INTERNATIONAL STANDARD

ISO 17215-3

Second edition

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

Part 3: Camera message dictionary

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

Partie 3: Dictionnaire de message de caméra

PROOF/ÉPREUVE

Reference number
ISO 17215-3:2021(E)

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

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 17215-3:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— corrections of Formulae and scaling in 7.6.8;

— editorial adoptions and corrections.

A list of all parts in the ISO 17215 series can be found on the ISO website.

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

Driver assistance systems are increasingly common in road vehicles. From the beginning, cameras were part of this trend. Analogue cameras were used in the beginning because of the 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) started being used in vehicles.

Currently, the market demands such systems with multiple functions. Even different viewing directions are in use. It seems plausible that in the near future a single vehicle could have between 6 and 12 cameras. For this reason and others like limitations in size, power consumption, etc., designs have been made where the cameras are separated from the processing unit. Therefore, a high-performance digital interface between camera and processing unit is necessary.

This document 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-the-art video communication interface for cameras, usable for operating and diagnosis purposes,

— 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 document 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 document, in accordance with Table 1 are broken into following layers:

— application (layer 7), specified in this document (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

Applicability	OSI 7 layers	Video communication interface for cameras		Camera diagnostics
Seven layers according to ISO 7498–1 and ISO/IEC 10731	Application (layer 7)	ISO 17215-3		
	Presentation (layer 6)	ISO 17215-2		
	Session (layer 5)	ISO 17215-2		
	Transport (layer 4)	ISO 17215-4	Other future interface standards	ISO 13400-2
	Network (layer 3)			
	Data link (layer 2)	ISO 17215-4		ISO 13400-3
	Physical (layer 1)			

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

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

ISO 17215-4 is the common standard for the OSI layers 1 to 4 for video communication interface for cameras. It 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 layer 5 to 7) services have been defined to be independent of the ISO 17215-4 (OSI layer 1 to 4) implementation. Therefore, ISO 17215-4 could be replaced by another future communication document.

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

Part 3:
Camera message dictionary

1 Scope

This document specifies the standardized camera messages and data types used by a VCIC camera (OSI layer 7).

Applications hosted on ECUs want to communicate with one or more cameras (e.g. “Ask camera for parameters.”). If the applications can use standardized services supported by the cameras (API layer 7), the development of a vision application is independent on the camera used. The services can be implemented by general libraries.

The definition of streaming data is not an issue of this API.

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 17215-1, *Road vehicles — Video communication interface for cameras (VCIC) — Part 1: General information and use case definition*

ISO 17215-2, *Road vehicles — Video communication interface for cameras (VCIC) — Part 2: Service discovery and control*

ISO 17215-4, *Road vehicles — Video communication interface for cameras (VCIC) — Part 4: Implementation of communication requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17215-1 and the following 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 http://www.electropedia.org/

3.1
extrinsic parameter
parameter that denotes the coordinate system transformations from 3D world (vehicle) coordinates (m,°) to 3D-camera coordinates (m,°)

3.2
frame rate
update rate per time of camera images

3.3
global shutter
exposure that exposes all pixels at the same time

3.4
histogram
type of chart that acts as a graphical representation of the tonal distribution in a digital image

3.5
intrinsic camera parameter
parameter that denotes the coordinate system transformations from 3D camera (m) to 2D pixel coordinates (pixel)

4 Symbols and abbreviated terms

API		Application Programming Interface
AEC		Automatic Exposure Control
AGC		Automatic Gain Control
DAS		Driver Assistance System
ECU		Electronic Control Unit
HDR		High Dynamic Range
HMI		Human Machine Interface
ID		Identifier
ISO		International Organization for Standardization
LDR		Low Dynamic Range
LSB		Least significant bit
MAC		Media Access Control
OSI		Open Systems Interconnection
PSE		Persistent storage entry
ROI	ρ	Region of Interest, i.e. sub-part of overall image
RPC		Remote Procedure Call

5 Conventions

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

6 Overview of ISO 17215 series

6.1 General

This document has been established to implement a standardized video communication interface for cameras on a communication data link.

The focus of this document is to use existing protocols.

— Figure 1 specifies the relation to the other parts of this document.

— Figure 2 specifies the relation of this document to existing protocols.

