop/2011/201102_ITSWORKSHOP/04_COOPERATIVESYSTEMS_usecase_apps_services/ITSKOREA_SANGHYUN_collectingandprovidingservices.pdf>.

Research and Innovative Technology Administration n.d., *Intelligent transportation systems joint program office*, homepage, RITA, US Department of Transportation, Washington DC, USA, viewed 7 October 2010, <http://www.its.dot.gov/>.

Research and Innovative Technology Administration 2007, *National ITS architecture: executive summary*, RITA, US Department of Transportation, Washington, DC, USA, viewed 7 October 2010, < http://www.iteris.com/itsarch/html/menu/documents.htm >.

Research and Innovative Technology Administration 2011, *Connected vehicle technology: safety pilot driver acceptance clinic overview*, RITA, US Department of Transportation, Washington, DC, USA, viewed 26 August 2011, <http://www.its.dot.gov/research/safety_pilot_overview.htm>.

APPENDIX A EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI) USE CASES

Recognising the need for a pragmatic approach to the initial deployment of C-ITS, the European Telecommunications Standards Institute (ETSI) has a list of potential applications/use cases that are considered as deployable within the initial period after the complete standardisation of the system (i.e. deployment of the platform(s)). The complete list of the use cases are listed in Table A 1. It is noted that, as of 2011, the use cases identified in the following table are suggestions only at this stage, with some being developed into test applications for trialling and assessing the benefits. It is also noted that the list of use cases is likely to change over time with the development of new use cases and/or the removal of old use cases. Therefore, Australia needs to keep abreast of the current list of use cases.

Table A 1: ETSI use cases

Application type	Applications class	Application	UC No.	Use case
Safety	Active road safety	Driving Assistance – Cooperative Awareness	UC001	Emergency vehicle warning
			UC002	Slow vehicle indication
			UC003	Intersection collision warning
			UC004	Motorcycle approaching indication
		Driving Assistance – Road Hazard Warning	UC005	Emergency electronic brake lights
			UC006	Wrong way driving warning
			UC007	Stationary vehicle – accident
			UC008	Stationary vehicle – vehicle problem
			UC009	Traffic condition warning
			UC010	Signal violation warning
			UC011	Roadwork warning
			UC012	Collision risk warning
			UC013	Decentralized floating car data – Hazardous location
			UC014	Decentralized floating car data – Precipitations
			UC015	Decentralized floating car data – Road adhesion
			UC016	Decentralized floating car data – Visibility
			UC017	Decentralized floating car data – Wind
Productivity, efficiency and environmental	Cooperative traffic efficiency	Speed Management	UC018	Regulatory/contextual speed limits notification
			UC019	Traffic light optimal speed advisory
		Cooperative Navigation	UC020	Traffic information and recommended itinerary
			UC021	Enhanced route guidance and navigation
			UC022	Limited access warning and detour notification
			UC023	In-vehicle signage

Application type	Applications class	Application	UC No.	Use case
Road user and road operator services	Cooperative local services	Location Based Services	UC024	Point of Interest notification
			UC025	Automatic access control and parking management
			UC026	ITS local electronic commerce
			UC027	Media downloading
	Global internet services	Communities Services	UC028	Insurance and financial services
			UC029	Fleet management
			UC030	Loading zone management
		ITS Station Life Cycle Management	UC031	Vehicle software/data provisioning and update
			UC032	Vehicle and RSU data calibration

Source: European Telecommunications Standards Institute (2010).

APPENDIX B US TRIALS OF V2V APPLICATIONS

The US DOT working with the Crash Avoidance Metrics Partnership (CAMP), a research consortium of eight vehicle manufacturers, will be undertaking driver clinics and a large-scale model deployment as discussed below (Research and Innovative Technology Administration n.d.)

B.1 Driver Clinic Feedback on V2V Applications

This will be undertaken as safety pilots conducted across six states. The safety pilots will look at user acceptance of the technology and the user acceptance to pay for and embrace the technology.

