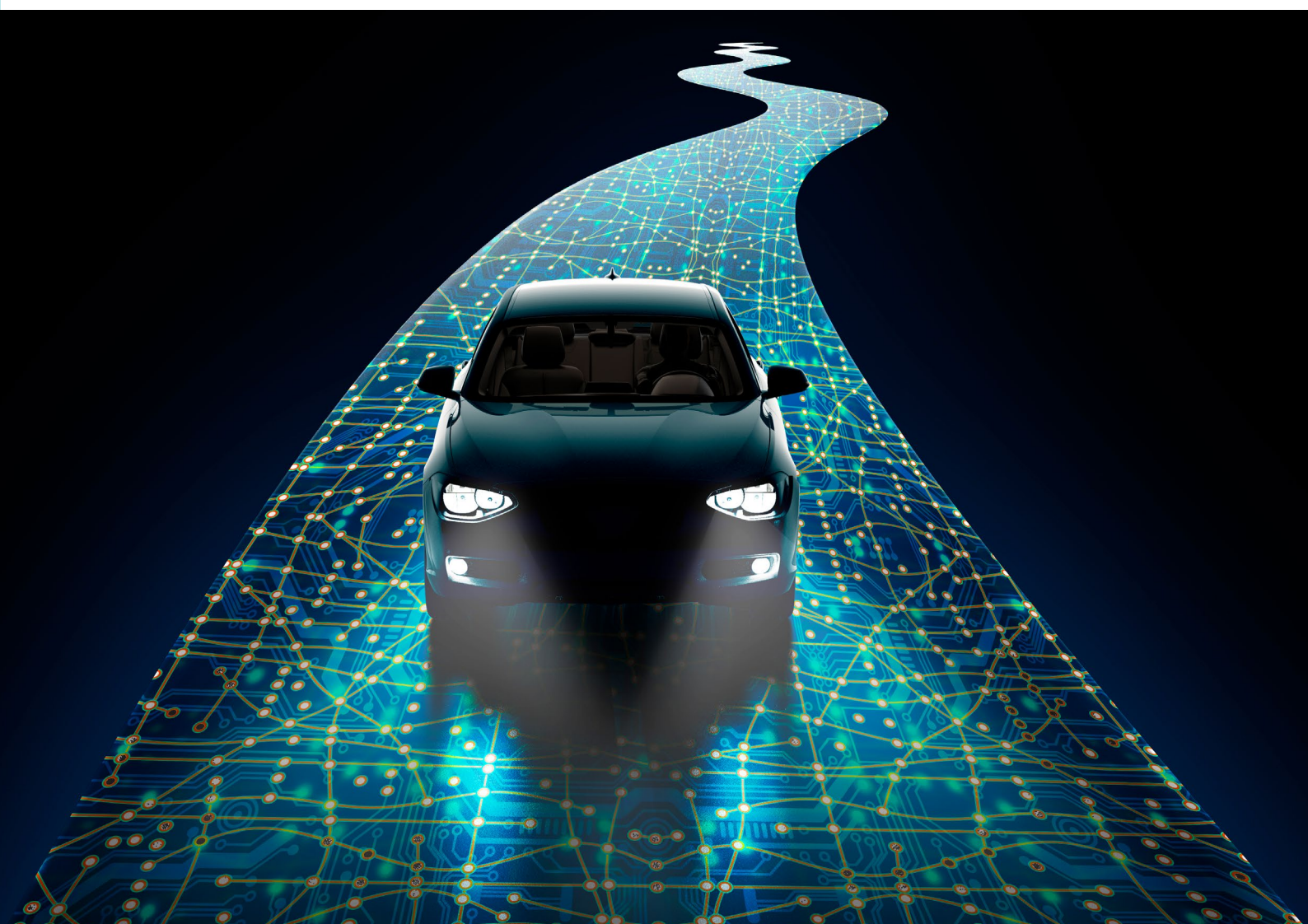# Connected and automated vehicles – Vocabulary v1.0
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Centre for Connected
& Autonomous Vehicles

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Publishing and copyright information

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Contents

Foreword

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Acknowledgement is given to Nick Reed, Reed Mobility, as the technical author.

