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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

Intended readers of the present document are:

- manufacturers of vehicles and their suppliers;
- manufacturers of after-market equipment intended for use in the vehicle;
- ITS service providers;
- mobile network operators;
- developers of equipment communicating with in-vehicle networks;
- suppliers of other services and devices that may be used in a vehicle;
- mobile communication device manufacturers;
- road administrations;
- road operators;
- insurance companies;
- European Research and Development projects.

Introduction

Whilst driving, the driver needs to focus on multiple tasks. This leads to varying levels of concentration and particularly a lower level of visual attention and ability. The present document highlights the potential dangers of driver distraction and the consequential impact that this can have on road safety. The present document also considers the use of ICT by passengers and of ICT jointly used by drivers and passengers.

The state of the art in the area has been studied, including the "European Statement of Principles on the Design of Human Machine Interaction, European Commission, 2006 (ESoP)" [i.21] which is currently being implemented by car manufacturers. Whereas the focus is on the users' needs and applications in this area, the present document identifies potential possibilities and any limitation(s) of technical solutions and, where appropriate, provides examples of the application of the ESoP and suggests future actions in order to open up new service opportunities.

1 Scope

The present document identifies the key aspects of use of ICT in cars and provides advice on safer and more effective use. Both the driver's and the passenger's requirements are examined. Factors relating to the safe use of ICT and to the personalization of the user experience are identified.

Issues with services and devices related to both the driver and passengers are addressed, including devices which are:

- mounted rigidly in the vehicle, either fitted during manufacture or later (e.g. for navigation, entertainment, games, emergency assistance services);
- communicating with the in-vehicle network e.g. for connecting phones, navigation equipment;
- portable equipment used in the vehicle.

Those aspects of ICT in cars with which the car user has no involvement are outside the scope of the present document. Also excluded from the scope are special functions designed exclusively for use in taxis or cars used as emergency service vehicles.

The approach taken in the present document is compatible with the European Statement of Principles on the Design of Human Machine Interaction [i.21].

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI EG 202 325: "Human Factors (HF); User Profile Management".

[i.2] ETSI ES 202 746: "Human Factors (HF); Personalization and User Profile Management; User Profile Preferences and Information".

[i.3] ETSI TS 102 747: "Human Factors (HF); Personalization and User Profile Management; Architectural Framework".

[i.4] ETSI EG 202 421: "Human Factors (HF); Multicultural and language aspects of multimedia communications".

[i.5] ETSI ES 202 076: "Human Factors (HF); User Interfaces; Generic spoken command vocabulary for ICT devices and services".

[i.6] ETSI EG 202 417: "Human Factors (HF); User education guidelines for mobile terminals and services".

[i.7] ETSI TR 102 638: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Definitions".

[i.8] ETSI TS 102 665: "Intelligent Transport Systems (ITS); Vehicular Communications Architecture".

[i.9] ISO 4040 (2001): "Road vehicles - passenger cars - location of hand controls, indicators and tell-tales".

[i.10] ISO 3958: "Road vehicles - Passenger car driver hand control reach".

[i.11] ISO 2575 (2004): "Road Vehicles - Symbols for Controls, Indications and Telltales".

[i.12] ISO 7000 (2004): "Graphical symbols for use on equipment - Index and synopsis".

[i.13] ISO 14813-1:2006: "Intelligent transport systems - Reference model architecture(s) for the ITS sector - Part 1: ITS service domains, service groups and services".

[i.14] ISO 14813-1:2007: "Intelligent transport systems - Reference model architecture(s) for the ITS sector - Part 1: ITS service domains, service groups and services".

[i.15] ISO/EN 16951: "Road vehicles - Ergonomic aspects of transport information and control systems - Procedure for determining priority of on-board messages presented to drivers".

[i.16] ISO/EN 15005: "Road vehicles - Ergonomic aspects of transport information and control systems - Dialogue management principles and compliance procedures".

[i.17] ISO/EN 15006: "Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and compliance procedures for in-vehicle auditory presentation".

[i.18] ISO/EN 15008: "Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and test procedures for in-vehicle visual presentation".

[i.19] ISO 11429: "Ergonomics - System of auditory and visual danger and information signals".

[i.20] ISO 17287: "Road vehicles - Ergonomic aspects of transport information and control systems - Procedure for assessing suitability for use while driving".

[i.21] European Commission (2006): "European Statement of Principles on the Design of Human Machine Interaction".

[i.22] European Commission (1999): "European Statement of Principles on the Design of Human Machine Interaction, European Commission".

[i.23] Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data.

[i.24] Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications).

[i.25] Directive 2006/24/EC of the European Parliament and of the Council of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending Directive 2002/58/EC.

[i.26] Nomadic Device Forum: Final Report - Short Form-, September 2009, eSafety Forum.

NOTE: See http://ec.europa.eu/information_society/activities/esafety/doc/2009/steering_group/09_ndf__final_report_short.pdf.