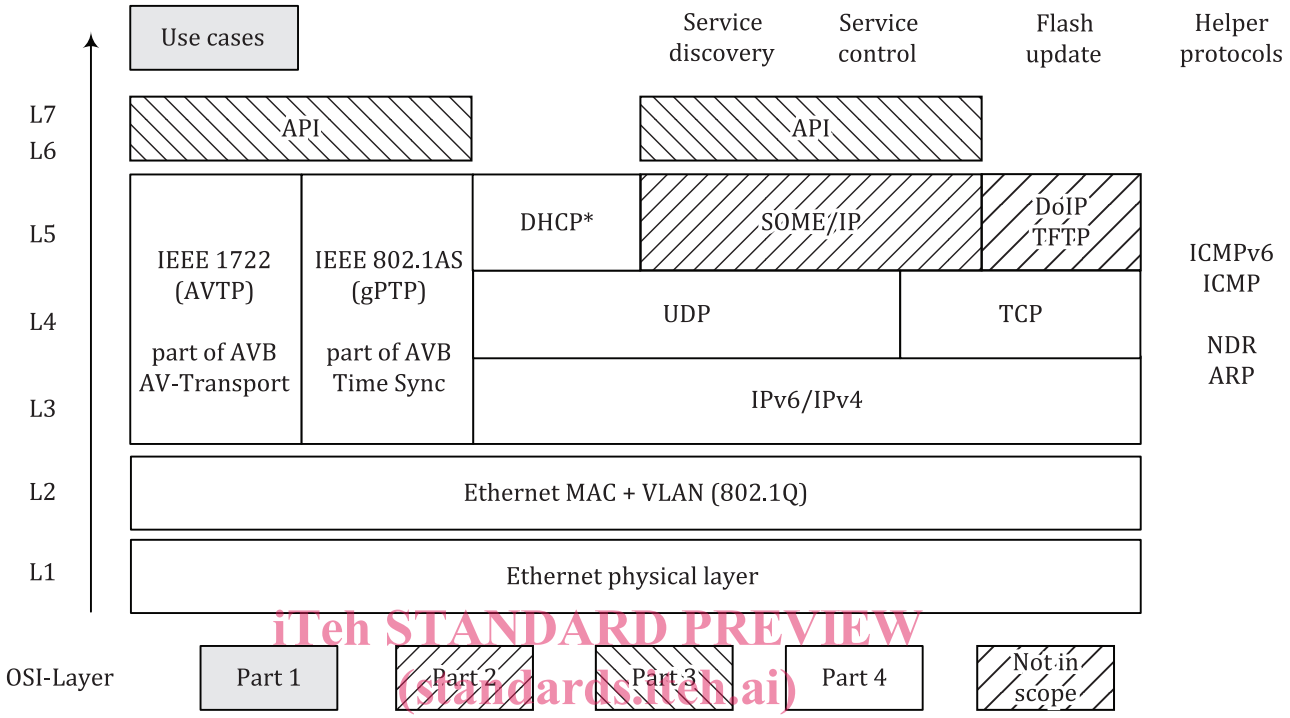

Figure 1 — Overview of the ISO 17215 series

6.2 Document overview and structure

The ISO 17215 series consists of a set of four parts, which provide all references and requirements to support the implementation of a standardized video communication interface for cameras according to the document at hand.

— ISO 17215-1 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 specifies the discovery and control of services provided by a VCIC camera.

— This document specifies the standardized camera messages and data types used by a VCIC camera (OSI layer 7).

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

6.3 Open Systems Interconnection (OSI) model

This document 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 the ISO 17215 series 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 document. It also shows how the OSI service conventions have been applied to this document.

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 document.

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 document 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.

6.4 Document reference according to OSI model

Figure 2 illustrates the document references.

