Safe Use of WiFi Technology at Wakatipu High School

INTRODUCTION

On 3rd November 2015, an 'information evening' was held at Queenstown's Memorial Hall where speakers laid out a variety of concerns relating to the safety of WiFi (and related technologies) in schools and around people, with specific concern directed at school-age children.

Deputy Principal James Rasmussen along with board member Jackie Kukutai both attended this event and James provided feedback to the Senior Leadership Team (SLT) on the nature of the concerns raised and the questions asked by the audience. James also provided copies of the pamphlet distributed at the event.

Whilst there is no contention that as new information (based in scientific fact) becomes available, approaches to the use of new technologies can change, it is important to ensure that we do not fail to take advantage of available technology to improve, where possible and suitable, the education afforded to our students.

This paper fully supports the gathering of further information on the general topic of wireless radiation and its impact on, if any, on the human body. Further, it acknowledges that precautionary steps can be taken to minimise exposure to WiFi and other wireless radiation, but suggests that these steps need perhaps not be quite so proscriptive as those put forward in the pamphlet.

However, given the levels of concern that can easily be generated by such events, this paper is presented to ensure that WHS Board of Trustees has a clear stance on which to communicate with staff, students, parents and the wider community by:

- Addressing the issues raised by the 'anti-WiFi' lobby
- Providing balancing information around the relevant issues
- Countering the misinformation and statements being made that appear designed to confuse some of the areas of debate
- Developing a clear stance, including assessment of available data surrounding possible hazards to health, through which to ensure that our obligations under the Health and Safety At Work Act and the National Administrative Guidelines are discharged

BACKGROUND

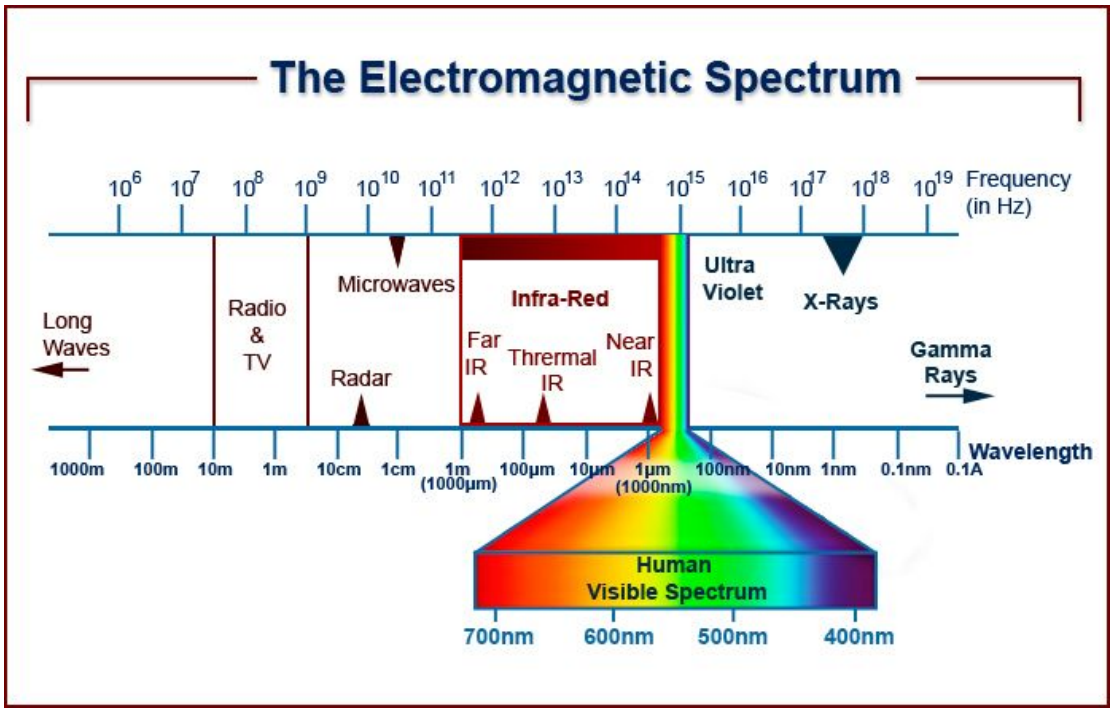
RADIO FREQUENCY / ELECTROMAGNETIC RADIATION

The terms Radio Frequency (RF) and Electromagnetic Radiation (EMR) refer to elements of the electromagnetic (EM) spectrum and their emissions of energy through radiation.

The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. The sun, earth, and other bodies radiate electromagnetic energy of varying wavelengths. Electromagnetic energy passes through space at the speed of light in the form of waves, transferring energy in the form of photons.

