mainroads
WESTERN AUSTRALIA

Our Roadmap to enabling C-ITS in Western Australia

2024 – 2028

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Executive Summary

What is C-ITS?

Cooperative Intelligent Transportation Systems (C-ITS) are a group of technologies that allow effective data exchange, offering road users the right information at the right time, based on where there they are and the situations they encounter.[1]

Benefits of C-ITS

C-ITS provides warnings and information to drivers and information to traffic operators to improve safety, movement and operational efficiency, environmental sustainability, and a better customer experience.

C-ITS requires collaboration

A nationally harmonised C-ITS ecosystem is necessary to maximise the benefits of C-ITS across WA and Australia. C-ITS requires collaboration between government, industry, and road users to enable:

+ C-ITS safety, efficiency, and sustainability benefits across WA.
+ A harmonised national system.
+ Real-time data to optimise operations.
+ Improved and consistent data sets for network operations across Australia.

Our C-ITS Vision

> The Main Roads C-ITS Roadmap will support the implementation of a nationally harmonised C-ITS ecosystem across the Western Australian road network to enhance safety, movement, regional resilience, and enable future vehicle technology.

How C-ITS can help

Some of the challenges on our metropolitan, regional, and rural road network include:

1. Safety for all road users at signalised intersections.
2. Keeping road users informed about changes to the road environment.
3. Delivering real-time road network event alerts across metropolitan, regional, and rural roads.
4. Managing competing road user priorities.

C-ITS use cases can address some of the key challenges on our road network and support realisation of benefits and our Vision. A recent study into the benefits of C-ITS has revealed benefits of over $11 billion across Australia over the next 10 years following deployment.[2]

C-ITS Deployment Strategy

Our deployment strategy aims to maximise early C-ITS benefits and achieve our C-ITS Vision by:

+ Aligning to the national approach and collaborating with other jurisdictions to deploy C-ITS in a harmonised way that promotes industry investment in C-ITS in Australia.
+ Leveraging C-ITS learnings from other jurisdictions to reduce deployment risks, timeframes, and costs. In parallel, testing and enabling C-ITS use cases that address our road challenges and support our policies and strategies in WA.
+ Building local capability and partnerships and incorporating C-ITS services and data into existing systems to support and develop a sustainable C-ITS industry.

C-ITS Roadmap

Coordinated action streams are needed to realise the potential of C-ITS in Western Australia. These align to, and support, the National Road Transport Technology Strategy and 2024-27 National CAV Action Plan.

Our roadmap consists of seven action streams:

1. **Collaboration and Research**
   Collaborate with research bodies and industry to further national understanding.
2. **National Harmonisation**
   Participate in national efforts to plan for harmonised C-ITS implementation with secure systems that manage the privacy of data to ensure a trusted transport environment.
3. **Future Proofing**
   Prepare for future vehicle technologies and set up foundational infrastructure for C-ITS deployment across WA over time.
4. **Proofs of Concept**
   Run a local testbed and/or test corridor(s) to develop readiness of C-ITS applications and identify any specific needs in WA.
5. **Capability Uplift**
   Provide opportunities to staff, working in conjunction with research bodies and industry, to develop capabilities in systems engineering, data engineering, cloud systems, and ITS architecture to support business change required for C-ITS in WA.
6. **Systems Uplift**
   Identify and implement the changes required to the ITS environment to support C-ITS use case deployment.
7. **Data Quality, Use, and Management**
   Improve road agency data to facilitate emerging C-ITS applications and, in turn, improve availability and quality of ITS data.

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Abbreviations

ACV2
Advanced Connected Vehicles Victoria

ADS
Automated Driving Systems

AIMES
Australian Integrated Multimodal EcoSystem

AV
Automated Vehicle

ANCAP
Australasian New Car Assessment Program

BCR
Benefit to Cost Ratio

C-ITS
Cooperative Intelligent Transport Systems

C2C-CC
CAR 2 CAR Communication Consortium

CAV
Connected and Automated Vehicle

CAVI
Cooperative Automated Vehicle Initiative

CCAM
Cooperative Connected and Automated Mobility

CCMS
C-ITS Credential Management System

CITI
Cooperative Intelligent Transport Initiative

C-Roads
C-Roads Platform is a joint initiative of European Member States and road operators for testing and implementing C-ITS services in light of cross-border harmonisation and interoperability

CV
Connected Vehicle

DSRC
Dedicated Short Range Communication; also known as ITS-G5

ETSI
European Telecommunications Standards Institute

EU
European Union

FRAME
European Intelligent Transport Systems Framework Architecture

FSI
Fatal and Serious Injuries

GLOSA
Green Light Optimal Speed Advisory

IT
Information Technology

ITS
Intelligent Transport Systems

ITS-G5
European standard for vehicular communications based on the IEEE 1609.X and IEEE 802.11p standards; also known as Dedicated Short Range Communication (DSRC)

I2V
Infrastructure-to-Vehicle

MRWA
Main Roads Western Australia

NSW
New South Wales

OEM
Original Equipment Manufacturer

OT
Operational Technology

OSOM
Over-size Over-mass

PATREC
Planning and Transport Research Centre

PoC
Proof of Concept

PVD
Probe Vehicle Data

SCMS
Security Credential Management System

SPTI
Signal Phasing and Timing Information

TTG
Time to Green

USDOT
United States Department of Transportation

V2I
Vehicle-to-Infrastructure

V2V
Vehicle-to-Vehicle

V2X
Vehicle-to-Anything

VRU
Vulnerable Road Users

WA
Western Australia

01

Introduction

Using C-ITS technology we can meet the current demands of the transport network and future-proof in the face of evolving mobility needs, technological advancements, and sustainability considerations.

01

Introduction

1.1 Purpose of this document

C-ITS has the potential to accelerate the realisation of our goals to improve safety, productivity, mobility, and sustainability for Western Australians. Our ITS Master Plan[3] identifies the need for a C-ITS Roadmap (this document).

The purpose of this C-ITS Roadmap is to establish our C-ITS Vision, C-ITS Deployment Strategy, and a short- to medium term roadmap with actionable steps to realise the benefits of C-ITS in WA.

This C-ITS Roadmap comprises:

+ **Introduction**
  Defines C-ITS and its benefits.
+ **Strategic context**
  Outlines the drivers for C-ITS from national and international policy and strategy.
+ **C-ITS Vision**
  States our goal for C-ITS and alignment to the ITS Policy[4] and ITS Master Plan.
+ **Key challenges for the Western Australian road network**
  Identifies the key challenges on our road network.
+ **C-ITS Use Cases for Western Australia**
  Identifies C-ITS use cases that could address key challenges to be considered in deployment and Proofs of Concepts (PoCs).
+ **C-ITS Deployment Strategy and Roadmap for Western Australia**
  Outlines a deployment strategy to realise the benefits of C-ITS, and defines key actions and initiatives that provide a clear direction for implementation of C-ITS services across Western Australia.

1.2 What is C-ITS?

C-ITS enables sharing of critical information

Connected vehicles (e.g. vehicles with inbuilt SIM cards) have the capability to communicate with other vehicles, road users, infrastructure, and wireless services.[5] C-ITS are a standards-based implementation of connected vehicles that enables harmonised communications between road users and road operators. C-ITS offers road users the right information at the right time, based on where they are and the situations they encounter.[6]

C-ITS is the technology that enables real-time communication between:

+ Vehicle-to-Vehicle (V2V)
+ Vehicle-to-Infrastructure (V2I)/ Infrastructure-to-Vehicle(I2V)
+ Vehicle-to-Anything (V2X)

C-ITS is distinct from automation

Connected vehicles (CVs) and automated vehicles (AVs) are developing in parallel, largely independent of each other. A convergence of the two technologies may occur in the future as technology and penetration increases (shown in Figure 1), with vehicles able to use both automated and connected capabilities together.

