Proposal for an improved long training symbol phase

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A comment on the long training symbol phase

Clause number; 17.3.3 PLCP preamble (SYNC)

Comment;
The phase relation between short preamble (t1-t10) and long preamble (T1,T2) in draft 5.0 causes degradation in timing detection accuracy. This is because the matched filter output for detecting the short preamble pattern has large side-lobe in boundary region between t10 and T1 when the phase relation in D5.0 is used. This large side-lobe badly affects the timing decision value when multi-path delayed signals are superimposed.
A symbol timing detection scheme

- Received training signal
- Matched filter output
- Matched filter
- Digital filter
- Symbol timing decision
- Detected symbol timing
- Remove cyclic extension

An effect of the long training symbol phase

- Short sequence
- Long sequence
- Draft 3.0
- Draft 5.0

- The Matched filter output of this region depends on relative phase between short and long preamble symbol
- A computer search is carried out to find the phase relation that generates low correlation side-lobe
The low sidelobe is obtained by the proposed long preamble phase.

Influence of the high correlation side-lobe on timing detection accuracy.

Matched filter output for direct path signal
- Disappearance of correlation peak signal

Matched filter output for delayed signal
- Large correlation side-lobe degrades symbol timing detection accuracy
PER performance in multipath propagation with AWGN

Packet error rate versus $E_b/N_0$

(a) Delay spread = 100ns
(b) Delay spread = 150ns

Conclusions

- A search was carried out to find the long preamble phase that gives low correlation side-lobe.
- Recommendation:
  Change Eq.(8) so as to rotate the all signal phase $(3/4)\pi$
  
  \[ L_{26,26} = [-1+j, -1+j, +1-j, +1-j, -1+j, -1+j, +1-j, +1-j, \ldots, -1+j, -1+j] / \sqrt{2.0} \]

- By only changing the preamble phase, the irreducible packet error is improved to less than 1/3 that of Draft 5.0