



Watch The Recording

5G mmWave Meter Learning Session

**With: Rob Metzinger, President of SLT
Electronics Engineering Technologist, BBEC, EMRS
Sr. EMR Instructor @ Building Biology Institute, USA**



www.safelivingtechnologies.com

www.slt.co

Safe and Sound Pro mm Wave Meter

Introductory Video



<https://www.youtube.com/watch?v=bwISuoQ0s-4&t=1s>

S & S Pro mm Wave Meter - Challenges

8 months of development – Release date June 30 2023 (Apologies for Delays)

Getting stable response required additional R & D to get desired BBI spec

We don't want to compromise on specifications and pricing

- Power usage very high (Difficult getting 6 hour battery life)
- Horn Antenna very costly
- Sensitivity below $0.5 \mu\text{W}/\text{m}^2$ - biggest challenge

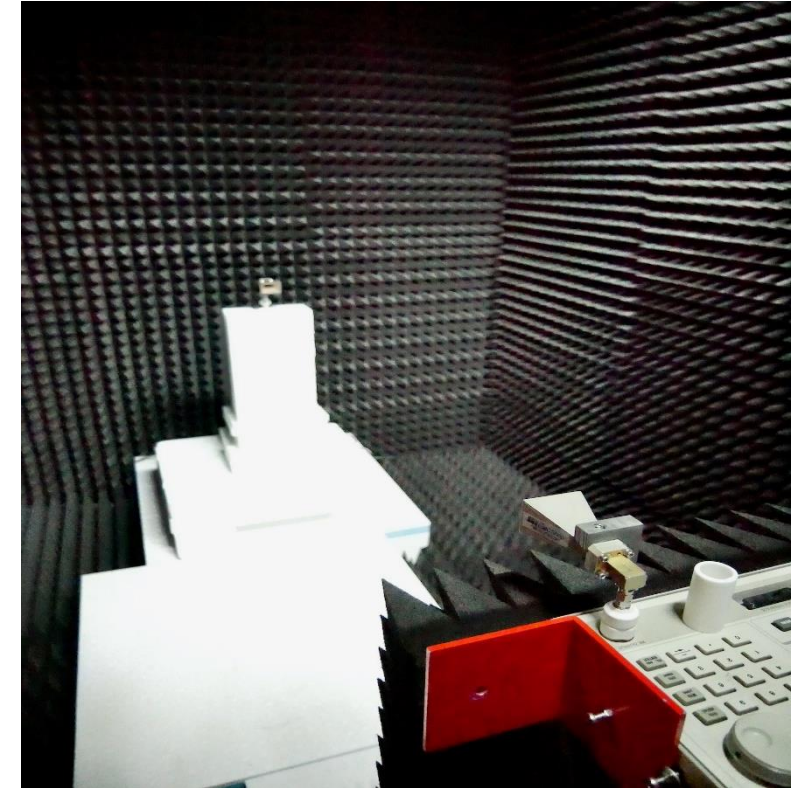
It is challenging – know of 2 other companies that have tried and failed after 2 years of development

Parts are very expensive and hard to source

Found testing is expensive at 3rd party facilities - Found they did not have adequate equipment to test to our needs and no testing methodology

Purchased own signal generators and power meters / spectrum analyzers
1 MHz to 40 GHz

Constructed SLT Full Anechoic Chamber (700MHz - ∞) (ceilings, walls and floor)



Safe and Sound Pro mm Wave Meter

Base Model



Frequency Range - **20** GHz to 40 GHz - High Band 5G RF Meter

- In USA covers 28 and 39 GHz 5G mmWave bands – live in major cities Verizon Wireless, AT&T, T-Mobile, Dish
- In Canada covers 26, 28 and 38 GHz - mmWave bands - spectrum auction planned for 2024
- They're called mmWave because their wavelengths are under a centimeter
- Industry calls this service Ultra Wideband (UW) (5G+)

Cost: \$849 USD (Base Model) **Release Date:** June 30,2023

<https://safelivingtechnologies.com/products/safe-and-sound-pro-mmwave-meter.html>

Horn Option



Features:

- Detects and measures 5G in the High mmWave band, **20** GHz to 40 GHz
- Common sources in this range: 5G high band cell towers, 5G high band cell phones, radar, automobile radar, point to point communication dishes and more...
- Built in North America, consumer-level
- Accurate and affordable – at a fraction of the cost of current High band detectors
- The perfect companion to Safe and Sound Pro II RF Meter
- Digital display in $\mu\text{W}/\text{m}^2$ and V/m - peak and average readings - Peak Hold
- Response Time < 50 μs
- Battery Life of 6 Hours with sound
- Audio feature – each source has unique sound – 3 levels

S & S Pro mm Wave Meter – LED Indicators



4 Colored LEDs like the Pro II and Classis II:

Red	Red (Fast Flash) 100,000 - 500,000 $\mu\text{W}/\text{m}^2$	Red
Red	Red (Flash) 10,000 - 100,000 $\mu\text{W}/\text{m}^2$	Red
Red	Red 1000 - 10,000 $\mu\text{W}/\text{m}^2$	Red
Orange	Orange 100-1000 $\mu\text{W}/\text{m}^2$	Orange
Yellow	Yellow 10-100 $\mu\text{W}/\text{m}^2$	Yellow
Green	Green 1-10 $\mu\text{W}/\text{m}^2$	Green
Green	Green (Flashing) $< 1 \mu\text{W}/\text{m}^2$	Green

