IEEE P802.11 Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proposed changes for TGbb draft 0.6 | | | | |
| Date: 2021-10-15 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Chong Han | pureLiFi |  |  | chong.han@purelifi.com |
| Nikola Serafimovski |  |  | [nikola.serafimovski@purelifi.com](mailto:nikola.serafimovski@purelifi.com) |
| Stephan Berner |  |  | [stephan.berner@purelifi.com](mailto:stephan.berner@purelifi.com) |
| Mostafa Afgani |  |  | [Mostafa.afgani@purelifi.com](mailto:Mostafa.afgani@purelifi.com) |
| Tamas Weszely |  |  | [Tamas.weszely@purelifi.com](mailto:Tamas.weszely@purelifi.com) |
| Tuncer Baykas | Hyperion Technology |  |  | [tbaykas@ieee.org](mailto:tbaykas@ieee.org) |

Abstract

This document is to reflect most of the technical comments regarding to structural changes to the draft 0.6.

***Discussion: Highlighted text preceded by “Discussion” are not to be copied into the TGbb Draft. Such text provides rationale for the proposed changes.***

***Highlighted text: changes made to D0.6.***

History

R0: reflect the technical comments in doc. 11-21/1640r2.

R1: update the channel mapping for 2.4, 5 GHz according to comments; words changed for the description of channel mapping.

R2: update channel mapping rules for 2.4 GHz 40 MHz channels; move light interface and multiple transmitters and receivers subclauses to the general PHY clause; update the text and Figure 1 in the light interface subclause.

R3: update the figure with original input from Figure 17-12.

R4: comment sheet 11-21/1640r4

R5: update channelization subclause 32.3.2.1.2

R6: update channelization subclause 32.3.2.1.2

32.3.2.1. Channel numbering

32.3.2.1.1 Channelization for LC CM PHY mode

The LC CM PHY shall operate at a center frequency of 26 MHz. The CM bandwidth shall be 20 MHz.

32.3.2.1.2 Channelization for the other LC PHY modes

Channel center frequencies for the LC IF signal are defined at every integer multiple of 5 MHz above the channel starting frequency. The relationship between center frequency and channel number is given in Equation (1)

Channel center frequency = Channel starting frequency + 5 x nch (MHz) (1)

where nch = 1,…, 61 and Channel starting frequency = 21 MHz.

Half of the IF spectrum shall be used in implementations with LC channels mapped to RF channels in the 5 GHz band. The other half of the IF spectrum shall be used in implementations with LC channels mapped to RF channels in the 6 GHz band. As shown in Fig. 1, in the TX chain, the LC IF signal is transmitted by TX OFE on the LC channel which maps to the RF channel used before going through the down-conversion. When LC IF signal is up-converted to the RF signal in the RX chain, the channel used by RF signal shall map to the LC channel which the RX OFE receives the transmission on.

***Discussion:***

***This comment together with the following two comments offer the mapping between the LC channels and the channelization in the existing standards. The mapping of LC channel to channelization existing standard shall be unique and dedicated, i.e., only mapping to one frequency band. For instance, if the LC STA operates in the LC HT mode, only map the LC channels to HT PHY in the 2.4 GHz (or 5 GHz) band. These three paragraphs shall be considered altogether to make a decision on channel mapping rules.***

***HT PHY mode may operate on either in the 2.4 GHz or 5 GHz band.***

***VHT PHY mode operates in the 5 GHz band.***

***HE PHY mode may operate on either in the 2.4 GHz, or 5 GHz or 6 GHz band.***

***2.4 GHz:***

***Map TGbb 20 MHz channels (1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61) to 20 MHz channels used by IEEE 802.11n/ax (1, …, 14) when operating at 2.4 GHz. Then the 40 MHz channels can be bonded by the standards themselves.***

|  |  |  |
| --- | --- | --- |
| **Channel bandwidth** | **20 MHz** | **40 MHz** |
| **IEEE 802.11 n/ax** | 1, ~~2, 3, 4,~~ 5, ~~6, 7, 8,~~ 9, ~~10, 11, 12,~~ 13, ~~14~~ (14 in total) | Combination of 20 MHz channels  (1,1), (9,1) |
| **TGbb** | 1, 5, 9, 13~~, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61~~ (16 in total) | 3, 11~~, 19, 27, 35, 43, 51, 59~~ |

***Discussion:***

***5 GHz:***

***Map TGbb channels to available channels used by IEEE 802.11n/ac/ax in the 5 GHz band.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel bandwidth** | **20 MHz (n)** | **40 MHz (n)** | **80 MHz** | **160 MHz** |
| **IEEE 802.11a/n/ac/ax** | ~~8, 12, 16, 32,~~ 36, 40, 44, 48, 52, 56, 60, 64, ~~68, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144, 149, 153, 157, 161, 165, 169, 173, 177, 183, 188, 192, 196~~ | ~~34,~~ 38, 46, 54, 62~~, 102, 110, 118, 126, 134, 142, 151, 159, 167, 175~~ | 42, 58, ~~106, 122, 138, 155, 171~~ | 50, ~~114, 163~~ |
| **TGbb** | 1, 5, 9, 13, 17, 21, 25, 29~~, 33, 37, 41, 45, 49, 53, 57, 61~~ | 3, 11, 19, 27~~, 35, 43, 51, 59~~ | 7, 23~~, 39, 55~~ | 15~~, 47~~ |

