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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 7856

Intelligent transport systems — Remote support for low speed automated driving systems (RS-LSADS) — Performance requirements, system requirements and performance test procedures

*Systèmes de transport intelligents — Téléassistance pour les
systèmes de conduite automatisée à basse vitesse (RS-LSADS) —
Exigences de performance, exigences du système et procédures
d'essai de performance*

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2024-09-10

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, Intelligent Transport Systems.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

For the sustainable operation of mobility services using automated driving system (ADS). It may be necessary to support the functioning of the ADS by additional support to enable mobility services to continue beyond the constraints of operational design domain (ODD). Such additional support may include human remote support, i.e. actions by humans outside the vehicle. The low speed of low speed automated driving systems (LSADS) equipped vehicles makes remote support less challenging.

In this document, remote support is defined as a combination of remote assistance and remote driving, which is defined in ISO/SAE PAS 22736 (SAE J3016).

Currently individual development and demonstration projects for remote support of LSADS are implemented in several regions and countries, including UK, US, CA, GE, FR, AU, KR, and JP etc. One example of implementation is given in [Annex A](#).

This standardisation indicates the technical requirements of remote support for LSADS (RS-LSADS) and is intended to provide a common basis for RS-LSADS development.

ISO/SAE PAS 22736 (SAE J3016) defines remote assistance and remote driving. In addition, in ISO 22737 external entity input is described. This document is described to complement ISO 22737, including remote driving.

Intelligent transport systems — Remote support for low speed automated driving systems (RS-LSADS) — Performance requirements, system requirements and performance test procedures

1 Scope

This document describes remote support, which is the provision of information, or temporary performance of the DDT, and remote monitoring required for these, to LSADS operated at Level 4 automation on predefined routes by a remotely located human in order to facilitate safe trip continuation.

This document is applicable to RS-LSADS in vehicles that provide passenger transport or logistics services on predefined routes.

This document specifies:

- the terms and definitions related to RS-LSADS and the system architecture of RS-LSADS.
- functions of RS-LSADS, which are: remote monitoring, remote assistance and remote driving that is operated under very limited conditions, and conditions when they need to be activated.
- the performance requirements, system requirements and performance test procedures of RS-LSADS.
- the data to be communicated between vehicles and the remote support facility (but not protocols or other aspects of communication system).

This document is applicable to remote support of operational and tactical functions during continuous operations, but does not apply to strategic functions or to RS-LSADS daily startup or shutdown.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/SAE PAS 22736, *Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles*

ISO 22737, *Intelligent transport systems — Low-speed automated driving (LSAD) systems for predefined routes — Performance requirements, system requirements and performance test procedures*

ISO 19206-2, *Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 2: Requirements for pedestrian targets*

ISO 19206-3, *Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 3: Requirements for passenger vehicle 3D targets*

ISO 19206-4, *Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions — Part 4: Requirements for bicyclist targets*

ISO/SAE 21434, *Road vehicles — Cybersecurity engineering*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/SAE PAS 22736 (2021), ISO 22737 (2021) and the followings apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

LSADS equipped vehicle

a vehicle which is equipped with Level 4 automated driving system that has a maximum speed not to exceed 8,89 m/s, and is operated driverless on a pre-defined route

3.2

remote support

remote monitoring, remote assistance and remote driving through a communication system by a remotely located human

3.3

remote monitoring

monitoring of the end-to-end communication status, driving environment, vehicle status, low speed automated driving system status, and passenger status through a communication system by a remotely located human

3.4

request for information

an alert provided by low speed automated driving system to a remote assistant indicating that s/he should provide information or advice

3.5

request for driving

an alert provided by low speed automated driving system to a remote driver indicating that s/he should take over the dynamic driving task temporarily

3.6

vehicle path

line to be traversed by the vehicle driven by the low speed automated driving system

3.7

communication data rate

rate of data transfer (in bits per second) between two entities using a communication system link

Note 1 to entry: This is also known as "baud rate".

3.8

information update rate

the number of times per second that each kind of information is updated at the receiver

3.9

RS-LSADS stakeholders

organizations that have relationships to remote support for low speed automated driving system (RS-LSADS) such as local authorities, service providers, manufacturers, operating organizations and other road users

3.10

Distance error due to latency

the maximum error between the actual and remotely observed distance between the subject vehicle and the fastest-moving other road user.