By way of an example, what we call 'light' is a particular type of electromagnetic radiation that can be seen and sensed by the human eye, but this EMR exists at a wide range of other wavelengths. The micron is the basic unit for measuring the wavelength of electromagnetic waves. The spectrum of waves is divided into sections based on wavelength. The shortest waves are gamma rays, which have wavelengths of 10^{-6} microns or less. The longest waves are radio waves, which have wavelengths of many kilometers. The range of visible radiation consists of a narrow portion of the spectrum, from 0.4 microns (blue) to 0.7 microns (red).

The diagram below illustrates the electromagnetic spectrum:



The term RF relates to those waves in the segment of the diagram labelled 'Radar' and 'Microwaves'.

EMR refers to the waves produced across the entire EM spectrum. This means that we can say that traditional light bulbs give off EMR in the form of visible light and heat (infrared), or the Sun gives off EMR that is felt on the Earth as light, heat and ultraviolet radiation.

The term radiation is often associated only with the harmful effects of the extremely short-wave part of the EM spectrum, such as gamma rays. This association is discussed further later in this paper, but it is important to note that any EM emission is actually 'radiation' of some form.

OTHER USEFUL INFORMATION

These terms and concepts are presented here for completeness and because they are often used interchangeably and inaccurately by the anti-WiFi lobby.

Power Output

The power output of wireless devices is a critical consideration in the assessment of any possible hazard. The unit of power is Watts, which in our context is a measure of how much energy is emitted by a device in one second.

Measuring Power: dBm/dBW

Many devices use a variation of the measurement of power, called the decibel (dB). This is a measure of 'absolute power' so that two or more devices' power outputs can be compared directly, whereas the simple relative measurement in Watts cannot always provide a meaningful comparison.

Most often with wireless devices, the measure of power is expressed as dBm, or the power in dB referenced to one milliwatt.

A power level of 0 (zero) dBm corresponds to a power of 1 milliwatt (mW). Each increase of 3dBm equates to a doubling of the power i.e. 3dBm is roughly 2mW, 6dBm is roughly 4mW and so on.

Effective Isotropic Radiated Power

EIRP is a measure of power that refers to a theoretical antenna which produces an even amount of power in all directions. Most wireless devices do not produce power evenly in all directions and therefore EIRP is used in order to allow direct comparisons between devices with different antenna characteristics such as size and shape.

Most wireless devices, including the Wireless Access Points (WAP) used in our school, have adaptive antennas that refine the shape of the transmitted radiation in order to reduce the actual power required to maintain a connection.

Because of its definition and calculation, the EIRP of a device can appear to be much larger than the device's power output during normal use.

EMISSIONS: DUTY CYCLES AND THE INVERSE SQUARE LAW

Wireless devices do not constantly emit radiation. Once a connection to a wireless access point (WAP, also known as a router) is established, the device and WAP transmit and receive only when data is actually being transferred - this is known as a device's active 'duty cycles'.

A report commissioned by the NZ government in 2014 found that wireless devices in classrooms had active duty cycles for an average of only 3 seconds per hour of use.

When carrying out tasks such as word processing, this duty cycle time was significantly lower.

It is important to remember that data transmission speeds are incredibly fast in modern devices. Whilst it is acknowledged that in a large area, with many users on many devices, the total time that devices are transmitting can aggregate quickly, the relative time of exposure is still extremely small.

A further important point in understanding the background to EM radiation is the concept of the inverse square law. This states that the power received from a transmitting device decreases in proportion to the square of the distance from that transmitter.

In practice, this means that doubling the distance between a WAP and a student's device results in the device receiving only one-quarter of the original transmitted power (radiation).

With this in mind, it is not a valid point to suggest that the transmit power of a device is what is received at another device or absorbed by your body: rather, it is the power level reduced in proportion with the inverse square of the distance from the device.

In any case, WAPs and laptops receive and transmit at far lower levels of RF radiation than mobiles, as shown below:

- Approx power received from the typical WAP (as below) at a laptop: 22 mW (NB: this varies by distance)
- Typical laptop transmit power: 32 mW
- Typical EIRP power transmitted by a WAP at source: 200 mW

- Typical power transmitted by a modern mobile phone: 250 mW
- Typical power emitted by a microwave oven: 2,000,000 mW

This huge variation in transmitted and received power, combined with the previously-mentioned concept of duty cycles, means that results in terms of heating effects or other biological effects cannot be read-across from one type of wireless device to another.

CLASSIFICATION OF ELECTROMAGNETIC FIELDS AS CARCINOGENIC

Much is made of the fact that the International Agency for Research on Cancer (IARC) has added wireless radiation to Class 2B of their list of cancer-causing agents.

