

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

Amendment 5: Television White Spaces (TVWS) Operation

IEEE Computer Society

Sponsored by the

LAN/MAN Standards Committee

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

IEEE Std 802.11af™-2013
(Amendment to
IEEE Std 802.11™-2012,
as amended by IEEE Std 802.11ae™-2012,
IEEE Std 802.11aa™-2012,
IEEE Std 802.11ad™-2012,
and IEEE Std 802.11ac™-2013)

IEEE Std 802.11af™-2013

(Amendment to
IEEE Std 802.11™-2012,
as amended by IEEE Std 802.11ae™-2012,
IEEE Std 802.11aa™-2012,
IEEE Std 802.11ad™-2012,
and IEEE Std 802.11ac™-2013)

**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**

**Amendment 5: Television White Spaces (TVWS)
Operation**

Sponsor

**LAN/MAN Standards Committee
of the
IEEE Computer Society**

Approved 11 December 2013

IEEE-SA Standards Board

Abstract: Enhancements to the IEEE 802.11 physical layers (PHYs) and medium access control (MAC) sublayer to support operation in the white spaces in television bands are defined.

Keywords: IEEE 802.11af™, television white spaces, TVWS, wireless LAN, WLAN

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

Copyright © 2014 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 21 February 2014. Printed in the United States of America.

IEEE and 802 are registered trademarks in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-0-7381-8748-8 STD98455
Print: ISBN 978-0-7381-8749-5 STDPD98455

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 amendment was completed, the IEEE 802.11 Working Group had the following officers:

Bruce P. Kraemer, *Chair*
Jon W. Rosdahl and **Adrian P. Stephens**, *Vice-chairs*
Stephen McCann, *Secretary*

At the time this amendment was submitted for balloting, the TV White Space Operation Task Group had the following membership:

Richard H. Kennedy, *Chair*
Peter Ecclesine, *Vice Chair and Technical Editor*
Zhou Lan, *Vice Chair and Secretary*

Osama S. Aboulmagd
Santosh P. Abraham
Roberto Aiello
Thomas Alexander
Peiman Amini
Sirikiat Lek Ariyavisitakul
Lee R. Armstrong
Yusuke Asai
Alex Ashley
Kwok Shum Au
Vijay Auluck
Stefan Aust
Geert A. Awater
David Bagby
Eugene Baik
Gabor Bajko
Raja Banerjea
Phillip Barber
Anuj Batra
Tuncer Baykas
Alan Berkema
Bijoy Bhukania
Philippe Boucachard
Andre Bourdoux
John Buffington
Lin Cai
George Calcev
Chris Calvert
Radhakrishna Canchi
Laurent Cariou
William Carney
Jaesun Cha
Romana Challans
Philippe Chambelin
Kim Chang
Kuor-Hsin Chang
Xin Chang
Clint F. Chaplin
Bin Chen
Lidong Chen
Minho Cheong
George Cherian
Rojan Chitrakar
Jinsoo Choi
Li Chia Choo

Sayantana Choudhury
Liwen Chu
Jinyoung Chun
John Coffey
Kenneth Coop
Carlos Cordeiro
Neiyer Correal
Subir Das
Hendricus De Ruijter
Rolf J. de Vegt
Yohannes Demessie
Xiandong Dong
Klaus Doppler
Roger P. Durand
Richard Edgar
Marc Emmelmann
Vinko Erceg
Ping Fang
Qin Fei
Stanislav Filin
Matthew J. Fischer
George Flammer
Chittabrata Ghosh
James P. K. Gilb
Reinhard Gloger
Daning Gong
David Goodall
Elad Gottlieb
Sudheer A. Grandhi
Stephen Grau
Michael Grigat
David Halasz
Mark Hamilton
Christopher J. Hansen
Hiroshi Harada
Dan N. Harkins
Brian D. Hart
Ahmadreza Hedayat
Robert F. Heile
Jerome Henry
Ken Hiraga
Chin Keong Ho
Anh Tuan Hoang
Dien Hoang
Jing-Rong Hsieh

David Hunter
Sung Hyun Hwang
Yasuhiko Inoue
Mitsuru Iwaoka
Sungeun Jin
Zhong Yi Jin
Nihar Jindal
Vince Jones
Jari Junell
Padam Kafle
Carl W. Kain
Hyunduk Kang
Mika Kasslin
Shuzo Kato
Stuart J. Kerry
Bonghoe Kim
Byoung-Hoon Kim
Eun Sun Kim
Eunkyung Kim
Jeongki Kim
Joonsuk Kim
Suhwook Kim
Taejoon Kim
Youhan Kim
Youngsoo Kim
Shoichi Kitazawa
Tero Kivinen
Jarkko Knecht
Gwangzeen Ko
Fumihide Kojima
Tom Kolze
Timo Koskela
Thomas M. Kurihara
Jin-Sam Kwak
Joseph Kwak
Young Hoon Kwon
Paul Lambert
Leonardo Lanante
James Lansford
Anseok Lee
Donghun Lee
Jae Seung Lee
Wookbong Lee
Zhongding Lei
Wai Kong Leung

Joseph Levy
Feng Li
Huan-Bang Li
Lingjie Li
Yunbo Li
Yunzhou Li
Erik Lindskog
Jianhan Liu
Yong Liu
Peter Loc
Long Luo
Yi Luo
Zhendong Luo
Kaiying Lv
Michael Lynch
Jouni K. Malinen
Hiroshi Mano
Simone Merlin
James Miller
Apurva Mody
Michael Montemurro
Kenichi Mori
Hitoshi Morioka
Ronald Murias
Andrew Myles
Yukimasa Nagai
Yuhei Nagao
Hiroki Nakano
Sai Shankar Nandagopalan
Pradeep Nemavat
Chiu Ngo
Paul Nikolich
Hiroyo Ogawa
Minseok Oh
Min-Seok Oh
David Olson
Satoshi Oyama
Michael J. Paljug
Santosh Ghanshyam Pandey
Anna Pantelidou
Giwon Park
Jonghyun Park
Minyoung Park
Seung-Hoon Park
Jaya Shankar Pathmasuntharam
Sandhya Patil
Xiaoming Peng
Eldad Perahia
James E. Petranovich
Albert Petrick
John Petro
Krishna Madhavan Pillai
Riku Pirhonen
Juho Pirskanen

Vishakan Ponnampalam
Daniel Popa
Ron Porat
Henry S. Ptasinski
Rethnakaran Pulikkoonattu
Chang-Woo Chang Pyo
Emily H. Qi
Huyu Qu
Harish Ramamurthy
Jayaram Ramasastry
Ivan Reede
Edward Reuss
Maximilian Riegel
Mark Rison
Kiseon Ryu
Kazuyuki Sakoda
Ruben Salazar Cardozo
Hemanth Sampath
Sigurd Schelstraete
Timothy Schmidl
Jean Schwoerer
Jonathan Segev
Cristina Seibert
Yongho Seok
Kunal Shah
Huairong Shao
Nir Shapira
Stephen J. Shellhammer
Ian Sherlock
Wei Shi
Nobuhiko Shibagaki
Shusaku Shimada
Thomas M. Siep
Michael Sim
Dwight Smith
Graham Kenneth Smith
Ill Soo Sohn
Robert Stacey
Dorothy Stanley
Rene Struik
Jung Hoon Suh
Chin-Sean Sum
Bo Sun
Chen Sun
Sheng Sun
Mohammad Hossein Taghavi
Kazuaki Takahashi
Mineo Takai
Sagar Tamhane
Joseph Teo
Thomas Tetzlaff
Jerry Thrasher
Jens Tingleff

Fei Tong
Solomon B. Trainin
Ha Nguyen Tran
Kazuyoshi Tsukada
Masahiro Umehira
Richard D. J. Van Nee
Allert Van Zelst
Prabodh Varshney
Sameer Vermani
Dalton T. Victor
Gabriel Villardi
George A. Vlantis
Chao Chun Wang
Haiguang Wang
James June Wang
Lei Wang
Qi Wang
Xuehuan Wang
Lisa Ward
Fujio Watanabe
Lei Wen
Menzo M. Wentink
Nicholas West
Eric Wong
Ian Wong
Harry R. Worstell
Tianyu Wu
Zhanji Wu
Xun Yang
Yunsong Yang
James Yee
Peter Yee
Wai-Leong Yeow
Kaoru Yokoo
Su Khiong Yong
Chanho Yoon
Christopher Young
Heejeung Yu
Zhan Yu
Tevfik Yucek
Katsuo D. A. Yunoki
Dezhi Zhang
Hongyuan Zhang
Junjian Zhang
Mu Zhao
Jun Zheng
Shoukang Zheng
Mingtuo Zhou
Chunhui Zhu
Yan Zhuang
Lawrence Zuckerman

Major contributions were received from the following individuals:

