



Australian Government
Australian Radiation Protection
and Nuclear Safety Agency



Submission to the House of Representatives Standing Committee on Communications and the Arts Inquiry into 5G in Australia

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Introduction

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is the Australian Government's primary authority on radiation protection and nuclear safety. ARPANSA regulates Commonwealth entities using radiation with the objective of protecting people and the environment from the harmful effects of radiation. A key function of the CEO as described in the *Australian Radiation Protection and Nuclear Safety Act 1998* (ARPANS Act) is to undertake research in relation to radiation protection. ARPANSA also provides services and promotes national uniformity and the implementation of international best practice across all jurisdictions.

With the deployment of 5G technology, ARPANSA has observed an increase in public interest with regard to health impacts from the radio waves that are emitted from mobile telecommunications. With approximately 30,000 studies and reviews in the area of electromagnetic fields, including radio waves, it is a widely researched area.

This submission is aimed at providing information to the inquiry on health and environmental impacts of radio waves to assist with consideration around the deployment of 5G technologies including the planned shift to higher frequency radio waves, and to outline the role of ARPANSA.

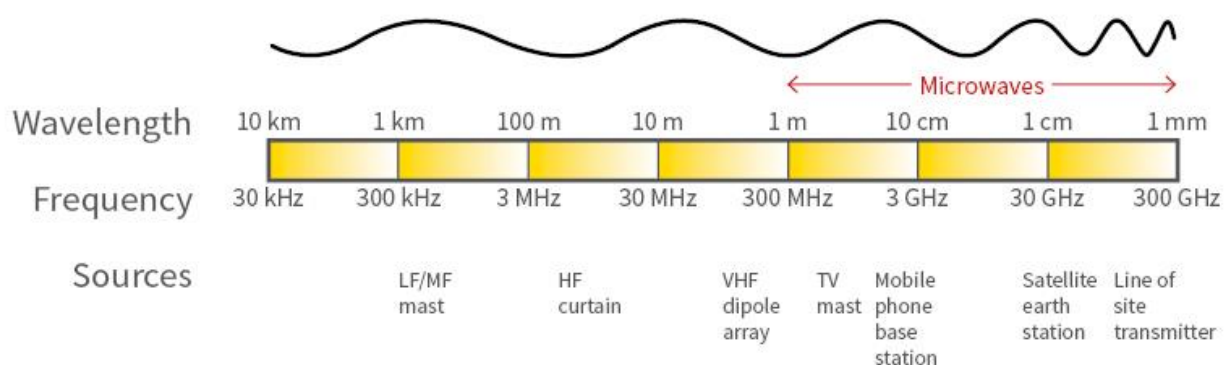
Impact of EME RF on Health and Environment

Wireless radiation and 5G

Mobile phone networks and other wireless telecommunications emit low-powered radio waves also known as radiofrequency (RF) electromagnetic energy (EME). These radio waves lie in the frequency range between 3 kilohertz (kHz) to 300 gigahertz (GHz). RF EME is different from ionising radiation, which is associated with nuclear energy or use in medicine.

Wireless telecommunications operate using radio waves at different frequencies. The 5G network will initially use similar frequencies as the current mobile phone networks (3G and 4G) which operate at lower microwave frequencies. In the future, 5G will use a higher microwave frequency band, sometimes called 'millimetre waves'. Higher frequencies do not mean higher exposure levels.

The radiofrequency radiation spectrum



What the science says about impact on humans

Very high levels of exposures to radio waves (more than 50 times above the limit in the ARPANSA RF standard) can heat biological tissue and cause tissue damage. For example, in applications such as industrial use of radio waves for welding, or close occupational exposure to AM radio towers that operate at a low frequency but high power to provide vast coverage. In these applications, appropriate safety measures are taken to manage risk to the public and workers.

The exposure to radio waves routinely encountered by the general public in the environment is too low to produce significant heating or increased body temperature. For the very low level of exposure from radio waves used in telecommunications, the evidence for production of harmful biological effects is ambiguous and unsubstantiated. Although there have been studies reporting biological effects ('bio-effects') at these levels, there has been no indication that such effects might constitute a human health hazard. Biological effects are physiological responses that can occur for a broad range of reasons, and are differentiated from 'health effects', which result in adverse conditions to the human body that may require medical treatment.

Health authorities around the world, including ARPANSA and the World Health Organization (WHO), have examined the scientific evidence for possible health effects from telecommunications sources. Current research indicates that there is no established evidence for health effects from radio waves used in mobile telecommunications. This includes the upcoming roll-out of the 5G network. ARPANSA's assessment is that 5G is safe.