S & S Pro mm Wave Meter – Antenna Reception Pattern

Horn - Directional
35 degree Beam width
Front only
Left Right and Up and Down

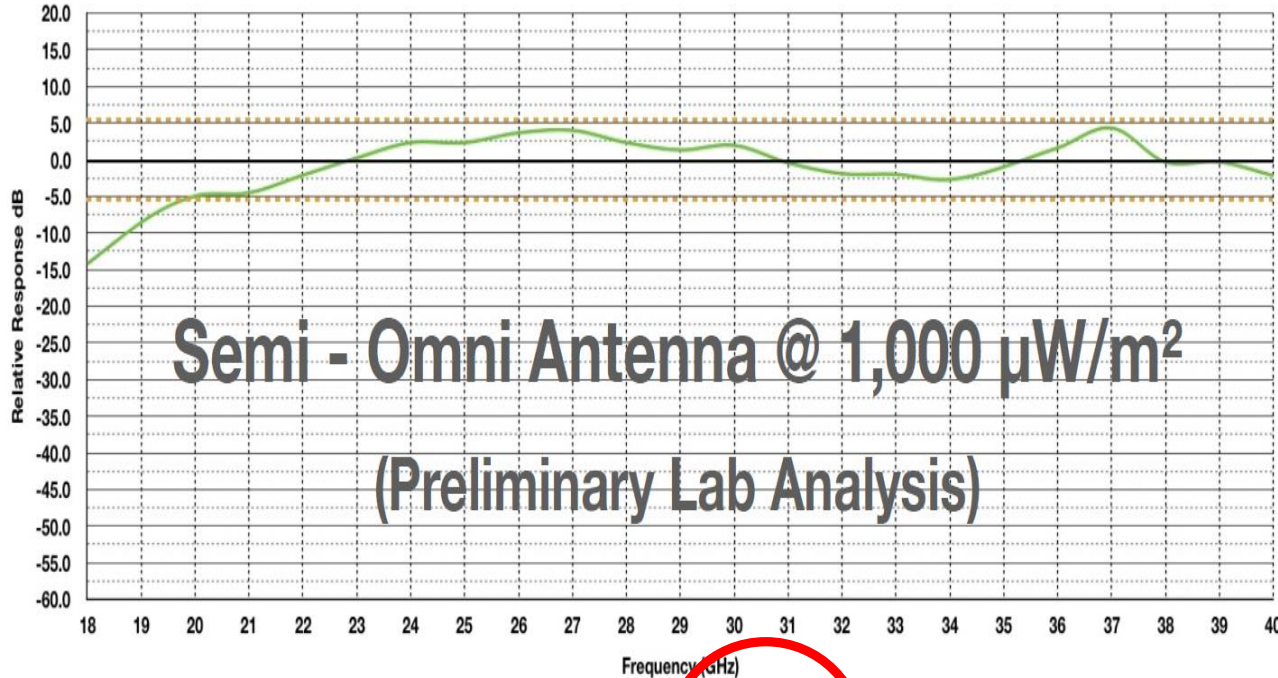


Stub – Semi Omni Directional
50 degree Beam width
Front and Back
Left Right and Up and Down



Stub Will yield higher readings

S & S Pro mm Wave Meter - Specifications



Stub Antenna :Semi Omni-directional

Frequency Response: +/- 5dB from 20-40 GHz (effective down to 18 GHz with reduced tolerance)

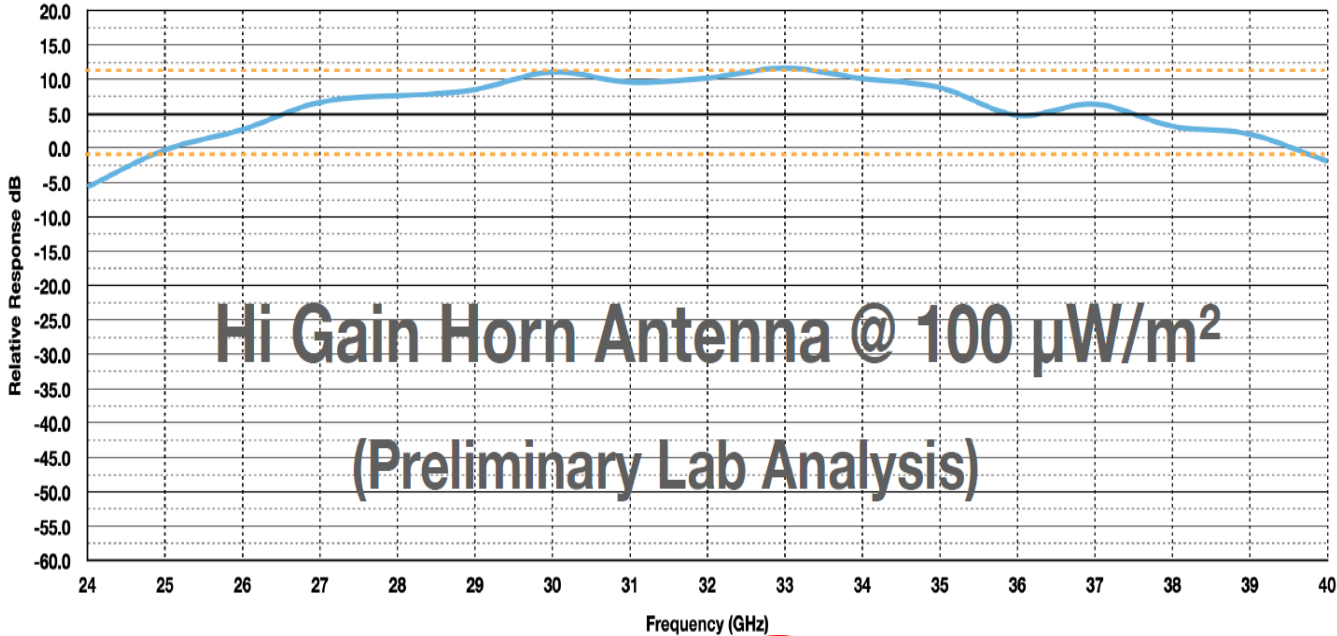
Minimum measurable signal: 5 $\mu\text{W}/\text{m}^2$

