

INTERNATIONAL
STANDARD

ISO/IEC/
IEEE
8802-22.2

First edition
2015-05-01

AMENDMENT 2
2017-09

**Information technology —
Telecommunications and information
exchange between systems — Local
and metropolitan area networks —
Specific requirements —**

Part 22:
Cognitive Wireless RAN Medium
Access Control (MAC) and Physical
Layer (PHY) Specifications: Policies
and Procedures for Operation in the
TV Bands

[ISO/IEC/IEEE 802.11-2015/Amd.2:2017](https://www.ieee802.org/1/standards/802.11-2015/Amd.2:2017)

AMENDMENT 2: Enhancement for
broadband services and monitoring
applications

*Technologies de l'information — Télécommunications et échange
d'information entre systèmes — Réseaux locaux et métropolitains —
Exigences spécifiques —*

*Partie 22: Spécifications du contrôle d'accès du milieu sans fil cognitif
(MAC) et de la couche physique (PHY) : Politiques et procédures pour
le fonctionnement dans les bandes TV*

*AMENDEMENT 2: Amélioration des services à bande large et
applications de la surveillance*



Reference number
ISO/IEC/IEEE 8802-22.2:2015/Amd.2:2017(E)



© IEEE 2015

iTeh Standards

(<https://standards.iteh.ai>)

Document Preview

[ISO/IEC/IEEE 8802-22:2015/Amd 2:2017](https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017)

<https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017>



COPYRIGHT PROTECTED DOCUMENT

© IEEE 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from ISO, IEC or IEEE at the respective address below.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA
stds.ipr@ieee.org
www.ieee.org

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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

The main task of ISO/IEC JTC 1 is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is called to the possibility that implementation of this standard may require the use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. ISO/IEEE is not responsible for identifying essential patents or patent claims for which a license may be required, for conducting inquiries into the legal validity or scope of patents or patent claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance or a Patent Statement and Licensing Declaration Form, 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 ISO or the IEEE Standards Association.

ISO/IEC/IEEE 8802-22:2015/Amd 2 was prepared by the LAN/MAN of the IEEE Computer Society (as IEEE 802.22b-2015). It was adopted by Joint Technical Committee ISO/IEC JTC 1, *Information technology, Telecommunications and information exchange between systems*, in parallel with its approval by the ISO/IEC national bodies, under the “fast-track procedure” defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE. IEEE is responsible for the maintenance of this document with participation and input from ISO/IEC national bodies.

IEEE Std 802.22b™-2015
(Amendment to
IEEE Std 802.22™-2011
as amended by IEEE Std 802.22a™-2014)

**IEEE Standard for Information Technology—
Telecommunications and information exchange
between systems
Wireless Regional Area Networks (WRAN)—
Specific requirements**

**Part 22: Cognitive Wireless RAN
Medium Access Control (MAC) and
Physical Layer (PHY) Specifications:
Policies and Procedures for
Operation in the TV Bands**

(<https://standards.iteh.ai>)

**Amendment 2: Enhancement for Broadband
Services and Monitoring Applications**

(ISO/IEC/IEEE 8802-22:2015/Amd 2:2017)

Sponsor

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

Approved 3 September 2015

IEEE-SA Standards Board

Abstract: Alternate physical layer (PHY) and necessary medium access control layer (MAC) enhancements to IEEE Std 802.22-2011 are specified in this amendment for operation in very high frequency/ultra-high frequency (VHF/UHF) television broadcast bands between 54 MHz and 862 MHz to support enhanced broadband services and monitoring applications. The amendment supports aggregate data rates greater than the maximum data rate supported by the IEEE Std 802.22-2011. This amendment defines new classes of IEEE 802.22™ devices to address these applications and supports more than 512 devices in a network. This amendment also specifies techniques to enhance communications among the devices and makes necessary amendments to the cognitive, security, and parameters and connection management clauses. This amendment supports mechanisms to enable coexistence with other IEEE 802® systems in the same band.

