Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Fast cell search for OFDMA**
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Re:	IEEE 802.16e D3 Draft
Abstract	To improve the cell search. This is a revision of the contribution. Inserted texts are highlighted in blue. The deleted texts are stroked out.
Purpose	To incorporate the changes here proposed into the 802.16e D4 draft.
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Fast Cell Search

1 Background

The current preamble per IEEE802.16-2004 is designed primarily for fixed deployment. The preamble search requires large amount of computation power at MSS for fast system access and for cell selection and reselection to support the device mobility in a multi-cell deployment scenarios and to perform frequency domain fine synchronization. For the initial cell search, there is no prior knowledge about the synchronization positions for potential base station candidates; hence MSS needs to perform the correlations with all possible PN sequences for each FFT window position within the entire searching window, such a window could be large even for the synchronous BS network. For hand-off, even with the presence of the adjacent BS list information broadcasted from the anchoring BS, the preamble search is of excessive high computational complexity. We propose a fast cell search procedure to reduce the cell search complexity by almost 60 times. Since the cell search must be performed for MSS in the active state, cell scanning and even idle mode. Fast cell search is very beneficial in terms drastically reduce the power consumption and battery life of portable device.

In this contribution, we propose to introduce a common preamble in addition to the existing cell specific preamble. The common preamble uses a common PN sequence for all BSs. MSS performs fine synchronization using the common PN sequence on the common preamble, the result will provide the locations of candidate BSs. The BS specific search is then performed in the vicinities of those peaks by using BS specific PN sequences. With this two stage cell search, the searching window is drastically reduced.

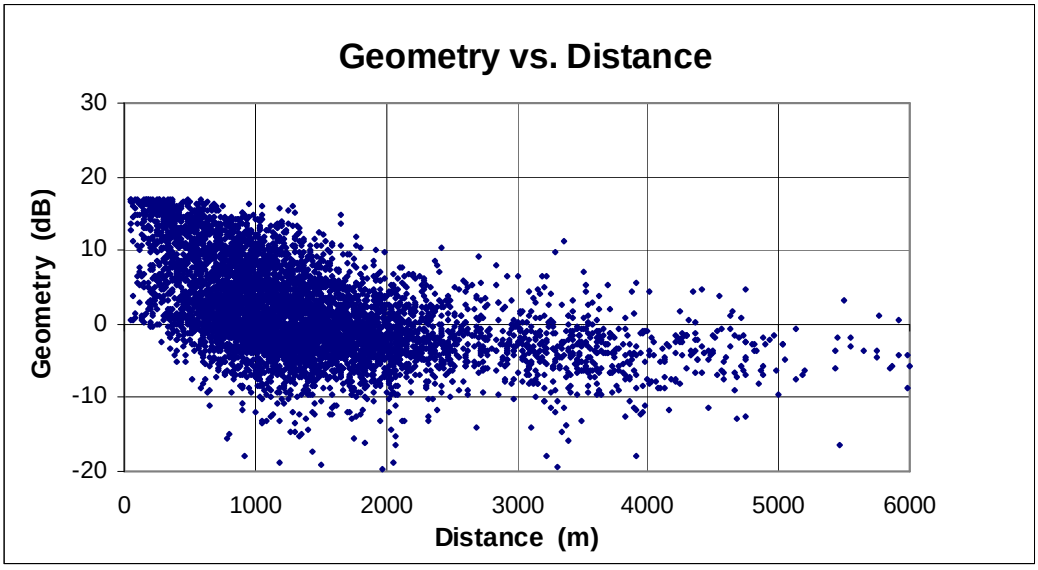


Figure 1 The best BS location may not be in the adjacent cell

For the synchronized BS deployment, let's assume that the anchor BS will broadcast the neighbor BS list for M sectors. And the searching window is 300 samples long (as we have 256 samples prefix), however the real world the searching window can be 2 times more than this (see Figure 1, where the cell to cell spacing is 3km). The correlation of common preamble allows the BS specific preamble search window to reduce to about 5 samples or less, then we can perform cell specific preamble search.

