

## **Wireless Health & Safety Concerns – Information provided by Verizon**

**15 minute report by CNBC:**

[https://www.youtube.com/watch?time\\_continue=13&v=Ag1hkv2Upww&feature=emb\\_logo](https://www.youtube.com/watch?time_continue=13&v=Ag1hkv2Upww&feature=emb_logo)

**Millimeter Wave Studies by the CTIA:**

dating back to 1976

<http://www.wirelesshealthfacts.com/wp-content/uploads/2020/01/Millimeter-Wave-Studies.pdf>

In an effort to continue to increase Verizon's transparency and communications, I want to provide you with the following resources regarding radio frequency health and safety. These resources are comprised from CTIA, the New York Times, and Verizon.

Following Resources:

*Verizon Cover Letter with hyperlinks to CTIA Resources (These links are key resources for valid research)*

*CTIA Testimony from leading scholar at the University of Pittsburgh*

*New York Times Article on 5G*

*Verizon Educational Handout*

*Verizon Question on 5G*

Furthermore, as I mentioned at the City Council Meeting on January 21st, 2020, Verizon wireless launched local websites to resource City residents in Spokane and Boise.

<http://improveyourwireless.com/spokane/>

<http://improveyourwireless.com/boise/>

Verizon can create a similar website for the City of Coeur d'Alene as an additional resource.

The IEE recently held a Wireless & 5G Forum at Gonzaga. The forum consisted of presentations from Dr. Robert Olsen, Professor Emeritus of Electrical Engineering WSU (on technology) as well as Dr. Martin Pall, Professor Emeritus of Biochemistry and Basic Medical Sciences (on biology). Attendees ranged from from both ends of the For/Against stance. I am working with other entities to provide more public forums for the public to attend and receive wireless information.

With all this being said, there is a lot of information here. Please do not hesitate to reach out to me for help in digesting any of this. I would be willing to walk through any of this information with you in a Council work session or individually. I continue to work with the City Councils within the region to bring the latest and greatest resources to you all.

Sincerely,

**verizon**  
**Jason Verduzco**

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March 4, 2020

City of Coeur d'Alene  
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Coeur d'Alene, ID 83814

Dear Mayor Widmyer, City Council, City Staff:

Thank you for the opportunity to provide an update from the wireless industry. On behalf of Verizon Wireless, we want to provide the Council with some additional data points in response to some of the feedback you have been receiving on health concerns. You may be aware that there was a Notice of Inquiry opened in 2013 requesting that the FCC reevaluate the health effects of Radio Frequency (RF). In December 2019, the FCC reaffirmed existing standards regulating RF emissions, including millimeter waves from 5G devices and equipment. The standards have wide safety margins and are designed to protect everyone, including children. Everyday exposure to RF energy from 5G small cells is well within those safety limits, and is comparable to exposure from products such as baby monitors, Wi-Fi routers, Bluetooth devices.

The interconnection of society and individuals with wireless technology continues to increase. We believe that the wireless industry, the community, and the City of Coeur d'Alene are best served by continuing the collaboration we have had to date in order to meet the needs of your constituents. Wireless technology is no longer a luxury; critical applications for 911 First Responders, medical device monitoring, education, and environmental responsibility all rely on a robust wireless infrastructure that is safe and aligns with Coeur d'Alene's aesthetic values.

The enclosed packet provides several reference materials from the CTIA and Verizon that may be of interest to you and your constituents. I will send this note electronically so you have the web links available for online access. Attached:

- [CTIA – Protecting Health and Safety](#)
- [CTIA FAQ](#)

I am available to answer any industry related questions or be a liaison to additional resources that can provide comprehensive information on the deployment of Small Wireless Facilities.

Yours sincerely,

Jason Verduzco  
Public Policy & Community Affairs  
Director – Eastern WA & Idaho

**verizon**<sup>v</sup>



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October 7, 2019

## Re: Health Effects of 5G Telecommunication Infrastructure

I have been asked by the CTIA to address any concerns over possible health effects related to 5G telecommunication infrastructure.

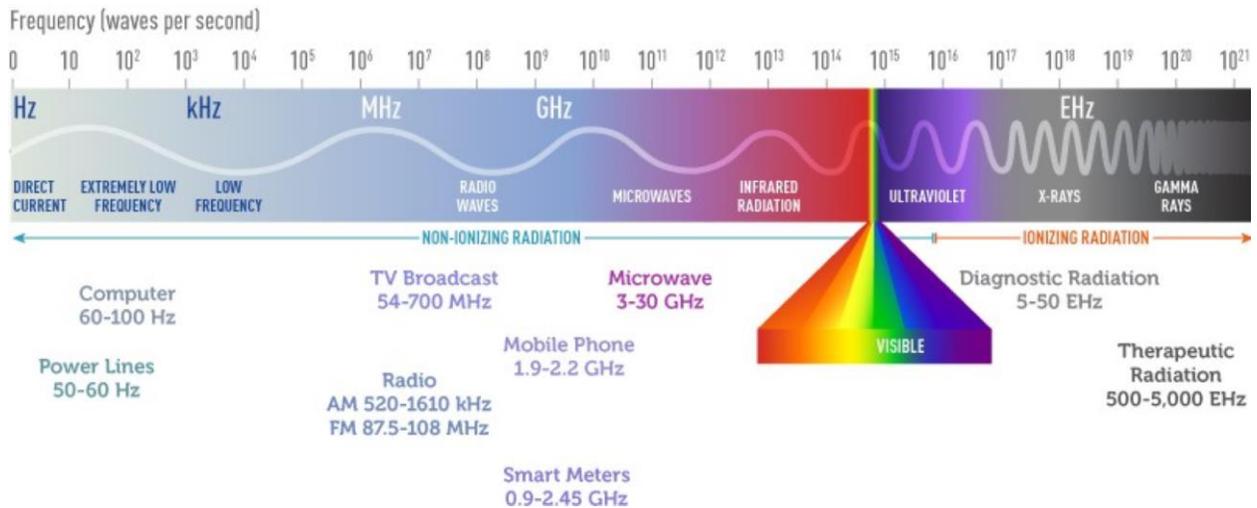
My name is Eric Swanson. I am a professor of theoretical physics at the University of Pittsburgh. I have published more than 100 papers on biophysics, nuclear physics, and condensed matter physics and given approximately 250 academic talks in 25 countries over a thirty-year career. I am the founder of the American Physical Society Topical Group on Hadronic Physics and an elected Fellow of the American Physical Society. I am also the author of *Science and Society* (Springer), *Applied Computational Physics* (Oxford University Press), and many newspaper and magazine op-eds and articles.

Because this report will be addressing issues concerning electromagnetic fields I would like to say a few words about what this is. Electromagnetic fields are waves that are created by moving charges (usually electrons) that traverse space at the speed of light. These waves are the *simplest phenomena known in the universe* and the physics related to them is well established. Waves only have three basic characteristics: frequency (how many times the wave oscillates per second), amplitude (the “height” of the wave), and polarization (we are most familiar with this via polaroid sunglasses). The figure below shows the “electromagnetic spectrum”, which is just a representation of the names that we apply to different frequencies of radiation. Notice that visible light is part of the spectrum. Other familiar parts are UV radiation at slightly higher frequency than visible light, x-rays at even higher frequency, and microwaves and radio waves at lower frequency.

