### **IEEE P802.11 Wireless LANs**

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| PDT AMP Downlink PPDU Format | | |
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| Author(s): | | |
| Name | Affiliation | Email |
| Panpan LI | Huawei | Lipanpan25@huawei.com |
| Steve Shellhammer | Qualcomm Technologies, Inc. |  |
| Nelson Costa | HaiLa Technologies |  |
| You-Wei Chen | MediaTek |  |
| Rui Cao | NXP |  |
| Weijie Xu | Oppo |  |
| Bin Qian | Huawei |  |
| Ke Wang | Oppo |  |
| Lei Zhou | New H3C |  |
| Amichai Sanderovich | Wiliot |  |
| Shengquan Hu | MediaTek |  |
| Yuxiao Hou | TP-Link Systems Inc. |  |
| Leif Wilhelmsson | Ericsson |  |
| Fang Juan | Intel |  |
| Alice Chen | Qualcomm Technologies, Inc. |  |

**Introduction**

This document provides proposed draft text for IEEE 802.11bp draft.

The following Motions apply to this PDT:

* **PM-6**: The AMP Downlink PPDU AMP-Sync field and the AMP-Data field will use On-Off Keying (OOK) modulation.

[Motion #9, [1] and [7]]

* **PM-7**: The AMP Downlink PPDU AMP-Data field will use Manchester encoding for non-backscatter operation.
  + For the Backscatter case, the AMP-Data field encoding scheme is TBD.

[Motion #10, [1] and [7]]

* **PM-9**: The AMP Downlink PPDU in 2.4 GHz shall support the following data rates:
  + 1 Mb/s (for non-Backscatter STAs only)
  + 250 kb/s.

[Motion #16, [1] and [9]]

* **PM-19**: The AMP-Data field of AMP DL PPDU for backscatter communication uses Manchester encoding.

[Motion #37, [1] and [40]]

* **PM-22**: For DL PPDU and UL PPDU for backscattering:
  + For AMP Manchester encoded OOK of rate 250kbps, each data bit is encoded based on the chip duration of 2us.
  + For AMP Manchester encoded OOK of rate 1Mbps, each data bit is encoded based on the chip duration of 0.5us.

[Motion #40, [1], [40], [41], [42] and [43]]

* **PM-23**: For DL PPDU and UL PPDU:
  + For AMP Manchester encoded OOK, data bit 1 is encoded as chip bits “01” and data bit 0 is encoded as chip bits“10”
  + Note: same definition as WUR HDR definition.

[Motion #41 and #79, [1], [40], [41], [42] and [43]]

* **PM-31**: For DL PPDU for non backscattering case:
  + For AMP Manchester encoded OOK of rate 250kbps, each data bit is encoded based on the chip duration of 2us.
  + For AMP Manchester encoded OOK of rate 1Mbps, each data bit is encoded based on the chip duration of 0.5us.

[Motion #77, [1], [44] and [76]]

***TGbp editor: Please add the following subclause***

***Note that the specification framework(25/1613r0) doesn’t divide DL and UL modulation and coding, so this document is revised based on PDT(25/1333r0) of “UL modulation and coding” from Alice (Qualcomm).***

***Please find black sentences for UL from DCN 25/1330r0.***

***Please find green sentences for DL which I added.***

## **40.3 AMP PHY**

### **40.3.5 AMP modulation and coding schemes (AMP-MCSs)**

The AMP modulation and coding scheme (MCS) represents the modulation and coding scheme used in the AMP-Data field of the AMP PPDUs.

There is one MCS corresponding to 250 kb/s data rate in DL backscattering transmissions. There are two MCSs, corresponding to 250 kb/s and 1 Mb/s data rates, in DL non-backscattering transmissions. The DL MCS in DL transmissions is determined by the AMP AP. The rate-dependent parameters are given in Table 40-D (MCS for DL AMP PPDU).

