IEEE P802.11
Wireless LANs

|  |
| --- |
| Resource unit-Interleaving for RUs and Multipe RUs |
| Date: 2020-09-06 |
| Author(s): |
| Name | Affiliation | Address | Phone | Email |
| Jianhan Liu | Mediatek |  |  | Jianhan.liu@mediatek.com |
| Junghoon Suh | Huawei |  |  | junghoon.suh@huawei.com |
| Ruchen Duan | Samsung |  |  | r.duan@samsung.com |
|  |  |  |  |  |

Abstract:

This document contains draft text of the following motions in [1]:

82, 92, 112(SP#12, SP#14), 115(SP#66, SP#67, SP#68, SP#69), 111 (#SP0611-02, #SP0611-03, , #SP0611-04, , #SP0611-05, , #SP0611-06), SP #149

**34.3.12.8 BCC interleavers**  BCC is applicable only to an RU or an MRU of size no larger than 242 tones, with number of spatial streams less than or equal to 4 and with one of the following modulations: BPSK, QPSK, 16-QAM, 64-QAM or 256-QAM.

A BCC encoder is applied to small-size MRUs. The BCC encoded bits are interleaved over the whole MRU".. The interleaver parameters for BCC encoded MRU are shown in Table 34-x1. Since DCM is applied only to the BPSK and single stream case, *NROT*is not applicable and *NROW*is determined without *NBPSCS*.

|  |  |  |
| --- | --- | --- |
| DCM | Parameter | MRU Size |
| 52+26 | 106+26 |
| Not Used | *NSD* | 72 | 126 |
| *NCOL* | 18 | 21 |
| *NROW* | 4 x *NBPSCS* | 6 x *NBPSCS* |
| *NROT* | 18 | 31 |
| Used | *NSD* | 36 | 63 |
| *NCOL* | 12 | 21 |
| *NROW* | 3 | 3 |
| *NROT* | N/A | N/A |

Table 34 – x1 Joint BCC interleaver parameters for small-size MRUs

**34.3.12.10 LDPC tone mapper**

The LDPC tone mapping shall be performed on all LDPC encoded streams mapped in an RU/MRU as described in this subclause. LDPC tone mapping shall not be performed on streams that are encoded using BCC. If DCM is applied to LDPC encoded streams, $D\_{TM DCM}$ shall be applied on both the lower half data subcarriers in an RU/MRU and the upper half data subcarriers of the RU/MRU. The LDPC tone mapping distance parameters $D\_{TM}$ and $D\_{TM\\_DCM}$ are constant for each RU/MRU size and the values for different RU/MRU sizes are given in Table x2 (LDPC tone mapping distance for each RU/MRU size within 80MHz subblock).

|  |  |  |
| --- | --- | --- |
| Table x2 LDPC tone mapping distance for each RU/MRU siz within 80MHz subblock |  |  |
| Parameter | RU/MRU Size (tones) |  |  |
| 26 | 52 | 52+26 | 106 | 106+26 | 242 | 484 | 242+484 | 996 |
| *DTM* | 1 | 3 | 4 | 6 | 6 | 9 | 12 | 18 | 20 |
| *DTM\_DCM* | 1 | 1 | 3 | 3 | 3 | 9 | 9 | 9 | 14 |

NOTE—For an RU or MRU that spans multiple 80M frequency subblocks, LDPC tone mapping is performed separately in each subblock on the portion of the RU/MRU falling within that subblock. The values of tone mapping parameters$D\_{TM\\_l}$ and $D\_{TM\\_DCM\\_l}$ for the portion of the RU/MRU falling within the l-th frequency subblock shall be determined as in Table x2.

For an EHT PPDU without DCM, the LDPC tone mapping for the LDPC encoded stream for user *u* in the portion of *r*-th RU/MRUlocated in the *l*-th 80MHz subblock is done by permuting the stream of complex numbers generated by the constellation mappers (see 34.X.X.X (Constellation mapping)) as defined by Equation ( 1)(XX-XX).

