

# ISO 23150:2021 (E)

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

---

### Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
3.1	Architectural components
3.2	Level of detail terms
3.3	Structure terms
3.4	Measurement terms
3.5	Requirement level terms
3.6	Road user relevant entity types
3.7	Axis and coordinate system terms
4	Abbreviated terms
5	Structure of the interface description
5.1	General
5.2	Signal
5.3	Interface
5.4	Specific signal grouping
5.5	Profile
6	Logical interface from a sensor as well as a sensor cluster to a fusion unit
6.1	General
6.2	Generic interface header
6.3	Generic interface entity
6.4	Profile: Uniqueness of interface versioning
7	Object level
7.1	General
7.2	Generic object level interface
7.2.1	Generic object level header
7.2.2	Generic object level entity
7.3	Potentially moving object interface
7.3.1	Potentially moving object header
7.3.2	Potentially moving object entity
7.3.3	Profile: Motion
7.4	Road object interface
7.4.1	Road object header
7.4.2	Road object entity
7.4.3	Profile: Colour model for RDOI
7.5	Static object interface
7.5.1	Static object header
7.5.2	Static object entity
7.5.3	Profile: Colour model for SOI
8	Feature level
8.1	General
8.2	Generic sensor cluster feature interface

- 8.2.1 Generic sensor cluster feature header
- 8.2.2 Generic sensor cluster feature entity
- 8.3 Camera feature interface
- 8.3.1 Camera feature header
- 8.3.2 Camera feature entity
- 8.3.3 Profile: Colour model for CFI
- 8.4 Ultrasonic feature interface
- 8.4.1 Ultrasonic feature header
- 8.4.2 Ultrasonic feature entity

## 9 Detection level

- 9.1 General
- 9.2 Generic sensor detection interface
- 9.2.1 Generic sensor detections header
- 9.2.2 Generic sensor detections entity
- 9.3 Radar detection interface
- 9.3.1 Radar detections header
- 9.3.2 Radar detections entity
- 9.3.3 Profile: Radar ambiguity
- 9.4 Lidar detection interface
- 9.4.1 Lidar detection header
- 9.4.2 Lidar detection entity
- 9.5 Camera detection interface
- 9.5.1 Camera detection header
- 9.5.2 Camera detection entity
- 9.5.3 Profile: Colour model for CDI
- 9.6 Ultrasonic detection interface
- 9.6.1 Ultrasonic detection header
- 9.6.2 Ultrasonic detection entity
- 9.6.3 Profile: Ultrasonic sensor cluster

## 10 Supportive sensor interfaces

- 10.1 General
- 10.2 Generic supportive sensor interface
- 10.2.1 Generic supportive sensor header
- 10.2.2 Generic supportive sensor entity
- 10.3 Sensor performance interface
- 10.3.1 Sensor performance header
- 10.3.2 Sensor performance entity
- 10.3.3 Profile: Uniqueness of interface versioning of SPIs
- 10.4 Sensor health information interface
- 10.4.1 Sensor health information header
- 10.4.2 Sensor health information entity

## Annex A (normative) Interface signals

- A.1 Header signals
- A.1.1 Interface version ID {major, minor, patch}
- A.1.2 Number of valid serving sensors
- A.1.3 Sensor ID
- A.1.4 Interface ID
- A.1.5 Time stamp – <...>
- A.1.5.1 Time stamp – predicted
- A.1.5.2 Time stamp – measurement
- A.1.6 <...> counter
- A.1.6.1 Cycle counter
- A.1.6.2 Message counter
- A.1.7 Interface cycle time
- A.1.8 Interface cycle time – variation
- A.1.9 Data qualifier
- A.1.10 Recognised <...> – capability
- A.1.10.1 Recognised potentially moving objects – capability
- A.1.10.2 Recognised road markings – capability
- A.1.10.3 Recognised road boundaries – capability
- A.1.10.4 Recognised general landmarks – capability