C-ITS is real-time

Real-time information can be broadly defined as information that is updated "in a short enough period of time such that the data appears to reflect reality at the moment the data is examined".[7]

For C-ITS this means that the information is provided with an end-to-end latency that meets the critical time-sensitive needs of the safety-critical application and avoid false decisions on "old" data. For some safety applications the desirable end to end latency is <300ms.[8]

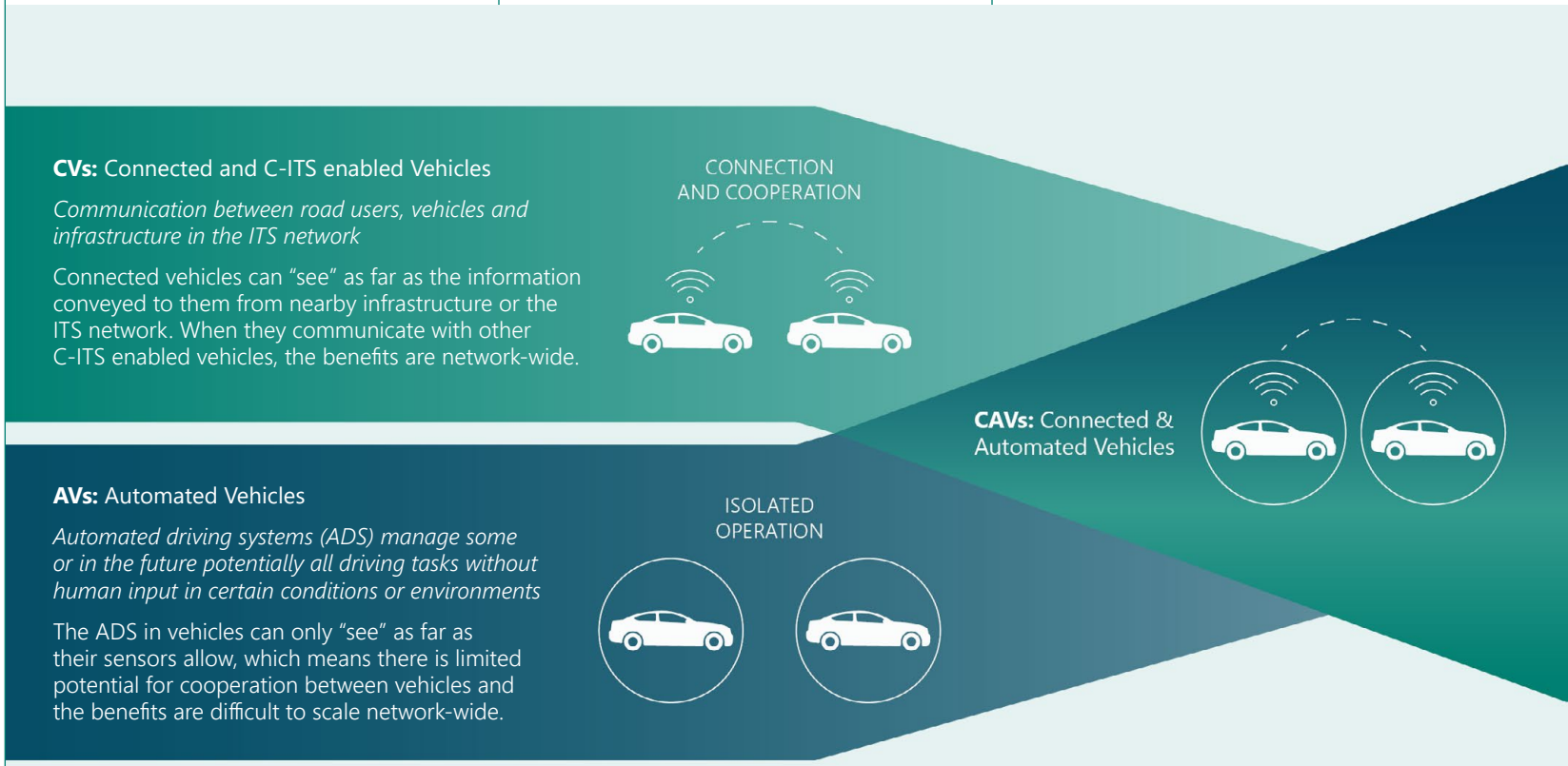

Figure 1
Connected Vehicle (CV) and Automated Vehicle (AV) operation and convergence

C-ITS is an ecosystem

C-ITS is an ecosystem with components that work together to enable communication and cooperation between road users, vehicles, and existing/new infrastructure (shown in Figure 2).

The main components of the ecosystem include:

+ **C-ITS Central Station(s):** manages and facilitates C-ITS communications and communicates information between Road Network Operations Centre and others e.g. vehicle or roadside stations.
+ **C-ITS Security Credential Management System (CCMS/SCMS):** manages enrolment, authorisation, and verification for communications.
+ **Roadside station:** (or Roadside Unit) equipment used to deliver time-sensitive dynamic information from roadside ITS infrastructure to nearby vehicles.
+ **Vehicle stations:** equipment typically provided by vehicle manufacturers (also known as Original Equipment Manufacturers or OEMs) that allows road users to communicate with the rest of the C-ITS ecosystem.
+ **Short-range communications:** allows vehicles to exchange real-time and critical safety messages locally. In Australia, this is currently delivered through DSRC (Dedicated Short Range Communications, also known as ITS-G5).
+ **Long range cellular communications:** secure network communication path, part of the ITS network, typically delivered via cellular telecommunications (4G/5G).

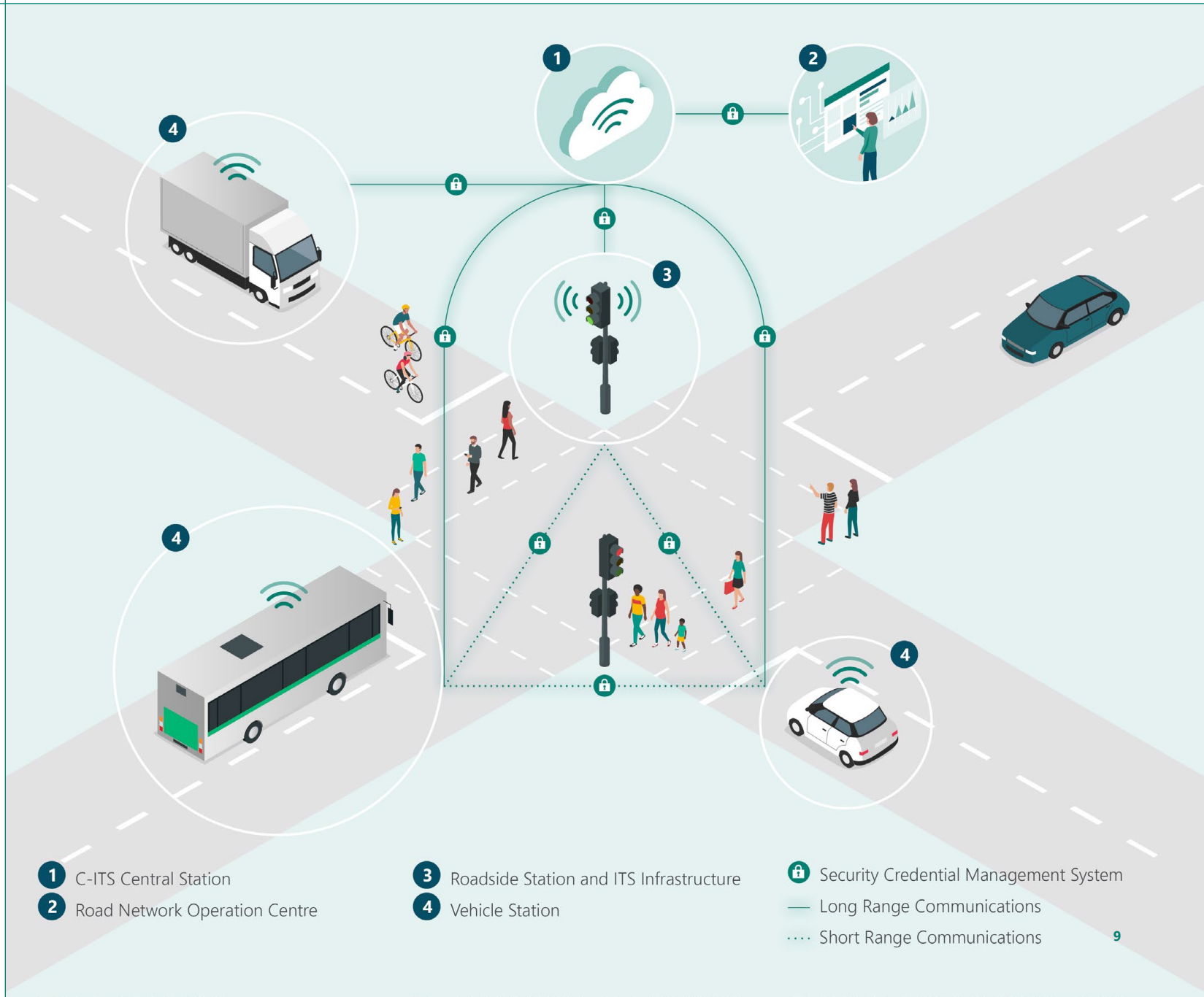

Figure 2
Components of the C-ITS ecosystem

C-ITS benefits safety, efficiency, sustainability, and a better customer experience

C-ITS provides information and warnings to road users and information to traffic operators under different scenarios to improve safety, movement and operational efficiency, environmental sustainability, and a better customer experience.[9] These benefits align to four of the areas of focus in our *Keeping WA Moving*[10] strategic direction. The fifth area of focus, capability, is also considered and incorporated into the broader C-ITS Roadmap.

