Create Healthy Homes

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Summary Points on 5G
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These are summary points on the topic of 5G, as 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 these Summary Points. The article also presents new Summary Tables that provide useful information on the 4G LTE and 5G services provided by each cellular carrier in the U.S. 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 U.S.

Summary points regarding 5G

- My primary goal is to provide information to those who are electrically sensitive to help them understand how 4G and 5G work, how to measure it, and how to protect themselves from the radio frequencies (RF) that 4G and 5G emit. I leave activism and advocacy to others who have the time to devote to that effort.
- As you take steps to oppose the deployment of 4G and 5G antennas near homes in residential neighborhoods, you must also pay attention to RF sources, and other EMFs, within your own home. EMFs and RF are silent, invisible and odorless. Follow these three rules: Reduce use, increase distance, and favor hardwired alternatives wherever and whenever possible.
- 5G has three parts: The high, millimeter wave (mmWave) band and the low to mid bands.

- The low to mid bands are contiguous and range from 600 MHz to 6 GHz. Those frequencies have been used for 1G through 4G LTE (first through fourth generation) cell service for forty years.
- The high, mmWave band starts at roughly 20 GHz and has never been used for cell service in the U.S. until now.
- The gap between 6 and 20 GHz is filled with radio frequencies used in the U.S. for decades for other purposes, including satellite, aviation, military, radar, police and other needs. The FCC has not allocated frequencies in that gap for cell service in the U.S.
- 5G, fifth generation cell service, is not the same as 5G on your router, which is shorthand for 5.8 GHz, a WiFi and cordless telephone frequency. 5.8 GHz, along with 2.4 GHz, are unlicensed frequencies allocated to router and cordless telephone manufacturers by the FCC so they can sell devices that transmit radio frequencies without the purchaser needing an FCC license to operate them.
- The 5G that everyone knows and fears, with beam-formed signals that are focused and can harm your skin, eyes and other organs, is in the high, mmWave band (and also in the mid band down to 2 GHz).
- 5G service in the high mmWave band, which some people call “true 5G”, is currently limited to some streets in certain neighborhoods within select cities, as well as places where lots of people gather (stadiums, arenas, convention centers, city centers, airports, college campuses, parks, metro stops). That is where the most customers are, so that is where industry is focusing its mmWave 5G deployment. Those cell carriers that have 5G service in the mmWave are in the process of expanding their coverage in those urban areas.
- 5G in the mmWave band has the fastest download speeds (1,000-3,000 Megabits per second, or Mbps, which is also 1-3 Gigabits per second, or Gbps, and beyond) but it is not the predominant deployment of 5G in the U.S.
- The bulk of 5G in the U.S. is in the low and mid bands. That type of 5G is really “4G Enhanced” or “5G Lite” with 30-900 Mbps (Megabits per second), with most new service realistically averaging 100-200 Mbps. That is roughly three to six times the download speeds we now have with 4G LTE, which currently averages 20-30 Mbps.
- 5G in the low and mid bands already now covers much of the U.S. and that is expanding rapidly.
- Cell signals, whether 4G or 5G, in the low and mid bands can easily pass through walls and they travel far, up to many miles. They are considered by industry to provide true “coverage spectrum” for customers in wide geographic areas because they cover such large distances with moderately faster download speeds compared to current 4G service.
- 5G in the low band does not use beam-forming but it does use advanced technologies, such as: carrier aggregation; 4T4R (four transmit, four receive) Multiple Input, Multiple Output (MIMO) radios and antennas vs. 2T2R MIMO radios and antennas used with current 4G LTE service; License Assisted Access (LAA); LTE-Machine Type Communication (LTE-M); Narrowband Internet of Things (NB-IoT); and 256 Quadrature Amplitude Modulation (QAM). All of these advanced technologies push more cell signals into the same airspace at faster speeds with far more modulation than current 4G cell technologies.