The V2V applications that will be tested for driver acceptance include:

- Emergency Electronic Brake Light (EEBL)
- Forward Collision Warning (FCW)
- Blind Spot Warning (BSW)/Lane Change Warning (LCW)
- Intersection Movement Assist (IMA)
- Do Not Pass Warning (DNPW).

A total of 24 original equipment manufacturer (OEM) passenger vehicles will be built for the safety pilots that are fully equipped with the aforementioned five V2V safety applications fully integrated into the vehicle with a commercial production finish. Clinics involving three to four fully equipped trucks will be undertaken separately.

At least 100 participants will be selected to participate in each of the six driver clinics.

B.2 Actual Model Deployment

This will be undertaken on 3000 vehicles in a concentrated area, with the aim being to estimate the benefits of the connected vehicle applications. The model deployment will also include roadside infrastructure that is able to connect to the vehicle.

The 3000 vehicles will be made up of:

- fully integrated V2V and V2I OEM passenger vehicles
- fully integrated V2V and V2I OEM trucks
- vehicles equipped with aftermarket V2V and V2I devices
- vehicles equipped with devices able to broadcast their position (i.e. 'here I am' devices).

APPENDIX C TASKS REQUIRED TO BE UNDERTAKEN TO DEPLOY C-ITS IN AUSTRALIA

Table C 1 provides an indicative work/activity program for the next five years and beyond. The program would require contributions from both governments and the industry. A total of 42 tasks across the various components of the delivery and management framework (with the exception of governance) have been identified.

Governance tasks have not been included in this table as they are overarching. They govern and drive the direction of the tasks listed within Table C 1. Governance tasks are as follows:

- Set up an appropriate structure and appoint a project leader responsible for delivering C-ITS in Australia.
- Oversee, provide direction, set tasks, and ensure tasks are delivered with respect to the C-ITS delivery and management framework.
- Make key decisions on the direction taken for C-ITS.
- Undertake key stakeholder engagement.
- Set up the appropriate regulatory framework and authority, implement acts of parliament and contribute to the development of ITS architecture.

The 42 C-ITS related tasks identified across the various components of the C-ITS delivery and management framework that are to be addressed are based around and expanded on those issues identified by the C-ITS Industry Reference Group (Austroads 2011b). They can be briefly summarised as follows:

- dynamic and uncertain environment
- interoperability
- functions, responsibilities, liabilities and governance
- privacy and security
- human machine interface (HMI)
- digital mapping and positioning
- communications
- aftermarket applications
- potential for conflict between commercial applications, network management and good practice driving
- roadworthiness
- building consumer confidence and market penetration.

The tasks have been allocated to be undertaken within a specific phase, as shown in Figure 7.1 and Figure 7.2. This guides when the actual task would be undertaken within the five-year timeframe.

A schedule has been determined for when tasks are to be undertaken as listed in Table C 1. This schedule is indicative only and is very much subject to international developments with respect to C-ITS, especially those tasks assigned to be commenced in Year 2 and beyond. As of 2011, Australia is in a position (based on international developments) to progress towards commencing those tasks assigned to Year 1. Table C 1 should be continually reviewed and amended based on the actual program for the delivery of the tasks. In addition, it is noted that it is likely that the number of tasks required to be undertaken would expand as the journey of C-ITS deployment in Australia unfolds.

The tasks listed in Table C 1 have been prioritised based on the following two deployment models:

- **C-ITS deployment model 1**: Governments undertake a minimum effort to enable the industry to deploy C-ITS and its applications (with the applications deployed being based on market forces, which may or may not be in line with the primary objective of governments – being to deliver safety outcomes)
- **C-ITS deployment model 2:** Undertake a joint effort between governments and the industry, where governments put some of the systems and processes in place to enable both the governments' (safety and transport) and the industry's objectives to be met and services to be delivered, while the industry develops their business models (through support and encouragement from governments) to enable C-ITS applications and devices on the global platform to be deployed in Australia.