4 Symbols and abbreviated terms

4.1 Symbols

S_{long}	Longitudinal distance of evaluation path
S_{lat}	Lateral distance between SV and target
S_{err}	Distance error due to latency
T_{G2G}	Glass to glass latency
T_{CS}	Control system latency
$\bar{T}_{\text{cs}}$	One second average control system latency
T_{ii}	Information input latency
$\bar{T}_{\text{ii}}$	One second average information input latency
T_{ee}	End-to-end latency
$\bar{T}_{\text{ee}}$	One second average end-to-end latency
R_{iu}	Information update rate
V_{LSADS}	Speed of the LSADS equipped vehicle
V_{pc}	Speed of pedalcyclist
V_{ped}	Speed of pedestrian
V_{s}	Speed of subject vehicle
V_{tv}	Speed of target vehicle
V_{T}	Speed of target entity (pedal cyclist, pedestrian or target vehicle)
V_{emax}	Maximum speed of other road users in the location where the SV is operating
d_{LSADS}	Deceleration rate of the LSADS equipped vehicle while performing MRM.
W_{sv}	Width of subject vehicle
L_{tv}	Length of target vehicle

4.2 Abbreviated terms

ADS	automated driving system
DDT	dynamic driving task
DEDTL	distance error due to latency
e-stop	emergency stop
G2G	glass to glass
LKAS	lane keeping assistance systems
LSADS	low speed automated driving system

MRC	minimal risk condition
MRM	minimal risk manoeuvre
ODD	operational design domain
RS-LSADS	remote support for low speed automated driving system
RFI	request for information
RFD	request for driving
SOTIF	safety of the intended functionality ^[8]
SPaT	Signal Phase and Timing ^[4]
SV	subject vehicle
TTC	time to collision
TV	target vehicle

5 RS-LSADS architecture

RS-LSADS consists of one or several L4 LSADS-equipped vehicles, server(s) and operator(s), belonging to a control centre. Operators have various roles, such as dispatching vehicles. An example of the data exchanges the control centre and the vehicle for LSADS equipped vehicle mobility service is given in [Annex B](#). However, the scope of this document is the remote assistance and the remote driving. Remote support is performed when the ADS cannot be operated by itself, e.g. due to insufficient information or operational conditions. Remote support has three functions, remote monitoring, remote assistance with information provisions and remote driving for temporary remote performance of the DDT. [Figure 1](#) depicts an example of RS-LSADS operational architecture.