Vinko Erceg
Padam Kafle
Eun Sun Kim
Zhou Lan

Wookbong Lee
Dongguk Lim
Ron Porat
Yongho Seok

Jae-Hyung Song
Chen Sun
Jens Tingleff
Tevfik Yucek

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

Tomoko Adachi	Noriyuki Ikeuchi	John Notor
Thomas Alexander	Sergiu Iordanescu	Robert O'Hara
Nobumitsu Amachi	Akio Iso	Satoshi Oyama
Butch Anton	Atsushi Ito	Brian Phelps
Lee R. Armstrong	Mitsuru Iwaoka	Clinton Powell
Kwok Shum Au	Raj Jain	Venkatesha Prasad
Stefan Aust	Bobby Jose	Michael Probasco
Tuncer Baykas	Padam Kafle	Demir Rakanovic
Harry Bims	Shinkyō Kaku	Jayaram Ramasastry
Gennaro Boggia	Hyunduk Kang	Ivan Reede
Nancy Bravin	Piotr Karocki	Maximilian Riegel
John Buffington	Assaf Kasher	Robert Robinson
William Byrd	Ruediger Kays	Benjamin Rolfe
William Carney	Richard H. Kennedy	Jon W. Rosdahl
Juan Carreon	John Kenney	John Santhoff
Dave Cavalcanti	Jeritt Kent	Shigenobu Sasaki
Wei-Peng Chen	Stuart J. Kerry	Naotaka Sato
Paul Chiuchiolo	Yongbum Kim	Yongho Seok
Sayantan Choudhury	Youhan Kim	Ian Sherlock
Keith Chow	Gwangzeen Ko	Shusaku Shimada
Charles Cook	Bruce P. Kraemer	Tsuyoshi Shimomura
Neiyer Correal	Thomas M. Kurihara	Ju-Hyung Son
Joseph Decuir	Zhou Lan	Chunyi Song
Michael Denson	Jeremy Landt	Kapil Sood
Patrick Diamond	James Lansford	Amjad Soomro
Roger P. Durand	Wookbong Lee	Robert Stacey
Sourav Dutta	James Lepp	Thomas Starai
Peter Ecclesine	Jean-Pierre Le Rouzic	Adrian P. Stephens
Richard Edgar	Arthur H. Light	Rene Struik
Charles Einolf	Chih-Che Lin	Walter Struppler
Marc Emmelmann	Lu Liru	Gary Stuebing
David Evans	Philip Lunsford	Chandrasekaran Subramaniam
Stanislav Filin	Greg Luri	Chin-Sean Sum
Avraham Freedman	Michael Lynch	Bo Sun
Stefano Galli	Chris Lyttle	Thomas Tetzlaff
Matthew Gast	Elvis Maculuba	Jens Tingleff
Devon Gayle	Jouni K. Malinen	Keat Beng Toh
Pieter-Paul Giesberts	James Marin	Fei Tong
James P. K. Gilb	Roger Marks	Ha Nguyen Tran
Tim Godfrey	Jeffery Masters	Kazuyoshi Tsukada
David Goodall	Stephen McCann	Lorenzo Vangelista
Sudheer A. Grandhi	Neal Mellen	Allert Van Zelst
Randall Groves	Steven Methley	Dmitri Varsanofiev
Michael Gundlach	James Miller	Prabodh Varshney
Gloria Gwynne	David Mitton	George A. Vlantis
Rainer Hach	Keiichi Mizutani	Khurram Waheed
David Halasz	Apurva Mody	Thomas Wandeloski
Mark Hamilton	Michael Montemurro	James June Wang
Christopher J. Hansen	Kenichi Mori	Lei Wang
Hiroshi Harada	Ronald Murias	Stephen Webb
Jerome Henry	Rick Murphy	Hung-Yu Wei
Marco Hernandez	Peter Murray	James Yee
Dien Hoang	Andrew Myles	Oren Yuen
Werner Hoelzl	Nabil Nasser	Hongyuan Zhang
David Howard	Michael Newman	Daidi Zhong
David Hunter	Nick S. A. Nikjoo	Mingtuo Zhou
	Paul Nikolich	

When the IEEE-SA Standards Board approved this standard on 11 December 2013, it had the following membership:

John Kulick, *Chair*
David J. Law, *Vice Chair*
Richard H. Hulett, *Past Chair*
Konstantinos Karachalios, *Secretary*

Masayuki Ariyoshi
Peter Balma
Farooq Bari
Ted Burse
Stephen Dukes
Jean-Philippe Faure
Alexander Gelman

Mark Halpin
Gary Hoffman
Paul Houzé
Jim Hughes
Michael Janezic
Joseph L. Koepfinger*
Oleg Logvinov
Ron Petersen

Gary Robinson
Jon Walter Rosdahl
Adrian Stephens
Peter Sutherland
Yatin Trivedi
Phil Winston
Yu Yuan

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Richard DeBlasio, *DOE Representative*
Michael Janezic, *NIST Representative*

Catherine Berger
IEEE Standards Program Manager, Document Development

Kathryn Bennett
IEEE Standards Program Manager, Technical Program Development

Introduction

This introduction is not part of IEEE Std 802.11af™-2013, 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—Amendment 5: Television White Spaces (TVWS) Operation.

This amendment defines enhancements to the IEEE 802.11 physical layers (PHYs) and medium access control (MAC) sublayer to support operation in the white spaces in television bands.

Contents

2.	Normative references	2
3.	Definitions, acronyms, and abbreviations.....	2
3.1	Definitions	2
3.2	Definitions specific to IEEE 802.11	2
3.2a	Definitions specific to IEEE 802.11 operation in some regulatory domains.....	4
3.3	Abbreviations and acronyms	7
3.4	Abbreviations and acronyms in some regulatory domains	7
4.	General description	8
4.3	Components of IEEE 802.11 architecture	8
4.3.10a	Very high throughput (VHT) STA	8
4.3.10b	Television very high throughput (TVHT) STA	8
4.3.19	Operation under geolocation database (GDB) control	9
6.	Layer management.....	12
6.3	MLME SAP Interface	12
6.3.3	Scan.....	12
6.3.3.3	MLME-SCAN.confirm.....	12
6.3.95	Channel Availability Query	12
6.3.95.1	Introduction.....	12
6.3.95.2	MLME-CHANNELAVAILABILITYQUERY.request	12
6.3.95.3	MLME-CHANNELAVAILABILITYQUERY.confirm	13
6.3.95.4	MLME-CHANNELAVAILABILITYQUERY.indication	14
6.3.95.5	MLME-CHANNELAVAILABILITYQUERY.response	15
6.3.96	Channel schedule management.....	16
6.3.96.1	Introduction.....	16
6.3.96.2	MLME-CHANNELSCHEDULEMANAGEMENT.request.....	17
6.3.96.3	MLME-CHANNELSCHEDULEMANAGEMENT.confirm.....	17
6.3.96.4	MLME-CHANNELSCHEDULEMANAGEMENT.indication	18
6.3.96.5	MLME-CHANNELSCHEDULEMANAGEMENT.response	19
6.3.97	Contact Verification Signal	20
6.3.97.1	Introduction.....	20
6.3.97.2	MLME-CVS.request.....	20
6.3.97.3	MLME-CVS.indication	21
6.3.98	GDD Enablement.....	22
6.3.98.1	Introduction.....	22
6.3.98.2	MLME-GDDENABLEMENT.request.....	22
6.3.98.3	MLME-GDDENABLEMENT.confirm.....	23
6.3.98.4	MLME-GDDENABLEMENT.indication	24
6.3.98.5	MLME-GDDENABLEMENT.response	25
6.3.99	Network channel control management	26
6.3.99.1	Introduction.....	26
6.3.99.2	MLME-NETWORKCHANNELCONTROL.request.....	26
6.3.99.3	MLME-NETWORKCHANNELCONTROL.confirm	27
6.3.99.4	MLME-NETWORKCHANNELCONTROL.indication	28
6.3.99.5	MLME-NETWORKCHANNELCONTROL.response	29
6.3.100	White space map (WSM).....	30
6.3.100.1	Introduction.....	30

6.3.100.2	MLME-WSM.request	31
6.3.100.3	MLME-WSM.indication	31
7.	PHY service specification	33
7.3	Detailed PHY service specifications	33
7.3.5	PHY-SAP detailed service specification	33
7.3.5.11	PHY-CCA.indication	33
8.	Frame formats	35
8.2	MAC frame formats	35
8.2.4	Frame fields	35
8.2.4.6	HT Control field	35
8.2.4.7	Frame Body field	35
8.2.6	TLV encodings	35
8.2.6.1	General	35
8.2.6.2	Common TLVs	36
8.3	Format of individual frame types	40
8.3.3	Management frames	40
8.3.3.2	Beacon frame format	40
8.3.3.9	Probe Request frame format	40
8.3.3.10	Probe Response frame format	41
8.4	Management frame body components	41
8.4.1	Fields that are not information elements	41
8.4.1.9	Status Code field	41
8.4.1.32	Rate Identification field	42
8.4.1.48	VHT Compressed Beamforming Report field	42
8.4.1.48a	TVHT Compressed Beamforming Report field	42
8.4.1.49	MU Exclusive Beamforming Report field	43
8.4.1.49a	TVHT MU Exclusive Beamforming Report field	43
8.4.1.50	Operating Mode field	44
8.4.1.53	Channel Schedule Management element	44
8.4.1.54	Device Location Information Body	46
8.4.1.55	WSM type and information	46
8.4.2	Information elements	47
8.4.2.1	General	47
8.4.2.24	Extended Capabilities element	47
8.4.2.29	Extended Capabilities element	48
8.4.2.31	EDCA Parameter Set element	48
8.4.2.54	DSE Registered Location element	49
8.4.2.95	Advertisement Protocol element	49
8.4.2.164	VHT Transmit Power Envelope element	50
8.4.2.165	Channel Switch Wrapper element	50
8.4.2.169	Device Location Information element	51
8.4.2.170	White Space Map element	51
8.4.2.171	Reduced Neighbor Report element	51
8.4.2.172	TVHT Operation element	53
8.4.5	Registered Location Query Protocol (RLQP) elements	55
8.4.5.1	General	55
8.4.5.2	Channel Availability Query RLQP-element	55
8.4.5.3	Channel Schedule Management RLQP-element	57
8.4.5.4	Network Channel Control RLQP-element	58
8.5	Action frame format details	59

