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Re:			
Abstract	This document contains analysis and proposal for preamble of the OFDM sub-channelization system.		
Purpose	This proposal provide and proposal for preamble of the OFDM sub-channelization system.		
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Modification of training sequence for OFDM subchannelization

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Samsung Electronic

1. References

- [1] BRAN30d53r1
- [2] BRAN30d023r1
- [3] P802.16a_D5.doc

2. Introduction

This document proposes to add the new training sequences for the preamble in the OFDM subchannelization mode. In the #30 meeting of BRAN HM the two preambles for OFDM subchannelization is adopted.

3. Technical discussion

In addition to the basic 256 OFDM modes in DL and UL, Hiperman also uses the OFDM subchannelization for UL to enhance the bandwidth efficiency.

4. Usage of sub-channelization

There are only three cases for the sub-channels: (see Table 18 in [2])

Case 1: use one sub-channel only, which is one of four sub-channels

Case 2: use two sub-channels, (sub-channel 1 and sub-channel 3) or (sub-channel 2 and sub-channel4) Case 3: use all sub-channels, which is same as OFDM mode

A. Training sequence of sub-channel in the current Hiperman

In the clause 5.6 in [1], the training sequence for OFDM mode was defined as follows:

 $P(-100:100) = \{ -1, 0, 1, 0, 1, 0, 1, 0, 1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1, 0, 1, 0, -1,$

And if the subchannlization was used , the training sequences for the sub-cahnnel was also described as follows:

If in the UL, if the allocation spans less than the whole OFDM symbol (i.e. when subchannelization is used), the preamble carriers that do not fall within the subchannels allocated shall not be transmitted.

B. The preamble of sub-channel

The preamble of sub-channel was just used for UL and was mainly used for channel estimation. Therefore, when we design the sequences for the sub-channels, the sequence should have a low PAPR Based on above, we can see, the PAPR of sub-channel is high (up to 7.4 db) as the following list. Sub-channel PAPR (db)

1 4.4092 2 5.8503

3	7.4339
4	6.9715
1+3	5.4292
2+4	5.9841
1+2+3+4	3.5805

5. Change to clause 5.6 in [1]

Replace the paragraph:

If in the UL, if the allocation spans less than the whole OFDM symbol (i.e. when subchannelization is used), the preamble carriers that do not fall within the subchannels allocated shall not be transmitted.

With:

If in the UL, if the allocation spans only one sub-channel, the following preamble vector is used in conjunction with subchannelization transmissions, and the preamble carriers that do not fall within the subchannels allocated shall not be transmitted.

```
P_{1subch}(-100:100) = \{
                         -1 0 -1
-1
        1
             0
                  1
                      0
                                       0
                                          -1
                                                 0
                                                        [-100:-89] subch1
    0
        -1
-1
    0
             0
                  -1
                       0
                          -1
                               0
                                  -1
                                        0
                                            1
                                                 0
                                                     1 [-88:-76] subch2
0
    -1
         0
             -1
                  0
                       1
                           0
                              -1
                                   0
                                       -1
                                            0
                                                -1
                                                        [-75:-64] subch3
                          0
0
    -1
         0
             1
                  0
                      1
                              -1
                                   0
                                       -1
                                            0
                                                -1
                                                     0
                                                            [-63:-51] subch4
    0
         1
             0
                     0 -1
                              0
                                   1
                                       0
                                           -1
                                                0
1
                                                        [-50:-39] subch1
             0
                                        0
-1
    0
         1
                  -1
                      0
                         -1
                               0
                                   1
                                           -1
                                                 0
                                                     -1
                                                            [-38:-26] subch2
0
         0
                 0
                          0
                                            0
    -1
             1
                     -1
                              -1
                                   0
                                        1
                                                 1
                                                        [-25:-14] subch3
0
     1
         0
              1
                  0
                      1
                          0
                              -1
                                    0
                                        1
                                            0
                                                -1
                                                     0
                                                            [-13:-1] subch4
0
0
    1
         0
            -1
                 0
                      1
                          0
                                   0
                                      -1
                                          0
                                               -1
                                                    0
                                                        [1:13] subch1
                              1
    0
        -1
             0
                      0
                              0
                                       0
1
                 -1
                          1
                                   1
                                               0
                                           1
                                                            [14:25] subch2
    0
        1
             0
                 1
                              0 -1
                                      0 -1
-1
                     0
                          1
                                               0 -1
                                                        [26:38] subch3
0
    1
         0
            -1
                 0
                      1
                          0
                              1
                                   0 -1
                                           0
                                              -1
                                                            [39:50] subch4
0
    -1
         0
            -1
                  0
                           0 -1
                                    0
                                        1
                                            0
                                               -1
                                                    0 [51:63] subch1
                     -1
                                       0 -1
1
    0
             0
                  1
                      0
                              0
                                   1
                                                0
        -1
                          1
                                                            [64:75] subch2
    0
        1
             0
                  1
                      0
                          1
                              0
                                   1
                                       0
                                               0
-1
                                          -1
                                                    1
                                                        [76:88] subch3
                                  0
           -1
                 0 -1
                          0 -1
                                       1
                                           0
0 -1 0
                                               -1
                                                            [89:100] subch4
}sqrt(2)*sqrt(2)
```

If the allocation spans only two sub-channels, the following preamble vector is used in conjunction with subchannelization transmissions, and the preamble carriers that do not fall within the subchannels allocated shall not be transmitted.

$P_{2subch}(-100:100) = \{$	
-1 0 1 0 1 0 -1 0 1 0 -1 0	[-100:-89] subch1+subch3
-1 0 -1 0 1 0 -1 0 1 0 -1 0 1	[-88:-76] subch2+subch4
0 -1 0 1 0 1 0 1 0 1 0 1	[-75:-64] subch1+subch3
0 -1 0 1 0 -1 0 1 0 1 0 -1 0	[-63:-51] subch2+subch4
1 0 1 0 1 0 -1 0 -1 0 -1 0	[-50:-39] subch1+subch3
-1 0 -1 0 1 0 1 0 -1 0 1 0 -1	[-38:-26] subch2+subch4
0 -1 0 1 0 1 0 -1 0 -1 0 -1	[-25:-14] subch1+subch3
0 -1 0 1 0 -1 0 1 0 1 0 -1 0	[-13:-1] subch2+subch4
0	
0 1 0 1 0 1 0 -1 0 1 0 1 0	[1:13] subch1+subch3
1 0 1 0 1 0 -1 0 1 0 1 0	[14:25] subch2+subch4
-1 0 1 0 1 0 -1 0 1 0 1 0 -1	[26:38] subch1+subch3
0 1 0 1 0 -1 0 -1 0 1 0 1	[39:50] subch2+subch4
0 1 0 1 0 -1 0 1 0 -1 0 1 0	[51:63] subch1+subch3
-1 0 -1 0 -1 0 -1 0 1 0 -1 0	[64:75] subch2+subch4
-1 0 -1 0 -1 0 1 0 -1 0 -1 0 -1	[76:88] subch1+subch3
0 1 0 1 0 1 0 -1 0 -1 0 -1	[89:100] subch2+subch4

6. Conclusion

The propasal sequences have lower PAPR.

Sub-channel	PAPR (proposal)
1	2.3889dB
2	2.3230dB
3	2.3230dB
4	2.38896dB
1+3	3.0551dB
2+4	3.0582dB

7. Summary

If we make "OFDM sub-channelization" as a part of 802.16a, then I propose add two more preambles for sub-channelization purpose.