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Inteligentni transportni sistemi (ITS) - Specifikacija dostopovne plasti pri inteligentnih transportnih sistemih, ki delujejo v frekvenčnem pasu 5 GHz

Intelligent Transport Systems (ITS) - Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band

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Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

National transposition dates	
Date of adoption of this EN:	2 July 2013
Date of latest announcement of this EN (doa):	31 October 2013
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 April 2014
Date of withdrawal of any conflicting National Standard (dow):	30 April 2014

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Introduction

The present document is outlining the two lowest layers - physical layer and data link layer - in the protocol stack for supporting vehicle-to-vehicle communications in an *ad hoc* network to be used at the 5,9 GHz frequency band allocated in Europe. The two lowest layers are termed access layer in the present document and the technology specified for the access layer is collectively called ITS-G5. The ITS-G5 standard is using already existing standards for communications. The data link layer is divided into two sublayers; medium access control and logical link control. The physical layer and the medium access control layer are covered in IEEE 802.11-2012 [3]. The logical link control is based on the IEEE/ISO/IEC 8802-2-1998 [5]. The ITS-G5 standard also adds features for decentralized congestion control (DCC) methods TS 102 687 [8] to control the network load and avoid unstable behaviour.

By setting the management information base (MIB) parameter `dot11OCBActivated` to true in IEEE 802.11-2012 [3] a new capability is introduced namely the possibility to communicate outside the context of a basic service set (BSS), which is the smallest building block of a 802.11 network. Communication outside the BSS implies that neither authentication/association procedures nor security mechanisms are supported. Further, no access point functionality is present. The disable of these features also affects other built-in features of IEEE 802.11-2012 [3]. The requirement that nodes should share a common clock is no longer valid while `dot11OCBActivated` is true. Further, scanning of available frequency channels for joining a BSS is also disabled implying that communication outside the context of the BSS requires that a node is configured for a predetermined frequency channel where more information about other available frequency channels can be obtained.

NOTE: IEEE has compiled a new version of the 802.11 standard where all approved amendments produced between 2007 and 2011 have been enrolled in the base standard including 802.11p. This new version called IEEE 802.11-2012 [3] was approved in March 2012. Due to this new version of 802.11 the 802.11p amendment is classified as superseded.

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1 Scope

The scope of the present document is to define the two lowest layers, physical layer and the data link layer, grouped into the access layer of the ITS station reference architecture EN 302 665 [i.8]. The access layer technology that is specified in the present document is collectively called ITS-G5. It is part of the communication stack supporting data exchange between mobile stations without prior network set-up, i.e. *ad hoc* mode, for the following frequency bands in Europe:

- ITS-G5A: Operation of ITS-G5 in European ITS frequency bands dedicated to ITS for safety related applications in the frequency range 5,875 GHz to 5,905 GHz.
- ITS-G5B: Operation in European ITS frequency bands dedicated to ITS non-safety applications in the frequency range 5,855 GHz to 5,875 GHz.
- ITS-G5D: Operation of ITS applications in the frequency range 5,905 GHz to 5,925 GHz.

The ITS-G5 technology is based on IEEE 802.11-2012 [3] and IEEE/ISO/IEC 8802-2-1998 [5]. By setting the MIB variable `dot11OCBActivated` to true in IEEE 802.11-2012 [3] communication outside the context of a BSS is possible. This type of communication allows for immediate exchange of data frames, avoiding the management overhead used with the establishment of a network. All requirements in IEEE 802.11-2012 [3] associated with communication "outside the context of a BSS" are also requirements in the present document. All optional functionality in IEEE 802.11-2012 [3] associated with communication "outside the context of a BSS" is also optional in the present document.

2 References

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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

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 302 571 (V1.1.1): "Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[2] ETSI TS 102 792 (V1.1.1): "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".

[3] IEEE 802.11-2012: "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".

[4] IEEE 802-2001: "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture".

[5] IEEE/ISO/IEC 8802-2-1998: "Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 2: Logical Link Control".

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[6] ISO/IEC 7498-1:1994: "Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model".

[7] Recommendation ITU-T X.691 (2008): "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".

[8] ETSI TS 102 687 (V1.1.1): "Intelligent Transport Systems (ITS); Decentralized Congestion Control Mechanisms for Intelligent Transport Systems operating in the 5 GHz range; Access layer part".

