

DFT spreading OFDM options for 11ah PHY enhancement

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Abstract

- **This presentation proposes DFT spreading OFDM options for 11ah PHY enhancement.**

Overview

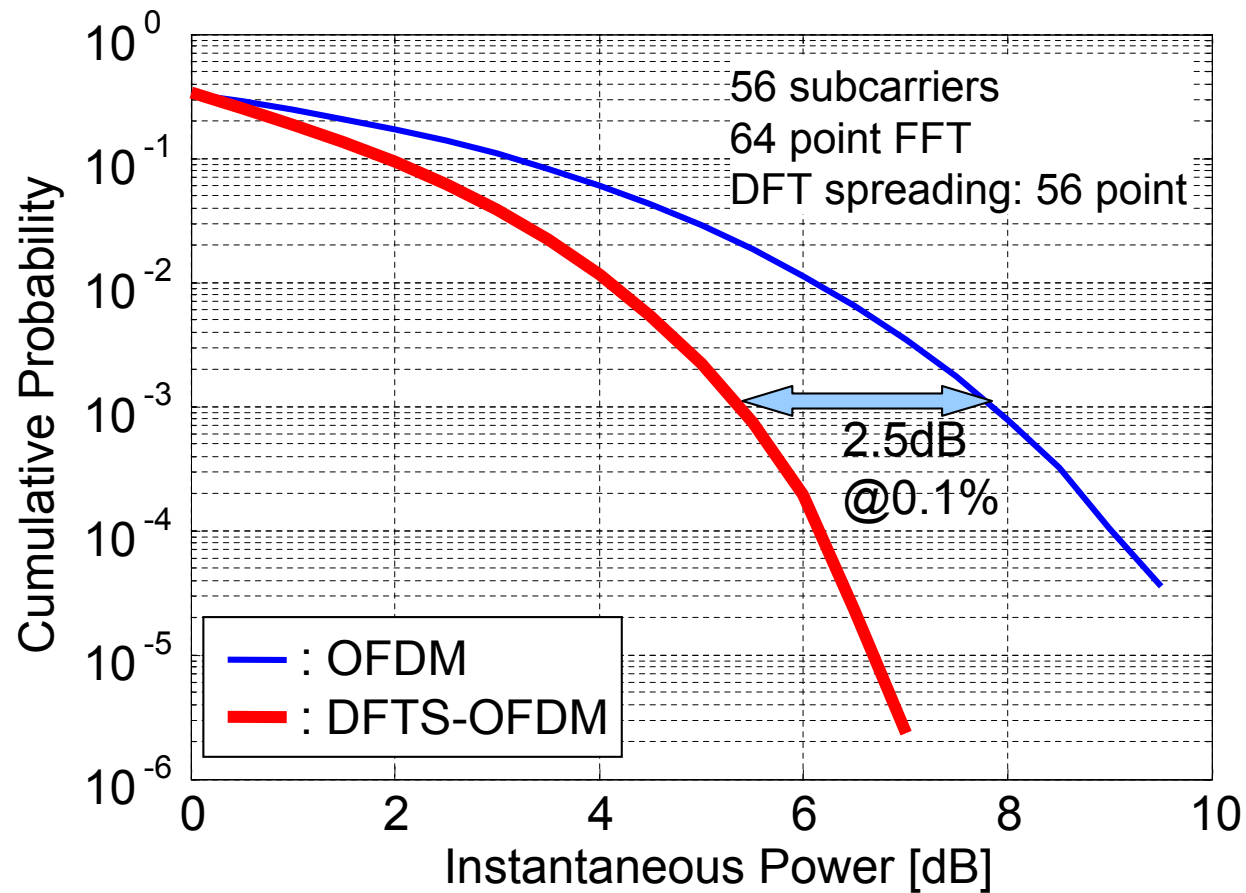
- **TGah decided to support 2/4/8/16MHz signals based on the down clocked versions of 11ac 20/40/80/160 MHz, and an 1MHz signal based on 32FFT.**
 - Both 2MHz and 1MHz receptions are mandatory in TGah PHY.
- **DFT spreading OFDM (DFTS-OFDM) is adopted for the uplink in IMT-2000 LTE, and the concept of DFTS-OFDM was presented in IEEE 802.11-11/0753r0.**
- **We propose DFTS-OFDM options for 11ah PHY enhancement for 1MHz and 2MHz signals, especially for the purpose of sensor applications in this presentation.**
 - Advantage of DFT-spreading OFDM
 - Proposal of DFT spreading OFDM option.