[i.27] Definition of Vehicle Categories.

NOTE: See http://www.acea.be/images/uploads/rf/DEFINITION_OF_VEHICLE_CATEGORIES.pdf.

[i.28] COMeSafety-DEL-D31-EuropeanITSCommunicationArchitecture-v2.0.pdf.

NOTE: See http://www.comesafety.org/index.php?id=17.

[i.29] AIDE deliverable D2.1.3: "Considerations on Test Scenarios".

NOTE: See http://www.aide-eu.org/pdf/sp2_deliv_new/aide_d2_1_3.pdf.

[i.30] Specification of AIDE methodology, AIDE D2.1.4 Summary.

NOTE: See http://www.aide-eu.org/pdf/sp2_deliv_new/aide_d2_1_4_summary.pdf.

[i.31] "The vision of AIDE".

NOTE: See http://www.aide-eu.org/vision.html.

[i.32] Final presentation of AIDE Sub-project 3.

NOTE: See http://www.aide-eu.org/res_sp3.html.

[i.33] AIDE deliverable D3.2.2: "System Architecture, data flow protocol definition and design AIDE specifications".

NOTE: The summary of [i.33] is available at http://www.aide-eu.org/pdf/sp3_deliv_new/aide_d3_2_2_summary.pdf.
The entire document is available upon request.

[i.34] Bart van Arem, Cornelie J. G. van Driel, and Ruben Visser (2006): "The impact of Co-operative Adaptive Cruise Control on traffic flow characteristics", IEEE Transactions on Intelligent Transportation Systems, Vol. 7, No. 4., pp. 429-436.

[i.35] Mohamed Morsi Mahmod MSc, Prof. dr. Bart van Arem (October 2008): "A simulation framework for modelling the impacts of an integrated road-vehicle system on local air quality", TRAIL Research School, Delft.

[i.36] "TRaffic Accident Causation in Europe (TRACE): Electronic Architecture and System Engineering for Integrated Safety Systems".

NOTE: See http://www.esafetysupport.org/en/esafety_activities/related_projects/research_and_development/trace.htm.

[i.37] evalue, Testing and Evaluation Methods for ICT-based Safety Systems; Deliverable D1.1: "State of the Art and eVALUE scope".

NOTE: See http://www.evalue-project.eu/pdf/evalue-080402-d11-v14-final.pdf.

[i.38] White Paper: "Developing telematic applications for the emergency services".

NOTE: See http://www.gstforum.org/download/White%20Papers/DOC_RSQ_White_Paper.pdf.

[i.39] GST Open Systems Architecture and Interface Specifications.

NOTE: See http://www.gstforum.org/download/SP%20level%20deliverables/Open%20Systems/DEL_OS_DEV_3_1_Architecture_and_interface_specifications_v1.1.pdf.

[i.40] COTH-070820-E-DA2: "Specification of knowledge database on guidelines and design criteria, Deliverable 1 of Task Force", HUMANIST.

NOTE: See http://www.noehumanist.org/documents/Deliverables/TFC/C-1-HUMANIST_OTH_deliverable_VA2.pdf.

[i.41] Intelligent Mobility AGents, Advanced Positioning and Mapping Technologies INtEgration Interoperable MulTimodal, location-based services; Fact sheet.

NOTE: See http://ec.europa.eu/information_society/activities/esafety/doc/esafety_library/projects_fact_sheets/imagine_it.pdf.

[i.42] Intelligent traffic and user-oriented technology (invent): "Driver Behavior and Human-Machine Interaction FVM".

NOTE: See http://www.invent-online.de/downloads/FVM-handout-E.pdf.

[i.43] The smart-vehicle (SMART-VEI), Smart-Vei project home page.

NOTE: See http://cordis.europa.eu/icadc/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=260&CAT=PROJ&QUERY=011aa1a08726:3784:05369063&RCN=86390.

[i.44] Work package 4 Evaluation Task 4.1 - "A priori evaluation of safety function effectiveness; Laboratory for Manufacturing Systems and Automation (LMS)".

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[i.49] Endsley, M.R. "Design and evaluation for situation awareness enhancement". Proceedings of the Human Factors Society 32nd Annual Meeting pp. 97-101(1988).

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[i.57] "Automobile Driving Behaviour Recognition Using Boosting Sequential Labelling Method for Adaptive Driver Assistance Systems" - ISBN: 978-3-540-85844-7.