The set of valid operating channel numbers for LC IF signals mapped to the 5 GHz band is defined as follows:

* the 20 MHz LC IF channels {1, 5, 9, 13, 17, 21, 25, 29} shall be selected and mapped to the 20 MHz channels {36, 40, 44, 48, 52, 56, 60, 64} respectively in the 5 GHz band;
* the 40 MHz LC IF channels {3, 11, 19, 27} shall be selected and mapped to the 40 MHz channels {38, 46, 54, 62} respectively in the 5 GHz band;
* the 80 MHz LC IF channels {7, 23} shall be selected and mapped to the 80 MHz channels {42, 58} respectively in the 5 GHz band;
* the 160 MHz LC IF channel {15} shall be selected and mapped to the 160 MHz channel {50} in the 5 GHz band.

***Discussion:***

***6 GHz:***

***Channel mapping between TGbb and channels available in the 6GHz band by an HE STA:   
TGbb is using a subset of the channel numbers as those available in IEEE 802.11ax in the 6 GHz band. Hence, the mapping could be proposed to use the channel 1-61 by an HE STA as operating in the 6 GHz band.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel bandwidth** | **20 MHz** | **40 MHz** | **80 MHz** | **160 MHz** |
| **IEEE 802.11 ax** | 1, 5, 9, 13, 17, 21, 25, 29~~, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93~~ | 3, 11, 19, 27~~, 35, 43, 51, 59, 63, 75, 83, 91~~ | 7, 23~~, 39, 55, 71, 87~~ | 15~~, 47, 79~~ |
| **TGbb** | ~~1, 5, 9, 13, 17, 21, 25, 29,~~ 33, 37, 41, 45, 49, 53, 57, 61 | ~~3, 11, 19, 27,~~ 35, 43, 51, 59 | ~~7, 23,~~ 39, 55 | ~~15,~~ 47 |

The mapping between the LC channels and RF channels in the 6 GHz band shall follow the rules below:

* the 20 MHz LC IF channels {33, 37, 41, 45, 49, 53, 57, 61} shall be selected and mapped to the 20 MHz channels {1, 5, 9, 13, 17, 21, 25, 29} respectively in the 6 GHz band;
* the 40 MHz LC IF channels {35, 43, 51, 59} shall be selected and mapped to the 40 MHz channels {3, 11, 19, 27} respectively in the 6 GHz band;
* the 80 MHz LC IF channels {39, 55} shall be selected and mapped to the 80 MHz channels {7, 23} respectively in the 6 GHz band;
* the 160 MHz LC IF channel {47} shall be selected and mapped to the 160 MHz channel {15} in the 6 GHz band.

***Editor’s note: TBD. Call for contributions to define the channelization. (e.g., need to add the numbers of channels for LC HT PHY and LC VHT PHY, 61 is for LC HE PHY.***

…

32.3.2.1 LC Light interface

Figure 1 shows an example of how the transmit OFE can be connected to the TX PHY and how the receive OFE can be connected to the RX PHY. A transmit OFE may for example consist of a power amplifier (PA) and a solid state lighting (SSL) devices, for example LEDs. A receive OFE may for example consist of a photo-diode (PD) and a trans-impedance amplifier (TIA).



1. — Interfacing common mode PHY to light emitter and receiver

In the TX chain, after the HPA, instead of transmitting the RF signal at the typical 2.4 GHz, 5 GHz or 6 GHz spectrum, the signal may go through the down-conversion stage where its center frequency is changed to align with the LC center frequency defined in 32.3.2.3 (Channel numbering). A DC bias is then added to the LC IF signal before the signal is fed to the transmitting OFE because the current through an SSL device can only be positive as illustrated in Figure 2.



1. — Operation of SSL device with DC bias

In the RX chain, the variations in the light level are detected by the receiving OFE and shall be converted into a current. After the DC component is removed, the signal may be up-converted to RF signal at the relevant 2.4 GHz, 5 GHz or 6 GHz spectrum and fed to the RX PHY.

32.3.2.2 Multiple transmitters and receivers

***Discussion:***

***Since LC HT/ VHT/HE PHY modes all support this functionality, move the existing sub-clause in the general section.***

This functionality is supported by the LC HT PHY, LC VHT PHY and LC HE PHY.

Figure 3 shows an example of multiple SSL devices connected to the TX baseband and Figure 4 shows an example of multiple PDs connected to the RX baseband.

The SSL devices may all operate at the same wavelength or at different wavelengths.

The TX baseband outputs shall be all quadrature modulated to the same common center frequency, see subclause 32.3.2.1 (LC CM Light interface) for details.



1. — Connecting multiple SSL devices to TX baseband



1. — Connecting multiple PDs to RX baseband