IEEE P802.11  
Wireless LANs

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| **Specification Framework for TGbp** | | | | |
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| **Author(s):** | | | | |
| **Name** | **Affiliation** | **Address** | **Phone** | **email** |
| Yinan Qi | OPPO | 18 Haibin Road, Wusha, Chang'an Town, Dongguan, Guangdong Province, P.R. China |  | [v-qiyinan@oppo.com](mailto:v-qiyinan@oppo.com) |

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 from task group members |
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| 7 | Mar 20, 2025 | Add motions passed in 2025 March meeting |
| 8 | May 22, 2025 | Add motions passed in 2025 May meeting |
| 9 | June 06, 2025 | Revised version based on the comments from task group memebers |
| 10 | July 17, 2025 | Revised version based on the comments from task group memebers |
| 11 | August 11, 2025 | Add motions passed in 2025 July meeting |
| 12 | August 19, 2025 | Revised version based on the comments from task group memebers |
| 13 | October 09, 2025 | Add motions passed in 2025 September meeting |

**Table of Contents**

[Revision history 2](#_Toc206484303)

[1. Abbreviations and acronyms 5](#_Toc206484304)

[2. AMP architecture 5](#_Toc206484305)

[2.1 General 5](#_Toc206484308)

[2.2 Architecture feature #1 5](#_Toc206484309)

[2.3 Architecture feature #2 5](#_Toc206484310)

[3. AMP MAC 6](#_Toc206484311)

[3.1 General 6](#_Toc206484313)

[3.2 AMP TSF 6](#_Toc206484314)

[3.3 UL access 6](#_Toc206484315)

[3.4 Power management for AMP non-AP STA 7](#_Toc206484316)

[3.4.1 Duty-cycle operation 7](#_Toc206484317)

[3.4.2 Service period 7](#_Toc206484318)

[3.5 Secure communication 8](#_Toc206484319)

[3.5.1 General 8](#_Toc206484320)

[3.5.2 Key generation 8](#_Toc206484321)

[3.5.3 Secured data communication 9](#_Toc206484322)

[3.6 Support of UHF RFID logic interface 9](#_Toc206484323)

[3.7 Power management for AMP-enabled non-AP STA 10](#_Toc206484324)

[3.8 MAC feature #7 10](#_Toc206484325)

[4. AMP PHY 10](#_Toc206484326)

[4.1 General 10](#_Toc206484328)

[4.2 AMP clock accuracy 11](#_Toc206484329)

[4.3 DL PPDU 11](#_Toc206484330)

[4.3.1 General 11](#_Toc206484331)

[4.3.2 DL PPDU format 11](#_Toc206484332)

[4.3.3 Waveform generation 13](#_Toc206484333)

[4.3.4 DL non-AMP portion preamble 13](#_Toc206484334)

[4.3.5 DL AMP-Sync field 14](#_Toc206484335)

[4.3.6 Modulation, coding and data rates 15](#_Toc206484336)

[4.4 UL PPDU 16](#_Toc206484337)

[4.4.1 General 16](#_Toc206484338)

[4.4.2 UL PPDU format 16](#_Toc206484339)

[4.4.3 UL AMP-Sync field 16](#_Toc206484340)

[4.4.4 Modulation, coding and data rates 16](#_Toc206484341)

[4.5 PHY feature #3 17](#_Toc206484342)

[5. AMP WPT 17](#_Toc206484343)

[5.1 General 17](#_Toc206484345)

[5.2 Energizer control 17](#_Toc206484346)

[5.3 AMP non-AP STA reporting 18](#_Toc206484347)

[5.4 WPT coexistence 18](#_Toc206484348)

[5.5 WPT feature #4 18](#_Toc206484349)

[6. AMP frame format 19](#_Toc206484350)

[6.1 General 19](#_Toc206484352)

[6.2 AMP Trigger frame 19](#_Toc206484353)

[6.3 AMP Ack frame 20](#_Toc206484354)

[6.4 AMP Wake-Up frame 20](#_Toc206484355)

[6.5 Field #4 20](#_Toc206484356)

[7. References 20](#_Toc206484357)

# 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]]

* **MM-23**: 802.11bp defines short timestamp to enable AMP NON-AP STA to monitor DL frames in duty-cycle operation.
  + The length of short timestamp is TBD..