 ( 1)

$d"\_{t\left(k,l\right),i,n,l,r,u}=d'\_{k,i,n,l,r,u} $where

$k=0,1,…,N\_{SD\\_l}-1$ for a 26‑,52‑,52+26‑,106‑,106+26‑,242‑,484‑,242+484‑,and 996‑tone RU/MRU in the *l*‑th subblock

$$i=1,…,N\_{SS,r,u}$$

$$n=0,1,…, N\_{SYM}-1$$

$$l= \left\{\begin{matrix}\begin{matrix}0 for a 26, 52, 52+26, 106,106+26, 242, 484, 242+484, and 996tone \\0,1 for a 484+996, \left(242+484\right)+996, and 2×996tone \end{matrix}\\\begin{matrix}0,1,2 for a 484+2×996, and 3×996tone \\0,1,2,3 for a 484+3×996, and 4×996tone \end{matrix}\end{matrix}\right.$$

$$u=0,…,N\_{user,r}-1$$

$$r=0,…,N\_{RU}-1$$

$N\_{SD\\_l}$ is the number of data tones in the portion of *r*-th RU/MRU located in the *l*-th subblock.

$$t\left(k,l\right)=D\_{TM\\_l}\left(k mod\frac{N\_{SD\\_l}}{D\_{TM\\_l}}\right)+ \left⌊\frac{k∙D\_{TM\\_l}}{N\_{SD\\_l}}\right⌋$$

$D\_{TM\\_l}$ is the LDPC tone mapping distance for the portion of *r*-th RU/MRU located in *l*-th subblock if DCM is not applied, defined in Table x2.

For an EHT PPDU with DCM applied to the Data field, the LDPC tone mapping for the LDPC encoded stream corresponding to user *u* in the portion of *r*-th RU/MRUlocated in the *l*-th 80MHz subblock is done by permuting the stream of complex numbers generated by the constellation mappers (see 34.X.X.X (Constellation mapping)) as defined by Equation ( 2).

(2)

$d"\_{t\left(k,l\right),i,n,l,r,u}=d'\_{k,i,n,l,r,u}$ where

$k=0,1,…,2N\_{SD\\_l}-1$ for the portion of an RU/MRU in the l th subblock that corresponds to 26‑,52‑,52+26‑,106‑,106+26‑,242‑,484‑,242+484‑,and 996‑tone.

$$i=1,…,N\_{SS,r,u}$$

$$n=0,1,…, N\_{SYM}-1$$

$$l= \left\{\begin{matrix}\begin{matrix}0 for a 26, 52, 52+26, 106,106+26, 242, 484, 242+484, and 996tone \\0,1 for a 484+996, \left(242+484\right)+996, and 2×996tone \end{matrix}\\\begin{matrix}0,1,2 for a 484+2×996, and 3×996tone \\0,1,2,3 for a 484+3×996, and 4×996tone \end{matrix}\end{matrix}\right.$$

$$u=0,…,N\_{user,r}-1$$

$$r=0,…,N\_{RU}-1$$

$N\_{SD\\_l}$ is the number of data tones in the portion of *r*-th RU/MRU located in the *l*-th subblock if DCM is applied defined in Table X-X (No table defined for DCM N\_SD).

$$t\left(k,l\right)=\left\{\begin{matrix}D\_{TM\\_DCM\\_l}\left(k mod\frac{N\_{SD\\_l}}{D\_{TM\\_DCM\\_l}}\right)+ \left⌊\frac{k∙D\_{TM\\_DCM\\_l}}{N\_{SD\\_l}}\right⌋, for k<N\_{SD\\_l}\\D\_{TM\\_DCM\\_l}\left((k-N\_{SD\\_l}) mod\frac{N\_{SD\\_l}}{D\_{TM\\_DCM\\_l}}\right)+ \left⌊\frac{(k-N\_{SD\_{l}})∙D\_{TM\\_DCM\\_l}}{N\_{SD\\_l}}\right⌋+N\_{SD\\_l}, for kN\_{SD\\_l}\end{matrix}\right.$$

$D\_{TM\\_DCM\\_l}$ is the LDPC tone mapping distance for the portion of *r*-th RU/MRUlocated in *l*-th subblock if DCM is applied, defined in Table x2.

NOTE—LDPC tone mapper for a 26-, 52-, (52+26)-, 106-, (106+26)-, 242-, 484- and 996-tone RU/MRUis defined as one subblock. LDPC tone mapping is performed separately for each 80 MHz frequency subblock.

Since LDPC tone mapping is not performed on BCC coded streams, for BCC coded spatial streams, Equation (3) applies.

