Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Common SYNC Symbol for Mobile Cell Searching**
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Re:	IEEE 802.16e/D5
Abstract	To enhance the Common SYNC Symbol to simplify mobile cell search
Purpose	To incorporate the changes here proposed into the 802.16e/D6 draft.
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Common SYNC Symbol for Mobile Cell Searching

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1 Introduction

In the current IEEE P802.16-REVe/D5-2004, the Common SYNC Symbol was introduced to simplify initial frame search. However it can not be used to speed up the cell searching for HO candidates in mobile environments. The computation power needed to identify all the neighboring preambles can be reduced to improve the battery life of MSS.

2 Proposed Solution

Here we would like to modify the Common SYNC symbol can be generated from total 8 common PN (CPN) sequences for all BSs and networks. The new Common SYNC Symbol can be used for fine timing synchronization and the group identification of the legacy preamble, which can shorten the search time and reduce MSS processing power for the legacy preamble search. The new Common SYNC symbol GroupID can be used to identify the group of neighboring cells as HO candidates. The presence of new Common SYNC Symbol can be used to greatly reduce the number of legacy preamble PN sequences used for neighboring cell search.

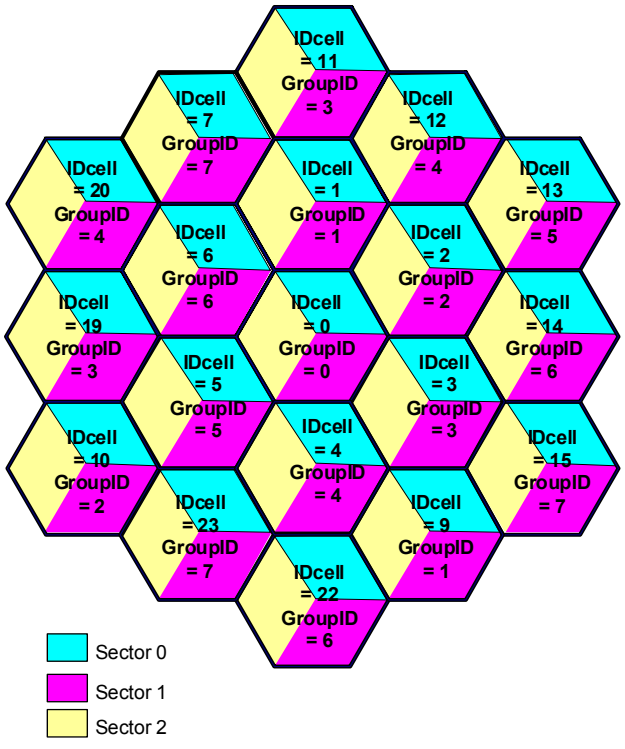

Figure 1. 3-sector cell deployment

Table 1. Mapping the Common SYNC Symbol GroupID to IDcell

Group SYNC ID	IDcell	Preamble PN Sequence #		
		Segment 0	Segment 1	Segment 2
0	0, 8,16,24	0, 8,16,24, 96	32,40,48,56,112	64,72,80,88, 104
1	1,9,17,25	1,9,17,25, 105	33,41,49,57,97	65,73,81,89,113
2	2,10,18,26	2,10,18,26,	34,42,50,58,106	66,74,82,90,98
3	3,11,19,27	3,11,19,27,99	35,43,51,59	67,75,83,91,107
4	4,12,20,28	4,12,20,28,108	36,44,52,60,100	68,76,84,92
5	5,13,21,29	5,13,21,29	37,45,53,61,109	69,77,85,93, 101
6	6,14,22,30	6,14,22,30,102	38,46,54,62	70,78,86,94,110
7	7,15,23,31	7,15,23,31,111	39,47,55,63,103	71,79,87,95

The presence of Common SYNC Symbol is periodic on a fixed time interval base. The longest period for Common SYNC Symbol transmission is TBD (say 120ms). It is up to the service provider to choose a proper Common SYNC Symbol time interval in the network deployment.

The presence cycle of the Common SYNC Symbol N_{SYNC_PERIOD} can be determined by the frame duration and Common SYNC Symbol periodicity in real time, as shown in Table 2. In addition, such a Common SYNC Symbol can be assigned in very frame. The overhead vs. common SYNC time interval is listed in Table 3.

