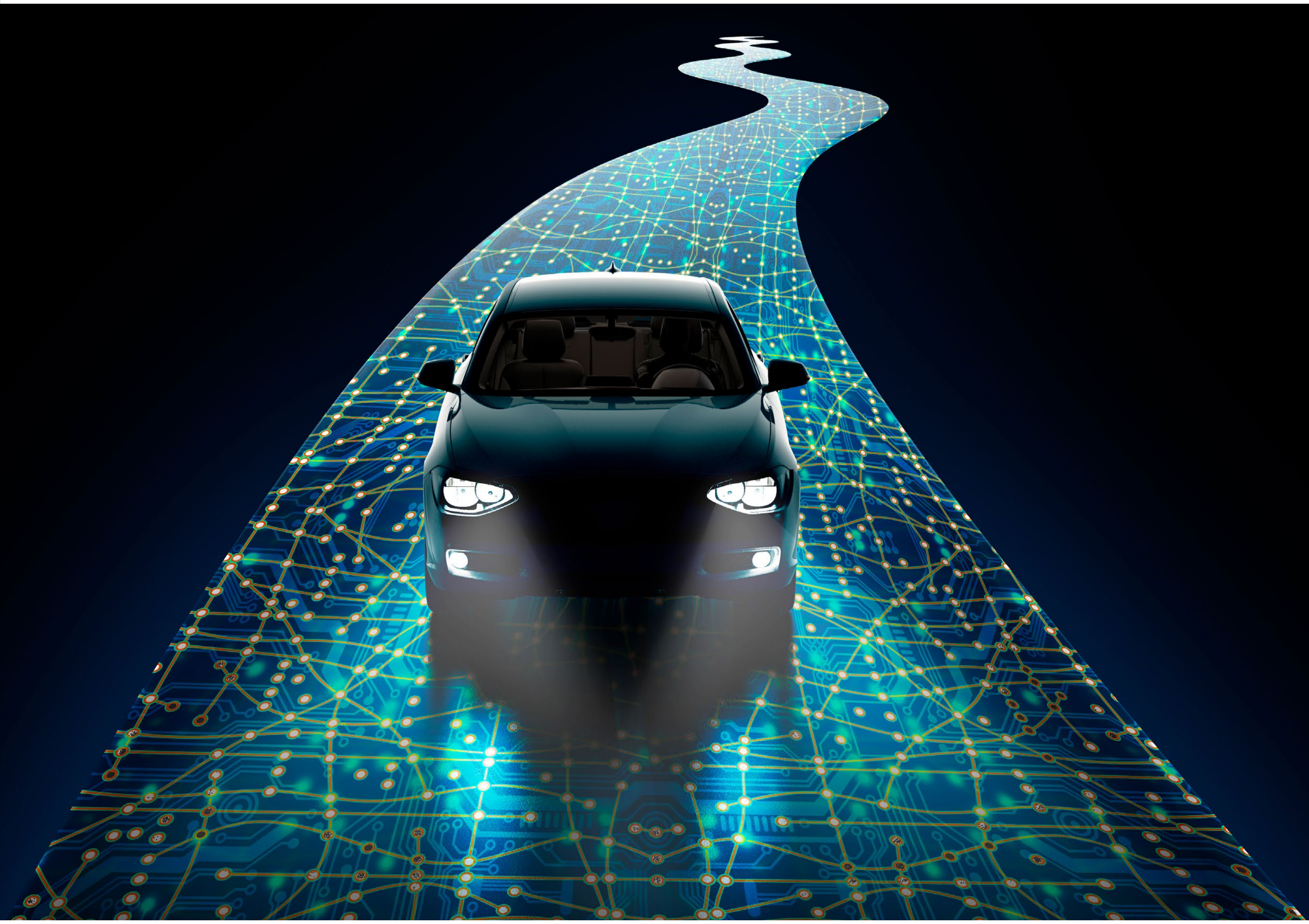
Connected and automated vehicles – Vocabulary
BSI Flex 1890 v4.0:2022-03



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Contents

Foreword

This BSI Flex was sponsored by The Centre for Connected and Autonomous Vehicles. Its development was facilitated by BSI Standards Limited and it was released under licence from The British Standards Institution. It came into effect on 11th March 2022.

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

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The agile BSI Flex development process enables a vocabulary to be developed rapidly, and on an iterative basis, in order to fulfil an immediate need in industry. A BSI Flex can be considered for further development as a PAS or British Standard, or constitute part of the UK input into the development of a European or International Standard.

Because the content in this version is part of an iterative process, it is likely to change from time to time with subsequent iterations.

Supersession

This version of BSI Flex 1890 supersedes BSI Flex 1890 v3.0:2020-10, which is withdrawn.

Information about this document

This release is Version 4 of BSI Flex 1890, which is the last planned version of the standard. All comments received will be reviewed to inform the future direction of this standard. Interested parties are encouraged to check the BSI website for any updates regarding any future plans.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at bsigroup.com/standards, or by contacting the Customer Services team.

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As a vocabulary, this BSI Flex takes the form of terms and definitions. It is not to be quoted as if it were a specification or a code of practice.

