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

Submission Title: Sub-GHz license-exempt frequency use in Atlanta
Date Submitted: 14 November 2023
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Re:

Abstract: This contribution shows measurement results in the sub-GHz frequency band in the US and potential implications on future 802.15.4 standards

Purpose: Presentation in 802.15.4 WNG

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Abstract

• This presentation shows spectrum measurements conducted in the license-exempt 915 MHz band during the IEEE 802 Wireless Interim in September 2023

• Measurements were done in the Hyatt Regency Atlanta in Buckhead and the Hilton in Downtown Atlanta
SDR Frontend

- An RSPduo Software-Defined Radio (SDR) Frontend (~250$) equipped sampled the band width 14 bit A/D resolution and 10MS/s
- The bandwidth for the later plot is limited to 5 MHz (SAW filter bandwidth of 5 MHz)
- Levels are not calibrated
Measurement Location Buckhead Hotel Room

- 0 dBd measurement antenna located next to the window in the 9th floor or the Hyatt in Buckhead, view towards downtown Atlanta
- A SAW filter (924.5 MHz, 5 MHz bandwidth, ~2 dB attenuation) below the antenna avoid non-linear effects of the pre-amplifiers (very strong cellular and broadcast signals)
- Metallized window may reduce RX level by 30 dB
Buckhead Hotel Room
Buckhead Hotel Room (BW 10MHz)

Filter slopes visible at the edges

5 MHz
Buckhead Hotel Room (Zoom)
Spectrum of Wideband Signal

• Bandwidth of 4-5 MHz
• O-QPSK waveform

⇒ O-QPSK PHY or SUN O-QPSK PHY?

⇒ FSK or OFDM would only require a fraction of the spectral footprint!
Measurement Location Buckhead Terrace

- 0 dBd measurement antenna located on Terrace of Hyatt in Buckhead
- Terrace is on 3rd floor, partly shielded by the building
- Same antenna/filter configuration as previous measurement
- Opposite side of the building compared to previous measurement
Buckhead, Terrace on 3rd Floor

Only 5 MS/s → Filter effects at the edges!
Buckhead, Terrace on 3\textsuperscript{rd} Floor (Zoom)
Measurement Location Hilton Downtown

- 0 dBi measurement antenna located next to the window in the 10th floor or the Hilton Downtown Atlanta, view towards the grave of Martin Luther King
- Same antenna/filter configuration as previous measurement
Downtown Hotel Room
Downtown Hotel Room (BW 10MHz)

Filter slopes visible at the edges and issues with non-linearity
Downtown Hotel Room (Zoom)
Downtown Hotel Room (Zoom II)
Important Findings and Summary

• Bands are heavily loaded
• Spreading is bad and consumes more spectrum than actually required → Deprecate asap!

• For new standards:
  – Minimize the spectral footprint
  – Ensure precise signal generation with minimized out-of-band emissions
  – Improve the FEC and ensure robustness in interfered channels by means of diversity in time and frequency
  – High bandwidth signals will always face interference
Thank You!