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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

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,
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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

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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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(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 ~~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]

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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.

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 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

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”.
- “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”.

— "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.

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.

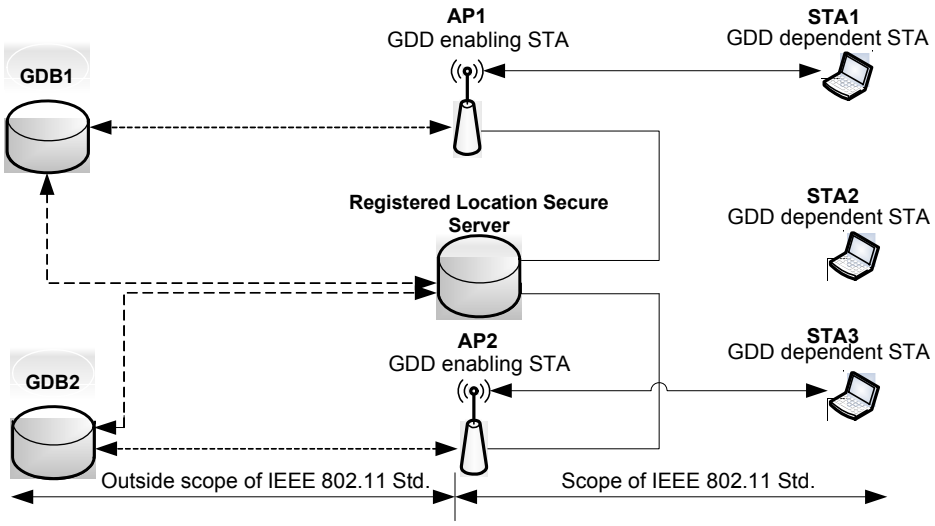


Figure 4-10b—Multiple APs and Multiple GDBs

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.
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.

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.

6.3.99.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-NETWORKCHANNELCONTROL.indication (
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 frame was 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 request was received using a Robust Management frame. If true, the request was received using the Protected Network Channel Control Public Action frame. If false, the request was received 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.

6.3.99.4.3 When generated

This primitive is generated by the MLME when a valid (Protected) Network Channel Control Public Action frame is received.

6.3.99.4.4 Effect of receipt

On receipt of this primitive, the SME decides whether to accept the network channel control request.

6.3.99.5 MLME-NETWORKCHANNELCONTROL.response

6.3.99.5.1 Function

This primitive is generated by the SME to schedule the transmission of a network channel control response.

6.3.99.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-NETWORKCHANNELCONTROL.response (

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 response 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 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.

6.3.99.5.3 When generated

This primitive is generated by the SME to request that a network channel control response be sent to the peer entity.

6.3.99.5.4 Effect of receipt

On receipt of this primitive, the MLME schedules the response to the specific peer MAC entity that has requested a network channel control response.

6.3.100 White space map (WSM)

6.3.100.1 Introduction

The following MLME primitives support the signaling of the WSM.

6.3.100.2 MLME-WSM.request

6.3.100.2.1 Function

This primitive requests that a White Space Map Announcement frame be sent by a GDD enabling STA in order to provide a WSM to a GDD dependent STA.

6.3.100.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-WSM.request (
PeerSTAAddress,
WhiteSpaceMap
)

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 WSM process.
WhiteSpaceMap	White Space Map element	As defined in 8.4.2.170	Specifies the service parameters for the WSM.

6.3.100.2.3 When generated

This primitive is generated by the SME to request that a White Space Map Announcement frame be sent by a GDD enabling STA to a specified peer MAC entity.

6.3.100.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a White Space Map Announcement frame. This frame is then scheduled for transmission.

6.3.100.3 MLME-WSM.indication

6.3.100.3.1 Function

This primitive indicates receipt of a request of a White Space Map Announcement frame.

6.3.100.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-WSM.indication (
PeerSTAAddress,
WhiteSpaceMap
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity from which a WSM was received.
WhiteSpaceMap	White Space Map element	As defined in 8.4.2.170	Specifies the service parameters for the WSM.

6.3.100.3.3 When generated

This primitive is generated by the MLME when a valid White Space Map Announcement frame is received.

6.3.100.3.4 Effect of receipt

On receipt of this primitive, the SME is notified of the receipt of White Space Map Announcement frame.

7. PHY service specification

7.3 Detailed PHY service specifications

7.3.5 PHY-SAP detailed service specification

7.3.5.11 PHY-CCA.indication

7.3.5.11.2 Semantics of the service primitive

Change the following rows of Table 7-5:

Table 7-5—The channel-list parameter elements

channel-list elements	Meaning
primary	For an HT STA that is not a VHT STA, indicates that the primary 20 MHz channel is busy. For a VHT STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 22.3.19.5.3. For a TVHT STA, indicates that the primary channel is busy according to the rules specified in 23.3.19.6.3.
secondary	For an HT STA that is not a VHT STA, indicates that the secondary channel is busy. For a VHT STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 22.3.19.5.4. For a TVHT STA, indicates that the secondary channel is busy according to the rules specified in 23.3.19.6.4.
secondary40	Indicates that the secondary 40 MHz channel is busy according to the rules specified in 22.3.19.5.4. For a TVHT STA, indicates that the secondary TVHT_2W channel is busy according to the rules specified in 23.3.19.6.4.

Insert the following paragraphs and figures (Figure 7-2a and Figure 7-2b) at the end of the 7.3.5.11.2:

For a TVHT STA, the relationship of the channel-list parameter elements to the TVHT_W, TVHT_2W, and TVHT_W+W BSS operating channel is illustrated in Figure 7-2a.

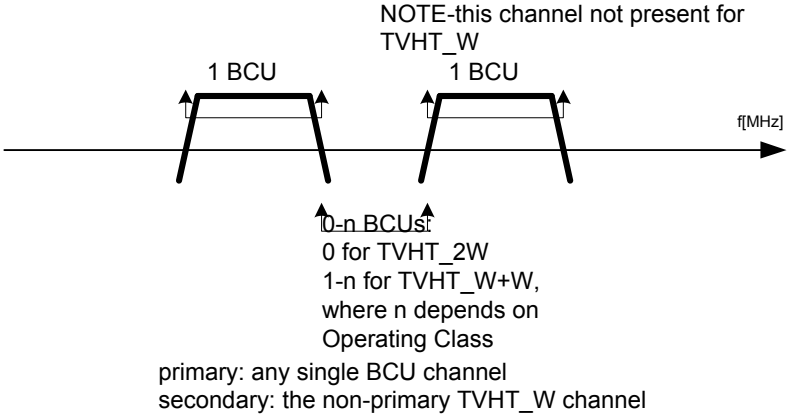
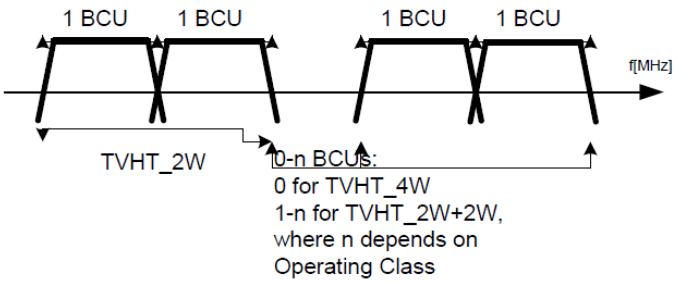


Figure 7-2a—TVHT channel-list parameter element and channel bandwidth for TVHT_W, TVHT_2W, and TVHT_W+W

For a TVHT STA, the relationship of the channel-list parameter elements to the TVHT_4W and TVHT_2W+2W BSS operating channel is illustrated in Figure 7-2b.



primary: any single BCU channel
secondary: the non-primary TVHT_W channel in the same TVHT_2W channel group
secondary40: the TVHT_2W channel group that does not contain the primaryTVHT_W

Figure 7-2b—TVHT channel-list parameter element and channel bandwidth for TVHT_4W and TVHT_2W+2W

8. Frame formats

8.2 MAC frame formats

8.2.4 Frame fields

8.2.4.6 HT Control field

8.2.4.6.3 VHT variant

Change the following row of Table 8-13b:

Table 8-13b—MFB subfield in the VHT variant HT Control field

Subfield	Meaning	Definition
BW	Bandwidth of the recommended VHT-MCS	If the Unsolicited MFB subfield is 1, the BW subfield indicates the bandwidth for which the recommended VHT-MCS is intended, as defined in 9.28.3: For a VHT STA: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz. For a TVHT STA: Set to 0 for TVHT_W Set to 1 for TVHT_2W and TVHT_W+W Set to 2 for TVHT_4W and TVHT_2W+2W The value 3 is reserved. If the Unsolicited MFB subfield is 0, the BW subfield is reserved.

8.2.4.7 Frame Body field

8.2.4.7.1 General

Change the second list item in the dashed list after the first paragraph of 8.2.4.7.1 as follows:

— The maximum PPDU duration (e.g., HT_MF, L_SIG, L_LENGTH, HT_GF, VHT, TVHT, or DMG aPPDUMaxTime (see Table 8-13c); any nonzero TXOP Limit; any regulatory constraints (e.g., CS4-msBehavior))

Insert the following subclauses, 8.2.6 to 8.2.6.2.5 (including Table 8-14a to Table 8-14h), after 8.2.5.8:

8.2.6 TLV encodings

8.2.6.1 General

The following TLV encodings are used to convey parameters within MAC Management frames (8.3.3, 8.4, and 8.5). The specification is complete regarding the endianness of multi-octet fields as they are covered by 8.2.2. Be aware that most protocols above the MAC operate in the opposite endianness. TLV tuples with type values that are unknown, not specified in this subclause, or specified as “reserved” are discarded upon receipt. The form of TLVs is shown in Table 8-14a.

Table 8-14a—General TLV format

Name	Type	Length (octets)	Value	Scope/ Country code
The name of the TLV	1	variable	Single Octet, Single Value, or Compound TLV tuples.	

Name is the name of the TLV tuple.

The '*m.n*' syntax in the Type field means that the TLV has type *n*, an unsigned 1-octet integer, and is embedded in the Value field of a TLV of type *m*. The length of the Type field is 1 octet.

The format of the Length field is an unsigned number of size 1 octet, and the value in the Length field specifies the number of octets in the Value field.

A single octet TLV has a Value field that is a single octet, a single value TLV has a Value field larger than 1-octet, and a compound TLV has a Value field that represents more than 1-octet fields.

When a Scope field entry contains two characters, it identifies the country or other entity to which the STA's operation is bound. If the two-character value stands for a country or other entity, then the value matches a code defined in ISO 3166-1. When a Scope field entry contains more than two characters, it identifies a scope for the TLV tuple.

8.2.6.2 Common TLVs

The general form of common TLVs is shown in Table 8-14a and is used in 8.2.6.2.1 to 8.2.6.2.5.

8.2.6.2.1 Device Class

This parameter contains the intended class of device for operation in TVWS band after it receives the available channel list at its location. The Device Class field format is shown in Table 8-14b.

Table 8-14b—Device Class field definition

Name	Type	Length (octets)	Value	Scope/ Country code
Device Class	2	1	The Device Class field contains an integer that indicates the device's TVWS band mode of operation as follows: 0: GDD non-AP STA 1: GDD geolocated non-AP STA 2: GDD AP 3: GDD fixed STA 4–255: Reserved	CAQ, GDDENABLEMENT, WSM

8.2.6.2.2 Device Identification Information

This parameter contains the identification information of the device initiating the channel availability query. The Device Identification Information field format is shown in Table 8-14c and related Device Identification Information Value fields tables in E.2 for specific regulatory domains.

Table 8-14c—Device Identification Information field definition

Name	Type	Length (octets)	Value	Scope/ Country code
Device Identification Information	3	variable	Single value TLV comprising fields in related table in E.2 for a specific regulatory domain.	CAQ, GDDENABLEMENT, CSM

8.2.6.2.3 Device Location Information

This parameter contains the location information of the device initiating the channel availability query. The Device Location Information field format is shown in Table 8-14d.

Table 8-14d—Device Location Information field definition

Name	Type	Length (octets)	Value	Scope/ Country code
Device Location Information	10	16	The Device Location Information field contains the latitude, longitude, and altitude information of the device in the format specified by the Device Location Information Body fields in Figure 8-80i. When the Device Type subfield (see Table 8-14b) is not GDD fixed STA, the altitude information (Altitude Type, Altitude Uncertainty, Altitude Fraction, and Altitude Integer subfields) of the Device Location Information field remain unused.	CAQ

8.2.6.2.4 Channel Schedule Descriptor

This parameter contains the channel number associated with channel schedule information used for channel schedule management. The Channel Schedule Descriptor Tuple attribute format is shown in Table 8-14e and Table 8-14f. Channel Schedule Descriptor field is constructed with either Channel Availability Starting Time field or Channel Availability Starting Timestamp field present or neither of these two fields present.

Table 8-14e—Channel Schedule Descriptor Tuple attribute definition

Name	Type	Length (octets)	Value	Scope/ Country code
Channel Schedule Descriptor	11	variable	Compound TLVs in Table 8-14f.	CSM

Table 8-14f—Channel Schedule Descriptor Value fields

Name	Subtype	Length (octets)	Value	Scope/ Country code
Operating Class	1	1	The Operating Class field is the number of the operating class of the channel, which is defined in E.1.	CSM
Channel Number	2	1	The Channel Number field is the number of the channel, which is the subject of the value of Channel Schedule Management Mode field. If the Channel Schedule Management Mode field indicates the schedule information is based on WLAN channels, the Channel Number is a channel from the STA's operating class as defined in E.1; otherwise, the Operating Class compound TLV is not present, and the Channel Number is a positive integer value as defined in D.1 to indicate the available TV channel for WLAN operation.	CSM
Channel Availability Starting Time	3	8	The Channel Availability Starting Time field indicates the starting time in Coordinated Universal Time (UTC) from when the channel indicated in the Channel Number field is available for operation. When neither this field nor a Channel Availability Starting Timestamp is present, the STA takes the time that the response element is received as the starting time of the channel availability. NOTE—The Channel Availability Starting Time field follows the UTC time definition of the Time Value field of the Time Advertisement element in 8.4.2.63, and the first 6 octets are used to indicate the UTC time until minutes. The left 2 octets are reserved.	CSM
Channel Availability Starting Timestamp	4	8	The Channel Availability Starting Timestamp field indicates the starting timestamp from when the channel indicated in the Channel Number field is available for operation. When neither this field nor a Channel Availability Starting Time field is present, the STA takes the time that the response element is received as the starting time of the channel availability.	CSM
Channel Availability Offset Time	5	2	The Channel Availability Offset Time field indicates the offset of channel availability time with respect to the time that the Channel Schedule Descriptor is received. This field is present when the Channel Availability Starting Time field is not present in the response TLV and the channel is not available at the moment the TLV is received.	CSM
Channel Availability Duration	6	2	The Channel Availability Duration field indicates the duration in minutes of the availability of the channel that indicated in the Channel Number field.	CSM

8.2.6.2.5 WSM information values

The format of the WSM information values is shown in Table 8-14g. If the value of WSM Type field of the White Space Map element (8.4.1.55) is 1, the WSM Information field specifies available channel information for TVWS, which is country-specific.

Table 8-14g—WSM information values

Name	Type	Length (octets)	Value	Scope/ Country code
WSM Information	12	variable	Single value TLV comprising fields in related table in E.2 for a specific regulatory domain.	WSM

The format of the WSM Information Value fields is shown in Table 8-14h.

Table 8-14h—WSM Information Value fields

Name	Length (octets)	Value	Scope/ Country code
Device Class	1	Single octet TLV comprising fields in Table 8-14b.	WSM
Map ID	1	Bit 0: Type bit indicates whether the following channel list is a full channel list or a partial channel list. If the Type bit is 1, the following channel list is a full channel list; and if the Type bit is 0, the following channel list is a partial channel list. Bits 1–7: Map version identifies the version of the WSM.	WSM
Channel Number	1	Channel Number field in related WSM Information Value fields table in E.2.	WSM
Maximum Power Level	1	Maximum Power Level field in related WSM Information Value fields table in E.2.	WSM
Validity	1	The Validity field indicates the time duration in minutes for which the Channel Number is available with the allowed maximum power level, where the Validity field is provided for each available Channel Number.	WSM, UK
Maximum Channel Bandwidth	2	Limits on the maximum contiguous and maximum noncontiguous instantaneous bandwidths of STA specified as $n \times 0.1$ MHz, where $n > 0$.	WSM, UK

The Device Class field is defined in 8.2.6.2.1 and identifies the device class used by the WSM. It determines the length of the channel availability tuple consisting of the Channel Number, Maximum Power Level, and Validity fields, which is repeated as indicated by the length field of WSM element. If the Device Class field is 0, the Validity field in WSM Information Value field is not present. Otherwise, the Validity field exists in the WSM Information Value field.

8.3 Format of individual frame types

8.3.3 Management frames

8.3.3.2 Beacon frame format

Change the following rows of Table 8-20:

Table 8-20—Beacon frame body

Order	Information	Notes
36	Supported Operating Classes	The Supported Operating Classes element is present if dot11ChannelSwitchActivated is true. The Supported Operating Classes element is optionally present if dot11TVHTOptionImplemented is true.
63	Channel Switch Wrapper element	The Channel Switch Wrapper is optionally present if dot11VHTOptionImplemented is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Beacon frame and the Channel Switch Wrapper element contains at least one subelement. The Channel Switch Wrapper element is optionally present if dot11TVHTOptionImplemented is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Beacon frame and the Channel Switch Wrapper element contains at least one subelement.

Insert the following rows into Table 8-20 before the Last row:

Table 8-20—Beacon frame body

Order	Information	Notes
201	Reduced Neighbor Report	The Reduced Neighbor Report element is optionally present if dot11TVHTOptionImplemented is true.
202	TVHT Operation	The TVHT Operation element is present for a TVHT STA when the dot11TVHTOptionImplemented is true; otherwise it is not present.

8.3.3.9 Probe Request frame format

Change the following row of Table 8-26:

Table 8-26—Probe Request frame body

Order	Information	Notes
6	Supported Operating Classes	The Supported Operating Classes element is present if dot11ChannelSwitchActivated is true. The Supported Operating Classes element is optionally present if dot11TVHTOptionImplemented is true.

8.3.3.10 Probe Response frame format

Change the following rows of Table 8-27:

Table 8-27—Probe Response frame body

Order	Information	Notes
36	Supported Operating Classes	The Supported Operating Classes element is present if dot11ChannelSwitchActivated is true. The Supported Operating Classes element is optionally present if dot11TVHTOptionImplemented is true.
63	Channel Switch Wrapper element	The Channel Switch Wrapper is optionally present if dot11VHTOptionImplemented is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Beacon frame and the Channel Switch Wrapper element contains at least one subelement. The Channel Switch Wrapper element is optionally present if dot11TVHTOptionImplemented is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Beacon frame and the Channel Switch Wrapper element contains at least one subelement.

Insert the following rows into Table 8-27 before the Last-1 row:

Table 8-27—Probe Response frame body

Order	Information	Notes
201	Reduced Neighbor Report	The Reduced Neighbor Report element is optionally present if dot11TVHTOptionImplemented is true.
202	TVHT Operation	The TVHT Operation element is present for a TVHT STA when the dot11TVHTOptionImplemented is true; otherwise it is not present.

8.4 Management frame body components

8.4.1 Fields that are not information elements

8.4.1.9 Status Code field

Insert the following rows into Table 8-37 in numeric order, and change the reserved values accordingly:

Table 8-37—Status codes

Status code	Name	Meaning
105	ENABLEMENT DENIED	Enablement denied
106	RESTRICTION FROM AUTHORIZED GDB	Enablement denied due to restriction from an authorized GDB
107	AUTHORIZATION DEENABLED	Authorization deenabled

8.4.1.32 Rate Identification field

Insert the following paragraphs, starting after the fifth paragraph, into 8.4.1.32:

The MCS Selector field value 4 indicates that the MCS Index field specifies values that are taken from Table 22-38 through Table 22-45, indicating a VHT-MCS for a 40 MHz channel width.

In frames transmitted by a TVHT STA, the MCS Selector field value 4 indicates that the MCS Index field specifies values that are taken from Table 23-26 through Table 23-29, indicating a TVHT_MCS for a TVHT_W channel width.

The MCS Selector field value 5 indicates that the MCS Index field specifies values that are taken from Table 22-46 through Table 22-53, indicating a VHT-MCS for an 80 MHz channel width.

In frames transmitted by a a TVHT STA, the MCS Selector field value 5 indicates that the MCS Index field specifies values that are taken from Table 23-30 through Table 23-33, indicating a TVHT_MCS for a TVHT_2W or TVHT_W+W channel width.

The MCS Selector field value 6 indicates that the MCS Index field specifies values that are taken from Table 22-54 through Table 22-61, indicating a VHT-MCS for a 160 MHz or 80+80 MHz channel width.

In frames transmitted by a a TVHT STA, the MCS Selector field value 6 indicates that the MCS Index field specifies values that are taken from Table 23-34 through Table 23-37, indicating a TVHT_MCS for a TVHT_4W or TVHT_2W+2W channel width.

Change the now 14th paragraph of 8.4.1.32 as follows:

If MCS Selector is 3, 4, 5, or 6, the MCS Index field format is as shown in Figure 8-70a. The NSS subfield indicates the number of spatial streams, and the VHT-MCS Index Row subfield indicates a value from the "VHT-MCS Index" column of Table 22-30 through Table 22-61 in 22.5 or from the "MCS Index" column of Table 23-26 through Table 23-37 in 23.5 that corresponds to the channel width and N_{SS} values.

8.4.1.48 VHT Compressed Beamforming Report field

Insert the following subclause, 8.4.1.48a, after 8.4.1.48:

8.4.1.48a TVHT Compressed Beamforming Report field

The format of the TVHT Compressed Beamforming Report field is the same as the VHT Compressed Beamforming Report field in 8.4.1.48 except for the following modifications.

The subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in Table 8-53g for 40 MHz are used for each basic channel unit (BCU) in TVHT_MODE_1 and TVHT_MODE_2N. See tone location description in Table 23-9.

For TVHT_MODE_2C with 6 MHz and 8 MHz channelization, the subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in the Lower BCU are based on subtracting 72 from the values shown in Table 8-53g and for the Upper BCU by adding 72.

For TVHT_MODE_2C with 7 MHz channelization, the subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in the Lower BCU are based on subtracting 84 from the values shown in Table 8-53g and for the Upper BCU by adding 84.

For TVHT_MODE_4C with 6 MHz and 8 MHz channelization, the subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in the lowest, second to lowest, second to highest, and highest BCUs are based on subtracting 216, subtracting 72, adding 72, and adding 216 from the values shown in Table 8-53g, respectively.

For TVHT_MODE_4C with 7 MHz channelization, the subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in the lowest, second to lowest, second to highest, and highest BCUs are based on subtracting 252, subtracting 84, adding 84, and adding 252 from the values shown in Table 8-53g, respectively.

For TVHT_MODE_4N channelization, the subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent in each of the two noncontiguous frequency segments are as described for TVHT_MODE_2C.

A STA with a TVHT_2W, TVHT_4W, TVHT_W+W, or TVHT_2W+2W operating channel width and sending feedback for a TVHT_W channel width includes a representation of the compressed beamforming feedback matrices of the subcarriers corresponding to the primary TVHT_W channel in the Compressed Feedback Beamforming Matrix subfield.

A STA with an TVHT_4W or TVHT_2W+2W operating channel width and sending feedback for a TVHT_2W channel width includes a representation of the compressed beamforming feedback matrices of the subcarriers corresponding to the primary TVHT_2W channel in the Compressed Feedback Beamforming Matrix subfield.

8.4.1.49 MU Exclusive Beamforming Report field

Insert the following subclause, 8.4.1.49a, after 8.4.1.49:

8.4.1.49a TVHT MU Exclusive Beamforming Report field

See 8.4.1.49 with the following modifications.

For each BCU in TVHT_MODE_1 and TVHT_MODE_2N, the subcarriers used in the Delta SNR subfield are defined in Table 8-53j for 40 MHz. See the tone location description in Table 23-9.

For TVHT_MODE_2C with 6 MHz and 8 MHz channelization, the subcarriers for which Delta SNR subfield is sent in the Lower BCU are based on subtracting 72 from the values shown in Table 8-53j and for the Upper BCU by adding 72.

For TVHT_MODE_2C with 7 MHz channelization, the subcarriers for which Delta SNR subfield is sent in the Lower BCU are based on subtracting 84 from the values shown in Table 8-53j and for the Upper BCU by adding 84.

For TVHT_MODE_4C with 6 MHz and 8 MHz channelization, the subcarriers for which Delta SNR subfield is sent in the lowest, second to lowest, second to highest, and highest BCUs are based on subtracting 216, subtracting 72, adding 72, and adding 216 from the values shown in Table 8-53j, respectively.

For TVHT_MODE_4C with 7 MHz channelization, the subcarriers for which Delta SNR subfield is sent in the lowest, second to lowest, second to highest, and highest BCUs are based on subtracting 252, subtracting 84, adding 84, and adding 252 from the values shown in Table 8-53j, respectively.

For TVHT_MODE_4N channelization, the subcarriers for which Delta SNR subfield is sent in each of the two noncontiguous frequency segments are as described for TVHT_MODE_2C.

8.4.1.50 Operating Mode field

Change the following row of Table 8-53k:

Table 8-53k—Subfield values of the Operating Mode field

Subfield	Description
Channel Width	If the Rx NSS Type subfield is 0, indicates the supported channel width: For a VHT STA: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz or 80+80 MHz For a TVHT STA: Set to 0 for TVHT_W Set to 1 for TVHT_2W and TVHT_W+W Set to 2 for TVHT_4W and TVHT_2W+2W The value of 3 is reserved. Reserved if the Rx NSS Type subfield is 1.

Insert the following subclauses, 8.4.1.53 to 8.4.1.55 (including Figure 8-80h, Figure 8-80i, and Table 8-53m to Table 8-53o), after 8.4.1.52:

8.4.1.53 Channel Schedule Management element

The Channel Schedule Management element is transmitted in the Public Action frame or protected Public Action or protected Public Action of RLQP to indicate a channel schedule change. The format of the Channel Schedule Management element is shown in Figure 8-80h.

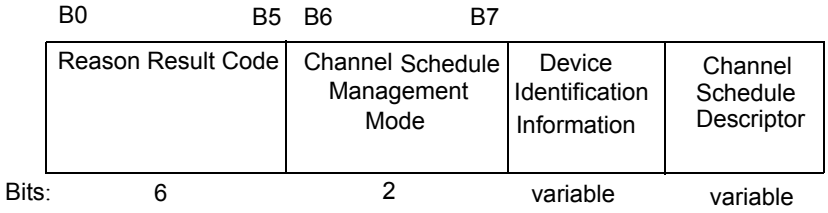


Figure 8-80h—Channel Schedule Management element format

The Length field indicates the length of the remaining fields in octets, and the value is variable.

The Reason Result Code field indicates the reason for transmitting a query request for channel schedule information. It also indicates the result of a query as successful or not and the reason when the query is not successful. The value of this field is defined in Table 8-53m.

Table 8-53m—Reason Result Code field values

Reason Result Code field values	Description
0	Request for channel schedule information from a RLSS.
1	Request for channel schedule information from a GDD enabling STA.
2	Success, returning full channel schedule information on the requested channels.
3	Success, returning additional timeslots from the list of the last query on the requested channels.
4	Success, returning timeslots deleted from the list of last query on the requested channels.
5	Success, returning deleted and added timeslots from the list of last query on the requested channels.
6	Success, returning no channel schedule changes from last query.
7	Request declined by the GDD enabling STA for unspecified reason.
8	Request declined by the GDD enabling STA because of no capability for providing schedule information on WLAN channels.
9	Request declined by RLSS for unspecified reason.
10	Request declined by RLSS because of no capability for providing schedule information on WLAN channels.
11	Unknown reason.
12	Continuation frame. This frame continues the fields from the previous CSM frame.
13–63	Reserved.

The Channel Schedule Management Mode field indicates if the schedule information of the channel availability is based on TV channels or WLAN channels. If the schedule information is based on WLAN channels, the optional Operating Class field is present in the Channel Schedule Descriptor field as defined in E.1. This field also indicates whether the optional Channel Availability Starting Time field is present in the Channel Schedule Descriptor field. The value of this field is defined in Table 8-53n.

Table 8-53n—Channel Schedule Management Mode field values

Channel Schedule Management Mode value	Description
0	The channel schedule information is based on TV channels. The Reason Result Code field is set to either 0 or 1.
1	The channel schedule information is based on WLAN channels. The Reason Result Code field is set to either 0 or 1.
2–3	Reserved.

The Device Identification Information field indicates the regulatory identification of the STA that is requesting the schedule information. The Device Identification Information field is present only when Reason Result Code is either 0 or 1. The value of the field is defined in 8.2.6.2.2.

The Channel Schedule Descriptor field indicates the channels for which the schedule information is requested, and the channel schedule information is provided in the response. The value of the field is defined in 8.2.6.2.4. The Channel Schedule Descriptor field is repeated, as determined by the Length field.

8.4.1.54 Device Location Information Body

A Device Location Information Body includes the location configuration information (LCI), which contains latitude, longitude, and altitude information.

The structure and information fields are little endian, per conventions defined in 8.2.2.

The format of the Device Location Information Body field is shown in Figure 8-80i.

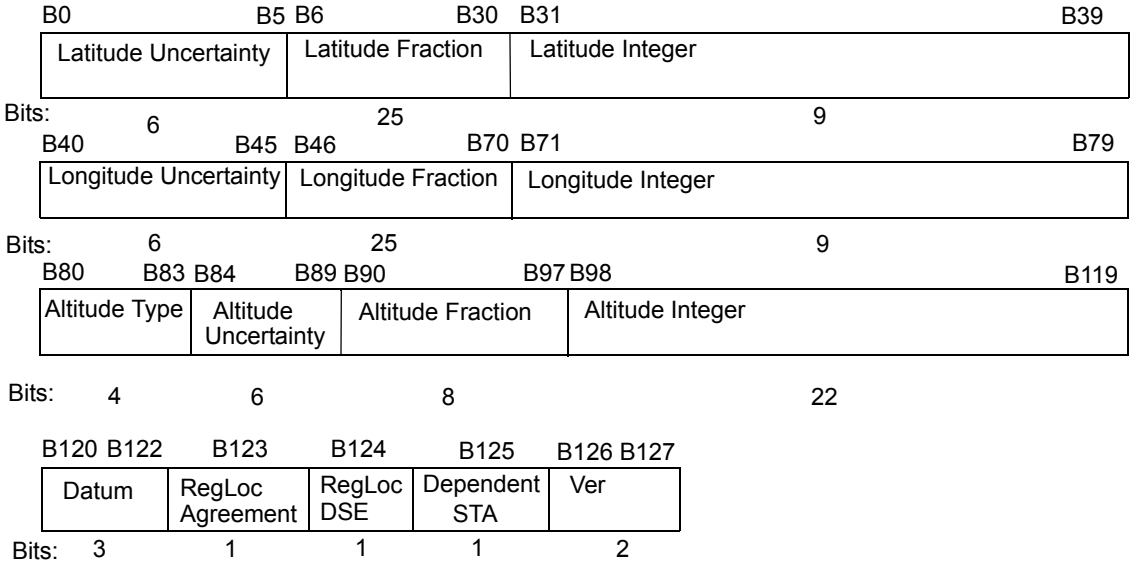


Figure 8-80i—Device Location Information Body field format

The fields within the Device Location Information Body field are as defined in section 2.2 of IETF RFC 6225-2011[2] except as defined in 8.4.2.54, and RegLocAgreement and RegLocDSE are set to zero.

8.4.1.55 WSM type and information

The WSM Type field is set to a number that identifies the type of WSM information and the frequency band where the following WSM Information field is applicable. The values of WSM Types are shown in Table 8-53o. A WSM Type field value of 1 indicates the WSM Information field of the WSM element contains available frequency information for operation in the TVWS. Other values are reserved.

The WSM Information field indicates the available channel information as defined in 8.2.6.2.5.

[2] Information on normative references can be found in Clause 2.

Table 8-53o—WSM Type definition

Name	WSM Type
Reserved	0
TV band WSM	1
Reserved	2–255

The WSM Information field corresponding to a TV band WSM is shown in Table 8-14g.

8.4.2 Information elements

8.4.2.1 General

Insert the following rows into Table 8-54 in numeric order, and change the reserved values accordingly:

Table 8-54—Element IDs

Element	Element ID	Length of indicated element (in octets)	Extensible
Reduced Neighbor Report (see 8.4.2.171)	201	8 to 257	Yes
TVHT Operation (see 8.4.2.172)	202	8	Yes
Device Location Information (see 8.4.2.169)	204	18 to 242	Yes
White Space Map (see 8.4.2.170)	205	3 to 257	Yes

8.4.2.24 Extended Capabilities element

8.4.2.24.10 Location Configuration Information Report

Change the second and third paragraphs of 8.4.2.24.10 as follows:

This structure and information fields are little endian, per conventions defined in 8.2.2, and are based on the LCI format described in IETF RFC 6225~~3825~~.

The ~~definition of~~ elements within the LCI report are ~~as~~ defined in section 2.2~~1~~ of IETF RFC 6225~~3825~~ (July 2011~~2004~~) or as defined herein.

Change the beginning of the note after Figure 8-162 in 8.4.2.24.10 as follows:

NOTE—An example of fixed/fractional notation, using the longitude of the Sears Tower from p. 28~~13~~ of IETF RFC 6225~~3825~~ (July 2011~~2004~~):

8.4.2.29 Extended Capabilities element

Insert the following rows into Table 8-103 in numeric order, and change the reserved values accordingly:

Table 8-103—Capabilities field

Bit	Information	Notes
65	Channel Schedule Management	The STA sets the Channel Schedule Management field to 1 when dot11ChannelScheduleManagementActivated is true and sets it to 0 otherwise. See 10.43.5.
66	Geodatabase Inband Enabling Signal	The STA sets the Geodatabase Inband Enabling Signal field to 1 when dot11GDDActivated is true and the STA permits GDD dependent STAs to operate. See 10.43.2.
67	Network Channel Control	The STA sets the Network Channel Control field to 1 when dot11NetworkChannelControlActivated is true and sets it to 0 otherwise. See 10.43.7.
68	White Space Map	The STA sets the White Space Map field to 1 when dot11WhiteSpaceMapActivated is true and sets it to 0 otherwise. See 10.43.9.
69	Channel Availability Query	The STA sets the Channel Availability Query field to 1 when dot11ChannelAvailabilityActivated is true and sets it to 0 otherwise. See 10.43.4.

8.4.2.31 EDCA Parameter Set element

Change Table 8-105 as follows:

Table 8-105—Default EDCA Parameter Set element parameter values if dot11OCBActivated is false

AC	CWmin	CWmax	AIFSN	TXOP limit			
				For PHYs defined in Clause 16 and Clause 17	For PHYs defined in Clause 18, Clause 19, Clause 20, and Clause 22	For PHY defined in Clause 23	Other PHYs
AC_BK	aCWmin	aCWmax	7	0	0	0	0
AC_BE	aCWmin	aCWmax	3	0	0	0	0
AC_VI	(aCWmin +1)/2 – 1	aCWmin	2	6.016 ms	3.008 ms	22.56 ms (BCU: 6 or 7 MHz), 16.92 ms (BCU: 8 MHz)	0
AC_VO	(aCWmin +1)/4 – 1	(aCWmin +1)/2 – 1	2	3.264 ms	1.504 ms	11.28 ms (BCU: 6 or 7 MHz), 8.46 ms (BCU: 8 MHz)	0

8.4.2.54 DSE Registered Location element

Change the third, fifth, and seventh paragraphs of 8.4.2.54 as follows:

This structure and information fields are little endian, per conventions defined in 8.2.2, and are based on the LCI format described in IETF RFC 6225~~3825~~.

The DSE Registered Location element body fields are shown in Figure 8-244.

Figure 8-244 remains unchanged.

The ~~definition of~~ fields within the DSE Registered Location element body is ~~as~~ defined in section 2.2~~1~~ of IETF RFC 6225~~3825~~ (July 2011~~2004~~) or as defined in this standard.

With an Altitude Type field value of 3 (i.e., height above ground is in meters), the altitude is defined to be in meters and is formatted in twos-complement, fixed-point, 22-bit integer part with 8-bit fraction.

The Datum field is a 3-bit field~~, rather than the 8-bit field~~ defined in IETF RFC 6225~~3825~~, and the codes used are as defined in IETF RFC 6225~~3825~~.

Change the beginning of the note after the 13th paragraph ("The Channel Number field ....") in 8.4.2.54 as follows:

NOTE—An example of fixed/fractional notation, using the longitude of the Sears Tower from p. 28~~13~~ of IETF RFC 6225~~3825~~ (July 2011~~2004~~) is shown below:

8.4.2.95 Advertisement Protocol element

Insert the following row into Table 8-175 in numeric order, and change the reserved values accordingly:

Table 8-175—Advertisement protocol ID definitions

Name	Value
Registered Location Query Protocol (RLQR)	4

Insert the following list item after the fourth list item ("The EAS allows ....") of the dashed list after the sixth paragraph ("The Advertisement Protocol ID is ....") of 8.4.2.95:

— The RLQP supports information retrieval from a RLSS. RLQP is a protocol used by a requesting STA to query another STA (i.e., the receiving STA can respond to queries with and without proxying the query to a server in an external network). See 10.24 for information on RLQP procedures.

8.4.2.160.2 VHT Capabilities Info field

Change the following rows of Table 8-183v:

Table 8-183v—Subfields of the VHT Capabilities Info field

Subfield	Definition	Encoding
Supported Channel Width Set	Indicates the channel widths supported by the STA. See 10.39.	Set to 0 if the STA does not support either 160 or 80+80 MHz. Set to 1 if the STA supports 160 MHz. Set to 2 if the STA supports 160 MHz and 80+80 MHz. The value 3 is reserved. For a TVHT STA, set the value of B2 to 1 if it supports TVHT_MODE_2C. For a TVHT STA, set the value of B3 to 1 if it supports TVHT_MODE_2N.
Short GI for 80 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to VHT and CH_BANDWIDTH equal to CBW80.	Set to 0 if not supported. Set to 1 if supported. For a TVHT STA, set the value of B5 to 1 if it supports TVHT_MODE_4C.
Short GI for 160 and 80+80 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to VHT and CH_BANDWIDTH equal to CBW160 or CBW80+80.	Set to 0 if not supported. Set to 1 if supported. For a TVHT STA, set the value of B6 to 1 if it supports TVHT_MODE_4N.