8.5.8	Public Action details	59
8.5.8.1	Public Action frames	59
8.5.8.27	Channel Availability Query frame format	60
8.5.8.28	Channel Schedule Management frame format	60
8.5.8.29	Contact Verification Signal frame format	61
8.5.8.30	GDD Enablement Request frame format	61
8.5.8.31	GDD Enablement Response frame format	62
8.5.8.32	Network Channel Control frame format	62
8.5.8.33	White Space Map Announcement frame format	63
8.5.11	Protected Dual of Public Action frames	64
8.5.11.1	Protected Dual of Public Action details	64
9.	MAC sublayer functional description	65
9.2	MAC architecture	65
9.2.1	General	65
9.3	DCF	65
9.3.2	Procedures common to the DCF and EDCAF	65
9.3.2.3	IFS	65
9.7	Multirate support	65
9.7.1	Overview	65
9.12	A-MPDU operation	66
9.12.2	A-MPDU length limit rules	66
9.19	HCF	66
9.19.2	HCF contention-based channel access (EDCA)	66
9.19.2.8	EDCA channel access in a VHT and TVHT BSSs	66
9.24	MAC frame processing	66
9.24.9	Extensible subelement parsing	66
9.24.10	Extensible TLV parsing	66
9.31	Null data packet (NDP) sounding	67
9.31.5	VHT sounding protocol	67
9.31.5.2	Rules for VHT sounding protocol sequences	67
9.31.5.3	Rules for fragmented feedback in VHT sounding protocol sequences	67
10.	MLME	68
10.11	Radio measurement procedures	68
10.11.9	Specific measurement usage	68
10.11.9.6	Location Configuration Information Report	68
10.24	WLAN interworking with external networks procedures	68
10.24.3	Interworking procedures: generic advertisement service (GAS)	68
10.24.3.2	ANQP procedures	68
10.24.3.3	Registered Location Query Protocol (RLQP) procedures	68
10.42	Basic TVHT BSS functionality	68
10.43	Operation under the control of a GDB	70
10.43.1	General	70
10.43.2	GDD enabling STA operation	70
10.43.3	GDD dependent STA operation	71
10.43.4	Channel availability query (CAQ) procedure	72
10.43.4.1	Introduction	72
10.43.4.2	CAQ requesting STA	73
10.43.4.3	CAQ responding STA	74
10.43.5	Channel schedule management (CSM) procedures	75
10.43.5.1	Introduction	75

10.43.5.2	CSM requesting STA	76
10.43.5.3	CSM responding STA	76
10.43.6	Contact verification signal (CVS)	77
10.43.7	Network channel control (NCC) procedures	77
10.43.7.1	Introduction	77
10.43.7.2	NCC requesting STA	78
10.43.7.3	NCC responding STA	79
10.43.8	Reduced neighbor report	79
10.43.9	White space map (WSM)	80
23.	Television Very High Throughput (TVHT) PHY specification	82
23.1	Introduction	82
23.1.1	Introduction to the TVHT PHY	82
23.1.2	Scope	83
23.1.3	TVHT PHY functions	84
23.1.3.1	General	84
23.1.3.2	PHY management entity (PLME)	84
23.1.3.3	Service specification method	84
23.1.4	PPDU formats	84
23.2	TVHT PHY service interface	84
23.2.1	Introduction	84
23.2.2	TXVECTOR and RXVECTOR parameters	84
23.2.3	Effects of CH_BANDWIDTH parameter on PPDU format	91
23.2.4	Support for NON_HT and HT formats	92
23.3	TVHT PHY sublayer	96
23.3.1	Introduction	96
23.3.2	VHT PPDU format in TVWS bands	96
23.3.3	Transmitter block diagram	96
23.3.4	Overview of the PPDU encoding process	98
23.3.4.1	General	98
23.3.4.2	Construction of L-STF	98
23.3.4.3	Construction of the L-LTF	98
23.3.4.4	Construction of L-SIG	99
23.3.4.5	Construction of TVHT-SIG-A	99
23.3.4.6	Construction of TVHT-STF	99
23.3.4.7	Construction of TVHT-LTF	99
23.3.4.8	Construction of TVHT-SIG-B	99
23.3.4.9	Construction of the Data field in an SU PPDU	100
23.3.4.10	Construction of the Data field in an MU PPDU	100
23.3.5	Modulation and coding scheme (MCS)	101
23.3.6	Timing-related parameters	101
23.3.7	Mathematical description of signals	102
23.3.8	TVHT preamble	106
23.3.8.1	Introduction	106
23.3.8.2	Non-TVHT portion of VHT format preamble	106
23.3.8.3	TVHT portion of VHT format preamble	107
23.3.9	Transmission of NON_HT and HT PPDU with multiple antennas	109
23.3.9.1	Transmission of NON_HT PPDU with more than one antenna	109
23.3.9.2	Transmission of HT format PPDU with more than four antennas	109
23.3.10	Data field	109
23.3.10.1	General	109
23.3.10.2	SERVICE field	109
23.3.10.3	CRC calculation for TVHT-SIG-B	109

23.3.10.4	Scrambler	109
23.3.10.5	Coding	109
23.3.10.6	Stream parser	110
23.3.10.7	Segment parser	110
23.3.10.8	BCC interleaver	110
23.3.10.9	Constellation mapping	110
23.3.10.10	Pilot subcarriers	111
23.3.10.11	OFDM modulation transmission in VHT format	111
23.3.10.12	Non-HT duplicate transmission	112
23.3.11	SU-MIMO and MU-MIMO Beamforming	112
23.3.11.1	General	112
23.3.11.2	Beamforming Feedback Matrix V	113
23.3.11.3	Group ID	113
23.3.12	TVHT preamble format for sounding PPDU's	113
23.3.13	Regulatory requirements	113
23.3.14	Channelization	113
23.3.15	Transmit RF delay	115
23.3.16	Slot time	115
23.3.17	Transmit and receive port impedance	115
23.3.18	PMD transmit specification	115
23.3.18.1	Transmit spectrum mask	115
23.3.18.2	Spectral flatness	116
23.3.18.3	Transmit center frequency and symbol clock frequency tolerance	118
23.3.18.4	Modulation accuracy	118
23.3.18.5	Time of Departure accuracy	119
23.3.19	TVHT receiver specification	119
23.3.19.1	General	119
23.3.19.2	Receiver minimum input sensitivity	119
23.3.19.3	Adjacent channel rejection	120
23.3.19.4	Nonadjacent channel rejection	120
23.3.19.5	Receiver maximum input level	121
23.3.19.6	CCA sensitivity	121
23.3.19.7	RSSI	122
23.3.20	PLCP transmit procedure	123
23.3.21	PLCP receive procedure	123
23.4	TVHT PLME	123
23.4.1	PLME_SAP sublayer management primitives	123
23.4.2	PHY MIB	123
23.4.3	TXTIME and PSDU_LENGTH calculation	123
23.4.4	PHY characteristics	123
23.5	Parameters for TVHT MCSs	124
Annex B (normative) Protocol Implementation Conformance Statement (PICS) proforma		131
B.2	Abbreviations and special symbols	131
B.2.2	General abbreviations for Item and Support columns	131
B.4	PICS proforma—IEEE Std. 802.11-2012	131
B.4.4.1	MAC protocol capabilities	132
B.4.4.2	MAC frames	132
B.4.12	Spectrum management extensions	133
B.4.14	QoS base functionality	135
B.4.18	DSE functions	135
B.4.19.1	HT MAC features	138
B.4.21	WNM extensions	139

B.4.25 RobustAVT extensions	140
B.4.28 TVWS functions.....	140
B.4.28.1 TVHT MAC features	141
B.4.28.2 TVHT PHY features	143
Annex C (normative) ASN.1 encoding of the MAC and PHY MIB	146
C.3 MIB Detail	146
Annex D (normative) Regulatory references.....	170
D.1 External regulatory references	170
Annex E (normative) Country elements and operating classes	171
E.1 Country information and operating classes	171
E.2 Band specific operating requirements.....	171
E.2.5 TVWS band in the United States and Canada (54 MHz to 698 MHz)	171
E.2.6 TVWS band in Europe	174
Annex H (normative) Usage of Ethertype 89-0d.....	175
Annex T (informative) Location and Time Difference accuracy test.....	176
T.2 Time Difference of Departure accuracy test.....	176

