IEEE P802.11
Wireless LANs

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| LC MTMR new text |
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Abstract

Comment resolution for SA ballot on P802.11bb/ D4.1, Response to resolved and postponed comments in doc. 11-22-1925r4 related to 32.3.5. (Multiple transmit chains and multiple receive chains).

# Revision History

# Comments

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| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| I-14 | 18.7 | 32.2.5 | "When LC optical TX antennas operate at the same wavelength..." How an LC STA might operate at different wavelengths is not defined in the spec. The spec does not even define the required wavelenth sensitivity for "operation at the same wavelength" | Remove references to operation at the same or different wavelengths. Define what it means to operate in the 800 to 1000 nm band, for example, "An LC optical RX antenna shall be sensitive to radiation with wavelengths between 800 to 1000 nm." Ideally, the statement should include a minimum sensitivity requirement. |
| I-48 | 18.4 | 32.2.5 | The various options how to use MIMO together with LC, e.g. on line 9-11 for using spatial separation, lines 12-14 using WDM, and a third new option using a subset of antennas as LC and the complementary subset of antennas over RF and a fourth option by using FDM together with ultra-wideband OFE should be separated as one subclause for one such optional usage of MIMO together with LC. For the third option, please, refer to the latest version of 11-22/1114. | Restructure and update the text accordingly. Possibly develop one graph illustrating each Tx option for MIMO and replace figure 32-6 which is the receiver configuration. |

# Editing instructions

**TGbb editor: Change text as follows:**

1. Already resolved comments

CID I-62, P18L7-8:

“When LC optical TX antennas operate at the same wavelength, their light cones should cover different areas. This can be realized by spatial separation (spatial diversity) or pointing directional beams into different directions (angular diversity).”

CID I-61, P18L9:

“When using multiple transmit and receive chains, LC optical antennas should have ~~sufficient~~ spatial separation ~~the STA~~. As an example, a single AP may provide coverage to two different areas and non-AP STAs in each area could then be served simultaneously.”

CID I-17: P18L17, P18L21 and P18L25 delete sentences at the end of paragraphs

“When the LC PHY with HT support is operated with multiple optical TX antennas, the LC PHY TX shall use the procedures defined in 19.3 (HT PHY), where *NTX* transmit chains in the HT PHY shall be connected to *NTX* LC optical TX antennas. ~~The LC PHY with HT support shall support the same maximum number of LC optical antennas as the maximum number of antennas supported by the HT PHY.~~

When the LC PHY with VHT support is operated with multiple optical TX antennas, the LC PHY TX shall use the procedures defined in 21.3 (VHT PHY), where *NTX* transmit chains in the VHT PHY shall be 20 connected to *NTX* LC optical TX antennas. ~~The LC PHY with VHT support shall support the same maximum number of LC optical antennas as the maximum number of antennas supported by the VHT PHY.~~

When the LC PHY with HE support is operated with multiple optical TX antennas, the LC PHY TX shall use the procedures defined in 27.3 (HE PHY), where *NTX* transmit chains in the HE PHY shall be connected to *NTX* LC optical TX antennas. ~~The LC HE PHY mode shall support the same maximum number of LC 25 optical antennas as the maximum number of antennas supported by the HE PHY.~~

1. Two postponed comments

CID I-14 and CID I-48: Remove P18L7-14 and insert the following after P19L3

**32.3.5.1. Spatial and angular diversity**

When LC optical TX antennas operate at the same wavelength, their light cones should cover different areas. This can be realized by spatial separation (spatial diversity) or pointing beams into different directions (angular diversity).

**32.3.5.2. Wavelength division multiplexing**

The LC PHY with multiple transmit chains may be operated at multiple wavelengths. Wavelength division multiplexing is applicable if spatial separation is small or directions are the same. Multiple transmit chains can then be mapped to different wavelength. Dicroic beamsplitter(s) with suitable cut-off wavelength(s) are applicable infront of the multiple receive chains to separate the signals.

For example, with two transmit chains operated at 940 nm (chain 1) and 850 nm (chain 2), a shortpass dicroic beamsplitter with a cut-off wavelength of 900 nm may be used infront of both receive chains. The wavelength of the first transmit chain is longer than the cut-off wavelength. It is reflected by the dicroic beam splitter and detected by the first receive chain. The wavelength of the second transmit chain is shorter than the cut-off wavelength. It is passed through the dicroic beam splitter and detected by the second receive chain.

A STA with a single transmit chain is fully interoperable with a STA with multiple transmit and multiple receive chains operating in wavelength division multiplexing mode. The sum of transmitted and reflected signals from a dicroic beamsplitter is approximately the same, independent of the wavelength.

For example, a first STA with a single optical antenna supports a single stream. This stream may be detected by both receive chains of a second STA with two optical antennas by combining their signals. In the reverse link direction, both transmit chains of the second STA are used to transmit a single stream which may be detected by the single receive chain of the first STA.

Note: When using LEDs with different wavelengths, their optical spectra may be wider and cause residual crosstalk at a receive chain. It should be minimized by using multiple-transmit multiple-receive antenna processing.

**32.3.5.3. Hybrid RF and LC operation**

The LC PHY with multiple transmit and receive chains may be used for hybrid RF-LC operation. Therefore, transmit chains 1 to N*RF* are connected to RF antennas and transmit chain N*RF*+1 to N*TX*-N*RF* to LC optical antennas, as shown in Figure 32-X (Hybrid RF and LC operation).

Note: The use of LC optical antennas instead of RF antennas is transparent.

For hybrid RF and LC operation, the channel mapping defined in 32.3.4 (Channel numbering) between LC IF and 5 GHz and 6 GHz RF center frequencies shall be used as defined in Table 32-1 (Channel mapping from 5 GHz and 6 GHz RF to LC IF).

A STA operating only in RF mode is fully interoperable with a STA operating in hybrid RF and LC mode. The LC STA operating in hybrid RF and LC mode can effectively use only up to N*RF* receive chains, limiting the maximum number of parallel streams, accordingly.

A STA operating only in LC mode is fully interoperable with an LC STA operating in hybrid RF and LC mode. The LC STA operating in hybrid RF and LC mode can effectively use only up to N*TX*-N*RF* receive chains, limiting the maximum number of parallel streams, accordingly.



**Figure 32-X—Hybrid RF and LC operation**