INTERNATIONAL STANDARD

ISO 17215-1

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Road vehicles — Video communication interface for cameras (VCIC) —

Part 1: General information and use case definition

Véhicules routiers — Interface de communication vidéo pour caméras (ICVC) —

Partie 1: Informations générales et définition de cas d'utilisation

Reference number
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Foreword

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 17215 consists of the following parts, under the general title *Road vehicles — Video communication interface for cameras (VCIC)*:

— *Part 1: General information and use case definition*

— *Part 2: Service discovery and control*

— *Part 3: Camera message dictionary*

— *Part 4: Implementation of communication requirements*

Introduction

Driver assistance systems are more and more common in road vehicles. From the beginning, cameras were part of this trend. Analogue cameras were used in the beginning, because of lower complexity of the first systems. With increasing demand for more advanced functionality, digital image processing has been introduced. So-called one box design cameras (combining a digital image sensor and a processing unit) appeared in the vehicles.

Currently, the market demands such systems with multiple functions. Even different viewing directions are in use. It seems to be common sense that six up to 12 cameras in a single vehicle will be seen in the next future. Out of this and the limitation in size, power consumption, etc. it will lead to designs where the cameras are separated from the processing unit. Therefore, a high performance digital interface between camera and processing unit is necessary.

This International Standard has been established in order to define the use cases, the communication protocol, and the physical layer requirements of a video communication interface for cameras which covers the needs of driver assistance applications.

The video communication interface for cameras

— incorporates the needs of the whole life cycle of an automotive grade digital camera,

— utilizes existing standards to define a long-term stable state-of-art video communication interface for cameras usable for operating and diagnosis purpose,

— can be easily adapted to new physical data link layers including wired and wireless connections by using existing adaption layers, and

— is compatible with AUTOSAR.

This part of ISO 17215 is related to the general information and use case definition. This is a general overview document which is not related to the OSI model.

To achieve this, it is based on the Open Systems Interconnection (OSI) basic reference model specified in ISO/IEC 7498-1 and ISO/IEC 10731 which structures communication systems into seven layers. When mapped on this model, the protocol and physical layer requirements specified by this International Standard, in accordance with Table 1, are broken into following layers:

— application (layer 7), specified in ISO 17215-3;

— presentation layer (layer 6), specified in ISO 17215-2;

— session layer (layer 5), specified in ISO 17215-2;

— transport protocol (layer 4), specified in ISO 17215-4, ISO 13400-2;

— network layer (layer 3), specified in ISO 17215-4, ISO 13400-2;

— data link layer (layer 2), specified in ISO 17215-4, ISO 13400-3;

— physical layer (layer 1), specified in ISO 17215-4, ISO 13400-3.

Table 1 — Specifications applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI 7 layers</th><th colspan="2">Video communication interface for cameras</th><th>Camera diagnostics</th></tr>
<tr><td rowspan="8">Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="2">ISO 17215-3</td><td></td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="2">ISO 17215-2</td><td></td></tr>
<tr><td>Session (layer 5)</td><td colspan="2">ISO 17215-2</td><td></td></tr>
<tr><td>Transport (layer 4)</td><td rowspan="2">ISO 17215-4</td><td rowspan="4">Other future interface standards</td><td rowspan="2">ISO 13400-2</td></tr>
<tr><td>Network (layer 3)</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 17215-4</td><td rowspan="2">ISO 13400-3</td></tr>
<tr><td>Physical (layer 1)</td></tr>
</table>

ISO 17215-1 has been established in order to define the use cases for vehicle communication systems implemented on a video communication interface for cameras; it is an overall document not related to the OSI model.

ISO 17215-3 covers the application layer implementation of the video communication interface for cameras; it includes the API.

ISO 17215-2 covers the presentation layer implementation of the video communication interface for cameras.

ISO 17215-4, being the common standard for the OSI layers 1 to 4 for video communication interface for cameras, complements ISO 13400-2 and ISO 13400-3 and adds the requirement for video transmission over Ethernet.

