IEEE 802.11
Wireless Access Method and Physical Specification

Title: **Proposal for Scrambling in the FH PHY**

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MOTION: Adopt frame synchronous scrambling in the FH PHY packet formatting prior to the bias suppression encoding.

Argument in Favor of Motion

In real life applications, data generated and sent in a packet may have long strings of ones or zeros. If some form of data randomization is not used prior to transmission in an 802.11 network, these long strings of ones or zeros will adversely affect the wireless system. In FH radios, these long strings will degrade the performance of transition based carrier sense. Carrier sense is difficult without transitions, especially distinguishing it from CW or other interference. In DS radios, long strings will increase the peak spectral density measurements. DS radios are therefore required to scramble the data prior to transmission.

Degraded performance with a data pattern that may occur more often than others is not a desirable feature of a system. We also cannot restrict the type of data that can be passed from the LLC to the MAC. Unless some form of randomization is used, these low transition patterns will be transmitted resulting in increased probability of collision.

Data randomization could be effectively accomplished by either compression, encryption, or scrambling. Compression is not being considered at the 802.11 level. Encryption is most likely going to be provided by an optional 802.10 layer above the MAC. Therefore, some PHY

level scrambling is desirable to maintain a high reliability carrier sense.

The cost of scrambling is low, e.g., using a frame synchronous scrambler requires a simple PRN generator and an exclusive OR which can be used for both transmit and receive. There is also no overhead on data rate with scrambling. The probability of a data pattern matching up to a given PRN sequence in both pattern and phase is very low; one bit off in phase of the sequence is sufficient to result in effectively uncorrelated patterns. This correlation does occur occasionally, but the resulting probability of long strings are the same as that occurring in pure random data. The analysis and reasoning behind the bias suppression algorithm was based on random data input to the encoding algorithm.

There are two types of scramblers which are commonly used: self-synchronous and frame synchronous. Self-synchronous is typically used in connection oriented communication where it is necessary to be able to resynchronize quickly. This feature is not necessary in connectionless, packet based communication systems, especially when error correction is not used. In addition, the self-synchronous scrambler suffers from error multiplication whereas the frame synchronous does not. Therefore, frame synchronous scramblers are much better suited to our application.

In the order of processing, the bias suppression encoding algorithm must be the last step of the transmit state machine. Thus, the scrambling must be done prior to the bias suppression encoding.