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Title	**Rate=5/6 LDPC Coding for OFDMA PHY**
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Re:	**Response to Sponsor Ballot on IEEE802.16e/D6 document**
Abstract	**In this contribution, ~~Rate~~rate=5/6 LDPC codes are provided to complete LDPC in IEEE802.16e.**
Purpose	**To incorporate the text changes proposed in this contribution into the 802.16e/D6 draft.**
Notice	
Release	
Patent Policy and Procedures	

Rate=5/6 LDPC Coding for OFDMA PHY

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Overview

"IEEE C802.16e-05/0066r3" has provided a harmonized LDPC scheme for IEEE802.16e, which has been widely supported by 13 companies. The design of these codes has overcome the problem of saving parity check matrices , and provided a very simply encoding scheme, and considered the "error floor" problem . Of course, these codes have the common merits of LDPC codes, such as simply decoding , high parallel degree and perfect performance near to Shannon limit. So these LDPC codes will have a bright prospect , and have a wide application to replace turbo codes.

However, "IEEE C802.16e-05/0066r3" hasn't provided rate=5/6 LDPC codes. So we propose that rate 5/6 codes should been added to IEEE802.16-REVe/D6 , because CC and CTC all have rate=5/6 codes.

As we all know, code rate, codeword length and degree distribution decide the performance of LDPC codes. When Message Passing algorithm is used, the short cycles in the bipartite of LDPC codes will obviously degrade the performance of the LDPC codes, especially when SNR is high. Girth was defined as the length of the shortest cycle of the bipartite of LDPC codes, and it has become a criterion on the performance of LDPC codes.

In our new design scheme, we can ensure that our design is uniform with "IEEE C802.16e-05/0066r3". 24-column base matrix has been adopted, and dual-dialog structure corresponding to parity check bits also has been used.

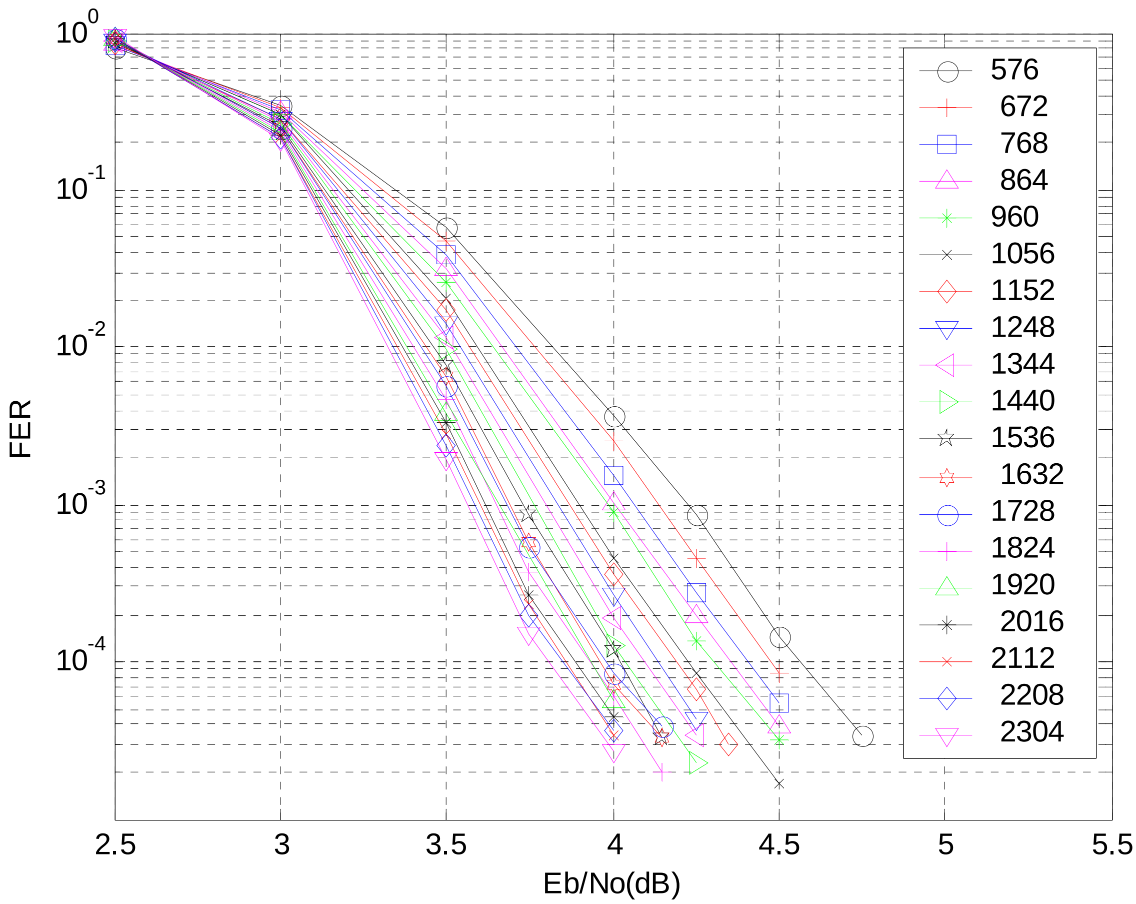
Features

- Simple encoding and decoding
- Less average iteration numbers
- Good performance
- Eliminate error floor

