Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Support for additional block sizes for CTC in OFDMA**
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Source(s)	John Benko, Marie-Helene Hamon France Telecom Research & Development 801 Gateway Blvd. Suite 500 South San Francisco, CA 94080 Voice: +1-650-875-1593 Fax: +1-650-875-1505 John.Benko@francetelecom.com, mhelene.hamon@francetelecom.com
Re:	IEEE P802.16e/D5-2004
Abstract	Optimal interleaver parameters for CTCs (Convolutional Turbo Codes) are given to support a larger range of frame sizes for OFDMA subchannelization
Purpose	To incorporate the given tables in this contribution into IEEE 802.16e/D5-2004
Notice	
Release	
Patent Policy and Procedures	

Support for additional block sizes for CTC in OFDMA

John Benko, Marie-Helene Hamon
France Telecom Research & Development

Motivation

New optimal interleaver parameters for CTCs are given to support a larger set of block sizes, that support the subchannelization of the OFDMA channel. In order to avoid backward compatibility issues, with the subchannelization defined in 802.16d, this proposal will suggest a new optional scheme that will not replace the old block sizes and subchannelization. As the standard is currently setup, the only way to see the performance gains with higher block sized CTCs is to use the *optional* H-ARQ mode. Optimal code performance (by increasing block size) should not be limited to an optional mode, especially when it is straightforward to implement. This will ensure maximum performance gain with the larger block sizes. In addition to the new block sizes proposed, a modification of the subchannel concatenation rules will be required, which are also proposed.

In this proposal the maximum block size, which was previously only 60 information bytes in non H-ARQ mode, will be increased to a maximum of 216 information bytes. Outer interleaver parameters for the new block sizes are also defined in Table 327a.

Main Points

- Larger block sizes for CTC = better performance.
- Complexity is increased, but not more than other advanced FECs. (most likely less, actually)
  - Duo-binary CTCs are less complex than traditional binary CTCs (used in 3G)
- Large block sizes are already included for CTCs, but only in the *optional* H-ARQ mode –not sufficient.
- In addition, new outer interleavers are required for the new block sizes. These have been included as well in a new table.
- For backwards compatibility, the new block sizes will have to be separate from the CTC sub-channelization concatenation defined in 802.16d, and have it's own sub-channelization concatenation defined.
  - MAC has to be slightly changed to add this new sub-channelization – to be done shortly

Suggestion: To add Tables 324a (increasing number of blocks) 323a, and 322a to Section 8.4.9.2.3.1, and Table 327a to Section 8.4.9.2.3.4.2 with the following text.

1. Section 8.4.9.2.3.1

<ADDED TEXT> A new sub-channelization of the CTC is defined to allow frame sizes up to 216 bytes. To use this scheme, Table 324a should be used in addition to Table 324. Table 324a specifies optimal interleaver parameters for frame sizes (unencoded blocks) between 64-216 bytes. This can be used for OFDMA subchannelization with QPSK, 16-QAM and 64-QAM. The interleaver parameters in the table are independent of the modulation used. The subchannelization rules to be used with this new sub-channelization scheme are defined fully in Tables 322a and 323a. Tables 322 and 323 are to be used for the block sizes defined in Table 324.

Table 324a – Optimal CTC channel coding for additional OFDMA Block Sizes

Data Block size (bytes)	Encoded Data Block size (bytes)	Code Rate	Nsch QPSK	Nsch 16-QAM	Nsch 64-QAM	N couples (2 bit pairs)	P0	P1	P2	P3
64	96	2/3	8	4	0	256	23	52	132	116
66	132	1/2	11	0	0	264	23	2	160	30
72	96	3/4	8	4	0	288	23	50	188	50
72	108	2/3	9	0	3	288	23	50	188	50
72	144	1/2	12	6	4	288	23	50	188	50
78	156	1/2	13	0	0	312	23	102	64	38
80	120	2/3	10	5	0	320	23	32	116	64
81	108	3/4	9	0	3	324	11	172	164	16
88	132	2/3	11	0	0	352	29	46	228	46
90	180	1/2	15	0	5	360	29	56	0	68
90	120	3/4	10	5	0	360	29	56	0	68
96	192	1/2	16	8	0	384	29	68	140	56
96	144	2/3	12	6	4	384	29	68	140	56
99	132	3/4	11	0	0	396	29	36	128	76
102	204	1/2	17	0	0	408	29	124	204	40
104	156	2/3	13	0	0	416	29	50	152	82
108	216	1/2	18	9	6	432	13	0	4	8
108	144	3/4	12	6	4	432	13	0	4	8
114	228	1/2	19	0	0	456	31	100	224	104
117	156	3/4	13	0	0	468	31	98	220	98
120	240	1/2	20	10	0	480	31	52	240	52
120	180	2/3	15	0	5	480	31	52	240	52
128	192	2/3	16	8	0	512	31	2	148	10
132	264	1/2	22	11	0	528	31	24	36	104
135	180	3/4	15	0	5	540	31	42	248	34
136	204	2/3	17	0	0	544	31	82	4	102
138	276	1/2	23	0	0	552	35	14	136	6
144	192	3/4	16	8	0	576	31	42	232	18
144	216	2/3	18	9	6	576	31	88	156	52
144	288	1/2	24	12	8	576	31	42	232	18
152	228	2/3	19	0	0	608	37	60	248	4
153	204	3/4	17	0	0	612	37	6	164	14
160	240	2/3	20	10	0	640	37	54	12	86
162	216	3/4	18	9	6	648	37	62	160	34
171	228	3/4	19	0	0	684	37	108	136	8
176	264	2/3	22	11	0	704	37	72	28	116
180	240	3/4	20	10	0	720	37	92	100	68
184	276	2/3	23	0	0	736	37	58	184	10
192	288	2/3	24	12	8	768	19	384	216	600

198	264	3/4	22	11	0	792	41	0	228	24
207	276	3/4	23	0	0	828	41	136	288	192
216	288	3/4	24	12	8	864	19	2	16	6

Table 323a – Encoding subchannel concatenation for different rates in CTC

Modulation	**j**
QPSK	24
16QAM	12
64QAM	8

Table 322a – Subchannel concatenation rule for CTC

Number of Subchannels	**Subchannels concatenated**
$n \le j$ AND $n \bmod 7 \ne 0$	1 block of n subchannels
$n \le j$ AND $n \bmod 7 = 0$	1 block of 4n/7 subchannels 1 block of 3n/7 subchannels
$n > j$	Same info from Table 322

2. Section 8.4.9.2.3.4.2 Subblock interleaving

<ADDED TEXT> Table 327a (along with Table 327) gives subblock interleaver parameters for the new CTC subchannelization defined by Tables 322a, 323a, 324, 324a.

Table 327a – Parameters for subblock interleavers

Block size (bits) N_{EP}	N	m	J
512	256	7	2
576	288	7	3
624	312	7	3
640	320	7	3
648	324	7	3
704	352	7	3
720	360	7	3
768	384	7	3
792	396	7	4
816	408	7	4
832	416	7	4
864	432	7	4
912	456	7	4

936	468	8	2
960	480	8	2
1024	512	8	2
1056	528	8	3
1088	544	8	3
1104	552	8	3
1152	576	8	3
1216	608	8	3
1224	612	8	3
1280	640	8	3
1296	648	8	3
1368	684	8	3
1408	704	8	3
1440	720	8	3
1472	736	8	3
1536	768	8	3
1584	792	8	4
1656	828	8	4
1728	864	8	4