We reached out to a panel of experts. Comprised of researchers, analysts, and advisors.

5G Health & Safety

A revolution in wireless communications is underway. The rollout of 5G wireless technology around the world is triggering excitement and trepidation. As this next-stage infrastructure begins to take shape, users will undoubtedly thrill at the new capabilities available from 5G: faster streaming, quicker uploads, and the ability to communicate across the globe at speeds of up to 100 Gigabits per second. While 4G tops out at a theoretical 100 megabits per second (Mbps). That means 5G is a hundred times faster than the current 4G technology—at its theoretical maximum speed, anyway.

Earlier this year, the country's first 5G network began a rollout in four large cities: Montreal, Ottawa, Toronto and Vancouver. While devices that can use the network won't be available until later in the year, by that time 20 additional markets should also be 5G compatible. The Canadian government has said that the addition of 5G will introduce a revolutionary improvement to the country's communication systems, especially in terms of connectivity, latency and bandwidth. Additionally, the government has assured citizens that safety is its primary concern. As a result, all 5G providers will continue to be held to the country's high SAR standards that establish limits for RF exposure.

As technology evolves, potential benefits always pair with apprehension, and 5G is no exception — the concerns around 5G center around the biological and environmental effects of electromagnetic radiation. Because some 5G networks operate at a higher frequency, the fear is that exposure to 5G will cause cellular damage and increase the risk of cancer.

While some high range frequencies, like X-rays, can pose a health risk, 5G does not fall into that category, and the reason why is relatively straightforward: Human skin. According to a study by Cornell University, human skin blocks high frequencies, like sunlight. Because falls even lower on the electromagnetic spectrum than UV, the supposition is that it is unlikely to penetrate human skin. What does that mean? Generally speaking, experts agree that 5G does not pose a threat to human health or the environment.

To gain a clearer picture of the health and safety implications of 5G networks, we reached out to a panel of experts. Comprised of researchers, analysts, and advisors, our respondents provided us with in-depth and insightful information on the potential impacts of 5G on human health and the environment.

Our 5G Health & Safety panel includes: Jonathan MacKenzie, policy and research analyst for CWTA, Tim Singer, Director General, Environmental and Radiation Health Sciences for Health Canada, Marc Bouvrette, President of Gap Wireless, Erika Zeroual, Communications Advisor and Media Relations for Innovation, Science and Economic Development Canada (ISED), Stuart Nicol, Director Product Development at APREL as well as Ernest Cid, CEO of Wavecontrol.

PANEL DISCUSSION

Is it dangerous to live near a 5G cell tower?

The threats posed by electromagnetic waves are related to how close we are to the source, the density and the exposure time," says Marc Bouvrette, President, Gap Wireless.

"The typical safety perimeter for a standard cell site is on the order of 3-5 meters whereas the typical height of a cell tower is 50+ meters," he continues, "so if we are 50 meters away from a transmitter that has been identified by Safety Code 6 regulations to have a safety perimeter of 5 meters… 10 times further away than the minimum recommendable distance".

"Given the antennas are placed at the top of cell towers at distances that are multiples of the safety perimeter, living near a cell site does not pose a specific threat due to electromagnetic radiation," Bouvrette concludes.

"All wireless devices must meet ISED's requirements and be certified before being sold in Canada," adds Jonathan MacKenzie, policy and research analyst, Canadian Wireless Telecommunications Association, CWTA. "Antenna installations must also meet ISED's requirements at all times as a condition of a carrier's license."

"Canada's mobile network operators consistently monitor their networks, and ISED audits wireless devices and antenna installations to ensure compliance with safety standards," Mackenzie continues. "Research by Health Canada and international bodies, including the World Health Organization, has produced no substantiated evidence of harmful effects from RF technologies used within existing safety standards".

"There is consequently no basis for finding that living or working next to cell towers, or other mobile wireless network equipment would pose a health hazard to the Canadian public."

Are there specific health concerns about 5G vs. 4G

"Contrary to misunderstandings about 5G technology and, in some cases, deliberate misinformation, there are no established health risks from the radiofrequency waves used in 5G networks in accordance with applicable safety standards," says Mackenzie.