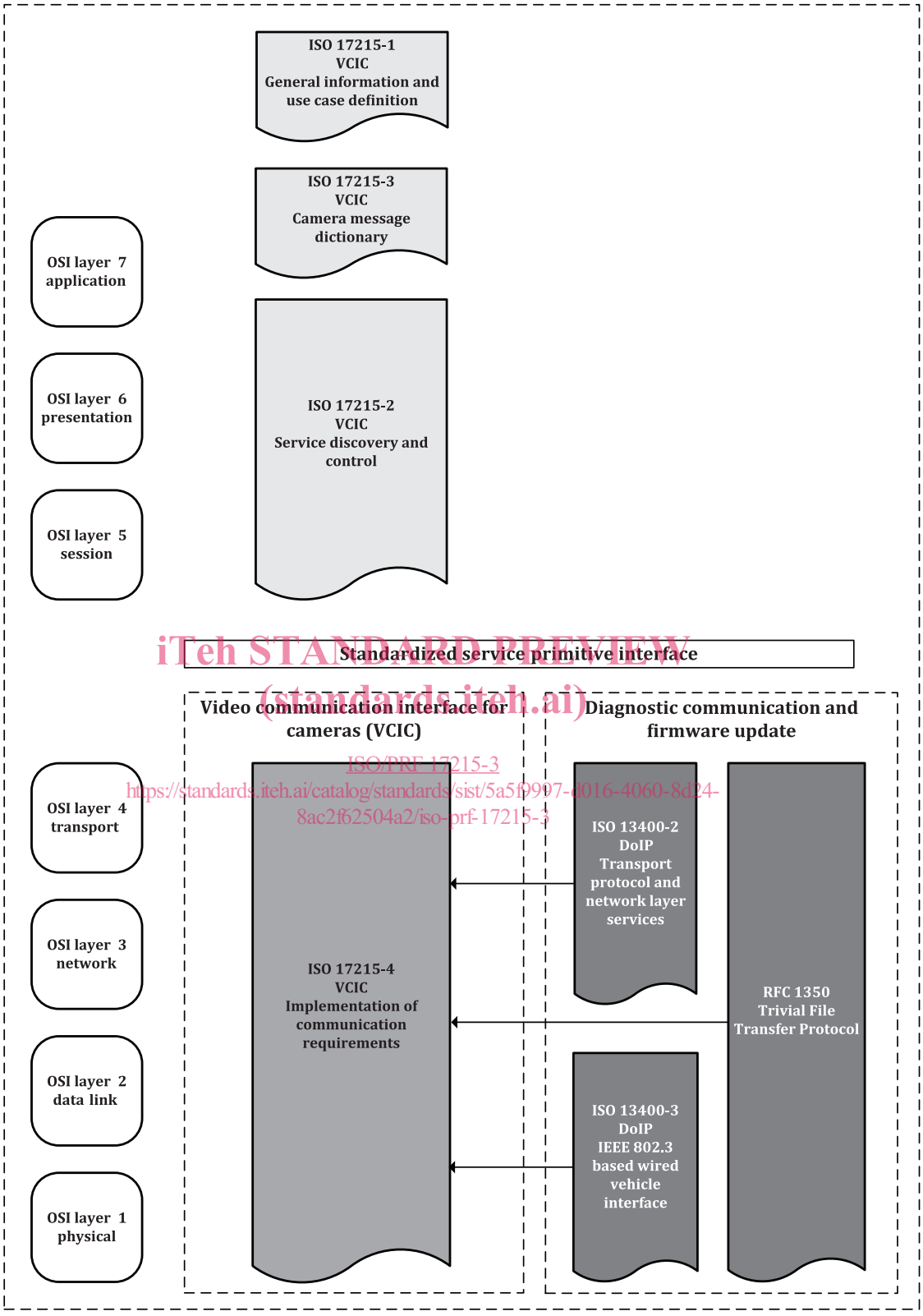

Figure 2 — Document reference according to OSI model

7 Camera application interface (OSI layer 7)

7.1 Specific properties

In the automotive environment, the network topologies are semi-static and the characteristics of all components, including cameras, are bound to a specific car platform design. Components and characteristics of components not included in the design need not to be supported.

There is no requirement for a least common video mode. The minimum compatibility requirement is to recognize the reason of unexpected behaviour. Compatibility is ensured during the design phase. Incompatibility is detected during development, assembling, or repair of a car.

Consequently, the standard specifies the interface to an automotive camera, but does not specify the characteristics of automotive cameras.

For instance, no mandatory or standard video formats are specified. However, all provisions are made to implement standard video formats.

7.2 API principles

The camera API consists of a variety of data structures describing video modes, camera controls, and stored items and a set of API functions.

The API is independent of specific programming languages. It is an abstract list of data structures and functions to be offered by all implementations. A fundamental principle of all camera API functions is the usage of remote procedure calls (RPC).

