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Title	Common SYNC Symbol for Mobile Cell Searching	
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Re:	Response to Sponsor Ballot on IEEE802.16e/D5a document	
Abstract	To enhance the Common SYNC Symbol to simplify mobile cell search	
Purpose	To incorporate the text changes proposed in this contribution 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. Periodically an MSS has to search and identify all the neighboring cell preambles (up to 20 in the neighboring list) to calculate their signal quality, only the one with higher quality can be considered as a HO candidate. Even though most of the times, the MSS will see the current serving BS remain the best, however the searching process continues. In each search, the computation power needed to identify all the neighboring preambles remains excessive, which can be reduced according to this contribution to improve the battery life of MSS.

2 Proposed Solution

Operating in a mobile network, an MSS has to continuously searching for the neighboring cells to seek a BS with better signal quality as a HO candidate. The common SYNC symbol proposed in this contribution can be used for fast cell search purpose. Here we would like to modify the common SYNC symbol, which can be generated from total of 4 common PN (CPN) sequences for all BSs and networks. Periodically MSS checks the common SYNC symbol transmitted from the neighboring BS and calculates, compares, and monitors the energy from these 4 common sequences. If no energy from the neighboring has higher signal quality than the existing one, skip the neighboring preambles search. Most of the times, an MSS only needs to check the common SYNC symbol. Once in a while if the neighboring cells have better signal quality, then up to additional 5 neighboring preambles search (instead of up to 20) needs to be performed to identify the HO candidate.

The GroupID carried by the new common SYNC symbol proposed in this contribution can be used to identify the group of neighboring cell IDs. The presence of the new common SYNC symbol can be used not only for fine timing synchronization and also for the group identification of the legacy preambles, which can greatly shorten the MSS search time and reduce the processing power significantly.