The IARC's definition of Class 2B indicates only the "possibility [of causing cancer] could not be conclusively ruled out using the available data". The evidence that mobile phones pose a health risk was 'limited' for glioma or acoustic neuroma, and 'inadequate' to suggest a link to any other form of cancer. The next section of this report provides further information on this topic.

This means there is no conclusive evidence that RF EM radiation from wireless devices can cause cancer.

To set this classification in some context, it is useful to note that other agents categorised as Class 2B include:

- Coffee
- Pickled vegetables
- Bracken
- Carpentry and joinery
- HPV

Links are also made in the anti-WiFi literature to other widely-known agents in Class 2B such as DDT. It should be noted that DDT was not removed from use because of its potential (yet unproven) carcinogenic effects. This is an example of how the group leading the denigration of wireless devices as dangerous use commonly-known terms and popular science phenomena to make fallacious causal links.

According to the group Cancer Research UK, if mobile phone usage causes brain cancer, then rates of these cancers should be 'skyrocketing'. In the UK, however, the incidence of brain cancer has been flat for several decades.

INTERPHONE STUDY ON MOBILE PHONE USE AND CANCER RISK

In 2010, the Interphone Study Group published the results of their study into the analysis of brain tumours in relation to mobile phone use.

This study is quoted to support the case of the ant-WiFi lobby yet simultaneously dismissed by that same lobby. The anti-WiFi stance refer to the fact that the study offers some support to the idea that exposure to radiation from mobile phone use may lead to a higher risk of developing certain types of brain tumour. On the other hand, they also disparage the report because it was funded largely by contributions from telecommunications-related companies.

The facts of the matter, referring to the IARC's press release on this study, are these:

1. No definitive *causal* link was discovered between mobile phone use and the occurrence of particular types of brain tumour i.e. some people with a brain tumour reported frequent use of a mobile phone in the previous 10 years, but this did not conclude that the mobile phone use in and of itself actually caused the cancer to occur;
2. The design of the study was considered to be somewhat flawed, with analysis based on questionnaire responses about mobile phone use made *after* a participant was diagnosed with the cancer, and therefore subject to recall bias;
3. The study funds were allocated through a 'Chinese Wall' system whereby the study researchers could not know from where their funding had been provided;
4. The linking of this study to drawing a conclusion that use of WiFi can also cause brain cancer is subject to the 'logical fallacy' characterised by the phrase *'post hoc ergo propter hoc'* or: 'that which follows the thing was caused by the thing'.

THE LOGICAL FALLACY

In simple terms, the logical fallacy supported by the anti-WiFi lobby runs thus:

- mobile phones emit RF radiation;
- mobile phones cause cancer;
- WiFi devices emit similar RF radiation;
- therefore WiFi devices cause cancer.

When expressed in this way it becomes apparent that such a link has not been proven. In fact, the first two statements have not been conclusively proven. However, even if there was to be a link proven between mobile phone usage and cancer, examining the relationship of similarity

(or rather the differences) in emissions between mobile phones and WiFi devices allows us to see that such a conclusion could not readily be extended to other wireless devices.

HEALTH EFFECTS of EMR

MUTAGENIC EFFECTS AND HEATING

Certain forms of EM radiation are acknowledged to cause adverse health effects. This subset of the EM spectrum, called ionising radiation, has properties that are not shared with other parts of the spectrum - which are known as non-ionising radiation.

Ionising radiation includes gamma rays, X-rays and ultraviolet light. These are known to be mutagens, or cancer-causing, agents. These types of radiation share characteristics in the energy levels of the photons that are transmitted as radiation. This high-energy radiation causes changes to the structure of atoms that in humans can affect DNA. Causing more than the 'normal' level of mutations in our body's cells at the atomic level is what we define as cancer.

However, non-ionising radiation has much lower-energy levels in its photons. This means that non-ionising RF radiation is simply unable, by any means understood by the scientific or medical communities, to cause the cellular mutations that lead to cancer. RF radiation simply does not carry enough energy to affect the bonds between the molecules that make up our bodies.

As a specific item to consider, some advocates of the dangers of wireless devices assert that there is a comparison between the heating effects of the sun's radiation (causing sunburn) and the heating effects of microwave (RF) radiation, and that there is also a corresponding comparison that may be expected between the mutagenic effects of UV radiation and RF radiation. This suggestion is flawed in that sunburn is *not* caused by a heating effect. A sunburn is not a thermal burn in the way that you are burned by a flame or by touching a hot cooker element. A sunburn is a UV radiation burn and this is why sunburns are seen as likely to increase the likelihood of cancer being caused.

In wireless devices, the heating effects that are often noted are due to the heating of electrical components within the device i.e. a purely thermal heating effect from electronic componentry conducting heat through the device's casing. The power levels at which wireless RF devices operate are so low as to be almost undetectable in terms of a heating effect, whether on biological material (like your body) or other physical materials nearby.

