IEEE P802.11  
Wireless LANs

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| PDT MAC MAPC Signaling and Protocol aspects | | | | |
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Abstract

This document contains Proposed Draft Text (PDT) for the multi-AP coordination (MAPC) framework of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

The PDT incorporates the latest passing motions in TGbn and resolution for the following CIDs marked in black color:

MAPC CIDs (29 are resolved):

147, 148, 152, 153, 160, 161, 181, 669, 775, 876, 1318, 1319, 1320, 1324, 1395, 1398, 1399, 1428, 1491, 1494, 1739, 1788, 1789, 2466, 3254, 3438, 3606, 3735, 3779, 3780, 3781.

***TGbn editor:Baselines for this document are 11bn D0.3, 11be D7.0, and REVme D7.0***

# Revision information

The following is a summary of the important changes that occurred within each revision of this document:

|  |  |
| --- | --- |
| **Revision** | **Major changes** |
| 0 | Initial revision |
| 1 | Editorials |
| 2 | Editorials |
| 3 | Incorporates members’ comments and other editorials.   * Edited definition of multi-AP coordination in 3.2 to match first paragraph in 37.8.1.1 (General) * Updated Table 9-X2 (clarified variants definitions) * Updated Table 9-K2 (clarified subelements definitions) * Clarified text and moved from above Table 9-K1 to below Table 9-K2 to improve clarity * Edited third paragraph of 37.8.1.2 (MAPC discovery) to provide details of Dialog Token setting * Renamed fields in Figures 9-J1, 9-J1, 9-J3 |
| 4 | Revised subclause 9.4.2.aa3.3 to satisfy comments and remodel the signaling to better follow MLO (e.g., added Status Code field, introduced Per-Scheme Profile subelement, introduced CoBF profile, CoSR profile, Co-TDMA profile, Co-RTWT profile, etc.) |
| 5 | Addition of Discussion section with summary of MAPC element design |
| 6 | Incorporates members’ comments and other editorials.   * Clarified that any of the 2 APs establishing an agreement can initiate a MAPC negotiation frame exchange to update/teardown the agreement (see 37.8.1.3.1) * Clarified meaning of setting AP TB PPDU Response Supported field to 0 (just below Figure 9-X5) * Clarified that the octets for Status Code are 0 or 2 (removed ‘variable’) in Figure 9-K3 * Replaced “MAPC Scheme Information field” with “MAPC Scheme Request field” * Replaced “MAPC Scheme Information Set field” with “MAPC Scheme Request Set field” * Introduced “MAPC Scheme Parameter Set field” in Per-Scheme profiles to provide per-AP per-scheme parameters, and provide text to describe it in the third to last paragraph above Figure 9-X3 * Adjusted MAPC element rationale for Discovery and Negotiations:   + r5: MAPC Schemes Info field present only in Negotiation MAPC element, it contains per-scheme profiles, each of which carries agreement requests/responses. For this reason different types of MAPC element (Discovery and Negotiation) were defined.   + r6: MAPC Scheme Information field is optionally present in Discovery MAPC element, and is present in Negotiation MAPC element. It contains per-scheme profiles. Each Per-Scheme profile carries AP’s general params for the scheme, and if carried in the MAPC Negotiation Request/Response frames it carries agreement requests/responses. For this reasons there is no need of different types of MAPC element (the presence or absence of the agreement requests/responses can be determined by the type of frame that contains the MAPC element)   + Summary: while in r5 MAPC Schemes Info field was absent in Discovery it can be carried in r6 (profiles can now be carried even in Discovery and include general per-AP per-scheme parameters). In r6, it is a field in the profiles (within the MAPC Schemes Info field) that is absent in Discovery (the field is MAPC Scheme Request Set, that is absent in Discovery) and clarification text is provided in the second to last paragraph above Figure 9-K3. The MAPC element types are removed from the PDT (Table 9-X2 is removed from r6 of the PDT as well as the MAPC Type field in Figure 9-X1). Accordingly, Figure 9-X3 is removed and Figure 9-X1 is modified to contain directly AP ID field without the need of the intermediate level of a Presence Bitmap field. Additionally it is clarified how to include Per-Scheme Profile subelements in MAPC element (just below Table 9-K2)   + Edit in second to last paragraph above Figure 9-aa14: Co-CR is treated similarly to Co-RTWT in the aspects of allowing multiple agreements (as opposed to Co-BF, Co-SR, Co-TDMA) * Adjusted the Discovery procedure:   + Introduced MAPC Discovery Request/Response frames in Table 9-471   + Added 9.6.7.y for MAPC Discovery Response frame format   + Adjustments in subclauses 37.8.1.2 |
| 7 | Incorporates members’ comments and other editorials.   * Replaced “MAPC Scheme ID” with “MAPC Scheme Type” * Removed note just above 37.8.1.3 * Other editorials |
| 8 | Incorporates members’ comments and other editorials.   * Updated Note in 37.8.1.1 * Removed MIB variables in declaration of support of schemes in MAPC Capabilities field (just below Figure 9-X5) * Replaced figure in ‘MAPC element in 25/0599r6’ in the Discussion section of this document with the correct one (now consistent with MAPC element definition that was provided since r6) |
| 9 | Incorporates members’ comments and other editorials.   * Introduced per-scheme ‘Agreement Establishment Enabled’ field (see Figure 9-X6), modified related text (second paragraph in 37.8.1.3.2 (MAPC agreement establishment)) |
| 10 | Alignment with 25/0600r10 |
| 11 | Removed CID 147 from resolved CIDs (deferred). Small editorials and alignment with 25/0600r11 |
| 12 | Small editorials |
| 13 | Removal of CID 3735 resolution (deferred). |
| 14 | * Alignment with TGbn draft D0.3 * Cleanup of redundant text after D0.3:   + Removal of redundant text between Figure 9-aa7 and Figure 9-aa8 (the corresponding new text and resolution of the TBD are already present in Figure 9-aa10 and the paragraph just below it)   + Removal of redundant subclauses 9.6.7.69, 9.6.7.70, and their content (were supposed to be replaced by the current 9.6.7.66 and 9.6.7.67, which solve the TBDs in 9.6.7.69 and 9.6.7.70)     - Removal of corresponding redundant entries in Table 9-516 in 9.6.10 * Fig 9-aa9: Allocating more bits to the MAPC Capabilities and MAPC Parameters fields for potentially more MAPC schemes in this or future generation. See Figure 9-aa10 and 9-aa11 * Below Figure 9-aa11: Clarified that the Agreement Establishment Enabled bit is set to 1 only if the scheme is supported * Incorporation of latest received comments and other changes: * Addition of text for Co-CR as a MAPC scheme (CID #876 resolved)   + MAPC definition in 3.2   + Fig 9-aa10: adding ‘Co-CR Supported‘ and more reserved bits according to the fields defined in Figure 9-aa9   + Fig 9-aa11: adding ‘Co-CR Agreement Establishment Enabled‘ and more reserved bits according to the fields defined in Figure 9-aa9   + Table 9-349f: added Co-CR profile   + Added subclause 9.4.2.aa3.2.6 (Co-CR profile) * Figure 9-aa14: Increased size of MAPC Request Control to 2 octets, mainly for increasing the size of the MAPC Operation Type field in Figure 9-aa15, see below. * Figure 9-aa15: allocate more than 2 bits for MAPC Operation Type (now 4 bits) to allow additional response types such as ‘accept’/’reject’/’alternate’. Impact on Table 9-349g, see below (\*). * (\*)Edits on Table 9-349g: new entries to expand ‘Response’ into 3 entries “Accept/Reject/Alternate” * Figure 9-aa15: defined a subfield ‘MAPC Per-Scheme Info’ to be further specified for each MAPC scheme in the corresponding profile subclause. For example, in the Co-RTWT profile it contains the ‘Co-RTWT ID’ and the ‘Last Co-RTWT Request’ fields. Impact on 9.4.2.aa3.2.5 (Co-RTWT profile), see below. * Edited text just below Table 9-349g: companion text detailing the edits to Figure 9-aa15 * Edited text in 9.4.2.aa3.2.2, 9.4.2.aa3.2.3, 9.4.2.aa3.2.4: removal of line regarding MAPC Info field and the Last MAPC Request field being reserved. PoCs of Co-BF, Co-SR, Co-TDMA, and Co-CR are kindly asked to take care defining the newly introduced ‘MAPC Per-Scheme Request Control’ (see Figure 9-aa15) in the respective profile subclause (see example of Co-RTWT, implemented in this PDT, 9.4.2.aa3.2.5) * Edits in 9.4.2.aa3.2.5 (Co-RTWT profile): definition of the MAPC Per-Scheme Info field format introduced in Figure 9-aa15 (includes B-TWT ID, Last Request bit, and reserved bits) * Edit in the first paragraph of 37.13.1.3.2 (MAPC agreement establishment): Firstly, there was a typo, and the ‘MAPC Scheme Parameters Set’ was supposed to be ‘MAPC Request Parameters Set’. Secondly, the removal is due to the sentence being incorrect. In fact due to the flexibility of the framework that allows a negotiation for a specific scheme to include/not include certain parameters, the presence or absence of this field is determined per-scheme. For example in Co-RTWT, since the MAPC Request Parameters Set field carries the details of the R-TWT schedule, we have a sentence at the bottom of the second paragraph of 37.13.2.4.2 (Co-RTWT negotiations): “ If the MAPC Operation Type is set to 0 or 1, the MAPC Request Parameter Set field defined in 9.4.2.aa3.2.5 (Co-RTWT profile) shall be included in the MAPC Scheme Request field.”. If, for example for another scheme there are no per-request parameters, it should be specified in the subclause for that scheme’s negotiations (similarly to 37.13.2.4.2) whether/when this field is included. The PoCs of each scheme are kindly asked to take this into account. * Edit in the first paragraph of 37.13.1.3.3 (MAPC agreement update): Similar edit to 37.13.1.3.2 (MAPC agreement establishment) * Removal of Status Code field in Fig 9-aa14 (and associated text, including removal of ‘Status Code field present’ column in Figure 9-349g) and insertion in the MAPC Negotiation Response Frame format in 9.6.7.67 (with associated text)   + Edits in 37.13.1.3.1 (General) to update the rules to set Status Code field in MAPC Negotiation Response Frame format (instead of 2 octets per request down in the element, we have an overall Status Code in the frame format). * Edits at the bottom of the 7th paragraph in 37.13.1.3.1 General. This text is companion to the removal of the last column in Table 9-349g |