C-ITS has been extensively tested globally, and when implemented in an interoperable way, initial C-ITS deployment across Europe is projected to provide a benefit-to-cost ratio (BCR) of up to 3.[11] In Australia, C-ITS benefits were shown to outweigh the cost with BCRs ranging between 1.4 to 2.9 over a 10 year period, depending on how C-ITS is implemented.[12]

Safety

C-ITS has the potential to reduce the number of fatalities and the severity of crashes by providing warning of a potential upcoming conflict.

This may include a conflict with another vehicle, an oncoming emergency services vehicle, weather and road conditions, and awareness of pedestrians, motorcyclists, or cyclists.

The implementation of C-ITS was found to reduce fatalities and serious injuries by up to 20% in the Queensland Cooperative and Automated Vehicle Initiative (CAVI) Project across eight use cases.[13]

Movement

C-ITS can improve traffic flow, reduce congestion and the number of disruptions due to incidents.

This is achieved through providing real-time information to allow traffic flow optimisation, dynamic route planning and guidance, congestion management, predictive maintenance, and enhanced public transport operations.

Microsimulation modelling assessments done as part of iMOVE Australia research found C-ITS at penetration rates of 30% could reduce peak congestion in arterial corridors by 11%, and improve average peak hour travel speeds by up to 10%.[14]

Customers

C-ITS can improve city liveability (transport accessibility, sustainability and equity) by providing tailored alerts about road conditions and transport information such as locations of electric vehicle chargers, available parking locations, route guidance, and public transport information.

All of this information is described as providing certainty and comfort to road users. These improvements are generally realised alongside safety and operational efficiency benefits.

Sustainability

Improvements to operational efficiency can translate to reduced vehicle pollution and greenhouse gas emissions whilst simultaneously increasing network capacity.

Providing real time travel information through C-ITS allows road users to optimise energy and fuel consumption. Informed route choices for travel can also lead to a reduction in total vehicle kilometres travelled.

Capability

C-ITS requires a diverse set of skills for Main Roads staff. We need to improve the capability of our people as well as procedures and technology to ensure C-ITS systems are built in a manner that allows for continuing evolution over time.

Capability should be leveraged from working with all levels of government, and working together nationally and internationally and importantly with private sector partners. It is critical that the capability is developed from PoCs within Western Australia focused on relevant solutions for our state.

02

Strategic context

C-ITS technology is advancing globally, and ongoing collaboration between government, industry, and road users is required to realise the benefits.

02

Strategic context

2.1 C-ITS drivers and trends

International drivers

Nationally and internationally, the basis of C-ITS technology has been demonstrated to be ready for deployment. C-ITS use cases are being tested and developed by the CAR 2 CAR Communication Consortium (C2C CC), C-Roads, and other organisations globally. Many jurisdictions have already started early deployments of C-ITS including Europe, the United States, Japan, China, and South Korea.

One of the *Principles for a National Approach to C-ITS in Australia*[15] recommends harmonising with international approaches, noting there are benefits in aligning to European approaches to C-ITS where possible. Recently, the Council of the European Union approved the adoption of a new framework to boost the roll out of C-ITS services for new vehicles.[16] This will drive the implementation of C-ITS in European vehicles, and potentially influence vehicle manufacturers in developing and importing C-ITS equipped vehicles into Australia.

National trends

Government action is required to enable C-ITS services so the benefits can be realised. The *National Road Transport Technology Strategy* and *2024-27 National Connected and Automated Vehicle (CAV) Action Plan* provides national actions for transport technologies including C-ITS. In addition, the *Principles for a National Approach to C-ITS in Australia* directs a focus on collaboration across governments to provide a consistent C-ITS environment in Australia. This includes secure systems that manage the privacy of data in C-ITS to ensure a trusted transport environment. This will support providing a seamless experience for road users and confident for the industry to invest.[17]

To date, there have been a number of C-ITS implementation trials in Australia, including:

+ Cooperative and Automated Vehicle Initiative (CAVI).[18]
+ Cooperative Intelligent Transport Initiative (CITI) project.[19]
+ Australian Integrated Multimodal EcoSystem (AIMES).[20]
+ Advanced Connect Vehicles Victoria (ACV2).[21]

Outcomes and learnings from these trials can be used to accelerate and support C-ITS deployment to realise the benefits in WA.

Other influences of C-ITS include the *Australian New Car Assessment Program (ANCAP)*, which will soon consider V2X (C-ITS) capability as a component of the safety rating.

Western Australia direction

Our *ITS Master Plan* roadmap identifies the need for a C-ITS Roadmap (this document) to guide the deployment of PoCs and determine the timing and direction of technology projects that will assist in implementing C-ITS. Activities in our *ITS Master Plan* align with, and are driven by, MRWA strategies including *Keeping WA Moving*, the *ITS Policy*, and other WA specific policies/strategies including *Driving Change: Road Safety Strategy for Western Australia 2020-3022*[22] and the *Infrastructure Western Australia State Infrastructure Strategy*.[23] The *State Infrastructure Strategy* highlighted the importance of considering the potential of connected (and automated) vehicles when developing strategic planning and business cases.

The ITS architecture for Main Roads adopts the European ITS Framework Architecture (FRAME). FRAME provides high level requirements and functionality for most ITS applications and services in the European Union (EU). FRAME also includes a C-ITS Reference Architecture. The implementation of C-ITS in WA will closely follow FRAME.

The key drivers influencing C-ITS deployment are shown in Figure 3.