Tables

Table 4-1—GDD mechanisms and timescales	11
Table 7-5—The channel-list parameter elements	33
Table 8-13b—MFB subfield in the VHT variant HT Control field	35
Table 8-14b—Device Class field definition	36
Table 8-14a—General TLV format	36
Table 8-14d—Device Location Information field definition	37
Table 8-14e—Channel Schedule Descriptor Tuple attribute definition	37
Table 8-14c—Device Identification Information field definition	37
Table 8-14f—Channel Schedule Descriptor Value fields	38
Table 8-14h—WSM Information Value fields	39
Table 8-14g—WSM information values	39
Table 8-20—Beacon frame body	40
Table 8-20—Beacon frame body	40
Table 8-26—Probe Request frame body	40
Table 8-27—Probe Response frame body	41
Table 8-27—Probe Response frame body	41
Table 8-37—Status codes	41
Table 8-53k—Subfield values of the Operating Mode field	44
Table 8-53n—Channel Schedule Management Mode field values	45
Table 8-53m—Reason Result Code field values	45
Table 8-54—Element IDs	47
Table 8-53o—WSM Type definition	47
Table 8-103—Capabilities field	48
Table 8-105—Default EDCA Parameter Set element parameter values if dot11OCBAActivated is false	48
Table 8-175—Advertisement protocol ID definitions	49
Table 8-183v—Subfields of the VHT Capabilities Info field	50
Table 8-183aa—TVHT Operation Information subfields	54
Table 8-190.a1—RLQP-element definitions	55
Table 8-190.a2—Reason Result Code field values	56
Table 8-190.a3—Reason Result Code field values	58
Table 8-210—Public Action field values	59
Table 8-228—Public Action field values defined for Protected Dual of Public Action frames	64
Table 10-20—TVHT BSS operating channel width	69
Table 23-1—TXVECTOR and RXVECTOR parameters	85
Table 23-2—PPDU format as a function of CH_BANDWIDTH parameter	91
Table 23-4—RATE field in L-SIG	93
Table 23-3—Modulation-dependent parameters for Non-HT duplicate mode in TVWS band	93
Table 23-5—Timing-related constants in Non-HT PPDU	94
Table 23-6—Tone location in Non-HT PPDU	95
Table 23-7—Fields of the VHT PPDU in TVWS bands	96
Table 23-8—Timing-related parameters	101
Table 23-9—Tone location	102
Table 23-10—Center frequency of a PPDU transmitted in frequency segment iSeg	104
Table 23-11—Tone scaling factor and guard interval duration values for PLCP fields	105
Table 23-12—Transmission mode and Gamma subk,m	105
Table 23-13—B0-B1 (BW) in TVHT-SIG-A1	108
Table 23-14—Number of rows and columns in the interleaver	110
Table 23-15—LDPC Tone Mapping Distance for each transmission mode	111
Table 23-16—Parameters for Non-HT duplicate transmissions	112
Table 23-17—Fields to specify TVHT channels	113
Table 23-18—Spectral mask frequency scaling factor for contiguous transmission	115
Table 23-19—Spectral mask frequency scaling factor for TVHT_MODE_4N	115

Table 23-20—Spectral mask frequency scaling factor for TVHT_MODE_2N	116
Table 23-21—Maximum transmit spectral flatness deviations	117
Table 23-22—Receiver minimum input level sensitivity	119
Table 23-23—Minimum required adjacent and nonadjacent channel rejection levels	120
Table 23-24—Conditions for CCA BUSY on the primary channel	122
Table 23-25—TVHT PHY characteristics	123
Table 23-26—TVHT MCSs for TVHT_MODE_1, NSS = 1	124
Table 23-27—TVHT MCSs for TVHT_MODE_1, NSS = 2	125
Table 23-28—TVHT MCSs for TVHT_MODE_1, NSS = 3	125
Table 23-29—TVHT MCSs for TVHT_MODE_1, NSS = 4	126
Table 23-30—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, NSS = 1	126
Table 23-31—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, NSS = 2	127
Table 23-32—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, NSS = 3	127
Table 23-33—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, NSS = 4	128
Table 23-34—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, NSS = 1	128
Table 23-35—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, NSS = 2	129
Table 23-36—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, NSS = 3	129
Table 23-37—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, NSS = 4	130
Table D-1—Regulatory requirement list	170
Table D-2—Behavior limits sets	170
Table E-4—Global operating classes	171
Table E-7—TVWS GDD timer limits	172
Table E-8—Device Identification Information Value fields	173
Table E-9—WSM Information Value fields	173
Table E-10—TVWS GDD timer limits	174
Table H-1—Payload Type field values	175

Figures

Figure 4-10b— Multiple APs and Multiple GDBs.....	10
Figure 7-2a— TVHT channel-list parameter element and channel bandwidth for TVHT_W, TVHT_2W, and TVHT_W+W	33
Figure 7-2b— TVHT channel-list parameter element and channel bandwidth for TVHT_4W and TVHT_2W+2W	34
Figure 8-80h— Channel Schedule Management element format	44
Figure 8-80i— Device Location Information Body field format	46
Figure 8-401cd— Device Location Information element format	51
Figure 8-401ce— WSM element format	51
Figure 8-401cf— Reduced Neighbor Report element format	51
Figure 8-401cg— Neighbor AP Information field format	52
Figure 8-401ch— TBTT Information Header subfield	52
Figure 8-401ci— TBTT Information field	53
Figure 8-401cj— TVHT Operation element format	53
Figure 8-401ck— TVHT Operation Information field	53
Figure 8-431.a1— RLQP-element format	55
Figure 8-431.a2— Channel Availability Query RLQP-element format	56
Figure 8-431.a3— Channel Query Info field format	57
Figure 8-431.a4— Channel Schedule Management RLQP-element format	57
Figure 8-431.a5— Network Channel Control RLQP-element format	58
Figure 8-460f— Channel Availability Query frame Action field format	60
Figure 8-460g— Channel Schedule Management frame Action field format	60
Figure 8-460h— Contact Verification Signal frame Action field format	61
Figure 8-460i— GDD Enablement Request frame Action field format	61
Figure 8-460j— GDD Enablement Response frame Action field format	62
Figure 8-460k— Network Channel Control frame Action field format	62
Figure 8-460l— White Space Map Announcement frame Action field format	63
Figure 10-39— GDD dependent STA state transition diagram	71
Figure 23-1— VHT PPDU format in TVWS bands	96
Figure 23-2— Transmitter block diagram for the Data field of a TVHT_MODE_2N or TVHT_MODE_4N SU PPDU with BCC encoding	97
Figure 23-3— Transmitter block diagram for the Data field of a TVHT_MODE_2N or TVHT_MODE_4N SU PPDU with LDPC encoding	98
Figure 23-4— Example transmit spectral mask for an 6+6 MHz mask PPDU	117

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

Amendment 5: Television White Spaces (TVWS) Operation

IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, 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>.

(This amendment is based on IEEE Std 802.11™-2012, as amended by IEEE Std 802.11ae™-2012, IEEE Std 802.11aa™-2012, IEEE Std 802.11ad™-2012, and IEEE Std 802.11ac™-2013.)

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard. The editing instructions are shown in **bold italic**. Four editing instructions are used: change, delete, insert, and replace. **Change** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strike through~~ (to remove old material) and underscore (to add new material). **Delete** removes existing material. **Insert** adds new material without disturbing the existing material. Deletions and insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. **Replace** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.¹

¹Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

2. Normative references

Delete the following reference from Clause 2:

~~IETF RFC 3825, Dynamic Host Configuration Protocol Option for Coordinate-based Location Configuration Information, Polk, J., Schnizlein, J., Linsner, M., July 2004.~~

Insert the following reference into Clause 2 in alphanumeric order:

IETF RFC 6225, Dynamic Host Configuration Protocol Options for Coordinate-Based Location Configuration Information, J. Polk, M. Linsner, M. Thomson, B. Aboba, July 2011.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

Change the following definition in 3.1:

location configuration information (LCI): As defined in IETF RFC ~~3825~~ 6225: includes latitude, longitude, and altitude, with resolution indicators for each.

Insert the following definitions into 3.1 in alphabetic order:

geolocation: Geolocation is a location within an earth-centric frame of reference.

registered location: The geolocation of a station (STA) registered in accordance with the requirements for the regulatory domain.

Registered Location Query Protocol (RLQP): The query protocol for registered location information that is received and transported by generic advertisement service (GAS) Public Action frames.

registered location secure server (RLSS): An entity that accesses and manages a database that organizes storage of information by geographic location and securely holds the location and some operating parameters of one or more basic service sets (BSSs).

television white spaces (TVWS): The opportunistic use of allocated but not assigned spectrum—spectrum allocated for broadcast television, but with no assignment at a particular location.

type/length/value (TLV): A formatting scheme that adds a tag to each transmitted parameter containing the parameter type (and implicitly its encoding rules) and the length of the encoded parameter.

3.2 Definitions specific to IEEE 802.11

Change the following definition in 3.2:

~~**very high throughput (VHT) basic service set (BSS) basic very high throughput (VHT) modulation and coding scheme (MCS) and number of spatial streams (NSS) set (BSSBasicVHTMCS_NSSSet)**~~
~~**(BSS basic VHT MCS and NSS set):**~~ The set of MCS and NSS tuples that are supported by all VHT stations (STAs) that are members of a VHT BSS or are supported by television very high throughput (TVHT) STAs that are members of a TVHT BSS.