[Motion #82, [1], [63], [78] and [79]]

* **MM-26**: 802.11bp specifies, for a short timestamp, coarse timing granularity larger than 1µs.
  + The detailed timing granularity are TBD.

[Motion #104, [1], [63], [78], [79] and [99]]

* **MM-31**: An AMP AP may transmit the AMP AP's partial timestamp in a broadcast AMP frame (name TBD). Length of the partial timestamp is TBD.

[Motion #115, [1], [22], [74], [75] and [114]]

## 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**:
  + 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-8**: 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-9**: 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-25**: 802.11bp supports a time-slot based random access mechanism, which includes:
  + Non-AP AMP STA randomly selects a time-slot among time-slots indicated by an AMP Trigger and the non-AP AMP STA transmits an uplink PPDU in the selected slot.
  + How to do random selection is TBD.

[Motion #102, [1] and [104]]

* **MM-26**: 802.11bp supports a two phases access mechanism for Active Tx non-AP AMP STAs, which includes:
  + Based on the uplink frame received in the one or more random access time-slots indicated by an AMP trigger frame from an AMP AP, the AMP AP can transmit another AMP trigger frame to assign one or more transmission time-slots for non-AP AMP STA(s) in a scheduled phase.

[Motion #103, [1] and [105]]

* **MM-27**: Upon receiving the AMP Trigger frame indicating a time-slot based random access session, a non-AP AMP STA performs the following actions:
  + Based on the Random Access Parameters, the non-AP AMP STA may transmit an uplink AMP PPDU carrying the uplink response in one of the slots allocated by the AMP Trigger frame.

[Motion #106, [1], [106], [107] and [108]]

* **MM-28**:
  + Upon receiving the AMP Trigger frame indicating a time-slot based scheduled access for non-AP AMP STA(s), a non-AP AMP STA performs the following actions:
    - If the AMP Trigger frame carries the ID of the non-AP AMP STA, the non-AP AMP STA may transmit an uplink AMP PPDU carrying the requested response in one of the time slots allocated by the AMP trigger frame.
  + the option of more than one Non-AP AMP STAs in multiple slots is limited to Active Tx communication.

[Motion #108, [1], [106], [107] and [108]]

## Power management for AMP non-AP STA

### 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]]

* **MM-24**: 802.11bp defines one mechanism that a non-AP AMP STA can derive its specific AMP service period in order to monitor AMP DL Frame.

[Motion #101, [1], [100], [101] and [103]]

### Service period

* **MM-22**: IEEE 802.11bp defines an AMP Service Period, that allows an Active Tx non-AP AMP STA to enter doze state after a minimum wake up time since the start of the AMP Service Period, if the Active Tx non-AP AMP STA does not receive any AMP DL PPDU from the AMP AP.

[Motion #75, [1], [22], [74] and [75]]

## Secure communication

### General

* **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]]

* **MM-21**:
  + 11bp uses short local addresses for AMP non-AP STAs in secure AMP communications.
  + Note—Whether to include backscatter non-AP STAs in this procedure is TBD

[Motion #68, [1], [67] and [68]]

### Key generation

* **MM-14**: 802.11bp defines for AMP-enabled non-AP STA:
  + AMP temporal key (ATK) to protect individually addressed AMP frames
  + AMP integrity group temporal key (AIGTK) to protect group addressed AMP frames

[Motion #61, [1], [64]]

* **MM-15**: 802.11bp uses the baseline authentication procedure for AMP-enabled non-AP STA to generate AMP temporal key(s) to protect individually and group addressed AMP frames.

[Motion #62, [1], [64]]

* **MM-17**: 802.11bp defines a mechanism to generate a transient key for an AMP non-AP STA that supports secure communication, where:
  + An AMP AP transmits a downlink frame containing an ANonce.
  + After receiving the downlink AMP frame from the AMP AP that contains an ANonce, an AMP non-AP STA generates an SNonce.
  + The AMP non-AP STA generates a transient key using the ANonce, the SNonce, the Authenticator Address (AA), the Supplicant Address (SA), and a Pairwise Master Key (PMK) between the AP and the client.
  + Note—Whether to include backscatter non-AP STAs in this procedure is TBD.