Insert the following sentence at the end of the last paragraph of 8.4.2.160.2:

For a TVHT STA, support for Short GI is mandatory.

8.4.2.164 VHT Transmit Power Envelope element

Insert the following paragraph at the end of 8.4.2.164:

In frames transmitted by a TVHT STA the Local Maximum Transmit Power for 20 MHz fields indicates the Local Maximum Transmit Power for TVHT_W bandwidth; the local Maximum Transmit Power for 40 MHz fields indicates the Local Maximum Transmit Power for TVHT_2W or TVHT_W+W bandwidth; the local Maximum Transmit Power for 80 MHz fields indicates the Local Maximum Transmit Power for TVHT_4W or TVHT_2W+2W bandwidth; the local Maximum Transmit Power for 160/80+80 MHz fields is not included in the VHT Transmit Power Envelope element.

8.4.2.165 Channel Switch Wrapper element

Insert the following paragraph at the end of 8.4.2.165:

For a TVHT STA, the Wide Bandwidth Channel Switch subelement is present when channel switching to a BSS operating channel width of TVHT_2W or TVHT_W+W bandwidth or wider; if switching to a TVHT_W bandwidth BSS operating channel width then this subelement is not present.

Insert the following subclauses, 8.4.2.169 to 8.4.2.172 (including Figure 8-401cd to Figure 8-401ck and Table 8-183aa), after 8.4.2.168:

8.4.2.169 Device Location Information element

A Device Location Information element includes the location configuration information (LCI), which contains latitude, longitude, and altitude information. The Device Location Information element format is shown in Figure 8-401cd.

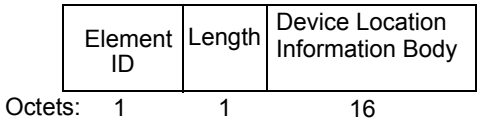


Figure 8-401cd—Device Location Information element format

The Element ID and Length fields are defined in 8.4.2.1.

The format of the Device Location Information Body is defined in 8.4.1.54.

8.4.2.170 White Space Map element

The White Space Map element includes available radio frequency information obtained from a GDB. The format of the WSM Information field is determined by the value of the WSM Type field. The format of the White Space Map Announcement element is shown in Figure 8-401ce.

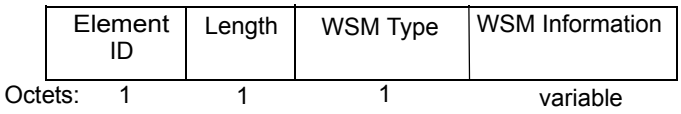


Figure 8-401ce—WSM element format

The Element ID and Length fields are defined in 8.4.2.1.

The format and values of WSM Type and WSM Information fields are defined in 8.4.1.55.

8.4.2.171 Reduced Neighbor Report element

The Reduced Neighbor Report element contains channel and other information related to neighbor APs. The format of the Reduced Neighbor Report element is shown in Figure 8-401cf.

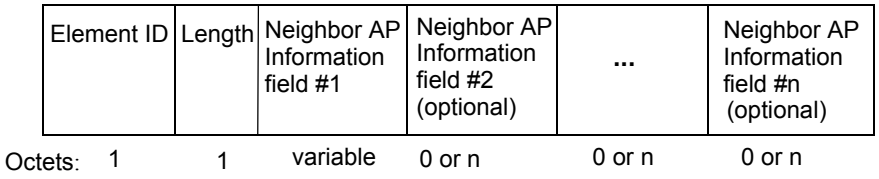


Figure 8-401cf—Reduced Neighbor Report element format

The Element ID and Length fields are defined in 8.4.2.1.

The format of Neighbor AP Information field is defined in 8.4.2.171.1.

8.4.2.171.1 Neighbor AP Information field

The Neighbor AP Information field specifies TBTT and other information related to a group of neighbor APs on one channel. See Figure 8-401cg.

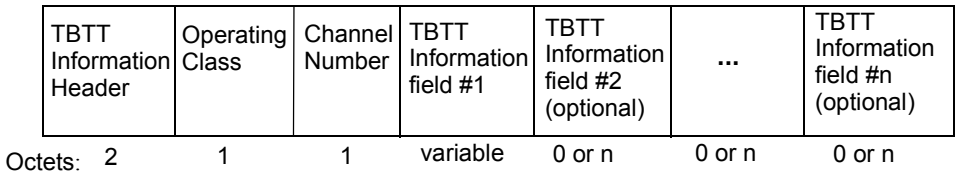


Figure 8-401cg—Neighbor AP Information field format

The format of TBTT Information Header subfield is defined in Figure 8-401ch.

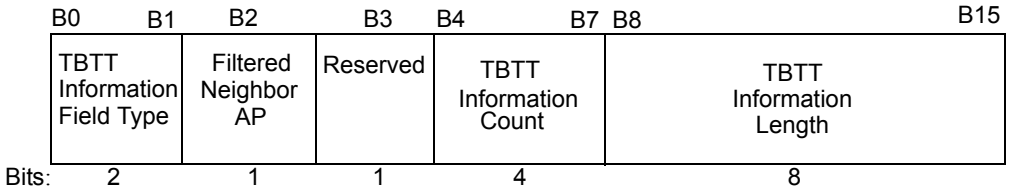


Figure 8-401ch—TBTT Information Header subfield

The TBTT Information Field Type subfield is 2 bits in length and defines the structure of the TBTT Information field. Its value is 0. Values 1, 2, and 3 are reserved.

The Filtered Neighbor AP subfield is 1 bit in length. It is set to 1 if the SSID of APs in this Neighbor AP Information field matches the specific SSID in the Probe Request frame. It is set to 0 otherwise. This field is valid only in the Reduced Neighbor AP Report element in a Probe Response frame and is reserved otherwise.

The TBTT Information Count subfield is 4 bits in length and contains the number of TBTT Information fields that are included in the Neighbor AP Information field, minus one. A value of 0 indicates one TBTT Information field is present.

The TBTT Information Length subfield is 1 octet in length and contains the length in octets of the TBTT Information field that is included in the Neighbor AP Information field.

Operating Class field is 1 octet in length and indicates the band and bandwidth of the primary channel of the APs in this Neighbor AP Information field. Valid values of Operating Class are shown in Table E-4.

Channel Number field is 1 octet in length and indicates the last known primary channel of the APs in this Neighbor AP Information field. Channel Number is defined within an Operating Class as shown in Table E-4.

The format of TBTT Information field is shown in Figure 8-401ci.

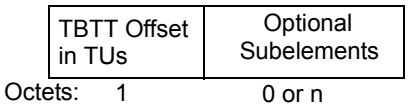


Figure 8-401ci—TBTT Information field

The TBTT Offset in TUs subfield is 1 octet in length and indicates the offset in TUs, rounded down to nearest TU, to the next TBTT of an AP from the immediately prior TBTT of the AP that transmits this element. The value 254 is used to indicate an offset of 254 TUs or higher. The value 255 is used to indicate an unknown offset value.

The Optional Subelements field format contains zero or more subelements, each consisting of a 1-octet Subelement ID field, a 1-octet Length field, and a variable-length Data field, as shown in Figure 8-402. Any optional subelements are ordered by nondecreasing Subelement ID.

8.4.2.172 TVHT Operation element

The operation of TVHT STAs in the BSS is controlled by the TVHT Operation element. The format of the TVHT Operation element is defined in Figure 8-401cj.

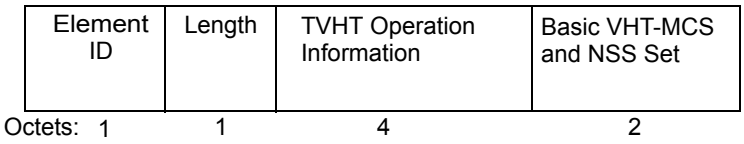


Figure 8-401cj—TVHT Operation element format

The Element ID and Length fields are defined in 8.4.2.1.

The structure of the TVHT Operation Information field is defined in Figure 8-401ck.

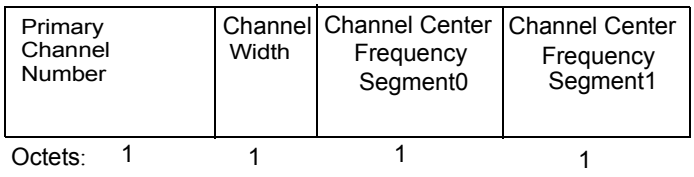


Figure 8-401ck—TVHT Operation Information field

The subfields of the TVHT Operation Information field are defined in Table 8-183aa.

Table 8-183aa—TVHT Operation Information subfields

Field	Definition	Encoding
Primary Channel Number	Indicates the channel number of the primary channel (see 10.42).	Channel number of the primary channel.
Channel Width	This field defines the BSS operating channel width (see 10.42).	Set to 0 for TVHT_W operating channel width. Set to 1 for TVHT_2W operating channel width. Set to 2 for TVHT_W+W operating channel width. Set to 3 for TVHT_4W operating channel width. Set to 4 for TVHT_2W+2W operating channel width. Values in the range 5 to 255 are reserved.
Channel Center Frequency Segment0	Defines the channel center frequency for a TVHT_W, TVHT_2W, and TVHT_4W TVHT BSS and the segment 0 channel center frequency for a TVHT_W+W and TVHT_2W+2W TVHT BSS. See 23.3.14.	For TVHT_W or TVHT_2W or TVHT_4W operating channel width, indicates the center frequency of the lowest TV channel index for the TVHT_W or TVHT_2W or TVHT_4W channel on which the TVHT BSS operates. For TVHT_W+W or TVHT_2W+2W operating channel width, indicates the lowest TV channel index for the TVHT_W or TVHT_2W channel of frequency segment 0 on which the TVHT BSS operates. Reserved otherwise.
Channel Center Frequency Segment1	Defines the segment 1 channel center frequency for a TVHT_W+W and TVHT_2W+2W TVHT BSS. See 23.3.14.	For a TVHT_W+W or TVHT_2W+2W operating channel width, indicates the lowest TV channel index in the segment for the TVHT_W or TVHT_2W channel of frequency segment 1 on which the TVHT BSS operates. Reserved otherwise.

The Basic VHT-MCS and NSS Set field indicates the MCSs for each spatial stream in VHT PPDU in TVWS bands that are supported by all TVHT STAs in the BSS (including IBSS). The Basic VHT-MCS and NSS Set field is a bitmap of size 16 bits; B8-B9, B10-B11, B12-B13, and B14-B15 are set to 3. For B0-B7, each 2 bits indicates the supported MCS set for N_{SS} from 1 to 4. The Basic VHT-MCS and NSS Set field is defined as B0-B7 of Rx VHT-MCS Map subfield in 8.4.2.160.3.

Insert the following subclauses, 8.4.5 to 8.4.5.4 (including Figure 8-431.a1 to Figure 8-431.a5 and Table 8-190.a1 to Table 8-190.a3), after 8.4.4.19:

8.4.5 Registered Location Query Protocol (RLQP) elements

8.4.5.1 General

RLQP-elements are defined to have a common format consisting of a 2-octet Info ID field, a 2-octet Length field, and a variable-length element-specific Information field. Each element is assigned a unique Info ID as defined in this standard. The RLQP-element format is shown in Figure 8-431.a1.

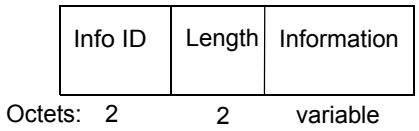


Figure 8-431.a1—RLQP-element format

Each RLQP-element in 8.4.5 is assigned a unique 2-octet Info ID. The set of valid Info IDs is defined in Table 8-190.a1. The 2-octet Info ID field is encoded following the conventions given in 8.2.2.

The Length field is a 2-octet field that indicates the number of octets in the Information field and is encoded following the conventions given in 8.2.2.

The RLQP-elements are shown in Table 8-190.a1. Info ID 56 797 stands for Vendor Specific information. When the Info ID is equal to 56 797, the format of the subfield follows the format of the vendor specific element in 8.4.2.28.

Table 8-190.a1—RLQP-element definitions

RLQP-element name	Info ID	RLQP-element (subclause)
Reserved	0–272	N/A
Channel Availability Query	273	8.4.5.2
Channel Schedule Management	274	8.4.5.3
Network Channel Control	275	8.4.5.4
Reserved	276–56 796	N/A
Vendor Specific	56 797	8.4.2.28
Reserved	56 798–65 535	N/A

8.4.5.2 Channel Availability Query RLQP-element

The Channel Availability Query element is used to exchange the requests and responses for the channel availability query process using the GAS protocol. The Channel Availability Query RLQP-element is included in a GAS Query Request or returned in a response to a GAS Query Request.

The element is in the format shown in Figure 8-431.a2.

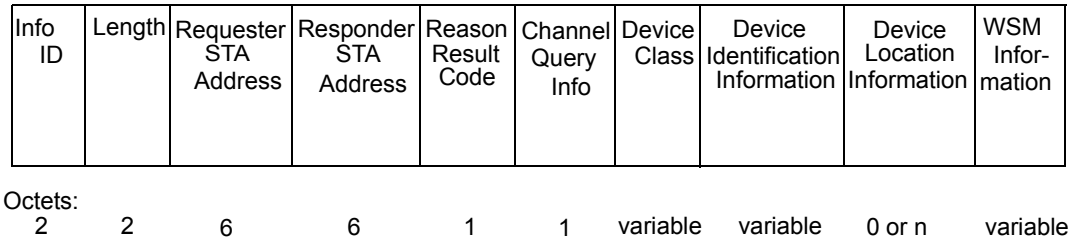


Figure 8-431.a2—Channel Availability Query RLQP-element format

The Info ID and Length fields are defined in 8.4.5.1.

The RequesterSTAAddress field is the MAC address of the requesting STA that initiates the channel query process. The length of the RequesterSTAAddress field is 6 octets.

The ResponderSTAAddress field is the MAC address of the responding STA that responds to the channel query requesting STA. The length of the ResponderSTAAddress field is 6 octets.

The Reason Result Code field is used to indicate the reason that a channel availability query was generated. It also indicates the result of the query as successful or not and the reason when the query is not successful. The length of the Reason Result Code field is 1 octet. The Reason Result Code field values that have been allocated are shown in Table 8-190.a2.

Table 8-190.a2—Reason Result Code field values

Reason Result Code field value	Name	Description
0		Reserved.
1		Channel availability list requested.
2	SUCCESS	Success with the available channel list result for a Device Location Information field.
3	SUCCESS_MULTIPLE	Success with an available channel list result for a bounded geographic area defined by multiple Device Location Information fields.
4	REFUSED	Request declined.
5	DEVICE_VERIFICATION_ FAILURE	Request not successful because of device identification verification failure. NOTE—Failure of providing an authorized identification of the corresponding regulatory organization can cause the responding STA to reject the query and return such a Reason Result Code.
6	Continuation frame	This frame continues the fields from the previous CAQ frame.
7–255		Reserved.

The Channel Query Info field is used to indicate the type of Channel Query request and associated parameters. The format of the Channel Query Info field is shown in Figure 8-431.a3.

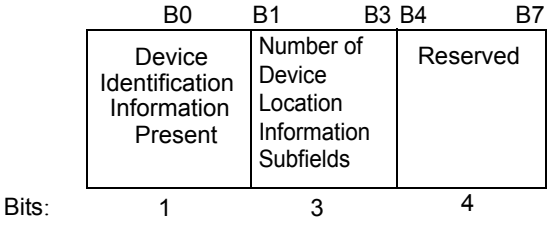


Figure 8-431.a3—Channel Query Info field format

A Device Identification Information Present subfield value of '1' indicates that the Device Location Information field is present in the Channel Availability Query element; otherwise it is 0 to indicate that the Device Identification Information field is not provided.

The Number of Device Location Information Subfields subfield indicates the number of device location information subfields presented in the Channel Availability Query element. When no device location is present, the Number of Device Location Information Subfields is 0.

The Device Class field is used to indicate the characteristics of STA requesting the channel availability query. The format of the Device Class field is specified in 8.2.6.2.1. The TLV is present only when the Reason Result Code field value is 1.

The Device Identification Information field is used to indicate the identification of the STA requesting the channel availability query. The format of the Device Identification Information field is specified in 8.2.6.2.2.

The Device Location Information field is used to provide the location of the STA requesting the channel availability query, which is provided in the format specified in 8.2.6.2.3.

The WSM Information field is defined in the White Space Map element (see 8.4.2.170). The TLV is present only when the Reason Result Code field value is 2 or 3, as the successful result of the query.

8.4.5.3 Channel Schedule Management RLQP-element

The Channel Schedule Management element is used by an GDD enabling STA to query the RLSS or another GDD enabling STA for channel schedule information. The element is in the format shown in Figure 8-431.a4.

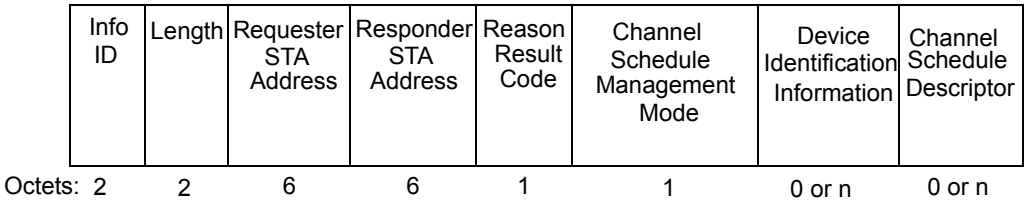


Figure 8-431.a4—Channel Schedule Management RLQP-element format

The Info ID and Length fields are defined in 8.4.5.1.

The Requester STA Address field is the MAC address of the requesting STA that initiates the channel schedule management process.

The Responder STA Address field is the MAC address of the responding STA that grants the channel schedule management process.

The remaining fields are as defined in the Channel Schedule Management element (see 8.4.1.53).

8.4.5.4 Network Channel Control RLQP-element

The Network Channel Control element is used to request network channel control and respond to network channel requests using the GAS protocol. The element is in the format shown in Figure 8-431.a5.

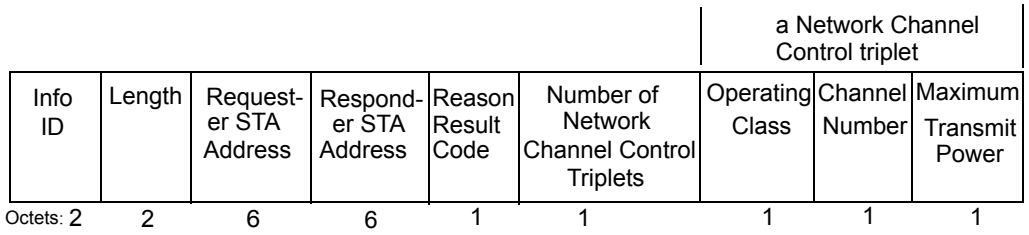


Figure 8-431.a5—Network Channel Control RLQP-element format

The Info ID and Length fields are defined in 8.4.5.1.

The RequesterSTAAddress field is the MAC address of the requesting STA that initiates the network channel control process.

The ResponderSTAAddress field is the MAC address of the responding STA that grants the network channel control process.

The Reason Result Code field is used to indicate the reason that a Network Channel Control frame was generated. The length of the Reason Result Code field is 1 octet. The encoding of the Reason Result Code field is shown in Table 8-190.a3.

Table 8-190.a3—Reason Result Code field values

Reason Result Code field value	Name	Description
0	REQUEST	Network channel request.
1	SUCCESS	Success.
2	REFUSED	Request declined.
3	TOO_MANY_SIMULTANEOUS_REQUESTS	Network channel request denied because the GDD enabling STA is unable to handle additional GDD dependent STAs.
4	Continuation frame	This frame continues the fields from the previous NCC frame.
5–255		Reserved.

The Number of Network Channel Control Triplets field indicates the number of triplets of Operating Class, Channel Number, and Transmit Power Constraint fields.

The Operating Class field indicates the channel set for which the network channel control request applies. The Operating Class field and Channel Number field are used together to specify the channel frequency and channel bandwidth for which the network channel control applies. Values for the Operating Class field are shown in E.1.

The Channel Number field of network channel control request indicates the channel that the requesting STA intends to operate on. The Channel Number field in the network channel control response frame indicates the channels that the responding STA permits the requesting STA to operate on. The Channel Number is defined within an Operating Class as shown in E.1.

The Maximum Transmit Power field gives the intended maximum transmit power in dBm for operation in the request frame and indicates the maximum allowable transmit power in dBm for operation in the response frame. The field is coded as a signed integer in units of 0.5 dBm. The field is set to –128 when a requesting STA requests a responding STA to provide a network channel control response without specifying in the request the intended maximum transmit power.

8.5 Action frame format details

8.5.8 Public Action details

8.5.8.1 Public Action frames

Insert the following rows into Table 8-210 in numeric order, and change the reserved values accordingly:

Table 8-210—Public Action field values

Public Action field value	Description
25	Channel Availability Query
26	Channel Schedule Management
27	Contact Verification Signal
28	GDD Enablement Request
29	GDD Enablement Response
30	Network Channel Control
31	White Space Map Announcement

Insert the following subclauses, 8.5.8.27 to 8.5.8.33 (including Figure 8-460f to Figure 8-460l), after 8.5.8.26:

8.5.8.27 Channel Availability Query frame format

The Channel Availability Query frame is an Action frame. It is transmitted by a STA as part of channel query. The format of the Channel Availability Query frame Action field is shown in Figure 8-460f.

Category	Public Action	Requester STA Address	Responder STA Address	Reason Result Code	Length	Channel Query Info	Device Class	Device Identification Information	Device Location Information	WSM Information
Octets: 1	1	6	6	1	1	1	variable	0 or n	0 or n	variable

Figure 8-460f—Channel Availability Query frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating a Channel Availability Query frame, as specified in Table 8-210 in 8.5.8.1.

The Length field indicates the length of the remaining frame fields in octets, and the value is variable.

The remaining fields are as defined in the Channel Availability Query element (see 8.4.5.2) and White Space Map element (see 8.4.2.170).

8.5.8.28 Channel Schedule Management frame format

The Channel Schedule Management frame is a Public Action frame. It is transmitted by a STA to exchange the channel schedule information as part of the channel schedule management procedure. The format of the Channel Schedule Management frame Action field is shown in Figure 8-460g.

Category	Public Action	Requester STA Address	Responder STA Address	Length	Reason Result Code	Channel Schedule Management Mode	Device Identification Information	Channel Schedule Descriptor
Octets: 1	1	6	6	1	1	1	0 or n	0 or n

Figure 8-460g—Channel Schedule Management frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating a Channel Schedule Management frame, as specified in Table 8-210 in 8.5.8.1.

The Requester STA Address field is the MAC address of the requesting STA that initiates the Channel Schedule Management process.

The Responder STA Address field is the MAC address of the responding STA that grants channel schedule management process.

The remaining fields are as defined in the Channel Schedule Management element (see 8.4.1.53).

8.5.8.29 Contact Verification Signal frame format

The Contact Verification Signal frame is a Public Action frame that is transmitted by a GDD enabling STA to notify whether the available channel information from the GDB has been updated. The format of the Contact Verification Signal frame Action field is shown in Figure 8-460h.

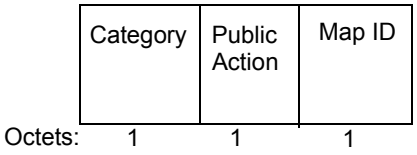


Figure 8-460h—Contact Verification Signal frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating Contact Verification Signal frame, as specified in Table 8-210 in 8.5.8.1.

The Map ID field is set to a number that is equal to the Map ID of the recently received WSM. The WSM is defined in Table 8-14h in 8.2.6.2.5.

8.5.8.30 GDD Enablement Request frame format

The GDD Enablement Request frame is a Public Action frame. The format of the GDD Enablement Request frame action field is shown in Figure 8-460i.

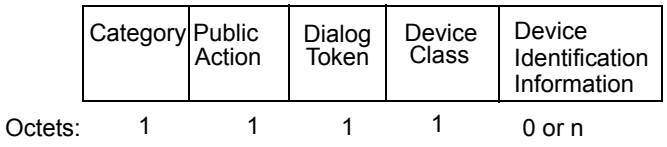


Figure 8-460i—GDD Enablement Request frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating the GDD Enablement Request frame, as specified in Table 8-210 in 8.5.8.1.

The Dialog Token field is a nonzero value chosen by the STA sending the GDD Enablement Request frame to identify the request/response transaction.

The Device Class field is used to indicate the characteristic of the STA requesting the GDD Enablement Request frame. The format of the Device Class field is specified in 8.2.6.2.1.

The Device Identification Information field is used to indicate the identification of the STA requesting the GDD Enablement Request frame. The format of the Device Identification Information field is specified in 8.2.6.2.2.

8.5.8.31 GDD Enablement Response frame format

The GDD Enablement Response frame is a Public Action frame. The format of the GDD Enablement Response frame action field is shown in Figure 8-460j.

	Category	Public Action	Dialog Token	Status Code	WSM Information
Octets:	1	1	1	2	variable

Figure 8-460j—GDD Enablement Response frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating the GDD Enablement Response frame, as specified in Table 8-210 in 8.5.8.1.

The Dialog Token field is a nonzero value of the corresponding GDD Enablement Request frame. If a GDD Enablement Response frame is being transmitted other than in response to an GDD Enablement Request frame, then the Dialog Token field is 0.

The Status Code field contains the status code in response to a GDD Enablement Request frame as defined in Table 8-37.

The remaining field is as defined in the WSM element (see 8.4.2.170).

8.5.8.32 Network Channel Control frame format

The Network Channel Control frame is a Public Action frame. It is transmitted by a GDD dependent STA and a GDD enabling STA as part of the procedure that allows a GDD enabling STA to control the frequency usage of a GDD dependent STA's WLAN network channels. The format of the Network Channel Control frame is shown in Figure 8-460k.

							a Network Channel Control triplet		
Category	Public Action	Length	Requester STA Address	Responder STA Address	Reason Result Code	Number of Network Channel Control Triplets	Operating lass	Channel Number	Maximum Transmit Power
Octets: 1	1	1	6	6	1	1	1	1	1

Figure 8-460k—Network Channel Control frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating the Network Channel Control frame, as specified in Table 8-210 in 8.5.8.1.

The Length field indicates the length of the remaining frame fields in octets, and the value is variable. The minimum value of the Length field is 14.

The Requester STA Address field is the MAC address of the requesting STA that initiates the network channel control process.

The Responder STA Address field is the MAC address of the responding STA that grants the network channel control process.

The Reason Result Code field is used to indicate the reason that a Network Channel Control frame was generated. The length of the Reason Result Code field is 1 octet. The encoding of the Reason Result Code field is shown in Table 8-190.a3.

The Number of Network Channel Control Triplets field indicates the number of triplets of Operating Class, Channel Number, and Maximum Transmit Power fields.

The Operating Class field indicates the channel set for which the network channel control request applies. The Operating Class and Channel Number fields together specify the channel frequency and channel bandwidth for which the network channel control applies. Values for the Operating Class field are shown in E.1.

The Channel Number field of network channel control request indicates the channel that the requesting STA intends to operate on. The Channel Number field in the network channel control response frame indicates the channels that the responding STA permits the requesting STA to operate on. The Channel Number is defined within an Operating Class as shown in E.1.

The Maximum Transmit Power field gives the intended maximum transmit power in dBm for operation in the request frame and indicates the maximum allowable transmit power in dBm for operation in the response frame. The field contains EIRP per channel bandwidth and is coded as a signed integer in units of 0.5 dBm. The field is set to 0 when a requesting STA requests a responding STA to provide a network channel control response without specifying in the request the intended maximum transmit power.

8.5.8.33 White Space Map Announcement frame format

The White Space Map Announcement frame is a Public Action frame. The format of the White Space Map Announcement frame body is shown in Figure 8-460l.

	Category	Public Action	Reason Result Code	White Space Map element
Octets:	1	1	1	variable

Figure 8-460l—White Space Map Announcement frame Action field format

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Public Action field is set to the value indicating White Space Map Announcement frame, as specified in Table 8-210 in 8.5.8.1.

The Reason Result Code value of 1 indicates the Public Action frame is a continuation of the previous WSM Public Action frame, and any other value indicates this is not a continuation of the previous WSM Public Action frame.

The remaining field is as defined in the White Space Map element (see 8.4.2.170).

8.5.11 Protected Dual of Public Action frames

8.5.11.1 Protected Dual of Public Action details

Insert the following rows into Table 8-228 in numeric order, and change the reserved values accordingly.

Table 8-228—Public Action field values defined for Protected Dual of Public Action frames

Action field value	Description	Defined in
25	Protected Channel Availability Query	8.5.8.27
26	Protected Channel Schedule Management	8.5.8.28
27	Protected Contact Verification Signal	8.5.8.29
28	Protected GDD Enablement Request	8.5.8.30
29	Protected GDD Enablement Response	8.5.8.31
30	Protected Network Channel Control	8.5.8.32
31	Protected White Space Map Announcement	8.5.8.33

9. MAC sublayer functional description

9.2 MAC architecture

9.2.1 General

Change the first paragraph of 9.2.1 as follows:

The MAC architecture is shown in Figure 9-1. When operating with any of the Clause 14 through Clause 20 PHYs, or Clause 22 PHY, or Clause 23 PHY, the MAC provides the HCF, including the PCF, through the services of the DCF. In a non-DMG QoS STA implementation, both DCF and HCF are present. In a non-DMG non-QoS STA implementation, only DCF is present. PCF is optional in all non-DMG STAs.

Change the text in the lower left box of Figure 9-1 as follows:

FHSS, IR, DSSS, OFDM, HR/DSSS, ERP, ~~or~~ HT, VHT, or TVHT PHY

9.3 DCF

9.3.2 Procedures common to the DCF and EDCAF

9.3.2.3 IFS

9.3.2.3.4 PIFS

Insert the following list item at the end of the dashed list after the second paragraph of 9.3.2.3.4:

— A TVHT STA performing CCA in the secondary TVHT_W and TVHT_2W channels before transmitting a TVHT_2W or TVHT_W+W mask PPDU and TVHT_4W or TVHT_2W+2W mask PPDU, respectively, using EDCA channel access as defined in 9.19.2.8

9.7 Multirate support

9.7.1 Overview

Change the last paragraph of 9.7.1 (including creating two new paragraphs) as follows:

For specific PHYs, the value of the Duration/ID field is determined using the PLME-TXTIME.request primitive and the PLME-TXTIME.confirm primitive. These specific PHYs are defined in

— Clause 17 for HR/DSSS
— Clause 18 for OFDM
— Clause 19 for ERP
— Clause 20 for HT
— Clause 21 for DMG
— Clause 22 for VHT
— Clause 23 for TVHT

The two PLME-TXTIME primitives are defined in the respective PHY specifications:

— 17.3.4 for HR TXTIME calculation
— 18.4.3 for OFDM TXTIME calculation

— 19.8.3.2, 19.8.3.3, and 19.8.3.4 for ERP-OFDM, ERP-PBCC, and DSSS-OFDM TXTIME calculations, respectively
— 20.4.3 for HT TXTIME calculation
— 21.12.3 for DMG PLME TXTIME calculation
— 22.4.3 for VHT PLME TXTIME calculation
— 23.4.3 for TVHT PLME TXTIME calculation

~~For the Clause 18, Clause 17, Clause 19, Clause 20, Clause 21, and Clause 22 PHYs, the time required to transmit a frame for use in calculating the value for the Duration/ID field is determined using the PLME-TXTIME.request primitive (see 6.5.7) and the PLME-TXTIME.confirm primitive (see 6.5.8), both defined in 18.4.3, 17.3.4, 19.8.3.2, 19.8.3.3, 19.8.3.4, 20.4.3, 21.12.3, or 22.4.3 depending on the PHY options. In QoS STAs, T~~the Duration/ID field in QoS STAs may cover multiple frames and may involve using the PLME-TXTIME.request primitive several times.

9.12 A-MPDU operation

9.12.2 A-MPDU length limit rules

Insert the following paragraph at the end of 9.12.2:

A STA shall not transmit a VHT PPDU in TVWS bands if the PPDU duration exceeds aPPDUMaxTime (defined in Table 23-25).

9.19 HCF

9.19.2 HCF contention-based channel access (EDCA)

Change the title of 9.19.2.8 as follows:

9.19.2.8 EDCA channel access in ~~a~~ VHT and TVHT BSS~~s~~

Insert the following list items at the end of the lettered list in 9.19.2.8.

f) Transmit a TVHT_4W or TVHT_2W+2W mask PPDU if the secondary TVHT_W channel and the secondary TVHT_2W channel were idle during an interval of PIFS immediately preceding the start of the TXOP.
g) Transmit an TVHT_2W or TVHT_W+W mask PPDU if the secondary TVHT_W channel was idle during an interval of PIFS immediately preceding the start of the TXOP.
h) Transmit a TVHT_W mask PPDU on the primary TVHT_W channel.

9.24 MAC frame processing

9.24.9 Extensible subelement parsing

Insert the following subclause, 9.24.10, after 9.24.9:

9.24.10 Extensible TLV parsing

A TVHT STA that receives a frame containing a TLV tuple with an unknown Type value shall discard the tuple and continue processing the next tuple.

9.31 Null data packet (NDP) sounding

9.31.5 VHT sounding protocol

9.31.5.2 Rules for VHT sounding protocol sequences

Insert following text at the end of 9.31.5.2:

In a frame transmitted by a TVHT STA, the TVHT Compressed Beamforming Report field replaces the VHT Compressed Beamforming Report field.

In a frame transmitted by a TVHT STA, the TVHT MU Exclusive Beamforming Report field replaces the MU Exclusive Beamforming Report field.

9.31.5.3 Rules for fragmented feedback in VHT sounding protocol sequences

Insert following text at the end of 9.31.5.3:

In a frame transmitted by a TVHT STA, the TVHT Compressed Beamforming Report field replaces the VHT Compressed Beamforming Report field.

In a frame transmitted by a TVHT STA, the TVHT MU Exclusive Beamforming Report field replaces the MU Exclusive Beamforming Report field.

10. MLME

10.11 Radio measurement procedures

10.11.9 Specific measurement usage

10.11.9.6 Location Configuration Information Report

Change the first sentence in the note after the first paragraph in 10.11.9.6 as follows:

NOTE—Section 2.2~~1~~ of IETF RFC 6225~~3825~~ (July 2011~~2004~~) defines formats and information fields for reporting physical location to sub-centimeter resolution.

10.24 WLAN interworking with external networks procedures

10.24.3 Interworking procedures: generic advertisement service (GAS)

10.24.3.2 ANQP procedures

Insert the following subclause, 10.24.3.3, after 10.24.3.2.10:

10.24.3.3 Registered Location Query Protocol (RLQP) procedures

When dot11GDDActivated is true, a STA may use RLQP to retrieve information as defined in Table 8-175 from a peer STA that has transmitted an Advertisement Protocol element indicating support for RLQP (see 8.4.2.95) in a Beacon or Probe Response frame.

If information is not configured for a particular RLQP-element, then a query for that element returns that element with no optional fields.

When RLQP is transmitted between the GDD enabling STA and the RLSS, it uses Ethertype 89-0d frames, as defined in Annex H. The RLQP payload contains RLQP-elements as specified in 8.4.5 and the Advertising Protocol element with an Advertising Protocol tuple whose Advertisement Protocol ID is set to the value of RLQR specified in Table 8-175. When RLQP is transmitted between the GDD dependent STA and its GDD enabling STA, it uses protected Action frames, but does not use Ethertype 89-0d frames.

In some regulatory domains, the GDD enabling STA may be required to have secured connection with the RLSS. In cases where security is required by regulation, the Ethertype 89-0d frame body may employ corresponding security features. Alternatively, various security protocols may also be selected by setting the Ethertype field to respective values. A webpage maintained by the IEEE Registration Authority Committee allowing search of the public values of the Ethertype field is found at http://standards.ieee.org/develop/regauth/ethertype/public.html.

Insert the following subclauses, 10.42 and 10.43.9 (including Table 10-20 and Figure 10-39), after 10.41:

10.42 Basic TVHT BSS functionality

The STA that is creating the BSS shall be able to receive and transmit at each of the <VHT-MCS, NSS> tuple values indicated by the BSSBasicVHTMCS_NSSSet and shall be able to receive at each of the <VHT-MCS, NSS> tuple values indicated by the OperationalVHTMCS_NSSSet. A STA for which dot11TVHTOptionImplemented is true shall set dot11VHTOptionImplemented to true.

A TVHT AP declares its channel width capability in the Supported Channel Width Set subfield of the VHT Capabilities element VHT Capabilities Info field, as defined in 8.4.2.160.2.

A TVHT AP shall set the Channel Width subfield in the TVHT Operation Information field to indicate the BSS operating channel width and transmitted PPDU type depending on value of B0-B1 in TVHT-SIG-A1 field from those shown in Table 10-20.

Table 10-20—TVHT BSS operating channel width

TVHT Operation element Channel Width field	BSS operating channel width	B0-B1 (BW) in TVHT-SIG-A1	PPDU type
0	TVHT_W	1	TVHT_MODE_1
1	TVHT_2W	1	TVHT_MODE_1
		2	TVHT_MODE_2C
2	TVHT_W+W	1	TVHT_MODE_1
		2	TVHT_MODE_2N
3	TVHT_4W	1	TVHT_MODE_1
		2	TVHT_MODE_2C
		3	TVHT_MODE_4C
4	TVHT_2W+2W	1	TVHT_MODE_1
		2	TVHT_MODE_2C
		3	TVHT_MODE_4N

A TVHT non-AP STA that receives a frame containing a TVHT Operation element shall determine the channelization based on the Channel Center Frequency Segment0, Channel Center Frequency Segment1, and Primary Channel Number subfields of the TVHT Operation Information field (see 23.3.14).

A TVHT STA that is a member of a TVHT BSS shall transmit a TVHT_MODE_1 PPDU only on the primary TVHT_W channel of the BSS, except for a TVHT_MODE_1 PPDU transmission on an off-channel TDLS direct link.

