

**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

**Source:** Joerg ROBERT, TU Ilmenau/Fraunhofer IIS

E-Mail: [joerg.robert@tu-ilmenau.de](mailto:joerg.robert@tu-ilmenau.de)

**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

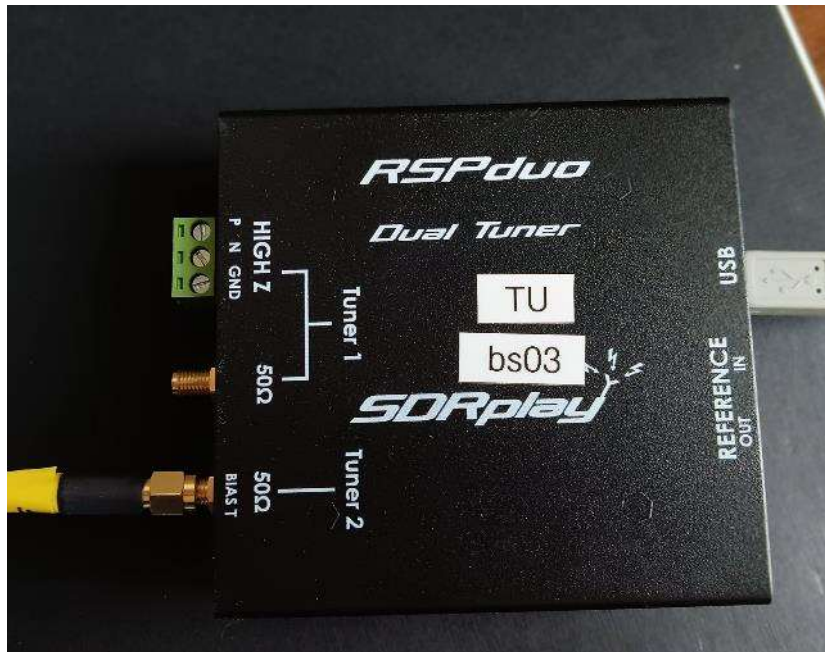
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# Abstract

- 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

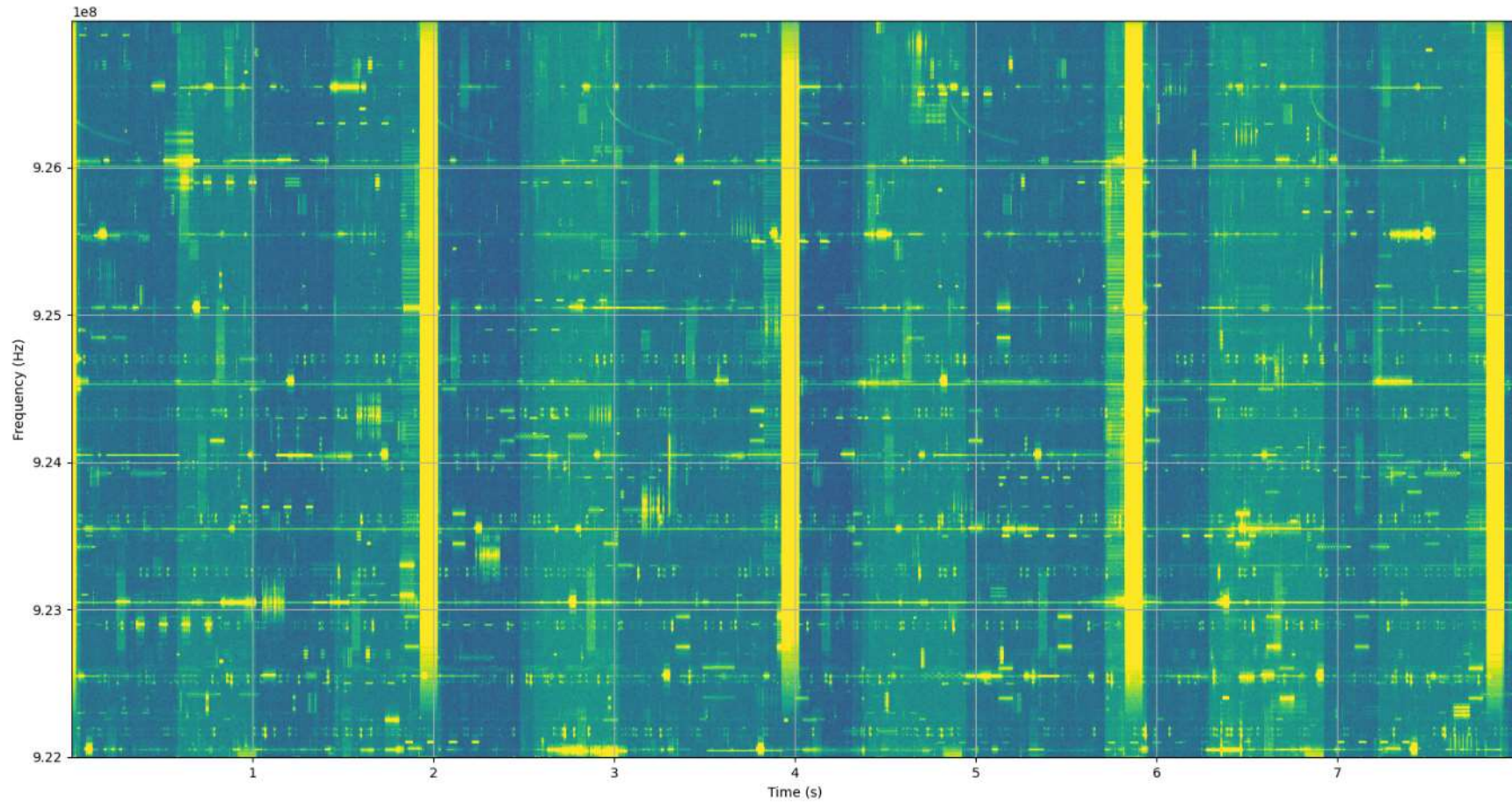
# Measurement Location Buckhead Hotel Room