[Motion #64, [1], [50], [20], [65] and [66]]

* **MM-18**: 802.11bp defines a mechanism to generate a transient key for an AMP AP that supports secure communication, where:
  + In response to the DL AMP frame from the AMP AP that contains an ANonce, the AMP AP receives an UL AMP frame from an AMP non-AP STA that carries the SNonce and a MIC.
    - The AMP non-AP STA generates the MIC using the derived transient key at the AMP non-AP STA.
    - If the uplink AMP frame is carrying any UL data, the data payload portion of the uplink AMP frame may be encrypted using the transient key generated at the AMP non-AP STA.
  + If the MIC is verified:
    - The AP uses the ANonce it transmitted in the previous downlink AMP frame, the SNonce, the Authenticator Address (AA), the Supplicant Address (SA), and the PMK to generate the transient key.
    - Using the generated transient key, the AMP AP decrypts the UL data payload (if the payload was encrypted).
  + Note—Whether to include backscatter non-AP STAs in this procedure is TBD.

[Motion #65, [1], [50], [20], [65] and [66]]

* **MM-30**: 11bp shall specify a low-complexity secure method to generate and update a PMK for secure AMP communication between an AMP AP and an AMP non-AP STA?
* Note:
  + The secure AMP communication method is defined in Motion 64, 65, 66.
  + Whether to include backscatter non-AP STAs in this method is TBD.

[Motion #113, [1], [68] and [111]]

### Secured data communication

* **MM-19**: the transient key generation at the AP and the AMP client in 802.11bp may occur concurrently with AMP downlink and uplink data communication:
  + The downlink AMP frame from the AP carries ANonce along with downlink data from the AP (e.g., AMP trigger).
  + The uplink AMP frame from the AMP client carries SNonce and MIC along with the UL data (e.g., UL response to the AMP trigger).
    - The UL data may be encrypted using the transient key generated at the AMP non-AP STA.
  + Note—Whether to include backscatter non-AP STAs in this procedure is TBD.

[Motion #66, [1], [50], [20], [65] and [66]]

* **MM-20**: the transient key generation at the AP and the AMP client in 802.11bp may be performed immediately before AMP downlink and uplink data communication:
  + Once the transient key is derived at both the AP and the AMP client, subsequent AMP data communication between the AP and the client can be secured using MIC and/or encryption based on the generated transient key.
  + Note—Whether to include backscatter non-AP STAs in this procedure is TBD.

[Motion #67, [1] and [20]]

## Support of UHF RFID logic interface

* **MM-10**: 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.

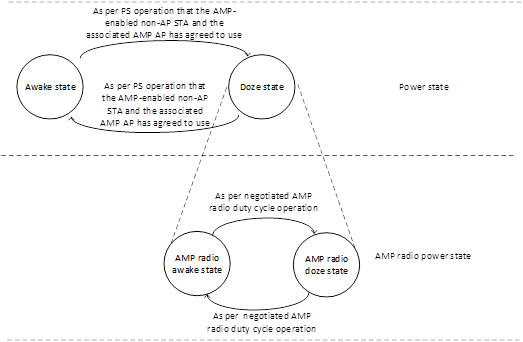
[Motion #52, [1], [54], [55], [56] and [57]]

* **MM-29**: For backscatter communication, 11bp shall support the following UHF commands as defined by the UHF RFID Standard:
  + Select, Read, Write, Authenticate
  + Other UHF commands supported by 11bp is TBD
  + NOTE – The UHF commands and the tag states are defined by the EPC® Radio-Frequency Identity Generation-2 Version 2 UHF RFID Standard.

[Motion #111 and #112, [1], [108] and [110]]

## Power management for AMP-enabled non-AP STA

* **MM-11**: 802.11bp defines an AMP duty cycle operation for an AMP-enabled non-AP STA, which follows the state transition diagram shown in the figure.
  + AMP duty cycle operation follows the negotiation procedure defined for WUR in the baseline



[Motion #58, [1], [64]]

* **MM-12**: If an AMP-enabled non-AP STA successfully receives an AMP Wake-Up frame from the associated AMP AP, the non-AP STA should transition to the Awake State and transmit a PS-Poll/UL frame to the AP to indicate that it is in the Awake State (PS/Active mode).

[Motion #59, [1], [64]]

* **MM-13**: If the non-AP STA transmits a frame with PM = 1 to the associated AP, then the non-AP may transition to the Doze state, and the AMP-enabled non-AP STA shall enter the AMP mode.