A TVHT STA that is a member of a TVHT BSS with a TVHT_2W, TVHT_4W, or TVHT_W+W operating channel width shall not transmit a TVHT_MODE_2C or TVHT_MODE_2N PPDU that does not use the primary TVHT_W channel and the secondary TVHT_W channel of the BSS, except for a TVHT_MODE_2C, TVHT_MODE_4C, or TVHT_MODE_2N PPDU transmission on an off-channel TDLS direct link.

A TVHT STA that is a member of a TVHT BSS with a TVHT_4W or TVHT_2W+2W operating channel width shall not transmit a TVHT_MODE_4C or TVHT_MODE_4N PPDU that does not use the primary TVHT_2W channel and the secondary TVHT_2W channel of the BSS, except for a TVHT_MODE_4C or TVHT_MODE_4N PPDU transmission on an off-channel TDLS direct link.

A TVHT STA shall not transmit to a TVHT STA using a bandwidth that is not indicated as supported in the Supported Channel Width Set subfield in the VHT Capabilities element or Operating Mode Notification frame recently received from that TVHT STA.

In a TVHT BSS, the primary TVHT_W channel is the primary channel.

10.43 Operation under the control of a GDB

10.43.1 General

When a STA implements support for one or more of the procedures described in this subclause, it shall set dot11TVHTOptionImplemented to true. When dot11TVHTOptionImplemented is true and a STA is initialized for operation in a band that requires GDB control, then dot11GDDActivated shall be true.

In some regulatory domains, STAs shall consult a GDB to determine permissible operating frequencies and parameters before transmitting. Such STAs may operate as geolocation database dependent (GDD) enabling STAs, which are required by regulation to provide their identification, geolocation, and other information to the GDB as specified by regulatory authorities. Other STAs are permitted to transmit when enabled by a GDD enabling STA. Such STAs operate as GDD dependent STAs.

Subclause 10.43 describes procedures for STAs when they are operating under the control of a GDB to satisfy regulatory requirements. For operation under such restrictions, GDD dependent STAs operate according to the control procedures of a GDD enabling STA that enables their operation. The frame exchange sequence between GDD enabling STA and GDD dependent STAs for enabling their operation occurs in State 4 (see 10.3.1).

A GDD enabling STA is a STA that is able to access a GDB and to obtain the information about the permitted frequencies and other information for use in its location. A GDD enabling STA or geolocated non-AP STA populates its dot11STALCITable with location information by a means that has received regulatory approval and is outside the scope of this standard. When location information is set in dot11STALCITable, the STA sets dot11GeolocationCapabilityActivated. The current dot11DSTALCITable entry in the MIB allows management access to the location information that is the basis for operation. A GDD enabling STA may transmit a GDD enabling signal and may enable operations of GDD dependent STAs.

A GDD dependent STA is a STA that is under the control of a GDD enabling STA.

The GDD enablement procedure for GDD dependent STAs and the operating rules for GDD enabling and GDD dependent STAs are defined in the following subclauses.

10.43.2 GDD enabling STA operation

A GDD enabling STA may transmit a GDD enabling signal in-band on an available frequency to indicate that it offers GDD enablement service.

The GDD enabling signal is a Beacon frame with an Extended Capabilities element that contains a Geodatabase Inband Enabling Signal field with a value of ‘1’. A GDD dependent STA shall not transmit any frames before it receives a GDD enabling signal over the air directly from a GDD enabling STA.

In some regulatory domains the GDD enabling STA may be required to have secure authentication or association with the GDD dependent STA before it sends the GDD Enablement Response frame. If required by regulation, the GDD enabling STA may contact a GDB to verify that the requesting GDD dependent STA is authorized to operate in the frequency band.

Upon receipt of a GDD Enablement Request frame from a GDD dependent STA, the GDD enabling STA sends a GDD Enablement Response frame with either of the following results:

a) The Status Code field set to 0 (“Successful”) to indicate the successful enablement of the requesting GDD dependent STA

b) The Status Code field set to 105 (“Enablement denied”) or 38 (“The request has not been successful as one or more parameters have invalid values”) or 106 (“Enablement denied due to restriction from the authorized GDB”), in which case the GDD enablement request has been denied

A GDD enabling STA may issue an unsolicited GDD Enablement Response frame with a Status Code 107 (“Authorization Deenabled”) to notify a GDD dependent STA to cease its transmissions and change its GDD enablement state to *Unenabled*. When an unsolicited GDD Enablement Response frame with a Status Code 107 (“Authorization Deenabled”) is transmitted, the WSM element is not included.

10.43.3 GDD dependent STA operation

A GDD dependent STA is configured with a GDD enablement state variable which is set to one of the following three states: *Unenabled*, *AttemptingGDDEnablement*, or *GDDEnabled*. A GDD dependent STA begins operation by setting its GDD enablement state variable to *Unenabled* and operates in receive-only mode within the band, passively scanning channels for a GDD enabling signal from a GDD enabling STA.

A typical state machine implementation of GDD dependent STA operation under GDD is provided in Figure 10-39.

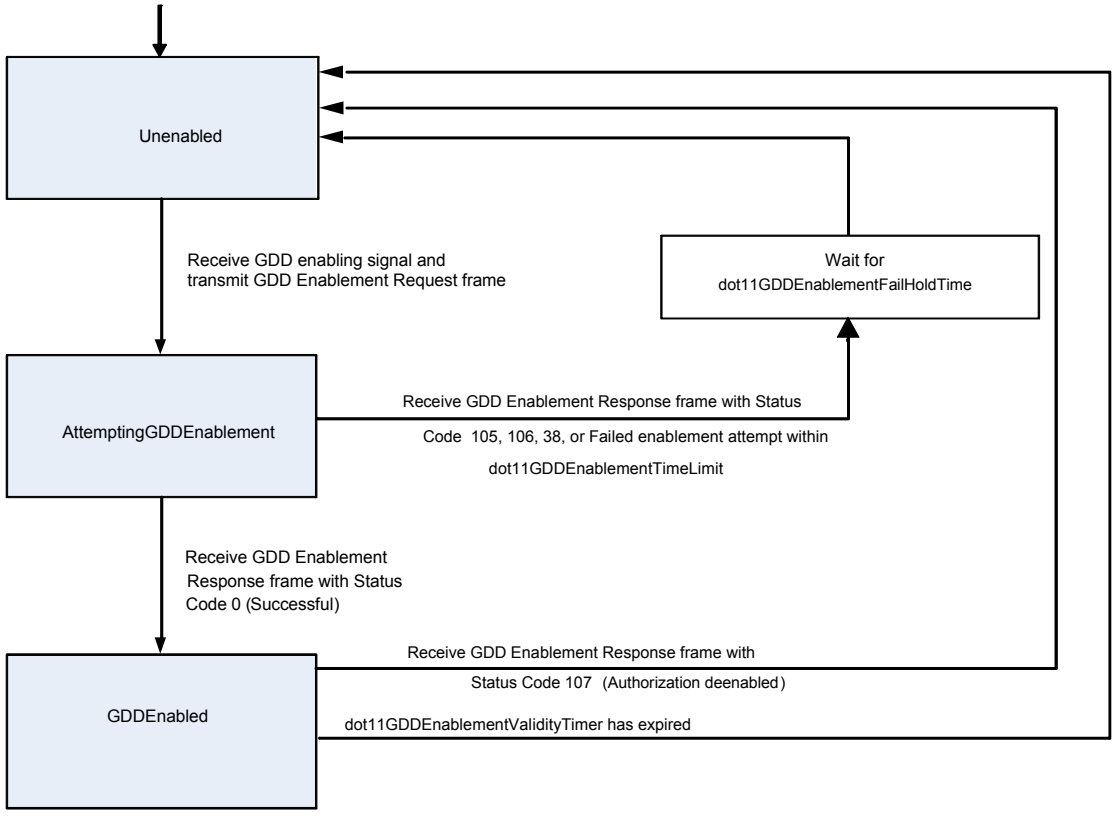


Figure 10-39—GDD dependent STA state transition diagram

A GDD dependent STA shall not transmit any frames unless it has received a valid GDD enabling signal from a GDD enabling STA.

A GDD dependent STA that is able to receive a valid GDD enabling signal, but has not been enabled by a GDD enabling STA shall not transmit, except to perform GDD enablement with a GDD enabling STA transmitting the GDD enabling signal.

A GDD dependent STA shall not transmit any frames other than GDD enablement-related frames and authentication and association frames before it performs the following GDD enablement procedure:

a) The GDD dependent STA changes its GDD enablement state variable to *AttemptingGDDEnablement* after receiving a GDD enabling signal.
b) After authentication and association, the GDD dependent STA securely sends a GDD Enablement Request frame to a GDD enabling STA from which it has received a GDD enabling signal. Based on the input received from the GDD dependent STA, the GDD enabling STA responds with a GDD Enablement Response frame indicating the result for the enablement request.
c) When a GDD dependent STA receives a GDD Enablement Response frame with the Status Code 0 (“Successful”) within dot11GDDEnablementTimeLimit, the GDD enablement state variable of the GDD dependent STA is set to *GDDEnabled*. Once it becomes enabled, the GDD dependent STA maintains a GDD enablement validity timer, which is initialized to dot11ContactVerificationSignalInterval.

A GDD dependent STA that has not attained GDD enablement from a GDD enabling STA shall not transmit beyond dot11GDDEnablementTimeLimit, measured from the time of the first PHY-TXSTART.request primitive, while attempting to attain GDD enablement. Then, when the GDD enablement attempt fails within the allowed maximum time, it shall not transmit for dot11GDDEnablementFailHoldTime, before it may again attempt to attain GDD enablement.

NOTE—A GDD dependent STA might detect several GDD enabling STAs. If the GDD dependent STA is unable to obtain a GDD Enablement Response frame from one GDD enabling STA, it might make further attempts with additional GDD enabling STAs within the maximum time limit of dot11GDDEnablementTimeLimit.

Once in *GDDEnabled* state, the following rules apply to a GDD dependent STA during its operations:

— The GDD dependent STA shall maintain a GDD enablement validity timer by decrementing the dot11GDDEnablementValidityTimer attribute. The procedures for maintaining the GDD enablement validity timer are defined in 10.43.9, 10.43.6, and 10.43.4.
— A GDD dependent STA shall cease all transmission when the dot11GDDEnablementValidityTimer has expired. It then changes its GDD enablement state to *Unenabled*.
— A GDD dependent STA shall immediately cease all transmission if it receives an unsolicited GDD Enablement Response frame with a Status Code of 107 (“Authorization Deenabled”) from the GDD enabling STA that enabled its operation.

10.43.4 Channel availability query (CAQ) procedure

10.43.4.1 Introduction

This subclause describes a channel availability query procedure that can be used to obtain the list of available channels for the operation of a GDD STA. A STA shall not use the CAQ procedure specified here unless dotGDDActivated is true.

A GDD dependent STA sends the channel availability query request to a GDD enabling STA to obtain the list of available channels. The CAQ procedure might be initiated by the GDD dependent STA in order to remain in the *GDDEnabled* state during its normal operational mode, as specified in 10.43.3.

The GDD dependent STA sends the Channel Availability Query frame to obtain the new channel availability information when it receives an indication of change in the available channel list for its use, such as from a recent CVS signal (see 10.43.6).

Once the GDD dependent STA successfully receives the response for its Channel Availability Query frame from the GDD enabling STA, it reinitializes the dot11GDDEnablementValidityTimer to dot11ContactVerificatonSignalInterval.

A GDD STA that acquires its geolocation position with the accuracy required by the regulatory domain sets its dot11GeolocationCapabilityActivated attribute to true. Any STA that operates as a GDD enabling STA might have its geolocation position before it initiates the CAQ procedure. Such a STA might transmit a channel availability query request to another GDD enabling STA. The responding STA generates the CAQ response after communicating to the RLSS, if the Channel Availability Query frame was received in a Channel Availability Query RLQP-element.

NOTE—A GDD enabling STA can send the Channel Availability Query frame to another GDD enabling STA. The responding GDD enabling STA, in such a case, can contact a GDB with the location and identifying parameters sent by the requesting STA.

A GDD enabling STA performs the CAQ procedure to update its channel availability when it determines that its geolocation position has moved beyond the permitted distance or beyond the validity time since its last query, as required by regulation.

STAs might transmit a channel availability query request in the protected dual of a CAQ Public Action frame (see 8.5.8.27, or in a GAS Initial Request frame containing an Channel Availability Query RLQP-element (see 8.4.5.2).

The procedures for channel availability query requesting STA and channel availability query responding STA are specified in 10.43.4.2 and 10.43.4.3.

In some regulatory domains, CAQ procedures may be conducted in other bands with properly implemented security to meet regulatory requirements. In such cases, CAQ RLQP rather than CAQ protected duals of public action frames shall be used.

10.43.4.2 CAQ requesting STA

A GDD dependent STA or a GDD enabling STA may initiate a CAQ procedure as a CAQ requesting STA.

A CAQ requesting STA may use RLQP to transmit a CAQ request when it detects RLQP support by its intended CAQ responder in a Beacon or Probe Response frame and to transmit a CAQ request to a STA with which it is associated when the requesting STA detects RLQP support.

Upon receipt of the MLME-GAS.request primitive with an AdvertisementProtocolID value of RLQP and Query parameters with the values of the fields in the RLQP Channel Availability Query element, the requesting STA performs the procedure specified in 10.24.3.1.2 to transmit a GAS Initial Request frame that contains the Channel Availability Query RLQP-element. The specific information items in the Query Request field of the GAS Initial Request frame are defined in 8.4.5.2.

The CAQ requesting STA may send the protected dual of a channel availability query Public Action frame where the CAQ responding STA does not support RLQP capability. Upon receipt of the MLME-CHANNELAVAILABILITYQUERY.request primitive with Reason Result Code of 1, the MLME schedules for transmission a Channel Availability Query Public Action frame. The specific information items in the protected dual of a CAQ Public Action are defined in 8.5.8.27.

The CAQ requesting STA sets the Reason Result Code field to 1 and provides the Query Info field, as shown in Figure 8-431.a3, to indicate if the Device Identification or Location Information fields are included in the Channel Availability Query frame.

A GDD enabling STA sending the Channel Availability Query frame should provide its device identification information in a format specified in 8.2.6.2.2.

A GDD enabling STA that has its dot11GeolocationCapabilityActivated attribute true should provide one or more Location Information fields in its Channel Availability Query frame.

A CAQ requesting STA may request a common channel list applicable to a bounded geographic area by providing more than one Device Location Information field in the Channel Availability Query frame. The bounded geographic area is defined by the area surrounded by the given sets of geographic coordinates in the multiple Device Location Information fields.

10.43.4.3 CAQ responding STA

A GDD enabling STA that receives the Channel Availability Query frame performs the role of the CAQ responding STA.

When a GDD enabling STA that has dot11RLSSActivated true receives a Channel Availability Query RLQP-element request, it generates and transmits the Channel Availability Query RLQP-element response to the requesting STA. Upon receipt of the MLME-GAS.response primitive with ResponseInfo parameter having a value of the corresponding field in the CAQ element, the responding STA transmits a Channel Availability Query RLQP-element response.

The CAQ responding STA generates the response to the CAQ requesting STA based on the result obtained from the RLSS. The specific information items in the Channel Availability Query RLQP-element response are defined in 8.4.5.2 and are set as follows:

— Requester STA Address field set to the MAC address of the STA from which the query was received.
— If no security method is enabled on the connection between the CAQ requesting STA and the CAQ responding STA, the Reason Result Code field is set to 4 (REFUSED).
— Reason Result Code field set to 2 or 3 for successful result or to 4 or 5 for failure, as defined in 8.4.5.2.
— WSM Information field, as defined in 8.2.6.2.5 when the Reason Result Code is set to 2 or 3.

NOTE—For the CAQ process, the RLSS provides the list of available channels for the location(s) provided by the requesting STA in the Query Response. In some regulatory domains, the RLSS can perform access to a GDB to derive its response for channel query request and the associated information it provides in its Query Response.

A CAQ responding STA might receive a Channel Availability Query Public Action frame or its protected dual. Upon receipt of the MLME-CHANNELAVAILABILITYQUERY.response primitive, the MLME schedules for transmission of a channel availability query response frame. The Channel Availability Query Public Action frame or its protected dual is generated based on the ResultCode and other parameters received from the SME for the Channel Availability Query frame, as follows:

— Requester STA Address field set to the value of the PeerSTAAddress parameter.
— If no security method is enabled on the connection between the CAQ framing STA and the CAQ responding STA, the Reason Result Code field is set to 4 (REFUSED).
— Reason Result Code field set to 2 or 3 for successful result or to 4 or 5 for failure, as defined in 8.4.5.2.
— WSM Information field, as defined in 8.2.6.2.5 when the Reason Result Code is set to 2 or 3.

When a CAQ Responding STA receives the Channel Availability Query frame from a GDD dependent STA, it sets the Reason Result Code field to 2 when the query is successful and provides the WSM information it has obtained for its own location.

When a CAQ Responding STA receives the Channel Availability Query frame from another GDD enabling STA that includes one or more Device Location Information fields in the Channel Availability Query frame, it sets the Reason Result Code field to 2 or 3 when the query is successful and provides the WSM information that is valid for the location of the requesting STA.

When the Channel Availability Query frame contains multiple Device Location Information fields, the WSM information in the CAQ response is applicable for any location within the bounded area defined by the multiple locations. When the Channel Availability Query frame contains two Device Location Information fields, the WSM information in the CAQ response is applicable for any location within the bounded area determined by the uncertainty values of the coordinates of the second Device Location Information field. If no common channels are available to the bounded geographic area defined by multiple locations, CAQ responding STA responds with Reason Result Code field set to 2 (Success with the available channel list result for Device Location Information field) and WSM information applicable to the first Device Location Information field in the Channel Availability Query frame. If one or more common channels are available to the bounded geographic area defined by multiple locations, the CAQ responding STA responds with Reason Result Code field set to 3 (Success with an available channel list result for a bounded geographic area defined by multiple Device Location Information fields) and a corresponding WSM Information field.

When a CAQ responding STA receives the protected Channel Availability Query frame, the response shall be sent using the protected Channel Availability Query frame.

10.43.5 Channel schedule management (CSM) procedures

10.43.5.1 Introduction

This subclause describes a channel schedule management procedure that can be used to obtain the list of available channels for the operation of a GDD STA. STAs can use the CSM procedure specified here when dot11GDDActivated is true.

Upon receipt of MLME-CHANNELSCHEDULEMANAGEMENT.request primitive, the MLME schedules transmission for a CSM request frame. If the parameter Protected of the MLME-CHANNELSCHEDULEMANAGEMENT.request primitive has the value true, then the CSM request frame as defined in 8.5.8.28 is transmitted in a Protected Dual of Public Action frame; otherwise the CSM request frame is transmitted in a Public Action frame.

Upon receipt of MLME-GAS.request primitive with an AdvertisementProtocolID parameter value of RLQP and Query parameter for a Channel Schedule Management RLQP-element, the requesting STA performs the procedure specified in 10.24.3.1.2 to transmit a GAS Initial Request frame that contains the Channel Schedule Management RLQP-element.

A GDD enabling STA transmits a CSM request to a RLSS to query the schedule information on TV channels. By default, a RLSS is able to provide channel schedule information on TV channels. However, the RLSS may reject the request by responding with Reason Result Code field set to the value for “Request declined by RLSS for unspecified reason.”

A GDD enabling STA transmits a CSM request to a RLSS to query the schedule information on WLAN channels. The RLSS maps channel schedule information from TV channels to WLAN channels and provides the schedule information, as defined in 8.2.6.2.4, to the GDD enabling STA that sent the query to facilitate WLAN operation. A RLSS that is not capable of providing WLAN channel schedule information responds to a request using the CSM response with the Reason Result Code field set to the value for “Request declined by RLSS because of no capability for providing schedule information on WLAN channels.”

A GDD enabling STA transmits a CSM request to another GDD enabling STA that is capable of database access as indicated in the GDD enabling signal. The GDD enabling STA that is capable of database access is able to access the RLSS and obtain the channel schedule information on TV channels. The GDD enabling STA may respond to a request by sending the CSM response with Reason Result Code field set to the value for "Request Declined by the GDD enabling STA because of no capability for providing schedule information on WLAN channels."

A GDD enabling STA may transmit a CSM request to query WLAN channel information from another GDD enabling STA. A GDD enabling STA responds to a CSM request using a CSM response with the Reason Result Code field set to the value for "Success" if it is capable of providing channel schedule information on WLAN channels obtained from a RLSS and responds with the Reason Result Code field set to the value for "Request declined by the GDD enabling STA because of no capability for providing schedule information on WLAN channels," otherwise.

When the information in a CSM response is identical to the information in the most recently transmitted CSM response to the same requesting STA, the responding STA can set the Reason Result Code field value CSM element in a query response to "Successful" with no channel schedule changes from the last query of the RLSS and omit both the Channel Schedule Management Mode and Channel Schedule Descriptor fields.

A GDD enabling STA with dot11ChannelScheduleManagementActivated true may send a CSM frame to update the channel schedule information of another GDD enabling STA that receives an available channel list from it.

The GDD dependent STA shall not transmit a CSM request.

The details of requesting and responding with CSM are provided in 10.43.5.2 and 10.43.5.3.

10.43.5.2 CSM requesting STA

A STA employing RLQP uses the GAS protocol for its CSM procedure with a RLSS. Upon receipt of the MLME-GAS.request primitive with an AdvertisementProtocolID value of RLQP and Query parameter with the value of Channel Schedule Management RLQP-element, the CSM requesting STA transmits an RLQP-element with RLQP ID for CSM in the Query Request field in a GAS Initial Request frame. The specific information items in the Query Request field of the GAS Initial Request frame are generated as follows:

— Reason Result Code field = 0 or 1 as defined in 8.4.1.53.
— Channel Schedule Management Mode field = 0 or 1 as defined in 8.4.1.53.
— Channel Schedule Descriptor field, as defined in 8.2.6.2.4, containing the channel that the STA wants to query.

A STA uses the CSM Public Action frame or its protected dual to query another STA for channel schedule information. Upon receipt of the MLME-CHANNELSCHEDULEMANAGEMENT.request primitive with the CSM parameter of CSM element, the requesting STA transmits a CSM frame. The request frame is generated as follows:

— Reason Result Code field = 0 or 1 as defined in 8.4.1.53.
— Channel Schedule Management Mode field = 0 or 1 as defined in 8.4.1.53.
— Channel Schedule Descriptor field, as defined in 8.2.6.2.4, contains only the channel that the STA wants to query.

10.43.5.3 CSM responding STA

A STA employing RLQP uses the GAS protocol for its CSM procedure with a RLSS. Upon receipt of the MLME-GAS.request primitive with an ResponseInfo parameter value of Channel Schedule Management

RLQP-element, the CSM responding STA transmits a RLQP-element with RLQP ID for CSM in the Query Response field in a GAS Initial Response frame or one or more GAS Comeback Response frames. The responding RLQP CSM shall be transmitted in a Protected Dual of Public Action frame if the received CSM is protected. The specific information items in the Query Response field of the GAS Initial Response frame are generated as follows:

— Reason Result Code field = values 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12 as defined in 8.4.1.53.
— Channel Schedule Descriptor field, as defined in 8.2.6.2.4, contains the channel and related channel schedule information.

A STA uses CSM Public Action frame or its protected dual to respond to another STA with channel schedule information. Upon receipt of the MLME-CHANNELSCHEDULEMANAGEMENT.request primitive with CSM parameter value of CSM element, the CSM responding STA transmits a CSM frame in response. The responding CSM shall be transmitted in a Protected Dual of Public Action frame if the received CSM is protected. The CSM response frame is generated as follows:

— Reason result code field = values 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12 as defined in 8.4.1.53.
— Channel Schedule Descriptor field, as defined in 8.2.6.2.4, contains the channel and related channel schedule information.

10.43.6 Contact verification signal (CVS)

The Contact Verification Signal frame is transmitted by a GDD enabling STA to establish that its GDD dependent STAs are within the reception range of the GDD enabling STA and to validate the available channel list. A GDD enabling STA with dot11ContactVerificationSignalActivated true shall transmit an individually addressed Protected CVS frame (see 8.5.8.29) to its GDD dependent STAs.

A GDD dependent STA receives a CVS frame transmitted from its GDD enabling STA that provided the WSMs to verify that it is within reception range of that GDD enabling STA. The CVS frame has a Map ID field that indicates whether the WSM has been changed. A GDD dependent STA compares values of the Map ID field in the CVS frame with the Map ID of its existing WSM. If they are the same, then the GDD dependent STA assumes that its WSM is valid, and it sets dot11GDDEnablementValidTimer equal to dot11ContactVerificationSignalInterval. If they are different, the WSM is invalid because WSM information has changed. The STA should transmit a channel availability query request frame and receive a channel availability query response frame that contains an updated WSM. If the GDD dependent STA fails to retrieve the updated WSM, it shall change its GDD enablement state to *unenabled* and stop transmitting over the air after dot11GDDEnablementValidTimer has expired.

10.43.7 Network channel control (NCC) procedures

10.43.7.1 Introduction

This subclause describes network channel control procedures that can be used to manage channels for operation of a GDD STA. STAs can use the NCC procedures specified here when dot11GDDActivated is true.

Network channel control utilizes a two-message transaction sequence to allow an NCC responding STA to control the frequency usage in TV bands of an NCC requesting STA's WLAN network channels. The first message sent by the NCC requesting STA asserts identity and requests NCC information. The NCC requesting STA may select its preferred frequencies from its WSM and request usage. The message sent by the NCC responding STA returns the NCC result. The NCC responding STA might grant permission for using the selected frequencies for multiple WLAN network channels to the NCC requesting STA by using the NCC response frame (see 8.5.8.32). When responding, the NCC responding STA provides the confirmed WLAN network channels and the transmit power constraints as well. The WLAN network channels that the

network channel control responding STA confirms might be the same network channels listed in the NCC request frame or a subset of the list in the NCC request frame.

An NCC requesting STA employing RLQP may send an NCC frame to the RLSS to request its preferred frequencies given by the WSM for WLAN network channels. The NCC requesting STA accomplishes this by transmitting an RLQP-element with the RLQP ID for NCC in the Query Request field in a Gas Initial Request frame. After it receives this frame the NCC responding STA forwards the NCC request to the RLSS. After receiving the NCC request, the RLSS responds and sends an NCC response via the NCC responding STA to the NCC requesting STA. When responding, the RLSS also provides the confirmed WLAN network channels and the transmit power constraints. The WLAN network channels that the RLSS confirms might be the same network channels listed in the NCC request frame or a subset of the list in the NCC request frame.

Whenever the WSM has changed due to the update of the database information or detection of the primary service signals, the network channel control requesting STAs may transmit the NCC request frame again.

10.43.7.2 NCC requesting STA

The NCC requesting STA may be a GDD dependent STA. An NCC requesting STA employing RLQP may use GAS protocol for its NCC procedure with a RLSS. Upon receipt of the MLME-GAS.request primitive with an AdvertisementProtocolID value of RLQP and Query parameter with the value of Network Channel Control RLQP-element, the NCC requesting STA transmits an RLQP-element with Info ID for NCC in the Query Request field in a GAS Initial Request frame. The specific information items in the Query Request field of the GAS Initial Request frame are generated as follows:

— The Requester STA Address field is set to the MAC address of the NCC requesting STA.
— The Responder STA Address field is set to the MAC address of the NCC responding STA.
— The Reason Result code is 0, as defined in 8.4.5.4.
— The Number of Network Channel Control Triplets field, as defined in 8.4.5.4, gives the number of triplets of Operating Class, Channel Number, and Transmit Power Constraint fields.
— The Operating Class and Channel Number fields, with the values defined in E.1, together specify the channel frequency and channel bandwidth for WLAN network channels selected by the NCC requesting STA.
— The Maximum Transmit Power field, as defined in 8.4.5.4, is set to the intended maximum transmit power in dBm for operation of the requesting STA.

An NCC Requesting STA might use the NCC Public Action frame or its protected dual to query another STA to request frequency usage in TV bands for WLAN network channels. Upon receipt of the MLME-NETWORKCHANNELCONTROL.request primitive with NCC parameter value of NCC element, the requesting STA transmits an Action frame containing an NCC element. The request frame is generated as follows:

— The Requester STA Address field is set to the MAC address of the NCC requesting STA.
— The Responder STA Address field is set to the MAC address of the NCC responding STA.
— The Reason Result Code is 0, as defined in 8.4.5.4.
— The Number of Network Channel Control Triplets field, as defined in 8.4.5.4, gives the number of triplets of Operating Class, Channel Number, and Transmit Power Constraint fields.
— The Operating Class and Channel Number fields, with the values defined in E.1, together specify the channel frequency and channel bandwidth for WLAN network channels selected by the NCC requesting STA.
— The Maximum Transmit Power field, as defined in 8.4.5.4, is set to the intended maximum transmit power in dBm for operation of the requesting STA.

10.43.7.3 NCC responding STA

The NCC responding STA may be a GDD enabling STA. An NCC responding STA employing RLQP may use the GAS protocol for its NCC procedure with a RLSS. Upon receipt of the MLME-GAS.response primitive with a ResponseInfo parameter value of Network Channel Control RLQP-element, the NCC responding STA transmits a RLQP-element with Info ID for NCC in the Query Response field in a GAS Initial Response frame or one or more GAS Comeback Response frames. The specific information items in the Query Response field of the GAS Initial Response frame are generated as follows:

- Requester STA Address field set to the MAC address of the NCC requesting STA.
- Responder STA Address field set to the MAC address of the NCC responding STA.
- Reason Result Code field = values 2, 3, 4, 5, or 6 as defined in 8.4.5.4.
- The Number of Network Channel Control Triplets field, as defined in 8.4.5.4, gives the number of triplets of Operating Class, Channel Number, and Transmit Power Constraint fields.
- The Operating Class and Channel Number fields, with the values defined in E.1, together specify the channel frequency and channel bandwidth that the NCC responding STA has granted permission to the NCC requesting STA for WLAN operation.
- The Maximum Transmit Power field, as defined in 8.4.5.4, sets to maximum allowable transmit power in dBm of the requesting STA's WLAN operation.

An NCC responding STA may use an NCC Public Action frame or its protected dual to respond to another STA with NCC information. Upon receipt of the MLME-NETWORKCHANNELCONTROL.response primitive with NCC parameter value of NCC element, the NCC responding STA transmits an Action frame containing an NCC element. The response frame is generated as follows:

- Requester STA Address field set to the MAC address of the NCC requesting STA.
- Responder STA Address field set to the MAC address of the NCC responding STA.
- Reason Result Code = values 2, 3, 4, 5, or 6 as defined in 8.4.5.4.
- The Number of Network Channel Control Triplets field, as defined in 8.4.5.4, gives the number of triplets of Operating Class, Channel Number, and Transmit Power Constraint fields.
- The Operating Class and Channel Number fields, with the values defined in E.1, together specify the channel frequency and channel bandwidth that the NCC responding STA has granted permission to the NCC requesting STA for WLAN operation.
- The Maximum Transmit Power field, as defined in 8.4.5.4, sets to maximum allowable transmit power in dBm of the requesting STA's WLAN operation.

10.43.8 Reduced neighbor report

In Beacon and Probe Response frames, a Reduced Neighbor Report element may be transmitted by an AP with dot11TVHTOptionImplemented true. A Reduced Neighbor Report element contains information on neighbor APs. A Reduced Neighbor Report element might not be exhaustive either by choice or by the fact that there may be neighbor APs not known to the AP.

The Reduced Neighbor Report element contains a list of operating classes and channels along with TBTT information for the reported neighbor APs on each operating class and channel. A Reduced Neighbor Report element includes only channels that are consistent with the Country element in the frame in which the Reduced Neighbor Report element appears. The Reduced Neighbor Report element contents may be derived from the NeighborListSet parameter of the MLME-NEIGHBORREPRESP.request primitive. The contents of the Reduced Neighbor Report element might also be configured or obtained by other means beyond the scope of this standard.

If the Supported Operating Classes element of the STA is included in the Probe Request frame, the reduced neighbor report contains information on neighbor APs whose current operating class matches the supported operating classes in the Probe Request frame.

The Reduced Neighbor Report element shall include the information on neighbor APs whose SSID matches the specific SSID in the Probe Request frame if the Filtered Neighbor AP bit in the Neighbor AP Information field is set to 1.

A serving AP shall include a value less than 255 in the TBTT Offset in TUs subfield if it is able to guarantee an accumulated error of 1.5 TU or better.

A STA receiving a Reduced Neighbor Report element may use the report to schedule passive scanning for faster AP discovery. The scheduling process is beyond the scope of this standard. A STA receiving a Reduced Neighbor Report element with an unknown subelement identifier shall ignore the unknown subelement and continue to process the remaining subelements.

10.43.9 White space map (WSM)

This subclause describes WSM procedures that can be used to obtain lists of available channels for operation of a GDD STA. STAs can use the WSM procedure specified here when dot11GDDActivated is true.

When dot11WhiteSpaceMapActivated is true, a GDD STA shall follow the procedures in this subclause.

If dot11WhiteSpaceMapActivated is true, a GDD enabling STA transmits a WSM, and a GDD dependent STA can transmit frames only on the available channels indicated in its valid WSM. GDBs can be different according to each regulatory domain and its regulatory requirements. A WSM Type field value of 1 indicates that the WSM is generated from the GDB and the WSM Information field of the WSM element specifies the available information for TVWS, which is country-specific and defined in 8.2.6.2.5.

A GDD enabling STA contacts a GDB to obtain the permissible frequencies and operating parameters before it begins its transmissions. After receiving the WSM information from a GDB, a GDD enabling STA operates in TVWS only in the frequencies that the GDB indicates are available. The GDD enabling STA generates WSMs based on the information from the GDB. It may update WSMs when STAs perform a measurement or receive a measurement report in which a primary service signal is measured on a channel, which is indicated as available from the GDB.

A WSM element includes a list of identified available channels and corresponding maximum allowed transmission powers for each available channel.

When a GDD enabling STA retrieves updated available frequency information, it is able to transmit individually addressed Protected WSM Announcement frames with an updated WSM element to its GDD dependent STAs.

A GDD dependent STA receiving a WSM element operates on the channels indicated in the WSM. A GDD dependent STA that receives an updated WSM from its GDD enabling STA shall move its channel of operation if it is operating on a channel that has become unavailable in the updated WSM.

A GDD enabling STA transmits a WSM within a GDD Enablement Response frame, CAQ response frame, and WSM Announcement frame. A Device Class field of a WSM in a GDD Enablement Response frame and CAQ response frame is set to a value of a Device Class field in a GDD Enablement Request frame and Channel Availability Query frame, respectively. A Device Class field of WSM in a WSM Announcement frame is set to a value of the Device Class field of a WSM in a GDD Enablement Request frame.

The value of the Map version bits in the Map ID field is increased by 1 (modulo 127) whenever the GDD enabling STA transmits the updated WSM. The most recently received WSM is used by the WSM receiving STAs. A WSM with a Map version value of 127 indicates that the WSM is informative and it does not affect the GDD enablement states of a GDD dependent STA. If the Type bit in the Map ID field is set to 1, the following channel list is a full channel list; and if the Type bit is set to 0, the following channel list is a partial channel list. If a STA receives several WSMs with the same Map version and the Type bit is equal to 0, the STA should construct the whole channel list using the multiple WSMs having the same Map version.

GDD dependent STAs receiving a WSM should scan for existing BSSs on the available channels identified within received WSM element. In TVWS a GDD dependent STA receiving a WSM element shall operate on the channels indicated in the WSM. A GDD dependent STA that has previously received a WSM and that receives an updated WSM from its AP or GDD enabling STA shall move its channel of operation if it is operating on a channel that has become unavailable in the updated WSM.

If dot11WhiteSpaceMapActivated is true, then the enabled GDD dependent STA may send a Probe Request frame on any channel identified in the received WSM element. An AP that has dot11WhiteSpaceMapActivated true and that receives a Probe Request frame should respond with a Probe Response frame containing a WSM element.

Insert the following text, Clause 23, after Clause 22:

23. Television Very High Throughput (TVHT) PHY specification

23.1 Introduction

23.1.1 Introduction to the TVHT PHY

Clause 23 specifies the PHY entity for a television very high throughput (TVHT) orthogonal frequency division multiplexing (OFDM) system.

Three basic channel units (BCUs) are defined as 6 MHz, 7 MHz, or 8 MHz, depending on the regulatory domain, and denoted in the rest of this clause as a BCU or TVHT_W. Many of the terms used in this clause refer to different bands, depending on the regulatory domain. These terms include

- TVHT_2W, which represents two contiguous BCUs (12 MHz, 14 MHz, or 16 MHz)
- TVHT_W+W, which represents two noncontiguous BCU (6+6 MHz, 7+7 MHz, or 8+8 MHz)
- TVHT_4W, which represents four contiguous BCUs (24 MHz, 28 MHz, or 32 MHz)
- TVHT_2W+2W, which represents two noncontiguous frequency segments, each of which is composed of two BCUs (12+12 MHz, 14+14 MHz, or 16+16 MHz)

TVHT_2W, TVHT_W+W, TVHT_4W, and TVHT_2W+2W represent two contiguous BCUs (12 MHz, 14 MHz, or 16 MHz), two noncontiguous BCUs (6+6 MHz, 7+7 MHz, or 8+8 MHz), four contiguous BCUs (24 MHz, 28 MHz, or 32 MHz), and two noncontiguous frequency segments whereby each frequency segment comprises two contiguous BCUs (12+12 MHz, 14+14 MHz, or 16+16 MHz), respectively.

The TVHT PHY is based on the VHT PHY as defined in 22.3, 22.4, 22.5, and 22.6 and on Clause 18.

All TVHT transmissions in one BCU shall use the VHT PHY parameters for 40 MHz channel defined in 22.3, 22.4, 22.5, and 22.6 with a sampling clock change to fit into each of the BCU bandwidths and with the number of encoders (N_{ES}) always being 1 (for SU-MIMO and per user in MU-MIMO).

Table 23-8 describes the sampling clock for each of the BCUs and the basic PHY parameters for transmission over one BCU.