Maximum measurable signal: 500,000 $\mu\text{W}/\text{m}^2$ or (50,000,000 $\mu\text{W}/\text{m}^2$ with attenuator)

Reception Pattern: Semi Omni-Directional reception pattern (50 degrees front and 50 degrees back)

Best reception: Best to have SLT Logo on Stub Facing the source, blank side faces the user

S & S Pro mm Wave Meter - Specifications



Horn Antenna - Directional

Frequency Response: +/- 6dB from 25 GHz - 40 GHz

Minimum measurable signal: 0.5 $\mu\text{W}/\text{m}^2$

Maximum measurable signal: 30,000 $\mu\text{W}/\text{m}^2$ or
(3,000,000 $\mu\text{W}/\text{m}^2$ with attenuator)

Directional reception pattern (35 degrees front)

Antenna: Customized for SLT

S & S Pro mm Wave Meter - Specifications



Attenuator

(-20dB or 100X signal reducer)

Frequency Response: DC (0 Hz) - 40 GHz

Attach between antenna and meter

Multiply display reading x 100

Allows the meter to display higher power density signals by a factor of 100

Range of up to 50,000,000 $\mu\text{W}/\text{m}^2$ with Stub Antenna + Fixed Attenuator

Range of up to 3,000,000 $\mu\text{W}/\text{m}^2$ with Directional Horn Antenna + Fixed Attenuator

S & S Pro mm Wave Meter - Specifications



Attenuator (Built in Power Overload Protection)

This RF detector chip is susceptible to damage if exposed to continuous high levels of RF

Overload Protection is activated when the following Power Density levels are exceeded:
Stub Antenna (> 500,000 $\mu\text{W}/\text{m}^2$ sustained)
Horn Antenna (> 30,000 $\mu\text{W}/\text{m}^2$ sustained)

Meter will power down after 3 seconds of elevated exposure and display a warning message

To read these higher power densith levels, Install attenuator

S & S Pro mm Wave Meter - Operation



Startup

Self Calibration

Battery Life

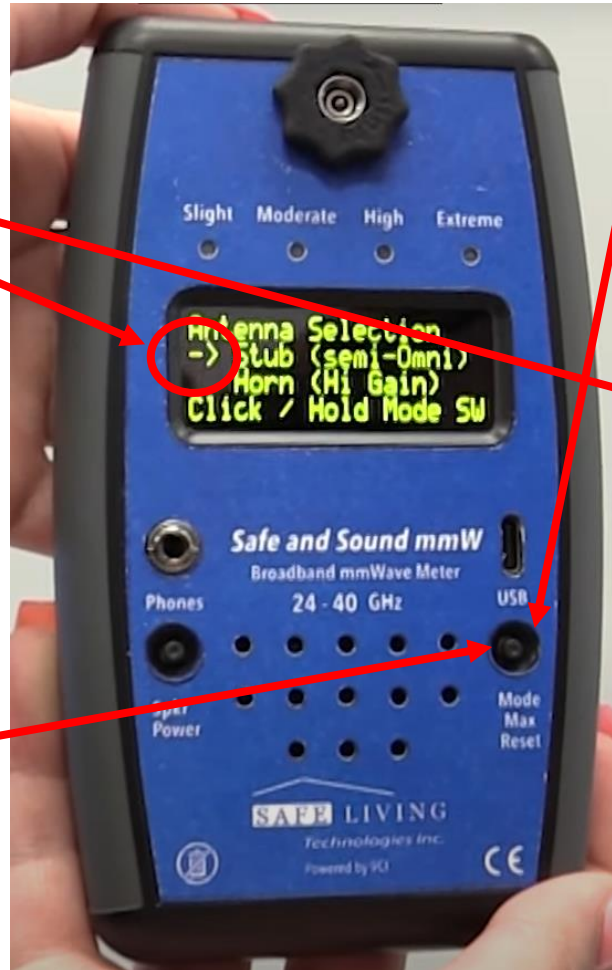
Can run continually if plugged into USB C Power

S & S Pro mm Wave Meter - Operation

Select Antenna Type VIA the Mode Switch (SW)

Press Mode Switch once to Toggle Antenna (Stub/Horn)

Press and Hold Mode Switch for 3 seconds to Select and Set Desired Antenna



S & S Pro mm Wave Meter - Operation

Measurement Types:

Peak

Peak Max

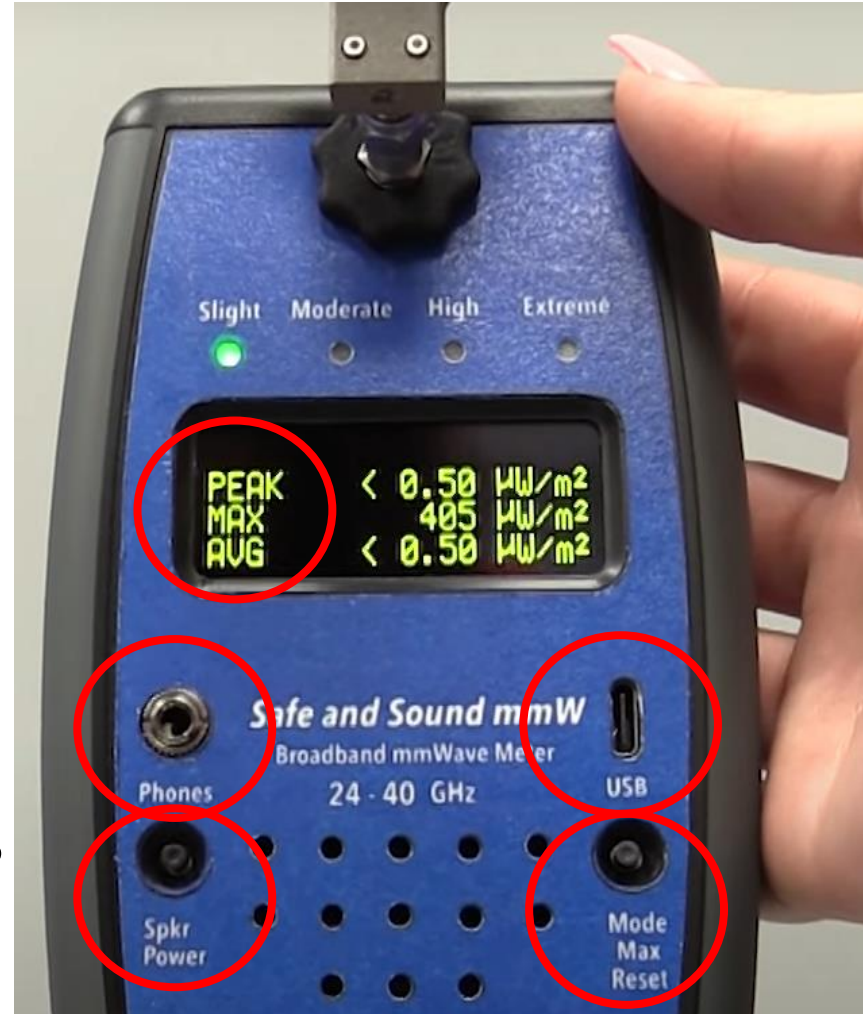
Average

Headphone Jack

3.5mm

Speaker/Sound 3 levels

Power



Power via USB Port
Continuous monitoring

Mode to select
Antennas
Max Reset
Hold to change units of
Measurement $\mu\text{W}/\text{m}^2$
to V/m

S & S Pro mm Wave Meter – Future Meters

Some Possible Options:

(200MHz – 8 GHz) + (20 GHz – 40 GHz)

8 GHz - 20 GHz

40 - 60 GHz – (60 GHz = High Band WiFi)

60 GHz - 90 GHz - (75 GHz = Car Radar)

Send us your suggestions!



EMF Meter – Safe and Sound EM3

Frequency Range – 50 Hz to (100kHz-150kHz) – Final testing required



- 3 in 1 Low Frequency meter: AC electric, AC magnetic fields and Body voltage
- Developed and made in North America – Professional Level
- Accurate – 3rd party certified +/- 0.5 dB or better (Final testing required)
- The perfect companion to Safe and Sound Pro II RF Meter
- More cost effective than the NFA1000
- Digital OLED display
- Powered by battery or USB power for continuous monitoring
- Common Sources: AC power lines, home electrical wiring, appliances and anything that consumes AC Power

Features:

3 axis Mag Meter

1 Axis E Meter

Body Voltage Meter

Cost: \$599 USD Release Date: Aug 2023 approx.

[Check website for more details!](#)

Thank you!

**For attending today's session
To all of our Beta Testers
And for considering adding these meters
to your EMF Tool Kit**



Rob Metzinger

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

June 28, 2023

Oram Miller, BBEC, EMRS

Certified Building Biology Environmental Consultant,
Electromagnetic Radiation Specialist

