C-ITS Roadmap

C-ROADS Platform

Working Group 2 Technical Aspects

Taskforce 2

18/04/2024

1 Introduction

1.1 C-ROADS platform for harmonisation of C-ITS deployment

The C-ROADS Platform is a joint initiative of European Member States and road operators for the deployment of Cooperative Intelligent Transport Systems (C-ITS). It has been launched by the Member States and the European Commission to link C-ITS deployment activities, jointly develop and share technical specifications and to verify interoperability through cross-site testing[1].

Through the C-ROADS Platform, authorities and road operators join together to harmonise the deployment activities of C-ITS across Europe. The goal is to achieve the deployment of interoperable cross-border C-ITS services for road users. C-ROADS also established a close cooperation with the automobile industry in the CAR 2 CAR Communication Consortium.

C-ITS enables vehicles to interact directly with each other and the surrounding road infrastructure. In road transport, C-ITS typically involves vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. In order to enable an efficient and undisturbed exchange of information within these services as well as a cross-border implementation, harmonised C-ITS specifications are indispensable. The approach starts from a functional perspective, then requirements applicable to all implementations and then towards technology specifications of validated interoperable implementations (ITS-G5 for short range communication, IP based for long range communication).

1.2 C-Roads Roadmap

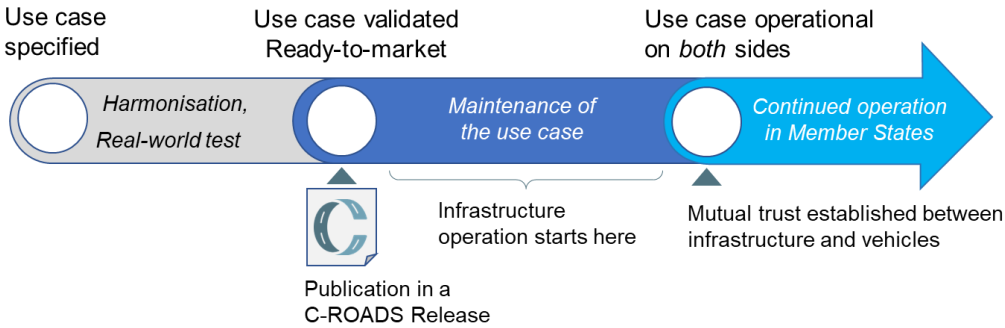
The purpose of the roadmap is to give infrastructure managers and OEMs an overview of the availability, the readiness and the deployment perspective of existing and upcoming C-ITS use cases and services from an infrastructure perspective.

This roadmap document gives an overview of the harmonised use cases that are supported by the infrastructure and gives a perspective for the integration into vehicles. It also sketches synergies in deploying use cases that initially serve a special purpose (such as public transport optimisation) but can be the platform for many use cases in the future.

The C-Roads use case landscape is organised into services, that contain a number of use cases. Use cases are described by a scenario including the expected benefit, a description of the necessary communication protocol elements and triggering conditions as well as references to the detailed message profiles and system profiles.

1.3 Specified, validated, ready-to-market

The C-Roads Roadmap is not a typical roadmap that projects the readiness of future specifications. All C-ROADS use cases in the published profiles have been tested and validated in pilot deployments in the real-world *before* they were published. Having such an implementation and having the opportunity of feedback from cross-border tests ensures that the implementation is feasible, working and thus “ready to market”



[1] European Commission: A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility, COM(2016) 766 final.

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2 Roadmap

2.1 Overview of operational use cases

Since its launch, the C-ROADS platform started with road works warning use cases and hazardous location notifications. Some of these use cases are already in operation in Europe and can be experienced by drivers today. Signalized intersections are already equipped with C-ITS for public transport prioritisation. Intersection information as well as in-vehicle information will be made available in vehicles within the next 3 years. On a longer time frame, ADAS and automated driving support will be added. All of these use cases require support by the infrastructure – hence, profiling has been initiated and for many of these use cases already completed in C-ROADS. Figure 1 shows how use cases have been implemented by OEMs and in special fleets with infrastructure support, including the planned timeline for future use cases. The timelines focus on ITS-G5 short range communication and the use case implementation based on the C-ROADS ITS-G5 Roadside and Mobile System profiles. Note: the hybrid approach of C-ROADS also allows to make use cases available via an IP-based interface, which is currently not in the scope of this document but might be added in a later stage.