For all VHT PPDUs and non-HT PPDUs in TVWS band, timing-related parameters shall be used as defined in Table 23-5 and Table 23-8; frequently used parameters shall be used as defined in Table 23-6 and Table 23-9; phase rotation parameter $\Upsilon_{k,\mathrm{BW}}$ shall be replaced by $\Upsilon_{k,\mathrm{M}}$, which is defined in Table 23-12; and cyclic shift parameters shall be used as defined in 23.3.8.3.2.

As shown in Table 23-8, the design is based on defining 144 OFDM tones in the 6 MHz and 8 MHz channel units and using up to tone 58 on each side of the DC tone for data and pilots, exactly matching the VHT 40 MHz PHY parameters. The 7 MHz channel unit is split into 168 tones to maintain the same tone spacing and PHY design as used for 6 MHz channels (note the ratio of 168 to 144 is identical to the ratio of 7 to 6). The choice of 144 and not 128 was made to reduce the PHY channel BW from 6 MHz to 5 1/3 MHz in order to allow sharper filtering to achieve 55 dB ACLR.

The TVHT PHY defines the following transmission modes that incorporate transmission on one, two, or four BCUs:

a) Mandatory transmission mode - one BCU (TVHT_MODE_1)
b) Optional transmission modes - multi-BCUs
    1) Two contiguous BCUs (TVHT_MODE_2C)
    2) Two noncontiguous BCUs (TVHT_MODE_2N)
    3) Four contiguous BCUs (TVHT_MODE_4C)
    4) Two noncontiguous frequency segments, each of which comprises two contiguous BCUs (TVHT_MODE_4N)

The tone spacing, DFT duration, and other timing parameters remain unchanged for all optional modes compared with the definition in Table 23-8.

The number of occupied tones in each BCU of any optional mode is the same as the number defined in Table 23-8.

The location of the occupied tones in each BCU of any optional mode is shown in Table 23-9.

The DATA encoding process for multi-BCUs transmission is similar to one BCU transmission and is defined in 23.3.10.

A TVHT STA shall support the following features:

— TVHT_MODE_1 (one BCU)
— Single spatial stream MCSs 0 to 7 (transmit and receive)
— Binary convolutional coding
— Normal and short guard interval (transmit and receive)

A TVHT STA may support the following features:

— TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, or TVHT_MODE_4N (two or four BCUs)
— Two or more spatial streams (transmit and receive)
— Beamforming sounding (by sending a VHT NDP frame)
— Respond to transmit beamforming sounding (provide compressed beamforming feedback)
— STBC (transmit and receive)
— LDPC (transmit and receive)
— VHT MU PPDUs (transmit and receive)
— MCSs 8 and 9 (transmit and receive)

23.1.2 Scope

The services provided to the MAC by the TVHT PHY consist of two protocol functions, defined as follows:

a) A PHY convergence function, which adapts the capabilities of the physical medium dependent (PMD) system to the PHY service. This function is supported by the physical layer convergence procedure (PLCP), which defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs using the associated PMD system.
b) A PMD system whose function defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. These STAs support a TVHT PHY.

23.1.3 TVHT PHY functions

23.1.3.1 General

See 22.1.3.1 with “TVHT” replacing “VHT”.

23.1.3.2 PHY management entity (PLME)

See 22.1.3.2.

23.1.3.3 Service specification method

See 22.1.3.3 with “TVHT” replacing “VHT”.

23.1.4 PPDU formats

The structure of the PPDU transmitted by a TVHT STA is determined by the TXVECTOR parameters as defined in 23.2.2.

The FORMAT parameter determines the overall structure of the PPDU and includes the following:

— Non-HT format (NON_HT), based on Clause 18. Support for non-HT format is mandatory.
— VHT format (VHT). Support for TVHT_W VHT format is mandatory.

23.2 TVHT PHY service interface

23.2.1 Introduction

See 22.2.1.

23.2.2 TXVECTOR and RXVECTOR parameters

The TXVECTOR and RXVECTOR parameters are defined in Table 23-1.

The TXVECTOR parameter FORMAT shall be set to NON_HT or VHT. When the TXVECTOR parameter FORMAT equals NON_HT, then NON_HT_MODULATION shall be set to NON_HT_DUP_OFDM.

When the TXVECTOR parameter FORMAT equals NON_HT, the TXVECTOR parameter L_DATARATE indicates the data rate used to transmit the PSDU in Mb/s. The allowed values are 6 Mb/s, 9 Mb/s, 12 Mb/s, 18 Mb/s, 24 Mb/s, 36 Mb/s, 48 Mb/s, and 54 Mb/s divided by 7.5 for 6 MHz and 7 MHz unit channels and by 5.625 for 8 MHz channels.

When the TXVECTOR parameter FORMAT equals VHT, the TXVECTOR parameter CH_BANDWIDTH indicates the channel width of the transmitted PPDU:

Enumerated type:

— TVHT_W for one BCU
— TVHT_2W for two contiguous BCUs
— TVHT_W+W for two noncontiguous BCUs
— TVHT_4W for four contiguous BCUs
— TVHT_2W+2W for two noncontiguous frequency segments, each of which comprises two contiguous BCUs

Note that TVHT_W represents the broadcast channel bandwidth for the regulatory domain, e.g., TVHT_W is 6 MHz, 7 MHz, or 8 MHz. TVHT_2W represents two contiguous BCUs with the same regulatory domain, e.g., TVHT_2W is 12 MHz, 14 MHz, or 16 MHz.

When the TXVECTOR parameter FORMAT equals NON_HT, the TXVECTOR parameter CH_BANDWIDTH indicates the channel width of the transmitted PPDU on transmission and the estimated channel width of the received PPDU on reception:

Enumerated type:

— TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, TVHT_2W+2W

When the TXVECTOR parameter FORMAT equals VHT, the TXVECTOR parameter NUM_STS indicates the number of space-time streams: range 1 to 4 for SU, 1 to 3 per user for MU. NUM_STS summed over all users shall be less than or equal to 4. The TXVECTOR parameter NUM_STS is not present when the TXVECTOR parameter FORMAT equals to NON_HT.

Table 23-1—TXVECTOR and RXVECTOR parameters

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: NON_HT indicates non-HT duplicated PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter. VHT indicates VHT format.	Y	Y
NON_HT_MODULATION	FORMAT is NON_HT	In TXVECTOR, indicates the format type of the transmitted non-HT PPDU. In RXVECTOR, indicates the estimated format type of the received non-HT PPDU. Enumerated type: NON_HT_DUP_OFDM indicates non-HT duplicate format.	Y	Y
	Otherwise	Not present	N	N
L_LENGTH	FORMAT is NON_HT	Indicates the length of the PSDU in octets in the range of 1 to 4095. This value is used by the PHY to determine the number of octet transfers that occur between the MAC and the PHY.	Y	Y
	FORMAT is VHT	Not present NOTE—The Length field of the L-SIG in VHT PPDUs is defined in Equation (23-9) using the scaling factor defined in 23.3.8.2.1.	N	N
L_DATARATE	FORMAT is NON_HT	Indicates the data rate used to transmit the PSDU in Mb/s. The allowed values are 6, 9, 12, 18, 24, 36, 48, and 54 divided by 7.5 for 6 MHz and 7 MHz unit channels and by 5.625 for 8 MHz channels.	Y	Y
	FORMAT is VHT	Not present NOTE—The RATE field in the L-SIG field in a VHT PPDU is set to the value representing 6/X Mb/s in TVWS band “Modulation BPSK and Coding rate 1/2” row of Table 23-4.	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
N_TX	FORMAT is VHT	Indicates the number of transmit chains.	Y	N
	Otherwise	Not present	N	N
EXPANSION_MAT_TYPE	FORMAT is VHT and EXPANSION_MAT is present.	Set to COMPRESSED_SV	Y	N
	Otherwise	See corresponding entry in Table 20-1		
EXPANSION_MAT	FORMAT is VHT	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 23.3.11.2 based on the channel measured during the training symbols of a previous VHT NDP PPDU.	M U	N
	Otherwise	See corresponding entry in Table 20-1		
CHAN_MAT_TYPE	FORMAT is VHT and PSDU_LENGTH equals zero	Set to COMPRESSED_SV NOTE—This parameter is present only for TVHT NDP PPDUs.	N	Y
	FORMAT is VHT and PSDU_LENGTH is greater than zero	Not present	N	N
	Otherwise	See corresponding entry in Table 20-1		
CHAN_MAT	FORMAT is VHT and PSDU_LENGTH equals zero	Contains a set of compressed beamforming feedback matrices as defined in 22.3.11.2 based on the channel measured during the training symbols of the received VHT NDP PPDU.	N	Y
	FORMAT is VHT and PSDU_LENGTH is greater than zero	Not present	N	N
	Otherwise	See corresponding entry in Table 20-1		
DELTA_SNR	FORMAT is VHT	Contains an array of delta SNR values as defined in 8.4.1.49a based on the channel measured during the training symbols of the received VHT NDP PPDU. NOTE—In the RXVECTOR this parameter is present only for VHT NDP PPDUs for MU sounding.	M U	Y
	Otherwise	Not present	N	N
RCPI		Is a measure of the received RF power averaged over all the receive chains in the Data field of a received PPDU. Refer to 20.3.21.6 for the definition of RCPI.	N	Y

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
SNR	FORMAT is VHT	Contains an array of measures of the received SNR for each spatial stream. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 8.4.1.48a.	N	Y
	Otherwise	See corresponding entry in Table 20-1		
NO_SIG_EXTN	FORMAT is VHT	Not present	N	N
	Otherwise	See corresponding entry in Table 20-1		
FEC_CODING	FORMAT is HT	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	M U	Y
	Otherwise	See corresponding entry in Table 20-1		
STBC	FORMAT is VHT	Indicates whether STBC is used. 0 indicates no STBC ($N_{STS}=N_{SS}$ in the Data field). 1 indicates STBC is used ($N_{STS}=2N_{SS}$ in the Data field).	Y	Y
	Otherwise	See corresponding entry in Table 20-1		
GI_TYPE	FORMAT is VHT	Indicates whether a short guard interval is used in the transmission of the Data field of the PPDU. Enumerated type: LONG_GI indicates short GI is not used in the Data field of the PPDU. SHORT_GI indicates short GI is used in the Data field of the PPDU.	Y	Y
	Otherwise	Not present	N	N
TXPWR_LEVEL	FORMAT is VHT	The allowed values for the TXPWR_LEVEL parameter are in the range from 1 to numberOfOctets(dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	Otherwise	See corresponding entry in Table 20-1		
RSSI	FORMAT is VHT	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the TVHT-LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	Otherwise	See corresponding entry in Table 20-1		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
MCS	FORMAT is VHT	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 9	M U	Y
	Otherwise	See corresponding entry in Table 20-1		
REC_MCS	FORMAT is VHT	Indicates the MCS that the STA's receiver recommends.	N	O
	Otherwise	Not present	N	N
CH_BANDWIDTH	FORMAT is VHT	Indicates the channel width of the transmitted PPDU: Enumerated type: TVHT_W for one BCU TVHT_2W for two contiguous BCUs TVHT_W+W for two noncontiguous BCUs TVHT_4W for four contiguous BCUs TVHT_2W+2W for two noncontiguous frequency segments, each of which comprises two contiguous BCUs	Y	Y
	FORMAT is NON_HT	In TXVECTOR, indicates the channel width of the transmitted PPDU. In RXVECTOR, indicates the estimated channel width of the received PPDU. Enumerated type: TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, TVHT_2W+2W if NON_HT_MODULATION equals NON_HT_DUP_OFDM	Y	Y
DYN_BANDWIDTH_IN_NON_HT	FORMAT is NON_HT	In TXVECTOR, if present, indicates whether the transmitter is capable of Static or Dynamic bandwidth operation. In RXVECTOR, if valid, indicates whether the transmitter is capable of Static or Dynamic bandwidth operation. Enumerated type: Static if the transmitter is capable of Static bandwidth operation Dynamic if the transmitter is capable of Dynamic bandwidth operation NOTE—In the RXVECTOR, the validity of this parameter is determined by the MAC based on the contents of the received MPDU.	O	Y
	Otherwise	Not present	N	N
CH_BANDWIDTH_IN_NON_HT	FORMAT is NON_HT	In TXVECTOR, if present, indicates the channel width of the transmitted PPDU, which is signaled via the scrambling sequence. In RXVECTOR, if valid, indicates the channel width of the received PPDU, which is signaled via the scrambling sequence. Enumerated type: TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, TVHT_2W+2W. NOTE—In the RXVECTOR, the validity of this parameter is determined by the MAC based on the contents of the received MPDU.	O	Y
	Otherwise	Not present	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
APEP_LENGTH	FORMAT is VHT	If equal to zero, indicates a TVHT NDP PPDU for both RXVECTOR and TXVECTOR. If greater than zero, in the TXVECTOR, indicates the number of octets in the range 1 to 1 048 575 in the A-MPDU pre-EOF padding (see 9.12.2) carried in the PSDU. This parameter is used to determine the number of OFDM symbols in the Data field and, after being rounded up to a 4-octet boundary with the two LSBs removed, is placed in the VHT-SIG-B Length field. NOTE—The rounding up of the APEP_LENGTH parameter to a 4-octet word boundary could result in a value that is larger than the PSDU_LENGTH calculated using the equations in 23.4.3. If greater than zero, in the RXVECTOR, is the value obtained from the VHT-SIG-B Length field multiplied by 4.	M U	O
	Otherwise	Not present	N	N
PSDU_LENGTH	FORMAT is VHT	Indicates the number of octets in the VHT PSDU in the range of 0 to 1 065 600 octets. A value of 0 indicates a VHT NDP PPDU.	N	Y
	Otherwise	Not present	N	N
USER_POSITION	FORMAT is VHT and $1 \leq$ GROUP_ID ≤ 62	Index for user in MU transmission. Integer: range 0 to 3. NOTE—The entries in the USER_POSITION array are in ascending order.	M U	O
	Otherwise	Not present	N	N
NUM_STS	FORMAT is VHT	Indicates the number of space-time streams. Integer: range 1 to 4 for SU, 1 to 3 per user in the TXVECTOR, and 0 to 4 in the RXVECTOR for MU. NUM_STS summed over all users is between 1 and 4.	M U	Y
	Otherwise	Not present	N	N
GROUP_ID	FORMAT is VHT	Indicates the group ID. Integer: range 0 to 63 (see Table 22-12) A value of 0 or 63 indicates a VHT SU PPDU. A value in the range 1 to 62 indicates a VHT MU PPDU.	Y	Y
	Otherwise	Not present	N	N
PARTIAL_AID	FORMAT is VHT and GROUP_ID is 0 or 63	Provides an abbreviated indication of the intended recipient(s) of the PSDU (see 9.17a). Integer: range 0 to 511.	Y	Y
	Otherwise	Not present	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
NUM_USERS	FORMAT is VHT	Indicates the number of users with nonzero space-time streams. Integer: range 1 to 4.	Y	N
	Otherwise	Not present	N	N
BEAMFORMED	FORMAT is VHT and GROUP_ID is 0 or 63	Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission as described in 20.3.11.11.2. Set to 0 otherwise. NOTE—When BEAMFORMED is set to 1, smoothing is not recommended.	Y	O
	Otherwise	Not present	N	N
TXOP_PS_NOT_ALLOWED	FORMAT is VHT	Indicates whether a VHT AP allows non-AP VHT STAs in TXOP power save mode to enter Doze state during the TXOP. 0 indicates that the VHT AP allows non-AP VHT STAs to enter doze mode during a TXOP. 1 indicates that the VHT AP does not allow non-AP VHT STAs to enter doze mode during a TXOP.	Y	Y
	Otherwise	Not present	N	N
TIME_OF_DEPARTURE_REQUESTED		Boolean value: true indicates that the MAC entity requests that the PHY entity measures and reports time of departure parameters corresponding to the time when the first PPDU energy is sent by the transmitting port. false indicates that the MAC entity requests that the PHY entity neither measures nor reports time of departure parameters.	O	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
RX_START_OF_FRAME_OFFSET	dot11MgmtOptionTimingMsmtActivated is true	0 to 2^{32}– 1. An estimate of the offset (in 10 ns units) from the point in time at which the start of the preamble corresponding to the incoming frame arrived at the receive antenna port to the point in time at which this primitive is issued to the MAC.	N	Y
	Otherwise	Not present	N	N

NOTE 1—In the "TXVECTOR" and "RXVECTOR" columns, the following apply:
Y = Present;
N = Not present;
O = Optional;
MU indicates that the parameter is present once for a VHT SU PPDU and present per user for a VHT MU PPDU. Parameters specified to be present per user are conceptually supplied as an array of values indexed by *u*, where *u* takes values 0 to NUM_USERS – 1.
NOTE 2—On reception, where valid, the CH_BANDWIDTH_IN_NON_HT parameter is likely to be a more reliable indication of subformat and channel width than the NON_HT_MODULATION and CH_BANDWIDTH parameters, since for non-HT or non-HT duplicate frames, CH_BANDWIDTH is a receiver estimate of the bandwidth, whereas CH_BANDWIDTH_IN_NON_HT is the signaled bandwidth.

23.2.3 Effects of CH_BANDWIDTH parameter on PPDU format

Table 23-2 shows the PPDU format as a function of the CH_BANDWIDTH and FORMAT parameters.

Table 23-2—PPDU format as a function of CH_BANDWIDTH parameter

FORMAT	CH_BANDWIDTH	PPDU format
VHT	TVHT_W	The STA transmits a VHT PPDU in TVWS bands (when FORMAT is VHT) with TVHT_MODE_1.
VHT	TVHT_2W	The STA transmits a VHT PPDU in TVWS bands (when FORMAT is VHT) with TVHT_MODE_2C.
VHT	TVHT_4W	The STA transmits a VHT PPDU in TVWS bands (when FORMAT is VHT) with TVHT_MODE_4C.
VHT	TVHT_W+W	The STA transmits a VHT PPDU in TVWS bands (when FORMAT is VHT) with TVHT_MODE_2N.
VHT	TVHT_2W+2W	The STA transmits a VHT PPDU in TVWS bands (when FORMAT is VHT) with TVHT_MODE_4N.

Table 23-2—PPDU format as a function of CH_BANDWIDTH parameter *(continued)*

FORMAT	CH_BANDWIDTH	PPDU format
NON_HT	TVHT_W	The STA transmits a NON_HT PPDU with NON_HT_MODULATION set to NON_HT_DUP_OFDM using one TVHT_W channel as defined in 23.3.10.12. If the BSS operating channel width is wider than TVHT_W, then the transmission shall use the primary TVHT_W channel.
NON_HT	TVHT_2W	The STA transmits a NON_HT PPDU with NON_HT_MODULATION set to NON_HT_DUP_OFDM using two adjacent TVHT_W channels as defined in 23.3.10.12. If the BSS operating channel width is wider than TVHT_2W, then the transmission shall use the primary TVHT_2W channel.
NON_HT	TVHT_4W	The STA transmits a NON_HT PPDU with NON_HT_MODULATION set to NON_HT_DUP_OFDM using four adjacent TVHT_W channels as defined in 23.3.10.12.
NON_HT	TVHT_W+W	The STA transmits a NON_HT PPDU with NON_HT_MODULATION set to NON_HT_DUP_OFDM using two nonadjacent frequency segments, with each frequency segment consisting of single TVHT_W channels as defined in 23.3.10.12.
NON_HT	TVHT_2W+2W	The STA transmits a NON_HT PPDU with NON_HT_MODULATION set to NON_HT_DUP_OFDM using two nonadjacent frequency segments, with each frequency segment consisting of two adjacent TVHT_W channels as defined in 23.3.10.12.

23.2.4 Support for NON_HT and HT formats

Transmission of HT PPDU is not supported in Clause 23. Except for Non-HT duplicate transmission defined in 23.3.10.12, transmission of NON_HT is not supported in Clause 23.

Non-HT duplicate transmission is based on Clause 18, unless otherwise stated in Clause 23.

Non-HT PPDU format is same as in Figure 18-1. Overview of the PPDU encoding process is defined in 18.3.2.2 except for following modifications:

Modulation-dependent parameters for Non-HT duplicate mode in TVWS band is defined in Table 23-3. Timing related parameters are defined in Table 23-5. t_{SIGNAL} in Equation (18-2) is equal to 16 multiplied by X μs, and t_{DATA} in Equation (18-2) is equal to 20 multiplied by X μs where X is 7.5 for 6 MHz and 7 MHz unit channels and X is 5.625 for 8 MHz channels.

The timings for preamble are multiplied by X where X is 7.5 for 6 MHz and 7 MHz unit channels and X is 5.625 for 8 MHz channels.

Constructions of L-STF, L-LTF, and L-SIG are same as in 23.3.4.2, 23.3.4.3, and 23.3.4.4 except for the value field parameters in L-SIG.

Table 23-3—Modulation-dependent parameters for Non-HT duplicate mode in TVWS band

Modulation	Coding rate (R)	Coded bits per subcarrier (N_{BPSC})	Coded bits per OFDM symbol (N_{CBPS})	Data bits per OFDM symbol (N_{DBPS})	Data rate (Mb/s) (TVWS band)
BPSK	1/2	1	48	24	6/X (see NOTE)
BPSK	3/4	1	48	36	9/X (see NOTE)
QPSK	1/2	2	96	48	12/X (see NOTE)
QPSK	3/4	2	96	72	18/X (see NOTE)
16-QAM	1/2	4	192	96	24/X (see NOTE)
16-QAM	3/4	4	192	144	36/X (see NOTE)
64-QAM	2/3	6	288	192	48/X (see NOTE)
64-QAM	3/4	6	288	216	54/X (see NOTE)

NOTE—In TVWS band, X depends on regulatory domain, i.e., 7.5 for 6 MHz and 7 MHz unit channels and 5.625 for 8 MHz channels.

Interpretation of the bits R1-R4 in the SIGNAL field is modified as in Table 23-4.

Table 23-4—RATE field in L-SIG

R1-R4	Modulation	Coding rate
1101	BPSK	1/2
1111	BPSK	3/4
0101	QPSK	1/2
0111	QPSK	3/4
1001	16-QAM	1/2
1011	16-QAM	3/4
0001	64-QAM	2/3
0011	64-QAM	3/4

Table 23-5 and Table 23-6 define the timing-related parameters for Non-HT format and location of occupied tones.

Table 23-5—Timing-related constants in Non-HT PPDU

Parameter	6 MHz	7 MHz	8 MHz	Description
N_{SD}	96	96	96	Number of complex data numbers per BCU
N_{SP}	8	8	8	Number of pilot values per BCU
N_{ST}	104	104	104	Total number of subcarriers per BCU
N_{SR}	58	58	58	Highest data subcarrier index per BCU
Δ_F	$\frac{6\text{ MHz}}{144} = 41\frac{2}{3}$ kHz	$\frac{7\text{ MHz}}{168} = 41\frac{2}{3}$ kHz	$\frac{8\text{ MHz}}{144} = 55\frac{5}{9}$ kHz	Subcarrier frequency spacing
T_{DFT}	24 μs	24 μs	18 μs	IDFT/DFT period
T_{GI}	6 μs = T_{DFT} /4	6 μs = T_{DFT} /4	4.5 μs = T_{DFT} /4	Guard interval duration
T_{GIS}	3 μs = T_{DFT} /8	3 μs = T_{DFT} /8	2.25 μs = T_{DFT} /8	Short guard interval duration

Other timing parameters are derived as in Table 18–5 using the definition of TFFT in Table 23-5. Table 23-6 defines the number of occupied tones and their location in all transmission modes. Zero denotes the DC tone of any contiguous segment.

Refer to Table 22-6 for parameters definition. The definitions in the table are applicable to Clause 23 with the exception that in each transmission mode in Clause 23 $N_{CBPSSI} = N_{CBPSS}$ for SU and MU PPDUs.

Table 23-6—Tone location in Non-HT PPDU

Parameter	TVHT_ MODE_1	TVHT_ MODE_2C	TVHT_ MODE_2N	TVHT_ MODE_4C	TVHT_ MODE_4N	Description
N_{ST}	104	104	104	104	104	Total number of occupied subcarriers per BCU
N_{TT}	104	208	208	416	416	Total number of occupied subcarriers across all BCUs
Subcarrier index	–58 to –33, –31 to –6, +6 to +31, and +33 to +58	–130 to –105, –103 to –78, –66 to –41, –39 to –14, +14 to +39, +41 to +66, +78 to +103, and +105 to +130	–58 to –33, –31 to –6, +6 to +31, and +33 to +58 for each BCU	–274 to –249, –247 to –222, –210 to –185, –183 to –158, –130 to –105, –103 to –78, –66 to –41, –39 to –14, +14 to +39, +41 to +66, +78 to +103, +105 to +130, +158 to +183, +185 to +210, +222 to +247, and +249 to +274	–130 to –105, –103 to –78, –66 to –41, –39 to –14, +14 to +39, +41 to +66, +78 to +103, and +105 to +130 for each BCU	Location of occupied subcarriers for 6 MHz and 8 MHz channel units
Subcarrier index	–58 to –33, –31 to –6, +6 to +31, and +33 to +58	–142 to –117, –115 to –90, –78 to –53, –51 to –26, +26 to +51, +53 to +78, +90 to +115, and +117 to +142	–58 to –33, –31 to –6, +6 to +31, and +33 to +58 for each BCU	–310 to –285, –283 to –258, –246 to –221, –219 to –194, –142 to –117, –115 to –90, –78 to –53, –51 to –26, +26 to +51, +53 to +78, +90 to +115, +117 to +142, +194 to +219, +221 to +246, +258 to +283, and +285 to +310	–142 to –117, –115 to –90, –78 to –53, –51 to –26, +26 to +51, +53 to +78, +90 to +115, and +117 to +142 for each BCU	Location of occupied subcarriers for 7 MHz

23.3 TVHT PHY sublayer

23.3.1 Introduction

See 22.3.1.

23.3.2 VHT PPDU format in TVWS bands

A single PPDU format is defined for this PLCP: the VHT PPDU format in TVWS bands. Figure 23-1 shows the VHT PPDU format in TVWS bands, with the timing parameters (8 μs and 4 μs) in Figure 22-4 replaced by numbers from Table 23-8.

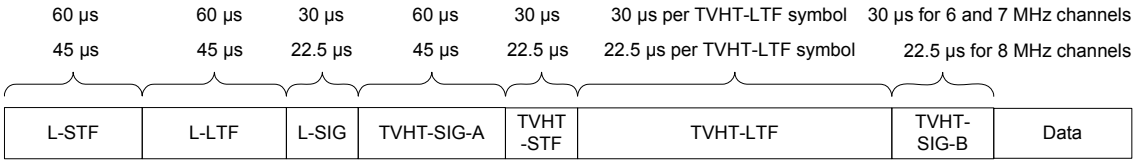


Figure 23-1—VHT PPDU format in TVWS bands

The fields of the VHT PPDU format in TVWS bands are summarized in Table 23-7.

Table 23-7—Fields of the VHT PPDU in TVWS bands

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
TVHT-SIG-A	TVHT Signal A field
TVHT-STF	TVHT Short Training field
TVHT-LTF	TVHT Long Training field
TVHT-SIG-B	TVHT Signal B field
Data	The Data field includes the PSDU (PLCP Service Data Unit)

The TVHT-SIG-A, TVHT-STF, TVHT-LTF, and TVHT-SIG-B fields exist only in VHT PPDU in TVWS bands. In a TVHT NDP, the Data field is not present. The number of symbols in the TVHT-LTF field, $N_{TVHTLTF}$, can be 1, 2, or 4 and is determined by the total number of space-time streams across all users being transmitted in the VHT PPDU in TVWS bands (see Table 22-13).

23.3.3 Transmitter block diagram

The transmit process for the L-SIG and TVHT-SIG-A fields of a VHT PPDU using one BCU is shown in Figure 22-5, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth.

The transmit process for generating the TVHT-SIG-B field of a VHT SU PPDU and VHT MU PPDU using one frequency segment is shown in Figure 22-6 and Figure 22-7, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth.

The transmit process for generating the Data field of a SU PPDU in TVHT_MODE_1, TVHT_MODE_2C, or TVHT_MODE_4C with BCC and LDPC encodings, using one BCU, is shown Figure 22-10 and Figure 22-11, respectively, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth. Single BCC encoder shall be assumed in Figure 22-10.

The transmit process for generating the Data field of a MU PPDU in TVHT_MODE_1, TVHT_MODE_2C, or TVHT_MODE_4C with BCC and LDPC encoding is shown in Figure 22-12, with “TVHT” replacing “VHT” and with bandwidth corrected according to TVHT bandwidth. In the case of BCC encoding, single BCC encoder shall be assumed in Figure 22-12.

Figure 23-2 and Figure 23-3 show the transmit process for generating the Data field of a TVHT_MODE_2N or TVHT_MODE_4N SU PPDU with BCC and LDPC encoding, respectively, where the subcarrier allocation block allocates the subcarriers for the two IDFTs in each transmit path by the subcarrier mapper as described in 23.3.10.11.

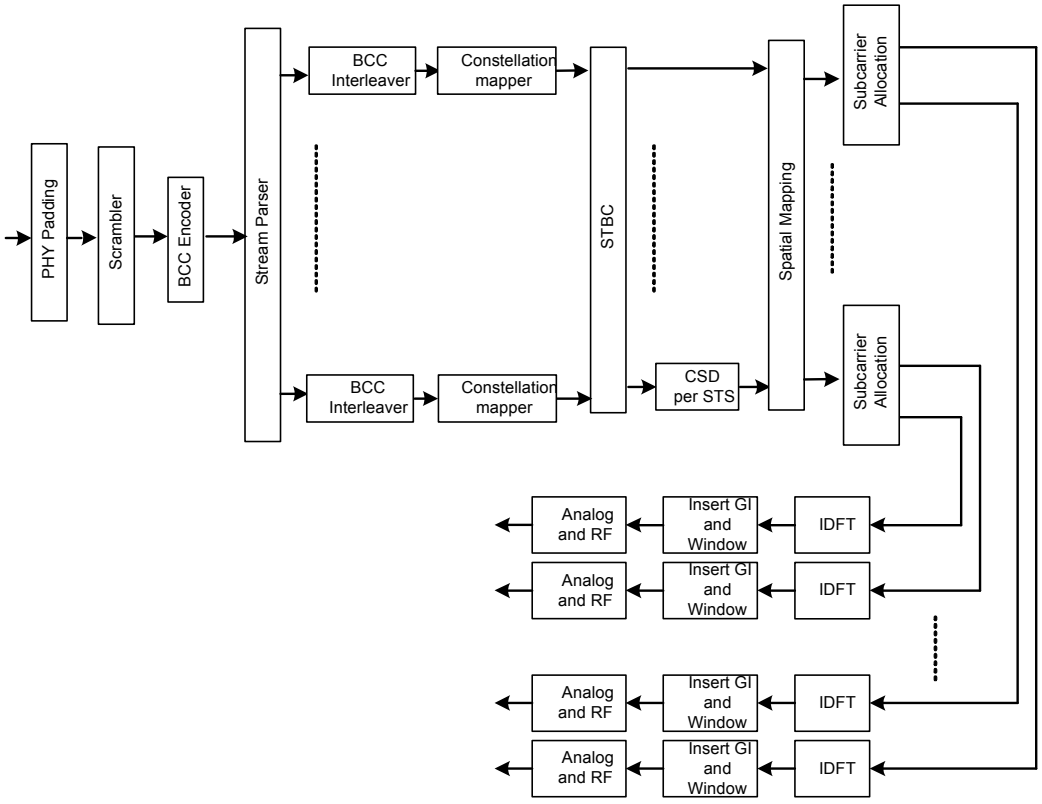


Figure 23-2—Transmitter block diagram for the Data field of a TVHT_MODE_2N or TVHT_MODE_4N SU PPDU with BCC encoding

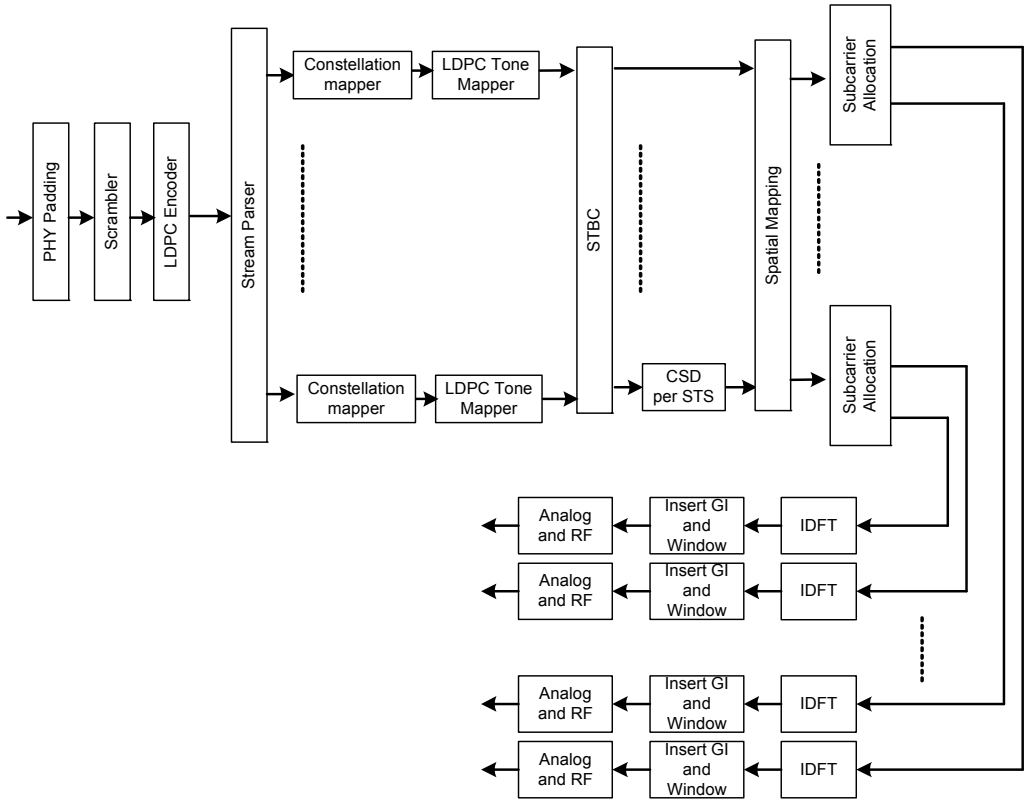


Figure 23-3—Transmitter block diagram for the Data field of a TVHT_MODE_2N or TVHT_MODE_4N SU PPDU with LDPC encoding

23.3.4 Overview of the PPDU encoding process

23.3.4.1 General

This subclause provides an overview of the VHT PPDU in TVWS bands encoding process.

23.3.4.2 Construction of L-STF

Construct the L-STF field as defined in 23.3.8.2.2 following the procedure in 22.3.4.2 reading "Clause 23" for references to "Clause 22" except the following:

c) Duplication and phase rotation: Duplicate the L-STF over the BCUs of the CH_BANDWIDTH. Apply appropriate phase rotation as defined in 23.3.7.

23.3.4.3 Construction of the L-LTF

Construct the L-LTF field as defined in L-LTF definition following the procedure in 22.3.4.3 reading "Clause 23" for references to "Clause 22" except the following:

c) Duplication and phase rotation: Duplicate the L-LTF over the BCUs of the CH_BANDWIDTH. Apply appropriate phase rotation as defined in 23.3.7.

23.3.4.4 Construction of L-SIG

Construct the L-SIG field as the SIGNAL field defined by 23.3.8.2.4 following the procedure in 22.3.4.4 reading "Clause 23" for references to "Clause 22" except the following:

a) For a VHT PPDU in TVWS bands, set the RATE subfield in the SIGNAL field R1-R4 to 1101. Set the Length, Parity, and Tail bits in the SIGNAL field as defined in 23.3.8.2.4. Add calculated one bit parity and N_{tail} bits into the L-SIG symbol.

f) Duplication and phase rotation: Duplicate the L-SIG field over the BCUs of the CH_BANDWIDTH. Apply appropriate phase rotation as defined in 23.3.7.

23.3.4.5 Construction of TVHT-SIG-A

The TVHT-SIG-A field consists of two symbols, TVHT-SIG-A1 and TVHT-SIG-A2, constructed as defined in 23.3.8.3.3 following the procedure in 22.3.4.5 reading "Clause 23" for references to "Clause 22" except the following:

e) Pilot insertion: Insert pilots following the steps defined in 23.3.10.10.

f) Duplication and phase rotation: Duplicate TVHT-SIG-A1 and TVHT-SIG-A2 over of the BCUs of the CH_BANDWIDTH. Apply the appropriate phase rotation as defined in 23.3.7.

i) Insert GI and apply windowing: Prepend a GI (LONG_GI) and apply windowing as defined in 23.3.7.

23.3.4.6 Construction of TVHT-STF

Construct the TVHT-STF field for each BCU as defined in 23.3.8.3.4 with channel bandwidth being 40 MHz, following the procedure in 22.3.4.6 reading "Clause 23" for references to "Clause 22" except the following:

b) Phase rotation: Apply appropriate phase rotation as defined in 23.3.7.

f) Insert GI and apply windowing: Prepend a GI (LONG_GI) and apply windowing as defined in 23.3.7.

In multiple BCU transmissions TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N, the TVHT-STF subcarriers of one BCU are repeated in each BCU with an appropriate phase rotation factor being applied as described in 23.3.8.3.4.

23.3.4.7 Construction of TVHT-LTF

Construct the TVHT-LTF field for each BCU as defined in 23.3.8.3.5 with channel bandwidth being 40 MHz, following the procedure in 22.3.4.7 reading "Clause 23" for references to "Clause 22" except the following:

b) Phase rotation: Apply appropriate phase rotation as defined in 23.3.7.

g) Insert GI and apply windowing: Prepend a GI (LONG_GI) and apply windowing as defined in 23.3.7.

In multiple BCU transmissions TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N, the TVHT-LTF subcarriers of one BCU are repeated in each BCU with an appropriate phase rotation factor being applied as described in 23.3.8.3.5.

23.3.4.8 Construction of TVHT-SIG-B

The TVHT-SIG-B field is constructed per-user for each BCU as defined in 22.3.4.8 with channel bandwidth being 40 MHz, reading "Clause 23" for references to "Clause 22" except the following:

i) Pilot insertion: Insert pilots following the steps defined in 23.3.10.10.

m) Phase rotation: Apply the appropriate phase rotations as defined in 23.3.7.

o) Insert GI and apply windowing: Prepend a GI (LONG_GI) and apply windowing as defined in 23.3.7.

