

# 5G mmWave Radiation Learning Session 2 — Field Experience with Safe & Sound mmWave RF Meter

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Oram Miller, BBEC, EMRS

Certified Building Biology Environmental Consultant,  
Electromagnetic Radiation Specialist

Los Angeles, California

310-720-7686

[www.createhealthyhomes.com](http://www.createhealthyhomes.com)

# Introduction

- ▶ This presentation contains videos and still photos from further field use of the Safe & Sound mmWave 5G RF meter in Santa Monica, California
- ▶ Presentation covers field testing in July 2023
- ▶ Most mmWave antennas found on busy boulevards
- ▶ Exclusively Verizon 5G mmWave Antenna arrays
- ▶ Also noted 4G LTE and Verizon low band 5G antennas
- ▶ These findings are a snapshot in time in one location
- ▶ We look forward to input from colleagues in other locations

# mmWave Antennas in California

- ▶ Additional Verizon mmWave antennas
- ▶ Signal strength reduces turning in place

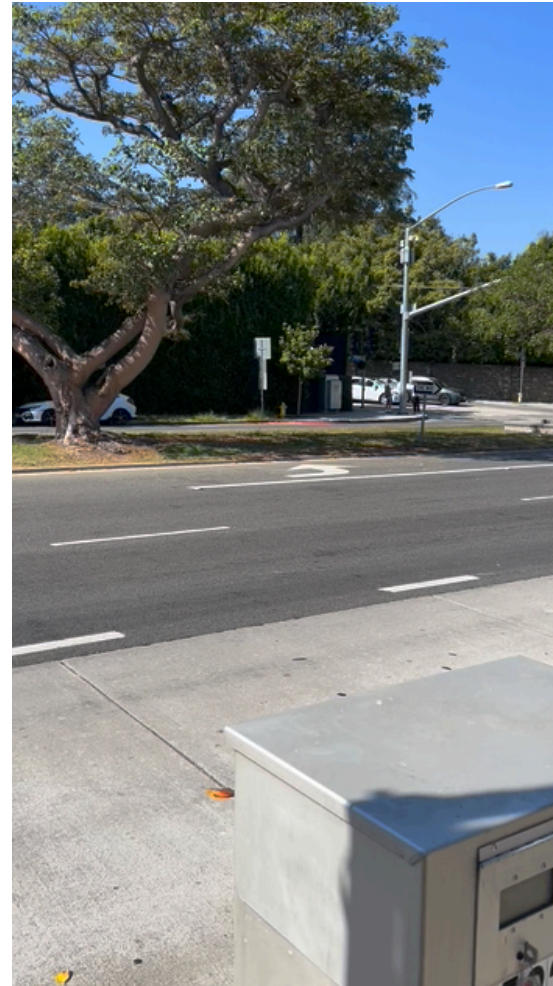
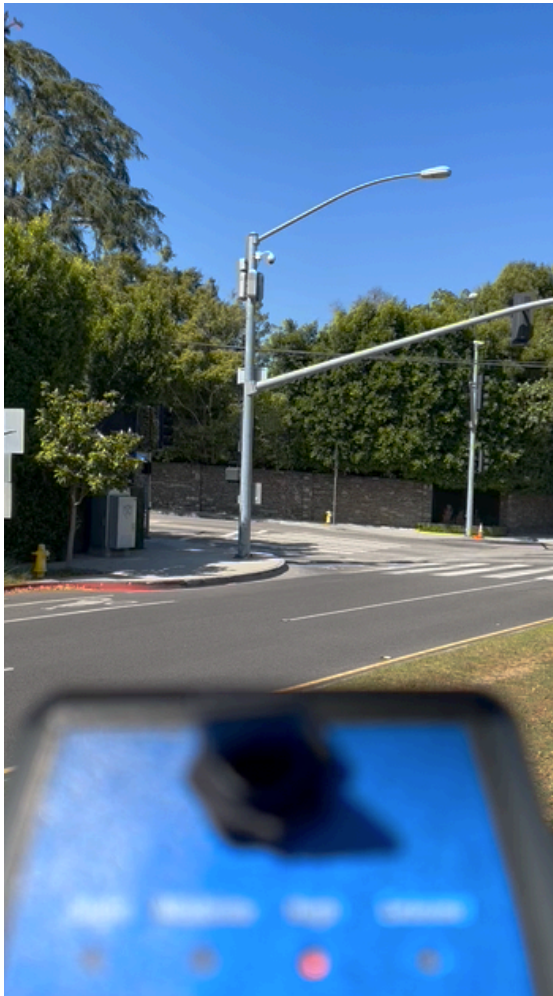
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# mmWave Antennas in California