ISO 17215-2 and ISO 17215-3 (OSI layers 5 to 7) services have been defined to be independent of the ISO 17215-4 (OSI layers 1 to 4) implementation. Therefore, ISO 17215-4 could be replaced by other future communication standards.

Road vehicles — Video communication interface for cameras (VCIC) —

Part 1: General information and use case definition

1 Scope

This International Standard describes the general use cases and communication scenarios, for a video communication interface for cameras used in video-based driver assistant systems.

This part of ISO 17215 gives an overview of the structure and the partitioning of this International Standard and shows the relation between the different parts (see Figure 1).

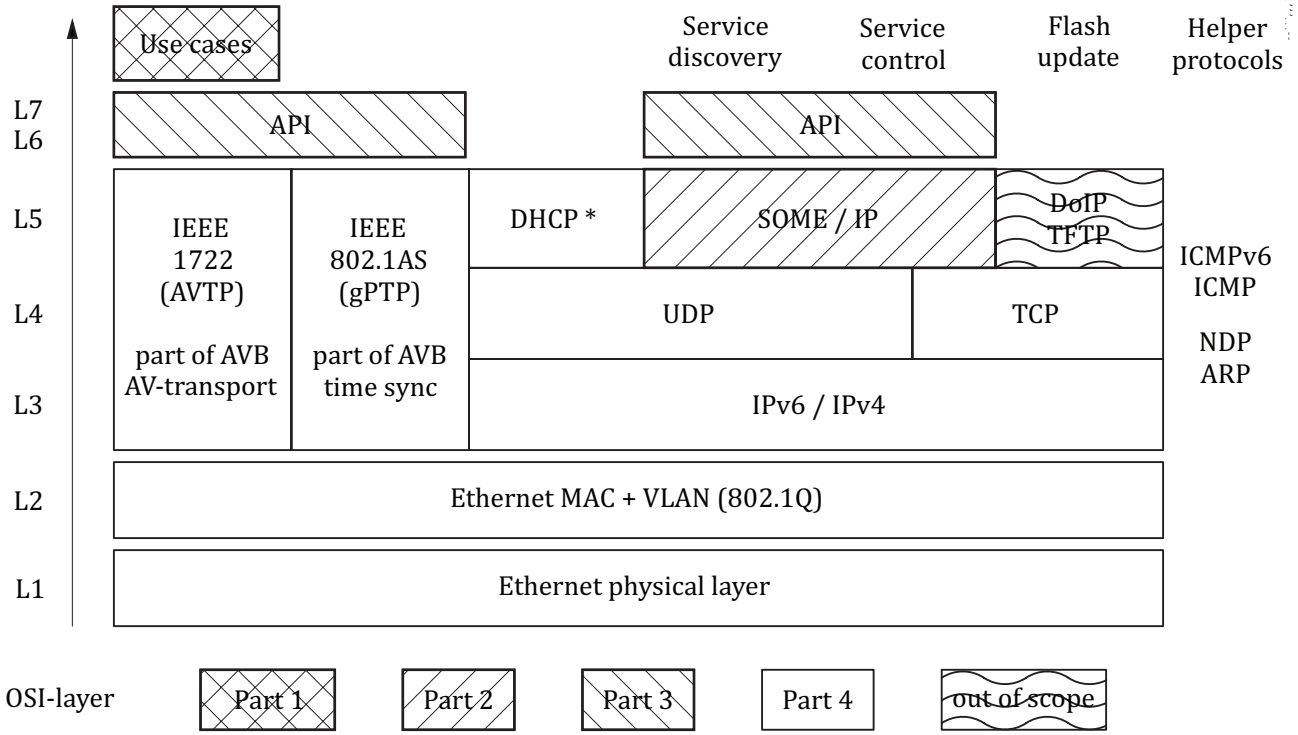


Figure 1 — Overview of ISO 17215

This part of ISO 17215 serves as communication infrastructure for driver assistant applications that could be

— presenting video images to the driver,

— presenting warnings to the driver (e.g. using an HMI), or

— interacting with the vehicle (e.g. emergency breaking).

