

5G & RADIO FREQUENCY (RF) ELECTROMAGNETIC FIELDS (EMF) [RF FIELDS] RADIATION

What is 5G?

5G is the fifth generation of mobile networks that is primarily used to provide public mobile services. It is a significant evolution of the fourth generation (4G) long-term evolution (LTE) networks. 5G has been designed to meet the extensive growth in data and connectivity of today's modern society, the Internet of things (IoT) with billions of connected devices, and tomorrow's innovations.

What are the advantages of 5G?

International Telecommunications Union (ITU) explains that 5G is expected to address the following key usage scenarios:

- (i) Enhanced mobile broadband: Including peak download speeds of at least 20 Gbps and a reliable 100 Mbps user experience data rate in urban areas. This will better support increased consumption of video as well as emerging services like virtual and augmented reality.
- (ii) Ultra-reliable communications: Including 1 ms latency and very high availability, reliability and security to support services such as autonomous vehicles and mobile healthcare.
- (iii) Massive machine-type communications: Including the ability to support at least one million IoT connections per square kilometre with very long battery life and wide coverage including inside buildings.
- (iv) Fixed wireless access: Including the ability to offer fibre type speeds to homes and businesses in both developed and developing markets using new wider frequency bands, massive Multiple Input Multiple Output (MIMO) and 3D beamforming technologies.

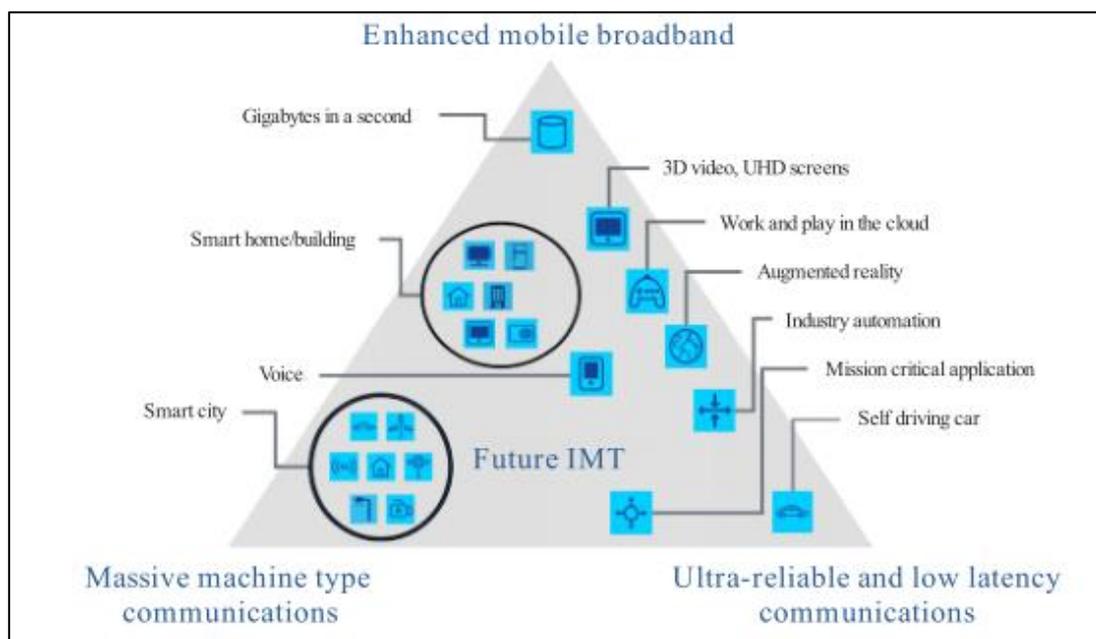


Figure 1: Usage scenarios of 5G (source - ITU)

How 5G Will Work?

5G will initially operate in conjunction with existing 4G networks before evolving to fully standalone networks in subsequent releases and coverage expansions. When a 5G connection is established, the user equipment (or device) connects to the 4G network to provide the control signalling and to the 5G network to help provide the fast data connection by adding to the existing 4G carriage. Where there is limited 5G coverage, the data is carried on the 4G network providing the continuous connection. Essentially with this design, the 5G network is complementing the existing 4G network. Figure 2 illustrates how the 5G integration with 4G networks will work.

