# Create Healthy Homes

**Environmental Design and Inspection Services**


Oram Miller, BBEC, EMRS
Certified Building Biology® Environmental Consultant
Electromagnetic Radiation Specialist
11693 San Vicente Blvd., #342
Los Angeles, California 90049

Phone 310.720.7686
info@createhealthyhomes.com
www.createhealthyhomes.com


## Synopsis of 5G Article by Oram Miller on www.createhealthyhomes.com

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*This is a synopsis of material presented in an article on 5G Cellular Technology that I wrote on my website, createhealthyhomes.com. The direct link to the article is https://createhealthyhomes.com/five_g.php .*

*That updated 5G article includes new Summary Tables that provide useful information on what cellular carriers provide 4G and 5G service at each band (low, mid and high/mmWave) and how they differ by characteristics. I also provide links to 5G coverage maps for each of the four major cell carriers in the US.*

**Where This Information on 5G Is Available**

Besides my own 5G article on my website, at https://createhealthyhomes.com/five_g.php, I have written about this topic in an article available on the Building Biology Institute website as a paid online course, entitled, "5G: Understanding The Technology & Protection Strategies", available at https://buildingbiologyinstitute.org/course/electromagnetic-radiation/5g-cellular-phone-systems/. A three-page fact sheet available on that same page is free and can be distributed.

**How I Obtained This Information**

Most of this information was obtained from a 5G trade show that I attended here in Los Angeles this past October (2019) each of the past two years. I listened to lectures and attended booths sponsored by cell antenna manufacturers and several cell carriers. The conferences were attended by 22,000 engineers and others in the 5G industry. It was very interesting to see this issue from their perspective.

I learned an incredible amount of detailed knowledge and took copious notes. I have also learned a great deal from industry publications. Much of that information is in articles I have written, the one for the Institute and the other on my own website. I have also explained this information in several interviews. Links to those interviews that are currently available are found in the 5G article on my website.

**5G Has Two Parts**

In essence, the confusion that exists about 5G is that it actually has two parts. The first is in what is called the low (600 MHz to 1 GHz) and mid (1 GHz to 6 GHz) bands, or as it is also known, sub-6 GHz 5G. The other part is in the high or millimeter wave (mmWave) band beginning at roughly 20 GHz and going up to several hundred GHz. That is also known as the super-20 GHz band. (In the US, no cell service will exist between 6-20 GHz for the foreseeable future.) This mmWave band above 20 GHz is what most people associate with the term 5G.

There is much confusion as to what 5G means in these two bands, the sub-6 GHz band and the super-20 GHz or mmWave band. The characteristics of cell signal transmissions within these two bands depends upon the physics of each band, meaning its frequencies, wavelengths and the modulation involved with shaping the signals.

**Multiple Input, Multiple Output (MIMO) in 4G Compared to 5G**

Since mmWave signals above 20 GHz have short wavelengths, they cannot pass through normal building materials. Signals therefore need to be beam formed in order to get through walls. That is where *massive* Multiple Input, Multiple Output, or MIMO, comes in.

Right now, existing 4G LTE macro cell antennas use 2T2R (two transmit, two receive) or 4T4R (four transmit, four receive) arrays on each 4G LTE antenna. That defines the maximum number of signals they can transmit in any direction, with about ten or so mobile cell customers served per array. Cell carriers are upgrading existing 4G equipment that have had 2T2R antennas with 4X4 antennas in what is known as "LTE Advanced". This doubles the amount of signals in a given air space.

Cell antennas in the high, mmWave band, on the other hand, must use multiple small antennas arrayed in a square or rectangle, up to 8 or more across and 8 or more high. That allows 64 or more antennas to simultaneously send signals that can be shaped electronically, using phased array, to send the combined signal from all 64 of them in one direction or another. This process is called beam forming or beam steering. AI (artificial intelligence) in the radio beneath (or embedded within) the antenna directs the whole process. Multiple signals can be sent out at once to multiple handheld user devices, such as 5G-enabled cell phones. This is the only way that 5G cell signals in the mmWave band can penetrate walls and windows, and not very well at that.

Beam forming using Massive MIMO can also be used down to 2 GHz. Thus, Sprint uses this technology for its 2.5 GHz 5G service. As explained below, they are able to devote 32 antennas of the 64 antenna array to 4G and the other 32 to 5G, or with a software change, all 64 can be devoted to 5G. This is all at the 2.5 MHz frequency. What differentiates the 4G from the 5G signal? The amount of modulation and pulsing that occurs in creating and shaping the cell signal. Modulation and pulsing of cell signals, as you will see below, have a significant impact on our health and are a great concern to 5G activists and advocates.