When it comes to human health concerns there is an important distinction between different parts of the spectrum. While I could explain this in terms of physical concepts, it is probably more useful to appeal to things we all know. UV radiation can be harmful because it can cause sunburns and skin cancer. X-rays and the higher frequency gamma rays can be even more harmful (at sufficient doses X-rays can cause cancer and gamma rays can kill people outright). Alternatively, we can happily spend days or months under indoor lighting with no chance of getting sunburn or skin cancer. The reason for this is that visible light is *below* the threshold frequency for causing damage to molecules in our cells. This threshold is referred to as the ionization threshold: electromagnetic waves that can break DNA bonds are called *ionizing* and electromagnetic waves that cannot break bonds are called *nonionizing*. The electromagnetic fields emitted by a cell phone and wireless infrastructure are nonionizing radiofrequency (RF) fields.

The frequencies used by 4G cellphones are around 2 GHz (this means two billion oscillations per second). These frequencies are about one million times lower than UV frequencies, which places them well on the safe side of the ionization threshold. 5G cellphones and infrastructure operate at RF frequencies that are approximately 30000 times below the ionizing threshold.

## ELECTROMAGNETIC SPECTRUM



In the USA, 5G wireless infrastructure and 5G-capable cellphones are regulated by the Federal Communications Commission. All new equipment is tested and must comply with safety limits that have been set by the FCC. The FCC adopted the RF emission regulations based on standards recommended by international standards setting bodies such as the National Council on Radiation Protection and the Institute of Electrical and Electronics Engineers. It did so after consulting with federal health and safety organizations such as the FDA, Environmental Protection Agency, Occupational Safety and Health Administration, and National Institute for Occupational Safety and Health to develop “consensus” regulations. Together, these bodies have assessed thousands of scientific studies concerning possible health effects of nonionizing radiation. Animal tests and other studies indicate that thermal effects start to be felt at an energy deposition rate of approximately 100W/kg (this is called the *specific absorption rate*, or SAR)<sup>1</sup>. The FCC mandates that the general public be exposed to no SARs greater than 1.6 W/kg. In fact, according to the FCC, typical exposures near cellphone towers are hundreds or thousands of times lower than this figure. The FCC also mandates that *maximum permissible exposure* (called MPE, this is a measurement of the energy deposition rate by area) be lower than approximately 1 mW/cm<sup>2</sup>.<sup>2</sup>

<sup>1</sup> For comparison, the heating pad I use to warm my arthritic knees is rated at 50W. I estimate it warms about 1 lb of my body, so this rather pleasant heating corresponds to a SAR of 100W/kg.

<sup>2</sup> FCC 13-39 (March 2013), Appendix A.

The consensus of the world-wide health and government health and safety organizations is that non-ionizing fields at the levels allowed by the FCC regulations are safe. For example, federal agencies responsible for regulating the safety of cell phones and wireless infrastructure and leading cancer and health research institutions in the United States have not found any link between electromagnetic fields allowed by the FCC regulations and cancer or other adverse health effects:

**The Federal Communications Commission (FCC):** “As discussed above, radiofrequency emissions from antennas used for cellular and PCS transmissions result in exposure levels on the ground that are typically thousands of times below safety limits. These safety limits were adopted by the FCC based on the recommendations of expert organizations and endorsed by agencies of the Federal Government responsible for health and safety. Therefore, there is no reason to believe that such towers could constitute a potential health hazard to nearby residents or students.”<sup>3</sup>

**The Food and Drug Administration (FDA):** “Based on our ongoing evaluation of this issue, the totality of the available scientific evidence continues to not support adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits.”<sup>4</sup>

**National Cancer Institute:** “... although many studies have examined the potential health effects of non-ionizing radiation from radar, microwave ovens, cell phones, and other sources, there is currently no consistent evidence that non-ionizing radiation increases cancer risk in humans.”<sup>5</sup>

**American Cancer Society:** “At ground level near typical cellular base stations, the amount of RF energy is thousands of times less than the limits for safe exposure set by the US Federal Communication Commission (FCC) and other regulatory authorities ... Some people have expressed concern that living, working, or going to school near a cell phone tower might increase the risk of cancer or other health problems. At this time, there is very little evidence to support this idea.”<sup>6</sup>

Other worldwide health and safety organizations are in accord:

**European Commission, Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) (2015):** “Overall, the epidemiological studies on mobile phone RF EMF

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<sup>3</sup> FCC RF Safety FAQ <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety#Q15> (last accessed March 11, 2019).

<sup>4</sup> FDA Statement, Statement from Jeffrey Shuren, M.D., J.D., Director of the FDA’s Center for Devices and Radiological Health on the National Toxicology Program’s report on radiofrequency energy exposure, Nov. 1, 2018, <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm624809.htm>.

<sup>5</sup> National Cancer Institute, “Cell Phones and Cancer Risk” Factsheet (2019), <https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet> (last accessed March 11, 2019).

<sup>6</sup> American Cancer Society, “Cellular Phone Towers”, <https://www.cancer.org/cancer/cancer-causes/radiation-exposure/cellular-phone-towers.html> (2018) (last accessed March 11, 2019).

exposure do not show an increased risk of brain tumours. Furthermore, they do not indicate an increased risk for other cancers of the head and neck region.”<sup>7</sup>

**World Health Organization** (2006): “Recent surveys have indicated that RF exposures from base stations and wireless technologies in publicly accessible areas (including schools and hospitals) are normally thousands of times below international standards . . . From all evidence accumulated so far, no adverse short- or long-term health effects have been shown to occur from the RF signals produced by base stations.”<sup>8</sup>

**Health Canada** (2014): “The Panel has concluded that the balance of evidence at this time does not indicate negative health effects from exposure to RF energy below the limits recommended in the Safety Code.”<sup>9</sup>

**United Kingdom Health Protection Agency Independent Advisory Group on Non-Ionizing Radiation (HPA)** (2012): “In summary, although a substantial amount of research has been conducted in this area, there is no convincing evidence that RF field exposure below guideline levels causes health effects in adults or children.”<sup>10</sup>

**Swedish Council for Working Life and Social Research** (2012): “Extensive research for more than a decade has not detected anything new regarding interaction mechanisms between radiofrequency fields and the human body and has found no evidence for health risks below current exposure guidelines.”<sup>11</sup>

**Norwegian Institute for Public Health** (2012): “The studies have been performed on cells and tissues, and in animals and humans. The effects that have been studied apply to changes in organ systems, functions and other effects. There are also a large number of population studies with an emphasis on studies of cancer risk. The large total number of studies provides no evidence that exposure to weak RF fields causes adverse health effects.”<sup>12</sup>

Similarly, the **Institute of Electrical and Electronics Engineers’ International Committee on Electromagnetic Safety (IEEE/ICES)**, which is one of the expert organizations that the FCC relies on in setting its RF emission standard, analyzed 52 years of studies and concluded that “the weight of scientific evidence supports the conclusion that there is no measurable risk associated with RF

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<sup>7</sup> European Commission, Scientific Committee on Emerging and Newly Identified Health Risks, Opinion, “Health Effects of Exposure to EMF,” (2015) (available at [https://ec.europa.eu/health/scientific\\_committees/emerging/docs/scenih\\_r\\_o\\_041.pdf](https://ec.europa.eu/health/scientific_committees/emerging/docs/scenih_r_o_041.pdf)).

<sup>8</sup> World Health Organization, “Electromagnetic fields and public health: base stations”, (2006), <https://www.who.int/peh-emf/publications/facts/fs304/en/> (last accessed March 11, 2019).

