Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Proposal to Amend Section 8.3.5.16 of TG3&4 Draft Document**	
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Re:	TG3&4 Draft document	
Abstract	This document proposes a new section 8.3.5.16 to replace the old one in the 802.16ab draft document. Section 8.3.5.16 describes some example burst configurations and affiliated processing techniques within the Single Carrier mode.	
Purpose	To propose replacement of section 8.3.5.16 and its dependent, descending subsections with the contents of this document.	
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Proposal to Amend Section 8.3.5.16 of TG3&4 Draft Document

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8.3.5.16 Examples of Burst for 256-point FFTs

The following example burst profiles and burst processing techniques are based on a U = 63-symbol length Unique Word, and a 256 T-symbol based FFT. The Acquisition sequence is assumed to be composed of 1 Unique Word, but could be composed of 2 Unique Words or more.

One standard signaling burst is involves the repetition of Unique Words (UWs), at regular intervals. Such repetition facilitates the FFT processing associated with frequency domain equalization. Figure 1 illustrates such a burst, which concludes with a (suffixing) UW, followed by a null transmit region, RxDS---which allows the delay spread to clear a receiver. Note that, for this signaling case, the payload length must be an integer multiple of 193 symbols. Note also the amount of overhead required, for both the repeated UWs, and for both the final UW and RxDS block. (No one can transmit while the delay spread is being cleared, although, in this case, this region could be used in the Rx/Tx transition gap switching.) The transmit efficiency (coefficient) for this case is E = 193 J / (256 J + 63 N + 63), where J is the number of 193 symbol payload sections transmitted, and N is the number of Unique Words (1 or more) composing the (initial) acquisition sequence.

Payload length = 193 J symbols

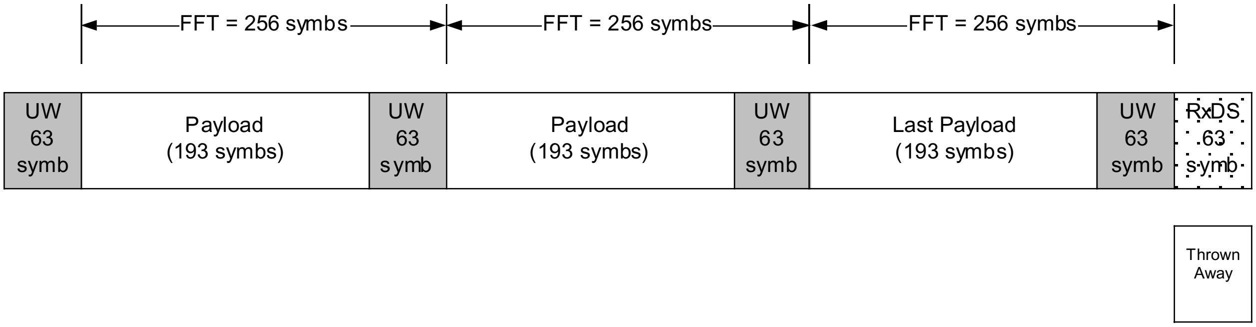

Figure 1: Repetitive UW patterned Burst with 256 pt Prefix-aided FFTs and suffixing UW

A slightly more efficient approach is to not transmit the last UW, as is illustrated in Figure 2. Observe that the last data payload is not cyclic, since it does not conclude with a Unique Word. Therefore, in order to perform FFT processing, the last FFT must overlap the earlier data by at least 63 symbols. What s more, some data must be thrown away, post-FFT. The payload length restriction in this case is that the payload must be M + 193 J symbols long, where J = 0,1,2, and M < 131 is the size of the final payload block. (Figure 2 illustrates the case of M = 130). Note that here the transmit efficiency is E = (M + 193 J)/(256 J + 63 N), where J is the number of 193 symbol payload subblocks transmitted, and N is the number of Unique Words (1 or more) composing the (initial) acquisition sequence.