Relationships with other publications

This document is part of BSI's 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 CAV safety and security, including PAS 1880, PAS 1881, PAS 1883, PAS 1884, PAS 1885 and PAS 11281;
- publications on safety critical data, 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.

Presentational conventions

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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1 Scope

This document defines terms, abbreviations, and acronyms for the connected and automated vehicle (CAV) sector, focused on those relating to vehicles and associated technologies.

It covers terms relating to connectivity and automation of roadgoing, land-based vehicles 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.

2 Terms, definitions and abbreviations

2.1 Terms and definitions

2.1.1 abort criteria

conditions defined through risk assessment that necessitate termination or non-initiation of the automated driving system (**2.1.7**) during authorized testing

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 *Preventative action can take the form of providing an advanced warning or providing the human driver with assistance in vehicle control, e.g. by applying the brakes.*

2.1.3 adaptive cruise control (ACC)

system that attempts to maintain the vehicle (**2.1.87**) at a driver-selected target speed and following distance, using 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".*

2.1.4 advanced driver assistance system (ADAS)

entity consisting of interdependent components that supports human drivers by performing a part of the dynamic driving task (**2.1.24**) or providing safety relevant information

NOTE *Examples include adaptive cruise control and automatic emergency braking.*

2.1.5 authorized self-driving entity (ASDE)

organization that puts an automated vehicle forward for authorization for use as self-driving and is responsible for its safe and lawful behaviour

NOTE 1 *This might be the vehicle manufacturer or software designer or a joint venture between the two.*

NOTE 2 *This term and definition is adapted from the Law Commission of England and Wales and Scottish Law Commission joint consultation paper 3 (2020) [1] and replaces the previous term automated driving system entity (ADSE).*

2.1.6 automated driving

the full function of the dynamic driving task (**2.1.24**) performed by the automated driving system (**2.1.7**) within its operational design domain (**2.1.48**)

NOTE 1 *An automated vehicle driving itself is performing automated driving.*

NOTE 2 *Automated driving might operate for some or all of a journey depending on the capabilities of the system, the suitability of infrastructure, any other constraints on its operational design domain (**2.1.48**) and the preferences of the user-in-charge (**2.1.85**).*

NOTE 3 *The Law Commission of England and Wales and Scottish Law Commission joint report (2022) [2] extended this definition with the condition that the vehicle is to drive "safely and legally, even if an individual is not monitoring the driving environment, the vehicle or the way that it drives".*

2.1.7 automated driving system (ADS)

hardware and software that are collectively capable of performing the dynamic driving task (**2.1.24**) on a sustained basis, regardless of whether it is limited to a specific operational design domain (**2.1.48**)

NOTE 1 *This definition is adapted from SAE J3016 (2018) [3] and is used specifically for driving automation systems that can deliver SAE level 3, 4, or 5 driving [the generic term driving automation system (**2.1.23**) covers systems that deliver SAE level 1 to 5 driving features].*

2.1.8 automated lane keeping system (ALKS)

hardware and software for low speed application which is activated by the driver and which keeps the vehicle within its lane for travelling speed of 60 kph or less by controlling the lateral and longitudinal movements of the vehicle for extended periods without the need for further driver input

{SOURCE: UNECE/TRANS/WP.29/2020/81, 2020 [4]}

2.1.9 automated vehicle (AV)

vehicle (**2.1.87**) designed or adapted to be capable, in at least some circumstances or situations, of safely driving itself and which may lawfully be used when driving itself, in at least some circumstances or situations, on roads or other public places in Great Britain

{SOURCE: Automated and Electric Vehicles Act, 2018 [5]}

2.1.10 automatic emergency braking (AEB)

vehicle system that uses sensors and computer processing to detect when the ego vehicle (**2.1.26**) could collide with an object in its path and applies the brakes automatically attempting to mitigate or avoid the collision, even if the driver takes no action

NOTE *AEB systems might use different sensor types (e.g. camera, radar, lidar), work in different driving conditions (e.g. highways, urban) and act on the ego vehicle in different ways (e.g. only slow the vehicle or bring it to a complete stop).*

2.1.11 automatic emergency steering (AES)

vehicle system that uses sensors and computer processing to detect when the ego vehicle (**2.1.26**) could collide with an object in its path and applies steering inputs automatically attempting to mitigate or avoid the collision, even if the driver takes no action

NOTE 1 *AES systems might use different sensor types (e.g. camera, radar, lidar), work in different driving conditions (e.g. highways, urban) and act on the ego vehicle in different ways depending on the situation.*

NOTE 2 *AES systems could consider the ego vehicle's surroundings and other objects and their trajectories to determine a predicted minimal risk steering trajectory.*

NOTE 3 *AES systems are distinct from steering support systems which augment a driver's steering input to avoid a collision only when the driver has initiated a steering movement.*

2.1.12 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

{SOURCE: UNECE/TRANS/WP.29/2017/10 [6]}

2.1.13 blind spot monitoring

vehicle system that warns of the presence of other vehicles (**2.1.87**) in areas that a human driver might have difficulty observing and that could present a hazard if the ego vehicle (**2.1.26**) were to execute a lane change or sudden turn