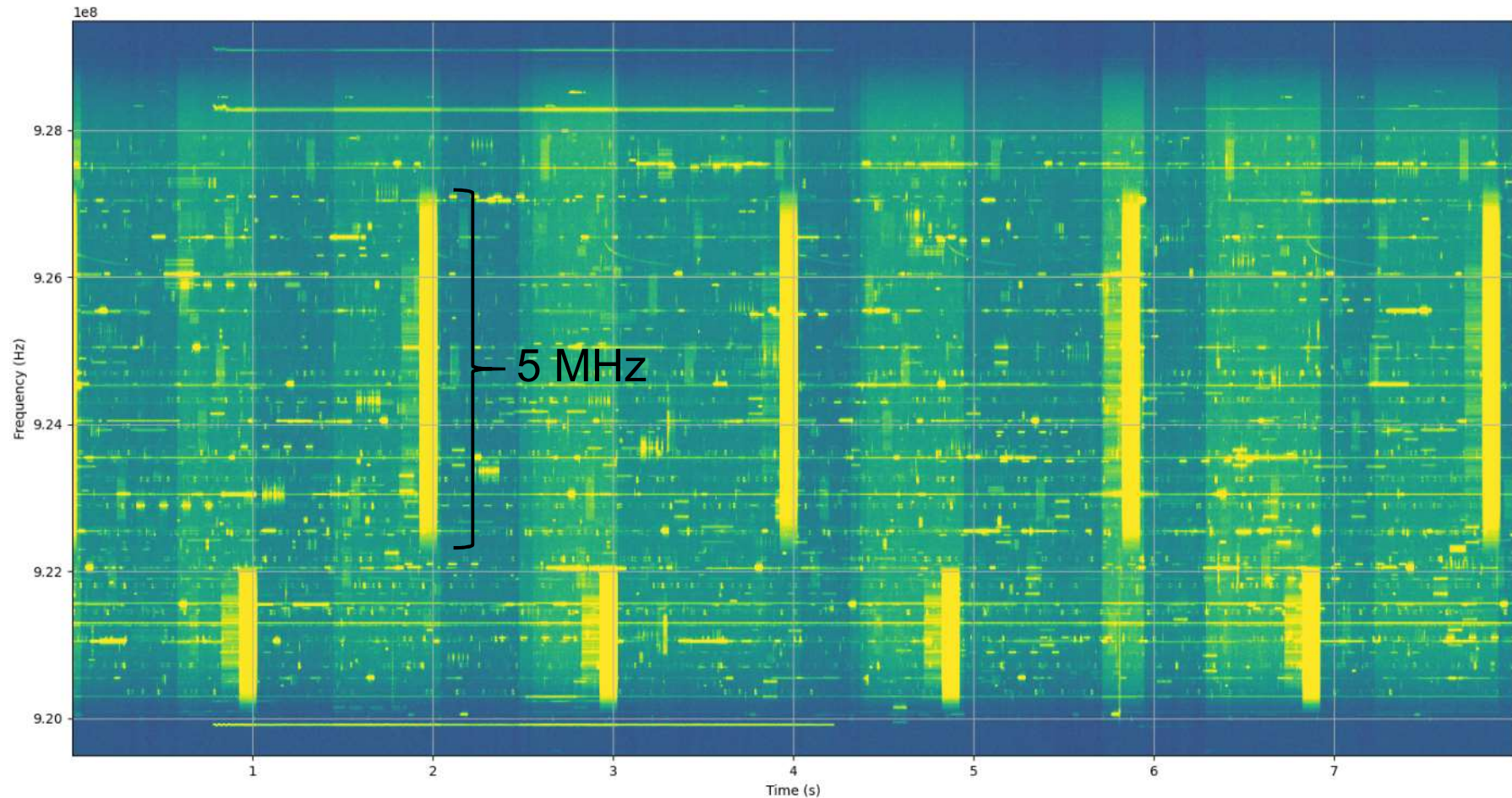
SAW-Filter

- 0 dBd measurement antenna located next to the window in the 9<sup>th</sup> floor of 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