4G LTE macro cell antennas broadcast at power levels up to 1,000 Watts Effective Radiated Power (ERP), which can travel up to 1 mile (and farther). Therefore, 4G LTE macro cell antennas are spaced about 1 to 1.5 miles apart. About 300,000 of them currently exist in the US. 4G LTE macro cell antennas are about three feet tall and skinny, about ten inches wide. You see them mounted on buildings and poles, pointed in various directions. Each slender antenna contains 4 or 16 antennas, which are larger than new 5G antennas because the wavelength of existing sub-6 GHz 4G LTE signals is 4-15 inches in length.

**Small Cell Arrays Will Have 4G/5G Hybrid Antennas and 5G Standalone Antennas**

New small cell antennas, on the other hand, will be located in neighborhoods between existing 4G LTE macro towers and most prominently in dense urban areas. They will transmit at 10 or 100 Watts ERP, not 1,000 Watts like existing 4G LTE antennas. Small cells will use both 4G LTE and 5G technology. Some small cell antennas will be hybrids with both 4G and 5G technology, while standalone 5G transmitters will also be put up. I was told at the trade show that for every 4G/5G hybrid small cell antenna, there will be two to three more 5G standalone antennas around them.

The majority of these 5G standalone antennas will broadcast in the low and mid bands. These include the nationwide rollout of T-Mobile's 600 MHz 5G service and AT&T's 850 MHz "5G Evolution" service to large parts of the US.

Sprint is rolling out their 2.5 GHz mid band "True Mobile" 5G service in large areas of nine cities throughout the US.

5G service in the high/mmWave band above 20 GHz is also provided by T-Mobile in much more limited service in six cities. AT&T provides mmWave "5G+" service in limited areas of 25 cities, but only to business customers. You need a different 5G phone from T-Mobile and AT&T to access these mmWave signals than you do to connect to their low band nationwide network.

Verizon has almost of all of their 5G presence in the mmWave band at 28 and 39 GHz, with a smaller amount of coverage in the upper mid band at 5.2 GHz.

See my website 5G article for more information about what each cell carrier is doing at each frequency and links to coverage maps on each carrier's website.

It is important for everyone to understand that the majority of new small cell antennas are 4G, using what is called LTE Advanced technology. This includes 4X4 antennas, carrier aggregation, and 256 QAM. All of these technologies increase data download speeds and the number of cell signals and information broadcast in the same airspace, but at the same strength as before. All new 4G antennas will have the capacity to be upgraded to 5G through software changes, but what kind of 5G that means depends upon the frequency band the 4G antenna is broadcasting in. 4G is only in the low and mid bands, so any upgrade to 5G would not involve beam forming unless it was broadcasting above 2 GHz in the mid band.

New 4G LTE Advanced and 5G cell signals are far more modulated than past generations of cell technology. They utilize polarized, pulsed signaling. This modulation and pulsed signaling may account for recent increases in health symptoms in residents living near new small cell antennas. Reports are emerging that certain individuals are reacting to new cell antennas, while they did not react to existing 4G LTE technology used for years.

This is important in my consideration of how one can protect oneself, as you will see.

**How mmWave 5G Signals Get Through Walls**

Massive MIMO, to be used as part of 5G technology, involves new 64T64R (and more) antennas. This means eight by eight antenna arrays totaling 64 or more in number, all packed into a rectangular antenna about the size of a pizza box. Each of the 64 antennas is smaller than the 4 or 16 antennas on 4G towers because the wavelength for mm wave 5G signals is less than one inch in size (only a few millimeters).

5G small cell antennas use artificial intelligence to shape the way the beams travel out from all 64 antennas at once. This allows the antenna to send a beam of data in a particular direction with highly focused energy, as has been discussed by many in our community. 5G arrays that use beam forming can send signals to multiple cell phones at once, or if only one subscriber is in front of it, that 5G-enabled phone will get all four signals. That would be highly focused energy for the person holding that phone.

**mmWave 5G Signals Are On Demand and Narrow**

One important distinction to understand between 4G LTE and 5G technology is that 5G signals in the mmWave band are sent on-demand. This is misunderstood by many who think 5G beam formed signals in the mmWave are always on. Instead, they only transmit when a 5G-enabled device calls for a connection. Then the 5G signal is sent out in a narrow beam using beam forming technology. Otherwise, the mmWave 5G small cell antenna is dormant (except for a weak, intermittent reference signal—see below). 5G small cell antennas using the mmWave band will not be sweeping the neighborhood with strong, focused beam formed signals, as some think.