<sup>9</sup> Health Canada, “A Review of Safety Code 6 (2013): Health Canada’s Safety Limits for Exposure to Radiofrequency Fields,” (2014) (available at [https://rsc-src.ca/sites/default/files/SC6\\_Report\\_Formatted\\_1.pdf](https://rsc-src.ca/sites/default/files/SC6_Report_Formatted_1.pdf)).

<sup>10</sup> Health Protection Agency, “Health Effects from Radiofrequency Electromagnetic Fields, Report of the Independent Advisory Group on Non-Ionising Radiation,” (2012) (available at <https://www.ncbi.nlm.nih.gov/nlmcatalog/101602435>).

<sup>11</sup> Ahlbom A., *et al.*, Swedish Council for Working Life and Social Research, “Radiofrequency Electromagnetic Fields and Risk of Disease and Ill Health: Research during the last ten years,” (2012) (available at <http://www.fas.se/pagefiles/5303/10-y-rf-report.pdf>).

<sup>12</sup> Norwegian Institute of Public Health, Report 2012:3, “Low-level radiofrequency electromagnetic fields, an assessment of health risks and evaluation of regulatory practice, (2012) (available at <http://www.fhi.no/dokumenter/545eea7147.pdf>).

exposures”<sup>13</sup> even at levels five times higher than that permitted by the FCC. In short, *the consensus of the scientific community is that the scientific evidence does not support any link between exposure to regulated RF and adverse health effects.*

5G telecommunication technology seeks to increase data rates by a factor of 100 over 4G networks (to 1Gbps or higher), decrease latency (time wasted in establishing communication) by a factor of 50 or more, and increase user density drastically (up to one mobile device per 10 square feet). These capabilities will enable smart city technology, the “internet of things”, mobile service on airplanes, remote medicine, and the machine-to-machine communication required for the robotic cars of the future. It will achieve these things by placing low power small cell wireless infrastructure close together and by employing more of the electromagnetic spectrum (specifically, the spectrum near 30 GHz). Because 30 GHz radiation is nonionizing and the emissions from cell phones and small cell wireless infrastructure are regulated by the FCC’s exposure standards that have withstood the test of time, there is no reason to believe there is a risk of adverse health effects. In addition, one can estimate MPE levels by using published data concerning the size of 5G small cell wireless infrastructure and their power ratings (these are also regulated by the FCC). The result is an MPE that is approximately 500 times below the FCC limit. Thus, 5G technology presents no substantial risk to the general public, and certainly does not present risk that current regulations cannot manage.

### **The National Toxicology Program Rat and Mouse RFR Studies**

The National Toxicology Program conducted a study of the effects of cellphone radiofrequency radiation (RFR) in rats<sup>14</sup> and mice<sup>15</sup>. The study was generally negative for adverse health effects. There was no finding of a carcinogenic effect in male mice, female mice, or female rats. There were a few elevated results for glioma and heart schwannoma (tumor of the heart) in some male rats under specific exposures well above what federal standards allow for cell phones. The findings for these tumors were weak and the authors of the NTP study disavowed the suggestion that their study demonstrated anything regarding human health effects<sup>16</sup>. Overall, the NTP study in fact supports the scientific consensus that there are no adverse human health effects from RFR. The U.S. Food and Drug Administration agreed, concluding, after the release of the NTP study, that “the totality of the available scientific evidence continues to not support adverse health effects in humans caused by exposures at or under the current radiofrequency exposure limits.”

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<sup>13</sup> Institute of Electrical and Electronics Engineers, International Committee on Electromagnetic Safety (SCC39), “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz,” (2006).

<sup>14</sup> “Toxicology and Carcinogenesis Studies in Hsd:Sprague Dawley SD Rats Exposed to Whole-body Radio Frequency Radiation at a Frequency (900 MHz) and Modulations (GSM and CDMA) used by Cell Phones”, M.E. Wyde *et al.*, NTP TR 595 (November, 2018).

<sup>15</sup> “Toxicology and Carcinogenesis Studies in B6C3F1/N Mice Exposed to Whole-body Radio Frequency Radiation at a Frequency (1900 MHz) and Modulations (GSM and CDMA) used by Cell Phones”, M.E. Wyde *et al.*, NTP TR 596 (November, 2018).

<sup>16</sup> Specifically, the NTP cautioned that their “findings should not be directly extrapolated to human cell phone usage.” The U.S. Food and Drug Administration explained: “We agree that these findings should not be applied to human cell phone usage.”

The weak elevated findings for glioma and heart schwannoma in male rats are questionable given some obvious flaws in the study:

- The study was based on exposing male and female rats to levels of RFR at levels far greater than permitted by the FCC for human use, and for periods of time much greater than typical human use. Testing of those animals was compared to testing of control groups of rats and mice that were not exposed. Notwithstanding the extremely high exposure levels and time periods, no adverse findings were found in the male mice, the female mice, or the female rats. Although adverse health effects were observed in some of the exposed male rats, it is very difficult to find a plausible biological explanation for a sexual difference in the incidence of health effects. Given that the male and female rats were subject to equal amounts of RFR exposure, this suggests that the higher incidence among males was attributable to something other than RFR. And the absence of health effects among male or female mice is also noteworthy.
- The NTP study reports that rats that were exposed to RFR *lived longer* than the control group which was not exposed to RFR. As the authors note, since cancer is associated with ageing, the higher cancer rate among the exposed rats may be explained by the very fact that they lived longer, not by the fact that they were exposed to RFR: “If malignant gliomas or schwannomas are late-developing tumors, the absence of these lesions in control males in the current study could conceivably be related to the shorter longevity of control rats in this study.”<sup>17</sup> And the data reflects that most of the tumors in the exposed group of male rats developed *after* the control rats had already died. Thus, the control rats died before they had the opportunity to develop glioma.
- The disparity between male and female rats might also be explained by the type of rats that were studied. Sprague-Dawley rats (the type used in the NTP study) are known to produce tumors at a high and variable rate<sup>18</sup>. A different study<sup>19</sup> examining cancer rates in Sprague-Dawley rats found that tumor incidence varied greatly depending on the commercial source of the rats. The authors “stressed the need for extreme caution in evaluation of carcinogenicity studies conducted at different laboratories and/or on rats from different sources.”
- The study found difficulty in consistently evaluating whether the test animals actually had diseases of a given type. This has been noted by an external referee, Dr. A.M. Michalowski,

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<sup>17</sup> Page 15, “Effect of cell phone radiofrequency radiation on body temperature in rodents: Pilot studies of the National Toxicology Program's reverberation chamber exposure system”, M.E. Wyde *et al.*, [Bioelectromagnetics](#), 2018 Apr; 39(3):190-199. doi: 10.1002/bem.22116.

<sup>18</sup> “Editor in Chief of Food and Chemical Toxicology answers questions on retraction”, A. Wallace Hayes, *Food and Toxicology*, 65 (2014) 394-395.