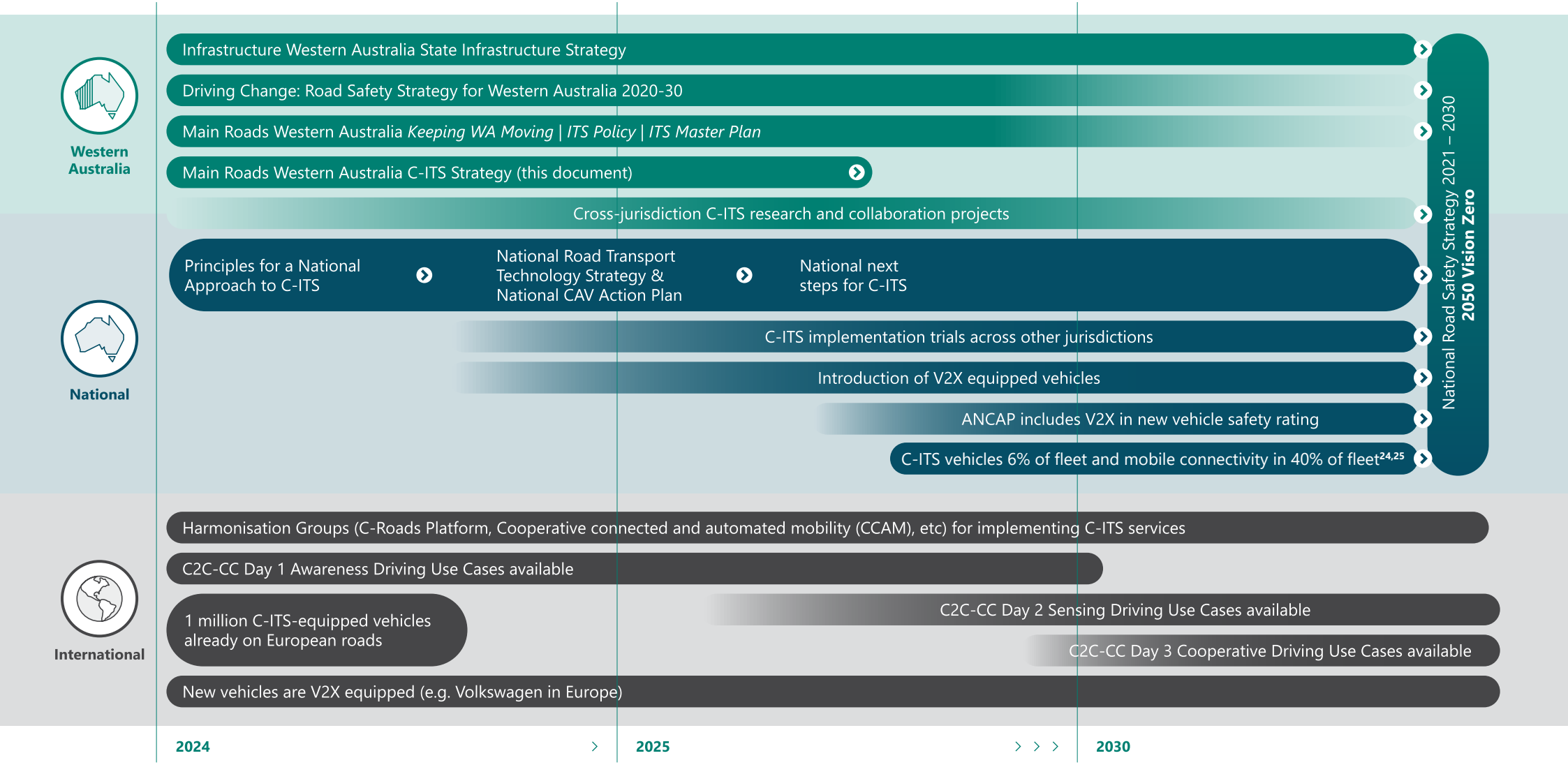

Figure 3 *Drivers for C-ITS deployment in WA*

2.2 Collaboration across the C-ITS ecosystem

Despite the growing maturity of C-ITS there are costs associated with its deployment, leading to the question which should come first:

C-ITS enabled vehicles or C-ITS infrastructure?

A user-centric approach with collaboration from all actors (shown in Figure 4) is essential to ensure road users accept C-ITS and take up services that will enable the benefits to be realised. Government involvement is required to encourage industry to continue development and provide C-ITS services (as shown in Table 1). Without this, benefits may not be realised.

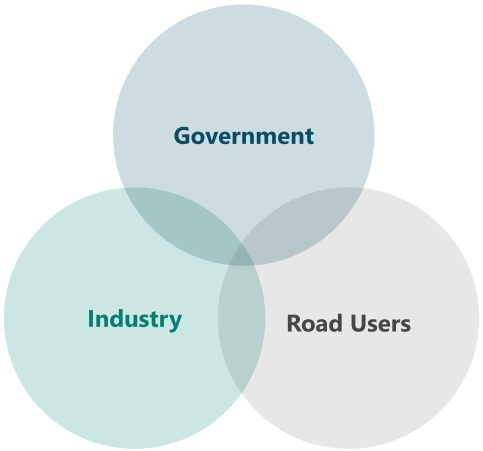

Figure 4 *Actors in the C-ITS ecosystem*

Table 1 *Responsibility of actors to enable C-ITS ecosystem elements*

Foundational C-ITS ecosystem elements	Responsibilities of actors (✓ = key enabler of this component)			We need to get involved to enable:
	Government *Local, State, and National*	**Industry** *Industry groups including OEMs, telecommunications, and service providers*	**Road Users**	
C-ITS Central Station	✓ Operate, monitor and maintain system to enable C-ITS	✓ Interacts with platform to deliver C-ITS services	Share and use data from system for C-ITS	+ C-ITS features to be turned on in vehicles by OEMs if there is C-ITS infrastructure in WA. + C-ITS safety, efficiency, and sustainability benefits. + A harmonised national system. + Ability to use real time data to optimise operations. + Complete data sets across Australia. Government involvement in deploying public C-ITS infrastructure supports realising a positive BCR between 1.4 to 2.9 in Australia.[26]
SCMS	✓ Secure C-ITS messages	✓ Enable secure C-ITS messages in products	Send/receive secure C-ITS messages	
Roadside stations	✓ Provide to enable C-ITS use cases	✓ Develop equipment to enable C-ITS use cases	Interact during C-ITS use cases	
Vehicle stations	Allow vehicle interaction with infrastructure	✓ Develop and provide C-ITS enabled vehicle	✓ Purchase and use C-ITS enabled vehicle	
Communications (short/long range)	✓ Use and maintain network for C-ITS communications	✓ Develop communications capability in products	Use to broadcast/receive data across a secure network that maintains data privacy	

03

C-ITS Vision

Our C-ITS Vision sets the focus of this C-ITS Roadmap.

03

C-ITS Vision

3.1 Our C-ITS Vision

Our C-ITS Vision sets the focus of the Roadmap to ensure we realise the benefits of C-ITS.

ITS Policy

Our ITS Policy Statement asserts that in *"developing, operating and maintaining Western Australia's road network, we and our partners shall consider and utilise current and emerging ITS technologies to enable and enhance safety, efficiency, resilience and positive customer experiences".*

ITS Master Plan

Our ITS Master Plan Vision is:

"World class mobility for Western Australians across an intelligent, safe, sustainable, and optimised network"

How does our C-ITS Roadmap align?

C-ITS offers benefits that support our ITS Policy and ITS Master Plan Vision. C-ITS provides a strong mechanism for accelerating our ability to meet those goals.

> The Main Roads C-ITS Roadmap will support the implementation of a nationally harmonised C-ITS ecosystem across the Western Australian road network to enhance safety, movement, regional resilience, and enable future vehicle technology.

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04

Key challenges for the Western Australian road network

With its significant geographical size and scattered population, Western Australia requires a transport network that accommodates the diverse and evolving needs of its communities and industries, both now and in the future.