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Introduction

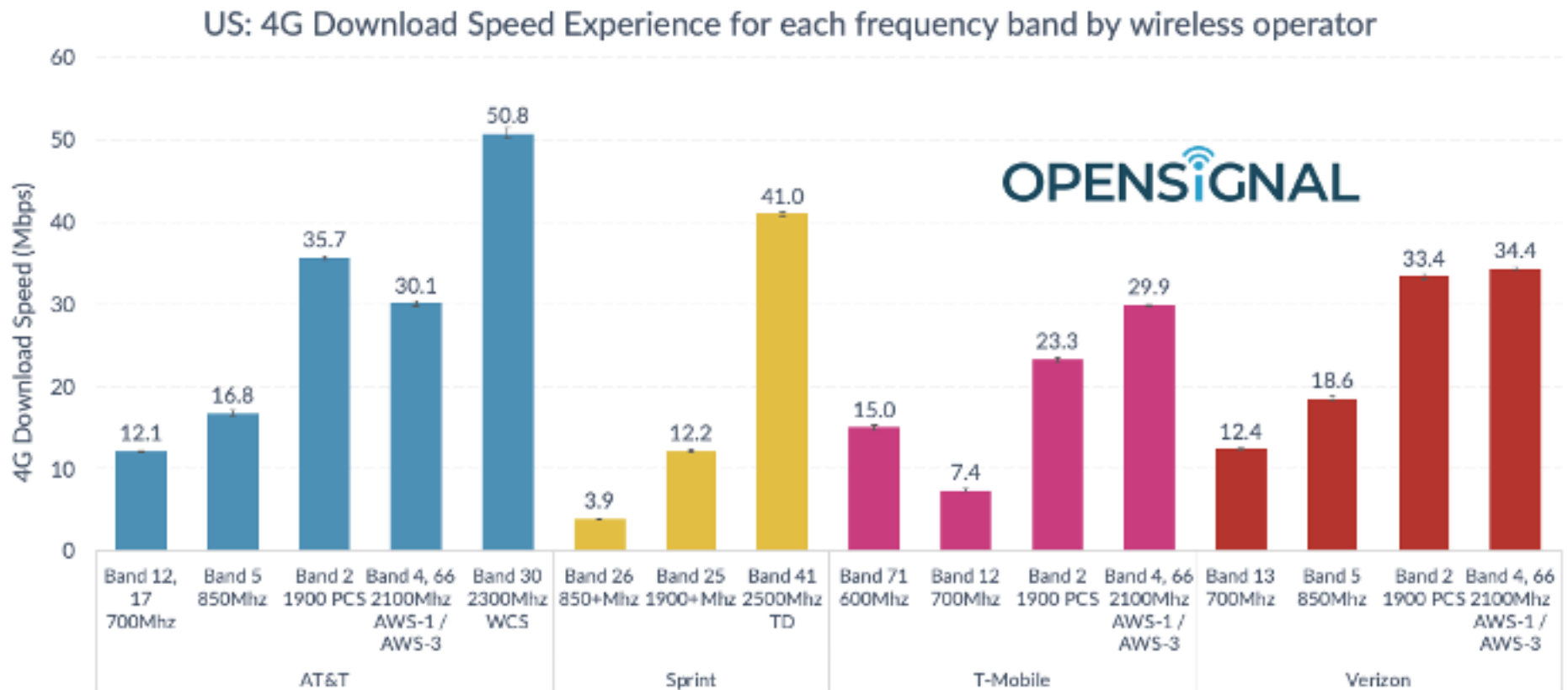
- ▶ I acquired the Safe & Sound mmWave 5G RF meter in early June 2023 as a beta tester
- ▶ I also had the FM5 mmWave 5G RF meter since late 2022
- ▶ This presentation covers field testing in June 2023
- ▶ More info on 5G in 57-page online 5G course on Building Biology Institute website, <https://buildingbiologyinstitute.org/course/electromagnetic-radiation/5g/>
- ▶ Also in 5G article on my website, with update and PPT, at www.createhealthyhomes.com/education/5g

5G Coverage by U.S. Cell Carrier

- ▶ **Low band 5G** (600 MHz to 1 GHz) — *repurposed* 4G LTE:
 - ▶ T-Mobile at 600 MHz for 200 million customers
 - ▶ AT&T's "5GE" (5G Enhanced) at 850 MHz for majority of customers
 - ▶ Verizon's "5G Nationwide" at 850 MHz for majority of customers
- ▶ **Mid band 5G NR** (1-6 GHz):
 - ▶ T-Mobile at 2.5 GHz (inherited from Sprint with merger in April 2020)
 - ▶ 3.4-3.5 GHz CBRS and 3.5-4.2 C-Band four carriers (Ver, AT&T, Dish, U.S. Cellular)
 - ▶ Verizon's C-band service called "5G Ultra Wideband" (along with mmWave service)
- ▶ **High, mmWave band 5G NR** (28 & 39 GHz):
 - ▶ Verizon's "5G Ultra Wideband" service — combined C-band and mmWave, in more than 100 cities covering 175 million people — went nationwide in Q1 2023
 - ▶ T-Mobile's "5G Ultra Capacity" service — combined 2.5 GHz and mmWave
 - ▶ AT&T "5G+" in 19 cities — mostly sports arenas, stadiums and airports

Characteristics of 5G Usage in U.S.

- ▶ Start with 4G LTE data download speeds
- ▶ Varies from roughly 12 to 50 Mbps
- ▶ T-Mobile merged with Sprint in April 2020

