TECHNICAL REPORT

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Intelligent transport systems — Cooperative ITS —

Part 3: Concept of operations (ConOps) for 'core' systems

Systèmes intelligents de transport — Systèmes intelligents de transport coopératifs —
Partie 3: Concept des opérations (ConOps) pour les systèmes 'principaux'

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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 systems 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 architectures(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 'Concept of operations for ore systems' supporting *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 in the movement of people and goods.

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

Some *ITS*s 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*s are informative, for example, 'Variable Message Signs' at the roadside, or transmitted into the vehicle, provide information and advice to the driver. Some *ITS*s are semi-autonomous, in that they are largely autonomous, but rely on 'static' or 'broadcast' data, for example, *GNSS*-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 system*s (*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 technologies enable vehicles to 'talk' to each other and to the infrastructure, and in so doing will have significant potential to improve the safe, sustainable and efficient operation of the transport network.

A distinguishing feature of '*C-ITS*' is that data is used across application/service boundaries. This means that data collected at one point and/or processed by one application becomes available to be re-used by other applications, which may be operating in the same, or different physical entities.

The difference between any '*ITS* implementation' and a '*C-ITS* implementation' is that *C-ITS*s are dependent on the interaction with other vehicles and/or the infrastructure, and the exchange of dynamic data, to receive data to enable their function, or conversely to provide data to other vehicles/infrastructure to enable their *C-ITS*s to function.

C-ITS as an entity, is therefore the *functionality that enables* such 'cooperative' and collaborative exchange of data, and in some cases, collaborative control, or even decision making, that will enable applications to provide their services to one or more *actors* (3.1).

ISO/TR 17465-1 provides a summary definition of *C-ITS* as a "subset paradigm of overall *ITS* that communicates and shares information between *ITS-station*s to give advice or facilitate actions with the objective of improving safety, sustainability, efficiency and comfort beyond the scope of stand-alone systems".

ISO 17427-1 will provide descriptions of the roles and responsibilities of *actors* involved in the provision and use of *C-ITS*.

ISO/TR 17427-2 provides a framework overview which characterize the components of a *Cooperative-ITS* (*C-ITS*), its context and relevance for *ITS service* provision, and provides references to Standards deliverables where specific aspects of *C-ITS* are defined.

This Technical Report concerns the high-level generic requirements for the "Concept of operations" for a 'Core System' (*CorSys)* (3.10) to support *C-ITS* in a connected vehicle-highway system paradigm. It is agnostic in respect of technology and operates with whatever (and probably multiple) *communication*s technologies and hardware technologies that can support its functionalities.

The benefits of *Intelligent Co-operative Systems* (*C-ITS*) stem from the increased information that is available from the vehicle and its environment and from other vehicles. The same set of information can be used to extend the functionality of the in-vehicle safety systems and through vehicle-to-

infrastructure *communications* for more efficient traffic control and management. The benefits include the following:

— improved safety;

— increased road network capacity;

— reduced congestion and pollution;

— shorter and more predictable journey times;

— improved traffic safety for all road users;

— lower vehicle operating costs;

— more efficient logistics;

— improved management and control of the road network (both urban and inter-urban);

— increased efficiency of the public transport systems;

— better and more efficient response to hazards, incidents and accidents.

(source: EC project CVIS)

It is important to understand that *C-ITS* is not an end in itself, but a combination of techniques, protocols, systems and sub-systems to enable 'cooperative'/collaborative service provision in a connected vehicle-highway system paradigm.

Other parts in this family of *C-ITS* standards will define specific aspects of technology and behaviour, and the roles and responsibilities within the context of *C-ITS*.

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 3:
Concept of operations (ConOps) for 'core' systems

1 Scope

This Technical Report provides the high-level generic requirements for the "Concept of operations" for a 'Core System' (*CorSys)* (3.10) to support *C-ITS service* delivery. It is intended as an input to the planning and development elaboration of core functions that will support the deployment of *cooperative intelligent transport systems* (*C-ITS*) in a connected vehicle-highway paradigm

The objective of this Technical Report is to raise awareness of and consideration of such issues and to give pointers, where appropriate, to standards existing that provide specifications for all or some of these aspects. This Technical Report does not provide specifications for solutions of these issues.

