IEEE P802.11
Wireless LANs

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| Resolution to Comments : CIDs 26, 27, 37, 38, 40-47, 49-53, 67-71, 114, 115, 118,120 and 124 |
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Abstract

This document presents suggested proposal towards CIDs 26, 27, 37, 38, 40-47, 49-53, 67-71, 114, 115, 118,120 and 124

***Modify the following definition into 10.3.1 as highlighted in red texts:***

* STA authentication and association

***Discussion:***

CIDs 26, 27, 37, 38, 40-47, 49-53, 67-71, 114, 115, 118,120 and 124 provide comments about dynamic bandwidth control mechanism for CDMG in IEEE 802.11aj. This proposal is intended to address and resolve the comments with adoption/revision to the suggestions.

***Proposed Resolution:***

*Replace the following subcaluses in TGaj 0.01.*

**9.40 Dynamic bandwidth control mechanism for CDMG**

**9.40.1 General**

A CDMG STA supports the operation of variable bandwidth channels according to the channelization specified in Annex E.1. A CDMG PBSS/infrastructure BSS can operate on a 1.08 GHz or 2.16 GHz bandwidth channel. As specified in Annex E.1, each 2.16 GHz channel encompasses two 1.08 GHz channel. A CDMG PBSS/infrastructure BSS shall use the following dynamic bandwidth control (DBC) mechanism when operating in the country which requires the support of variable bandwidth channels operation to mitigate interference between other CDMG and DMG BSSs.

A CDMG AP or PCP shall follow the procedures in 10.1.4.4.2 to initialize a CDMG BSS on a 1.08 GHz or a 2.16 GHz bandwidth channel. An AP or PCP operating the BSS on a 1.08 GHz channel shall periodically transmit DMG Beacon frames (8.3.4.1) on the 2.16 GHz channel that encompasses the 1.08 GHz channel on which the BSS is operating. A CDMG AP or PCP may change the operating bandwidth of its BSS dynamically from 1.08 GHz to 2.16 GHz or vice versa.

A CDMG AP or PCP may request the AP or PCP of an existing CDMG BSS operating on a 2.16 GHz channel (e.g. Channel 2) to shift its operating channel to one of the 1.08 GHz channels (e.g. Channel 5) within its original 2.16 GHz channel by sending a Channel Splitting Request frame (8.5.23.4) or an Extended Channel Splitting Request frame (8.5.8.29). If the existing CDMG BSS changed its operating channel to one of the 1.08 GHz channels (e.g. Channel 5), the CDMG AP or PCP that sends the request frame may then operate a new BSS on the other adjacent 1.08 GHz channel (i.e. Channel 6) within the 2.16 GHz channel (i.e. Channel 2).

A pair of CDMG BSSs operating on adjacent 1.08 GHz channels (e.g. Channel 5 and Channel 6) within a 2.16 GHz channel (i.e. Channel 2) should maintain synchronization with each other to mitigate the interference caused by the transmission of the DMG Beacon and other frames on the 2.16 GHz channel (i.e. Channel 2) according to 9.40.2.3.

**9.40.2 CDMG channel access**

**9.40.2.1 CDMG BSS operating on a 2.16 GHz Channel**

A CDMG PCP or AP operating a PBSS/infrastructural BSS on a 2.16 GHz channel (e.g. Channel 2) shall follow the channel access rules as described in 9.33.

**9.40.2.2 CDMG BSS operating on a 1.08 GHz Channel**

A CDMG PCP or AP operating a PBSS/infrastructural BSS on a 1.08 GHz channel (e.g. Channel 5) shall periodically transmit DMG Beacon frames (8.3.4.1) on the 2.16 GHz channel (i.e. Channel 2) that encompasses its operating channel (i.e. Channel 5). The time interval between two consecutive DMG Beacon frames transmitted on the 2.16 GHz channel shall be no more than aMaxBIDuration. The generation of the DMG Beacon frames shall follows the rules in (10.1.3.2a).

The AP or PCP that starts a PBSS/infrastructure BSS on a 1.08 GHz channel (e.g. Channel 5) shall set a TSF timer to track the beacon interval (BI) on the encompassing 2.16 GHz channel (i.e. Channel 2). At the beginning of a beacon interval on 2.16 GHz channel, the AP or PCP shall schedule a notification period (NP) or a BHI (9.33.2) indicated by the DBC Option field of Dynamic Bandwidth Control element (8.4.2.160) contained in each DMG Beacon frame as shown in Figure 9-81a and Figure 9-81b, respectively. If a NP is scheduled on the 2.16 GHz channel, at least one BHI shall be scheduled on the 1.08 GHz channel. The NP may include the BTI, A-BFT and ATI.

During the BTI on the 2.16 GHz channel, the AP or PCP shall transmit DMG Beacon frame containing the Dynamic Bandwidth Control element (8.4.2.160) that information on the operating status of the BSS through the DBC Control field and Channel Number field. The beacon interval length on the 2.16 GHz channel is indicated by the Beacon Interval field (8.4.1.3) contained in each DMG Beacon frame.

The AP or PCP may also establish an independent beacon interval on its operating 1.08 GHz channel and set another TSF timer to track it. As illustrated in Figure 9.81a, the beacon interval length on 1.08 GHz channel shall be set as an integer factor of the beacon interval length on 2.16 GHz channel in terms of TUs. The maximum length shall be the beacon interval length on the 2.16 GHz channel. The channel access on the 1.08 GHz shall follow the rules described in 9.33 with a BHI period within each BI. If BHIs are present on the 1.08 GHz channel, the DBC Option subfield of Dynamic Bandwidth Control element within the DMG Beacon Frame shall be set as 0, otherwise the subfield shall be set as 1.

