

Public transport — Road vehicle scheduling and control systems —

Part 6: CAN message content

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National foreword

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Summary of pages

This document comprises a front cover, an inside front cover, the CEN/TS title page, pages 2 to 126, an inside back cover and a back cover.

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Amendments issued since publication

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English Version

**Public transport - Road vehicle scheduling and control systems -
Part 6: CAN message content**

Transports publics - Systèmes d'ordonnancement et de
contrôle des véhicules routiers - Partie 6: Contenu de
messages CAN

Straßentransport- und Verkehrstelematik - Planungs- und
Steuerungssysteme für Straßenfahrzeuge - Teil 6: CAN
Nachrichteninhalt

This Technical Specification (CEN/TS) was approved by CEN on 27 June 2004 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This Technical Specification (CEN/TS 13149-6:2005) has been prepared by Technical Committee CEN/TC 278 "Road Transport and Traffic Telematics", the secretariat of which is held by NEN.

Annex A is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this CEN Technical Specification: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This Technical Specification is part 6 of EN 13149, which gives rules for on-board data transmission systems.

This part 6 together with part 4 and part 5 describes a complete solution independent from part 1, part 2 and part 3.

This document uses terms which are already used in other standards e.g. ENV 12896:1997 "Public transport - Reference data model", when applicable.

1 Scope

This Technical Specification specifies the choice and the general application's rules of an onboard data transmission bus between the different equipment for service operations and monitoring of the fleet. This applies to equipment installed onboard buses, trolley-buses and tramways only as part of a bus fleet operation. It excludes tramways when they are operated as part of a train, subway or metro operation. This equipment includes operation aid systems, automatic passenger information systems, fare collection systems, etc.

The equipment directly related to the safety-related functioning of the vehicle (propulsion management, brake systems, door opening systems, etc.) are excluded from the scope of the present standard and are dealt with in other standardisation bodies.

For the described application two bus systems are standardised. Part 1 to part 3 describe the WORLDIFIP bus system and part 4 to part 6 describe the CANopen bus system. There is no ranking between the two bus systems.

This Technical Specification covers the link between equipment inside a single vehicle. Although it could be applied to multiple vehicles, this application is not explicitly covered by this standard.

Part 4 of this European Standard specifies the CANopen-based network. This specification describes the general architecture in terms of hierarchical layers according to the ISO reference model for Open Systems Interconnection (OSI) specified in ISO 7498.

Part 5 of this European Standard specifies in detail the connectors and the connector pin assignment and the cabling.

Part 6 (this document), which will be published as a Technical Specification specifies in detail the application profiles for the virtual devices in public transport.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 13149-4, *Public transport - Road vehicle scheduling and control systems - Part 4: General application rules for CANopen transmission buses.*

EN 13149-5, *Public transport - Road vehicle scheduling and control systems - Part 5: CANopen cabling specifications.*

EN 50325-4, *Industrial communication subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 4: CANopen*

ENV 12896, *Road transport and traffic telematics - Public transport - Reference data model.*

ISO 11898-1, *Road vehicles - Controller area network (CAN) – Part 1: Data link layer and physical signalling.*

ISO 11992-3, *Road vehicles - Interchange of digital information on electrical connections between towing and towed vehicles - Part 3: Application layer for equipment other than braking and running gear.*

ISO 16844-7, *Road vehicles - Tachograph systems - Part 7: Parameters.*

ISO/IEC 646, *Information technology - ISO 7-bit coded character set for information interchange.*

ISO/IEC 8859-1, *Information technology - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1.*

ISO/IEC 8859-2, *Information technology - 8-bit single-byte coded graphic character sets - Part 2: Latin alphabet No. 2.*

ISO/IEC 8859-15, *Information technology - 8-bit single-byte coded graphic character sets - Part 15: Latin alphabet No. 9.*

3 Terms and definitions

For the purposes of this Technical Specification, the terms and definitions given in ENV 12896 apply.

3.1 Identifiers and numbers

3.1.1 Vehicle related identifiers and numbers

The vehicle ID is assigned uniquely by the system designer to the vehicle. Usually it refers to the vehicle ID text object (611C_n) containing the number given inside of the main computer or the number is coded by a fixed connector at the main computer (see Figure 1: x).

The body ID assigned by the system designer refers to the body ID text object (611D_n) containing the readable identification on the vehicle body. Usually this text is printed on the vehicle body (see Figure 1: y).

The radio ID assigned by the system designer refers to the radio ID text object (611E_n) containing the textual radio address of the bus. This address is necessary for selective calls to this bus (see Figure 1: z).

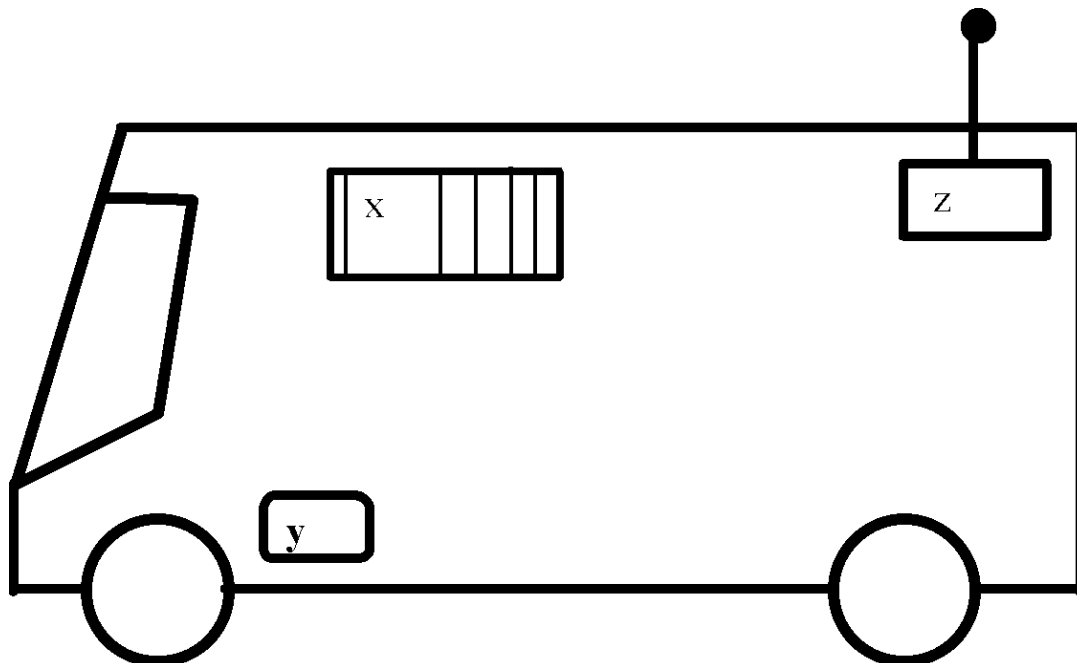


Figure 1 — Vehicle related identifiers and numbers

3.1.2 Vehicle operation identifiers and numbers

The garage ID assigned by the system designer refers to the garage ID text object (611F_n) containing the textual description of the depot or garage, where a vehicle is going to be parked during the night (see Figure 2).