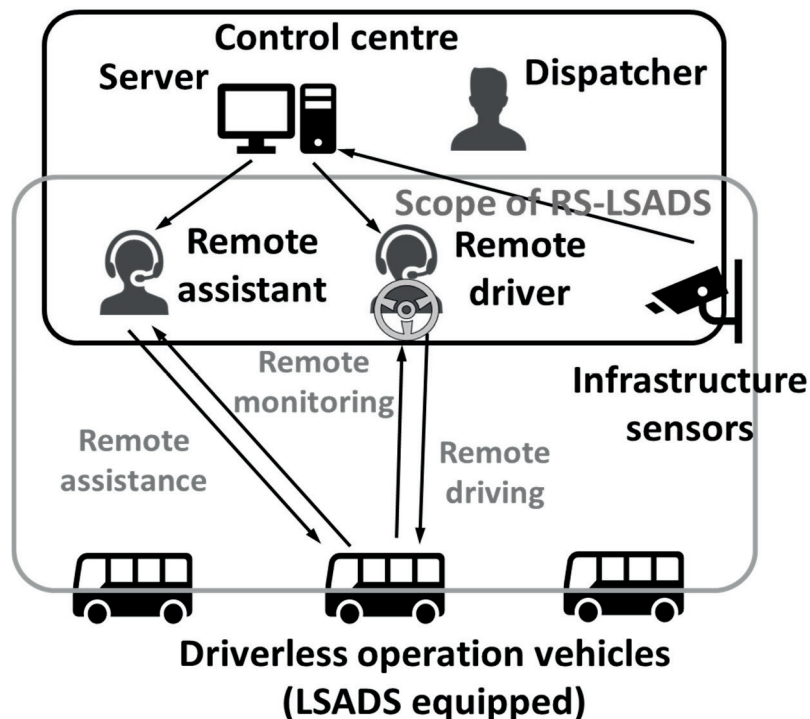


Figure 1 — An example of RS-LSADS operational architecture and scope

Figure 2 represents the functional architecture of an individual RS-LSADS. Generally, remote support systems have remote and onboard systems. Figure 2 also highlights the functional components from the RS-LSADS architecture that are specified within the scope of this document. This functional architecture is made based on the architecture of ISO 22737 LSADS with necessary functional components for RS-LSADS. In addition to the functions such as remote monitoring, remote driving, and remote assistance, for LSADS, end-to-end communication monitor and function to transmit the audio and video information to the control centre are added. As an option, there could also be an input to the control centre from infrastructure sensors [1], [2], [3].

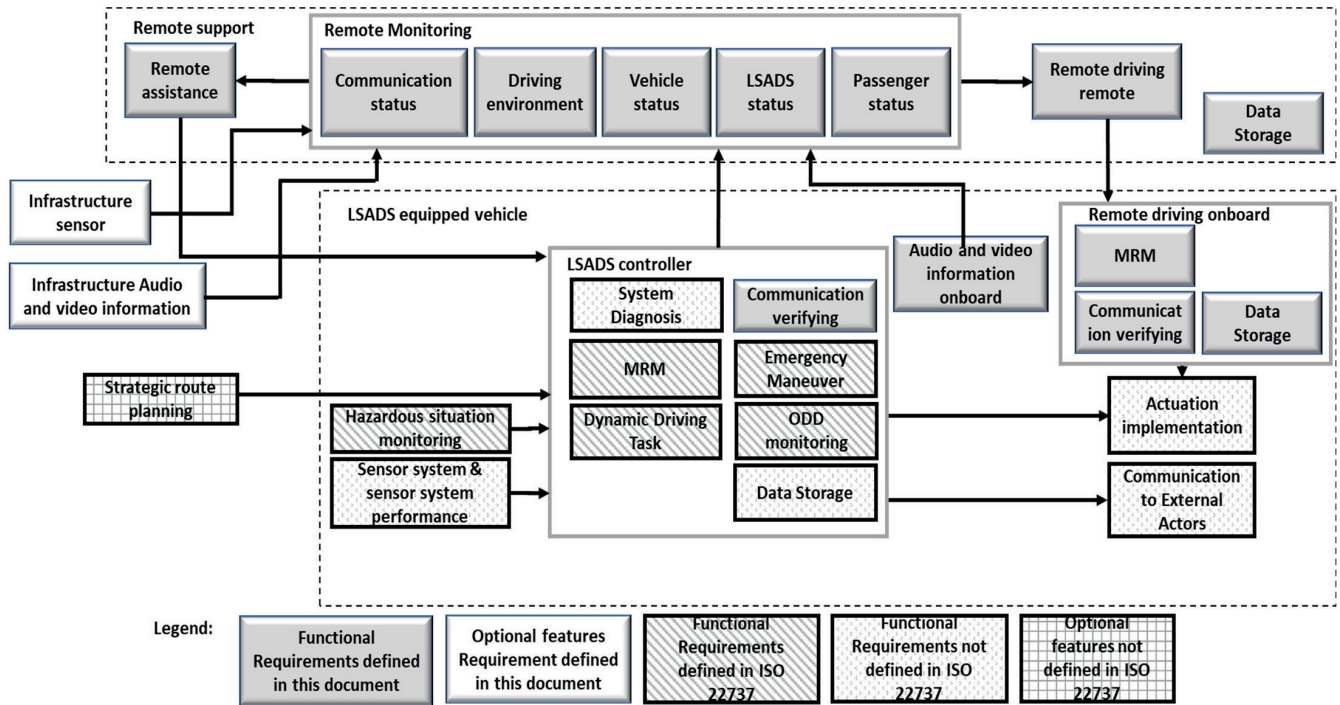


Figure 2 — RS-LSADS functional architecture

6 Functions of RS-LSADS

6.1 General

RS-LSADS has three functions of remote support: remote monitoring, remote assistance and remote driving.