A guard interval (GI) may follow a NP/BHI on the 2.16 GHz channel as shown in Figure 9-81a and Figure 9-81b for CDMG STAs to switch from transmitting and receiving frames on the 2.16 GHz channel to transmitting and receiving frames on the 1.08 GHz channel. The determination of the length of the GI is implementation dependent. At the end of the GI (or the NP/BHI if the GI is not present), the AP or PCP shall be ready to transmit or receive frames on the 1.08 GHz operating channel indicated by the Channel Number field of the Dynamic Bandwidth Control element.

If a CDMG AP or PCP transmits DMG Beacon frame with the DBC Option subfield of Dynamic Bandwidth Control element equal to 0, it shall schedule quiet periods (QPs) on the 1.08 GHz channel by scheduling SPs with the AllocationType subfield to 2 in the Allocation field and the Source AID subfield and Destination AID subfield to its own AID. The starting times and durations of these QPs shall coincide with the starting times and durations of the NPs on the 2.16 GHz channel. The AP or PCP may also schedule the starting times of the QPs to be earlier than the NPs and the durations of the QPs to be greater than the durations of the NPs to establish a GI before and after each NP as shown in Figure 9-81a.

If a CDMG AP or PCP transmits DMG Beacon frame with the DBC Option subfield of Dynamic Bandwidth Control element equal to 1, it may schedule QPs before and after the BHIs to serve as GIs as shown in Figure 9-81b. The GIs in this case should be longer than the time taken for all the CDMG STAs to switch from transmitting and receiving frames on the 2.16 GHz channel to transmitting and receiving frames on the 1.08 GHz channel. The determination of the length of the GIs is, however, implementation dependent.

If a non-AP or non-PCP CDMG STA receives a DMG Beacon frame from the CDMG AP or PCP with the BSSID equal to the BSSID of the BSS of which the STA is a member and with the DBC Option subfield of Dynamic Bandwidth Control element equal to 0, the STA shall switch to the 1.08 GHz operating channel indicated by the Channel Number field of the received Dynamic Bandwidth Control element to receive the DMG Beacon frame transmitted on the corresponding 1.08 GHz channel and follow the beamforming rules in 9.35 and the channel access rules in 9.33 within the 1.08 GHz channel. The non-AP or non-PCP STA may use the BI Offset subfield of Dynamic Bandwidth Control element in the received DMG Beacon frame to predict the starting time of BTI on the 1.08 GHz channel. In the following medium time, the non-AP or non-PCP STA should be prepare to receive and transmit frames on the 1.08 GHz channel unless it is assigned by the AP or PCP to monitor the 2.16 GHz common channel, communicates with other DMG STAs, leaves the current PBSS/infrastructure BSS, or the PBSS/infrastructure BSS ceases its services.

Alternatively, if a non-AP or non-PCP CDMG STA receives a DMG Beacon frame from the CDMG AP or PCP with the BSSID equal to the BSSID of the BSS of which the STA is a member and with the DBC -Option subfield of Dynamic Bandwidth Control element equal to 1, the STA shall follow the beamforming rules in 9.35 and the channel access rules in 9.33 within the 2.16 GHz channel during the BHI duration. During the DTI, the STA shall switch to the 1.08 GHz operating channel indicated by the Channel Number field of the received Dynamic Bandwidth Control element to receive and transmit frame following the channel access rules in 9.33 within the 1.08 GHz channel.





**Figure 9-81a. Example of an AP or PCP starts its PBSS/infrastructure BSS on Channel 5 by transmitting DMG Beacon frames on both Channel 2 and Channel 5.**





Figure 9-81b. Example of A CDMG AP or PCP starts its PBSS/infrastructure BSS on Channel 5 through transmitting DMG Beacon frames on Channel 2 only.

**9.40.2.3 Synchronization of CDMG PBSS/infrastructure BSSs on adjacent 1.08 GHz channels within a 2.16 GHz channel**

A CDMG AP or PCP setting up an infrastructure BSS/PBSS on a 1.08 GHz channel (e.g. Channel 5) that has a CDMG BSS established on the adjacent 1.08 GHz channel (i.e. Channel 6) within the same 2.16 GHz channel (i.e. Channel 2) should follow the procedures below to maintain synchronization.

A CDMG AP or PCP shall scan the 2.16 GHz channel (e.g. Channel 2) that encompasses the 1.08GHz channel (e.g. Channel 6) on which the CDMG AP or PCP is going to set up its BSS for DMG Beacon frames. If the CDMG AP or PCP received a DMG Beacon frame containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1, the Channel Number field indicating the existing AP or PCP works on a 1.08 GHz channel and the Adjacent Channel Occupancy subfield equal to 1, the AP or PCP may send an Extended Notification Period Request frame (8.5.20.27) during the following ATI of the BSS indicated by the BSSID field of the received DMG Beacon frame, to request the existing AP or PCP to allocate time for NPs/BHI to transmit DMG Beacon frames on the encompassing 2.16 GHz channel with the NP/BHI Duration field in the Extended Notification Period Request frame indicating the requested duration of NPs/BHIs.

Alternatively, the scanning AP or PCP may attempt to associate with the PBSS/infrastructure BSS indicated by the BSSID field of the received DMG Beacon frame following the rules in 10.3 and subsequently send a Notification Period Request frame (8.5.23.2). A non-AP or non-PCP CDMG STA within a PBSS/infrastructure BSS operating on a 1.08 GHz channel may send a Notification Period Request frame (8.5.23.2) during the ATI, SP, or CBAP, to request the AP or PCP to allocate time for NPs/BHIs to transmit DMG Beacon frames on the encompassing 2.16 GHz channel with the -NP/BHI Duration field in the Notification Period Request frame indicating the requested duration of NPs/BHIs.

