DFT spreading OFDM options for 11ah PHY enhancement

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Authors:

Name	Affiliations	Address	Phone	email
Masahiro Umehira	Ibaraki Univ.	4-12-1, Nakanarusawa-cho, Hitachi-shi, Japan	+81-294-38-5108	umehira@mx.ibaraki.ac.jp
Ken Mori	Panasonic Corp			Mori.ken1@jp.panasonic.com
Yoshio Urabe	Panasonic Corp.			Urabe.yoshio@jp.panasonic.com
Kazu Takahashi	Panasonic Corp.			Takahashi.kazu@jp.panasonic.com
Raymond Yu Zhan	Panasonic Singapore Labs			Raymond.yuz@sg.panasonic.com
Michael Sim	Panasonic Singapore Labs.			Michael.Simhc@sg.panasonic.com
Rojan Chitrakar	Panasonic Singapore Labs.			Rojan.Chitrakar@sg.panasonic.com

Abstract

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

Overview

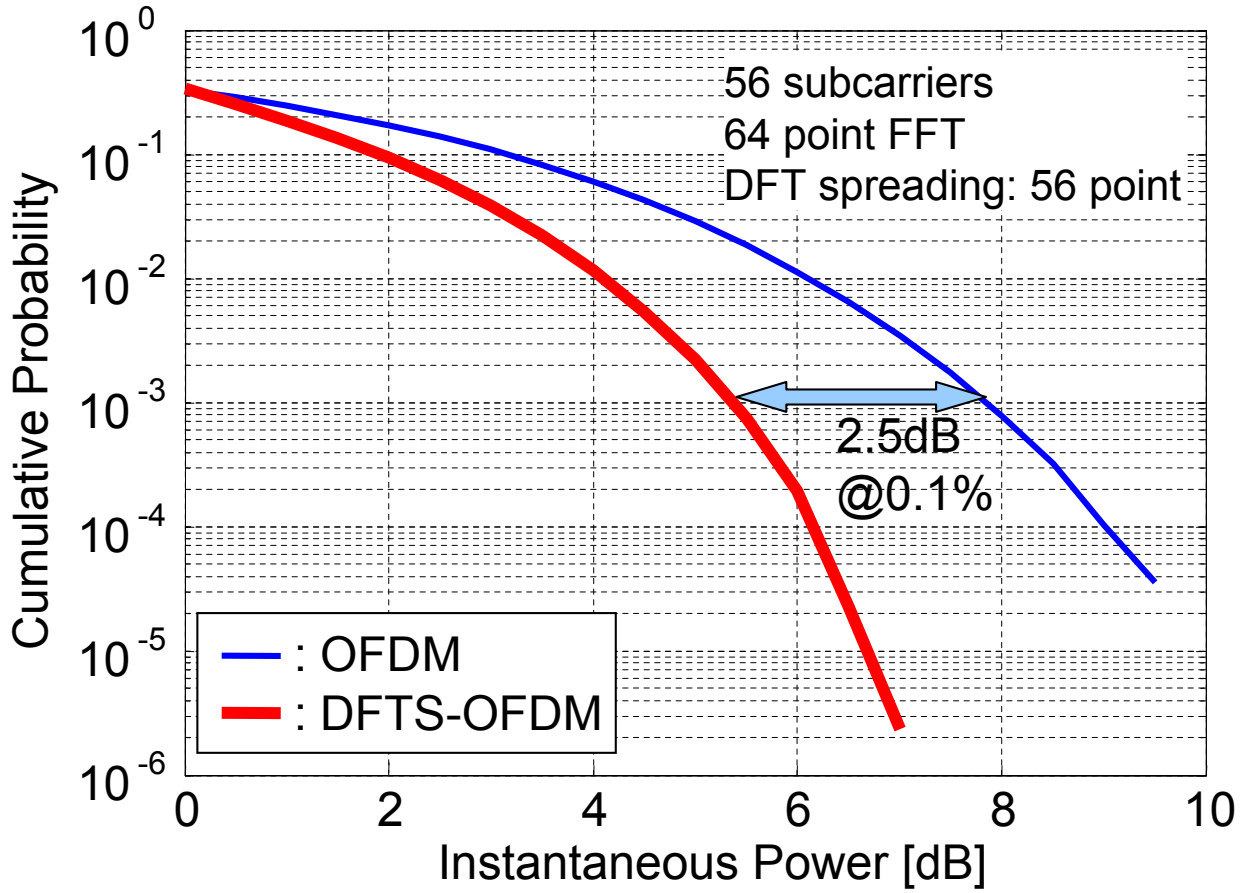
- **TGah decided to support 2/4/8/16MHz signals based on the down clocked versions of 11ac 20/40/80/160 MHz, and an 1MHz signal based on 32FFT.**
  - Both 2MHz and 1MHz receptions are mandatory in TGah PHY.
- **DFT spreading OFDM (DFTS-OFDM) is adopted for the uplink in IMT-2000 LTE, and the concept 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.