In order to progress safety, environmental and productivity outcomes, and provide road user and road operator services beyond current practice, it is recommended that model 2 be adopted. If the governments do not want to invest the resources and funds required to implement model 2, then consideration could be given to model 1. However, the outcome of model 1 may not be as desirable as that associated with model 2 and as a consequence the safety benefits of C-ITS may not be maximised.

The priority assigned to each task in Table C 1 is described below. This priority regime provides guidance in terms of defining how flexible the schedule for these tasks can be. The priority option is primarily applicable to governments for model 2, and primarily applicable to the industry for model 1.

- P1 (Priority 1): must be commenced as soon as possible and undertaken in accordance with the anticipated timeframe specified in Table C 1; must have resources dedicated to the task.
- P2 (Priority 2): should be commenced and undertaken in accordance with the anticipated timeframe specified in Table C 1; the timeframe may be pushed out slightly but generally by no more than one year, resources should be dedicated to the task and should not be taken away from high priority tasks in order to undertake medium priority tasks.
- P3 (Priority 3): it is desirable to have these tasks undertaken in accordance with the anticipated timeframe specified in Table C 1; however, the timeframe may be pushed out slightly but generally by no more than two years. Resources should be dedicated to the task; however, resources should not be taken away from the high and medium priority tasks in order to undertake these lower priority tasks.
- P4 (Priority 4): tasks that may not need to be undertaken.

Appendix D outlines the skills sets envisaged to be required to undertake the tasks listed in Table C 1.

Table C 1: C-ITS related issues delivery program table

C-ITS roadmap to deployment – task program		Year*								Priority	
		1	2*	3*	4*	5*	5+*	5++*	5+++*	2**	1***
Policy requirements											
1	Developing and implementing policies to ensure one platform for Australia (this includes developing architectures and standards).		1	2	3	4	5	5	5	P2	P2
2	Developing and implementing policies to maximise user acceptance, in addition to understanding the customer's willingness to pay, and establishing business models either independently or in combination or through cross leveraging with other projects.			1	2	4	4	5	5	P2	P2
3	Developing and implementing policies to promote the fast uptake of the technology.						1	2	5	P3	P4
4	Developing and implementing policies with respect to the retrofitting of aftermarket devices to maximise early benefits.					1	3	4	5	P3	P4
5	Mapping the key functions, stakeholders and allocation of responsibilities for C-ITS deployment.				1	1				P2	P2
6	Developing and implementing policies to ensure privacy for customers.				1	2	3	4	5	P1	P1
7	Establishing the legal framework and clearly clarifying the users' and authorities' roles and responsibilities with respect to any litigation.				1	2	3	4	5	P1	P1
8	Developing and implementing policies to ensure the C-ITS system cannot be tampered with and/or viewed or used by unauthorised parties.				1	2	3	4	5	P1	P1
9	Understanding data ownership and allocation of risk.				1	2	3	4	5	P1	P1
10	Securing the 5.9 GHz spectrum and defining and implementing a management regime.	1	1	2	3	4	4	4	4	P1	P1
11	Establish the policies, rules, minimum standards and operating requirements for all applications and services to be deployed on the platform.			2	2	2				P1	P1
12	Establishing product testing and certification requirements.			2	2	2				P2	P2
13	Undertaking research to address policy issues/matters as they arise and to fill knowledge gaps.	As required								N/A	N/A
International and national engagement											
14	Leverage off existing committees (such as IT-023) and establish and maintain a single entity (e.g. project team) responsible for national and international engagement, including engaging, embedding, establishing and maintaining professional connections with key international bodies and stakeholders.	1	1	1	1	1	1	1	1	P1	P4
15	In line with emerging international and national C-ITS developments further define, scope and prioritise activities of the C-ITS program including identifying skills sets and resourcing.				1	1	1	1	1	P1	P4
16	Establish a systematic and coordinated approach to knowledge gathering and transfer.	1	1	1	1	1	1	1	1	P1	P3