[Motion #60, [1], [64]]

* **MM-16**: an AMP-enabled non-AP STA and the associated AMP AP use AMP mode setup to exchange AMP capabilities
  + AMP mode setup may occur during the association procedure or post-association.

[Motion #63, [1], [64]]

## MAC feature #7

Description for MAC feature #7

# 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]]

* **PM-29**: 11bp defines at least one mode of MAC/PHY that supports mono-static backscattering communication in sub-1 GHz.

[Motion #73, [1] and [72]]

## AMP clock accuracy

* **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-28**: The maximum allowed clock inaccuracy for the backscattering tag using OOK modulation is 100,000 ppm for both receive mode and backscattering transmit mode.

[Motion #72, [1], [15] and [71]]

* **PM-34**: The maximum clock offset for a non-backscatter STA is ±10,000 PPM when receiving.

[Motion #84, [1] and [84]]

* **PM-56**: The receiver requirements for a non-AP AMP STA capable of bistatic backscatter in 2.4 GHz shall be the same as that of an active Tx non-AP AMP STA. This includes,
  + Clock accuracy, center frequency accuracy.

[Motion #133, [1] and [121]]

## 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-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]]

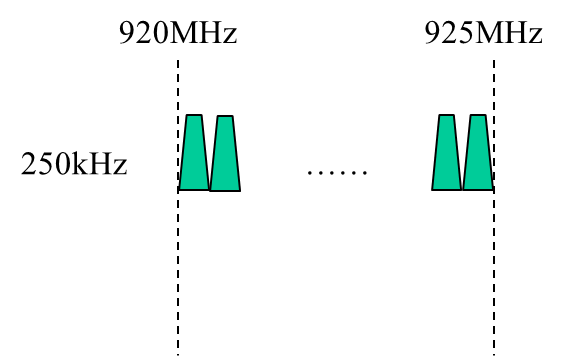
* **PM-38**: 11bp defines two PPDU variants of the AMP DL PPDU for backscattering operation in 2.4GHz.
  + PPDU subtype 1 consists of the 802.11bp preamble, an Excitation field, an AMP SYNC field, and an AMP Data field and an Excitation field

https://www.ieee802.org/11/email/stds-802-11-tgbp/pngTI16YYYUYn.png

* + PPDU subtype 2 consists of the 802.11bp preamble, an AMP SYNC field, and an AMP Data field and an Excitation field.

https://www.ieee802.org/11/email/stds-802-11-tgbp/pngShn5usl31L.png

* [Motion #88, [1] and [90]]
* **PM-45**: 11bp shall adopt the following channelization scheme for China:
  + Operating bands: 920-925MHz
  + Bandwidth 250kHz
  + There are 20 channels, with center frequency (MHz): (920.125+N\*0.25) MHz, N=0,…,19



[Motion #95, [1] and [97]]

* **PM-46**: For mono-static backscattering communication in sub-1 GHz, the maximum allowed clock inaccuracy for the backscattering tag is 100,000 ppm for both receive mode and backscattering transmit mode.
  + 11bp shall specify an AMP-S1G Downlink PPDU supporting downlink transmission for backscattering AMP STA in sub-1 GHz. AMP-S1G Downlink PPDU contains at least an Excitation field, an AMP-Sync field and an AMP-Data field.
    - Inclusion of an AMP-SIG field is TBD.
    - Inclusion of an 802.11 preamble is TBD.
    - Additionally, there will be one or more Excitation fields
    - Additionally, there may be more than one AMP-Data field
    - Additionally, AMP-Sync and AMP-SIG field may precede each AMP-Data field
  + 11bp shall specify an AMP-S1G Uplink PPDU supporting uplink transmission for backscattering AMP STA in sub-1 GHz. AMP-S1G Uplink PPDU contains an AMP-Sync field and AMP-Data field.
  + The AMP-S1G Downlink PPDU and AMP-S1G Uplink PPDU AMP-Data field will use Manchester encoding for backscattering operation.
  + The AMP-Sync field and the AMP-Data field of AMP-S1G Downlink PPDU and AMP-S1G Uplink PPDU for backscatter communication use OOK modulation

[Motion #96, [1] and [97]]