Table 1 Cell search for hand-off case

Number of preamble correlation	One tier cell		Two tier cell	
	3-sectors cell	9-beams cell (AAS)	3-sectors cell	9-beams cell (AAS)
Baseline Cell Search	300x20=6000	300x63=18900	300x19x3=17099	300x19x9=51299
Fast Cell Search	5x20=100	5x63=315	5x19x3=285	5x19x9=855

As we can see that the common preamble assisted cell search can speed up the preamble search time by 60 times, or to reduce the search computational complexity by 60 times.

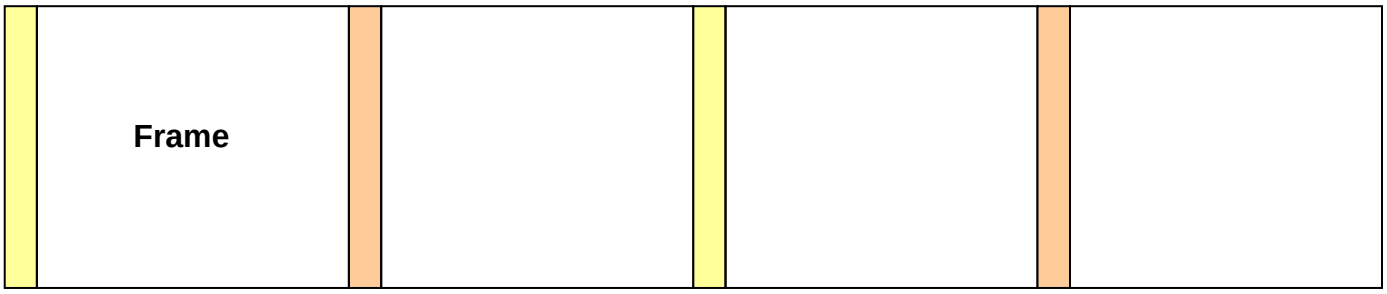
In this contribution, we first discuss several possible solutions considered. To address the backward compatibility issue raised in reply comment, we proposed to use solution 2 instead of solution 1 as previously proposed.

1.1 Solution 1

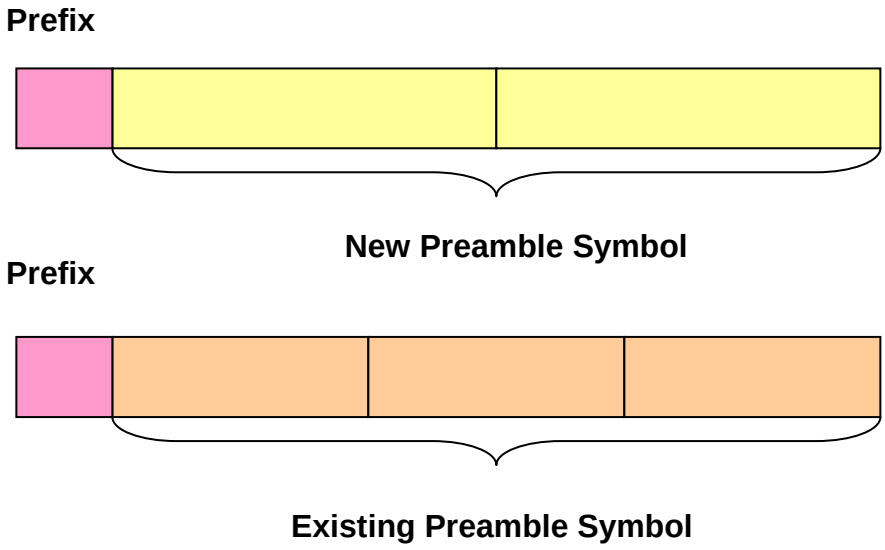
The current .D5 standard defines 3 carrier sets, each of which is used by a segment. In previous version (D4), 6 carrier sets are used; each segment uses two carrier sets. We can use the same 6 carrier sets. One carriers set in each segment is used for the common SYNC channel. For 2 transmit antennas, antenna 0 uses odd carrier set, antenna 1 uses even carrier set. The common SYNC channel is mapped to carriers sets used by antenna 0.

