IEEE P802.11  
Wireless LANs

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| **Specification Framework for TGbp** | | | | |
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Abstract

This document provides the framework from which the draft TGbp amendment will be developed. The document provides an outline of each the functional blocks that will be a part of the final amendment. The document is intended to reflect the working consensus of the group on the broad outline for the draft specification. As such it is expected to begin with minimal detail reflecting agreement on specific techniques and highlighting areas on which agreement is still required. It may also begin with an incomplete feature list with additional features added as they are justified. The document will evolve over time until it includes sufficient detail on all the functional blocks and their inter-dependencies so that work can begin on the draft amendment itself.

# Revision history

|  |  |  |
| --- | --- | --- |
| Revision | Date | Changes |
| 0 | Sep 09, 2024 | Initial version |
| 1 | Sep 19, 2024 | Add motions passed in 2024 September meeting |
| 2 | Sep 25, 2024 | Revised version based on the comments from task group members |
| 3 | Nov 21, 2024 | Add motions passed in 2024 November meeting |
| 4 | Feb 01, 2025 | Add motions passed in 2025 January meeting |
| 5 | Mar 06, 2025 | Revised version based on the comments for task group members |
| 6 | Mar 10, 2025 | Revised version based on the comments for task group members |
| 7 | Mar 20, 2025 | Add motions passed in 2025 March meeting |

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# Abbreviations and acronyms

AMP ambient power

WPT wireless power transfer

OOK on-off keying

# AMP architecture



## General

* **AM-1**: 11bp defines an “AMP AP STA”
  + AMP non AP STAs may or may not communicate with AMP AP STA without association
  + The AMP AP STA may or may not provide access to the DS for the AMP non AP STA
  + Note: the AMP AP STA may be part of an access point.

[Motion #22, [1], [16] and [17]]

* **AM-2**:
  + Backscatter non-AP AMP STA: A non-AP AMP STA that is capable of receiving only AMP Downlink PPDUs and supports uplink backscatter transmission.
  + Active Tx non-AP AMP STA: A non-AP AMP STA that is capable of receiving only AMP Downlink PPDUs and supports active transmission of AMP Uplink PPDUs.
  + AMP Enabled non-AP STA: A non-AP STA (e.g. non-HT, HT or HE STA) that is also capable of receiving AMP Downlink PPDUs.

[Motion #29, [1] and [18]]

* **AM-3**:
  + IEEE 802.11bp defines an AMP Energizer that contains an Energizing Function, which is capable of transmitting WPT waveform and/or excitation waveform for backscattering operation. Additionally, the AMP Energizer may contain or be co-located (which one is TBD) with an IEEE 802.11 non-AMP non-AP STA.
  + Note: WPT waveform is transmitted over sub1-GHz. Depending on whether the backscattering operation happens in sub1-GHz or 2.4GHz, accordingly the excitation waveform will be transmitted in the same band.

[Motion #34, [1], [30] and [31]]

## Architecture feature #1

Description for Architecture feature #1

## Architecture feature #2

Description for Architecture feature #2

# AMP MAC



## General

This section describes the functional blocks in the AMP MAC.

## AMP TSF

* **MM-1**: If AMP device is able to support AMP TSF, the maximum timing offset is ±104 ppm.

[Motion #13, [1] and [2]]

## UL access

* **MM-2**: 11bp defines a mechanism to allow an AP to solicit AMP uplink PPDU(s) from one or more 802.11bp clients.

[Motion #24, [1] and [19]]

* **MM-6**: 802.11bp to define a slot-based procedure to enable one or more clients to access the medium to send uplink AMP PPDU(s).

[Motion #45, [1] and [19]]

* **MM-7**: 802.11bp defines an AMP Trigger frame that an AP transmits to solicit UL AMP PPDU(s) from one or more 802.11bp clients and may carry the following content
  + Transmitter ID
  + Receiver ID(s)
  + FCS
  + Other parameters TBD.

[Motion #46, [1], [20] and [52]]

* **MM-8**:
  + An 802.11bp client may use the receive time of the AMP Trigger frame, which solicits UL AMP PPDUs from the client, to determine the timing for transmitting UL AMP PPDUs in the same TXOP
  + The definition of receive time is TBD.

[Motion #47, [1], [53]]

* **MM-9**: When the AP solicits UL AMP PPDUs from 802.11bp clients using a slot-based procedure, the AMP Trigger frame shall carry the following parameters
  + Number of slots for UL PPDU transmissions in that TXOP
  + Other parameters TBD.

[Motion #48, [1], [19] and [53]]

* **MM-10**: 802.11bp supports a time-slot based random access mechanism for Active Tx non-AP AMP STAs:
  + AMP AP transmits an AMP frame that indicates one or more time-slots.
  + Further details (e.g., frame formats, how a STA chooses a random access time-slot etc.) are TBD.