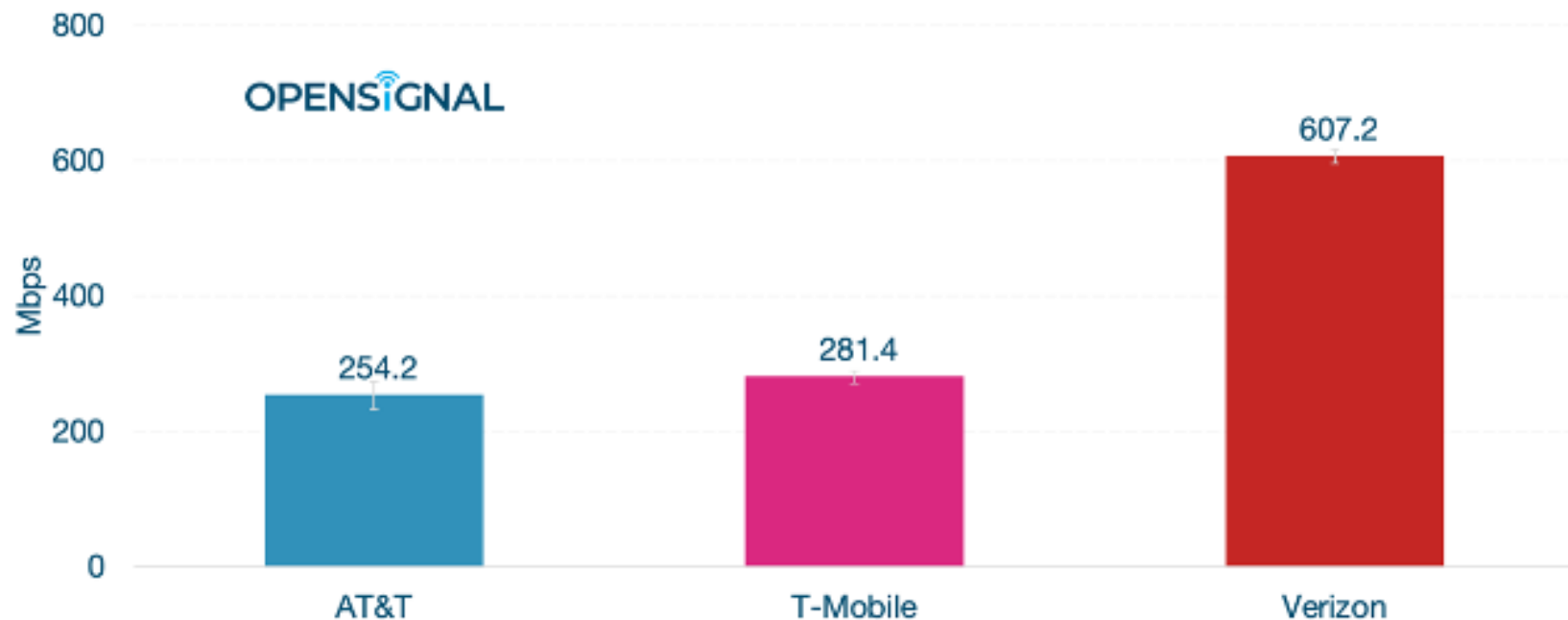


Data collection August 1 - October 30, 2019. Note: band represents primary band in use.

Characteristics of 5G Usage in U.S.

- ▶ mmWave download speeds 10-100 times faster than 4G LTE
- ▶ Verizon leads other carriers

Average download speeds on mmWave 5G in the US, by carrier

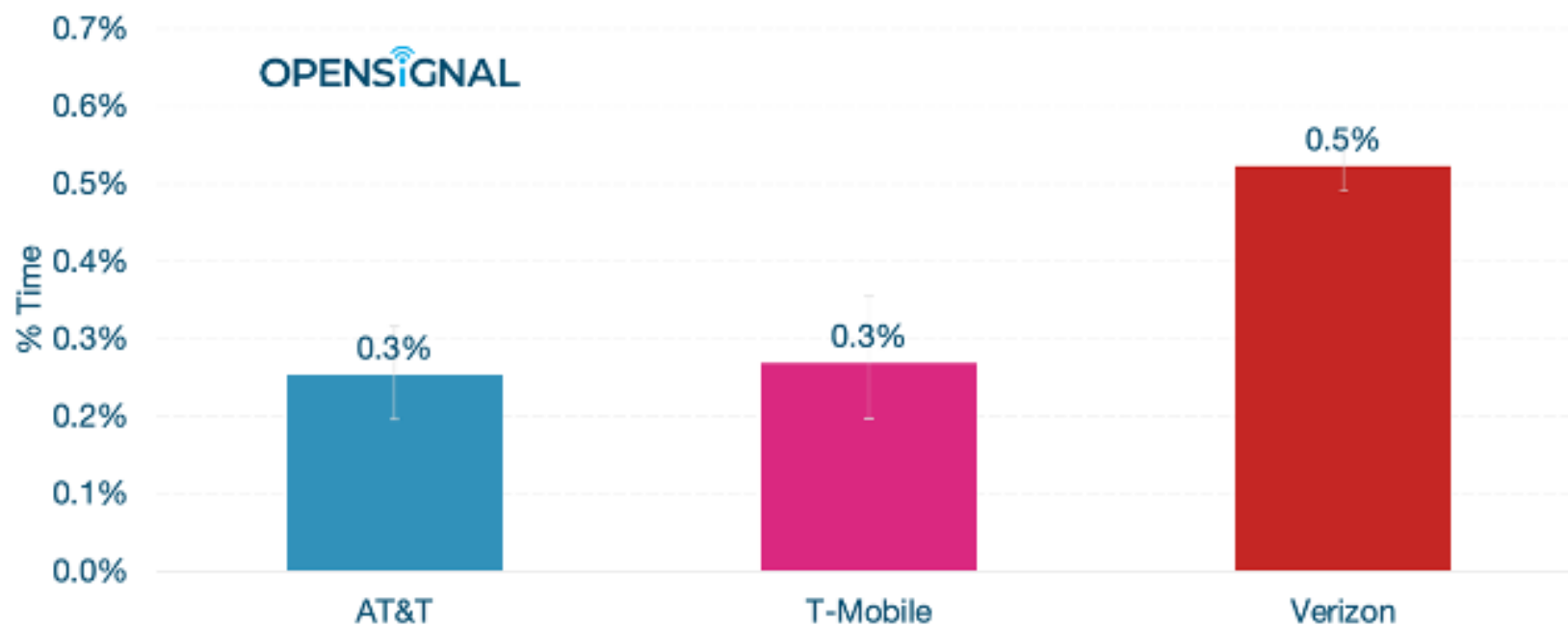


Data collection period: June 14 – September 11, 2021 | © Opensignal Limited

Characteristics of 5G Usage in U.S.

