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Intelligent transport systems — Cooperative ITS —

Part 10: Driver distraction and information display

Systèmes intelligents de transport — Systèmes intelligents de transport coopératifs —
Partie 10: Distraction du conducteur et affichage des informations

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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 204, *Intelligent transport systems*.

ISO 17427 consists of the following parts, under the general title *Intelligent transport systems — Cooperative ITS*:

— *Part 2: Framework Overview* [Technical Report]

— *Part 3: Concept of operations (ConOps) for 'core' systems* [Technical Report]

— *Part 4: Minimum system requirements and behaviour for core systems* [Technical Report]

— *Part 6: 'Core system' risk assessment methodology* [Technical Report]

— *Part 7: Privacy aspects* [Technical Report]

— *Part 8: Liability aspects* [Technical Report]

— *Part 9: Compliance and enforcement aspects* [Technical Report]

— *Part 10: Driver distraction and information display* [Technical Report]

The following parts are under preparation:

— *Part 1: Roles and responsibilities in the context of co-operative ITS architecture(s)*

— *Part 5: Common approaches to security* [Technical Report]

— *Part 11: Compliance and enforcement aspects* [Technical Report]

— *Part 12: Release processes* [Technical Report]

— *Part 13: Use case test cases* [Technical Report]

— *Part 14: Maintenance requirements and processes* [Technical Report]

This Technical Report provides an informative 'driver distraction and information display aspects' for Cooperative Intelligent Transport Systems (*C-ITS*). It is intended to be used alongside ISO 17427-1, ISO/TR 17465-1 and other parts of ISO 17465, and ISO 21217. Detailed specifications for the application context will be provided by other ISO, CEN and SAE deliverables, and communications specifications will be provided by ISO, IEEE and ETSI.

Introduction

Intelligent transport systems (*ITS*) are transport systems in which advanced information, communication, sensor and control technologies, including the Internet, are applied to increase safety, sustainability, efficiency, and comfort.

A distinguishing feature of '*ITS*' is its communication with outside entities.

Some *ITS* systems operate autonomously, for example, 'adaptive cruise control' uses radar/lidar/ and/or video to characterize the behaviour of the vehicle in front and adjust its vehicle speed accordingly. Some *ITS* systems are informative, for example, 'Variable Message Signs' at the roadside, or transmitted into the vehicle, provide information and advice to the driver. Some *ITS* systems are semi-autonomous in that they are largely autonomous but rely on 'static' or 'broadcast' data, for example, *GNSS* (2.5) based 'SatNav' systems operate autonomously within a vehicle but are dependent on receiving data broadcast from satellites in order to calculate the location of the vehicle.

Cooperative Intelligent Transport Systems (*C-ITS*) are a group of *ITS* technologies where service provision is enabled by, or enhanced by, the use of 'live', present situation related, dynamic data/information from other entities of similar functionality [for example, from one vehicle to other vehicle(s)], and/or between different elements of the transport network, including vehicles and infrastructure [for example, from the vehicle to an infrastructure managed system or from an infrastructure managed system to vehicle(s)]. Effectively, these systems allow vehicles to 'talk' to each other and to the infrastructure. These systems have significant potential to improve the transport network.

A distinguishing feature of '*C-ITS*' is that data are used across *application*/service boundaries.

It will be immediately clear to the reader that such systems present the possibility of driver *distraction* (2.4), both through visual overload (display presentation and visual or oral provision of information and/or via instructions or advice). The purpose of this Technical Report is to identify potential critical driver distraction and information display issues that *C-ITS* service provision may introduce, to consider how to control, limit or mitigate such issues.

Existing *rules* (2.12) govern the use of technology inside vehicles to reduce driver *distraction* (2.4). This Technical Report identifies and discusses how *C-ITS applications* may fit within these existing rules and discusses whether they may raise additional risks.

This Technical Report is a 'living document' and as our experience with *C-ITS* develops, it is intended that it will be updated from time to time, as and when we see opportunities to improve this Technical Report.

Intelligent transport systems — Cooperative ITS —

Part 10:
Driver distraction and information display

1 Scope

The scope of this Technical Report is, as an informative document, to identify potential critical driver *distraction* (2.4) and information display issues that *C-ITS* service provision may introduce, to consider strategies for how to identify, control, limit or mitigate such issues. The objective of this Technical Report is to raise awareness of and consideration of such issues and to give pointers, where appropriate, to existing standards deliverables that provide specifications for all or some of these aspects. This Technical Report does not provide specifications for solutions of these issues.