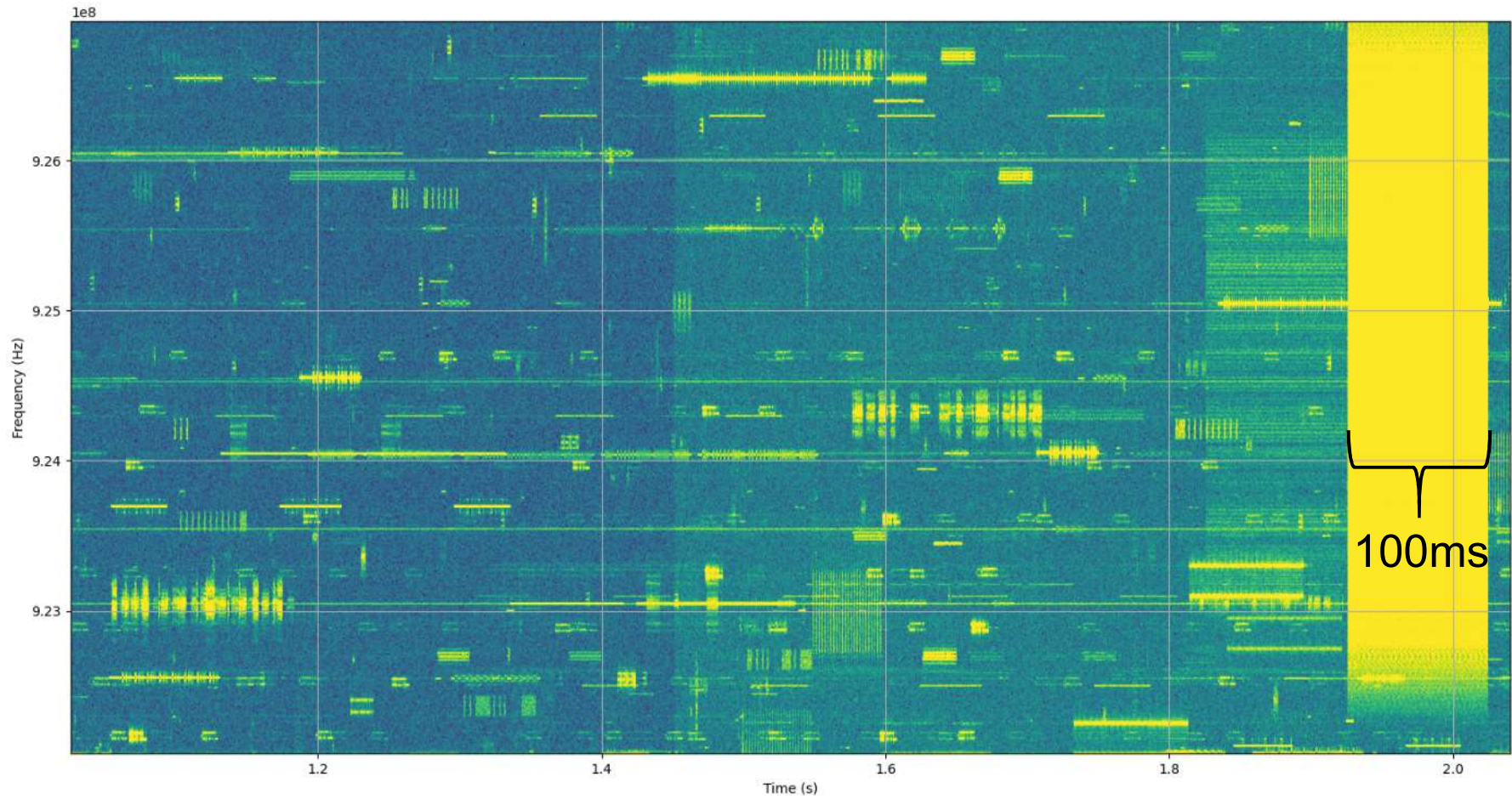


# Buckhead Hotel Room (BW 10MHz)

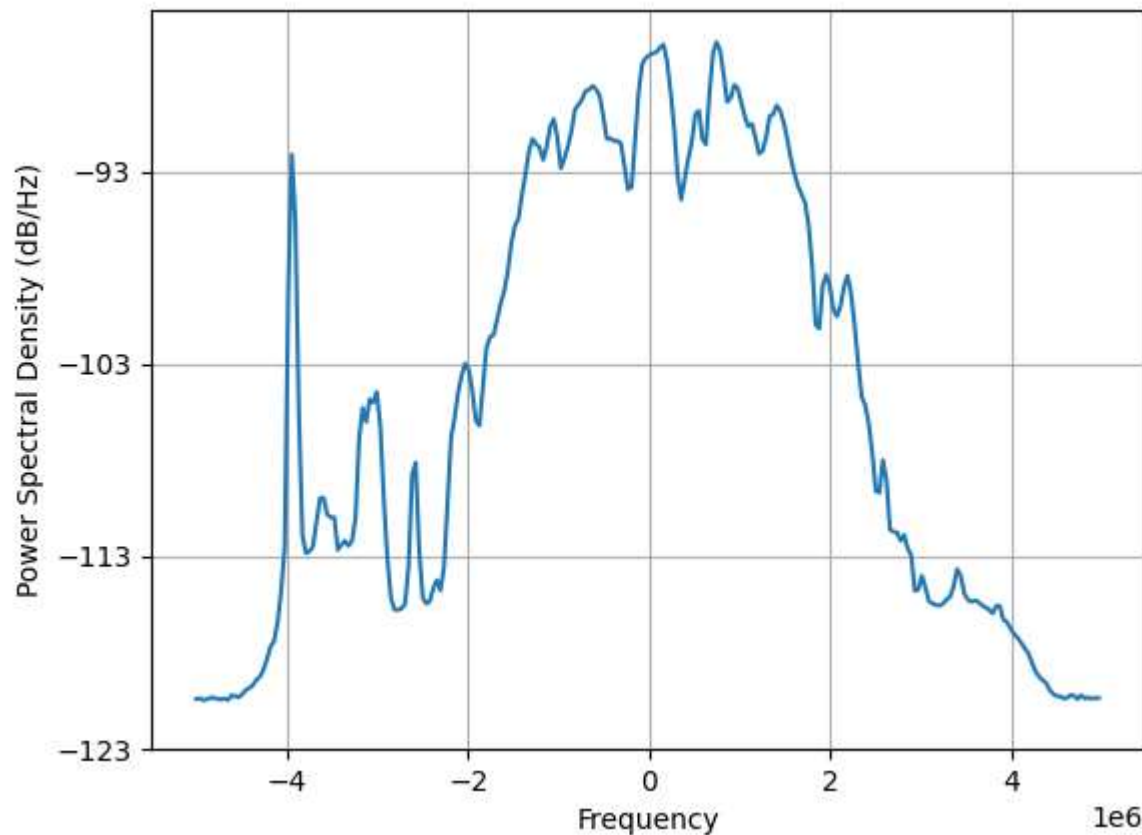


Filter slopes visible at the edges

# Buckhead Hotel Room (Zoom)



# Spectrum of Wideband