The block ID assigned by the system designer indicates the work of a vehicle from the time it leaves a parking point (depot, garage) after parking until its next return to park at a parking point. Any subsequent departure from a parking point after parking marks the start of a new block. A block should consist of one or several lines (see Figure 2). The block ID refers to the block ID text object (6197_n) containing the textual description of the block.

The line ID assigned by the system designer refers to the line ID text object (6196_n) containing the textual or numerical name of the line, which is known from the public by. A line should consist of a single route or a group of routes.

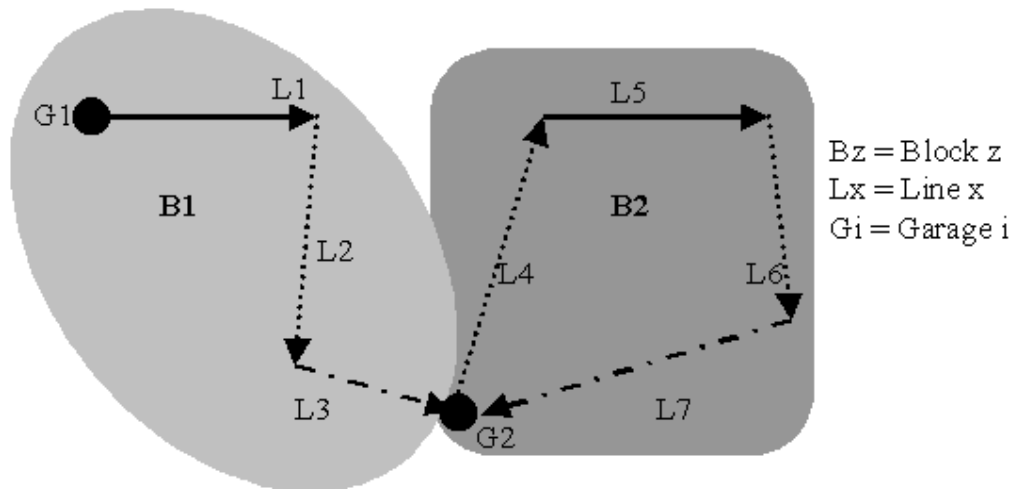


Figure 2 — Non-closed and closed block

A route is an ordered list of points defining one single path through the road (or rail) network. Stop points, timing points and points of other types should be used to define this path uniquely. The route number is related to a line (see Figure 3).

The stop point ID assigned by the system designer refers to the stop point ID text object (6120_n) representing uniquely a stop point within a transportation network (see Figure 3).

The destination number is the reference to the route destination. The number may differ from stop point ID (see Figure 3).

The number of running in route representation is the running stop point number within a route (see Figure 3).

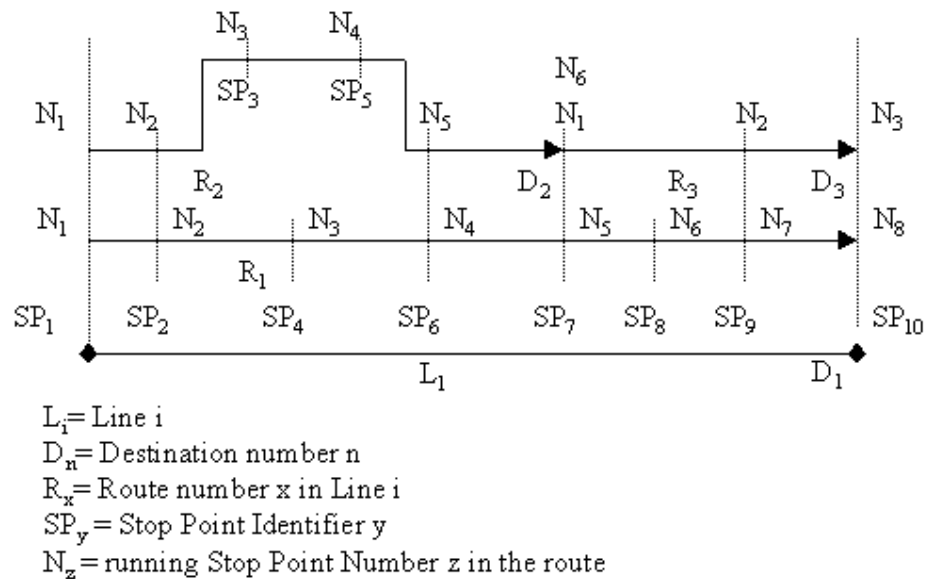


Figure 3 — Definition of a line

The journey number refers to a journey (between one terminus to another terminus) related to a given time or time table (see Figure 4).

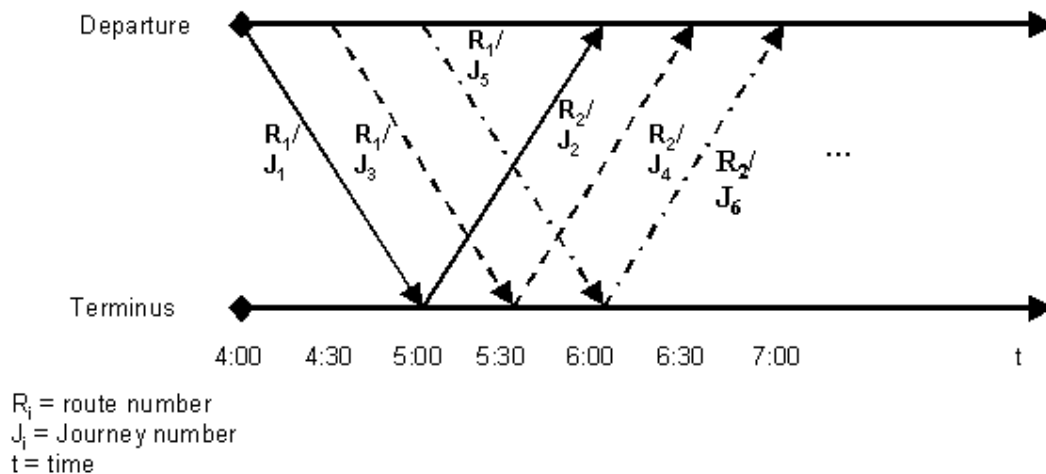


Figure 4 — Definition of a journey

The route destination ID identifies a unique route and line. With this identifier the path and the rail track of this line/route is defined for a vehicle. For example, this is used for the controlling of rail switches in the track (see Figure 5)