<sup>19</sup> “Comparison of Neoplasms in Six Sources of Rats”, W.F. MacKenzie and F.M. Garner, *JNCI*, 50 (5) (1973), 1243-1257.

who suggested that the various working groups who examined the animals may have employed different sets of criteria in their evaluations. “Working list of limitations potentially impacting NTP study interpretations. Difficulty in achieving diagnostic consensus in lesions classifications of rare, unusual, and incompletely understood lesion association. Document appears to indicate that the second Pathology Working Group (PWG) empaneled to review and obtain lesion classification consensus, following the inability of the initial PWG to do so, may have reviewed different lesions sets.”<sup>20</sup>

- Among other things, the study looked at the incidence of a tumor known as a schwannoma. Exposed male rats had a higher incidence of schwannomas of the heart. Yet the rats had their whole bodies irradiated with excessive amounts of RFR. If RFR contributed to the schwannomas, it is not immediately obvious why schwannomas would preferentially appear in the heart as opposed to other parts of the body that were exposed. Indeed, when one examines all schwannomas, not just the cardiac schwannomas, there does not appear to be a significant relationship to RFR.

All of these conclusions reinforce the NTP authors’ own admonition that their studies do not establish a basis for concluding that RFR poses a health risk to humans.

The NTP study also suffers from a common methodological flaw known as the “problem of multiple outcomes.” In short, the more variables that are simultaneously introduced into a test, the higher the likelihood of false positives. For example, if researchers decide to test whether a particular drug is effective at treating certain diseases, the more diseases they introduce into the testing, the more likely it is that the drug will *appear* to have been effective as to at least one of the diseases due to the effects of random sampling, i.e., a false positive. If an experiment has a 5% false positive rate, doing two experiments has a 9.8% chance of finding a false positive. Things rapidly get worse as more experiments are done—performing 20 experiments yields a 64% chance of finding a false positive.

We find this phenomenon at work in the NTP study. In an attempt at thoroughness, the NTP study exposed four different groups of animals to two types of signal modulation (CDMA and GSM) at three different levels of exposure. Furthermore, the animals were examined for dozens of types of cancer. Statistically, the resulting multitude of subclasses being tested mean it is very likely that false positives occur.

Although there are well-established methods to overcome the “problem of multiple outcomes” (such as the Bonferonni method), the NTP authors did not apply any of them, thus exacerbating the problem of false positives. This problem was noted by an external referee (Dr. Michael S Lauer), who commented, “The low power implies that there is a high risk of false positive findings, especially since the epidemiological literature questions the purported association between cell phone exposure and cancer.”<sup>21</sup>

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<sup>20</sup> Page 62, Ref. footnote 17.

<sup>21</sup> Page 36. Ref. footnote 17.

Finally, glioma is rare (the incidence rate in the USA is approximately 3 per 100,000 persons<sup>22</sup>), and it is expensive and difficult to perform experiments on a sufficient number of rats to obtain statistically reliable results. To test this, I have computed the relative likelihood for obtaining the experimental results observed by the NTP researchers. In the NTP study none of the control rats developed a glioma. However, if one examines the incidence of glioma in *all* NTP experiments (using data presented in Appendix D of Ref. 17) one finds a *lower incidence of glioma among rats exposed to RFR*. This could be interpreted of strong statistical evidence that RFR exposure actually *reduces* the incidence of glioma. This implausible result is yet another indication of the unreliable statistical significance of the NTP study conclusions.

Sincerely,



E.S. Swanson  
Professor of Physics  
University of Pittsburgh

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<sup>22</sup> The incidence for Sprague-Dawley rats is estimated to be 1.5%.

## The 5G Health Hazard That Isn't

How one scientist and his inaccurate chart led to unwarranted fears of wireless technology.

By William J. Broad

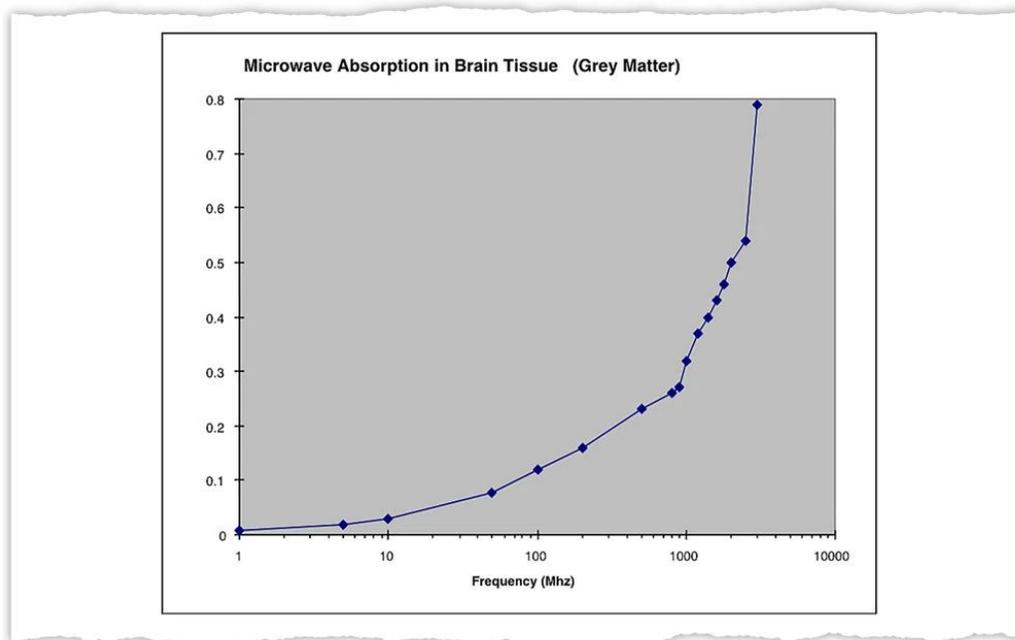
<https://www.nytimes.com/2019/07/16/science/5g-cellphones-wireless-cancer.html>

In 2000, the [Broward County Public Schools](#) in Florida received an alarming report. Like many affluent school districts at the time, Broward was considering laptops and wireless networks for its classrooms and 250,000 students. Were there any health risks to worry about?

The district asked [Bill P. Curry](#), a consultant and physicist, to study the matter. The technology, [he reported back](#), was “likely to be a serious health hazard.” He summarized his most troubling evidence in a large graph labeled “Microwave Absorption in Brain Tissue (Grey Matter).”

The chart showed the dose of radiation received by the brain as rising from left to right, with the increasing frequency of the wireless signal. The slope was gentle at first, but when the line reached the wireless frequencies associated with computer networking, it shot straight up, indicating a dangerous level of exposure.

“This graph shows why I am concerned,” Dr. Curry wrote. The body of his report detailed how the radio waves could sow brain cancer, a terrifying disease that kills most of its victims. Over the years, Dr. Curry’s warning spread far, resonating with educators, consumers and entire cities as the frequencies of cellphones, cell towers and wireless local networks rose. To no small degree, the blossoming anxiety over the professed health risks of 5G technology can be traced to a single scientist and a single chart.



A 2000 graph by physicist Bill P. Curry purported to show that tissue damage increases with the rising frequency of radio waves. But it failed to account for the shielding effect of human skin.

Except that Dr. Curry and his graph got it wrong.

According to experts on the biological effects of electromagnetic radiation, radio waves become safer at higher frequencies, not more dangerous. (Extremely high-frequency energies, such as X-rays, behave differently and do pose a health risk.)

In his research, Dr. Curry looked at studies on how radio waves affect tissues isolated in the lab, and misinterpreted the results as applying to cells deep inside the human body. His analysis failed to recognize the protective effect of human skin. At higher radio frequencies, the skin [acts as a barrier](#), shielding the internal organs, including the brain, from exposure. Human skin blocks the even higher frequencies of sunlight.

“It doesn’t penetrate,” said [Christopher M. Collins](#), a professor of radiology at New York University who studies the effect of high-frequency electromagnetic waves on humans. Dr. Curry’s graph, he added, failed to take into account “the shielding effect.”