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Relationship with other publications

This document is part of a two-year Connected and Automated Vehicles programme which aims to develop a suite of technical standards and guidance to help promote the design, testing and safe deployment of automated vehicles on UK roads. This document is issued as a vocabulary document that underpins the suite of CAV-related publications. It is intended to be read in conjunction with:

- publications on system safety, including PAS 1880, PAS 1883 and PAS 11281;
- publications on data security, including PAS 1882;
- safety and stakeholder requirements, including the Department for Transport's Code of practice: Automated vehicle trialling, Transport for London's Connected and autonomous vehicles: Guidance for London trials, and Highways England's GG104: Requirements for safety risk assessment; and
- existing legislation for UK vehicles and roads.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

0 Introduction

This document has been created in response to industry calls for a consistent, reliable set of terms and definitions in the Connected and Automated Vehicles (CAV) sector. It has been developed via a new iterative method, which relies on a team of industry experts working virtually to agree on content to release to the marketplace quickly. This method permits a rapid response to industry changes and can result in the release of several document iterations a year.

Therefore, by its nature, the content released in the iteration of this document will change from time to time with subsequent iterations. Offered as a free-to-use central resource, this document is intended to supplement and support other related BSI PAS projects including PAS 1880 and 1881. Every attempt has been made to incorporate terms already defined within related BSI publications.

Please note, iteration or version 1 of this content is considered a 'beta' version and whilst it has undergone technical review and a consensus building process, this is the first time it is issued for public consultation. All subsequent versions will go through this review process.

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1 Scope

This document defines terms, initialisms and acronyms for the connected and automated vehicle (CAV) sector.

It covers terms relating to connectivity and automation of land-based vehicles, their environments and their users. It does not cover terms that are manufacturer-specific.

This document is for use by insurers, regulators, legislators and organizations involved in CAV infrastructure, as well as CAV manufacturers and consumers.

1 Scope

2 Terms, definitions, initialisms and acronyms

2.1 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

2.1.1 5G

fifth generation cellular network technology supporting faster data rates, higher connection density and lower latency than previous generations

NOTE The International Telecommunication Union has set out requirements for 5G networks, devices and services as International Mobile Telecommunications-2020 (IMT-2020 Standard).

2.1.2 active safety system

entity consisting of interdependent components that uses sensor input and processing to detect impending collisions and takes preventative or mitigating action

NOTE Preventive action may take the form of providing an advanced warning or providing the human driver with assistance in vehicle control

2.1.3 adaptive cruise control (ACC)

system that attempts to maintain the vehicle (2.1.58) at a driver (2.1.22) selected set speed and uses sensors and automation to regulate vehicle speed

NOTE 1 The purpose is to keep a safe distance relative to other slower moving vehicles ahead before reverting to the set speed when the lane clears

NOTE 2 Some early adaptive cruise control systems, especially those vehicles with manual transmission, are not capable of bringing the vehicle to a complete stop and require the human driver to intervene to do so. Systems that are capable of controlling the vehicle to a stop have a variety of additional names such as 'Stop & Go' and 'Traffic Jam Assist'.

2.1.4 advanced driver assistance system (ADAS)

entity consisting of interdependent components that supports human drivers (2.1.22) by performing a part of the driving task or providing information about the driving environment

NOTE Examples include adaptive cruise control and automatic emergency braking.

2.1.5 antilock braking system (ABS)

entity consisting of interdependent components that prevents the braking wheels from locking during brake application

NOTE It does this by rapidly pulsing the brakes on and off, thereby maintaining tractive contact with the road surface and improving vehicle control

2.1.6 automated driving

when full responsibility for the dynamic driving task (2.1.25) rests with the automated driving system (2.1.7)

2.1.7 automated driving system (ADS)

hardware and software that are collectively capable of performing the dynamic driving task (2.1.25) on a sustained basis, regardless of whether it is limited to a specific operational design domain (2.1.42)

NOTE This definition is adapted from SAE J3016 (2018) and is used specifically to driving automation systems that can deliver SAE level 3, 4, or 5 driving.

2.1.8 automated driving system entity (ADSE)

organization or individual that puts an automated driving system forward for authorization for use on a road and is responsible for its safety

2.1.9 automated vehicle (AV)

vehicle (2.1.58) equipped with an automated driving system (2.1.7) capable of sustained automation of the dynamic driving task (2.1.25)

NOTE The Automated and Electric Vehicles Act 2018 describes an automated vehicle as being "designed or adapted to be capable, in at least some circumstances or situations, of safely driving themselves" and "may lawfully be used when driving themselves, in at least some circumstances or situations, on roads or other public places in Great Britain."

2.1.10 automatic emergency braking (AEB)

vehicle system that uses sensors and computer processing to detect when the driven vehicle (2.1.58) could collide with an object in its path and provides warnings for the human driver before applying the brakes automatically attempting to mitigate or avoid the collision, even if the human driver (2.1.22) takes no action

2.1.11 automatically commanded steering function (ACSF)

electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate continuous control action in order to assist the driver

2.1.12 blind spot monitoring

vehicle system that warns of the presence of other vehicles (2.1.58) in areas that a human driver might have difficulty observing and that could present a hazard if the driven vehicle were to execute a lane change or sudden turn

NOTE Some blind spot monitoring systems include cross traffic alert systems.

