

Wireless Networking in Schools

*A call to limit unnecessary
radiation exposure in light of
potential health risks.*

A submission to the Department of Education and
other policy makers.

Executive Summary

- A growing body of peer-reviewed scientific evidence indicates that there may be very real health risks resulting from exposure to a broad spectrum of electromagnetic radiation (EMR) frequencies (EMF), including wireless local area networks (WLAN / 'wireless networking' / 'wi-fi').
- While some peak bodies assert that there is no scientific consensus supporting suggested health concerns, the historical direction of the debate shows that the scientific consensus is slowly shifting to a position of concern as the results come in from thousands of studies.
- Reflecting this growing consensus of concern, in May 2011 the World Health Organisation (WHO) classed radio frequency (RF) electromagnetic radiation (RF-EMR, which encompasses wi-fi) as a Group 2B "possible human carcinogen".¹
- As early as 1988, experts warned that children absorb high frequency EMR more readily than adults.² Consequently, current radiation absorption guideline limits are breached by up to 40% in experimental models of children at maximum exposure levels that were calculated to prevent these limits being reached.³
- The Australian standard developed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) recommends a precautionary approach which, according to ARPANSA's fact sheet, "requires owners of RF sources to minimise unnecessary exposure of the public to RF fields".⁴
- Emerging international precedents are reflecting the growing concerns regarding EMR. For example, the Israeli Parliament is considering legislation that would require mobile phones to carry health warnings,⁵ and in a current case in a US civil court, a parent is suing his public school's District due to WLAN.⁶
- Despite the above, WLANs are becoming increasingly commonplace in schools, purely for convenience and the short-term fiscal benefits WLANs offers over wired networks. Tasmania's Department of Education (DoE) stated that "the use of WLAN [i.e. a Group 2B possible human carcinogen] is a safe and practical solution to the computing communications needs in the modern teaching and learning environment".⁷ DoE's implementation can hardly be considered to be limited to 'necessary' exposure – wi-fi is available 24/7, exposing children to RF EMR even when they are not using computers. This submission is a call to action to reassess current policy on the use of WLANs in schools.

¹International Agency for Research on Cancer 2011. www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

² Independent Expert Group on Mobile Phones 2000, "The Stewart Report", 6.23, 6.29, 6.30: http://www.iegmp.org.uk/documents/iegmp_6.pdf This paper states that 1988 guidelines acknowledged increased risk of exposure to children, but I've not been able to locate these older guidelines in online databases.

³ http://iopscience.iop.org/0031-9155/53/6/001/pdf/pmb8_6_001.pdf

⁴ ARPANSA 2012 http://www.arpansa.gov.au/RadiationProtection/Factsheets/is_rfStandard.cfm

⁵ See: Hebrew Parliamentary record: <http://www.knesset.gov.il/spokesman/heb/Result.asp?HodID=9871>

Translated to English via Google® Translate:

<http://translate.google.com/translate?hl=en&sl=iw&tl=en&u=http%3A%2F%2Fwww.knesset.gov.il%2Fspokesman%2Fheb%2FPrintResult.asp%3FHodId%3D9871>

An English news report: <http://www.haaretz.com/business/knesset-backs-bill-requiring-cell-phones-to-bear-health-hazard-warning-1.415677>

⁶ <http://www.katu.com/news/local/124406914.html> (This case is discussed in more detail later in this submission).

⁷ E-mail communication from the manager of IT Infrastructure 2/3/2012, filed by DoE under CEN_39286/1.

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Introduction

Background

I am a parent of two children attending a public primary school with around 140 other students. Upon reading in one of the first school newsletters for this year that all laptops work wirelessly across the school, a concern that had been in the back of my mind for some time took a step forward.

I am an IT (information technology) consultant, and while I focus on the software side of IT rather than the hardware side, it's fair to say that, if anything, I have a vested interest in seeing information communications technology (ICT) flourish. While I wouldn't class myself as an 'early adopter' of technology, I'm not a technology-hating luddite: my household has included a PC since the late 1980s; I have used the internet since dial-up days, progressed to satellite broadband, then ADSL; I've owned a range of handheld devices from Palm pilots to smartphones; in employment and private business I have worked with state and federal government, and small and multinational software houses, and my business sees me working with clients in Australia, New Zealand, the UK, Europe and the US all by the 'magic' of the internet.

At time of writing, if you visited our school's website you'd be greeted with the website that a small group of students put together over some months, as part of an extra IT class that I developed and taught on a volunteer basis; I have seen first hand the challenges that schools face with IT infrastructure. During that website project I wrote to the Principal to advise that it took one student 25 minutes to switch on a computer, log on, and start a software application. When my children were in kindergarten, having watched the children wrestling with the tangle that a wired mouse created, I gave the kindergarten a wireless mouse.