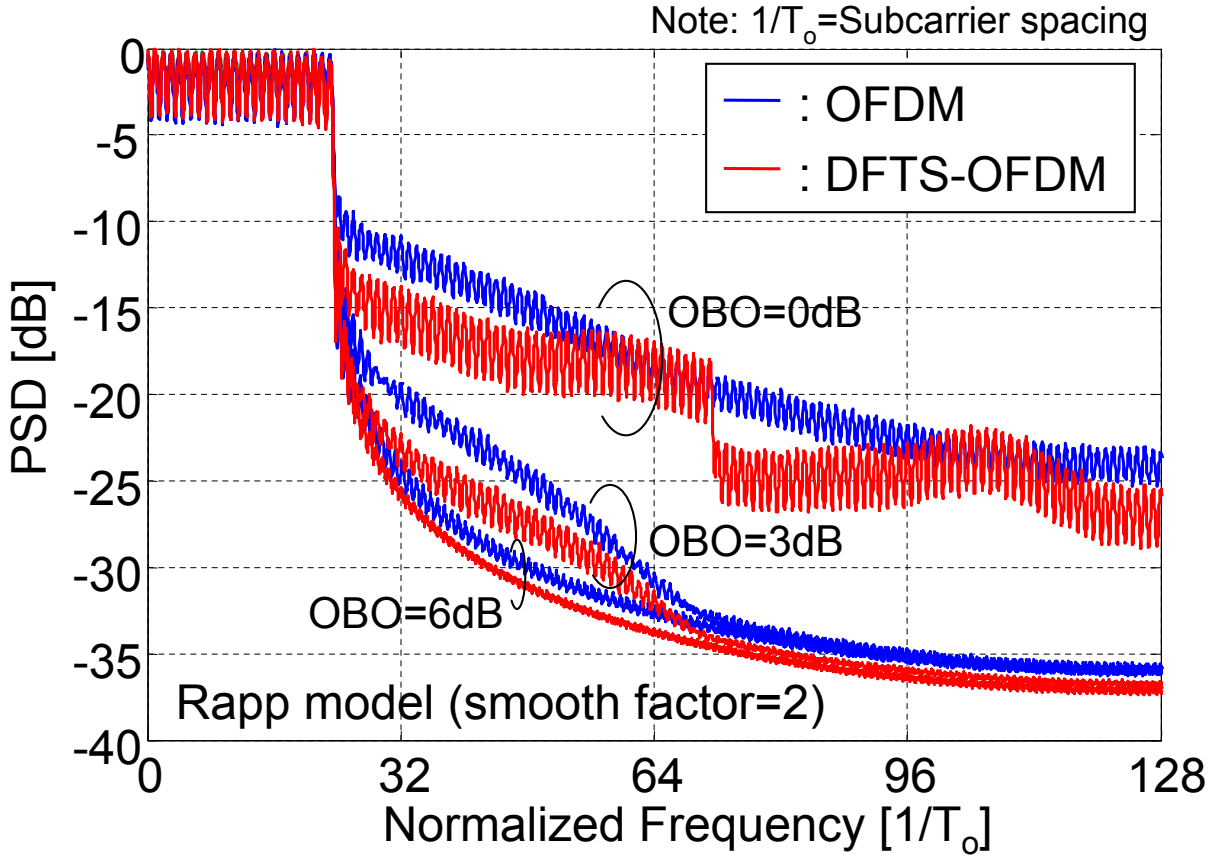
Comparison of PAPR

DFTS-OFDM achieved lower PAPR than OFDM.