2.1.13 cellular vehicle-to-everything (C-V2X)

communication with and between vehicles (2.1.58) using 4G and 5G cellular networks

NOTE Cellular V2X (C-V2X) is a 3GPP standard describing a technology to achieve the V2X requirements. C-V2X is an alternative to 802.11p, the IEEE specified standard for V2V and other forms of V2X communications

2.1.14 central processing unit (CPU)

primary circuitry that responds to and executes the basic instructions that drive a computer

2.1.15 connected automated vehicle (CAV)

vehicle (2.1.58) equipped with communications technology and systems that can perform sustained automation of the dynamic driving task

2.1.16 connected vehicle (CV)

vehicle (2.1.58) equipped with wireless communications technology that enables data transfer with other vehicles, infrastructure or other networks

2.1.17 cooperative

two or more systems that communicate to improve a transport service

NOTE Examples of cooperative systems in road transport typically relate to communication to vehicles upstream of hazardous conditions ahead such as a collision or extreme weather conditions.

2.1.18 corner case

scenario in which two or more independent parameter values are each within the capabilities of the system but together constitute a rare condition that challenges its capabilities

2.1.19 cross traffic alert (CTA)

vehicle (2.1.58) system that uses sensors and computer processing to detect hazards approaching from the side of the vehicle and warns the human driver of a potential collision

NOTE Front cross traffic alert systems relate to hazards approaching from the side as the driven vehicle pulls forward into moving traffic; rear cross traffic alert systems relate to hazards approaching from the side as the driven vehicle reverses into moving traffic.

2.1.20 cyber security

collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and users' assets

NOTE Organization and users' assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cyber security strives to ensure the attainment and maintenance of the security properties of the organization and users' assets against relevant security risks in the cyber environment. The general security objectives include:

- *availability;*
- *integrity, which may include authenticity and nonrepudiation;*
- *confidentiality.*

[SOURCE: ITU-T Recommendation X.1205]

2.1.21 dedicated short range communication (DSRC)

one- or two-way short to medium range wireless communications using a corresponding set of protocols and standards designed for automotive use

NOTE In Europe, standards for DSRC have been developed by CEN (TC278) and test specifications have been developed by ETSI.

2.1.22 driver

suitably trained and certified entity responsible for observing the environment, path planning, hazard response and vehicle (2.1.58) control tasks constituting the dynamic driving task

NOTE In an automated vehicle, responsibility for the sustained dynamic driving task may be distributed between a human and the automated driving systems and depending on the level of automation, the automation systems may have full responsibility for driving and therefore the systems constitute the 'driver'.

2.1.23 driver monitoring system (DMS)

entity consisting of interdependent components for assessing the alertness state of the human driver (2.1.22) with respect to the dynamic driving task (2.1.25)

NOTE Typically camera based, might also play a role in occupant recognition for identity / security purposes.

2.1.24 driving automation system (DAS)

hardware and software that are collectively capable of performing part or all of the dynamic driving task (2.1.25) on a sustained basis

NOTE This definition is adapted from SAE J3016 (2018) and is used specifically to describe systems that can deliver SAE level 1 to 5 driving.

2.1.25 dynamic driving task (DDT)

real-time operational and tactical functions required to operate a vehicle (2.1.58) safely in on-road traffic

NOTE Excludes strategic functions such as trip scheduling and selection of destinations and waypoints.

2.1.26 edge case

scenario in which extreme or rare conditions result in challenges to the capabilities of the system

2.1.27 electronic stability control (ESC)

vehicle (2.1.58) system that continuously monitors steering and vehicle direction and compares intended direction to the vehicle's actual direction and intervenes by applying the brakes independently to each of the wheels to correct loss of control much faster than a typical human driver (2.1.22)

NOTE Also referred to as electronic stability program (ESP) or dynamic stability control (DSC). Intended direction is determined by measuring steering wheel angle; the vehicle's actual direction is determined by measuring lateral acceleration, vehicle rotation and individual road wheel speeds.