"The primary difference between any of the technologies over time is mostly related to the modulation or signal type, which should not have any effect on health concerns," says Bouvrette. "While there have not been any conclusive studies on the long term effects of electromagnetic waves used in mobile communications networks on the human body, we do know from other types of radiation such as ultra-violet and X-rays (which are more than 1,000,000 times to 100,000,000 times the frequency of current mobile communications and above the visible light range), that the amount of power, density of power and total exposure time will contribute to the lasting effects of electromagnetic radiation."

"Electromagnetic waves of higher frequencies carry more energy than lower frequency fields," adds Ernest Cid, CEO of Wavecontrol. "(While) 5G uses higher frequencies than earlier generations, allowing more devices to connect and at faster speeds, 5G radio waves are still non-ionizing, like precedent 2G, 3G, and 4G technologies, which means they do not have enough energy to break bonds between molecules."

"At this moment, neither ISED nor any other international body related to RF safety, like ICNIRP or WHO, has raised specific health concerns about 5G, other than not exceeding the currently established limits," he adds.

. "Research by Health Canada and international bodies, including the World Health Organization, has produced no substantiated evidence of harmful effects from RF technologies used within existing safety standards".

Jonathan MacKenzie, policy and research analyst, Canadian Wireless Telecommunications Association, CWTA

Discussion Panel Profile: CWTA

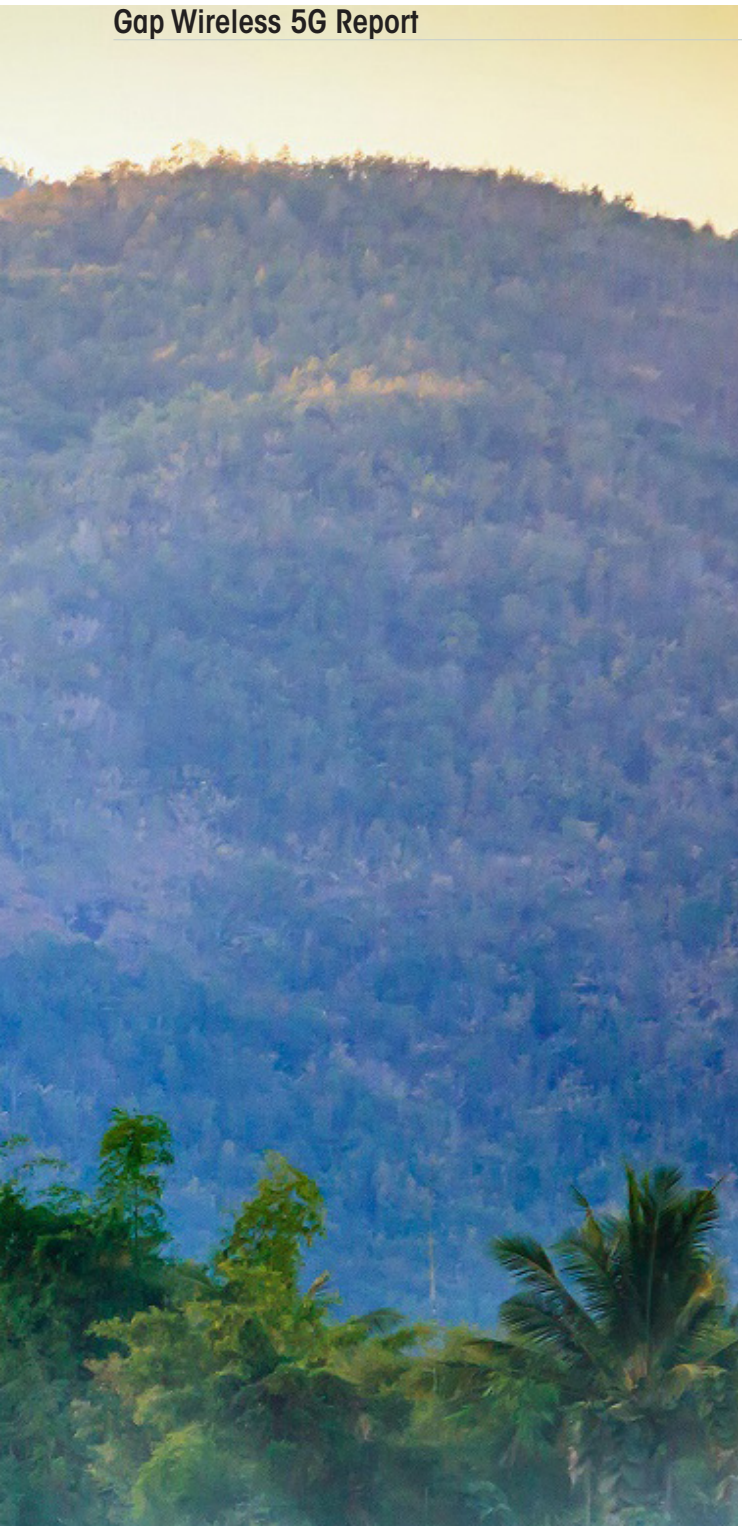
Canadian Wireless Telecommunications Association is the authority on wireless issues, developments and trends in Canada. It represents companies that provide services and products across the wireless sector. Representing the industry before all levels of government and various regulatory agencies, CWTA actively promotes the industry with the goal of ensuring continued growth of the wireless sector in Canada. CWTA administers a number of initiatives on behalf of its members, including corporate social responsibility programs and the national common short codes program.