If a CDMG AP or PCP receives a Notification Period Request frame or an Extended Notification Period Request frame, it may allocate QPs on its operating 1.08 GHz channel at the same recurring position in each beacon interval of the 2.16 GHz channel and reply with a Notification Period Response frame (8.5.23.3) or an Extended Notification Period Response frame (8.5.20.28) containing a Dynamic Bandwidth Control element with the -TBTT Offset field indicating the target starting time of the allocated NPs/BHIs and the NP/BHI Duration field and the Adjacent NP/BHI Duration field indicating the lengths of the NPs/BHIs on the 2.16 GHz channel of itself and the scanning AP or PCP. The CDMG AP or PCP may schedule the starting times of the QPs to be earlier than the NPs and the durations of the QPs to be greater than the durations of the NPs to establish a GI before and after each NP/BHI as shown in Figure 9-82a and Figure 9-82b. The AP or PCP shall scan for DMG Beacon frames in the allocated NPs to determine if a new BSS has been established on the adjacent 1.08 GHz channel.

If a CDMG STA receives a Notification Period Response frame or Extended Notification Period Response frame addressed to itself, it may establish a PBSS/infrastructure BSS on the 1.08 GHz channel adjacent to the channel indicated in the Channel Number field of the Dynamic Bandwidth Control element and become the AP or PCP using the following steps. The scanning AP or PCP shall start to transmit DMG Beacon frames at the start of the allocated NP/BHI indicated by the TBTT Offset field of Dynamic Bandwidth Control element and set a TSF timer to track its beacon interval on the 2.16 GHz channel. The duration of the beacon interval on the 2.16 GHz channel shall be equal to the Beacon Interval field in the received Notification Period Response frame or an Extended Notification Period Response frame. The duration of NP/BHI on the 2.16 GHz channel shall be set to the value of the Adjacent NP/BHI Duration field of Dynamic Bandwidth Control element in the received Notification Period Response frame or an Extended Notification Period Response frame. The scanning AP or PCP shall continue to receive the DMG Beacon frames from the existing AP or PCP during the NPs/BHIs starting at the time obtained from Beacon Interval field minus the TBTT Offset field from the beginning of each beacon interval on the 2.16 GHz channel with the length indicated by the NP/BHI Duration field of the Dynamic Bandwidth Control element in the previously received Notification Period Response frame or Extended Notification Period Response frame -and maintain synchronization by adjusting its TSF to match the Timestamp field (8.4.1.10) in the received DMG Beacon frames transmitted in these NPs/BHIs. The scanning AP or PCP shall also use the DBC Option field of Dynamic Bandwidth Control element in each DMG Beacon frame to announce whether the beacon interval on its 1.08 GHz operating channel is present or not described in 9.40.2.2.

A CDMG AP or PCP operating on a 1.08 GHz channel may also actively allocate reserved NPs/BHIs on the 2.16 GHz channel to allow a new CDMG BSS to be established on the adjacent 1.08 GHz channel. The CDMG AP or PCP may allocate QPs on its 1.08 operating GHz channel at the same recurring position in each beacon interval of the 2.16 GHz channel and announce the presence of the reserved NPs/BHIs by transmitting DMG Beacon frames on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1, the Adjacent Channel Occupancy subfield equal to 1, and the value of the Adjacent NP/BHI Duration field not equal to 0. The –TBTT Offset field and the Adjacent NP/BHI Duration field in Dynamic Bandwidth Control element indicates the target starting time and the duration of the reserved NPs/BHIs respectively. The AP or PCP shall scan for DMG Beacon frames in the reserved NPs to determine if a new BSS has been established on the adjacent 1.08 GHz channel.

If a CDMG AP or PCP receives a DMG Beacon frame on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1, the Adjacent Channel Occupancy field equal to 1 and the Adjacent NP/BHI Duration field not equal to 0, it may establish a PBSS/infrastructure BSS on the 1.08 GHz channel adjacent to the channel indicated in the Channel Number field of the Dynamic Bandwidth Control element using the following steps. The AP or PCP shall continue scan for DMG Beacon frames on the 2.16 GHz channel during the reserved NPs/BHIs indicated by the TBTT Offset field of the Dynamic Bandwidth Control element for an interval of at least aMinChannelTime. If it does not receive any valid DMG Beacon frame, it may start a new BSS by transmitting a DMG Beacon frame at the start of the reversed NP/BHI and set a TSF timer to track its beacon interval on the 2.16 GHz channel. The duration of the beacon interval on the 2.16 GHz channel shall be equal to the Beacon Interval field in the received DMG Beacon frame of the existing AP or PCP. The scanning AP or PCP shall continue to receive the DMG Beacon frames in NPs/BHIs of the existing AP or PCP operating on the adjacent 1.08 GHz channel to maintain synchronization by adjusting its TSF to match the Timestamp field (8.4.1.10) in the received DMG Beacon frames. The scanning AP or PCP shall also use the DBC Option field of Dynamic Bandwidth Control element contained in each DMG Beacon frame to announce whether the beacon interval on its 1.08 GHz operating channel is present or not described in 9.40.2.2.

The NPs/BHIs of the two APs or PCPs operating on adjacent 1.08 GHz channels within a 2.16 GHz channel may be arranged consecutively without interspaces to reduce the number of times they need to switch between transmitting and receiving frames on the 2.16 GHz channel and the 1.08 GHz channels.

Figure 9-82a shows an example of two NPs (i.e. NP 1 of AP/PCP 1 and NP 2 of AP/PCP 2) arranged consecutively without interspaces. Figure 9-82b shows another example of two BHIs (i.e. BHI 1 of AP/PCP 1 and BHI 2 of AP/PCP 2) arranged arbitrarily apart from each other.