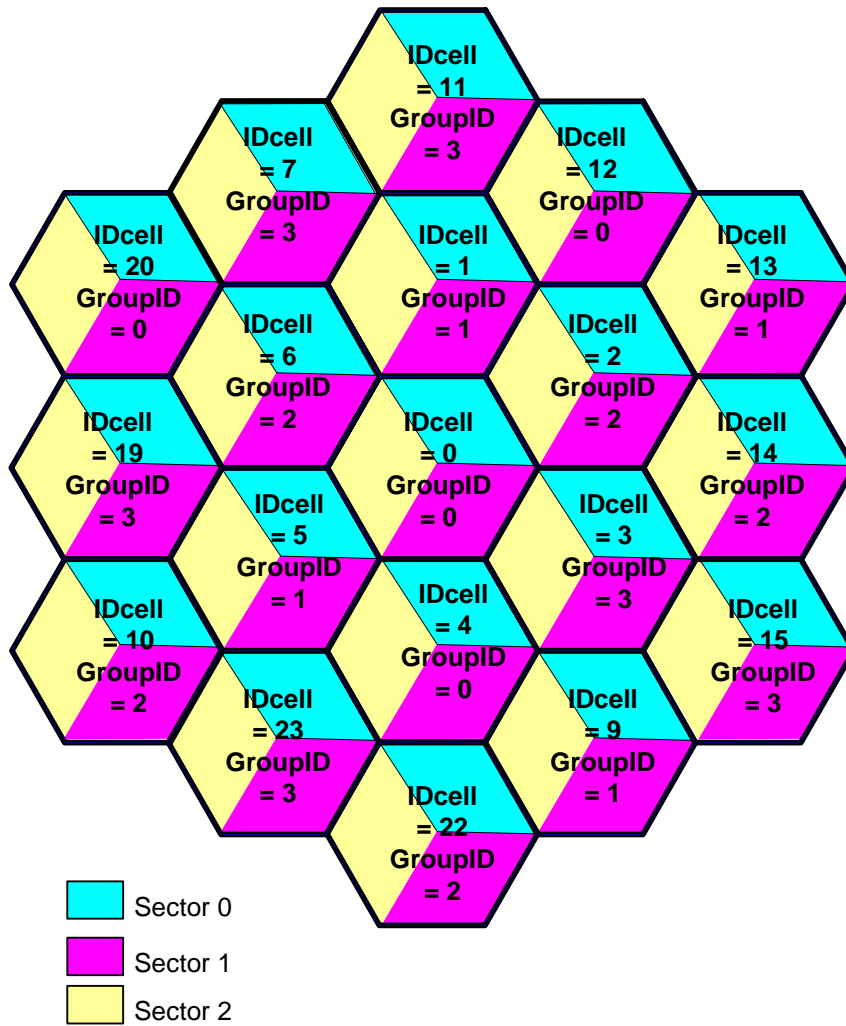


Figure 1. Example of 3-sector cell deployment

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, 4,12,20,28	0, 8,16,24, 96, 4,12,20,28,108	32,40,48,56,112, 36,44,52,60,100	64,72,80,88, 104, 68,76,84,92
1	1,9,17,25, 5,13,21,29	1,9,17,25, 105, 5,13,21,29	33,41,49,57,97, 37,45,53,61,109	65,73,81,89,113, 69,77,85,93, 101
2	2,10,18,26, 6,14,22,30	2,10,18,26, 6,14,22,30,102	34,42,50,58,106, 38,46,54,62	66,74,82,90,98, 70,78,86,94,110
3	3,11,19,27, 7,15,23,31	3,11,19,27,99, 7,15,23,31,111	35,43,51,59, 39,47,55,63,103	67,75,83,91,107, 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 up to 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 $N_{\text{SYNC_PERIOD}}$ 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. $N_{\text{SYNC_PERIOD}}$ Time Interval vs. Frame Length

Frame Duration	Common SYNC Time Interval						
	$N_{\text{POSTAMBLE PERIOD}}$						
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	0x8CE7BF989CA5AD4CA88B4135A80E84A979C2B5CEC39528C969E646DB0E5 2515CA923CAFAE3AF258BCB724624E7DCB115FDB493F2160CDDF972D58BD4 492DD573EC17F6DA41C21B89F9C03AEEBCA2279DB8C95290E595B72160C42E 2A141CF6493C3905BEC6FA6A101EA66	5.73

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

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	0xAA26D242170E620C3EA12B6E79B40253B3DDFA3911357E4C27C743	4.84
3	0x96EE6503B7E42A9C76D235D61B9E855945D9148602462D8E80342D	4.54

Table 307f—Common SYNC sequences for 128-OFDMA mode

Group ID	128-OFDMA Group SYNC symbol PN sequences	PAPR (dB)
0	0x4D13844885326B	3.42
1	0xED8AD506263922	3.36
2	0x646FF3FFB16CCC	3.19
3	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, 4, 8, 12, 16, 20, 24, 28	0, 4, 8, 12, 16, 20, 24, 28, 96, 108	32, 36, 40, 44, 48, 52, 56, 60, 100, 112	64, 68, 72, 76, 80, 84, 88, 92, 104
1	1, 5, 9, 13, 17, 21, 25, 29	1, 5, 9, 13, 17, 21, 25, 29, 105	33, 37, 41, 45, 49, 53, 57, 61, 97, 109	65, 69, 73, 77, 81, 85, 89, 93, 101, 113
2	2, 6, 10, 14, 18, 22, 26, 30	2, 6, 10, 14, 18, 22, 26, 30, 102	34, 38, 42, 46, 50, 54, 58, 62, 106	66, 70, 74, 78, 82, 86, 90, 94, 98, 110
3	3, 7, 11, 15, 19, 23, 27, 31	3, 7, 11, 15, 19, 23, 27, 31, 99, 111	35, 39, 43, 47, 51, 55, 59, 63, 103	67, 71, 75, 79, 83, 87, 91, 95, 107

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

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

Frame Duration	Common SYNC Time Interval						
	$/N_{\text{SYNC_PERIOD}}$						
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	120ms /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