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Abstract: This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

Keywords: high efficiency, PHY, physical layer, MAC, medium access control, OFDMA, orthogonal frequency division multiple access, wireless local area network, WLAN

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Introduction

This introduction is not part of IEEE P802.11ax /D0.5, September 2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area network—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 6: Enhancements for High Efficiency WLAN(#1121).

This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

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IEEE P802.11ax™/D0.5

Draft 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 6: Enhancements for High Efficiency WLAN(#1121)

[This amendment is based on IEEE P802.11REVmc/D6.0(#2111) amended by IEEE P802.11ai/D4.0, IEEE P802.11ah/D5.0, IEEE P802.11aq/D3.0, IEEE P802.11ak/D1.0 and IEEE P802.11aj/D1.0]

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. 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.

Editorial Notes

Editor's Note: Editorial Notes in the body of the standard appear like this. They will be removed before publication. They may highlight some issue that the editor has had to address during the implementation of a change. Where there may be any technical impact from an editing issue, the editor will raise a technical letter ballot comment. There is no need for voters to comment on such issues unless they have a specific resolution they wish to present.

Editor's Note: Headings with empty content or Headings preceding editing instructions that modify the contents of the referenced subclause are there to provide context to the reader of this document, they have no other significance.

Editor's Note: The default IEEE-SA style for tables is to "float". This means that they be repositioned later, usually at the head of the next page, to avoid splitting the table and reduce the amount of blank space. The table can appear to move out of the subclause it is referenced first from, and can even split a paragraph. This is the intended IEEE-SA behavior, please do not report it as a defect in the draft. In many cases, additional line feeds have been inserted to force tables to follow text, rather than float beyond sequential text. The additional line feeds will be removed before publication, please do not report them as a defect in the text.

Editor's Note: Line numbering is only approximate. This is a limitation of the FrameMaker tool. Whitespace between paragraphs is part of the IEEE-SA style, as defined in their templates. The combination of these two facts leads to the appearance of blank lines in the draft between every paragraph. Please do not report this as an editorial defect as it is the unavoidable behavior.

Tags:

Tags are placed in this draft near changes to identify the source of the change. Changes resulting from incorporation of an approved proposal are shown like this: (#<number>), where <number> identifies the submission/revision that introduced that change.

These tags will be hidden in versions of the draft sent out to letter ballot - i.e., they are present only to assist the editorial review panel in checking that changes have been properly applied.

Tags are shown close to the point of change. When a whole subclause is new, the heading is tagged.

Otherwise, when a whole paragraph is new, the paragraph is tagged. Otherwise tags are placed after a section of changes within a paragraph or at the end of the paragraph if the changes are substantial.

New tables are tagged in the table caption (if there is one), or in the introductory paragraph. Otherwise, new rows in existing tables are tagged only in the first column, to avoid distraction. Otherwise, a modified cell is tagged.

Finally, any other changes made by the editor (e.g., for grammar, language, style & consistency with other comment resolutions, baseline, etc.) are tagged (#Ed).

Editor's Note: A cumulative status of the versions of this draft is shown below.

Table 1—Draft Status

Draft	Date	Status
D0.1	2016-03-03	Converted to FrameMaker from 16/0024r1 Proposed draft specification
D0.2	2016-06-06	Includes tentative resolutions for most editorials. Includes resolutions for technical comments motioned in May 2016 session.
D0.3	2016-08-11	Includes resolutions for technical comments motioned in July 2016 session.
D0.4	2016-08-26	Included motioned draft changes from July 2016 session and corrected errors
D0.5	2016-09-30	Included comment resolutions and other changes motioned at the September 2016 session

3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Insert the following definitions maintaining alphabetical order:

non-orthogonal frequency division multiple access (non-OFDMA): A full bandwidth HE transmission with 242-tone RU, 484-tone RU, 996-tone RU, 2×996-tone RU, or 2×996-tone RU allocated for 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz transmission, respectively.(#355)

target wake time (TWT) scheduling STA: A STA that schedules broadcast TWTs and provides these schedules in a broadcast TWT element.

target wake time (TWT) scheduled STA: A STA that follows the schedules provided in a broadcast TWT element.(#544)

3.4 Abbreviations and acronyms

Insert the following acronym definitions (maintaining alphabetical order):

