IEEE P802.11
Wireless LANs

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Cc: **Mr. Jamshid Khun-Jush, Chairman, BRAN PHY Working Group**
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Enclosures: Draft Standard P802.11a/D5.3
doc802.11-99/42r1
doc802.11-99/124

Subject: **An update on 802.11 OFDM PHY status**

Dear BRAN and MMAC officers and members,

We would like to bring you an update on the status of the 802.11a physical layer and on the changes which were incorporated during the March and May 1999 meetings. Some of the changes made reflect proposals brought by BRAN and MMAC members. In the following we shall list the changes and the rationale to those. We hope that after studying the rationale you will adopt the changes and by that we shall maintain and enhance the alignment of the physical layers of our projects.

1) Following a request from MMAC, we increased the duration of the short training sequence to ten repetitions of the short sequence, bringing it to 8 microseconds. This makes the duration a multiple of 4 microseconds, which eases MAC design. Another benefit is that it gives more time for antenna selection, if antenna diversity is implemented.

2) We adopted a proposal by BRAN to change the subcarrier phases of the short training sequence ($S_{-26,26}$ in our notation) to values suggested by BRAN. The new short training sequence has better peak-to-average-power-ratio properties and better dynamic range than the previous 802.11a short training sequence. On the other hand, we declined, after lengthy discussion, BRAN's proposal to invert the polarity of the last repetition of the short training sequence (t10 in our notation). The main reason is that relying on the detection of this phase reversal in order to detect the transition from short to long training sequences demands, in the case of selection antenna diversity, to make the decision on the preferred antenna some 3 microseconds earlier. This hardly leaves time for detecting signal's presence and comparing both antennae. The discussion we conducted on this issue is captured in an attached document 99/124. We hope that after studying the rationale for our decision, you will adopt our approach of not inverting the last short subsequence.

3) We accepted BRAN's proposal to state in the standard that the symbol clock and the carrier frequency shall be derived from same reference oscillator. This is a natural design choice for a portable equipment, and it improves the performance and reduces the complexity of the carrier tracking loop.

4) Following a comment from MMAC, we added scrambling to the pilot subcarriers. Prior to this change the constant phases of the pilot subcarriers caused the pilots to degenerate into a CW spectral lines. This might cause regulatory problems – for example, documents on sharing the 5.15-5.25 GHz band with the MSS uplink mention measurements performed in 4 KHz bandwidth, causing a significant increase in the measured spectral density. To remedy for that, we decided to rotate the phases of the subcarriers in a pseudorandom manner. We decided to rotate all the 4 pilots in each OFDM symbol by the same phase, derived from a 127 bit long fixed pseudorandom sequence. This solution has two benefits – it preserves the low peak-to-average-power-ratio property of the pilot pattern, and it eases the receiver implementation, since the descrambling needs to be implemented on a per-symbol rather than on a per-pilot basis. We hope that you will agree with and adopt this solution.

5) We changed the permutation used in the interleaver to a different one. The new interleaver permutation is formed by a two step procedure. The first step remains same, and its purpose is to place adjacent coded bits in nonadjacent subcarriers. The second permutation reorders the bits within each subcarrier to ensure that there are no long runs of coded bits mapped onto least significant bits in the constellation. The second stage was added after showing that it provides some advantage with 16QAM and a significant advantage with 64QAM constellations, especially in multipath conditions. Further data supporting this decision is found in document 99/47r1. Please note that the text describing this change was incorrect in drafts 4.0 and 5.0 and was corrected in Draft 5.3.

6) We rotated the points of the BPSK constellation to lie along the "I" quadrature axis. This change does not affect performance, but simplifies the implementation in the receiver. This change applies also to the subcarriers of the long training sequence, which are derived from the BPSK set.

7) Few 802.11-specific changes were made – we increased the SIFS (short inter-frame space) to be 16 microseconds and the Slot Time to 9 microseconds for ease of implementation. We changed the location of the RATE bit-field within the SIGNAL field so that it will become available to the receiver earlier.

We would like to take this opportunity to thank the BRAN and MMAC members for their participation in the March and May 1999 meetings and their contributions, which enabled us to improve our draft standard. You will find all these changes incorporated in the draft standard 802.11a/D5.3, which is enclosed. We will be glad to receive your comments as a part of our recirculation ballot.

A concern was expressed during May 1999 meeting about the IP implications of the changes introduced. We are not aware of any IP related to those specific changes.

The 802.11a is currently in a Sponsor Ballot phase. We have processed most of the comments during the May 1999 meeting, and we shall process the remaining issues before end of May. In June we intend to send the updated Draft to a Recirculation Sponsor Ballot.

Sincerely,

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