04

Key challenges for the Western Australian road network

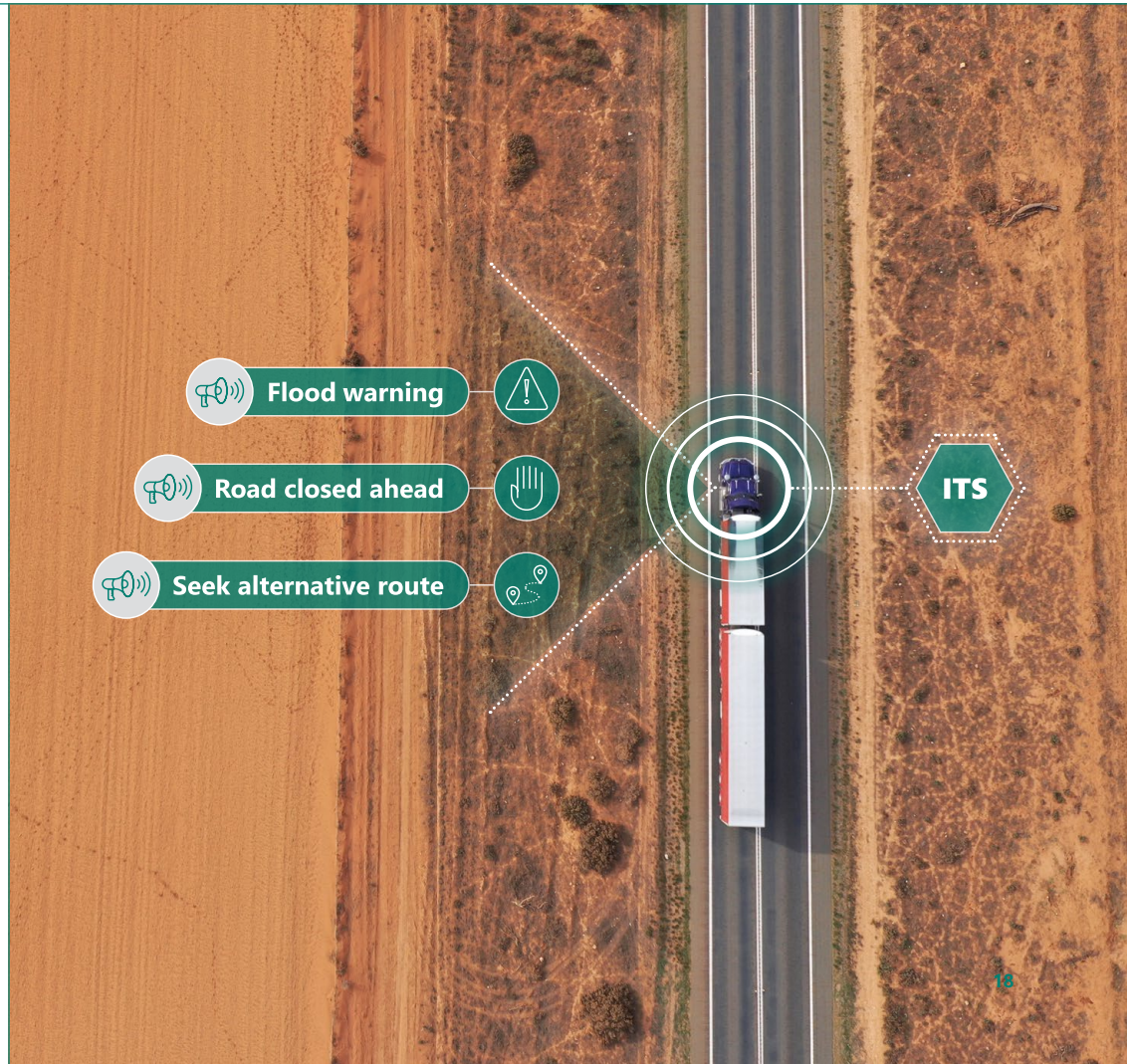
4.1 Our road network

Western Australia has one of the most diverse road networks in the world from urban motorways to remote rural roads. With 128,633 kilometres of roads across 2.5 million km^2 not including roads managed by the Department of Biodiversity Conservation and Attractions.[27]

Over the last 20 years, we have gradually shifted from an agency solely responsible for building and maintaining a road network to one that increasingly focuses on facilitating better use of the transport network. As congestion on our road network continues to grow, the focus on network operations initiatives, enabled through use of technology and ITS is heightened and we now need solutions, such as C-ITS, that can deliver improved performance safely, efficiently, and sustainably.

To understand the key challenges on our road network, we collaborated with our stakeholders to identify problems we encounter that C-ITS could address, considering the following questions:

+ What are the key road safety issues?
+ What problems do we have moving people and moving goods on our roads?
+ What unique regional/rural road issues do we face?



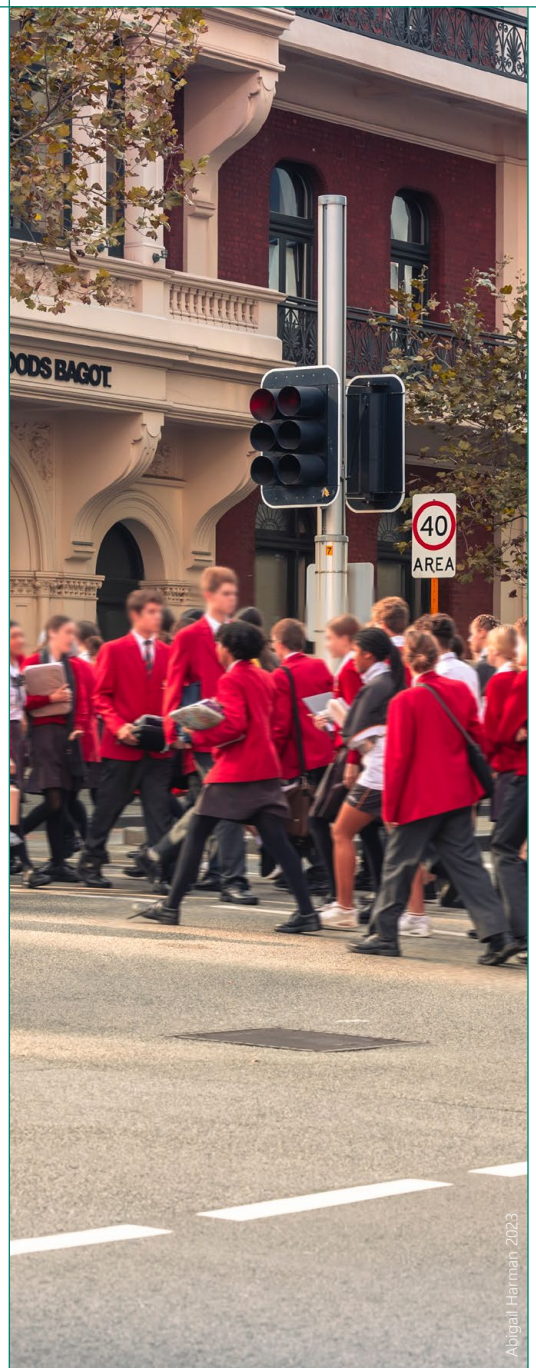
4.2 Key challenges

CHALLENGE 1

Safety for all road users at signalised intersections

Road safety is a priority challenge for Western Australians. 51% of all people in fatal and serious injuries (FSI) in metropolitan areas were in crashes that occurred at intersections[28] which include:

+ Collisions due to vehicles running red lights.
+ Collisions with vulnerable road users e.g., pedestrian or cyclist. A key challenge includes protecting cyclists when left turning vehicles use the bicycle lane.
+ Collisions with the back of another vehicle due to queueing from a slow moving or stationary vehicle.



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CHALLENGE 2

Keeping road users informed about changes to the road environment

Variable or changing road conditions (such as speed limits) can cause incidents when drivers are unaware of changing road conditions.

+ In regional areas, 25% of people FSI (12% in metropolitan areas) are in crashes where speed is suspected to be a contributing factor.[29,30] This might be influenced by lack of awareness of the prevailing speed limit.
+ In metropolitan areas, inattentive drivers could miss key messages on Variable Speed Limit Signs, or speed changes on Variable Speed Limit Signs.
+ There are also high safety risks where traffic wardens for children's crossings are operating on roads with speeds over 40km/h outside the immediate school vicinity, with limited signage to denote changed speed conditions.

In regional and rural areas, signage for infrastructure is often sparse.

+ Driver fatigue is a contributing factor to 20% of regional crashes.[31] Fatigue can arise from driving long stretches of road with lack of signage or upcoming rest area information.
+ Drivers may choose to overtake road trains or other large freight vehicles on regional/rural roads where there is no dedicated overtaking facility, due to limited awareness of upcoming overtaking lanes. This can lead to fatal crashes.

There are currently over 900 public rail level crossings in WA[32], over two-thirds of which are unsignalised. Level crossing collisions often occur when a driver of either a private or commercial vehicle:

+ Does not realise there is an upcoming railway level crossing.
+ Overlooks the warning lights of the active signalling system.
+ Overlooks the signage at a passive (unsignalised) level crossing.

There have been situations where a road train has driven into the path of a freight train due to reasons above, causing a significant collision.

Other challenges around driver awareness include:

+ Detecting and preventing drivers of over-height and over mass vehicles from causing delays at bridges (e.g. Hay Street Bridge) and limiting risk of collisions.
+ Reducing driver frustration and travel times by providing sufficient wayfinding and parking information to, from, and within train stations and airports. This could also include providing sufficient information about Electric Vehicle charging infrastructure availability.

CHALLENGE 3

Delivering real-time road network event alerts across metropolitan, regional, and rural roads

Drivers are often unaware of changing traffic conditions. Without real-time driver information of temporary changes in road conditions, traffic management operations may cause driver frustration, and lack of awareness can lead to incidents on West Australian roads.