1.2 Solution 2

To keep the backward compatibility, we introduce a new preamble, which is inserted into the frame structure alternatively with the current preamble as shown in the following diagram. This new preamble is used as a common SYNC channel.

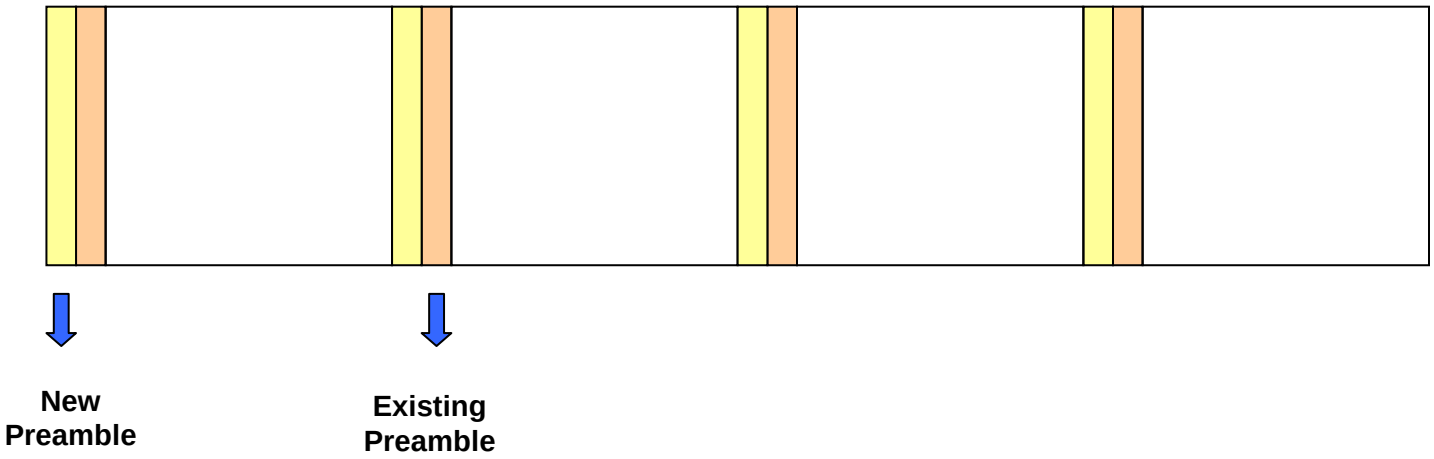


The new preamble has the different structure shown below. Frame (course timing) Sync can be performed based on the repetition structure of the new preamble. Fine timing Sync is based on the common Sync channel and provides the candidate timing synchronization positions. Base station identification can be done based on the existing preamble in the next frame at the candidate timing synchronization positions.



1.3 Solution 3

It is the similar idea as solution 2, except it inserts the new preamble into the frame structure before the current preamble. It requires more overhead, but provides faster system access.



Specific Text Proposal

Insert to Section 8.4.6.1.1

---------Start text proposal-------

A new preamble is inserted into the frame structure alternatively with the existing preamble as shown in the Figure AAA. This new preamble is used as a common SYNC channel.