Why DFTS-OFDM ?

- **Battery driven wireless terminals are used for sensor network applications**
- **Basic Requirements for the use cases of 1a/1f and 2d/2e/2f**
 - Relatively low transmission speed
 - Long battery life time
 - Reduced power consumption at wireless sensor terminals
 - **Higher efficiency at HPA, i.e. low output power back-off operation**
- **Computer simulation results on PAPR, Power spectrum after HPA and BER are shown in the following slides.**
 - 56 points DFT spreading is assumed.

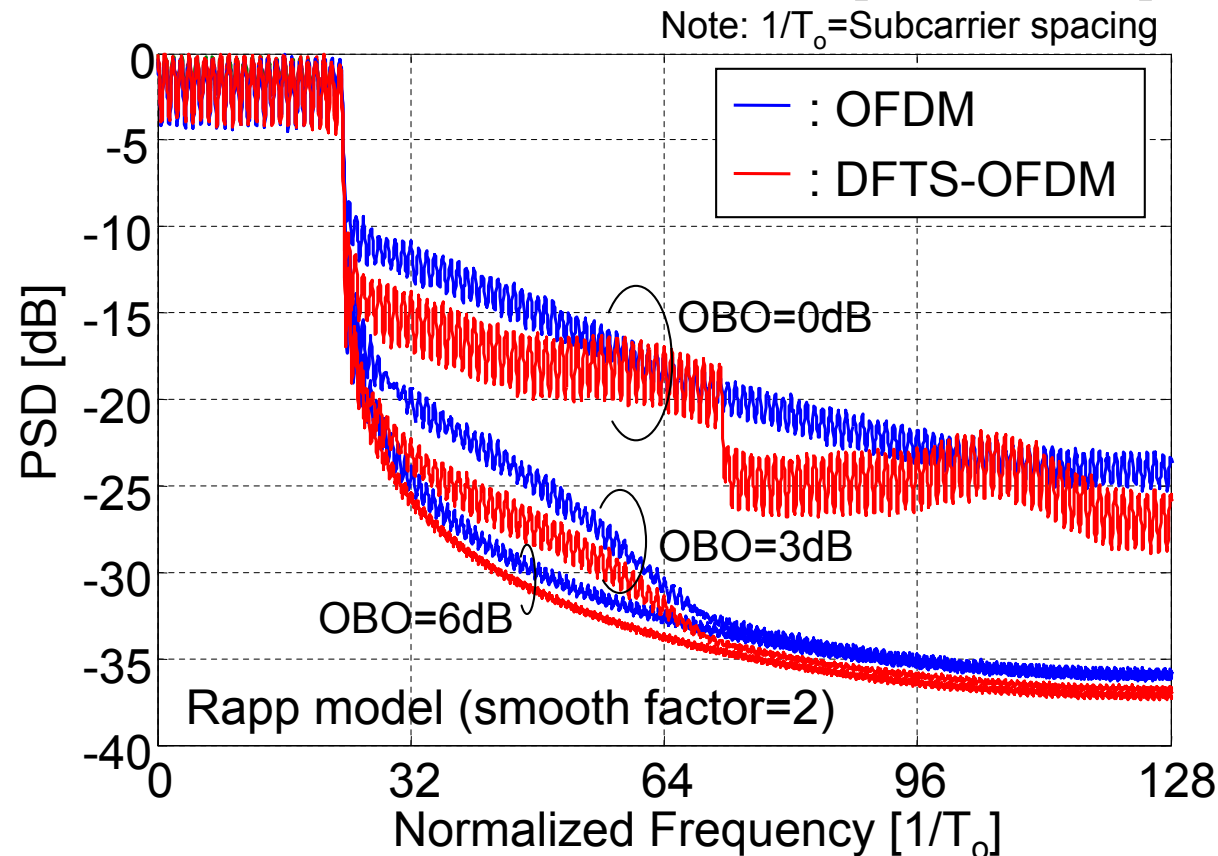
Comparison of PAPR

DFTS-OFDM achieved lower PAPR than OFDM.



