Transmit Modulation Accuracy

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Considered degradation factors at transmitter

Transmitter

- Quadrature phase error
- Quadrature amplitude imbalance
- Quantization error
- Phase noise
- Non-linear distortion
Considered degradation factors at receiver

- Quadrature phase error
- Quadrature amplitude unbalance
- Quantization error
- Phase noise
- A/D
- IQ-det
- LNA
- Remove GI
- APC Clock recovery
- FFT
- Demapping
- P/S
- FEC Decoder
- AFC Clock recovery

Receiver

C/N degradation with degradation factor (16QAM-OFDM Information data rate = 24 Mbit/s, Coding rate = 1/2)

Packet length = 1000 byte

- OBO = 3.7 dB (C.E. = -16.2 dB)
- QPE = 3° (C.E. = -31.4 dB)
- A/D resolution = 8 bit (-34.4 dB)
- IFFT word length = 8 bit (-40.9 dB)
- Phase noise = -23 dB (-37.7 dB)
- Rx A/D resolution = 8 bit (-34.4 dB)
- D/A resolution = 8 bit (-37.7 dB)
- (corner freq. = 5 kHz)

- QPE = 3° (corner freq. = 5 kHz)
- OBO = 0.5 dB
- A/D resolution = 8 bit
- FFT word length = 8 bit
- Soft decision = 6 bit
- Phase noise = -23 dB
- QAU = 0.5 dB
- Rx A/D resolution = 8 bit
- D/A resolution = 8 bit
- (corner freq. = 5 kHz)

C/N degradation versus Constellation error

- OBO = 3.7 dB (C.E. = -16.2 dB)
- QPE = 3° (C.E. = -31.4 dB)
- QAU = 0.5 dB
- QAU = 0.5 dB
C/N degradation with degradation factor

(16QAM-OFDM Information data rate = 36 Mbit/s, Coding rate = 3/4)

QPE  = Quadrature phase error
QAU = Quadrature amplitude unbalance

* QPE = 3°
QAU = 0.5 dB

Allowed Relative Constellation Error versus Data Rate

<table>
<thead>
<tr>
<th>Data Rate</th>
<th>Relative Constellation Error</th>
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</thead>
<tbody>
<tr>
<td>24 Mbit/s</td>
<td>-16 dB</td>
</tr>
<tr>
<td>36 Mbit/s</td>
<td>-20 dB</td>
</tr>
</tbody>
</table>

Conclusion

Proposed transmitter constellation error is shown below.
Resolution bandwidth = 305 Hz (24.8 dB)

Phase noise within corner frequency
= -48.4 - 24.8 = -73.2 (dBc/Hz)

Example of phase noise spectrum
at $\phi_{\text{rms}} = -20$ dB and $F_c = 50$ kHz

Phase noise model
$$\exp\left(\frac{\phi}{\phi_{\text{rms}}}ight) = \exp\left(\frac{\phi_{\text{rms}}}{\phi_{\text{rms}}}ight)$$

- Corner frequency (50 kHz)
- Noise-to-carrier ratio = -48.4 (dBc)

Power (dB) vs. Frequency (Hz)

Phase noise level versus Phase variance

Corner freq. = 5 kHz

Phase noise level (dBc/Hz)

$\phi_{\text{rms}}$ (dB)

Triangle frequency multiplication of phase noise in 1.6GHz PLL (catalog)

Phase noise level versus Phase variance

$\phi_{\text{rms}}$ (dB)