The terminology defined in this part of ISO 17215 is common for all video communication interfaces for cameras communication systems and is used throughout all parts of this International Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model —Part 1*

ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

ISO 17215 (all parts), *Road vehicles — Video communication interface for cameras (VCIC)*

ISO 13400-2, *Road vehicles - Diagnostic communication over Internet Protocol (DoIP) — Part 2: Transport protocol and network layer services*

ISO 13400-3, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 3: Wired vehicle interface based on IEEE 802.3*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

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

3.1.1
camera configuration
setup and installation of the camera

3.1.2
extrinsic auto calibration
extrinsic parameters will denote the coordinate system transformations from 3D world (vehicle) coordinates (m,°) to 3D camera coordinates (m,°)

3.1.3
firmware
program code and data stored in electronic unit

3.1.4
histogram
graphical representation of the tonal distribution in a digital image

3.2 Abbreviated terms

Term	Description
API	Application Programming Interface
AUTOSAR	Automotive Open System Architecture
AVTP	Audio Video Transport Protocol
DAS	Driver Assistance System
DHCP	Dynamic Host Configuration Protocol
ECU	Electronic Control Unit

Term	Description
EMC	Electromagnetic Compatibility
gPTP	Generalized Precision Time Protocol
HDR	High Dynamic Range
HMI	Human Machine Interface
ICMP	Internet Control Message Protocol
IDL	Interface Description Language
ISO	International Organization for Standardization
LDR	Low Dynamic Range
LLC	Logical Link Control
MAC	Media Access Control
MII	Media Independent Interface
NDP	Neighbour Discovery Protocol
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PHY	Physical Layer
POE	Power over Ethernet
ROI	Region of Interest, i.e. sub-part of overall image
RPC	Remote Procedure Call
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
VLAN	Virtual Local Area Network

4 Conventions

This International Standard is based on the conventions specified in the OSI service conventions (see ISO/IEC 10731) as they apply for physical layer, protocol, network, and transport protocol and diagnostic services.

5 Overview

5.1 General

This International Standard has been established in order to implement a standardized video communication interface for cameras on a communication data link. The focus of this International Standard is using existing protocols.

Figure 1 specifies the relation to the other parts of this International Standard.

Figure 2 specifies the relation of this International Standard to existing protocols.

5.2 Document overview and structure

This International Standard consists of a set of four sub-documents, which provide all references and requirements to support the implementation of a video communication interface for cameras according to the standard at hand.

— ISO 17215-1: This section provides an overview of the document set and structure along with use case definitions and a common set of resources (definitions, references) for use by all subsequent parts.

— ISO 17215-2: This section specifies the discovery and control of services provided by a VCIC camera.

— ISO 17215-3: This section specifies the standardized camera messages and data types used by a VCIC camera (see OSI layer 7).

— ISO 17215-4: This section specifies standardized low-level communication requirements for implementation of the physical, data link, network and transport layer (see OSI layers 1 to 4).

5.3 Open Systems Interconnection (OSI) model

This International Standard is based on the Open Systems Interconnection (OSI) basic reference model as specified in ISO/IEC 7498 which structures communication systems into seven layers.

All parts of this International Standard are guided by the OSI service conventions as specified in ISO/IEC 10731 to the extent that they are applicable to diagnostic services. These conventions define the interaction between the service user and the service provider through service primitives.

The aim of this subclause is to give an overview of the OSI model and show how it has been used as a guideline for this part of ISO 17215. It also shows how the OSI service conventions have been applied to this International Standard.

The OSI model structures data communication into seven layers called (from top to bottom) the application layer (layer 7), presentation layer, session layer, transport layer, network layer, data link layer, and physical layer (layer 1). A subset of these layers is used in this International Standard.

