Decreasing Driver Distraction

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Texting, making calls, and other interaction with in-vehicle information and communication systems while driving is a serious source of driver distraction and increases the risk of traffic accidents. Technology-caused driver distraction is a global problem and has its stake in the more than 1.2 million people dying in road crashes each year. This ITU-T Technology Watch Report provides an overview of technology-caused driver distraction and surveys standards, guidelines and initiatives aiming at making the use of in-vehicle information and communica-tion systems less distracting.

The rapid change of the telecommunication/information and communication technologies (ICT) environment requires related technology foresight and immediate action in order to propose possible ITU-T standardization activities as early as possible.

ITU-T Technology Watch surveys the ICT landscape to capture new topics for standardization activities. Technology Watch Reports assess new technologies with regard to existing standards inside and outside ITU-T and their likely impact on future standardization.

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Please send your feedback and comments to tsbtechwatch@itu.int.

The opinions expressed in this report are those of the authors and do not necessarily reflect the views of the International Telecommunication Union or its membership.

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I. Introduction

Mobile phones play a vital role in our society. However, the convenience they offer must be judged against the hazards they pose, particularly when used while driving a vehicle. Text messaging, making and receiving calls all contribute to the problem of inattentive driving and to an increased risk of traffic accidents. World-wide, safety and health advocates are concerned about driver distraction, in particular distraction caused by the use of mobile phones, and consequently more than 40 countries restrict or prohibit the use of hand-held phones while driving.

At the same time, automakers, service providers and high-tech companies are pushing forward to bring other potentially distracting services and gadgets, including access to the World Wide Web and e-mail, 3D maps/navigation and high-definition video, to the front seat.

These and other in-vehicle information and communication services are delivered via original equipment manufacturer (OEM) components, automotive aftermarket devices (personal navigation devices, PND) and – rapidly gaining market share – smartphones (see Box 1).

This report provides an overview of technology-caused driver distraction and surveys standards, guidelines and initiatives aiming at making the use of in-vehicle information and communication systems less distracting. It is important that standards addressing driver distraction be valid and applicable independent of type of device, manufacturer and level of experience of driver/user.

Finally, the report describes related work done by the International Telecommunication Union (ITU) and its standardization arm, ITU-T, and recommends further steps to better address the important issue of driver distraction.

II. Distraction in numbers

In 2006, a study distributed by the U.S. Department of Transportation (DOT), National Highway Traffic Safety Administration (NHTSA) reported that the leading factor in most crashes and near-crashes (80 per cent of crashes and 65 per cent of near-crashes) is driver inattention within three seconds before the event [1].

Dialing a hand-held device increases a driver's chance of being involved in a vehicle crash by three times and listening or talking on such device increases the crash risk by 1.3 times. However, the number of crashes and near-crashes attributable to dialing is nearly identical to the number associated with talking or listening. Dialing is more dangerous but occurs less often than talking or listening.

While mobile phones are the most familiar form of distraction, the NHTSA study found that:

- Reaching for a moving object while driving increases the risk of a crash or near-crash by 9 times,
- Looking at an external object while driving by 3.7 times,
- Reading while driving by 3 times, and
- Applying makeup while driving by 3 times.

One of the most deadly forms of driver distraction is text messaging or *texting*. According to numbers published by CTIA-The Wireless Association®, more than 1.5 trillion text messages were sent and received in 2009 – amounting to almost 5 billion messages per day [2] – despite the danger, many of them at the wheel [3].

Box 1: Categories of in-vehicle information and communication devices

OEM components	Aftermarket devices	Smartphones
Many vehicle manufacturers offer in-vehicle information and communication solutions as an option in their vehicles. Displays and controls of these OEM parts are typically integrated in the car's dashboard, steering wheel, or console. Applications include navigation and other telematics, control of entertainment, AC, and communications systems (integrated or external, e.g., via Bluetooth), and emergency assistance. OEM components follow guidelines outlined in this report to minimize driver distraction.	At a lower cost compared to OEM components a number of manufacturers supply nomadic aftermarket devices for in-vehicle use. Personal navigation devices (PND) are bundled with windshield mount and charger. Their displays (often resistive touchscreens) are typically larger than those of smartphones, allowing for menu systems, display letters and numerals to be optimized for usability when driving. Most PND manufacturers implement human machine interface standards and guidelines described in this report.	In addition to basic features such as making and receiving telephone calls, texting, smartphones offer advanced computing ability and connectivity to mobile phones, which enable applications such as access to web and e-mail, multimedia, presence services, etc. As GPS is becoming a standard in a growing number of smartphones, these handhelds are taking over the navigation market for cars. At a smaller screen size it can be difficult to see and operate smartphone navigation while driving.