[Dr. Marvin C. Ziskin](#), an emeritus professor of medical physics at Temple University School of Medicine, agreed. For decades, Dr. Ziskin explored whether such high frequencies could sow illness. Many experiments, he said, support the safety of high-frequency waves.

Despite the benign assessment of the medical establishment, Dr. Curry’s flawed reports were amplified by alarmist websites, prompted articles linking cellphones to brain cancer and served as evidence in lawsuits urging the removal of wireless classroom technology. In time, echoes of his reports fed Russian news sites noted for stoking misinformation about 5G technology. What began as a simple graph became a case study in how bad science can take root and flourish.

“I still think there are health effects,” Dr. Curry said in an interview. “The federal government needs to look at it more closely.”

### **An authoritative mistake**

Dr. Curry was not the first to endorse the idea that advances in wireless technology could harbor unforeseen risks. In 1978, Paul Brodeur, an investigative journalist, published “The Zapping of America,” which drew on suggestive but often ambiguous evidence [to argue](#) that the growing use of high frequencies could endanger human health.

In contrast, Dr. Curry’s voice was authoritative. He became a private consultant in the 1990s after [federal budget cuts](#) brought [his research career](#) to an end. [He had degrees](#) in physics (1959 and 1965) and electrical engineering (1990). His credentials and decades of experience at federal and industrial laboratories, including the Lawrence Livermore National Laboratory, seemed to make him a very strong candidate to conduct the Broward study.

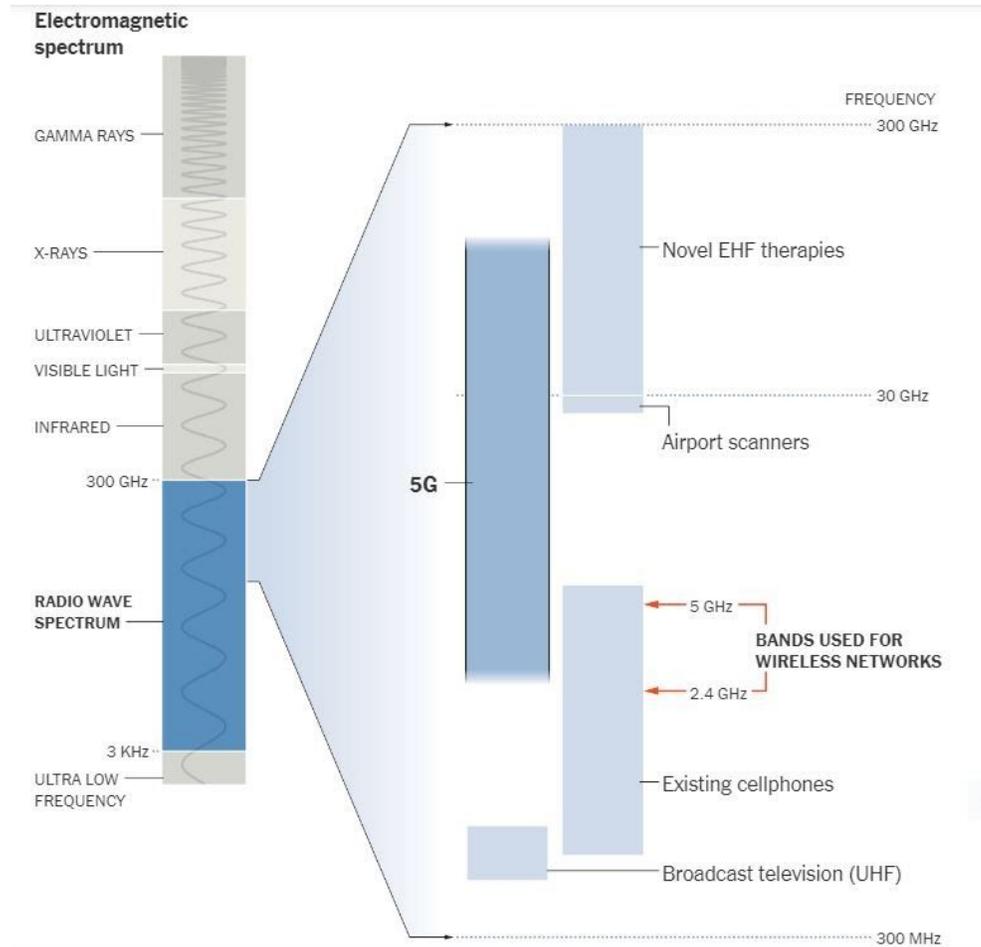
“He was a very bright guy,” recalled Gary Brown, an expert in the district’s technology unit who worked with Dr. Curry to prepare the reports. But Dr. Curry lacked biological expertise. He could solve atomic and electromagnetic puzzles with ease, but he had little or no formal training in the intricacies of biomedical research.

In 2000, Dr. Curry, writing on letterhead from [his home office](#) in the Chicago suburbs, sent the Broward district two reports, [the first](#) in February 2000 and [the second](#) in September of that year. The latter study went to the superintendent, the school board and the district’s head of safety and risk management.

The frequency graph in the second report was far more detailed. Its rising line bore annotations noting the precise locations for the wireless-network dose and, far lower down, for radio, television and cellphone signals.

## 5G's Place in the Spectrum

The newest generation of cellphones, 5G, will operate near the highest frequencies of the radio wave spectrum. Lower down in the spectrum are wireless networks used in homes and schools.



By The New York Times | Sources: National Aeronautics and Space Administration, National Academies of Sciences, National Institute of Environmental Health Sciences, Congressional Research Service, Institute of Electrical and Electronics Engineers

Over all, Dr. Curry's reports cast the emerging topic as crucial for public health. He warned that children were especially vulnerable to the cancer risk of wireless technology. "Their brains are developing," he noted in [his first report](#).

Dr. Curry belonged to [a national group of wireless critics](#), and his two reports for the Broward district soon began [to circulate widely](#) among industry foes. One reached Dr. [David O. Carpenter](#), who for decades had clashed with the science establishment on the health risks of radio waves.

Dr. Carpenter's credentials were impressive. He graduated magna cum laude from Harvard in 1959 and cum laude from its medical school in 1964. From 1985 to 1997, he served as dean of the School of Public Health at the State University of New York in Albany, and in 2001 became director of its Institute for Health and the

Environment, where he still works. [His resumé](#) lists hundreds of journal reports, jobs, grants, awards, advisory boards, books and legal declarations.

Dr. Carpenter stirred global controversy in the 1980s by asserting that high-voltage power lines could cause leukemia in nearby children. He appeared as an authority in Mr. Brodeur's 1989 book, "Currents of Death." But federal researchers [failed to find solid evidence](#) to support the warnings.

In late 2011, Dr. Carpenter introduced Dr. Curry's graph in [a lawsuit](#) that sought to force the Portland, Ore., public schools to abandon their wireless computer networks. The suit had been filed by a worried parent.

As an expert witness, Dr. Carpenter said in a [legal declaration](#) on Dec. 20, 2011, that the graph showed how the brain's absorption of radio-wave energy "increases exponentially" as wireless frequencies rise, calling it evidence of grave student danger. The graph "illustrates the problem with the drive of the wireless industry toward ever higher frequencies," he said.

In response to such arguments, the industry noted that it obeys government safety rules. The judge in the Portland case said the court had no jurisdiction over federal regulatory matters, and [dismissed the lawsuit](#).