The purpose of each layer is to provide services to the layer above. The active parts of each layer, implemented in software, hardware, or any combination of software and hardware, are called entities. In the OSI model, communication takes place between entities of the same layer in different nodes. Such communicating entities of the same layer are called peer entities.

The services provided by one layer are available at the Service Access Point (SAP) of that layer. The layer above can use them by exchanging data parameters.

This International Standard distinguishes between the services provided by a layer to the layer above it and the protocol used by the layer to send a message between the peer entities of that layer. The reason for this distinction is to make the services, especially the application layer services and the transport layer services, reusable also for other types of networks than the video communication interface for cameras. In this way, the protocol is hidden from the service user and it is possible to change the protocol if demanded by special system requirements.

5.4 Document reference according to OSI model

Figure 2 illustrates the document references.

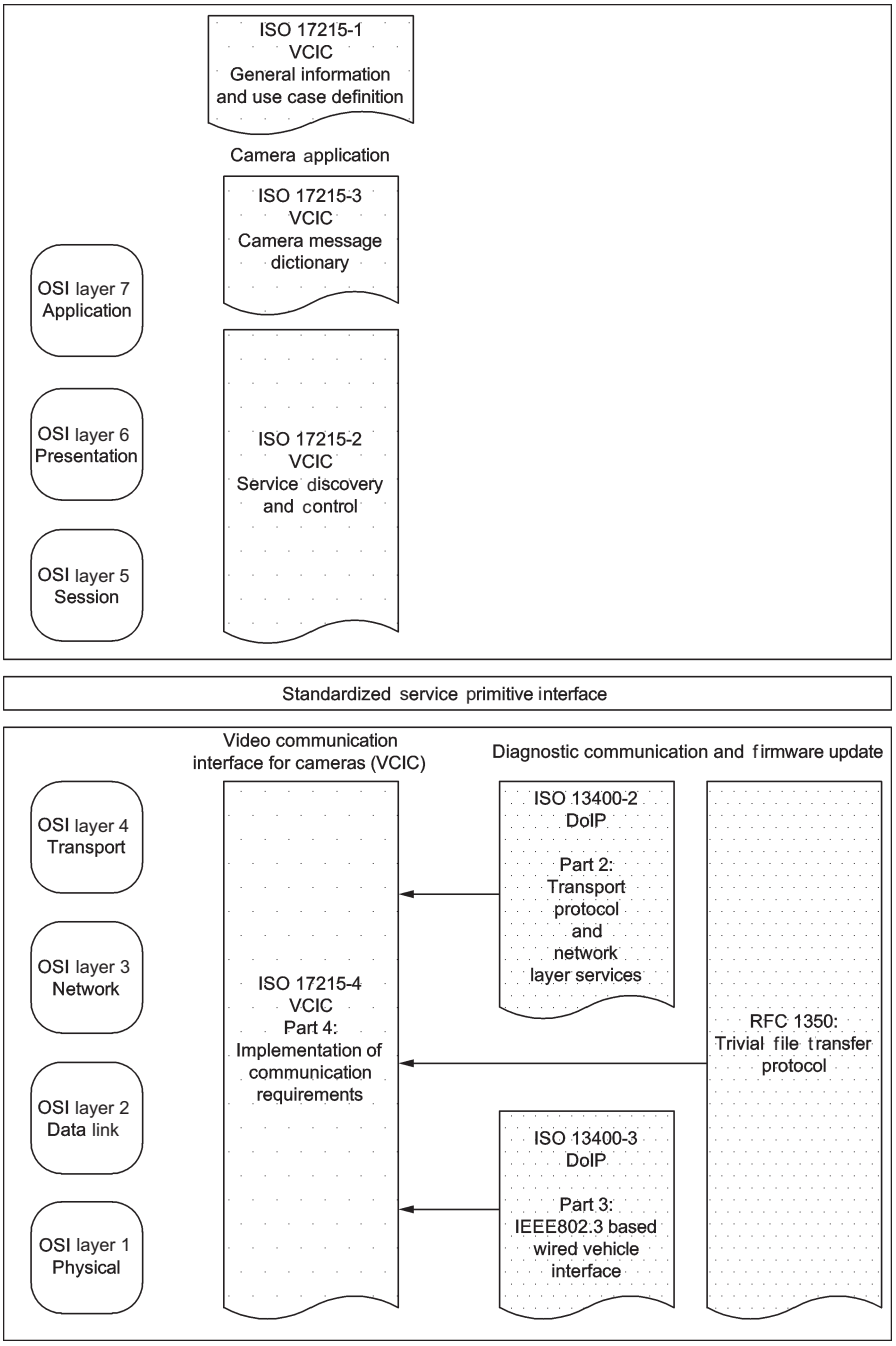


Figure 2 — Video communication interface for cameras document reference according to OSI model

6 Use cases

6.1 Main use case cluster

This subclause defines use case clusters of the video communication interface for cameras.

Table 2 provides an overview of the main camera use case clusters. A camera use case cluster can have one or more use case definitions.

Table 2 — Video communication interface for camera's main use case clusters

#	Main title of use case cluster	Brief description
1	Vehicle assembly line inspection and repair	The purpose of this cluster package is to define the minimum level of functions required to support assembly process of video interface systems. Typically, these use case functions are related to the setting and reading of data during system assembly process. For example, the setup and calibration of multiple camera systems and processor devices. These requirements shall assist manufacturers to ensure the system is correctly integrated.
2	Normal operation environment	The purpose of this cluster package is to define the minimum level of functions required to support the normal operation of the video interface system. Typically, these use case functions are related to the transfer of data in the video system and dynamically controlled functional settings. These requirements shall enable the video interface to provide a flexible operating function.