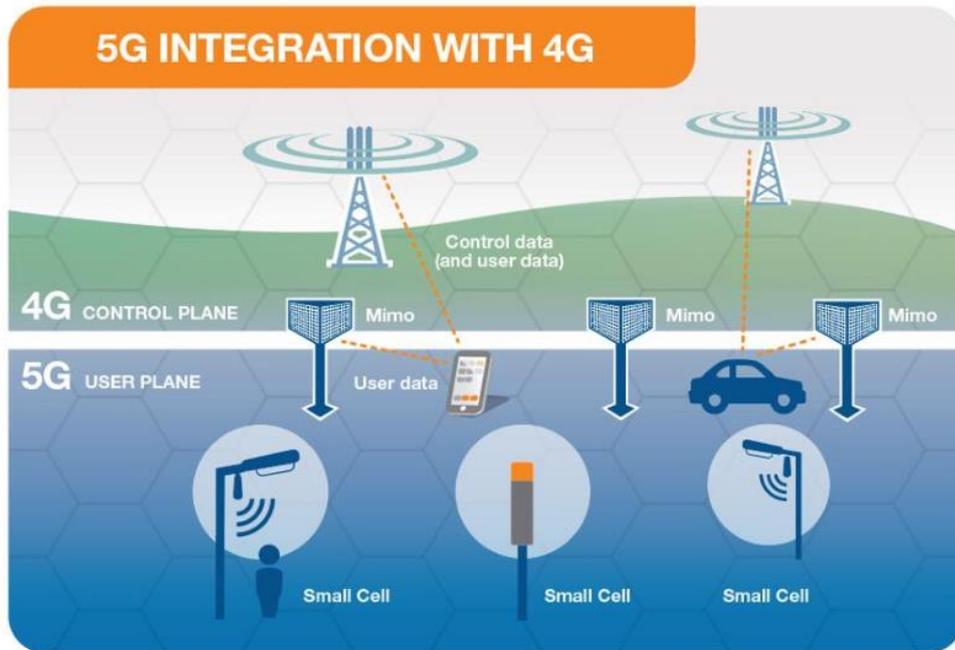


Figure 2: 5G integration with 4G (source - ITU)

5G represents an evolution in telecommunication standards. To enable increased performance, 5G uses frequencies from three different frequency bands: below 1GHz (low frequency bands), 1-6 GHz (mid frequency bands) and above 24 GHz (high frequency bands). The high frequency band is new to mobile phone networks, but are commonly used in other applications, such as point-to-point fixed radio links and satellite services.

5G uses predominately additional spectrum in the 3-100 GHz range to add significantly more capacity compared to current mobile technologies. The additional spectrum and greater capacity will enable more users, more data and faster connections. It is also expected that there will be future reuse of the existing low-band spectrum for 5G as legacy networks decline in usage and to support future use cases. All experiments and future deployment use frequencies already addressed by existing standards. Wireless 5G networks will use frequencies comparable to legacy networks, like second generation (2G), 3G or 4G.

At high frequency band, 5G networks will use a greater number of base stations and of connected objects. 5G will further employ beam-forming antennas to focus signals more efficiently towards the device in use, rather than having the signal spread in broad directions as in current base station antennas.

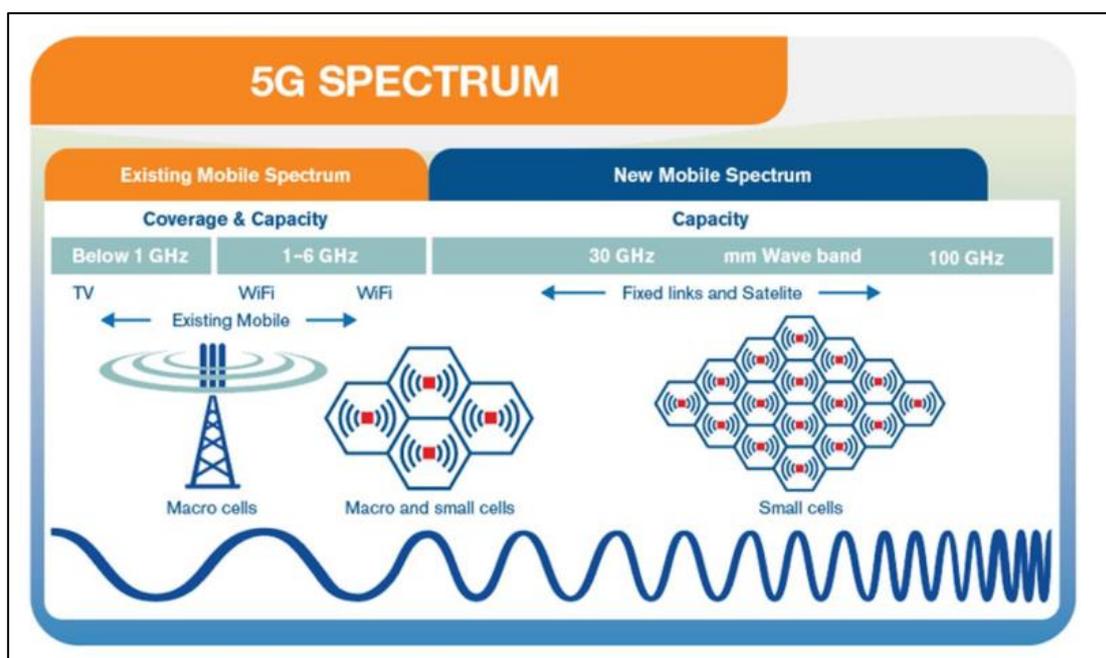


Figure 3: Existing and new spectrum to be used for 5G (source - ITU)

Status of 5G Across Various Countries

The table below shows the status of 5G deployments in various countries across the world.