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] ETSI EN 300 674 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band".

[i.2] ECC/REC/(08)01: "ECC Recommendation (08)01 on the use of the band 5855-5875 MHz for Intelligent Transport Systems (ITS)".

[i.3] ERC/DEC(99)23: "ERC Decision of 29 November 1999 on the harmonised frequency bands to be designated for the introduction of High Performance Radio Local Area Networks (HIPERLANs)".

[i.4] ECC/DEC(02)01: "ECC Decision of 15 March 2002 on the frequency bands to be designated for the co-ordinated introduction of Road Transport and Traffic Telematic Systems".

[i.5] Commission Decision 2005/513/EC of 11 July 2005 on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs).

[i.6] Commission Decision 2007/90/EC of 12 February 2007 amending Decision 2005/513/EC on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs).

[i.7] Commission Decision 2008/671/EC of 5 August 2008 on the harmonised use of radio spectrum in the 5 875-5 905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS).

[i.8] ETSI EN 302 665 (V1.1.1): "Intelligent Transport Systems (ITS); Communications Architecture".

[i.9] ETSI TS 102 724 (V0.0.11): "Intelligent Transport Systems (ITS); Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band".

[i.10] ANSI/IEEE Std 802.1D 1998: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Common specifications- Part 3: Media Access Control (MAC) Bridges".

[i.11] IEEE 802.11p-2010: "IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments".

[i.12] IEEE 802.11a-1999: "IEEE Standard for Telecommunications and Information Exchange Between Systems - LAN/MAN Specific Requirements - Part 11: Wireless Medium Access Control (MAC) and physical layer (PHY) specifications: High Speed Physical Layer in the 5 GHz band".

[i.13] IEEE 802.11e-2005: "IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment: Medium Access Method (MAC) Quality of Service Enhancements".

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[i.14] ETSI EN 301 893 (V1.5.1): "Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.15] ETSI EN 302 502 (V1.2.1): "Broadband Radio Access Networks (BRAN); 5,8 GHz fixed broadband data transmitting systems; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 302 571 [1], TS 102 792 [2], IEEE 802.11-2012 [3], IEEE 802-2001 [4], IEEE/ISO/IEC 8802-2-1998 [5], ISO/IEC 7498-1 [6], Recommendation ITU-T X.691 [7] and the following apply:

ethertype: identifier to the network protocol above the data link layer

ITS-G5: access technology to be used in frequency bands dedicated for European intelligent transport System (ITS)

ITS-G5 Control Channel: physical channel for ITS-G5

ITS-G5 Service Channel: physical channel for ITS-G5

ITS-G5 Station: ITS station that operates using ITS-G5 channels

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3.2 Symbols

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

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aCWmax	Maximum value of Contention Window
aCWmin	Minimum value of Contention Window
AIFS	Arbitration InterFrame Space
AIFSN	Arbitration InterFrame Space Number
aSIFSTime	Short InterFrame Space defined by the physical layer
aSlotTime	A slot time defined by the physical layer
CW	Contention Window
CW_{max}	Maximum value of Contention Window
CW_{min}	Minimum value of Contention Window

3.3 Abbreviations

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

AC	Access Category
AC_BE	Access Category Best Effort
AC_BK	Access Category Background
AC_VI	Access Category Video
AC_VO	Access Category Voice
ACK	Acknowledgment
AIFS	Arbitration InterFrame Space
AIFSN	Arbitration InterFrame Space Number
AP	Access Point
BE	Best Effort
BK	Background
BPSK	Binary Phase Shift Keying
BRAN	Broadband Radio Access Network
BSS	Basic Service Set