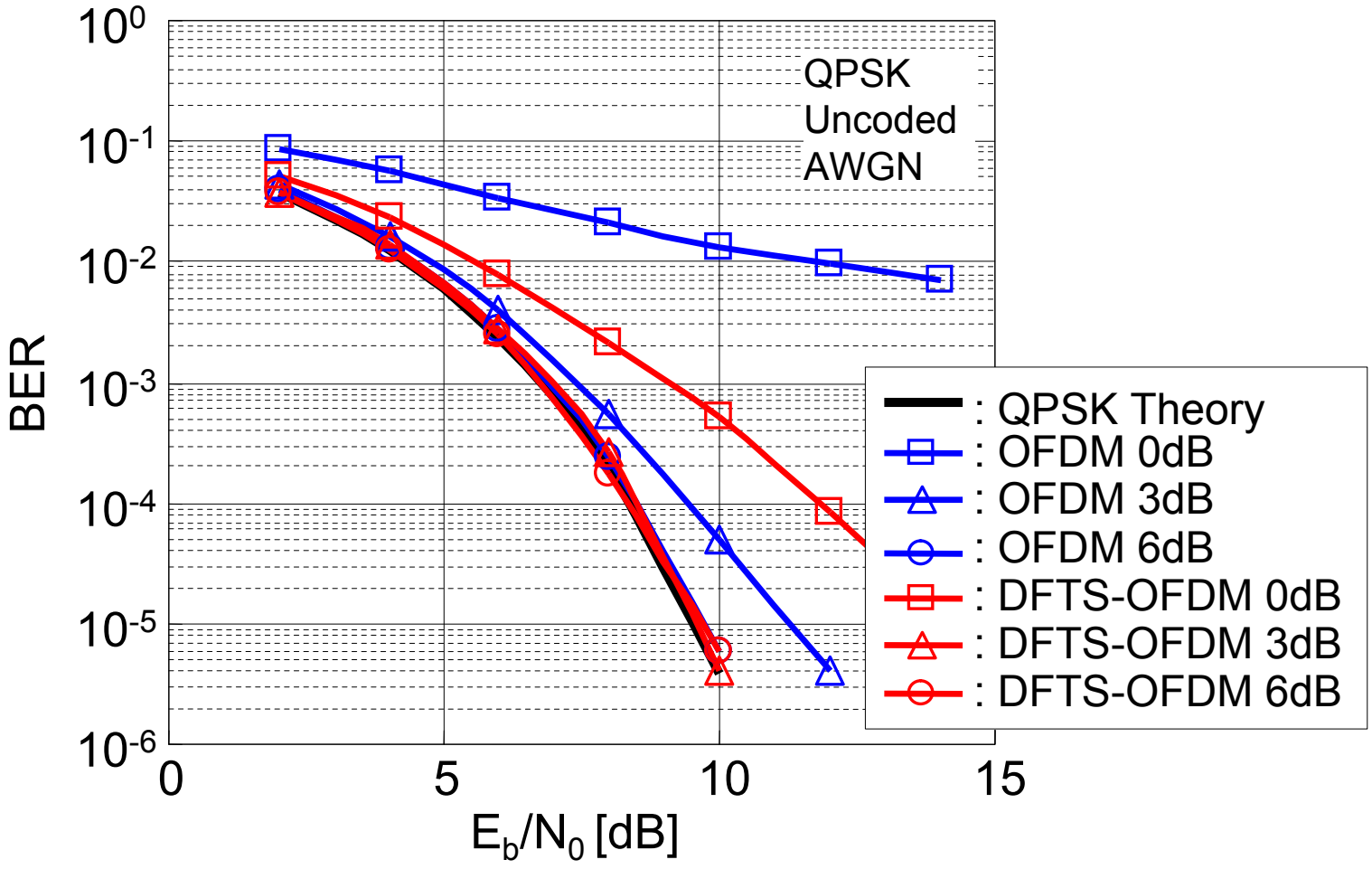
Comparison of output spectrum after HPA

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



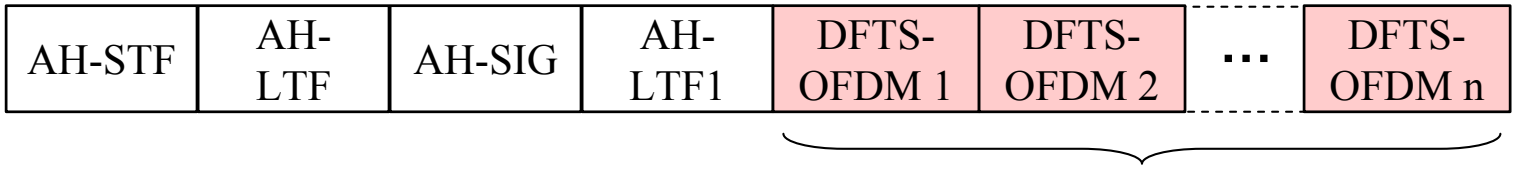
BER performance

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

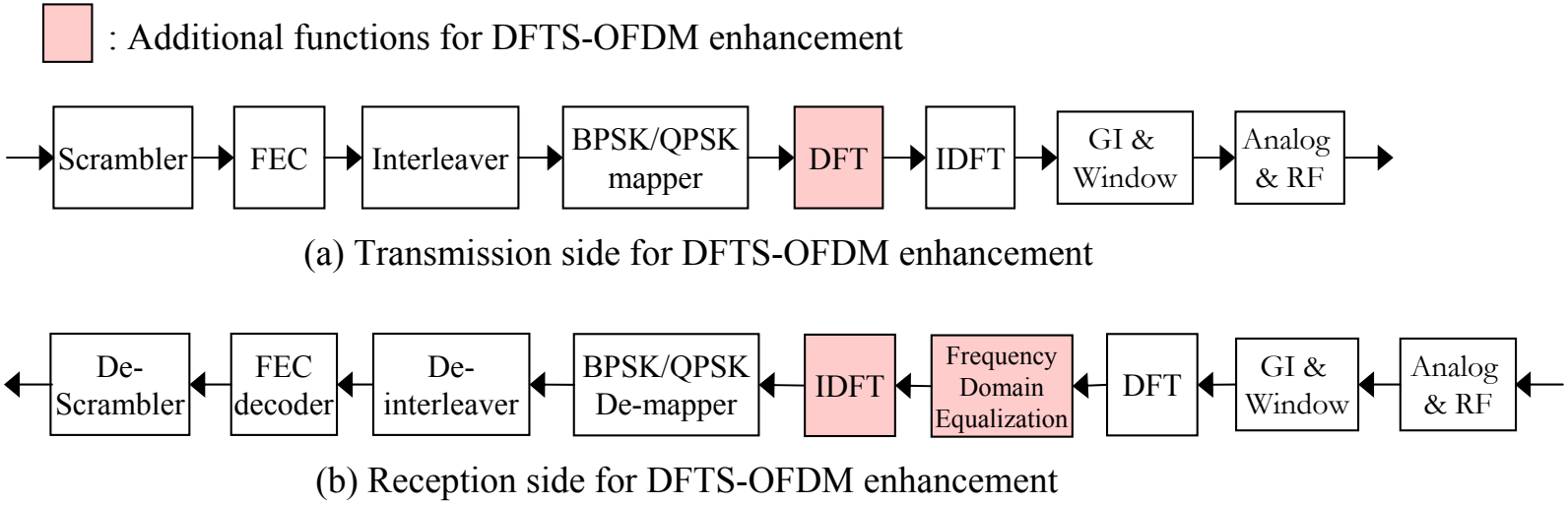


Transmission flow for DFTS-OFDM options (1)

- **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



Transmission flow for DFTS-OFDM options (2)



- **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 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