- ▶ However, 5G mmWave service **less than 1%** of cellular connections
- ▶ mmWave 5G service only available in urban and suburban areas

Average time with an active mmWave 5G connection in the US, by carrier

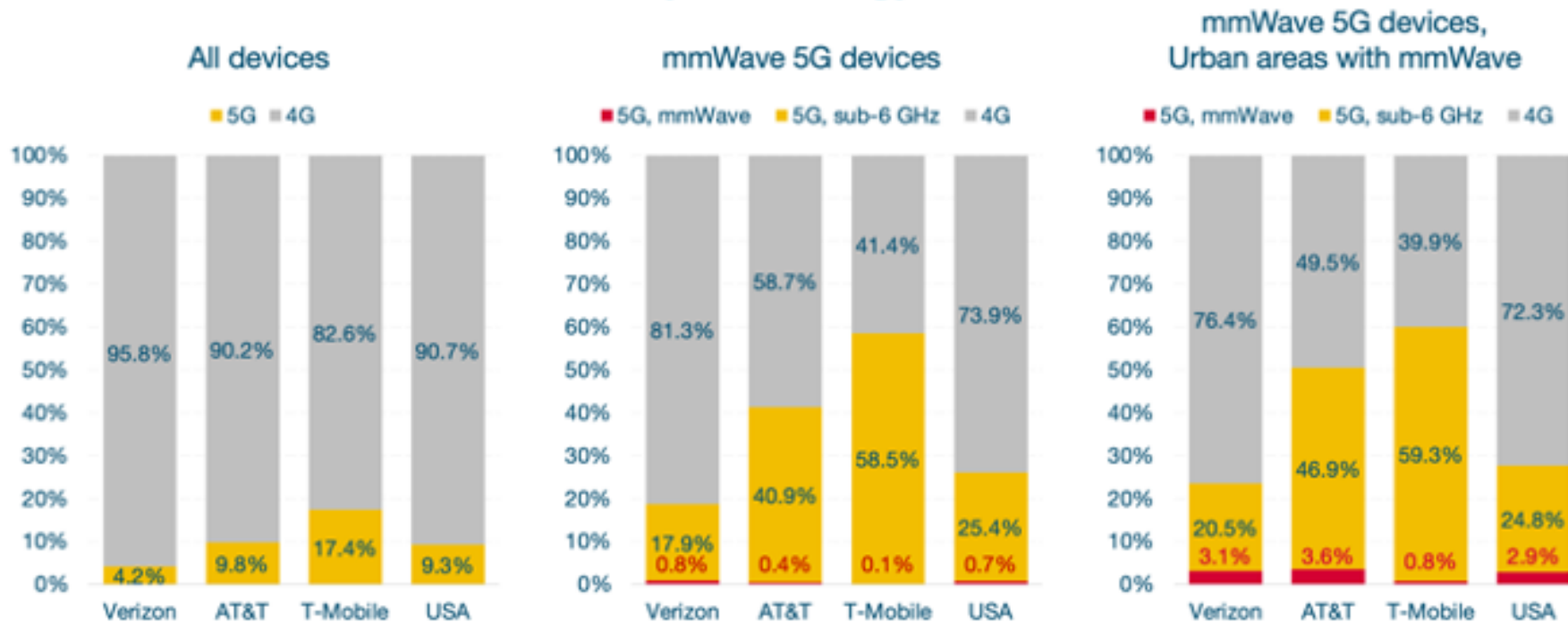


Data collection period: June 14 – September 11, 2021 | © Opensignal Limited

Characteristics of 5G Usage in U.S.

- ▶ 5G includes low, mid and mmWave band
- ▶ 4G LTE still dominates
- ▶ Most 5G is sub-6 GHz (low and mid bands)

Share of US mobile data traffic, by technology



This analysis excludes data consumed on 3G and 2G networks. We also exclude mobile data that could not be confidently assigned to either network technology, for example when the connection moved from a 4G network to 5G, and vice versa. Data collection period: Jul. 1 – Jul. 31, 2021 | © Opensignal Limited

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<https://www.opensignal.com/2021/09/22/mmwave-5g-provides-a-big-capacity-boost-to-us-users-in-high-traffic-areas>

Oram Miller, BBEC, EMRS

History of My mmWave Testing

- ▶ I have used the FM5 for over six months and had not found mmWave cellular signals in front of any client's home in suburban residential areas
- ▶ I do find low and mid-band 4G LTE and 5G with S&S Pro II
- ▶ I had not had the time to look for mmWave signals in urban areas; I only used FM5 when I went to client's homes
- ▶ I only took the time to look for mmWave signals in urban areas when I obtained SLT's mmWave RF meter as a beta tester, and found them recently on busy boulevards

mmWave Antennas in California

- ▶ Verizon mmWave antennas in Santa Monica, California



mmWave Antennas in California

- ▶ Verizon mmWave antennas in Santa Monica, California



mmWave Antennas in California

- ▶ Verizon mmWave antennas in Los Angeles, California



mmWave Antennas in California

- ▶ What mmWave antennas sound like (click each image to play video)