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

communication with and between vehicles (**2.1.87**) 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 ITS-G5 802.11p, the IEEE specified standard for V2V and other forms of V2X communications.*

2.1.15 connected and automated vehicle (CAV)

automated vehicle (**2.1.9**) equipped with communications technology that enables data transfer with other vehicles, infrastructure or other networks

2.1.16 connected vehicle

vehicle (**2.1.87**) equipped with wireless communications technology that enables data transfer with other vehicles, infrastructure or other networks

2.1.17 conventional vehicle

vehicle designed to be operated by an in-vehicle driver during part or all of every trip using standard controls within the type approval for that vehicle class

NOTE 1 *This definition is adapted from SAE J3016 (2021) [7].*

NOTE 2 *A conventional vehicle may be equipped with driving automation system (**2.1.23**) features that support the driver in performing the dynamic driving task (**2.1.24**) but do not perform the complete dynamic driving task. A conventional vehicle may also be equipped with sub-trip feature(s) that require an in-vehicle driver to operate the vehicle during portions of each trip.*

2.1.18 cooperative

two or more roadside or vehicle systems that communicate to facilitate transportation

NOTE *This term is defined in relation to CAVs. Examples of cooperative systems in road transport include those providing communication with vehicles upstream of hazardous conditions such as a collision or extreme weather conditions.*

2.1.19 corner case

rare but plausible combination of two or more independent parameter values within a scenario

NOTE *Contrast with edge case (**2.1.25**) which represents a single rare but plausible independent parameter value.*

2.1.20 cross traffic alert (CTA)

vehicle (**2.1.87**) 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 ego vehicle (__2.1.26__) pulls forward into moving traffic; rear cross traffic alert systems relate to hazards approaching from the side as the ego vehicle reverses into moving traffic.

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 European Telecommunications Standards Institute (ETSI).

2.1.22 driver monitoring system (DMS)

entity consisting of interdependent components for assessing the state of the human driver with respect to their ability to engage with the dynamic driving task (**2.1.24**)

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

2.1.23 driving automation system (DAS)

hardware and software that are collectively capable of performing part or all of the dynamic driving task (**2.1.24**) on a sustained basis

__NOTE__ This definition is adapted from SAE J3016 (2018) [3] and is used specifically to describe systems that can deliver SAE level 1 to 5 driving (the specific term, automated driving system (__2.1.7__), covers systems that deliver SAE level 3 to 5 driving features).

2.1.24 dynamic driving task (DDT)

real-time operational and tactical functions required to operate a vehicle (**2.1.87**) safely in on-road traffic

__NOTE__ Michon (1985) [8] defines operational driving functions as those delivered over a time constant of milliseconds and include tasks such as steering inputs to keep within a lane or braking to avoid an emerging hazard; tactical driving functions are those delivered over a time constant of seconds and include tasks such as lane choice, gap acceptance and overtaking. The DDT excludes strategic functions, which are those delivered over a longer time constant and include tasks such as trip scheduling and selection of destinations and waypoints.

2.1.25 edge case

rare but plausible independent parameter value within a scenario

__NOTE__ Edge case contrasts with corner case (__2.1.19__) which represents a combination of rare but plausible parameter values.

2.1.26 ego vehicle

subject connected and/or automated vehicle, the behaviour of which is of primary interest in testing, trialling or operational scenarios (**2.1.73**)

__NOTE__ Ego vehicle is used interchangeably with subject vehicle (__2.1.79__) and vehicle under test (VUT).

2.1.27 electronic stability control (ESC)

vehicle (**2.1.87**) 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

__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 (**2.1.87**) 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 fallback

process by which the full function of the dynamic driving task is delivered when a driving automation system or systems (**2.1.23**) cease to operate

__NOTE 1__ Fallback might be required due to mechanical breakdown, driving automation system failure, departure from the operational design domain for the driving automation system or failure of the human driver to respond to a request to resume the full function of the dynamic driving task.

__NOTE 2__ Fallback performance in automated vehicles is delivered by the automated driving system; for vehicles with less capable driving automation systems, the human driver delivers some or all of the fallback process.

__NOTE 3__ If a trip cannot be completed, fallback requires a minimal risk manoeuvre (__2.1.44__) to achieve a minimal risk condition (__2.1.43__). These could be delivered by the human driver or automated driving systems, depending on the capabilities of the vehicle and extent of any system failure.

2.1.30 fault injection testing

method to evaluate the effect of a fault within an element by inserting faults, errors or failures in order to observe the safety operator (**2.1.71**) and/or automated driving system (**2.1.7**) response

2.1.31 forward collision warning (FCW)

vehicle (**2.1.87**) system that uses sensors and computer processing to detect when the vehicle might collide with an object in its path and provides warnings for the human driver to prompt avoiding action

2.1.32 full-trip feature

automated driving system (**2.1.7**) features that operate a vehicle (**2.1.87**) throughout complete trips (**2.1.84**)

[SOURCE: SAE J3016 APR2021, **3.7.3**]

2.1.33 fully automated vehicle

vehicle (**2.1.87**) equipped with an automated driving system (**2.1.7**) that operates without any operational design domain (**2.1.48**) limitations for some or all of the journey, without the need for human intervention as a fallback (**2.1.29**) to ensure road safety