In multiple BCU transmissions TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N, the TVHT-SIG-B subcarriers of one BCU are repeated in each BCU with an appropriate phase rotation factor being applied as described in 23.3.8.3.6.

23.3.4.9 Construction of the Data field in an SU PPDU

23.3.4.9.1 Using BCC

The construction of the Data field in a VHT SU PPDU with BCC encoding proceeds as defined in 22.3.4.9.1 reading “Clause 23” for references to “Clause 22” except the following:

d) BCC encoder: Only one encoder is used.

f) Segment parser is omitted.

i) Segment deparser is omitted.

l) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.2.

n) Phase rotation: Apply the appropriate phase rotations as defined in 23.3.7.

o) IDFT: When in TVHT_MODE_2N or VHT_MODE_4N, allocate the subcarriers for the two IDFTs in each transmit path as described in 23.3.10.11.

p) Insert GI and apply windowing: Prepend a GI (SHORT_GI or LONG_GI) and apply windowing as defined in 23.3.7.

23.3.4.9.2 Using LDPC

The construction of the Data field in a VHT SU PPDU with LDPC encoding proceeds as defined in 22.3.4.9.2 reading “Clause 23” for references to “Clause 22” except the following:

f) Segment parser is omitted.

i) Segment deparser is omitted.

l) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.2.

n) Phase rotation: Apply the appropriate phase rotations as defined in 23.3.7. When in TVHT_-MODE_2N or VHT_MODE_4N, allocate the subcarriers for the two IDFTs in each transmit path as described in 22.3.10.11.1.

o) IDFT: When in TVHT_MODE_2N or VHT_MODE_4N, allocate the subcarriers for the two IDFTs in each transmit path as described in 23.3.10.11.

p) Insert GI and apply windowing: Prepend a GI (SHORT_GI or LONG_GI) and apply windowing as defined in 23.3.7.

23.3.4.10 Construction of the Data field in an MU PPDU

23.3.4.10.1 General

See 22.3.4.10.1.

23.3.4.10.2 Using BCC

A Data field with BCC encoding is constructed using the process defined in 23.3.4.9.1 before the spatial mapping block and repeated for each user that uses BCC encoding.

23.3.4.10.3 Using LDPC

A Data field with LDPC encoding is constructed using the process defined in 23.3.4.9.2 before the spatial mapping block and repeated for each user that uses LDPC encoding.

23.3.4.10.4 Combining to form MU PPDU

The per-user data is combined as defined in 22.3.4.10.4 except the following:

a) Spatial mapping: The *Q* matrix is applied as defined in 23.3.10.11. The combining of all user data is done in this block.

b) Phase rotation: Apply the appropriate phase rotations as defined in 23.3.7.

d) Insert GI and apply windowing: Prepend a GI (SHORT_GI or LONG_GI) and apply windowing as defined in 23.3.7.

e) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.5 Modulation and coding scheme (MCS)

The MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the TVHT-SIG-A field for SU PPDUs and in the TVHT-SIG-B field for MU PPDUs. Rate-dependent parameters for the full set of MCSs are shown in Table 23-26 to Table 23-37 (in 23.5). These tables give rate-dependent parameters for MCSs with indices 0 to 9, with number of spatial streams from 1 to 4 and bandwidth options of one, two, or four BCUs. Equal modulation (EQM) is applied to all streams for a particular user.

Table 23-26 to Table 23-29 show rate-dependent parameters for MCSs for one to four streams for one BCU operation. Table 23-30 to Table 23-33 show rate-dependent parameters for MCSs for one to four streams for dual BCU operation. Table 23-34 to Table 23-37 show rate-dependent parameters for MCSs for one to four streams for quad BCU operation.

23.3.6 Timing-related parameters

Table 23-8 and Table 23-9 define the timing-related parameters for VHT format and location of occupied tones in TVWS bands.

Table 23-8—Timing-related parameters

Parameter	6 MHz	7 MHz	8 MHz	Description
N_{SD}	108	108	108	Number of complex data numbers per BCU
N_{SP}	6	6	6	Number of pilot values per BCU
N_{ST}	114	114	114	Total number of subcarriers per BCU
N_{SR}	58	58	58	Highest data subcarrier index per BCU
Δ_F	$\frac{6\text{ MHz}}{144} = 41\frac{2}{3}$ kHz	$\frac{7\text{ MHz}}{168} = 41\frac{2}{3}$ kHz	$\frac{8\text{ MHz}}{144} = 55\frac{5}{9}$ kHz	Subcarrier frequency spacing
T_{DFT}	24 μs	24 μs	18 μs	IDFT/DFT period
T_{GI}	6 μs = T_{DFT} /4	6 μs = T_{DFT} /4	4.5 μs = T_{DFT} /4	Guard interval duration

The rest of the timing parameters are derived as in Table 22-5 using the definition of T_{DFT} in Table 23-8. Table 23-9 defines the number of occupied tones and their location in all transmission modes. Zero denotes the DC tone of any contiguous segment.

Table 23-9—Tone location

Parameter	TVHT_ MODE_1	TVHT_ MODE_2C	TVHT_ MODE_2N	TVHT_ MODE_4C	TVHT_ MODE_4N	Description
N_{ST}	114	114	114	114	114	Total number of occupied subcarriers per BCU
N_{TT}	114	228	228	456	456	Total number of occupied subcarriers across all BCUs
Subcarrier index	–58 to –2 and +2 to +58	–130 to –74, –70 to –14, +14 to +70, and +74 to +130	–58 to –2 and +2 to +58 for each BCU	–274 to –218, –214 to –158, –130 to –74, –70 to –14, +14 to +70, +74 to +130, +158 to +214, and +218 to +274	–130 to –74, –70 to –14, +14 to +70, and +74 to +130 for each BCU	Location of occupied subcarriers for 6 MHz and 8 MHz channel units
Subcarrier index	–58 to –2 and +2 to +58	–142 to –86, –82 to –26, +26 to +82, and +86 to +142	–58 to –2 and +2 to +58 for each BCU	–310 to –254, –250 to –194, –142 to –86, –82 to –26, +26 to +82, +86 to +142, +194 to +250, and +254 to +310	–142 to –86, –82 to –26, +26 to +82, and +86 to +142 for each BCU	Location of occupied subcarriers for 7 MHz

Refer to Table 22-6 for the frequency parameters. The definitions in the table are applicable to Clause 23 with the exception that in each transmission mode in Clause 23 $N_{CBPSSI} = N_{CBPSS}$ for SU and MU PPDUs.

23.3.7 Mathematical description of signals

For a description of the conventions used for the mathematical description of the signals, see 18.3.2.5.

For all VHT PPDU in TVWS bands transmission modes the signal is transmitted on subcarriers as defined in Table 23-9.

Let

$f_{c,\text{idx0}}$ = dot11CurrentChannelCenterFrequencyIndex0 (see Table 23-17)

$f_{c,\text{idx1}}$ = dot11CurrentChannelCenterFrequencyIndex1 (see Table 23-17)

$f_{\text{PW, idx}}$ = dot11CurrentPrimaryChannel (see Table 23-17), where TVHT_W refers to a BCU of 6 MHz, 7 MHz, or 8 MHz

$f_{\text{CH, start}}$ = Channel starting frequency given in the operation class (E.1)

When dot11CurrentChannelWidth is TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, or TVHT_2W+2W, $f_{PW,idx}$ and $f_{c,idx1}$ shall have the relationship specified in Equation (23-1).

$$f_{\text{PW, idx}} = f_{c,\text{idx0}} + n_{\text{PW}} \tag{23-1}$$

where

$$N_{PW} = \begin{cases} 1 \text{ in TVHT\_W and TVHT\_W+W} \\ 2 \text{ in TVHT\_2W and TVHT\_2W+2W} \\ 4 \text{ in TVHT\_4W} \end{cases}$$

n_{PW} is an integer with possible range $0 \le n_{\text{PW}} \le N_{PW} - 1$

When dot11CurrentChannelWidth is TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, or TVHT_2W+2W,

— The primary TVHT_W channel is the channel with TVHT_W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{\text{PW, idx}}$, where $f_{\text{PW, idx}}$ is given in Equation (23-1).

When dot11CurrentChannelWidth is TVHT_2W, TVHT_4W, or TVHT_2W+2W,

— The secondary TVHT_W channel is the channel with TVHT_W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{\text{SW, idx}}$, where $f_{\text{SW, idx}}$ is given in Equation (23-2).

$$f_{\text{SW, idx}} = \begin{cases} f_{\text{PW, idx}} + 1, & \text{if } n_{\text{PW}} \text{ is even} \\ f_{\text{PW, idx}} - 1, & \text{if } n_{\text{PW}} \text{ is odd} \end{cases} \tag{23-2}$$

When dot11CurrentChannelWidth is TVHT_W+W,

— The secondary TVHT_W channel is the channel with TVHT_W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{\text{SW, idx}}$, where $f_{\text{SW, idx}}$ is given in Equation (23-3).

$$f_{\text{SW, idx}} = f_{c,\text{idx1}} \tag{23-3}$$

When dot11CurrentChannelWidth is TVHT_2W, TVHT_4W, or TVHT_2W+2W,

— The primary TVHT_2W channel is the channel with TVHT_2W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{\text{P2W, idx}} + 0.5 \times \text{TVHT\_W}$ MHz, where $f_{\text{P2W, idx}}$ is given in Equation (23-4).

— The secondary TVHT_2W channel is the channel with TVHT_2W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{S2W,\text{idx}} + 0.5 \times \text{TVHT\_W}$ MHz, where $f_{S2W,\text{idx}}$ is given in Equation (23-5).

$$f_{\text{P2W, idx}} = f_{c,\text{idx0}} + 2 \times n_{\text{P2W}} \quad 0 \le n_{\text{P2W}} \le N_{P2W} - 1 \quad N_{P2W} = \begin{cases} 1 \text{ in TVHT\_2W and TVHT\_2W+2W} \\ 2 \text{ in TVHT\_4W} \end{cases} \tag{23-4}$$

When dot11CurrentChannelWidth is TVHT_4W,

— The secondary TVHT_2W channel is the channel with TVHT_2W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{S2W, \text{idx}} + 0.5 \times \text{TVHT\_W}$ MHz, where $f_{S2W, \text{idx}}$ is given in Equation (23-5).

$$f_{\text{S2W, idx}} = \begin{cases} f_{\text{P2W, idx}} + 2, & \text{if } n_{\text{P2W}} \text{ is even} \\ f_{\text{P2W, idx}} - 2, & \text{if } n_{\text{P2W}} \text{ is odd} \end{cases} \quad (23\text{-}5)$$

When dot11CurrentChannelWidth is TVHT_2W+2W,

— The secondary TVHT_2W channel is the channel with TVHT_2W bandwidth centered at $f_{\text{CH, start}} + \text{TVHT\_W} \times f_{S2W, \text{idx}} + 0.5 \times \text{TVHT\_W}$ MHz, where $f_{S2W, \text{idx}}$ is given in Equation (23-3).

The transmitted signal is defined in complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the relation shown in Equation (22-11) in Clause 22.

$f_c^{(i_{Seg})}$ represents the center frequency of the PPDU transmitted in frequency segment i_{Seg} in each transmission mode in Clause 23.

Note that in TVHT_MODE_2C and TVHT_MODE_4C, the gap between the center frequencies of the adjacent segments is as shown in Table 23-9.

Table 23-10 shows $f_c^{(i_{Seg})}$ as a function of dot11CurrentChannelWidth.

Table 23-10—Center frequency of a PPDU transmitted in frequency segment i_{Seg}

dot11CurrentChannel Width	CH_BANDWIDTH	$f_c^{(i_{Seg})} = f_{\text{CH, start}} + \text{TVHT\_W} \times f_{(i_{Seg})} + Correction$	
		$(f_{(0)}, Correction)$	$(f_{(1)}, Correction)$
TVHT_W	TVHT_W	$(f_{c, \text{idx0}}, 0)$	—
TVHT_2W	TVHT_W	$(f_{\text{PW, idx}}, 0)$	—
	TVHT_2W	$(f_{c, \text{idx0}}, 0.5 \times \text{TVHT\_W})$	—
TVHT_W+W	TVHT_W	$(f_{\text{PW, idx}}, 0)$	
	TVHT_W+W	$(f_{c, \text{idx0}}, 0)$	$(f_{c, \text{idx1}}, 0)$
TVHT_4W	TVHT_W	$(f_{\text{PW, idx}}, 0)$	—
	TVHT_2W	$(f_{\text{P2W, idx}}, 0.5 \times \text{TVHT\_W})$	—
	TVHT_4W	$(f_{c, \text{idx0}}, 1.5 \times \text{TVHT\_W})$	—
TVHT_2W+2W	TVHT_W	$(f_{c, \text{idx0}}, 0)$	
	TVHT_2W	$(f_{c, \text{idx0}}, 0.5 \times \text{TVHT\_W})$	
	TVHT_2W+2W	$(f_{c, \text{idx0}}, 0.5 \times \text{TVHT\_W})$	$(f_{c, \text{idx1}}, 0.5 \times \text{TVHT\_W})$

NOTE—Transmitted signals in TVHT_MODE_2N and TVHT_MODE_4N may have different impairments such as phase offset or phase noise between the two frequency segments in TVHT_MODE_2N or TVHT_MODE_4N, which is not shown in Equation (22-11) for simplicity. See 23.3.18.3.

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The signal transmitted on frequency segment i_{Seg} of transmit chain i_{TX} is described by Equation (22-12) in 22.3.7. The timing boundaries for the various fields are shown in Figure 22-17.

Each field is defined as the summation of one or more subfields, where each subfield is defined to be an inverse discrete Fourier transform as specified in Equation (22-13) and where references to Table 22-5, Table 22-6, Table 22-8, Table 22-9, Table 22-10, and Table 22-11 are replaced by the corresponding descriptions in Clause 23 including Table 23-8, Table 23-9, Table 23-11, and Table 23-12.

Table 23-11 summarizes the various values of $N_{\text{Field}}^{\text{Tone}}$ as a function of number of BCUs (TVHT_MODE_1 has one BCU, TVHT_MODE_2C and TVHT_MODE_2N have two BCUs, and TVHT_MODE_4C and TVHT_MODE_4N have four BCUs).

Table 23-11—Tone scaling factor and guard interval duration values for PLCP fields

Field	$N_{\text{Field}}^{\text{Tone}}$ as a function of the number of BCUs			Guard interval duration
	One	Two	Four	
L-STF	24	48	96	—
L-LTF	104	208	416	T_{GI2}
L-SIG	104	208	416	T_{GI}
VHT-SIG-A	104	208	416	T_{GI}
VHT-STF	24	48	96	-
VHT-LTF	114	228	456	T_{GI}
VHT-SIG-B	114	228	456	T_{GI}
VHT-Data	114	228	484	T_{GI} or T_{GIS} (see NOTE 2)
NON_HT_DUP_OFDM-Data (see NOTE 1)	104	208	416	T_{GI}

NOTE 1—For notational convenience, NON_HT_DUP_OFDM-Data is used as a label for the Data field of a NON_HT PPDU with format type NON_HT_DUP_OFDM.
NOTE 2—T_{GI} denotes guard interval duration when TXVECTOR parameter GI_TYPE equals LONG_GI, T_{GIS} denotes short guard interval duration when TXVECTOR parameter GI_TYPE equals SHORT_GI.

In addition, the parameter $\Upsilon_{k,\text{BW}}$ in Equation (22-13) is replaced by $\Upsilon_{k,\text{M}}$ as defined in Table 23-12.

Table 23-12—Transmission mode and Gamma sub$_{k,M}$

Transmission mode	$\Upsilon_{k,\text{M}}$
TVHT_MODE_1, TVHT_MODE_2N	$\Upsilon_{k,1}$ per segment
TVHT_MODE_2C, TVHT_MODE_4N	$\Upsilon_{k,2}$ per two contiguous segments
TVHT_MODE_4C	$\Upsilon_{k,4}$

For TVHT_MODE_1 and TVHT_MODE_2N PPDU transmission,

$$\Upsilon_{k,1} = \begin{cases} 1, & k < 0 \\ j, & k \geq 0 \end{cases} \quad (23\text{-}6)$$

For TVHT_MODE_2C and TVHT_MODE_4N PPDU transmission,

$$\Upsilon_{k,2} = \begin{cases} 1, & k < -72 \text{ for 6 MHz and 8 MHz channels, } k < -84 \text{ for 7 MHz channels} \\ -1, & k \geq -72 \text{ for 6 MHz and 8 MHz channels, } k \geq -84 \text{ for 7 MHz channels} \end{cases} \quad (23\text{-}7)$$

For TVHT_MODE_4C PPDU transmission,

$$\Upsilon_{k,4} = \begin{cases} 1, & k < -216 \text{ for 6 MHz and 8 MHz channels, } k < -252 \text{ for 7 MHz channels} \\ -1, & -216 \leq k < 0 \text{ for 6 MHz and 8 MHz channels, } -252 \leq k < 0 \text{ for 7 MHz channels} \\ 1, & 0 \leq k < 72 \text{ for 6 MHz and 8 MHz channels, } 0 \leq k < 84 \text{ for 7 MHz channels} \\ -1, & k \geq 72 \text{ for 6 MHz and 8 MHz channels, } k \geq 84 \text{ for 7 MHz channels} \end{cases} \quad (23\text{-}8)$$

23.3.8 TVHT preamble

23.3.8.1 Introduction

A TVHT preamble is defined to carry the required information to operate in either single user or multi-user mode.

23.3.8.2 Non-TVHT portion of VHT format preamble

23.3.8.2.1 Cyclic shift definition for pre-TVHT modulated fields

The cyclic shift value $T_{CS}^{i_{TX}}$ for the L-STF, L-LTF, L-SIG, and VHT-SIG-A fields of the PPDU for transmit chain i_{TX} out of a total of N_{TX} is defined in Table 22-10 with a scaling factor to account for the change in sampling clock frequency. The CSD delay values shall be multiplied by the corresponding correction values for the 6 MHz, 7 MHz, and 8 MHz channels, respectively.

The scaling factor for transmissions over 6 MHz and 7 MHz channels is 7.5.

The scaling factor for transmissions over 8 MHz channels is 5.625.

As an example, the CSD value for antenna-2 with 2-transmit antennas is –200 ns, and the corresponding CSD value for 6 MHz channels is –1.5 us.

23.3.8.2.2 L-STF definition

The L-STF field for each BCU in any transmission mode is defined by Equation (20-9) in 20.3.9.3.3.

The time domain representation of the signal on BCU i_{Seg} in transmit chain i_{TX} is specified in Equation (22-20), where $\Upsilon_{k,\mathrm{BW}}$ is replaced by $\Upsilon_{k,\mathrm{M}}$ as defined in Table 23-12 and where N_{SR} is defined in Table 23-8.

23.3.8.2.3 L-LTF definition

The L-LTF field for each BCU in any transmission mode is defined by Equation (20-12) in 20.3.9.3.4.

Note that these equations do not include the phase rotations as defined in Table 23-12.

The time domain representation of the signal in transmit chain i_{TX} is specified in Equation (22-23), where $\Upsilon_{k,\mathrm{BW}}$ is replaced by $\Upsilon_{k,\mathrm{M}}$ as defined in Table 23-12 and where N_{SR} is defined in Table 23-8.

23.3.8.2.4 L-SIG definition

The L-SIG field is used to communicate data rate and length information. The structure of the L-SIG field is defined in Figure 18-5.

In a VHT PPDU, the RATE field shall be set to the value corresponding to 6 Mb/s in the 20 MHz channel spacing column of Table 18-6.

In a NON_HT_DUP PPDU, the RATE field is defined in 18.3.4.2 using the L_DATARATE parameter in the TXVECTOR.

The LENGTH field shall be set to the value given by Equation (23-9).

$$\mathrm{LENGTH} = [(\mathrm{TXTIME} - (20 \cdot \text{scaling factor}))/(4 \cdot \text{scaling factor})] \times 3 - 3 \quad (23\text{-}9)$$

where the scaling factor is defined in 23.3.8.2.1 and TXTIME is defined in 23.4.3. In a non-HT duplicate PPDU, the LENGTH field is defined in 18.3.4.3 using the L_LENGTH parameter in the TXVECTOR.

The time domain waveform of the L-SIG field in each BCU is specified in Equation (22-25) using $N_{20\mathrm{MHz}} = 2$, where $\Upsilon_{k,\mathrm{BW}}$ is replaced by $\Upsilon_{k,\mathrm{M}}$ as defined in Table 23-12 and where the rest of the variables are specified in 23.3.7.

23.3.8.3 TVHT portion of VHT format preamble

23.3.8.3.1 Introduction

The TVHT portion of the VHT format preamble consists of the TVHT-SIG-A, TVHT-STF, TVHT-LTF, and TVHT-SIG-B fields.

Notational conventions are specified in 22.3.8.2.1.

23.3.8.3.2 Cyclic shift for TVHT modulated fields

The definition, application, and CSD values are defined in 22.3.8.3.2 with scaling factors as defined in 23.3.8.2.1.

23.3.8.3.3 TVHT-SIG-A definition

The TVHT-SIG-A field carries information required to interpret VHT PPDU in TVWS bands and defined in 22.3.8.3.3.

The time domain waveform of the TVHT-SIG-A field in each BCU is specified in Equation (22-28), where $N_{20\mathrm{MHz}} = 2$ and where the rest of the variables are specified in 23.3.7.

Fields in the TVHT-SIG-A fields are the same as in Table 22-12 except for the description B0-B1 (BW) and B10-B21 in TVHT-SIG-A1. Description of B0-B1 is specified in Table 23-13

Table 23-13—B0-B1 (BW) in TVHT-SIG-A1

B0-B1	TVHT_MODE
00	Not used
10	TVHT_MODE_1
01	TVHT_MODE_2C and TVHT_MODE_2N
11	TVHT_MODE_4C and TVHT_MODE_4N

Description of B10-B21 (N_{STS}/Partial AID) is specified as follows:

For an MU PPDU:

N_{STS} is divided into 4 user positions of 3 bits each. User position p, where

$0 \le p \le 3$, uses bits B(10+3p)-B(12+3p). The number of space-time streams for user u is indicated at user position p = USER_POSITION[u] where u = 0, 1, ..., NUM_USER − 1 and where the notation A[b] denotes the value of array A at index b. Zero space-time streams are indicated at positions not listed in the USER_POSITION array.

Set to 0 for 0 space time streams
Set to 1 for 1 space time stream
Set to 2 for 2 space time streams
Set to 3 for 3 space time streams
Values 4 to 7 are reserved

For an SU PPDU:

B10-B12

Set to 0 for 1 space time stream
Set to 1 for 2 space time streams
Set to 2 for 3 space time streams
Set to 3 for 4 space time streams
Values 4 to 7 are reserved

B13-B21

Partial AID: Set to the value of the TXVECTOR parameter PARTIAL_AID. Partial AID provides an abbreviated indication of the intended recipient(s) of the PSDU (see 9.17a).

23.3.8.3.4 TVHT-STF definition

The TVHT-STF field for each BCU in any transmission mode is defined by Equation (22-30) in 22.3.8.3.4.

The time domain waveform of the TVHT-STF field in each BCU is specified in Equation (22-33), where $\Upsilon_{k,\mathrm{BW}}$ is replaced by $\Upsilon_{k,\mathrm{M}}$ as defined in Table 23-12 and where N_{SR} is defined in Table 23-8.

23.3.8.3.5 TVHT-LTF definition

The TVHT-LTF field is defined in 22.3.8.3.5.

The TVHT-LTF sequence transmitted for each BCU in any transmission mode is defined by Equation (22-37).

The time domain waveform of the TVHT-LTF field in each BCU is specified in Equation (22-42), where $\Upsilon_{k,\mathrm{BW}}$ is replaced by $\Upsilon_{k,\mathrm{M}}$ as defined in Table 23-12 and where N_{SR} is defined in Table 23-8.

23.3.8.3.6 TVHT-SIG-B definition

The TVHT-SIG-B field for each BCU in any transmission mode is as defined in 22.3.8.3.6 for 40 MHz bandwidth.

The 27 TVHT-SIG-B bits are first repeated twice; then BCC is encoded, interleaved, and made into constellations as described by Figure 22-22 and the corresponding text in 22.3.8.3.6. If the channel bandwidth of the current PPDU is TVHT_W, then the IDFT is conducted as defined in 22.3.8.3.6.

The time domain waveform for the TVHT-SIG-B field in each BCU in a VHT PPDU is the same as Equation (22-47) with channel bandwidth being 40 MHz. If the channel bandwidth of the current PPDU is larger than TVHT_W, then the TVHT-SIG-B subcarriers as described above are repeated in each BCU, with appropriate phase rotation factors $\Upsilon_{k,\mathrm{M}}$ being applied as shown in Table 23-12, before conducting IDFT.

23.3.9 Transmission of NON_HT and HT PPDUs with multiple antennas

23.3.9.1 Transmission of NON_HT PPDUs with more than one antenna

A TVHT STA that transmits a NON_HT PPDU shall apply the cyclic shifts defined in 23.3.8.2.1 for L-STF, L-LTF, and L-SIG fields of the PPDU.

23.3.9.2 Transmission of HT format PPDUs with more than four antennas

Transmission of HT PPDU with any number of antennas is not supported in Clause 23.

23.3.10 Data field

23.3.10.1 General

See 22.3.10.1, with “TVHT” replacing “VHT”.

23.3.10.2 SERVICE field

See 22.3.10.2, with “TVHT” replacing “VHT”.

23.3.10.3 CRC calculation for TVHT-SIG-B

The CRC calculation and insertion is illustrated in Figure 22-23.

The value of the CRC field shall be the 1s complement of Equation (22-59) with the values of N set to 21 for all Modes.

23.3.10.4 Scrambler

See 22.3.10.4 with “TVHT” replacing “VHT”.

23.3.10.5 Coding

See 22.3.10.5 with “TVHT” replacing “VHT”.

23.3.10.6 Stream parser

After coding and puncturing, the data bit streams at the output of the FEC encoders are processed in groups of N_{CBPS} bits. Each of these groups is rearranged into N_{SS} blocks of N_{CBPSS} bits ($N_{SS,u}$ blocks of $N_{CBPSS,u}$ bits in the case of an MU transmission). This operation is referred to as "stream parsing" and is described in 22.3.10.6.

23.3.10.7 Segment parser

The segment parser as described in 22.3.10.7 is not used in Clause 23. All modes of operation use a common interleaver in the case of BCC or use a common tone mapper in the case of LDPC.

23.3.10.8 BCC interleaver

The BCC interleaver and deinterleaver for one BCU (TVHT_MODE_1) is as defined in 22.3.10.8 for 40 MHz.

The BCC interleaver and deinterleaver for TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N reuse the same formulas as described in 22.3.10.8 for 40 MHz with new values for N_{COL} , N_{ROW}, and N_{ROT} as defined in Table 23-14.

Table 23-14—Number of rows and columns in the interleaver

Parameter	TVHT_MODE_1	TVHT_MODE_2C, TVHT_MODE_2N	TVHT_MODE_4C, TVTH_MODE_4N
N_{COL}	18	27	48
N_{ROW}	$6 \times N_{BPSCS}$	$8 \times N_{BPSCS}$	$9 \times N_{BPSCS}$
N_{ROT} ($N_{SS} \leq 4$)	29	46	78

23.3.10.9 Constellation mapping

23.3.10.9.1 General

The mapping between bits at the output of the interleaver and complex constellation points is as described in 22.3.10.9.1.

The streams of complex numbers in frequency subblock l for user u are denoted

$d'_{k,i,n,l,u}$; $k = 0, 1, \ldots, N_{SD} - 1$; $i = 1, \ldots, N_{SS,u}$; $n = 0, 1, \ldots, N_{SYM} - 1$;
$l = 0$ for all transmission modes.

23.3.10.9.2 LDPC tone mapping

The LDPC tone mapping for one BCU (TVHT_MODE_1) is as defined in 22.3.10.9.2 for 40 MHz.

The LDPC tone mapping for TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N reuses the same formulas as described in 22.3.10.9.2 for 40 MHz with values for D_{TM} as defined in Table 23-15.

Table 23-15—LDPC Tone Mapping Distance for each transmission mode

Parameter	TVHT_MODE_1	TVHT_MODE_2C, TVHT_MODE_2N	TVHT_MODE_4C, TVHT_MODE_4N
D_{TM}	6	8	9

For all Clause 23 transmission Modes, the LDPC tone mapping for LDPC-coded streams corresponding to user u is done by permuting the stream of complex numbers

$$d''_{k,i,n,l,u};\quad k = 0, 1, \ldots, N_{SD}-1;\quad i = 1, \ldots, N_{SS,u};\quad n = 0, 1, \ldots, N_{SYM}-1;$$
$$l = 0 \text{ for all transmission modes.}$$

generated by the constellation mappers, to obtain

$$d''_{t(k),i,n,l,u};\quad k = 0, 1, \ldots, N_{SD}-1;\quad i = 1, \ldots, N_{SS,u};\quad n = 0, 1, \ldots, N_{SYM}-1;$$
$$l = 0 \text{ for all transmission modes.}$$

where

$$t(k) = D_{TM}\left(k \bmod \frac{N_{SD}}{D_{TM}}\right) + \left\lfloor \frac{k \cdot D_{TM}}{N_{SD}} \right\rfloor \quad \text{for all transmission modes}$$

23.3.10.9.3 Segment deparser

The segment deparser is not used in Clause 23 as no segment parser is used in Clause 23.

23.3.10.9.4 Space-time block coding

See 22.3.10.9.4 with “TVHT” replacing “VHT”.

23.3.10.10 Pilot subcarriers

For TVHT_MODE_1 transmission, six pilot tones shall be inserted in subcarriers –53, –25, –11, 11, 25, and 53. The pilots are generated as described in 22.3.10.10 for 40 MHz transmission.

When multiple BCUs are used (TVHT_MODE_2C, TVHT_MODE_2N, TVHT_MODE_4C, and TVHT_MODE_4N), each BCU shall use the same pilot tones, which are generated as described in 22.3.10.10 for 40 MHz transmission.

23.3.10.11 OFDM modulation transmission in VHT format

For TVHT transmissions, the signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ shall be as specified in Equation (22-95).

For TVHT_MODE_1 transmission, parameters shall be selected to be the same with 40 MHz VHT transmission as defined in 22.3.10.11.1.

For multi-segment transmissions TVHT_MODE_2C and TVHT_MODE_4C, each frequency segment shall follow the waveform as described in Equation (22-95), and the data and pilot subcarriers are allocated to the IDFT block according to the subcarrier mapping as specified in Table 23-9 in consecutive order from the lowest subcarrier to the highest subcarrier.

For multi-segment transmissions TVHT_MODE_2N and TVHT_MODE_4N, each frequency segment shall follow the waveform as described in Equation (22-95), and the data and pilot subcarriers are allocated by the subcarrier allocation block, as shown in Figure 23-2, to the two IDFT blocks according to the subcarrier mapping as specified in Equation (22-95) and Table 23-9 in consecutive order from the lowest subcarrier to the highest subcarrier in each of the two frequency segments, the lower half of the subcarriers are mapped to the IDFT corresponding to the lower frequency segment, and the upper half of the subcarriers are mapped to the IDFT corresponding to the upper frequency segment.

23.3.10.12 Non-HT duplicate transmission

When the TXVECTOR parameter FORMAT is NON_HT and the TXVECTOR parameter NON_HT_MODULATION is NON_HT_DUP_OFDM, the transmitted PPDU shall be a non-HT duplicate. Multiple BCUs non-HT duplicate transmission is used to transmit to TVHT STAs that may be present in a part of a channel.

For non-HT duplicate transmission, the Data field shall be as defined in 22.3.10.12, with "TVHT" replacing "VHT" and with references to "Clause 23" replacing references to "Clause 22", using the parameter values defined in Table 23-16. The Data field shall be as defined by Equation (22-100) with following modifications. $N_{20\text{MHz}}$ is defined in Table 23-16. $K_{\text{Shift}}(i)$ in Equation (22-100) is replaced by $K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32 + 8 \cdot \lfloor N_{20\text{MHz}}/4 \rfloor + 8 \cdot \lfloor N_{20\text{MHz}}/8 \rfloor - (16 \cdot \lfloor i/2 \rfloor)$.

$T_{\text{CS}}^{i_{TX}}$ represents the cyclic shift of the transmit chain i_{TX} and is defined in 23.3.8.2.1. $N_{\text{NON\_HT\_DUP\_OFDM-Data}}^{\text{Tone}}$ is defined in Table 23-16.

Table 23-16—Parameters for Non-HT duplicate transmissions

Parameter	TVHT_ MODE_1	TVHT_ MODE_2C	TVHT_ MODE_2N	TVHT_ MODE_4C	TVHT_ MODE_4N
$N_{20\text{MHz}}$	2	4	2	8	4
$N_{\text{NON\_HT\_DUP\_OFDM-Data}}^{\text{Tone}}$	104	208	104	416	208

In addition, the parameter $\Upsilon_{k,BW}$ is replaced by $\Upsilon_{k,M}$ as defined in Table 23-12. For a noncontiguous TVHT_W+W or TVHT_2W+2W non-HT duplicate transmission, data transmission in each frequency segment shall be as defined for a TVHT_W or TVHT_2W non-HT duplicate transmission, respectively.

For the TXVECTOR and RXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, if present, the value CBW40 indicates the TVHT_W bandwidth; the value CBW80 indicates the TVHT_2W or TVHT_W+W bandwidth; the value CBW160 and value CBW80+80 indicate the TVHT_4W or TVHT_2W+2W bandwidth; and the value CBW20 is not allowed.

23.3.11 SU-MIMO and MU-MIMO Beamforming

23.3.11.1 General

SU-MIMO and DL-MU-MIMO beamforming in TVWS band is used as defined in 22.3.11.1 reading "Clause 23" for references to "Clause 22" except for feedback report format described in 8.4.1.48a.

23.3.11.2 Beamforming Feedback Matrix V

Beamforming Feedback Matrix V is constructed as defined in 22.3.11.2 reading “Clause 23” for reference to “Clause 22” except for CSD values defined in 23.3.8.3.2.

23.3.11.3 Group ID

See 22.3.11.4 with “TVHT” replacing “VHT”.

23.3.12 TVHT preamble format for sounding PPDUs

The format of a VHT NDP PPDU in TVWS bands is constructed as defined Figure 23-1.

NOTE—The number of VHT-LTF symbols in the NDP is determined by the SU N_{STS} field in VHT-SIG-A.

The VHT NDP PPDU has the following properties:

— Uses the VHT PPDU format but without the Data field.
— Is a VHT SU PPDU as indicated by the VHT-SIG-A field.
— Has the data bits of the VHT-SIG-B field set to a fixed bit pattern (see 23.3.8.3.6).

23.3.13 Regulatory requirements

See 22.3.13.

23.3.14 Channelization

A TVHT channel is specified by the four PLME MIB fields specified in Table 23-17.

Table 23-17—Fields to specify TVHT channels

Field	Meaning
dot11CurrentChannelWidth	Channel width. Possible values represent TVHT_W, TVHT_2W, TVHT_W+W, TVHT_4W, TVHT_2W+2W.
dot11CurrentChannelCenterFrequencyIndex0	In TVHT_MODE_1, TVHT_MODE_2C, and TVHT_MODE_4C operation denotes the center frequency of the lowest TV channel. In TVHT_MODE_2N and TVHT_MODE_4N operation, denotes the center frequency of the lowest TV channel in the frequency segment that contains the primary channel. Valid range is 1 to 200. See Equation (23-10).
dot11CurrentChannelCenterFrequencyIndex1	In TVHT_MODE_2N and TVHT_MODE_4N operation, denotes the center frequency of the lowest TV channel in the frequency segment that does not contain the primary channel. Valid range is 1 to 200. See Equation (23-10). Undefined for TVHT_MODE_1, TVHT_MODE_2C, and TVHT_MODE_4C operation.
dot11CurrentPrimaryChannel	Denotes the location of the primary TVHT_W channel. Valid range is 1 to 200. See Equation (23-11).

Given dot11CurrentChannelCenterFrequencyIndex0 and dot11CurrentChannelCenterFrequencyIndex1, the respective center frequency is given by Equation (23-10).

$$\text{Channel center frequency [MHz]} = \text{Channel starting frequency} + \text{TVHT\_W} \times \text{dot11CurrentChannelCenterFrequencyIndex} + \text{ChannelCenterFrequencyCorrection} \quad (23\text{-}10)$$

where

Channel starting frequency is given by the Operating Class (E.1) and
dot11CurrentChannelCenterFrequencyIndex is either dot11CurrentChannelCenterFrequencyIndex0 or dot11CurrentChannelCenterFrequencyIndex1 and
ChannelCenterFrequencyCorrection is
0 for TVHT_MODE_1 and TVHT_MODE_2N,
0.5 × TVHT_W for TVHT_MODE_2C and TVHT+MODE_4N ,
1.5 × TVHT_W for TVHT_MODE_4C.

NOTE—Channel starting frequency is the frequency that results in the regulatory domain's channel number being the RLAN channel number, i.e., the center frequency of the channel for index 0. For example, the center frequency of U.S. TV channel 2 is 57 MHz. The center frequency of U.S. TV channel 2 is obtained by Equation (23-10) as follows:
Channel center frequency [MHz] = Channel starting frequency + TVHT_W × dot11CurrentChannelCenterFrequencyIndex + ChannelCenterFrequencyCorrection = (0.045 × 1000) + 6 × 2 + 0 = 57 MHz.

The center frequency of the primary TVHT_W channel is given by Equation (23-11).

$$\text{Primary channel center frequency [MHz]} = \text{Channel starting frequency} + \text{TVHT\_W} \times \text{dot11CurrentPrimaryChannel} \quad (23\text{-}11)$$

The channel starting frequency is given by the Operating Class (see E.1).

For TVHT_MODE_2N operation, any two non-identical channels may be used.

For TVHT_MODE_4N operation, any two channels that would each be allowed as TVHT_2W channels and whose center frequencies are separated by greater than TVHT_2W (difference between dot11CurrentChannelCenterFrequencyIndex0 and dot11CurrentChannelCenterFrequencyIndex1 corresponds to a frequency difference greater than 2) may be used.