- ▶ mmWave signal strength diminishes at width of cone pattern
- ▶ Also diminishes with distance from mmWave antenna

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# mmWave Antennas in California

- ▶ mmWave antenna strength diminishes behind tree
- ▶ Drove through residential area testing for mmWave signal

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# mmWave Antennas in California

- ▶ AT&T and Verizon 4G LTE and Verizon mmWave antennas

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# mmWave Antennas in California

- ▶ mmWave 5G once again easily blocked by tree; car radar end of video
- ▶ Passing cars emit mmWave RF from radar (maybe Verizon phones)

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# mmWave Antennas in California

- ▶ mmWave antenna signal strength closer with stub and horn antennas

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# mmWave Antennas in California

- ▶ Close up of 4G LTE and mmWave antenna
- ▶ Second sound on mmWave meter when antenna increased signal

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# mmWave Antennas in California

- ▶ Strength of mmWave antenna readily drops off with distance

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# mmWave Antennas in California

- ▶ Strength of mmWave antenna readily drops off with distance, continued

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# mmWave Antennas in California

- ▶ “5G” seen on Verizon phone—what would you expect to see on your RF meters?

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# mmWave Antennas in California

- ▶ Analysis of findings on RF meters from “5G” on Verizon phone
- ▶ Do not see “5GUW”; no activity on mmWave meter

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# mmWave Antennas in California

- ▶ First, and only, mmWave 5G antenna array found in residential neighborhood
- ▶ Includes 4G LTE antenna at the top

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# mmWave Antennas in California

- ▶ Speculation on potential harm to local residents close to mmWave 5G antenna
- ▶ Further evidence of rapid reduction in mmWave signal with distance from antenna

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# mmWave Antennas in California

- ▶ Recap of finding of minimal mmWave antenna presence in residential neighborhood in Santa Monica, California

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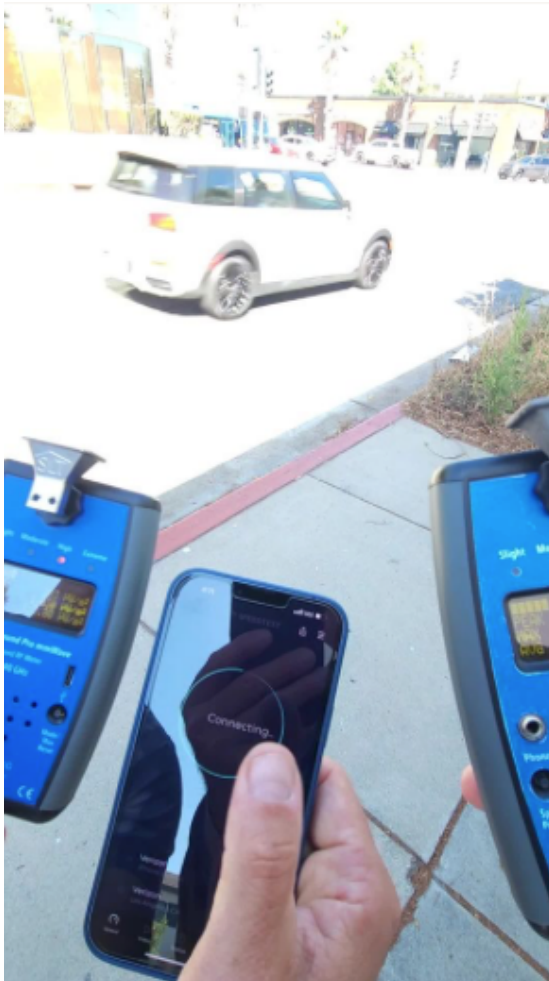




# mmWave Antennas in California

- ▶ Phone data triggers mmWave beam-formed signal; reduces with distance
- ▶ Demonstration of width of beam-formed mmWave signal, with Mitch Marchand

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# mmWave Antennas in California

- ▶ Further reduction in beam-formed signal moving phone further away from RF meter
- ▶ Demonstrated from two separate locations within full mmWave antenna cone

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# mmWave Antennas in California