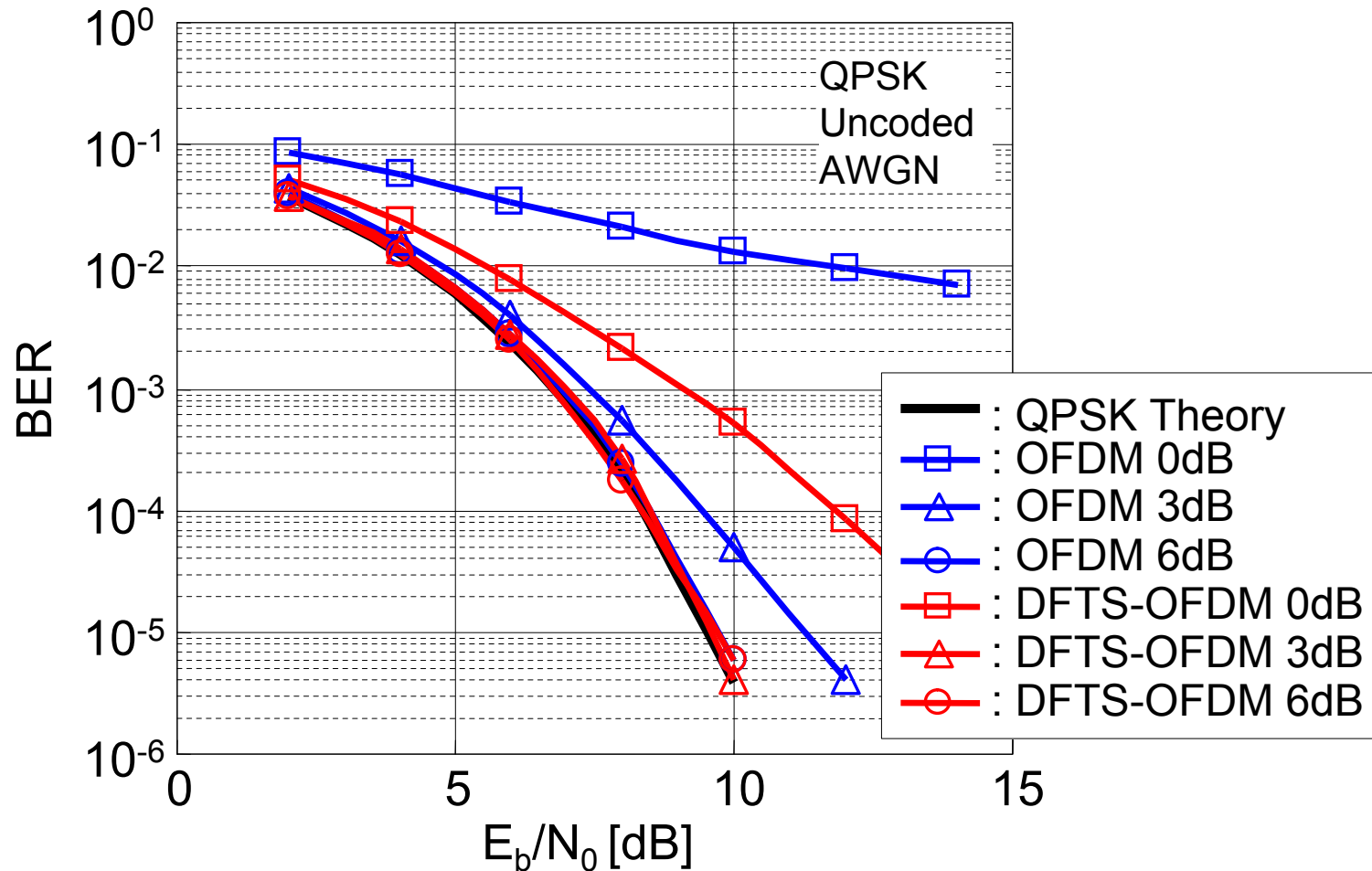
Comparison of output spectrum after HPA

- DFTS-OFDM achieved less ACL (adjacent channel power leakage) when output backoff is small.
- DFTS-OFDM is more suitable for low output backoff operation.