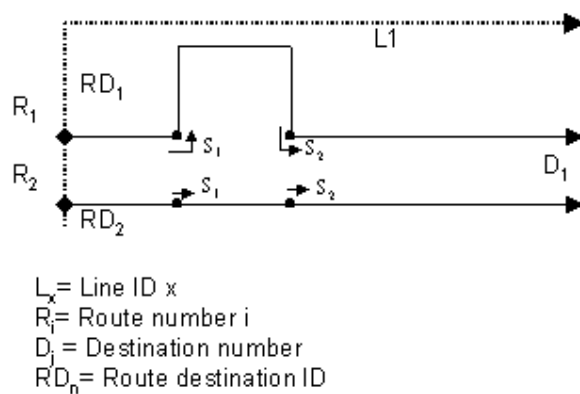


Figure 5 — Description of the use of Route Destination ID

3.1.3 Fare terms and related identifiers and numbers

The route segment number indicates a set of consecutive links on a given route and is unique for a fare zone (see Figure 6).

The fare zone indicates the current fare zone number (see Figure 6).

The previous fare zone indicates the number of the last/previous crossed fare zone (see Table 1).

The previous route segment number is the number of the last/previous crossed route segment (see Table 1).

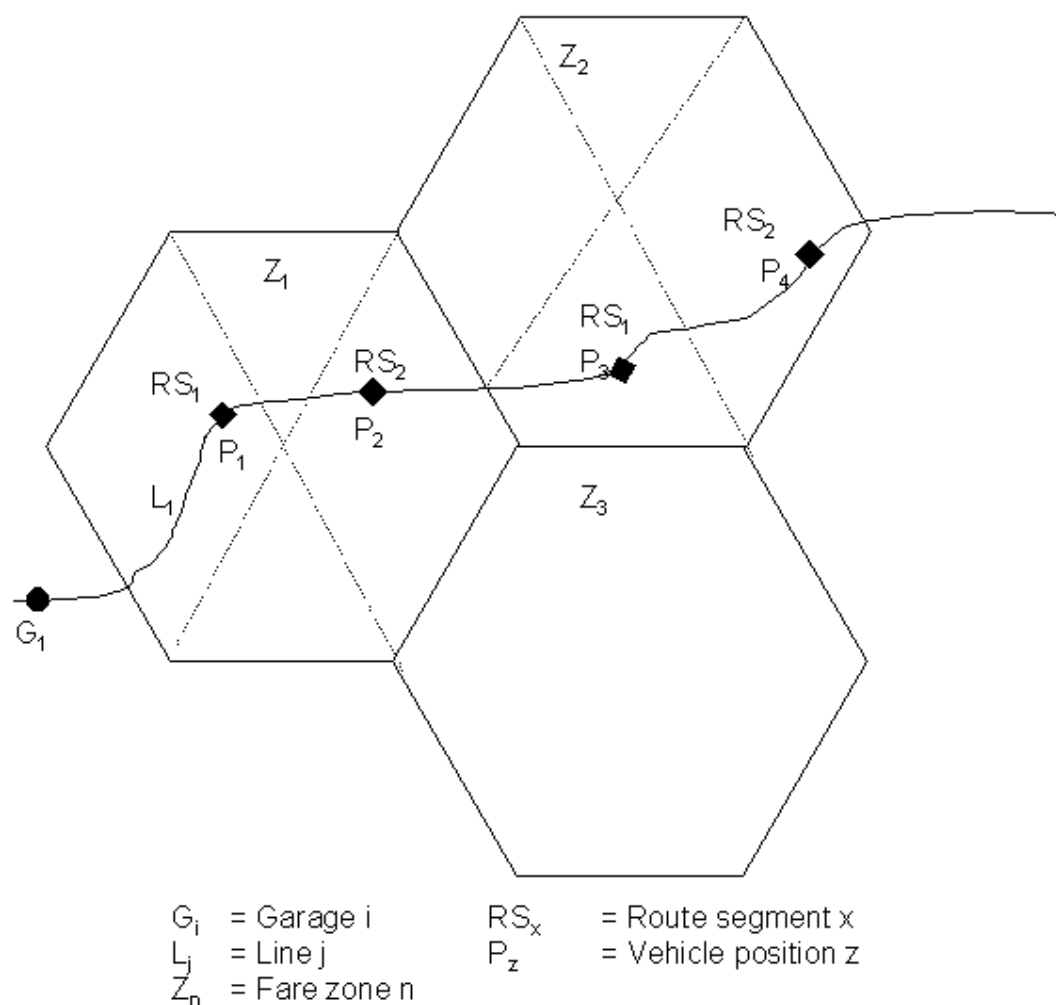


Figure 6 — Fare terms and related identifiers and numbers

Table 1 — Contents of the objects at the different vehicle positions p_x

Positions	P_1	P_2	P_3	P_4
Fare zone	Z_1	Z_1	Z_2	Z_2
Route segment	RS_1	RS_2	RS_1	RS_2
Previous fare zone	-	-	Z_1	Z_1
Previous route segment	-	RS_1	RS_2	RS_1

4 Abbreviations

4.1

AAS

Acoustic Announcement System

System that controls the acoustic announcements on a vehicle.

4.2

CAN

Controller Area Network

Data link layer protocol for serial communication as specified in ISO 11898-1.

4.3

CiA

CAN in Automation

International users and manufacturers group promoting CAN.

4.4

COB

Communication Object

Data transportation unit in a CAN network mapped to one or more CAN frames.

4.5

COB-ID

COB Identifier

Identifies a COB uniquely in a network and determines the priority of that COB in the network.

4.6

DRCC

Data Radio Communication Control

Controls data radio transmission between vehicle and central station.

4.7

DSRC

Dedicated Short Range Communication

Controls radio or infrared short distance communicator.

4.8

GIF

Graphics Interchange Format

The data stream-oriented file format maintained by CompuServe, defines the transmission protocol of bitmap data.

4.9

HMI

Human Machine Interface

Device providing input and/or output capability for human users.

4.10

IAM

IBIS Application Manager

Main on-board computer controlling the IBIS system.

4.11

IBIS

Integrated Board information system

Integrated on-vehicle information system for passengers and drivers.