This can occur during pre-planned events including the following:

+ Road works usually affect the road layout and driving regulations. Despite dedicated signage prior to road works or hazards, the changed conditions frequently come as a surprise to vehicle drivers, which could lead to a potential collision within the road works zone or even with road workers.
+ Route detours may be poorly signed and/or communicated in advance, and can result in driver frustration and increased chance of collision if drivers are not fully attentive.
+ Seasonal grain movements[33] that may delay other road users.

There are also unplanned hazards on the road that drivers have limited time to respond to/are unaware of that can lead to collisions and delay, such as:

+ Obstacles on the road.
+ Road closures and route detours due to fire or flooding etc. events, which pose significant safety issues in rural areas.

CHALLENGE 4

Managing competing road user priorities

Road corridors are often multimodal and specific road users may need priority, for example:

+ Even with sirens and lights, emergency services may not be audible or visible to all vehicles, and could be involved in a collision if other road users are unaware of their surroundings.
+ Freight corridors where there is a mixture of private and industrial vehicles using the road.

Congestion at signalised intersections causes delay for all road users, reducing productivity and increasing risks of incidents. Balancing the safe movement of all vehicles through intersections requires detailed road user information.

Special vehicles that could benefit from priority movements to support their activities and overall productivity include:

+ Active emergency services vehicles.
+ Public transport to improve reliability of services.
+ Freight vehicles, in particular, Over-size Over mass (OSOM) vehicles.
+ Freight at intersections accessing/egressing key productivity destinations such as ports and airports.

05

C-ITS Use Cases for Western Australia

C-ITS use cases can address key challenges on our road network to deliver road safety, operational efficiency, environmental sustainability, and mobility and journey comfort benefits across Western Australia.

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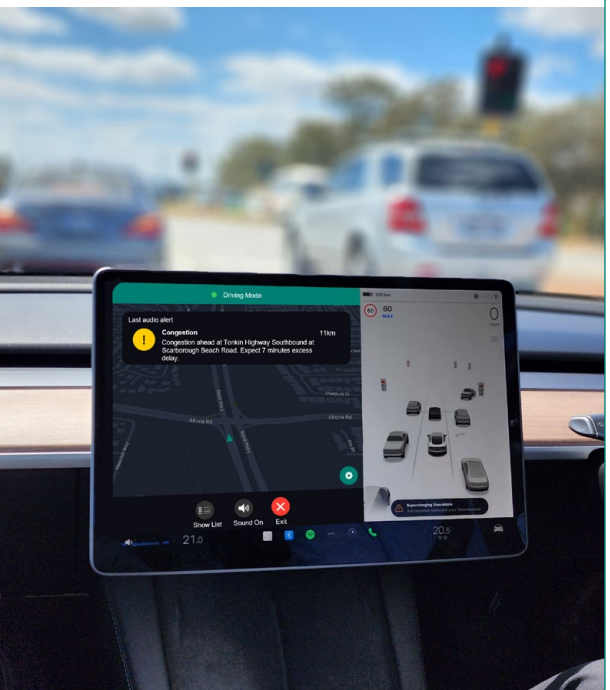
05

C-ITS Use Cases for Western Australia

5.1 Identifying use cases

C-ITS use cases

A C-ITS use case represents a specific functionality and service within the C-ITS ecosystem. Example use cases are shown in Figure 5 and Figure 6.



Selecting use cases to test and deploy

Foundational C-ITS infrastructure elements (discussed earlier in Table 1) are required to enable vehicle connectivity features and secure vehicle communications for C-ITS use cases to operate.

Once foundational C-ITS infrastructure is in place, a phased approach to C-ITS use case deployment can be taken. This can involve trialling a small number of use cases to help establish the C-ITS deployment process and understand the benefits in the WA context before further progressing deployment.

Use cases should be chosen considering the following questions:

+ C-ITS ecosystem elements
  - What are the minimum requirements to deliver use case?
+ Benefits
  - What are the proposed benefits?
+ Readiness
  - Is this use case defined elsewhere?
  - Has the use case been trialled in Australia?
  - Is the use case ready to be tested and deployed in WA now?

Example use case
In vehicle speed warning (I2V)

In-vehicle warning alerts driver to active/static/variable speed limits. It then alerts them if they are exceeding that limit.

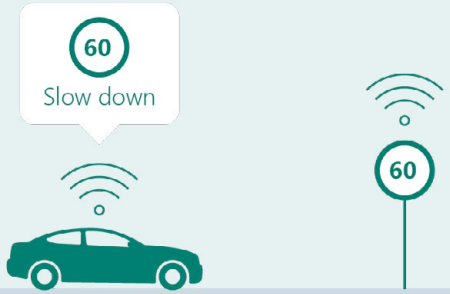


Figure 5
C-ITS use case: In-vehicle speed warning

Example use case
Road works warning (I2V)

In-vehicle warnings alert drivers to upcoming roadworks. This prepares drivers for the risk that they are travelling at an unsafe speed, or in the wrong lane, giving them time to slow down and/or change lanes.

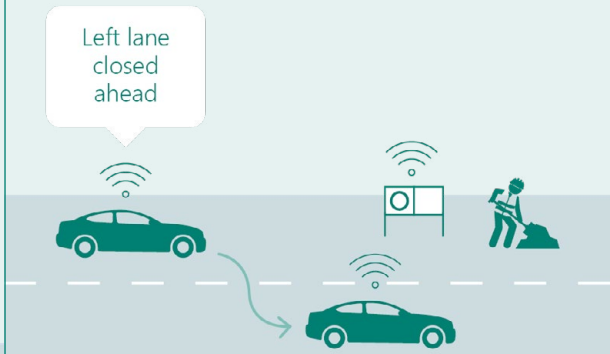


Figure 6
C-ITS use case: Road works warning

5.2 Use Cases for Western Australia

C-ITS use cases can address some of the key challenges on our road network (discussed in Section 4.2). The deployment of C-ITS will likely begin with less complex use cases. A set of verified road operator use cases for initial C-ITS deployment has been developed and provided by C-Roads.[34]

Table 2 identifies the C-ITS use cases that could help address some of our road network challenges, outlines the communication method (i.e. how the C-ITS message would be communicated), and demonstrates alignment of these use cases to the ITS Master Plan Focus Areas.

The C-ITS use cases identified align to those outlined in C-Roads, and can be considered for PoCs and potential deployment across WA.