Existing *rules* (2.12) govern the use of technology inside vehicles to reduce driver distraction.

NOTE The issues of driver *distraction* (2.4) and information display affect the design of all aspects of *C-ITS* service provision and are a critical factor in *C-ITS* system design and instantiation. However, while the general issues that affect *C-ITS* system design and implementation and related issues of what and how data in a *C-ITS* assisted *application service* provides and is realized and is therefore developed within ISO TC 204/CEN TC 278, most of the detailed aspects of physical presentation and human factors within the vehicle are standardized within ISO TC 22.

2 Terms and definitions

2.1
application
software application

2.2
application service
service provided by a service provider accessing data from the *IVS* (2.7) within the vehicle in the case of C-ITS, via a wireless communications network, or provided on-board the vehicle as the result of software (and potentially also hardware and firmware) installed by a service provider or to a service provider's instruction

2.3
cooperative ITS
C-ITS
group of ITS technologies where service provision is enabled, or enhanced by, the use of 'live', present situation related, data/information from other entities of similar functionality [for example, from one vehicle to other vehicle(s)], and/or between different elements of the transport network, including vehicles and infrastructure (for example, from the vehicle to an infrastructure managed system or from an infrastructure managed system to vehicle(s))

2.4
distraction
something that draws the attention of a driver away from the driving task and/or divides or confuses the attention of the driver

2.5
global navigation satellite system
GNSS
several networks of satellites that transmit radio signals containing time and distance data that can be picked up by a receiver, allowing the user to identify the location of its receiver anywhere around the globe

2.6
guideline
principle put forward to set standards or determine a course of action; usually, but not always, as a recommendation or advice without the requirement of law but adherence to published guidelines may in some circumstances become a requirement of a regulation

2.7
in-vehicle system
IVS
hardware, firmware and software on-board a vehicle that provides a platform to support C-ITS service provision, including that of the *ITS-station* (2.9) (ISO 21217), the facilities layer, data pantry and on-board 'apps'

2.8
intelligent transport systems
ITS
transport systems in which advanced information, communication, sensor and control technologies, including the Internet, are applied to increase safety, sustainability, efficiency, and comfort

2.9
ITS-station
ITS-s
entity in a communication network [comprised of *application* (2.1), facilities, networking and access layer components] that is capable of executing ITS-S application processes, comprised of an ITS-S facilities layer, *ITS-S* networking and transport layer, *ITS-S* access layer, ITS-S management entity and ITS-S security entity, which adheres to a minimum set of security principles and procedures so as to establish a level of trust between itself and other similar ITS stations with which it communicates

2.10
jurisdiction
government, road or traffic authority which makes and enforce *regulations* (2.11)

EXAMPLE Country, state, city council, road authority, government department (customs, treasury, transport), etc.

2.11
regulation
order issued by a jurisdiction having the force of law

2.12
rule
authoritative *regulation* (2.11) or direction concerning method or procedure, as for a court of law, legislative body, game, or other human institution or activity, especially any body which may exert control (e.g. an employer, a jurisdiction, a school, etc.)

3 Abbreviated terms

C-ITS cooperative intelligent transport systems, cooperative ITS

ESOP European statement of principles

IHRA International Harmonized Research Activities

ITS intelligent transport systems (2.8)

IVS in-vehicle system (2.7)

NHTSA (US) National Highways Traffic Safety Administration

TR technical report

4 How to use this Technical Report

4.1 Acknowledgements

Much of the inspiration for this Technical Report and its considerations and content originate from the reports "*Cooperative ITS Regulatory Policy Issues*" and "*Cooperative Intelligent Transport Systems Policy Paper*" National Transport Commission, Australia. This source is acknowledged and thanked.[1][17]

Contribution from the EC project AIDE is acknowledged.

Contribution from various documents made available by UN-ECE (Nations Economic Commission for Europe) WP.29 is acknowledged and including contributions from US NHTSA.

See Bibliography for further details.