## 4G LTE Signals Are Always On, Wide and Strong

4G LTE signals, on the other hand, *do* bathe a neighborhood with strong, always on RF energy at widths of 120 degrees. They are every bit the culprit as 5G signals in this story.

Some engineers told me that a beam formed 5G signal, when it does transmit, is 2 degrees wide, others said it is up to 15 degrees wide, so I write 2-15 degrees wide. Since the signal is 10-100 Watts, it does not go as far as a macro 4G signal at 1,000 Watts. The industry says small cell signals at 10 to 100 Watts travel roughly 1-1.5 blocks, however Verizon has logged 1+ Gbps download speeds at 28 GHz at half a mile.

4G LTE signals from small cell antennas, on the other hand, are, as I have said, always on regardless of the power density, whether 10 or 100 Watts, as on new small cell antennas, or 1,000 Watts, as on existing macro cell towers. Small cell antennas with 4G LTE transmitters would therefore send out a constant RF signal that is 120 degrees wide and shaped like a cone. Even though it would be transmitting at 10-100 Watts, the 4G LTE signal from one of those small cell antennas could be as close as 30-100 feet from your house at the second story level. I discuss below the very high RF levels that have been measured in second story bedrooms from these 4G LTE signals.

## 4G Is as Problematic as 5G—Measuring and Shielding

5G activists with whom I have spoken who helped us write the 5G article for the Building Biology Institute told me they are most concerned with the presence of *4G LTE* transmitters on new small cell antennas being much closer to people's homes on every street, even if they transmit at only 10 or 100 Watts (compared to 1,000 Watts for macro towers). At least you can measure the 4G LTE signal from a small cell antenna with every RF meter/detector we have available to us, because they use low and mid band sub-6 GHz frequencies, all of which we can measure with our RF meters. Also, most RF-shielding materials will shield signals in these bands, including paint, building foil and RF-shielding fabrics.

In the super-20 GHz mmWave band, 5G signals will also be able to be blocked by solid RF-shielding materials like two layers of paint or foil. Also, Aaronia has a silver fabric that appears to block signals in those mmWave frequencies (https://www.aaronia.com/Datasheets/Screening/Shielding_fabric_Aaronia_Shield_50dB.pdf ), but all other fabrics won't do as well. Their RF-shielding pattern is on a downward path on the graph as you approach 18 GHz, which is as high as we can measure with current equipment. See https://www.slt.co/Downloads/Shared/All_Fabrics_Shielding_Line_Graph.pdf.

## How Does 5G Work at Low Band Frequencies?

As to the question about what exactly is considered to be 5G in the low and mid bands below 6 GHz, I asked that very question of antenna manufacturers at the 5G industry conference. I knew that beam forming can be used down to 2 GHz, which is in the mid band, involving massive MIMO, but I asked them about the new 600 MHz signals used by T-Mobile that is also touted as 5G. One company had antennas that could transmit both 4G and 5G at 600 MHz for T-Mobile that showed how much signal was being emitted using 4G technology and how much used 5G technology on spectrum analyzers.

Their answer was that 5G in the low and mid bands involved more modulation of the signal to make it faster and to have more signals sent out in the same airspace. This is not massive MIMO and not beam forming, not below 2 GHz. They use carrier aggregation and 256 QAM, or quadrature amplitude modulation (higher than before). Quadrature amplitude modulation has to do with how the signal is shaped and transmitted and it determines how much information can be sent in a given airspace and at what speed. Up until now, they have used less than 256 QAM. This new level of technology, at 256, is an improvement over previous generations of the technology. I personally do not understand the technology, but that was what I learned.

The net result is faster download speeds and lower latency using existing frequencies below 6 GHz. Latency is the speed with which signals translate into action, meaning, how real-life the sending and processing of data becomes. This has an impact upon the realism of virtual reality and the reliability of self-driving cars and other tasks.

I have learned to follow most of the lingo used by the industry, but it certainly is a language unto itself, and the engineering concepts are quite complex.