The future use of millimetre waves by 5G

At the frequencies where current mobile phone technology operates (including 4G and 5G), some of the energy is absorbed into the body. However, it is too low to produce any significant heating of tissue. The millimetre waves that are planned to be used by 5G in the future do not penetrate past the skin. The power level will be low and no appreciable heating will occur in the skin. Millimetre wave frequencies, while higher than current frequencies used, are covered by the current *Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz* (ARPANSA RF Standard).

Electromagnetic hypersensitivity

Some individuals have reported a wide range of non-specific health problems that they attribute to low-level radio waves and other electromagnetic sources. The symptoms most commonly reported include headaches, body pain, lethargy, tinnitus (ringing in the ear), nausea, burning sensation, heart arrhythmia and anxiety. This self proclaimed sensitivity to electromagnetic fields is termed 'electromagnetic hypersensitivity' or EHS, which in medical literature is also known as idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF). EHS is not a medically recognised syndrome.

While ARPANSA and the WHO recognise that the symptoms of EHS are real and can have a disabling effect for the affected individual, EHS has no clear diagnostic criteria and the science so far has not provided evidence that RF exposure is the cause. The majority of scientific studies published to date have found that under controlled laboratory conditions, EHS individuals cannot detect the presence of RF sources any more accurately than non-EHS individuals. Several studies have indicated a nocebo effect i.e. an adverse effect due to the belief that something is harmful.

Do radio waves cause cancer?

Radio waves are classified as non-ionising radiation, meaning that they have insufficient energy to break chemical bonds, and in doing so cause DNA damage that may lead to cancer. There is no established evidence that low-level exposure to radio waves causes cancer. However, the assessment of potential health risks of exposure to radio waves includes a level of uncertainty. Some epidemiological studies have shown an association between heavy mobile phone use and brain cancer; however, limitations of the methods of these studies prevent conclusions of causality being drawn from these observations. Based largely on this limited evidence, the International Agency for Research on Cancer (IARC) in 2011 classified RF EME as possibly carcinogenic to humans. This classification is not intended to cause alarm, but to encourage further research in this area. Other things that IARC classify at this level include pickled vegetables and aloe vera.

Even when taking the IARC decision into account, the overall evidence suggests that the radio waves from mobile phone handsets and other wireless devices are not harmful to the user. A recent study led by ARPANSA, published with the British Medical Journal Open, found that the wide use of mobile phones in Australia has not increased the rate of brain cancer.

How ARPANSA and other health authorities consider the science and provide advice

Expertise required

To study the biological effects of radio waves, various disciplines of expertise need to be utilised, including biology, epidemiology, medicine, physics, engineering and social sciences. All of these disciplines play important individual and collective roles in evaluating possible adverse effects on health, and provide information on the need for, and approaches to, protection. ARPANSA has expertise in many of these areas and collaborates with a number of key organisations including universities, other health authorities (WHO, the International Commission for Non-Ionizing Radiation Protection (ICNIRP)), and various national agencies, that collectively have expertise in all of the specialised disciplines relevant to health research.

To determine any health effects in human or other biological populations, a key area of expertise required is epidemiology. This is the scientific study and research of causes and distribution of disease across populations, including ways to reduce the impact of diseases on the health of communities. ARPANSA employs staff with epidemiological expertise to assess the state of the science on EME and population health.

Approach taken

No single scientific study, considered in isolation, will provide a meaningful answer to the question of whether or not radio waves can cause (or contribute to) adverse health effects in people, animals or the environment. The relevance of individual studies to health and environmental protection also varies. In order to draw an informed conclusion from research studies, it is critical to weigh-up the science in its totality.

Scientific evidence is deemed to be established when it is consistent and generally accepted by the broader scientific community. This usually follows an evaluation of the available data by expert scientific bodies, using a 'health risk assessment' approach. In a health risk assessment, all available studies with either positive or negative effects need to be evaluated and judged on their own merit, and then collectively using the weight-of-evidence approach. It is important to determine how much a single set of new evidence may change the probability that exposure to radio waves causes an effect that has not been shown across the

existing body of evidence. Generally, studies must be replicated, or be in agreement with similar studies to exclude the possibility that the results were random or caused by an external factor. The evidence for an effect is further strengthened if the results from different types of studies (epidemiology and laboratory) point to the same conclusion.

Health authorities like ARPANSA, or international organisations such as WHO and ICNIRP, assess scientific evidence and provide appropriate advice. Individual studies are usually published as peer-reviewed journal papers, however conclusions from these can often vary. Science continually evolves, and ARPANSA reviews new research into the potential health effects of radio waves on an ongoing basis, and consults relevant stakeholders in order to provide accurate up-to-date health advice.