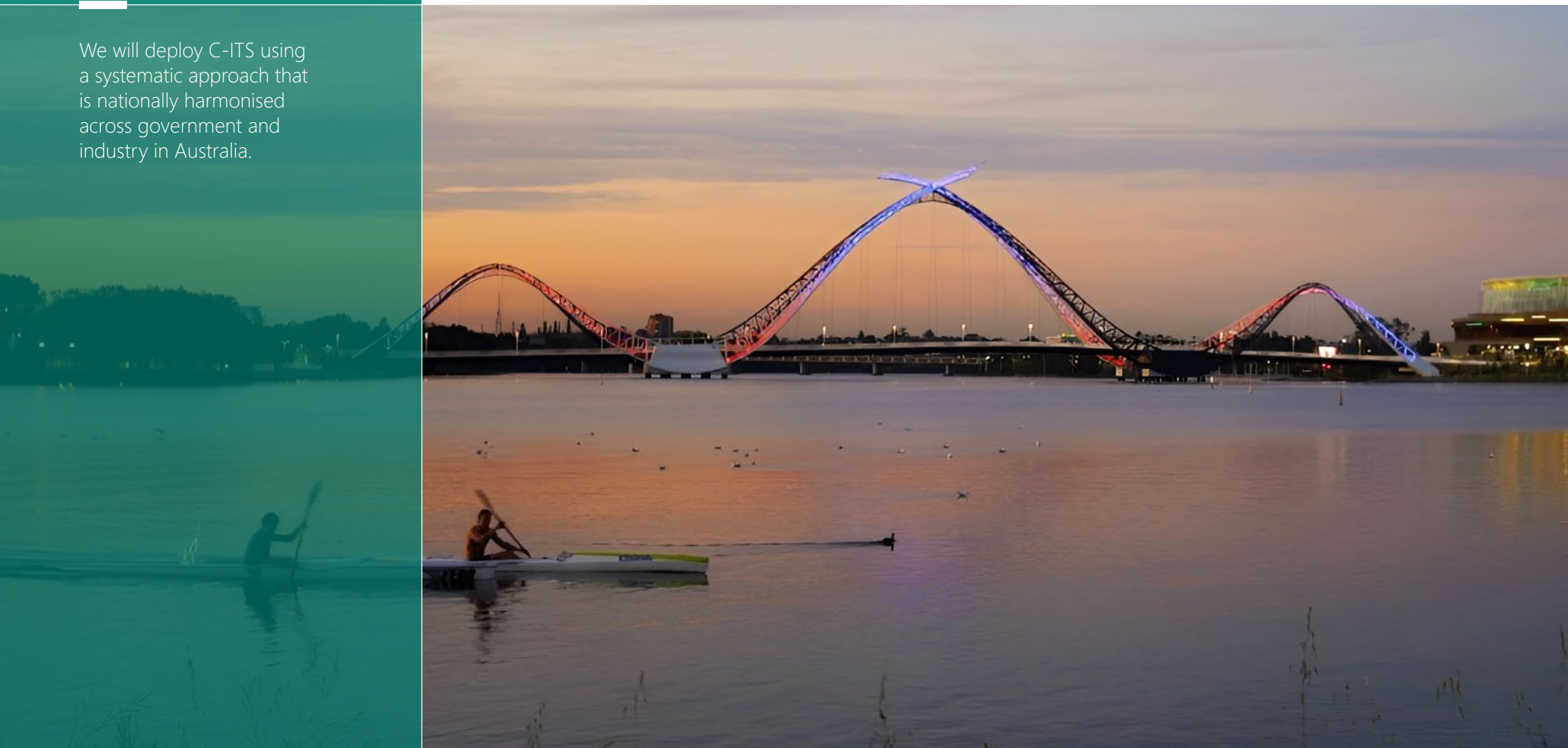
Challenge	C-ITS use case to address the challenge & predominate communication method (V2V, V2I, I2V)		Benefits and alignment to ITS Master Plan Focus Areas					
			Safety and Imagine Zero	Sustainability and Net Zero	Regional Resilience	Moving People	Moving Goods	Future Vehicle Technology
1. Safety for all road users at signalised intersections	Signal Violation Warning / Intersection Safety	I2V	✓			✓	✓	✓
	Vulnerable Road User (VRU) Protection (pedestrians, cyclists, and motorcyclists)	I2V	✓	✓	✓	✓	✓	✓
	Traffic Jam Ahead Warning/ Back of Queue Warning	I2V/V2V	✓	✓		✓	✓	✓
2. Keeping road users informed about changes to the road environment	In-Vehicle Signage – Traffic Signs (e.g. speed limits)	I2V	✓			✓	✓	✓
	In-Vehicle Signage – Free Text (e.g. available parking spaces on highway rest areas, upcoming overtaking lane)	I2V			✓	✓	✓	✓
	Railway Level Crossing	I2V	✓			✓	✓	✓
	Electric Vehicle Charging Availability Notification	I2V		✓	✓	✓		✓
3. Delivering real-time road network event alerts across metropolitan, regional, and rural roads	Road Works Warning	I2V	✓		✓	✓	✓	✓
	Road Hazard Warning (Accident Zone/ Obstacle on the road)	I2V	✓		✓	✓	✓	✓
	Weather Condition Warning	I2V	✓		✓	✓	✓	✓
	Probe Vehicle Data (PVD)	V2I	✓	✓	✓	✓	✓	✓
4. Managing competing road user priorities	Emergency vehicle approaching	V2V/I2V	✓			✓		✓
	Traffic Signal Priority for Public Transport or Emergency Vehicles	V2I	✓	✓		✓	✓	✓
	Signal Phasing and Timing Information (SPTI)	I2V	✓	✓		✓	✓	✓
	Green Light Optimal Speed Advisory (GLOSA)/ Time to Green (TTG)	I2V		✓		✓	✓	✓

Table 2 *C-ITS use case to address key challenges on our road network*

06

C-ITS Deployment Strategy and Roadmap for Western Australia

We will deploy C-ITS using a systematic approach that is nationally harmonised across government and industry in Australia.



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C-ITS Deployment Strategy and Roadmap for Western Australia

6.1 C-ITS Deployment Strategy

Our C-ITS deployment strategy consists of seven action streams outlined in Table 3. The action streams represent the areas that, when delivered together, will enable the realisation of C-ITS potential in WA. The action streams align to, and support, the National Road Transport Technology Strategy and 2024-27 National CAV Action Plan.

In line with our C-ITS Vision, our deployment strategy aims to maximise early C-ITS benefits by:

+ Aligning to the national approach and collaborating with other jurisdictions to deploy C-ITS in a harmonised way that promotes industry investment in C-ITS in Australia. **(Action Streams 1 and 2)**
+ Leveraging C-ITS learnings from other jurisdictions to reduce deployment risks, timeframes, and costs. In parallel, testing and enabling C-ITS use cases that address our road challenges and support our policies and strategies in WA. **(Action Streams 3 and 4)**
+ Building local capability and partnerships and incorporating C-ITS services and data into existing systems to support and develop a sustainable C-ITS industry. **(Action Streams 5, 6 and 7)**

Action Stream	Description
1 **Collaboration and Research**	Collaborate with research bodies and industry to further national understanding.
2 **National Harmonisation**	Participate in national efforts to plan for harmonised C-ITS implementation with secure systems that manage the privacy of data to ensure a trusted transport environment.
3 **Future Proofing**	Prepare for future vehicle technologies and set up foundational infrastructure (i.e. C-ITS Central Station, SCMS, and Roadside Stations) to enable vehicle connectivity features and secure vehicle communications so the benefits of C-ITS can be realised. Plan for and begin C-ITS deployment across WA over time.
4 **Proofs of Concept**	Run a local testbed and/or test corridor(s) to develop readiness of C-ITS applications and identify specific needs in WA.
5 **Capability Uplift**	Provide opportunities to staff, including training in C-ITS for Main Roads Graduates working in conjunction with research bodies and industry, to develop capabilities in systems engineering, data engineering, cloud systems, and ITS architecture to support business change required for C-ITS in WA.
6 **Systems Uplift**	Identify and implement the changes required to the ITS environment to support C-ITS deployment.
7 **Data Quality, Use, and Management**	Improve road agency data to facilitate emerging C-ITS applications and, in turn, improve the availability and quality of ITS data.

Table 3 *C-ITS deployment strategy action streams*

6.2 C-ITS Roadmap

Our C-ITS Roadmap which captures initiatives, key projects, and programs is presented in Figure 7. The Roadmap presents a series of actions that have multiple relationships and dependencies, and as such, is subject to change and will be reviewed and updated every year.

The C-ITS Roadmap is a strategic plan to ensure we meet our overall C-ITS Vision. It is not intended to be fully itemised, prioritised, and costed; instead, it provides strategic guidance in response to the emerging challenges of society and technology trends inherent in industry. It outlines our plan for coordinated investment in needs-based infrastructure deployment as well as the delivery and enabling of C-ITS services.

Further detail on each activity is provided in Table 4.