3	Service environment	The purpose of this cluster package is to define the minimum level of functions required to support the service environment in the confirmation of operating status and during maintenance of the video system. Typically, these use case functions are related to the setting and reading of data to aid diagnosis. These requirements shall enable maintenance or service technicians to interrogate the component performance and perform related diagnostic activities.

6.2 Video communication interface for camera's use case definition

6.2.1 UC1 vehicle assembly line inspection and repair

6.2.1.1 UC1.1 check the vehicle related camera configuration

Table 3 specifies the use case that is done for every single camera at the vehicle manufacturing process.

Table 3 — UC1.1 check the vehicle related camera configuration

Actor	Vehicle manufacturing
Goal	To check the correct configuration of the camera system and the assembly of the vehicle with the correct cameras at the assembly line
Use case input	Request from the external communication interface for system test
Use case output	Response messages from the vehicle: — number of camera instances; — array of instances (position in the network topology, vendor, model no., firmware version, etc.).
Brief description	After vehicle is assembled with the camera systems, it will be checked by starting the communication with the individual systems. By reading out the information, it can be decided, whether the configuration was successful or not.
Typical example	Reading camera instances for valid parameters

6.2.1.2 UC1.2 failure detection and correction

Table 4 specifies the use case to detect and correct a failure in system setup during vehicle manufacturing and at the inspection and repair station.

Table 4 — UC1.2 failure detection and correction

Actor	Vehicle manufacturing/inspection and repair
Goal	To detect and correct a failure of a single camera device at the assembly line/inspection and repair
Use case input	Camera system failed at start-up configuration.

Table 4 *(continued)*

Use case output	— diagnostic of error memory — execution of extrinsic auto calibration — correct the vehicle related camera configuration
Brief description	This is used to detect the root cause for the non-working camera system and fix the system during manufacturing or inspection and repair.
Typical example	Camera shows wrong firmware version or is not accessible at communication line.

6.2.1.3 UC1.3 camera firmware update

Table 5 specifies the use case for updating the firmware of a camera system during vehicle manufacturing and at the inspection and repair station.