This Technical Report is agnostic in respect of technology and operates with whatever (and probably multiple) *communications* technologies and hardware technologies that can support its functionalities.

2 Normative references

There are no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
actor
party participating in a system, within this Technical Report participating in *C-ITS* (3.6) service provision/receipt

3.2
application
'app'
software application to provide functionality to realize *C-ITS* (3.6)

3.3
application service
service provided by a service provider accessing data from the *IVS* vehicle in the case of *C-ITS* (3.6), 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

3.4
back office
central system ('*centre*'/*CorSys*) for commercial *applications* (3.2)

Note 1 to entry: The terms '*back office*' and '*Centre*' are used interchangeably throughout this Technical Report. '*Centre*' is a traditionally transport-focused term, evoking management *centres* to support transport needs, while *back office* generally refers to commercial *applications* (3.2). From the perspective of this *ConOps,* their functions are considered to be similar.

3.5
bounded secure managed domain
BSMD
secure *ITS-station* entity capable to conduct secure peer-to-peer *communications* (3.8) between entities (*ITS-stations*) that are themselves capable of being secured and remotely managed

Note 1 to entry: The bounded nature is derived from the requirement for *ITS-stations* to be able to communicate amongst themselves, i.e. peer-to-peer, as well as with devices that are not secured (referred to as 'other *ITS-stations*'),and realizing that to achieve this in a secure manner often requires distribution and storage of security-related material that needs to be protected within the boundaries of the *ITS-stations*, leads to the secured nature of the entity - as there is great flexibility to achieve desired *communication* goals, there is a requirement that this flexibility be managed; within *C-ITS* (3.6) and ISO 21217 such *ITS-stations* are defined as operating within *bounded secured managed domains* (*BSMD*), or outside of the *BSMD*.

3.6
cooperative ITS
C-ITS
group of *ITS* technologies where service provision is enabled, or enhanced by, cooperating to provide 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)

3.7
centre
central system
traditionally transport-focused term, evoking management *centres* (3.7) to support transport needs and/or providing/supporting *application service(s)* (3.3) managed through a central facility; from the perspective of the *CorSys* similar to '*back office*'

3.8
communication
communications
wireless (and in some cases, *wireline*) networks that facilitate data exchange, including roadside *ITS-stations* where appropriate

3.9
Concept of operations
ConOps
document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system

Note 1 to entry: It is used to communicate the quantitative and qualitative system characteristics to all stakeholders.

3.10
core system
CorSys
combination of enabling technologies and services that will provide the foundation for the support of a distributed, diverse set of *applications* (3.2)/*application* transactions which work in conjunction with external *support systems* (3.24) such as certificate authorities

Note 1 to entry: The system boundary for the *CorSys* is not defined in terms of devices or agencies or vendors, but by the open, standardized interface specifications that govern the behaviour of all interactions between *CorSys* users.

3.11
data store
permanent storehouse of data (files, databases, text documents, etc.)

3.12
end user
citizen or legal entity who exercises or benefits from the services of the transport system

3.13
equipped person(s)
persons with mobile phones, tablets or similar *communications* (3.8) devices that provide data collection and processing capacity to perform in the *C-ITS* (3.6) context

3.14
equipped vehicle(s)
vehicles equipped with the device(s) that provide the role of an *ITS-station* in the *C-ITS* (3.6) context

3.15
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

3.16
home agent
'IPv6 router' with which mobiles register their current Care-of Address (RFC 3753)

3.17
in-vehicle system
IVS
hardware, firmware and software on board a vehicle that provides a platform to support *C-ITS* (3.6) service provision, including that of the *ITS-station* (ISO 21217), its facilities layer, data pantry and on-board 'apps'

3.18
intelligent transport system
ITS
transport systems in which advanced information, *communication* (3.8), sensor and control technologies, including the Internet, are applied to increase safety, sustainability, efficiency, and comfort

3.19
ITS application
functionality that either completely provides what is required by an *ITS service* (3.21) or works in conjunction with other *ITS applications* (3.2) to provide one or more *ITS services*

3.20
ITS-s border router
ITS-S router with additional functionality that provides connectivity to other ITS *communication* (3.8) nodes over external networks