* **PM-55**:
* The AMP DL PPDU for bistatic backscattering operation in 2.4GHz shall be PPDU subtype 2.
  + PPDU subtype 2 consists of the 802.11bp preamble, an AMP SYNC field, and an AMP Data field and an Excitation field.
  + The AMP SYNC is the same sync design as for active Tx non-AP AMP STA.
  + The AMP Data uses the same Manchester encoded OOK with data rates of 250kbps, 1 Mbps.

https://www.ieee802.org/11/email/stds-802-11-tgbp/pngShn5usl31L.png

* The AMP Uplink PPDU for bistatic backscattering operation in 2.4GHz shall reuse the following fields from active Tx.
  + The AMP SYNC is the same sync design as for active Tx non-AP AMP STA.
  + The AMP Data uses the same Manchester encoded OOK with data rates of 250kbps, 1 Mbps as same as Active TX non-AP AMP STA.  4 Mbps is TBD.

[Motion #132, [1] and [121]]

* **PM-59**:
* 11bp shall adopt the following channelization scheme for EU:
  + Bands: 865-868MHz
  + BW: 200kHz
  + Channel center frequency: 865.1+N\*0.2, N=0,…,14;
* Note: support of 400kHz bandwidth in 915-921MHz is TBD.

[Motion #136, [1] and [123]]

### Waveform generation

* **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]]

* **PM-26**:
  + The SYNC, Data field and Excitation field of 11bp DL PPDU use OFDM symbol as base carrier waveform for OOK modulated AMP communication.

[Motion #70, [1], [41], [42] and [70]]

* **PM-27**:
  + The base OFDM symbol is defined as 4us OFDM symbol, and generated by performing 64-point IFFT of the predefined sequence and pre-append the last 0.8us waveform as the cyclic prefix.

[Motion #71, [1], [41], [42] and [70]]

* **PM-44**: 11bp recommend single carrier wave as WPT waveform in Sub-1GHz.

[Motion #94, [1] and [96]]

* **PM-47**: The SYNC, Data field and Excitation field of 11bp AMP-S1G Downlink PPDU and AMP-S1G Uplink PPDU use single carrier wave as base carrier waveform for OOK modulated AMP communication.

[Motion #98, [1] and [98]]

### DL non-AMP portion preamble

* **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-36**:
  + The RATE field in L-SIG of an AMP DL PPDU in 2.4 GHz shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing.
  + The LENGTH field in L-SIG of an AMP DL PPDU in 2.4 GHz is set to a value satisfying the condition that the remainder is zero when LENGTH is divided by 3.

[Motion #86, [1], [85] and [89]]

* **PM-37**: An DL AMP PPDU in 2.4 GHz is identified in its U-SIG with the following setting.
  + PHY version value sets to 0
  + One or multiple Validate bit subfields sets to  0 or subfield(s) set to a validate state.

[Motion #87, [1], [85] and [89]]

* **PM-54**: An DL AMP PPDU in 2.4 GHz is identified in its U-SIG with the following setting:
  + PHY version value set to 0
  + PPDU Type And Compression Mode value set to 3..

[Motion #131, [1] and [120]]

### DL 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]]

* **PM-25**:
  + IEEE 802.11bp defines 4 base sequences used for AMP DL/UL SYNC field in 2.4GHz frequency band.
    - 1 base sequences, S1, for DL non-backscatter SYNC field.  S1 and a function of S1, are used for different DL data rate.
    - 1 sequence, S2,  for DL backscatter SYNC field.
    - 1 base sequence, S3, for UL active transmission SYNC field.
    - 1 sequence, S4, for UL backscatter SYNC field.
    - Detailed SYNC sequence designs are TBD
  + Besides the above 4 base sequences, the need of additional sequence S5 is TBD if mono-static and bi-static backscattering UL SYNC field design is different.

[Motion #69, [1] and [69]]

* **PM-30**: IEEE 802.11bp will specify, in 2.4 GHz, DL synchronization sequence with the same chip duration for all data rates for non-backscatter case.

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

* **PM-39**: The AMP DL SYNC for backscattering without frequency shift shall differentiate the operating band of sub-1GHz or 2.4GHz.

[Motion #89, [1] and [91]]

* **PM-40**: The Chip Duration of the Downlink Sync Field Transmitted in 2.4 GHz to a non-Backscatter STA shall be 2 µs.