cwta

Is 5G an issue for the environment?

"5G works with higher frequencies to be able to provide higher communication speeds," explains Ernest. "Higher frequencies mean less coverage, so the 5G network will consist of more antennas that are closer to us. However, they will be smaller and will need less power to operate. It shouldn't be an issue for the environment if they are correctly deployed."

"While 5G does operate on both the lower and higher frequency spectrum, all 5G devices will still be required to comply with current RF safety requirements," says Erika Zeroual Communications Advisor, Media Relations, Innovation, Science & Economic Development Canada, ISED. "Because safety limits are already set well below the threshold for potential adverse health effects, widescale implementation of 5G will not significantly increase RF exposure to the general public."



Is it safer to use a cellphone or a hands-free device near the ear?

"Both devices will transmit and receive electromagnetic signals, so the evaluation of risk from one vs. the other is related once again to power, power density, and time of exposure," says Bouvrette. "In both cases, the total power that can be transmitted is well below the prescribed rates by ISED and Safety Code 6. Like with transmitter sites, a safety perimeter could be calculated for these devices, and we would find that the perimeter would be less than 1mm around the antenna, which means the perimeter is internal to the actual device."

"We have demonstrated above that power, and power density is not a concern, and this is true for any amount of exposure time," Bouvrette adds. "Looking at the way we use each of these devices if one was concerned with accumulated exposure time and considering the hands-free devices often remain attached to our ears even when not in use, total radiation absorption could be considered to be higher with the use of hands-free devices."

"It is important to point out however that while not in use but while powered on, mobile phones like hands-free devices will continue to transmit and receive, but at much lower levels and for short periods of times, essentially "checking in" to ensure communication is available and ready to open a full channel if required," he concludes.

Discussion Panel Profile: ISED Canada

Innovation, Science and Economic Development Canada is the department of the Government of Canada with a mandate of fostering a growing, competitive, and knowledge-based Canadian economy. ISED has three core responsibilities. These responsibilities are to oversee Canadian companies, investment and growth; people, skills and communities; and science, technology, research and commercialization.

Innovation, Science and Economic Development Canada
Innovation, Sciences et Développement économique Canada

What specific safety measures should be adopted around 5G?

"Basically, (safety measures should be) the same as with previous generations," says Ernest Cid. "(that means ensuring) that all antenna systems meet Canadian limits (Safety Code 6) [1], which are consistent with limits used in other parts of the world (USA, EU, Australia, etc.)"

"There are three basic means of assessing human exposure: using portable EMF meters, monitoring EMF exposure 24/7 with fixed units, and wearing RF personal monitors," Cid elaborates. "Portable EMF meters are used for the certification of transmitters or working places, fixed monitoring instruments are used at specific sensitive places, while RF personal monitors are mainly worn by workers that have to be near transmitters, like tower climbers or RF engineers. IEEE Std. C95.7 points out that a good RF Safety Program 'must include RF safety awareness training for all tower workers and use of RF personal monitors.' The same applies to other workers that may find themselves near transmitters, for example, electrical service contractor workers."

