Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Impact of out-of-band emission limit in TVWS to OFDM signals
Date Submitted: January 19, 2012
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Re: Call for Contribution (IEEE802.15.4m)

Abstract: This contribution discusses an impact of out-of-band emission limit in TV white space for consideration of the technical guidance document.

Purpose: Technical Contribution for discussion in IEEE802.15.4m

Introduction

- Impact of out-of-band emission limit in TVWS for FSK and OFDM signal is presented in [1].

- This contribution presents impact of out-of-band emission limit to the OFDM signals based on the IEEE802.15.4g specification.

Out-of-band emission limit in TVWS

- ## FCC (unlicensed)
  - – See the right figure.

- ## Canada (licensed)
  - – Out of band emission: more than 27dB reduction

- ## UK Ofcom (unlicensed)
  - – Not specified yet
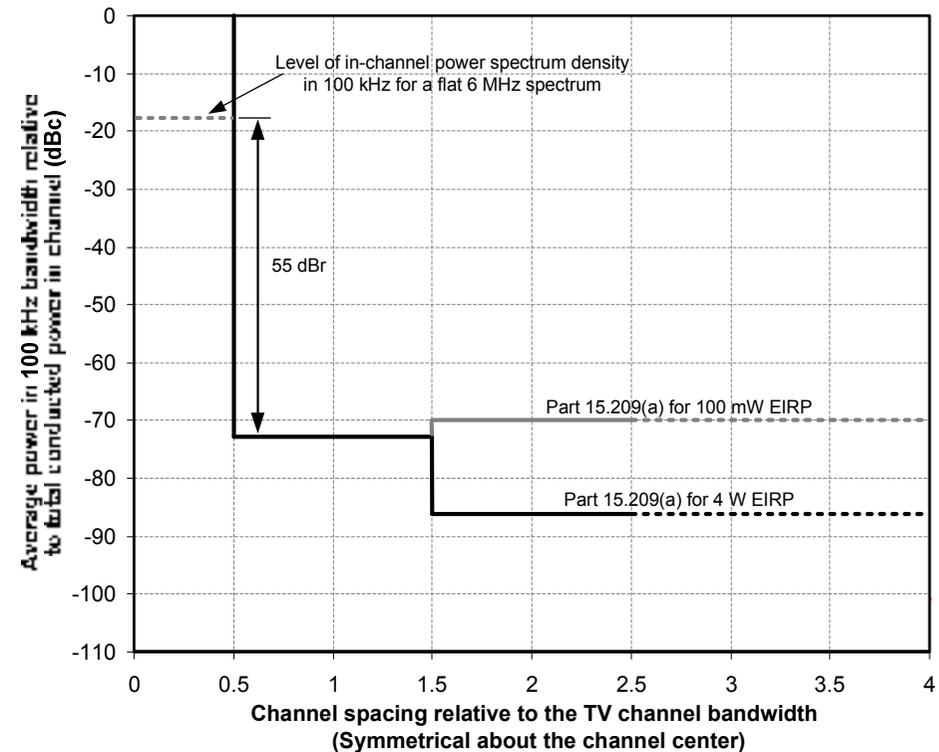
Fig. 1 RF spectrum mask in USA
(Source: IEEE Std 802.22[TM]-2011, Annex A)

Simulation Parameters

- ## Common parameters

  - ### Band of interest: 572-578 [MHz] (31ch in US)

  - ### QPSK modulation

| Parameters	Option1	Option2	Option3	Option4
Bandwidth[kHz]	1094	552	281	156
Channel spacing[kHz]	1200	800	400	200
FFT size(N_{FFT})	128	64	32	16
# of active tones	104	52	26	14
# of data tones	96	48	24	12
# of pilot tones	8	4	2	2
Guard tones	24	12	6	2