Table 2. N_{SYNC_PERIOD} Time Interval vs. Frame Length

Frame Duration	Common SYNC Time Interval /$N_{POSTAMBLE\_PERIOD}$						
2.0 ms	4ms /2	8ms /4	8ms /4	20ms /10	40ms /20	60ms /30	120ms /60
2.5 ms	-	5ms /2	10ms /4	20ms /8	40ms /16	60ms /24	120ms /48
4.0 ms	-	8ms /2	8ms /2	16ms /4	40ms /10	56ms /14	120ms /30
5.0 ms	-	-	10ms /2	20ms /4	40ms /8	60ms /12	12ms /24
8.0 ms	-	-	-	16ms /2	32ms /4	48ms /6	112ms /14
10.0 ms	-	-	-	20ms /2	40ms /4	60ms /6	120ms /12
12.5 ms	-	-	-	-	25ms /2	50ms /4	100ms /8
20.0 ms	-	-	-	-	40ms /2	40ms /2	120ms /6

Table 3. DL subframe overhead vs. Common SYNC Symbol time

Frame Duration	4ms	8ms	10ms	20ms	40ms	60ms	120ms
DL Subframe Overhead with Single SYNC Symbol	<5%	<2.5 %	<2%	<1%	<0.5 %	<0.3 %	<0.15 %
DL Subframe Overhead with Dual SYNC Symbols	<10 %	<5%	<4%	<2%	<1%	<0.6 %	<0.3%

3 Proposed Text

Example text changes with 7a option are provided below.

*[Replace **Table 307e** [1] with following tables]*
----------Start text ----------
8.4.6.1.1.1 Common SYNC Symbol (optional)

In every ~~fourth~~ N_{SYNC_PERIOD} downlink transmission frame, …

Table 307e—Common SYNC Sequences for 2048-OFDMA Mode

Group ID	2048-OFDMA Common SYNC Symbol PN sequences	PAPR (dB)
0	0x2D7F22905CA89706A1C1AF33A469092813FE7D4177E8C153ECEDF834FA9A FBFE93029535BC61EE9C985EA3EDB8F08E7921DC1EA9B0F701B6AA0C8E503 3C9F0D7FCE8CFFBE0DE91DCAEBFFA111BD1CBCF65D9F5D0386517BB39ED 3B26AD61F6272E16981363C65E012B441	5.95
1	0xBEB39F48C5EC2015ABBA6148068BE6B3DF63C90CCD051E1174B7F386CA9 D6E1F5FDF597509CA8AF83B64E7A4B0876EA9DFCEEDDBFE4612DC4CAA33 BCAC8FE21580F83545A990FF10568C301B9D809B4AE5E40C4D3084FE5940E33 AE6951AE594B1BBE3271202A6D0D2384	5.93
2	0x41B0D6E6792F47020F1F8B878F1E5BD1964B6F81FD66584B2D58888553B7BA 41E9AC243DB7AE47552F13641A7648A9FACC9218E2F410EFCF4747858BEABA EE93FFFBB803EF7CA2DCA4C751A83D62181597BC9130B729C8938708057F144 C75B1C1788E040717E84AD2E0F	5.95
3	0xBF74090707623D2B31ACAC571815898ABB27A1B7635EB848075AAEBC9D42 DE884BEDF6F110AE80A0427FB414D501765F8C052A7DA413050A4CCA84CA2 27CBFB0F6E6F903FCE23864F31F63FDAD5BB8D67D596F5A918BC41E1AFEE0 36882B2A77FFE9269790BDFEE27FEE4	5.95
4	0x0A218C185779E3974CE4B5CE3554CAA5CF8BBF52DE65D45B5FF07AF074A1 AECCB914C1B6D3F3FC64F3C97253CE8A97A4CD3332443905491403C5A0FB66 46DE18B3CA47351A9E97C6EA4A85A6B352EE61EC27FA8E05B748DCA9F7E06 289FE93A7FDB1C388D95DBE1B1829E	5.95
5	0x8CE7BF989CA5AD4CA88B4135A80E84A979C2B5CEC39528C969E646DB0E5 2515CA923CAFAE3AF258BCB724624E7DCB115FDB493F2160CDDF972D58BD4 492DD573EC17F6DA41C21B89F9C03AEEBCA2279DB8C95290E595B72160C42E 2A141CF6493C3905BEC6FA6A101EA66	5.73
6	0x994AE551A730AF57F247B42D83D4A1386D5A34BAACCA3F9BD2CCCC346C 7A4F8CE620BA42E9DF2D672A5DC43363D86FB8C5856A8713F118B87DDFC9F A58787C2BFFBA27148FD33B1A79E67C5F63E8756221A803F6A14B5ADD55E10 75A7BD184DA4A1D3F8B28B58E68643A7	5.96
7	0x49C0D0463E94F54A0774C9FAF5D03D0638C3312D28FBC89A77978FC0DF460 E9FDE85AC444D6B24779900036EBC9CFC689CC935CB0B798E57B9120AF2279 E192FBF27E2F2E2961C90E0C50F8C06EBFAB2CDCA7F20B61CCADF6D9A35E C94DC84521F2F322947BEEF504D4BD	5.95