[Motion #50, [1], [54], [55], [56] and [57]]

* **MM-11**: 802.11bp supports a time-slot based scheduled access mechanism for Active Tx non-AP AMP STAs:
  + AMP AP transmits an AMP frame to assign one or more transmission time-slots.
  + Further details (e.g., frame formats, how the time-slots are assigned etc.) are TBD.

[Motion #51, [1], [54], [55], [56] and [57]]

* **MM-13**: AMP trigger frame may indicate parameters for a slot-based procedure of time slots to AMP non-AP STA(s).
  + The exact parameters are TBD.

[Motion #56, [1], [62] and [63]]

## Duty-cycle operation

* **MM-4**: If an AMP device is able to support TSF, it can monitor AMP DL Frame in a duty-cycle manner.

[Motion #32, [1], [21] and [22]]

## Secure communication

* **MM-3**: 11bp defines a mechanism to support secure communications for 802.11bp clients.

[Motion #26, [1] and [20]]

* **MM-5**:
  + IEEE 802.11bp will specify secure data communication methods that do not require maintaining security associations.
  + Note:
    - The methods are based on existing 802.11 security protocols.
    - The security for backscattering AMP devices are TBD.
    - The details are TBD.

[Motion #44, [1], [47], [48], [49], [50] and [51]]

## Support of UHF RFID logicl interface

* **MM-12**: 11bp supports a mode of operation in which a sub-set of the logical interface of the UHF RFID Standard is used for backscattering communication.
  + Applicable UHF commands are carried in 802.11bp frames.
  + Applicable to both mono-static & bi-static backscattering.
  + The sub-set of the logical interface to be reused is TBD.
  + NOTE – The logical interface of the UHF RFID Standard is defined by the EPC® Radio-Frequency Identity Generation-2 UHF RFID Standard.

[Motion #52, [1], [54], [55], [56] and [57]]

## MAC feature #6

Description for MAC feature #2

# AMP PHY



## General

* **PM-1**: 11bp supports a mode to enable AMP devices to operate in legacy WLAN network by defining AMP DL and required control/signaling.

[Motion #7, [1] and [3]]

* **PM-2**: 11bp defines at least one mode of MAC/PHY that allows an AMP-only device with active uplink communication in 2.4GHz subject to the following requirements:
  + clock accuracy requirement is relaxed compared to legacy 802.11 devices;
  + the active uplink communication can only be sent in response to being polled by the AP.

[Motion #14, [1] and [4]]

* **PM-3**: 11bp defines at least one mode of MAC/PHY that supports close-range mono-static backscattering communication in 2.4 GHz.

[Motion #15, [1] and [5]]

* **PM-4**: 11bp defines at least one mode of MAC/PHY that supports bi-static backscattering communication in 2.4 GHz.

[Motion #15, [1] and [6]]

## DL PPDU

### General

This section describes DL PPDU design.

### DL PPDU format

* **PM-5**: IEEE 802.11bp will specify, in 2.4 GHz, an AMP Downlink PPDU containing at least an 802.11 preamble field, an AMP-Sync field and an AMP-Data field. Inclusion of an AMP-SIG field is TBD.
  + The details of the 802.11 preamble field are TBD.
  + Additionally, for transmission to backscatter STAs there will be one or more Excitation fields
  + Additionally, for transmission to backscatter STAs there may be more than one AMP-Data field
    - Additionally, AMP-Sync and AMP-SIG field may precede each AMP-Data field
  + Name of this Downlink PPDU is TBD.

[Motion #8, [1] and [7]]

* **PM-15**: The preamble of an AMP DL PPDU includes L-STF, L-LTF, L-SIG, RL-SIG, and U-SIGs for AMP enabled non-AP STA and active TX non-AP AMP STA in 2.4 GHz.

[Motion #28, [1] and [23]]

* **PM-16**: The (3dB) bandwidth of the AMP DL PPDU in 2.4 GHz is at least 10 MHz for backscattering communication. The transmit spectrum mask is TBD.

[Motion #30, [1], [24] and [25]]

* **PM-21**:
  + The carrier waveform for AMP Downlink PPDU is constructed by repeating one predefined base waveform of TBD micro-second, and additional pseudo-random phase is applied to each base waveform
  + The base waveform definition is TBD.
  + Note:
    - The SYNC and Data fields are OOK modulated on the carrier waveform.
    - The Excitation field is not OOK modulated.