[Motion #90, [1] and [92]]

* **PM-41**:
* The Downlink Sync Field Transmitted in 2.4 GHz to a non-Backscatter STA shall use a Sequence of Chips  to indicate a data rate of 250 kb/s and a Sequence of Chips  to indicate a data rate of 1 Mb/s.
* Note,  is the Logical Complement of .

[Motion #91, [1] and [92]]

* **PM-42**: The Downlink Sync Field transmitted in 2.4 GHz to a non-Backscatter STA consists of two Segments
  + The first Segment is a Chip Sequence designed to support Sync Field Detection and Timing alignment.
  + The second Segment is a “Special Segment” which is designed to reduce the False Alarm rate.

[Motion #92, [1] and [93]]

* **PM-43**: The AMP-Sync field of the AMP DL PPDU for non-backscatter STAs in 2.4 GHz, shall support both the correlation-based Sync field detector and the differential decoder Sync field detector.

[Motion #93, [1], [94] and [95]]

* **PM-53**: The first segment of the Downlink Sync Field transmitted to non-Backscatter STAs, uses the sequence 𝑾 for the 250 kb/s data rate or the sequence https://www.ieee802.org/11/email/stds-802-11-tgbp/pngS2yvZpOzjJ.pngfor the 1 Mb/s data rate.  The sequences are:
  + 𝑾 = 01011010010111000110001011101100
  + = 10100101101000111001110100010011



[Motion #130, [1] and [119]]

### 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 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]]

* **PM-45**: The AMP-S1G Downlink PPDU shall support at least one the following data rates:
  + 62.5 kb/s
  + Support of other data rates is TBD

[Motion #97, [1] and [98]]

## UL PPDU

### General

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

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

* **PM-33**:
  + 11bp defines at least one mode of bistatic backscatter that can use frequency shifting within a 40 MHz channel in 2.4 GHz band.
  + Existing 40 MHz medium protection mechanisms will be leveraged.

[Motion #83, [1], [80], [81], [82] and [83]]

### 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]]

### UL AMP-Sync field

* **PM-35**: IEEE 802.11bp will specify that the same chip duration is used for AMP sync field and AMP data field of a single AMP UL PPDU in 2.4 GHz
  + For both UL backscattering transmission and UL non-backscattering transmission.

[Motion #85, [1], [76], [85], [86], [87] and [88]]

* **PM-51**: The Uplink Sync Field Transmission from a non-Backscatter STA for all data rates shall have a length 48 chips.

[Motion #128, [1] and [118]]

* **PM-52**:
  + Length-48 sync sequence for UL non-backscatter transmission is constructed by repeating length-24 base sequence twice, i.e. S48 = [S24 S24]
  + The length-24 base sequence is given as below:
    - S24=[1,  1,  1,  1,  1,  0,  1,  0,  0,  1,  1,  0,  0,  1,  1,  0,  0,  0,  0,  1,  0,  1,  0,  0].

[Motion #129, [1] and [118]]

* **PM-57**: AMP Sync field for uplink monostatic backscattering transmission has a structure of [S, S, S] for both 2.4GHz and sub-1GHz.
  + S = [1 1 0 1 0 1 0 0].

[Motion #134, [1] and [122]]

### 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]]

* **PM-32**:
  + For UL PPDU for non backscattering case, for AMP Manchester encoded OOK  the chip duration of data portion is different for different data rates. The exact chip duration is TBD.
    - 4Mbps is TBD.

[Motion #78, [1], [44] and [76]]

* **PM-48**: 11bp defines mandatory forward error correcting code (FEC) of coding rate ½ for the data portion of UL active transmission in 2.4 GHz at rates of 0.25,1Mbps and non-coded mode at rate of 4Mbps.

[Motion #125, [1], [116] and [117]]

* **PM-49**: 11bp defines forward error correcting code (FEC) for the data portion of UL active transmission in 2.4 GHz based on the code as defined in 17.3.5.6 in 802.11-2024.

[Motion #126, [1], [116] and [117]]

* **PM-50**: In the data field of AMP UL active transmission in 2.4 GHz,
  + 250kbps data rate only uses 1us chip duration and rate 1/2 binary convolution code (BCC)
  + 1Mbps data rate only uses 0.25us chip duration and the same rate 1/2 BCC
  + 4Mbps doesn’t use BCC.