3.21
ITS service
functionality provided to surface transport system users

3.22
ITS-station
ITS-s
entity in a *communication* (3.8) network [comprised of *application* (3.2), facilities, networking and access layer components] that is capable of executing *ITS-S* application processes (sometimes within a bounded, secured, managed domain), 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

3.23
jurisdiction
government, road or traffic authority which owns the *regulatory applications* (3.2)

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

3.24
support system(s)
facilities that assist in *C-ITS* (3.6) service provision, including security credentials certificate and registration authorities, that allow devices and systems to establish trust relationships

3.25
wireline
traditional permanent 'wired' connection (although may in reality include microwave and other wireless connections)

4 Abbreviated terms

2G	second-generation cellular phone technology, e.g. GSM
3G	third-generation mobile phone technology, e.g. UMTS
4G	fourth-generation mobile phone technology, e.g. E-UTRAN (sometimes known as LTE)
BSMD	bounded secure managed domain
C-ITS	cooperative intelligent transport systems, cooperative ITS
CALM	Communications Access for Land Mobiles
ConOps	concept of operations
CorSys	core system
CVIS	Cooperative Vehicle Infrastructure Systems
DoT	Department of Transport
ESS	External System Support
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
GNSS	global navigation satellite systems
GSM	Global System for Mobile Communication (2G mobile communications)
IPv6	Internet Protocol version 6
ITS	intelligent transport systems
ITS-s	ITS-station
IVS	in-vehicle system
PII	personal identification information
RSE	roadside equipment
SatNav	Satellite Navigation (see 3.15)

TMC	transport management centres
V2I	vehicle to/from infrastructure
V2V	vehicle to vehicle
VANET	vehicular ad hoc network
VMS	variable message sign
UML	Unified Modelling Language (ISO/IEC 19501)

5 Using this Technical Report

This Technical Report is intended to assist parties instantiating a *CorSys*, becoming involved as an *actor* in a *C-ITS* (3.6) that involves the use of a *CorSys*, or becoming involved with the development or use of such a *CorSys*.

This Technical Report provides guidance on the aspects to be considered in developing a 'Concept of operations' (*ConOps*) for a *CorSys* for *C-ITS* support. As such, the advice in this Technical Report is generic and not instantiation specific to any one *jurisdiction* (3.23) or implementation.

This Technical Report is intended to provide a framework and guidance to enable the development of an instantiation specific *Conops* specification after taking into account the aspects specified herein together with the location specific situation (technical and political) and conditions.

6 Overview of the role of a 'Core System' in C-ITS

6.1 What is a Concept of operations?

A 'Concept of operations' is a user-oriented document that describes system characteristics for a proposed system from the users' viewpoint. This 'Concept of operations' describes *C-ITS* stakeholders, their roles and responsibilities in a connected vehicle-highway system paradigm, an overview of the emerging system design, and provides a high-level description of how such systems may operate.

A concept of operations document describes the systems' objectives, user needs, the functions, the *actors* (3.1) and stakeholders involved, and the enactment of roles and responsibilities. (ISO 17427-1 contains an explanation of roles and responsibilities.) A concept of operations is one of the early phases of the Systems Engineering approach. Systems Engineering is an interdisciplinary approach used to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, and then proceeding with design synthesis and system validation.

In respect of *C-ITS*, additional information can be obtained from one of the "standard" architectures such as the US 'Connected Vehicle Reference Implementation Architecture',[3] or the 'European ITS Framework (FRAME) Architecture',[12] or in the architecture document supporting a specific implementation.

It is important to understand that this 'Concept of operations' is focused on, and relates to the provision of, *CorSys* requirements that are necessary in order to facilitate and enable *C-ITS* assisted service provision. This deliverable does not consider in any depth the whole *C-ITS* perspective in a connected vehicle-highway systems paradigm (ISO/TR 17427-2 and ISO 17427-1 contains more detailed consideration of such aspects). This Technical Report is focused on the 'core' system aspects required to support *C-ITS* in a connected vehicle-highway system paradigm. This '*Core system* Concept of operations' does not provide a concept of operations for any particular *application service(s)* (3.3), but for the background facilitation and infrastructure support required for such service provision.

Much of the source material for this deliverable has been obtained from the US DoT RITA "connected Vehicle" initiative [Connected Vehicle Technology. US DoT; Connected Vehicle Reference Implementation