	C-ITS roadmap to deployment – task program	Year*								Priority	
		1	2*	3*	4*	5*	5+*	5++*	5+++*	2**	1***
	Technical requirements										
17	Be well informed of international developments on architectures and standards to advise, steer and update the project appropriately (this also includes assisting in the development of the ITS architectures and standards).	1	2	2	2					P1	P1
18	Contribute to the development of architecture and standards internationally and compare the architectures and standards being developed with the Australian C-ITS requirements, and modify and align accordingly.	1	2	2	2					P1	P1
19	Adopt appropriate architecture and standards for Australia.		1	2	2					P1	P1
20	Interpret the entire technical environment, including C-ITS architecture, and refer to and incorporate it in the development of the national ITS architectures and standards.		1	2	2					P2	P2
21	Adopt detailed concept of operations (CONOPS) and functional requirements for the platform and for each proposed new application.					2	2	2	2	P2	P2
22	Determine how prioritising of messaging (i.e. safety versus operational applications) will be achieved.			1	2	2				P2	P2
23	Develop, adopt and adapt specifications for all devices and communications systems within and with C-ITS (including control systems, backhaul systems, in-field civil infrastructure, in-vehicle units and roadside units).			1	2	2				P2	P2
24	Understanding what data is required in the data dictionary (i.e. what information is to be sent to and from the roadside units and on-board units) and confirming that the data dictionary as defined by a global platform will not cause issues for deployment in Australia (this will be referred to and incorporated in the development of the national ITS architectures and standards).		1	1	2	2				P2	P2
25	Understand the testing regime and requirements developed globally for all devices and associated equipment and verify that devices and associated equipment to be deployed in Australia have met the testing regime; and be comfortable that the testing regime for each device and associated equipment is appropriate to ensure that the devices and associated equipment are safe for operation prior to being deployed for public consumption.				1	2	2			P3	P3
26	Adopt and understand the vehicle identification and certificate requirements as developed globally to enable C-ITS to undertake its objectives while satisfying any privacy and data security requirements.				1	1	2	2		P3	P3
27	Determine how to technically implement the international vehicle profile for C-ITS in Australia.		1	1	2	2				P2	P2
28	Determine the aspects/functions of systems (e.g. signal controllers, VMS, VSL, communications networks, SCATS and STREAMS) that have legacy risks needing work in order to be compatible with C-ITS, and the extent of change needed and effort required (this includes commencing work towards national standardised systems).		1	1	2	2				P3	P3
29	Identify any additional Australian design rules (ADR) required and/or any associated revisions and changes.				1	2	2			P3	P3
30	Technically finalise the allocation of the 5.9 GHz band for C-ITS.	1								P1	P1
31	Understand the international position with respect to the HMI requirements for deployed applications and adopt them.		1	1	2	2				P3	P3
32	Determine the technical requirements for Australia in relation to positioning and mapping based on the C-ITS applications proposed to be deployed.	1	1	1	2	2				P2	P2