[Motion #127, [1], [76], [85], [117] and [118]]

* **PM-58**: The same chip duration shall be used for AMP backscattering uplink Sync field and AMP backscattering uplink data field in sub-1GHz.

[Motion #135, [1] and [122]]

## PHY feature #3

Description for PHY feature #3

# AMP WPT



## General

This section describes the functional blocks in the AMP WPT.

## 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]]

* **WM-6**:
  + Control information that may be sent from the AMP AP to the AMP Energizer relating to the excitation signal includes one or more of the following: Start Time, Duration, Transmit Power and frequency related parameters.
  + The frequency related parameters may include central frequency information, etc.

[Motion #74, [1], [31] and [73]]

* **WM-8**: IEEE 802.11bp defines at least the following capability parameters to be reported by the energizer to the AMP AP.
  + Whether or not support S1G WPT transmission
    - If supported, frequency related parameters for WPT. The frequency related parameters may include central frequency information, bandwidth information, etc.
  + Whether or not support 2.4G excitation waveform transmission.
  + Maximum Tx power.
  + Note: The energizer should at least support one of the following transmissions: S1G WPT transmission or 2.4G excitation waveform transmission.

[Motion #81, [1], [58] and [77]]

## 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 coexistence

* **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]]

* **WM-7**: Energizer may perform LBT before transmitting WPT signals in S1G. The details of LBT are TBD.

[Motion #80, [1], [60], [61] and [77]]

* **WM-9**:
* IEEE 802.11bp supports a mechanism in which a non-AP AMP STA may report the transmission time it can sustain.
* How the non-AP AMP STA may report this time is TBD.

[Motion #114, [1], [112] and [113]]

## WPT feature #4

Description for WPT feature #2

# AMP 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-11**: If the AMP frame is protected (for security), the FCS field of the AMP frame carries a 16-bits MIC.

[Motion #109, [1], [107], [108] and [109]]

* **FM-12**: 802.11bp defines an AMP frame to carry uplink response from a non-AP AMP STA:
  + Names of the AMP Frame is TBD

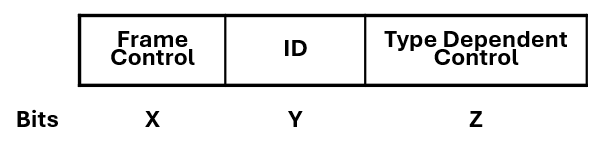
[Motion #110, [1], [107], [108] and [109]]

* **FM-13**: The AMP frame consists of the following basic components:
  + A MAC header
  + A variable-length frame body, which if present, contains information specific to the frame type
  + An FCS, which contains either a TBD-bit CRC or a 16-bit MIC
    - Whether FCS is always present or not for backscatter PPDUs is TBD
    - Whether to allow both CRC and MIC in the same frame in certain condition is TBD.
  + With the length of the AMP frame being expressed in octets with the unit TBD.



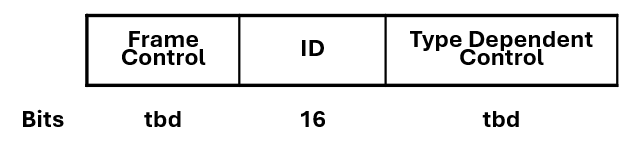
[Motion #116, [1] and [115]]

* **FM-14**: The MAC Header of the AMP frame comprises Frame Control, ID, and Type Dependent Control fields.
  + Frame Control contains a Type field that indicates the type of AMP frame, and other fields that are TBD.
  + ID contains an identifier for the AMP frame
    - Whether the ID field is always present or not is TBD
  + Type Dependent Control contains control information that depends on the type of AMP frame
    - Whether Type Dependent Control field is always present or not is TBD
  + There can be additional identifier(s) of AMP STA(s) in the AMP frame in certain cases and their location, if present, is TBD
  + Whether there are other fields in the MAC Header is TBD



[Motion #117, [1] and [115]]

* **FM-15**:
  + The MAC Header of the backscatter AMP frame comprises Frame Control, ID, and Type Dependent Control fields
    - Frame Control contains a Type field that indicates the type of backscatter AMP frame, and other fields that are TBD.
    - ID contains an identifier for the backscatter AMP frame
      * Whether the ID field is always present or not is TBD, and has a length of 16 bits
    - Type Dependent Control contains control information that depends on the type of AMP frame
      * Whether Type Dependent Control field is always present or not for the backscatter AMP frame is TBD
  + There can be additional identifier(s) of AMP STA(s) in the AMP frame in certain cases and their location, if present, is TBD.