**Relatively Slower Download Speeds in Low to Mid Bands vs. Faster Download Speeds in mmWave Band**

In practical terms, what the manufacturer’s reps told me and what I learned in lectures and industry articles was that 5G in the low to mid sub-6 GHz band would essentially be what they call, "enhanced 4G LTE" or "5G-lite". Right now, 4G LTE is capable of delivering about 30 Megabits per second on average, or Mbps of data download speed. That is what we are all used to now when downloading or streaming data and videos.

5G in the low to mid sub-6 GHz band will be increased to about 200-300 Mbps. That’s it. That is what T-Mobile is advertising now with the recent rollout of their new 600 MHz nationwide 5G network. Their claim is that they have the jump on their competition because they are using their existing 600 MHz 4G LTE network, which has been enhanced on their new 5G network using new 5G-enabled phones with new carrier aggregation and modulation technologies to send more data at the same frequencies as their 4G LTE network uses now. Signals at 600 MHz have the longest wavelength of any cell signals in the US. 600 MHz is the lowest frequency used by any cell carrier but it has the longest wavelength, about 15 inches or so. That penetrates building walls very easily and travels the farthest.

AT&T will follow soon with their own rollout of a nationwide 5G network at 850 MHz, which is also in the low band. Again, download speeds will be in the low hundreds of Mbps and it will essentially be enhanced 4G. However, like the T-Mobile 5G network at 600 MHz, AT&T's 5G network at 850 MHz will use already existing frequencies and will therefore travel far and get into buildings well. Both T-Mobile and AT&T also have spectrum at other frequencies in the super-20 GHz mmWave band. In addition, T-Mobile and Sprint are hoping to merge, expanding their networks to one large network using low, mid and high/mmWave band frequencies.

Cell signals in the super-20 GHz mmWave band, on the other hand, which is where everyone in our community thinks 5G only exists, will be able to transmit data at never before seen speeds of 1,000 to 2,000 Megabits per second (Mbps) or 1-2 Gigabits per second (Gbps). That is thirty to sixty times faster than we currently have. That means downloading videos at super fast speeds with much lower latency. However, those signals don't go very far and they are easily blocked. That is why industry has resisted for so long in using frequencies above 20 GHz.

Specifically, mmWave frequencies have such a short wavelength, only a few millimeters or a half an inch, they only go a relatively short distance and cannot easily pass through walls. Even rain, moisture and air molecules themselves easily block mmWave signals. Satellite TV has used these mmWave frequencies above 20 GHz for decades. If you put a satellite dish inside your attic, under your roof, you get no signal. The mmWave signal used by satellite TV companies for years does not pass through regular shingles and plywood. The dish has to be on the roof with no trees in the way.

Verizon is primarily using signals primarily in the mmWave band for their new 5G network, with smaller holdings in the upper mid band at 5.2 MHz.

**5G Small Cell Antennas Will Transmit a Weak Reference Signal**

One thing I learned at the 5G trade show was that small cell mmWave 5G antennas do send out what industry calls a reference signal looking for a 5G-enabled device. Those bursts will last 10 or 20 milliseconds and will occur a few times a minute. To conserve power, this signal is very weak. It was measured at -60 to -70 dBm, or decibels per meter, at two booths on the recent trade show floor, where measuring devices were located. We used $35,000 to $60,000 spectrum analyzers to measure 28 GHz 5G signals coming from antennas in the rafters of the Los Angeles Convention Center. Those antennas were not part of the show. They have been installed by a cell company for attendees of all the trade shows at the Convention Center.

That -60 to -70 dBm signal is equal to 0.1 to 0.01 microWatts/meter squared. You can see that equivalence by clicking on http://media.withtank.com/fb49c6376d.pdf and scrolling down on the chart to -60 dBm and then scrolling over to the column for uW/m2 (microWatts/meter squared).
That -60 to -70 dBm would be measured outside a house conceivably coming from a beam formed 5G signal sent in the mid or high/mmWave band from a small cell antenna

located in front of your house. The walls and window glass of your house would then block that signal considerably from getting into the house. Granted, no one wants to have any RF coming to their house from any source, but a signal that weak and at that wavelength would not penetrate walls very well. That 0.1 to 0.01 microWatt signal would also be overshadowed by the 5-20 microWatts/meter squared or more RF signals I routinely measure standing in front of every urban and suburban home I evaluate in my EMF practice here in Southern California coming from distant 4G LTE cell towers all around most houses. Those 4G signals have a much longer wavelength and do penetrate the walls of every house. You have to be out in the country to avoid having 4G LTE towers nearby.