Figure 9-82a. Two APs or PCPs establish PBSSs/infrastructure BSSs on Channel 5 and Channel 6, respectively, and their NPs are arranged consecutively.





Figure 9-82b. Two APs or PCPs establish PBSSs/infrastructure BSSs on Channel 5 and Channel 6, respectively, and their BHIs are arranged apart from each other.

If a CDMG AP or PCP operating on a 1.08 GHz channel with the adjacent 1.08 GH channel occupied by another CDMG BSS does not receive any DMG Beacon frame transmitted by the CDMG AP or PCP operating on the adjacent 1.08 GHz channel in the assigned NPs/BHIs for a period of 4×aMinBTIPeriod beacon intervals on the 2.16 GHz channel, starting from when the last frame is received from the neighboring AP or PCP, it may proceed to make changes to the assigned NPs/BHIs on the 2.16 GHz channel. The AP or PCP may continue to allocate a NP/BHI on 2.16 GHz channel at the same position to allow another AP or PCP to establish a new BSS on the adjacent 1.08 GHz channel as described above or it may stop allocating QPs on its operating channel that correspond to the NPs/BHIs on 2.16 GHz channel of the BSS operating on the adjacent 1.08GHz channel.

The CDMG AP or PCP may also move its TBTT (10.30.2) on the 2.16 GHz channel (e.g. Channel 2) backward so that its NPs/BHIs are followed closely by the BHI on its 1.08 GHz operating channel (e.g. Channel 6) as illustrated in Figure 9-83b.





Figure 9-83a. An AP or PCP ceases its service on Channel 5





Figure 9-83b. The neighboring AP or PCP moves its TBTT in Channel 2

**9.40.3 Channel splitting of a 2.16 GHz channel**

If a CDMG STA receive a DMG Beacon frame from a CDMG AP or PCP operating on a 2.16 GHz channel (e.g. Channel 2), it may request the AP or PCP to shift its operating channel to one of the 1.08 GHz channels (e.g. Channel 5) within its original 2.16 GHz channel by sending an Extended Channel Splitting Request frame (8.5.8.29) during the following ATI or it may to associate with the PBSS/infrastructure BSS indicated by the BSSID field of the received DMG Beacon frame following the rules in 10.3 and subsequently send a Channel Splitting Request frame (8.5.23.4).

A non-AP or non-PCP CDMG STA within a PBSS/infrastructure BSS operating on a 2.16 GHz channel (e.g. Channel 2) may send a Channel Splitting Request frame (8.5.23.4) during the ATI, SP, or CBAP, to request the AP or PCP to shift its operating channel to one of the 1.08 GHz channels (e.g. Channel 5) within its original 2.16 GHz. If the existing CDMG BSS changed its operating channel to one of the 1.08 GHz channels (e.g. Channel 5), the CDMG STA that sends the request frame may then operate a new BSS on the other adjacent 1.08 GHz channel (i.e. Channel 6) within the 2.16 GHz channel (i.e. Channel 2) as the AP or PCP.

The Channel Splitting Request frame or Extended Channel Splitting Request frame shall use the NP/BHI Duration field to indicate the required length of NP/BHI on 2.16 GHz channel.

If a CDMG AP or PCP receives a Channel Splitting Request frame (8.5.23.4) or Extended Channel Splitting Request frame (8.5.8.29), the AP or PCP may follow 10.9.8.6 to switch its operating channel to a 1.08 GHz channel (e.g. Channel 5) within its original 2.16 GHz channel (i.e. Channel 2). If the AP of PCP switches the operating channel after receiving a Channel Splitting Request frame, it shall inform all its non-AP or non-PCP STAs with the DBC option it selects to operate on 1.08 GHz channel after channel splitting, the target 1.08 GHz channel number to which it switches and the starting time of the first beacon interval on 2.16 GHz channel when the channel splitting begins through the DBC Option subfield of Dynamic Bandwidth Control element, the New Channel Number field and the Channel Switching Count field of Channel Switch Announce element contained in the DMG Beacon and/or Announce frames. The AP or PCP shall also send a Channel SplittingResponse frame (8.5.23.5) or Extended Channel SplittingResponse frame (8.5.8.30) to announce the target 1.08 GHz channel number to which it switches and the starting time of the first beacon interval on 2.16 GHz channel when the channel splitting begins through the New Channel Number field and the Channel Switching Count field of Channel Switch Announce element, the length of its beacon interval on 2.16 GHz channel after channel splitting through Beacon Interval field, and the time offset of the scanning AP’s or PCP’s beacon interval relative to the existing AP’s or PCP’s beacon interval on 2.16 GHz channel and the lengths of NP/BHI durations for both APs or PCPs on 2.16 GHz channel through the TBTT Offset field, the NP/BHI Duration and the Adjacent NP/BHI Duration fields of Dynamic Bandwidth Control element to the CDMG STA indicated in the Source AID field in the received Channel Splitting Request frame or Extended Channel Splitting Request frame.

If a CDMG AP or PCP receives a Channel Splitting Request frame or Extended Channel Splitting Request frame but is not switching its operating channel, it may reply a Channel Splitting Response frame or an Extended Channel SplittingResponse frame to reject the request.

If a CDMG STA sends a Channel Splitting Request frame or Extended Channel Splitting Request frame and then receives Channel Splitting Response frame or an Extended Channel SplittingResponse frame with the Channel Splitting subfield set to 1, it shall follows the procedures described in 9.40.2.3 to maintain synchronization with the CDMG AP or PCP that sends the Channel Splitting Response frame or an Extended Channel SplittingResponse frame when it starts a new BSS on the adjacent 1.08 GHz channel as the AP or PCP.