ALLEGED HEALTH EFFECTS FROM WIRELESS DEVICES

Apart from cancer, a variety of adverse health effects are suggested to be caused by exposure to RF radiation. These include headaches, insomnia, depression, shortness of breath, blurred vision, tinnitus and burning skin, amongst many others.

Whilst not completely discounted, the general consensus around many of these effects is that they may be linked to physiological issues such as posture, length of time spent on a device and the sociological effects of applications such as social media, rather than being a direct result of the radiation emitted by the devices or nearby WAPs.

ELECTROMAGNETIC HYPERSENSITIVITY

There are many reports in existence where people claim to suffer a variety of disorders or effects as a result of exposure to even the weakest EMR. whilst the effects claimed to be experienced are often seen to be real, the experiments and studies performed to date have struggled to show that EMF can actually trigger the symptoms (Rubin et al, 2005). This report concludes that EM Hypersensitivity is not actually related to the presences of EMR.

OTHER HEALTH ISSUES RELATED TO CHILDREN

The pamphlet issued by the organisers of the presentation this week refers also to 'other issues related to children and excessive screen time'.

These issues include mental health issues, addictions, postural alterations and obesity. Such problems have no link to the issue at hand, namely the impact of RF radiation. Whilst not dismissing these issues, they are able to be addressed through other means which will not be covered within this paper.

"INDUSTRIAL GRADE ROUTERS"

It is true that school routers or WAPs can have greater output powers than domestic routers. The use of the term 'industrial grade' however is rather inflammatory and conjures images of heavy machinery and dangerous chemicals that are not suitable for a home or school environment.

WAPs and routers designed for schools and businesses recognise that there is increased traffic through the device, and that there are often obstacles, such as furniture or partition walls, that prevent good quality signals and connection strength. The design of these WAPs, though, also

allows for much more sophisticated beam shaping and power management, ensuring that any transmissions are kept as low as possible whilst still ensuring a functional link is maintained. It is not a case of turning the tap fully on and standing back as a stream of high-powered radiation is emitted 24/7.

NZ STANDARDS

Some comment is made in the pamphlet from the anti-WiFi group about the NZ standard NZS2772:1 (1999) relating to Radiofrequency Fields Maximum Exposure Levels. The claim is made that this standard is outdated and and thus devices complying with this standard may be used in New Zealand which may be banned in other countries. The fact is that, whatever the NZ Standard dictates, almost all wireless devices are manufactured and sold in many other countries. This means that by default, New Zealanders are protected by the more stringent standards dictated by other major organisations such as the US FCC or FDA, or the UK's Health and Safety Executive's Operational Guidelines/Operational Circulars and associated standards on the management of risk relating to EMR from wireless devices.

"THE FRENCH DIS-CONNECTION"

Comments have been widely made around the restrictions in France on use of WiFi in schools. It should be noted that WiFi use has been restricted only in areas used primarily for the care of children under 3 years. This means that WiFi may not be used in and around nurseries, but its use has not been restricted for children of school age.

WHAT IS RECOMMENDED FOR WHS?

- There are no clear links between wireless devices and any health effects - where claims have been made, significant flaws have been found in methodology of the studies performed
- However, there is no harm in following some facets of the so-called 'precautionary stance' in terms of minimising exposure - even though no reputable agencies such as the US FCC endorse the need for such actions
- Recommended actions are:
    - Wired connections may be used if available, but need not be mandated
    - The availability of wired computer connections need not be a driving requirement in the design of new school learning spaces
    - As already practised in our existing network installation, WAPs should be located high on walls, and away from areas in which staff and students sit, so that people do not sit immediately adjacent to antennas in the areas of highest power transmission
    - Ensure that WAPs use appropriate power management and/or beam shaping to reduce active transmission time and power

REFERENCES

Gaudin, N., IARC Press Release No. 208. May 2011.

de Vocht et al. "Time trends (1998-2007) in brain cancer incidence rates in relation to mobile phone use in England". Bioelectromagnetics. 2011

Wireless Devices and Health Concerns. March 2014. Retrieved from: https://www.fcc.gov/guides/wireless-devices-and-health-concerns

Cancer Controversies: Mobile phones, wifi and power lines. March 2015. Retrieved from: http://www.cancerresearchuk.org/about-cancer/causes-of-cancer/cancer-controversies/mobile-phones-wifi-and-power-lines

EMF Services. Exposures to radiofrequency fields from WiFi in New Zealand schools. Wellington: Ministry of Health. 2014.

WHO. What are electromagnetic fields? 2015. Retrieved from: http://www.who.int/peh-emf/about/WhatisEMF/en/