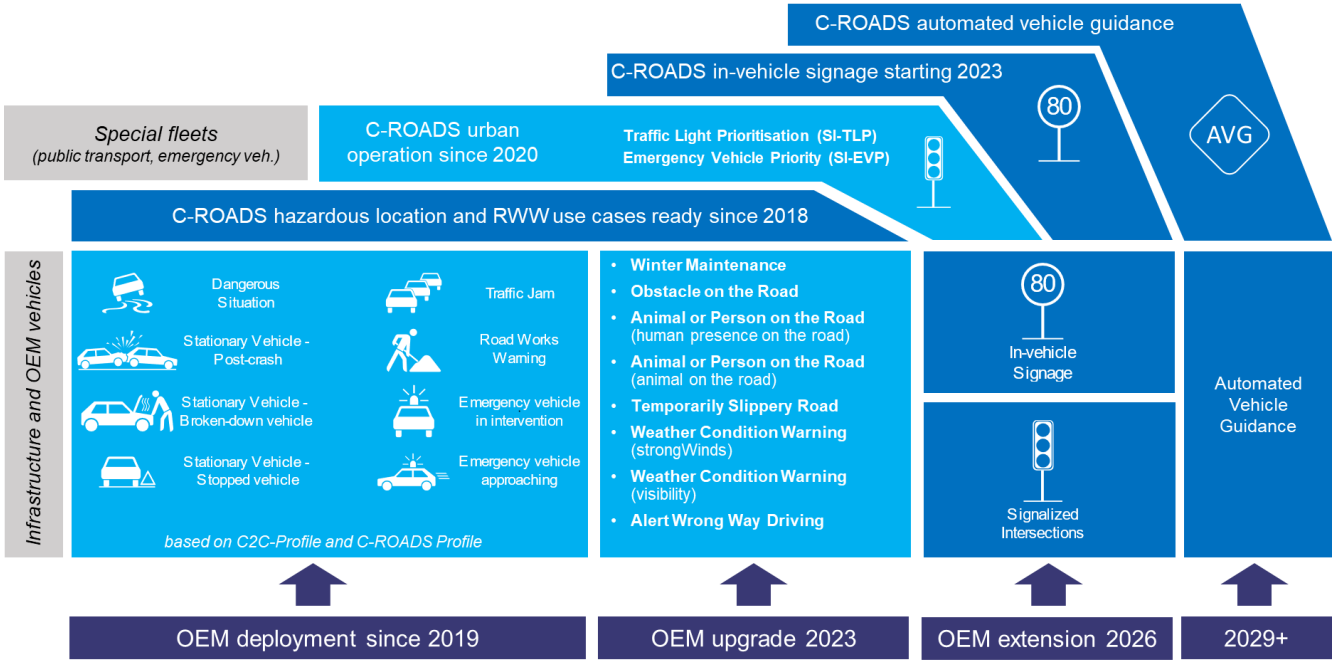

Figure 1 - Overview of use case implementations by OEMs or in special fleets

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2.2 C-ROADS Use Case Roadmap