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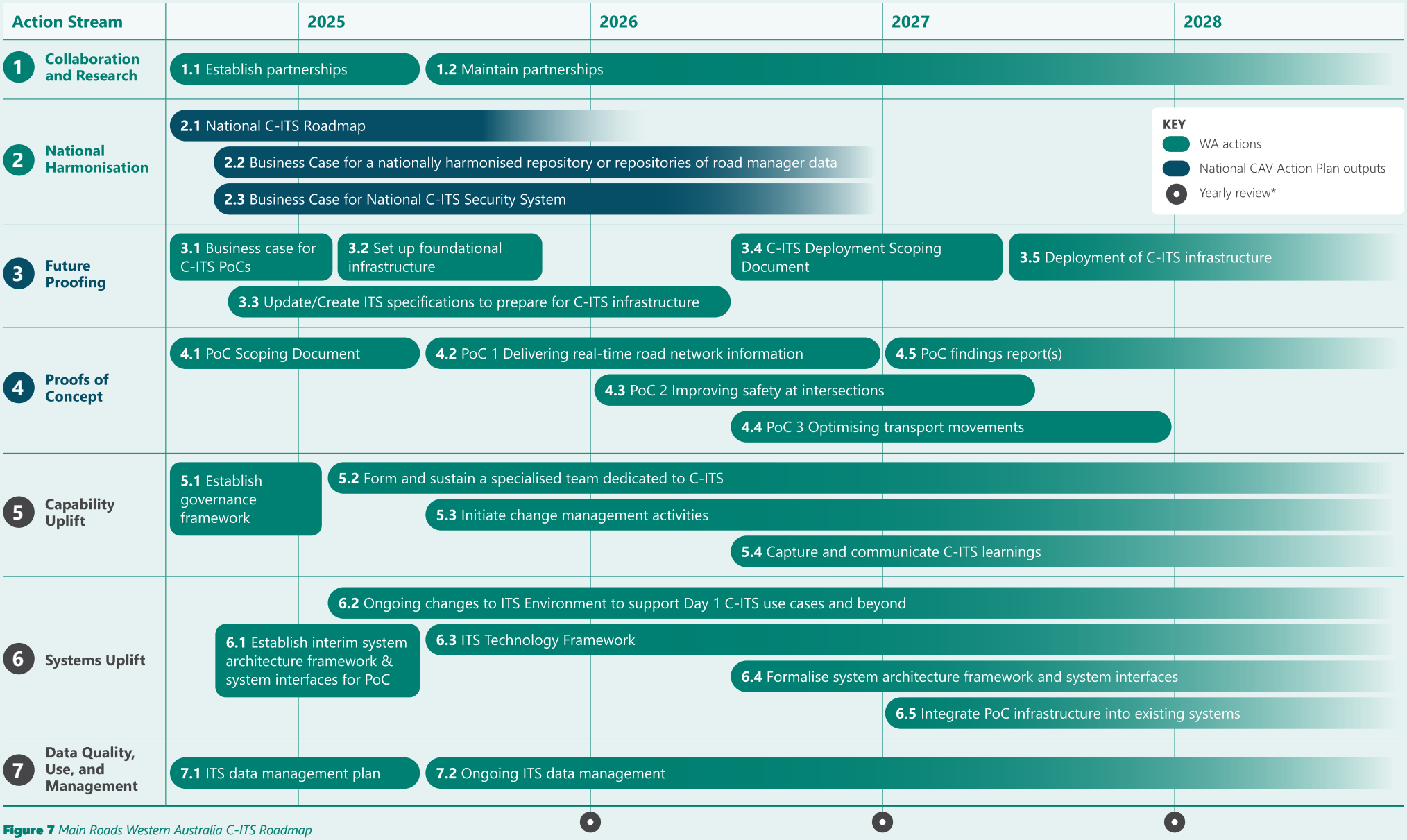

Figure 7 *Main Roads Western Australia C-ITS Roadmap*

* Yearly review of progress on WA's C-ITS Roadmap, National Road Transport Technology Strategy, and 2024-27 National CAV Action Plan

Action Stream	Activity	Description
1 **Collaboration and Research**	**1.1** Establish partnerships	Collaborate and build partnerships with Austroads, government and academic initiatives (like CAVI and AIMES), research bodies (like Planning and Transport Research Centre (PATREC), iMOVE, and other Cooperative Research Centres) and industry to perform research and feed back to the national understanding. These partnerships will support examining the readiness of C-ITS applications and perform research and development on the application of C-ITS to our key challenges.
	1.2 Maintain Partnerships	Ongoing collaboration with partners established in Activity 1.1, and establishment of new partnerships as required.
2 **National Harmonisation**	**2.1** National C-ITS Roadmap	Contribute to developing the National C-ITS Roadmap.
	2.2 Business Case for a nationally harmonised repository or repositories of road manager data	Contribute to the Business Case for a nationally harmonised repository or repositories of road manager data.
	2.3 Business Case for National C-ITS Security System	Contribute to the Business Case for a National C-ITS Security System.
3 **Future Proofing**	**3.1** Business case for C-ITS in WA	Prepare a business case to analyse and justify the deployment of C-ITS in WA.
	3.2 Set up foundational infrastructure	Deploy foundational infrastructure (SCMS, Central Station, Roadside Station) using specifications, trial processes, and standards that have already been tested in other jurisdictions. This will enable early implementation of C-ITS use cases and PoCs and allow us to realise benefits immediately.
	3.3 Update/Create ITS specifications to prepare for C-ITS infrastructure	Update existing standards that govern the deployment and operation of intelligent transportation systems to accommodate and align with the requirements and functionalities associated with C-ITS.
	3.4 C-ITS Deployment Scoping Document	Outline the key parameters, objectives, and considerations for large-scale C-ITS deployment across WA. This document will provide a clear and comprehensive overview of the scope and requirements and take into consideration ongoing learnings from PoCs.
	3.5 Deployment of C-ITS infrastructure	Deploy C-ITS infrastructure across WA following scope and guidance from C-ITS Deployment Scoping Document.
4 **Proofs of Concept**	**4.1** PoC Scoping Document	Define the scope, goals, and objectives for each PoC including consideration for funding, resources, and the framework for delivery, and reporting. This will ensure that all stakeholders are aligned, and risks are identified and mitigated. Determine criteria for measuring success of the PoC and create a Benefits Realisation Plan.
	4.2 to 4.4 PoCs	Run three PoCs of C-ITS use cases to address different key challenges on our road network. This should focus on use cases that have already been trialled and deployed in Australia.
	4.5 PoC findings report(s)	Document and evaluate the results of each PoC. Earlier findings should feed into the progressive deployment of future PoCs. The report(s) should determine if scope and objectives have been met and provide recommendations for future actions around C-ITS deployment.

Table 4 *C-ITS Roadmap activity descriptions*

Action Stream	Activity	Description
5 Capability Uplift	**5.1** Establish governance framework	Establish a governance framework to provide clear guidance, management, coordination, and oversight of C-ITS deployment in WA.
	5.2 Form and maintain a specialised team dedicated to C-ITS	Invest in staff capability and training to build capability to support and use future vehicle technology in WA by building competencies within Main Roads and through partnership with industry.
	5.3 Initiate change management activities	Provide education and management support to enable C-ITS change initiatives. To maximise the benefits of C-ITS in WA, it is vital that the people within the organisation and Transport portfolio embrace the C-ITS journey and understand the benefits provided by C-ITS. Rotation of graduates through the C-ITS team will assist wider organisation development.
	5.4 Capture and communicate C-ITS learnings	Creating a community hub to share the lessons learned from C-ITS pilots and deployment and consider creating implementation guidance. This will promote fast and broad deployment of the C-ITS ecosystem.
6 Systems Uplift	**6.1** Ongoing changes to ITS Environment to support PoC use cases and beyond	Understand further modifications required to existing ITS and Traffic Signal systems alongside PoCs to enable early C-ITS use cases and further implementation and trials.
	6.2 Establish interim system architecture framework & system interfaces for PoC	It is necessary to have interim system architecture due to the concurrency of C-ITS development activities. An interim system architecture that should align to the current FRAME ITS Architecture. This will help provide certainty during the development and trial phases, establishes boundaries between operational and organisational technology frameworks, and clarifies knowns and unknowns for broader development, which could also be addressed during the PoCs.
	6.3 Formalise system architecture framework and system interfaces	This activity is part of ongoing efforts to achieve national harmonisation as well as a consistent and robust system for state-wide deployment.
	6.4 ITS Technology Framework	An ITS Technology Framework will assist in defining and managing Operational Technology (OT) environment and Information Technology (IT) systems. The framework will guide security, privacy and performance requirements.
	6.5 Integrate PoC infrastructure into existing systems	Prior to state-wide deployment of C-ITS, it is necessary to develop an initial version of the C-ITS sub systems for integration back into the ITS control systems.
7 Data Quality, Use, and Management	**7.1** ITS data management plan	The ITS data management plan provides guidance for ongoing management of C-ITS data. This document will outline the strategies and protocols for the effective handling, processing, distribution, and use of C-ITS data.
	7.2 Ongoing ITS data management	Implementation and continuous improvement for the management of C-ITS data. Considering C-ITS will in-turn improve the future consideration and availability and quality of ITS data.

Table 4 *C-ITS Roadmap activity descriptions (continued)*

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