Signal



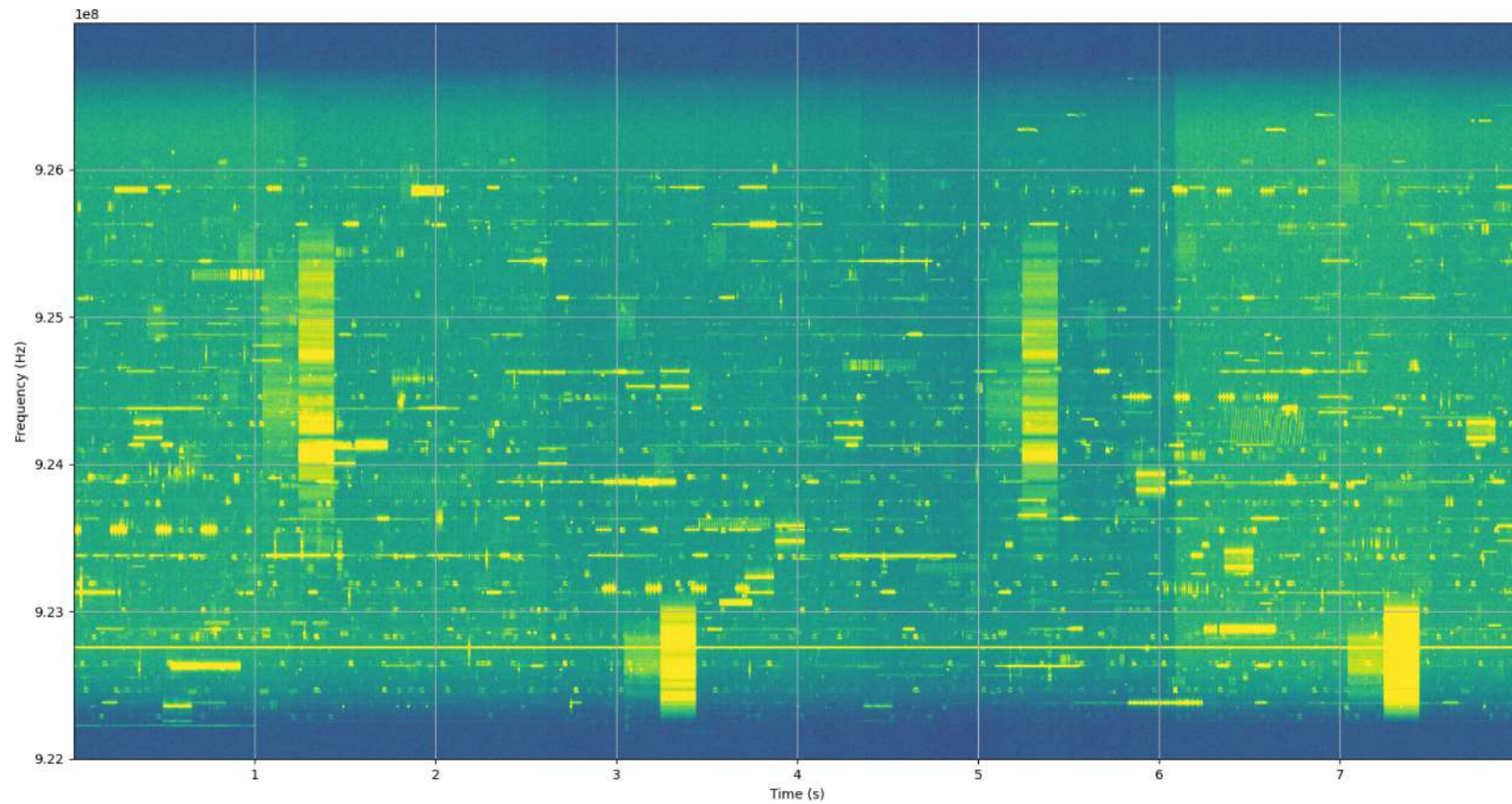
- Bandwidth of 4-5 MHz
  - O-QPSK waveform
- ➔ O-QPSK PHY or SUN O-QPSK PHY?
- ➔ FSK or OFDM would only require a fraction of the spectral footprint!