4.12**JPEG**

Joint Photographic Experts Group

The best known standard from JPEG is ISO 10918-1, which is the first of the multi-part set of standards for still image compression.

4.13**PDO**

Process Data Object

Unconfirmed COB containing process data and mapped to one CAN data frame.

4.14**rffu**

Reserved for future use

Place holder for future definitions

4.15**RPDO**

Receive PDO

PDO received by one node or several nodes depending on the configuration.

4.16**SDO**

Service Data Object (SDO)

Confirmed and Optionally segmented COB providing peer-to-peer communication with access to the Object Dictionary of a device.

4.17**SRCR**

Short Range Command Radio

SRCR is a radio short distance command communication link

4.18**TPDO**

Transmit PDO

PDO transmitted by one node.

4.19**UTC**

Universal Time Coordinated (UTC)

International time base previously known as GMT.

4.20**VRCC**

Voice Radio Communication Control

Controls voice radio transmission between vehicle and central station.

4.21**XML**

Extensible Markup Language

Formatting language for text (<http://www.w3.org/TR/2000/WD-xml-2e-20000814>).

5 Hardware preferences

5.1 General

This clause defines the hardware preferences for CANopen network implementations.

5.2 Physical layer

The definitions given in EN 13149-4 and EN 13149-5 shall be used in CANopen networks for devices compliant to this application profile.

5.2.1 Bit rates

See EN 13149-4.

5.2.2 Bus connector

See EN 13149-5 and CiA DR 303-1:2002 "Cabling and connector pin assignment (version 1.1)".

5.2.3 Bus cable

See EN 13149-5 and CiA DR 303-1:2002 "Cabling and connector pin assignment (version 1.1)".

6 Data modelling

6.1 General

Application objects should use a standardized structure. Different application objects use the following data definitions. Most of the data may be transmitted within a single PDO. In case of an object with a length of more than 8 byte, SDO communication is used.

6.2 Large data

The transfer of texts and other data (e.g. bitmaps) longer than 8 byte requires a segmented transfer performed by SDO. As the transporting of the SDOs is done through a peer-to-peer connection, it is not possible to supply all devices with the text simultaneously.

The following procedure is determined:

- Texts and other data to be stored may be sent to the equipment at any time using SDO service.
- Each text or data has a system-wide, definite reference number, which is sent within the SDO.
- Devices may also request text and data (by SDO).
- The texts and data may be clearly addressed via the reference number.
- Using a PDO, which contains a reference number the devices (respective indicators) should be requested to display a text.

6.3 Text structure

6.3.1 General

Texts may be stored (and transferred) in two different formats: plain text and XML formatted text.

6.3.2 Plain text

This format will be used to store and transfer plain text without any specific control characters. It is usual to control old style displays or to store the names of stations.

6.3.3 XML formatted text

The standard permit to convey XML formatted text. The content is considered as user defined.

6.3.3.1 Referenced text

To be specified

6.3.3.2 Referenced CANopen objects

To be specified

6.3.3.3 Call-up parameter

To be specified

7 Virtual device profiles

7.1 General

The main approach of this application profile specification is the definition of virtual devices and their application objects. A physical device consists of one or more virtual devices. A virtual device shall not be distributed to several physical devices. Each virtual device supports a set of mandatory objects and should implement additionally a variable set of optional objects. Physical devices will not be defined, because they should implement multiple functions.

The virtual device implements different application objects, some shall be supported (**M**andatory) and some should be supported (**O**ptional). In the virtual device description, the access attribute is defined, indicating if an application object is read only (ro), read/write (rw) or write only (wo). Read only indicates that this shall not be written via the bus; read/write allows to read and to write this object; and write only means that this application object shall be not read via the bus.

7.2 Main on-board computer

Main on-board computer controls and supervises the on-vehicle information system application.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	Virtual_device_events	M	wo
6002 _h	Main_onboard_computer_events	M	ro
6100 _h	Vehicle_ID	O	ro
6101 _h	body_ID	O	ro
6102 _h	Garage_ID	O	ro
6103 _h	radio_ID	O	ro
6104 _h	Vehicle_class	O	ro
6105 _h	number_of_vehicle_units	O	ro
6106 _h	driver_schedule_number	O	ro
6107 _h	route_destination_ID	O	ro
6108 _h	journey_direction	M	ro
6109 _h	stop_point_ID	M	ro
610A _h	number_of_running_in_route_representation	M	ro
610B _h	line_short_representation	M	ro
610C _h	text_line/route_description	O	ro
610D _h	text_of_destination	O	ro
610E _h	local_time_and_date	M	ro
610F _h	time_standby	O	ro
6110 _h	route_segment_number	M	ro
6111 _h	fare_zone	M	ro
6112 _h	text_of_stop_point	O	ro
6113 _h	previous_route_segment	O	ro
6114 _h	previous_fare_zone	O	ro
6115 _h	scheduled_time_and_date	O	ro
6116 _h	blocking_of_ticket_canceller	M	ro
6117 _h	traffic_light_prioitiy_request	O	ro
6118 _h	stop_point_short_representation	M	ro
6119 _h	Inside_temperature	O	ro
611A _h	car_mileage	O	ro
611B _h	car_mileage_calibration_information	O	ro
611C _h	Vehicle_ID_text	O	ro
611D _h	body_ID_text	O	ro
611E _h	Garage_ID_text	O	ro
611F _h	radio_ID_text	O	ro
6120 _h	stop_point_ID_text	O	ro
6121 _h	route_destination_ID_text	O	ro
6122 _h	Driver_schedule_number_text	O	ro
6123 _h	vehicle_speed	O	ro

Index	Name	Cat.	Access
6190 _h	Driver_ID	M	wo
6191 _h	destination_number	M	wo
6192 _h	line_ID	M	wo
6193 _h	route_number	M	wo
6194 _h	block_ID	M	wo
6195 _h	journey_number	M	wo
6196 _h	line_ID_text	O	ro ¹
6197 _h	block_ID_text	O	ro ¹
6198 _h	Driver_ID_text	O	ro ¹
6204 _h	bus_stop_request	M	ro
6481 _h	Wheel_based_vehicle_speed	O	wo
6482 _h	vehicle_mileage	O	wo
6483 _h	vehicle_mileage_precision	O	wo
6484 _h	drive_flag_and_direction_flag	O	wo
6486 _h	compass_bearing	O	wo
6487 _h	compass_bearing_precision	O	wo
6488 _h	state_of_doors	O	wo
6489 _h	ambient_air_temperature	O	wo
6520 _h	tachograph_speed	O	wo
6552 _h	high_resolution_vehicle_distance	O	wo
6660 _h	Position	O	wo
6661 _h	position_precision	O	wo
6662 _h	GPS_based_speed	O	wo
6663 _h	GPS_based_heading	O	wo
6664 _h	GPS_mileage	O	wo
6665 _h	GPS_mileage_precision	O	wo
6680 _h	time_universal_reference	O	wo
6720 _h	passenger_counting_manager_data	O	wo
6721 _h	total_in/out_passenger_counting_value	O	wo
6722 _h	counter_passenger_sum	O	wo
6723 _h	passenger_capacity_use	O	wo
6740 _h	Short_diagnostic_error_field	M	wo
6741 _h	extended_diagnostic_message_file	O	wo
6742 _h	error_class_1	O	wo
6743 _h	error_class_2	O	wo
6744 _h	error_class_3	O	wo

¹ In some cases the identification device should have the access type ,ro' and the main on-board computer ,wo' and ,rw'.

