IEEE P802.11
Wireless LANs

TGa Preamble Improvent Proposal

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Abstract

In this submission we consider a modification to the proposed preamble structure as presented in the standard draft. The proposal affects both the channel estimation section and the short sequences in the Frequency estimation section.

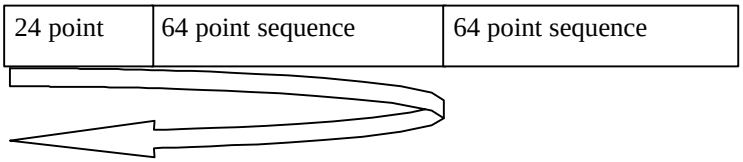
Channel estimation section

The channel estimation section is composed of two long sequences, similar in structure to the OFDM Data symbol. The structure of the channel estimation section is given in figure 1.

Figure 1.

The GI is a 12 point cyclic extension. The overall length is 2*(12+64)=152.

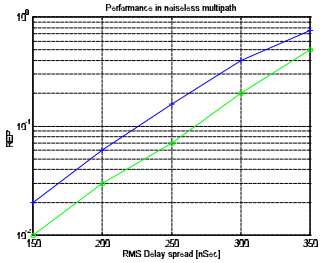
We propose the following structure



The length of the section is 24+2*64=152 points, same as before.

The main advantage of the proposed structure is that the effective guard interval is now effectively doubled, without increasing the preamble length. As a consequence, the immunity of the channel estimation against longer channel is greatly improved. The estimation process can be performed as before, by averaging the two 64 point sequences and performing an inverse fourier transform.

To demonstrate the improvement, we simulated the performance of the QAM16 rate=1/2 scheme under noiseless multipath conditions. The results are shown in figure 3.



Legend: blue cross: old sequence
green circle: new sequence

Figure 3.

It can observed that an improvement of about 40nSec (20%) in delay spread immunity is achieved.

Short preamble sequences

The short preamble sequences are defined first 16 points of the IFFT of the predefined 64 point sequence given by

S={. . . 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 –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 . . . }. (1)

The boldface zero marks the location of the zero frequency.
The non zero elements of *S* are on a *4*n+2* grid (n=0,1,2…). The IFFT of *S* therefore cannot be decomposed into 4 equal 16 points subsequences, and therefore 4 short preamble sequences cannot be simply constructed with a 64 point IFFT operation. The concatenation of 4 equal subsequences has a spectrum different from the original spectral lines – the new sequence has its lines on a *4*n* grid, it has a nonzero DC term and it has energy out of the desired 49 spectral lines. The fact that the 16 points subsections have *non zero DC element* causes the DC leakage of the transmitter to be coupled into frequency estimation process.

We propose using the sequence *B* given by

B={…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 **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 …}. (2)

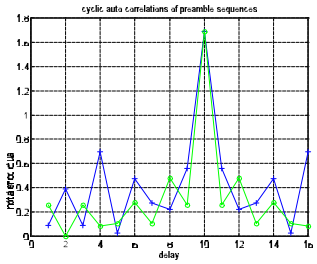
The non zero elements of B are on the *4*n* grid and the 4 short sequences can be produced with one 64 point IFFT. Furthermore the 16 point sequnce are of zero DC bias.

An additional advantage is the the 16 point FFT of the short sequence is composed of elements of the form +/-1 +/-j This allows signal processing operations using a 16 point FFT to be performed in the receiver.

Next we compare the key features of the sequences

	Standard draft	Proposal
AC coupled power / DC coupled power	-0.62 dB	0 dB
Peak level / RMS power	1.4	1.32

The cyclic autocorrelation of the sequences is compared in figure 4.



Legend: blue cross - standard sequence. Green circle- proposal

Figure 4

Summary

Two modifications to the TGa preamble were proposed - deleting an extra guard interval in the channel estimation section and shifting the frequencies in the frequency estimation section. Both changes incur no overhead, improve performance and therefore we move to accept it in 802.11a.