IEEE P802.11
Wireless LANs

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| 11bn PDT PHY Null subcarriers |
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| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Bo Gong | Huawei Technologies Co.,Ltd. |  |  | gongbo8@huawei.com |
| Alice Chen | Qualcomm Technologies, Inc. | 5775 Morehouse Dr, San Diego, CA 92131, USA |  | alicel@qti.qualcomm.com |
| Ross (Jian Yu) | Huawei Technologies Co.,Ltd. |  |  | ross.yujian@huawei.com |
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Abstract

This document contains Proposed Draft Text (PDT) for the subclause 38.xxx of the proposed TGbn (UHR, Ultra High Reliability) amendment to the 802.11 standard.

**Revision information**

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

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| **Revision** | **Major changes** |
| 0 | Initial revision |
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**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:

**Relevant passing motions:**

All the passing motions up to and including those in the 2024 November IEEE 802 Plenary Session (see [1]).

* In the ELR transmission, a repeating of 52-tone RRU is used in 20MHz.
	+ The same data is repeated in four 52-tone RRUs in 20 MHz.
	+ The subcarrier allocation of 52-tone RRU equals the 52-tone RU defined in 11be.

[Motion #93, [1] and [175]]

* 11bn supports per 80MHz DRU/RRU switch if PPDU BW >80MHz and no hybrid DRU and RRU mode for up to 80MHz

[Motion #66, [1] and [167]]

* In a non-punctured 80 MHz PPDU, the following DBW modes are allowed for DRU
	+ 80 MHz
	+ 20 MHz + 20 MHz + 40 MHz (or 40 MHz + 20 MHz + 20 MHz)

[Motion #20, [1] and [36]]

* DRU DBW of 60 MHz is defined in an 80 MHz frequency subblock (with the highest 20 MHz subchannel unallocated) in a UHR TB PPDU
* No allocation is made in the highest 20 MHz subchannel

[Motion #64, [1] and [166]]

* For 80 MHz PPDU where one of the 20 MHz channels is punctured, the following DBW mode is allowed for DRU
	+ 20 MHz + 40 MHz (or 40 MHz + 20 MHz) mode

[Motion #87, [1] and [173]]

* For 160 MHz and 320 MHz PPDUs, in an 80 MHz frequency subblock where one of the 20 MHz channels is punctured, the following distribution bandwidth mode is allowed for DRU
	+ 20 MHz + 40 MHz (or 40 MHz + 20 MHz) mode

[Motion #88, [1] and [173]]

* For 160 MHz and 320 MHz PPDUs, in an 80 MHz frequency subblock where one of the 40 MHz channels is punctured (i.e., either 1100 or 0011 case), the following DBW mode is allowed for DRU
	+ 40 MHz mode

[Motion #89, [1] and [173]]

* For a 40 MHz PPDU, the following DBW mode is allowed for DRU
	+ Only 40 MHz mode

[Motion #90, [1] and [173]]

* Data and pilot subcarrier indices for DRUs in a 20 MHz UHR PPDU are defined in following table:

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| **Data and pilot subcarrier indices for Distributed Tone RUs (DRUs) in a 20 MHz UHR PPDU** |
| **DRU type** | **DRU index and subcarrier range** |
| 26-tone DRUi=1:9 | DRU1[-120:9:-12, 6:9:114] | DRU2[-116:9:-8, 10:9:118] | DRU3[-118:9:-10, 8:9:116] | DRU4[-114:9:-6, 12:9:120] | DRU5[-112:9:-4, 5:9:113] |
| DRU6[-119:9:-11, 7:9:115] | DRU7[-115:9:-7, 11:9:119] | DRU8[-117:9:-9, 9:9:117] | DRU9[-113:9:-5, 4:9:112] |   |
| 52-tone DRUi=1:4 | DRU126-tone [DRU1, DRU2] | DRU226-tone [DRU3, DRU4] |   |
| DRU326-tone [DRU6, DRU7] | DRU426-tone [DRU8, DRU9] |   |
| 106-tone DRUi=1:2 | DRU126-tone [DRU1~4], [-3, 3] | DRU226-tone [DRU6~9], [-2, 2] |   |

[Motion #56, [1] and [33]]

* Data and pilot subcarrier indices for DRUs in a 40 MHz UHR PPDU are defined in following table:

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| **Data and pilot subcarrier indices for Distributed Tone RUs (DRUs) in a 40 MHz UHR TB PPDU** |
| **DRU type** | **DRU index and subcarrier range** |
| 26-tone DRUi=1:18 | DRU1[-242:18:-26, 10:18:226] | DRU2[-233:18:-17, 19:18:235] | DRU3[-238:18:-22, 14:18:230] | DRU4[-229:18:-13, 23:18:239] | DRU5[-225:18:-9, 27:18:243] | DRU6[-240:18:-24, 12:18:228] |
| DRU7[-231:18:-15, 21:18:237] | DRU8[-236:18:-20, 16:18:232] | DRU9[-227:18:-11, 25:18:241] | DRU10[-241:18:-25, 11:18:227] | DRU11[-232:18:-16, 20:18:236] | DRU12[-237:18:-21, 15:18:231] |
| DRU13[-228:18:-12, 24:18:240] | DRU14[-234:18:-18, 18:18:234] | DRU15[-239:18:-23, 13:18:229] | DRU16[-230:18:-14, 22:18:238] | DRU17[-235:18:-19, 17:18:233] | DRU18[-226:18:-10, 26:18:242] |
| 52-tone DRUi=1:8 | DRU1[-242:9:-17, 10:9:235] | DRU2[-238:9:-13, 14:9:239] | DRU3[-240:9:-15, 12:9:237] |
| DRU4[-236:9:-11, 16:9:241] | DRU5[-241:9:-16, 11:9:236] | DRU6[-237:9:-12, 15:9:240] |
| DRU7[-239:9:-14, 13:9:238] | DRU8[-235:9:-10, 17:9:242] |   |
| 106-tone DRUi=1:4 | DRU126-tone [DRU1~4], [-8,5] | DRU226-tone [DRU6~9], [-6,7] | DRU326-tone [DRU10~13], [-7,6] |
| DRU426-tone [DRU15~18], [-5,8] |   |   |
| 242-tone DRUi=1:2 | DRU1106-tone [DRU1~2],26-tone DRU5, [-244,-4,3,9] | DRU2106-tone [DRU3~4],26-tone DRU14, [-243,-3,4,244] |   |

[Motion #57, [1] and [33]]

* Data and pilot subcarrier indices for DRUs in an 80 MHz UHR PPDU are defined in following table:

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| **Data and pilot subcarrier indices for Distributed Tone RUs (DRUs) in a 80 MHz UHR TB PPDU** |
| **DRU type** | **DRU index and subcarrier range** |
| 52-tone DRUi=1:16 | DRU1[-483:36:-51, 17:36:449],[-467:36:-35, 33:36:465] | DRU2[-475:36:-43, 25:36:457],[-459:36:-27, 41:36:473] | DRU3[-479:36:-47, 21:36:453],[-463:36:-31, 37:36:469] | DRU4[-471:36:-39, 29:36:461],[-455:36:-23, 45:36:477] |
| DRU5[-477:36:-45, 23:36:455],[-461:36:-29, 39:36:471] | DRU6[-469:36:-37, 31:36:463],[-453:36:-21, 47:36:479] | DRU7[-481:36:-49, 19:36:451],[-465:36:-33, 35:36:467] | DRU8[-473:36:-41, 27:36:459],[-457:36:-25, 43:36:475] |
| DRU9[-482:36:-50, 18:36:450],[-466:36:-34, 34:36:466] | DRU10[-474:36:-42, 26:36:458],[-458:36:-26, 42:36:474] | DRU11[-478:36:-46, 22:36:454],[-462:36:-30, 38:36:470] | DRU12[-470:36:-38, 30:36:462],[-454:36:-22, 46:36:478] |
| DRU13[-476:36:-44, 24:36:456],[-460:36:-28, 40:36:472] | DRU14[-468:36:-36, 32:36:464],[-452:36:-20,48:36:480] | DRU15[-480:36:-48, 20:36:452],[-464:36:-32, 36:36:468] | DRU16[-472:36:-40, 28:36:460],[-456:36:-24, 44:36:476] |
| 106-tone DRUi=1:8 | DRU152-tone [DRU1~2], [-495, 485] | DRU252-tone [DRU3~4],[-491, 489] | DRU352-tone [DRU5~6],[-489, 491] | DRU452-tone [DRU7~8],[-493, 487] |
| DRU552-tone [DRU9~10],[-494, 486] | DRU652-tone [DRU11~12],[-490,490] | DRU752-tone [DRU13~14],[-488,492] | DRU852-tone [DRU15~16],[-492,488] |
| 242-tone DRUi=1:4 | DRU1[-499:4:-19, 17:4:497] | DRU2[-497:4:-17, 19:4:499] |
| DRU3[-498:4:-18, 18:4:498] | DRU4[-496:4:-16, 20:4:500] |
| 484-tone DRUi=1:2 | DRU1[-499:2:-17, 17:2:499] | DRU2[-498:2:-16, 18:2:500] |