"Safety Code 6 should continue to be respected along with recommendations from ISED and Health Canada," adds Bouvrette. "Special considerations should be given to antenna transmission techniques such as "Massive-MIMO" or Beamforming to ensure we understand the dynamic adjustments in power density and power steering."

"Although we will see an increase in power density for 5G sites, the incremental size of the safety perimeters will likely no more than double – we must remember that power density decreases at a rate of the square of the increase in power, meaning a doubling in safety perimeter radius would represent a quadrupling in power density, which is not the case in current beamforming solutions. This means that the biggest impact around 5G will be related to cell site technicians and other workers that may come in close contact with cell site transmitters, specifically on rooftop sites where other workers (like roofers, window washers or HVAC installers) may need to come in relatively close proximity with transmitters," he continues.

"All technologies in use today and prior to 5G for mobile communications operate under 3 GHz. Some 5G will also be deployed in the sub-3GHz spectrum and many studies have been made on health effects at these frequencies. New spectrum being made available for 5G services rises to 28 GHz and 39 GHz, more than 10 times the frequency of current technologies, but still millions of times smaller than the penetrating Ultraviolet, X-Ray or Gamma Rays we know to have effects at higher power densities and exposure times. It is important to understand, however, that power dissipates at much higher rates as frequency increases compared to a lower frequency, physical forces that will contribute to lowering the power density being transmitted by these high-frequency transmitters," he concludes.

"Health Canada does not call for taking specific steps to avoid RF from wireless networks, as exposure levels in Canada are far below the safety limits set by the federal government," explains Mackenzie. "In the United States, the Federal Communications Commission (FCC) has determined that current RF exposure limits are sufficient to ensure the safety of 5G networks, and Canada's science-based safety standards are consistent with those of the United States, as well as other jurisdictions including the EU, Japan, Australia, and New Zealand."

"Although the public is already protected by ISED's and Health Canada's existing RF exposure regulations, individual Canadians may choose to limit their personal exposure to RF energy from mobile wireless equipment - including 5G devices and antennas - by shortening the length of phone calls; substituting calls with text messages; or using accessories such as headsets, speakerphones or earpieces to increase the distance between a user and the device," he concludes.

Discussion Panel Profile: Wavecontrol

Wavecontrol designs and develops professional instruments for measurement, monitoring and evaluation of human exposure to electromagnetic fields. Their calibration laboratory (LabCal Wavecontrol) is ENAC accredited and recognised in most countries around the world through the ILAC network. All devices manufactured by Wavecontrol are delivered standard with ISO 17025 accredited individual calibration at no extra cost, as a further indication of our commitment to quality and reliable measurement.

What is SAR or Specific Absorption Rates and how are they measured?

"The emergence of 5G has led to a need for changes in the methodologies in how manufacturers will certify their radios for safety, specifically human exposure or Specific Absorption Rate (SAR)," begins Stuart Nicol, Director Product Development at APREL. "As it currently stands in Canada, there won't be any real change to the dynamics of how we will see 5G for frequencies above 3GHz in the next 12 months, considering the previous Spectrum Auction only sold off the 600MHz band with the next slice being 3500MHz," adds Nicol.