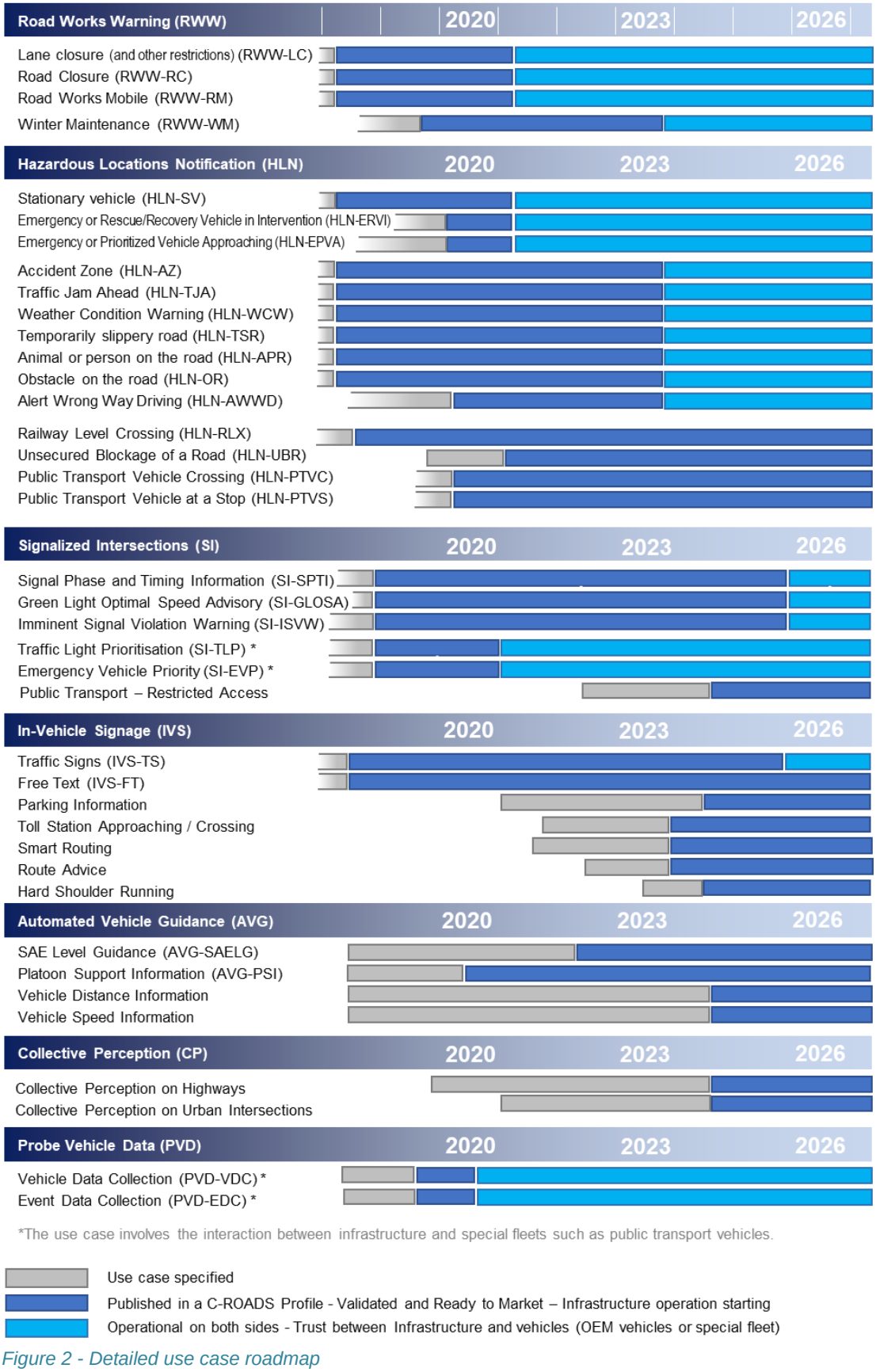

Figure 2 - Detailed use case roadmap

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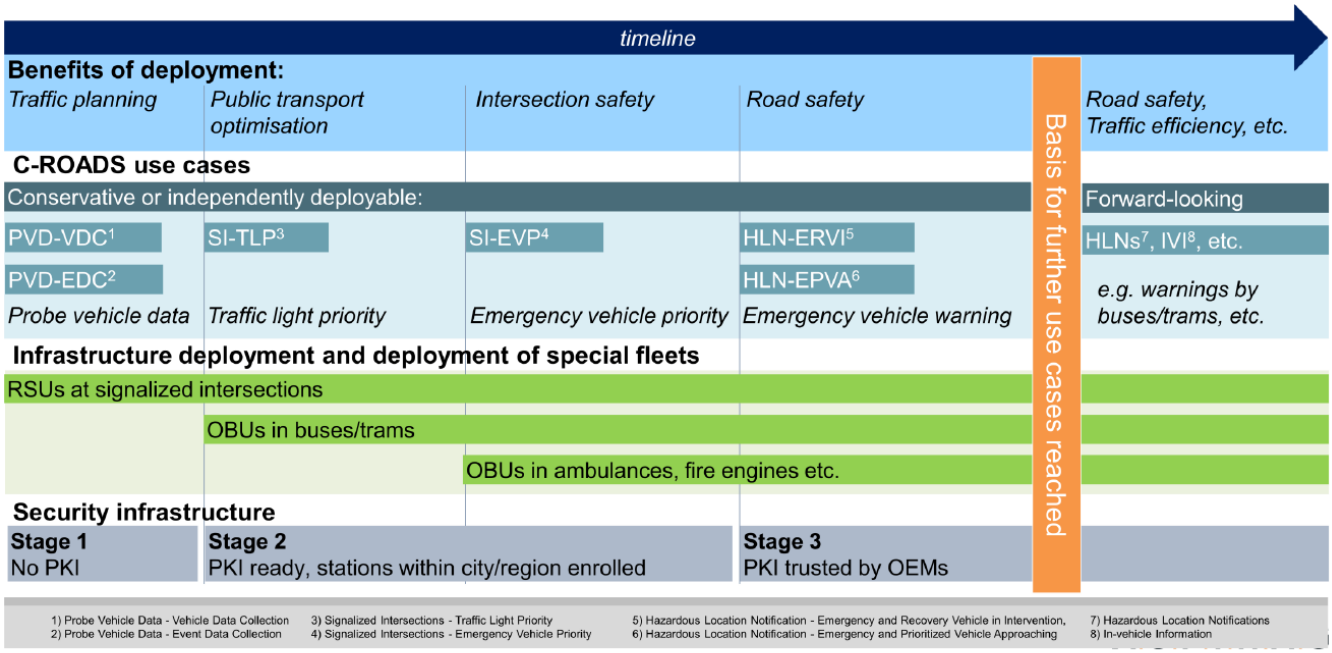
3 Deployment Synergies

The C-ROADS profile establishes common baselines for many use cases. System profiles for roadside and mobile C-ITS stations as well as the message profiles give a detailed implementation guideline that serves as basis for the use case definitions. A deployment that starts into operation with a few use cases has already made most of the necessary steps to deploy other use cases. The example in Figure 3 shows an urban deployment example, where public transport prioritisation is the driver to implement C-ITS at urban intersections but enables at the same time further use cases where emergency organisations and normal passenger vehicles benefit later. Thus, infrastructure deployment is a starting point and initiator for enabling further use cases that bring immediate benefits to early adopters.



From: S. Ruehrup, L. Conceição, J. Montenegro, P. Meckel: "The Chicken and the Egg – Perspectives of C-ITS Deployment", ITS European Congress, 2023

Figure 3 - Deployment Synergies for Urban C-ITS Deployment

The trust relationship between infrastructure and vehicles (OEM vehicles or special fleets) is managed by a public key infrastructure. This trust is meant in the context of security, where the receiver is enabled to validate the authenticity and integrity of the data.

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4 ADAS and Automated Driving Support

The following services of the C-ROADS profile support Advanced Driver Assistance Systems (ADAS) and Automated Driving. Some use cases under the Automated Vehicle Guidance are specifically developed for Automated Driving (see Figure 4 below). Other use cases can inform the human driver, but also serve as an input into ADAS and automation systems. The complex road works zone information is a further development of the Road Works Warning, and the detailed information about the layout and the topology of the work zone becomes especially useful with higher degrees of automation, where the vehicle is supported with a digital representation of work zone elements.

Overall, a digitalisation of the three essential categories of warnings and regulatory information can be observed: (1) hazard warnings, (2) regulatory traffic signs including VMS and (3) traffic signals at intersections will become available as digital information, which are supporting automated driving functions.