C-ITS roadmap to deployment – task program	Year*								Priority	
	1	2*	3*	4*	5*	5+*	5++*	5+++*	2**	1***
33 Undertaking research to address technical issues/matters as they arise and to fill knowledge gaps.	As required								N/A	N/A
Platform deployment										
34 Identify what the governments and their statutory authorities (local, state, federal) need to do; preparation of business cases to justify deployment; and identify changes in the business processes of state road authorities (SRAs) and local governments as a result of deploying C-ITS (although a large part of this task will be undertaken after the development of a national ITS architecture and once C-ITS has been developed to a level where it is ready for deployment, some parts of this task may need to be undertaken in the medium-term).				1	1	2	2	2	P3	P3
35 Delivering C-ITS deployment in the field (to be delivered at a state based and/or local level rather than at a national level).			3	3	4	4	4	4	P3	P3
Trials and demonstrations										
36 Undertake trials that are in line with the applications likely to be deployed onto the platform and are in accordance with the Australian government's position with respect to C-ITS (to be undertaken at a state based and/or local level rather than at a national level).			3	3	3	3	3	3	P3	P3
37 Set up a national central unit where trials can be encouraged, facilitated and coordinated; and information obtained from the trials disseminated and aligned with marketing in order to galvanise community interest.			3	3	3	3	3	3	P3	P3
38 Where possible, align existing and future trials with the architecture, standards and applications likely to be deployed onto the global platform.			3	3	3	3	3	3	P3	P3
39 Undertaking trials to ensure that new applications developed internationally function at an acceptable level (i.e. the probability of a fault occurring is at an acceptable level as deemed by the application); and to market test prototype C-ITS applications in order to monitor user acceptance prior to initial and wider scale deployment.			3	3	3	3	3	3	P3	P3
Marketing and communications										
40 Develop and implement a marketing strategy to promote public uptake and interest in the technology in order to aid deployment.			5	5	5	5	5	5	P3	P4
41 Obtain an appreciation of what C-ITS applications will drive the deployment of C-ITS.			5	5	5	5	5	5	P3	P4
42 Undertake stakeholder engagement, manage media and communications with industry and the public, engage the public in discussion/debate on C-ITS, and educate the public on the benefits of C-ITS.			5	5	5	5	5	5	P3	P4

Table legend and notes on the following page.

Table C 1 notes:

* Tasks assigned to commence in Year 2 and beyond are subject to international developments and as such the actual timing for commencement may be different from that outline in Table C 1.
** C-ITS deployment model 2 as discussed in Appendix C. C-ITS deployment model 2 is 'Undertake a joint effort between governments and the industry where governments puts systems in place to enable governments' objectives to be met, while the industry establishes the mechanism to enable the deployment of C-ITS.
*** C-ITS deployment model 1 as discussed in Appendix C. C-ITS deployment model 1 is 'Governments undertake the minimum effort to enable the industry to deploy C-ITS in a structured manner'.
n/a = not applicable. The task applies to all tasks and across all phases simultaneously.

Table C 1 priority legend:

P1 (Priority 1): Must be commenced and undertaken in accordance with the anticipated timeframe specified in the table. Must have resources dedicated to the task.
P2 (Priority 2): Should be commenced and undertaken in accordance with the anticipated timeframe specified in the table; however, the timeframe may be pushed out slightly but by no more than one year. Resources should be dedicated to the task; however, resources should not be taken away from high priority tasks in order to undertake medium priority tasks.
P3 (Priority 3): It is desirable to have these tasks undertaken in accordance with the anticipated timeframe specified in the table; however, the timeframe may be pushed out slightly but by no more than two years. Resources should be dedicated to the task; however, resources should not be taken away from the high and medium priority tasks in order to undertake these low priority tasks.
P4 (Priority 4): Tasks that may not need to be undertaken.

Table C 1 shading legend:

Development phases
1 = Phase 1. Establishing foundations – defining high level requirements and business processes.
2 = Phase 2. Establishing C-ITS requirements – adopting and adapting international platform.

Delivery phases
3 = Phase 3. Developing applications and devices – prototyping and demonstrating.
4 = Phase 4. Platform deployment – including managing service and basic infrastructure roll out.
5 = Phase 5. Increasing market penetration – aftermarket devices, promotion and mandating.

Miscellaneous
AR = as required.

APPENDIX D SKILLS SETS REQUIRED FOR THE DEPLOYMENT OF C-ITS IN AUSTRALIA

Table D 1 provides a skills sets matrix required for the 42 tasks to be undertaken as contained in Appendix C. This table shows the number of tasks requiring involvement from a particular skill set, but does not reflect the amount of resources required. Some of the skills sets may be combined. Some may be only a small contribution to the delivery of a task and hence able to be engaged on an 'as needs' basis (e.g. contract role) rather than fully engaged within a C-ITS project team. The dominant skills sets across the 42 tasks are policy writers/specialists, traffic engineers, road safety engineers, operational specialists, technical specialists (system engineers and communications engineers) and network engineers. The necessary specialists may need to be sourced from outside the road agencies to enable C-ITS to be deployed in Australia.