4.2 Guidance

This Technical Report is designed to provide guidance and a direction for those considering the issues concerning driver distraction and information display associated with the deployment of *C-ITS* service provision. It does not purport to be a list of all potential driver *distraction* (2.4) and information display factors which will vary according to the *application* (2.1) service being provided, the regime of the *jurisdiction* (2.10), the location of the instantiation, and to the form of the instantiation, nor does it provide definitive specification. Rather, this Technical Report discusses and raises awareness of the major driver distraction and information display issues to be considered and provides guidance and direction for considering and managing driver distraction and information display in the context of future and instantiation specific deployments of *C-ITS*.

4.3 ITS and 'driver distraction and information display'

Driver *distraction* (2.4) has become an increasing concern amongst road safety experts, with the increasing range of technologies within vehicles creating the potential for drivers to have their attention taken away from the driving task. *C-ITS* has the potential to create further distractions if not implemented appropriately.

Distraction (2.4) is when drivers divert their attention away from the driving task to focus on another activity instead. Distraction can come in several ways:[14][1]

— visual – eyes off the road (or focusing on the wrong part);

— manual – hands off the wheel;

— cognitive – mind off the road;

— biomechanical – requiring action on the part of the driver.

C-ITS have the potential to increase safety and, for example, collision warning systems will be designed to only notify a driver by exception (i.e. an alarm would be generated only when a crash was likely and the driver needed to take evasive action). These alarms should therefore not affect the general driving task the majority of time. However, designers will need to be careful to ensure that such warning alarms are sufficiently intuitive that drivers immediately know what to do; poorly designed alarms could decrease safety if they divert attention from the immediate risk or create confusion.

'Infotainment' *applications* may create more of an on-going *distraction* (2.4) risk; this is however already an existing risk with infotainment systems today. *C-ITS* channels may create new ways for this content to be shared with a vehicle but it is not expected that this will substantially change the risks involved associated with 'infotainment'.

Driver *distraction* (2.4) and information display is the subject of International *Regulation* and National Regulations and recommendations.

The reader's attention is again drawn particularly to the standards deliverables of ISO TC 22 especially, International Standards Organization ISO/TC 22/SC 13.

— Distraction metrics (measurement of distracting tasks) and design *guidelines* (2.6) (e.g. prioritization)

and the Society of Automotive Engineers (SAE) Safety and Human Factors Committee.

NOTE The following list is illustrative and does not claim to be a complete list.

Primarily:

— ESOP - Commission of the European Communities (2007) Commission Recommendation on Safe and Efficient In-Vehicle Information and Communication Systems; Update of the European Statement of Principles on Human Machine Interface;

— JAMA - Japan Automobile Manufacturers Association Guidelines for In-Vehicle Display Systems, Version 3.0, 2004;

— Alliance of Automobile Manufacturers (AAM) Statement of Principles, Criteria and Verification Procedures on Driver Interactions with Advanced In-Vehicle Information and Communication Systems, June 26, 2006;

— International Telecommunications Union ITU-T FG Distraction Recommendations:

  — P.UIA—ITU-T Recommendation on automotive user interface requirements;

  — G.SAM—ITU-T Mechanisms for managing the situational awareness of drivers;

  — G.V2A—ITU-T Recommendation on an automotive interface for *applications* external to the vehicle gateway;

— Car Connectivity Consortium:

  — Driver Workload Guidelines for MirrorLink™[1] Mobile *Applications*;

  — "drive-ready" certification to MirrorLink™[1] apps. that are deemed not to adversely affect driving;

  — Guidelines for developers are based on existing *distraction* (2.4) *guidelines* (2.6) (i.e. ESOP, JAMA and Alliance).

See also Annex A for a comparison of ESOP, JAMA and AAM considerations.

4.3.1 ESOP

4.3.1.1 ESOP scope

The principles apply primarily to in-vehicle information and communication systems intended for use by the driver while the vehicle is in motion.

Apply to systems and functionalities in OEM-, aftermarket-, and nomadic (portable) systems.

1) MirrorLink™ is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

4.3.1.2 ESOP principles

a) Installation

b) Information presentation

c) Interface with displays and controls

d) System behaviour

e) Information about the system

4.3.1.3 ESOP design objectives

— The system supports the driver and does not give rise to potentially hazardous behaviour by the driver or other road users.

— The allocation of driver attention while interacting with system displays and controls remains compatible with the attentional demand of the driving situation.

— The system does not distract or visually entertain the driver.

— The system does not present information to the driver which results in potentially hazardous behaviour by the driver or other road users.