- ▶ Horn pegs at 31,600  $\mu\text{W}/\text{m}^2$  and stub pegs at 501,000  $\mu\text{W}/\text{m}^2$
- ▶ Number on “Average” reveals how you set up meter (stub vs. horn)

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# mmWave Antennas in California

- ▶ mmWave antenna and phone signal strengths, two mmWave RF meters with horn antennas, beam-form triggered by phone data usage

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# mmWave Antennas in California

- ▶ Antenna and phone, two mmWave RF meters, horn antennas, phone on data much further away

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# mmWave Antennas in California

- ▶ Summary of mmWave antenna activity and beam-formed signal

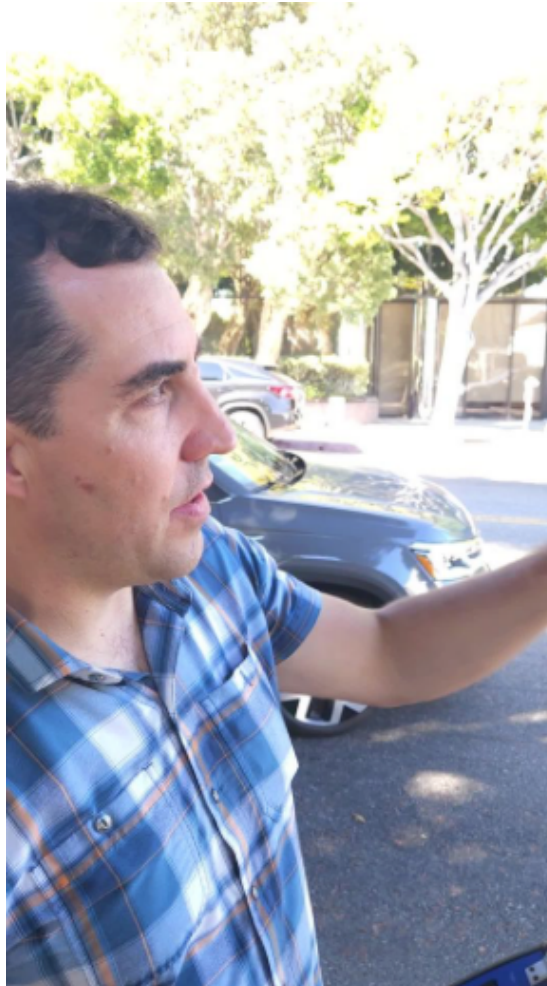
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# mmWave Antennas in California

- ▶ Further summary of mmWave antenna activity and beam-formed signal

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# mmWave Antennas in California

- ▶ Triggering of Verizon beam-formed signal with Verizon cell phone data
- ▶ Summary of mmWave impact on nearby residents

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# Summary Points of mmWave 5G

- ▶ Conclusions by Mitch Marchand, BSc, EE, EMRS
- ▶ Beam-formed signal fairly significant from mmWave antenna
- ▶ Three separate effects when in proximity to mmWave 5G antenna:
  1. 24/7 background level across full cone (120 degrees wide?)
  2. Phone triggers beam-formed signal with data usage as “spot light” to phone or tablet, 3-4 feet wide,  $>31,600 \mu\text{W}/\text{m}^2$
  3. At same time, background exposure level across full cone elevates slightly,  $100 \mu\text{W}/\text{m}^2$ , when a customer accesses data

# Summary Points of mmWave 5G

- ▶ Conclusions by Mitch and Oram to date
- ▶ Beam-formed signal fairly significant from mmWave antenna, triggered by phone from *same* cell carrier as mmW antenna
- ▶ Three separate effects in proximity to mmWave 5G antenna
- ▶ mmWave antennas still rare in residential neighborhoods
- ▶ mmWave signal blocked by solid walls, foil, paint
- ▶ mmWave signal *not* blocked by glass, fabric or mesh screen (signal can pass through holes in fabric or screen)



# Summary Points of mmWave 5G

- ▶ Recommendations for further testing:
- ▶ Use cell phone from *same* cell carrier as mmW antenna to trigger beam-formed signal from mmWave antenna
- ▶ Verizon predominates mmWave 5G service in U.S.
- ▶ Use attenuator when measuring with horn antenna, as signal from antenna and from phone will exceed rated capacity for horn antenna of  $31,600 \mu\text{W}/\text{m}^2$
- ▶ Note increase in Average value, indicating more dense antenna RF transmission (less time between pulses)

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