Country	Spectrum Bands Allocated/Assigned/Considered	Deployment Status	Launch Date
Austria	3.4-3.8 GHz	Launched	March 2019
Finland	703-733/758-788 MHz	Launched	June 2019
	3.4-3.8 GHz		
Germany	25.1-27.5 GHz	Launched	July 2019
	703-733/758-788 MHz		
Italy	3.4-3.7 GHz	Launched	June 2019
	24.25-27.5 GHz		
United Kingdom	3.4-3.8 GHz	Launched	May 2019
	26.5-27.5 GHz		
United States of America	3.4-3.6 GHz	Launched	April 2019
	24.25-26.5 GHz		
	27.5-28.35 GHz		
	24.25-24.45 GHz		
South Korea	24.75-25.25 GHz	Launched	April 2019
	3.5 GHz		
China	3.4-3.7 GHz	Launched	November 2019
	26.5-28.9 GHz		
	3.3-3.6 GHz		
	3.6-4.2 GHz		
	4.8-5 GHz		
Japan	24.75-27.5 GHz	Launched	April 2020
	37-42.5 GHz		
	3.6-4.2 GHz		
India	4.4-4.9 GHz	Planned	Planned for 2022
	27.5-29.5 GHz		
	3.3-3.6 GHz		
	24.75-27.5 GHz		
Kuwait	71-76 GHz	Planned	Planned for 2022
Qatar	81-86 GHz		
Saudi Arabia	57-64 GHz		
South Africa	3.3-3.8 GHz		
United Arab Emirates	3.3-3.8 GHz	Launched	June 2019
Australia	3.3-3.8 GHz	Launched	April 2019
New Zealand	3.4-3.8 GHz	Launched	June 2019
Philippines	3.4-3.8 GHz	Launched	June 2019
Singapore	3.4-3.6 GHz	Launched	September 2019
Thailand	3.4-3.6 GHz	Launched	May 2019
Bahrain	3.3-3.8 GHz	Launched	May 2019
Maldives	3.4-4.2 GHz	Launched	December 2019
Trinidad	3.4-3.8 GHz	Launched	December 2019
	Information not available	Launched	June 2019
	Information not available	Launched	August 2019
	Information not available	Launched	December 2019

Status of 5G in Seychelles

In Seychelles, two mobile operators namely Cable and Wireless (Seychelles) Limited (CWS) and Intelvision Limited (Intelvision) have been assigned spectrum for the deployment of 5G services. The spectrum have been assigned from the 2496 - 2690 MHz and 3300 - 3800 MHz frequency bands.

It is important to note that the spectrum currently assigned for 5G in Seychelles is very close in terms of the wavelength and frequency to the spectrum currently being used for 3G. This means that their propagation and radiation characteristics are practically similar.

Ionizing and Non-Ionizing Radiation

There are two forms of radiation in the electromagnetic spectrum; ionizing and non-ionizing. Ionizing radiation is radiation with enough energy so that during interaction with an atom it can remove bound electrons from the orbit of an atom, causing that atom to become charged or ionized. Not all electromagnetic radiation is ionizing; only the high frequency portion of the electromagnetic spectrum are classified as ionizing radiation which includes X-rays and gamma rays. Exposure to ionizing radiation increase the risk of the long term effect of causing cancer.

Non-ionizing radiation on the other hand is radiation in the part of the electromagnetic spectrum where there is insufficient energy to cause ionization. It includes RF fields, infrared, microwaves and visible radiation.