A.1.10.5 Recognised traffic signs – capability  
 A.1.10.6 Recognised traffic lights – capability  
 A.1.10.7 Recognised features – capability  
 A.1.10.8 Recognised detections – capability  
 A.1.10.9 Recognised shapes – capability  
 A.1.11 Recognised <...> – status  
 A.1.11.1 Recognised potentially moving objects – status  
 A.1.11.2 Recognised road markings – status  
 A.1.11.3 Recognised road boundaries – status  
 A.1.11.4 Recognised general landmarks – status  
 A.1.11.5 Recognised traffic signs – status  
 A.1.11.6 Recognised traffic lights – status  
 A.1.11.7 Recognised features – status  
 A.1.11.8 Recognised detections – status  
 A.1.11.9 Recognised shapes – status  
 A.1.12 Number of valid <...>  
 A.1.12.1 Number of valid potentially moving objects  
 A.1.12.2 Number of valid road markings  
 A.1.12.3 Number of valid road boundaries  
 A.1.12.4 Number of valid general landmarks  
 A.1.12.5 Number of valid traffic signs  
 A.1.12.6 Number of valid traffic lights  
 A.1.12.7 Number of valid features  
 A.1.12.8 Number of valid detections  
 A.1.12.9 Number of valid shapes  
 A.1.12.10 Number of valid field-of-view segments  
 A.1.13 Tracking motion model  
 A.1.14 Motion type  
 A.1.15 Colour model type  
 A.1.16 Radial velocity ambiguity domain {begin, end}  
 A.1.17 Range ambiguity domain {begin, end}  
 A.1.18 Angle azimuth ambiguity domain {begin, end}  
 A.1.19 Angle elevation ambiguity domain {begin, end}  
 A.1.20 Interface applicability  
 A.1.21 Vehicle coordinate system type  
 A.1.22 Sensor origin point {x, y, z}  
 A.1.23 Sensor origin point {x, y, z} – error  
 A.1.24 Sensor orientation {yaw, pitch, roll}  
 A.1.25 Sensor orientation {yaw, pitch, roll} – error  
 A.1.26 Vanishing point {azimuth, elevation}  
 A.1.27 Vanishing point {azimuth, elevation} – error  
 A.2 Object level entity signals  
 A.2.1 Existence probability – object level  
 A.2.2 Object ID  
 A.2.3 Object grouping ID  
 A.2.4 Age  
 A.2.5 Number of valid observations – object level  
 A.2.6 Time stamp reference – object level  
 A.2.7 Observation status – object level  
 A.2.8 Track quality  
 A.2.9 Measurement status – object level  
 A.2.10 Number of valid potentially moving object classifications  
 A.2.11 Potentially moving object classification type  
 A.2.12 Potentially moving object classification type – confidence  
 A.2.13 Position – object level {x, y, z}  
 A.2.14 Position – object level {x, y, z} – error  
 A.2.15 Orientation {yaw, pitch, roll}  
 A.2.16 Orientation {yaw, pitch, roll} – error  
 A.2.17 Reference point  
 A.2.18 Road level  
 A.2.19 Bounding box extent {length, width, height}  
 A.2.20 Bounding box extent {length, width, height} – error  
 A.2.21 Bounding box ground clearance  
 A.2.22 Included geometric structures