For example, in the United States, a channel specified by

dot11CurrentChannelWidth = TVHT_2W (12 MHz)
dot11CurrentChannelCenterFrequencyIndex0 = 15
dot11CurrentPrimaryChannel = 16

is a 12 MHz channel with a center frequency of 482 MHz and the primary 6 MHz channel centered at 485 MHz.

A channel specified by

dot11CurrentChannelWidth = TVHT_4W (24 MHz)
dot11CurrentChannelCenterFrequencyIndex0 = 14
dot11CurrentPrimaryChannel = 17

is a 24 MHz channel with a center frequency of 482 MHz and the primary 6 MHz channel centered at 491 MHz.

A channel specified by

dot11CurrentChannelWidth = TVHT_2W+2W (12+12 MHz)
dot11CurrentChannelCenterFrequencyIndex0 =15
dot11CurrentChannelCenterFrequencyIndex1 = 40
dot11CurrentPrimaryChannel = 16

is an 12+12 MHz channel in which frequency segment 0 has 12 MHz bandwidth and center frequency of 482 MHz. Frequency segment 1 also has 12 MHz bandwidth and center frequency of 632 MHz. The primary 6 MHz channel is centered at 485 MHz.

23.3.15 Transmit RF delay

The transmitter RF delay is defined in 18.3.8.6.

23.3.16 Slot time

The slot time for the TVHT PHY shall be 24 μs for 6 MHz and 7 MHz channel units and 20 μs for 8 MHz channel units.

23.3.17 Transmit and receive port impedance

Transmit and receive antenna port impedance for each transmit and receive antenna is defined in 18.3.8.8.

23.3.18 PMD transmit specification

23.3.18.1 Transmit spectrum mask

For transmission in TVHT_MODE_1, TVHT_MODE_2C, and TVHT_MODE_4C, the transmit spectral mask shall be as described for 40 MHz mask PPDU in 22.3.18.1 with the frequency axis multiplied by the frequency scaling factor as defined in Table 23-18.

Table 23-18—Spectral mask frequency scaling factor for contiguous transmission

Mode	Scaling for 6 MHz channels	Scaling for 7 MHz channels	Scaling for 8 MHz channels
TVHT_MODE_1	6 / 40	7 / 40	8 / 40
TVHT_MODE_2C	12 / 40	14 / 40	16 / 40
TVHT_MODE_4C	24 / 40	28 / 40	32 / 40

For transmission in mode TVHT_MODE_4N, the transmit spectral mask shall be as described for 80+80 MHz mask PPDU in 22.3.18.1 with the frequency axis multiplied by the frequency scaling factor as defined in Table 23-19.

Table 23-19—Spectral mask frequency scaling factor for TVHT_MODE_4N

Mode	Scaling for 6 MHz channels	Scaling for 7 MHz channels	Scaling for 8 MHz channels
TVHT_MODE_4N	12 / 80	14 / 80	16 / 80

NOTE 1—In the presence of additional regulatory restrictions, the device has to meet both the regulatory requirements (measured as defined in the relevant regulation) and the mask defined in this subclause.

NOTE 2—For rules regarding TX center frequency leakage levels, see 23.3.18.4.2.

For a TVHT_W+W mask PPDU of VHT or non-HT duplicate format, the overall transmit spectral mask is constructed in the following manner. First, the 40 MHz interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 38 MHz, –20 dBr at 21 MHz frequency offset, –28 dBr at 40 MHz frequency offset, and –40 dBr at 60 MHz frequency offset and above. The 40 MHz interim transmit spectral mask for frequency offsets in between 19 MHz and 21 MHz, 21 MHz and 40 MHz, and 40 MHz and 60 MHz shall be linearly interpolated in dB domain from the requirements for 19 MHz, 21 MHz, 40 MHz, and 60 MHz frequency offsets. Then the 40 MHz interim spectral mask frequency points are scaled as defined in Table 23-20 to produce a TVHT_W interim spectral mask. Then, the TVHT_W interim spectral mask is placed on each of the two segments to produce the TVHT_W+W interim spectral mask. Then, for each frequency at which both of the TVHT_W interim spectral masks have values greater than –40 dBr and less than –20 dBr, the sum of the two TVHT_W interim mask values (summed in linear domain) shall be taken as the overall TVHT_W+W interim spectral mask value. Next, for each frequency at which neither of the two TVHT_W interim masks has values greater than or equal to –20 dBr and less than or equal to 0 dBr, the higher value of the two interim masks shall be taken as the overall TVHT_W+W interim mask spectral value. Finally, for any frequency region where the TVHT_W+W interim mask value has not been defined yet, linear interpolation (in dB domain) between the nearest two frequency points with the TVHT_W+W interim spectral mask value defined shall be used to define the TVHT_W+W interim spectral mask value. The transmit spectrum shall not exceed the maximum of the TVHT_W+W interim transmit spectrum mask and –59 dBm/MHz at any frequency offset.

Table 23-20—Spectral mask frequency scaling factor for TVHT_MODE_2N

Mode	Scaling for 6 MHz channels	Scaling for 7 MHz channels	Scaling for 8 MHz channels
TVHT_MODE_2N	6 / 40	7 / 40	8 / 40

Example transmit spectral mask for a TVHT_W+W mask PPDU for BCU of 6 MHz and spacing of 12 MHz is shown in Figure 23-4.

23.3.18.2 Spectral flatness

Spectral flatness measurements shall be conducted using BPSK modulated PPDUs. See 23.3.18.4.4 for the demodulation procedure of the PPDUs as well as the number of PPDUs and OFDM symbols to be used for testing.

Let $E_{i,avg}$ denote the average constellation energy of a BPSK modulated subcarrier i in a TVHT data symbol.

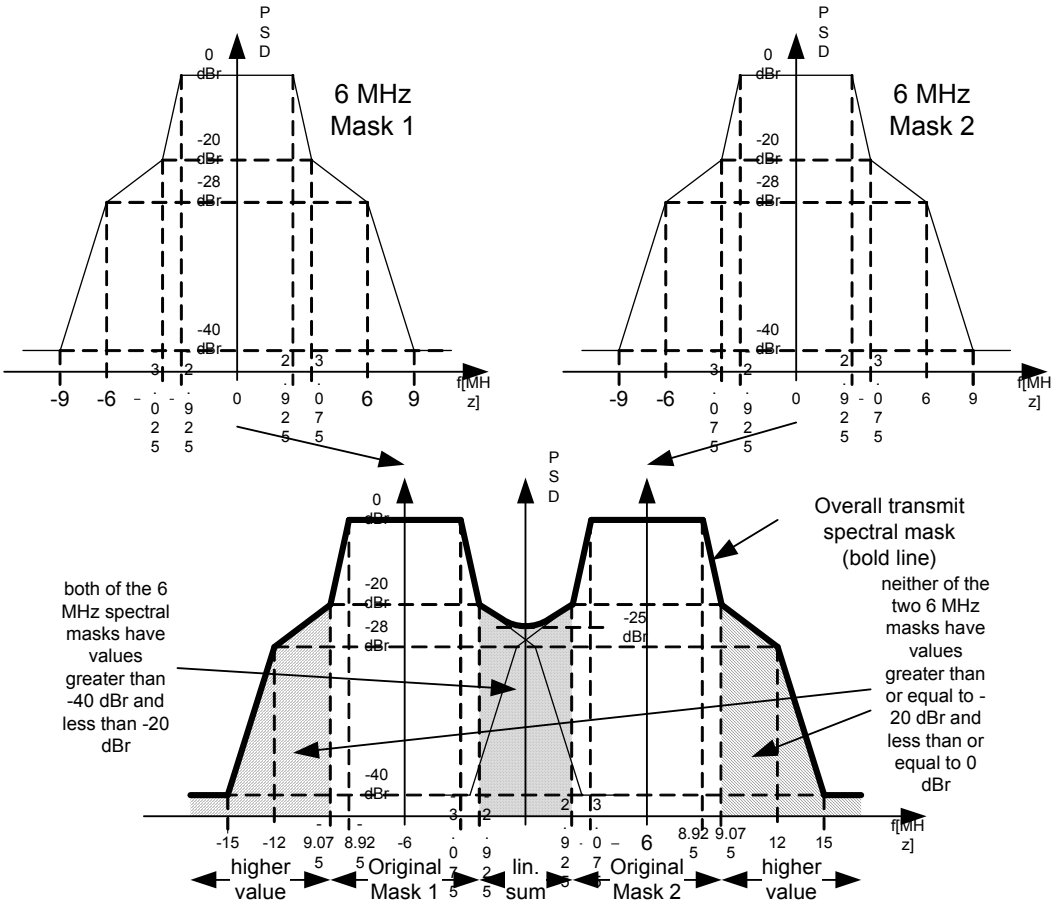


Figure 23-4—Example transmit spectral mask for an 6+6 MHz mask PPDU

For TVHT_MODE_1 contiguous non-HT duplicate or TVHT transmission having a bandwidth listed in Table 23-21, $E_{i,avg}$ of each of the subcarriers with indices listed as tested subcarrier indices shall not deviate by more than the specified maximum deviation in Table 23-21 from the average of $E_{i,avg}$ over subcarrier indices listed as averaging subcarrier indices. Averaging of $E_{i,avg}$ is done in the linear domain.

Table 23-21—Maximum transmit spectral flatness deviations

Format	Bandwidth of transmission (MHz)	Averaging subcarrier indices (inclusive)	Tested subcarrier indices (inclusive)	Maximum deviation (dB)
VHT	TVHT_W	–42 to –2 and +2 to +42	–42 to –2 and +2 to +42	±4
			–58 to –43 and +43 to +58	+4/–6
non-HT duplicate	TVHT_W	–42 to –33, –31 to –6, +6 to +31, and +33 to +42	–42 to –33, –31 to –6, +6 to +31, and +33 to +42	±4
			–43 to –58 and +43 to +58	+4/–6

For transmissions consisting of multiple contiguous or noncontiguous BCUs, each BCU shall meet the spectral flatness requirement for TVHT_MODE_1 transmission.

For the spectral flatness test, the transmitting STA shall be configured to use a spatial mapping matrix Q_k (see 23.3.10.11) with flat frequency response. Each output port under test of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation.

23.3.18.3 Transmit center frequency and symbol clock frequency tolerance

The transmitter center frequency maximum allowable deviation shall be ±25 ppm. Carrier (LO) and symbol clock frequencies for the all transmit chains and BCUs shall be derived from the same reference oscillator.

NOTE—For multi-channel operation, the signal phase of each BCU might be uncorrelated.

The symbol clock frequency tolerance shall be maximum ±25 ppm. The transmit center frequency and the symbol clock frequency for all transmit antennas and contiguous BCUs shall be derived from the same reference oscillator.

23.3.18.4 Modulation accuracy

23.3.18.4.1 Introduction to modulation accuracy tests

Transmit modulation accuracy specifications are defined in 23.3.18.4.2 and 23.3.18.4.3. The test method is described in 22.3.18.4.4.

23.3.18.4.2 Transmit center frequency leakage

For transmissions using all formats except noncontiguous where the RF LO falls outside both BCUs, TX LO leakage shall meet the following requirements:

— When the RF LO is in the center of the transmitted PPDU BW, the power measured at the center of transmission BW using resolution BW (6/144 or 8/144) MHz shall not exceed the average power per subcarrier of the transmitted PPDU, or equivalently $(P - 10\log 10(N_{ST}))$, where P is the transmit power per antenna in dBm and N_{ST} is defined in Table 23-8.

— When the RF LO is not at the center of the transmitted PPDU BW, the power measured at the location of the RF LO using resolution BW (6/144 or 8/144) MHz shall not exceed the maximum of –32 dB relative to the total transmit power and –20 dBm, or equivalently $max(P - 32, -20)$, where P is the transmit power per antenna in dBm and N_{ST} is defined in Table 23-8.

For transmissions using TVHT_MODE_2N and TVHT_MODE_4N, where the RF LO falls outside both BCUs, the RF LO shall follow the spectral mask requirements as defined in 23.3.18.1.

23.3.18.4.3 Transmitter constellation error

For all modes defined in TVHT PHY, the requirements for transmit constellation RMS error is same as defined in 22.3.18.4.3.

For non-HT duplicate transmissions, requirements defined in 18.3.9.7.4 apply to all parts of the channel bandwidth. The channel bandwidth is determined by the TXVECTOR parameter CH_BANDWIDTH.

23.3.18.4.4 Transmitter modulation accuracy (EVM) test

For the transmit modulation accuracy test, the same methodology as that defined in 22.3.18.4.4 shall be as a BCU of the channel bandwidth. The channel bandwidth is determined by the TXVECTOR parameter CH_BANDWIDTH.

23.3.18.5 Time of Departure accuracy

For Time of Departure accuracy test, the test parameters defined in 22.3.18.5 shall be used for evaluation of TOD except the channel bandwidth, TTR and TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH. The channel bandwidth is determined by TXVECTOR parameter CH_BANDWIDTH in 23.2.2. TTR and TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH shall be multiplied by the corresponding scaling factor for the 6 MHz, 7 MHz, and 8 MHz channels, where the scaling factor is defined in 23.3.8.2.1.

23.3.19 TVHT receiver specification

23.3.19.1 General

See 22.3.19.

23.3.19.2 Receiver minimum input sensitivity

The packet error ratio (PER) shall be less than 10% for a PSDU length of 4096 octets with the rate-dependent input levels listed in Table 23-22. The test in this subclause and the minimum sensitivity levels specified in Table 23-22 apply only to non-STBC modes, long GI, BCC, and VHT PPDU in TVWS bands.

Table 23-22—Receiver minimum input level sensitivity

Modulation	Rate (R)	Minimum sensitivity (dBm)					
		6 or 7 MHz (TVHT_MODE_1)	12/14 MHz (TVHT_MODE_2C) or 6+6/7+7 MHz (TVHT_MODE_2N)	24/28 MHz (TVHT_MODE_4C or 12+12/14+14 MHz (TVHT_MODE_4N)	8 MHz (TVHT_MODE_1)	16 MHz (TVHT_MODE_2C) or 8+8 MHz (TVHT_MODE_2N)	32 MHz (TVHT_MODE_4C) or 16+16/16+16 MHz (TVHT_MODE_4N)
BPSK	1/2	–88	–85	–82	–87	–84	–81
QPSK	1/2	–85	–82	–79	–84	–81	–78
QPSK	3/4	–83	–80	–77	–82	–79	–76
16-QAM	1/2	–80	–77	–74	–79	–76	–73
16-QAM	3/4	–76	–73	–70	–75	–72	–69
64-QAM	2/3	–72	–69	–66	–71	–68	–65
64-QAM	3/4	–71	–68	–65	–70	–67	–64
64-QAM	5/6	–70	–67	–64	–69	–66	–63
256-QAM	3/4	–65	–62	–59	–64	–61	–58
256-QAM	5/6	–63	–60	–57	–62	–59	–56

23.3.19.3 Adjacent channel rejection

Adjacent channel rejection for TVHT_MODE_1, TVHT_MODE_2C, and TVHT_MODE_4C follow the definition in the first paragraph of 22.3.19.2 and use the values in Table 23-23.

Adjacent channel rejection for TVHT_MODE_2N (TVHT_W+W) and TVHT_MODE_4N (TVWT_2W+2W) follows the definition in the second paragraph of 22.3.19.2, where “80 MHz” is replaced by “TVHT_W” for TVHT_MODE_2N and “TVHT_2W” for TVHT_MODE_4N, and uses the values in Table 23-23.

The definitions in the rest of 22.3.19.2 apply to Clause 23 using the values in Table 23-23.

Table 23-23—Minimum required adjacent and nonadjacent channel rejection levels

Modulation	Rate (R)	Adjacent channel rejection (dB)		Nonadjacent channel rejection (dB)	
		6 MHz, 7 MHz, 8 MHz, 12 MHz (TVHT_MODE_2C), 14 MHz (TVHT_MODE_2C), 16 MHz (TVHT_MODE_2C), 24 MHz (TVHT_MODE_4C), 28 MHz (TVHT_MODE_4C), 32 MHz (TVHT_MODE_4C)	6+6 MHz (TVHT_MODE_2N), 7+7 MHz (TVHT_MODE_2N), 8+8 MHz (TVHT_MODE_2N), 12+12 MHz (TVHT_MODE_4N), 14+14 MHz (TVHT_MODE_4N), 16+16 MHz (TVHT_MODE_4N)	6 MHz, 7 MHz, 8 MHz, 12 MHz (TVHT_MODE_2C), 14 MHz (TVHT_MODE_2C), 16 MHz (MTVHT_MODE_2C), 24 MHz (TVHT_MODE_4C), 28 MHz (TVHT_MODE_4C), 32 MHz (TVHT_MODE_4C)	6+6 MHz (TVHT_MODE_2N), 7+_7 MHz (TVHT_MODE_2N), 8+8 MHz (TVHT_MODE_2N), 12+12 MHz (TVHT_MODE_4N), 14+14 MHz (TVHT_MODE_4N), 16+16 MHz (TVHT_MODE_4N)
BPSK	1/2	16	13	32	29
QPSK	1/2	13	10	29	26
QPSK	3/4	11	8	27	24
16-QAM	1/2	8	5	24	21
16-QAM	3/4	4	1	20	17
64-QAM	2/3	0	–3	16	13
64-QAM	3/4	–1	–4	15	12
64-QAM	5/6	–2	–5	14	11
256-QAM	3/4	–7	–10	9	6
256-QAM	5/6	–9	–12	7	4

23.3.19.4 Nonadjacent channel rejection

Nonadjacent channel rejection for TVHT_MODE_1, TVHT_MODE_2C, and TVHT_MODE_4C channels follows the definition in the first paragraph of 22.3.19.3 and use the values in Table 23-23.

Nonadjacent channel rejection for TVHT_MODE_2N (TVHT_W+W) and TVHT_MODE_4N (TVWT_2W+2W) follows the definition in the second paragraph of 22.3.19.3, where “80 MHz” is replaced by “TVHT_W” for TVHT_MODE_2N and “TVHT_2W” for TVHT_MODE_4N, and uses the values in Table 23-23.

The definitions in the rest of 22.3.19.3 apply to Clause 23 using the values in Table 23-23.

23.3.19.5 Receiver maximum input level

The receiver shall provide a maximum PER of 10% at a PSDU length of 4096 octets, for a maximum input level of –20 dBm, measured at each antenna for any baseband TVHT modulation.

23.3.19.6 CCA sensitivity

23.3.19.6.1 General

The thresholds in this subclause are compared with the signal level at each receiving antenna.

23.3.19.6.2 CCA sensitivity for operating classes requiring CCA-ED

For the operating classes requiring CCA-Energy Detect (CCA-ED), CCA shall also detect a medium busy condition when CCA-ED detects a channel busy condition.

For improved spectrum sharing, CCA-ED is required in some bands. The behavior class indicating CCA-ED is given in Table D-2. The operating classes requiring the corresponding CCA-ED behavior class are given in E.1. A STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED. The CCA-ED is not required for license-exempt operation in any band.

CCA-ED shall indicate a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary TVHT_W channel and the secondary TVHT_W channel and dot11OFDMEDThreshold+3 dB for the secondary TVHT_2W channel. The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5.

NOTE—The requirement to issue a CCA signal busy as stated in 23.3.19.6.3 and 23.3.19.6.4 is a mandatory energy detect requirement on all Clause 23 receivers. Support for CCA-ED is an additional requirement that relates specifically to the sensitivities defined in D.2.5.

23.3.19.6.3 CCA sensitivity for signals occupying the primary channel

The PHY shall issue a PHY-CCA.indication(BUSY, {primary}) if one of the conditions listed in Table 23-24 is met in an otherwise idle TVHT_W (TVHT_MODE_1), TVHT_2W (TVHT_MODE_2C), TVHT_4W (TVHT_MODE_4C), TVHT_W+W (TVHT_MODE_2N), and TVHT_2W+2W (TVHT_MODE_4N) operating channel width. With >90% probability, the PHY shall detect the start of a PPDU that occupies at least the primary TVHT_W channel under the conditions listed in Table 23-24 within a period of aCCATime (see 23.4.4) and hold the CCA signal busy (PHY_CCA.indicate(BUSY, channel-list)) for the duration of the PPDU.

The receiver shall issue a PHY-CCA.indication(BUSY, {primary}) for any signal that exceeds a threshold equal to 20 dB above the minimum modulation and coding rate sensitivity (–88 + 20 = –68 dBm in the case of 6 MHz channel) in the primary TVHT_W channel within a period of aCCATime after the signal arrives at the receiver’s antenna(s); then the receiver shall not issue a PHY-CCA.indication(BUSY,{secondary}), PHY-CCA.indication(BUSY,{secondaryTVHT_2W}), or PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.

Table 23-24—Conditions for CCA BUSY on the primary channel

Frequency segment width	Conditions
6 MHz	The start of a 6 MHz non-HT duplicate or VHT PPDU in TVWS bands in the primary 6 MHz channel at or above –88 dBm.
7 MHz	The start of a 7 MHz non-HT duplicate or VHT PPDU in TVWS bands in the primary 7 MHz channel at or above –88 dBm.
8 MHz	The start of a 8 MHz non-HT duplicate or VHT PPDU in TVWS bands in the primary 8 MHz channel at or above –87 dBm.

23.3.19.6.4 CCA sensitivity for signals not occupying the primary channel

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) are not present and one of the following conditions is present in an otherwise idle TVHT_W (TVHT_MODE_1), TVHT_2W (TVHT_MODE_2C), TVHT_4W (TVHT_MODE_4C), TVHT_W+W (TVHT_MODE_2N), and TVHT_2W+2W (TVHT_MODE_4N) operating channel width:

— Any signal within the secondary channel at or above a threshold (–68 dBm for 6 MHz, –68 dBm for 7 MHz, and –67 dBm for 8 MHz) within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY,{secondaryTVHT_2W}) or PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.

— A TVHT_W non-HT duplicate or VHT PPDU in TVWS bands detected in the secondary channel at or above a threshold (–81 dBm for 6 MHz, –81 dBm for 7 MHz, and –80 dBm for 8 MHz) with >90% probability within a period aCCAMidTime (see 23.4.4).

The PHY shall issue a PHY-CCA.indication(BUSY, {secondaryTVHT_2W}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) and PHY-CCA.indication(BUSY, {secondary}) are not present and one of the following conditions is present in an otherwise idle TVHT_2W (TVHT_MODE_2C), TVHT_4W (TVHT_MODE_4C), TVHT_W+W (TVHT_MODE_2N), and TVHT_2W+2W (TVHT_MODE_4N) operating channel width:

— Any signal within the secondary TVHT_2W channel at or above a threshold (–65 dBm for 12 MHz, –65 dBm for 14 MHz, and –64 dBm for 16 MHz) within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.

— A TVHT_2W non-HT duplicate or VHT PPDU in TVWS bands detected in the secondary TVHT_2W channel at or above a threshold (–78 dBm for 6+6 MHz, –78 dBm for 7+7 MHz, and –77 dBm for 8+8 MHz or 16 MHz) with >90% probability within a period aCCAMidTime (see 23.4.4).

— A TVHT_W non-HT duplicate or VHT PPDU in TVWS bands detected in any TVHT_W subchannel of the secondary TVHT_2W channel at or above a threshold (–81 dBm for 6 MHz, –81 dBm for 7 MHz, and –80 dBm for 8 MHz) with >90% probability within a period aCCAMidTime.

23.3.19.7 RSSI

See 22.3.19.6 with "TVHT" replacing "VHT".

23.3.20 PLCP transmit procedure

See 22.3.20 with “TVHT” replacing “VHT”.

23.3.21 PLCP receive procedure

See 22.3.21 with “TVHT” replacing “VHT”.

23.4 TVHT PLME

23.4.1 PLME_SAP sublayer management primitives

See 22.4.1 with “TVHT” replacing “VHT”.

23.4.2 PHY MIB

See 22.4.2 with “tvht(10)” replacing “vht(9)”, “TVHT” replacing “VHT”, and “In4W” replacing “In80” and with the removal of “dot11VHTShortGIOptionIn160and80p80Implemented” and “dot11VHTShortGIOptionIn-160and80p80Activated”.

23.4.3 TXTIME and PSDU_LENGTH calculation

See 22.4.3 with “TVHT” replacing “VHT”.

23.4.4 PHY characteristics

The static TVHT PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 20-25 except parameters listed in Table 23-25 and aPreambleLength, aSTFOneLength, aSTFTwoLength, aLTFOneLength, aLTFTwoLength, aPLCPHeaderLength, and aPLCPSigTwoLength, which are multiplied by 7.5 for 6 MHz and 7 MHz unit channels and by 5.625 for 8 MHz unit channels. The definitions for these characteristics are given in 6.5.

Table 23-25—TVHT PHY characteristics

Characteristics	Value
aSlotTime	24 μs (BCUs: 6 MHz or 7 MHz) 20 μs (BCUs: 8 MHz)
aSifsTime	120 μs (BCUs: 6 MHz or 7 MHz) 90 μs (BCUs: 8 MHz)
aSignalExtension	0 μs
aCCATime	< 15 μs (6 MHz or 7 MHz) < 11.25 μs (8 MHz)
aCCAMidTime	< 94 μs (6 MHz or 7 MHz) < 70 μs (8 MHz)
aAirPropagationTime	3 μs
aPPDUMaxTime	20 ms
aPSDUMaxLength	1 065 600 octets (see NOTE)
NOTE—This is the maximum length in octets for SU PPDUs with a bandwidth of 32 MHz or 16+16 MHz, MCS9 and 4 spatial streams, limited by 740 possible Short GI data symbols in aPPDUMaxTime.	

23.5 Parameters for TVHT MCSs

The rate-dependent parameters for one BCU mode (6 MHz, 7 MHz, and/or 8 MHz) and corresponding two and four BCU modes with $N_{SS} = 1, \ldots, 4$ are given in Table 23-26 through Table 23-37. Support for MCS 8 and 9 (when valid) is optional in all cases. A TVHT STA shall support single spatial stream MCSs within the range MCS 0 to MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Data Rate subfield values in the TVHT Supported MCS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Data Rate subfield values in the TVHT Supported MCS Set field may result in a reduced MCS range (cut-off) for $N_{SS} = 2, \ldots, 4$. Support for 6 MHz, 7 MHz, or 8 MHz with $N_{SS} = 1$ is mandatory. Support for 6 MHz, 7 MHz, and 8 MHz with $N_{SS} = 2, \ldots, 4$ is optional. Support for two BCU modes with 12 MHz, 14 MHz, and 16 MHz or with 6+6 MHz, 7+7 MHz, and 8+8 MHz with $N_{SS} = 1, \ldots, 4$ is optional. Support for four BCU modes with 24 MHz, 28 MHz, and 32 MHz or with 12+12 MHz, 14+14 MHz, and 16+16 MHz with $N_{SS} = 1, \ldots, 4$ is optional. N_{ES} values were chosen to yield an integer number of punctured blocks per OFDM symbol. Note that N_{ES} values are 1 for all Clause 23 modulations.

Table 23-26 through Table 23-37 define TVHT MCSs not only for SU transmission but also for user u of MU transmission. In the case of TVHT MCSs for MU transmission, the parameters, N_{SS}, R, N_{BPSCS}, N_{CBPS}, and N_{DBPS} are replaced with $N_{SS,u}$, R_u, $N_{BPSCS,u}$, $N_{CBPS,u}$, and $N_{DBPS,u}$, respectively.

Table 23-26—TVHT MCSs for TVHT_MODE_1, $N_{SS} = 1$

MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	108	6	108	54	1.8	2.0	2.4	2.7
1	QPSK	1/2	2	108	6	216	108	3.6	4.0	4.8	5.3
2	QPSK	3/4	2	108	6	216	162	5.4	6.0	7.2	8.0
3	16-QAM	1/2	4	108	6	432	216	7.2	8.0	9.6	10.7
4	16-QAM	3/4	4	108	6	432	324	10.8	12.0	14.4	16.0
5	64-QAM	2/3	6	108	6	648	432	14.4	16.0	19.2	21.3
6	64-QAM	3/4	6	108	6	648	486	16.2	18.0	21.6	24.0
7	64-QAM	5/6	6	108	6	648	540	18.0	20.0	24.0	26.7
8	256-QAM	3/4	8	108	6	864	648	21.6	24.0	28.8	32.0
9	256-QAM	5/6	8	108	6	864	720	24.0	26.7	32.0	35.6

Table 23-27—TVHT MCSs for TVHT_MODE_1, N_{SS} = 2

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	108	6	216	108	3.6	4.0	4.8	5.3
1	QPSK	1/2	2	108	6	432	216	7.2	8.0	9.6	10.7
2	QPSK	3/4	2	108	6	432	324	10.8	12.0	14.4	16.0
3	16-QAM	1/2	4	108	6	864	432	14.4	16.0	19.2	21.3
4	16-QAM	3/4	4	108	6	864	648	21.6	24.0	28.8	32.0
5	64-QAM	2/3	6	108	6	1296	864	28.8	32.0	38.4	42.7
6	64-QAM	3/4	6	108	6	1296	972	32.4	36.0	43.2	48.0
7	64-QAM	5/6	6	108	6	1296	1080	36.0	40.0	48.0	53.3
8	256-QAM	3/4	8	108	6	1728	1296	43.2	48.0	57.6	64.0
9	256-QAM	5/6	8	108	6	1728	1440	48.0	53.3	64.0	71.1

Table 23-28—TVHT MCSs for TVHT_MODE_1, N_{SS} = 3

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	108	6	324	162	5.4	6.0	7.2	8.0
1	QPSK	1/2	2	108	6	648	324	10.8	12.0	14.4	16.0
2	QPSK	3/4	2	108	6	648	486	16.2	18.0	21.6	24.0
3	16-QAM	1/2	4	108	6	1296	648	21.6	24.0	28.8	32.0
4	16-QAM	3/4	4	108	6	1296	972	32.4	36.0	43.2	48.0
5	64-QAM	2/3	6	108	6	1944	1296	43.2	48.0	57.6	64.0
6	64-QAM	3/4	6	108	6	1944	1458	48.6	54.0	64.8	72.0
7	64-QAM	5/6	6	108	6	1944	1620	54.0	60.0	72.0	80.0
8	256-QAM	3/4	8	108	6	2592	1944	64.8	72.0	86.4	96.0
9	256-QAM	5/6	8	108	6	2592	2160	72.0	80.0	96.0	106.7

Table 23-29—TVHT MCSs for TVHT_MODE_1, N_{SS} = 4

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	108	6	432	216	7.2	8.0	9.6	10.7
1	QPSK	1/2	2	108	6	864	432	14.4	16.0	19.2	21.3
2	QPSK	3/4	2	108	6	864	648	21.6	24.0	28.8	32.0
3	16-QAM	1/2	4	108	6	1728	864	28.8	32.0	38.4	42.7
4	16-QAM	3/4	4	108	6	1728	1296	43.2	48.0	57.6	64.0
5	64-QAM	2/3	6	108	6	2592	1728	57.6	64.0	76.8	85.3
6	64-QAM	3/4	6	108	6	2592	1944	64.8	72.0	86.4	96.0
7	64-QAM	5/6	6	108	6	2592	2160	72.0	80.0	96.0	106.7
8	256-QAM	3/4	8	108	6	3456	2592	86.4	96.0	115.2	128.0
9	256-QAM	5/6	8	108	6	3456	2880	96.0	106.7	128.0	142.2

Table 23-30—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, N_{SS} = 1

MCS Index	Modulation	*R*	N_{BPSCS}	$N_{SD} \cdot N_{Seg}$	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	216	12	216	108	3.6	4.0	4.8	5.3
1	QPSK	1/2	2	216	12	432	216	7.2	8.0	9.6	10.7
2	QPSK	3/4	2	216	12	432	324	10.8	12.0	14.4	16.0
3	16-QAM	1/2	4	216	12	864	432	14.4	16.0	19.2	21.3
4	16-QAM	3/4	4	216	12	864	648	21.6	24.0	28.8	32.0
5	64-QAM	2/3	6	216	12	1296	864	28.8	32.0	38.4	42.7
6	64-QAM	3/4	6	216	12	1296	972	32.4	36.0	43.2	48.0
7	64-QAM	5/6	6	216	12	1296	1080	36.0	40.0	48.0	53.3
8	256-QAM	3/4	8	216	12	1728	1296	43.2	48.0	57.6	64.0
9	256-QAM	5/6	8	216	12	1728	1440	48.0	53.3	64.0	71.1

Table 23-31—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, N_{SS} = 2

MCS Index	Modulation	R	N_{BPSCS}	N_{SD}· N_{Seg}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	216	12	432	216	7.2	8.0	9.6	10.7
1	QPSK	1/2	2	216	12	864	432	14.4	16.0	19.2	21.3
2	QPSK	3/4	2	216	12	864	648	21.6	24.0	28.8	32.0
3	16-QAM	1/2	4	216	12	1728	864	28.8	32.0	38.4	42.7
4	16-QAM	3/4	4	216	12	1728	1296	43.2	48.0	57.6	64.0
5	64-QAM	2/3	6	216	12	2592	1728	57.6	64.0	76.8	85.3
6	64-QAM	3/4	6	216	12	2592	1944	64.8	72.0	86.4	96.0
7	64-QAM	5/6	6	216	12	2592	2160	72.0	80.0	96.0	106.7
8	256-QAM	3/4	8	216	12	3456	2592	86.4	96.0	115.2	128.0
9	256-QAM	5/6	8	216	12	3456	2880	96.0	106.7	128.0	142.2

Table 23-32—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, N_{SS} = 3

MCS Index	Modulation	R	N_{BPSCS}	N_{SD}· N_{Seg}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	216	12	648	324	10.8	12.0	14.4	16.0
1	QPSK	1/2	2	216	12	1296	648	21.6	24.0	28.8	32.0
2	QPSK	3/4	2	216	12	1296	972	32.4	36.0	43.2	48.0
3	16-QAM	1/2	4	216	12	2592	1296	43.2	48.0	57.6	64.0
4	16-QAM	3/4	4	216	12	2592	1944	64.8	72.0	86.4	96.0
5	64-QAM	2/3	6	216	12	3888	2592	86.4	96.0	115.2	128.0
6	64-QAM	3/4	6	216	12	3888	2916	97.2	108.0	129.6	144.0
7	64-QAM	5/6	6	216	12	3888	3240	108.	120.0	144.0	160.0
8	256-QAM	3/4	8	216	12	5184	3888	129.6	144.0	172.8	192.0
9	256-QAM	5/6	8	216	12	5184	4320	144.0	160.0	192.0	213.3

Table 23-33—TVHT MCSs for TVHT_MODE_2C and TVHT_MODE_2N, N_{SS} = 4

MCS Index	Modulation	*R*	N_{BPSCS}	$N_{SD} \cdot N_{Seg}$	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	216	12	864	432	14.4	16.0	19.2	21.3
1	QPSK	1/2	2	216	12	1728	864	28.8	32.0	38.4	42.7
2	QPSK	3/4	2	216	12	1728	1296	43.2	48.0	57.6	64.0
3	16-QAM	1/2	4	216	12	3456	1728	57.6	64.0	76.8	85.3
4	16-QAM	3/4	4	216	12	3456	2592	86.4	96.0	115.2	128.0
5	64-QAM	2/3	6	216	12	5184	3456	115.2	128.0	153.6	170.7
6	64-QAM	3/4	6	216	12	5184	3888	129.6	144.0	172.8	192.0
7	64-QAM	5/6	6	216	12	5184	4320	144.0	160.0	192.0	213.3
8	256-QAM	3/4	8	216	12	6912	5184	172.8	192.0	230.4	256.0
9	256-QAM	5/6	8	216	12	6912	5760	192.0	213.3	256.0	284.4

Table 23-34—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, N_{SS} = 1

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	432	24	432	216	7.2	8.0	9.6	10.7
1	QPSK	1/2	2	432	24	864	432	14.4	16.0	19.2	21.3
2	QPSK	3/4	2	432	24	864	648	21.6	24.0	28.8	32.0
3	16-QAM	1/2	4	432	24	1728	864	28.8	32.0	38.4	42.7
4	16-QAM	3/4	4	432	24	1728	1296	43.2	48.0	57.6	64.0
5	64-QAM	2/3	6	432	24	2592	1728	57.6	64.0	76.8	85.3
6	64-QAM	3/4	6	432	24	2592	1944	64.8	72.0	86.4	96.0
7	64-QAM	5/6	6	432	24	2592	2160	72.0	80.0	96.0	106.7
8	256-QAM	3/4	8	432	24	3456	2592	86.4	96.0	115.2	128.0
9	256-QAM	5/6	8	432	24	3456	2880	96.0	106.7	128.0	142.2

Table 23-35—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, N_{SS} = 2

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	432	24	864	432	14.4	16.0	19.2	21.3
1	QPSK	1/2	2	432	24	1728	864	28.8	32.0	38.4	42.7
2	QPSK	3/4	2	432	24	1728	1296	43.2	48.0	57.6	64.0
3	16-QAM	1/2	4	432	24	3456	1728	57.6	64.0	76.8	85.3
4	16-QAM	3/4	4	432	24	3456	2592	86.4	96.0	115.2	128.0
5	64-QAM	2/3	6	432	24	5184	3456	115.2	128.0	153.6	170.7
6	64-QAM	3/4	6	432	24	5184	3888	129.6	144.0	172.8	192.0
7	64-QAM	5/6	6	432	24	5184	4320	144.0	160.0	192.0	213.3
8	256-QAM	3/4	8	432	24	6912	5184	172.8	192.0	230.4	256.0
9	256-QAM	5/6	8	432	24	6912	5760	192.0	213.3	256.0	284.4

Table 23-36—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, N_{SS} = 3

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	432	24	1296	648	21.6	24.0	28.8	32.0
1	QPSK	1/2	2	432	24	2592	1296	43.2	48.0	57.6	64.0
2	QPSK	3/4	2	432	24	2592	1944	64.8	72.0	86.4	96.0
3	16-QAM	1/2	4	432	24	5184	2592	86.4	96.0	115.2	128.0
4	16-QAM	3/4	4	432	24	5184	3888	129.6	144.0	172.8	192.0
5	64-QAM	2/3	6	432	24	7776	5184	172.8	192.0	230.4	256.0
6	64-QAM	3/4	6	432	24	7776	5832	194.4	216.0	259.2	288.0
7	64-QAM	5/6	6	432	24	7776	6480	216.0	240.0	288.0	320.0
8	256-QAM	3/4	8	432	24	10368	7776	259.2	288.0	345.6	384.0
9	256-QAM	5/6	8	432	24	10368	8640	288.0	320.0	384.0	426.7

