Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Changes to IEEE 802.16ab-01/01, Sections 8.3.6.3.3.5 and 8.3.6.4.2.2**
Date Submitted	**03-07-2001**
Source(s)	Shawn Taylor Ron Murias Wi-Lan Inc. 300, 801 Manning Rd., Calgary. AB. T2E 8J5. Voice: (403)207-6491 Fax: (403)273-5100 mailto:shawnt@wi-lan.com;
Re:	
Abstract	Changes suggested in IEEE 802.16ab-01/01, Sections 8.3.6.3.3.5 and 8.3.6.4.2.2.
Purpose	This document is submitted in response for call for comments IEEE 802.16ab-01/02.
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate text contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:r.b.marks@ieee.org> as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

1 Introduction

The following submission proposes a preamble design for the OFDM modes of 802.16a and 802.16b. It borrows some ideas from the HIPERLAN/2 standard and modifies them to suit a FWA system. It is suggested that the following forms the basis for sections 8.3.6.3.3.5 and 8.3.6.4.2.2.

2 PHY bursts

The OFDM mode has 3 types of PHY bursts

1) Downlink burst
2) Uplink burst with short training
3) Uplink burst with no short training

Independently of the burst type each burst consists of two sections: preamble and payload. Each burst is started with a preamble section, $r_{PREAMBLE}$, which is followed by a payload section, $r_{PAYLOAD}$, and its baseband format is

$$r_{BURST}(t) = r_{PREAMBLE}(t) + r_{PAYLOAD}(t - t_{PREAMBLE})$$

The time offset $t_{PREAMBLE}$ determines the starting point of the payload section of the burst and depends on the burst type . The basic structure of a PHY burst is illustrated in figure 1.

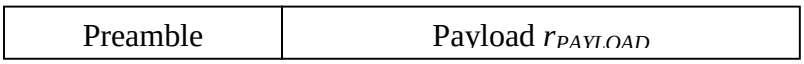

Figure 1: PHY burst format

2.1 Preamble

The preamble field is used for synchronization. It consists of a short training sestion and a long training section.

The short training section consists of either 5 or 10 short symbols. The term "short symbol" refers only to its length that is 16 samples instead of a normal OFDM symbol of 256 samples. The short symbols consist of 12 sub-carriers (±4, ±8, ±12, ±16, ±20, and ±24), which are modulated by the elements of the sequence SB given by

$SB_{-26...26} = \sqrt{(13/6)}*\{0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, -1-j, 0, 0, 0, 1+j, 0, 0, 0, \mathbf{0}, 0, 0, 0, -1-j, 0, 0, 0, -1-j, 0, 0, 0, 1+j, 0, 0, 0, 1+j, 0, 0, 0, 1+j, 0, 0, 0, 1+j, 0, 0\}$

The first 4 short symbols are generated directly by applying a 64-point inverse Discrete Fourier transform to sequence SB. The last short symbol is then repeated to give 5 short symbols. In the same manner a group of 10 short symbols can also be created. The last short symbol in both cases is a sign-inverted repetition of the previous short time-domain symbol B, i.e. IB=-B.

The long training section of the preamble consists of two OFDM symbols (C) of normal length preceded by a cyclic repetition (CP) of the symbols. All the 200 sub-carriers are in use and they are modulated by the elements of the sequence SC given by

$SC_{-100...100} = \{1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, \mathbf{0}, 1, -1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, -1, 1, 1, 1, 1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, -1, 1, 1, 1, 1\}$

The cyclic repetition CP is a copy of the 64 (note: we should look at this number) last samples of the C symbols.

It should be noted that no real-time IFFT or IDFT is required to generate the preamble symbols but any implementation may be used. Further, in practical implementations an approximate value of the normalization factor may be used, as long as the device conforms to the general transmitter and receiver performance requirements specified in this document.

2.2 Downlink burst

Downlink burst consists of a preamble with 10 short training symbols and 2 long training symbols. Structure of the downlink burst preamble is illustrated in figure 2. These bursts are used for all downlink transmissions.

Note: Depending on the length of the downlink burst, midambles could also be added. The midamble would consist of a long training symbol placed between OFDM data symbols.

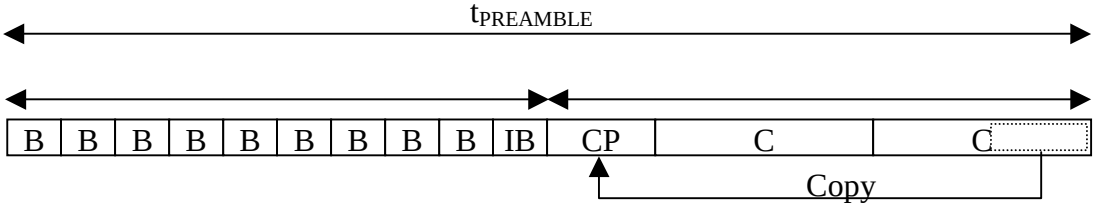

Figure 2: Preamble for downlink bursts.

2.3 Uplink burst with short training symbols

It consists of a preamble with 5 short training symbols and 2 long training symbols. Structure of the short preamble for uplink bursts is illustrated in figure 3. These bursts are used by an SU during uplink contention slots when the power and frequency settings are not yet determined and the arrival ambiguity is high.

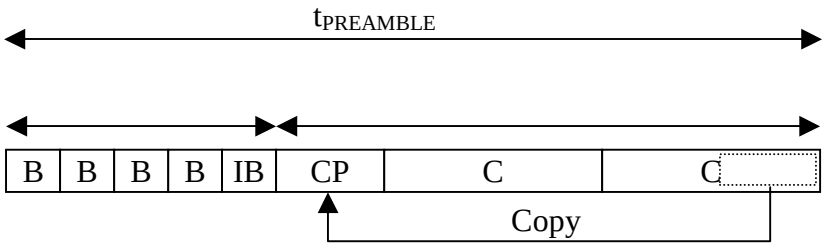

Figure 3: Preamble for uplink bursts with short training.

2.4 Uplink burst with no short training symbols

It consists of a preamble with 2 long training symbols. Structure of the preamble for uplink bursts is illustrated in figure 4. These bursts are used during regular uplink transmissions where the base station and subscriber unit have already determined appropriate power and frequency settings and the arrival ambiguity is low.

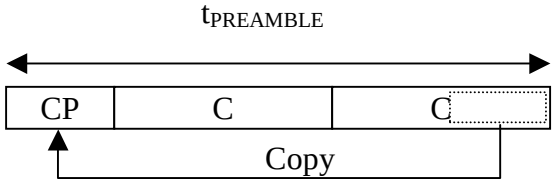

Figure 4: Preamble for uplink bursts with no short training.