IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proposed Draft Text: Phase Noise per 160 MHz | | | | |
| Date: 2021-01-25 | | | | |
| Au-thor(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Brian Hart | Cisco Systems |  |  | brianh@cisco.com |
| Wook Bong Lee | Samsung |  |  |  |
| Srinivas Kandala | Samsung |  |  |  |
| Sigurd Schelstraete | ON Semiconductor |  |  |  |
| Shimi Shilo | Huawei |  |  |  |
| Ross Jian Yu | Huawei |  |  |  |

Abstract

This submission shows

* Reporting the potential existence of uncorrelated phase noise between 160MHz segments

Baseline is D0.3

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Added new figures, updated author name in footer
* Rev 2: Modified proposal to reuse the related VHT/HE language
* Rev 3: Modified note and added explicit TX EVM text

**Discussion**

Consider two EHT implementations that support 8SS \* 320 MHz

1. An implementation that only supports 8SS \* 320MHz via 8 converter pairs (for a 320MHz passband) and one PLL generating a single RF LO
2. An implementation that supports two modes of operation; either:
3. 16SS \* 160MHz via 16 converter pairs (for a 160MHz passband) and one PLL generating a single RF LO, and
4. 8SS \* 320MHz via 16 converter pairs (for a 160MHz passband) and two PLLs generating two RF LOs nominally separated by 160MHz that are used to mix two 160 MHz frequency portions to adjacent RF spectrum anda thereby create a composite signal of 320 MHz nominal bandwifth.

Both PLLs must be locked to the same oscillator so are subject to the same ppm offset. This same oscillator also drives the DAC clock.

Sidebar:

* In implementation A, because of the DAC clock, the separation between tones nominally at ±80MHz is actually 160 \* (1 + ppm) and the width of the transmission is 320MHz \* (1+ppm).
* In implementation B.2, because the PLLs produce (fc±80MHz) \* (1+ppm), then the separation between the two center frequencies is again 160MHz \* (1 + ppm), and the width of the composite transmission is 160MHz \* (1+ppm) + 160MHz \* (1+ppm) = 320MHz \* (1+ppm) again.

Much the same ideas can be expressed in more detail by way of two figures and some embedded math:





For both architectures, it is observed that the 5 identified frequency points (at the end of each figure) map to identical RF frequencies, and there is no additional carrier offset between the two frequency portions in Implementation B.2. In the absence of phase noise between the two RF LOs, implementations A and B.2 have identical outputs.

Take-away

For a receiver to support a transmitter that implements 320 MHz via two 160MHz frequency portions each with its own DAC pair and PLL/RF LO locked to the same oscillator, the receiver can use a single time-domain carrier frequency offset corrector, a single FFT, yet independent CPE/STO estimation per 160MHz frequency portion (i.e. two pilot estimation units).

This is equivalent to the requirements on 80+80MHz in VHT and HE; and such transmitter implementation flexibility should be retained in EHT.

***TGbe editor: please change the following text as indicated by Word track changes***

36.3.18.4.4 Transmitter modulation accuracy (EVM) tes

The transmitter modulation accuracy test procedure for the occupied subcarriers of the PPDU is similar as in steps of the transmit modulation accuracy test procedure defined in 27.3.19.4.4 (Transmitter modulation accuracy (EVM) test) as follows.

a) Start of PPDU shall be detected.

b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be derotated according to a single estimated frequency offset. Sampling offset drift shall be also compensated.

e) For each EHT-LTF symbol, transform the symbol into subcarrier received values, estimate a single common phase error (CPE) and a single symbol timing offset (STO)~~the phase~~ from the pilot subcarriers, and derotate the subcarrier values according to the two estimated parameters.

f) Estimate the complex channel response coefficient for each of the subcarriers and each of the transmit streams.

g) For each of the data OFDM symbols, transform the symbol into subcarrier received values, estimate a single CPE and a single STO~~the phase~~ from the pilot subcarriers, and compensate the subcarrier values according to the two estimated parameters, group the results from all of the receiver chains in each subcarrier to a vector, and multiply the vector by a zero-forcing equalization matrix generated from the estimated channel.

***TGbe editor: please change the following text as indicated by Word track changes including changing the remaining red text to black***

36.3.18.3 Transmit center frequency and symbol clock frequency tolerance

Transmit signals with TXVECTOR parameter CH\_BANDWIDTH set to CBW320 may be generated using two separate RF local oscillators, one for each of the lower and upper 160 MHz frequency portions.

NOTE—Although constrained by the requirements in 36.3.18.4 (Modulation accuracy), the signal phase of the two 160 MHz frequency portions might not be entirely correlated.