# Introduction

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes, and references sections are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbn Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

## Explanation of the proposed changes:

The proposed changes to the 802.11 TGbn draft within this document are based on the following motions adopted by the TGbn task group and CIDs collected during CC50 on D0.1.

### Relevant Passing Motions

[Motion #50]

* 11bn defines a common framework of a Multi-AP Coordination for various coordination schemes.
  + Note - Coordination schemes such as (but not limited to): Co-SR (TXOP-based with power control), Co-BF, Co-TDMA, Co-RTWT, etc.

[Motion #51]

* 11bn defines a common framework of a Multi-AP Coordination that can enable the following procedures:
  + Multi-AP Coordination Discovery procedure
  + Multi-AP Coordination agreement negotiation procedure
  + Note: Details of the procedures and whether the above procedures are mandatory/optional - TBD

[Motion #120]

* A UHR AP shall indicate to another AP its capability to respond in a TB PPDU or not

[Motion #135]

* The sharing AP, that transmits a Trigger frame as part of a transmission sequence in a Multi-AP coordinated transmission scheme, identifies the shared AP via an AP ID carried in the AID12 field of the User Info field of the frame
  + Note: the name of "sharing AP" and "shared AP" are TBD
  + Note: Multi-AP coordinated transmission schemes are Co-SR, Co-BF and Co-TDMA

[Motion #147]

* APs that intend to participate in Multi-AP coordination can use management frames to advertise/discover the capabilities and/or parameters of individual schemes.

[Motion #148]

* APs that discovered each other and want to establish agreement(s) for Multi-AP coordination scheme(s), can use individually addressed management frames to establish the agreement(s) and negotiate parameters
  + Note: The management frame can be a Public Action and/or new Action frames, and so on.

[Motion #184, [1]]

* 11bn enhances existing mechanism(s) to improve latency for a non-AP STA communication with another non-AP STA on the base channel and off-channel, respectively, by
  + enhancing mechanism(s) to allow an AP to share a TXOP with multiple peer-to-peer (P2P) non-AP STAs(s)
  + enhancing the baseline Channel Usage procedure to provide better recommendation on channel selection for P2P by enabling coordination between APs that do not belong to the same ESS so that the channels recommended for P2P operation sent by those APs are the same.

**Note 1:** the coordinated channel recommendation is an optional feature. Also, the responding AP has an option to reject the request for such coordination.

**Note 2:**

* Base channel is the channel where the AP associated with the non-AP STA is operating.
* A channel outside its associated AP’s operating BW is an off-channel for the non-AP STA.

[Motion #185]

* Define a mechanism in 11bn that defines:
  + AP-to-AP frame formats to enable interoperable MAPC across APs and including MLME primitive(s) so that a pair of AP’s SMEs can orchestrate the over-the-air transmission and reception of these frames
  + MLME primitive(s) so that a pair of AP’s SMEs may send the content of the non-real-time instances of such AP-to-AP frames over-the-DS between peer AP-MLMEs (rather than over-the-air via peer AP MACs)

[Motion #265]

* As a part of M-AP coordination agreement procedure, an AP may assign an AP ID to another AP with the following constraints:
  + The AP ID is used for the AP to identify another AP as a coordinated AP, when necessary.
  + The AP ID field has the same size and the field value has a range as defined in AID field (see 9.4.1.8)
  + The AP shall ensure that the AP ID value is not assigned by the AP or by its affiliated MLD to any other STA (e.g., STA is an associated non-AP STA, an unassociated non-AP STA that has been allocated a (Ranging session Identifier) RSID , or any other coordinated AP), or a non-AP MLD that is associated with the AP MLD
  + It's TBD whether the AP ID value is greater than 2^n where n is the maximum of the value carried in the MBSSID Indicator (n) field of the Multiple BSSID element for any AP affiliated with the AP MLD that belongs to a multiple BSSID set

[Motion #342]

* Established coordination between two APs can be terminated by an explicit teardown performed by one of the two APs.

[Motion #358]

* TGbn defines new actions for Public Action frames for MAPC communications such as discovery and negotiations
  + An action is defined for MAPC Discovery
  + An action is defined for MAPC Negotiation Request
  + An action is defined for MAPC Negotiation Response
  + Others are TBD

[Motion #359]

* When an AP use Management frames to discover the capabilities and/or parameters of individual M-AP coordination schemes, the AP shall use the defined MAPC Public Action frame with the following setting:
  + The action field is set to MAPC Discovery

[Motion #360]

* When an AP (AP1) uses an individually addressed Management frame to initiate a negotiation to establish agreements for M-AP coordination schemes (if enabled by another AP (AP2)), the AP (AP1) shall use the defined MAPC Public Action frame with the following setting:
  + The Action field is set to MAPC Negotiation Request
  + If new negotiations are disabled by another AP (AP2) the AP (AP1) shall not send a negotiation request to the other AP (AP2)
  + TBD details of ‘new negotiations disabled

[Motion #361]

* When an AP (AP2) receives an individually addressed Management frame that initiates a negotiation to establish agreements for M-AP coordination schemes, the AP (AP2) shall respond by using the defined MAPC Public Action frame with the following setting, if negotiations are enabled:
  + The Action field is set to MAPC Negotiation Response

[Motion #48]

* Define mechanisms that enable APs to coordinate their rTWT schedule(s) and/or to ensure that one AP provides the protection of the rTWT schedule(s) of the other AP.
* NOTE – TBD mechanisms including negotiation between 2 APs and advertisement.

[Motion #149]

* If an AP extends the protection of the rTWT schedule of another AP, following negotiation or through other means, then:
  + The AP shall ensure its TXOP ends before the start time of the corresponding OBSS rTWT SP(s)
  + The AP, if it has at least one associated STA that is capable of rTWT, shall advertise in the beacon frames it transmits the OBSS rTWT schedule so that its associated STAs supporting rTWT follow the baseline rTWT rules for the OBSS rTWT schedule.