7.3 Identification

The identification device provides daily identification and numbering objects.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6190 _h	driver_ID	M	ro
6191 _h	destination_number	M	ro
6192 _h	line_ID	M	ro
6193 _h	route_number	M	ro
6194 _h	block_ID	M	ro
6195 _h	journey_number	M	ro
6196 _h	line_ID_text	O	wo ¹
6197 _h	block_ID_text	O	wo ¹
6198 _h	driver_ID_text	O	wo ¹

¹ In some cases the identification device should have the access type ,ro' and the main on-board computer ,wo' and ,rw'.

7.4 Passenger information

Passenger information device displays data.

class	1	destination indicator
	2	next stop indicator
	3	information indicator
subclass	1	Simple
	2	Text
	3	Graphics
	4	Extended

Assignment of objects to class and subclass:

Index	Name	class	1	1	1	1	2	2	2	2	3	3	3	3	Cat.
		subclass	1	2	3	4	1	2	3	4	1	2	3	4	
6001 _h	virtual_device_events		O	O	O	O	O	O	O	O	O	O	O	O	ro
6002 _h	main_onboard_computer_events		O	O	O	O	O	O	O	O	O	O	O	O	wo
6101 _h	body_ID		-	O	O	O	-	O	O	O	-	O	O	O	wo
6109 _h	stop_point_ID		-	-	-	O	M	M	M	M	M	M	M	M	wo
610B _h	line_short_representation		-	O	M	M	M	M	M	M	M	M	M	M	wo
610C _h	text_line/route_description		O	O	O	O	-	-	-	-	O	M	O	O	wo
610D _h	text_of_destination		-	M	O	O	-	O	O	O	-	M	O	O	wo
610E _h	local_time_and_date		-	-	-	O	-	-	-	O	-	-	-	O	wo
6110 _h	route_segment_number		M	M	M	M	-	-	-	-	M	M	M	M	wo
6112 _h	text_of_stop_point		-	O	O	O	-	M	O	O	-	M	O	O	wo
6119 _h	inside_temperature		-	-	-	O	-	-	-	O	-	O	O	O	wo
611D _h	body_ID_text		-	O	O	O	-	O	O	O	-	O	O	O	wo
6120 _h	stop_point_ID_text		-	-	-	O	M	M	M	M	M	M	M	M	wo
6121 _h	route_destination_ID_text		O	O	O	O	O	O	O	O	O	O	O	O	wo
6123 _h	vehicle_speed		-	-	-	O	-	-	-	O	-	O	O	O	wo
6191 _h	destination_number		M	M	M	M	M	M	M	M	M	M	M	M	wo
6192 _h	line_ID		O	M	M	M	O	M	M	M	M	M	M	M	wo
6193 _h	route_number		M	M	M	M	M	M	M	M	M	M	M	M	wo
6196 _h	line_ID_text		O	M	M	M	O	M	M	M	M	M	M	M	wo
6200 _h	XML_text		O	O	O	O	O	O	O	O	O	O	O	M	rw
6201 _h	special_character_files		-	O	O	O	O	O	O	O	O	O	O	O	rw
6202 _h	referenced_files_for_XML_files		O	O	O	O	O	O	O	O	O	O	O	M	rw
6203 _h	display_mapping		M	M	M	M	M	M	M	M	M	M	M	M	rw
6204 _h	bus_stop_request		-	-	-	-	-	O	O	O	O	O	O	O	wo
6205 _h	character_set		-	-	-	-	-	O	O	O	O	O	O	O	wo
6481 _h	wheel_based_vehicle_speed		-	-	-	O	-	-	-	O	-	O	O	O	wo
6488 _h	state_of_doors		-	-	-	O	-	-	-	O	-	O	O	O	wo
6489 _h	Ambient_air_temperature		-	-	-	O	-	-	-	O	-	O	O	O	wo
6520 _h	tachograph_speed		-	-	-	O	-	-	-	O	-	O	O	O	wo
6662 _h	GPS_based_speed		-	-	-	O	-	-	-	O	-	O	O	O	wo
6740 _h	Short_diagnostic_message_field		-	-	-	-	-	-	-	-	O	O	O	O	wo
6741 _h	extended_diagnostic_message_file		-	-	-	-	-	-	-	-	O	O	O	O	wo

Index	Name	class	1	1	1	1	2	2	2	2	3	3	3	3	Cat.
		subclass	1	2	3	4	1	2	3	4	1	2	3	4	
6742 _h	error_class_1		-	-	-	-	-	-	-	-	O	O	O	O	wo
6743 _h	error_class_2		-	-	-	-	-	-	-	-	O	O	O	O	wo
6743 _h	error_class_3		-	-	-	-	-	-	-	-	O	O	O	O	wo

7.5 Ticket canceller

Ticket canceller device cancels tickets.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	virtual_device_events	O	ro
6002 _h	main_onboard_computer_events	O	wo
6100 _h	vehicle_ID	O	wo
6105 _h	number_of_vehicle_units	O	wo
6108 _h	journey_direction	M	wo
6109 _h	stop_point_ID	M	wo
610A _h	number_of_running_in_line_representation	O	wo
610B _h	line_short_representation	O	wo
610E _h	local_time_and_date	M	wo
6110 _h	route_segment_number	M	wo
6111 _h	fare_zone	M	wo
6112 _h	text_of_stop_point	O	wo
6116 _h	blocking_of_ticket_canceller	O	wo
6118 _h	stop_point_short_representation	O	wo
611C _h	vehicle_ID_text	O	wo
6120 _h	stop_point_ID_text	M	wo
6191 _h	destination_number	M	wo
6192 _h	line_ID	M	wo
6193 _h	route_number	O	wo
6194 _h	block_ID	M	wo