# Measurement Location Buckhead Terrace

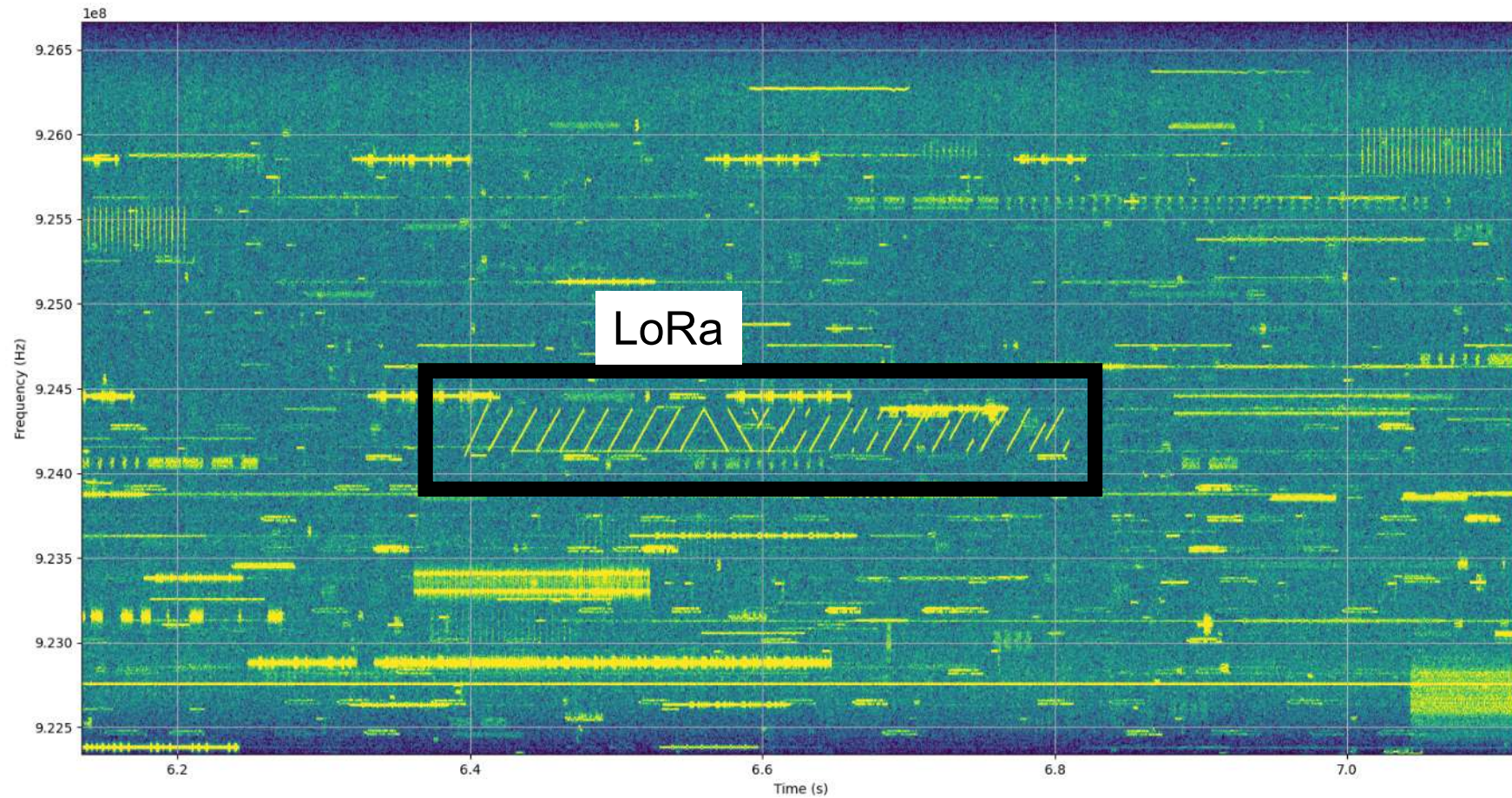
- 0 dBd measurement antenna located on Terrace of Hyatt in Buckhead
- Terrace is on 3<sup>rd</sup> floor, partly shielded by the building
- Same antenna/filter configuration as previous measurement
- Opposite side of the building compared to previous measurement

# Buckhead, Terrace on 3<sup>rd</sup> Floor



Only 5 MS/s  $\rightarrow$  Filter effects at the edges!