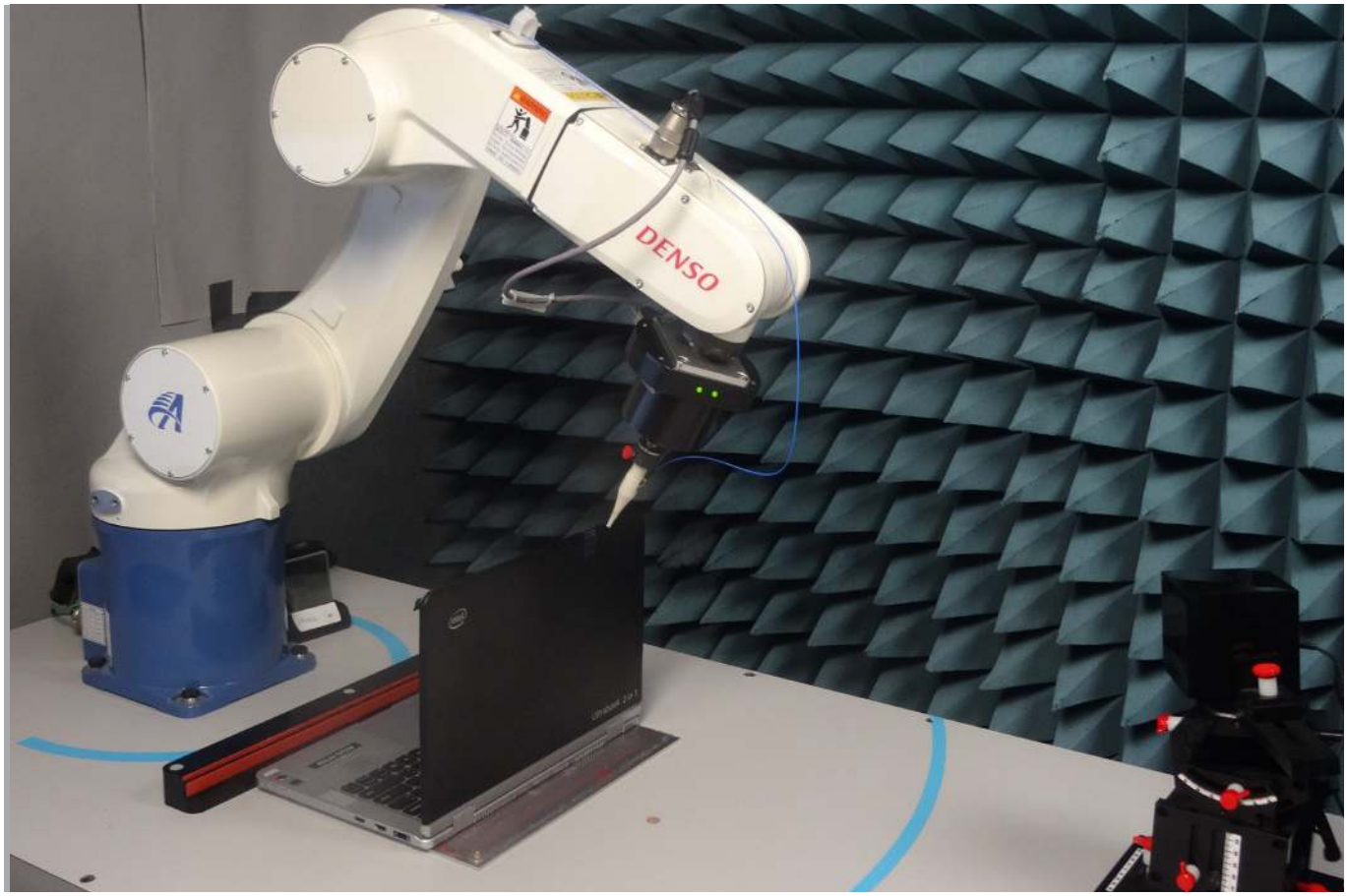
"Traditional SAR measurement techniques that use E-Field probes which demodulate the complex radio frequency signal have concerns where higher bandwidths and complex modulation schemes may not be properly addressed when measuring for exposure following the current experimental SAR methodology," says Nicol. "Studies conducted by APREL where 200/400/800MHz bandwidths using 2/4/8 carriers have revealed significant issues in regard to how much exposure has been measured when applying existing standards [2]

IEC tasked the committee JWG12 with the job of creating methodologies for the assessment of 5G technologies operating in the mm-wave frequency range."

"The working group had to investigate appropriate methods for the assessment of exposure-based in science and applicable to an experimental process," he continues. "Consideration of antenna types (MIMO, Phase Array), modulation schemes, and bandwidth all had to be investigated, and appropriate methods for assessment understood and described."

"The result of this research was the publication of a technical report IEC-TR63170 [3], which will be the basis for experimental assessment in regard to human exposure for mm-wave technologies," he adds.

"By employing a system that can be utilized as a design tool that can also perform compliance measurements, the effectiveness of the development process can be improved on significantly."



Discussion Panel Profile: APREL

APREL is an independent research-driven engineering company specialized in automated near-field test solutions for a wide range of existing and new technologies. Our approach through working directly with world leading manufacturers provides a unique opportunity and insight into emerging technologies where our solutions ensure they get to the market quicker.