Simulation Results

Simulation results for ZTE high girth codes of the rate 5/6 code families are shown in Figure 1. For the rate, code sizes considered are all 576-2304. The simulation conditions are: AWGN channel, BPSK modulation, max iterations times 50, using generic floating-point belief propagation. From the simulation results we can find that our codes overcome the "error floor" phenomenon, and the BER curve of them will descend more steeply. When SNR is high, our high girth method obviously obtained an improved performance.

The expansion factor *z* ranges from 24 to 96, as shown in Figures 1. The block size and the expansion factor are related by *n* = 24*z.



Recommended Text Changes:

[Add/Modify the text in 802.16e_D6 as follows, adjusting the numbering as required:]

In the "8.4.9.2.5.1 Code Description"~~,~~
There is a sentence as following:
To support 5/6 codes, we suggest that a sentence should have some changes as following:
For code rates 1/2, 3/4 A and B code, ~~and~~ 2/3 B code, and 5/6 code, the shift sizes {*p(f, i, j)*} for a code size corresponding to expansion factor *zf* are derived from {*p(i,j)*} by scaling *p(i,j)* proportionally

$$p(f,i,j) = \begin{cases} p(i,j), & p(i,j) \le 0 \\ \left\lfloor \dfrac{p(i,j) z_f}{z_0} \right\rfloor, & p(i,j) > 0 \end{cases} \qquad (129a)$$

Between Rate 3/4 B code base matrix and "Direct Encoding", suggested base matrix should be added.
Rate 5/6 code:

1 25 55 -1 47 4 -1 91 84 8 86 52 82 33 5 0 36 20 4 77 0 0 -1 -1
-1 6 -1 36 40 47 12 79 47 -1 41 21 12 71 14 72 0 44 49 0 18 0 0 -1
51 81 83 4 67 -1 21 -1 31 24 91 61 81 9 86 78 60 88 67 15 -1 -1 0 0
68 -1 50 15 -1 36 13 10 11 20 53 90 29 92 57 30 84 92 11 66 0 -1 -1 0

In the "8.4.9.2.5.3 Code Rate and Block Size Adjustment"
"Table 333a—LDPC Block Sizes and Code Rates" have some changes as following:

n (bits)	n (bytes)	k (bytes)				Number of subchannels		
		R=1/2	R=2/3	R=3/4	R=5/6	QPSK	16QAM	64QAM
576	72	36	48	54	60	6	3	2
672	84	42	56	63	70	7		
768	96	48	64	72	80	8	4	
864	108	54	72	81	90	9		3
960	120	60	80	90	100	10	5	
1056	132	66	88	99	110	11		
1152	144	72	96	108	120	12	6	4
1248	156	78	104	117	130	13		
1344	168	84	112	126	140	14	7	
1440	180	90	120	135	150	15		5
1536	192	96	128	144	160	16	8	
1632	204	102	136	153	170	17		
1728	216	108	144	162	180	18	9	6
1824	228	114	152	171	190	19		
1920	240	120	160	180	200	20	10	
2016	252	126	168	189	210	21		7
2112	264	132	176	198	220	22	11	
2208	276	138	184	207	230	23		
2304	288	144	192	216	240	24	12	8

In the "11.3.1.1 Uplink burst profile encodings"

<In 11.3.1, p. 474, line 45 add the following text>
11.3.1.1 Uplink burst profile encodings
Insert the following text in the "Value" column of the first row ("FEC code type and modulation type") of Table 357 p. 474 of *802.16-REVe/D6*, and change "41..255=Reserved" to "44..255=Reserved"
41=QPSK (LDPC) 5/6
42=16-QAM(LDPC) 5/6
43=64-QAM(LDPC) 5/6

In the "11.4.2 Downlink burst profile encodings"

<In 11.4.2, p. 478, line 45 add the following text>
11.4.2 Downlink burst profile encodings
Insert the following text in the "Value" column of the first row ("FEC code type and modulation type") of *Table 361 p. 478* of *802.16-REVe/D6, and* change "41..255=Reserved" to "44..255=Reserved"
41=QPSK (LDPC) 5/6
42=16-QAM(LDPC) 5/6
43=64-QAM(LDPC) 5/6