There are two MCSs, corresponding to 250 kb/s and 1 Mb/s data rates, in UL backscattering transmissions. There are three data rates, 250 kb/s, 1 Mb/s and 4 Mb/s, in UL active transmissions. The UL data rate or MCS in UL backscattering transmissions or UL active transmissions is indicated by the AMP AP in the preceding AMP Trigger frame. The rate-dependent parameters for UL backscattering transmissions and UL active transmissions are given in Table 40-B (MCS for UL AMP PPDU in Backscattering Transmission) and Table 40-C (MCS for UL AMP PPDU in Active Transmission), respectively.

### **40.3.9 Data field**

#### **40.3.9.1 Modulation**

On-off keying (OOK) modulation is used for the AMP-Data field in DL transmissions, UL backscattering transmissions and UL active transmissions. The AMP OOK modulation in DL transmissions and UL backscattering transmissions shall be generated by using the multicarrier on-off keying (MC-OOK) modulation technique with a signal constructed from multiple subcarriers. The AMP OOK modulation in UL active transmissions is generated by TBD.

In DL transmissions, the duration of the AMP OOK symbol corresponding to each encoded bit is dependent on the AMP data rate: 2 μs for 250 kb/s and 0.5 μs for 1 Mb/s. For 250 kb/s, 2 μs duration AMP OOK Off and On symbols are denoted as SymMcOokMcs0Off and SymMcOokMcs0On, respectively. For 1 Mb/s, 0.5 μs duration AMP OOK Off and On symbols are denoted as SymMcOokMcs1Off and SymMcOokMcs1On, respectively.

In UL backscattering transmissions, the duration of the AMP OOK symbol corresponding to each encoded bit is dependent on the AMP data rate: 2 μs for 250 kb/s and 0.5 μs for 1 Mb/s. For 250 kb/s, 2 μs duration AMP OOK Off and On symbols are denoted as SymMcOokMcs0Off and SymMcOokMcs0On, respectively. For 1 Mb/s, 0.5 μs duration AMP OOK Off and On symbols are denoted as SymMcOokMcs1Off and SymMcOokMcs1On, respectively.

In DL AMP transmissions or UL backscattering transmissions, SymMcOokMcs0On and SymMcOokMcs1On are described in 40.3.7 (Mathematical description of signals). The generation of SymMcOokMcs0On and SymMcOokMcs1On is described in 40.3.3.1 (AMP DL carrier wave generation).

In UL active transmissions, the duration of the AMP OOK symbol corresponding to each encoded bit is dependent on the AMP data rate: TBD μs for 250 kb/s, TBD μs for 1 Mb/s, and TBD μs for 4 Mb/s. For 250 kb/s, TBD μs duration AMP OOK Off and On symbols are denoted as SymAtMcs0Off and SymAtMcs0On, respectively. For 1 Mb/s, TBD μs duration AMP OOK Off and On symbols are denoted as SymAtMcs1Off and SymAtMcs1On, respectively. For 4 Mb/s, TBD μs duration AMP OOK Off and On symbols are denoted as SymAtMcs2Off and SymAtMcs2On, respectively.

In UL active transmissions, SymAtMcs0On, SymAtMcs1On and SymAtMcs2On are described in 40.3.7 (Mathematical description of signals). The generation of SymAtMcs0On, SymAtMcs1On and SymAtMcs2On is described in 40.3.3.1a (AMP UL active transmission carrier wave generation).

#### **40.3.9.2 Coding**

##### **40.3.9.2.1 General**

In DL transmissions, the AMP OOK symbols are Manchester encoded for both data rates of 250 kb/s and 1 Mb/s.

In UL backscattering transmissions, the AMP OOK symbols are Manchester encoded for both data rates of 250 kb/s and 1 Mb/s. In UL active transmissions, the AMP OOK symbols are Manchester encoded for both data rates of 250 kb/s and 1 Mb/s, and are TBD for 4 Mb/s.

