IEEE P802.22 Wireless RANs

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| Errata – 802.22 base std, LTS and STS |
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Abstract

In our work to create test vectors and testing an implementation for compliance to the base 802.22 standard, it was discovered that the intended operation of normalization is broken by an erroneous mathematical expression describing both the STS and LTS.

Also, the lower and upper halves of the spectrum are inverted (confirmed on the spectrum analyser) in a mathematical expression describing the LTS due to an erroneous swap of indices 115 and 536.

***Proposed corrections to sub-clauses 9.4.1.1.1 and 9.4.1.1.2
 of the IEEE Std 802.22TM- 2011***

Generation of STS

[Change all occurrences of the normalization factor SQRT(NT/420) for SQRT(1680/NT)

Generation of LTS

First, a periodic sequence with a period of 1024 is generated using a pseudo-noise (PN) sequence generator with a polynomial of. 1275HFigure 1 depicts an implementation of this PN sequence generator using a Linear Feedback Shift Register.



1. — Structure of a Linear Feedback Shift Register implementation
for the given LTS polynomial

The LTS sequence generator is initialized to a value of 11 1111 1111. The resultant  sequence of 1023 samples (using BPSK mapping) is given as follows:

 = {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}

Second, define $S\_{115}\left(0:419\right)=P\_{REF}^{LT}\left(115:534\right)$and $S\_{536}\left(0:419\right)=P\_{REF}^{LT}\left(536:955\right)$ respectively. The first 420 binary values of these sequences are as follows:

S115(0:419) = {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}, and

S536(0:419) = {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}, and

For illustration only, consider that after resetting the LTS generator, the pair of sequences { S115, S536,} can be represented in Hexadecimal format where the elements with amplitude value of –1 are mapped to bit0 (bit zero) and the elements with value of +1 are mapped to bit1 (bit one). These sequences can therefore be represented in hex format (bit ordering from left to right) as follows:

{S115hex}= A877F40C94889D20B91E7FB49616CB714A17845A62EE00A795947CC27EFBBD3E32F5B7E0FE2607056F6669D872C8A0376E8ED764F

{S536hex}= F1C4677539900F45F5E42A3418663A12B8F6C1081350487D8D55D344BACF02CD9C9BCD68C4932A67D2AC0473878B1F970A2A938DF

The coefficients of the 2048 frequency elements to be presented at the input of the inverse DFT are then formed from the above two sequences using the following equation where *NT* represents the number of used subcarriers:

 $P\_{LT}\left(k\right)=\left\{\begin{matrix}\sqrt{\frac{N\_{T}}{840}}S\_{536}\left(\frac{k+840}{2}\right),-840\leq k\leq -2,kmod2=0\\\sqrt{\frac{N\_{T}}{840}}S\_{115}\left(\frac{k-2}{2}\right),2\leq k\leq 840,kmod2=0\\0,otherwise\end{matrix}\right.$[ Swap indices 536 and 115.] (3)

and results in the long training (LT) sequence as shown below:

PLT (–1024:–841) = {0, 0, 0, 0, 0, …, 0, 0, 0, 0, 0}

PLT (–840:–1) =  {1, 0, –1, 0, 1, 0, –1, 0, 1, 0, –1, 0, –1, 0, –1, 0, –1, 0, 1, 0, …, 1, 0, –1, 0, –1, 0, 1, 0, –1, 0, –1, 0, 1, 0, 1, 0, 1, 0, 1, 0}

PLT(0) = 0

PLT(1:840) =  {0, 1, 0, 1, 0, 1, 0, 1, 0, –1, 0, –1, 0, –1, 0, 1, 0, 1, 0, …, 0, –1, 0, –1, 0, 1, 0, 1, 0, –1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1}

PLT (841:1023) = {0, 0, 0, 0, 0, …, 0, 0, 0, 0, 0}

Taking the inverse DFT of PLT will result in 2 repetitions of a 1024-sample vector in the time domain. The factor  is used to normalize the signal energy, where *NT* represents the number of used subcarriers.

[Change all occurrences of the normalization factor SQRT(NT/840) for SQRT(1680/NT)