6.2 Remote monitoring

This document describes the remote monitoring required for standby and execution of remote assistance or remote driving. Remote monitoring is the task of monitoring the following items by the system, remote assistant and/or remote driver. The remote system constantly receives the data and displays to remote assistant and/or remote driver the following items while the system is active, and the remote assistant and/or remote driver monitors each item as required.

- End-to-end communication status monitoring: Monitor end-to-end information latency and information update rate.
- Driving environment monitoring: Monitor other road users and vehicles surrounding the SV, weather, road conditions of vehicle path etc. with onboard cameras, other onboard sensors, and optionally infrastructure cameras and other infrastructure-based sensors.
- Vehicle status monitoring: Monitor the vehicle position and vehicle behaviour such as speed, powertrain status etc. using vehicle onboard sensors.

- LSADS status monitoring: Monitor the LSADS status and its issuance of RFI or RFD.
- Passenger status monitoring: Monitor the passenger status in the cabin with onboard cameras and other onboard sensors.

Remote monitoring is also a part of remote assistance and remote driving.

6.3 Remote assistance

The remote assistance function provides information to the LSADS and provides event-driven information to facilitate the continuation of the trip if the LSADS encounters a situation that is difficult to deal with. The remote assistance does not perform the DDT but provides information on whether the situation is safe to proceed, information on signals, and/or information about the vehicle path within the drivable area in order to avoid obstacles. Remote assistance may provide the LSADS with revised goals and/or tasks.

The remote assistance provides inputs to the LSADS controller, which then combines this information with the other sensing information to perform DDT.

The remote assistance is provided during normal LSADS operation, when no fallback occurs. Therefore, the level of automation of the LSADS does not change.

6.4 Remote driving

The remote driving function in this document is limited to supporting the continuation of the LSADS trip over short times and distances at low speed in cases where remote assistance is insufficient. Remote driving is only invoked in very limited conditions, outside the LSADS active state.

The remote driving system consists of a remote side and an on-board side that receives commands from the remote side. The on-board side continuously verifies if the end-to-end communication requirements are met. If they are not met, the vehicle transitions to MRC or a standstill.

The remote driver temporarily performs the DDT on behalf of LSADS in response to RFD from LSADS. Remote driver is provided with the information and images through remote monitoring. Using control input devices installed in the control centre, the remote driver provides remote input commands to the vehicle such as accelerating, braking, shifting and steering for manoeuvres through a communication system. S/he also operates the turn signals and horn. During remote driving the LSADS is not performing the DDT.

7 RS-LSADS functional scenarios

7.1 Remote support scenarios

The remote support function is needed in the case of situations when LSADS cannot perform level 4 automated driving (cannot complete the DDT).

The remote assistance is applied within the scope of the requirements of ISO 22737 and interacts with other road users driving at speed up to the speed limit along LSADS' predefined route and its connected road segments according to LSADS' ODD.

For the remote driving described in this document, the available scenarios are limited, and the maximum speed of the SV is limited to 1,67 m/s (6 km/h) and the duration of the remote driving is limited to 60 seconds.

The following are the possible scenarios when remote support is used to extend the LSADS operation.

The scenarios for which remote support is used are shown in [Table 1](#). Detailed examples of scenarios are given in [Annex C](#).

Table 1 — Remote support required functional scenarios

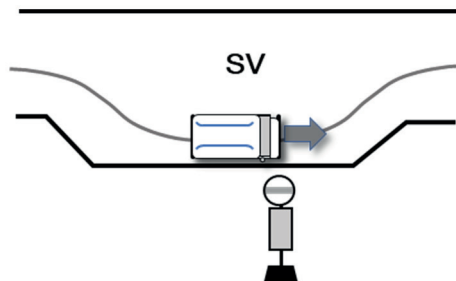
Functional scenarios	Attribute of scenario	Recommended support	Scenario
Planned scenarios	Re-starting after stopping at the bus bay	Remote assistance	Scenario 1
	Entering the unsignalized intersection	Remote assistance	Scenario 2
	Entering the signalized intersection (no signal information from roadside to vehicle via I2V)	Remote assistance Signal information check	Scenario 3
		Remote assistance Signal information and both lateral directions check	Scenario 4
Unplanned scenarios	Existence of unrecognized or unplanned obstacles on the route	Remote assistance or remote driving	Scenario 5
	Out of ODD due to environmental conditions	Remote driving	Scenario 6