Table 23-37—TVHT MCSs for TVHT_MODE_4C and TVHT_MODE_4N, N_{SS} = 4

MCS Index	Modulation	*R*	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s) for 6 MHz or 7 MHz		Data rate (Mb/s) for 8 MHz	
								6.0 µs GI	3.0 µs GI	4.5 µs GI	2.25 µs GI
0	BPSK	1/2	1	432	24	1728	864	28.8	32.0	38.4	42.7
1	QPSK	1/2	2	432	24	3456	1728	57.6	64.0	76.8	85.3
2	QPSK	3/4	2	432	24	3456	2592	86.4	96.0	115.2	128.0
3	16-QAM	1/2	4	432	24	6912	3456	115.2	128.0	153.6	170.7
4	16-QAM	3/4	4	432	24	6912	5184	172.8	192.0	230.4	256.0
5	64-QAM	2/3	6	432	24	10368	6912	230.4	256.0	307.2	341.3
6	64-QAM	3/4	6	432	24	10368	7776	259.2	288.0	345.6	384.0
7	64-QAM	5/6	6	432	24	10368	8640	288.0	320.0	384.0	426.7
8	256-QAM	3/4	8	432	24	13824	10368	345.6	384.0	460.8	512.0
9	256-QAM	5/6	8	432	24	13824	11520	384.0	426.7	512.0	568.9

Annex B

(normative)

Protocol Implementation Conformance Statement (PICS) proforma

B.2 Abbreviations and special symbols

B.2.2 General abbreviations for Item and Support columns

Insert the following abbreviation into B.2.2:

TVHTM	television very high throughput medium access control (MAC) features
TVHTP	television very high throughput physical layer (PHY) features
TVWS	television white spaces
WS	white spaces

B.4 PICS proforma—IEEE Std. 802.11-2012

Change the following rows of the B.4.3 table, and insert the new row in numeric order as shown:

B.4.3 IUT configuration

Item	IUT configuration	References	Status	Support
*CF10	Is spectrum management operation supported?	8.4.1.4, 10.6	(CF6 OR CF16 OR CF29 OR CF30): O	Yes ☐ No ☐ N/A ☐
*CF11	Operating classes capability implemented	8.4.2.10, 18.3.8.4.2, 18.3.8.6, 18.4.2, Annex D	(CF6 OR CF16 OR CF30) &CF8& CF10:O	Yes ☐ No ☐ N/A ☐
*CF12	Quality of service (QoS) supported	9.19, 9.21, 4.3.10, 4.3.15.3	O (CF16 OR CF21 OR CF22): M CF30:M	Yes ☐ No ☐ N/A ☐
...				
*CF30	TVWS Operation	Annex D, Annex E	O	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.4.1 table, and insert the new rows in numeric order as shown:

B.4.4.1 MAC protocol capabilities

Item	Protocol capability	References	Status	Support
PC9	Multirate support	9.7, Annex J	M	Yes ☐ No ☐
PC9.1	Rate selection using Rx Supported VHT-MCS and NSS Set / Tx Supported VHT-MCS and NSS Set	9.7.11.1, 9.7.11.2	CF29:M CF30:M	Yes ☐ No ☐ N/A ☐
PC9.2	Cropping of VHT Basic MCS Set	9.7.11.3	CF29:O CF30:O	Yes ☐ No ☐ N/A ☐
...				
PC31	Support transmission of CTS-to-self sequence as described in the references	9.3.2.11	CF9:O CF30:O	Yes ☐ No ☐ N/A ☐
PC32	Support reception of CTS-to-self sequence as described in the references	9.3.2.11	CF9:M CF30:M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.4.2 table, and insert the new rows in numeric order as shown:

B.4.4.2 MAC frames

Item	MAC frame	References	Status	Support
...	Is transmission of the following MAC frames supported?	Clause 8, Annex ~~J~~E		
FT27	VHT NDP Announcement	Clause 8	VHTM4.1:M TVHTM4.1:M	Yes ☐ No ☐ N/A ☐
FT28	Beamforming Report Poll	Clause 8	VHTM4.1:O VHTM4.3:M TVHTM4.1:O TVHTM4.3:M	Yes ☐ No ☐ N/A ☐
...	Is reception of the following MAC frames supported?	Clause 8, Annex ~~J~~E		
FR27	VHT NDP Announcement	Clause 8	VHTM4.2:M TVHT4.2:M	Yes ☐ No ☐ N/A ☐
FR28	Beamforming Report Poll	Clause 8	VHTM4.2:O VHTM4.4:M TVHTM4.2:O TVHTM4.4:M	Yes ☐ No ☐ N/A ☐
FR29	Reception of Operating Mode Notification frame and Operating Mode Notification element	8.5.23.4, 8.4.2.168, 10.41	O CF29:M CF30:M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.12 table:

B.4.12 Spectrum management extensions

Item	IUT configuration	References	Status	Support
SM1	Country, Power Constraint, and transmit power control (TPC) Report elements included in Beacon and Probe Response frames	8.3.3.2, 8.3.3.10, 8.4.2.10, 8.4.2.14, 8.4.2.17	CF10: M	Yes ☐ No ☐ N/A ☐
SM1.1	VHT Transmit Envelope element(s) in Beacon and Probe Response frames	8.4.2.164	CF10 AND CF29:M CF10 AND CF30:M	Yes ☐ No ☐ N/A ☐
SM20	Channel switch procedure			
SM20.1	Transmission of channel switch announcement and channel switch procedure by an AP	10.9.8	(CF1 and CF10):M	Yes ☐ No ☐ N/A ☐
SM20.2	Transmission of channel switch announcement and channel switch procedure by a STA	10.9.8	(CF2.2 and CF10):M	Yes ☐ No ☐ N/A ☐
SM20.3	Reception of channel switch announcement and channel switch procedure by a STA	10.9.8	CF10:M	Yes ☐ No ☐ N/A ☐
SM20.4	Transmission of Wide Bandwidth Channel Switch element in Channel Announcement frame and transmission of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/Probe Response frames, and associated channel switching procedure by an AP	10.39.4	(CF1 and CF10 and CF29):M (CF1 and CF10 and CF30):M	Yes ☐ No ☐ N/A ☐
SM20.5	Transmission of Wide Bandwidth Channel Switch element in Channel Announcement frame and transmission of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/Probe Response frames, and associated channel switching procedure by a STA.	10.39.4	(CF2.2 and CF10 and CF29):M (CF2.2 and CF10 and CF30):M	Yes ☐ No ☐ N/A ☐

B.4.12 Spectrum management extensions *(continued)*

Item	IUT configuration	References	Status	Support
SM20.6	Reception of Wide Bandwidth Channel Switch element in Channel Announcement frame and reception of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated channel switching procedure by a STA.	10.39.4	(CF10 and CF29):M (CF10 and CF30):M	Yes ☐ No ☐ N/A ☐
SM20.7	Transmission of New VHT Transmit Power Envelope element in Channel Announcement frame and transmission of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated channel switching procedure by an AP.	10.39.4	(CF1 and CF10 and CF29):M (CF1 and CF10 and CF30):M	Yes ☐ No ☐ N/A ☐
SM20.8	Transmission of New VHT Transmit Power Envelope element in Channel Announcement frame and transmission of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated channel switching procedure by a STA.	10.39.4	(CF2.2 and CF10 and CF29):M (CF2.2 and CF10 and CF30):M	Yes ☐ No ☐ N/A ☐
SM20.9	Reception of New VHT Transmit Power Envelope element in Channel Announcement frame and reception of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated channel switching procedure by a STA.	10.39.4	(CF10 and CF29):M (CF10 and CF30):M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.14 table:

B.4.14 QoS base functionality

Item	Protocol capability	References	Status	Support
QB4	Block Acknowledgments (Block Acks)			
QB4.1	Immediate Block Ack	8.3.1.8.1, 8.3.1.8.2, 8.3.1.9.1, 8.3.1.9.2, 8.5.5, 9.21 (except 9.21.7 and 9.21.8), 10.5	CF12:O (CF16 OR CF25 OR CF30):M	Yes ☐ No ☐ N/A ☐
QB4.3	Compressed Block Ack			
QB4.3.1	Compressed Block Ack	8.3.1.8.3	CF12:O (CF16 OR CF25 OR CF30):M	Yes ☐ No ☐ N/A ☐
QB4.4	MultiTID Block Ack	8.3.1.8.4	CF12:O (CF16 OR CF30):M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.18 table:

B.4.18 DSE functions

Item	Protocol capability	References	Status	Support
DSE9	Extended channel switch procedure			
DES9.1	Transmission of extended channel switch announcement frame/element and extended channel switch procedure by an AP.	10.10.3	(CF15&CF1):M (CF1 and CF29):M (CF1 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.2	Transmission of extended channel switch announcement frame/element and extended channel switch procedure by a STA.	10.10.3	(CF15&CF2.2):M (CF2.2 and CF29):M (CF2.2 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.3	Reception of extended channel switch announcement frame/ element and extended channel switch procedure by a STA.	10.10.3	CF15:M CF29:M CF30:M	Yes ☐ No ☐ N/A ☐
DSE9.4	Transmission of Wide Bandwidth Channel Switch element in Extended Channel Announcement frame and transmission of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/Probe Response frames, and associated extended channel switching procedure by an AP.	10.39.4	(CF1 and CF29):M (CF1 and CF30):M	Yes ☐ No ☐ N/A ☐

B.4.18 DSE functions *(continued)*

Item	Protocol capability	References	Status	Support
DSE9.5	Transmission of Wide Bandwidth Channel Switch element in Extended Channel Announcement frame and transmission of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	(CF2.2 and CF29):M (CF2.2 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.6	Reception of Wide Bandwidth Channel Switch element in Extended Channel Announcement frame and reception of Wide Bandwidth Channel Switch subelement in Channel Switch Wrapper element in Beacon/Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	CF29:M CF30:M	Yes ☐ No ☐ N/A ☐
DSE9.7	Transmission of New VHT Transmit Power Envelope element in Extended Channel Announcement frame and transmission of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by an AP.	10.39.4	(CF1 and CF29):M (CF1 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.8	Transmission of New VHT Transmit Power Envelope element in Extended Channel Announcement frame and transmission of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	(CF2.2 and CF29):M (CF2.2 and CF30):M	Yes ☐ No ☐ N/A ☐

B.4.18 DSE functions *(continued)*

Item	Protocol capability	References	Status	Support
DSE9.9	Reception of New VHT Transmit Power Envelope element in Extended Channel Announcement frame and transmission of New VHT Transmit Power Envelope subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	CF29:M CF30:M	Yes ☐ No ☐ N/A ☐
DSE9.10	Transmission of New Country element in Extended Channel Announcement frame and transmission of New Country subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by an AP.	10.39.4	(CF1 and CF29):M (CF1 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.11	Transmission of New Country element in Extended Channel Announcement frame and transmission of New Country subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	(CF2.2 and CF29):M (CF2.2 and CF30):M	Yes ☐ No ☐ N/A ☐
DSE9.12	Reception of New Country element in Extended Channel Announcement frame and reception of New Country subelement in Channel Switch Wrapper element in Beacon/ Probe Response frames, and associated extended channel switching procedure by a STA.	10.39.4	CF29:M CF30:M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.19.1 table:

B.4.19.1 HT MAC features

Item	Protocol capability	References	Status	Support
HTM1	HTM capabilities signaling			
HTM1.1	HTM Capabilities element	8.4.2.55.1	CF16:M CF30:M	Yes ☐ No ☐ N/A ☐
HTM1.2	Signaling of STA capabilities in Probe Request, (Re)Association Request frames	8.4.2.58, 8.3.3.9, 8.3.3.5, 8.3.3.7	(CF16 and CF2):M (CF30 and CF2):M	Yes ☐ No ☐ N/A ☐
HTM1.3	Signaling of STA and BSS capabilities in Beacon, Probe Response, (Re)Association Response frames	8.4.2.58, 8.3.3.2, 8.3.3.10, 8.3.3.6, 8.3.3.8	(CF16 and CF1):M (CF30 and CF1):M	Yes ☐ No ☐ N/A ☐
HTM2	Signaling of HT operation	8.4.2.59	(CF16 and CF1):M (CF30 and CF1):M	Yes ☐ No ☐ N/A ☐
HTM5	Block Ack			
HTM5.1	Block Ack mechanism	8.3.1.8, 8.3.1.9, 8.4.1.14, 9.21, 10.11	CF16:M CF30:M	Yes ☐ No ☐ N/A ☐
HTM5.2	Use of compressed bitmap between HT STAs	8.3.1.9.3, 9.21.6	CF16:M CF30:M	Yes ☐ No ☐ N/A ☐
HTM5.3	HT-immediate Block Ack extensions	9.21.7	CF16:M CF30:M	Yes ☐ No ☐ N/A ☐
HTM5.4	HT-delayed Block Ack extensions	9.21.8	CF16 and QB4.2:M CF30 and QB4.2:M	Yes ☐ No ☐ N/A ☐
HTM9	Truncation of TXOP as TXOP holder	9.20.2.7	CF16:O CF30:O	Yes ☐ No ☐ N/A ☐
HTM10	Reception of +HTC frames	8.2.4.1.10, 8.4.2.58.5, 9.9	CF16:O CF30:O	Yes ☐ No ☐ N/A ☐

B.4.19.1 HT MAC features *(continued)*

Item	Protocol capability	References	Status	Support
*HTM11	Reverse direction (RD) aggregation exchanges	9.25	CF16:O CF30:O	Yes ☐ No ☐ N/A ☐
...				
HTM12	Link adaptation			
HTM12.1	Use of the HT Control field for link adaptation in immediate response exchange	8.2.4.6, 8.3.3.14, 9.28.2	CF16:O CF30:O	Yes ☐ No ☐ N/A ☐
HTM12.2	Link adaptation using explicit feedback mechanism	8.3.3.14, 9.29.3	CF16:O CF30:O	Yes ☐ No ☐ N/A ☐
HTM17	SM power save support			
*HTM17.1	AP support for dynamic and static SM power save mode	10.2.4	(CF16 and CF1):M (CF30 and CF1):M	Yes ☐ No ☐ N/A ☐
*HTM17.2	STA support for dynamic and static SM power save mode	10.2.4	(CF16 and CF2):O (CF30 and CF2):O	Yes ☐ No ☐ N/A ☐
...				
HTM17.4	Receive SM Power Save state information and support frame exchanges with SM Power Save STAs	10.2.4	CF16:M CF30:M	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.21 table:

B.4.21 WNM extensions

Item	Protocol capability	References	Status	Support
*WNM19	DMS	10.23.15	(CF19 & CF16):O (CF19 & CF30):O	Yes ☐ No ☐ N/A ☐
WNM22	WNM-Notification	10.23.16	(CF19 & CF16):O (CF19 & CF30):O	Yes ☐ No ☐ N/A ☐

Change the following rows of the B.4.25 table:

B.4.25 RobustAVT extensions

Item	Protocol capability	References	Status	Support
AVT2	Groupcast with Retries (GCR)	10.23.15.3.2, 10.23.15.3.3, 10.23.15.3.4, 10.23.15.3.5, 10.23.15.3.6	(CF16 and CF23 and WNM19):M (CF30 and CF23 and WNM19):M (CF1 and CF23 and WNM19 and HTM4.4):M	Yes ☐ No ☐ N/A ☐
AVT4.3	Drop eligibility indicator (DEI)	10.26.2	(CF16 and AVT4):M (CF30 and AVT4):M	Yes ☐ No ☐ N/A ☐
AVT6	GCR for Mesh	8.4.2.29, 9.21.10, 10.23.15.3.7, 10.23.15.3.6	(WNM19 and HTM4.4 and CF16 and CF23 and CF2a):O (WNM19 and HTM4.4 and CF30 and CF23 and CF2a):O	Yes ☐ No ☐ N/A ☐

Insert the following subclauses, B.4.28 to B.4.28.2, after B.4.27.2:

B.4.28 TVWS functions

Item	Protocol capability	References	Status	Support
WS1	Fixed STA TVWS operation	10.43, Annex D, E.2.5	CF30:O	Yes ☐ No ☐ N/A ☐
WS2	Master STA TVWS operation	10.43, 10.43.2, Annex D, E.2.5	CF30:O	Yes ☐ No ☐ N/A ☐
*WS3	Client STA TVWS operation	10.43.3, Annex D, E.2.5	CF30:O	Yes ☐ No ☐ N/A ☐
WS3.1	GDD dependent STA TVWS behavior	10.43.3, Annex D, E.2.5	WS3:M	Yes ☐ No ☐ N/A ☐
WS4	Channel Availability Query	8.4.5.2, 8.5.8.27, 10.43.4	CF30:M	Yes ☐ No ☐ N/A ☐
WS5	Channel Schedule Management	8.4.1.53, 8.4.5.3, 8.5.8.28, 10.43.5	CF30:M	Yes ☐ No ☐ N/A ☐
WS6	Contact Verification Signal	8.5.8.29, 10.43.6	CF30:M	Yes ☐ No ☐ N/A ☐
*WS7	Network Channel Control	6.3.99, 8.4.5.4, 8.5.8.32, 10.43.7	CF30:M	
WS7.1	NCC Requesting STA	10.43.7.2	CF30:M	Yes ☐ No ☐ N/A ☐
WS7.2	NCC Responding STA	10.43.7.3	CF30:O	Yes ☐ No ☐ N/A ☐
WS8	White Space Map Announcement	8.4.2.170, 8.5.8.33, 10.43.9	CF30:M	Yes ☐ No ☐ N/A ☐

B.4.28.1 TVHT MAC features

Item	Protocol capability	References	Status	Support
	Are the following MAC protocol features supported?			
TVHTM1	TVHT Capabilities element			
TVHTM1.1	VHT Capabilities element	8.4.2.160.1	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM1.2	Signaling of STA capabilities in Probe Request, (Re)Association Request frames	8.4.2.160.1, 8.3.3.9, 8.3.3.5, 8.3.3.7	(CF30 AND CF2):O (CF30 AND CF21):O	Yes ☐ No ☐ N/A ☐
TVHTM1.3	Signaling of STA and BSS capabilities in Beacon, Probe Response, (Re)Association Response frames	8.4.2.160, 8.3.3.2, 8.3.3.10, 8.3.3.6, 8.3.3.8	(CF30 AND CF1):O (CF30 AND CF21):O	Yes ☐ No ☐ N/A ☐
TVHTM2	Signaling of VHT operation	8.4.2.161	(CF30 AND CF1):O (CF30 AND CF21):O (CF30 AND CF2.2):O	Yes ☐ No ☐ N/A ☐
TVHTM3	Link adaptation			
TVHTM3.1	Use of the VHT variant HT Control field for link adaptation in immediate response exchange	8.2.4.6, 8.3.3.14, 9.28.3	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM4	Transmit beamforming			
*TVHTM4.1	SU Beamformer Capable	8.4.2.160	CF30:O	Yes ☐ No ☐ N/A ☐
*TVHTM4.2	SU Beamformee Capable	8.4.2.160	CF30:O	Yes ☐ No ☐ N/A ☐
*TVHTM4.3	MU Beamformer Capable	8.4.2.160	CF1 AND TVHTM4.1:O	Yes ☐ No ☐ N/A ☐
*TVHTM4.4	MU Beamformee Capable	8.4.2.160	CF2 AND TVHTM4.2:O	Yes ☐ No ☐ N/A ☐
TVHTM4.5	Transmission of null data packet	9.31	TVHTM4.1:M	Yes ☐ No ☐ N/A ☐
TVHTM4.6	Reception of null data packet	9.31	TVHTM4.2:M	Yes ☐ No ☐ N/A ☐
TVHTM5	VHT sounding protocol			
TVHTM5.1	VHT sounding protocol as SU beamformer	9.31.5	TVHTM4.1:M	Yes ☐ No ☐ N/A ☐
TVHTM5.2	VHT sounding protocol as SU beamformee	9.31.5	TVHTM4.2:M	Yes ☐ No ☐ N/A ☐
TVHTM5.3	VHT sounding protocol as MU beamformer	9.31.5	TVHTM4.3:M	Yes ☐ No ☐ N/A ☐
TVHTM5.4	VHT sounding protocol as MU beamformee	9.31.5	TVHTM4.4:M	Yes ☐ No ☐ N/A ☐
TVHTM6	TXOP Sharing			
TVHTM6.1	Sharing of EDCA TXOP	9.19.2.3a	CF30:O	Yes ☐ No ☐ N/A ☐

B.4.28.1 TVHT MAC features *(continued)*

Item	Protocol capability	References	Status	Support
TVHTM6.2	Use of Primary and Secondary AC	9.19.2.3a	TVHTM6.1: M	Yes ☐ No ☐ N/A ☐
TVHTM7	TXOP Power Saving	10.2.1.4a	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM8	BSS Operation			
TVHTM8.1	Use of primary TVHT_W, secondary TVHT_W, and secondary TVHT_2W channels	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM8.2	CCA on primary TVHT_W, secondary TVHT_W, and secondary TVHT_2W channels	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM9	Group ID			
TVHTM9.1	Transmission of Group ID Management frame	8.5.23.3	TVHTM4.3:M	Yes ☐ No ☐ N/A ☐
TVHTM9.2	Reception of Group ID Management frame	8.5.23.3	TVHTM4.4:M	Yes ☐ No ☐ N/A ☐
TVHTM10	Bandwidth signaling			
TVHTM10.1	Support for non-HT bandwidth signaling and static operation	9.3.2.5a	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTM10.2	Support for non-HT bandwidth signaling and dynamic operation	9.3.2.5a	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM11	VHT single MPDU format	9.12.7	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTM12	Partial AID in VHT PPDU	9.17a	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTM13	Extended BSS Load element	8.4.2.162	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM13.1	Transmission of the Extended BSS Load element	8.4.2.162	CF1 AND CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM14	Quiet Channel element			
TVHTM14.1	Transmission of Quiet Channel element by an AP or mesh STA in Beacon and Probe Response frames	8.3.3.2, 8.3.3.10, 8.4.2.167, 10.9.3	(CF1 OR CF21) AND CF10 AND CF30 AND TVHTP3.4:O	Yes ☐ No ☐ N/A ☐
TVHTM14.2	Transmission of Quiet Channel element by an independent STA or mesh STA in Beacon and Probe Response frames	8.3.3.2, 8.3.3.10, 8.4.2.167, 10.9.3	(CF2 OR CF21) AND CF10 AND CF30 AND TVHTP3.4:O	Yes ☐ No ☐ N/A ☐
TVHTM14.3	Reception of Quiet Channel element by an independent STA or mesh STA in Beacon and Probe Response frames	8.3.3.2, 8.3.3.10, 8.4.2.167, 10.9.3	(CF2 OR CF21) AND CF10 AND CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM15	Space-time block coding (STBC)			
TVHTM15.1	STBC operation	8.4.2.160, 9.15	TVHTP9:M	Yes ☐ No ☐ N/A ☐
TVHTM15.2	Transmission of at least 2x1 STBC	8.4.2.160.2	TVHTP9:O.1	Yes ☐ No ☐ N/A ☐

B.4.28.1 TVHT MAC features *(continued)*

Item	Protocol capability	References	Status	Support
TVHTM15.3	Reception of 1 STBC spatial stream	8.4.2.160.2	TVHTP9:O.1	Yes ☐ No ☐ N/A ☐
TVHTM15.4	Reception of 2 STBC spatial stream	8.4.2.160.2	TVHTM15.3:O	Yes ☐ No ☐ N/A ☐
TVHTM15.5	Reception of 3 STBC spatial stream	8.4.2.160.2	TVHTM15.4:O	Yes ☐ No ☐ N/A ☐
TVHTM15.6	Reception of 4 STBC spatial stream	8.4.2.160.2	TVHTM15.5:O	Yes ☐ No ☐ N/A ☐
TVHTM16	Highest Supported Long GI Data Rate			
TVHTM16.1	Tx Highest Supported Long GI Data Rate	8.4.2.160.3	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTM16.2	Rx Highest Supported Long GI Data Rate	8.4.2.160.3	CF30:O	Yes ☐ No ☐ N/A ☐
NOTE—Required support for MCS might be limited by the declaration of Tx and Rx Highest Supported Long GI Data Rates.				

B.4.28.2 TVHT PHY features

Item	Protocol capability	References	Status	Support
	Are the following PHY protocol features supported?			
TVHTP1	PHY operating modes			Yes ☐ No ☐ N/A ☐
TVHTP2	VHT format	22.3.2	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP3	BSS bandwidth			
TVHTP3.1	TVHT_W operation	10.42	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP3.2	TVHT_2W operation	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP3.3	TVHT_W+W operation	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP3.4	TVHT_4W operation	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP3.5	TVHT_2W+2W operation	10.42	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP4	Bandwidth indication	18.3.5.5	CF29:M	Yes ☐ No ☐ N/A ☐
TVHTP5	PHY timing parameters			
TVHTP5.1	Values in 6 MHz channel	23.3.6	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP5.2	Values in 7 MHz channel	23.3.6	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP5.3	Values in 8 MHz channel	23.3.6	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP5.4	Values in non-HT 6 MHz, 7 MHz, and 8 MHz channels	23.2.4	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP6	TVHT preamble	23.3.8	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP7	Use of LDPC Code	22.3.10.5.4	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP8	Modulation and coding schemes (MCS)			

B.4.28.2 TVHT PHY features *(continued)*

Item	Protocol capability	References	Status	Support
TVHTP8.1	TVHT_MODE_1	23.5		
TVHTP8.1.1	TVHT-MCS with Index 0-7 and N_{SS} = 1	23.5	CF30:M	Yes ☐ No ☐ N/A ☐
TVHTP8.1.2	TVHT-MCS with Index 0-8 and N_{SS} = 1	23.5	TVHTP8.1.1:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.3	TVHT-MCS with Index 0-9 and N_{SS} = 1	23.5	TVHTP8.1.2:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.4	TVHT-MCS with Index 0-7 and N_{SS} = 2	23.5	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.5	TVHT-MCS with Index 0-8 and N_{SS} = 2	23.5	TVHTP8.1.4:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.6	TVHT-MCS with Index 0-9 and N_{SS} = 2	23.5	TVHTP8.1.5:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.7	TVHT-MCS with Index 0-7 and N_{SS} = 3	23.5	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.8	TVHT-MCS with Index 0-8 and N_{SS} = 3	23.5	TVHTP8.1.7:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.9	TVHT-MCS with Index 0-9 and N_{SS} = 3	23.5	TVHTP8.1.7:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.10	TVHT-MCS with Index 0-7 and N_{SS} = 4	23.5	CF30:O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.11	TVHT-MCS with Index 0-8 and N_{SS} = 4	23.5	TVHTP8.1.10: O	Yes ☐ No ☐ N/A ☐
TVHTP8.1.12	TVHT-MCS with Index 0-9 and N_{SS} = 4	23.5	TVHTP8.1.11: O	Yes ☐ No ☐ N/A ☐
TVHTP8.2	TVHT_MODE_2C and TVHT_MODE_2N	23.5		
TVHTP8.2.1	TVHT-MCS with Index 0-7 and N_{SS} = 1	23.5	(TVHTP3.2 AND TVHTP3.3):M	Yes ☐ No ☐ N/A ☐
TVHTP8.2.2	TVHT-MCS with Index 0-8 and N_{SS} = 1	23.5	TVHTP8.2.1:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.3	TVHT-MCS with Index 0-9 and N_{SS} = 1	23.5	TVHTP8.2.2:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.4	TVHT-MCS with Index 0-7 and N_{SS} = 2	23.5	(TVHTP3.2 AND TVHTP3.3):O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.5	TVHT-MCS with Index 0-8 and N_{SS} = 2	23.5	TVHTP8.2.4:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.6	TVHT-MCS with Index 0-9 and N_{SS} = 2	23.5	TVHTP8.2.5:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.7	TVHT-MCS with Index 0-7 and N_{SS} = 3	23.5	(TVHTP3.2 AND TVHTP3.3):O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.8	TVHT-MCS with Index 0-8 and N_{SS} = 3	23.5	TVHTP8.2.7:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.9	TVHT-MCS with Index 0-9 and N_{SS} = 3	23.5	TVHTP8.2.8:O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.10	TVHT-MCS with Index 0-7 and N_{SS} = 4	23.5	(TVHTP3.2 AND TVHTP3.3):O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.11	TVHT-MCS with Index 0-8 and N_{SS} = 4	23.5	TVHTP8.2.10: O	Yes ☐ No ☐ N/A ☐
TVHTP8.2.12	TVHT-MCS with Index 0-9 and N_{SS} = 4	23.5	TVHTP8.2.11: O	Yes ☐ No ☐ N/A ☐

B.4.28.2 TVHT PHY features *(continued)*

Item	Protocol capability	References	Status	Support
TVHTP8.3	TVHT_MODE_4C and TVHT_MODE_4N	23.5		
TVHTP8.3.1	TVHT-MCS with Index 0-7 and $N_{SS} = 1$	23.5	(TVHTP3.4 AND TVHTP3.5):M	Yes ☐ No ☐ N/A ☐
TVHTP8.3.2	TVHT-MCS with Index 0-8 and $N_{SS} = 1$	23.5	TVHTP8.3.1:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.3	TVHT-MCS with Index 0-9 and $N_{SS} = 1$	23.5	TVHTP8.3.2:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.4	TVHT-MCS with Index 0-7 and $N_{SS} = 2$	23.5	(TVHTP3.4 AND TVHTP3.5):O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.5	TVHT-MCS with Index 0-8 and $N_{SS} = 2$	23.5	TVHTP8.3.4:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.6	TVHT-MCS with Index 0-9 and $N_{SS} = 2$	23.5	TVHTP8.3.5:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.7	TVHT-MCS with Index 0-7 and $N_{SS} = 3$	23.5	(TVHTP3.4 AND TVHTP3.5):O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.8	TVHT-MCS with Index 0-8 and $N_{SS} = 3$	23.5	TVHTP8.3.7:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.9	TVHT-MCS with Index 0-9 and $N_{SS} = 3$	23.5	TVHTP8.3.8:O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.10	TVHT-MCS with Index 0-7 and $N_{SS} = 4$	23.5	(TVHTP3.4 AND TVHTP3.5):O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.11	TVHT-MCS with Index 0-8 and $N_{SS} = 4$	23.5	TVHTP8.3.10: O	Yes ☐ No ☐ N/A ☐
TVHTP8.3.12	TVHT-MCS with Index 0-9 and $N_{SS} = 4$	23.5	TVHTP8.3.11: O	Yes ☐ No ☐ N/A ☐
TVHTP9	Space-time block coding (STBC)	23.3.10.9.4	CF30:O	Yes ☐ No ☐ N/A ☐

Annex C

(normative)

ASN.1 encoding of the MAC and PHY MIB

C.3 MIB Detail

Insert the following entries at the end of the "dot11smt OBJECT IDENTIFIER ::= { ieee802dot11 1 }" of "Major Sections" in Annex C as follows:

```
   -- dot11TVHTStationConfigTable                    ::= { dot11smt 32 }
   -- dot11STALCITable                               ::= { dot11smt 33 }
```

Change the end of the dot11StationConfigEntry sequence list, as shown:

```
Dot11StationConfigEntry ::= SEQUENCE
    {
        ...
        dot11RobustAVStreamingImplemented          TruthValue,
        dot11VHTOptionImplemented                  TruthValue,
        dot11OperatingModeNotificationImplemented  TruthValue,
        dot11TVHTOptionImplemented                 TruthValue,
        dot11ChannelScheduleManagementActivated    TruthValue,
        dot11ContactVerificationSignalActivated    TruthValue,
        dot11ContactVerificationSignalInterval     Unsigned32,
        dot11NetworkChannelControlActivated        TruthValue,
        dot11RLSSActivated                         TruthValue,
        dot11WhiteSpaceMapActivated                TruthValue,
        dot11WSSTAType                             INTEGER,
        dot11GeolocationCapabilityActivated        TruthValue,
        dot11GDDActivated                          TruthValue,
        dot11GDDEnablementTimeLimit                Unsigned32,
        dot11GDDEnablementFailHoldTime             Unsigned32,
        dot11GDDEnablementValidityTimer            Unsigned32
    }
```

Insert the following new elements at the end of the dot11StationConfigTable element definitions:

```
dot11TVHTOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.
        This attribute indicates whether the entity is
        TVHT Capable."
    ::= { dot11StationConfigEntry 143}

dot11ChannelScheduleManagementActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized for
```



```
        operation in a band defined by an Operating Class.

        This attribute, when true, indicates that the STA
        implementation is capable of supporting Channel
        Schedule Management Announcement. The capability is
        disabled, otherwise."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 145 }

dot11ContactVerificationSignalActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect for the next MLME-START.request
        primitive.

        This attribute, when true, indicates that the system
        capability for contact verification signal is activated.
        false indicates that the STA has contact verification
        signal capability, but it is disabled."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 146 }

dot11ContactVerificationSignalInterval OBJECT-TYPE
    SYNTAX Unsigned32(1..255)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.

        dot11ContactVerificationSignalInterval indicates the maximum
        number of seconds that a GDD dependent STA may receive the
        Contact Verification Signal frame.
        Unless another value is mandated by regulatory authorities,
        the value is 60 seconds."
    DEFVAL { 60 }
    ::= { dot11StationConfigEntry 147 }

dot11NetworkChannelControlActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized for
        operation in a band defined by an Operating Class.

        This attribute, when true, indicates that the STA
        implementation is capable of supporting network channel
        control. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 148 }

dot11RLSSActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by the SME or an external management entity.
```

```
        Changes take effect as soon as possible in the device.

        This attribute, when true, indicates that the RLQP
        capability is activated. The capability is disabled,
        otherwise."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 149 }

dot11WhiteSpaceMapActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect for the next MLME-START.request
        primitive or MLME-JOIN.request primitive.

        This attribute, when true, indicates that the STA
        capability for white space map is activated. false indicates
        the STA has no white space map capability or
        that the capability is present but is disabled."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 150 }

dot11WSSTAType OBJECT-TYPE
    SYNTAX INTEGER {gddap(1), gddnonapsta(2),
        gddfixedsta(3), reserved(4) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized for
        operation in a band that requires Geolocation Database
        Control.

        This attribute specifies the type of STA mode for the
        purpose of channel availability query requirements. This
        value is used to set the desired channel availability query
        request parameters in using GAS frames carrying Channel
        Availability Query element of RLQP. When set to gddap, the
        STA indicates that it operates as a personal/portable AP
        STA after channel availability query.
        When set to gddnonapsta, the STA indicates that it
        operates as a personal/portable non-AP STA after channel
        availability query. When set to gddfixedsta, the STA
        indicates that it operates as a fixed STA after channel
        availability query. When set to any other
        values, its use is reserved, and remains unspecified."
    ::= { dot11StationConfigEntry 151}

dot11GeolocationCapabilityActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME.
        Changes take effect as soon as practical in the
        implementation.

        This attribute, when true, indicates that the has obtained
        its device location information in geospatial coordinates
        for its position using its geolocation capability, as
```



```
        required for its device class, otherwise this is set
        to false."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 152 }

dot11GDDActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized for
        operation in a band that requires Geolocation Database
        Dependent behavior.

        This attribute, when true, indicates that the STA
        capability for operation with Geolocation Database Dependent
        behavior is activated. The capability is disabled,
        otherwise."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 153 }

dot11GDDEnablementTimeLimit OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized.
        Changes take effect as soon as practical in the
        implementation.

        dot11GDDEnablementTimeLimit indicates the maximum number of
        seconds that a GDD dependent STA may transmit in a frequency
        band under the control of a geolocation database while
        attaining GDD enablement with a GDD enabling STA. Unless
        another value is mandated by regulatory authorities, the
        value is 32 seconds."
    DEFVAL { 32 }
    ::= { dot11StationConfigEntry 155 }

dot11GDDEnablementFailHoldTime OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized.
        Changes take effect as soon as practical in the
        implementation.

        dot11GDDEnablementFailHoldTime indicates the number of
        seconds that a GDD dependent STA shall not transmit in a
        frequency band under control of a geolocation database when
        it fails to attain GDD enablement with an GDD enabling STA
        within dot11GDDEnablementTimeLimit seconds. Unless another
        value is mandated by regulatory authorities, the value is
        512 seconds."
    DEFVAL { 512 }
    ::= { dot11StationConfigEntry 156 }

dot11GDDEnablementValidityTimer OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
```

```
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when the device is initialized.
        Changes take effect as soon as practical in the
        implementation.

        dot11GDDEnablementValidityTimer indicates the number of
        seconds that a GDD dependent STA remains in GDDEnabled
        state. Unless another value is mandated by regulatory
        authorities, the value is 60 seconds."
    DEFVAL { 60 }
    ::= { dot11StationConfigEntry 157 }
```

After the end of the dot11VHTStationConfigTABLE, insert the following:

```
-- ************************************************************************
-- * dot11TVHTStationConfig TABLE
-- ************************************************************************
dot11TVHTStationConfigTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11TVHTStationConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Station Configuration attributes. In tabular form to allow
        for multiple instances on an agent."
    ::= { dot11smt 32 }

dot11TVHTStationConfigEntry OBJECT-TYPE
    SYNTAX Dot11TVHTStationConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry (conceptual row) in the
        dot11HTStationConfig Table. ifIndex - Each IEEE 802.11
        interface is represented by an ifEntry. Interface tables in
        this MIB module are indexed by ifIndex."
    INDEX { ifIndex }
    ::= { dot11TVHTStationConfigTable 1 }

Dot11TVHTStationConfigEntry ::=
    SEQUENCE {
        dot11TVHTMaxMPDULength                  INTEGER,
        dot11TVHTMaxRxAMPDUFactor               Unsigned32,
        dot11TVHTControlFieldOptionImplemented  TruthValue,
        dot11TVHTTXOPPowerSaveOptionImplemented TruthValue,
        dot11TVHTRxVHTMCSMap                    OCTET STRING,
        dot11TVHTRxHighestDataRateSupported     Unsigned32,
        dot11TVHTTxVHTMCSMap                    OCTET STRING,
        dot11TVHTTxHighestDataRateSupported     Unsigned32,
        dot11TVHTOBSSScanCount                  Unsigned32
    }

dot11TVHTMaxMPDULength OBJECT-TYPE
    SYNTAX INTEGER { short(3895), medium(7991), long(11454) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.
        This attribute indicates the supported maximum MPDU size."
    DEFVAL { short }
    ::= { dot11TVHTStationConfigEntry 1 }
```



```
dot11TVHTMaxRxAMPDUFactor OBJECT-TYPE
   SYNTAX Unsigned32 (0..7)
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.
      This attribute indicates the maximum length of A-MPDU that
      the STA can receive. The Maximum Rx A-MPDU defined by this
      field is equal to 2^(13+dot11TVHTMaxRxAMPDUFactor)
      -1 octets."
   DEFVAL { 0 }
   ::= { dot11TVHTStationConfigEntry 2 }

dot11TVHTControlFieldOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.
      This attribute, when true, indicates that the STA
      implementation is capable of receiving the VHT variant
      HT Control field."
   DEFVAL { false }
   ::= { dot11TVHTStationConfigEntry 3 }

dot11TVHTTXOPPowerSaveOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.
      This attribute, when true, indicates that the STA
      implementation is capable of TXOP Power Save operation."
   DEFVAL { false }
   ::= { dot11TVHTStationConfigEntry 4 }

dot11TVHTRxVHTMCSMap OBJECT-TYPE
   SYNTAX OCTET STRING (SIZE(8))
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.
      Each octet represents the highest VHT-MCS supported (for Rx)
      on the number of streams represented by the octet position
      (first octet represents 1stream, second octet represents 2
      streams, etc.). A value 0 indicates that VHT-MCSs 0-7 are
      supported. A value 1 indicates that VHT-MCSs 0-8 are
      supported.
      A value 2 indicates that VHT-MCSs 0-9 are supported. A value
      3 indicates no support for that number of spatial streams."
   ::= { dot11TVHTStationConfigEntry 5 }

dot11TVHTRxHighestDataRateSupported OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.
```

```
        Represents the highest data rate in Mb/s that the STA is
        capable of receiving."
    ::= { dot11TVHTStationConfigEntry 6 }

dot11TVHTTxVHTMCSMap OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(8))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.
        Each octet represents the highest VHT-MCS supported (for Tx)
        on the number of streams represented by the octet position
        (first octet represents 1 stream, second octet represents 2
        streams, etc.).
        A value 0 indicates that VHT-MCSs 0-7 are supported. A value
        1 indicates that VHT-MCSs 0-8 are supported.
        A value 2 indicates that VHT-MCSs 0-9 are supported. A value
        3 indicates no support for that number of spatial streams."
    ::= { dot11TVHTStationConfigEntry 7 }

dot11TVHTTxHighestDataRateSupported OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.
        Represents the highest data rate in Mb/s that the STA is
        capable of transmitting."
    DEFVAL { 0 }
    ::= { dot11TVHTStationConfigEntry 8 }

dot11TVHTOBSSScanCount OBJECT-TYPE
    SYNTAX Unsigned32 (3..100)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.
        This attribute indicates the minimum number of scan
        operations performed on a channel to detect another OBSS."
    DEFVAL { 3 }
    ::= { dot11TVHTStationConfigEntry 9 }

-- ************************************************************
-- * End of dot11TVHTStationConfigTable TABLE
-- ************************************************************
```

In the dot11LCIDSE Table, in dot11LCIDSEEntries 4 to 14, delete the following sentence:

~~This field is derived from IETF RFC 3825.~~

Also in dot11LCIDSEEntry 14, change the following sentence:

IETF RFC 6225~~3825~~ defines the values of Datum.