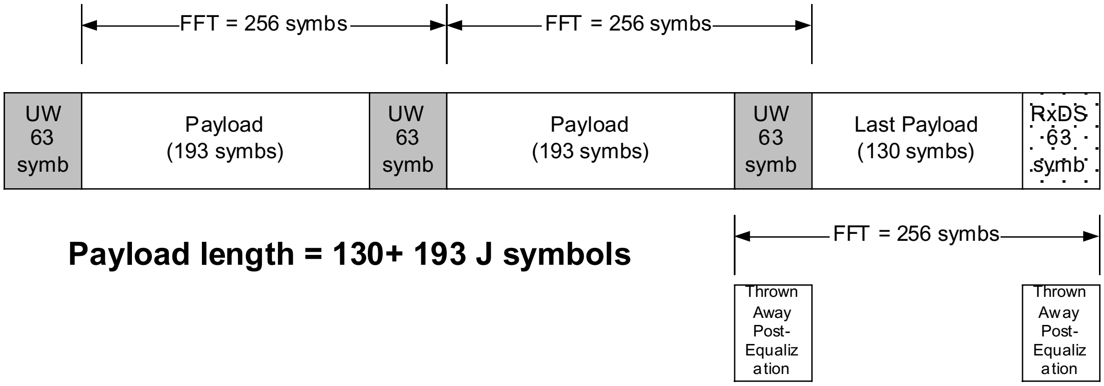

Figure 2: Repetitive UW Patterned Burst with 256 pt UW-aided FFTs and no suffixing UW

Since bursts tend to be short, the channel estimation performed at the beginning of the burst may be sufficient. What s more, overlap FFT processing is possible, so the repetitive UW-pattern may not always be necessary---if one is willing to use more FFTs to process a block. Figure 3 illustrates one example of how overlapping FFTs may be used in an overlap-save processing scheme. Note that the first and last 63 symbols of an FFT are eliminated, post equalization. The payload length restriction in the illustrated case is that the payload must be 130 J symbols long, where J = 0,1,2, Here the transmit efficiency is E = (130 J)/(130 J + 63 N + 63), where J is the number of 130 symbol payload subblocks transmitted, and N is the number of Unique Words (1 or more) composing the (initial) acquisition sequence. Note that by increasing the overlap factor, the payload granularity may be decreased, so that payloads are M J symbols long, where M < 131. For this more general case, E = M J / (M + 63 N + 63).

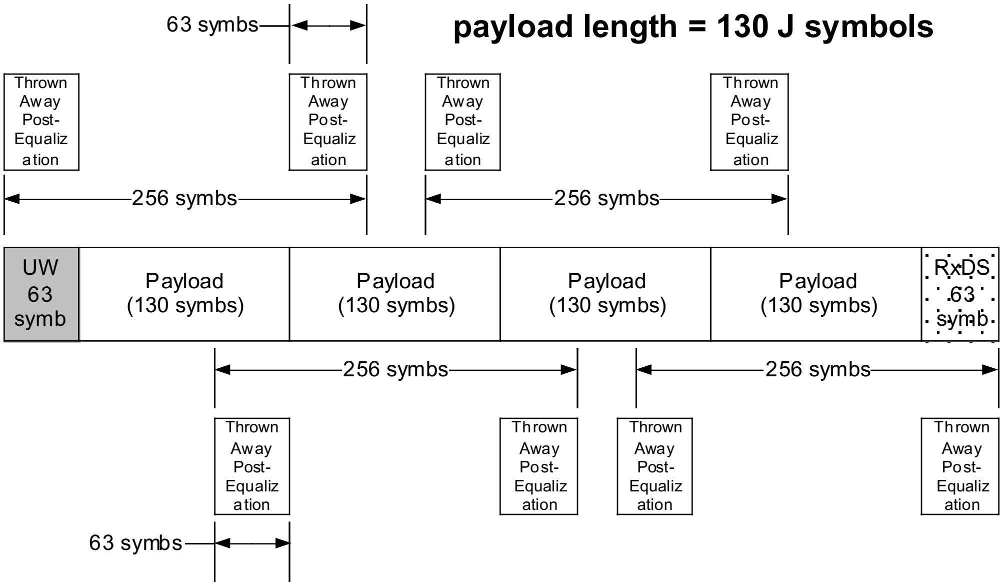

Figure 3: Burst with 256 pt Overlapping FFTs

A variation on the aforesaid technique is to use regularly overlapping FFTs for the main data, and use an extended overlap to cover the last payload subblock, which may be smaller than the preceding payload subblocks. This approach is illustrated in Figure 4. Note that any arbitrary payload larger than 129 symbols can be accommodated with this approach. The transmit efficiency for this case is E = Payload Length/(Payload Length + 63 N + 63), where N is the number of Unique Words (1 or more) composing the (initial) acquisition sequence.