[i.58] ISO 21217 (2010): "Intelligent transport systems - Communications access for land mobiles (CALM) - Architecture".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

accessibility: ensuring that all sectors of the community have equal access to communications and online information

Advanced Driver Assistance System (ADAS): "interacting" with the driver with the main purpose of supporting the driving task on the tracking and regulating levels

car: vehicle with three or more (and most commonly four) wheels that has its own onboard means of propulsion (rather than being moved by another vehicle or animal) moving primarily on roads, that has seating for one to eight people and is constructed principally for the transport of people rather than goods

feedback: information presented to users that relates to an action that the user has requested

primary driving task: activities that the driver has to undertake while driving in navigating, manoeuvring and handling a vehicle including steering, braking and accelerating

profile: total set of user related information, preferences, rules and settings which affects the way in which a user experiences terminals, devices and services

NOTE: The use of the word profile in the present document implies user profile unless otherwise stated.

secondary task: all interaction tasks undertaken by the driver that are not primary tasks

usability: extent to which a product can be used by specific users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use

user: person using ICT services

user profile: see profile

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ABS	Anti-lock Braking System
ACC	Adaptive Cruise Control
ADAS	Advanced Driver Assistance System
AIDE	Adaptive Integrated Driver-vehicle InterfacE
ARV	Application Request Vector
AU	Application and Control Unit
CALM	Communications Access for Land Mobiles
CCAS	Car Collision Avoidance System
CCTV	Closed-Circuit Television
CCU	Communication and Control Unit
CSV	Channel Status Vector
DIM	Driver Impairment Monitoring
DVE	Driver-Vehicle-Environment
DVEM	Driver Vehicle Environment Monitoring
GPL	Liquefied Petroleum Gas
GPS	Global Positioning System
HMI	Human Machine Interaction
HUD	Head-Up Display
ICA	Interaction and Communication Assistant
ICE	In-Car Entertainment
ICT	Information and Communication Technology
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISA	Intelligent Speed Adaptation
ITS	Intelligent Transport Systems
IVIS	In-Vehicle Information and Communication System
MPH	Miles Per Hour
MSD	Minimum Set of Data
PDA	Personal Data Assistant
PM	Profile Management
PSAP	Public Safety Answering Point
RNV	Request No More Valid Vector
RV	Reply Vector
TICS	Transport Information and Control System
V2X	Vehicle to Vehicle or/and to road Infrastructure
VMS	Variable Message Signs

4 Background

4.1 What is "ICT in cars"?

"ICT in cars" can be simply and broadly defined as information and communication equipment and related services which are used within the car environment. The present document focuses on where ICT in cars interacts with the car occupants. This definition includes the impact of both Intelligent Transport Systems (ITS) and pure entertainment systems such as radio, music and video on the driver and passengers.

Those ITS services whose operation does not require a direct interaction with the driver or passengers will not be considered in the present document.

4.2 Previous work on ICT in cars

Significant research work that considers how ICT in cars impacts on the drivers and passenger has been carried out over a number of years in research projects and by in-house work from vehicle manufacturers and road transport testing laboratories. Much of this work has been undertaken in European research projects, see annex B. The European Commission has paid particular attention to ensuring that the best research findings were analysed and discussed, and the outcome of this programme has been incorporated into the "European Statement of Principles on the Design of Human Machine Interaction", which was first produced in 1999 [i.22] and significantly updated and enhanced in 2006 [i.21]. A detailed analysis has been made of existing ITS projects (National and European) and also of the work of Consortiums/Organizations/Institutes working in the ITS related area, and the high-level observations on what work may be relevant to the context of the present document are contained in annex B.

The present document fully reflects the importance of this Statement of Principles by making significant references to it in all those parts of the document where the fundamental best practice requirements for the Human Factors (HF) are discussed.

The ETSI Human Factors work on personalization [i.1] can be useful for meeting the specific needs and requirements of the individuals such as preferred language [i.4]. Further details on personalization are given in clause 10. The ETSI Human Factors work on voice commands [i.5] is relevant for use in secondary tasks, where spoken input will allow the visual focus of the driver to remain on the primary driving tasks. Further details on voice commands are given in clause 7.2.2.

In addition to the work referred to above, much work on ITS services has taken place in the standards bodies ISO and ETSI. Most of this work has not yet reached the marketplace and some of which have had little or no experimental trials of any kind. Although the focus of the ETSI work on ITS is on the communication system there was a need to define a set of applications [i.7] comprising, road safety use case, traffic efficiency, other applications (e.g. stolen vehicle, tourist information, parking) to assess the functional requirements for communications. A comprehensive history of the development of ITS services is contained in annex C.

4.3 Major achievements during the last ten years and identified problems

Major achievements during the last ten years:

- improved display technologies that allow a more flexible, dynamic and adaptable dashboard;
- haptic devices have become available, providing new channels to give feedback to the driver;
- speech input lowers driver's distraction when commanding the vehicle or its options (e.g. navigation devices, radios or mobile phones) compared to the usual control involving hand-eye co-ordination;
- better understanding of human factors (e.g. prioritising of tasks).

Major problems, now and in coming ten years:

- the availability of new services and devices (onboard and nomadic) are driving towards increased complexity of the driver's environment;
- despite the potential to bring safety benefits (e.g. from the use of navigation systems), nomadic devices could also increase safety risks (e.g. by masking important warnings from safety systems), unless integrated into the in-car human interaction environment.