##### **40.3.9.2.2 Manchester coding**

Manchester encoded bits corresponding to each input bit are shown in Table 40-A (AMP Manchester encoded bits). The encoded binary data shall be modulated so that encoded bits 0 and 1 shall be represented by Off and On symbols, respectively.

###### Table 40-A AMP Manchester encoded bits

|  |  |
| --- | --- |
| **Input bit** | **Encoded bits** |
| 0 | 10 |
| 1 | 01 |

## **40.5 Parameters for AMP-MCSs**

The rate-dependent parameters for UL backscattering transmissions are given in Table 40-B (MCS for UL AMP PPDU in Backscattering Transmission). Manchester encoding and OOK modulation shall be used for all MCS in the AMP-Data field of an UL AMP PPDU in backscattering transmission.

Table 40-B MCS for UL AMP PPDU in Backscattering Transmission

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **AMP-UL-BS-MCS index** | **Modulation** | **Symbol Structure** | | **Equivalent information bit duration** | **NSPDB** | **Data rate (kb/s)** |
| 0 | AMP MC-OOK | Information 0 | [SymMcOokMcs0On, SymMcOokMcs0Off] | 4 μs | 2 | 250 |
| Information 1 | [SymMcOokMcs0Off, SymMcOokMcs0On] |
| 1 | AMP MC-OOK | Information 0 | [SymMcOokMcs1On, SymMcOokMcs1Off] | 1μs | 2 | 1000 |
| Information 1 | [SymMcOokMcs1Off, SymMcOokMcs1On] |

The rate-dependent parameters for UL active transmissions are given in Table 40-C (MCS for UL AMP PPDU in Active Transmission). Manchester encoding and OOK modulation shall be used for 250 kb/s and 1 Mb/s in the AMP-Data field of an UL AMP PPDU in active transmission. 4 Mb/s is TBD. In UL active transmissions, the duration of the AMP OOK symbol corresponding to each encoded bit is different for different data rates. The duration of the AMP OOK symbol corresponding to each encoded bit for each data rate is TBD.

Table 40-C MCS for UL AMP PPDU in Active Transmission

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **AMP-UL-AT-MCS index** | **Modulation** | **TBD** | **TBD** | **TBD** | **TBD** | **Data rate (kb/s)** |
| 0 | AMP OOK | TBD | TBD | TBD | TBD | 250 |
| TBD | TBD | TBD | TBD |
| 1 | AMP OOK | TBD | TBD | TBD | TBD | 1000 |
| TBD | TBD | TBD | TBD |
| 2 | AMP OOK | TBD | TBD | TBD | TBD | 4000 |
| TBD | TBD | TBD | TBD |

The rate-dependent parameters for DL transmissions are given in Table 40-C (MCS for DL AMP PPDU). Manchester encoding and OOK modulation shall be used for all MCS in the AMP-Data field of an UL AMP PPDU in backscattering transmission.

Table 40-C MCS for DL AMP PPDU

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **AMP-DL-MCS index** | **Modulation** | **Symbol Structure** | | **Equivalent information bit duration** | **NSPDB** | **Data rate (kb/s)** |
| 0 | AMP MC-OOK | Information 0 | [SymMcOokMcs0On, SymMcOokMcs0Off] | 4 μs | 2 | 250 |
| Information 1 | [SymMcOokMcs0Off, SymMcOokMcs0On] |
| 1 | AMP MC-OOK | Information 0 | [SymMcOokMcs1On, SymMcOokMcs1Off] | 1μs | 2 | 1000 |
| Information 1 | [SymMcOokMcs1Off, SymMcOokMcs1On] |

**References:**

1. [11-24-1613r10](https://mentor.ieee.org/802.11/dcn/24/11-24-1613-10-00bp-specification-framework-for-tgbp.docx): Specification Framework for TGbp, Yinan Qi (OPPO)