Berg Insight, a research firm, estimates that in 2009 there were more than 150 million navigation systems worldwide, including about 35 million OEM components, over 90 million PNDs and an estimated 28 million navigation-enabled mobile handsets with GPS. Worldwide shipments of PNDs are forecasted to peak at around 50 million devices annually in 2011–2012 and gradually decline to 43 million units in 2015.

A study by market research firm iSuppli suggests that smartphones have already become the most important platform for maps, navigation and other location-based services (LBS). According to the study, the number of smartphone-based navigation systems is increasing to 81 million in 2010, and expected to rise to 297 million by 2014.

Sources: Berg Insight (2009). Personal Navigation Devices – 3rd Edition. November 2009. http://berginsight.com/ShowReport.aspx?m_m=3&id=92. iSuppli (2010). Smart Phones Become the New Location Based Services (LBS) Battleground. 21 June 2010. http://www.isuppli.com/Automotive-Infotainment-and-Telematics/News/Pages/Smart-Phones-Become-the-New-Location-Based-Services-LBS-Battleground.aspx

A simulation study conducted by Monash University's Accident Research Centre (Australia), one of the foremost research institutions on driver distraction, concluded that *"retrieving and, in particular, sending text messages has a detrimental effect on a number of safety critical driving measures, such as the ability to maintain lateral position, detect hazards, and to detect and respond appropriately to traffic signs."* When texting, drivers spend up to 400 per cent more time with their eyes off the road than they do when not texting [4].

There are a number of measures coming into effect that aim to guide states on how to address mobile phone use. For example, the Vienna Convention on Road Traffic, agreed upon in 1968, included mobile phones in its 2006 amendment: *"A driver of a vehicle shall at all times minimize any activity other than driving. Domestic legislation should lay down rules on the use of phones by drivers of vehicles. In any case, legislation shall prohibit the use by a driver of a motor vehicle or moped of a hand-held phone while the vehicle is in motion."* [1]

[1] See Article 8.6, Convention on Road Traffic, http://www.unece.org/trans/conventn/Conv_road_traffic_EN.pdf

Several resolutions of the United Nations General Assembly encouraged member states to adhere to its regulations in order to ensure greater uniformity in the rules governing road traffic in the *Contracting Parties* and to improve road safety.

UN Secretary General Ban Ki-Moon and U.S. President Barack Obama banned their employees from texting while driving: *"Texting while driving kills."* [5]

Celebrity-backed distracted driving campaigns on one side,[2] lobbyists and industry in fear of a full ban of mobile phones while driving on the other [6], driver distraction is far more than a technical issue.

III. What is driver distraction?

According to the American Automobile Association Foundation for Traffic Safety (AAAFTS) driver distraction occurs *"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."*

NHTSA breaks up the phenomenon into four distinct types of distraction: visual, auditory, biomechanical/physical and cognitive [7]:

Visual Distraction

- The driver's visual field is blocked by objects, such as stickers on the car's windscreen or dark window tints that prevent from detecting or recognizing objects or hazards in the road environment.
- The driver neglects to look at the road and instead focuses on another visual target, such as a mobile phone, an in-car route navigation system or billboard, for an extended period of time.
- The driver loses visual "attentiveness", often referred to as "looked, but did not see". Interferes with the driver's ability to recognize hazards in the road environment.

Auditory Distraction

- The driver momentarily or continually focuses its attention on sounds or auditory signals rather than on the road environment. Auditory distraction is most pronounced when using a mobile phone, but can also occur when listening to the radio or when holding a conversation with a passenger.

Biomechanical / Physical Distraction

- The driver removes one or both hands from the steering wheel to physically manipulate an object (e.g., composing a text message) instead of focusing on the physical tasks required to drive safely such as steering in the appropriate direction or changing gears.

Cognitive Distraction

- The driver's attention is absorbed to the point where he/she is unable to navigate through the road network safely and the reaction time is reduced. Talking on a mobile phone while driving is one of the most well documented forms of cognitive distraction; however it can also occur when trying to operate in-vehicle devices such as route navigation systems or talking to a passenger.