{SOURCE: UNECE/TRANS/WP.1/165, 2018 [9]}

2.1.34 green light optimized speed advisory (GLOSA)

vehicle (**2.1.87**) system that receives upcoming traffic signal cycle information over V2X communication channels and uses relative vehicle position to compute and display a speed recommendation that, if adopted by the driver, would allow the vehicle to pass the upcoming traffic lights during a green interval, thereby reducing stops at red lights

2.1.35 handover

process by which the sustained dynamic driving task (**2.1.24**) function transitions either from a human driver to an automated driving system (**2.1.7**) or from an automated driving system to a human driver

2.1.36 highly automated vehicle

vehicle equipped with an automated driving system (**2.1.7**) that operates within a specific operational design domain (**2.1.48**) for some or all of the journey, without the need for human intervention as a fallback (**2.1.29**) to ensure road safety

{SOURCE: UNECE/TRANS/WP.1/165, 2018 [9]}

2.1.37 intelligent speed adaptation (ISA)

vehicle (**2.1.87**) system that supports drivers 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 (including electronic signs and signals); speed limits could also be broadcast from infrastructure to vehicles to communicate relevant speed limits to the ISA system. Some systems provide a human driver with warnings of excessive speed while others actively moderate vehicle speed to comply with limits.*

2.1.38 intervention

action or set of actions initiated by the safety operator (**2.1.71**) to override automated operation of the subject vehicle (**2.1.78**)

{SOURCE: PAS 1884:2021, **3.1.15** [N4]}

2.1.39 ITS-G5

protocol stack for supporting vehicle-to-vehicle (**2.1.91**) 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 (5.9 GHz) upon which it was designed to operate.*

2.1.40 lane centring

vehicle (**2.1.87**) 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 (**2.1.42**), 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.*

2.1.41 lane departure warning (LDW)

vehicle (**2.1.87**) 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

NOTE *Unlike lane centring (**2.1.40**) and lane-keeping assist (**2.1.42**), 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.*

2.1.42 lane-keeping assist (LKA)

vehicle (**2.1.87**) system that uses cameras or other inputs and automated controls to direct the vehicle away from the edges of the driven lane

*NOTE Unlike lane centring (**2.1.40**), 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.*

2.1.43 minimal risk condition (MRC)

stable, stopped condition to which a human driver or automated driving system (**2.1.7**) brings a vehicle after performing the dynamic driving task (**2.1.24**) fallback (**2.1.29**) in order to reduce the risk of a collision or other loss when a given trip cannot be continued

NOTE 1 Examples of reasons for which a trip cannot 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 the full function of the dynamic driving task.

*NOTE 2 The form of the MRC is highly dependent on the operational design domain (**2.1.48**) of the automated vehicle (**2.1.9**) and the reason for which the MRC was required. For example, the MRC for an automated vehicle on a highway with a minor sensor fault might be to manoeuvre to the hard shoulder, decelerate gently to a stop and activate the hazard warning lights; the MRC for a low speed automated shuttle operating in an urban environment with a damaged forward lidar system might be to come to an immediate halt.*

2.1.44 minimal risk manoeuvre (MRM)

tactical or operational manoeuvre triggered and executed by the automated driving system (**2.1.7**) or the human driver to achieve the minimal risk condition (**2.1.43**)

NOTE 1 Michon (1985) [8] defines operational driving functions as those delivered over a time constant of milliseconds and include tasks such as steering inputs to keep within a lane or braking to avoid an emerging hazard; tactical driving functions are those delivered over a time constant of seconds and include tasks such as lane choice, gap acceptance and overtaking.

*NOTE 2 The form of the MRM is highly dependent on (and needs to be within) the operational design domain (**2.1.48**) of the automated vehicle (**2.1.9**), e.g. the MRM performed by a vehicle performing automated driving (**2.1.6**) at freeflow speed on a highway might be very different to that performed by a low speed automated shuttle operating in an urban environment.*

2.1.45 non-user-in-charge (NUIC) vehicle

highly automated vehicle (**2.1.36**) which is authorized for use without a user-in-charge (**2.1.85**)

NOTE This term and definition is adapted from the UK Law Commission and Scottish Law Commission joint consultation paper (2019): Automated Vehicles: Consultation Paper 2 on Passenger Services and Public Transport [10].

2.1.46 object and event detection and response (OEDR)

subtasks of the dynamic driving task (**2.1.24**) that include monitoring the driving environment and executing an appropriate response

NOTE 1 This definition is adapted from SAE J3016 (2021) [7].

NOTE 2 The definition includes detecting, recognizing, and classifying objects and events and preparing and executing responses as needed.

2.1.47 on-board diagnostics (OBD)

vehicle (**2.1.87**) 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).

2.1.48 operational design domain (ODD)

operating conditions under which a given driving automation system (**2.1.23**) or feature thereof is specifically designed to function

[SOURCE: SAE J3016 JUN2018, **3.22**]

NOTE 1 Including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or road characteristics.

NOTE 2 For further information refer to PAS 1883 [N3].