7.1.1 Scenario 1: Re-starting after stopping at the bus bay

SV of LSADS automatically drives to the bus bay and stops. When SV intends to depart, after passengers board and alight, SV sends a support request of re-start to the control centre. (Figure 3)

In this scenario, SV has insufficient rearward and periphery detection capability to ensure a safe start by using its onboard ADS sensors. However, it is possible for the remote assistant to recognise relevant other road users using additional onboard cameras and/or roadside camera images.

On receipt of the request, the remote assistant uses onboard cameras or roadside cameras to confirm the rearward and periphery situation and supports the SV by advising it is safe to start when there are no vehicles approaching close enough from behind and no objects on the periphery of SV to create a hazardous condition for its departure from the bus bay.

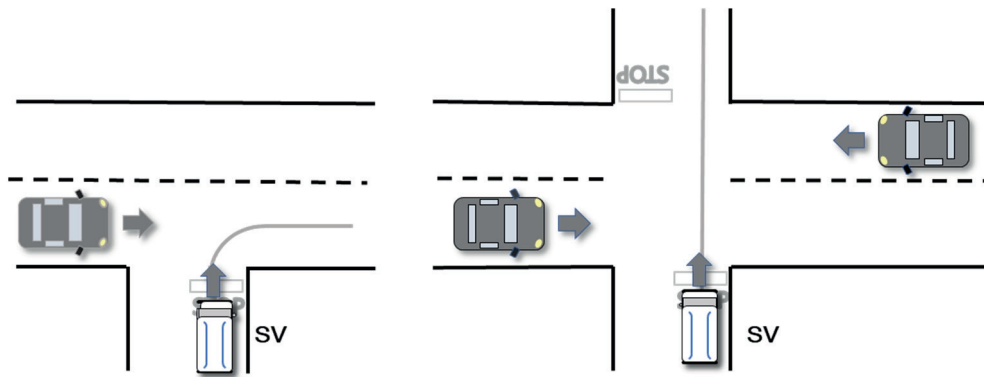
**Figure 3 — Scenario 1 (Re-starting after stopping at the bus bay)**

7.1.2 Scenario 2: Entering the unsignalized intersection

SV of LSADS automatically drives and stops at the stop line in front of an intersection that has no traffic signal. SV sends a support request to the control centre to advise the LSADS when to turn and merge into the priority road or to cross the priority road. (Figure 4)

In this scenario, if SV has insufficient lateral detection capability by use of its onboard sensors, it is possible for the remote assistant to recognise relevant other road users approaching from the lateral directions on the priority road by using additional onboard cameras and/or roadside camera images.

On receipt of the request, the remote assistant uses onboard or roadside cameras to support the SV by advising its LSADS whether or not it is safe to proceed into the priority road to turn or cross the priority road. In case the remote assistant provides information that it is not safe to proceed, the remote assistant will then inform the SV that it is safe to proceed when the situation turns safe.



Left: Right turn and merge into the road, Right: Cross the road

Figure 4 — Scenario 2 (Entering unsignalized intersection)

NOTE Left turns at intersections are not included in the scenarios in this document due to the complexity and variety of the scenarios when crossing oncoming traffic and the high workload on the remote assistant.

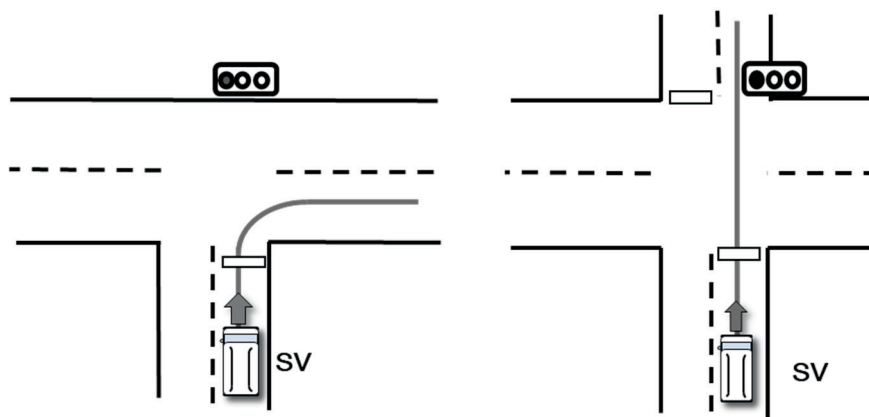
7.1.3 Scenario 3: Entering the signalised intersection (signal information only)

In case that LSADS drives automatically but has insufficient capability to detect the traffic signal condition, SV sends a support request to the control centre to provide the traffic signal information.