[Motion #58, [1] and [33]]

* DRUs on frequency subblocks of wide bandwidth PPDU should be defined as DRUs on 20MHz, 40MHz and 80MHz PPDU with the following constant shifts

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| --- | --- | --- | --- |
| **Frequency Subblock Size** | **BW80** | **BW160** | **BW320** |
| 20MHz  | [-380,-133,132,379] | [-892,-645,-380,-133,132,379,644,891] | [ -1916, -1669, -1404, -1157, -892, -645, -380,-133, 132, 379, 644, 891, 1156, 1403, 1668, 1915] |
| 40MHz | [-256, 256] | [-768,-256,256,768] | [-1792,-1280,-768,-256,256,768,1280,1792] |
| 80MHz | 0 | [-512,512] | [-1536,-512,512,1536] |

[Motion #60, [1] and [163]]

**Text to be adopted begins here.**

***TGbn editor: Please add the following new subclause 38.xxx Null subcarriers to the 802.11bn draft D0.1:***

# 38.3 UHR PHY

## 38.3.2 Subcarrier and resource allocation

### 38.3.2.3 Null subcarriers

The null subcarriers are located near the DC or edge tones to provide protection from transmit center frequency leakage, receiver DC offset, and interference from neighbouring RRU(s), MRU(s), or DRU(s). The null subcarriers have zero energy.

#### 38.3.2.3.1 Null subcarriers for RRUs and MRUs

For RRUs in a UHR MU PPDU or UHR TB PPDU, the indices of the null subcarriers for 20 MHz and 40 MHz are enumerated in Table 27-10 (Null subcarrier indices). The indices of the null subcarriers for 80 MHz, 160 MHz, and 320 MHz are enumerated in Table 36-16 (Null subcarrier indices for 80 MHz, 160 MHz, and 320 MHz).

The indices of the null subcarriers for MRUs are determined by the size and the location of each component RU in each bandwidth.

The indices of the null subcarriers for a UHR ELR PPDU are [-122, -69, -16:-4, 4:16, 69, 122].

#### 38.3.2.3.2 Null subcarriers for DRUs

For DRUs in a 20MHz UHR TB PPDU and a 40MHz UHR TB PPDU, the indices of the null subcarriers are enumerated in Table 38-x1 (Null subcarrier indices for DRUs for 20MHz and 40MHz).

Table 38-x1 Null subcarrier indices for DRUs for 20MHz and 40MHz

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| Channel width | DRU Size | Null subcarrier indices |
| 20MHz | 26, 52 | [-122, -121, -3, -2 , 2, 3, 121, 122] |
| 106 | [-122, -121, 121, 122] |
| 40MHz | 26, 52 | [-244, -243, -8:-3, 3:9, 244 ] |
| 106 | [-244, -243, -4, -3 , 3, 4, 9, 244] |
| 242 | none |

For DRUs in an 80MHz UHR TB PPDU, the indices of the null subcarriers are enumerated in Table 38-x2 (Null subcarrier indices for DRUs for 80MHz).

Table 38-x2 Null subcarrier indices for DRUs for 80MHz

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| Distribution Bandwidth | Frequency subblock index | DRU Size | Null subcarrier indices |
| 20MHz | 1 | 26, 52 | [-383 -382 -381 -380 -379 -378 -377 -259 -258 -257] |
| 106 | [-381 -380 -379 -259 -258 -257] |
| 2 | 26, 52 | [-256 -255 -254 -136 -135 -134 -133 -132 -131 -130 -12] |
| 106 | [-256 -255 -254 -134 -133 -132 -12] |
| 3 | 26, 52 | [129 130 131 132 133 134 135 253 254 255] |
| 106 | [131 132 133 253 254 255] |
| 4 | 26, 52 | [256 257 258 376 377 378 379 380 381 382 500] |
| 106 | [256 257 258 378 379 380 500] |
| 40MHz | 1 | 26, 52 | [-500 -499 -264:-247 -12] |
| 106 | [-500 -499 -260:-252 -247 -12] |
| 242 | [-258:-254] |
| 2 | 26, 52 | [12 13 248:265 500] |
| 106 | [12 13 252:260 265 500] |
| 242 | [254:258] |
| 80MHz | NA | 52 | [-500:-484, -451:-448, -415:-412, -379:-376, -343:-340, -307:-304, -271:-268, -235:-232, -199:-196, -163:-160, -127:-124, -91:-88, -55:-52, -19:-12, 12:16, 49:52, 85:88, 121:124, 157:160, 193:196, 229:232, 265:268, 301:304, 337:340, 373:376, 409:412, 445:448, 481:500] |
| 106 | [-500:-496, -487:-484, -451:-448, -415:-412, -379:-376, -343:-340, -307:-304, -271:-268, -235:-232, -199:-196, -163:-160, -127:-124, -91:-88, -55:-52, -19:-12, 12:16, 49:52, 85:88, 121:124, 157:160, 193:196, 229:232, 265:268, 301:304, 337:340, 373:376, 409:412, 445:448, 481:484, 493:500] |
| 242 | [-500, -15:-12, 12:16] |
| 484 | [-500, -15:-12, 12:16] |