2.1.49 over-the-air (OTA)

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

2.1.50 path planning

determination of route from origin to destination, optimized across a range of possible criteria, taking account of the capabilities and limitations of the vehicle (**2.1.87**)

NOTE 1 Optimization could be across one or more critieria, e.g. the shortest route, the quickest route, the route with the fewest hazards.

2.1.51 passenger

user in a vehicle (**2.1.87**) who has no role in the operation of that vehicle

NOTE 1 This definition is adapted from SAE J3016 (2021) [7].

*NOTE 2 A passenger can be an occupant of a non-user-in-charge vehicle (**2.1.45**) or an additional occupant of a vehicle where another occupant is either the user-in-charge (**2.1.85**) in an automated vehicle (**2.1.9**) or at the controls of a conventional vehicle (**2.1.7**).*

2.1.52 pedestrian detection

vehicle (**2.1.87**) system that uses sensors and computer processing to identify the presence of pedestrians in the path of the ego vehicle (**2.1.26**) and takes action directly or indirectly to help avoid or mitigate collisions

*NOTE The scope of pedestrian detection systems is increasing to cover a wider range of vulnerable road users (**2.1.94**) beyond pedestrians.*

2.1.53 place of relative safety

location that puts an effective safety clearance between the subject vehicle (**2.1.78**), safety operator (**2.1.71**), other in-vehicle occupants or freight and the risks presented by hazards in the surrounding environment, that minimizes hazards to other users

{SOURCE: PAS 1884:2021, **3.1.24** [N4]}

NOTE 1 Places of relative safety might include a side road, rest or service area, lay-by, hard shoulder or emergency refuge area. The relative safety of a location, or locations, will vary depending on the test or trial environment and hazards presented by the road and road traffic. Dynamic risk assessment can be used to determine the safest location at a given point in time.

*NOTE 2 A minimal risk manoeuvre (**2.1.44**) should aim for the vehicle to achieve a minimal risk condition in a place of relative safety, if possible.*

2.1.54 platooning

linking of two or more vehicles (**2.1.87**) in a convoy using connectivity technology and automated driving support systems which allow the vehicles to maintain automatically a set, close distance between each other when connected for certain parts of a journey and to adapt to changes in the movement of the lead vehicle with little to no action from the drivers

{SOURCE: Regulation (EU) 2019/2144 [11]}

2.1.55 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

2.1.56 remote assistance

event-driven provision, by a remote operator (**2.1.62**) of information or advice to an automated vehicle (**2.1.9**), its occupants or other road users

NOTE 1 This definition is adapted from SAE J3016 (2021) [7] with the modification that the term "remote" indicates beyond visual line-of-sight of the subject vehicle.

*NOTE 2 Remote assistance does not include dynamic driving task (**2.1.24**) or fallback (**2.1.29**) performance by a remote driver. The automated driving system (**2.1.7**) performs the complete dynamic driving task (**2.1.24**) and/or fallback, even when assisted by a remote operator.*

*NOTE 3 Remote assistance supports trip continuation, safety and comfort and could include providing an automated driving system (**2.1.7**) with revised goals and/or tasks and information for occupants or other road users.*

2.1.57 remote control

continual oversight of automated vehicle (**2.1.9**) operation by a remote operator (**2.1.62**) who performs a safety-critical role

NOTE 1 This definition is adapted from TRL Published Project Report PPR1012 [12].

*NOTE 2 This might include a requirement to intervene and could range from pressing an emergency stop button (remote intervention) to performing the full dynamic driving task [remote driving (**2.1.59**)], given the circumstances.*

NOTE 3 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.58 remote driver

human able to perform the dynamic driving task (**2.1.24**) for an automated vehicle from beyond visual line-of-sight

NOTE This definition is adapted from SAE J3016 (2021) [7] with the modification that the term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.59 remote driving

real-time performance of the dynamic driving task (**2.1.24**) by a remote driver (**2.1.58**)

NOTE 1 This definition is adapted from SAE J3016 (2021) [7] with the modification that the term "remote" indicates beyond visual line-of-sight of the subject vehicle.

*NOTE 2 A receptive remote fallback-ready user becomes a remote driver (**2.1.58**) when the user performs the fallback (**2.1.29**).*

*NOTE 3 The remote driver (**2.1.58**) performs or completes the object and event detection and response (**2.1.46**) task and has the authority to overrule the automated driving system (**2.1.7**) for purposes of lateral and longitudinal vehicle motion control.*

NOTE 4 Remote driving is not driving automation.

2.1.60 remote monitoring

continual oversight of automated vehicle (**2.1.9**) operation by a remote operator (**2.1.62**)

NOTE 1 A remote operator can monitor one or more automated vehicles.

NOTE 2 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.61 remote operation

functions needed to support the management of an automated vehicle (**2.1.9**) or a fleet of automated vehicles by a remote operator (**2.1.62**), potentially including driving and non-driving related tasks

NOTE The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.62 remote operator

safety operator (**2.1.71**) who oversees the operation of an automated vehicle (**2.1.9**) from a remote location

NOTE 1 A remote operator might be responsible for remote driving, remote assistance or remote monitoring tasks.