### Comments (CIDs) resolved:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 148 | Jay Yang | 37.8.1.2 | 71.35 | the details of MAPC discovery procedure is missing, please add it. | the commenter will provide a solution on this. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID148. |
| 152 | Jay Yang | 9.6.7.55a | 63.26 | The details of MPAC Request frame format is missing, and the TBD should be fixed | the commenter will provide a solution on this. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID152. |
| 153 | Jay Yang | 9.6.7.55b | 63.33 | The details of MPAC Response frame format is missing, and the TBD should be fixed | the commenter will provide a solution on this. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID153. |
| 160 | Jay Yang | 37.8.1.3.2 | 72.08 | If one AP can be sharing AP of Co-SR,Co-BF or Co-TDMA , it may assign the AP ID in MAPC request or MAPC response frame, such AP should advice it's sharing AP's capability is discovery phase. | the commenter will provide a solution on this. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID160. |
| 161 | Jay Yang | 37.8.1.3 | 71.43 | The MAPC parameter can be updated due to any reason, we need to define a MAPC parameter update procedure | the commenter will provide a solution on this. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID161. |
| 181 | Jay Yang | 9.6.10 | 63.38 | in Table 9-516, all itemts have the prefix "Protected", please add prefix "Protected" in MAPC Request, and MAPC Response | change "MAPC Request" to "Protected MAPC Request"; change "MAPC Response" to "Protected MAPC Response" | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID181. |
| 669 | Jungjun Kim | 37.8.1.3.1 | 71.48 | MAPC agreement negotiation process should cover not only the establishment but also update of an agreement. | Change "to establish" to "to establish or update". To elaborate difference between the intial agreement establishment and agreement updates, we may add "37.8.1.3.2 Inital agreement establishment" and "37.8.1.3.3 Agreement update". | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID669. |
| 775 | Seongho Byeon | 37.8.1.3 | 71.50 | Suggest changing from "in addition to the specific rules for Multi-AP coordination scheme used for this agreement" to "in addtion to the specific rules for Multi-AP coordiniation scheme(s) used for this agreement", if one agreemment can contain multiple MAPC schemes. | As in comment. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID775. |
| 876 | Tomoko Adachi | 37.15.2 |  | Co-CR should also cover the case when APs belong to the same ESS. Make it consistent with other MAPC schemes. Even though there is already a way to recommend channels within the same ESS using channel usage frames, this Co-CR concept should also cover such case and should be extended to enable giving recommendation of channels over the air. | As in comment. | Revised  Agree in principle.  Co-CR is added as one of the MAPC schemes.  TGbn editor: please implement changes as shown in this document tagged CID876. |
| 1318 | Jonghoe Koo | 9.6.10 | 63.38 | No motion to use Protected Dual of Public Action frames for MAPC | Remove Section 9.6.10 | Rejected  The comment fails to identify a technical issue. Not all contents in the draft is required to have a motion in the SFD. |
| 1319 | Jonghoe Koo | 9.6.7.55a | 63.26 | No motion to use Protected Dual of Public Action frames for MAPC | Remove Section 9.6.7.55a | Rejected  The comment fails to identify a technical issue. Not all contents in the draft is required to have a motion in the SFD. |
| 1320 | Jonghoe Koo | 9.6.7.55b | 63.32 | No motion to use Protected Dual of Public Action frames for MAPC | Remove Section 9.6.7.55b | Rejected  The comment fails to identify a technical issue. Not all contents in the draft is required to have a motion in the SFD. |
| 1324 | Jonghoe Koo | 37.8.1.2 | 71.37 | We need to specifiy which Management frames can be used for MAPC discovery to address "TBD Management frames". | Specify which Management frames to be used for MAPC discovery, e.g., Beacon frame, a new Action frame, one of existing Action frame with a new Action value, and etc. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1324. |
| 1395 | Renlong Zhou | 37.8.1.3 | 71.43 | A standardized procedure for updating MAPC parameters needs to be established to accommodate dynamic operational requirements. | As it says in the comment | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1395. |
| 1398 | Insun Jang | 37.8.1.2 | 71.38 | TBD frame for advertising MAPC capabilties should be defined | It can be Beacon and/or other Action frames 1) In case of Action frame, its periodicity or when it is transmitted should be considered 2) The information of MAPC capabilities should be defined (e.g., possible MAPC type) | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1398. |
| 1399 | Insun Jang | 37.8.1.3.1 | 71.54 | TBD frame for negotiatinig agreements should be defined | 1) It should be new Action frames (e.g., MAPC Request/Response frame) 2) It allows to negotiate the agreements of one or more MAPC scheme(s) and therefore it should include an element for MAPC that consists of Common Info across all requested MAPC schemes and per-requested MAPC scheme info 3) In response frame, Status code has to be introduced at least per MAPC scheme (especially for Co-RTWT, per schedule (i.e., Broadcast TWT ID)) | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1399. |
| 1428 | Akira Kishida | 37.8.1.3 MAPC agreement negotiation | 71.55 | The frame types for establishing the MAPC agreement by the MAPC initiating AP should not be limited to the management frame(s). | Consider there is room for using other frame types, such as control frame(s). | Rejected  There are passing motions for Management frames that provide a complete solution. The comment fails to identify the technical need of using Control frames for the purpose. |
| 1491 | Kotaro NAGANO | 37.8.1.3 MAPC agreement negotiation | 71.55 | The maximum number of APs in "... MAPC agreement with the one or more UHR APs." is unclear. | The maximum number of APs in the MAPC should be specified to determine the number of octets in the AP ID. | Revised  Passing motions underline pair-wise negotiations between APs to establish agreements. Clarifications are provided.  TGbn editor: please implement changes as shown in this document tagged CID1491. |
| 1494 | Kotaro NAGANO | 37.8.1.2 MAPC discovery | 38.38 | The timing or trigger of frame exchange in the "UHR APs participating in MAPC may transmit TBD Management frames..." is unclear. | If the capabilities of Multi-AP coordination schemes and parameters vary depending on the environment and conditions, the timing and conditions under which management frames must be sent should be described. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1494. |
| 1739 | Kosuke Aio | 37.8.1.3.1 | 71.48 | For detailed negotiations on MAPC, it is necessary to cover cases where multiple APs have different primary channels set. | Please define the procedure to set the same primary channel for MAPC in the negotiation. | Rejected  The comment fails to identify a technical issue. |
| 1788 | Junichi Iwatani | 37.8.1.3.1 | 71.48 | Need to clarify the conditions of APs that can establish an agreement of MAPC, such as the conditions of the primary channel or bandwidth. | As in comment. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1788. |
| 1789 | Junichi Iwatani | 37.8.1.3.1 | 71.55 | The procedures for canceling an agreement of MACP should be described. (e.g., an agreeement may be canceled by using Management frame(s)) | As in comment. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID1789. |
| 2466 | Yanjun Sun | 9.6.10 | 63.53 | There is no motion yet on protected frames for MAPC, so it's premature to include protected dual for MAPC Request and Response. It looks that this can be resolved in one of the two ways: 1) delete them from 9.6.10 for now. 2) get a motion passed to support this and make sure the protection also applies to control frames among the APs, which are likely sent over the air more frequently. | as in comment | Rejected  The comment fails to identify a technical issue. Not all contents in the draft is required to have a motion in the SFD. |
| 3254 | GEORGE CHERIAN | 37.8.1.2 | 71.38 | Define the management frame for MAC discovery | As in the comment | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID3254. |
| 3438 | Muhammad Kumail Haider | 37.8.1.3.1 | 71.46 | The framework should allow negotiation of multiple MAPC schemes with a single management frame if the two (or more) APs support the same (sub)set of MAPC schemes |  | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID3438. |
| 3606 | kaiying Lu | 37.8.1.2 | 71.35 | Describe the MAPC discovery procedure in details | As in comment. | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID3606. |
| 3779 | Yongho Seok | 37.8.1.2 | 71.41 | "Details are TBD." MAPC discovery should be simple, and it is not necessary to broadcast it in the Beacon frame | As in the comment | Revised  Agree in principle.  TGbn editor: please implement changes as shown in this document tagged CID3779. |
| 3780 | Yongho Seok | 37.8.1.3.1 | 71.54 | "...and may transmit TBD individually addressed Management frame(s) to establish a MAPC agreement with the one or more UHR APs." The negotiation can be performed over the DS. Please clarify that the negotiation procedure over the air is not an only way for the MAPC. | As in the comment | Revised  Agree in principle  TGbn editor: please implement changes as shown in this document tagged CID3780. |
| 3781 | Yongho Seok | 37.8.1.3.2 | 72.03 | "A UHR AP shall follow the rules defined in this subclause additionally to the rules defined in 37.8.1.3 (MAPC agreement negotiation) to assign an AP ID to another AP with which it establishes a MAPC agreement." Since the negotiation can be performed over the DS (i.e., Multi-AP Coordination Over-the-DS), 'shall' should be changed to 'may'. | As in the comment | Revised  Agree in principle that the following the rules of this subclause is conditional to be establishing a new agreement. A clarification is provided.  TGbn editor: please implement changes as shown in this document tagged CID3781. |

# Discussion:

### MAPC element in 25/0599r5

The structure of the MAPC element defined in subclause 9.4.2.aa3 (MAPC element) of 25/0599r5 is summarized in the figure below.

A group of white rectangular boxes with text

AI-generated content may be incorrect.

### MAPC element in 25/0599r6

The structure of the MAPC element defined in subclause 9.4.2.aa3 (MAPC element) of 25/0599r6 is summarized in the figure below.

A diagram of a computer program

AI-generated content may be incorrect.

### MAPC element in 25/0599r14

The structure of the MAPC element defined in subclause 9.4.2.aa3 (MAPC element) of 25/0599r14 is summarized in the figure below.

A group of white papers with text and numbers

AI-generated content may be incorrect.

