
**Road vehicles — Data communication
between sensors and data fusion unit
for automated driving functions —
Logical interface**

*Véhicules routiers — Communication de données entre capteurs et
unité de fusion de données pour les fonctions de conduite automatisée
— Interface logique*



This document is a preview generated by ELS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	vi
Introduction.....	viii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 Architectural components	1
3.2 Terms for logical interface layers	2
3.3 Structure terms	3
3.4 Measurement terms	3
3.5 Requirement level terms	6
3.6 Road user relevant entity types	7
3.7 Axis and coordinate system terms	9
4 Abbreviated terms	15
5 Structure of the interface description	16
5.1 General	16
5.2 Signal	17
5.3 Interface	17
5.4 Specific signal grouping	18
5.5 Profile	19
6 Logical interface from a sensor as well as a sensor cluster to a fusion unit	19
6.1 General	19
6.2 Generic interface header	22
6.3 Generic interface entity	22
6.4 Profile: Uniqueness of interface versioning	23
7 Object level	23
7.1 General	23
7.2 Generic object level interface	24
7.2.1 Generic object level header	24
7.2.2 Generic object level entity	25
7.3 Potentially moving object interface	25
7.3.1 Potentially moving object header	34
7.3.2 Potentially moving object entity	35
7.3.3 Profile: Motion type	36
7.3.4 Profile: Motion state vector	37
7.4 Road object interface	38
7.4.1 Road object header	49
7.4.2 Road object entity	51
7.4.3 Profile: Colour model for RDOI	53
7.5 Static object interface	53
7.5.1 Static object header	81
7.5.2 Static object entity	83
7.5.3 Profile: Colour model for SOI	91
7.5.4 Profile: Detection references for 3D detections	91
7.6 Free space area object interface	94
7.6.1 Free space area object header	99
7.6.2 Free space area object entity	100

8	Feature level	101
8.1	General.....	101
8.2	Generic sensor cluster feature interface	102
8.2.1	Generic sensor cluster feature header	102
8.2.2	Generic sensor cluster feature entity	103
8.3	Camera feature interface.....	103
8.3.1	Camera feature header	107
8.3.2	Camera feature entity.....	108
8.3.3	Profile: Colour model for CFI	109
8.4	Ultrasonic feature interface	110
8.4.1	Ultrasonic feature header	113
8.4.2	Ultrasonic feature entity	114
9	Detection level.....	114
9.1	General.....	114
9.2	Generic sensor detection interface.....	115
9.2.1	Generic sensor detections header.....	115
9.2.2	Generic sensor detections entity.....	116
9.3	Radar detection interface	117
9.3.1	Radar detections header	119
9.3.2	Radar detections entity.....	121
9.3.3	Profile: Radar ambiguity	121
9.4	Lidar detection interface.....	121
9.4.1	Lidar detection header.....	124
9.4.2	Lidar detection entity	125
9.5	Camera detection interface	125
9.5.1	Camera detection header	130
9.5.2	Camera detection entity	131
9.5.3	Profile: Colour model for CDI.....	132
9.6	Ultrasonic detection interface.....	132
9.6.1	Ultrasonic detection header.....	135
9.6.2	Ultrasonic detection entity	136
9.6.3	Profile: Ultrasonic sensor cluster.....	137
10	Supportive sensor interfaces.....	139
10.1	General.....	139
10.2	Generic supportive sensor interface.....	140
10.2.1	Generic supportive sensor header.....	140
10.2.2	Generic supportive sensor entity	141
10.3	Sensor performance interface.....	141
10.3.1	Sensor performance header.....	145
10.3.2	Sensor performance entity	147
10.3.3	Profile: Uniqueness of interface versioning of SPIs.....	147
10.4	Sensor health information interface.....	147
10.4.1	Sensor health information header.....	150
10.4.2	Sensor health information entity	151
11	Sensor input interface	151
11.1	General.....	151
11.2	Generic sensor input interface.....	151
11.2.1	Generic sensor inputs header.....	151
11.2.2	Generic sensor inputs entity	152
11.2.3	Profile: Uniqueness of interface versioning of SII.....	152
11.3	Common sensor input interface	152
11.3.1	Common sensor input header	156
11.3.2	Common sensor input entity.....	156

Annex A (normative) Interface signals	158
Annex B (normative) Options and constraints	328
Bibliography	344

This document is a preview generated by EVS

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This second edition cancels and replaces the first edition (ISO 23150:2021), which has been technically revised.