NOTE 2 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.63 remote supervision

intermittent oversight of automated vehicle (**2.1.9**) operation by a remote operator (**2.1.62**) to support the safety and comfort of automated vehicle occupants

NOTE 1 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

*NOTE 2 Remote supervision includes applying limited interventions over automated vehicle operation, including triggering of a minimal risk manoeuvre (**2.1.44**) if deemed necessary, but does not include the full dynamic driving task (**2.1.24**) (which is remote driving, rather than remote supervision).*

2.1.64 remote supervisor

remote operator (**2.1.62**) that provides intermittent oversight of automated vehicle (**2.1.9**) operation to support the safety and comfort of automated vehicle occupants.

NOTE 1 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

*NOTE 2 A remote supervisor can apply limited interventions over automated vehicle operation, including triggering of a minimal risk manoeuvre (**2.1.44**) if deemed necessary, but cannot deliver the full dynamic driving task (**2.1.24**) (which would be by a remote driver, rather than a remote supervisor).*

2.1.65 remote user assistance

event-driven provision, by a remote operator (**2.1.62**), of information or advice to the occupants of an automated vehicle (**2.1.9**) or other road users in the vicinity

NOTE The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.66 remote user monitoring

continual oversight of the occupants of an automated vehicle (**2.1.9**) by a remote operator (**2.1.62**)

NOTE 1 A remote operator might monitor the occupants of one or more automated vehicles.

NOTE 2 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.67 remote vehicle assistance

intermittent oversight of automated vehicle (**2.1.9**) operation by a remote operator (**2.1.62**) in response to a request from the automated vehicle once an issue has been encountered and the automated vehicle has come to a safe stop

NOTE 1 This definition is adapted from TRL Published Project Report PPR1012 [12].

*NOTE 2 Assistance might include providing an automated driving system (**2.1.7**) with instructions to nudge or manoeuvre an automated vehicle around an obstacle or providing approvals or permissions to facilitate trip continuation.*

NOTE 3 This does not include providing instruction regarding selection of destinations or trip initiation timing (i.e. dispatch services).

NOTE 4 The term "remote" indicates beyond visual line-of-sight of the subject vehicle.

2.1.68 safety case

structured argument, supported by evidence, intended to justify that a system and activity is acceptably safe for a specific application in a specific operating environment

NOTE For further information, refer to PAS 1881 [N2].

2.1.69 safety driver

safety operator (**2.1.71**) at the controls within an automated vehicle (**2.1.9**), observing the driving environment, enforcing the operational design domain (**2.1.48**), recognizing challenging situations, detecting deviations from expected behaviour and ready and able to deliver the full function of the dynamic driving task (**2.1.24**) when needed in order to preserve safety during development, testing or trial activities, in accordance with the safety case (**2.1.68**)

2.1.70 safety of the intended functionality (SOTIF)

absence of unreasonable risk due to hazards resulting from functional insufficiencies of the intended functionality or from reasonably foreseeable misuse by persons

{SOURCE: PD ISO/PAS 21448:2019, **3.10** [N1]}

2.1.71 safety operator

person who is trained and able to monitor, assist or drive an automated vehicle (**2.1.9**) either at the controls within the subject vehicle (**2.1.78**) or from a remote location

[SOURCE: PAS 1884:2021, **3.1.28**]

*NOTE The safety operator is used to describe a safety driver (**2.1.69**) or remote operator (**2.1.62**). A safety driver is a safety operator who is situated within the vehicle itself to oversee its operation. A remote operator is beyond line-of-sight of the subject vehicle.*

2.1.72 safety supervisor

safety operator at the controls of the subject vehicle (**2.1.78**) not responsible for the dynamic driving task (**2.1.24**) but monitoring vehicle systems and the driving environment and able to trigger a minimal risk manoeuvre (**2.1.44**) when needed in order to preserve safety during development, testing or trial activities, in accordance with the safety case (**2.1.68**)

2.1.73 scenario

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

2.1.74 self-driving

full function of the dynamic driving task (**2.1.24**), performed by the automated driving system (**2.1.7**) within its operational design domain (**2.1.48**)

*NOTE 1 Although this term is deprecated within SAE J3016 (2021) [7], it is included here because this is the term best understood by the public to mean the definition as stated (which is the same as that for automated driving (**2.1.6**).*

NOTE 2 The Law Commission of England and Wales and Scottish Law Commission joint report (2022) [2] extended this definition with the condition that the vehicle is to drive "safely and legally, even if an individual is not monitoring the driving environment, the vehicle or the way that it drives".

2.1.75 sensor fusion

process of combining information from multiple sensor types in order to improve performance that is obtainable from a single sensor type

2.1.76 simulation

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

NOTE Simulation in the CAV domain can refer to a wide range of virtual test environments from microsimulation of traffic to simulation of CAV sensors and components to human-in-the-loop simulations of CAVs.