# Text to be adopted begins here:

3.2 Definitions specific to IEEE 802.11

***TGbn editor: Please modify the body of subclause 3.2 (Definitions specific to IEEE 802.11) as follows (tracked changes):***

**multi-AP**(#1679) **coordination:** [MAPC] A framework that includes a set of coordination schemes (such as(#462) Co-BF, Co-SR, Co-TDMA, Co-RTWT, (#876)and Co-CR) and procedures in which APs operating their BSSs on the same primary 20 MHz channel coordinate to reduce interference levels and to improve network performance such as medium utilization efficiency, communication reliability, and latency.(#1965, #2841)

**9.4.2 Elements**

**9.4.2.1 General**

9.4.2.aa3 MAPC element

***TGbn editor: Please modify the body of subclause 9.4.2.aa3 (MAPC element) as follows (tracked changes):***

9.4.2.aa3.1 General(#3448)

The format of the MAPC element is shown in Figure 9-aa7 (MAPC element format). The usage of this element

is described in 37.13 (Multi-AP coordination (MAPC) framework).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | MAPC Control | MAPC Common Info | MAPC Schemes Info |
| Octets: | 1 | 1 | 1 | 1 | variable | variable |

Figure 9-aa7—MAPC element format

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The format of the MAPC Control field is defined in Figure 9-aa8 (MAPC Control field).

|  |  |  |
| --- | --- | --- |
|  | B0 | B1 B7 |
|  | AP ID Present | Reserved |
| Bits: | 1 | 7 |

Figure 9-aa8—MAPC Control field format

The AP ID Present field is set to 1 if the AP ID field is present in the MAPC Common Info field, and it is set to 0 otherwise.

The MAPC Common Info field carries information that is common to all the MAPC schemes. The format of the MAPC Common Info field is defined in Figure 9-aa9 (MAPC Common Info field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | MAPC Common Info Length | MAPC Capabilities | MAPC Parameters | AP ID |
| Octets: | 1 | 2 | 2 | 0 or 2 |

Figure 9-aa9— MAPC Common Info field format

The MAPC Common Info Length field indicates the number of octets in the MAPC Common Info field including one octet for the MAPC Common Info Length field.

(#CID2118)(#CID3179)The format of the MAPC Capabilities field is defined in Figure 9-aa10 (MAPC Capabilities field format).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 | B6 B15 |
|  | AP TB PPDU Response Supported | Co-BF Supported | Co-SR Supported | Co-TDMA Supported | Co-RTWT Supported | Co-CR Supported | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 10 |

Figure 9-aa10— MAPC Capabilities field format

The AP TB PPDU Response Supported field is set to 1 if the AP supports transmitting a TB PPDU in response to a Trigger frame. Otherwise, the AP TB PPDU Response Supported field is set to 0 to indicate that the AP does not support transmitting a TB PPDU in response to a Trigger frame.

(#3179)The Co-BF Supported field is set to 1 if the AP supports Co-BF. Otherwise, the Co-BF Supported field is set to 0.

(#3179)The Co-SR Supported field is set to 1 if the AP supports Co-SR. Otherwise, the Co-SR Supported field is set to 0.

(#3179)The Co-TDMA Supported field is set to 1 if the AP supports Co-TDMA. Otherwise, the Co-TDMA Supported field is set to 0.

(#2118)(#3179)The Co-RTWT Supported field is set to 1 if the AP supports Co-RTWT. Otherwise, the Co-RTWT Supported field is set to 0.

(#876)The Co-CR Supported field is set to 1 if the AP supports Co-CR. Otherwise, the Co-CR Supported field is set to 0.

The format of the MAPC Parameters field is defined in Figure 9-aa11 (MAPC Parameters field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 | B5 B15 |
|  | Co-BF Agreement Establishment Enabled | Co-SR Agreement Establishment Enabled | Co-TDMA Agreement Establishment Enabled | Co-RTWT Agreement Establishment Enabled | Co-CR Agreement Establishment Enabled | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 1 | 11 |

Figure 9-aa11— MAPC Parameters field format

The Co-BF Agreement Establishment Enabled field is set to 1 if the Co-BF Supported field is set to 1 and the AP has enabled MAPC negotiations for establishing new MAPC agreements for Co-BF. Otherwise, the Co-BF Agreement Establishment Enabled field is set to 0.

The Co-SR Agreement Establishment Enabled field is set to 1 if the Co-SR Supported field is set to 1 and the AP has enabled MAPC negotiations for establishing new MAPC agreements for Co-SR. Otherwise, the Co-SR Agreement Establishment Enabled field is set to 0.

The Co-TDMA Agreement Establishment Enabled field is set to 1 if the Co-TDMA Supported field is set to 1 and the AP has enabled MAPC negotiations for establishing new MAPC agreements for Co-TDMA. Otherwise, the Co-TDMA Agreement Establishment Enabled field is set to 0.

(#2118)The Co-RTWT Agreement Establishment Enabled field is set to 1 if the Co-RTWT Supported field is set to 1 and the AP has enabled MAPC negotiations for establishing new MAPC agreements for Co-RTWT. Otherwise, the Co-RTWT Agreement Establishment Enabled field is set to 0.

(#876)The Co-CR Agreement Establishment Enabled field is set to 1 if the Co-CR Supported field is set to 1 and the AP has enabled MAPC negotiations for establishing new MAPC agreements for Co-CR. Otherwise, the Co-CR Agreement Establishment Enabled field is set to 0.

The AP ID field is used to assign an AP ID to another AP. The AP ID field is optionally included in the MAPC Common Info field of a MAPC element (see Table 9-aa9 (MAPC Common Info field format)) as defined in 37.13.1.3.2.2 (AP ID assignment).

9.4.2.aa3.2 MAPC Schemes Info field

9.4.2.aa3.2.1 General

(#1409)(#1416)The MAPC Schemes Info field carries information specific to one or more MAPC schemes and is optionally present. When the MAPC Schemes Info field is present, it contains one or more subelements. The Subelement ID field values for the subelements are shown in Table 9-349e (Optional subelement IDs of the MAPC Scheme Info field).

**Table 9-349e—** **Optional subelement IDs of the MAPC Scheme Info field**

|  |  |  |
| --- | --- | --- |
| **Subelement ID** | **Subelement name** | **Extensible** |
| 0 | Per-Scheme Profile | Yes |
| 1-220 | Reserved |  |
| 221 | Vendor Specific | Vendor defined |
| 222-253 | Reserved |  |
| 254 | Fragment | No |
| 255 | Reserved |  |

The format of the Per-Scheme Profile subelement is defined in Figure 9-aa12 (Per-Scheme Profile subelement format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Subelement ID | Length | MAPC Scheme Control | MAPC Scheme Parameter Set | MAPC Scheme Request Set |
| Octets: | 1 | 1 | 1 | variable | variable |

Figure 9-aa12— Per-Scheme Profile subelement format

The format of the MAPC Scheme Control field is defined in Figure 9-aa13 (MAPC Scheme Control field format).

|  |  |  |
| --- | --- | --- |
|  | B0 B2 | B3 B7 |
|  | MAPC Scheme Type | Reserved |
| Bits: | 4 | 4 |

Figure 9-aa13— MAPC Scheme Control field format

The MAPC Scheme Type field indicates a value that identifies a MAPC scheme as defined in Table 9-349f (MAPC Scheme Type field values).

**Table 9-349f—** **MAPC Scheme Type field values**

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | Co-BF profile |
| 1 | Co-SR profile |
| 2 | Co-TDMA profile |
| 3 | Co-RTWT profile |
| 4 | Co-CR profile |
| 5-15 | Reserved |

The MAPC Schemes Info field contains zero or one Co-BF profile, Co-SR profile, Co-TDMA profile, Co-RTWT profile, and Co-CR profile.

The MAPC Scheme Parameter Set field carries parameters specific to the AP for the MAPC scheme indicated by the MAPC Scheme Type field. The MAPC Scheme Parameter Set field is optionally included and it has a format defined for each MAPC scheme in 9.4.2.aa3.2.2 (Co-BF profile), 9.4.2.aa3.2.3 (Co-SR profile), 9.4.2.aa3.2.4 (Co-TDMA profile), 9.4.2.aa3.2.5 (Co-RTWT profile), and 9.4.2.aa3.2.6 (Co-CR profile), respectively.

The MAPC Scheme Request Set field is optionally included. When the MAPC element that includes the Per-Scheme Profile subelement is carried in a MAPC Negotiation Request frame, the MAPC Scheme Request Set field is included and carries information related to request(s) for MAPC agreement(s) specific to the MAPC scheme indicated by the MAPC Scheme Type field. When the MAPC element that includes the Per-Scheme Profile subelement is carried in a MAPC Negotiation Response frame, the MAPC Scheme Request Set field is included and carries information related to response(s) to request(s) for MAPC agreement(s) specific to the MAPC scheme indicated by the MAPC Scheme Type field. The MAPC Scheme Request Set field is not included when the MAPC element that includes the Per-Scheme Profile subelement is carried in a MAPC Discovery Request frame or a MAPC Discovery Response frame. The MAPC Scheme Request Set field carried in a Co-BF, Co-SR, or Co-TDMA profile contains a single MAPC Scheme Request field. (#1417)(#3449)The MAPC Scheme Request Set field carried in a Co-RTWT profile contains one or more MAPC Scheme Request fields, each corresponding to an R-TWT schedule.