**9.40.4 Channel expansion of 1.08 GHz channel**

A CDMG AP or PCP operating a PBSS/infrastructure BSS services on a 1.08 GHz channel (e.g. Channel 5) may expand its operating bandwidth by switching to the 2.16 GHz channel (i.e. Channel 2) encompassing its original operating channel without interruption to its BSS services.

If a CDMG AP or PCP operating a PBSS/infrastructure BSS services on a 1.08 GHz channel (e.g. Channel 5) transmits DMG Beacon frames on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1 and the Adjacent Channel Occupancy subfield equal to 1, the AP or PCP may follow 10.9.8.6 to switch its operating channel to the 2.16 GHz channel (e.g. Channel 2).

If a CDMG AP or PCP operating a PBSS/infrastructure BSS services on a 1.08 GHz channel (e.g. Channel 5) transmits DMG Beacon frames on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1 and the Adjacent Channel Occupancy subfield equal to 0 but does not receive any DMG Beacon frame during the allocated NPs/BHI from another CMDG AP or PCP for a time period of 4×aMinBTIPeriod beacon intervals on 2.16 GHz channel, the AP or PCP may follow 10.9.8.6 to switch its operating channel to the 2.16 GHz channel (e.g. Channel 2).

If a CDMG AP or PCP operating a PBSS/infrastructure BSS services on a 1.08 GHz channel (e.g. Channel 5) transmits DMG Beacon frames on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1 and the Adjacent Channel Occupancy subfield equal to 0 and receives a DMG Beacon frame during a NP/BHI from another CMDG AP or PCP operating on the adjacent 1.08 GHz channel e.g. Channel 6) within a 2.16 GHz channel (i.e. Channel 2), it shall not expand its operating bandwidth by switching to the 2.16 GHz channel.

If the CDMG AP of PCP is switching the operating channel, it shall transmits DMG Beacon frames during the scheduled NPs on the 2.16 GHz channel containing a Dynamic Bandwidth Control element with the Channel Splitting subfield equal to 1 and the Adjacent Channel Occupancy subfield equal to 0 until the intended channel switch time. The AP or PCP shall inform all the non-AP or non-PCP STAs in the BSS with the target 2.16 GHz channel number to which it switches and the starting time of the first beacon interval on 2.16 GHz channel after the channel expansion through the New Channel Number field and the Channel Switching Count field of the Channel Switch Announce element contained in the DMG Beacon and/or Announce frames. Here, the starting time is set until to the end of a subsequent beacon interval on the 2.16 GHz channel. Note that the beacon interval length after channel expansion might be different with that before channel expansion.

Figure 9-84a and Figure 9-84b illustrate the examples that an AP or PCP (e.g. PCP/AP 1) operating on Channel 5 switches to Channel 2. In Figure 9-84a, PCP/AP 1 established an independent beacon interval in Channel 5 while in Figure 9-82b, PCP/AP 1 does not.





Figure 9-84a. AP or PCP operating in Channel 5 with independent beacon interval expanding the operating bandwidth to Channel 2



Figure 9-84b. AP or PCP operating in Channel 5 without independent beacon interval expanding the operating bandwidth to Channel 2

**9.40.5 Backward compatibility and interoperation**

A CDMG AP or PCP operating a PBSS/infrastructure BSS shall provide interoperability to DMG STAs regardless of the BSS’s operating channel. If a CDMG BSS is operating on a 2.16 GHz channel, the CDMG AP or PCP shall follow the channel access rules as described in 9.33 to provide services to non-AP or non-PCP DMG STA.

If a CDMG PBSS/infrastructure BSS is operating on a 1.08 GHz channel, the CDMG AP or PCP shall follow the channel access rules in the BHI as described in 9.33 during the NPs/BHIs on the 2.16 GHz channel to admit non-AP or non-PCP DMG STAs into the BSS and provides scheduling information to DMG STAs. In the following medium time, the CDMG AP or PCP shall follow the rules in 9.33.6 to schedule the SPs or CBAPs for DMG non-AP or non-PCP STAs on the 2.16 GHz channel. If the CDMG AP or PCP establishes an independent beacon interval on its operating 1.08 GHz channel, it shall schedule SPs or CBAPs with DMG non-AP or non-PCP STAs as the source or destination STAs such that the scheduled SPs or CBAPs shall not be overlapped in time with the BHI periods on the 1.08 GHz channel. The CDMG AP or PCP may also schedule SPs or CBAPs on the 2.16 GHz channel for DMG STAs within the BSS to communicate with CDMG STAs within the BSS.

If a CDMG AP or PCP is operating on a 1.08 GHz channel, with another CDMG BSS operating on the adjacent 1.08 GHz channel within a 2.16 GHz channel, the CDMG AP or PCP shall only schedule SPs or CBAPs with DMG non-AP or non-PCP STAs as the source or destination STAs in time periods which has been reported as available by the other CDMG AP or PCP through the Extended Schedule element in its DMG Beacon frames. The CDMG AP or PCP should announce all its available time for the other CDMG AP or PCP to create SPs or CBAPs on 2.16 GHz channel in the following beacon intervals. The CDMG AP or PCP may transmit DMG Beacon frames during its NP/BHI on 2.16 GHz channel containing Extended Schedule elements that announce such allocations with the AllocationType subfield of an Allocation field set to 4 and the Source AID subfield and Destination AID subfield set to 255. The CDMG AP or PCP that intends to allocate time on the 2.16 GHz channel may also transmit an Allocation Request frame (8.5.23.6) during the ATI of the other AP’s or PCP’s NP/BHI on the 2.16 GHz channel to request for the available time for allocations on the 2.16 GHz channel. A CDMG AP or PCP that receives an Allocation Request frame from a CDMG AP or PCP operating on its adjacent 1.08 GHz channel shall reply with an Allocation Response frame (8.5.23.7) with the AllocationType subfield of an Allocation field set to 4 and the Source AID subfield and Destination AID subfield set to 255 within an Extended Schedule element to indicate the schedule of all its available time.