2.1.77 software development kit (SDK)

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

2.1.78 subject vehicle

connected and/or automated vehicle, the behaviour of which is of primary interest in testing, trialling or operational scenarios (**2.1.73**)

[SOURCE: PAS 1884:2021, **3.1.32**]

*NOTE Subject vehicle is used interchangeably with ego vehicle (**2.1.26**) and vehicle under test (VUT).*

2.1.79 sub-trip feature

driving automation system (**2.1.23**) feature equipped on a conventional vehicle that requires a human driver to perform the complete dynamic driving task (**2.1.24**) for at least part of every trip (**2.1.84**)

NOTE 1 This definition is adapted from SAE J3016 (2021) [7].

*NOTE 2 Sub-trip features require a human driver to operate the vehicle between the point-of-origin and the boundary of the feature's operational design domain (**2.1.48**), and/or after leaving the feature's operational design domain until the destination is reached.*

2.1.80 telematics

collection and communication of vehicle (**2.1.87**) operational and status data

2.1.81 teleoperation

see remote operation (**2.1.61**)

2.1.82 teleoperator

see remote operator (**2.1.62**)

2.1.83 transition demand

logical, intuitive procedure to transfer the dynamic driving task (DDT) from the system (automated control) to the human driver (manual control) following a request from the system to the human driver

[SOURCE: Safe Use of Automated Lane Keeping System (ALKS) Summary of Responses and Next Steps, CCAV, 2021]

2.1.84 trip

complete journey by a vehicle (**2.1.87**) from the point of origin to a destination

NOTE 1 This definition is adapted from SAE J3016 (2021) [7].

*NOTE 2 Performance of the dynamic driving task (**2.1.24**) during a given trip which could be accomplished in whole or in part by a driver, driving automation system (**2.1.23**), or both.*

2.1.85 user-in-charge

human in the vehicle (**2.1.87**) who is qualified to drive it and in a position to operate the controls of the vehicle while a relevant automated driving system (**2.1.7**) feature is engaged

*NOTE 1 The role of user-in-charge is not intended for use in reference to human occupants of automated vehicles during development, testing or trials, which might be safety drivers (**2.1.69**) or safety operators (**2.1.71**).*

*NOTE 2 The main role of the user-in-charge is to take over in planned circumstances as a conscious choice, in response to a transition demand (**2.1.83**) or after the vehicle has come to a safe stop. The user-in-charge would also have obligations to maintain and insure the vehicle and report collisions. An automated vehicle would require a user-in-charge unless it is authorized to operate without one. The user-in-charge needs to be in the vehicle (**2.1.87**) and can be distinguished from a remote operator.*

NOTE 3 Being qualified to drive means the user-in-charge holds a current and valid driving licence to drive the relevant vehicle in the jurisdiction in which it is being operated.

NOTE 4 This term and definition is adapted from the Law Commission of England and Wales and Scottish Law Commission joint consultation paper 3 (2020) [1].

2.1.86 validation

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

2.1.87 vehicle

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

2.1.88 vehicle control system

the combination of hardware and software responsible for enacting the outputs of the perception and decision-making entities and thereby delivering changes in lateral and/or longitudinal movement of the vehicle (**2.1.87**)

2.1.89 vehicle-to-everything (V2X)

unidirectional or bidirectional sharing of data between vehicles and other vehicles, infrastructure, other road users or any other communications system

*NOTE The definition is not intended to indicate that a vehicle is necessarily connected to everything but reflects that vehicles can be connected to a broad spectrum of systems of which vehicle-to-vehicle (**2.1.91**) and vehicle-to-infrastructure (**2.1.90**) communications are examples.*

2.1.90 vehicle-to-infrastructure (V2I)

unidirectional or bidirectional sharing of data between vehicles (**2.1.87**) and infrastructure

2.1.91 vehicle-to-vehicle (V2V)

vehicles (**2.1.87**) sharing data with other vehicles

2.1.92 verification

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

2.1.93 visual line-of-sight (VLOS)

continuous maintenance of direct unaided visual contact of the subject vehicle (**2.1.78**) that is under safety operator (**2.1.71**) control throughout a test or trial, and a clear view of the road ahead in the foreseeable path of the automated vehicle (**2.1.9**) in order to detect objects, threats and other road users at a distance that would allow the safety operator to intervene in time to avoid hazards

{SOURCE: Civil Aviation Authority, modified [13]}

2.1.94 vulnerable road user (VRU)

non-motorized road users

NOTE *Examples of non-motorized road users include pedestrians and cyclists and horse riders as well as motor-cyclists, users of mobility scooters or e-scooters and persons with disabilities or reduced mobility and orientation.*

{SOURCE: Directive 2010/40/EU [14]}

2.2 Abbreviations

ACC
adaptive cruise control

ACSF
automatically commanded steering function

ADS
automated driving system

AEB
automatic emergency braking

AES
automatic emergency steering

ALKS
automated lane keeping system

AV
automated vehicle

CPU
central processing unit

CTA
cross traffic alert

DDT
dynamic driving task

DMS
driver monitoring system

DSC
dynamic stability control

ELK
emergency lane keeping

ESC
electronic stability control

ESP
electronic stability program

FCTA
front cross traffic alert

FCW
forward collision warning

GPU
graphics processing unit

IOT
internet of things

ITS
intelligent transport systems

LKA
lane keep assist

MRC
minimal risk condition

MRM
minimal risk manoeuvre

OEDR
object and event detection and response

OEM
original equipment manufacturer

OTA
over-the-air

RCTA
rear cross traffic alert

RTK
real-time kinematics

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 organization for automotive engineering.*