Despite the setback, Dr. Carpenter's 2011 declaration, which included Dr. Curry's graph, kept drawing attention. In 2012, he introduced it as part of [his testimony](#) to a Michigan state board assessing wireless dangers, and it soon [began circulating](#) online among [wireless critics](#).

And he saw a new danger. Between 2010 and 2012, the frequencies of the newest generation of cellphones, 4G, rose past those typical of the day's wireless networks. Dr. Carpenter now had a much larger and seemingly more urgent target, especially since cellphones were often held snugly against the head.

"There is now much more evidence of risks to health, affecting billions of people," [he said](#) in introducing a 1,400-page report on wireless dangers that he edited [with an aide](#). "The status quo is not acceptable." His [BioInitiative Report](#), released in late 2012, gained worldwide notice. But mainstream science rejected its conclusions. Two Oxford University researchers [described it](#) as "scientifically discredited."

## **A 'fact' is born**

Unbowed, Dr. Carpenter worked hard to revise established science. In 2012, he became editor in chief of [Reviews on Environmental Health](#), a quarterly journal. He published [several authors](#) who filed alarmist reports, as well as his own.

"The rapid increase in the use of cellphones increases risk of cancer, male infertility, and neurobehavioral abnormalities," [Dr. Carpenter wrote in 2013](#).

In subsequent years, as the frequencies of wireless devices continued to rise, an associated risk of brain cancer was repeated uncritically, often without attribution to Dr. Curry or Dr. Carpenter. Instead, it came to be regarded by activists as an established fact of modern science.

"The higher the frequency, the more dangerous," according to Radiation Health Risks, a website, in reference to [signals from 5G towers](#). The idea was echoed by a similar website, 5G Exposed — "Higher frequencies are more dangerous to health" — [on a page](#) entitled "Scientific Discussion." Over all, the site bristled with brain-cancer warnings.

Recently, Dr. Carpenter [told RT America](#), a Russian television network, that the newest cellphones represented a dire health threat. “The rollout of 5G is very frightening,” he said. “Nobody is going to be able to escape the radiation.”

In recent months, the network has run a series of segments critical of 5G technology. “The higher the frequency, the more dangerous it is to living organisms,” a RT reporter [told viewers](#) in March. The show described children as particularly vulnerable.

The new cellphones are to employ a range of radio frequencies up to dozens of times higher than those Dr. Curry identified two decades ago as endangering student health. But mainstream scientists continue to see no evidence of harm from cellphone radio waves.

“If phones are linked to cancer, we’d expect to see a marked uptick,” David Robert Grimes, a cancer researcher at the University of Oxford, [wrote recently](#) in The Guardian. “Yet we do not.”

In a recent interview, Dr. Carpenter defended his high-frequency view. “You have all this evidence that cellphone radiation penetrates the brain,” he said. But he conceded after some discussion that the increasingly high frequencies could in fact have a difficult time entering the human body: “There’s some legitimacy to that point of view.”

He noted that, in cities, 5G service requires the placement of many antenna towers, because walls, buildings, rain, leaves and other objects can block the high-frequency signals. “That’s why they put the towers so close together,” he said. “The waves don’t penetrate.” If human skin also blocks 5G signals, Dr. Carpenter acknowledged, “maybe it’s not that big a deal.”

Dr. Curry, now 82, was less forthcoming. In an interview, he said he no longer follows the wireless industry and disavowed any knowledge of having made a scientific error.

“They can say whatever they want,” Dr. Curry said of his detractors. “I’ll leave it to the young in the business and let them figure it out.”

# Answering Questions About 5G



Verizon may install wireless equipment to upgrade to 5G service in your area. Some people are curious about 5G. Others have a few questions. We want to keep you informed about what's going on.

## **Let's be clear about one thing up-front:**

Verizon's equipment complies with all federal safety standards, so it is safe.

## **What is "5G," anyway?**

We call this service 5G because it is the fifth generation of wireless communication technology. The first generation (1G) gave us cell phones with voice capability. The second generation (2G) gave us text and messaging. The third generation (3G) gave us smartphones and wireless access to the internet. And the fourth generation (4G) gave us video streaming and many other connected services and devices that we rely on and enjoy today. Verizon is upgrading to 5G to improve existing communications and to support innovative applications. 5G will enable self-driving cars, virtual and augmented reality, smart homes, smart buildings, and smart cities. 5G is at the heart of the Internet of Things.

## **How does 5G work?**

Like the equipment used for earlier generations of wireless technology, 5G equipment uses radio waves, or radiofrequency (RF) energy. It's the same type of energy that is all around us and that has been used safely for over 100 years. RF energy is used for radios, televisions, cordless phones, cell phones, WiFi routers, and garage door openers. The new 5G equipment includes "small cells," which are low-powered radios attached to antennas. These small cells send and receive information from wireless devices using radio waves. The 5G small cells support both mobile and fixed broadband internet services to homes and businesses.

### **How is Verizon building the 5G network?**

You may see us installing 5G small cells on poles and at other locations in your neighborhood. The 5G small cells sometimes are physically closer to users and more numerous than the wireless equipment we've used in the past. That's because the 5G radio waves that are capable of supporting very fast speeds and low latency do not travel as far as the radio waves that 4G service uses. So to provide 5G service, we have to use more small cells to cover the same area as 4G service.

### **What makes it safe?**

No matter which generation of technology we use, all Verizon equipment must comply with federal government safety standards. Those standards have wide safety margins and are designed to protect everyone, including children.

In December 2019, in a unanimous and bipartisan decision, the FCC affirmed those safety standards. The FCC took action after a lengthy proceeding, in consultation with multiple federal agencies and close examination of the RF research conducted for decades by scientists in the US and around the world. The research continues to this day, and agencies continue to monitor it.

### **What do the experts say?**

Scientists have studied potential health effects of RF emissions from cell phones for decades. When reviewing the science, experts look at the entire body of scientific evidence, rather than rely on one or two specific studies. That's in part because there may be outliers and some studies, such as one that was recently discussed in a New York Times article, are later determined to be flawed. Based on all the research, federal agencies have concluded that equipment that complies with the safety standards poses no known health risks. And advisers to the World Health Organization have specifically concluded that the same goes for 5G equipment. In fact, the RF safety standards adopted by the United States Federal Communications Commission (FCC) are even more conservative than the levels adopted by some international standards bodies.

### **I heard that Russia is trying to scare Americans into thinking that 5G is unsafe. Is that true?**

Sources linked to the Russian government have produced several media stories, aired in the United States and targeted at U.S. audiences online, alleging that 5G is not safe. A recent article in the New York Times explored the situation. A copy of that article is attached.

