

IEEE Standard for Wireless Access in Vehicular Environments (WAVE)— Networking Services

IEEE Vehicular Technology Society

Sponsored by the
Intelligent Transportation Systems Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 1609.3™-2016
(Revision of
IEEE Std 1609.3-2010)

IEEE Std 1609.3™-2016

(Revision of
IEEE Std 1609.3-2010)

IEEE Standard for Wireless Access in Vehicular Environments (WAVE)— Networking Services

Sponsor

**Intelligent Transportation Systems Committee
of the
IEEE Vehicular Technology Society**

Approved 29 January 2016

IEEE-SA Standards Board

Abstract: Services to WAVE devices and systems are provided in IEEE Std 1609.3™, IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services. Layer 3 and layer 4 of the open system interconnect (OSI) model and the Internet Protocol (IP), User Datagram Protocol (UDP), and Transmission Control Protocol (TCP) elements of the Internet model are represented. Management and data services within WAVE devices are provided.

Keywords: IEEE 1609.3™, Provider Service Identifier (PSID), WAVE Service Advertisement (WSA), WAVE Short Message (WSM), Wireless Access in Vehicular Environments (WAVE)

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2016 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 29 April 2016. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-0763-2 STD20839
Print: ISBN 978-1-5044-0764-9 STDPD20839

IEEE prohibits discrimination, harassment, and bullying.

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at <http://ieeexplore.ieee.org/xpl/standards.jsp> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <http://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this IEEE standard was completed, the P1609 Working Group had the following membership:

Thomas M. Kurihara, *Chair*
Justin McNew, John Moring, William Whyte, *Vice Chairs*

Mike Brown	Carl Kain	Randy Roebuck
Hanbyeog Cho	John Kenney	Richard Roy
Hans-Joachim Fischer	Bill Lattin	Kevin Smith
Ramez Gerges	Jules Madey	Jasja Tijink
Aleksandar Gogic	Sean Maschue	Michaela Venderveen
Shubha Gopalakrishna	Jim Misener	George Vlantis
Gloria Gwynne	Frank Perry	Jason Wang
Ronald Hochnadel		Aaron Weinfield

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

Iwan Adicandra	Noriyuki Ikeuchi	Richard Roy
Nobumitsu Amachi	Piotr Karocki	Osman Sakr
Lee Armstrong	John Kenney	Bartien Sayogo
Harry Bims	Stuart Kerry	Kevin Smith
William Byrd	Dmitri Khijniak	Rene Struik
Keith Chow	Thomas M. Kurihara	Walter Struppler
Sourav Dutta	Paul Lambert	Gerald Stueve
Richard Edgar	Jeremy Landt	Jasja Tijink
Marc Emmelmann	Justin McNew	Steven Tilden
Pedro Fernandes	John Moring	Thomas Tullia
Randall Groves	Michael Newman	John Vergis
Gloria Gwynne	Alexandros Nikitas	George Vlantis
Ronald Hochnadel	Satoshi Oyama	Hung-Yu Wei
Werner Hoelzl	Venkatesha Prasad	William Whyte
David Hunter	Alon Regev	Oren Yuen

When the IEEE-SA Standards Board approved this standard on 29 January 2016, it had the following membership:

Jean-Philippe Faure, *Chair*
Vacant position, *Vice Chair*
John Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Chuck Adams	Ronald W. Hotchkiss	Mehmet Ulema
Masayuki Ariyoshi	Michael Janezic	Yingli Wen
Ted Burse	Joseph L. Koepfinger*	Philip Winston
Stephen Dukes	Hung Ling	Howard Wolfman
Jianbin Fan	Kevin Lu	Don Wright
J. Travis Griffith	Annette D. Reilly	Yu Yuan
Gary Hoffman	Gary Robinson	Daidi Zhong

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 1609.3™-2016, IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services.

A WAVE system is a radio communications system intended to provide seamless, interoperable services to transportation. These services include those recognized by the U.S. National Intelligent Transportation Systems (ITS) Architecture [B7]^a and many others contemplated by the automotive and transportation infrastructure industries. These services include vehicle-to-roadside communication, vehicle-to-vehicle communications, and potentially communication among other devices. Networking Services provides services to WAVE devices and systems. Layer 3 and layer 4 of the open system interconnect (OSI) model and the Internet Protocol (IP), User Datagram Protocol (UDP), and Transmission Control Protocol (TCP) elements of the Internet model are represented. Management and data services within WAVE devices are provided. Network Services is but one component in the overall WAVE architecture, which is described in IEEE Std 1609.0™.