Table 5 — UC1.3 camera firmware update

Actor	Vehicle manufacturing/inspection and repair
Goal	To update the camera firmware during assembly line and at inspection and repair station
Use case input	Communication interface available for updating the firmware via DoIP or TFTP connection. Check for HW version. Check the installed firmware version.
Use case output	Firmware version
Brief description	During production process, it should be possible to have the interface available for a firmware update.
Typical example	Update of the camera HW to the latest available firmware version.

6.2.2 UC2 normal operation environment

6.2.2.1 UC2.1 video operation

Table 6 specifies the use case of video streaming in normal operation environment.

Table 6 — UC2.1 video operation

Actor	Designated car communication system/ECU
Goal	Delivery of video data to the requesting ECU
Use case input	Select and start the corresponding video format. Read and control the camera control parameters (exposure time, ROI, etc.).
Use case output	Video streaming data
Brief description	In normal operation, a video stream will be sent by ECU request from the corresponding camera.
Typical example	To transfer the required video information inside the car communication system

6.2.2.2 UC2.2 subscribe of camera services

Table 7 specifies the use case to get data from the camera.

Table 7 — UC2.2 subscribe of camera services

Actor	Designated car communication system/ECU
Goal	Set up single or cyclic request for camera data, e.g. feature information and control parameters from a camera device
Use case input	Request for camera feature information and control parameters

Table 7 *(continued)*

Use case output	Receive response/notification packages with — feature information (e.g. histogram, black level, imager parameters, etc.); — camera control parameters (e.g. exposure time, ROI, etc).
Brief description	In normal operation, the ECU request feature information and camera control parameters which are used for operation of the camera system.
Typical example	Cyclic read out of histogram information from camera

6.2.3 UC2.3 time synchronization

Table 8 specifies the use case to synchronize cameras at the vehicle.

Table 8 — UC2.3 time synchronization

Actor	Designated car communication system/ECU
Goal	Synchronisation between cameras
Use case input	Camera parameter and position information
Use case output	Video data based on a timestamp
Brief description	Some driver assistance systems will require the need for synchronization (stereo, top view, etc.). Therefore, the timestamp of the transport protocol will be used to synchronise and generate the corresponding output.
Typical example	Generate out of cameras at different positions a top view picture.

6.2.4 UC2.4 camera operation Mode

Table 9 specifies the use case to put the camera in specific operation modes.

Table 9 — UC2.4 camera operation mode

Actor	Designated car communication system/ECU
Goal	To set the camera in specific operation mode
Use case input	Car status information (e.g rear switch)
Use case output	Change of operation mode of camera
Brief description	Some driver assistance systems will require the need to set the camera in a special operating mode, like sleep, wake, reset, etc. (rear view camera).
Typical example	To set the operation mode of a video interface component to sleep for rear view camera during driving forward direction.

6.2.5 UC3 service environment

6.2.5.1 UC3.1 failure detection and correction

Table 10 specifies the use case to detect and correct a failure in system setup during inspection and repair station.

Table 10 — UC3.1 failure detection and correction

Actor	Inspection and repair
Goal	To detect and correct a failure of a single camera device at inspection and repair
Use case input	Camera system failed during system operation.

Table 10 *(continued)*

Use case output	— diagnostic of error memory — execution of extrinsic auto calibration — check the vehicle related camera configuration
Brief description	This is used to detect the root cause for the non-working camera system and fix the system in inspection and repair.
Typical example	Camera shows wrong firmware version or is not accessible at communication line.

6.2.5.2 UC3.2 camera firmware update

Table 11 specifies the use case how to update the firmware of a camera system at inspection and repair station.

Table 11 — UC3.2 camera firmware update

Actor	Inspection and repair
Goal	To update the camera firmware during inspection and repair station
Use case input	Communication interface available for updating the firmware via DoIP or TFTP connection. Check for HW version. Check the installed firmware version.
Use case output	Firmware version
Brief description	During the lifetime of the vehicle, it should be possible to update the camera HW with a firmware update.
Typical example	Update of the camera HW to the latest available firmware version

7 Camera communication scenarios

7.1 Overview of camera network configurations

There are different communication scenarios, where one or more cameras within a vehicle can be networked over Ethernet.