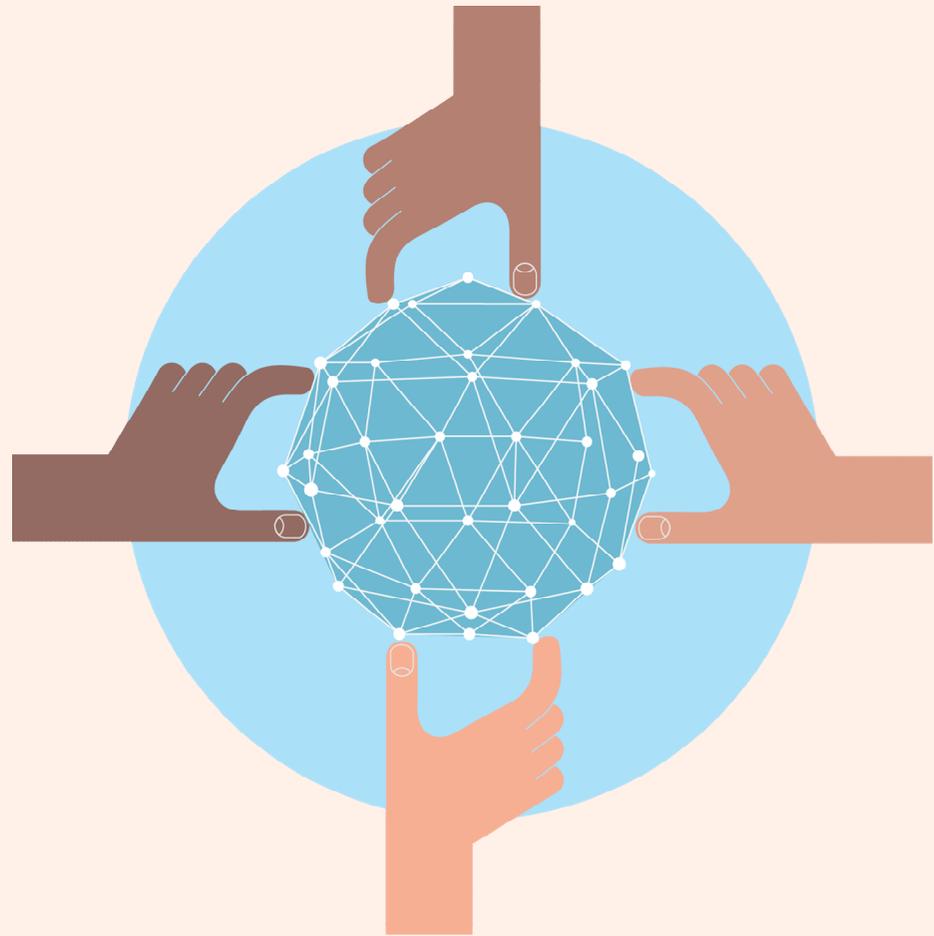
### **Here's the bottom line:**

Everyday exposure to RF from 5G small cells will be well within the FCC's safety limit. It is comparable to RF exposure from products such as baby monitors, WiFi routers, and Bluetooth devices. Verizon has a comprehensive program to ensure that our network functions within the FCC's safety limit. Here at Verizon, we are committed to your health and safety as we bring you everything 5G has to offer.



**Connecting  
our homes,  
businesses  
and communities.**

**verizon**<sup>✓</sup>

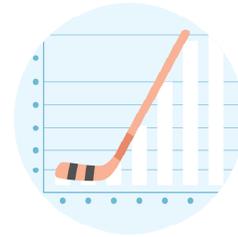


# Why are we expanding the wireless network?

More people than ever before rely on wireless connections to manage their lives and businesses.

Verizon is expanding its wireless network to meet the growing demands of today and tomorrow.

But it takes time.



The average North American smartphone user will consume 48 GB of data per month in 2023, up from just 5.2 GB per month in 2016 and 7.1 GB per month in 2017 .<sup>1</sup>



Of American homes are wireless only.<sup>2</sup>



In North America, the average household has 13 connected devices with smartphones outnumbering tablets 6 to 1.<sup>3</sup>

1. Ericsson Mobility Report, November 2017  
2. CDC's 2018 Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July-December, 2018  
3. IHS Market Connected Device Market Monitor: Q1 2016 , June 7, 2016

# What it takes to keep families and businesses connected.

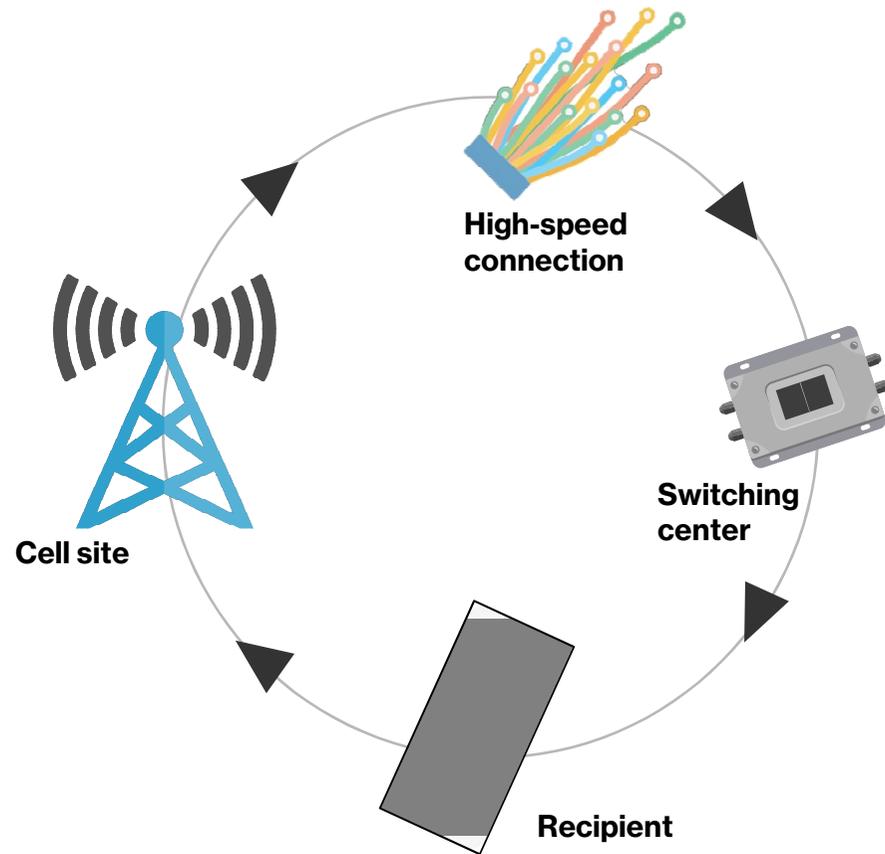
## How does wireless service work?

Radio frequencies can carry signals from radios and televisions, to baby monitors, garage door openers, home Wi-Fi service, and cordless phones.

Cell service uses these radio frequencies to wirelessly connect a mobile device with the nearest antenna. That antenna may be hidden in a church steeple, sitting on a rooftop, attached to a building façade or mounted on a freestanding tower structure. All are known generically as cell sites.

From the cell site, the call or data session then travels through a high-speed connection to a network switching center where it is then directed to the recipient.

This all happens in fractions of a second.



**The many types of wireless technologies include cellular and fixed wireless, or Wi-Fi.**

# Different locations require different solutions.

Verizon uses a balanced approach to engineering the best possible network given the local community's needs.

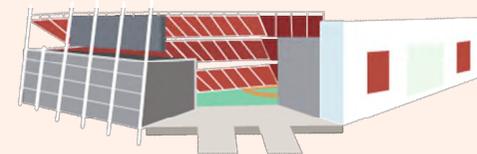


Traditional, or macro cell sites, are most often the best choice for meeting coverage and capacity needs. Macro sites are traditional cell sites or towers that provide coverage to a broad area, up to several miles.



Small cells are just like the name implies – short range cell sites used to complement macro cell towers in a smaller geographic area ranging from a few hundred feet to upwards of 1,000 feet. These lower power antennas enhance capacity in high traffic areas, dense urban areas, suburban neighborhoods, and more. Small cells use small radios and a single antenna placed on existing structures including utility poles and street lights.