7.6 Ticket printer

Ticket printer device prints tickets.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6100 _h	vehicle_ID	O	wo
6108 _h	journey_direction	M	wo
6109 _h	stop_point_ID	M	wo
610A _h	number_of_running_in_route_representation	O	wo
610B _h	line_short_representation	O	wo
610C _h	text_line/route_description	O	wo
610E _h	local_time_and_date	M	wo
6110 _h	route_segment_number	M	wo
6111 _h	fare_zone	M	wo
6112 _h	text_of_stop_point	M	wo
6116 _h	blocking_of_ticket_canceller	O	wo
6118 _h	stop_point_short_representation	O	wo
611C _h	vehicle_ID_text	O	wo
6120 _h	stop_point_ID_text	M	wo
6191 _h	destination_number	M	wo
6192 _h	line_ID	M	wo
6193 _h	route_number	M	wo
6194 _h	block_ID	M	wo
6196 _h	line_ID_text	M	wo
6197 _h	block_ID_text	O	wo
6740 _h	short_diagnostic_message_field	M	wo
6741 _h	extended_diagnostic_message_file	O	wo
6742 _h	error_class_1	O	wo
6743 _h	error_class_2	O	wo
6744 _h	error_class_3	O	wo

7.7 Ticket/card reader/validator

Ticket/card reader/validator device reads and/or validates the ticket.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.8 Acoustic announcer

Acoustic announcement device is used for voice announcement to passengers, in particular to announce next stop point or current stop point. It should provide for indoor and outdoor loud-speakers.

Object 6109_h shall be used to trigger the announcement.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6109 _h	stop_point_ID	M	wo
6120 _h	stop_point_ID_text	O	wo

7.9 Acoustic control manager

Acoustic control manager controls the AAS/Intercom sub-system.

Simple acoustic passenger information system consists only of a digital acoustic announcer and a power amplifier. The main on-board computer triggers an announcement with writing to object 6109_h of the acoustic announcement virtual device. All other functions are realised in hardware.

In more powerful systems, the main on-board computer is able to control the AAS sub-system with object 6001_h. For example, the driver wants to make a manually controlled announcement to speak to passengers via microphone and loudspeakers. He pushes the related button on the panel (driver's console keyboard). The driver's console display device sends a corresponding event to the main on-board computer. The main on-board computer translates this request in a command for the acoustic control manager to realise a manually controlled driver's announcement (that means to switch the audio paths in the hardware).

Complex systems provide passenger driver intercommunication additionally to manually controlled and pre-recorded (digitised and analogue) announcements. Such systems consist of more than one device, distributed over a train or a bus. One device (acoustic control manager) controls the other devices (acoustic control units). The interaction between Acoustic Control Manager and Acoustic Control Units is manufacturer-specific. That is why this standard defines only the interface between the main on-board computer and the acoustic control manager. The

communication between Acoustic Control Manager and Acoustic Control Units should be established with objects in the area 2000_h – 5FFF_h (Manufacturer Specific Profile Area).

The object 6001_h may be used to switch audio paths in an AAS sub-system on or off by the main on-board computer.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	virtual_device_events	O	ro
6002 _h	main_onboard_computer_events	O	wo

7.10 Train bus gateway

The train bus gateway virtual device is user-transparent. It may consume application objects from all connected devices by means of RPDO and SDO services. Additionally, the train bus gateway virtual device may implement virtual devices that are remotely connected in order to produce the corresponding application objects.

class	0	not used
subclass	0	not used

7.11 Vehicle gateway

Vehicle gateway device is used for interaction to other in-vehicle networks. Mainly it performs the logical information exchange between the driver's working place (vehicle driver indicator virtual device), drivetrain (e.g. engine, brake and gearbox), bodytrain (e.g. door control units), and multiplex-train (e.g. sensors, lamps and switches). The tachograph virtual device will be very often implemented together with the vehicle gateway in one physical device.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
610E _h	local_time_date	O	ro
6481 _h	wheel_based_vehicle_speed	O	ro
6482 _h	vehicle_mileage	O	ro
6483 _h	vehicle_mileage_precision	O	ro
6484 _h	drive_flag_and_direction_flag	O	ro
6486 _h	compass_bearing	O	ro
6487 _h	compass_bearing_precision	O	ro
6488 _h	state_of_doors	O	ro
6489 _h	ambient_air_temperature	O	ro
648A _h	fuel_economy	O	ro
648B _h	brake_switch	O	ro
648C _h	engine_coolant_temperature	O	ro
648D _h	operation_times	O	ro

7.12 Vehicle driver indicator

Vehicle driver indicator device is used for interaction to the vehicle driver.

Class (C)	1	Display only
	2	Display with keyboard
subclass	0	not used

Assignment of objects to class and subclass:

Index	Name	Cat. C1	Cat. C2	Access
610E _h	local_time_and_date	O	M	wo
6488 _h	state_of_doors	O	O	wo
6489 _h	ambient_air_temperature	O	O	wo
648A _h	fuel_economy	O	O	wo
648B _h	brake_switch	O	O	wo
648C _h	engine_coolant_temperature	O	O	wo
648C _h	operation_times	O	O	wo
6740 _h	short_diagnostic_error_field	O	O	wo

7.13 Tachograph

Tachograph device provides data as specified in ISO 16844. The Tachograph itself should be a Modular Tachograph chart unit (MTCO), a Tachograph Simulation Unit (TSU) or a Digital Tachograph (DTCO). The Tachograph virtual device will usually be implemented together with the vehicle gateway virtual device.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6190 _h	driver_ID	M	wo
6520 _h	tachograph_speed	M	ro
6521 _h	drive_recognition_and_direction_indication	M	ro
6522 _h	high_resolution_vehicle_distance	M	ro
6523 _h	tachograph_time_and_date	O	ro
6524 _h	tachograph_driver_ID	M	ro
6525 _h	continuous_driving_time	M	ro

7.14 Data radio communication controller (DRCC)

DRCC device controls data radio communication between vehicle and central station.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.15 Voice radio communication controller (VRCC)

VRCC device controls voice radio communication between vehicle and central station.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.16 Dedicated Short Range Communication (DSRC) device

A radio, or infrared short distance communication link. DSRC device receives and transmits wireless data between vehicle and the non-vehicle unit located e.g. at a depot refuelling station, at a depot entrance, or at a specific location at the roadside.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.17 Geographical positioning device

Geographical positioning device provides accurate geographical position derived from the Global Positioning System (GPS).