The main changes are as follows:

- extension of the potentially moving object interface at object level (extension of the logical signal group person);
- update of the road object interface at object level (extension of the road marking sign);
- extension of the static object interface at object level (extension of the entity type traffic sign; addition of new entity type traffic sign board);
- addition of new free space area interface at object level;
- extension of the camera detection interface at detection level (addition of new entity type point; update of existing entity type shape);
- addition of new interfaces group/layer – sensor input interface (addition of new generic sensor input interface; addition of new common sensor input interface);

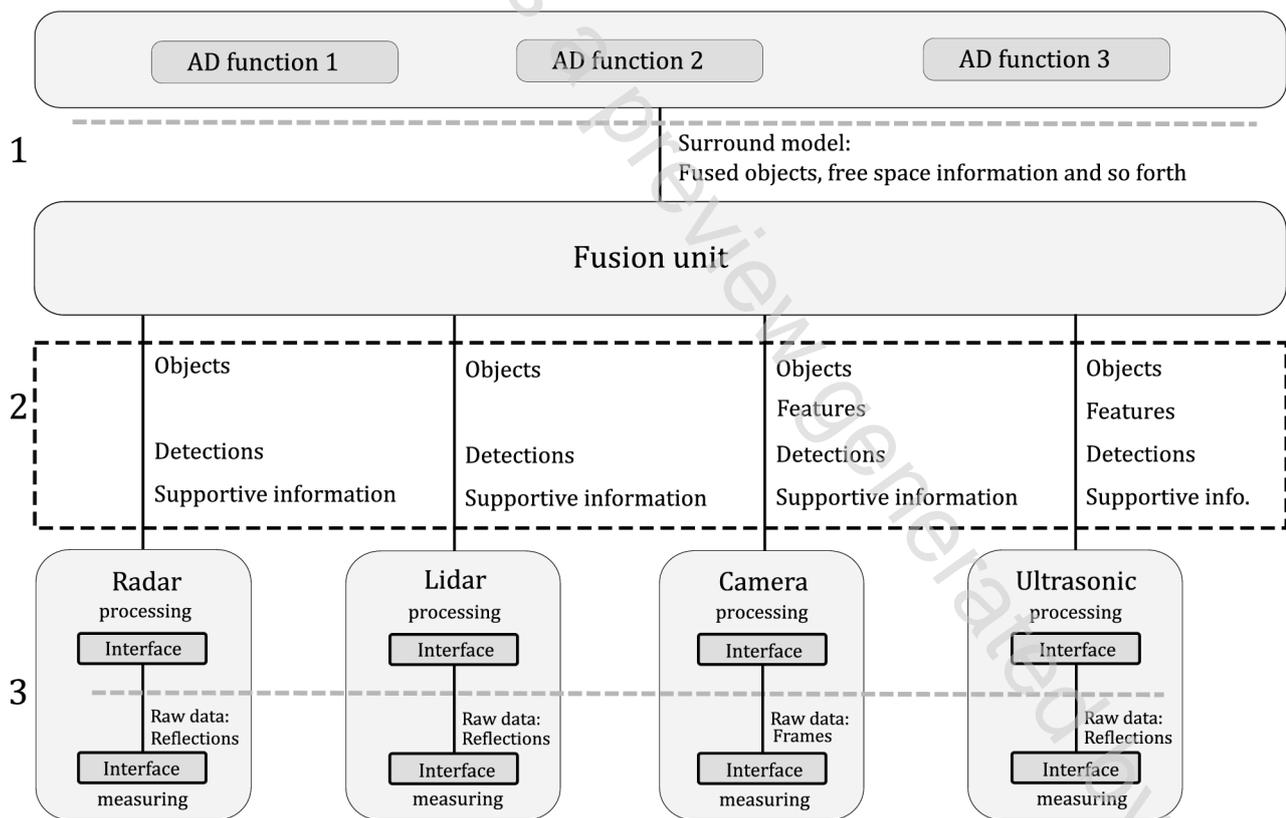
- extension of the error model (addition of covariances, cross-covariances and time series as error model implementation);
- refinement of the terms, for example, value as measured-, tracked- and predicted quantity value;
- new measures to link signals with their origin, that means linking signals at object level with, for example, detection entities;
- harmonisation of the document, for example, to achieve a better readability;
- update and add figures for clarification.

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

(Highly-)automated driving (AD) functions for road vehicles require a situation awareness of the surroundings of the vehicle and, preferably, a comprehensive scene understanding. For the fast and reliable recognition of real-world objects, a sensor suite is necessary to provide information for the fusion unit. Utilisation of different sensor technologies like radar, lidar, camera and ultrasonic with different detection capabilities is indispensable to ensure both complementary and redundant information. The fusion unit analyses and evaluates the different sensor signals and finally generates a dynamic surround model with sufficient scene understanding.

While current partly-automated functions utilise only particular objects (for example, vehicles, pedestrians, road markings) to generate a simple surround model, it is necessary for future highly-automated driving functions to merge not only the recognised objects but also to include other sensor-specific properties and characteristics of these objects for the generation of a coherent surround model of the surroundings. To minimise the development efforts for the sensors and the fusion unit and to maximise the reusability of development and validation efforts for the different functions on the sensor and fusion unit side, a standardised logical interface layer between the sensor suite and the fusion unit and a standardised logical interface layer to the sensor suite are worthwhile and beneficial for both the sensor supplier and the system supplier.