The format of the MAPC Scheme Request field is defined in Figure 9-aa14 (MAPC Scheme Request field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | MAPC Request Control | MAPC Per-Scheme Info |  | MAPC Request Parameter Set |
| Octets: | 1 | 0 or 1 |  | variable |

Figure 9-aa14— MAPC Scheme Request field format

(#1417)(#1418)The MAPC Request Control field format is defined in Figure 9-aa15 (MAPC Request Control field format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B2 | B3 | B4 B7 |  |  |
|  | MAPC Operation Type | MAPC Per-Scheme Info Present | Reserved |  |  |
| Bits: | 3 | 1 | 4 |  |  |

Figure 9-aa15— MAPC Request Control field format

The MAPC Operation Type field indicates the type of operation to be carried out. Table 9-349g (MAPC Operation Type field values) shows the values and meaning of the MAPC Operation Type field and (#1418)the frame that carries the MAPC element with this MAPC Operation Type value.

***TGbn editor: Please modify Table 9-349g by deleting the last two columns (‘Status Code field present’ and ‘MAPC Request Parameter Set field present’), deleting the fifth row (‘Value=3’) and other tracked edits as displayed below:***

**Table 9-349g—** **MAPC Operation Type field values**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Value** | **Meaning** | **Contained in** |  |  |
| 0 | Agreement Establishment | MAPC Negotiation Request frame |  |  |
| 1 | Agreement Update | MAPC Negotiation Request frame |  |  |
| 2 | Agreement Teardown | MAPC Negotiation Request frame |  |  |
|  |  |  |  |  |
| 3 | Agreement Accept | MAPC Negotiation Response frame |  |  |
| 4 | Agreement Reject | MAPC Negotiation Response frame |  |  |
| 5 | Agreement Alternate | MAPC Negotiation Response frame |  |  |
| 6-7 | Reserved |  |  |  |

The MAPC Per-Scheme Info Present field is set to 1 when the MAPC Per-Scheme Info field is included. Otherwise, MAPC Per-Scheme Info Present field is set to 0.

The MAPC Per-Scheme Info field carries information specific to the MAPC scheme identified by the MAPC Scheme Type field. The MAPC Per-Scheme Info field is defined for each MAPC scheme in 9.4.2.aa3.2.2 (Co-BF profile), 9.4.2.aa3.2.3 (Co-SR profile), 9.4.2.aa3.2.4 (Co-TDMA profile), 9.4.2.aa3.2.5 (Co-RTWT profile), and 9.4.2.aa3.2.6 (Co-CR profile), respectively.

The MAPC Request Parameter Set field carries parameters specific to a request and is optionally included. The format of the MAPC Request Parameter Set field is defined for each MAPC scheme in 9.4.2.aa3.2.2 (Co-BF profile), 9.4.2.aa3.2.3 (Co-SR profile), 9.4.2.aa3.2.4 (Co-TDMA profile), 9.4.2.aa3.2.5 (Co-RTWT profile), and 9.4.2.aa3.2.6 (Co-CR profile), respectively. The MAPC Request Parameter Set is included according to the rules defined in 37.13.2 (Rules for specific multi-AP coordination schemes) for each specific MAPC scheme.

9.4.2.aa3.2.2 Co-BF profile

The MAPC Scheme Type field is set to the value for Co-BF as indicated in Table 9-349f.

9.4.2.aa3.2.3 Co-SR profile

The MAPC Scheme Type field is set to the value for Co-SR as indicated in Table 9-349f.

9.4.2.aa3.2.4 Co-TDMA profile

The MAPC Scheme Type field is set to the value for Co-TDMA as indicated in Table 9-349f.

9.4.2.aa3.2.5 Co-RTWT profile

(#1409)(#1410)(#1415)(#1806)The MAPC Scheme Type field is set to the value for Co-RTWT as indicated in Table 9-349f.

The MAPC Scheme Parameter Set is not included.

The format of the MAPC Per-Scheme Info field is defined in Figure 9-aaX.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B4 | B5 | B6 B7 |
|  | Broadcast TWT ID | Last Co-RTWT Request | Reserved |
| Bits: | 5 | 1 | 2 |

Figure 9-aaX— MAPC Per-Scheme Info field of the Co-RTWT profile format

The Broadcast TWT ID field carries the identifier of the R-TWT schedule.

The Last Co-RTWT Request field is set to 0 to indicate that the Co-RTWT profile carries a subsequent MAPC Scheme Request field that follows this MAPC Scheme Request field. The Last Co-RTWT Request field is set to 1 to indicate that this is the last MAPC Scheme Request field in the Co-RTWT profile.

(#3447)The MAPC Request Parameter Set field contains a Co-RTWT Parameter Set field with format defined in Figure 9-aa16 (Co-RTWT Parameter Set field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Target Wake Time | Nominal Minimum TWT Wake Duration | TWT Wake Interval Mantissa | Service Period Info |
| Octets: | 8 | 1 | 2 | 2 |

Figure 9-aa16—Co-RTWT Parameter Set field format

(#277)(#1411)(#1599)(#2519)(#3258)The Target Wake Time field contains an unsigned integer corresponding to the Co-RTWT SP start time expressed in terms of the TSF of the Co-RTWT requesting AP.

The Nominal Minimum TWT Wake Duration field indicates the nominal duration of the Co-RTWT SPs, in units of 256 μs.

The TWT Wake Interval Mantissa field is set to the value of the mantissa of the TWT wake interval value in microseconds, base 2.

(#3178)The format of the Service Period Info field is defined in Figure 9-aa17 (Service Period Info field format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B4 | B5 B12 | B13 B14 | B15 |
|  | TWT Wake Interval Exponent | Broadcast TWT Persistence | Restricted TWT Schedule Info | Reserved |
| Bits: | 5 | 8 | 2 | 1 |

Figure 9-aa17— Service Period Info field format

The TWT Wake Interval Exponent field is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval is the time between successive Co-RTWT SPs start times and is equal to (TWT Wake Interval Mantissa) × .

The Broadcast TWT Persistence field indicates the number of TBTTs of the Co-RTWT requesting AP during which the Co-RTWT SPs corresponding to this Co-RTWT Parameter set are present. The number of TBTTs of the Co-RTWT requesting AP during which the Co-RTWT SPs are present is equal to the value in the Broadcast TWT Persistence field plus 1, except that the value 255 indicates that the Co-RTWT SPs are present until explicitly terminated.

(#3178)The Restricted TWT Schedule Info field is defined in Table 9-349a (Restricted TWT Schedule Info subfield values).

9.4.2.aa3.2.6 Co-CR profile(#876)

The MAPC Scheme Type field is set to the value for Co-CR as indicated in Table 9-349f.

9.6.7 Public Action frame details

9.6.7.1 Public Action field

**Table 9-471—Public Action field values**

|  |  |
| --- | --- |
| **Public Action field value** | **Description** |
| … | … |
| <ANA> | MAPC Discovery Request |
| <ANA> | MAPC Discovery Response |
| <ANA> | MAPC Negotiation Request |
| <ANA> | MAPC Negotiation Response |
| … | … |

9.6.7.64 MAPC Discovery Request frame format

The MAPC Discovery Request frame is used by an AP to advertise its capabilities and common parameters for MAPC. The format of the MAPC Discovery Request frame is defined in Figure 9-aa20 (MAPC Discovery Request frame format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Category | Public Action | Dialog Token | MAPC Discovery Info |
| Octets: | 1 | 1 | 1 | variable |

Figure 9-aa20— MAPC Discovery Request frame format

The Category field is defined in 9.4.1.11 (Action field).

The Public Action field is defined in 9.6.7.1 (Public Action field).

The Dialog Token field is set to a nonzero value chosen by the AP sending the MAPC Discovery Request frame.

The MAPC Discovery Info field carries a MAPC element as defined in 9.4.2.aa3.1 (MAPC element).

NOTE —When a MAPC element carrying per-scheme profiles is included in a MAPC Discovery Request frame, the MAPC Scheme Request Set field is not included in the reported per-scheme profiles.

9.6.7.65 MAPC Discovery Response frame format

The MAPC Discovery Response frame is used by an AP to respond to a MAPC Discovery Request frame. The format of the MAPC Discovery Response frame is defined in Figure 9-aa21 (MAPC Discovery Response frame format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Category | Public Action | Dialog Token | MAPC Discovery Info |
| Octets: | 1 | 1 | 1 | variable |

Figure 9-aa21— MAPC Discovery Response frame format

The Category field is defined in 9.4.1.11 (Action field).

The Public Action field is defined in 9.6.7.1 (Public Action field).

The Dialog Token field is set to a nonzero value chosen by the AP sending the MAPC Discovery Response frame.

The MAPC Discovery Info field carries a MAPC element as defined in 9.4.2.aa3.1 (MAPC element).

NOTE —When a MAPC element carrying per-scheme profiles is included in a MAPC Discovery Response frame, the MAPC Scheme Request Set field is not included in the reported per-scheme profiles.