Spectrum Example (Option 1 and 2)
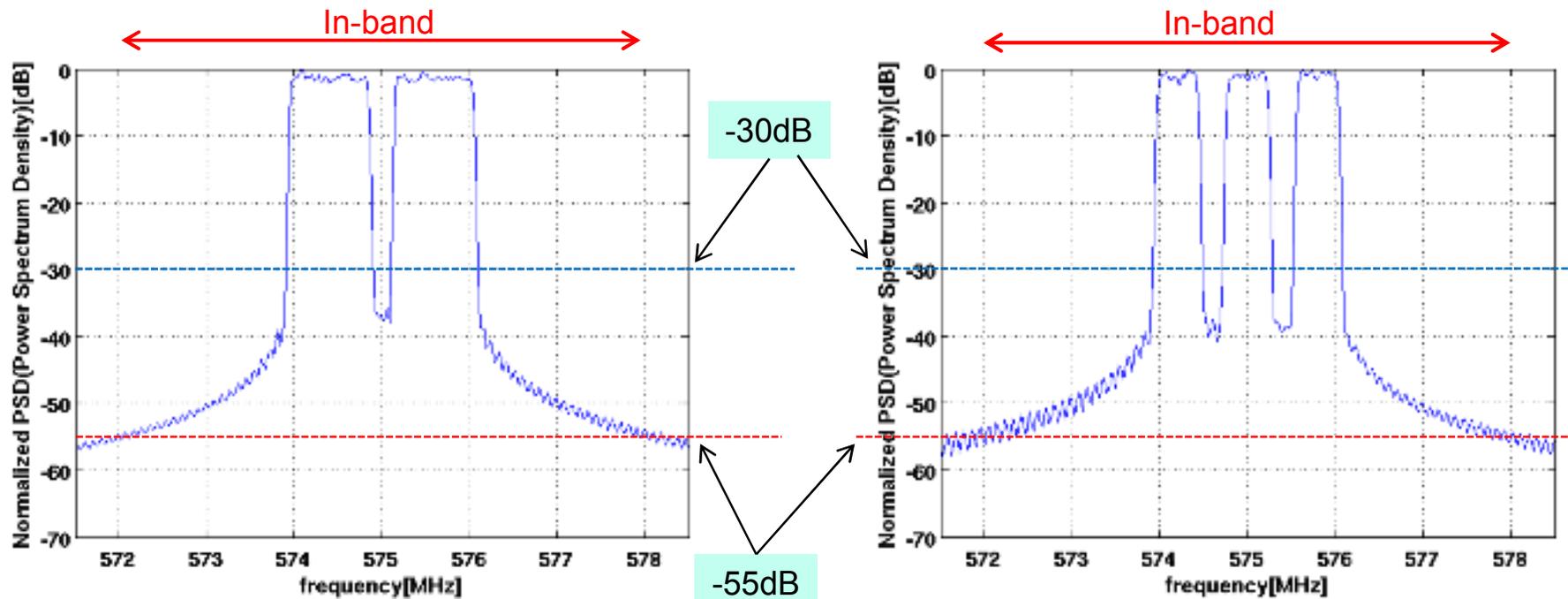
- ## Option 1 (N_{FFT}=128)
  - 2 channels
  - $B_{[-55dB]}$ =6.12(MHz)
  - $B_{[-30dB]}$ =2.10(MHz)

- ## Option 2 (N_{FFT}=64)
  - 3 channels
  - $B_{[-55dB]}$ =5.98(MHz)
  - $B_{[-30dB]}$ =2.16(MHz)

Spectrum Example (Option 3 and 4)
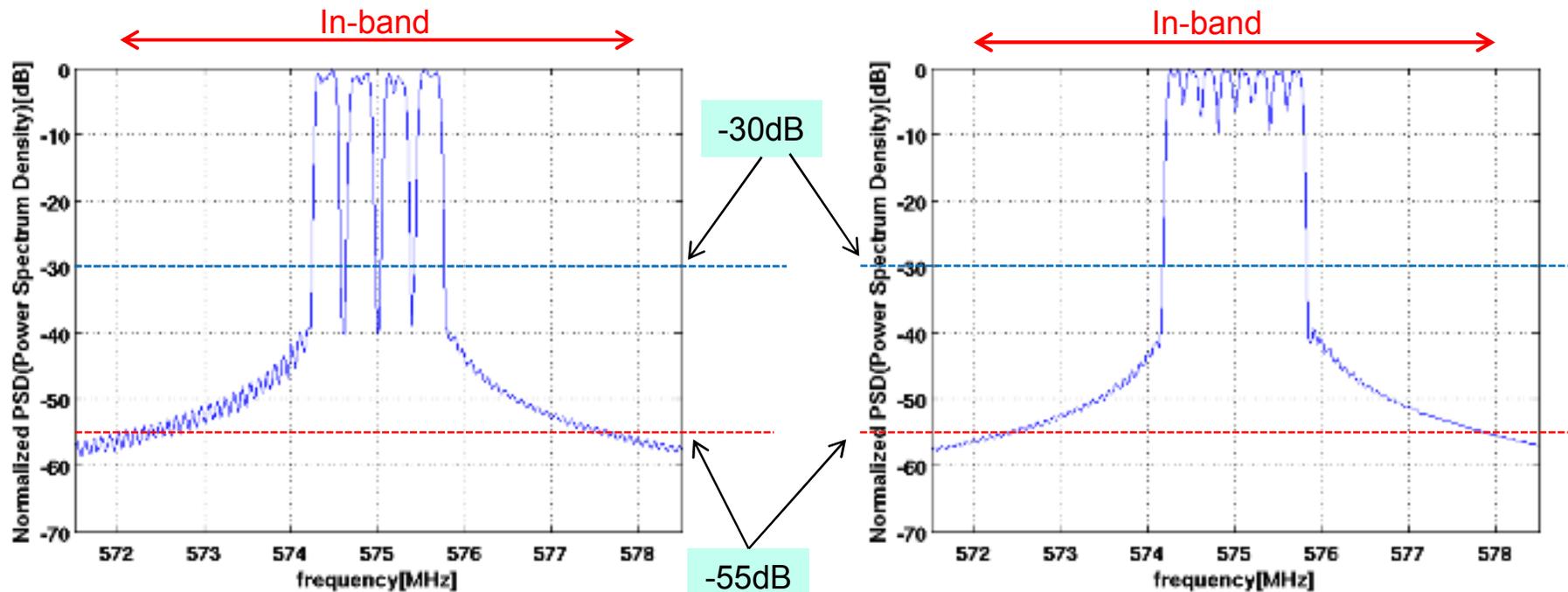
-30dB

-55dB

- ## Option 3 (N$_{FFT}$=32)
  - 4 channels
  - B$_{[-55dB]}$ =5.23(MHz)
  - B$_{[-30dB]}$ =1.53(MHz)

