INTERNATIONAL STANDARD

ISO/IEC/ IEEE 8802-11

First edition
2012-11-01

AMENDMENT 5
2015-09-01

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

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

Partie 11: Spécifications du contrôle d'accès du milieu sans fil (MAC) et de la couche physique (PHY)

AMENDEMENT 5

Reference number
ISO/IEC/IEEE 8802-11:2012/Amd.5:2015(E)

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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

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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,
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IEEE Std 802.11af™-2013

(Amendment to
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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—
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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

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

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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.

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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

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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 ~~strikethrough~~ (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]

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

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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 6225~~3825~~: 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.

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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).

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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

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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 PPDUs:

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 PPDUs:

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

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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].

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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]

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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”.
- “dot11TVHTOptionImpelemented” replaces “dot11VHTOptionImplemented”.
- “dot11TVHTControlFieldOptionImplemented” replaces both “dot11VHTControlFieldOption-Implemented” and “dot11HTControlFieldSupported”.
- “dot11TVHTShortGIOptionIn80Activated” replaces “dot11VHTShortGIOptionIn80Activated”.
- “dot11TVHTSUBeamformerOptionImplemented” replaces “dot11VHTSUBeamformerOption-Implemented”.
- “dot11TVHTSUBeamformeeOptionImplemented” replaces “dot11VHTSUBeamformeeOption-Implemented”.
- “dot11TVHTMUBeamformerOptionImplemented” replaces “dot11VHTMUBeamformerOption-Implemented”.
- “dot11TVHTMUBeamformeeOptionImplemented” replaces “dot11VHTMUBeamformeeOption-Implemented”.
- “dot11TVHTSUBeamformeeActivated” replaces “dot11VHTSUBeamformeeActivated”.

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— "dot11TVHTTXOPPowerSaveOptionImplemented" replaces "dot11VHTTXOPPowerSaveOptionImplemented".
— "dot11TVHTOBSSScanCount" 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.

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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.

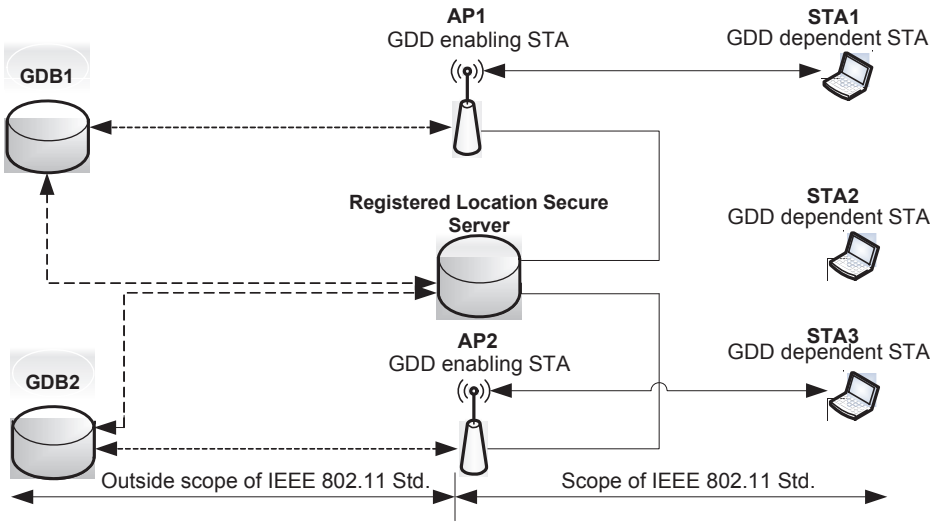

Figure 4-10b—Multiple APs and Multiple GDBs

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

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— 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.

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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.

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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.

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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.

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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.

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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.
ChannelAvailability Query	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.

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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.

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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.

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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.

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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:

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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.

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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.

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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.

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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.

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