However, I'd also been vaguely aware of health concerns associated with EMR exposure, and while I'd been content to live in relative ignorance, the more snippets I heard, the more uneasy I became. Eventually I switched off the wireless router in our house and ran network cabling through the walls and ceiling, so that my wife's computer and my own did not need the wireless router. When the kids grew older and I set up an old 'hand-me-down' laptop for them, I flicked the wireless router back on as a matter of convenience, and then off again as I started to feel less comfortable about how little I really knew.

Upon learning that the school is now covered with wireless radio frequency radiation, I determined to do some research on what the current consensus is around the safety of WLANs in schools. This document is the result of that research.

Approach

The first step was contacting the Principal, who referred me to DoE's ICT unit. The responses I received from that unit were reassuring on some levels, and less than reassuring on others and, having read more about the issue since, I feel that DoE may need to reconsider current evidence given its duty of care obligations.

This document is an attempt to gather what I see as being the salient points in the debate, with more focus on the 'against' side of the debate. I take this approach primarily because it's been these points of which I was most ignorant, and I can perhaps therefore reasonably assume that others may

be oblivious to them as well; and they are, I believe, very important points. As such, this document may be best considered as a springboard for further reading.

While I cite research publications, I certainly don't claim that I have read enough to be able to say whether the articles I refer to are representative of the current weight of scientific evidence (there are thousands of research papers on the potential health effects of EMR); however, in my reading over some estimated 40 hours, I did get the sense that there was a definite pattern emerging – a pattern of mounting evidence, of growing consensus (despite what seems to be entrenched resistance in some important quarters), and of policy makers slowly catching up, while the technology is rolled out at rates far faster than a scientific consensus could ever be achieved on a complex biomedical question.

Similarly, I make no claims to being formally qualified to comment on the physics or complex biological mechanisms that may come under question in examining the issue; I do, however, feel I have enough knowledge to be able to come to a reasonably informed position, together with an ability for critical thinking that allows me to incorporate the science into the more sociological aspects of the debate.

There are a host of internet sites claiming to be educational resources on this issue. I've not been content to take any claim from such sites at face value, and have always sought to confirm the validity of claims from within authoritative sources of information, locating the documents they've cited. Any exceptions to this approach are noted.

In this submission, any links to website resources are the original document or as close to the source as possible (that is, reliable intermediaries – for example, the US National Library of Medicine's PubMed database for medical studies). Any exceptions to this approach are noted. The approach to referencing here is a mix of formal and informal, designed to provide the reader with the necessary information to access the source documents as quickly as possible (e.g. rather than providing author name and publication date, it may be faster for the reader to just directly access the document from the link provided, from which they can ascertain authorship details as desired).

Facts that I consider to be 'general knowledge' to someone who has done some basic reading on the subject, may not be supported by references.

My hope is that other interested parties will take the time to review the debate first hand, rather than taking my word for it.⁸ I'm human and I'll have no doubt made mistakes, having tackled this unpaid 'project' in 'spare' moments spread over some weeks. I especially hope that suitably qualified individuals, who may have previously assumed 'all is well', will take the time to contribute to the discussion.

The crux of the issue

There is little doubt that the current scientific consensus is that properly installed WLANs create radiation exposure that is typically well below the current Australian standard's limits for radiofrequency exposure. However, the growing concern is that the current limits are flawed.

⁸ If you'd like to locate any of the resources I cite in this document, note that in a PDF document (like this one), links that span more than one line may not direct you to the right address (in this case, clicking the link can attempt to access an address that is comprised of only the first line of text – which is not the right address). To locate a website resource using a multi-line link, copy the entire link and paste it into your web browser.

In Australia, ARPANSA is the government body responsible for setting the standard. ARPANSA has acknowledged that the basis for its standard is the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ARPANSA limits that cover the frequency range encompassing typical WLAN are the same as ICNIRP's limits in this range.⁹

Radiation is classified as being either ionizing or non-ionizing. Ionizing radiation is known to affect the structure of molecules, and includes radiation such as gamma rays and X-rays. Ionizing radiation actually removes electrons from atoms (that's what 'ionizing' usually means). Non-ionizing radiation does not alter molecular structure in this way.¹⁰

This doesn't mean non-ionizing radiation is safe (otherwise there would be no guidelines for non-ionizing radiation at all, and ICNIRP wouldn't exist), it just means that the health concerns associated with non-ionizing radiation are different. The radiation emitted by WLAN devices is a non-ionizing radiation, in a similar part of the EMR spectrum as mobile phones (both are classified as RF microwaves, while WLAN has a higher frequency than mobile phones).