9.6.7.66 MAPC Negotiation Request frame format

(#1408)The MAPC Negotiation Request frame is used by an AP to request to establish, update, or teardown agreement(s) for MAPC scheme(s). The format of the MAPC Negotiation Request frame is defined in Figure 9-aa22 (MAPC Negotiation Request frame format).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Category | Public Action | Dialog Token | MAPC Negotiation Info |
| Octets: | 1 | 1 | 1 | variable |

Figure 9-aa22— MAPC Negotiation Request frame format

The Category field is defined in 9.4.1.11 (Action field).

The Public Action field is defined in 9.6.7.1 (Public Action field).

The Dialog Token field is set to a nonzero value chosen by the AP sending the MAPC Negotiation Request frame.

The MAPC Negotiation Info field carries a MAPC element as defined in 9.4.2.aa3.1 (MAPC element).

NOTE —When a MAPC element carrying per-scheme profiles is included in a MAPC Negotiation Request frame, the MAPC Scheme Request Set field is included in the reported per-scheme profiles.

9.6.7.67 MAPC Negotiation Response frame format

***TGbn editor: Please modify the body of subclause 9.6.7.67 (MAPC Negotiation Response frame format) as follows (tracked changes):***

(#1408)The MAPC Negotiation Response frame is used by an AP to respond to another AP that transmits a MAPC Negotiation Request frame. The format of the MAPC Negotiation Response frame is defined in Figure 9-aa23 (MAPC Negotiation Response frame format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Category | Public Action | Dialog Token | Status Code | MAPC Negotiation Info |
| Octets: | 1 | 1 | 1 | 2 | variable |

Figure 9-aa23— MAPC Negotiation Response frame format

The Category field is defined in 9.4.1.11 (Action field).

The Public Action field is defined in 9.6.7.1 (Public Action field).

The Dialog Token field is set to a nonzero value chosen by the AP sending the MAPC Negotiation Response frame.

The Status Code field is defined in 9.4.1.9 (Status Code field). Status Code field indicates the status of a MAPC negotiation as indicated in Table 9-80 (Status codes) and it is set by following the rules defined in 37.13.1.3 (MAPC agreement negotiation).

The MAPC Negotiation Info field carries a MAPC element as defined in 9.4.2.aa3.1 (MAPC element).

NOTE —When a MAPC element carrying per-scheme profiles is included in a MAPC Negotiation Response frame, the MAPC Scheme Request Set field is included in the reported per-scheme profiles.

***TGbn editor: Please remove 9.6.7.69, 9.6.7.70, and their content (tracked changes).***

9.6.10 Protected Dual of Public Action frame details

***TGbn editor: Please modify 9.6.10 as follows (delete two rows ‘MAPC Request’ and ‘MAPC Response’ and remove the underlining from the following two rows ‘Protected MAPC Negotiation Request’ and ‘Protected MAPC Negotiation Response’ from Table 9-516):***

**Table 9-516—Public Action field values defined for Protected Dual of Public Action frames**

|  |  |  |
| --- | --- | --- |
| **Public Action field value** | **Description** | **Defined in** |
| … | … |  |
|  |  |  |
|  |  |  |
| <ANA> | Protected MAPC Negotiation Request | 9.6.7.66 (MAPC Negotiation Request frame format) |
| <ANA> | Protected MAPC Negotiation Response | 9.6.7.67 (MAPC Negotiation Response frame format) |
| … | … |  |

37.13 Multi-AP coordination (MAPC) framework

***TGbn editor: Please modify the body of subclause 937.13 (Multi-AP coordination (MAPC) framework) as follows (tracked changes):***

37.13.1 Common procedures for all multi-AP coordination schemes

37.13.1.1 General

(#3710)(#1439)The MAPC framework includes a set of schemes (such as Co-BF, Co-SR, Co-TDMA, Co-RTWT, (#876)and Co-CR) and procedures in which APs operating their BSSs on the same primary 20 MHz channel coordinate to reduce interference levels and to improve network performance such as medium utilization efficiency, communication reliability, and latency.

An AP may use a MAPC scheme with another AP if it has established an agreement for that MAPC scheme by following the procedures defined in 37.13.1 or via other means out of the scope of this standard.

This subclause details the common procedures applicable for all the coordination schemes. The MAPC discovery procedure is defined in 37.13.1.2 (MAPC discovery). The MAPC agreement negotiation procedure is defined in 37.13.1.3 (MAPC agreement negotiation).

NOTE — For example, two APs that belong to the same ESS can enable the use of MAPC schemes via other means than the MAPC discovery and MAPC agreement negotiation procedures defined in this subclause.

All other procedures that are specific to each coordination scheme are detailed in 37.13.2 (Procedures for specific multi-AP coordination schemes).

37.13.1.2 MAPC discovery

This subclause defines MAPC discovery procedures for APs to advertise and discover MAPC capabilities and parameters of other APs.

An AP may advertise its MAPC capabilities, common MAPC parameters, and parameters specific to MAPC schemes by transmitting a MAPC Discovery Request frame (see 9.6.7.64 (MAPC Discovery Request frame format)) to the broadcast address, or as an individually addressed frame to another AP.

If an AP receives a soliciting MAPC Discovery Request frame from a transmitting AP, the AP shall respond by sending a MAPC Discovery Response frame to the broadcast address or as an individually addressed Management frame to the transmitting AP. The value of the Dialog Token field of the MAPC Discovery Response frame (see Figure 9-aa21) by the AP shall be set equal to the value of the Dialog Token field of the soliciting MAPC Discovery Request frame.

An AP that transmits a MAPC Discovery Request frame or a MAPC Discovery Response frame may include a Per-Scheme Profile subelement in the reported MAPC element for each MAPC scheme for which it signals a capability (see Figure 9-aa10). The AP shall not include the MAPC Scheme Request Set field in the reported Per-Scheme Profile subelements. 37.13.1.3 MAPC agreement negotiation

37.13.1.3.1 General

(#1408)This subclause defines procedures for MAPC agreement negotiation. An AP shall follow the rules defined in this subclause to establish(#669), update or tear down agreements for MAPC through negotiation, in addition to the specific rules for multi-AP coordination schemes defined in 37.13.2 (Procedures for specific multi-AP coordination schemes).

A MAPC requesting AP is an AP that initiates a MAPC negotiation for one or more MAPC schemes with another AP.

(#1050)(#2118)(#3179)A MAPC requesting AP shall not initiate a MAPC negotiation for a specific MAPC scheme with a peer AP if the peer AP has set the corresponding field for the support of that MAPC scheme in the MAPC Common Info field (see Figure 9-aa10 (MAPC Capabilities field format)) reported in the MAPC Discovery Request frame, MAPC Discovery Response frame, or MAPC Negotiation Request frame most recently received by the MAPC requesting AP to 0.

A MAPC responding AP is an AP that responds to a MAPC requesting AP.

(#3257)A MAPC requesting AP may initiate a MAPC negotiation for one or more MAPC schemes by sending an individually addressed MAPC Negotiation Request frame (see 9.6.7.66 (MAPC Negotiation Request frame format)) to a MAPC responding AP. The MAPC Negotiation Request frame shall include a MAPC element including at least one Per-Scheme Profile subelement in the MAPC Schemes Info field. Additionally, the MAPC requesting AP shall not include the Per-Scheme Profile subelement for a specific MAPC scheme in the MAPC element (see Table 9-349f (MAPC Scheme Type field values)) if it has not indicated support for that MAPC scheme in the MAPC Capabilities field carried in the MAPC element (see Figure 9-aa10 (MAPC Capabilities field format)). If a Per-Scheme Profile subelement is included in the MAPC element, it shall carry the MAPC Scheme Request Set field including at least one MAPC Scheme Request field.

NOTE—Each Per-Scheme Profile subelement of the MAPC Schemes Info field in a MAPC Negotiation Request frame carries request(s) for a specific MAPC scheme (see 9.4.2.aa3.2 (MAPC Schemes Info field)).

