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Road vehicles — Extended Vehicle (ExVe) time critical applications — General requirements, definitions and classification methodology of timeconstrained situations related to Road and ExVe Safety (RExVeS)

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National foreword

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Road vehicles — Extended Vehicle (ExVe) time critical applications — General requirements, definitions and classification methodology of time-constrained situations related to Road and ExVe Safety (RExVeS)

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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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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

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.

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Introduction

Preventing death and serious injury in road traffic crashes is a global priority. With the advent of vehicular data communications, road vehicles become connected vehicles, and safety is one of the key issues in the development of such road vehicles. ISO 26262-1 defines the vehicle safety as the absence of unreasonable risks that arise from malfunctions of the E/E system. The absence of unreasonable risk due to these potentially hazardous behaviours related to specific limitations (identified in ISO/PAS 21448[7]) is defined as the safety of the intended functionality (SOTIF). Functional safety (addressed by the ISO 26262 series) and SOTIF are distinct and complementary aspects of safety.

This document defines a complementary methodology for the prioritization of safety-related external communication use-cases to help to design extended vehicle time-critical interfaces described in the ISO 20077-1.

NOTE 1 ISO 20077-1 defines the concepts and terms related to the extended vehicle (ExVe), whereas ISO 20077-2 specifies general rules and basic principles that the manufacturer of the ExVe considers when elaborating its own design method.

NOTE 2 ISO 20077-1 defines an "extended vehicle" (ExVe) as an "entity, still in accordance with the specifications of the vehicle manufacturer, that extends beyond the physical boundaries of the road vehicle and consists of the road vehicle, off-board systems, external interfaces, and the data communication between the road vehicle and the off-board systems". Road vehicles without off-board systems and road vehicles equipped with telematics units are extended vehicles.

Recent developments in the field of connected vehicles, in various parts of the world, bring hope of being able to improve road safety, e.g. by reducing the number of road fatalities through collision avoidance cooperation. Connected vehicles taking into account ISO 20077-1 and ISO 20077-2 take their part in this global effort.

Due to the limited per design embedded resources, a priority management is necessary to apply these resources to the function and request with the highest criticality.

For these connected vehicles, the use of the “ExVe time critical interfaces" is firstly associated with safety-critical functions (e.g. emergency braking, steering) that are functions for which the priorities are based on a criticality concept.

It is important that all the functions using the “ExVe time critical interfaces” take into account the capabilities of the vehicles in which they are installed.

During the design phase, the connected vehicle behaviour regarding all safety-critical situations and its interactions with the external environment should be defined. Its implementation can be based on the methodology proposed in this document.

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Road vehicles — Extended Vehicle (ExVe) time critical applications — General requirements, definitions and classification methodology of time-constrained situations related to Road and ExVe Safety (RExVeS)

1 Scope

This document defines the classification methodology of time-constrained situations and their requirements, that are to be addressed by the “ExVe time critical interfaces" described in ISO 20077-1. Time-constrained situations include safety-critical situations.

It is important for the design of the vehicle to have priority management of "ExVe time critical interface" resources in order to comply with time constrained situations requirements.

The methodology provides a classification, which determines application priorities for optimal vehicle resource allocation.

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 20077-1, *Road Vehicles — Extended vehicle (ExVe) methodology — Part 1: General information*

ISO 20077-2, *Road Vehicles — Extended vehicle (ExVe) methodology — Part 2: Methodology for designing the extended vehicle*

ISO 26262-1, *Road vehicles — Functional safety — Part 1: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20077-1, ISO 20077-2, ISO 26262-1 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
road and ExVe safety
RExVeS
set of means (e.g. use cases), conditions and requirements to be considered by the “ExVe time-critical interfaces” described in ISO 20077-1, including time-constrained and *safety-critical situations* (3.4)

Note 1 to entry: The intent is to minimise risk of harm (as described in ISO 26262-1) in road safety-related situations.

Note 2 to entry: In the context of RExVeS, a use case is a set of *scenarios* (3.2) that have a common goal.