2.1.28 emergency lane keeping (ELK)

vehicle system that attempts to prevent the vehicle from crossing a lane marking into a lane where there is an obstruction or risk of collision, irrespective of whether the human driver has operated the direction indicator

2.1.29 forward collision warning (FCW)

vehicle system that uses sensors and computer processing to detect when the driven vehicle (2.1.58) might collide with an object in its path and provides warnings for the human driver to prompt avoiding action

2.1.30 handover

process by which responsibility for the sustained dynamic driving task (2.1.25) transitions either from a human driver to an automated driving system (2.1.7) or from an automated driving system to a human driver

2.1.31 highly automated road passenger service (HARPS)

supply of journeys on roads (2.1.49) to passengers using automated vehicles (2.1.9) without a human driver or user-in-charge (2.1.56)

2.1.32 highly automated road passenger service operator

business which carries passengers for hire or reward using automated vehicles (2.1.9) on the road (2.1.49) without the services of a human driver or user-in-charge (2.1.56)

2.1.33 intelligent speed adaptation (ISA)

vehicle (2.1.58) system that supports drivers (2.1.22) in complying with legally enforced speed limits

NOTE Systems can use satellite-based positioning and tracking the position against a database of speed limits and/or cameras to detect speed limits shown on road signs. Some systems provide a human driver with warnings of excessive speed while others actively moderate vehicle speed to comply with limits.

2.1.34 internet of things (IoT)

infrastructure of interconnected objects, people, systems, and information resources together with intelligent services to allow them to process information of the physical and the virtual world and react

[SOURCE: ISO 19731:2017(en), 3.21]

2.1.35 ITS-G5

protocol stack for supporting vehicle-to-vehicle (2.1.58) communications in an ad hoc network based on IEEE 802.11-2012 and ANSI/IEEE Std 802.2

NOTE ITS stands for intelligent transport systems; G5 is derived from the frequency band (5.9GHz) upon which it was designed to operate.

2.1.36 lane centring

vehicle (2.1.58) system that uses cameras or other inputs and automated controls to help the vehicle stay in the centre of the driven lane

NOTE Unlike lane-keeping assist, this system operates continuously, applying steering controls to keep the vehicle in the centre of the lane whilst in operation. Current systems rely on lane markings of sufficient quality and visibility to support the function. The system can be cancelled by use of the turn signals.

2.1.37 lane departure warning (LDW)

vehicle (2.1.58) system that uses cameras or other inputs to detect impending lane exceedances by the vehicle and provide visual, auditory or haptic feedback to the human driver (2.1.22)

NOTE Unlike lane centring and lane-keeping assist, this system does not actively apply any control inputs to the vehicle. Current systems rely on lane markings of sufficient quality and visibility to support the function. The system can be cancelled by use of the turn signals.

2.1.38 lane-keeping assist (LKA)

vehicle (2.1.58) system that uses cameras or other inputs and automated controls to direct the vehicle away from the edge of the driven lane

NOTE Unlike lane-centring, this system operates exceptionally when it detects that the vehicle is about to depart from the driven lane. Some systems allow a degree of line crossing before directing the vehicle back into the lane from which it is departing. Current systems rely on lane markings of sufficient quality and visibility to support the function. The system can be cancelled by use of the turn signals.

2.1.39 lidar

sensor that measures distances to objects by emitting laser light and measuring the time taken for reflected returns

2.1.40 minimal risk condition

state to which a human driver (2.1.22) or an automated driving system (2.1.7) can bring a vehicle in which the likelihood of a collision is minimised when a trip can not be completed

NOTE Examples of reasons for which a trip can not be completed include mechanical breakdown, automated driving system failure, departure from the operational design domain for an automated driving system or failure of the human driver to respond to a request to resume responsibility for the dynamic driving task.

2.1.41 on-board diagnostics (OBD)

vehicle (2.1.58) system for checking and reporting specific faults

NOTE The OBD-II / EOBD (European on-board diagnostics) regulations have standardized connections, format and messaging for this capability for M1 category cars since 2001 (petrol) and 2004 (diesel).

2.1.42 operational design domain (ODD)

operating conditions under which a given driving automation system (2.1.24) or feature thereof is specifically designed to function

NOTE Including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.

2.1.43 over-the-air (OTA)

wireless transmission of information often used to deliver software, firmware or configuration updates

2.1.44 passengerless vehicle

automated vehicle (2.1.9) designed to travel without any human occupants

NOTE Generally designed specifically for goods delivery, that can operate without a human driver and with no space for passengers

2.1.45 pedestrian detection

vehicle (2.1.58) system that uses sensors and computer processing to attempt to identify the presence of pedestrians and takes action directly or indirectly to help avoid or mitigate collisions

2.1.46 platooning

vehicles (2.1.58) travelling in column formation with the intention to reduce aerodynamic drag and thereby improve fuel efficiency

NOTE Platooning may be at time headways closer than would be considered safe for human drivers if supported by suitable vehicle-to-vehicle communication and automation systems.