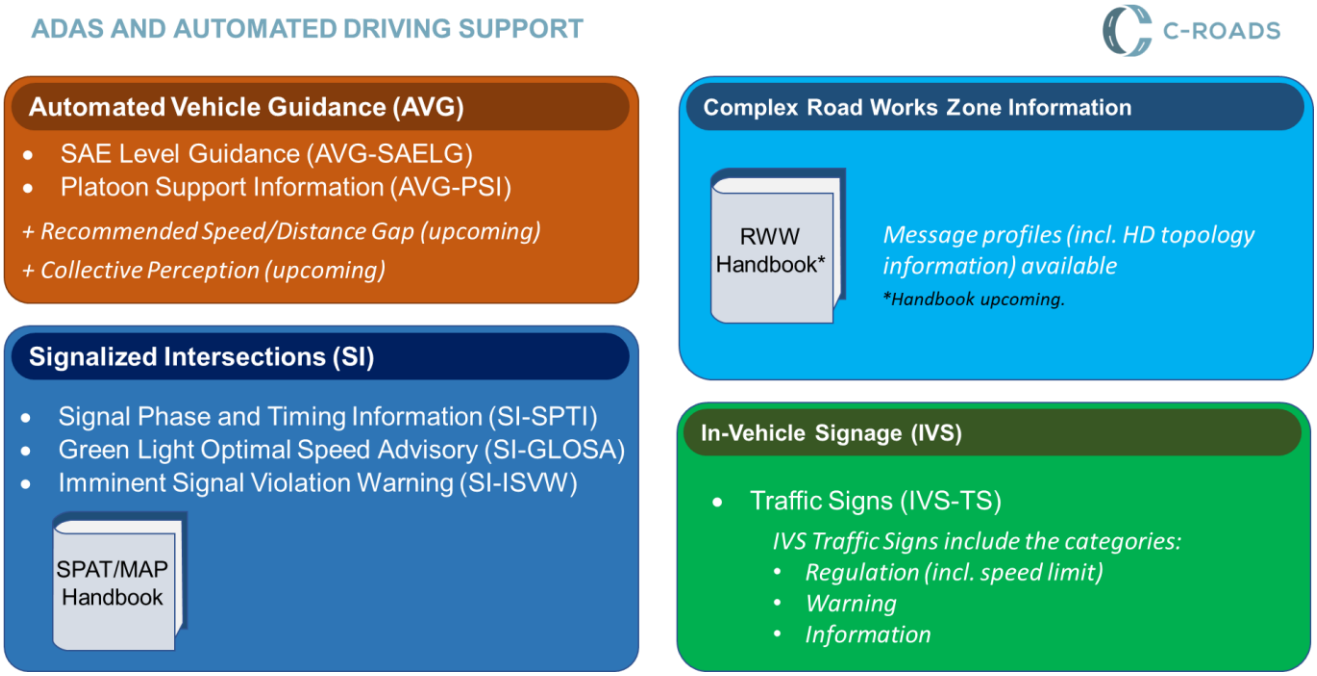

Figure 4 - ADAS and Automated Driving Support in the C-ROADS Profile

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Publication History

Version	Date	Description, updates and changes	Status
1.0	18/04/2024	First C-Roads C-ITS Roadmap release	R

Acronyms

ADAS	Advanced Driving Assistance Systems
C-ITS	Cooperative ITS
CPM	Collective Perception Message
ITS	Intelligent Transport Systems
ITS-G5	ITS-G5 is a European standard for ad-hoc short-range communication of vehicles among each other (V2V) and with Road ITS Stations (V2I). The ITS-G5 Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band is given in ETSI EN 302 663. ITS-G5 is a profile of the amendment IEEE 802.11p, which has been incorporated into the main IEEE 802.11 standard, and an IEEE 802.2 LLC. It uses the 5.9 GHz frequency band to support safety- and non-safety ITS applications.
ITS-S	ITS Station
IVI	In-Vehicle Information
IVIM	In-Vehicle Information Message
IVS	In-Vehicle Signage
I2V	Infrastructure to vehicle
RWW	Roadworks Warning
SPAT/MAP	Signal Phase and Timing / Map (topology) information
V2I	Vehicle to infrastructure
V2V	Vehicle to vehicle

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