Insert the following definitions into 3.2 in alphabetic order:

basic channel unit (BCU): For television very high throughput (TVHT) operation, 6 MHz, 7 MHz, or 8 MHz, depending on the regulatory domain.

geolocation database (GDB): A database whose operation is mandated or authorized by a regulatory authority and that organizes storage of information by geographic location.

geolocation database dependent (GDD): A modifier describing when station (STA) operation is dependent on information received from a geolocation database (GDB).

geolocation database dependent (GDD) access point (AP): A station (STA) dependent on information received from a geolocation database (GDB) in order to initiate and maintain a network.

geolocation database dependent (GDD) dependent station (STA): A STA that is under the control of a GDD enabling STA.

geolocation database dependent (GDD) enabling station (STA): A STA that has the authority to control the operation of GDD dependent STAs after obtaining available spectrum for use at its own location.

geolocation database dependent (GDD) fixed station (STA): A STA whose geographical location information is fixed and maintained in a geolocation database (GDB) and whose operation depends on information received from that database.

geolocation database dependent (GDD) geolocated non-access point (non-AP) station (STA): A STA that is not an AP and is authorized by a geolocation database (GDB) to operate at its current location.

geolocation database dependent (GDD) non-access point (non-AP) station (STA): A STA that is not an AP but operates under the control of a GDD enabling STA.

television very high throughput 2W (TVHT_2W): Two contiguous basic channel units (BCUs) in television white spaces (TVWS).

television very high throughput 2W+2W (TVHT_2W+2W): Two noncontiguous frequency segments, each of which comprises two contiguous basic channel units (BCUs) in television white spaces (TVWS).

television very high throughput 4W (TVHT_4W): Four contiguous basic channel units (BCUs) in television white spaces (TVWS).

television very high throughput W (TVHT_W): One basic channel unit in television white spaces (TVWS).

television very high throughput W+W (TVHT_W+W): Two noncontiguous basic channel units (BCUs) in television white spaces (TVWS).

television very high throughput (TVHT) basic service set (BSS): A set of stations (STAs) that consists of a geolocation database dependent (GDD) enabling STA operating in television white spaces (TVWS) and one or more of its GDD STAs.

white space map (WSM): Information on identified available frequencies that is obtained from a geolocation database (GDB) and that is used by IEEE 802.11 stations (STAs).

Insert the following subclause, 3.2a, after 3.2:

3.2a Definitions specific to IEEE 802.11 operation in some regulatory domains

ISO 3166-1 defines the international two-letter designation for country names, and these designations are included [in square brackets] at the end of each definition that has clear attribution to a regulatory domain.

contact verification signal (CVS): A signal sent by a geolocation database dependent (GDD) enabling station (STA) to validate the list of available frequencies and to verify that the receiving GDD STA is within reception range of the master white space device (WSD) [US].

model identifier: A unique text string set by the manufacturer at the time a device is placed on the market. The model identifier is communicated to a database provider as required by regulation.

non-high-throughput (non-HT) duplicate in television white spaces (TVWS) band: A transmission format of the physical layer (PHY) that duplicates a single basic channel unit (BCU) non-high-throughput (non-HT) transmission in two or more BCUs and allows a station (STA) in a non-HT basic service set (BSS) on any one BCU to receive the transmission. A non-HT duplicate format is one of the following:

- a) TVHT_W non-HT duplicate: A PHY transmission that replicates a non-HT physical layer convergence procedure (PLCP) protocol data unit (PPDU) two times in a single BCU
- b) TVHT_2W non-HT duplicate: A PHY transmission that replicates a non-HT PPDU four times in two contiguous BCUs
- c) TVHT_4W non-HT duplicate: A PHY transmission that replicates a non-HT PPDU eight times in four contiguous BCUs
- d) TVHT_W+W non-HT duplicate: A PHY transmission that replicates a non-HT PPDU two times in each single BCU
- e) TVHT_2W+2W non-HT duplicate: A PHY transmission that replicates a non-HT PPDU four times in each of two contiguous BCUs

non-high-throughput (non-HT) duplicate physical layer convergence procedure (PLCP) protocol data unit (PPDU) in television white spaces (TVWS) band: A PPDU transmitted by a Clause 23 physical layer (PHY) with the TXVECTOR parameter FORMAT set to NON_HT and the TXVECTOR parameter CH_BANDWIDTH set to TVHT_W, TVHT_2W, TVHT_4W, TVHT_W+W, or TVHT_2W+2W.

personal/portable station (STA): A STA that uses network communications at unspecified locations [US].

shared bands: Radio frequency bands in which dissimilar services are permitted.

television band device (TVBD): An intentional radiator that operates on an unlicensed basis on available channels in the broadcast television frequency bands [US].

TVHT_2W mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs:

- a) A Clause 23 TVHT_2W very high throughput (VHT) PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_2W transmit spectral mask defined in 23.3.18.1
- b) A Clause 23 TVHT_2W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_2W transmit spectral mask defined in 23.3.18.1

- c) A Clause 23 TVHT_W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_2W transmit spectral mask defined in 23.3.18.1
- d) A Clause 23 TVHT_W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_2W transmit spectral mask defined in 23.3.18.1

TVHT_2W+2W mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDU:

- a) A Clause 23 TVHT_2W+2W very high throughput (VHT) PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W+2W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1
- b) A Clause 23 TVHT_2W+2W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W+2W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1
- c) A Clause 23 TVHT_2W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1
- d) A Clause 23 TVHT_2W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1
- e) A Clause 23 TVHT_W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1
- f) A Clause 23 TVHT_W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_2W+2W transmit spectral mask defined in 23.3.18.1

TVHT_4W mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDU:

- a) A Clause 23 TVHT_4W very high throughput (VHT) PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_4W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1
- b) A Clause 23 TVHT_4W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_4W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1
- c) A Clause 23 TVHT_2W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1
- d) A Clause 23 TVHT_2W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_2W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1
- e) A Clause 23 TVHT_W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1

- f) A Clause 23 TVHT_W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_4W transmit spectral mask defined in 23.3.18.1

TVHT_MODE_1 physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs: A Clause 23 TVHT_W VHT PPDU or TVHT_W NON_HT PPDU.

TVHT_MODE_2C physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs: A Clause 23 TVHT_2W VHT PPDU or TVHT_2W NON_HT PPDU.

TVHT_MODE_2N physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs: A Clause 23 TVHT_W+W VHT PPDU or TVHT_W+W NON_HT PPDU.

TVHT_MODE_4C physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs: A Clause 23 TVHT_4W VHT PPDU or TVHT_4W NON_HT PPDU.

TVHT_MODE_4N physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs: A Clause 23 TVHT_2W+2W VHT PPDU or TVHT_2W+2W NON_HT PPDU.

TVHT_W mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs:

- a) A Clause 23 TVHT_W very high throughput (VHT) PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_W transmit spectral mask defined in 23.3.18.1
- b) A Clause 23 TVHT_W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_W transmit spectral mask defined in 23.3.18.1

TVHT_W+W mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): One of the following PPDUs:

- a) A Clause 23 TVHT_W+W very high throughput (VHT) PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W+W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_W+W transmit spectral mask defined in 23.3.18.1
- b) A Clause 23 TVHT_W+W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W+W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_W+W transmit spectral mask defined in 23.3.18.1
- c) A Clause 23 TVHT_W VHT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W and TXVECTOR parameter FORMAT set to VHT) transmitted using the TVHT_W+W transmit spectral mask defined in 23.3.18.1
- d) A Clause 23 TVHT_W NON_HT PPDU (TX_VECTOR parameter CH_BANDWIDTH set to TVHT_W, TXVECTOR parameter FORMAT set to NON_HT, and TXVECTOR parameter NON_HT_MODULATION set to NON_HT_DUP_OFDM) transmitted using the TVHT_W+W transmit spectral mask defined in 23.3.18.1

white space device (WSD): Entity that employs cognitive facilities to use white space spectrum without causing harmful interference to protected services [EU].

3.3 Abbreviations and acronyms

Insert the following abbreviations into 3.3 in alphabetic order:

BCU	basic channel unit
CAQ	channel availability query
CSM	channel schedule management
CVS	contact verification signal
GDB	geolocation database
GDD	geolocation database dependent
NCC	network channel control
RLQP	Registered Location Query Protocol
RLSS	registered location secure server
TLV	type/length/value
TVHT	television very high throughput
TVWS	television white spaces
WSM	white space map

Insert the following subclause, 3.4, after 3.3:

3.4 Abbreviations and acronyms in some regulatory domains

ISO 3166-1 defines the international two-letter designation for country names, and these designations are included [in square brackets] at the end of each abbreviation that has clear attribution to a regulatory domain.

PLMR/CRS	private land mobile radio/cellular radio service [US]
TVBD	television band device [US]
WSD	white space device [EU]

4. General description

4.3 Components of IEEE 802.11 architecture

4.3.10a Very high throughput (VHT) STA

Insert the following subclause, 4.3.10b, after 4.3.10a:

4.3.10b Television very high throughput (TVHT) STA

The IEEE 802.11 TVHT STA operates in television white spaces (TVWS) bands.