(#3257)A MAPC responding AP that receives an individually addressed MAPC Negotiation Request frame from a MAPC requesting AP shall respond by sending an individually addressed MAPC Negotiation Response frame to the MAPC requesting AP. The value of the Dialog Token field of the MAPC Negotiation Response frame (see Figure 9-aa23 (MAPC Negotiation Response frame format)) shall be set equal to the value of the Dialog Token field of the MAPC Negotiation Request frame (see Figure 9-aa22 (MAPC Negotiation Request frame format)). The Status Code field shall be set to SUCCESS if the MAPC responding AP accepts all the requests carried in the received MAPC Negotiation Request frame. Otherwise, the MAPC responding AP shall set the corresponding Status field to indicate an appropriate rejection status code as per Table 9-80 (Status codes). The MAPC Negotiation Response frame shall include a MAPC element including one Per-Scheme Profile subelement in the MAPC Schemes Info field for each Per-Scheme Profile subelement included by the MAPC requesting AP in the MAPC Negotiation Request frame. (#1416)In the MAPC Negotiation Response frame, each Per-Scheme Profile subelement shall include a MAPC Scheme Request field with MAPC Operation Type field set to 3, 4, or 5 (see Table 9-349g (MAPC Operation Type field values)). If the MAPC Operation Type field is set to 3 or 4, the MAPC Request Parameter Set shall not be included. If the MAPC Operation Type field is set to 5, the MAPC Request Parameter Set shall be included. If the MAPC Operation Type field is set to 3, the MAPC responding AP accepts the request. If the MAPC Operation Type field is set to 4, the MAPC responding AP rejects the request. If the MAPC Operation Type field is set to 5, the MAPC responding AP rejects the request and indicates that the MAPC responding AP may accept a subsequent request with parameter values as those included by the MAPC responding AP in the MAPC Request Parameter Set.

After two APs establish a MAPC agreement, any of the two APs may initiate a MAPC negotiation as MAPC requesting AP to update or teardown the MAPC agreement.

37.13.1.3.2 MAPC agreement establishment

To request for a new agreement establishment, the MAPC requesting AP shall set the MAPC Operation Type field to 0 (see Table 9-349g (MAPC Operation Type field values)). If the MAPC Operation Type field is set to 0, the MAPC Request Parameter Set is included according to the rules defined in 37.13.2 (Rules for specific multi-AP coordination schemes) for each specific MAPC scheme.

(#1050, #1717, #1718, #2118)A MAPC requesting AP shall not request to establish a new agreement for a specific MAPC scheme if the MAPC responding AP has set to 0 the corresponding field for enabling MAPC agreement establishment for that MAPC scheme (see Figure 9-aa11) in the MAPC Discovery Request frame, MAPC Discovery Response frame, or MAPC Negotiation Request frame most recently received by the MAPC requesting AP.

To accept,reject, or suggest alternative parameters for a MAPC agreement establishment, the MAPC responding AP shall follow the rules defined in 37.13.1.3.1 (General).

If the MAPC responding AP has accepted the request to establish a new MAPC agreement for a specific MAPC scheme, the MAPC requesting AP and the MAPC responding AP have established a MAPC agreement for that specific MAPC scheme.

NOTE —If, for example, a MAPC requesting AP transmits a MAPC Negotiation Request frame including a Co-BF profile and a Co-RTWT profile, where the Co-BF profile includes a MAPC Scheme Request field for a new agreement establishment request (MAPC Operation Type is set to 0) and the Co-RTWT profile includes three MAPC Scheme Request fields for three new agreement establishment requests, the MAPC responding AP responds with a MAPC Negotiation Response frame including a Co-BF profile and a Co-RTWT profile, where the Co-BF profile includes a MAPC Scheme Request field indicating the response to the agreement establishment request and the Co-RTWT profile includes three MAPC Scheme Request fields each indicating the response to the corresponding agreement establishment. In this example the MAPC requesting AP and the MAPC responding AP can establish up to one Co-BF agreement, and up to three Co-RTWT agreements (one for each R-TWT schedule).

A MAPC requesting AP and a MAPC responding AP may establish up to one MAPC agreement for each one of Co-BF, Co-SR, and Co-TDMA, and up to one MAPC agreement per R-TWT schedule for Co-RTWT.

37.13.1.3.2.1 AP ID assignment

When an AP participates in a MAPC negotiation to establish new MAPC agreement(s) as defined in 37.13.1.3.2 (MAPC agreement establishment), the AP shall additionally follow the rules defined in this subclause to assign an AP ID to a peer AP with which the AP establishes a MAPC agreement.

The AP ID is as described in 9.4.1.8 (AID field).

The same AP ID value shall not be assigned by the AP or by its affiliated MLD to any other STA.

NOTE— The STA is an associated non-AP STA, an unassociated non-AP STA that has been allocated a (Ranging session Identifier) RSID, any other coordinated AP, or a non-AP MLD that is associated with the AP MLD.

The same AP ID value shall not be assigned by any other AP within the same multiple BSSID set to any other STA.

The AP ID value shall not be assigned by any other AP MLD that has any affiliated AP within the same multiple BSSID set to any other non-AP MLD.

The AP ID value shall be greater than 2n where n the value carried in the MBSSID Indicator (n) field of the Multiple BSSID element if the AP belongs to a multiple BSSID set.

To assign an AP ID to another AP, an AP shall include the AP ID field in a MAPC element (see 9.4.2.aa3 (MAPC element)).

A MAPC requesting AP shall include the AP ID field in the MAPC element carried in the transmitted MAPC Negotiation Request frame only if the MAPC requesting AP has not established any MAPC agreement for any one of Co-BF, Co-SR, or Co-TDMA with the MAPC responding AP and the MAPC requesting AP is requesting to establish a new MAPC agreement for any one of Co-BF, Co-SR, or Co-TDMA by following the rules defined in 37.13.1.3.2.

A MAPC responding AP shall include the AP ID field in the MAPC element carried in the transmitted MAPC Negotiation Response frame, only if the MAPC responding AP has not established any MAPC agreement for any one of Co-BF, Co-SR, or Co-TDMA with the MAPC requesting AP and the MAPC responding AP is accepting a new MAPC agreement for any one of Co-BF, Co-SR, or Co-TDMA by following the rules defined in 37.13.1.3.2.

NOTE —For example, if the MAPC responding AP rejects all the requests for new agreements establishment, and there are no previously existing agreements, then the AP ID assignment from the MAPC requesting AP is considered void, and the MAPC responding AP does not assign an AP ID in the MAPC Negotiation Response frame.

The AP IDs assigned to the MAPC requesting AP and the MAPC responding AP shall be valid until at least one established agreement among Co-BF, Co-SR, and Co-TDMA is in existence between the two APs.

37.13.1.3.3 MAPC agreement update

To request a parameter update for an established MAPC agreement, the MAPC requesting AP shall set the MAPC Operation Type field to 1 (see Table 9-349g (MAPC Operation Type field values)). If the MAPC Operation Type field is set to 1, the MAPC Request Parameter Set is included according to the rules defined in 37.13.2 (Rules for specific multi-AP coordination schemes) for each specific MAPC scheme.

To accept,reject, or suggest alternative parameters for an update of an existing MAPC agreement, the MAPC responding AP shall follow the rules defined in 37.13.1.3.1 (General). If the MAPC responding AP rejects the update by setting the MAPC Operation Type field to 4 or 5, the agreement update procedure fails and the parameters of the MAPC agreement are not updated.

37.13.1.3.4 MAPC agreement teardown

(#1414)To request the teardown of an existing agreement, the MAPC requesting AP shall set the MAPC Operation Type field to 2 (see Table 9-349g (MAPC Operation Type field values)) in the MAPC Scheme Request field that carries the request. If the MAPC Operation Type field is set to 2, the MAPC Request Parameter Set shall not be included.

The MAPC responding AP shall accept the request to teardown an existing MAPC agreement by following the rules defined in 37.13.1.3.1 (General).

NOTE —When a MAPC requesting AP tears down the last MAPC agreement among Co-BF, Co-SR, and Co-TDMA with a MAPC responding AP, the mutually assigned AP IDs are released and their values can be reassigned.

37.13.2 Procedures for specific multi-AP coordination schemes

**37.13.2.4 Coordinated R-TWT (Co-RTWT)**

***TGbn editor: Please apply changes to the body of subclause 37.13.2.4 (Coordinated R-TWT (Co-RTWT)) as follows (tracked changes):***

**37.13.2.4.1 General**

(#3259)Coordinated restricted target wake time (Co-RTWT) operations described in subclause 37.13.2.4 (Coordinated R-TWT (Co-RTWT)) enable an AP to coordinate its R-TWT schedule(s) with OBSS AP(s) and/or obtain extended protection for its R-TWT schedule(s) from OBSS APs and their BSSs.

A Co-RTWT requesting AP is an AP with (#1715)dot11CoRTWTOptionImplemented equal to true that requests protection for one or more of its R-TWT schedules. A Co-RTWT requesting AP may request protection for its R-TWT schedule(s) either via Co-RTWT negotiations or via other means out of the scope of this standard.(#1716, #1719, #2117, #2674, #3175, #3885).

(#3176, #3177, #3445, #3446)A Co-RTWT coordinated AP is an AP with (#1715)dot11CoRTWTOptionImplemented equal to true that extends protection for R-TWT schedule(s) that are requested by a Co-RTWT requesting AP, either via Co-RTWT negotiations or via other means(#1716, #1719, #2117, #2674, #3175, #3885) out of the scope of this standard, (#832, #3450, #3582)by following the rules defined in 37.13.2.4.3 (Co-RTWT announcement rules) and 37.13.2.4.4 (TXOP and backoff procedure rules for Co-RTWT SPs(#901)).