Keywords: broadband wireless access network, enhanced broadband services, high capacity, high throughput, IEEE 802.22™, IEEE 802.22b™, monitoring applications, WRAN standard

iTeh Standards (<https://standards.iteh.ai>) Document Preview

[ISO/IEC/IEEE 8802-22:2015/Amd 2:2017](https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017)

<https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017>

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

Copyright © 2015 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 30 October 2015. Printed in the United States of America.

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

PDF: ISBN 978-0-7381-9838-5 STD20318
Print: ISBN 978-0-7381-9839-2 STDPD20318

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 on 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.

iTeh Standards 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

When this amendment went to sponsor ballot, the IEEE 802.22 Working Group had the following officers:

Apurva Mody, Chair
Chang-woo Pyo, Vice Chair

When this amendment was sent to sponsor ballot, the Task Group b had the following membership:

Chang-woo Pyo, Chair and Editor
Sung Hyun Hwang, Vice Chair
Gabriel Villardi, Secretary

Gregory Buchwald
Winston Caldwell
Gerald Chouinard
Subir Das
Peter Flynn
Thomas Gurley
Hiroshi Harada
Bob Heile
Dien Hoang
Byung Jang Jeong

Jerome J. Kalke
Hynduk Kang
Gwangzeen Ko
Bruce Kraemer
Donghun Lee
PinHsun Lin
Liru Lu
Michael Lynch
Apurva Mody
Paul Nikolich

Masayuki Oodo
Ranga K. Reddy
Ivan Reede
Shigenobu Sasaki
Steve Shellhammer
Chunyi Song
Keat-Beng Toh
Xin (Amy) Zhang
Bing Xuan Zhao
Lei Zhongding

Major contributions were received from the following individuals:

Sung Hyun Hwang
Masayuki Oodo
Chang-woo Pyo
Aziz Rahman

Ranga K. Reddy
Shigenobu Sasaki
Chunyi Song

Keat-Beng Toh
Gabriel Villardi
Xin (Amy) Zhang
Bing Xuan Zhao

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

Iwan Adhicandra
Nobumitsu Amachi
Butch Anton
Madhusudan Banavara
Tuncer Baykas
Harry Bims
Nancy Bravin
William Byrd
Edgar Callaway
Juan Carreon
Keith Chow
Charles Cook
Carlo Donati
Sourav Dutta
Richard Edgar
Charles Einolf
Stanislav Filin
Devon Gayle
Alexander Gelman
Tim Godfrey
Randall Groves
Michael Gundlach
Thomas Gurley
Chris Guy
Werner Hoelzl
Sung Hyun Hwang
Noriyuki Ikeuchi
Akio Iso
Atsushi Ito
Raj Jain
Shinkyo Kaku
Jerome J. Kalke
Piotr Karocki
Stuart Kerr
Adrian Kliks
Bruce Kraemer
Yasushi Kudoh
Paul Lambert
Arthur H. Light
Daniel Lubar
William Lumpkins
Elvis Maculuba
James Marin
Jeffery Masters
Michael McInnis
Apurva Mody
Nabil Nasser
Michael Newman
Nick S. A. Nikjoo
Paul Nikolich
Masayuki Oodo
Satoshi Oyama
Subburajan Ponnuswamy
Venkatesha Prasad
Chang-woo Pyo
Verotiana Rabariaona
Robert Robinson
William Rose
John Santhoff
Shigenobu Sasaki
Naotaka Sato
Chunyi Song
Kapil Sood
Thomas Starai
Walter Struppler
Keat-Beng Toh
Ha-Nguyen Tran
David Trejo Pizzo
Mark-Rene Uchida
Gabriel Villardi
Hung-Yu Wei
Oren Yuen
Mingtuo Zhou

When the IEEE-SA Standards Board approved this amendment on 3 September 2015, it had the following membership:

John Kulick, Chair
Jon Walter Rosdahl, Vice Chair
Richard H. Hulett, Past Chair
Konstantinos Karachalios, Secretary

Masayuki Ariyoshi
Ted Burse
Stephen Dukes
Jean-Phillippe Faure
J. Travis Griffith
Gary Hoffman
Michael Janezic

Joseph L. Koepfinger*
David J. Law
Hung Ling
Andrew Myles
T. W. Olsen
Glenn Parsons
Ronald C. Peterson
Annette D. Reilly

Stephen J. Shellhammer
Adrian P. Stephens
Yatin Trivedi
Phillip Winston
Don Wright
Yu Yuan
Daidi Zhong

*Member Emeritus

iTeh Standards (<https://standards.iteh.ai>) Document Preview

[ISO/IEC/IEEE 8802-22:2015/Amd 2:2017](https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017)

Introduction

This introduction is not part of IEEE Std 802.22b™-2015, IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Wireless Regional Area Networks (WRAN)—Specific requirements—Part 22: Cognitive Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands—Amendment 2: Enhancement for Broadband Services and Monitoring Applications.

This amendment specifies alternate physical layer (PHY) and necessary medium access control layer (MAC) enhancements to IEEE Std 802.22-2011 for operation in very high frequency/ultra high frequency (VHF/UHF) television broadcast bands between 54 MHz and 862 MHz to support enhanced broadband services and monitoring applications. PHY specifications (i.e., Operation Mode 1 and Operation Mode 2) in Clause 9 and Clause 9a are designed to meet the needs required by channel models. A multi-channel operation (7.24), high modulation and coding (9.2 and 9a.2), and multiple-input, multiple-output (MIMO) (9.15 and 9a.15) provide higher throughput (compared to the IEEE Std 802.22-2011), which may be achieved by individual use or combinational use. Point-to-multipoint connections and relay connections are specified in Clause 7.

iTeh Standards (<https://standards.iteh.ai>) Document Preview

[ISO/IEC/IEEE 8802-22:2015/Amd 2:2017](https://standards.iteh.ai/catalog/standards/iso/06d36fda-f70a-4b65-a59e-a50e58213d38/iso-iec-ieee-8802-22-2015-amd-2-2017)

Contents

1. Overview	2
1.3 Reference application	2
3. Definitions	2
4. Abbreviations and acronyms	4
7. MAC Common Part sublayer	5
7.1 General.....	5
7.2 Addressing and connections	6
7.3 General superframe structure.....	7
7.4 General frame structure (on PHY-OM1).....	7
7.4a General frame structure (on PHY-OM2).....	8
7.4a.1 General frame structure for normal mode.....	8
7.4a.2 General frame structure for self-coexistence mode	8
7.4a.3 Frame format.....	8
7.4b General frame structure for a relay network.....	12
7.4b.1 General frame structure for a centralized scheduling mode	12
7.4b.2 General frame structure for a distributed scheduling mode.....	13
7.4b.3 Detail of zones	15
7.4b.3.1 Access zone (AZ).....	15
7.4b.3.2 Centralized relay zone (CRZ)	16
7.4b.3.3 Distributed relay zone (DRZ)	17
7.4b.3.4 Application of PHY Operation Mode to Zone Type	18
7.5 Control header	18
7.5.1 Superframe Control header	18
7.5.2 Frame Control header.....	18
7.5.2a Frame control header for PHY-OM2	19
7.5.2a.1 General	19
7.5.2a.2 Extended frame control header (Ex-FCH)	20
7.5.2b Distributed relay zone (DRZ) Frame Control header (DRZ-FCH)	23
7.6 MAC PDU formats	24
7.6.1 MAC headers	24
7.6.1.1 Generic MAC header	24
7.6.1.2 MAC subheaders and special payloads	25
7.6.1.2.5 Extended subheader types	26
7.6.1.3 CBP MAC PDU format	27
7.6.1.3.1 CBP information elements	28
7.7 Management messages	30
7.7.1 Downstream Channel Descriptor (DCD)	30
7.7.1.1 DCD Channel information elements.....	32
7.7.2 Downstream MAP (DS-MAP).....	34
7.7.2.1 DS-MAP IE	35
7.7.2.1.1 DIUC allocations	35
7.7.2.1.2 DS-MAP Extended DIUC IE	37
7.7.3 Upstream Channel Descriptor (UCD).....	42
7.7.3.1 UCD Channel IEs	44
7.7.4 Upstream MAP (US-MAP).....	45
7.7.4.1 US-MAP IE.....	46
7.7.4.1.1 UIUC allocations	49
7.7.4.1.4 US-MAP Extended UIUC IE	50