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6660 _h	position	M	ro
6661 _h	position_precision	O	ro
6662 _h	GPS_based_speed	O	ro
6663 _h	GPS_based_heading	O	ro
6664 _h	GPS_mileage	M	ro
6665 _h	GPS_mileage_precision	O	ro

7.18 Time fixing device

Time fixing device provides accurate time (UTC).

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6660 _h	position	M	wo
6680 _h	time_universal_reference	M	ro

7.19 Driver's console display

Driver's console display device is used for displaying information.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.20 Driver's console keyboard

Driver's console keyboard provides push button, keyboard and other digital input capability.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
66C0 _h	Flag direction forward selection	O	ro
6760 _h	digital input	M	ro

7.21 Passenger counter

Passenger counter is used for the counting process of the door area by an open door request.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	virtual_device_events	O	ro
6002 _h	main_onboard_computer_events	O	wo
6488 _h	state_of_doors	O	wo
6700 _h	passenger_counting_in_and_out_per_door	M	ro

7.22 Passenger counting manager

Passenger counting manager device is used for data collection processing. Once the counting process has been completed at a stopping point, the counting values from all doors will be transferred to the managing unit where they are summarized and concatenated with the line information and be stored afterwards:

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	virtual_device_events	M	ro
6002 _h	main_onboard_computer_events	M	wo
6100 _h	vehicle_ID	O	wo
6108 _h	journey_direction	M	wo
6109 _h	stop_point_ID	M	wo
610E _h	local_time_and_date	M	wo
6191 _h	destination_number	M	wo
6192 _h	line_ID	M	wo
6193 _h	route_number	M	wo
6488 _h	state_of_doors	O	wo
6700 _h	passenger_counting_in_and_out_per_door	M	wo
6720 _h	passenger_counting_manager_data	O	ro
6721 _h	total_in/out_passenger_counting_value	M	ro
6722 _h	counter_passenger_sum	M	ro
6723 _h	passenger_capacity_usage	O	ro

7.23 Diagnostics device

Diagnostics device manages and provides diagnostic information.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6001 _h	virtual_device_events	M	ro
610E _h	local_time_and_date	M	wo
6660 _h	position	O	wo
6740 _h	short_diagnostic_error_field	M	ro
6741 _h	extended_diagnostic_message_file	O	ro
6742 _h	error_class_1	O	ro
6743 _h	error_class_2	O	ro
6744 _h	error_class_3	O	ro

7.24 Generic I/O device

Generic I/O device provides simple digital and analogue I/O functionality in accordance with /4/.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
6760 _h	digital_input	O	ro
6761 _h	digital_output	O	rw
6762 _h	analogue_input	O	ro
6763 _h	analogue_output	O	rw

7.25 Power supply

Power supply device supplies power for the passenger information modules.

class	0	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

7.26 Short range command radio (SRCR) device

SRCR is a radio short distance command communication link. SRCR device primarily receives messages (commands) from the non-vehicle unit located in the hand of a blind or visually impaired person. This communication link may also be used for communication between a vehicle and a Non-interactive dynamic passenger information on ground or at a traffic cross light control.

class	1	not used
subclass	0	not used

All objects used by this virtual device are listed as follows:

Index	Name	Cat.	Access
rffu	rffu	rffu	rffu

8 Error handling

8.1 General

This clause defines the error handling in a CANopen environment.

8.2 Principle

Emergency messages shall be triggered by internal errors in the device and they are assigned the highest possible priority to ensure that they get access to the bus without latency. By default, the Emergency Messages shall contain the error field with pre-defined numbers and additional information.

8.3 Error behaviour

If a serious device failure is detected the module shall enter by default autonomously the pre-operational state. If object 1029_h is implemented, the device may be configured to enter alternatively the stopped state or remain in the current state in case of a device failure. Device failures shall include the following communication errors:

- Bus-off conditions of the CAN interface
- Life guarding event with the state 'occurred'
- Heartbeat event with state 'occurred'

Serious device errors also may be caused by device internal failures.

8.4 Additional error codes

In addition to the Emergency message error codes specified in CiA DS 301:2002 "CANopen application layer and communication profile (version 4.02)", the following error codes should be used for this application profile.

Error code	Meaning
2110 _h	Short circuit
2310 _h	Current at outputs too high (overload)
2320 _h	Short circuit at outputs
2330 _h	Load dump at outputs
3110 _h	Supply voltage too high
3120 _h	Supply voltage too low
3210 _h	Internal voltage too high
3220 _h	Internal voltage too low
3310 _h	Output voltage too high
3320 _h	Output voltage too low
3330 _h	Output voltage missing
FF01 _h	Out of paper (ticket printer)
FF02 _h	No signal (GPS, time fixing)
FF03 _h	No radio connection (DRCC, VRCC, DSRC and SRCR)
FF04 _h	Requested display mapping format not supported (display and ticket printer)
FF05 _h	No announcements available (Acoustic announcement)

9 Predefinitions

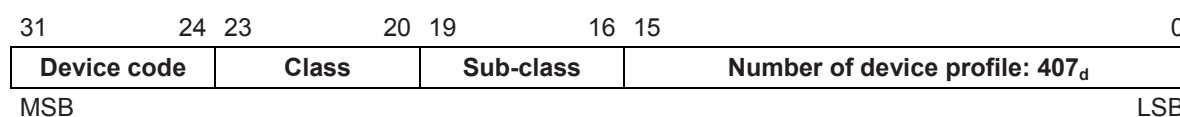
9.1 Predefined communication objects

9.1.1 General

This sub-clause defines de predefined communication objects.

9.1.2 Object 1000_n: Device type

The object at index 1000h describes the type of device and its functionality.



If the device implements only one virtual device, the additional information contains the virtual device code (8 bit), the device class code (4 bit), and the device subclass code (4 bit).

If the device code is '0', the physical device is supporting more than only one virtual device. In this case, the object 6000h contains the codes of the all supported virtual devices.

Codes of virtual device:

Code	Function	class/subclass
00 _h	Multiple virtual device	-
01 _h	Main on-board computer	No
02 _h	Identification	No
03 _h	Passenger information	Yes
04 _h	Ticket canceller	No
05 _h	Ticket printer	No
06 _h	Ticket/card reader/validators	No
07 _h	Acoustic announcement	No
08 _h	Acoustic control manager	No
09 _h	Train bus gateway	No
0A _h	Vehicle gateway	No
0B _h	Vehicle driver information	No
0C _h	Tachograph	No
0D _h	Data radio communication control (DRCC)	No
0E _h	Voice radio communication control (VRCC)	No
0F _h	Data short range communication (DSRC)	No
10 _h	Geographical positioning	No
11 _h	Time fixing	No
12 _h	Driver's console display	Yes
13 _h	Driver's console keyboard	No
14 _h	Passenger counting	Yes
15 _h	Passenger counting manager	Yes
16 _h	Diagnostics device	No
17 _h	Generic I/O device	No
18 _h	Power supply	No
19 _h	Short range command radio (SRCR)	No
1A _h ..FF _h	Reserved	-

9.1.3 Object 1001_h: Error register

The device profile specific bit in the error register is reserved for future use.