A TVHT STA supports all mandatory features of a VHT STA as mandatory features except for 20 MHz, 40 MHz, and 80 MHz channel widths. A TVHT STA supports all optional features of a VHT STA as optional features except for 160 MHz or 80+80 MHz channel widths and more than 4 spatial streams. The 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz channel widths and more than 4 spatial streams are not permitted for STAs operating as TVHT STAs. The features and behaviors of VHT STAs specified in Clause 6, Clause 7, Clause 8, Clause 9, Clause 10, Clause 13, and Annex G apply to TVHT STAs as well, unless stated otherwise.

For Clause 6, Clause 7, Clause 8, Clause 9, Clause 10, and Clause 13, the following replacements are applied for TVHT STAs:

- “TVHT_W/TVHT_2W” replaces “20/40 MHz”.
- “TVHT_W/TVHT_2W/TVHT_4W” replaces “20/40/80/160 MHz”.
- “TVHT_W”, “TVHT_2W”, and “TVHT_4W” replace “20 MHz”, “40 MHz”, and “80 MHz,” respectively.
- “TVHT_W” replaces “CBW20”.
- “TVHT_2W” replaces “CBW40”.
- “TVHT_4W” replaces “CBW80” and “CBW80+80”.
- “secondaryTVHT_2W” replaces “secondary40”.
- “TVHT STA” replaces “VHT STA”.
- “TVHT AP” replaces “VHT AP”.
- “TVHT BSS” replaces “VHT BSS”.
- “TVHT-MCS” replaces “VHT-MCS”.
- “TVHT Operation” replaces “VHT Operation”.
- “dot11TVHTOptionImplemented” replaces “dot11VHTOptionImplemented”.
- “dot11TVHTControlFieldOptionImplemented” replaces both “dot11VHTControlFieldOptionImplemented” and “dot11HTControlFieldSupported”.
- “dot11TVHTShortGIOptionIn80Activated” replaces “dot11VHTShortGIOptionIn80Activated”.
- “dot11TVHTSUBeamformerOptionImplemented” replaces “dot11VHTSUBeamformerOptionImplemented”.
- “dot11TVHTSUBeamformeeOptionImplemented” replaces “dot11VHTSUBeamformeeOptionImplemented”.
- “dot11TVHTMUBeamformerOptionImplemented” replaces “dot11VHTMUBeamformerOptionImplemented”.
- “dot11TVHTMUBeamformeeOptionImplemented” replaces “dot11VHTMUBeamformeeOptionImplemented”.
- “dot11TVHTSUBeamformeeActivated” replaces “dot11VHTSUBeamformeeActivated”.

- “dot11TVHTTXOPPowerSaveOptionImplemented” replaces “dot11VHTTXOPPowerSaveOptionImplemented”.
- “dot11VHTOBSSScanCount” replaces “dot11VHTOBSSScanCount”.
- Reference to 8.4.1.48a replaces reference to 8.4.1.48.
- Reference to 8.4.1.49a replaces reference to 8.4.1.49.
- Reference to 8.4.2.172 replaces reference to 8.4.2.161.
- Reference to 10.42 replaces reference to 10.39.1.
- Reference to Clause 23 and its subclauses replace reference to Clause 22 and its subclauses.

For Annex G, the following replacements are applied for TVHT STAs:

- “TVHT” replaces “VHT”.
- “tvht” replaces “vht”.

The main PHY features in a TVHT STA that are not present in a VHT STA are the following:

- Mandatory support for TVHT_W channel width.
- Optional support for TVHT_W+W channel width.
- Optional support for TVHT_2W channel width.
- Optional support for TVHT_4W channel width.
- Optional support for TVHT_2W+2W channel width.

These TVHT features are available to TVHT STAs associated with a TVHT AP in a BSS. A subset of the TVHT features is available for use between two TVHT STAs that are members of the same IBSS.

Insert the following subclause, 4.3.19 (including Figure 4-10b and Table 4-1), after 4.3.18:

4.3.19 Operation under geolocation database (GDB) control

Regulators are specifying television broadcast bands for the deployment of dynamic sharing technologies. Different schemes result in different times that should elapse from the moment an authorized database is told to change access to a particular slice of spectrum and the time that sharing radios are required to change their operations.

One current system design allows the GDBs to utilize a fully populated map of all protected services, and the databases have precalculated maps that are effective on timescales of one to two days.

Another system design allows the protected services to negotiate with controllers of unlicensed devices so that both may share available broadcast channels and facilitate response times of less than an hour where necessary and even within minutes if desired.

Another system design has the GDB fully control all white space devices by requiring them to tell the database their intended location and emissions footprint and receive permission before any broadcast band transmission starts. Any change of intended frequencies or powers is told to the database, and permission is received before the change takes place.

The architectural role of components depends on the security and timeliness requirements in particular regulatory domains. Figure 4-10b shows two infrastructure BSSs in which APs are geolocation database dependent (GDD) enabling STAs and the other STAs are GDD dependent STAs.

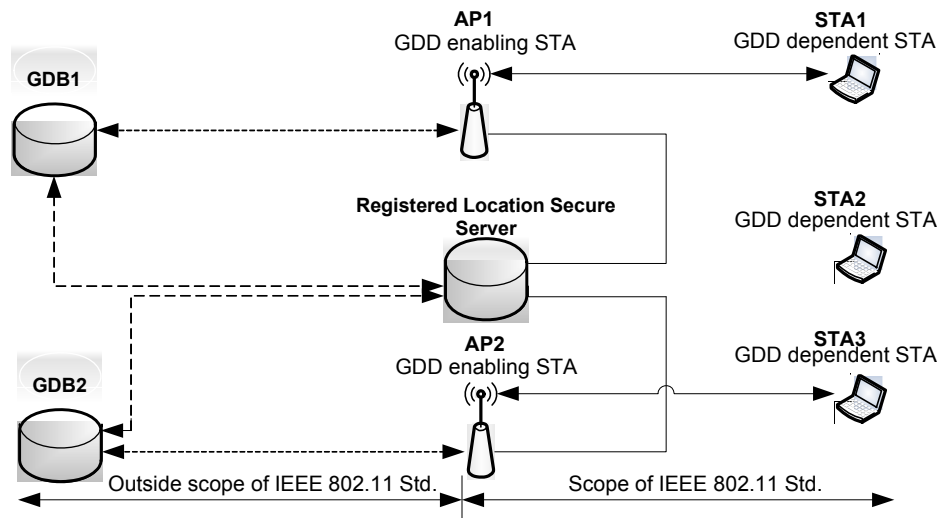


Figure 4-10b—Multiple APs and Multiple GDBs

In most regulatory domains, GDD enabling STAs are required to

- Securely communicate with GDBs
- Maintain the white space maps (WSMs) and other information received from GDBs
- Create and transmit a contact verification signal to inform GDD dependent STAs that the map they received is still valid

A Registered Location Query Protocol (RLQP) is provided to share the WSMs and current channel use among GDD enabling STAs in a neighborhood. GDD dependent STAs can query both their GDD enabling STA and the registered location secure server (RLSS) about WSMs and channel utilization. In some regulatory domains, a RLSS can provide GDBs with the current channel use information for all the BSSs and IBSSs that communicate with it. In some regulatory domains, the RLSS communicates with controllers of other white space systems to coordinate emissions footprints of their services. By accessing and using this information, the STAs can make intelligent decisions about the most effective way to utilize the available spectrum, power, and bandwidth for their communications.

The specific mechanisms are as follows:

- Channel availability query, used to obtain one or more WSMs of available channels for an area or a geolocation
- Channel schedule management, used to obtain start and ending times for each available white space channel
- Contact verification signal, used by a GDD dependent STA to verify it is still receiving frames from its GDD enabling STA
- GDD enablement, the procedure where a GDD enabling STA forms a network and maintains the network under the control of a GDB
- Network channel control, used to inform a local channel controller that has a view of nearby transmitters and their emissions footprints

- WSM, used to retrieve the available white space channels and their transmit power restrictions

The use of the mechanisms in a particular regulatory domain depends on the specific regulatory requirements. Table 4-1 gives a view of the use of specific mechanisms to meet regulatory requirements in terms of daily, hourly, and minute timescales. Implementers are referred to the regulatory sources in Table D-1 for further information. Operation in countries within defined regional regulatory domains might be subject to additional or alternative national regulations.

Table 4-1—GDD mechanisms and timescales

Mechanism	Daily consultation required	Hourly consultation required	Minute responsiveness
Channel availability query	Informative	Informative	Not applicable
Channel schedule management	Informative	Informative	Not applicable
Contact verification signal	Required to be secure	May be secure	Loss of consecutive signals requires action
GDD enablement	Required	Required	Required
Network channel control	Informative	Informative	Not applicable
WSM	Required for GDD enabling STA, might be translated for GDD dependent STA	Required for GDD enabling STA, might be translated for GDD dependent STA	Required for GDD enabling STA, might be translated for GDD dependent STA

These mechanisms allow a BSS to manage and query its radio environment and a GDB to control the radio environment for all wireless services.