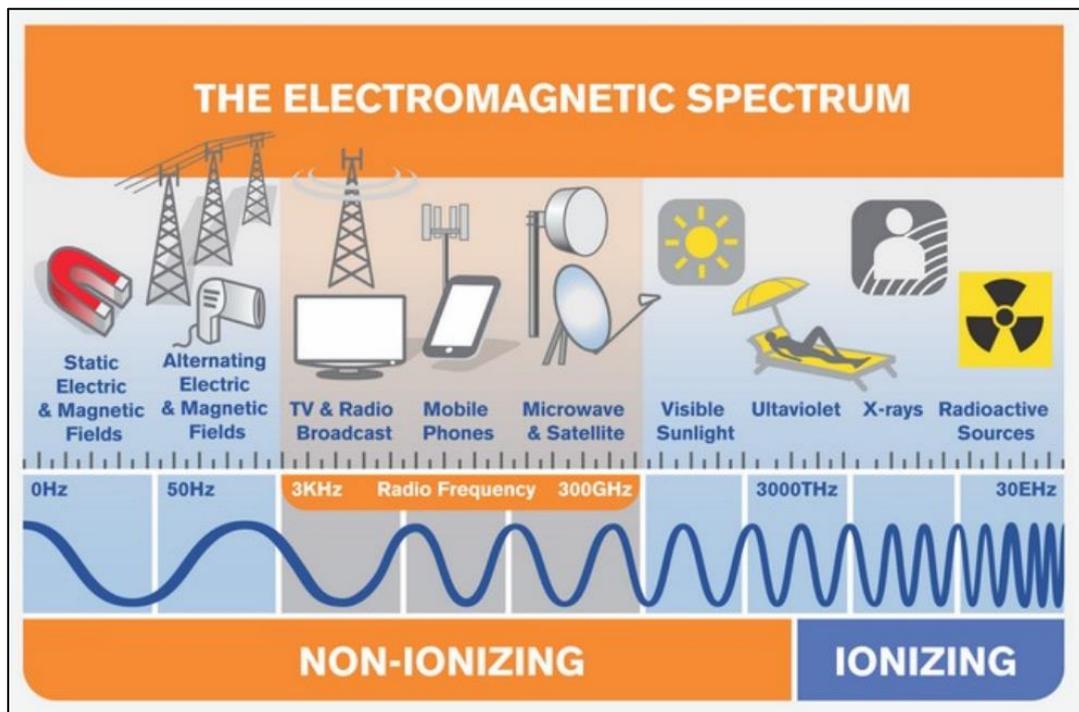


Figure 4: Ionizing & Non-Ionizing Radiation (source - ITU)

International Corporation of Non-Ionizing Radiation Protection (ICNIRP)

ICNIRP is an association registered in Munich, Germany, as a non-profit organization with a scientific mission. In 1992, ICNIRP was chartered as an independent commission to continue the work of the International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA). It is formally recognized as an official collaborating non-state actor by the World Health Organization (WHO) and the International Labour Organization (ILO).

ICNIRP is free of vested interests and to safeguard ICNIRP's independence, only donations from private individuals or from businesses not related in any way to the field of non-ionizing radiations can be accepted. ICNIRP's budget relies on support granted by public bodies. Additionally, ICNIRP members and ICNIRP Scientific Expert Group (SEG) members cannot be employed by industry. Finally, all ICNIRP draft guidelines are made available online for public consultation ahead of final publication. These are some of the key elements to ICNIRP's commitment to independence and transparency, which ICNIRP believes is fundamental to carrying out its scientific mission.

ICNIRP aims to protect people and the environment against adverse effects of non-ionizing radiation. It develops and disseminates science-based advice on limiting exposure to non-ionizing radiation. Experts from different countries and disciplines such as biology, epidemiology, medicine, physics, and chemistry, work together with and within ICNIRP to assess the risk of non-ionizing radiation exposure and provide exposure guidance. ICNIRP experts base their advice on scientific publications about

biological effects and action mechanisms of radiation, for the whole non-ionizing radiation frequency range. ICNIRP's protection advice is formulated in its guidelines, Reviews and Statements, which are publicly and freely available online.

The WHO formally endorses the ICNIRP guidelines and encourages countries to adopt these guidelines. Various countries such as Australia, United Kingdom, Canada, Hong Kong, Singapore, Mauritius, etc. either have adopted the ICNIRP guidelines or developed their own RF field exposure standards based on the ICNIRP guidelines. The conclusion from the WHO review of the ICNIRP guidelines is that RF fields exposures below the limits recommended in the ICNIRP guidelines do not appear to have any known consequence on health. The WHO has also recommended the ICNIRP guidelines in its "*Framework for Developing Health-Based EMF Standard*" and "*Model legislation for Electromagnetic Fields Protection*". Note that ITU also endorses the ICNIRP guidelines and it uses the safety limits set by such guidelines in its recommendations. The European Union's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) also endorses the ICNIRP guidelines.

The ICNIRP have published the latest guideline "ICNIRP guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz)" (ICNIRP (2020) guidelines) are for the protection of humans exposed to RF fields in the range 100 kHz to 300 GHz. The ICNIRP (2020) guidelines cover many applications including 5G, Wi-Fi, Bluetooth, mobile phones, and base stations.

Health Concerns Regarding RF Fields

Understanding the health impact of RF fields falls within the mandate of the World Health Organization (WHO) in the area of environmental health. The WHO established the International EMF project in 1996, in response to general concern over health effects of RF fields exposure. The aim of the EMF project is to encourage the establishment of exposure limits/levels and other control measures that provide the same or similar level of health protection for all people.

A common concern about base station and local wireless network antennas relates to the possible long-term health effects that whole-body exposure to the RF fields may have. As per WHO, to date, the only health effect from RF fields identified in scientific reviews has been related to an increase in body temperature ($> 1\text{ }^{\circ}\text{C}$) from exposure at very high field intensity found only in certain industrial facilities.

The levels of RF exposure from base stations and wireless networks are so low that the temperature increases are insignificant and do not affect human health. The strength of RF fields is greatest at its source, and diminishes quickly with distance. Access near base station antennas is restricted where RF fields may exceed international exposure limits. Recent surveys have indicated that RF fields exposures from base stations and wireless technologies in publicly accessible areas (including schools and hospitals) are normally thousands of times below international standards.