The R&D team at APREL is forging a new path in system development within near-field evaluations for SAR, HAC and EMI.

Which Government body is responsible for ensuring the public is not exposed to unsafe exposures of Radio Frequencies? What is Safety Code 6?

"Health Canada administers the Radiation Emitting Devices Act, which governs the sale, lease, and importation of radiation-emitting devices in Canada," explains Tim Singer, Director General, Environmental and Radiation Health Sciences for Health Canada.

The Department's mandate regarding human exposure to radiofrequency (RF) electromagnetic energy from wireless devices includes carrying out research into possible health effects, monitoring the scientific literature related to such effects on an ongoing basis, and developing RF exposure guidelines, commonly referred to as Safety Code 6.

"Safety Code 6 sets recommended limits for safe human exposure to electromagnetic fields (EMF) in federally regulated industries and workplaces and covers all frequencies (and combinations thereof) in the range from 3 kHz to 300 GHz," says Singer. "This range covers both the frequencies used by existing communications devices (including those using 4G technology) and those that may be used by devices employing 5G technology (i.e., above 6 GHz."

"Health Canada's Safety Code 6 takes into account recent scientific data from studies carried out worldwide," he continues. "When developing the exposure limits in Safety Code 6, departmental scientists consider all peer-reviewed scientific studies and employ a weight-of-evidence approach when evaluating possible health risks from exposure to RF energy. Safety Code 6 limits are among the most stringent science-based limits in the world."

"Compliance with Health Canada's Safety Code 6 is an ongoing obligation, regardless of the technology used," adds Zeroual.

"The radiofrequency exposure limits set by Safety Code 6 cover the frequency ranges that will be used by 5G devices and antenna installations, which are set far below the threshold (at least 50-fold safety margin) for all known established adverse health effects. These limits protect all age groups, including children, on a continuous basis (24 hours a day, seven days a week)," Zeroual elaborates.

"This means that if anyone, including a small child, were exposed to radiofrequency energy from multiple sources within the Safety Code 6 limits for 24 hours a day, 365 days a year, their exposure would still be well below the threshold for adverse health effects," says Zeroual. "Similar to current wireless devices and associated infrastructure, 5G devices and antenna installations must meet radiofrequency exposure requirements before they can be sold or operated in Canada.

"ISED maintains a market surveillance program and routinely audits antenna installations and devices to verify compliance with SC6," she concludes. "As the responsibility for developing Safety Code 6 lies with Health Canada, questions regarding its development should be directed to that Department."

Does 5G cause cancer?

"To date, thousands of scientific studies have been carried out globally to evaluate the safety of RF energy," says Singer.

For over 20 years, Health Canada has conducted its own research on the biological effects of RF energy. As Singer explains, this research has increased scientific knowledge regarding the intensity of RF energy in the environment. It has also helped to establish the human exposure threshold where potentially adverse health effects can occur.

"This important information, along with all other Canadian and international peer-reviewed scientific studies, forms the basis for establishing safety standards for RF energy that protect the health of Canadians," says Singer.

"It is Health Canada's position that the health of Canadians is protected from RF energy when the human exposure limits recommended by Safety Code 6 are respected," emphasizes Singer. "This applies to devices using 4G and 5G technologies. Safety Code 6 has always established and maintained a human exposure limit that is far below the threshold for potential adverse health effects. Health Canada continues to monitor scientific research.

"If new scientific evidence were to demonstrate that exposure to RF energy below levels found in Safety Code 6 from wireless technologies is a concern, Health Canada would take appropriate action to help protect the health and safety of Canadians," he adds.

Nine years ago, in 2011, a cadre of international scientists working as part of the International Agency for Research on Cancer (IARC), assessed the cancer risk of RF-EMF exposure. They concluded that although the risk of developing some cancers – like glioma (cancer of the central nervous system) and acoustic neuroma – they felt evidence of a connection between exposure to RF-EMF and cancer was "not conclusive." (4)

"The language used by researchers can seem vague," says Bouvrette, "but their caution is indicative of the broader cancer research community, where cause-and-effect is scrutinized and continually tested."

