

**Intelligent Transport Systems (ITS);  
Communications Architecture**

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Intelligent Transport System (ITS), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

The present document is in support of early implementations. ETSI TC ITS welcomes feedback in order to facilitate future revisions.

<b>Proposed national transposition dates</b>	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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## Introduction

Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships). Elements of ITS are standardized in various standardisation organisations, both on an international level at e.g. ISO TC204, and on regional levels, e.g. in Europe at ETSI TC ITS and at CEN TC278.

The present document specifies the architecture of communications in ITS (ITSC) supporting a variety of existing and new access technologies and ITS applications. The term ITSC denotes communications protocols, related management and additional functionality. The present document is arranged as a tool-box, i.e. conformance with the present document does not require to implement the whole functionality illustrated and partly specified in the present document.

ITSC is to a large extent independent from specific communication technologies and specific ITS applications. The ITSC architecture is intended to be an open systems architecture, i.e. an architecture that is open and not proprietary.

Activities related to the scope of the present document are e.g. the European projects:

- COMeSafety (<http://www.comesafety.org>),
- COOPERS (<http://www.coopers-ip.eu>),
- CVIS (<http://www.cvisproject.org>),
- FRAME (<http://frame-online.net>),
- GeoNet (<http://www.geonet-project.eu/>),

- KAREN (<http://www.frame-online.net/home.htm>),
- Pre-Drive C2X (<http://www.pre-drive-c2x.eu>),
- SAFESPOT (<http://www.safespot-eu.org>),
- SEVECOM (<http://www.sevecom.org>),

the industry activity:

- C2C-CC (<http://www.car-to-car.org>)

the standardisation work being conducted at:

- ISO TC204 (Intelligent Transport Systems)
  - WG16 CALM (Communications Access for Land Mobiles) (<http://www.isotc204wg16.org>),
  - WG18, jointly developing standards with CEN TC278 WG16 on cooperative systems,
- IEEE 802.11 [i.1] /p and 1609 WAVE,

other research projects.

ITS applications make use of wireless communications:

- Communications between mobile ITS stations (vehicles), and between mobile ITS stations and fixed ITS stations (roadside installations), with single-hops or multiple hops between the source and destination ITS stations.
- Access to public and private (local) networks including the global Internet.
- Infrastructure and satellite broadcast.

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# 1 Scope

The present document specifies the global communication architecture of communications for Intelligent Transport Systems (ITSC). This version of the present document is dedicated to the road transport context.

The present document on the ITSC architecture specifies mandatory and optional elements and interfaces of ITSC.

Some elements of ITS applications, especially those directly related to ITSC, are also considered.

The present document is enabling different implementation architectures as presented in the informative annex B.

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# 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>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

## 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.

- [1] ETSI TS 102 636-3: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network architecture".
- [2] ETSI ES 202 663: "Intelligent Transport Systems (ITS); European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band".
- [3] ITU-T Recommendation X.901: "Information technology - Open distributed processing - Reference Model: Overview".
- [4] ISO/IEC 7498-1: "Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model".
- [5] ISO/IEC 8825-2: "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".
- [6] ISO/IEC 21210: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - IPv6 networking".
- [7] ISO/IEC 21214: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - IR medium".

- [8] ISO/IEC IS 21215: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - M5 medium".
- [9] ISO/IEC 21217: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Architecture".
- [10] ISO/IEC 21218: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Lower layer service access points".
- [11] ISO/IEC 24102: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Management".
- [12] ISO/IEC 29281: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Non-IP networking".
- [13] IEEE Standard 802-2001: "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture".

## 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] IEEE 802.11: "IEEE Standard for Information Technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements; Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".
- [i.2] IEEE 1609: "Trial-Use Standard for Wireless Access in Vehicular Environments (WAVE)".
- [i.3] CEN EN 12253: "Road transport and traffic telematics - Dedicated Short Range, Communication (DSRC) - Physical layer using microwave at 5,8 GHz".
- [i.4] CEN EN 12795: "Road transport and traffic telematics - Dedicated Short Range, Communication (DSRC) - DSRC data link layer: medium access and logical link control".
- [i.5] CEN EN 12834: "Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC application layer".
- [i.6] ETSI TS 102 636 (all parts): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking".
- [i.7] ETSI TS 102 636-6-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 6: Internet Integration; Subpart 1: Transmission of IPv6 Packets".
- [i.8] ETSI TS 102 637-2: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Co-operative Awareness Basic Service".
- [i.9] ETSI TS 102 637-3: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Application; Part 3: Specification of Decentralized Environmental Notification Basic Service".
- [i.10] ETSI TS 102 723-1: " Intelligent Transport Systems; OSI cross-layer topics; Part 1: Architecture and addressing schemes".
- [i.11] ETSI TS 102 723-2: " Intelligent Transport Systems; OSI cross-layer topics; Part 2: Management information base".
- [i.12] ETSI TS 102 723-3: "Intelligent Transport Systems; OSI cross-layer topics; Part 3: Interface between management entity and access layer".
- [i.13] ETSI TS 102 723-4: "Intelligent Transport Systems; OSI cross-layer topics; Part 4: Interface between management entity and network and transport layers".