In this scenario, the remote assistant checks the signal phase and provides information to the LSADS on whether it is safe to proceed or not. To improve safety, it is assumed that the SV always stops before entering the intersection, regardless of the signal phase, and waits for support from the remote assistant, or the remote assistant is in a situation where the phase and remaining time of the signal is provided by the infrastructure as in SPaT.

SV approaches the signalized intersection and sends a support request to the control centre for advice about traffic signal information (see [Figure 5](#)).

On receipt of the request, the remote assistant uses onboard cameras or roadside cameras, or traffic signal information provided by infrastructure systems and transmits information to the LSADS on whether it is safe to proceed or not. SV stops at the stop line of the intersection and re-starts to enter the intersection, or SV enters the intersection without stopping, based on the provided information.



Left: Right turn and merge into the road, Right: Cross the road

Figure 5 — Scenario 3 (Entering the signalised intersection)

NOTE Left turns at intersections are not included in the scenarios in this document due to the complexity and variety of the scenarios when crossing oncoming traffic and the high workload on the remote assistant.

NOTE SPaT as described in ISO TS 19091 is a direct I2 V communication between the signal controller and the vehicle, the environment here assumes that data equivalent to that provided by the SPaT is communicated to the remote assistant.

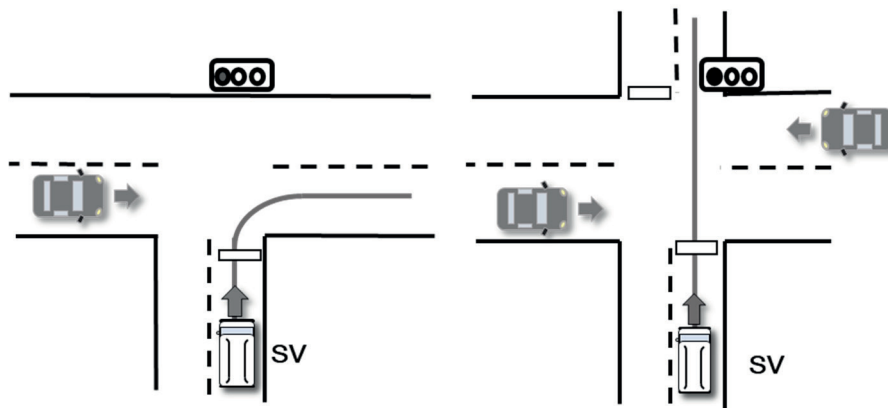
7.1.4 Scenario 4: Entering the signalised intersection (signal information and both lateral directions check)

In case that SV of LSADS drives automatically but its LSADS has insufficient capability to detect the traffic signal condition and to detect crossing traffic by use of its onboard sensors, SV sends a support request to the control centre to provide the traffic signal information and information about crossing traffic hazards.

In this scenario, the remote assistant checks the signal phase and the remaining time of that phase and relevant other road users approaching on the crossing road, and then provides information to the LSADS on whether it is safe to proceed or not. To improve safety, it is assumed that the SV always stops before entering the intersection, regardless of the signal phase, and waits for support from the remote assistant, or the remote assistant is in a situation where the phase and remaining time of the signal is provided by the infrastructure as in SPaT.

SV approaches the signalized intersection and sends a support request to the control centre for advice about signal information and lateral direction other road users' situation. ([Figure 6](#))

On receipt of the request, the remote assistant uses onboard cameras or roadside cameras, or traffic signal information provided by infrastructure systems and supports the SV by advising its LSADS whether or not it is safe to proceed. SV stops at the stop line of the intersection and re-starts to enter the intersection, or SV enters the intersection without stopping, based on the information provided by remote assistance.