A CDMG AP or PCP is operating on a 1.08 GHz channel, with another CDMG BSS operating on the adjacent 1.08 GHz channel within a 2.16 GHz channel should appropriately reserve and schedule the available time for the AP or PCP operating on adjacent 1.08 GHz channel and itself to allocate SPs or CBAPs on the 2.16 GHz channel, but the method to determine the reservation is implementation dependent.



Figure 9-85a. The CDMG AP or PCP that establishes its PBSS/infrastructure BSS on Channel 5 with the beacon interval starting on this channel allows the DMG STAs to join as non-AP or non-PCP STAs and allocates their SPs or CBAPs on Channel 2 only.



Figure 9-85b. The CDMG AP or PCP that establishes its PBSS/infrastructure BSS on Channel 5 without starting the beacon interval on this channel allows the DMG STAs to join as non-AP or non-PCP STAs and allocates their SPs or CBAPs on Channel 2 only.



Figure 9-86a. The APs or PCPs that establish their PBSSs/infrastructure BSSs on Channel 5 and Channel 6, respectively, with the beacon interval starting on this channel, allow the DMG STAs to join any of them as non-AP or non-PCP STAs and allocate their SPs or CBAPs on Channel 2 only.



Figure 9-86a. The APs or PCPs that establish their PBSSs/infrastructure BSSs on Channel 5 and Channel 6, respectively, without starting the beacon interval on this channel, allow the DMG STAs to join any of them as non-AP or non-PCP STAs and allocate their SPs or CBAPs on Channel 2 only.

**8.3.4.1 DMG Beacon**

*Change the Figure 8-34b with*



**Figure 8-34b**—**Beacon Interval Control**

*Insert the following sentences:*

The DBC Present field is set to 1 to indicate that the Dynamic Bandwidth Control element is present in the DMG Beacon frame. Otherwise, the Dynamic Bandwidth Control element is not present. The CDMG STAs shall set this field to 1 by default.

**8.3.4.1 DMG Beacon**

*Insert a new row into the table before the Last–n row:*

Table 8-33a – DMG Beacon frame body

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| … | … | … |
| 14 | Multi-band | The Multi-band element is optionally present if dot11MultibandImplemented is true. |
| 15 | Dynamic Bandwidth Control | The Dynamic Bandwidth Control element is optionally present if the AP or PCP is a CDMG STA. |
| Last - *n* | One or more elements can appear in this frame. These elements follow all other elements that are not vendor-specific elements and precede all other elements that are vendor-specific elements that are part of the Last field in the frame. Except for the Multi-band element, an element can be included only once in the frame. | Optional |
| last | Vendor Specific | One or more vendor-specific elements are optionally present. These elements follow all other elements. |

**8.4.1.9 Status Code field**

*Change the following rows in Table 8-37, and insert the new rows into the table in numeric order:*

Table 8-37 – Status Code

|  |  |  |
| --- | --- | --- |
| **Status Code** | **Name** | **Meaning** |
| … | … | … |
| 104 | DENIED\_NOTIFICATION\_PERIOD\_ALLOCATION | Request denied because the allocation of notification period is failed. |
| 105 | DENIED\_CHANNEL\_SPLITTING | Request denied because the request of channel splitting is failed. |
| 106 | DENIED\_ALLOCATION | Request denied because the allocation request is failed |
| 107-65535 |  | Reserved. |

**8.4.1.11 Action field**

*Change the following row in Table 8-38, and insert a new row into the table in numeric order:*

**Table 8-38**—**Category values**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Code | Meaning | Sub-clause | Robust | Group addressed privacy | Action frame |
| 21 | CDMG | 8.5.23 | Yes | No |  |
| 22-125 | Reserved | — | — | — |  |

**8.4.2 Information elements**

**8.4.2.1 General**

*Insert a new row into Table 8-54 in numeric order:*

**Table 8-54**—**Element IDs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Element ID** | **Length (in octets)** | **Extensible** |
| Dynamic Bandwidth Control | ANA | 22 | Yes |

**8.4.2.134 Dynamic Bandwidth Control element**

*Change the following row in Table 8-183i, and insert a new row into the table in numeric order:*

**Table 8-183i**—**AllocationType field values**

|  |  |  |  |
| --- | --- | --- | --- |
| Bit 4 | Bit 5 | Bit 6 | Meaning |
| 0 | 0 | 0 | SP allocation on a 2.16 GHz channel |
| 1 | 0 | 0 | CBAP allocation on a 2.16 GHz channel |
| 0 | 1 | 0 | SP allocation on a 1.08 GHz channel |
| 1 | 1 | 0 | CBAP allocation on a 1.08 GHz channel |
| 0 | 0 | 1 | Reserved time that is available on a 2.16 GHz channel |
| All other combinations | Reserved |

**8.4.2.160 Dynamic Bandwidth Control element**

The Dynamic Bandwidth Control element defines the information from the CDMG PCP or AP to support the dynamic bandwidth control mechanism described in 9.40 and CDMG PCP or AP clustering mechanism described in 9.34a. The Dynamic Bandwidth Control element is included in DMG Beacon, Announce, Notification Period Response frames, transmitted to the peer STA and the PCP/AP of the BSS. The format of Dynamic Bandwidth Control element is shown in Figure 8-401bp.



**Figure 8-401bp**—**Dynamic Bandwidth Control element format**

The format of DBC Control field is shown in Figure 8-401bq.