In fact, in most homes that I evaluate, I routinely measure 20-150 microWatts/meter squared of RF in second story bedrooms, where neighbor's houses don't block the signals mostly coming in from nearby outside 4G LTE macro cell towers. How do I know that these RF signals are from cell towers? By the high-pitched squealing sound they make that I have learned to associate with cell towers. I have seen and heard this on my Gigahertz Solutions HF59B RF meter for years (and now also on my Safe & Sound Pro II RF meter). Sometimes the WiFi of my client's router or a neighbor's router is mixed in, but the strength of the neighbor's signal drops off with distance.

That is the milieu in which we all live in any city or town in America before small cell antennas of any kind are added. We already have a toxic soup of 4G LTE signals right now. Fifth generation (5G) cell technology to be implemented over the coming decade will add many more 4G LTE and 5G small cell antennas to our neighborhoods, especially in dense cities (if they are not stopped through neighborhood efforts).

**5G-enabled Cell Phones Must Be Stationary to Receive 5G Signals**

Beam formed 5G signals in the mmWave band are best received when the 5G-enabled cell phone is stationary inside someone's house. When the phone is moved around, it will be passed from one zone to another coming from the 5G antenna, or it will be passed back to a nearby 4G LTE tower or to the person's indoor Wi-Fi network with data flowing at slower speeds. (Dynamic 5G where the 5G small cell antenna can track the phone as it is moved around is not yet possible, but engineers expect that to happen within a few years.) The fast 5G download primarily happens when the 5G-enabled phone is kept in one place. Journalists for Wired magazine lost the 5G signal and were switched back to slower 4G when they walked into stores when testing 5G downloads in test cities. They only received the fast 5G signal when outside on the city sidewalk.

Also, 5G-enabled cell phones do not currently send data back at 5G mmWave frequencies, according to engineers with whom I spoke. They use 4G LTE frequencies and protocols when sending data back to a 5G tower.

Alasdair Phillips wrote a very succinct piece recently saying that 5G in the mmWave band will primarily be deployed in dense urban areas. It is not considered by industry as a carrier or blanket network because it does not go as far nor does it penetrate building materials as sub-6 GHz signals do, which are now 4G LTE and will be expanded and upgraded to 5G.

**4G LTE Will Be Transformed to 5G in Low and Mid Bands**

4G LTE technology in the slower low and mid sub-6 GHz bands will all gradually be transformed to 5G technology in the coming decade, again using carrier aggregation, 256 QAM and other modulation techniques. This is happening now with what is called "LTE Advanced" technology. Beam forming and the use of massive MIMO will involve signals down to 2 GHz, but not below that frequency. However, download speeds will only be marginally faster than current speeds, hence the terms "enhanced 4G" and "5G-lite". None of this is good from a biological standpoint, especially for those living, working and visiting in dense urban areas and some suburbs.

**What to Pay Attention to in Neighborhoods**

I say, what you really don't want is a 4G LTE small cell antenna in front of your house. This is because the 4G LTE antenna will be always on, transmitting RF 24/7 into your house with a signal that is 120 degrees wide. Again, even if it is only 10 to 100 Watts and not 1,000 Watts like an existing 4G LTE cell tower a mile away, the new 4G LTE small cell antenna in front of your house will be only 30-100 feet away with always on 4G cell signals. Colleagues have measured up to 400,000 microWatts/meter squared of RF power flux density with their Gigahertz Solutions HF59B RF meter in second story bedrooms. (You can also measure this well with the Acoustimeter RF meter (http://www.aitsafe.com/go.htm?go=www.lessemf.com/rf.html&afid=51307&tm=90&im=#139)—measuring in peak, not average—as well as the new Safe and Sound Pro II RF Detector from Safe Living Technologies—https://slt.co/Products/RFMeters/SafeandSoundProIIRFMeter.aspx).

Remember, if you can measure an RF signal with your RF meter coming from any small cell antenna, you are measuring the 4G LTE signal transmitting in the low or mid band, not a super-20 GHz mmWave 5G signal. Our RF meters cannot measure 24, 28 or 39 GHz, which are the frequencies cell carriers are using in the mmWave band (with more frequencies to come as they are auctioned off by the FCC).

In my efforts to help my electrically sensitive clients to avoid RF exposure from coming Fifth Generation cell technology, I am telling them that as they oppose small cell antennas in their neighborhood, if a small cell antenna does end up in front of their house in spite of their efforts to stop it, what they *don't* want, as I said above, is a 4G model. The 4G LTE signal will be always on and constantly broadcasting in a wide path.