"Perhaps it makes more sense to look to organizations that operate under a less stringent mandate, like the World Health Organization (WHO)," Bouvrette continues. "According to WHO, there are no adverse health effects from long-term, low-level exposure to radiofrequency or power frequency fields, like RF-EMF." (5)

"In the US, WHO's conclusions are substantiated," says Bouvrette. "The Federal Communications Commission recently stated that harmful biological effects associated with low levels of RF radiation exposure were "ambiguous and unproven." (6)

"Generally speaking, many international studies on the health effects of RF energy have been conducted over the last several decades," says Bouvrette, "and the conclusion reached is that the impact of RF exposure depends on frequency range and duration. Higher ranges could result in tissue heating, while prolonged exposure to lower frequency ranges can produce nerve stimulation and a tingling sensation." (7)
"In the US, the FDA is responsible for the collection and analysis of scientific information that may relate to the safety of cellphones and other electronic products. In an April 24th, 2019, letter from the FDA to the FCC addressed to Julius Knapp, Chief of the Office of Engineering and Technology publicly stated that as part of their ongoing monitoring activities, the FDA had reviewed the results and conclusions of the recently published rodent study from the National Toxicology Program (8). The review was conducted in the context of all available scientific information, including epidemiological studies. The letter also states that they concluded that no changes to the current standards are warranted at this time. As we have stated publicly, NTP's experimental findings should not be applied to human cell phone usage. The available scientific evidence to date does not support adverse health effects in humans due to exposures at or under the current limits, and that the FDA is committed to protecting public health and continues its review of the many sources of scientific literature on this topic. (9)

In other words, while studies continue to assess the impact of exposure to RF, at this time, 5G falls well within the safety parameters for human exposure. It is also worth noting that while 5G transmitters will require the creation of a large number of new base stations with a large number of transmitters, each transmitter will operate on lower power levels than 4G technology, resulting in a net reduction of RF exposure.

The electromagnetic spectrum is ever-present. It includes radar, satellites, Bluetooth, WiFi, and, of course, 5G. While invisible to the human eye, humans interact with high-frequency radio waves every day. While there's no doubt higher-energy signals, like X-rays, can pose a danger to humans and the environment, it is essential to understand that technologies like 5G operate in a completely different spectrum, where the risk of harm is significantly lower.

For Canadians, the introduction of 5G will create a completely new method of communication. This fast, flexible network will not only enhance existing systems, but will adapt to evolving generations of wireless technology. The government is also establishing a set of protocols to ensure the safety and security of all Canadians. This includes adherence to Safety Code, as well as continued monitoring of 5G systems. With the rollout of 5G, the Canadian government has set the stage for smarter, more innovative use of wireless technologies and set the country up to be a world in leader in 5G.

The truth is, the advantages made possible by 5G are extraordinary. The accelerated speeds made possible by 5G infrastructure will enable us to achieve new heights in terms of connectivity and communication, not to mention the Internet of Things and its potential to transform society. Even more importantly, the evidence clearly demonstrates that 5G is not only safe, but continues to be highly regulated and monitored. And that's good news because we can all safely reap the benefits of a better, faster, more Connected world.

References

(1) Health Canada, (June 2015). Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz. Retrieved from https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/limits-human-exposure-radiofrequency-electromagnetic-energy-range-3-300.html

(2) IEC 62209-2:2010. Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

(3) IEC TR 63170:2018. Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz

(4) Carcinogenicity of radiofrequency electromagnetic, The Lancet, Vol. 12, Issue 7, P624-626, July 01, 2011 (https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(11)70147-4/fulltext)

(5) World Health Organization, (August, 2016), What are electromagnetic fields?, Retrieved from https://www.who.int/peh-emf/about/WhatisEMF/en/index1.html

(6) RF Safety FAQ, FCC, (Nov 2015), RF Safety FAQ, Retrieved from https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety#Q5

(7) Industry Canada, (February 2019), Radiofrequency Energy and Safety, Retrieved from https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11467.html

(8) Shuren, Jeffrey. "Re: FDA to the FCC on Radiofrequency Exposure", Received by Knapp, Julius, April 24, 2019, Retrieved from https://www.fda.gov/media/135022/download

(9) National Toxicology Program, (November 2018), Cell Phone Radio Frequency Radiation, Retrieved from https://ntp.niehs.nih.gov/whatwestudy/topics/cellphones/index.html