6. Layer management

6.3 MLME SAP Interface

6.3.3 Scan

6.3.3.3 MLME-SCAN.confirm

6.3.3.3.2 Semantics of the service primitive

Insert the following row at the end of the untitled table describing BSSDescriptions in 6.3.3.3.2:

Name	Type	Valid range	Description	IBSS adoption
TVHT Operation	As defined in frame format	As defined in 8.4.2.172	The values from the TVHT Operation element if such an element was present in the Probe Response or Beacon frame; otherwise, null. The parameter is optionally present only if dot11TVHTOptionImplemented is true.	Adopt

Insert the following subclauses, 6.3.95 to 6.3.100.3.4, after 6.3.94.3.4:

6.3.95 Channel Availability Query

6.3.95.1 Introduction

The following MLME primitives support the signaling of channel availability query process for the channel query requests and responses.

6.3.95.2 MLME-CHANNELAVAILABILITYQUERY.request

6.3.95.2.1 Function

This primitive requests that a (Protected) Channel Availability Query Public Action frame be sent to a specified peer MAC entity.

6.3.95.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-CHANNELAVAILABILITYQUERY.request (
    PeerSTAAddress,
    ChannelAvailabilityQuery,
    Protected,
    VendorSpecificInfo
)
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC address	The address of the peer MAC entity to which the Channel Availability Query frame is sent.
ChannelAvailabilityQuery	A set of information subfields	As defined in 8.5.8.27	Specifies the parameters of channel query.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected Channel Availability Query frame. If false, the request is sent using the Channel Availability Query frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.95.2.3 When generated

This primitive is generated by the SME to request channel query procedure with a specified peer MAC entity.

6.3.95.2.4 Effect of receipt

This primitive initiates a channel query procedure. The MLME subsequently issues a MLME-CHANNELAVAILABILITYQUERY.confirm primitive that reflects the results.

6.3.95.3 MLME-CHANNELAVAILABILITYQUERY.confirm**6.3.95.3.1 Function**

This primitive reports the results of a channel query attempt with a specified peer MAC entity.

6.3.95.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELAVAILABILITYQUERY.confirm (

PeerSTAAddress,

ResultCode,

ChannelAvailabilityQuery,

Protected,

VendorSpecificInfo

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC address	The address of the peer MAC entity from which the response to the Channel Availability Query frame was received.
ResultCode	Enumeration	SUCCESS, SUCCESS_MULTIPLE, REFUSED, DEVICE_VERIFICATION_FAILURE	Indicates the result of MLME-CHANNELAVAILABILITYQUERY.request primitive.
ChannelAvailabilityQuery	A set of information fields	As defined in 8.5.8.27	Specifies the parameters of channel query.
Protected	Boolean	true, false	Specifies whether the response was received using a Robust Management frame. If true, the response was received using the Protected Channel Availability Query Public Action frame. If false, the response was received using the Channel Availability Query Public Action frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.95.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-CHANNELAVAILABILITYQUERY.request and indicates the results of a channel availability query procedure.

6.3.95.3.4 Effect of receipt

The SME is notified of the results of the channel query procedure.

6.3.95.4 MLME-CHANNELAVAILABILITYQUERY.indication

6.3.95.4.1 Function

This primitive indicates that a (Protected) Channel Availability Query frame was received from a peer STA.

6.3.95.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELAVAILABILITYQUERY.indication (

PeerSTAAddress,
ChannelAvailabilityQuery,
Protected,
VendorSpecificInfo
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC address	The address of the peer MAC entity from which the Channel Availability Query frame was received.
ChannelAvailabilityQuery	A set of information subfields	As defined in 8.5.8.27	Specifies the parameters of channel query.
Protected	Boolean	true, false	Specifies whether the request was received using a Robust Management frame. If true, the request was received using the Protected Channel Availability Query Public Action frame. If false, the request was received using the Channel Availability Query Public Action frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.95.4.3 When generated

This primitive is generated by the MLME as a result of the receipt of a channel query request from a specific peer MAC entity.

6.3.95.4.4 Effect of receipt

The SME is notified of the receipt of this channel query request.

6.3.95.5 MLME-CHANNELAVAILABILITYQUERY.response**6.3.95.5.1 Function**

This primitive is used to send a response to a specified peer MAC entity that requested channel query with the STA that issued this primitive.

6.3.95.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELAVAILABILITYQUERY.response (

PeerSTAAddress,
ResultCode,
ChannelAvailabilityQuery,
Protected,
VendorSpecificInfo
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC address	The address of the peer MAC entity to which the Channel Availability Query frame with the response is sent.
ResultCode	Enumeration	SUCCESS, SUCCESS_MULTIPLE, REFUSED, DEVICE_VERIFICATION_FAILURE	Indicates the result response of the channel availability query from the peer MAC entity.
ChannelAvailabilityQuery	A set of information subfields	As defined in 8.5.8.27	Specifies the parameters of channel query.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected Channel Availability Query Public Action frame. If false, the response is sent using the Channel Availability Query Public Action frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.95.5.3 When generated

This primitive is generated by the SME of a STA as a response to an MLME-CHANNELAVAILABILITYQUERY.indication primitive.

6.3.95.5.4 Effect of receipt

Upon receipt of this primitive, the MLME constructs the Channel Availability Query frame as the response. This frame is then scheduled for transmission to the peer MAC address.

6.3.96 Channel schedule management

6.3.96.1 Introduction

The following MLME primitives support the signaling of channel schedule management.

6.3.96.2 MLME-CHANNELSCHEDULEMANAGEMENT.request**6.3.96.2.1 Function**

This primitive requests that a (Protected) Channel Schedule Management frame be sent.

6.3.96.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELSCHEDULEMANAGEMENT.request (

PeerSTAAddress,

ChannelScheduleManagement,

Protected,

VendorSpecificInfo

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any valid individual MAC address	The address of the peer MAC entity to which the Channel Schedule Management frame is sent.
ChannelScheduleManagement	A set of information subfields	As defined in 8.4.1.53	Specifies the parameters of channel schedule management.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected Channel Schedule Management frame. If false, the request is sent using the Channel Schedule Management frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.96.2.3 When generated

This primitive is generated by the SME to request that a (Protected) Channel Schedule Management frame be sent by a STA.

6.3.96.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs and schedules transmission of a (Protected) Channel Schedule Management frame.

6.3.96.3 MLME-CHANNELSCHEDULEMANAGEMENT.confirm**6.3.96.3.1 Function**

This primitive reports the result of a channel schedule management query.

6.3.96.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELSCHEDULEMANAGEMENT.confirm (

PeerSTAAddress,
ChannelScheduleManagement,
Protected,
VendorSpecificInfo

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any valid individual MAC address	The address of the peer MAC entity from which the Channel Schedule Management frame was received.
ChannelScheduleManagement	A set of information subfields	As defined in 8.4.1.53	Specifies the parameters of channel schedule management.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected Channel Schedule Management frame. If false, the response is sent using the Channel Schedule Management Public Action frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.96.3.3 When generated

This primitive is generated by the MLME when a channel schedule request completes. Possible unspecified failure causes include an inability to provide the channel schedule information.

6.3.96.3.4 Effect of receipt

The SME is notified of the results of the channel schedule management procedure.

6.3.96.4 MLME-CHANNELSCHEDULEMANAGEMENT.indication

6.3.96.4.1 Function

This primitive indicates that a (Protected) Channel Schedule Management frame was received from a peer STA.

6.3.96.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELSCHEDULEMANAGEMENT.indication (

PeerSTAAddress,
ChannelScheduleManagement,
Protected,
VendorSpecificInfo

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any valid individual MAC address	The address of the peer MAC entity from which the Channel Schedule Management frame was received.
ChannelScheduleManagement	A set of information subfields	As defined in 8.4.1.53	Specifies the parameters of channel schedule management.
Protected	Boolean	true, false	Specifies whether the request was received using a Robust Management frame. If true, the request was received using the Protected Channel Schedule Management frame. If false, the request was received using the Channel Schedule Management frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.96.4.3 When generated

This primitive is generated by the MLME when a valid (Protected) Channel Schedule Management frame is received.

6.3.96.4.4 Effect of receipt

On receipt of this primitive, the SME decides whether to provide the channel schedule information.

6.3.96.5 MLME-CHANNELSCHEDULEMANAGEMENT.response**6.3.96.5.1 Function**

This primitive is used to provide channel schedule information on channel availability.

6.3.96.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CHANNELSCHEDULEMANAGEMENT.response (

PeerSTAAddress,
ChannelScheduleManagement,
Protected,
VendorSpecificInfo

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any valid individual MAC address	The address of the peer MAC entity to which the Channel Schedule Management frame is sent.
ChannelScheduleManagement	A set of information subfields	As defined in 8.4.1.53	Specifies the parameters of channel schedule management.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected Channel Schedule Management Public Action frame. If false, the response is sent using the Channel Schedule Management Public Action frame.
VendorSpecificInfo	A set of elements	As defined in 8.4.2.28	Zero or more elements.

6.3.96.5.3 When generated

This primitive is generated by the SME to provide the channel schedule information.

6.3.96.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs the appropriate (Protected) channel schedule management response frame and schedules the transmission of the frame to the peer MAC entity.

6.3.97 Contact Verification Signal

6.3.97.1 Introduction

The following MLME primitives support the signaling of the contact verification signal (CVS).