- Modulation of cell signals has harmful biological effects on all life (WiFi signals within your home are also heavily modulated—don't use them—use hardwired Ethernet connections, instead).
- This modulation of cell signals transmitted in the low and mid bands from new 5G and 4G LTE-Advanced small cell radios and antennas popping up everywhere probably accounts for the majority of people living near these antennas who report the onset of health symptoms not experienced previously.
- 5G signals in the mmWave band also cause symptoms, but their deployment in certain areas of urban neighborhoods is more limited compared to 5G and new 4G LTE-Advanced antennas in the low and mid bands.
- 5G in the mmWave band, which is limited in the U.S. to metropolitan areas with high population densities, is on-demand and only sends its signal to a small slice in front of each antenna, roughly 10 degrees wide, and only when a 5G-enabled phone that operates in the mmWave band calls for a connection. That mmWave 5G signal will only go into that house where a 5G-enabled phone is located, not into neighbor's houses.
- 5G in the mmWave band is not considered by industry to be a coverage spectrum serving large geographic areas like 5G and 4G service in the low and mid bands is. 5G in the mmWave band is expected to be most successful in limited urban areas and primarily for outdoor use. It does not pass into buildings well at all. When you move a mmWave 5G-enabled phone, it reverts back to 4G coverage.
- The biggest number of new small cell antennas popping up in suburban residential neighborhoods have 4G Advanced LTE technologies. That includes all the technologies listed above (carrier aggregation, 4X4 MIMO, LAA, LTE-M, NB-IoT, and 25 QAM).
- These 4G LTE-Advanced radios and antennas can be switched to 5G at a later date with a software upgrade. If the 4G/5G antennas are in the low band, that is, below 2 GHz, the 5G signals will not be beam-formed with massive MIMO capabilities.
- Specifically, many new radios and antennas being installed at small cell sites have Dynamic Spectrum Sharing (also known as Dynamic Spectrum Switching), or DSS, which allows the antennas to send out 4G or 5G signals at the same time from the same antenna at the same frequency, depending upon the needs of the user's cell phone. It is said that cell phones will smoothly switch back and forth between 5G (if it is available) and 4G. Again, if the 4G frequencies are below 2 GHz, then the 5G service will not be beam-formed but it will certainly be modulated, which has its own deleterious health effects.
- This is how cell carriers are deploying 5G in the U.S., by piggybacking it onto existing and new 4G technology and antennas.
- If you are therefore not near a city center and you see a new antenna go up on a utility or light pole in front of your house, chances are it is a 4G LTE-Advanced antenna, but through DSS, it can also have 5G capabilities.
- If, on the other hand, you are near a city center, you can have a pole in front of your house that may have two or three 4G antennas inside a cylindrical covering on top of the pole, broadcasting in the low or mid band, along with a flat, pizza box-sized rectangular antenna mounted a bit lower on the pole broadcasting 5G in the mmWave band—the signal of which will be on-demand and narrow. Download the synopsis of

this article to see photos of 4G and 5G antennas, by clicking on 5G_synopsis_2_20_20.pdf .