A.2.23	Velocity {x, y, z} – object level
A.2.24	Velocity {x, y, z} – object level – error
A.2.25	Acceleration {x, y, z}
A.2.26	Acceleration {x, y, z} – error
A.2.27	Instantaneous centre of rotation {x, y}
A.2.28	Instantaneous centre of rotation {x, y} – error
A.2.29	Rotation rate at instantaneous centre of rotation {yaw}
A.2.30	Rotation rate at instantaneous centre of rotation {yaw} – error
A.2.31	Movement status
A.2.32	Number of valid lights
A.2.33	Light type
A.2.34	Light status
A.2.35	Number of valid person's poses
A.2.36	Person pose type
A.2.37	Person pose {yaw, pitch, roll}
A.2.38	Person pose {yaw, pitch, roll} – error
A.2.39	Object lane association
A.2.40	Angle between object edge and lane {left edge right lane, right edge left lane}
A.2.41	Angle between object edge and lane {left edge right lane, right edge left lane} – error
A.2.42	Percentage side lane {left, right}
A.2.43	Angular position {azimuth}
A.2.44	Angular velocity {azimuth}
A.2.45	Scale change – object level
A.2.46	Entity radar cross section
A.2.47	Entity lidar reflectivity
A.2.48	Road type
A.2.49	Number of valid road surface classifications
A.2.50	Road surface classification type
A.2.51	Road surface classification type – confidence
A.2.52	Road surface roughness
A.2.53	Number of valid road surface condition classifications
A.2.54	Road surface condition classification type
A.2.55	Road surface condition classification type – confidence
A.2.56	Number of valid road marking classifications
A.2.57	Road marking type
A.2.58	Road marking type – confidence
A.2.59	Road object lane association
A.2.60	Road object lane association – confidence
A.2.61	Arrow orientation {yaw}
A.2.62	Arrow direction
A.2.63	Number of valid sign classifications
A.2.64	Sign classification type
A.2.65	Sign classification type – confidence
A.2.66	Sign value
A.2.67	Sign value unit
A.2.68	Sign state
A.2.69	Colour value – object level
A.2.70	Colour tone – confidence – object level
A.2.71	Number of valid connections
A.2.72	Connection type
A.2.73	Connection grouping ID
A.2.74	Number of valid polynomials
A.2.75	Polynomial coefficient y {c0, c1, c2, c3}
A.2.76	Polynomial coefficient z {c0, c1, c2, c3}
A.2.77	Polynomial y – error
A.2.78	Polynomial z – error
A.2.79	Polynomial range x {begin, end}
A.2.80	Width – polynomial
A.2.81	Width – polynomial – error
A.2.82	Width – polynomial – confidence
A.2.83	Height – polynomial
A.2.84	Height – polynomial – error
A.2.85	Height – polynomial – confidence
A.2.86	Number of valid data ranges

A.2.87	Supported data range x {begin, end}
A.2.88	Supported axis
A.2.89	Polyline interpolation method
A.2.90	Number of valid polylines
A.2.91	Number of valid vertices
A.2.92	Vertex point {x, y, z}
A.2.93	Vertex point {x, y, z} – error
A.2.94	Vertex point – confidence {x, y, z}
A.2.95	Width – vertex
A.2.96	Width – vertex – error
A.2.97	Width – vertex – confidence
A.2.98	Height – vertex
A.2.99	Height – vertex – error
A.2.100	Height – vertex – confidence
A.2.101	Number of valid road boundary classifications
A.2.102	Road boundary type
A.2.103	Road boundary type – confidence
A.2.104	Number of valid general landmark classifications
A.2.105	General landmark classification type
A.2.106	General landmark classification type – confidence
A.2.107	Sign geometry
A.2.108	Number of valid lane relevance classifications
A.2.109	Lane relevance classification type
A.2.110	Lane relevance classification type – confidence
A.2.111	Number of valid traffic supplementary signs
A.2.112	Number of valid supplementary sign classifications
A.2.113	Supplementary sign classification type
A.2.114	Supplementary sign classification type – confidence
A.2.115	Relative position
A.2.116	Relative position order
A.2.117	Number of valid structure light classifications
A.2.118	Structure light classification type
A.2.119	Structure light classification type – confidence
A.2.120	Minimum visibility distance
A.2.121	Total number of traffic light spots
A.2.122	Total number of traffic light spots – confidence
A.2.123	Number of valid traffic light spots
A.2.124	Number of valid light shape classifications
A.2.125	Light shape classification type
A.2.126	Light shape classification type – confidence
A.2.127	Light shape value
A.2.128	Number of valid colour classifications
A.2.129	Colour classification type
A.2.130	Colour classification type – confidence
A.2.131	Number of valid light mode classifications
A.2.132	Light mode classification type
A.2.133	Light mode classification type – confidence
A.3	Feature level entity signals
A.3.1	Existence probability – feature level
A.3.2	Feature ID
A.3.3	Object ID reference – feature level
A.3.4	Time stamp difference – feature level
A.3.5	Number of valid observations – feature level
A.3.6	Time stamp reference – feature level
A.3.7	Observation status – feature level
A.3.8	Feature grouping ID
A.3.9	Number of valid shape classifications – feature level
A.3.10	Shape classification type – feature level
A.3.11	Shape classification type – confidence – feature level
A.3.12	Colour value – feature level
A.3.13	Colour tone – confidence – feature level
A.3.14	Shape type – feature level
A.3.15	Number of valid shape points – feature level
A.3.16	Point existence probability – feature level