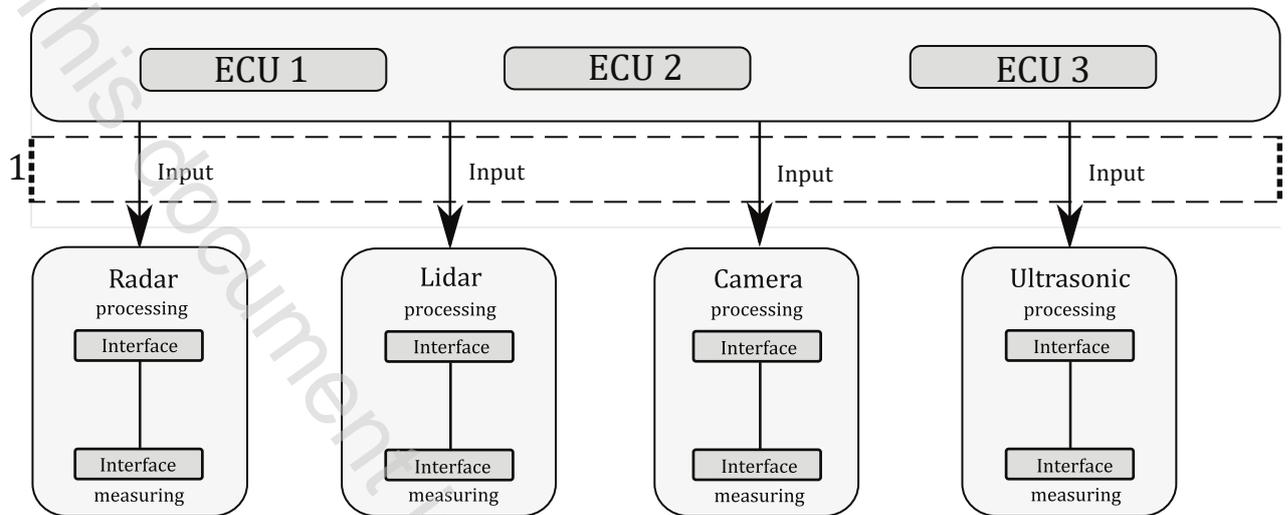
Key

- 1 logical interface layer between the fusion unit and AD functions
- 2 logical interface layer between a single sensor as well as a single sensor cluster and the fusion unit
- 3 interface layer on raw data level of a sensor's sensing element(s) and its processing

Figure 1 — Architecture: sensors/sensor clusters – fusion unit – AD functions

The logical interface layer between a single sensor as well as a single sensor cluster and the fusion unit (see Figure 1, key 2) addresses the encapsulation of technical complexity as well as objects including

free space areas, features and detections to enable object-level, feature-level and detection-level fusion. Additional supportive information of the sensor as well as the sensor cluster will supplement the data for the fusion unit.



Key

- 1 logical interface layer between other in-vehicle electronic control units (ECUs) (for example, odometry) and a single sensor or a single sensor cluster

Figure 2 — Architecture: ECUs' sensor input – sensors/sensor clusters

The logical interface layer between an electronic control unit and a single sensor as well as a single sensor cluster (see Figure 2, key 1) addresses the input of a single sensor as well as a single sensor cluster.

Road vehicles — Data communication between sensors and data fusion unit for automated driving functions — Logical interface

1 Scope

This document is applicable to road vehicles with automated driving functions. The document specifies the logical interface between in-vehicle environmental perception sensors (for example, radar, lidar, camera, ultrasonic) and the fusion unit which generates a surround model and interprets the scene around the vehicle based on the sensor data. The interface is described in a modular and semantic representation and provides information on object level (for example, potentially moving objects, road objects, static objects) as well as information on feature and detection levels based on sensor technology specific information. Further supportive information is available.

This document does not provide electrical and mechanical interface specifications. Raw data interfaces are also excluded.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

3.1 Architectural components

3.1.1 fusion

act of uniting *signals* (3.3.1) from two or more *sensors* (3.1.5) as well as *sensor clusters* (3.1.6) to create a *surround model* (3.1.7)

3.1.2 fusion unit

computing unit where the *fusion* (3.1.1) of *sensor* (3.1.5) data as well as a *sensor cluster* (3.1.6) data is performed

3.1.3 interface

shared boundary between two functional units, defined by various characteristics pertaining to the functions, physical interconnections, *signal* (3.3.1) exchanges and other characteristics of the units, as appropriate

[SOURCE: ISO/IEC 2382:2015, 2124351, modified — Notes to entry have been removed.]