For DRUs corresponding to DBW 20MHz and 40MHz in the first 80MHz frequency subblock of a 160MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [-523:-501] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i in a 80MHz UHR TB PPDU minus 512 and, in which, i ∈[1, 2, 3, 4] for a 20MHz frequency subblock and i ∈ [1, 2] for a 40MHz frequency subblock. For DRUs corresponding to DBW 80MHz in the first 80MHz frequency subblock of a 160MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [-523:-501] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU minus 512.

For DRUs corresponding to DBW 20MHz and 40MHz in the second 80MHz frequency subblock of a 160MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [501:523] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i-N/2 in a 80MHz UHR TB PPDU plus 512, in which, i ∈[5, 6, 7, 8] for a 20MHz frequency subblock, i ∈ [3, 4] for a 40MHz frequency subblock, and N = max(i). For DRUs corresponding to DBW 80MHz in the second 80MHz frequency subblock of a 160MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [501:523] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU plus 512.

For DRUs corresponding to DBW 20MHz and 40MHz in the first 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [-1547:-1525, -1035:-1025] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i in a 80MHz UHR TB PPDU minus 1536, in which, i ∈[1, 2, 3, 4] for a 20MHz frequency subblock and i ∈ [1, 2] for a 40MHz frequency subblock. For DRUs corresponding to DBW 80MHz in the first 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [-1547:-1525, -1035:-1025] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU minus 1536.

For DRUs corresponding to DBW 20MHz and 40MHz in the second 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [-1024:-1013, -523:-501] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i-N/2 in a 80MHz UHR TB PPDU minus 512, in which, i ∈[5, 6, 7, 8] for a 20MHz frequency subblock, i ∈ [3, 4] for a 40MHz frequency subblock, and N = max(i). For DRUs corresponding to DBW 80MHz in the second 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [-1024:-1013, -523:-501] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU minus 512.

For DRUs corresponding to DBW 20MHz and 40MHz in the third 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [501:523, 1013:1023] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i-2/3\*N in a 80MHz UHR TB PPDU plus 512, in which, i ∈[9, 10, 11, 12] for a 20MHz frequency subblock, i ∈ [5, 6] for a 40MHz frequency subblock, and N = max(i). For DRUs corresponding to DBW 80MHz in the third 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [501:523, 1013:1023] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU plus 512.

For DRUs corresponding to DBW 20MHz and 40MHz in the fourth 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size corresponding to a DBW on frequency subblock i are [1024:1035, 1525:1547] and the null subcarrier indices for the same DRU size corresponding to the same DBW on frequency subblock i-3/4\*N in a 80MHz UHR TB PPDU plus 1536, in which, i ∈[13, 14, 15, 16] for a 20MHz frequency subblock and i ∈ [7, 8] for a 40MHz frequency subblock, and N = max(i). For DRUs corresponding to DBW 80MHz in the fourth 80MHz frequency subblock of a 320MHz UHR TB PPDU, the null subcarrier indices for a DRU size are [1024:1035, 1525:1547] and the null subcarrier indices for the same DRU size corresponding to DBW 80MHz in an 80MHz UHR TB PPDU plus 1536.

For a 160MHz UHR TB PPDU and a 320MHz UHR TB PPDU with hybrid mode, the indices of the null subcarriers are the same as the indices of the null subcarriers in the corresponding 80MHz frequency subblock.

**Text to be adopted ends here.**

**References:**

1. [11-24-0171r21](https://mentor.ieee.org/802.11/dcn/24/11-24-0171-21-00bn-tgbn-motions-list-part-1.pptx): 11-24-0171-21-00bn-tgbn-motions-list-part-1, Alfred Asterjadhi (Qualcomm Inc.)