Obviously, these four forms of distraction are not mutually exclusive. Operating a mobile phone may involve all four forms of distraction: physical distraction caused by dialing a number; visual distraction caused by looking at the phone to dial a number; auditory distraction caused by holding a conversation on the phone;

[2] See, for instance, http://www.distraction.gov/ (U.S. DOT), http://www.oprah.com/nophonezone (Oprah Winfrey), http://www.who.int/roadsafety/ (World Health Organization), http://donttwive.blogspot.com/ (@donttwive – Don't Tweet and Drive Blog).

and cognitive distraction caused by focusing on the topic of conversation rather than monitoring any changes in the road environment.

Regardless of whether the phone is hands-free or hand-held, drivers in most cases remove their eyes from the road and their hands off the wheel to reach for the phone and to initiate a call by either dialing a number or answering an incoming call. Many studies have found that using a hands-free phone while driving is in no way safer than using a hand-held phone [7].

Calls and text messages only account for two potential sources of driver distraction; other technology-based distracters include navigation/route guidance systems, traffic information and entertainment, including car radios, CD and MP3 players. The next generation of so-called infotainment will bring the Internet and the power of the PC to the car.

Thanks to high-speed wireless interfaces, advanced screen technologies, ever-increasing processing power and falling manufacturing costs these systems are likely to become standard equipment in many cars before long.

Despite technological advancements increasing a vehicle's autonomy to sense, control and navigate the road, there will always be a human involved to perform the driving task. Older and inexperienced drivers have different cognitive capacities and sensory requirements than experienced drivers. Users who are unfamiliar with a system or an interface may suffer a greater level of distraction than experienced users. How much an in-vehicle information and communication system distracts from driving depends on the user, the task and its demands, and not on the device, the manufacturer, or how it got into the vehicle [8].

IV. Standards and guidelines for minimizing distraction

Considering the increasing options a driver has to stay informed, entertained or connected, standards should not make distinction between OEM and other products, or between permanently installed and carry-in devices.

In-vehicle systems must be easy to learn, intuitive to use and include design features to individually address the four types of distraction described above. Tasks, such as entering a destination into the route guidance system, need to be resumable (or '*chunkable*'). Users should be able to control the pace of interaction with the system and completing a desired task shall neither exceed a time limit nor adversely affect driving [8].

These and other principles of sound basic ergonomics, as well as the interplay of in-vehicle information and communication systems with other in-car and driver assistance systems (e.g., adaptive cruise control, lane keeping assistance, collision warning) have been outlined in standards and guidelines issued by standards bodies and automobile organizations, including ISO (International Organization for Standardization), SAE International (Society of Automotive Engineers), the AAM (The Alliance of Automobile Manufacturers), JAMA (Japan Automobile Manufacturers Association), and the UK's Transport Research Laboratory. The European Commission issued a recommendation on safe and efficient in-vehicle information and communication systems.

While implementation of these guidelines and standards contributes to less driver distraction in most OEM in-vehicle information and communication systems and many aftermarket personal navigation devices, mobile phones, smartphones and their applications are not necessarily designed bearing in mind the specific requirements of distraction-free driving.

Within ISO, TC 22/SC 13 ("Ergonomics applicable to road vehicles"), in particular its Working Group 8 ("Transport Information and Control Systems (TICS) on Board – Man-Machine Interface (MMI)"), is responsible for the development of driver interface standards, which address both, design and design process is-

sues, as well as performance assessment of in-vehicle systems. An overview of related standards published under responsibility of ISO TC 22/SC 13 WG 8 is given in Annex 1. [3]

ISO TC 204 "Intelligent transport systems" (ITS) studies, inter alia, the integration of nomadic devices in ITS (Working Group 17) and has developed standards specifically related to high-priority warnings for in-vehicle ITS, which could be triggered when drivers are distracted and inattentive, e.g.,

- Forward Vehicle Collision Warning (ISO 15623:2002),
- (Roadside) Traffic Impediment Warning (ISO/TS 15624:2001), or
- Lane Departure Warning (ISO 17361:2007).

Other, more general ISO standards related to in-vehicle system design include ISO 2575 ("Symbols for controls, indicators and tell-tales") and ISO 11429 ("System of auditory and visual danger and information signals", TC 159/SC 5).