- [i.14] ETSI TS 102 723-5: "Intelligent Transport Systems; OSI cross-layer topics; Part 5: Interface between management entity and facilities layer".
- [i.15] ETSI TS 102 723-6: "Intelligent Transport Systems; OSI cross-layer topics; Part 6: Interface between management entity and security entity".
- [i.16] ETSI TS 102 723-7: "Intelligent Transport Systems; OSI cross-layer topics; Part 7: Interface between security entity and access layer".
- [i.17] ETSI TS 102 723-8: "Intelligent Transport Systems; OSI cross-layer topics; Part 8: Interface between security entity and network and transport layers".
- [i.18] ETSI TS 102 723-9: "Intelligent Transport Systems; OSI cross-layer topics; Part 9: Interface between security entity and facilities layer".
- [i.19] ETSI TS 102 723-10: "Intelligent Transport Systems; OSI cross-layer topics; Part 10: Interface between access layer and network and transport layers".
- [i.20] ETSI TS 102 723-11: "Intelligent Transport Systems; OSI cross-layer topics; Part 11: Interface between network and transport layers and facilities layer".
- [i.21] ETSI EN 302 895: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Local Dynamic Map (LDM) Specification".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in [3], [4], [9], [10], [11], [12], [13] and the following apply:

**access layer:** OSI physical and data link layers for ITSC

**central ITS station:** ITS station in a central ITS sub-system

**central ITS sub-system:** ITS sub-system in the context of an ITS centre

**communication adaptation layer:** optional upper part of the access layer for legacy access technologies

**communication interface:** instantiation of a specific access layer technology and protocol, e.g. ITS-G5, GPRS, UMTS

**FA interface:** interface between the facilities layer and the ITS-S applications entity

**facilities layer:** OSI layers five, six and seven for ITSC

**generic domain:** collection of legacy elements used for ITS/ITSC

**IN interface:** interface between the access layer and the networking & transport layer

**inter-management communication:** ITSC station-internal communication between management entities

**in-vehicle network:** implementation of the ITS station-internal network in a vehicle

**ITS application:** association of two or more complementary ITS-S applications

**ITS domain:** collection of elements used for ITS/ITSC being specified in dedicated ITS/ITSC standards

**ITS service:** service provided by an ITS application to the user of ITS

**ITS station:** functional entity specified by the ITS station (ITS-S) reference architecture

**ITS sub-system:** sub-system of ITS with ITSC components for a specific context

**ITS-S application:** fragment of an ITS application available at an ITS station that uses ITS-S services to connect to one or more other fragments of the same ITS application

**ITS-S border router:** routing functionality based on the ITS station reference architecture connecting to legacy networking protocols

**ITS-S gateway:** gateway functionality based on the ITS station reference architecture

**ITS-S host:** functionality of the whole ITS station reference architecture, i.e. especially also including ITS-S applications

**ITS-S interceptor:** generic router/gateway functionality

**ITS-S router:** routing functionality based on the ITS station reference architecture

**ITS-S service:** communication functionality offered by an ITS-S to an ITS-S application

**MA interface:** interface between the communication and station management entity and the ITS-S applications entity

**medium:** physical entity upon which for the purpose of communications a signal is impressed or from which a signal is received, e.g. wireless (radio waves with a given frequency range and bandwidth, light with a given wave length, ultrasonics) or on a wire (electrical signal, optical signal)