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3.2
scenario
<RExVeS> sequence of *connected vehicle* (3.11) actions, events, reactions, and interactions, in a road safety setting

3.3
time-constrained situation
<RExVeS> combination of a road safety-related *connected vehicle* (3.11) *scenario* (3.2) and RExVeS-related time constraints, in which lack of communication capability or excessive (communication) latency can lead to malfunctions or other injurious consequences

3.4
safety-critical situation
<RExVeS> combination of a road safety-related *connected vehicle* (3.11) *scenario* (3.2) and an unacceptable risk of harm

3.5
situation priority class
<RExVeS> one of six situation priority classes (P1, P2, P3, P4, P5 or P6) determined according to the severity, the probability of exposure, and the controllability associated with an evaluated *time-constrained situation* (3.3)

3.6
safety-critical situation priority class
<RExVeS> one of the four *situation priority classes* (3.5) (P3, P4, P5 or P6) determined according to the severity, the probability of exposure, and the controllability associated with an evaluated *safety-critical situation* (3.4)

3.7
time-constrained safety-related function
<RExVeS> function under strict time constraints that contributes to the achievement of safety objectives

EXAMPLE "CAM generation" (see ETSI EN 302 637-2[1]) and "BSM generation" (see SAE J2735[2]and SAE J2945[3]). "DENM generation" (see ETSI EN 302 637-3[4]) is another example of time-constrained safety-related function.

3.8
peri-vehicular
<RExVeS> near or around a vehicle

3.9
peri-vehicular data communication
<RExVeS> vehicular data communications in the geographic vicinity of a vehicle

3.10
safety-critical situation reaction time interval
<RExVeS> time-interval from the detection of a *safety-critical situation* (3.4) to the broadcast to neighbouring road users at risk of an appropriate safety-critical message via *time-constrained safety-related functions* (3.7) and *peri-vehicular data communications* (3.9)

3.11
connected vehicle
<RExVeS> road vehicle using *peri-vehicular data communications* (3.9)

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4 Symbols and abbreviated terms

ADAS	Advanced Driver-Assistance Systems
BSM	Basic Safety Message
CAM	Cooperative Awareness Message
DENM	Decentralized Environmental Notification Message
ExVe	Extended Vehicle
RExVeS	Road and ExVe safety
TAI	International Atomic Time
UTC	Coordinated Universal Time

5 Conventions and guidelines for specifying RExVeS-related requirements

In this document, requirements are formalized as follow:

REQ	*Number*	**RExVeS** – *Name*
Description		

"Number" represents the individual requirement number.

"Name" is the name of requirement, if needed.

"Description" is the requirement itself.

Requirements in this document are generic and technology agnostic. No actual testing is to be done against them, but they should be used as a guide to define the technology-dependent requirements.

Some technology-dependent requirements may not enable to address all priority classes of RExVeS-related time-constrained situations (see 6.3.5).

Unless otherwise stated, the requirements in this document apply to all priority classes.

6 The RExVeS methodology

6.1 General

The RExVeS methodology brings forward means to identify and classify time-constrained situations (safety-critical or not) that are addressed by the "ExVe time critical interfaces" described in ISO 20077-1. The methodology provides an automotive-specific risk-based approach to determine the priority class of a RExVeS-related time-constrained situation. It is adapted from ISO 26262-3[5] hazard analysis and risk assessment (HARA) and enriched with systems-theoretic process analysis (STPA) insights. The major difference is that in ISO 26262-3[5], the results of the analysis are ASILs while in this document the results are time-constrained situation priority classes.

NOTE 1 The appropriate use of the RExVeS methodology is intended to fulfil RExVeS-related requirements and a set of connected vehicle design prerequisites (see Clause 7).

NOTE 2 Unless otherwise stated, in this document, connected vehicle means connected vehicle taking into account ISO 20077-1 and ISO 20077-2.

The RExVeS methodology starts with the analysis of road safety-related connected vehicle scenarios in which time-constrained situations (safety-critical or not) may occur. Then, a systematic evaluation

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