IEEE P802.11
Wireless LANs

|  |
| --- |
| LC STA definition |
| Date: 2022-07-14 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Robert Stacey | Intel |  |  | Robert.stacey@intel.com |
| Volker Jungnickel | Fraunhofer HHI |  |  | Volker.jungnickel@hhi.fraunhofer.de |

Abstract

Comment resolution for TGbb D2.1

# Revision History

R0 – initial proposal

R1 – removed insertion of transmit specification receive specification (not related to LC STA definition). Don’t delete entire Clause 31 – we may add MAC requirements.

R2 – Volker’s edits

R3 – Editing during AM1 Thu July 14 meeting

R4 – After editing D3.0

# Comments

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Name** | **Comment** | **Page** | **Subclause** | **Line** | **Proposed Change** |
| 32 | Volker Jungnickel | 802.11bb proposes a very enery inefficient HW architecture which is in no way acceptable for implementation at mobile devices | 14 | 32.3.2 | 13 | revise the LC light interface and add a baseband implementation proposal which is interoperable with the up-/down conversion HW architecture |
| 46 | Robert Stacey | "An LC STA is a STA with an OFE": based on Figure 32-1, I don't think this is accurate. Figure 32-1 has modules called "LC Optical TX Antenna" and "LC Optical RX Antenna" that, in addition to the OFE, have RF up/down conversion. | 12 | 4.3.30 | 17 | Maybe something like: "An LC STA is an HT, VHT or HE STA where the RF antenna is replaced by an LC optical antenna." And then all we really need to do is define this "LC optical antenna" |

# Proposed resolution

REVISED -

Revisit the definition of an LC STA.

Capture the essential characteristic of an LC STA – that it operates in the light band -- in 4.3.30.

Define LC STA as having an LC PHY in one of three flavors. And then being either an HT STA, VHT STA or HE STA depending on the PHY flavor.

Update the PHY clauseto describe both the RF -> LC IF conversion and the baseband -> LC IF conversion

TGbb editor to implement the changes under “Editing instructions” in this document.

# Editing instructions

4.3.30 Light Communications (LC) STA

***TGbb editor -- change as follows:***

An LC STA operates in the light band with wavelengths in the range of 800 nm to 1000 nm.

An LC STA has an LC PHY with one of three levels of support: HT, VHT or HE. An LC STA with an LC PHY that has HT support is an HT STA (see 4.3.13) except for the band in which it operates. An LC STA with an LC PHY that has VHT support is a VHT STA (see 4.3.15) except for the band in which it operates. An LC STA with an LC PHY that has HE support is an HE STA (see 4.3.16) except for the band in which it operates.

An LC STA has support for MAC features such as frame aggregation, block ack, beamforming, and fast session transfer in a multi-band device. The applicable channel information used in MAC signaling is specified in Annex E table entries for which the Behavior limits set column contains “Applicable to LC”.

***TGbb editor – NOTE: remainder of clause is unchanged***

***TGbb editor -- delete Clause 31***

**32. LC PHY specification**

**32.1 General**

Clause 32 (LC PHY specification) specifies the PHY entity for a Light Communications (LC) orthogonal
frequency division multiplexing (OFDM) system with intensity modulation and direct detection (IM/DD)
optical interface. LC systems transmit on wavelengths within the 800 nm to 1000 nm band.

***TGbb editor – change as follows:***

An LC PHY provides one of three levels of support: HT, VHT or HE.

An LC PHY with HT support conforms to the requirements for an HT PHY as defined in Clause 19 except where the requirements in Clause 32 superscede these requirements.

An LC PHY with VHT support conforms to the requirements for a VHT PHY as defined in Clause 21 except where the requirements in Clause 32 superscede these requirements.

An LC PHY with HE support conforms to the requirements for an HE PHY as defined in Clause 27 except for the requirements in Clause 32 that superscede these requirements.

***TGbb editor – delete 32.1.1, 32.1.2:***

**32.2 LC PHY Service interface**

The LC PHY service is provided to the MAC through the PHY service primitives described in Clause 8 (PHY
service specification).

**32.3 LC PHY**

**32.3.1 Introduction**

***TGbb editor – change as follows:***

The procedure by which an LC PHY converts a PSDU into an PPDU is defined in 19.3 (HT PHY), 21.3 (VHT PHY), and 27.3 (HE PHY) for an LC PHY with HT, VHT and HE support, respectively, except for the differences described in the remainder of 32.3 (LC PHY).

For the requirements in 21.3 and 27.3, the term frequency segment applies to the LC IF signal.

An LC PHY with VHT or HE support does not support 80+80 MHz noncontiguous channel width.

***TGbb editor – change 32.3.2 as follows:***

32.3.2 Transmitter block diagram

The transmitter block diagrams in 19.3.3 (Transmitter block diagram), 21.3.3 (Transmitter block diagram), and 27.3.5 (Transmitter block diagram) show an Analog and RF block that is described as upconverting the complex baseband waveform associated with each transmit chain to an RF signal.

In the LC PHY, the complex baseband waveform associated with each transmit chain is upconverted to an LC IF signal instead of an RF signal. A DC bias is added to LC IF signal which is then fed into an optical front end (OFE). The OFE converts the DC biased LC IF signal into an intensity modulated optical signal.

In some implementations, the complex baseband waveform is upconverted directly to an LC IF signal as shown in Figure 32-1a.

In other implementations, the complex baseand waveform might first be upconverted to an RF signal and then downconverted to the LC IF signal as shown in Figure 32-1b.

***TGbb editor – separate the following figure into two figures; the top half Figure 32-1a and the bottom half Figure 32-1b. Remove existing Figure 32-1.***



Figure 32-1—LC PHY transmitter

In this example, in the LC PHY TX, after the HPA, the RF signal, in the 5 GHz or 6 GHz spectrum, is down-converted such that the center frequency aligns with the LC IF channel frequency defined in 32.3.4 (Channel numbering). A DC bias is next 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 32-2. The reference clock of the local
oscillator for the downconversion at the LC Optical TX antenna is the same as in the LC PHY TX.

[Figure 32-2]

***TGbb editor – delete 32.3.3 (including 32.3.3.1-4)***

***TGbb editor – insert new subclauses as follows:***

**32.3.2a Mathematical description of signals**

The LC IF signal is described by Equation 19-1, Equation 21-11, and Equation 27-1 for an LC PHY with HT, VHT or HE support, respectively, where f\_c is the LC IF.

32.3.5 Multiple transmit chains and multiple receive chains

***TGbb editor – change as follows:***

An LC PHY supports the use of multiple transmit chains and
multiple receive chains. An example of the LC PHY TX connected to multiple LC optical TX antennas is
shown in Figure 32-3, and an example of multiple LC optical RX antennas connected to the LC PHY RX is
shown in Figure 32-4.

***TGbb editor –*** *remove the reference clock in Figures 32-3 and 32-4****:***

**References:**