**MF interface:** interface between the communication and station management entity and the facilities layer

**MI interface:** interface between the communication and station management entity and the access layer

**MN interface:** interface between the communication and station management entity and the networking & transport layer

**MS interface:** interface between the communication and station management entity and the security entity

**networking & transport layer:** OSI layers three and four for ITSC

**NF interface:** interface between the networking and transport layer and the facilities layer

**personal ITS station:** ITS station in a personal ITS sub-system

**personal ITS sub-system:** ITS sub-system in the context of an portable device for ITS

**roadside ITS station:** ITS station in a roadside ITS sub-system

**roadside ITS sub-system:** ITS sub-system in the context of roadside ITS equipment

**SA interface:** interface between the security entity and the ITS-S applications entity

**SF interface:** interface between the security entity and the facilities layer

**SI interface:** interface between the security entity and the access layer

**SN interface:** interface between the security entity and the networking & transport layer

**vehicle ITS station:** ITS station in a vehicular ITS sub-system

**vehicle ITS sub-system:** ITS sub-system in the context of a ITS equipment used in a vehicle

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in [4], [9], [10], [11], [12], [13] and the following apply:

AL	Access Layer
API	Application Programming Interface
CAL	Communication Adaptation Layer
CALM	Communications Access for Land Mobiles
CAM	Cooperative Awareness Message

CEN	Commission Européen de Normalisation
DENM	Decentralized Environmental Notification Messages
DSRC	Dedicated Short Range Communication
ECU	Electronic Control Unit
FA	name of interface between facilities layer and ITS-S applications
GPRS	General Packet Radio Service
HSM	Hardware Security Module
IETF	Internet Engineering Task Force
IN	name of interface between access layer and networking and transport layer
IP	Internet Protocol
IPv6	Internet Protocol version 6
IR	infra red incoherent light
ISO	International Standards Organisation
ITS	Intelligent Transport System
ITSC	ITS Communications
ITS-S	ITS-Station
IUMC	Inter-Unit Management Communication
IVN	In-Vehicle Network
LCH	Logical CHannel
LCH0	LCH for management communications between ITS stations
LCH1	LCH for organization of communication and initialisation of sessions (service advertisement)
LCH2	LCH for data exchange in sessions
LCHx	LCH with a defined meaning
LDM	Local Dynamic Map
MA	name of interface between management entity and ITS-S applications
MAE	management adaptation entity
MF	name of interface between management entity and facilities layer
MI	name of interface between management entity and access layer
MIB	Management Information Base
MN	name of interface between management entity and networking & transport layer
MS	name of interface between management entity and security entity
NF	name of interface between networking & transport layer and facilities layer
OBE	On-Board Equipment
PDA	Personal Digital Assistant
PDU	Protocol Data Unit
RSE	Road Side Equipment
RTTT	Road Transport and Traffic Telematics
SA	name of interface between security entity and ITS-S applications
SAE	Security Adaptation Entity
SF	name of interface between security entity and facilities layer
SI	name of interface between security entity and access layer
SIB	Security Information Base
SN	name of interface between security entity and networking & transport layer
UMTS	Universal MobileTelecommunications System

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## 4 Basics

### 4.1 Document overview

The present document specifies the global framework of ITS communications in the road transport domain, and selected technical and procedural details of general applicability. Normative references to other ITS standards will be used if applicable.

- Clause 4 specifies basic architectural elements of ITSC.
- Clause 5 specifies the general management of ITS applications with respect of ITSC.
- Clause NOTE: Further details are outside the scope of the present document.

- 6 specifies general parts of the ITSC OSI protocol stack.
- Clause 7 specifies general parts of the ITSC management entity.
- Clause 8 specifies general parts of the ITSC security entity.
- The normative annex A specifies the ASN.1 module of the present document.
- The informative annex B describes examples of possible implementations of ITS stations.

## 4.2 Severability clause

The specification of ITSC is provided by:

- the set of ITSC standards prepared by ETSI TC ITS, and
- by other standards.

Elements of these standards partly may be mandatory, and partly may be optional. Thus these standards constitute a ITSC tool-box.

## 4.3 ITSC design principles

ITSC is a new type of communication system dedicated to transportation scenarios, e.g. as illustrated in figure 1. It is based on two domains:

- ITS domain; and
- Generic domain.

"ITS domain" refers to all elements of ITSC which are specified in ITS/ITSC standards. "Generic domain" refers to other elements used for ITS/ITSC.

NOTE 1: In ISO TC204 WG16 these two domains are distinguished by the terms "CALM-aware" (= ITS domain) and "Non-CALM-aware" (= generic domain).