# Buckhead, Terrace on 3<sup>rd</sup> Floor (Zoom)

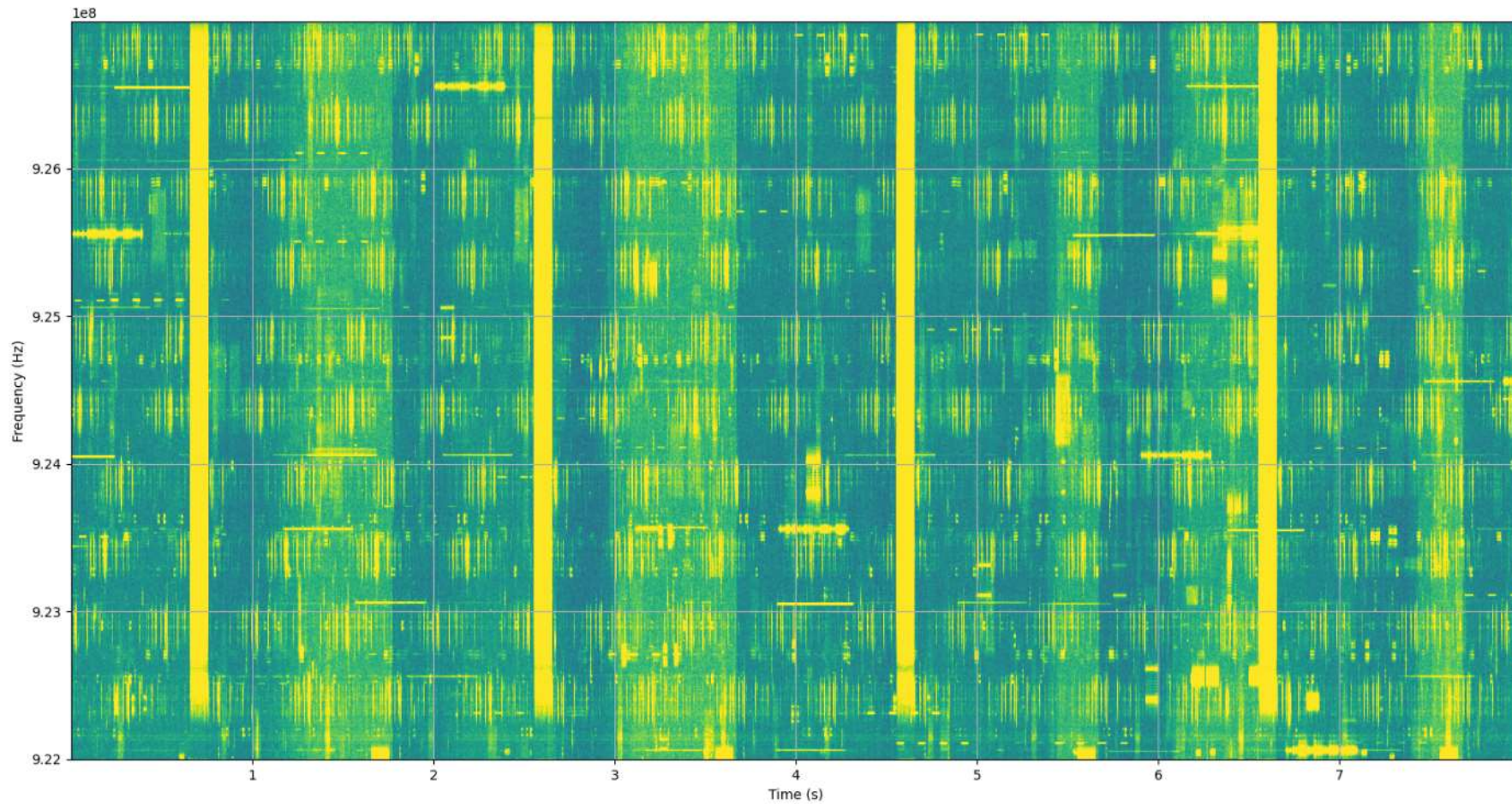


# Measurement Location Hilton Downtown

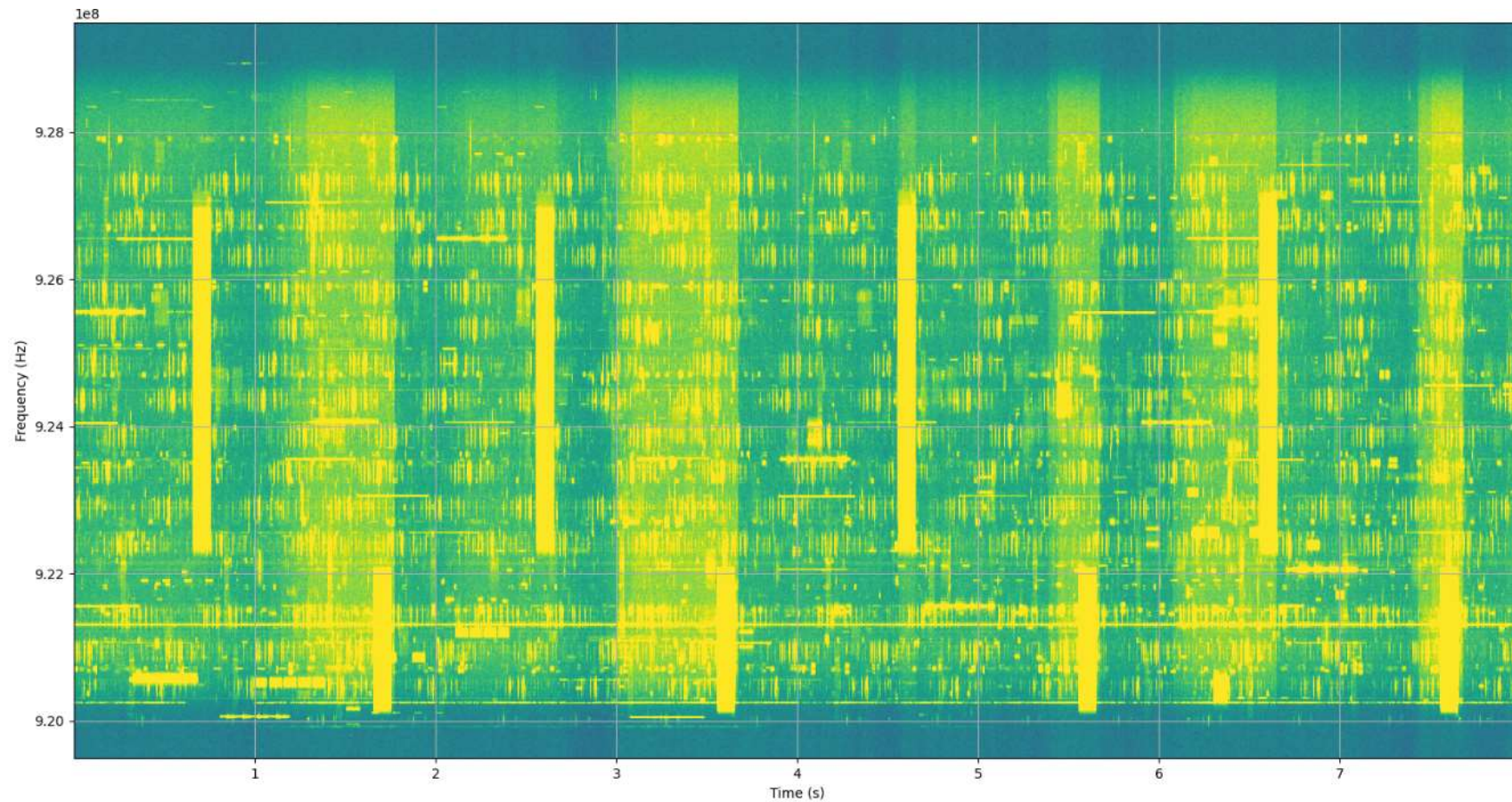


- 0 dBd measurement antenna located next to the window in the 10th floor of the Hilton Downtown Atlanta, view towards the grave of Martin Luther King
- Same antenna/filter configuration as previous measurement