- ## Option 4 (N$_{FFT}$=16)
  - 8 channels
  - B$_{[-55dB]}$ =5.44(MHz)
  - B$_{[-30dB]}$ =1.66(MHz)

Spectrum Example in different parameters
(Same bandwidth and channel spacing as in option 1)
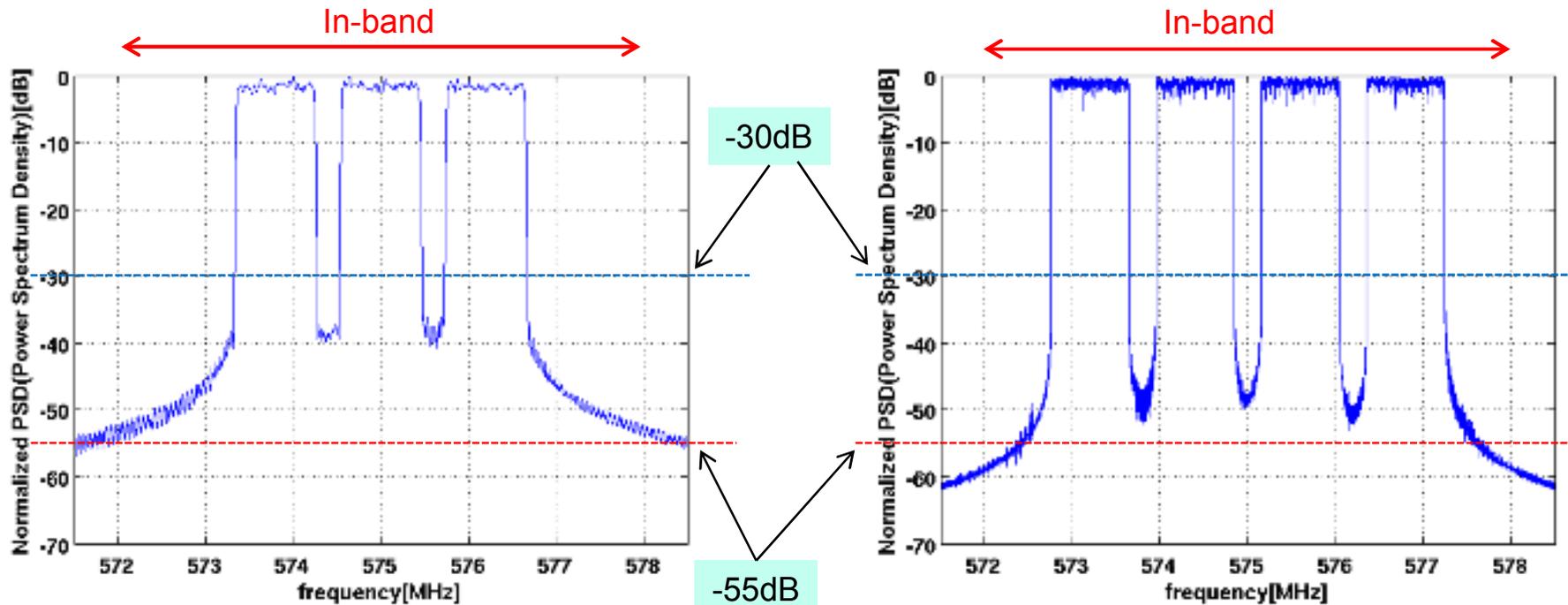
- N_{FFT}=256, QPSK
- 192 data + 16 pilot carriers
- 3 channels
- $B_{[-55dB]}$ =6.86(MHz), $B_{[-30dB]}$ =3.37(MHz)

- N_{FFT}=2048, QPSK
- 1536 data + 128 pilot carriers
- 4 channels
- $B_{[-55dB]}$ =5.22(MHz), $B_{[-30dB]}$ =4.50(MHz)

Observations and Conclusions

- A couple of channels can be accommodated within one TV channel (6MHz) in the case of OFDM signals based on the IEEE802.15.4g specifications .

- Spectrum efficiency is limited due to stringent spectrum mask

- More channels may be accommodated by using larger number of FFT points, however, further investigation will be necessary, e.g. impact of nonlinear devices.

References

1. TG4m Technical Guidance Document, Doc. IEEE 802.15-11-0684-00-004m, Sept. 2011

2. FCC Second MO&O, FCC-10-174, Sep. 2010.

3. IEEE802.22-2011, Annex A, July 2011

4. S. Sasaki, T. Inoko, and Y. Fukaishi, Doc. IEEE 802.15-11-0820-00-004m, Nov. 2011