.

Table D 1: Skills set matrix envisaged for the deployment of C-ITS in Australia

No.	Skill set	Task number as per Table C 1																																										Number of task requiring involvement
		Policy requirements													International and national engagement			Technical requirements																	Platform deployment		Trials and demonstrations				Marketing and communications			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
1	Lawyers and other legal specialists	✓	✓				✓	✓	✓	✓	✓	✓		✓																														9
2	Policy writers/specialists	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																		✓									17
3	Strategic leaders														✓	✓	✓																											3
4	Contract managers (experienced in service provision and management)																																			✓								1
5	Project managers												✓							✓	✓															✓	✓	✓	✓	✓				4
6	Business analysts		✓		✓									✓																					✓									4
7	Economic modellers		✓											✓																					✓									3
8	Marketing specialists		✓	✓	✓									✓			✓																		✓						✓		✓	8
9	Writers and journalists																✓																									✓		2
10	Human machine interface specialists (psychologists and behavioural scientists)																															✓		✓										2
11	Traffic engineers	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓	✓				✓				✓					✓										18
12	Road safety engineers	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓																														11
13	Human factors and behavioural specialists																																									✓		1
14	ICT project managers																	✓	✓	✓	✓	✓		✓	✓			✓						✓										9

No.	Skill set	Task number as per Table C 1																																										Number of task requiring involvement
		Policy requirements													International and national engagement			Technical requirements																	Platform deployment		Trials and demonstrations				Marketing and communications			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
15	Communications engineers																						✓	✓	✓									✓		✓								5
16	Operational specialists	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			✓				✓					16
17	Technical specialists (system engineers and communications/radio engineers)	✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓																											13
18	Safe systems engineers		✓	✓									✓	✓								✓		✓		✓								✓										8
19	Electronic engineers																	✓	✓	✓	✓							✓						✓	✓									7
20	Network engineers																	✓	✓	✓	✓	✓		✓				✓	✓					✓	✓									10
21	Radio frequency engineers																	✓	✓	✓	✓							✓						✓										6
22	Spatial scientists																																✓	✓										2
23	System architects																	✓	✓	✓	✓	✓		✓	✓			✓						✓										9
24	Technical specification writers																		✓		✓			✓				✓								✓								1
25	Device and system testing and audit specialists																																			✓								1
26	Automotive engineers				✓									✓											✓					✓				✓										5
27	Privacy specialists						✓						✓	✓																														3
28	IT security specialists												✓	✓													✓							✓										4
29	Database and web managers																✓																											1
30	Software engineers																						✓				✓	✓	✓					✓										5

INFORMATION RETRIEVAL

Austroads, 2012, **Co-operative ITS – Strategic Plan**, Sydney, A4, pp. 51. AP-R413-12
Keywords: Cooperative Intelligent Transport Systems, Cooperative ITS, Strategic Plan, connected vehicle. **Abstract:** The Cooperative Intelligent Transport Systems (C-ITS) platform is a system that has the potential to make a substantial contribution to moving people and goods safely and efficiently. This is achieved by connecting road users in their vehicles to their road environment through real-time information exchange about their road environment, such as road and traffic conditions, events, threats and potential hazards. C-ITS has the potential to deliver many safety, productivity, efficiency and environmental outcomes to the road sector, while providing enhanced road user and road operator services. The potential benefits of the myriad of applications able to be delivered through C-ITS are considered to outweigh the cost of deploying C-ITS in Australia. Austroads and its members have identified the potential benefits of C-ITS for the Australian road transport sector and have also identified the need for a strategic plan to be developed that sets a clear direction for Australia with respect to the deployment of C-ITS. The plan also outlines the definition of C-ITS, its mission, vision, objectives and guiding principles for Australia, and finally provides an indication of how C-ITS would be deployed in Australia.