Similar to ISO's work described above the Safety and Human Factors Steering Committee of SAE International, a worldwide professional organization of automotive engineers, government, suppliers, and academicians, develops standards covering driver interfaces, ITS displays and warning systems.[4]

SAE Recommended Practice J2364 presents test methods and criteria to determine if visual-manual tasks involved in the use of OEM/aftermarket navigation systems should not be performed while driving. The longer an in-vehicle task takes to complete, the greater is the time the driver is distracted from keeping the eyes on the road, and the risk of a crash increases. Here, the acceptable mean task duration is 15 seconds, but some experts recommend a limit of ten seconds to minimize distraction [9]. Although the title of J2364 "Navigation and Route Guidance Function Accessibility While Driving" suggests a limitation to navigation-system-related tasks, the practice should apply to other visual-manual tasks, too. Compliance to the "15-second rule" can be estimated using a method to compute total task time for visual-manual tasks, described in J2365.

Drivers are increasingly challenged with managing textual information from radio data systems (RDS), navigation, information systems and other sources. SAE J2831, a new standard currently under development, will provide guidelines and requirements for the design of in-vehicle text messages in (non-nomadic) textual information systems. By developing a sound design strategy to mitigate distraction caused by alpha-numeric messages, the usability of displays will increase and consequently aid the driver.[5]

Terms and measures of driver performance will be defined in SAE J2944. These definitions will assist in assessing safety and usability of in-vehicle information and communication systems and driver assistance systems.[6]

The AAM, together with NHTSA, created a Driver Focus-Telematics Working Group, which in 2002 published a second version of a "Statement of Principles, Criteria and Verification Procedures on Driver Interactions with Advanced In-Vehicle Information and Communication Systems" [10]. The 24 principles are voluntary and publicly available, and address areas such as system installation, information presentation, interaction with displays and controls, system behavior and information about the system.

The guidelines for in-vehicle display systems issued by JAMA are very prescriptive about system design [11]. The content of information to be displayed, method of display system operation, and location of display sys-

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3 See ISO TC 22/SC 13 "Ergonomics applicable to road vehicles" website: http://www.iso.org/iso/iso_technical_committee.html?commid=46880

4 See SAE International Safety and Human Factors Steering Committee website: http://www.sae.org/servlets/works/committeeHome.do?comtID=TEITSSHF

5 See http://standards.sae.org/wip/j2831/

6 See http://standards.sae.org/wip/j2944/

tems are prescribed with the aim of fully utilizing the beneficial functions of in-vehicle display systems. Based on four main principles, the document addresses specific requirements for in-vehicle display systems in order to minimize distraction:

1) A display system is so designed that its adverse effect on safe driving will be kept to a minimum.
2) A display system is installed in such an in-vehicle position that the driving operation and the visibility of forward field will not be obstructed.
3) The types of information to be provided by a display system are such that the driver's attention will not be distracted from driving; for example, entertainment types of information need to be avoided.
4) A display system can be operated by the driver without adversely affecting his or her driving work.

The UK Transport Research Laboratory's "safety check list for the assessment of in-vehicle information systems" is an assessment tool to rate different tasks on how much of a risk they present to the driver and other drivers on the road [12].

The European Commission's recommendation on safe and efficient in-vehicle information and communication systems (2006) [13] replaces the European Statement of Principles (ESoP) on human-machine interface for these systems, elaborated in 1998/99 [14]. The scope of this document primarily includes in-vehicle information and communication systems intended for use by the driver while the vehicle is in motion, for example navigation systems, mobile phones and traffic and travel information systems (TTI) – both portable and permanently installed. The 43 principles outlined in this recommendation promote the introduction of well designed systems into the market, and by taking into account both the potential benefits and associated risks they do not prevent innovation of the industry. The primary goal of the principles is, however, that drivers can fulfill their main task: the safe control of the vehicle in a complex and dynamic traffic environment.

Similar to the statements published by AAM, which were initially based on ESoP, the European Commission principles focus on:

- Design goals,
- Installation,
- Information presentation,
- Interaction with displays and controls,
- System behavior,
- Information about the system, and
- Recommendations on influencing use (e.g., "Vehicle hire companies should ensure that a copy of the manufacturer's instructions for use is available in every equipped vehicle.").

Harman/Becker, a producer of both nomadic and OEM automotive systems, analyzed that while the majority of the ESoP principles can be fulfilled by personal navigation devices available on the market today, more effort is required by manufacturers to comply with the remaining principles. Two of the principles would need to be revised to become also applicable to PNDs, due to differences in technology and other factors [15].