While most radio technologies have used analog signals, modern wireless telecommunications are using digital transmissions. Detailed reviews conducted so far have not revealed any hazard specific to different RF modulations.

Over the past 15 years, studies examining a potential relationship between RF transmitters and cancer have been published. These studies have not provided evidence that RF fields exposure from the transmitters increases the risk of cancer. Likewise, long-term animal studies have not established an increased risk of cancer from exposure to RF fields, even at levels that are much higher than produced by base stations and wireless networks.

WHO confirms that from all evidence accumulated so far, no adverse short or long term health effects have been shown to occur from the RF fields produced by base stations. Since wireless networks produce generally lower RF signals than base stations, no adverse health effects are expected from exposure to them. Also, all reviews of studies and literatures conducted so far have indicated that exposures below the limits recommended in the ICNIRP guidelines, covering the RF spectrum from 0-300 GHz, do not produce any known adverse health effect.

The ICNIRP guidelines form the basis of regulatory limits for mobile network antennas and devices in most parts of the world and are supported by the WHO. The Public Health Authority (PHA) has also adopted the ICNIRP guidelines as the exposure standard for limiting exposure to RF fields.

International Agency for Research on Cancer's (IARC) Position on RF Fields

The IARC is the specialized cancer agency of the WHO. The objective of the IARC is to promote international collaboration in cancer research. In 2011, the IARC classified RF fields as possibly carcinogenic to humans i.e. Group 2B, a category used when a causal association is considered credible, but when chance, bias or confounding cannot be ruled out with reasonable confidence. Possibly carcinogenic to humans is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals. The IARC website lists 314 agents classified as group 2B including RF fields, gasoline engine exhaust, pickled vegetables, dry-cleaning, etc. Nevertheless, in 2020, IARC published the latest World Cancer Report and with respect to cancer causation it indicates that because RF fields belong to the non-ionizing part of the electromagnetic spectrum, the photon energy is too weak to ionize molecules and thereby cause direct DNA damage. Also, it indicates that absorption of RF fields is known to heat biological tissue, but a minimal temperature increase below the regulatory limits is not expected to increase the risk of cancer. Despite considerable research efforts, no mechanism relevant for carcinogenesis has been consistently identified to date.

RF Fields Study Conducted in Seychelles

As per International best practice, protection against exposure to RF fields is a health issue. The health ministries or authorities, or the institutions involved in radiation and nuclear safety usually are at the forefront to develop or adopt the necessary exposure standards/guidelines and defining the exposure limits.

The enforcement of the exposure standards, such as the ICNIRP guidelines, vis-à-vis compliance to the exposure limits defined therein is usually carried out by the broadcasting and telecommunications regulator with respect to radiated RF fields from broadcasting and telecommunications infrastructure.

As such, DICT being the broadcasting and telecommunications regulator for Seychelles, its role is limited to ensure that the broadcasting and telecommunications operators comply with the exposure guidelines adopted by the PHA. This is a similar model adopted by various other countries such as Australia, United Kingdom, Canada, Hong Kong, Singapore, etc.

In 2019, DICT conducted a study to take measurements of RF fields generated from mobile cellular installations of 2G, 3G and 4G mobile systems. The conclusion of the study is that the exposure levels measured across 25 sites around Mahé, Praslin and La Digue are well below the limits of the 'general public' reference levels defined in the ICNIRP guidelines. The final report of the study is publicly available at the following link. <http://www.ict.gov.sc/Documents/EMFReport.pdf>

ICNIRP's Position on Health Concerns Regarding 5G

In addition to the mid frequency bands that are used for 3G and 4G systems (1-6 GHz), 5G systems will also use high frequency bands (above 24 GHz). RF fields at higher frequencies produce relatively superficial exposure, with less power penetrating deep into the body; the restrictions in the ICNIRP guidelines account for this to ensure that exposure does not cause any harm. Different frequencies also behave differently in the environment, and as a result, additional antennas are required to utilise the high frequency band. These are not expected to affect the exposure scenario appreciably, and initial measurement studies suggest that exposure from 5G antennas will be approximately similar to that from 3G and 4G antennas.

A key feature of the 5G system is that it will use beam-forming technology, which allows for the RF fields to be focused to the region where it is needed (e.g. to a person using a mobile phone), rather than being spread out over a large area. This will allow, for example, the same frequencies to be sent to different users concurrently without interfering with one another, which increases communication rates because the frequency band does not need to be shared between the users. This also reduces exposure in regions where communication is not needed.

As 5G can utilise high frequency bands in addition to those currently used (low and mid frequency bands), power from those high frequency bands will be primarily absorbed more superficially than that from previous mobile telecommunications technologies. However, although the proportion of power that is absorbed superficially (as opposed to deeper in the body) is larger for the high frequency band,

the ICNIRP (2020) restrictions have been set to ensure that the resultant peak spatial power will remain far lower than that required to adversely affect health. Accordingly, 5G exposures will not cause any harm provided that they adhere to the ICNIRP (2020) guidelines. It is important to note that, in terms of the 5G exposure levels measured so far, the ICNIRP (1998) guidelines would also provide protection for 5G if they produce the exposure levels that are so far predicted; these are predicted to be approximately similar to the exposures from previous mobile telecommunications technologies (e.g. 4G). However, ICNIRP (2020) guidelines have made a number of changes that do not rely on such predictions, and that will ensure that 5G is not able to cause harm, regardless of our current expectations.