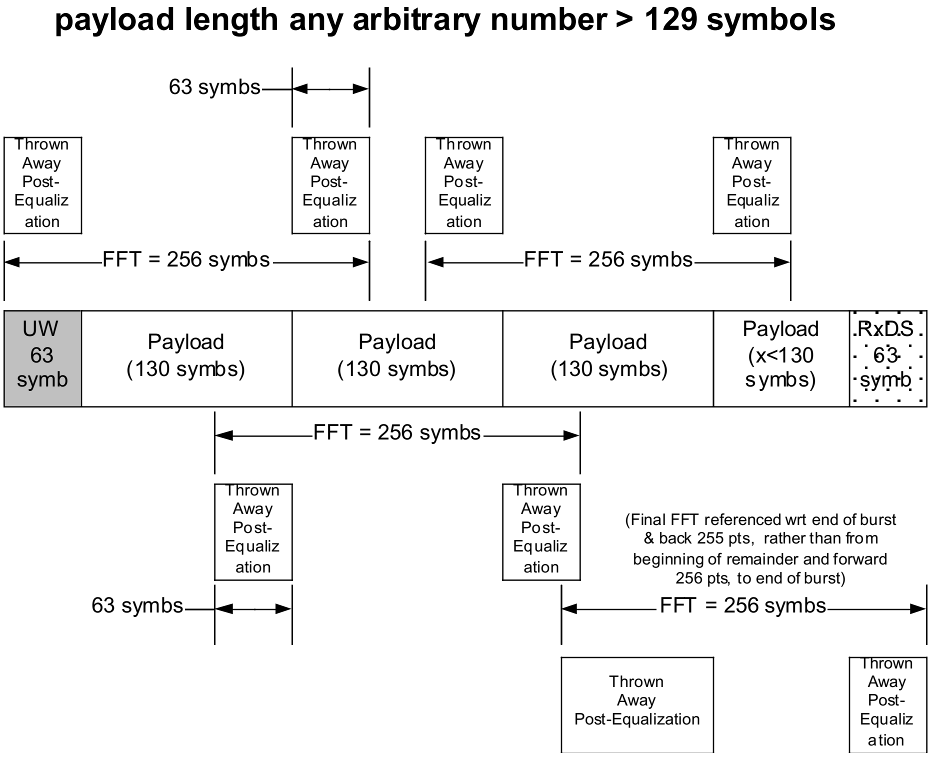

Figure 4: Burst with Overlapping 256 point FFTs, with overlap of last FFT increased.

The technique described in Figure 4 is quite flexible in terms of payload sizes, but it does require the final FFT to back up in further time, to realize a larger overlap. A more regular FFT processing technique, with regular overlaps, might be better. A receiver processing technique that realizes this goal, using the same transmit format as used in Figure 4, is illustrated in Figure 5. Note that with this technique, the receiver insert zeros into the data stream following the RxDS delay spread clearing section, so that the final FFT is a full 256 points long. Mark that the transmitter does not transmit these zero pad symbols. The great advantage is that, with this technique, payloads of <u>any</u> size may be accommodated. Like the technique of Figure 4, the transmit efficiency is E = Payload Length/(Payload Length + 63 N + 63), where N is the number of Unique Words (1 or more) composing the (initial) acquisition sequence. Note that, if addition pilot symbols are needed for channel estimation in long burst, Unique Words could be added to the payload stream of Figure 5, without the requirement that they be utilized within the data FFT processing. They may be still used to estimate the channel, using separate channel estimation processing.