9.1.4 Object 1029_h: Error behavior

This object specifies to which state the device shall be set, when a communication error or an in-vehicle network error is detected. Besides the specification given in EN 50325-4 the following sub-indexes may be implemented. If the object is not implemented the device shall behave as the default values define.

00_h = pre-operational (only if current state is operational)

01_h = no state change

02_h = stopped

Object description

See EN 50325-4.

Entry description

Sub-Index	02 _h
Description	internal_device_error
Access	rw
Entry Category	Optional
PDO Mapping	No
Value Range	00 _h to 02 _h
Default Value	00 _h

9.2 Pre-defined configurations

9.2.1 General

This sub-clause describes the pre-defined configurations.

9.2.2 Minimum configuration

The minimum configuration includes the following devices:

- Main on-board computer (virtual device code 01_h)
- Identification device (virtual device code 02_h)
- Passenger information (virtual device code 03_h)
 - class 1: Destination indicator
 - subclass 2: text
- Ticket canceller (virtual device code 04_h)

9.2.3 Typical configuration

The typical configuration includes following devices:

- Main on-board computer (virtual device code 01_h)
- Identification device (virtual device code 02_h)
- Passenger information (virtual device code 03_h)
 - class 1: Destination indicator
 - subclass 2: text
- Passenger information (virtual device code 03_h)
 - class 2: Next stop indicator
 - subclass 2: text
- Ticket canceller (virtual device code 04_h)
- Ticket printer (virtual device code 05_h)

9.3 Pre-defined PDOs

Table 2 shows the PDOs for minimum configuration (shaded fields) and for typical configuration (all fields). The TPDO1 of the main on-board computer is received as RPDO1 by the ticket canceller in the minimal configuration; in the typical configuration, the TPDO1 of the main on-board computer is also received by the ticket printer as RPDO1.

The PDOs shall be transmitted once after reaching the NMT operational state and after that each change of value shall cause transmission. Event timer and inhibit timer of all TPDOs shall be 0_d except the event timer of TPDO_1 of the main on-board computer device (default value = 1 min). The transmission type of all TPDOs and RPDOs shall be 255_d. Main on-board computer and identification device shall reside on different physical devices; they are not required to reside on the same node as the NMT master.

Table 2 — PDOs for minimum and typical configurations

Message No.	CAN-ID	Main on-board comp. (01 _h)	Identification (02 _h)	Destination indicator (03 _h :01 _h :02 _h)	Next stop indicator (03 _h :02 _h :02 _h)	Ticket canceller (04 _h)	Ticket printer (05 _h)
1	181 _h	TPDO1	-	-	-	RPDO1	RPDO1
2	381 _h	TPDO2	-	RPDO2	-	RPDO2	RPDO2
3	401 _h	TPDO3	-	-	RPDO4	-	RPDO4
4	481 _h	TPDO4	-	-	-	-	RPDO5
5	501 _h	TPDO5	-	-	-	-	RPDO6
6	201 _h	RPDO2	TPDO1	-	-	-	-
7	281 _h	RPDO3	TPDO2	RPDO3	-	RPDO3	RPDO3
8	301 _h	RPDO1	TPDO3	RPDO1	-	-	-

Table 3 — PDO mappings for minimum (shaded objects) and typical configurations (all objects)

Message No.	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
1	610E:01 _h year	610E:02 _h day	610E:03 _h month	610E:04 _h hour	610E:05 _h minute	610E:06 _h second	not transmitted	
2	6110:00 _h route_segment_number		6111:00 _h fare_zone	6116:00 _h blocking_of_ticket_canceller	6108:00 _h journey_direction	610A:00h number_of_running_in_route_representation	not transmitted	
3	6109:00 _h stop_point_ID				6002:00 _h events_for_virtual_devices			
4	610B:01-08 _h line_short_representation							
5	6118:01-08 _h stop_point_short_representation							
6	6190:00 _h driver_ID				Not transmitted			
7	6194:00 _h block_ID				6192:00 _h line_ID		6195:00 _h journey_number	
8	6191:00 _h destination_number				6193:00 _h route_number		not transmitted	

9.4 Operator-specific configuration

Operator-specific configuration may include any virtual device specified in this application profile as well as any generic CANopen devices.

The NMT master shall configure generic CANopen devices before they are switched into NMT operational state in order to avoid inconsistencies regarding PDO communication and mapping parameters; alternatively the user should integrate off-line pre-configured devices.

10 Object dictionary overview

Each physical device compliant with this application profile specification shall share the object dictionary entries from 6000_h to 67FF_h. These entries are common to all modules and each module only implements those objects relevant to its functions (virtual device).

The application objects are grouped so that index ranges are belonging to virtual devices.

Index range	Object providing devices
6000 _h – 60FF _h	Physical device
6100 _h – 618F _h	Main on-board computer
6190 _h – 61FF _h	Identification
6200 _h – 62FF _h	Passenger information
6300 _h – 631F _h	Ticketing canceller
6320 _h – 633F _h	Ticket printer
6340 _h – 635F _h	Ticket/card reader/validators
6380 _h – 63AF _h	Acoustic announcer
63B0 _h – 63CF _h	Acoustic control manager
6400 _h – 647F _h	Train bus gateway
6480 _h – 64FF _h	Vehicle gateway
6500 _h – 651F _h	Vehicle driver indicator
6520 _h – 657F _h	Tachograph
6600 _h – 661F _h	DRCC
6620 _h – 663F _h	VRCC
6640 _h – 665F _h	DSRC
6660 _h – 667F _h	Geographical positioning
6680 _h – 669F _h	Time fixing
66A0 _h – 66BF _h	Driver's console display
66C0 _h – 66DF _h	Driver's console keyboard
6700 _h – 671F _h	Passenger counting
6720 _h – 673F _h	Passenger counting manager
6740 _h – 675F _h	Diagnostics device
6760 _h – 677F _h	Generic I/O device
6780 _h – 679F _h	Power supply
67A0 _h – 67BF _h	SRCC
67FF _h	Device type object (see EN 50325-4)
7000 _h – 9FFF _h	reserved for future