A.3.17 Position – feature level {x, y, z}  
 A.3.18 Position – feature level {x, y, z} – error  
 A.3.19 Number of valid shape reference points – feature level  
 A.3.20 Shape surface normal {x, y, z}  
 A.3.21 Shape surface normal {x, y, z} – error  
 A.3.22 Translation rate {x, y, z} – feature level  
 A.3.23 Translation rate {x, y, z} – feature level – error  
 A.3.24 Rotation rate {yaw, pitch, roll}  
 A.3.25 Rotation rate {yaw, pitch, roll} – error  
 A.3.26 Scale change – feature level  
 A.3.27 Scale change – feature level – error  
 A.3.28 Number of valid ultrasonic feature classifications  
 A.3.29 Ultrasonic feature classification type  
 A.3.30 Ultrasonic feature classification type – confidence  
 A.3.31 Number of valid points  
 A.3.32 Orientation – feature level {pitch}  
 A.3.33 Orientation – feature level {pitch} – error  
 A.3.34 Height – feature level  
 A.3.35 Height – feature level – error  
 A.3.36 Velocity {x, y} – feature level  
 A.3.37 Velocity {x, y} – feature level – error  
 A.3.38 Trilateration status  
 A.3.39 Measurement status – feature level  
 A.4 Detection level entity signals  
 A.4.1 Existence probability – detection level  
 A.4.2 Object ID reference – detection level  
 A.4.3 Feature ID reference  
 A.4.4 Time stamp difference – detection level  
 A.4.5 Radar cross section  
 A.4.6 Radar cross section – error  
 A.4.7 Signal to noise ratio – detection level  
 A.4.8 Signal to noise ratio – detection level – error  
 A.4.9 Multi target probability  
 A.4.10 Ambiguity grouping ID  
 A.4.11 Detection ambiguity probability  
 A.4.12 Free space probability  
 A.4.13 Number of valid detection classifications  
 A.4.14 Detection classification type  
 A.4.15 Detection classification type – confidence  
 A.4.16 Position {radial distance, azimuth, elevation}  
 A.4.17 Position {radial distance, azimuth, elevation} – error  
 A.4.18 Relative velocity {radial distance}  
 A.4.19 Relative velocity {radial distance} – error  
 A.4.20 Height – lidar  
 A.4.21 Height – lidar – error  
 A.4.22 Reflectivity  
 A.4.23 Reflectivity – error  
 A.4.24 Number of valid shape classifications – detection level  
 A.4.25 Shape classification type – detection level  
 A.4.26 Shape classification type – confidence – detection level  
 A.4.27 Shape ambiguity grouping ID  
 A.4.28 Colour value – detection level  
 A.4.29 Colour tone – confidence – detection level  
 A.4.30 Shape type – detection level  
 A.4.31 Number of valid shape points – detection level  
 A.4.32 Point existence probability – detection level  
 A.4.33 Number of valid shape reference points – detection level  
 A.4.34 Translation rate {x, y, z} – detection level  
 A.4.35 Translation rate {x, y, z} – detection level – error  
 A.4.36 Second sensor ID reference  
 A.4.37 Distance  
 A.4.38 Distance – error  
 A.4.39 Height – ultrasonic  
 A.4.40 Height – ultrasonic – error