- 4G antennas mounted inside the cylindrical covering on top of poles or appearing as short, two-foot long narrow antennas will be always-on and send out wide coverage that is shaped like a 120 degree-wide cone in front of it.
- Cylinders usually have two to three 4G LTE antennas back to back inside of them, pointing up and down the street if there are two. Those signals will catch houses on either side of the street. If there are three antennas inside, some will point directly at nearby houses in a diagonal direction. 4G small cell antennas can also look like a narrow, short flat panel, roughly two feet high.
- Existing 4G LTE macro cell antennas are placed one or two miles apart. They look like the traditional thin, tall antennas we have seen for years. They transmit at up to 1,000 Watts Effective Radiated Power (ERP). Their signals travel up to 1 to 1.5 miles (and farther).
- 4G Advanced LTE and 5G small cell antennas in residential neighborhoods transmit at up to 10 to 100 Watts ERP (sometimes more), which is lower than 4G LTE macro cell antennas, but they are much closer to people's homes and their cell signal is always-on. RF levels of tens to hundreds of thousands of microWatts/meter squared have been measured in second story bedrooms in the path of nearby 4G and low/mid band 5G small cell antennas.
- We can measure 4G LTE-Advanced and 5G antennas in the low and mid bands with our existing RF meters. Our RF meters only go up to 8-10 GHz. The low and mid bands stop at 6 GHz, so we can measure 4G LTE-Advanced and 5G antennas transmitting in those low and mid bands.
- 5G in the mmWave band starts at 24 GHz. We don’t have accurate RF meters to measure those frequencies (but remember, their signals are idle until called for by a 5G-enabled cell phone). You need spectrum analyzers to measure those higher frequencies and they are very expensive. Lower cost (under $1,000) RF meters to measure 5G in the mmWave band are in development by several engineers and companies.
- Presently you need a different cell phone to receive 5G cell service at these different bands. Current cell phones that receive 5G in the low and mid bands cannot receive 5G in the high, mmWave band and vice versa (that will change in the near future).
- See tables in my 5G article (https://createhealthyhomes.com/five_g-44.php#2) with specific information on 5G service provided by each of the major cell carriers throughout the U.S. You can also see a list of 5G service in U.S. cities on the website, Android Central by clicking on https://www.androidcentral.com/heres-every-us-city-5g-coverage-right-now .
- All four U.S. cell carriers are deploying massive numbers of 4G LTE-Advanced small cell antennas in urban and suburban residential neighborhoods—that is the predominant deployment of new cell antennas near homes. 5G activists are saying they are seeing as many, or more, cellular permit applications for new 4G small cell service in residential neighborhoods as 5G. However, remember that these new low and mid band 4G small cell antennas will all have the capacity to be switched to 5G service in the future with a software update.

- We can shield our homes against 4G LTE-Advanced and 5G signals in the low and mid bands with RF-shielding paint, building foil, metal mesh insect screen, window film and RF-shielding fabrics.
- We can shield mmWave 5G signals with only paint and foil. Mesh screen and fabric don't work as well at blocking mmWave frequencies in the mmWave band as they do at lower frequencies. The one exception appears to be Aaronia's Silver Mesh fabric, which reportedly maintains its shielding capabilities above 20 GHz. It is available at https://www.aaronia.com/Datasheets/Screening/Shielding_fabric_Aaronia_Shield_50dB.pdf .
- Finally, the strongest RF signals many of you encounter now and will encounter in the future are not from antennas outside your house. They come from the many wireless devices we keep inside our homes, close to our head and body.
- First and foremost among them is your cell phone. RF levels can be as high as 1 to 2 million microWatts/meter squared (uW/m2) at close range from a cell phone or cordless telephone. Cell phones also emit strong RF on standby, 24/7. At the very least, disable your Bluetooth and WiFi on your cell phone. Remember, these signals are also more modulated now than they used to be.
- Right now, 5G-enabled cell phones transmit back to 5G cell towers using 4G technology, but that will change, where your cell phone itself will be sending back data signals using modulated 5G technology.
- The strength of an RF signal drops off exponentially with distance, but it can still be quite strong from a current cell phone on standby, over 5-10 thousand uW/m2 at 4-5 feet, beyond arm's length. We say, RF power densities above 1,000 uW/m2 are an extreme biological anomaly for sleeping areas, and we want our clients to be down to 10-100 uW/m2 as much as possible (and below 1-10 uW/m2 for children and electrically sensitive people.) See my profession's Building Biology Evaluation Guidelines at https://createhealthyhomes.com/bb_standards.php .
- RF, and other EMFs, are silent, invisible and odorless (unlike cigarette smoke). You don't know these frequencies are present in your house and personal space until you purchase an RF meter, especially one with sound, and see for yourself how strong they are right near you. See a list of suggested RF meters in my 5G article, at https://createhealthyhomes.com/five_g.php#3 .
- I cannot emphasize enough the possible harm to people's health coming from the various wireless devices many of us use and have in our homes. Pay attention to this while you also organize to halt deployment of small cell antennas in your neighborhood.
- Remember these three recommendations for cell phone and wireless use: Reduce use, increase distance, and favor hardwired connections whenever and wherever possible. You can put your cell phone in Airplane mode, making sure WiFi and Bluetooth are off while in Airplane mode, and do most every function on your cell phone on a different, hardwired device when inside your house. That includes talking, texting, emailing, audio and video streaming, and using various apps. See below in this article and elsewhere on my website for recommendations on how to do that.