[Motion #118, [1] and [115]]

* **FM-16**: The Frame Control field of the AMP frame is 8 bits
  + Type field uses 3 to 4 bits of the Frame Control
  + Whether the Type field is the first field of the Frame Control is TBD

[Motion #119, [1] and [115]]

* **FM-17**: The length of the ID field is based on the frame type/use case:
  + 12 bits for AMP enabled non-AP STAs,
  + Either 12 or 16 bits for active TX non-AP AMP STAs,
  + 16 bits for backscatter non-AP AMP STAs.

[Motion #120, [1] and [115]]

* **FM-18**: The Type Dependent Control field is
  + 12 bits for AMP enabled non-AP STAs.
  + If present, either 8, 12 or 16 bits for active TX non-AP AMP STAs.
  + If present, TBD bits (multiple of 8 bits) for backscatter non-AP AMP STAs.

[Motion #121, [1] and [115]]

* **FM-19**: For Active TX and Backscatter use cases, the length of the Frame Body field (if variable) is indicated in the MAC header of the AMP frame.
  + Specific location, encoding and size is TBD.
  + Note – If the length is indicated in the PHY header, there is no need for length indication in the MAC header.
  + Note – For AMP-enabled use case, the length is already signaled in the Frame Control field.

[Motion #122, [1] and [115]]

* **FM-20**: For unprotected Active TX and Backscatter use cases, when the FCS field is carrying the CRC, the length of the FCS field is 16 bits.
  + It is TBD if the CRC is 8-bit long under certain conditions.
  + Note – For AMP-enabled use case, we continue to use baseline 16 bits CRCs/MICs.
  + Note – If the FCS field carries the MIC, the length of the FCS field is 16 bits (already in SFD).

[Motion #123, [1] and [115]]

* **FM-21**: The CRC of AMP frames shall use the 16-bit CRC engine from IEEE 802.11ba.
  + If the group decides to carry 8-bit long CRC in certain AMP frames, it is TBD how to obtain the 8-bit CRC from the 16-bit CRC engine output.

[Motion #124, [1] and [115]]

## AMP Trigger frame

* **FM-2**: 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]]

* **FM-3**: 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]]

* **FM-5**: 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]]

* **FM-7**: 802.11bp allows short timestamp to be carried in an AMP trigger Frame.
  + Note: The presence of the short timestamp is configurable.

[Motion #99, [1], [78], [79], [63] and [99]]

* **FM-8**: 802.11bp allows duty-cycle configuration to be carried in an AMP trigger Frame.
  + Details of Duty-cycle configuration (e.g., AMP service period) are TBD.
  + Note: The presence of the duty-cycle configuration is configurable.

[Motion #100, [1], [100], [101], [102] and [103]]

* **FM-9**: An AMP AP transmits an AMP Trigger frame indicating a time-slot based random access session for non-AP AMP STAs. The frame carries:
  + Random Access Parameters: Indicates parameters for random access
  + Parameters for random access are TBD.

[Motion #105, [1], [106], [107] and [108]]

* **FM-10**:
  + An AMP AP transmits an AMP Trigger frame indicating a time-slot based scheduled access for non-AP AMP STAs. The frame may carry：
    - Number of Slots (N) indicating the number of slots immediately after the AMP Trigger frame that are allocated for uplink transmissions, and,
    - IDs of one or more non-AP AMP STAs that are scheduled for uplink transmission.
    - Other parameters are TBD.
  + the option of more than one Non-AP AMP STAs in mutiple slots is limited to Active Tx communication..

[Motion #107, [1], [106], [107] and [108]]

## AMP Ack frame

* **FM-4**: 802.11bp defines an AMP Ack frame that an AMP AP transmits to acknowledge the received UL AMP frame(s).

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

## AMP Wake-Up frame

* **FM-6**: 802.11bp defines an AMP Wake-Up frame, which an AMP AP transmits to AMP-enabled non-AP STA(s) to indicate that the AP intends to exchange non-AMP frames with the non-AP STA
  + The expectation is to reuse WUR frame format for the AMP Wake-Up frame and to carry it in an AMP PPDU

[Motion #57, [1], [64]]

## Field #4

Description for field #3

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