Left: Turn and merge into the road, Right: Cross the road

Figure 6 — Scenario 4 (Entering the signalised intersection)

NOTE Left turns at intersections are not included in the scenarios in this document due to the complexity and variety of the scenarios when crossing oncoming traffic and the high workload on the remote assistant.

NOTE SPaT as described in ISO TS 19091 is a direct I2 V communication between the signal controller and the vehicle, the environment here assumes that data equivalent to that provided by the SPaT is communicated to the remote assistant.

7.1.5 Scenario 5: Bypassing obstacles that block the vehicle path

SV approaches an obstacle that blocks the intended path of the vehicle, preventing the continuation of the trip ([Figure 7](#)). In this scenario, SV sends a support request to the control centre for advice about how to bypass the obstacle safely after stopping in front of the obstacle.

On receipt of the request, the remote assistant provides a new vehicle path within the drivable area that has no oncoming traffic for the LSADS to take to avoid the obstacle.

In cases when the LSADS is operating on a road without other oncoming traffic and it is unable to respond to changes in the vehicle path or it does not receive a new vehicle path, or there is no feasible vehicle path within the driveable area, the SV requests the remote driver to operate the SV.

On receipt of the request, the remote driver performs the avoidance manoeuvre based on his or her decision that remote driving is viable in the current environment.

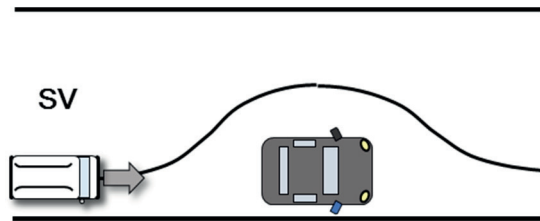


Figure 7 — Scenario 5 (Bypassing obstacles that block the vehicle path)

NOTE Obstacle could be road construction, fallen material or parked car etc.

7.1.6 Scenario 6: Out of ODD due to environmental conditions

In this scenario, LSADS drives automatically, but its ODD restrictions are violated due to sudden changes in environmental conditions such as fog and rainfall. ([Figure 8](#))

LSADS automatically stops the SV because the conditions impair the ability of the sensors to detect hazards in the driving environment and sends a support request to the control centre.

On receipt of the request, the remote driver confirms whether the cameras available on the SV provide sufficient visibility for him or her to safely perform the DDT. If the visibility is sufficient, the remote driver drives the SV to the nearest available road shoulder or turnout area.

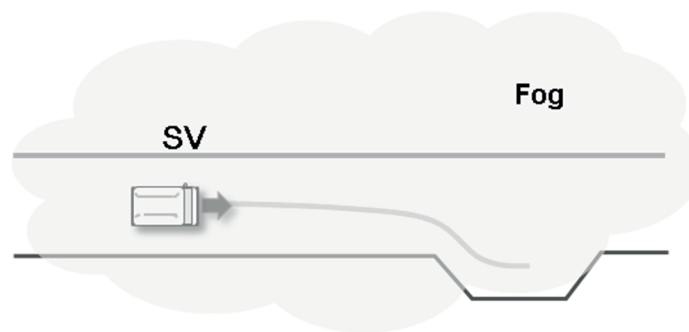


Figure 8 — Scenario 6 (Out of ODD due to environmental conditions)

8 System requirements

8.1 General

RS-LSADS have remote assistance or remote driving, or both of them. In case the system has both remote assistance and remote driving, if LSADS is not able to decide which is appropriate, remote assistance is requested first, in which the ADS can remain active, and in case the remote assistance does not settle the situation, remote driving is subsequently requested.

Remote monitoring shall provide the remote assistant and/or the remote driver with information of the vehicle status, LSADS status, the driving environment, passenger status, and the end-to-end communication status.

In addition, infrastructure supports such as roadside cameras and other sensors may be utilized by RS-LSADS. Systems that provide information directly from infrastructure cameras and/or sensors to LSADS could also be considered, however, these are outside the scope of this document. In this document, infrastructure facilities are assumed to be those used to provide information on the traffic environment to the remote assistant and/or the remote driver.