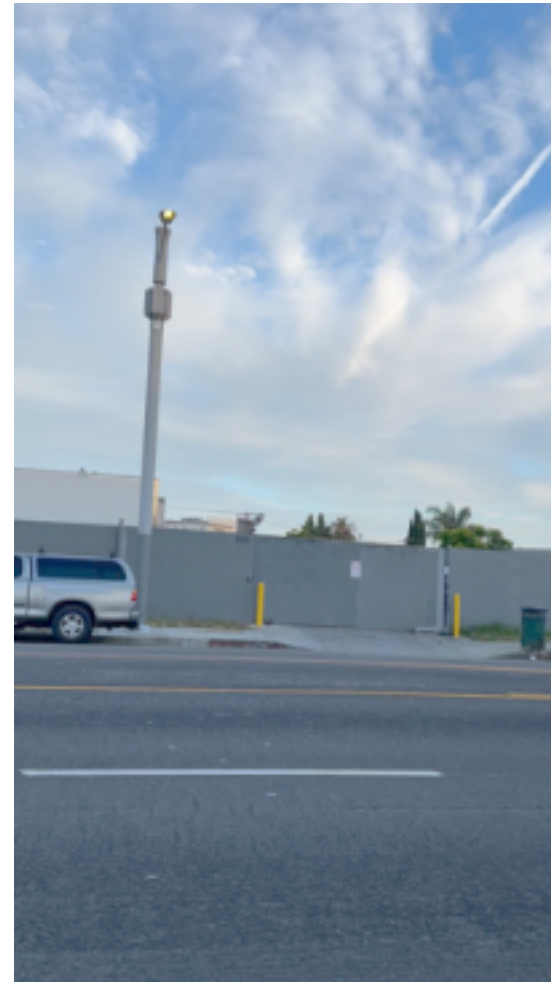
mmWave Antennas in California

- ▶ mmWave RF meter with horn antenna vs. stub antenna (click each image to play video)



mmWave Antennas in California

- ▶ mmWaves blocked by walls; not so much by glass (click each image to play video)



mmWave Antennas in California

- ▶ mmWave signals *much* weaker than 4G LTE at same distance (click each image to play video)



Details of Field Testing

- ▶ mmWave cell signals are no longer on-demand as they initially were since early years of 5G starting in 2018
- ▶ Currently-measured mmWave antennas are always-on
- ▶ mmWave signal is consistent in power flux density (PFD) across full 120 degree-wide transmission pattern side to side, just like 4G LTE and low and mid-band 5G
- ▶ Power density of mmWave signal is *significantly* less strong than 4G LTE at same distance from antenna array
- ▶ Generally only 100-1,000 $\mu\text{W}/\text{m}^2$ vs. 10,000-250,000 $\mu\text{W}/\text{m}^2$

Details of Field Testing

- ▶ mmWave signals dissipate quickly with distance and were not measurable beyond one city block away from antenna
- ▶ Compare that to 4G LTE and low and mid-band 5G that travel at high power densities for one mile or more
- ▶ I am not measuring mmWave signals in residential suburban neighborhoods
- ▶ mmWave signals are so far confined to main boulevards with foot traffic and commercial and apartment buildings

Details of Field Testing

- ▶ mmWave service is primarily an outdoor phenomenon, supplementing low and mid-band 4G LTE and 5G service
- ▶ mmWaves do not penetrate building walls well
- ▶ Shielding would be highly effective when used
- ▶ mmWaves do penetrate Low-E glass roughly 50-70%
- ▶ Film, metal mesh screen and RF curtains could be effective on and over windows and need to be tested

Details of Field Testing

- ▶ mmWave signals *not* dependent upon presence of cell phone
- ▶ Verizon mmWave antenna signal power density unrelated to whether my Verizon iPhone had 5G enabled, disabled, or was in Airplane Mode or off — different than early 5G era since 2018
- ▶ But my Verizon iPhone emitted high RF levels, $>500,000 \mu\text{W}/\text{m}^2$
- ▶ RF signals from Verizon iPhone not present when my iPhone is not near a Verizon mmWave antenna
- ▶ Only phones from same carrier that installed antenna will have 5G transmissions from cell phone turned on by antenna

Details of Field Testing

- ▶ I measured higher mmWave readings on my mmWave RF meter when passersby walked by, presumably with their Verizon cell phone triggered by Verizon mmWave antenna
- ▶ These high RF levels from cell phones may be a stronger health threat than actual mmWave signals from antenna
- ▶ Granted, mmWave signals from antenna are beam-formed
- ▶ I do not know if RF from cell phones triggered by mmWave antenna is beam-formed — needs to be researched

Value of Using mmWave Antenna

- ▶ Considering you will likely not see mmWave signals in suburban residential areas, mmWave RF meter is valuable for reassuring clients they do not have “5G” outside their house
- ▶ They are greatly relieved!
- ▶ Also see where mmWave service does exist in urban areas
- ▶ Show how strong and pervasive 4G LTE and low/mid 5G is
- ▶ Show how strong RF levels are from all the portable wireless devices within a client’s personal space (cell phones, tablets, laptops)

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