Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**A common SYNC symbol design for OFDMA**
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Re:	IEEE 802.16e D4 Draft
Abstract	Addition of a common SYNC symbol to aid in fast cell search.
Purpose	To incorporate the changes here proposed into the 802.16e D5 draft.
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A Common SYNC Symbol Design for OFDMA

1 Background

In contribution document C80216e-04/261, a common SYNC symbol is specified for various FFT sizes. In this contribution we proposed a structural way to generate the common SYNC symbol based on Chu and Frank-Zadoff CAZAC sequences and introduce spectrum folding to ensure low PAPR.

2 Proposed Solution

For theoretical derivations of using CAZAC sequence in the construction of preamble sequences, refer to contribution document C80216e-04_265.

3 Proposed Text Change

----------Start text ----------

8.4.6.1.1 Preamble

The sequence for the common SYNC symbol is defined below.

Table xxx. Common SYNC symbol

FFT size	2048	1024	512	128
Length of sequence	1024	512	256	64
Sequence type	Chu	Frank-Zadoff	Chu	Chu
Sequence length	512	256	128	32

For the FFT sizes of 2048, 1024, 512, and 128, the common SYNC symbols are derived from Fran-Zadoff [xx] or Chu [xx] sequences and possess CAZAC (Constant Amplitude Zero Auto-correlation) properties.

The Chu sequence generation is expressed as

(x)

The Frank-Zadoff sequence generation is expressed as

The common SYNC symbol modulates each 2'nd subcarrier with modified CAZAC sequences and uses legacy preamble boosting formula described in 8.4.9.4.3.1. Figure X depicts an example of the subcarrier modulation.

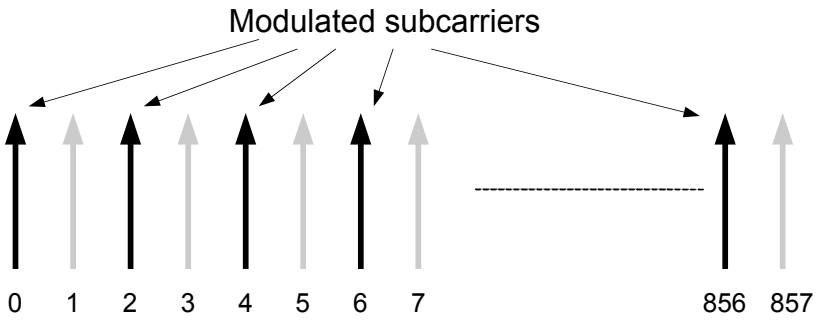

Figure X. Common SYNC symbol basic structure

8.4.6.1.1.1 2048-FFT OFDMA DL Common SYNC Symbol Generation

The common SYNC modulation data of 2048 physical subcarriers are assembled in such a way that the folded frequency spectrum of even-numbered subcarriers of the 2x subsampled time waveform closely resembles a 512-element Frank-Zadoff sequence while maintaining constant amplitude. The assembling process uses a 512-element Chu sequence described in the last section and the procedures are

where

and *GROUP* is between 0 and 7 and is the three LSB bits of *IDcell*. and are the numbers of guard subcarriers on the left- and right-hand sides, respectively, as defined in Table 309a. is a 512-element Chu sequence defined earlier in (x).

8.4.6.1.1.2 1024-FFT OFDMA DL Common SYNC Symbol Generation

The common SYNC modulation data of 1024 physical subcarriers are assembled in such a way that the folded frequency spectrum of even-numbered subcarriers of the 2x subsampled time waveform closely resembles a 256-element Frank-Zadoff sequence while maintaining constant amplitude. The assembling process uses a 256-element Frank-Zadoff sequence described in the last section and the procedures are

where

and *GROUP* is between 0 and 7 and is the three LSB bits of *IDcell*. and are the numbers of guard subcarriers on the left- and right-hand sides, respectively, as defined in Table 309b. is a 256-element Chu sequence defined earlier in (x).

8.4.6.1.1.3 512-FFT OFDMA DL Common SYNC Symbol Generation

The common SYNC modulation data of 512 physical subcarriers are assembled in such a way that the folded frequency spectrum of even-numbered subcarriers of the 2x subsampled time waveform closely resembles a 128-element Chu sequence while maintaining constant amplitude. The assembling process uses a 128-element Chu sequence described in the last section and the procedures are

where

and *GROUP* is between 0 and 7 and is the three LSB bits of *IDcell*. . and are the numbers of guard subcarriers on the left- and right-hand sides, respectively, as defined in Table 309c. is a 128-element Chu sequence defined earlier in (x).

8.4.6.1.1.4 128-FFT OFDMA DL Common SYNC Symbol Generation

The common SYNC modulation data of 128 physical subcarriers are assembled in such a way that the folded frequency spectrum of even-numbered subcarriers of the 2x subsampled time waveform closely resembles a 32-element Chu sequence while maintaining constant amplitude. The assembling process uses a 32-element Chu sequence described in the last section and the procedures are

where

and *GROUP* is between 0 and 7 and is the three LSB bits of *IDcell*. . and are the numbers of guard subcarriers on the left- and right-hand sides, respectively, as defined in Table 309d. is a 32-element Chu sequence defined earlier in (x).

----------End text ----------

4 References

[1] IEEE P802.16-REVe/D4-2004 Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Band.

[2] IEEE C80216e-04/265r1, Preamble Sequence For Fast Cell Search, Low Computational Complexity, and Low PAPR