SDK
software development kit

V2I
vehicle-to-infrastructure

V2V
vehicle-to-vehicle

V2X
vehicle-to-everything

VRU
vulnerable road user

WLAN
wireless local area network

2.3 Acronyms

ADAS
advanced driver assistance system

ASDE
authorized self-driving entity

BVLOS
beyond visual line-of-sight

CAV
connected and automated vehicle

CAM
connected automated mobility

CAM
cooperative awareness message

DEN
decentralized environmental notification

DENM
decentralized environmental notification message

GLOSA
green light optimized speed advisory

ISA
intelligent speed adaptation

LIDAR
light detection and ranging

NUIC
non-user-in-charge

RADAR
radio detection and ranging

SOTIF
safety of the intended functionality

UIC
user-in-charge

VLOS
visual line-of-sight

Bibliography

Standards publications

PD ISO/PAS 21448:2019, *Road vehicles – Safety of the intended functionality*

PAS 1881, *Assuring the safety of automated vehicle trials and testing – Specification*

PAS 1883, *Operational design domain (ODD) taxonomy for an automated driving system (ADS) – Specification*

PAS 1884:2021, *Safety operators in automated vehicle testing and trialling – Guide*

Other publications

[1] LAW COMMISSION & SCOTTISH LAW COMMISSION. *Automated Vehicles: Consultation Paper 3 – A regulatory framework for automated vehicles*. A joint consultation paper, Law Commission (Consultation Paper No 252), Scottish Law Commission (Discussion Paper No 171) 2020. Available at https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2021/01/AV-CP3.pdf

[2] LAW COMMISSION & SCOTTISH LAW COMMISSION. *Automated Vehicles: joint report*. Law Commission (No 404), Scottish Law Commission (No 258) 2022. Available at: https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2022/01/Automated-vehicles-joint-report-cvr-24-01-22.pdf

[3] SOCIETY OF AUTOMOTIVE ENGINEERS. J3016_201806: Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles. 2018.

[4] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. *Proposal for Supplement 1 to the original version of UN Regulation No. 157 (Automated Lane Keeping System).* UNECE/TRANS/WP.29/2020/81. 2021. Available at https://undocs.org/ECE/TRANS/WP.29/2020/81

[5] GREAT BRITAIN. Automated and Electric Vehicles Act 2018. LONDON: THE STATIONERY OFFICE. Available at http://www.legislation.gov.uk/ukpga/2018/18/section/1/enacted

[6] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. Proposal for the Definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation on automated vehicles. UNECE/TRANS/WP.29/2017/10. 2017. Available at https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp29/ECE-TRANS-WP29-2017-010e.pdf

[7] SOCIETY OF AUTOMOTIVE ENGINEERS. J3016_202104: Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles. 2021.

[8] MICHON, J.A. A critical view of driver behavior models: what do we know, what should we do?. In Human behavior and traffic safety. pp. 485-524. Springer, Boston, MA, U.S.A. 1985.

[9] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. *Report of the Global Forum for Road Traffic Safety on its seventy-seventh session.* UNECE/TRANS/WP.1/165. 2018. Available at http://www.unece.org/fileadmin/DAM/trans/doc/2018/wp1/ECE-TRANS-WP1-165e.pdf

[10] LAW COMMISSION & SCOTTISH LAW COMMISSION. *Automated Vehicles: Consultation Paper 2 on Passenger Services and Public Transport*. A joint consultation paper, Law Commission (Consultation Paper No 245), Scottish Law Commission (Discussion Paper No 169) 2019. Available at: https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2019/10/Automated-Vehicles-Consultation-Paper-final.pdf

[11] COUNCIL OF THE EUROPEAN UNION. Regulation (EU) 2019/2144 Of The European Parliament And Of The Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users. OJ L 325, 16.12.2019, pp. 1–40.

[12] KALAIYARASAN, A., SIMPSON, B., JENKINS, D., MAZZEO, F., YE, H., OBAZELE, I., COURTIER, M., WONG, M.C.S., BALL, P., WILFORD, R. *Remote operation of Connected and Automated Vehicles. Project Endeavour - WP15b - Summary report.* TRL Published Project Report PPR1012. 2021. Available at https://trl.co.uk/uploads/trl/documents/PPR1012-Remote-operation-of-CAVs---Project-Endeavour---Summary-Report.pdf

[13] CIVIL AVIATION AUTHORITY. *An introduction to remotely piloted aircraft systems.* 2022. Available at: https://www.caa.co.uk/consumers/remotely-piloted-aircraft/our-role/an-introduction-to-remotely-piloted-aircraft-systems/

[14] COUNCIL OF THE EUROPEAN UNION. Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport, Official Journal of the European Union, 2010. OJ L 207, 6.8.2010, pp. 1–13.

Further reading

PAS 1880, *Guidelines for developing and assessing control systems for automated vehicles*

PAS 1882, *Data collection and management for automated vehicle trials for the purpose of incident investigation. Specification*

PAS 1885, *The fundamental principles of automotive cyber security – Specification*

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