# Downtown Hotel Room

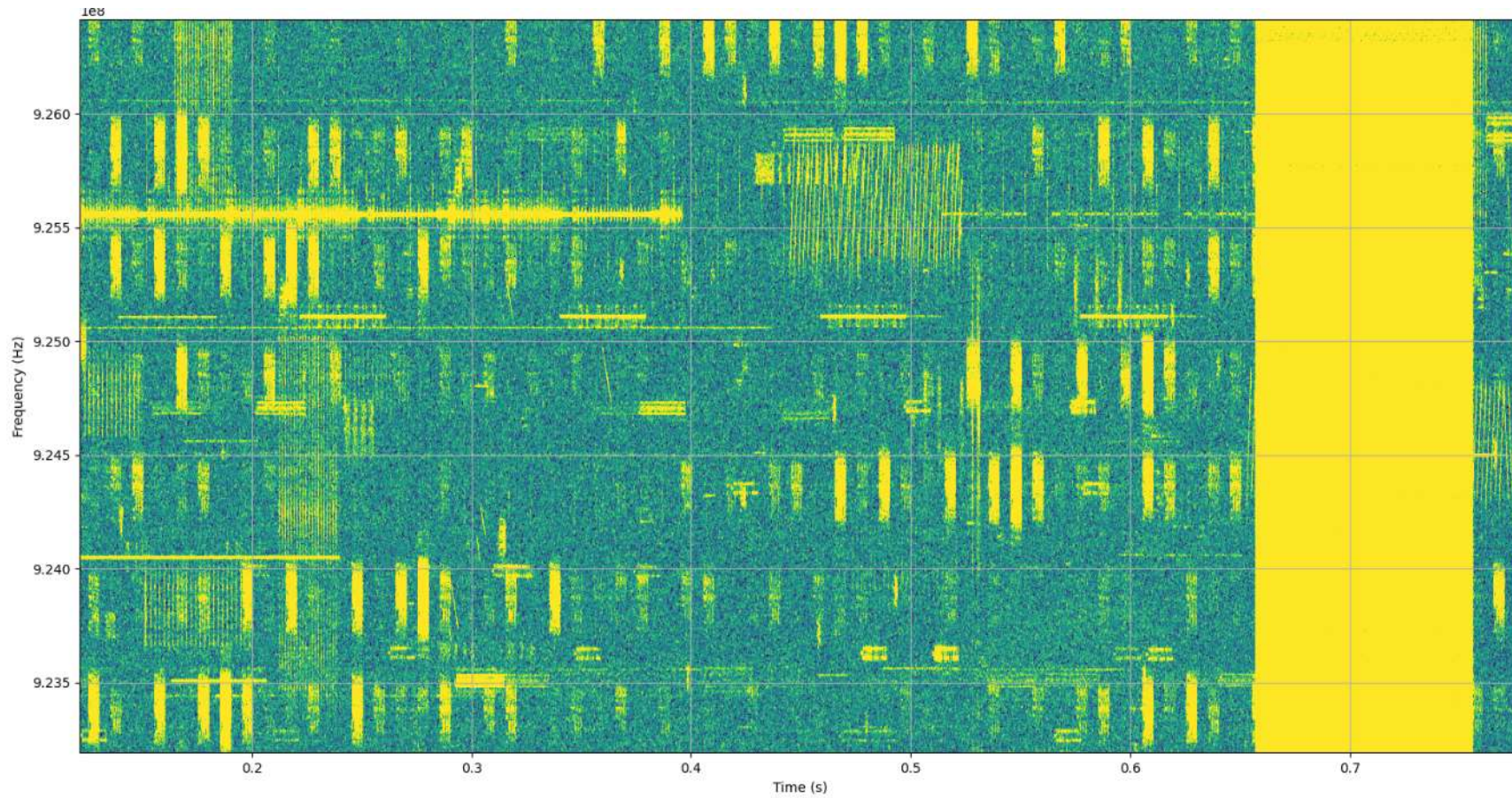


# Downtown Hotel Room (BW 10MHz)

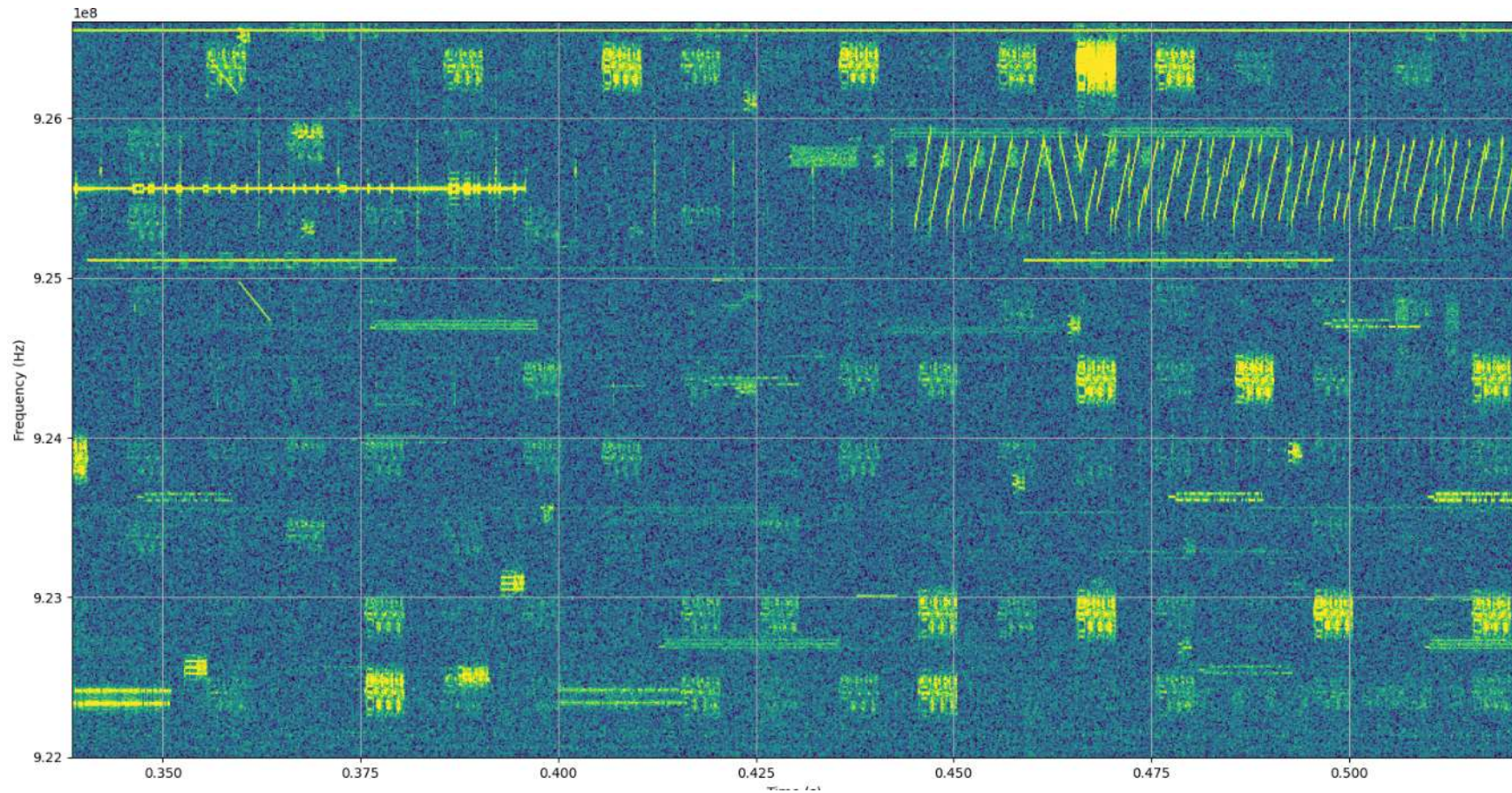


Filter slopes visible at the edges and issues with non-linearity

# 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!