WHO's Position on Health Concerns Regarding 5G

Exposure from 5G infrastructures from mid frequency band is similar to that from existing mobile phone base stations used for 3G or 4G. With the use of multiple beams from 5G antennas, exposure could be more variable as a function of location of the users and their usage. Given that 5G is currently at an early stage of deployment, the extent of any change in exposure to RF fields is still under investigation.

As previously mentioned, to date, and after much research performed, no adverse health effect has been causally linked with RF fields exposure to wireless technologies. Health-related conclusions are drawn from studies performed across the entire radio spectrum but, so far, only a few studies have been carried out at the high frequency bands to be used by 5G. However, tissue heating is the main mechanism of interaction between RF fields and the human body. RF fields exposure levels from current technologies result in negligible temperature rise in the human body. As the frequency increases, there is less penetration into the body tissues and absorption of the energy becomes more confined to the surface of the body (skin and eye). According to WHO, ICNIRP guidelines are not technology-specific and they cover radiofrequencies up to 300 GHz, including the frequencies under discussion for 5G. Also, provided that the overall RF fields exposure remains below international guidelines, no consequences for public health are anticipated. Nevertheless, WHO will review scientific evidence related to potential health risks from 5G exposure as the new technology is deployed, and as more public health-related data become available. Also, WHO is conducting a health risk assessment from exposure to RF fields, covering the entire radiofrequency range, including 5G, to be published by 2022.

ITU's Position on Health Concerns Regarding 5G

As per ITU, 5G networks are specifically designed to minimize transmitter power, even more than existing 4G networks. 5G networks use a new advanced radio and core architecture that is very efficient and minimizes transmissions, which results in lower RF fields levels. With the introduction of new technologies, there may be a small localized increase in the overall level of radio signals due to the fact that new transmitters are active. In some countries, deployment of 5G may occur as part of the closure of earlier wireless networks. Based on the transition from previous wireless technologies, we can expect that overall exposure levels will remain similar and will be a small fraction of the international exposure limits.

Some deployments of 5G will use massive MIMO antennas that have multiple elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput in more efficient ways. The smart antennas will have the possibility to transmit required data only in the direction of the user and only during the time of usage. 5G systems with smart antennas will be more efficient, which will result in minimized RF fields exposure.

ITU advises that it does not set maximum levels of exposure of the public to RF fields and these levels are set by competent bodies (such as ICNIRP) and ITU in turn references their standards and recommendations in its relevant ITU Recommendations. Also, that despite extensive studies into the health effects of mobile phones over the last two or three decades, there is no indication of an increased health risk when exposed to RF fields below the levels specified by international bodies. Also, there is no evidence that RF fields from existing (2G, 3G and 4G) mobile networks pose any health risks, provided that administrations enforce the exposure limits established by international bodies.

ITU indicates that the WHO, SCENIHR of the European Union and ICNIRP have concluded that exposure related to RF fields (including from 5G) does not lead to adverse effects for public health if it is below the limits recommended by the ICNIRP guidelines.

Health Concerns Regarding 5G in Europe

Questions regarding health concerns associated with RF fields and 5G have been raised a number of times in the European Parliament. In 2017, over 170 scientists from all over the world appealed to the European Union institutions for 5G deployment to be blocked due to growing concerns about the increase in radiofrequency radiation and the related health risks for European citizens.

The European Commission (EC) has advised that the Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) has the standing mandate to provide an independent update of the scientific evidence available, including the assessment of health risks that may be associated with exposure to RF fields. Till date, SCHEER has produced five opinions, none of which have provided any scientific justification to revise the limits set by Council Recommendation 1999/519/EC on the exposure of the general public to RF fields. These limits are based on independent guidance issued by the ICNIRP.

During 2018 and 2019, the Committee had advised that it may reassess the situation depending on the outcome of the review of the ICNIRP guidelines. Consequently, following the recent review of the ICNIRP guidelines (March 2020), the Commission is now reassessing the situation, in collaboration with the Scientific Committee, and, if needed, with the Scientific Advice Mechanism. This will include an in-depth review of the scientific evidence currently available.

EC has advised that all frequency bands envisaged for the deployment of 5G are covered by the aforesaid Council Recommendation. Also, it is expected that the exposure to RF fields is very close to the exposure due to 4G. 5G networks are expected to use smaller cells with lower power levels and therefore lower exposure levels than existing (large) cells in 4G networks. The overall exposure with the roll-out of 5G networks should be comparable to existing levels and remain well below the safe health limits for public exposure defined at international level and recommended at EU level. 5G will also generally use lower emission powers in frequency bands that have already been in use for other applications for a long time.