6.3.97.2 MLME-CVS.request

6.3.97.2.1 Function

This primitive requests that a Contact Verification Signal frame be sent by a STA to a specified peer MAC entity in order to validate a WSM.

6.3.97.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CVS.request (

PeerSTAAddress,
Protected,
ContactVerificationSignal
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the contact verification signal process.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected Contact Verification Signal frame. If false, the request is sent using the Contact Verification Signal frame.
ContactVerificationSignal	Contact Verification Signal element	As defined in 8.5.8.29	Specifies the service parameters for the Contact Verification Signal frame.

6.3.97.2.3 When generated

This primitive is generated by the SME to request that a Protected Contact Verification Signal frame be sent by a STA to a specified peer MAC entity.

6.3.97.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Protected Contact Verification Signal frame. This frame is then scheduled for transmission.

6.3.97.3 MLME-CVS.indication

6.3.97.3.1 Function

This primitive indicates that a Contact Verification Signal frame was received from a specific peer MAC entity.

6.3.97.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CVS.indication (

PeerSTAAddress,
Protected,
ContactVerificationSignal
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity from which a Contact Verification Signal frame was received.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected Contact Verification Signal frame. If false, the request is sent using the Contact Verification Signal frame.
ContactVerificationSignal	Contact Verification Signal element	As defined in 8.5.8.29	Specifies the service parameters for the Contact Verification Signal frame.

6.3.97.3.3 When generated

This primitive is generated by the MLME when a valid Protected Contact Verification Signal frame is received.

6.3.97.3.4 Effect of receipt

On receipt of this primitive, the SME is notified of the receipt of the Contact Verification Signal frame.

6.3.98 GDD Enablement

6.3.98.1 Introduction

The following MLME primitives support the signaling of GDD enablement.

6.3.98.2 MLME-GDDENABLEMENT.request

6.3.98.2.1 Function

This primitive requests that a (Protected) GDD Enablement Request frame be sent to a peer entity.

6.3.98.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-GDDENABLEMENT.request (

PeerSTAAddress,
DialogToken,
Protected,
DeviceClass,
DeviceID
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any individual valid MAC address	Specifies the address of the peer MAC entity with which to perform the GDD enablement process.
DialogToken	Integer	1–255	The dialog token to identify the event transaction.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected GDD Enablement Request frame. If false, the request is sent using the GDD Enablement Request frame.
DeviceClass	DeviceClass	As defined in 8.2.6.2.1	Specifies the service parameters for the GDD Enablement Request frame.
DeviceID	Device Identification Information	As defined in 8.2.6.2.2	Specifies the service parameters for the GDD Enablement Request frame.

6.3.98.2.3 When generated

This primitive is generated by the SME to request that a (Protected) GDD Enablement Request frame be sent to the peer entity.

6.3.98.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a (Protected) GDD Enablement Request frame. This frame is then scheduled for transmission.

6.3.98.3 MLME-GDDENABLEMENT.confirm**6.3.98.3.1 Function**

This primitive reports the result of an MLME-GDDENABLEMENT.request primitive to initiate GDD enablement.

6.3.98.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-GDDENABLEMENT.confirm (

PeerSTAAddress,
DialogToken,
Protected,
ResultCode,
WSM
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any individual valid MAC address	Specifies the address of the peer MAC entity with which to perform the GDD enablement process.
DialogToken	Integer	1–255	The dialog token to identify the event transaction.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected GDD Enablement Response frame. If false, the response is sent using the GDD Enablement Response frame.
ResultCode	Enumeration	SUCCESS, REFUSED, ENABLEMENT DENIED, ENABLEMENT Denied due to restriction from GDB	Indicates the result response to the GDD Enablement Request frame from the peer entity.
WSM	WSM element	As defined in 8.4.1.55	Specifies the service parameters for the white space map.

6.3.98.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-GDDENABLEMENT.request primitive and indicates the results of the request.

This primitive is generated when the STA successfully receives a GDD Enablement Response frame from the peer entity or when an unspecified failure occurs.

6.3.98.3.4 Effect of receipt

On receipt of this primitive, the SME evaluates the results of the MLME-GDDENABLEMENT.request primitive and may use the reported data.

6.3.98.4 MLME-GDDENABLEMENT.indication

6.3.98.4.1 Function

This primitive indicates that a (Protected) GDD Enablement Request frame was received from a peer entity.

6.3.98.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-GDDENABLEMENT.indication (

PeerSTAAddress,
DialogToken,
Protected,
DeviceClass,
DeviceID
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any individual valid MAC address	The address of the peer entity from which a GDD Enablement Request frame was received.
DialogToken	Integer	1–255	The dialog token to identify the event transaction.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected GDD Enablement Request frame. If false, the request is sent using the GDD Enablement Request frame.
DeviceClass	DeviceClass	As defined in 8.2.6.2.1	Specifies the service parameters for the GDD Enablement Request frame.
DeviceID	Device Identification Information	As defined in 8.2.6.2.2	Specifies the service parameters for the GDD Enablement Request frame.

6.3.98.4.3 When generated

This primitive is generated by the MLME when a valid (Protected) GDD Enablement Request frame is received.

6.3.98.4.4 Effect of receipt

On receipt of this primitive, the SME operates according to the procedure in 10.43.1.

6.3.98.5 MLME-GDDENABLEMENT.response**6.3.98.5.1 Function**

This primitive indicates that a (Protected) GDD Enablement Response frame be sent to the peer entity.

6.3.98.5.2 Semantics of the service primitive

MLME-GDDENABLEMENT.response (

PeerSTAAddress,
DialogToken,
Protected,
ResultCode,
WSM

)

Name	Type	Valid range	Description
PeerSTAAddress	MAC address	Any individual valid MAC address	The address of the peer entity from which a GDD Enablement Request frame was received.
DialogToken	Integer	1–255	The dialog token to identify the event transaction.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected GDD Enablement Response frame. If false, the response is sent using the GDD Enablement Response frame.
ResultCode	Enumeration	SUCCESS, REFUSED, ENABLEMENT DENIED, ENABLEMENT Denied due to restriction from GDB	Indicates the result response to the GDD Enablement Request frame from the peer entity.
WSM	WSM element	As defined in 8.4.1.55	Specifies the service parameters for the white space map.

6.3.98.5.3 When generated

This primitive is generated by the SME to request that a GDD Enablement Response frame be sent to the peer entity.

6.3.98.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs a GDD Enablement Response frame. This frame is then scheduled for transmission.

6.3.99 Network channel control management

6.3.99.1 Introduction

The following MLME primitives support the signaling of network channel control management.

6.3.99.2 MLME-NETWORKCHANNELCONTROL.request

6.3.99.2.1 Function

This primitive requests that a (Protected) Network Channel Control Public Action frame be sent by a STA to a specified peer MAC entity.

6.3.99.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-NETWORKCHANNELCONTROL.request (
    PeerSTAAddress,
    DialogToken,
    NetworkChannelControl,
    Protected,
    VendorSpecificInfo
)
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual or group MAC Address	The address of the peer MAC entity to which the Network Channel Control frame is transmitted.
DialogToken	Integer	0–255	The dialog token to identify the network channel control transaction.
NetworkChannelControl	A set of information subfields	As defined in 8.5.8.32	Specifies the parameters of network channel control.
Protected	Boolean	true, false	Specifies whether the request is sent using a Robust Management frame. If true, the request is sent using the Protected Network Channel Control frame. If false, the request is sent using the Network Channel Control frame.
VendorSpecificInfo	A set of vendor specific elements	As defined in 8.4.2.28	Zero or more elements.

6.3.99.2.3 When generated

This primitive is generated by the SME to request that a (Protected) Network Channel Control Public Action frame be sent by a STA to the specified peer MAC entity.

6.3.99.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a (Protected) Network Channel Control Public Action frame. This frame is then scheduled for transmission.

6.3.99.3 MLME-NETWORKCHANNELCONTROL.confirm**6.3.99.3.1 Function**

This primitive reports the result of a request to network channel control.

6.3.99.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-NETWORKCHANNELCONTROL.confirm (
    PeerSTAAddress,
    DialogToken,
    NetworkChannelControl,
    Protected,
    VendorSpecificInfo
)
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC address	The address of the peer MAC entity from which the network channel control response frame is received.
DialogToken	Integer	0–255	The dialog token to identify the network channel control transaction.
NetworkChannelControl	A set of information subfields	As defined in 8.5.8.32	Specifies the parameters of network channel control.
Protected	Boolean	true, false	Specifies whether the response is sent using a Robust Management frame. If true, the response is sent using the Protected Network Channel Control Public Action frame. If false, the response is sent using the Network Channel Control Public Action frame.
VendorSpecificInfo	A set of vendor specific elements	As defined in 8.4.2.28	Zero or more elements.

6.3.99.3.3 When generated

This primitive is generated by the MLME when a network channel control request completes. Possible unspecified failure causes include an inability to schedule a Network Channel Control Public Action frame.

6.3.99.3.4 Effect of receipt

The SME is notified of the results of the network channel control procedure.

6.3.99.4 MLME-NETWORKCHANNELCONTROL.indication

6.3.99.4.1 Function

This primitive indicates that a (Protected) Network Channel Control Public Action frame was received from a STA.