Unsubstantiated views

Opinions on health risks, which are not peer-reviewed, are often provided in the media and on the internet. This includes the possible health effects of radio waves from some scientists that are contrary to the assessment of ARPANSA and the WHO.

For example, the 2007 Bioinitiative Report, including updated versions, is an online document reporting on the relationship between the electromagnetic fields associated with power lines and wireless devices and health. It has not been peer-reviewed and has been heavily criticised by governments and independent research groups for its lack of balance in formulating views, selective use of scientific data and claims that lack a scientific basis. ARPANSA supports the critical assessment of this Report.

The 5G Appeal was prepared in 2017 by some scientists and doctors around the world (including in Australia) who are calling for the European Union to ‘halt the roll out of 5G due to serious potential health effects from this new technology’. The Appeal is selective in the use of the available literature and scientific data on radio waves and health. Neither the 5G Appeal nor the Bioinitiative report follow the weight of evidence approach described earlier.

Impact on the environment

A common theme ARPANSA has observed in arguments by anti-5G groups is the impact this network would have on flora and fauna. As an example, a common argument is that bee populations are being impacted by exposure to current mobile networks and this will be made worse under 5G.

The majority of studies investigating the effects of radio waves or electromagnetic fields in general are usually performed on standard laboratory animals used in toxicological studies, such as rats and mice. However, some studies have also included other species such as short-living flies for the investigation of genotoxic effects. There is limited research on the effects of electromagnetic fields on the diversity or abundance of insects or bees. The few ecological studies that do exist generally report little or no evidence of a significant environmental impact. The studies that do show an effect, such as the ones listed, suffer from poor scientific method and the reported effect of electromagnetic field exposure cannot be separated from other environmental factors.

Recommendations for further research

Although the body of science demonstrates there are no health effects from radio waves in mobile telecommunications, it is important to continue the research in radiation safety. ARPANSA has made recommendations for areas where the body of knowledge can be expanded. The research

recommendations include ongoing assessment of personal and environmental exposure to radio waves from new and emerging technologies.

The WHO's Radiation Programme has an ongoing project to assess potential health effects of exposure to radio waves in the general and working population. The WHO has identified areas of further research and will commission in 2020 systematic reviews to analyse and synthesise the evidence.

ARPANSA and our role in mobile telecommunications

Role in 5G

ARPANSA is not a proponent of technology and does not have a regulatory role for public mobile telecommunications. Our role as a radiation health authority is the development of the safety standard for exposure to radio waves from telecommunications sources like 5G. ARPANSA also provides information and advice on the safety of sources emitting radio waves. In order to provide the best advice on the protection of the Australian public from the effects of radio waves, ARPANSA undertakes its own research and reviews the relevant scientific research. ARPANSA's role is not to convince people of the science, rather to provide our assessment based on the body of the evidence and where possible, respond to questions or provide information to highlight this information.

The ARPANSA RF Standard

To address the health risks of radio waves, in 2002, ARPANSA published the *Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz* (ARPANSA RF Standard). The ARPANSA RF Standard is designed to protect people of all ages and health status against all known adverse health effects from exposure to radio waves. It is based on scientific research that shows the levels at which harmful effects occur and it sets safety limits, based on international guidelines that are considered best practice, well below these harmful levels. The ARPANSA RF Standard applies a precautionary approach in setting exposure limits. In order to compensate for uncertainties in the scientific knowledge, large safety factors are incorporated into the exposure limits i.e. the limits are set well below the level at which all known adverse health effects occur.

Using this standard, the Australian Communications and Media Authority (ACMA) establishes EME exposure limits under its *Radiocommunications (Electromagnetic Radiation-Human Exposure) Standard 2014* and *Radiocommunications Licence Conditions (Apparatus Licence) Determination 2015* under which all licence holders must operate. Radio wave exposure to the public from all wireless telecommunications sources including 5G have to comply with the limits set by the ARPANSA RF Standard and enforced via the ACMA regulatory instruments.

The ARPANSA RF Standard is closely aligned with international guidelines prepared by the International Commission for Non-Ionising Radiation Protection (ICNIRP) in 1998 and endorsed by the World Health Organization (WHO). The ICNIRP guidelines form the basis for regulations for the majority of countries. Some regions worldwide have, without any scientific justification, developed limits that are lower than the ICNIRP guidelines. Health authorities like ARPANSA, or international organisations such as WHO and ICNIRP, do not support such an approach, and the WHO has in response developed its Framework for Developing Health-Based EMF Standards.