Vehicles managed by the control centre shall be time synchronized with the control centre to an accuracy of less than $\pm 0,05$ s. Infrastructure sensors and cameras, if used, shall also be synchronized with the control centre to an accuracy of less than $\pm 0,05$ s.

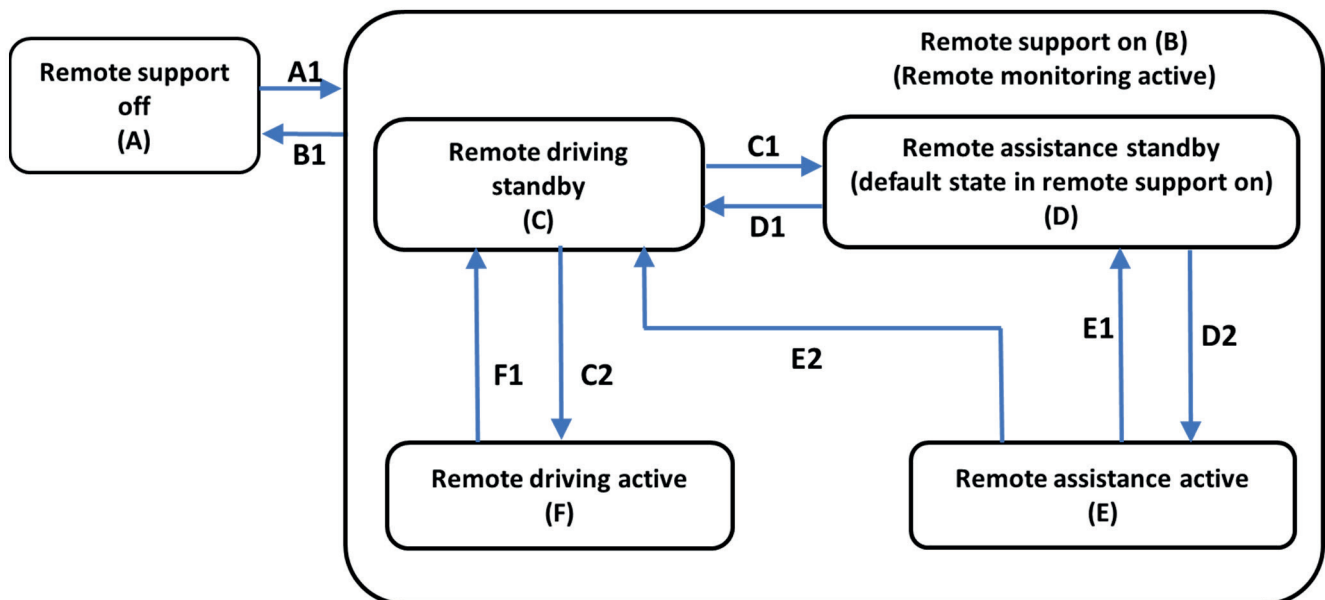
Specific requirements for remote monitoring, remote assistance, remote driving and end-to-end communication performance, such as latency, are described in [clause 10](#).

RS-LSADS should be developed using functional safety methodologies such as ISO 26262^[7] and IEC 61508,^[9] and SOTIF methodologies such as ISO 21448^[8].

As the RS-LSADS is based on connecting LSADS equipped vehicles with the control centre using wireless communication systems, the RS-LSADS shall be developed, managed and maintained according to ISO/SAE 21434.

8.2 RS-LSADS state transition diagram

RS-LSADS state transition diagram is shown in [Figure 9](#). The state transitions in RS-LSADS are linked to the state transitions in LSADS. A diagram of the relationship between the state of LSADS and the state of RS-LSADS is shown in [Figure 10](#). [Figure 10](#) shows that the remote driving becomes active only when LSADS is in standby state. Therefore, the remote driving and LSADS cannot be active at the same time. In addition, remote driving starts when the vehicle is in standstill and ends when the vehicle is in standstill. The remote assistance can only be activated when LSADS is active.



Key

- A1 power on by the remote dispatcher commands and self-test passed
- B1 power off by the remote commands
- C1 LSADS resumes performance of the DDT
- C2 LSADS issues an RFD, and the remote driver has responded
- D1 Remote assistant cannot resolve the problem, so remote assistant requests transition to remote driving