— Interfaces and interface with systems intended to be used in combination by the driver while the vehicle is in motion are consistent and compatible.

4.3.2 US NHTSA distraction guidelines

Minimize driver *distraction* (2.4) from electronic devices by encouraging better driver-device interfaces.

Conformance is voluntary.

Guidelines (2.6) implementation in three phases:

— Phase 1 – Visual-manual interfaces for devices installed by vehicle manufacturers (2013);

— Phase 2 – Portable and aftermarket devices (future work);

— Phase 3 – Voice-based auditory interfaces (future work).

4.4 C-ITS driver distraction and overload issues in context

It is important that potential driver *distraction* (2.4) and display issues created by *C-ITS* service provision are not viewed in isolation. *C-ITS* service provision is simply yet another potential source of driver distraction of visual or audible overload. Indeed, designed wisely, *C-ITS* service provision may often be used to reduce such overloads.

The prime driver *distraction* (2.4) and visual display issues remain those described and addressed in 4.3. The principle context for C-IS is to ensure that

a) *C-ITS* service provision does not add to driver distraction/overload, and

b) *C-ITS* service provision, where possible, uses opportunity to reduce driver distraction/overload

5 What are the key driver distraction and information display issues

5.1 General

Existing *rules* (2.12) and guidelines (see 4.3) govern the use of technology inside vehicles to reduce driver *distraction* (2.4). An assessment is required of how *C-ITS applications* fit within these existing rules and whether they raise additional risks. Key findings indicate the following:

— Initial *C-ITS applications* are likely to require human recognition of the signals and timely and proportionate responses. This reliance on human factors (see 4.3) could increase risks in certain circumstances;

— *C-ITS*, including driver distraction and information display considerations, are not yet explicitly regulated in most countries;

— Relevant terms such as 'visual display unit' and 'driver's aid' are not precisely defined in the 'Highway Code/Driving Rules' of most countries. However, devices providing *C-ITS applications* would likely fall under the definition of a 'driver's aid' or similar and be allowable under the road rules;

— In addition to ensuring that *C-ITS* meets safety objectives, legislation may be required to ensure that legitimate *C-ITS* functions are legalized and that drivers using the technology are not caught by laws prohibiting the use of mobile phones while driving. Any required changes to the law will need to be addressed by *jurisdictions* on a national or state basis;

— Guidelines relating to the safety and ergonomic functionality of in-vehicle electronic devices have been developed to address this issue (see 4.3 and Bibliography).

C-ITS will provide more information to drivers to empower them to make better driving decisions, at least in its early development when *C-ITS* is expected to be, at least initially, largely based on advisory systems that require human recognition of the signals. The challenge for designers is to achieve this without overloading the driver's cognitive load. Messages shall be prioritized in order to ensure that the driver receives critical information at the critical time. Drivers should be able to distinguish a critical message from a host of other *in-vehicle systems* (2.7) competing for his or her attention.

Safety is a primary objective of *C-ITS* but there is a risk that its introduction will inadvertently compromise safety in certain scenarios. The challenge for manufacturers and *C-ITS* service providers is to provide more in-vehicle information or enable more selective prioritized presentation of information through new systems without unnecessarily distracting, overwhelming or confusing drivers.

The American Automobile Association Foundation for Traffic Safety defines driver *distraction* (2.4) as occurring:

"when a driver is delayed in the recognition of information needed to safely accomplish the driving task because some event, activity, object or person within or outside the vehicle compelled or tended to induce the driver's shifting attention away from the driving task."

It has alternatively been defined as "the diversion of attention away from activities critical for safe driving toward a competing activity."[4]

As stated above, *distraction* (2.4) can be visual, auditory, biomechanical, physical or cognitive.

Driver *distraction* (2.4) can be caused by the actions of the driver, for example, adjusting the radio, answering a phone or texting, or it might be caused by unexpected visual, auditory or haptic experiences that are outside the driver's control, such as a distracting billboard image or sudden in-vehicle high pitched tone or vibration.

It might also be caused by an active screen demanding attention, a visual or audible warning, or by an inappropriate warning. For example, if a forward collision warning system indicated a medium risk of collision that demanded the driver's attention looking ahead but there was an unannounced higher critical level situation of a side impact collision which was unnoticed because of the driver's attention being focused on the less imminent threat.