Since 2000, research in the area of RF and health has grown rapidly and several major research programs and reviews have been undertaken internationally. Through the national EME Program, ARPANSA was able to undertake a review in 2014 of the current level of evidence which was published in the 'Review of Radiofrequency Health Effects Research – Scientific Literature 2000–2012'. The review concluded that, while the exposure limits of the ARPANSA RF Standard are still valid for protection against known adverse effects, under some circumstances the margin of safety between these limits and the threshold for harmful effects may be less than originally intended. This review provided a level of confidence to concerned members of the public that the Standard remained fit for purpose.

At the time, the ARPANSA RF Standard was prepared, it was recognised that new scientific research may indicate that changes may need to be made to the limits or the implementation of the Standard. Since then, the rationale for known health effects has remained the same. However, there have been advances in the measurement of radio wave absorption by the human body and ICNIRP is currently revising its guidelines. ARPANSA is planning to revise its RF Standard following the publication of the revised ICNIRP Guidelines. It should be pointed out that changes are expected to refine the maximum exposure limits and are not expected to impact exposure from telecommunications (including 5G) which tend to be much lower than the maximum exposure limits.

National EME program

Commencing in 1997, the Australian Government established the EME Program. This program provides \$1 million per annum to support research into, and provide information to the public, about health issues associated with telecommunications devices and equipment. The program is indirectly offset by a levy on radiocommunication licensees collected by the ACMA.

The program has three elements:

- an Australian research program managed by the National Health and Medical Research Council (NHMRC) to conduct research into EME issues of relevance to Australia and to complement overseas research activities,
- international engagement with Australian participation in the WHO Electromagnetic Fields Project through ARPANSA's role as a WHO Collaborating Centre for Radiation Protection, and
- a public information program (managed by ARPANSA) to provide information to the public on EME and health.

Of the total \$1m funding, \$700,000 is allocated to NHMRC for research, and \$300,000 allocated to ARPANSA for international engagement and public information programs. This set amount has not been changed since 1997. This funding allocation is part of ARPANSA's government appropriation.

The program however has evolved considerably from when it first started with ARPANSA taking on an expanded role in the NHMRC grant program and development of standards.

ARPANSA's communication activities on 5G and EME generally

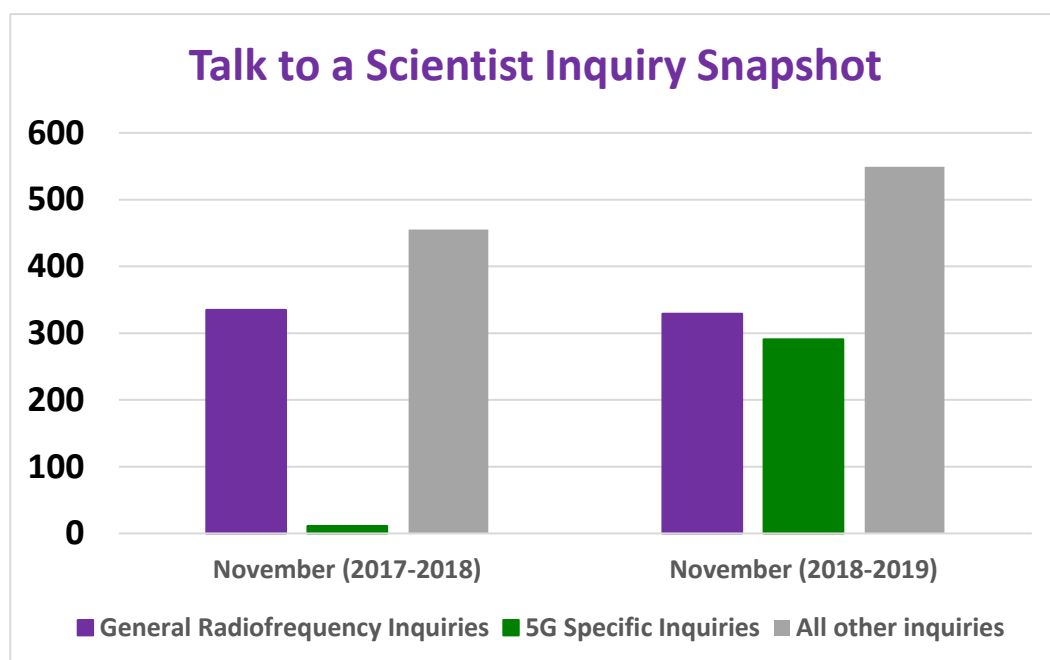
ARPANSA's communication activities on radio waves centres around four key focus areas: website content and fact sheets, direct public engagement, media engagement and advice to key stakeholders.