Future approaches and standards to reduce driver distraction could include constantly updated status information provided by both, (fixed and nomadic) devices and vehicle. Most smartphones and other devices are equipped with different kind of sensors and GPS receivers; this information could be combined with data obtained from vehicle onboard units and driver assistance systems, or with traffic updates received from external service providers or traffic police. Based on parameters such as the car's velocity, location, density of traffic or even driving style (e.g., aggressive or defensive, anticipatory) and driver's experience (e.g., beginner) the in-vehicle information and communication system can decide and enable/disable, which, if any, feature is safe enough to be used in this situation. As an example, a mobile phone may allow a hands-free call when driving on a highway outside the city, but prohibit a call in hectic traffic situations, and temporary suspend the call when turning right (with a message to the other end - call temporarily suspended for driv-

ing conditions), not allow a ring when overtaking (message on the other end - please wait for driving conditions).

From a technical perspective, this would require well defined and standardized interfaces between vehicular systems and all kinds of ICT devices used in vehicles. However, besides the involvement of automotive and ICT sectors, collaboration with law and policy makers and road safety experts will be essential to define an all-encompassing set of vehicle status information and rules, applicable to traffic laws worldwide.

V. ITU's role in decreasing driver distraction

In April 2010, ITU Council adopted a Resolution titled "ITU's role in ICTs and improving Road Safety." Resolution 1318 considers *"that driver distraction and road-user behavior, which includes among many examples "texting", "text messaging", interfacing with in-vehicle navigation and communication systems, are among the leading contributors to road traffic fatalities and injuries,"* and that the proliferation of ICT use in cars may contribute to driver distraction [16].

Since 2006, communication from, to, in and between vehicles has been covered by different ITU-T Focus Groups. While not researching the impact of ICTs on driver distraction explicitly, some of the topics under discussion in the Focus Group on Car Communication (FG CarCom; see Box 2) are related, and may contribute to reducing driver distraction, given that findings are following certain principles or guidelines (e.g., those highlighted above).

So far, however, the group has been primarily focusing on quality of service (QoS) and quality of experience (QoE) aspects. In view of Resolution 1318, which explicitly mentions Focus Group CarCom and its parent group, ITU-T Study Group 12 on performance, QoS and QoE, the scope needed to be broadened to include design principles and safety aspects of in-vehicle information and communication systems, taking into account the requirements for PNDs as well as OEM systems.

Obviously, this would require increased efforts to involve experts from the ergonomics and human factors community. Some of them may easily be found in ITU-T Study Group 2: e.g. Question 4 on human factors of ICT aims at maximizing the accessibility and usability of ICT services and products for all members of society, including older people and persons with disabilities. Equally important is collaboration with Study Group 16, which is currently working on a standard describing an open interface between the in-vehicle network and ICT devices brought into the car. An overview of aforementioned ITU-T Study Groups and their questions potentially related to the subject of driver distraction is given in Table 1.

Providing means to decrease driver distraction caused by mobile phones will remain a challenging task, one that requires the cooperation and collaboration of equipment manufacturers, network operators, mobile platform and application developers, safety advocates, standards makers and other stakeholders. New navigation and route-guidance applications are released each day and downloaded to smartphones. An ITU-T Focus Group, providing the links to the ICT sector, the automotive industry and the relevant authorities in ITU's 192 Member States, could be a place to coordinate such an effort.

ITU Council also resolved to raise awareness of the important role that ICTs can play to improving road safety. This could happen at the WSIS Forum 2011, the 2012 World Telecommunication and Information Society Day, and, last but not least, at the annual Fully Networked Car workshops, jointly organized by ISO, IEC and ITU at the Geneva International Motor Show.[7]

[7] See http://www.itu.int/wsis/, http://www.itu.int/wtisd/, http://www.itu.int/ITU-T/worksem/ict-auto/

In March 2010, participants in one technical session at the Fully Networked Car workshop concluded that quality and naturalness of all speech services need to be increased to reduce driver distraction and seamless interaction [17]. A special session on driver distraction is planned for the 2011 edition of the workshop.