Although not as efficient in terms of yielded data per FFT as the technique of Figure 1, the technique and frame format of Figure 5 is probably the most accepting and flexible in terms of payload sizes and transmit efficiency. Figure 6 illustrates how the technique may be applied to very short bursts, involving one FFT of data. Note that, even in these cases, a single 256 point FFT may be used, and payload sizes of 1 to 130 symbols can be supported, with high transmit efficiencies: E = Payload size/ (Payload size + 63 N + 63). No dummy data need to be added to the payload to fill out a block . This is particularly important for BW request messages, which are only 6 bytes in length, and would be sent with the most robust modulation, rate _ QPSK. Even with a very powerful rate _ Reed-Solomon outer code (N=12 bytes,K=6 bytes,T=3 bytes), and 6 tail symbols to terminate the inner code, the total number of payload symbols required, X = 48 + 48 + 6 = 102 symbols, could be easily accommodated within a single FFT, and transmitted without any payload bit stuffing.

payload length any arbitrary number > 0 symbols

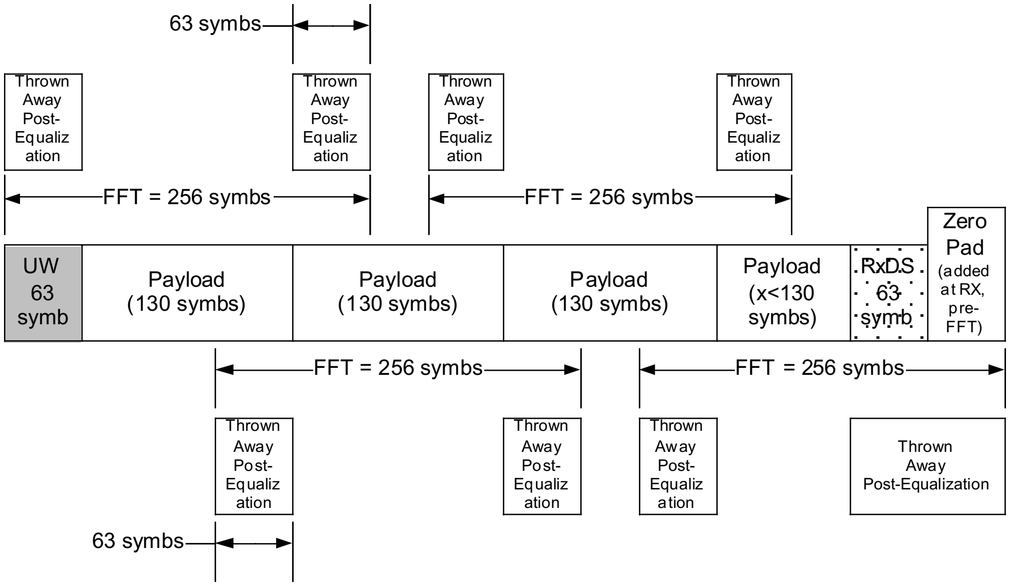

Figure 5 : Burst with Regular Overlapping 256 point FFTs and zero-pad pre-FFT processing at the Receiver

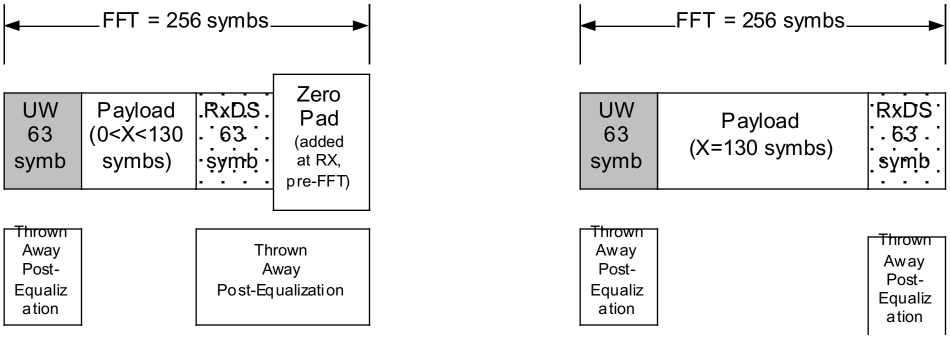

Figure 6: Short burst involving single 256 pt FFT (and zero-pad pre-FFT processing).