( 3)

$d"\_{k,i,n,l,r,u}=d'\_{k,i,n,l,r,u}$ where

$k=0,1,…,N\_{SD\\_l}-1$ for a 26‑,52‑,52+26‑,106‑,106+26‑, and 242‑tone RU/MRU in the *l*‑th subblock

$$i=1,…,N\_{SS,r,u}$$

$$n=0,1,…, N\_{SYM}-1$$

$$l= 0, for a 26, 52, 52+26, 106,106+26, and 242tone $$

$$u=0,…,N\_{user,r}-1$$

$$r=0,…,N\_{RU}-1$$

Apended Motions:

For LDPC coding, for combined RUs sent to a user with RU size less than 242-tone, a single tone mapper shall be used.

[Motion 82, [17] and [23]]

In 802.11be, for LDPC encoding each PSDU only uses one encoder.

[Motion 92, [17] and [19]]

For the combined multiple RU with the combined RU size less than 242 tones, the BCC can be supported.

* Mandatory or Optional for BCC, TBD.
* Only for modulation up to 256 QAM (with or without DCM – if defined in 802.11be).
* Only for NSS <=4.

[Motion 112, #SP12, [9] and [15]]

In case of small size MRU transmission, 802.11be supports applying a common BCC encoder and joint bit Interleaver for the combined RU.

[Motion 112, #SP14, [9] and [15]]

802.11be supports the following BCC interleaver parameters for RU78:

* Note: the parameters are defined without considering DCM.

|  |  |
| --- | --- |
| **RU78** | **Parameters** |
| Nsd | 72 |
| Ncol | 18 |
| Nrow | 4\*Nbpscs |

[Motion 115, #SP66, [7] and [20]]

802.11be supports the following BCC interleaver parameters for RU132:

* Note: the parameters are defined without considering DCM.

|  |  |
| --- | --- |
| **RU132** | **Parameters** |
| Nsd | 126 |
| Ncol | 21 |
| Nrow | 6\*Nbpscs |

[Motion 115, #SP67, [7] and [20]]

802.11be supports the following BCC interleaver parameters for RU52+RU26:

* Note: the parameters are defined without considering DCM.

|  |  |
| --- | --- |
| **RU52+RU26** | **Parameters** |
| Nrot | 18 |

[Motion 115, #SP68, [7] and [20]]

802.11be supports the following BCC interleaver parameters for RU106+RU26:

* Note: the parameters are defined without considering DCM.

|  |  |
| --- | --- |
| **RU106+RU26** | **Parameters** |
| Nrot | 31 |

[Motion 115, #SP69, [7] and [20]]

The following BCC interleaver and LDPC DTM parameters are defined for DCM.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NSD | BCC NCOL | BCC NROT | LDPC DTM |
|  | No DCM | DCM | No DCM | DCM | No DCM | DCM | No DCM | DCM |
| RU78 | 72 | 36 | 18 | **12** | 18 | - | 4 | **3** |
| RU132 | 126 | 63 | 21 | 21 | 31 | - | 6 | 3 |
| RU726 | 702 | 351 | - | - | - | - | 18 | 9 |

* This is for R1.

[Motion 122, #SP149, [10] and [98]]

802.11be supports joint interleaving for BCC and joint tone mapper for LDPC for RU and aggregated RU size <= 80 MHz.

[Motion 111, #SP0611-02, [9] and [27]]

The segment parser bit distribution sequence starts from the lowest frequency location to the highest frequency, just like in 802.11ac/802.11ax.

[Motion 111, #SP0611-03, [9] and [27]]

802.11be supports the following LDPC tone mapper parameters:

* for RU52+RU26: D\_TM = 4
* for RU106+RU26: D\_TM = 6
* Existing RUs: identical to 802.11ax

[Motion 111, #SP0611-04, [9] and [27]]

802.11be supports the following LDPC tone mapper parameters:

* for RU484+RU242: D\_TM = 18

[Motion 111, #SP0611-05, [9] and [27]]

For aggregated RUs and PPDU BW larger than 80 MHz, a separate LDPC tone mapper is applied in each 80 MHz segment.

[Motion 111, #SP0611-06, [9] and [28]]

**References:**

[1]. 11-20-0566-44-00be-compendium-of-straw-polls-and-potential-changes-to-the-specification-framework-document, Edward Au.