A.5	Supportive sensor interface entity signals
A.5.1	Segment azimuth {begin, end}
A.5.2	Segment elevation {begin, end}
A.5.3	Measurement grid resolution {radial distance, azimuth, elevation}
A.5.4	Beam divergence {azimuth, elevation}
A.5.5	Range gain
A.5.6	Blockage status
A.5.7	Number of valid field-of-view reduction reasons
A.5.8	Field-of-view reduction reason type
A.5.9	Field-of-view reduction reason type – confidence
A.5.10	Number of valid recognisable object types
A.5.11	Recognised object type
A.5.12	Detection range radial distance {begin, end}
A.5.13	True positive rate
A.5.14	False positive rate
A.5.15	Positive predictive value
A.5.16	Number of valid reference target types
A.5.17	Reference target type
A.5.18	Radar cross section reference target
A.5.19	Reflectivity reference target
A.5.20	Relative radial velocity range {begin, end}
A.5.21	Signal to noise ratio – supportive level
A.5.22	Spatial separability {radial distance, azimuth, elevation}
A.5.23	Velocity separability {radial distance, azimuth, elevation}
A.5.24	Number of valid sensor operation modes
A.5.25	Sensor operation mode
A.5.26	Sensor defect detected
A.5.27	Sensor defect reason
A.5.28	Status supply voltage
A.5.29	Sensor temperature status
A.5.30	Number of valid sensor input signal statuses
A.5.31	Sensor input signal – type
A.5.32	Sensor input signal – status
A.5.33	Sensor externally disturbed
A.5.34	Sensor transmit power reduced
A.5.35	Status sensor heating
A.5.36	Status sensor cleaning
A.5.37	Sensor time sync
A.5.38	Sensor time sync offset value
A.5.39	Number of valid sensor-calibratable components
A.5.40	Sensor-calibratable component
A.5.41	Sensor calibration status
A.5.42	Calibration process state
A.5.43	Sensor origin point – correction {x, y, z}
A.5.44	Sensor origin point – correction {x, y, z} – error
A.5.45	Sensor origin translation – correction limit {xbegin, xend, ybegin, yend, zbegin, zend}
A.5.46	Sensor orientation – correction {yaw, pitch, roll}
A.5.47	Sensor orientation – correction {yaw, pitch, roll} – error
A.5.48	Sensor pose angle – correction limit {yawbegin, yawend, pitchbegin, pitchend, rollbegin, rollend}
A.5.49	Number of valid sensors
A.5.50	Sensor ID reference

## Annex B (normative) Options and constraints

B.1	Options for interface optimisation
B.1.1	List length optimisation
B.1.2	Redundancy optimisation
B.1.3	Alternative value representation optimisation
B.1.4	Alternative entity representation optimisation
B.1.5	Implicit values
B.1.6	Unrolling tuple-lists
B.2	Requirement level conditional reasons
B.2.1	Sensor technology specific conditional requirements
B.2.2	Signal dependencies

- B.2.3 Multiple entity types for one interface**
- B.3 Cross interface optimisation**
- B.3.1 Link between interfaces**
- B.3.2 Assignment of information to one interface**
- B.3.3 Need of logical signal group**
- B.4 Cross interface definition**
- B.4.1 Error model implementation**
- B.4.1.1 Measurements statistics**
- B.4.1.2 Signal values and associated error value calculation method**
- B.4.1.2.1 Signal value as sample mean, error value as sample standard deviation**
- B.4.1.2.2 Signal value as the sample median and error value as the interquartile range**
- B.4.1.2.3 Customised error value calculation method**
- B.4.1.3 Error value classification method**
- B.4.1.3.1 Accuracy error value**
- B.4.1.3.2 Trueness and precision error values**
- B.4.1.3.3 Variant and covariant error values**
- B.4.1.3.4 Customised error value classification method**

Page count: 227