Co-RTWT negotiation(s) to establish Co-RTWT agreement(s) are performed by following the rules defined in (#1050, #1408, #1414, #1416, #1417, #1717, #1718, #3257)37.13.1.3 (MAPC agreement negotiation) and 37.13.2.4.2 (Co-RTWT negotiations).

(#1716, #1719, #2117, #2674, #3175, #3885)NOTE—An AP with dot11CoRTWTOptionImplemented set to 1 can participate in Co-RTWT by means that do not follow the protocol defined in 37.13.1 and are out of the scope of this standard. For example, an AP (Co-RTWT coordinated AP) can be configured by the network to extend protection for R-TWT schedules of another AP (Co-RTWT requesting AP) in the same ESS. In another example, an AP (Co-RTWT coordinated AP) might listen to the Beacon frame of another AP (Co-RTWT requesting AP) in the same ESS and extend protection for R-TWT schedules that are announced in that Beacon frame.

**37.13.2.4.2 Co-RTWT negotiations**

(#3447, #3710, #1806, #3179, #3447, #3448, #3710, #3886, #3887, #3888)A Co-RTWT requesting AP that follow the rules defined in 37.13.1.3 (MAPC agreement negotiation) to establish, update, or tear down Co-RTWT agreement(s) is also a MAPC requesting AP and additionally follows the rules defined in this subclause.

(#1721, #1806, #3447, #3448)The Co-RTWT requesting AP shall include a Co-RTWT profile in the MAPC element carried in a transmitted individually addressed MAPC Negotiation Request frame. (#3449)The Co-RTWT profile shall include one or more MAPC Scheme Request fields where each corresponds to an R-TWT schedule. The MAPC Per-Scheme Info Present field shall be set to 1. The Broadcast TWT ID field identifies the R-TWT schedule, (#1413)and shall be set equal to the value of the Broadcast TWT ID field of the Restricted TWT Parameter Set field corresponding to the R-TWT schedule that is announced by the Co-RTWT requesting AP in its own BSS (see 35.8.3.1 (Rules for R-TWT scheduling AP)). (#880)The MAPC Operation Type shall be set to 0 to establish a new Co-RTWT agreement, to 1 to update an existing Co-RTWT agreement, (#1414)or to 2 to teardown an existing Co-RTWT agreement (see Table 9-349g). If the MAPC Operation Type is set to 0 or 1, the MAPC Request Parameter Set field defined in 9.4.2.aa3.2.5 (Co-RTWT profile) shall be included in the MAPC Scheme Request field.

(#1721, #1806, #3447, #3448)If the MAPC Request Parameter Set field is included in the MAPC Scheme Request field for an R-TWT schedule, the MAPC Request Parameter Set field shall specify the associated Co-RTWT parameter set as follows: the Target Wake Time field, the Nominal Minimum TWT Wake Duration field, the TWT Wake Interval Mantissa field, the TWT Wake Interval Exponent field, the Broadcast TWT Persistence field, and the Restricted TWT Schedule Info field shall be set equal to the value of the Target Wake Time field, Nominal Minimum TWT Wake Duration field, the TWT Wake Interval Mantissa field, the TWT Wake Interval Exponent field, the Broadcast TWT Persistence field, and the Restricted TWT Schedule Info field, respectively, as reported in the Restricted TWT Parameter Set field corresponding to the R-TWT schedule that is announced by the Co-RTWT requesting AP in its own BSS as defined in 35.8.3.1.

An AP that responds to a Co-RTWT requesting AP in a MAPC agreement negotiation for Co-RTWT agreement(s) is also a MAPC responding AP and responds by following the rules defined in 37.13.1.3.

An AP that has established one or more MAPC agreements for Co-RTWT with a Co-RTWT requesting AP is a Co-RTWT coordinated AP.

Each Co-RTWT agreement is uniquely identified by the <broadcast TWT ID, MAC address> tuple, where the broadcast TWT ID is the value of the Broadcast TWT ID field (see 9.4.2.aa3.2.5 (Co-RTWT profile)) and is greater than 0 and the MAC address is the address of the Co-RTWT requesting AP.

**37.13.2.4.3 Co-RTWT announcement rules**

(#1435, #3582, #1419)As part of extending protection for R-TWT schedule(s) of a Co-RTWT requesting AP, the Co-RTWT coordinated AP shall advertise the (#3884)active R-TWT schedule(s) in its transmitted Beacon frames if the Co-RTWT coordinated AP has at least one associated STA that supports R-TWT.

(#1720, #3181, #3795, #2119)NOTE —The Co-RTWT coordinated AP’s associated STA(s) that support R-TWT follow the rules defined in 35.8.4.1 (TXOP and backoff procedure rules for R-TWT SPs) for the R-TWT schedule(s).

To advertise (#3884)active R-TWT schedule(s) of a Co-RTWT requesting AP, the Co-RTWT coordinated AP shall announce R-TWT schedule(s) information by including Restricted TWT Parameter Set field(s) in the Broadcast TWT element defined in 9.4.2.198 (TWT element) and contained in transmitted Management frame(s) as specified in 26.8.3 (Broadcast TWT operation), 35.8 (Restricted TWT (R-TWT)), and by additionally following the rules defined in this subclause.

(#439, #1420)When a Co-RTWT coordinated AP advertises an (#3884)active R-TWT schedule of a Co-RTWT requesting AP, the Co-RTWT coordinated AP shall include a Restricted Parameter Set field describing the R-TWT schedule in the Broadcast TWT element:

* With the Restricted TWT Schedule Info subfield set to 3, and
* With the Broadcast TWT ID subfield set to 31.

(#439, #1420)When a Co-RTWT coordinated AP in a co-hosted BSSID set advertises an (#439, #1420)active R-TWT schedule of a Co-RTWT requesting AP, then all the other APs in the same co-hosted BSSID set are Co-RTWT coordinated APs and shall advertise the same R-TWT schedule:

* With the Restricted TWT Schedule Info subfield set to 3, and
* With the Broadcast TWT ID subfield set to 31.

(#1721)When a Co-RTWT coordinated AP advertises an (#3884)active R-TWT schedule of a Co-RTWT requesting AP, the Co-RTWT coordinated AP shall set all the other parameters of the Restricted TWT Parameter Set field as follows:

* The TWT Wake Interval Exponent field, the TWT Wake Interval Mantissa field shall be set equal to the corresponding value in the Co-RTWT parameter set,
* (#202, #277, #1411, #2519)The Target Wake Time field shall be set to [10:25], where corresponds to the start time of the R-TWT scheduled for this Restricted TWT parameter set that will occur after the Co-RTWT coordinated AP has queued for transmission the frame that contains the TWT element. The value of is obtained by converting the value of the Target Wake Time field of the Co-RTWT parameter set received from the Co-RTWT requesting AP to the Co-RTWT coordinated AP’s local TSF.
* (#1599, #3258)The four MSBs of the Nominal Minimum TWT Wake Duration/Target Wake Time Extension field shall be set to [6:9].
* (#1599, #3258)TSF timer at which that R-TWT is scheduled has bits 0 to 5 equal to 0 and bits 26 to 63 equal to the same value as the respective bits in the current value of the TSF timer of the Co-RTWT coordinated AP.
* The Broadcast TWT Persistence subfield for the R-TWT schedule shall be set to a value equal to the number of the Co-RTWT coordinated AP’s TBTTs for which the R-TWT schedule of the Co-RTWT requesting AP is expected to be in existence, counting forward from the current Co-RTWT coordinated AP’s TBTT. (#830)The value shall be determined by the Co-RTWT coordinated AP to include the TBTT immediately following the time at which the R-TWT schedule of the Co-RTWT requesting AP ceases to exist, that is obtained by the Broadcast TWT Persistence field of the most recent Co-RTWT parameter set. The Co-RTWT coordinated AP may change the value of the Broadcast TWT Persistence subfield for any Broadcast TWT within any transmitted TWT element.

NOTE —A non-AP STA does not request to establish membership in an R-TWT schedule advertised by the R-TWT scheduling AP with the Restricted TWT Schedule Info subfield set to 3 (see 35.8.3.2 (Rules for the R-TWT scheduled STA)).

**37.13.2.4.4 TXOP and backoff procedure rules for Co-RTWT SPs(#901)**

(#1435)(#3582)As part of extending protection for R-TWT schedule(s) of a Co-RTWT requesting AP, the Co-RTWT coordinated AP as a TXOP holder shall ensure that its TXOP ends before the start time of any active Co-RTWT SP for which protection is extended.

(#994)In addition, before starting transmission of any PPDU, the Co-RTWT coordinated AP shall check if there is enough time for the frame exchange to complete prior to the start of the Co-RTWT SP and, if there is not enough time, then the Co-RTWT coordinated AP shall defer transmission by selecting a random backoff count using the present CW[AC] (without advancing to the next value of CW[AC]). The QSRC[AC] for the MSDU or A-MSDU is not affected.

# Text to be adopted ends here.

**References:**