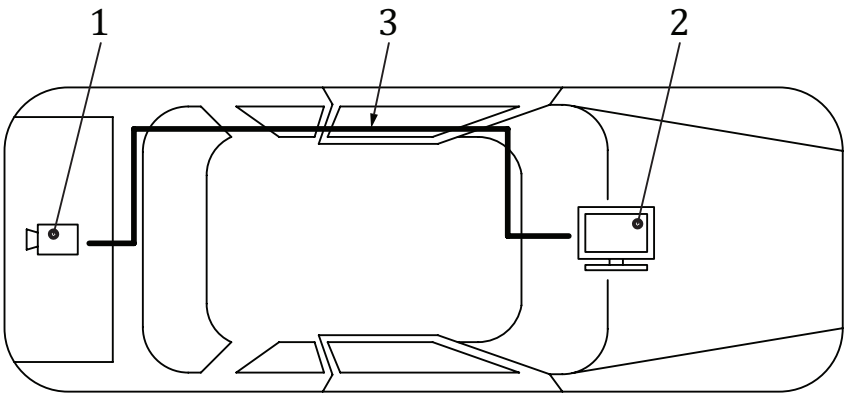
The following network topologies are defined.

— single camera application: direct physical connection between camera/s to ECU;

— multi-camera application: networked connection between camera/s and ECU.

7.2 Single camera application

In case of a single camera application system, the camera is directly connected to the ECU. Data communication (video and control) is available on this point-to-point interface. This single camera application interface can be used for simple applications, like rear view or front camera applications.



Key

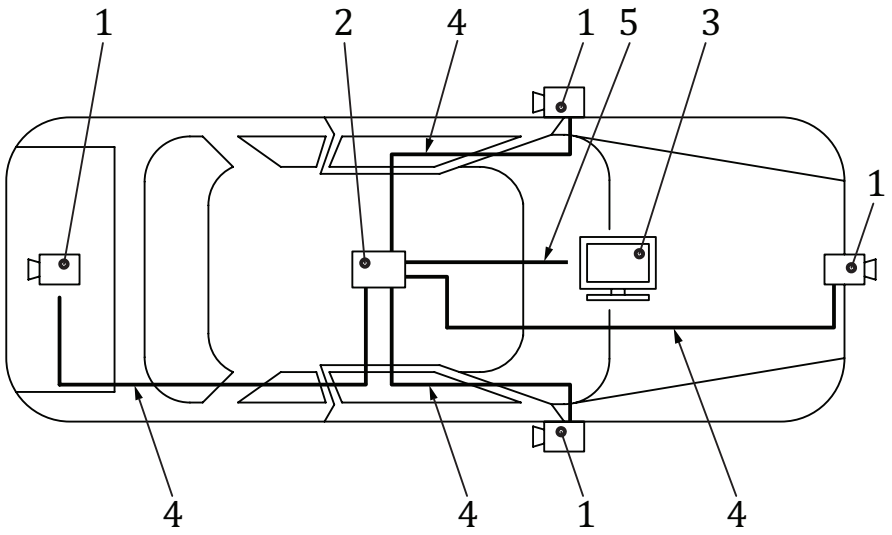
1 DAS camera
2 head unit
3 Ethernet cable

Figure 3 — Single camera application

7.3 Multi-camera application

In case of a multi-camera application system, all relevant cameras are connected via switches with an ECU.

This multi-camera application interface can be used for applications, like surround view camera or top view camera systems.



Key

1 DAS camera
2 image processing ECU with integrated switch
3 head unit
4 Ethernet cable
5 unspecified cable connection

Figure 4 — Multi-camera application

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Price based on 11 pages