[Motion #39, [1], [40], [41], [42] and [43]]

### AMP-Sync field

* **PM-10**: The AMP-Sync field in AMP Downlink PPDU in 2.4 GHz is defined with chip duration of 2µs for backscattering case.

[Motion #18, [1] and [10]]

* **PM-18**: IEEE 802.11bp defines at least one AMP-Sync in the AMP Downlink PPDU in 2.4 GHz for backscatter communication, and at least one AMP-Sync in the AMP Downlink PPDU in 2.4 GHz for non-backscatter communication. The AMP-Sync is independent of the integrated and non-integrated deployment.

[Motion #33, [1] and [26]]

### Modulation, coding and data rates

* **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 backscattering:
  + 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, [1], [40], [41], [42] and [43]]

## UL PPDU

### General

* **PM-12**: When performing transmission, the maximum clock offset is ± 103 ppm for AMP Non-AP STA supporting active transmission.

[Motion #20, [1], [12] and [13]]

* **PM-14**: 11bp defines one mode of backscattering without carrier center frequency shift.

[Motion #27, [1] and [27]]

### UL PPDU format

* **PM-8**: IEEE 802.11bp shall specify, in 2.4 GHz, an AMP uplink PPDU for AMP STA supporting active transmission that contains an AMP-Sync field and AMP-Data field. Inclusion of an AMP-SIG field in the AMP uplink PPDU is TBD.
  + The bandwidth of the AMP uplink PPDU is less than 20 MHz.

[Motion #11, [1] and [8]]

* **PM-24**:
  + 11bp shall specify, in 2.4 GHz, an AMP UL PPDU for backscatter non-AP AMP STAs that contains an AMP-Sync field and an AMP-Data field.
  + Note: This AMP UL PPDU is within one excitation field of an AMP DL PPDU.

[Motion #42, [1], [44], [45] and [46]]

### Modulation, coding and data rates

* **PM-11**: 11bp defines Manchester encoding for the data portion of UL transmission in 2.4 GHz, including both backscattering and active transmission.

[Motion #19, [1] and [11]]

* **PM-13**: 11bp will define On-Off Keying (OOK) modulation for AMP-Sync field and the AMP-Data field in an AMP Uplink PPDU for Active Transmission.

[Motion #21, [1], [14] and [15]]

* **PM-17**: 11bp defines the following data rates for AMP uplink transmissions at 2.4GHz
  + 250kbps and 1Mbps for both backscatter and non-backscatter uplink transmission;
  + 4Mbps for non-backscatter uplink transmission only.
    - Mandatory or optional is TBD

[Motion #31, [1], [28] and [29]]

* **PM-20**: The AMP-Sync field and the AMP-Data field of AMP UL PPDU for backscatter communication use OOK modulation.

[Motion #38, [1], [40]]

* **PM-25**:
  + The PHY parameters (at least data rate) for AMP UL transmission are indicated by the AMP AP.
  + Other PHY parameters TBD.

[Motion #43, [1], [44]]

## PHY feature #3

Description for PHY feature #3

# AMP WPT



## General

* **WM-4**: WPT signals from two or more transmitters in S1GHz are allowed to occupy the same channel simultaneously.

[Motion #54, [1], [60] and [61]]

## Energizer control

* **WM-1**: IEEE 802.11bp defines a mechanism that allows control information to be sent by AMP AP STA to the AMP Energizer. The control information is TBD.

[Motion #35, [1], [31], [32] and [33]]

* **WM-3**:
  + Control information that is sent from the AMP AP to the AMP Energizer relating to the WPT waveform may include at least one or more of the following: Start Time, Duration, Interval, Transmit Power, and frequency related parameters.
  + The frequency related parameters may include central frequency information, bandwidth information, etc.
  + Note: Interval refers to a repetition of the WPT waveform.

[Motion #53, [1], [31], [32], [33], [35], [58] and [59]]

* **WM-5**: Energizer should report its WPT and excitation related capability to the AMP AP. The parameters to be reported are TBD.

[Motion #55, [1], [58]]

## AMP non-AP STA reporting

* **WM-2**: IEEE 802.11bp defines a mechanism that allows an AMP non-AP STA to report its energy harvesting and power related information to AMP AP STA. The parameters that are included in the report and how to report such information is TBD.

[Motion #36, [1], [32]-[39]]

## WPT feature #3

Description for WPT feature #2

# Frame format



## General

* **FM-1**: 11bp defines communication between AMP non AP STA and AMP AP STA through 11bp frames.

[Motion #23, [1], [16] and [17]]

* **FM-2**: 802.11bp defines an AMP Ack frame that an AMP AP transmits to acknowledge the received UL AMP frame(s).

[Motion #49, [1], [52]]

## Field #1

Description for field #1

## Field #2

Description for field #2

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