^a The numbers in brackets correspond to those of the bibliography in Annex A.

Contents

1. Overview	10
1.1 Scope	10
1.2 Purpose	11
1.3 System overview.....	11
1.4 Applicability	11
1.5 Conformance	11
1.6 Document conventions	12
2. Normative references.....	12
3. Definitions, acronyms, and abbreviations	13
3.1 Definitions	13
3.2 Acronyms and abbreviations	15
4. General description.....	17
4.1 Overview	17
4.2 Data services.....	18
4.3 Management services.....	18
5. Data plane.....	19
5.1 General	19
5.2 Logical link control	20
5.3 Internet Protocol version 6.....	20
5.4 Other IP-based protocols	20
5.5 WAVE Short Message Protocol (WSMP).....	21
6. Management plane.....	22
6.1 General	22
6.2 Service requests and channel access assignment	22
6.3 WAVE Service Advertisement monitoring	34
6.4 IPv6 configuration	35
6.5 MIB maintenance	36
7. Service primitives.....	36
7.1 General	36
7.2 Channel identification.....	38
7.3 WSM SAP	38
7.4 WME SAP	42
7.5 WAVE LSAP	56
7.6 MLME and MLMEX SAPs.....	57
7.7 Sec SAP	58
8. WAVE information formats	58
8.1 General	58
8.2 WAVE Service Advertisement (WSA) format.....	60
8.3 WAVE Short Message (WSM) format.....	70
Annex A (informative) Bibliography	76
Annex B (informative) WME MIB table.....	77

Annex C (normative) ASN.1 encoding of the WME MIB	80
Annex D (normative) Protocol Implementation Conformance Statement (PICS) proforma	118
Annex E (informative) Service usage examples	122
E.1 Provider service request	122
E.2 User service request with automatic channel assignment	122
E.3 User service request with notification	123
E.4 MIB monitoring by higher layer in support of user service request	124
E.5 Multi-PHY and multi-channel operation	125
E.6 Unconditional user service request	126
Annex F (normative) Allocated WAVE Information Element IDs	128
Annex G (informative) Packet format examples	129
G.1 WSA example	129
G.2 WSM example	134
Annex H (normative) IEEE Std 1609.2 security specification for WSA	135
H.1 WSA	135
Annex I (informative) General WSA security considerations	142
Annex J (informative) ASN.1 specifications for WAVE extension elements	143
J.1 General	143
J.2 ASN.1 module IEEE-1609-3-WEE	143
J.3 Explanations and further requirements	146
Annex K (informative) ASN.1 specifications for WSM	147
K.1 General	147
K.2 ASN.1 module IEEE-1609-3-WSM	147
K.3 Explanations and further requirements	152
Annex L (informative) ASN.1 specifications for WSA	154
L.1 General	154
L.2 ASN.1 module IEEE-1609-3-WSM	154
L.3 Explanations and further requirements	158

IEEE Standard for Wireless Access in Vehicular Environments (WAVE)— Networking Services

IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.

1. Overview

A WAVE system is a radio communications system intended to provide interoperable services to transportation. These services include those recognized by the U.S. National Intelligent Transportation Systems (ITS) Architecture and many others contemplated by the automotive and transportation infrastructure industries. These services include communications between vehicles and roadside units, vehicles and other vehicles, and perhaps communications among other WAVE devices. WAVE Networking Services provide management services and data delivery services between WAVE devices. Networking Services is but one component in the overall WAVE architecture, which includes IEEE Std 1609.2TM,¹ IEEE Std 1609.4TM, and IEEE Std 802.11TM. The WAVE architecture is described in IEEE Std 1609.0TM.

1.1 Scope

The scope of this standard is to define services, operating at the network and transport layers, in support of wireless connectivity among vehicle-based devices, and between fixed roadside devices and vehicle-based devices using the 5.9 GHz Dedicated Short Range Communications/Wireless Access in Vehicular Environments (DSRC/WAVE) mode.

¹ Information on references can be found in Clause 2.