In the dot11LCIReport Table, in dot11LCIReportEntries 5 to 14, delete the following sentence:

~~This field is derived from IETF RFC 3825.~~

In the dot11APLCI Table, in dot11APLCIEntries 2 to 12, delete the following sentence:

~~This field is derived from IETF RFC 3825.~~

Also in dot11APLCIEntry 12, change the following sentence:

IETF RFC 6225~~3825~~ defines the values of Datum.

Change dot11BeaconRprtPhyType as follows:

```
dot11BeaconRprtPhyType OBJECT-TYPE
    SYNTAX INTEGER {
        fhss(1),
        dsss(2),
        irbaseband(3),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7),
        dmg(8),
        vht(9),
        tvht(10) }
    UNITS "dot11PHYType"
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when a measurement report is completed.

        This attribute indicates the PHY used for frame reception in this row of
        the frame report."
    ::= { dot11BeaconReportEntry 9 }
```

Change dot11FrameRprtPhyType as follows:

```
dot11FrameRprtPhyType OBJECT-TYPE
    SYNTAX INTEGER {
        fhss(1),
        dsss(2),
        irbaseband(3),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7),
        dmg(8),
        vht(9),
        tvht(10) }
    UNITS "dot11PHYType"
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when a measurement report is completed.

        This attribute indicates the PHY used for frame reception in this row of
        the frame report."
```

```
    ::= { dot11FrameReportEntry 10 }
```

Change dot11RMNeighborReportPhyType as follows:

```
dot11RMNeighborReportPhyType OBJECT-TYPE
    SYNTAX INTEGER {
        fhss(1),
        dsss(2),
        irbaseband(3),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7),
        dmg(8),
        vht(9),
        tvht(10) }
    UNITS "dot11PHYType"
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when a measurement report is completed.

        This attribute indicates the PHY Type of the neighbor AP identified by
        this BSSID."
    ::= { dot11RMNeighborReportEntry 15 }
```

Change the dot11PHYType object as follows:

```
dot11PHYType OBJECT-TYPE
    SYNTAX INTEGER {
        fhss(1),
        dsss(2),
        irbaseband(3),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7),
        dmg(8),
        vht(9),
        tvht(10) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the PHY.

        This is an 8-bit integer value that identifies the PHY type supported by
        the attached PLCP and PMD. Currently defined values and their
        corresponding PHY types are:

        FHSS 2.4 GHz = 01, DSSS 2.4 GHz = 02, IR Baseband = 03,
        OFDM = 04, HRDSSS = 05, ERP = 06, HT = 07, DMG = 08, VHT = 09, TVHT = 10"
    ::= { dot11PhyOperationEntry 1 }
```

Insert the dot11 Phy TVHT TABLE and dot11 TVHT Transmit Beamforming table below after the dot11VHT Transmit Beamforming TABLE:

```
-- ********************************************************************
-- * dot11 Phy TVHT TABLE
-- ********************************************************************
```



```
dot11PhyTVHTTable OBJECT-TYPE
   SYNTAX SEQUENCE OF Dot11PhyTVHTEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "Entry of attributes for dot11PhyTVHTTable. Implemented as a table indexed
      on ifIndex to allow for multiple instances on an Agent."
   ::= { dot11phy 25 }

dot11PhyTVHTEntry OBJECT-TYPE
   SYNTAX Dot11PhyVHTEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "An entry in the dot11PhyTVHTEntry Table. ifIndex - Each IEEE 802.11
      interface is represented by an ifEntry. Interface tables in this MIB
      module are indexed by ifIndex."
   INDEX {ifIndex}
   ::= { dot11PhyTVHTTable 1 }

Dot11PhyTVHTEntry ::=
   SEQUENCE {
      dot11TVHTChannelWidthOptionImplemented         INTEGER,
      dot11CurrentChannelWidth                       INTEGER,
      dot11CurrentChannelCenterFrequencyIndex0       Unsigned32,
      dot11CurrentChannelCenterFrequencyIndex1       Unsigned32,
      dot11TVHTShortGIOptionIn4WImplemented          TruthValue,
      dot11TVHTShortGIOptionIn4WActivated            TruthValue,
      dot11TVHTLDPCCodingOptionImplemented           TruthValue,
      dot11TVHTLDPCCodingOptionActivated             TruthValue,
      dot11TVHTTxSTBCOptionImplemented               TruthValue,
      dot11TVHTTxSTBCOptionActivated                 TruthValue,
      dot11TVHTRxSTBCOptionImplemented               TruthValue,
      dot11TVHTRxSTBCOptionActivated                 TruthValue,
      dot11TVHTMUMaxUsersImplemented                 Unsigned32,
      dot11TVHTMUMaxNSTSPerUserImplemented           Unsigned32,
      dot11TVHTMUMaxNSTSTotalImplemented             Unsigned32,
      dot11TVHTMaxNTxChainsImplemented               Unsigned32,
      dot11TVHTMaxNTxChainsActivated                 Unsigned32
   }

dot11TVHTChannelWidthOptionImplemented OBJECT-TYPE
   SYNTAX INTEGER { tvht_mode_1(0), tvht_mode_2c(1), tvht_mode_2n(2),
      tvht_mode_4c(3), tvht_mode_4n(4) }
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute indicates the channel widths supported: W MHz, 2W MHz, W+W
      MHz, 4W MHz or 2W+2W MHz."
   DEFVAL { tvht_mode_1 }
   ::= { dot11PhyTVHTEntry 1 }

dot11CurrentChannelWidth OBJECT-TYPE
   SYNTAX INTEGER { tvht_w(0), tvht_2w(1), tvht_wpw(2), tvht_4w(3),
      tvht_2wp2w(4) }
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a status variable.
```

```
        This attribute indicates the operating channel width."
    DEFVAL { tvht_w }
    ::= { dot11PhyTVHTEntry 2 }

dot11CurrentChannelCenterFrequencyIndex0 OBJECT-TYPE
    SYNTAX Unsigned32 (0..200)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.

        For a W MHz, 2W MHz or 4W MHz channel, denotes the channel center
        frequency.
        For an W+W or 2W+2W MHz channel, denotes the center frequency of frequency
        segment 0. See 23.3.14."
    DEFVAL { 0 }
    ::= { dot11PhyTVHTEntry 3 }

dot11CurrentChannelCenterFrequencyIndex1 OBJECT-TYPE
    SYNTAX Unsigned32 (0..200)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.

        For an W+W or 2W+2W MHz channel, denotes the center frequency of frequency
        segment 1.
        Set to 0 for a W MHz, 2W MHz or 4W MHz channel. See 23.3.14."
    DEFVAL { 0 }
    ::= { dot11PhyTVHTEntry 4 }

dot11TVHTShortGIOptionIn4WImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the device is capable of
        receiving 4W MHz short guard interval packets."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 5 }

dot11TVHTShortGIOptionIn4WActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS,
        respectively.

        This attribute, when true, indicates that the reception of 4W MHz short
        guard interval packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 6 }

dot11TVHTLDPCCodingOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
```



```
    STATUS current
    DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       This attribute, when true, indicates that the LDPC coding option for TVHT
       packets is implemented."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 7 }

dot11TVHTLDPCCodingOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect as soon as practical in the implementation. Changes
       made while associated with an AP or while operating a BSS should take
       effect only after disassociation or the deactivation of the BSS,
       respectively.

       This attribute, when true, indicates that the LDPC coding option for TVHT
       packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 8 }

dot11TVHTTxSTBCOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       This attribute, when true, indicates that the device is capable of
       transmitting TVHT PPDUs using STBC."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 9 }

dot11TVHTTxSTBCOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect as soon as practical in the implementation. Changes
       made while associated with an AP or while operating a BSS should take
       effect only after disassociation or the deactivation of the BSS,
       respectively.

       This attribute, when true, indicates that the entity's capability for
       transmitting TVHT PPDUs using STBC is enabled."
    DEFVAL { false }
    ::= { dot11PhyTVHTEntry 10 }

dot11TVHTRxSTBCOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.
```

```
       This attribute, when true, indicates that the device is capable of
       receiving TVHT PPDUs using STBC."
   DEFVAL { false }
   ::= { dot11PhyTVHTEntry 11 }

dot11TVHTRxSTBCOptionActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect as soon as practical in the implementation. Changes
       made while associated with an AP or while operating a BSS should take
       effect only after disassociation or the deactivation of the BSS,
       respectively.

       This attribute, when true, indicates that the entity's capability for
       receiving TVHT PPDUs using STBC is enabled."
   DEFVAL { false }
   ::= { dot11PhyTVHTEntry 12 }

dot11TVHTMUMaxUsersImplemented OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       This attribute indicates the maximum number of users to which this device
       is capable of transmitting within a TVHT MU PPDU."
   DEFVAL { 1 }
   ::= { dot11PhyTVHTEntry 13 }

dot11TVHTMUMaxNSTSPerUserImplemented OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       This attribute indicates the maximum number of space-time streams per user
       that this device is capable of transmitting within a TVHT MU PPDU."
   DEFVAL { 1 }
   ::= { dot11PhyTVHTEntry 14 }

dot11TVHTMUMaxNSTSTotalImplemented OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       This attribute indicates the maximum number of space-time streams for all
       users that this device is capable of transmitting within a TVHT MU PPDU."
   DEFVAL { 1 }
   ::= { dot11PhyTVHTEntry 15 }

dot11TVHTMaxNTxChainsImplemented OBJECT-TYPE
   SYNTAX Unsigned32
```



```
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of transmit chains within this
        device."
    DEFVAL { 1 }
    ::= { dot11PhyTVHTEntry 16 }

dot11TVHTMaxNTxChainsActivated OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation.

        This attribute indicates the maximum number of transmit chains that are
        activated within this device, unless this attribute exceeds
        dot11TVHTMaxNTxChainsImplemented, in which case the maximum number of
        transmit chains that are activated within this device is equal to
        dot11TVHTMaxNTxChainsImplemented."
    DEFVAL { 2147483647 }
::= { dot11PhyTVHTEntry 17 }

-- ****************************************************************
-- * End of dot11PhyTVHT TABLE
-- ****************************************************************

-- ****************************************************************
-- * dot11 TVHT Transmit Beamforming Config TABLE
-- ****************************************************************

dot11TVHTTransmitBeamformingConfigTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11TVHTTransmitBeamformingConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Entry of attributes for dot11TVHTTransmitBeamformingConfigTable.
        Implemented as a table indexed on ifIndex to allow for multiple instances
        on an Agent."
    ::= { dot11phy 26 }

dot11TVHTTransmitBeamformingConfigEntry OBJECT-TYPE
    SYNTAX Dot11TVHTTransmitBeamformingConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An entry in the dot11TVHTTransmitBeamformingConfig Table.
        ifIndex - Each IEEE 802.11 interface is represented by an ifEntry.
        Interface tables in this MIB module are indexed by ifIndex."
    INDEX {ifIndex}
    ::= { dot11TVHTTransmitBeamformingConfigTable 1 }

Dot11TVHTTransmitBeamformingConfigEntry ::=
    SEQUENCE {
        dot11TVHTSUBeamformeeOptionImplemented  TruthValue,
        dot11TVHTSUBeamformerOptionImplemented  TruthValue,
        dot11TVHTMUBeamformeeOptionImplemented  TruthValue,
        dot11TVHTMUBeamformerOptionImplemented  TruthValue,
        dot11TVHTNumberSoundingDimensions       Unsigned32,
```

```
        dot11TVHTBeamformeeNTxSupport           Unsigned32
    }

dot11TVHTSUBeamformeeOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the SU
        Beamformee role."
    DEFVAL { false }
    ::= { dot11TVHTTransmitBeamformingConfigEntry 1 }

dot11TVHTSUBeamformerOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the SU
        Beamformer role."
    DEFVAL { false }
    ::= { dot11TVHTTransmitBeamformingConfigEntry 2 }

dot11TVHTMUBeamformeeOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the MU
        Beamformee role."
    DEFVAL { false }
    ::= { dot11TVHTTransmitBeamformingConfigEntry 3 }

dot11TVHTMUBeamformerOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the MU
        Beamformer role."
    DEFVAL { false }
    ::= { dot11TVHTTransmitBeamformingConfigEntry 4 }

dot11TVHTNumberSoundingDimensions OBJECT-TYPE
    SYNTAX Unsigned32 (1..8)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the number of antennas used by the beamformer
```



```
        when sending beamformed transmissions."
    ::= { dot11TVHTTransmitBeamformingConfigEntry 5 }

dot11TVHTBeamformeeNTxSupport OBJECT-TYPE
    SYNTAX Unsigned32 (1..8)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of space-time streams that the
        STA can receive in a TVHT NDP, the maximum value for NSTS, total that can
        be sent to the STA in a TVHT MU PPDU if the STA is MU beamformee capable
        and the maximum value of Nr that the STA transmits in a TVHT Compressed
        Beamforming frame."
    ::= { dot11TVHTTransmitBeamformingConfigEntry 6 }

-- ********************************************************************
-- * End of dot11 TVHT Transmit Beamforming Config TABLE
-- ********************************************************************
```

Insert dot11STALCI table as follows:

```
-- ********************************************************************
-- * dot11STALCI TABLE
-- ********************************************************************

dot11STALCITable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11STALCIEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "This table represents the geolocation of the STA as
        specified in 10.43.1."
    ::= { dot11smt 33 }

dot11STALCIEntry OBJECT-TYPE
    SYNTAX Dot11STALCIEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
         "STA's location information in Geospatial coordinates"
    INDEX {dot11STALCIIndex }
    ::= { dot11STALCITable 1 }

Dot11STALCIEntry ::=
    SEQUENCE {
        dot11STALCIIndex                Unsigned32,
        dot11STALCILatitudeUncertainty  Unsigned32,
        dot11STALCILatitudeInteger      Integer32,
        dot11STALCILatitudeFraction     Integer32,
        dot11STALCILongitudeUncertainty Unsigned32,
        dot11STALCILongitudeInteger     Integer32,
        dot11STALCILongitudeFraction    Integer32,
        dot11STALCIAltitudeType         INTEGER,
        dot11STALCIAltitudeUncertainty  Unsigned32,
        dot11STALCIAltitudeInteger      Integer32,
        dot11STALCIAltitudeFraction     Integer32,
        dot11STALCIDatum                INTEGER }

dot11STALCIIndex OBJECT-TYPE
    SYNTAX Unsigned32
```

```
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
       "Index for STA LCI elements in dot11STALCITable, greater
       than 0."
    ::= { dot11STALCIEntry 1 }

dot11STALCILatitudeUncertainty OBJECT-TYPE
    SYNTAX Unsigned32 (0..63)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity or the SME.
       Changes take effect as soon as practical in the
       implementation.

       Latitude uncertainty is 6 bits indicating the amount of
       uncertainty in latitude value. A value of 0 is reserved to
       indicate that the uncertainty is unknown; values greater
       than 34 are reserved. This field is derived from IETF
       RFC 6225."
    ::= { dot11STALCIEntry 2 }

dot11STALCILatitudeInteger OBJECT-TYPE
    SYNTAX Integer32 (-359..359)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity or the SME.
       Changes take effect as soon as practical in the
       implementation.

       Latitude is a 2s complement 34 bit fixed point value
       consisting of 9 bits of integer and 25 bits of fraction. This
       field contains the 9 bits of integer portion of Latitude.
       This field is derived from RFC 6225."
    ::= { dot11STALCIEntry 3 }

dot11STALCILatitudeFraction OBJECT-TYPE
    SYNTAX Integer32 (-16777215..16777215)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity or the SME.
       Changes take effect as soon as practical in the
       implementation.

       Latitude is a 2s complement 34 bit fixed point value
       consisting of 9 bits of integer and 25 bits of fraction. This
       field contains the 25 bits of fraction portion of Latitude.
       This field is derived from RFC 6225."
    ::= { dot11STALCIEntry 4 }

dot11STALCILongitudeUncertainty OBJECT-TYPE
    SYNTAX Unsigned32 (0..63)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity or the SME.
       Changes take effect as soon as practical in the
```



```
        implementation.

        Longitude resolution is 6 bits indicating the amount of
        uncertainty in longitude value. A value of 0 is reserved to
        indicate that the uncertainty is unknown; values greater
        than 34 are reserved. This field is derived from RFC 6225."
    ::= { dot11STALCIEntry 5 }

dot11STALCILongitudeInteger OBJECT-TYPE
    SYNTAX Integer32 (-359..359)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Longitude is a 2s complement 34 bit fixed point value
        consisting of 9 bits of integer and 25 bits of fraction. This
        field contains the 9 bits of integer portion of Longitude.
        This field is derived from RFC 6225."
    ::= { dot11STALCIEntry 6 }

dot11STALCILongitudeFraction OBJECT-TYPE
    SYNTAX Integer32 (-16777215..16777215)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Longitude is a 2s complement 34 bit fixed point value
        consisting of 9 bits of integer and 25 bits of fraction. This
        field contains the 25 bits of fraction portion of Longitude.
        This field is derived from IETF RFC 6225."
    ::= { dot11STALCIEntry 7 }

dot11STALCIAltitudeType OBJECT-TYPE
    SYNTAX INTEGER {
        meters(1),
        floors(2),
        hagm (3) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Altitude Type is four bits encoding the type of altitude.
        Codes defined are:
        meters in 2s complement fixed-point 22-bit integer part
        with 8-bit fraction
        floors: in 2s complement fixed-point 22-bit integer part
        with 8-bit fraction
        hagm: Height Above Ground in meters, in 2s complement fixed-
        point 22-bit integer part with 8-bit fraction.
        This field is derived from IETF RFC 6225."
    ::= { dot11STALCIEntry 8 }
```

```
dot11STALCIAltitudeUncertainty OBJECT-TYPE
    SYNTAX Unsigned32 (0..63)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Altitude uncertainty is 6 bits indicating the amount of
        uncertainty in the altitude value. A value of 0 is reserved
        to indicate that altitude uncertainty is not known; values
        above 30 are also reserved. Altitude uncertainty
        applies only to Altitude Type 1. This field is derived from
        IETF RFC 6225."
    ::= { dot11STALCIEntry 9 }

dot11STALCIAltitudeInteger OBJECT-TYPE
    SYNTAX Integer32 (-2097151..2097151)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Altitude is a 30 bit value defined by the Altitude type
        field. The field is encoded as a 2s complement fixed-point
        22-bit integer Part with 8-bit fraction. This field contains
        the fixed-point Part of Altitude. This field is derived from
        IETF RFC 6225."
    ::= { dot11STALCIEntry 10 }

dot11STALCIAltitudeFraction OBJECT-TYPE
    SYNTAX Integer32 (-127..127)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Altitude is a 30 bit value defined by the Altitude type
        field. The field is encoded as a 2s complement fixed-point
        22-bit integer Part with 8-bit fraction. This field is
        derived from IETF RFC 6225."
    ::= { dot11STALCIEntry 11 }

dot11STALCIDatum OBJECT-TYPE
    SYNTAX INTEGER { wgs84 (1), nad83navd88 (2), nad93mllwvd (3) }
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the
        implementation.

        Datum is an 8-bit value encoding the horizontal and vertical
        references used for the coordinates given in this LCI.
        IETF RFC 6225 defines the values of Datum. Type 1 is WGS-84,
```



```
        the coordinate system used by GPS. Type 2 is NAD83 with
        NAVD88 vertical reference. Type 3 is NAD83 with Mean Lower
        Low Water vertical datum. All other types are reserved. This
        field is derived from IETF RFC 6225."
    ::= { dot11STALCIEntry 12 }

-- ************************************************************************
-- * End of dot11STALCI TABLE
-- ************************************************************************
```

After the end of the dot11AVSAPCGroup, insert the* dot11TVWSComplianceGroup *as defined below:

```
dot11TVWSComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11ChannelScheduleManagementActivated,
        dot11ContactVerificationSignalActivated,
        dot11NetworkChannelControlActivated,
        dot11WhiteSpaceMapActivated,
        dot11GDDActivated
        }
    STATUS current
    DESCRIPTION
        "Attributes that configure the TVWS Group for IEEE 802.11."
    ::= { dot11Groups 70 }
```

Insert the following compliance objects in dot11Groups after the dot11PhyTxPowerComplianceGroup2 object:

```
dot11TVHTTransmitBeamformingGroup OBJECT-GROUP
    OBJECTS {
        dot11TVHTSUBeamformeeOptionImplemented,
        dot11TVHTSUBeamformerOptionImplemented,
        dot11TVHTMUBeamformeeOptionImplemented,
        dot11TVHTMUBeamformerOptionImplemented,
        dot11TVHTNumberSoundingDimensions,
        dot11TVHTBeamformeeNTxSupport
        }
    STATUS current
    DESCRIPTION
        "Attributes that configure TVHT transmit beamforming for IEEE 802.11."
    ::= { dot11Groups 80 }

dot11PhyTVHTComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11TVHTChannelWidthOptionImplemented,
        dot11TVHTCurrentChannelWidth,
        dot11TVHTCurrentChannelCenterFrequencyIndex0,
        dot11TVHTCurrentChannelCenterFrequencyIndex1,
        dot11TVHTShortGIOptionIn4WImplemented,
        dot11TVHTShortGIOptionIn4WActivated,
        dot11TVHTLDPCCodingOptionImplemented,
        dot11TVHTLDPCCodingOptionActivated,
        dot11TVHTTxSTBCOptionImplemented,
        dot11TVHTTxSTBCOptionActivated,
        dot11TVHTRxSTBCOptionImplemented,
        dot11TVHTRxSTBCOptionActivated,
        dot11TVHTMUMaxUsersImplemented,
        dot11TVHTMUMaxNSTSPerUserImplemented,
        dot11TVHTMUMaxNSTSTotalImplemented,
        dot11TVHTMaxNTxChainsImplemented,
        dot11TVHTMaxNTxChainsActivated
```

```
        }
    STATUS current
    DESCRIPTION
        "Attributes that configure the TVHT PHY."
    ::= { dot11Groups 81 }
```

Change the dot11Compliance object as follows:

```
dot11Compliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
        "The compliance statement for SNMPv2 entities that implement the IEEE
        802.11 MIB."
    MODULE  -- this module
    MANDATORY-GROUPS {
        dot11SMTbase12,
        dot11MACbase3,
        dot11CountersGroup3,
        dot11SmtAuthenticationAlgorithms,
        dot11ResourceTypeID,
        dot11PhyOperationComplianceGroup2 }

    GROUP dot11PhyDSSSComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        dsss.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyOFDMComplianceGroup3
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        ofdm.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyHRDSSSComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        hrdsss.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
```



```
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyERPComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is ERP.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyHTComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType has the
        value of ht.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyDMGComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType has the
        value of dmg.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup"

    GROUP dot11PhyVHTComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType has the
        value of vht.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyTVHTComplianceGroup"
```

```
    GROUP dot11PhyTVHTComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType has the
        value of tvht.
        This group is mutually exclusive to the following groups:
        dot11PhyIRComplianceGroup
        dot11PhyFHSSComplianceGroup2
        dot11PhyDSSSComplianceGroup
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup"
```

Change OPTIONAL-GROUPS as follows:

```
-- OPTIONAL-GROUPS {
    -- dot11SMTprivacy,
    -- dot11MACStatistics,
    -- dot11PhyAntennaComplianceGroup,
    -- dot11PhyTxPowerComplianceGroup,
    -- dot11PhyRegDomainsSupportGroup,
    -- dot11PhyAntennasListGroup,
    -- dot11PhyRateGroup,
    -- dot11MultiDomainCapabilityGroup,
    -- dot11PhyFHSSComplianceGroup2,
    -- dot11RSNAadditions,
    -- dot11OperatingClassesGroup,
    -- dot11Qosadditions,
    -- dot11RMCompliance,
    -- dot11FTComplianceGroup,
    -- dot11PhyAntennaComplianceGroup2,
    -- dot11HTMACadditions,
    -- dot11PhyMCSGroup,
    -- dot11TransmitBeamformingGroup,
    -- dot11VHTTransmitBeamformingGroup,
    -- dot11PhyVHTComplianceGroup,
    -- dot11VHTMACAdditionsGroup,
    -- dot11TVHTTransmitBeamformingGroup,
    -- dot11PhyTVHTComplianceGroup,
    -- dot11WNMCompliance}
```

Within dot11Compliance, after the end of the dot11DMGCountersComplianceGroup, insert the following:

```
GROUP dot11TVWSComplianceGroup
DESCRIPTION
       "The dot11TVWSComplianceGroup is optional."
```

Within dot11Compliance, change the last entry in dot 11 Compliances 1 as follows:

```
    -- dot11VHTComplianceGroup,
    -- dot11TVWSComplianceGroup
```


After the end of the dot11Compliances 14, insert the following:

```
-- ****************************************************************
-- * Compliance Statements - TVWS
-- ****************************************************************
dot11TVWSCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The compliance statement for SNMPv2 entities that imple-
        ment the IEEE 802.11 MIB for TVWS operation."
    MODULE -- this module
    MANDATORY-GROUPS {
        dot11PhyTVWSComplianceGroup,
        dot11PhyTxPowerComplianceGroup2,
        dot11TVHTTransmitBeamformingGroup,
        dot11VHTMACAdditions, dot11TVWSComplianceGroup }
    ::= { dot11Compliances 15 }
```

Annex D

(normative)

Regulatory references

D.1 External regulatory references

Change the following row of Table D-1, and insert a new row as shown:

Table D-1—Regulatory requirement list

Geographic area	Approval standards	Documents	Approval authority
Canada	Minister of Industry	RSS-210 — Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment	Industry Canada
United States	Federal Communications Commission (FCC)	47 CFR [B9], Part 15, Sections 15.205, 15.209, and 15.247; and Subpart E, Sections 15.401–15.407, and Subpart H, Sections 15.701-15.716, Section 90.210, Sections 90.371–383, Sections 90.1201–90.1217, Sections 90.1301–90.1337, Section 95.639, Sections 95.1501–1511	FCC

Insert the following row into Table D-2 in numeric order:

Table D-2—Behavior limits sets

Encoding	Behavior limits set	Description
21	GeoDB	A STA operating in a TVWS band where broadcast TV operation is primary and STA operation has GDB requirements. When operating in TVWS, channel numbers are as assigned in regulation.

Annex E

(normative)

Country elements and operating classes

E.1 Country information and operating classes

Insert the following rows into Table E-4 in numeric order:

Table E-4—Global operating classes

Operating class	Non-global operating class(es)	Channel starting frequency (GHz)	Channel spacing (MHz)	Channel set	Channel center frequency index	Behavior limits set
85	85	—	6, 7, 8	—	—	GeoDB
86	86	—	12, 14, 16	—	—	GeoDB
87	87	—	24, 28, 32	—	—	GeoDB

Insert the following paragraph immediately after Table E-4 (and before the paragraph introducing Table E-5) in E.1:

For Behavior limits set GeoDB, Channel starting frequency shall be the frequency that results in the regulatory domain's channel number being the RLAN channel number.

E.2 Band specific operating requirements

Insert the following subclauses, E.2.5 and E.2.6 (including Table E-7 to Table E-10), after E.2.4:

E.2.5 TVWS band in the United States and Canada (54 MHz to 698 MHz)

Each GDD enabling STA and AP in TVWS determines the available TV channels at its location using its own geographic location identification and TV bands database access capabilities. Each GDD dependent STA in TVWS receives an available TV channel list from the STA that enables its operation.

The registration authorities are FCC designated TV bands administrators (FCC 47 CFR [B9], sections 15.713-715).

NOTE—IEEE 802.11 terms differ from FCC 47 CFR [B9], section 15.703, in many particulars. However, generally, a GDD enabling STA is Fixed or Mode II TVBD, and each GDD dependent STA has only one GDD enabling STA at any time. Generally, GDD dependent STAs are Mode I TVBDs. Each Fixed or Mode II TVBD is required to contact an authorized TV bands device database and operate based on the information received from that TV bands database. Fixed and Mode II TVBDs are certified to operate with specific TV bands databases using protocols specified by TV bands database administrators. FCC regulations require an encrypted Contact Verification Signal be received by Mode I TVBD to verify the integrity of the list of available channels FCC 47 CFR, section 15.711. Canadian regulation RSS-196 allows Remote Rural Broadband operation at transmit powers to 125 W in 6 MHz. The Canadian Minister of Industry held a

consultation documented in SMSE-012-12, wherein a decision to act in concert with FCC license-exempt low power regulations was taken. It is expected that Canadian RSS-210 will be revised to align with FCC 47 CFR, Part 15, Subpart H-Television Band Devices.

STAs operating in TVWS shall use

— CS/CCA
— DFS

No STA operating in TVWS shall use Channel Switch Announcement.

STAs operating in TVWS shall have the following set to “true”

— dot11GDDActivated
— dot11OperatingClassesRequired
— dot11SpectrumManagementRequired
— dot11MultiDomainCapabilityActivated
— dot11ContactVerificationSignalActivated

For GDD dependent STA operation in TVWS, the GDD enabling signal (see 10.43.2) is received directly from a GDD enabling STA and is a Beacon frame or Probe Response frame containing a Geodatabase Inband Enabling Signal field indicating that enablement in the frequency band is possible.

All GDD dependent STAs shall set the dot11GDD timer values as shown in Table E-7.

Table E-7—TVWS GDD timer limits

Parameter	Seconds
dot11GDDEnablementTimeLimit	32
dot11GDDEnablementFailHoldTime	512
dot11ContactVerificationSignalInterval	60
dot11GDDEnablementValidityTimer	60

Be aware that most protocols above the MAC operate in the opposite endianness from what is used in Table E-8 and Table E-9.

The Device Identification Information format is shown in Table E-8.

Table E-8—Device Identification Information Value fields

Name	Type	Length (octets)	Value	Scope/ Country code
FCC ID	4	14	The device identification contains the 14-octet FCC ID of the device. This value not present in Canada.	US
Industry Canada ID	5	11	The device identification contains the 11-octet Industry Canada ID of the device. This value not present in the United States.	CA
Device Serial Number	6	4	The Device Serial Number field contains the manufacturer's serial number. This field is present only if the Device Class field (Table 8-14b) is equal to 2 (GDD AP) or 3 (GDD fixed STA); otherwise, this field is not present. This value not present in Canada.	US

The WSM Information Value fields format is shown in Table E-9. In some regulatory domains, an AP can retrieve the WSM information from the GDB through the upper layer protocol (e.g., IETF Protocol to Access WS database 'paws-protocol'). When the AP retrieves the WSM information from the upper layer, it may translate it to the WSM Information field format shown in Table E-9, which is the link-layer-specific information.

Table E-9—WSM Information Value fields

Name	Length (octets)	Value	Scope/ Country code
Device Class	1	Single octet TLV comprising fields in Table 8-14b.	WSM
Map ID	1	Bit 0: Type indicates whether the following channel list is a full channel list or a partial channel list. If the Type bit is 1, the following channel list is a full channel list; and if the Type bit is 0, the following channel list is a partial channel list. Bits 1–7: Map version identifies the version of the WSM.	WSM
Channel Number	1	The Channel Number field is a positive integer value as defined in E.1 that indicates the available TV channel for WLAN operation. When the Channel Number field and Maximum Power Level field pairs are repeated, they are listed in ascending TV channel order.	WSM, US
Maximum Power Level	1	The Maximum Power Level field indicates the maximum power, in units of 0.5 dBm, allowed to be transmitted on the Channel Number.	WSM, US

NOTE—In the United States, an example of full Map 1 for a U.S. GDD non-AP STA describing two available channels with power limits of 100 mW and 40 mW is shown as 85, 0x06, 0x00, 0x03, 0x15, 0x28, 0x33, 0x20.

Type is 85, Length is 0x06, Device Class is 0x00, a full map with MapID 1 is 0x03, TV channel 21 is 0x15, 20 dBm Maximum Power Level is 0x28, TV channel 51 is 0x33, 16 dBm Maximum Power Level is 0x20.

E.2.6 TVWS band in Europe

Each GDD enabling STA and AP in TVWS determines the available TV channels at its location using its own geographic location identification and TV bands database access capabilities. Each GDD dependent STA in TVWS receives an available TV channel list from the STA that enables its operation.

The Harmonized Standard for unlicensed device operation in TVWS is EN 301 598.

STAs operating in TVWS shall use:

— CS/CCA
— DFS

No STA operating in TVWS shall use Channel Switch Announcement.

STAs operating in TVWS shall have the following set to “true”

— dot11GDDActivated
— dot11OperatingClassesRequired
— dot11SpectrumManagementRequired
— dot11MultiDomainCapabilityActivated
— dot11ContactVerificationSignalActivated

For GDD dependent STA operation in TVWS, the GDD enabling signal (see 10.43.2) is received directly from a GDD enabling STA and is a Beacon frame or Probe Response frame containing a Geodatabase Inband Enabling Signal field indicating that enablement in the frequency band is possible.

All GDD dependent STAs shall set the dot11GDD timer values as shown in Table E-10.

Table E-10—TVWS GDD timer limits

Parameter	Seconds
dot11GDDEnablementTimeLimit	32
dot11GDDEnablementFailHoldTime	512
dot11ContactVerificationSignalInterval	60
dot11GDDEnablementValidityTimer	60

Annex H

(normative)

Usage of Ethertype 89-0d

Change Table H-1 as follows:

Table H-1—Payload Type field values

Protocol name	Payload type	Subclause
Remote Request/Response	1	12.10.3
TDLS	2	10.22.2
FST	3	10.32.5
RLQP	4	10.24.3.3
Reserved	~~4~~5–255	

Annex T

(informative)

Location and Time Difference accuracy test

T.2 Time Difference of Departure accuracy test

Change the following list item in the lettered list in T.2:

l) The Time Difference of Departure accuracy test is passed if both of the following conditions are met:

1) The RMS value of *e* is less than

i) ~~aTxPmdTxStartRMS when transmitting a non-VHT PPDU or~~ aTxPHYTxStartRMS when transmitting a VHT or a TVHT PPDU or

ii) aTxPmdTxStartRMS otherwise.

2) TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH is greater than

i) ~~aTxPmdTxStartRMS when transmitting a non-VHT PPDU or~~ aTxPHYTxStartRMS when transmitting a VHT or TVHT PPDU or

ii) aTxPmdTxStartRMS otherwise, ~~is less than TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH,~~

where the following are properly accounted for:

— Units of *e*,

— ~~aTxPmdTxStartRMS when transmitting a non-VHT PPDU or~~ aTxPHYTxStartRMS ~~when transmitting a VHT PPDU~~ or aTxPmdTxStartRMS, as applicable, and

— TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH ~~are properly accounted for~~.