Box 2: ITU-T Focus Group on Car Communication (FG CarCom)

FG CarCOM was established by ITU-T Study Group 12, the lead study group on quality of service and quality of experience, at its November 2009 meeting. Key areas of attention of the group include:

- In-car communication: Quality parameters and testing methods,
- Interaction of car hands-free systems with the radio channel,
- Requirements for car hands-free on a sub-system level,
- Requirements and testing procedures for super-wideband and fullband systems, interaction with other audio components and systems in the car,
- Special requirements and testing procedures for speech recognition systems in cars,
- Quality models and how they can be applied in the car environment.

The objective of the Focus Group is to develop a new set of requirements and specifications to help advance the work in these areas, which are in line with Questions 4/12 and 12/12 (also see Table 1).

FG CarCom currently consists of experts in the field of speech and audio processing in cars with special focus on hands-free terminal design and integration. Participation is open to ITU members and non-members (e.g., administrations, network operators, manufacturers, industry trade organizations, user groups).

Source: ITU-T Focus Group on Car Communication, http://www.itu.int/ITU-T/focusgroups/carcom/

Table 1: ITU-T Study Groups and questions under study potentially related to driver distraction

Study Group	Title	Question	Title	URL
2	Operational aspects of service provision and telecommunications management	Q 4/2	Human factors related issues for improvement of the quality of life through international telecommunications	http://www.itu.int/ITU-T/studygroups/com02/sg2-q4.html
12	Performance, QoS and QoE	Q 4/12	Hands-free communication in vehicles	http://www.itu.int/ITU-T/studygroups/com12/sg12-q4.html
		Q 6/12	Analysis methods using complex measurement signals including their application for speech enhancement techniques and hands-free telephony	http://www.itu.int/ITU-T/studygroups/com12/sg12-q6.html
		Q 12/12	Operational aspects of telecommunication network service quality	http://www.itu.int/ITU-T/studygroups/com12/sg12-q12.html
16	Multimedia coding, systems and applications	Q 27/16	Vehicle gateway platform for telecommunication / ITS services / applications	http://www.itu.int/ITU-T/studygroups/com16/sg16-q27.html

VI. Conclusion

Research has shown that texting, making calls, and other use of in-vehicle information and communication systems while driving is a serious source of driver distraction and increases the risk of accidents. Technology-caused driver distraction is a global problem and has its stake in the more than 1.2 million people dying in road crashes each year. The problem is addressed by national laws and awareness campaigns, and some organizations have started to develop guidelines and standards to make in-vehicle information and communication systems less distracting. ITU-T's CarCom Focus Group, working on the crossroads of ICTs and automotive technologies, could widen its scope and membership to also include human factor and safety aspects and to discuss innovative ICT-based approaches to increase road safety. Particular attention should be given to the development of standards aiming at reducing the distraction caused by mobile phones and smartphones while driving.

Finally, it must be stated that ITU, leading UN agency for ICT issues, has not yet joined the UN Road Safety Collaboration, a network of 50 agencies with a mission to promote and strengthen international collaboration to reduce road traffic injuries.[8] Given the negative, sometimes fatal impact of ICT use while driving, but also the options ITU and its membership have to contribute to a reduction in technology-caused driver distraction, e.g., by creating safety standards and raising awareness for the issue, ITU should consider joining this important initiative.

[8] See http://www.who.int/roadsafety/en/

Glossary of acronyms

AAAFTS	American Automobile Association Foundation for Traffic Safety
AAM	Alliance of Automobile Manufacturers
DOT	U.S. Department of Transportation
ESoP	European Statement of Principles
FG CarCom	Focus Group on Car Communication
GPS	Global Positioning System
HMI	Human-Machine Interface
ICTs	Information and Communication Technologies
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITS	Intelligent Transport System
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
JAMA	Japan Automobile Manufacturer Association
LBS	Location-Based Services
MMI	Man-Machine Interface
NHTSA	National Highway Traffic Safety Administration
OEM	Original Equipment Manufacturer
PND	Personal Navigation Device
QoE/QoS	Quality of Experience / Quality of Service
RDS	Radio Data System
SAE	Society of Automotive Engineers
TC	Technical Committee
TICS	Transport Information and Control System
TTI	Travel Information Systems
UN	United Nations
WSIS	World Summit on the Information Society

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ANNEX 1: Overview of driver interface standards published by ISO TC 22/SC 13