Distributed Antenna Systems (DAS) are a group of antennas in outdoor or indoor locations that connect to a base station. DAS systems are typically used in large venues including stadiums and shopping centers.



# Staying ahead of demand.

A wireless network is like a highway system...



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More wireless traffic needs more wireless facilities just like more vehicle traffic needs more lanes.

- Many wireless users share each cell site and congestion may result when too many try to use it at the same time.
- Wireless coverage may already exist in an area, but with data usage growth increasing exponentially each year, more capacity is needed.
- To meet capacity demands, we need to add more wireless antennas closer to users and closer to other cell sites to provide the reliable service customers have come to expect from Verizon.

In the US, mobile data traffic was 1.3 Exabytes per month in 2016, the equivalent of 334 million DVDs each month or 3,687 million text messages each second.\*

\*Cisco VNI Mobile Forecast Highlights, 2016-2021, February 2017

# Finding the right location.

To meet customer needs and expectations, wireless providers need the ability to expand and enhance their networks where users live, work, travel and play.



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Verizon gathers information from many sources including customer feedback, results of our own exhaustive network testing, and data from third parties.

When an area for improvement is identified, utilizing our existing network is always our first effort. If that is not possible, we then look at adding a new site.

## Steps to finding a new site

Our engineers analyze the areas that need improvement to figure out the ideal location based on customer needs, terrain and modeling results.

Using existing structures is considered first.

Network teams perform exhaustive searches in the area needing improvement to find a location that will meet our technical needs. We also look at interest from property owners.

We pick a location that has the highest likelihood of meeting technical needs and works for the community.

## Guidelines for new sites

We comply fully with all requirements for community notification and review, zoning and permitting.

Potential antenna locations must meet all local, state and federal regulations.

Verizon holds Federal Communications Commission (FCC) licenses for the frequencies utilized and we strictly follow their regulations.

# Wireless facilities and property values.

Cell service in and around the home has emerged as a critical factor in home-buying decisions.



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National studies demonstrate that most home buyers value good cell service over many other factors including the proximity of schools when purchasing a home.



More than 75% of prospective home buyers said a good cellular connection was important to them.<sup>1</sup>



The same study showed that 83% of Millennials (those born between 1982 and 2004) said cell service was the most important fact in purchasing a home.



90% of U.S. households use wireless service. Citizens need access to 911 and reverse 911 and wireless may be their only connection.<sup>2</sup>

1. RootMetrics/Money, The Surprising Thing Home Buyers Care About More than Schools, June 2, 2015  
2. CTIA, June 2015

# Health and safety background.

Health and safety organizations worldwide have studied potential health effects of RF emissions for decades, and studies continue.



## Hundreds of times less

RF emissions exposure at ground level is well below Federal Communication Commission limits.

The Federal Communications Commission (FCC) guidelines for operating wireless networks are based on the recommendations of federal health and safety agencies including:

- The Environmental Protection Agency (EPA)
- The Food and Drug Administration (FDA)
- The National Institute for Occupational Safety and Health (NIOSH)
- The Occupational Safety and Health Administration (OSHA)
- The Institute of Electrical and Electronics Engineers (IEEE)
- The National Council on Radiation Protection and Measurements (NCRP)

Wireless technology, equipment and network operations are highly regulated.

**More information can be found through these organizations:**

**Federal Communications Commission Radio Frequency Safety Program:**

[http://wireless.fcc.gov/siting/FCC\\_LSGAC\\_RF\\_Guide.pdf](http://wireless.fcc.gov/siting/FCC_LSGAC_RF_Guide.pdf)

<http://www.fcc.gov/oet/rfsafety/>

**World Health Organization:**

<http://www.who.int/peh-emf/publications/facts/fs304/en/>

**American Cancer Society**

<http://www.cancer.org/cancer/cancercauses/othercarcinogens/athome/cellular-phone-towers>

# Building a wireless network you can rely on in a crisis.

The reliability of your cell phone is never more important than when crisis strikes. That's when a simple call or text message can make the difference between life and death.



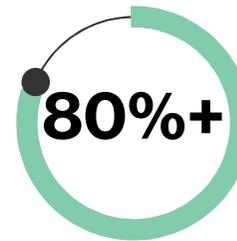
verizon<sup>✓</sup>

We build reliability into every aspect of our wireless network to keep customers connected when you need it most.

Reliability starts when we choose the safest, most secure locations for our wireless equipment. The likelihood of earthquakes, and risk from wildfires, mudslides, floods, hurricanes and more are all considered.

When disaster strikes, we coordinate with first responders and can mobilize charging stations, special equipment, emergency vehicles and more to support local, state and federal agencies in all 50 states.

**It's who we are.**



With over 80% of 9-1-1 calls now coming from cell phones...<sup>1</sup>

**240 million**

911 calls are made annually. In many areas, 80% or more are from wireless devices.<sup>1</sup>

1. National Emergency Number Association, Enhancing 9-1-1 Operations With Automated Abandoned Callback & Location Accuracy (Motorola Solutions) (August 23, 2018)  
2. National Emergency Number Association, 9-1-1 Statistics (January 7, 2019)

## Did You Know?

### Wireless and Education

Wireless connectivity is critical in schools and communities.



Wireless is a critical component in schools and for today's students.



**20,000 learning apps are available for iPads. 72% of iTunes top selling educational apps are designed for preschoolers and elementary students.**



**600+ school districts replaced text books with tablets in classrooms.**



**77% of parents think tablets are beneficial to kids.**



**74% of school administrators feel digital content increases student engagement.**



**70% of teens use cellphones to help with homework.**

Source: CTIA's Infographics Today's Wireless Family, October, 2017

## Did You Know?

### Wireless and Medicine

Wireless is a critical component in today's medical fields.



Smart pill bottles and cases can help patients and their care-givers track medication usage, ensuring medications are taken on time and correctly. This supports increased medical compliance, provides more consistent care, and enables preventative care, keeping patients in their homes longer and reducing the number of emergency visits to the doctor's office or hospital.



Wireless connected glucose monitors, blood-pressure cuffs, and EKGs can track a patient's vital signs and catch an issue before it turns into an emergency.



Pace makers and sleep apnea monitors can be tracked remotely.



Routine eye exams can be conducted with a wireless device connected to a smart phone, bringing solutions and services to low-income and remote areas that would otherwise go unsupported.

# Did You Know?

## Wireless in Communities

Wireless is a critical component in today's communities.



Wireless smart city solutions are being used to track available parking and minimize pollution and wasted time.



These same solutions are being used to track pedestrian and bike traffic to help planning and minimize accidents.



Smart, wireless connected lighting enables cities to control lighting remotely, saving energy and reducing energy costs by 20%.



4G technology is utilized to track and plan vehicle deliveries to minimize travel, maximize efficiency, and minimize carbon footprint.



4G technology is also used to monitor building power usage down to the circuit level remotely, preventing energy waste and supporting predictive maintenance on machines and equipment.



Wireless sensors placed in shipments are being used to track temperature-sensitive medications, equipment, and food. This is important for preventing the spread of food-borne diseases that kill 3,000 Americans each year.

**Verizon is part of your community.**

**Because we live and work there too.**

**We believe technology can help solve our biggest social problems.**

**We're working with innovators, community leaders, non-profits, universities and our peers to address some of the unmet challenges in education, healthcare and energy management.**

Learn more about our corporate social responsibility at [www.verizon.com](http://www.verizon.com).

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