**Figure 8-401bp**—**Dynamic Bandwidth Control element format**

The Channel Splitting subfield is set to 0 to indicate that the AP or PCP operates on a 2.16 GHz channel and the following subfield are reserved. Otherwise, this subfield is set to 1 to indicate that the AP or PCP operates on a 1.08 GHz channel.

The DBC Option subfield indicates the DBC option that the PCP or AP selects to operate on a 1.08 GHz channel. A value of 0 indicates that the beacon interval or BHIs are present on the 1.08 GHz channel. Otherwise, this subfield is set to 1.

The PCP/AP Role subfield is set to 0 to indicate that the transmitting PCP or AP operating on a 1.08 GHz channel can provide a time reference to the PCP or AP operating on the adjacent 1.08 GHz channel. Otherwise, this subfield is set to 1 to indicate that the transmitting PCP or AP should scan for DMG Beach frames transmitted from the PCP or AP operating on the adjacent 1.08 GHz channel to maintain synchronization among them following the rules in 9.40.2.3.

The Adjacent Channel Occupancy subfield is set to 0 to indicate that the adjacent 1.08 GHz channel of the transmitting AP or PCP is occupied by another AP or PCP. Otherwise, this subfield is set to 1.

The Clustering Status indicates the cluster status of two 1.08 GHz channel within the same 2.16 GHz channel. The first/second bit is set to 0 to indicate that a cluster starts in the current/adjacent 1.08 GHz channel. Otherwise, the first/second bit of this field is set to 1.

The Synchronizing PCP/AP MAC Address indicates the MAC address of the AP or PCP that provides the time reference for the transmitting AP or PCP. If the PCP/AP Role subfield is set to 0, this subfield is set to the MAC address of itself. Otherwise, this subfield is set to the MAC address of the AP or PCP operating on the adjacent 1.08 GHz channel.

The Channel Number field is set to the number of the channel the transmitting STA is operating on.

The BI Offset field contains the time offset of the TBTT of the first beacon interval that the transmitting AP or PCP starts on a 1.08 GHz channel relative to the TBTT of the beacon interval that the transmitting AP or PCP starts on the 2.16 GHz channel encompassing this 1.08 GHz channel. If the DBC Option subfield is set to 1, this field is reserved.

The TBTT Offset field contains the time offset of the target starting time of NP/BHI on a 2.16 GHz channel of the transmitting AP or PCP operating on one of 1.08 GHz channels relative to that of another AP or PCP operating on the adjacent 1.08 GHz channel.

The NP/BHI Duration field is set to the length of the NP/ BHI duration on a 2.16 GHz channel by the transmitting AP or PCP operating on one of 1.08 GHz channels.

The Adjacent NP/BHI Duration field is set to the length of the NP/ BHI duration on a 2.16 GHz channel by the AP or PCP operating on the adjacent 1.08 GHz channel of the transmitting AP or PCP.

**8.5.8.1 Public Action frames**

*Insert the following rows into Table 8-210 in numeric order, and update the reserved row accordingly:*

**Table 8-210**—**Public Action field values**

|  |  |
| --- | --- |
| **Public Action field values** | **Description** |
| 18 | Extended Notification Period Request |
| 19 | Exdented Notification Period Response |
| 20 | Extended Channel Splitting Request |
| 21 | Extended Channel Splitting Response |

**8.5.8.27 Extended Notification Period Request frame format**

The format of the Extended Notification Period Request frame Action field is shown in Table 8-221f.

**Table 8-221f**—**Extended Notification Period Request frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | Action |
| 2 | Dialog Token |
| 3 | NP/BHI Duration |

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Action field is set to the value indicating Extended Notification Period Request frame, as specified in 8.5.8.1.

The Dialog Token field is set to a nonzero value chosen by the STA sending the request to identify the transaction.

The NP/BHI Duration field is set to the length of the NP/BHI Duration requested by the STA intending to establish its BSS on a free 1.08 GHz channel to the peer STA operating the adjacent 1.08 GHz channel. The length of this field is 2 octets.

**8.5.8.28 Exdented Notification Period Response frame format**

The format of the Exdented Notification Period Response frame Action field is shown in Table 8-221g.

**Table 8-221g**—**Notification Period Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | Action |
| 2 | Dialog Token |
| 3 | Status Code |
| 4 | Dynamic Bandwidth Control element |

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Action field is set to the value indicating Extended Notification Period Response frame, as specified in 8.5.8.1.

The Dialog Token field is set to the value in the corresponding Extended Notification Period Request frame that generated this response.

The Status Code field indicated the result of the notification period allocation request and is defined in 8.4.1.9.

The Dynamic Bandwidth Control element is defined in 8.4.2.160. This information is included only if the status code indicated successful.

**8.5.8.29 Extended Channel Splitting Request frame format**

The format of the Extended Channel Splitting Request frame Action field is shown in Table 8-221h.

**Table 8-221h**—**Extended Channel Splitting Request frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | Action |
| 2 | Dialog Token |
| 3 | NP/BHI Duration |

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Action field is set to the value indicating Extended Channel Splitting Request frame, as specified in 8.5.8.1.

The Dialog Token field is set to a nonzero value chosen by the STA sending the request to identify the transaction.

The NP/BHI Duration field is set to the length of the NP/BHI Duration requested by the STA intending to establish its BSS on a free 1.08 GHz channel to the peer STA operating the adjacent 1.08 GHz channel. The length of this field is 2 octets.

**8.5.8.30 Extended Channel Splitting Response frame format**

The format of the Extended Channel Splitting Response frame Action field is shown in Table 8-221i.