Document	Short Title	Abstract / Comment
ISO 15005:2002	Dialogue management principles and compliance procedures	This International Standard presents ergonomic principles for the design of the dialogues that take place between the driver of a road vehicle and the vehicle's transport information and control systems (TICS) while the vehicle is in motion. It also specifies compliance verification conditions for the requirements related to these principles. The standard is applicable to TICSs consisting of either single or multiple devices, which can be either independent or interconnected. It is not applicable to TICSs without dialogues, TICS failures or malfunctions, or controls or displays used for non-TICS functions.
ISO 15006:2004	Specifications and compliance procedures for in-vehicle auditory presentation	This International Standard establishes ergonomic specifications for the presentation of auditory information related to TICS through speech or sounds. It is applicable only to the use of auditory displays when the vehicle is in motion. It presents a set of requirements and recommendations for in-vehicle auditory messages from TICS, and provides message characteristics and functional factors for maximizing message intelligibility and utility while helping prevent auditory or mental overload.
ISO 15007-1:2002	Measurement of driver visual behavior with respect to transport information and control systems - Part 1: Definitions and parameters	*Revision under development*
ISO/TS 15007-2:2001	Measurement of driver visual behavior with respect to transport information and control systems - Part 2: Equipment and procedures	*Revision under development* This Technical Specification gives guidelines on equipment and procedures for analyzing driver visual behavior, intended to enable assessors of TICS to - plan evaluation trials, - specify (and install) data capture equipment, and - analyze, interpret and report visual-behavior metrics (standards of measurement). It is applicable to both road trials and simulated driving environments. It is not applicable to the assessment of head-up displays.
ISO 15008:2009	Specifications and test procedures for in-vehicle visual presentation	ISO 15008:2009 specifies minimum requirements for the image quality and legibility of displays containing dynamic (changeable) visual information presented to the driver of a road vehicle by on-board TICS used while the vehicle is in motion. These requirements are intended to be independent of display technologies, while reference to test methods and measurements for assessing compliance with them have been included where necessary. ISO 15008:2009 is applicable to mainly perceptual, and some basic cognitive, components of the visual information, including character legibility and color recognition. It is not applicable to other factors affecting performance and comfort such as coding, format and dialogue characteristics, or to displays using

Document	Short Title	Abstract / Comment
		- characters presented as a part of a symbol or pictorial information, - superimposed information on the external field (e.g. head-up displays), - pictorial images (e.g. rear view camera), - maps and topographic representations (e.g. those for setting navigation systems), or - quasi-static information.
ISO/TR 16352:2005	Warning systems	This Technical Report provides a literature survey about the human-machine interface of warning systems in vehicles. It covers the experimental experiences about the efficiency and acceptance of different modalities and combinations of warnings, and the design of the sensorial, code and organizational parameters of visual, auditory and tactile warnings.
ISO 16673:2007	Occlusion method to assess visual demand due to the use of in-vehicle systems	ISO 16673:2007 provides a procedure for measuring visual demand due to the use of visual or visual-manual interfaces accessible to the driver while the vehicle is in motion. It applies to OEM and aftermarket in-vehicle systems. It applies to both permanently installed and portable systems. It applies to any means of visual occlusion and is not dependent on one specific physical implementation.
ISO/TS 16951:2004	Procedures for determining priority of on-board messages presented to drivers	This Technical Specification provides formal procedures and two alternative methods for determining the priority of on-board messages presented to drivers of road vehicles by TICS, and other systems. It is applicable to the whole range of TICS in-vehicle messages, including traveler information, navigation, travel and traffic advisories, "yellow pages" information, warnings, systems status, emergency calling system information, and electronic toll/fee collection, as well as to messages from non-TICS sources such as telephone, warnings and telltales.
ISO 17287:2003	Procedure for assessing suitability for use while driving	Specifies a procedure for assessing whether specific TICS, or a combination of TICS with other in-vehicle systems, are suitable for use by drivers while driving. It addresses user-oriented TICS description and context of use, TICS task description and analysis, assessment process, and documentation. The TICS description and context of use includes consideration of improper use, reasonably foreseeable misuse and TICS failure. The TICS description, analysis and assessment include a process for identifying and addressing suitability issues. ISO 17287:2003 does not recommend specific variables for assessing suitability nor does it define criteria for establishing the suitability of use of a TICS Table while driving.
ISO/PRF 26022	Simulated lane change test to assess in-vehicle secondary task demand	*Under development* Describes a PC-based driving simulator test of the demand of a driver interface to assess distraction.

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