7.7.7	REG-REQ/RSP	60
7.7.7.3	REG-REQ/RSP information elements	60
7.7.7.3.4	CPE capability	60
7.7.7.3.6	Local SID Group	61
7.7.8.9	Service Flow encodings	61
7.7.8.9.19	Per-RS QoS	61
7.7.11	CPE Basic Capability Request/Response (CBC-REQ/RSP)	62
7.7.11.3	CBC-REQ/RSP information elements	62
7.7.11.3.2	Physical parameters supported	62
7.7.11.3.4	Relay CPE Mode	63
7.7.11.3.5	Multi-channel operation supported	64
7.7.24	Confirmation codes	64
7.7.25	Local Cell Update messages	64
7.7.25.1	Local Cell Update Indication (LCU-IND) message	64
7.7.25.2	Local Cell Update Acknowledgment (LCU-ACK) message	65
7.7.26	Container message	66
7.7.26.1	Message format	66
7.7.26.2	Container ACK message	66
7.7.27	Downstream Transmit Test (DTT) messages	67
7.7.27.1	DTT Request (DTT-REQ) message	67
7.7.27.1.1	Message format	67
7.7.27.1.2	DTT-REQ information element	67
7.7.27.2	DTT Response (DTT-RSP) message	67
7.7.27.2.1	Message format	67
7.7.27.2.2	DTT-RSP information element	68
7.7.27.3	DTT Report (DTT-RPT) message	68
7.7.27.3.1	Message format	68
7.7.27.3.2	DTT-RPT information element	68
7.7.27.4	DTT Confirmation (DTT-CFM) message	69
7.7.27.4.1	Message format	69
7.7.27.4.2	DTT-CFM information element	69
7.7.28	Relay-Schedule (Relay-SCHE) message	69
7.7.29	Channel Allocation Manager management messages	70
7.7.29.1	Overview	70
7.7.29.2	Add new operating channel (CAM-ADD) message	70
7.7.29.3	Stop operating channel (CAM-STOP) message	71
7.7.29.4	Stop operating channel acknowledgment (CAM-STOP-ACK) message	71
7.7.29.5	Switch operating channel (CAM-SWH) message	71
7.7.29.6	Switch operating channel acknowledgment (CAM-SWH-ACK) message	72
7.7.30	Group Resource Allocation management messages	72
7.7.30.1	Group Resource Allocation Configuration (GRA-CFG) message	72
7.7.30.2	Group Resource Allocation Update (GRA-UPD) message	73
7.7.31	Ranging Report (RNG-RPT) message	75
7.8	Management of MAC PDUs	75
7.8.4	Packing	75
7.8.4.3	ARQ Feedback IEs	75
7.8.7	MAC PDU construction for relay	76
7.8.7.1	General	76
7.8.7.2	MAC PDU construction for distributed scheduling A-CPE on non-ARQ connections	76
7.8.7.2.1	Overview	76
7.8.7.2.2	Procedure 1 on non-ARQ connections	76
7.8.7.2.3	Procedure 2 on non-ARQ connections	77
7.8.7.2.4	Procedure 3 on non-ARQ connections	78