2.1.47 radar

system that transmits radio waves and collects signals reflected from objects to allow estimation of their relative location and speed

NOTE Objects can differ markedly in the extent to which they reflect radio waves. Large, regularly shaped metallic objects (e.g. motor vehicles) produce a strong radar return so their presence is more readily detected by radar systems; smaller, irregularly shaped objects (e.g. pedestrians) typically offer a much weaker radar return and so their presence is harder to detect using radar systems

2.1.48 real-time kinematics (RTK)

technique used to increase the accuracy of satellite-based positioning signals by using one or more fixed base stations that wirelessly sends out corrections to a moving receiver for reference

2.1.49 road

prepared surface with identifiable edges and is open to members of the public to walk or ride or drive along it

2.1.50 safety driver

human operative at the controls of an automated vehicle (2.1.9), observing the driving environment, recognising challenging situations, detecting deviations from expected behaviour and ready and able to intervene in the dynamic driving task (2.1.25) when needed in order to preserve safety

2.1.51 scenario

description of a driving situation that includes the actors, environment, objectives and sequences of events

2.1.52 sensor fusion

amalgamation of outputs from independent sensor systems in an attempt to build a more detailed understanding of the situation

2.1.53 simulation

computer generated environments used to test components, systems or human behaviours

2.1.54 software development kit

programs and other operating information used to arrive at new applications for a specific device or operating system

2.1.55 telematics

collection and communication of vehicle (2.1.58) operational and status data

2.1.56 user-in-charge

human in the vehicle or in line of sight of the vehicle (2.1.58) who is qualified and fit to drive and in a position to operate the controls of the vehicle

2.1.57 validation

means by which it is proven beyond reasonable doubt that an end product meets its design intent and stated performance specification

2.1.58 vehicle

motorised, wheeled conveyance that is mechanically propelled and intended or adapted for use on roads

2.1.59 vehicle-to-everything (V2X)

vehicles (2.1.58) sharing data with other vehicles, infrastructure, other road users or any other communications system

2.1.60 vehicle-to-grid (V2G)

system that enables plug-in vehicles (2.1.58) to act as distributed energy storage by providing demand responsive services to the power grid

2.1.61 vehicle-to-infrastructure (V2I)

vehicles (2.1.58) sharing data with infrastructure

2.1.62 vehicle-to-vehicle (V2V)

vehicles (2.1.58) sharing data with other vehicles

2.1.63 verification

test of a system to prove that it meets all its specified requirements at a particular stage of its development

2.1.64 visual processing

analysis of optical data to interpret the local environment

NOTE Driver warning systems or automation of the driving task might be based on visual processing. It might also contribute to sensor fusion.

2.1.65 wireless local area network (WLAN)

matrix that allows devices to connect and communicate wirelessly within a limited area

NOTE a WLAN may be connected to the internet via a gateway.

2.2 Initialisms

2.2.1 ACC
adaptive cruise control

2.2.2 ACSF
automatically commanded steering function

2.2.3 ADS
automated driving system

2.2.4 AV
automated vehicle

2.2.5 CPU
central processing unit

2.2.6 CTA
cross traffic alert

2.2.7 DSC
dynamic stability control

2.2.8 ELK
emergency lane leeping

2.2.9 ESC
electronic stability control

2.2.10 ESP
electronic stability program

2.2.11 FCTA
front cross traffic alert

2.2.12 GPU
graphics processing unit

2.2.13 IOT
internet of things

2.2.14 ITS
intelligent transport systems

2.2.15 ITS-G5
intelligent transport systems communicating using the 5.9GHz frequency band

2.2.16 OEM
original equipment manufacturer

2.2.17 OTA
over-the-air

2.2.18 RCTA
rear cross traffic alert

2.2.19 RTK
real-time kinematic

2.2.20 SAE
Society of Automotive Engineers
NOTE SAE is itself an abbreviation of SAE International, the full name for the U.S.-based standards and professional development organisation for automotive engineering.

2.2.21 SDK
software development kit

2.2.22 V2G
vehicle-to-grid

2.2.23 V2I
vehicle-to-infrastructure

2.2.24 V2V
vehicle-to-vehicle

2.2.25 V2X
vehicle-to-everything

2.2.26 WLAN
wireless local area network

2.3 Acronyms

2.3.1 ADAS
advanced driver assistance system

2.3.2 HARPS
highly automated road passenger service

2.3.3 LIDAR
light detection and ranging

2.3.4 RADAR
radio detection and ranging

Bibliography

Standards publications

Content to be developed in next iteration.

Other publications

Content to be developed in next iteration.

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