Website content and fact sheets

ARPANSA has developed a large range of information for its website and flyers covering the issue of radio waves. While 5G is currently being discussed, prior focus has been on other types of technologies using radio waves that has been topical including smart meters, NBN fixed wireless and mobile phone towers. With increasing discussion in the community around 5G, ARPANSA has also increased its use of social media and news articles on the ARPANSA website. This included a 3 June 2019 post on 'Misinformation about Australia's 5G network' that was reported widely in media.

Direct public engagement

ARPANSA provides a unique opportunity for the public and community to talk directly with our scientists on issues about radiation exposure and protection in Australia via its Talk-to-a-Scientist Program. This service offers members of the public the opportunity to find answers to science-related questions that they have been unable to find using other resources. While covering all issues to do with both ionising and non-ionising radiation, the service receives a high volume of calls and email enquiries around radio waves with a particular increase in those related to 5G.



Media engagement

With increased interest in 5G, ARPANSA have actively worked to ensure that the Australian media have access to accurate information. Since January 2019, ARPANSA has been interviewed by print, online, radio and television media on this topic on more than 40 occasions. More broadly ARPANSA advice (including our misinformation statement) or research has been referenced in 151 Australian news articles with a calculated average potential reach of 1.22 million readers, and 105 broadcasts on radio with a calculated national viewership of 1.74 million listeners/viewers. Internationally ARPANSA has been widely reported with 72 articles in the same period reaching a calculated average of 2.15 million readers.

Advice to key stakeholders

ARPANSA has prioritised the provision of information to key stakeholders as a cost-efficient way of reaching a broader audience. ARPANSA has played a key role in supporting broader Australian Government, through

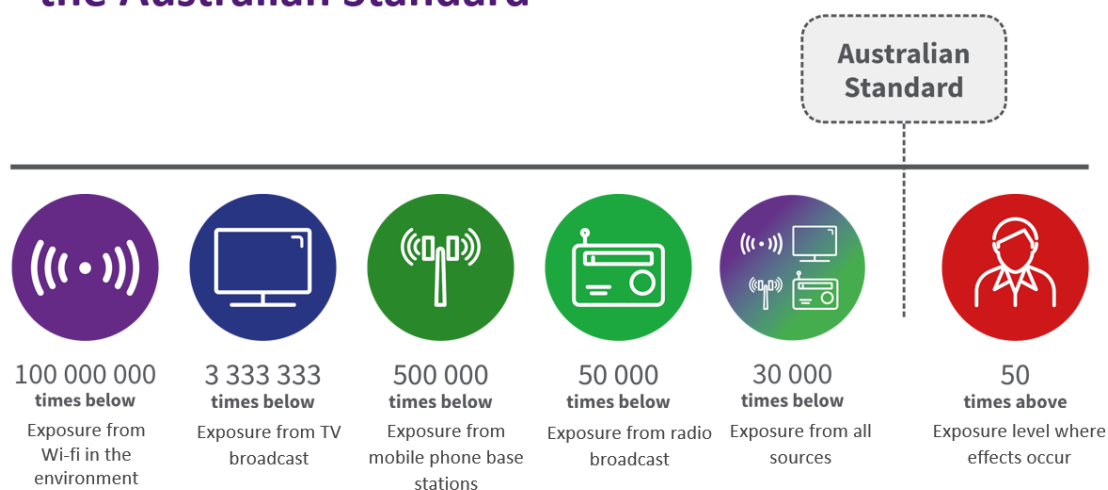
the provision of expert advice including supporting the development of content on the ACMA website, and the Department of Communications and the Arts video ‘Electromagnetic energy (EME) and you¹’. ARPANSA has also supported state and territory, and local government through the provision of information and technical briefings.

Key ARPANSA research

As mentioned previously, ARPANSA has recently completed a study (published in the British Medical Journal Open) comparing the incidence of brain cancer in Australia from 1982 to 2013 to mobile phone use during the same period. The study found that there was no increase in brain tumours that can be attributed to mobile phone use.

ARPANSA has also conducted its own measurements of environmental radio waves from various sources (radio, mobile phone towers, TV, Wi-Fi etc.) detectable in urban areas. All the measurements have shown radio wave exposure in the everyday environment is typically much lower than the safety limits prescribed in the ARPANSA RF Standard and international guidelines. As an example, the Wi-Fi in schools measurement study conducted in 2016 found that in a schoolyard, the dominant exposure continued to be from AM radio with the combined exposure of all sources including mobile networks still 30,000 times below these limits.

Typical public exposure to radio waves against the Australian Standard



¹ https://www.youtube.com/watch?v=XGf_LcqtDIQ