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**Inteligentni transportni sistemi (ITS) - Komunikacijska arhitektura**

Intelligent Transport Systems (ITS) - Communications Architecture

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*European Standard (Telecommunications series)*

## 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).

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

| National transposition dates | |
|---|---|
| Date of adoption of this EN: | 17 September 2010 |
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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),

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- GeoNet (http://www.geonet-project.eu/),
- KAREN (http://www.frame-online.net/),
- 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.

# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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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

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[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".

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[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 necessary for the application of the present document but they assist the user with regard to a particular subject area.

[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".

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[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".

# 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

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**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

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**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

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**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 & 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

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## 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 & 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 |

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| | |
|---|---|
| IUMC | Inter-Unit Management Communication |
| IVN | In-Vehicle Network |
| LCH | Logical CHannel |
| LCH0 | LCH number 0 for management communications between ITS stations |
| LCH1 | LCH number 1 for organization of communication and initialisation of sessions (service advertisement) |
| LCH2 | LCH number 2 for data exchange in sessions |
| LCHx | LCH number x 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 |
| 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

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## 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 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.