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BSSID	Basic Service Set Identification
CCH	Control Channel
CEN	European Committee for Standardisation
CSMA/CA	Carrier Sense Multiple Access with Collision Avoidance
CW	Contention Window
DCC	Decentralized Congestion Control
DCF	Distributed Coordination Function
DFS	Dynamic Frequency Selection
DIFS	Distributed InterFrame Space
DSRC	Dedicated Short-Range Communication
ECC	Electronic Communication Committee
EDCA	Enhanced Distribution Coordination Access
EE	Excellent Effort
EIRP	Effective Isotropic Radiated Power
EN	European Norm
G5-CCH	ITS-G5 Control Channel
G5-SCH	ITS-G5 Service Channel
GPS	Global Positioning System
IBSS	Independent Basic Service Set
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transport System
ITS-G5A	Frequency band ranging from 5 875 MHz to 5 905 MHz
ITS-G5B	Frequency band ranging from 5 855 MHz to 5 875 MHz
ITS-G5C	Frequency band ranging from 5 470 MHz to 5 725 MHz
ITS-G5D	Frequency band ranging from 5 905 MHz to 5 925 MHz
LLC	Logical Link Control
MAC	Medium Access Control
MIB	Management Information Base
MPDU	MAC Protocol Data Unit
NC	Network Control
OFDM	Orthogonal Frequency Division Multiplexing
OSI	Open Systems Interconnect
PHY	Physical layer
PLCP	Physical Layer Convergence Protocol
PPDU	PLCP Protocol Data Unit
PSDU	PLCP Service Data Unit
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RLAN	Radio Local Area Network
SNAP	SubNetwork Access Protocol
TPC	Transmit Power Control
TR	Technical Report
TS	Technical Specification
TX	Transmitter
UP	User Priority
VI	Video
VO	Voice
WLAN	Wireless Local Area Network

4 General requirements

4.1 Architecture

Figure 1 shows the ITS station reference architecture EN 302 665 [i.8]. The present document specifies one access technology for cooperative ITS namely ITS-G5 based on IEEE 802.11-2012 [3]. The access layer of the ITS station reference architecture includes both the physical layer and the data link layer of the OSI model.

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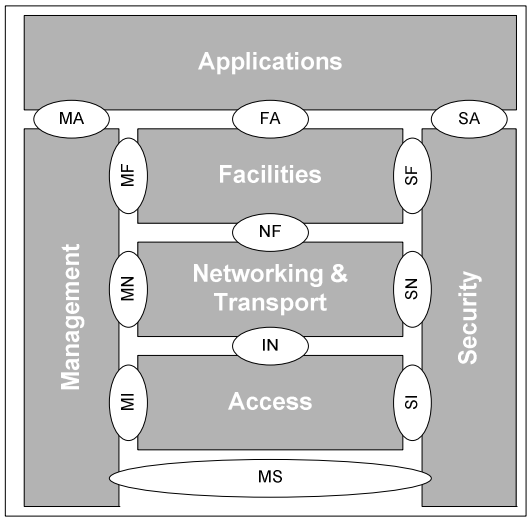

Figure 1: ITS station reference architecture

In Figure 2 the ITS-G5 access layer architecture is outlined. The security entity shown in Figure 1 is included as a part of the management entity EN 302 665 [i.8].

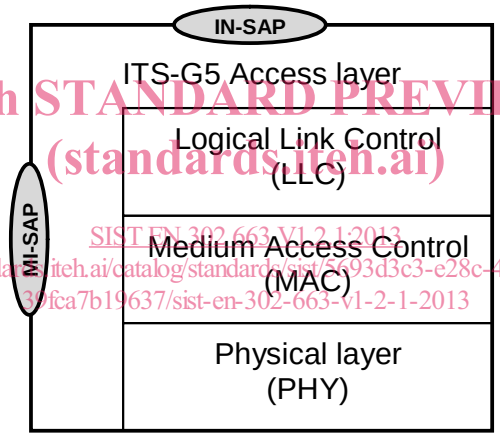

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Figure 2: ITS-G5 access layer architecture

An ITS-G5 station shall be compliant with the following IEEE standards:

1) The physical (PHY) layer orthogonal frequency division multiplexing (OFDM) as defined in clause 18 of IEEE 802.11-2012 [3].

2) The medium access control (MAC) layer functionality as defined in IEEE 802.11-2012 [3] by setting the MIB parameter `dot11OCBActivated` to true enabling communication outside the context of a basic service set (BSS).

3) The logical link control (LLC) as defined in IEEE/ISO/IEC 8802-2-1998 [5] and the mode of operation is set to Type 1 - unacknowledged connectionless mode.

4) The subnetwork access protocol (SNAP) as defined in IEEE 802-2001 [4].

An ITS-G5 station shall comply to the functionality defined in clause 5 ITS-G5 Access layer.

The SNAP provides the possibility to distinguish between different network protocols through EtherTypes.

In annex B an informative introduction to IEEE 802.11-2012 [3], where the MIB parameter `dot11OCBActivated` is set to true, is given to facilitate the reading of the present document.