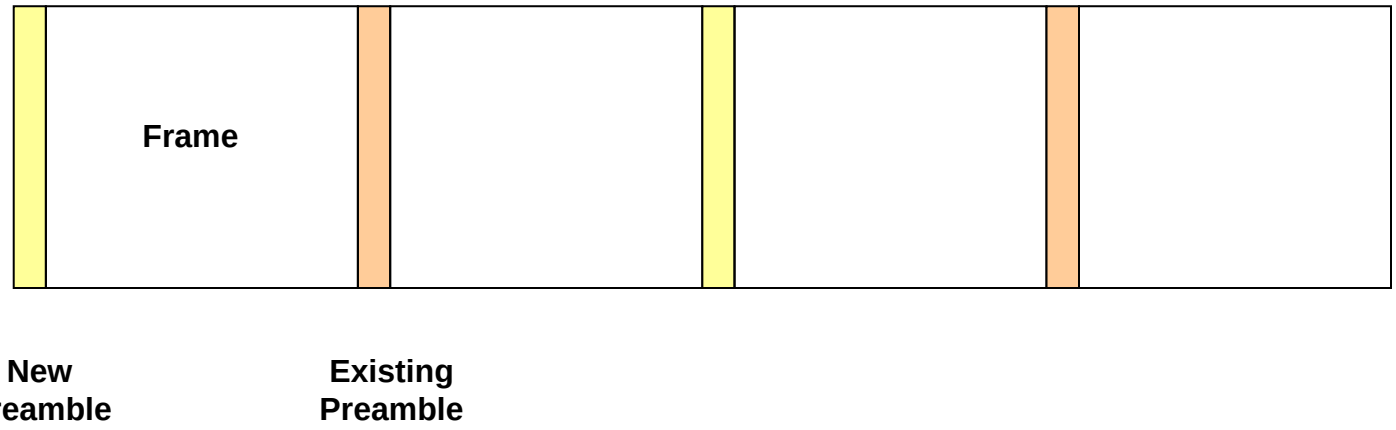
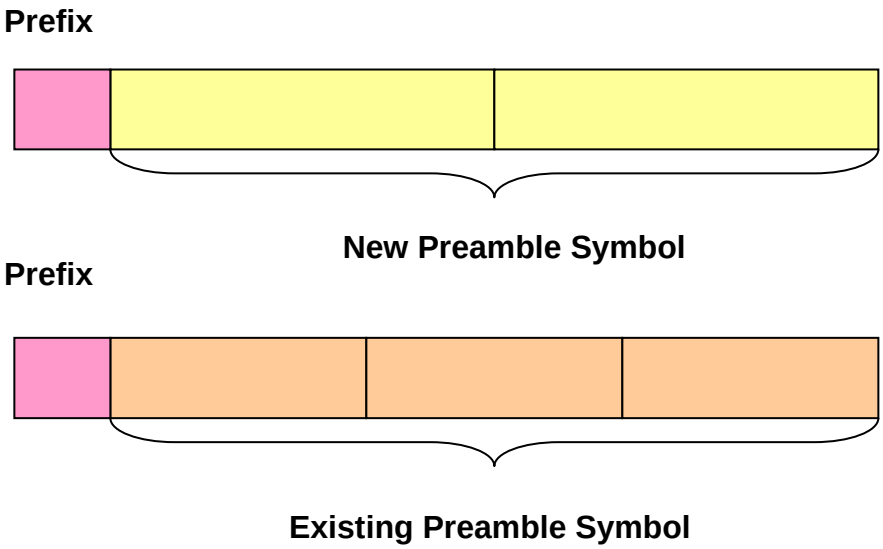


Figure AAA: A new preamble used as a common SYNC channel

The time domain structure of the new preamble has the structure shown in Figure BBB.



In each segment, the 6 carrier sets are used; each segment uses two carrier sets. The same 6 carrier sets are used . One carriers set in each segment is used for the common preamble.

~~Each segment uses 2 types of preamble out of the 6 sets in the following manner:~~

~~Segment 0 uses preamble carrier-set 0 and 3~~
~~Segment 1 uses preamble carrier-set 1 and 4~~
~~Segment 2 uses preamble carrier-set 2 and 5~~

~~For 2 transmit antennas, antenna 0 uses odd carrier set, antenna 1 uses even carrier set. The common preamble is mapped to carriers sets used by antenna 0. Each segment uses 2 types of preamble carrier-sets (one for each antenna or pair of antennas) out of the 6 sets in the following manner:~~
~~For two transmit MIMO:~~

~~Segment 0 - carrier set 0 used by antenna 0, carrier set 3 used by antenna 1~~

~~Segment 1 - carrier set 1 used by antenna 0, carrier set 4 used by antenna 1~~
~~Segment 2 - carrier set 2 used by antenna 0, carrier set 5 used by antenna 1~~

The same PN series as defined in that Table 207 [Ref-1]

---------End text proposal-------

Ref-1: IEEE P802.16-REVd/D4-2004