DCM	Dual carrier modulation(#2567)
DL	Downlink(#2401)
DL MU	Downlink multi-user
HE	High efficiency
OBO	Orthogonal frequency division multiple access (OFDMA) backoff(#1747)
OCW	Orthogonal frequency division multiple access (OFDMA) contention window(#1747)
OFDMA	Orthogonal frequency-division multiple access
OMI	Operation mode indication(#2200)(#2328)
PPE	PHY padding extension(#1723)
MU-RTS	Multi-user request to send
UL	Uplink
UL MU	Uplink multi-user(#545)

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4. General description

4.3 Components of the IEEE Std 802.11 architecture

Insert a new subclause after subclause 4.3.12 as follows:

4.3.12a High efficiency (HE) STA

The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 6 GHz.

An HE STA is VHT STA or HT non-AP STA that, in addition to the features supported as a VHT STA or HT non-AP STA respectively, supports the MAC features defined in Clause 25 and the PHY features defined in Clause 26. (PHY Motion #163)

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6. Layer management

6.1 Overview of management model

6.2 Generic management primitives

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

(#2306) Insert the following rows at the end of the BSSDescription table:

Name	Type	Valid range	Description	IBSS adoption
HE Capabilities	As defined in frame format	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.	Do not adopt
HE Operation	As defined in frame format	As defined in 9.4.2.219 (HE Operation element)	Specifies the parameters within the HE Operation element that are supported by the AP. The parameter is present if dot11HEOptionImplemented is true.	Adopt

6.3.4 Synchronization

6.3.4.2 MLME-JOIN.request

6.3.4.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

```

MLME-JOIN.request(
    ...
    AdvertisementProtocolInfo,
    HE Capabilities,(#1227)(#1238)
    VendorSpecificInfo
)
    
```

1 *Insert the following entry into the unnumbered table in this subclause:*

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.

6.3.7 Associate

6.3.7.4 MLME-ASSOCIATE.indication

6.3.7.4.2 Semantics of the service primitive

22 *Change the primitive parameters as follows (not all existing parameters in the baseline are shown):*

25 The primitive parameters are as follows:

```

26 MLME-ASSOCIATE.indication(
27     ...
28     HE Capabilities.(#1227)(#1239)(#1240)(#2294)
29     VendorSpecificInfo
30 )

```

33 *Insert the following entry into the unnumbered table in this subclause:*

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Association Request frame received from the STA; otherwise, this parameter is not present.

6.3.8 Reassociate

6.3.8.4 MLME-REASSOCIATE.indication

6.3.8.4.2 Semantics of the service primitive

56 *Change the primitive parameters as follows (not all existing parameters in the baseline are shown):*

59 The primitive parameters are as follows:

```

60 MLME-REASSOCIATE.indication(
61     ...
62     HE Capabilities.(#1227)(#1239)(#1240)
63     VendorSpecificInfo
64 )

```

1 *Insert the following entry into the unnumbered table in this subclause:*
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 3

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Reassociation Request frame received from the STA; otherwise, this parameter is not present.

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 17 **6.3.11 Start**

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 19 **6.3.11.2 MLME-START.request**

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 22 **6.3.11.2.2 Semantics of the service primitive**

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 24 *Change the primitive parameters as follows (not all existing parameters in the baseline are shown):*

25 MLME-START.request(
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 28 HE Capabilities,
 29 HE Operation,
 30 VendorSpecificInfo
 31)
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 33

34 *Insert the following entry into the unnumbered table in this subclause:*
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Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is (#1230)present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.
HE Operation	As defined in HE Operation element.(#1122)	As defined in 9.4.2.219 (HE Operation element)	The additional HE capabilities to be advertised for the BSS. The parameter is present if (#1152)dot11HEOptionImplemented is true; otherwise, this parameter is not present.

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 47 **6.3.27 Management of direct links**

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 50 **6.3.27.4 6.3.27.4 MLME-DLS.indication**

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 53 **6.3.27.4.2 6.3.27.4.2 Semantics of the service primitive**

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 65 *Change the primitive parameters as follows (not all existing parameters in the baseline are shown):*

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MLME-DLS.indication(
 ...
 HE Capabilities,
 VendorSpecificInfo
)(#1352)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HEOptionImplemented is true; otherwise, not present.