**Table 8-281i**—**Extended Channel Splitting Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | Action |
| 2 | Dialog Token |
| 3 | Status Code |
| 4 | Channel Switch Announcement |
| 5 | Beacon Interval |
| 6 | Dynamic Bandwidth Control |

The Category field is set to the value indicating the Public category, as specified in Table 8-38.

The Action field is set to the value indicating Extended Notification Period Response frame, as specified in 8.5.8.1.

The Dialog Token field is set to the value in the corresponding Extended Notification Period Request frame that generated this response.

The Status Code field indicated the result of the notification period allocation request and is defined in 8.4.1.9.

The Channel Switch Announcement element is defined in 8.4.2.21. This information is included only if the status code indicated successful.

The Beacon Interval field specifies the beacon interval length on a 2.16 GHz channel set by the STA operating on one of 1.08 GHz channel after channel splitting and is defined in 8.4.1.3. This information is included only if the status code indicated successful.

The Dynamic Bandwidth Control element specifies the information of the STA operating on a 1.08 GHz channel after channel splitting and is defined in 8.4.2.160. This information is included only if the status code indicated successful.

**8.5.23 CDMG Action frame details**

**8.5.23.1 CDMG Action field**

Several Action frame formats are defined to support CDMG features. A CDMG Action field, in the octet immediately after the Category field, differentiates the CDMG Action frame formats. The CDMG Action field values associated with each frame format within the CDMG category are defined in Table 8-281ah.

**Table 8-281ah**—**CDMG Action field values**

|  |  |
| --- | --- |
| **CDMG Action field value** | **Meaning** |
| 0 | Notification Period Request frame |
| 1 | Notification Period Response frame |
| 2 | Channel Splitting Request frame |
| 3 | Channel Splitting Response frame |
| 4 | Allocation Request frame |
| 5 | Allocation Response frame |

**8.5.23.2 Notification Period Request frame format**

The format of the Notification Period Request frame Action field is shown in Table 8-281ai.



**Figure 8-502k**—**Notification Period Request frame Action field format**

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 0 (representing Notification Period Request).

The Dialog Token field is set to a nonzero value chosen by the STA sending the request to identify the transaction.

The NP/BHI Duration field is set to the length of the NP/BHI Duration requested by the STA intending to establish its BSS on a free 1.08 GHz channel to the peer STA operating the adjacent 1.08 GHz channel.

**8.5.23.3 Notification Period Response frame format**

The format of the Notification Period Response frame Action field is shown in Table 8-281ai.

**Table 8-281ai**—**Notification Period Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | CDMG Action |
| 2 | Dialog Token |
| 3 | Status Code |
| 4 | Dynamic Bandwidth Control element |

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 1 (representing Notification Period Response).

The Dialog Token field is set to the value in the corresponding Notification Period Request frame that generated this response.

The Status Code field indicated the result of the notification period allocation request and is defined in 8.4.1.9.

The Dynamic Bandwidth Control element is defined in 8.4.2.160. This information is included only if the status code indicated successful.

**8.5.23.4 Channel Splitting Request frame format**

The format of the Channel Splitting Request frame Action field is shown in Figure 8-502l.



**Figure 8-502l**—**Channel Splitting Request frame Action field format**

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 2 (representing Channel Splitting Request).

The Dialog Token field is set to a nonzero value chosen by the STA sending the request to identify the transaction.

The NP/BHI Duration field is set to the length of the NP/BHI Duration requested by the STA intending to establish its BSS on a free 1.08 GHz channel to the peer STA operating the adjacent 1.08 GHz channel.

**8.5.23.5 Channel Splitting Response frame format**

The format of the Channel Splitting Response frame Action field is shown in Table 8-281aj.

**Table 8-281aj**—**Channel Splitting Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | CDMG Action |
| 2 | Dialog Token |
| 3 | Status Code |
| 4 | Channel Switch Announcement |
| 5 | Beacon Interval |
| 6 | Dynamic Bandwidth Control |

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 3 (representing Channel Splitting Response).

The Dialog Token field is set to the value in the corresponding Channel Splitting Request frame that generated this response.

The Status Code field indicated the result of the channel splitting request and is defined in 8.4.1.9.

The Channel Switch Announcement element is defined in 8.4.2.21. This information is included only if the status code indicated successful.

The Beacon Interval field specifies the beacon interval length on a 2.16 GHz channel set by the STA operating on one of 1.08 GHz channel after channel splitting and is defined in 8.4.1.3. This information is included only if the status code indicated successful.

The Dynamic Bandwidth Control element specifies the information of the STA operating on a 1.08 GHz channel after channel splitting and is defined in 8.4.2.160. This information is included only if the status code indicated successful.

**8.5.23.6 Allocation Request frame format**

The format of the Allocation Request frame Action field is shown in Figure 8-502m.



**Figure 8-502m**—**Channel Splitting Request frame Action field format**

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 4 (representing Allocation Request).

The Dialog Token field is set to a nonzero value chosen by the STA sending the request to identify the transaction.

**8.5.23.7 Allocation Response frame format**

The format of the Allocation Response frame Action field is shown in Table 8-281ak.

**Table 8-281ak**—**Allocation Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 0 | Category |
| 1 | CDMG Action |
| 2 | Dialog Token |
| 3 | Status Code |
| 4 | Extended Schedule |

The Category field is set to 21 (representing CDMG).

The CDMG Action field is set to 5 (representing Allocation Response).

The Dialog Token field is set to the value in the corresponding Allocation Request frame that generated this response.

The Status Code field indicated the result of the Allocation request and is defined in 8.4.1.9.

The Extended Schedule element indicates all the available time that can be allocated to the DMG STAs on a 2.16 GHz channel by the STA operating on the adjacent 1.08 GHz channel of the STA sending this response and is defined in 8.4.2.134. This information is included only if the status code indicated successful.