Questions regarding health concerns associated with RF fields and 5G have been raised in the United Kingdom Parliament too. Consequently, Public Health England (PHE), an executive agency of the Department of Health and Social Care in the United Kingdom, has advised that based on the accumulated evidence and reviews, the guidelines of the ICNIRP should be adopted and there is no convincing evidence that RF fields exposures below the ICNIRP guideline levels can cause adverse health effects. PHE also indicates that while a small increase in overall exposure to RF fields is possible when 5G is added to the existing network, the overall exposure is expected to remain low and well within the ICNIRP guidelines.

5G RF Fields Measurements Conducted by Telstra

In 2019, Telstra, an Australian mobile operator, in collaboration with Ericsson, Narda and Total Radiation Solutions conducted RF fields exposure measurements from Telstra's 5G network under typical use conditions and locations of public interest close to 5G base stations, including a sports ground, school, street, cafés and apartments. The purpose of this exercise was to show a comparison of RF fields exposure levels from 5G, 4G, 3G and Wi-Fi in everyday use conditions to the public RF human exposure limits set by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) based on the ICNIRP guidelines. The results of the exercise showed that the RF fields exposure levels from 5G were similar to 3G, 4G and Wi-Fi. In addition, the exposure levels found to be well below the safety limit, and in many cases over a thousand times lower.

5G and COVID-19

WHO has advised that 5G mobile networks do not cause or spread COVID-19. As described by the WHO, you need to physically come into contact with the corona virus to become infected by it, and as RF fields from 5G cannot carry viruses, they cannot bring you into contact with the virus.

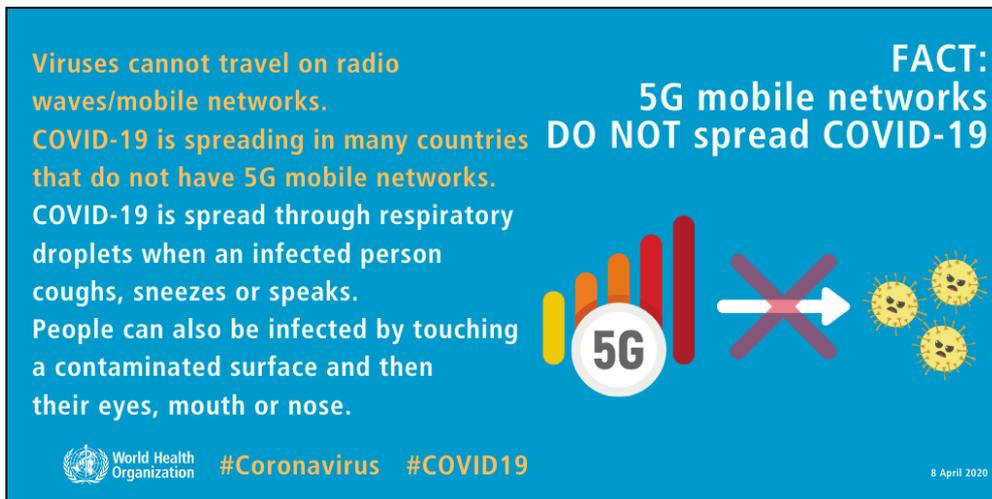


Figure 5: 5G & COVID-19 (source - WHO)

ICNIRP states that claims such as exposure to RF fields generated by 5G devices can both cause COVID-19 and increase its severity are not supported by any evidence (not even extremely weak evidence), and the large body of scientific knowledge regarding the RF fields relevant to 5G demonstrates that those claims are not feasible. ICNIRP confirms that RF fields exposure from 5G devices does not cause COVID-19, nor does it have any effect on the disease process or health outcomes of those who are infected by the new corona virus that causes COVID-19.

As described by the WHO, you need to physically come into contact with the corona virus to become infected by it, and as RF fields from 5G cannot carry viruses, they cannot bring you into contact with the virus.

Confusion over Ban on Huawei's 5G Equipment

Some countries such as United States of America, United Kingdom, Japan, Australia, New Zealand and Taiwan have imposed a ban on using Huawei's 5G equipment. It is important to understand and not to be confused that these countries have banned the 5G deployment. Note that these countries have concerns to use the 5G equipment manufactured by the Chinese company 'Huawei' due to alleged national security concerns.