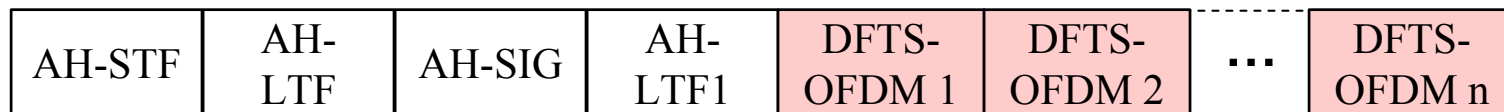
BER performance

- DFTS-OFDM achieved better BER performance, when OBO=0dB-3dB.



Transmission flow for DFTS-OFDM options (1)

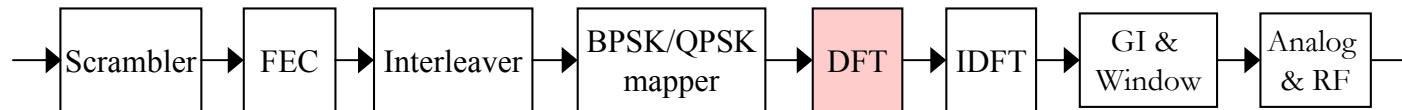
- **DFTS-OMDF options will be useful for 1MH/2MHz BPSK/QPSK signals.**
- **It is desirable not to change the basic signal design and preamble of OFDM signals.**
 - 1MHz (32 FFT)
 - 24 Data tones, 2 Pilot tones, 5 Guard tones, and 1 DC tone
 - 2MHz(64 FFT)
 - 52 Data tones, 4 Pilot tones, 7 Guard tones, and 1 DC tone



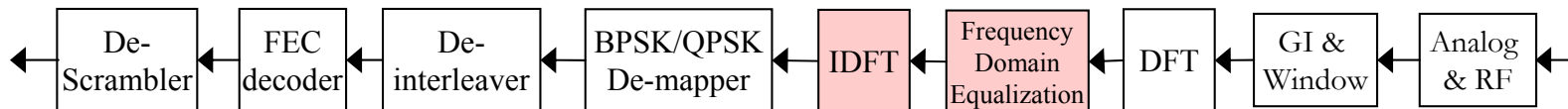
DFT Spreading is applied in the data field only.

Transmission flow for DFTS-OFDM options (2)

: Additional functions for DFTS-OFDM enhancement



(a) Transmission side for DFTS-OFDM enhancement



(b) Reception side for DFTS-OFDM enhancement

- **DFT on the transmission side**
 - 26 or 27 points DFT for 1MHz, 56 or 57 points DFT for 2MHz
- **IDFT and FDE on the reception side**
 - 26 or 27 points IDFT for 1MHz, 56 or 57 points IDFT for 2MHz
 - FDE is performed using CSI

Discussions

- **57 DFT/IDFT is the simplest approach for DFTS-OFDM, however FFT algorithm can not be applied for DFT/IDFT implementation since 57 is not power of two.**
 - It needs large amount of signal processing for DFT/IDFT.
- **56 DFT/IDFT is another simple approach for DFTS-OFDM.**
 - 56 DFT/IDFT needs less amount of signal processing than 57 DFT/IDFT.
 - DC tone is replaced with one data tone.
- **Though 57/56 DFT/IDFT needs large amount of signal processing, it is worth to employ DFTS-OFDM for 1MHz/2MHz signals for sensor network applications where low PAPR is strongly desired.**
 - Direct DFT/IDFT will be possible because of its low symbol rate.
 - Other DFTS-OFDM based approaches can be employed based on the trade-off between PAPR and signal processing.

Straw Poll

- **Do you support DFTS-OFDM based options for 11ah PHY enhancement for its advantage of low PAPR and better BER performance in non-linear HPA operation ?**
 - Applied only for 1MHz/2MHz signals with BPSK/QPSK mode.
 - Needs further considerations on other approaches based on trade-off between PAPR and signal processing.

References

- [1] **011-11-0753-00-00ah-dft-spread-ofdm-optimized-for-802-11ah**
- [2] **11-11-1482-00-00ah-preamble-format-for-1-MHz**
- [3] **11-11-1483-00-00ah-11ah-preamble-for-2MHz-and-beyond**
- [4] **11-11-1484-06-00ah-11ah-phy-transmission-flow**