Table 307f—Common SYNC Sequences for 1024-OFDMA Mode

Group ID	1024-OFDMA Group SYNC symbol PN sequences	PAPR (dB)
0	0xDDA9978E3EA49F489313C4FCDCDABE16AC061B8AC6F085C88EE8867D86 A2AB8D5FD6B50B2026CE461C12E0281E81084CB397D8511F4	5.43
1	0x827A2DDF3C6B8D19CE66CF5909E716C47B4035CAF872490622B23547C3C02 1AF8AA642AF8A700E10B4B5F36F42B24C74099A01790DF	5.35
2	0xD6E74BD6F13F9FC809429082A9B1B7E2A1127C0A782123E4A3771FC3A5AC F2FFA854443DC69A9298C46BC645704F909E5EC14226D27	5.46
3	0x6DF7F2CB22C1A43D1A05E4379471FC534723A9540BC315533E081CC7B80A8 864B9F99F524FD339E8672DC9534E056B92CEFA950D2F9	5.45
4	0xEC3CAE1B05F02E594C4EE633051B1D5982D7232985ABFB191A7E8878023AF 2CFB40D317E165477DB5B940514DE09592D1F62554EFE5	5.50
5	0x7F22603ECB9135E532B0643AD7C714A60ED8AF861F303B568E7BD8BA2D8B D5C64256B4CDFEF412882809FC6F416BBA703A17F860D0A	5.50
6	0x3D4399D1881F8DBA1671CC9C86122B150DA42BFDB903A781F4E47C6E2D7F DE4B300437295C46AC2EAF02D1813CBD36AD34532919836	5.62
7	0x8C537D4BEAF9C007D431010F019E121651E59AC3BABA3D6AA4785E44C382 8326A4A84E4FFA61C13E78C6FE7D9908ACC4B44EAFF2748	5.60

Table 307f—Common SYNC Sequences for 512-OFDMA Mode

Group ID	512-OFDMA Group SYNC symbol PN sequences	PAPR (dB)
0	0x49283FA8D65C99B2058622E62007A51D8B7860652F827E643F6AF6	4.8
1	0xA008C7DC5A71164AA87EA4093F0BFC48F0EAE052619F28A718D9B4	4.77
2	0xB5A5A376E7499E113A505CBE9E28F5A7228A90E4582A8E742B0037	4.85
3	0xAA26D242170E620C3EA12B6E79B40253B3DDFA3911357E4C27C743	4.84
4	0x96EE6503B7E42A9C76D235D61B9E855945D9148602462D8E80342D	4.54
5	0xD61953D9422ED77CCCF35CD141909FA4ED4B6F33B1C223EBB33744	4.85
6	0xAED0FC2E1B07F9B61F4B3ECFF476FF1171992BB67345F1ABD88630	4.91
7	0xB39DD381538BFB0372F7C2CE75FF9101E36EDB172FBE5B73CDE292	4.96

Table 307f—Common SYNC Sequences for 128-OFDMA Mode

Group ID	128-OFDMA Group SYNC symbol PN sequences	PAPR (dB)
0	0x06F96F9D0D6767	3.52
1	0x40ABB30B3D34CF	3.64
2	0x75EB164DD44FBC	3.59
3	0x4D13844885326B	3.42
4	0xED8AD506263922	3.36
5	0x646FF3FFB16CCC	3.19
6	0x40ABB30B3D34CF	3.64
7	0x3263728845CD62	3.30

Table 307g— Mapping group SYNC ID to IDcell

Group SYNC ID	IDcell	Preamble PN Sequence #		
		Segment 0	Segment 1	Segment 2
0	0, 8,16,24	0, 8,16,24, 96	32,40,48,56,112	64,72,80,88, 104
1	1,9,17,25	1,9,17,25, 105	33,41,49,57,97	65,73,81,89,113
2	2,10,18,26	2,10,18,26,	34,42,50,58,106	66,74,82,90,98
3	3,11,19,27	3,11,19,27,99	35,43,51,59	67,75,83,91,107
4	4,12,20,28	4,12,20,28,108	36,44,52,60,100	68,76,84,92
5	5,13,21,29	5,13,21,29	37,45,53,61,109	69,77,85,93, 101
6	6,14,22,30	6,14,22,30,102	38,46,54,62	70,78,86,94,110
7	7,15,23,31	7,15,23,31,111	39,47,55,63,103	71,79,87,95

Starting from frame 0, the location of the Common SYNC Symbol can be determined by every N_{SYNC_PERIOD} frames, as listed in Table 307g.

Table 307g— N_{SYNC_PERIOD} Time Interval vs. Frame Length

Frame Duration	Common SYNC Time Interval /N_{SYNC_PERIOD}						
2.0 ms	4ms /2	8ms /4	8ms /4	20ms /10	40ms /20	60ms /30	120ms /60
2.5 ms	-	5ms /2	10ms /4	20ms /8	40ms /16	60ms /24	120ms /48
4.0 ms	-	8ms /2	8ms /2	16ms /4	40ms /10	56ms /14	120ms /30
5.0 ms	-	-	10ms /2	20ms /4	40ms /8	60ms /12	12ms /24
8.0 ms	-	-	-	16ms /2	32ms /4	48ms /6	112ms /14
10.0 ms	-	-	-	20ms /2	40ms /4	60ms /6	120ms /12
12.5 ms	-	-	-	-	25ms /2	50ms /4	100ms /8
20.0 ms	-	-	-	-	40ms /2	40ms /2	120ms /6

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

4 References

[1] IEEE P802.16-REVe/D5-2004
[2] IEEE P802.16-2004