References

ITU

- 1) Supplement 1 to ITU-T K-series Recommendations: Guide on electromagnetic fields and health
- 2) Supplement 9 to ITU-T K-series Recommendations: 5G technology and human exposure to radio frequency electromagnetic fields
- 3) Supplement 16 to ITU-T K-series Recommendations: Electromagnetic field compliance assessments for 5G wireless networks
- 4) Recommendation ITU-R M.2083-0: IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond
- 5) <https://www.itu.int/en/mediacentre/backgrounders/Pages/5G-EMF-health.aspx>
- 6) <https://www.itu.int/en/mediacentre/backgrounders/Pages/5G-fifth-generation-of-mobile-technologies.aspx>
- 7) <https://www.itu.int/en/mediacentre/backgrounders/Pages/5G-EMF-health.aspx>

WHO

- 8) <https://www.who.int/news-room/q-a-detail/what-are-the-health-risks-associated-with-mobile-phones-and-their-base-stations>
- 9) <https://www.who.int/news-room/fact-sheets/detail/electromagnetic-fields-and-public-health-mobile-phones>
- 10) <https://www.who.int/news-room/q-a-detail/5g-mobile-networks-and-health>
- 11) https://www.who.int/peh-emf/project/EMF_Project/en/
- 12) <https://www.who.int/peh-emf/publications/facts/fs304/en/>

- 13) <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters#5g>

ICNIRP

- 14) <https://www.icnirp.org/en/applications/5g/index.html>
- 15) <https://www.icnirp.org/en/about-icnirp/funding-governance/index.html>
- 16) <https://www.icnirp.org/en/activities/news/news-article/covid-19.html>
- 17) <https://www.icnirp.org/en/about-icnirp/aim-status-history/index.html>
- 18) <https://www.icnirp.org/en/differences.html>
- 19) <https://www.icnirp.org/en/rf-faq/index.html>

EU

- 20) https://www.europarl.europa.eu/doceo/document/E-8-2018-001797_EN.html
- 21) https://www.europarl.europa.eu/doceo/document/E-8-2018-001797-ASW_EN.html
- 22) https://www.europarl.europa.eu/doceo/document/E-8-2018-001837_EN.html
- 23) https://www.europarl.europa.eu/doceo/document/E-8-2018-001837-ASW_EN.html
- 24) https://www.europarl.europa.eu/doceo/document/E-8-2018-003975_EN.html
- 25) https://www.europarl.europa.eu/doceo/document/E-8-2018-003975-ASW_EN.html
- 26) https://www.europarl.europa.eu/doceo/document/E-8-2018-005128_EN.html
- 27) https://www.europarl.europa.eu/doceo/document/E-8-2018-005128-ASW_EN.html
- 28) https://www.europarl.europa.eu/doceo/document/E-9-2019-004409_EN.html
- 29) https://www.europarl.europa.eu/doceo/document/E-9-2019-004409-ASW_EN.html
- 30) https://www.europarl.europa.eu/doceo/document/E-8-2019-001586_EN.html
- 31) https://www.europarl.europa.eu/doceo/document/P-8-2019-001526_EN.html
- 32) https://www.europarl.europa.eu/doceo/document/P-8-2019-001526-ASW_EN.html
- 33) https://www.europarl.europa.eu/doceo/document/P-9-2020-000221_EN.html
- 34) https://www.europarl.europa.eu/doceo/document/P-9-2020-000221-ASW_EN.html
- 35) https://www.europarl.europa.eu/doceo/document/P-9-2020-002498_EN.html
- 36) https://www.europarl.europa.eu/doceo/document/P-9-2020-002498-ASW_EN.html

Other Sources

- 37) <https://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2019-06-03/259202/>
- 38) <https://www.gsma.com/spectrum/wp-content/uploads/2020/03/5G-Spectrum-Positions.pdf>
- 39) https://www.gsma.com/publicpolicy/wp-content/uploads/2018/07/Health-Booklet_2017_A4_12pp-ENGLISH_WEB.pdf
- 40) <https://www.gsma.com/publicpolicy/resources/5g-emf-exposure-and-safety>
- 41) http://5gobservatory.eu/wp-content/uploads/2020/07/90013-5G-Observatory-Quarterly-report-8_1507.pdf
- 42) <https://www.nokia.com/networks/5g/5g-in-action/>
- 43) https://en.wikipedia.org/wiki/Availability_of_5G_by_country
- 44) https://www-file.huawei.com/-/media/CORPORATE/PDF/public-policy/public_policy_position_5g_spectrum.pdf
- 45) <https://www.qualcomm.com/media/documents/files/spectrum-for-4g-and-5g.pdf>
- 46) <https://www.oecd-ilibrary.org/deliver/2f880843-en.pdf?itemId=%2Fcontent%2Fpaper%2F2f880843-en&mimeType=pdf>
- 47) <https://www.ericsson.com/en/5g/5g-networks/5g-contracts>
- 48) <https://exchange.telstra.com.au/5-surveys-of-5g-show-eme-levels-well-below-safety-limits/>
- 49) <https://intallaght.ie/all-the-countries-that-have-kicked-huawei-out-of-its-5g/>
- 50) <https://www.bbc.com/news/world-48309132>
- 51) <https://www.statista.com/chart/17528/countries-which-have-banned-huawei-products/>
- 52) <https://www.npr.org/2020/07/14/890812517/in-reversal-u-k-will-ban-huawei-equipment-from-its-5g-network>
- 53) <https://www.nytimes.com/2020/07/14/business/huawei-uk-5g.html>