The super 20 GHz mmWave 5G signal, on the other hand, from that small cell antenna will be on-demand. When it does transmit, the signal will be 2-15 degrees wide, aimed at the house of the neighbor who has a new 5G-enabled cell phone. This sounds like heresy, but I am realizing that if one only has a beam formed mmWave 5G antenna in front of their house *instead of* a 4G LTE small cell transmitter, that would be somewhat less of a threat because that beam formed 5G antenna would not be transmitting high levels of RF energy into their house on a constant basis, as would be the case with an additional 4G LTE antenna.

That beam would be narrow and only sent into the home of a neighboring customer with a 5G-enabled phone. This is also only in certain urban neighborhoods. 5G service in the low band, on the other hand, from T-Mobile and AT&T would be different, meaning, not beam formed, more wide and always on.

From what I have learned from multiple engineers, that is my current understanding. I am in no way saying a small cell antenna of any kind is safe in front of anyone's house. I am saying, if it happens that the EHS people with whom I work end up having a mmWave beam formed 5G antenna in front of their house, that might not be as devastating as having a 4G LTE antenna of any power, because 4G LTE antennas are always on and their signal is wide.  Neither belong in residential neighborhoods and we need to join organizations and individuals protesting the placement of small cell antennas of any kind in residential neighborhoods.

I have seen 4G LTE antennas covered in a cylinder at the top of a small cell array on a light pole, with a square pizza box-sized rectangular 5G antenna below it. Below both is another box, which is the radio for both antennas.

If a 5G antenna (without the cylinder or some other 4G shape) does go up in front of one of my clients' houses, if they don't get a new 5G-enabled cell phone, or if they shut that feature off (I believe you can do that), then I contend that that narrow 5G beam formed signal will not go into their house when it is sent out from that 5G antenna to their neighbor's house. This may be somewhat of a silver lining, but it in no way means anyone should not still oppose the presence of a small cell antenna in their residential neighborhood. I want to be clear about that. I am only trying to help my EHS clients in case a mmWave 5G antenna does end up on their street.

How can you tell if a small cell antenna is a mmWave 5G antenna and not a 4G antenna? Once it is activated, if you cannot measure a signal with your RF meter, it will be a 5G antenna transmitting in the mmWave band. If you do measure a strong signal on your RF meter that you know is coming from that antenna, then it has a 4G or a low band 5G transmitter in it.

You can put your RF meter in front of your chest and turn around in a circle in place. If the RF signal on your meter drops when your back is to the antenna and increases when you turn so that you are facing it, and if the RF signal level and sound increases as you walk towards it, that is proof that that is the source. You will also have other signals mixed in from stronger 4G cell antennas farther away that all sound the same (a high-pitched squeal), but you can use your hands to block the signal on different sides of the RF meter and use your body. The water in our bodies and hands is an excellent shield that blocks RF signals. This helps determine the direction of RF sources.

If you have a 4G small cell array near your house, you can shield the RF signals with Y-Shield paint (two layers) or building foil, plus window shielding. That will block both 4G LTE and 5G signals in the low to mid band, as well as super-20 GHz 5G signals. (Fabric, except the Aaronia silver fabric, will not block mmWave 5G signals well.)

**Don't Forget the Many RF Sources Inside Your Home**

Also, it goes without saying that everyone needs to pay extra attention to eliminating *all* RF sources inside your homes, including Wi-Fi, Bluetooth, etc. from cell phones, tablets, laptops, cordless telephones, smart TVs, etc. We have hardwired alternatives for all of that. Go to my website on the Safer Use of Computers page, at https://createhealthyhomes.com/safercomputers.php.

I see clients worry about 5G who have RF all throughout their house daily. Clients often have me evaluate their homes because of fears of 5G. We routinely find a half-dozen sources of very high RF right inside the house. Chief among them are the clients' cell phones. Bluetooth is now on constantly on most iPhones that I measure. Check that out with your RF meter and listen to the sounds cell phones make, right in your pocket.

This is all very complicated, to say the least, but I hope it has helped. I suggest that folks consider reading through this material more than once, possibly with some time between readings so the information sinks in. You will pick up and rem11ember more of it with each re-reading.

I also suggest that you consider downloading the online course on 5G that we wrote on the Building Biology Institute website at https://buildingbiologyinstitute.org/course/electromagnetic-radiation/5g-cellular-phone-systems/.