The addressing of multiple cameras can be expressed by Formula (1):

$$F_{\text{Camera}} = f\{C_{\text{Instance}}, F_{\text{API}}\{I_{\text{Method}}, a_1, \ldots, a_n\}\} \quad (1)$$

where

F_{Camera} is the camera function;

C_{Instance} is the camera instance;

F_{API} is the API function;

I_{Method} is the Method ID;

a_1 is the argument 1;

a_n is the argument n;

The implementation depends highly on the programming language used. Therefore, this document only covers the API function itself.

Camera data structures can be read, written, and deleted using the associated camera API functions.

Camera API functions can be grouped by the mechanism they are using in:

— set, get, and erase functions, and

— subscribe and unsubscribe functions.

All API functions starting with set, get, and erase are used to modify the cameras data structures and the underlying functionality, for instance setting the exposure time of the imager. They are using a request/response mechanism. A request is followed by a single response.

Functions are generally identified by their Method ID.

The Method IDs are specified in 7.5.1.

All API functions starting with unsubscribe/subscribe are used to acquire cyclically data from the camera, for instance, a video stream. They are using subscribe/notification mechanism. After subscribing an event, multiple notification packages follow.

Events are identified by its respective Eventgroup ID.

The Eventgroup IDs are specified in 7.5.2.

The SOME/IP protocol defined in ISO 17215-2 provides the mechanism for such an RPC-based implementation.

Camera functions and the associated structures can be grouped in functional context in:

— general camera functions (MethodID 0001_{16} –$00FF_{16}$);

— video format functions (MethodID 0101_{16} –$01FF_{16}$);

— image control functions (MethodID 0201_{16} –$02FF_{16}$), and;

— imager functions (MethodID 0301_{16} –$03FF_{16}$).

7.2.1 Image cropping and windowing

The definition of the image windows is shown in Figure 3.

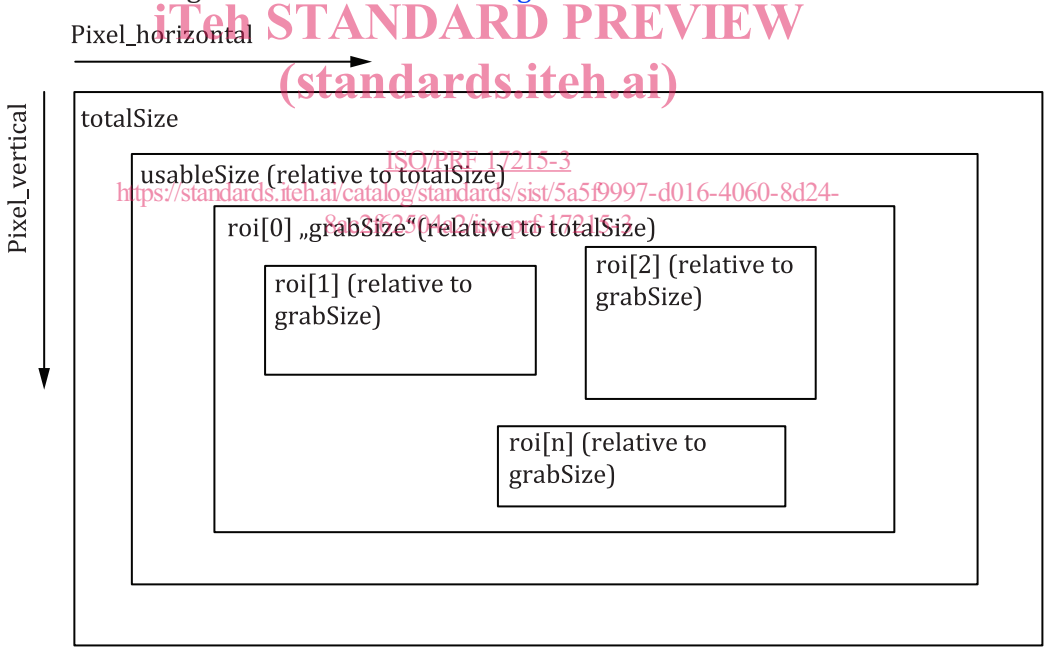

Figure 3 — Image cropping and windowing

7.3 API data types

All used data types are specified in ISO 17215-2:2014, 6.3.1.

7.4 API Return codes

Each function of the API returns a byte (8 bits) to signalize the status of the operation.

— The return codes (00_{16} to $1F_{16}$) are defined in ISO 17215-2:2014, 6.1.1.7.