The debate at present really hinges on the concern that the ICNIRP guidelines for non-ionizing radiation may be completely inadequate, both in regard to the set limits, and to the fundamental assumptions behind these limits; the reasoning behind the ICNIRP guidelines for WLAN frequency radiation, which were established in 1998 and haven't changed since, is based on the belief that non-ionizing radiation in this frequency is only known to cause adverse health effects *if the radiation is at levels that will heat body tissues to adverse levels* – these are known as “thermal effects”, and the guidelines are set to avoid such effects.¹¹

The growing concern is that this view is outdated and ignores accumulating evidence of adverse biological effects as a result of radiation levels many times lower than these thermal levels. These effects are referred to in the literature, variously, as “biological”, “athermal”, “non-thermal”, and “sub-thermal” effects, and are held to be inducing a range of effects on tissues and biochemistry in ways that are not fully understood. Some of these effects are referred to in the coming pages.

Understanding ‘consensus’

Science is a very demanding field in terms of ‘proof’. Scientists are generally hesitant to claim that anything is true. Even in studies that show a strong correlation between X and Y, they will acknowledge, correctly, that this doesn't necessarily mean that X *causes* Y, and will also acknowledge limitations of their studies, and call for further research to confirm or disprove their findings. Scientists submitting papers to peer-reviewed journals can also expect their studies to be evaluated critically by reviewers (but it should be noted that typically only two external reviewers assess the papers for their suitability for publication; peer review is no guarantee that a paper will be flawless and free of bias), as well as potentially coming under fire by peers once published.

In short, science typically builds up a body of knowledge very slowly, as a series of explorations into new areas, improvements on existing broad bodies of knowledge, and fine tuning well-understood areas of study, facilitated by study and counter-study.

⁹ ARPANSA 2002, pp ii, 7. <http://www.arpansa.gov.au/pubs/rps/rps3.pdf> For wireless frequency (2.4GHz is the most often used), the ARPANSA basic restrictions are the same as the ICNIRP basic restrictions, as are the reference levels (while ARPANSA goes to three significant figures rather than two - e.g. 61.4 compared with 61, 0.163 compared with 0.16, and 10.0 compared with 10).

¹⁰ U.S. Environmental Protection Agency 2011, http://www.epa.gov/radiation/understand/ionize_nonionize.html

¹¹ ICNIRP 1998, p. 507 <http://www.icnirp.org/documents/emfgdl.pdf>

A scientific consensus, then, begins with a mass of information that slowly evolves. This mass of evolving findings is not quite raw data, but in terms of an issue which is still intensely studied, the studies *themselves* are unlikely to yield a consensus.

The role of organisations such as WHO in a debate of this type, is to examine the available scientific evidence and come to a position on the basis of that evidence. This position naturally needs to be governed by the weight of evidence; if 80% of studies say 'A' and 20% of studies say 'B', it would be outlandish to expect that WHO would establish 'B' as their position.

However, when reading the findings of such bodies, it's easy to lose sight of the 'B'; it's easy to lose sight of the fact that 'finding B' even exists in the literature, and it's easy to lose sight of the fact that while only 20% of studies found B, the last time such a review was performed, only 5% of studies found B – that is, it's easy to get the impression from a 30-second 'sound bite' on a media report, or a paragraph from a review's summary, that there's actually no evidence for B at all, let alone that the evidence for B could be *growing*. (Note that these are all arbitrary percentages – I'm not suggesting anything here regarding the actual ratio of weight of evidence.)

For example, DoE's response to my enquiry about the health effects of WLAN advised me that "there is no evidence to support that a correctly installed Wireless Local Area Network (WLAN) radiation poses a risk. There have been many studies carried out but none point to a WLAN as being dangerous". Depending on one's definition of 'risk', 'evidence' and 'dangerous', this is simply incorrect – see, for example the study titled "Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation".¹² One study certainly does not constitute scientific consensus, but the conclusions of the study include the fact that exposing sperm (outside the body), "to a wireless internet-connected laptop decreased motility and induced DNA fragmentation by a nonthermal effect. We speculate that keeping a laptop connected wirelessly to the internet on the lap near the testes may result in decreased male fertility". To state there's **no** evidence of risk is a gross misrepresentation of the facts – and this is just *one* of the studies that suggests risk, as will be seen.

I expect that such misrepresentation is a result of a misunderstanding of the way scientific consensus works. For example, bodies such as WHO state that "considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects."¹³ That statement taken in isolation could give rise to someone stating that "there is no evidence to support that a correctly installed Wireless Local Area Network radiation poses a risk". But considered in the broader context – including the fact that the evidence is such that WHO itself, despite the preceding, older statement of reassurance, now classes RF radiation as a Group 2B carcinogen – it becomes more clear that scientific consensus is a slow-moving creature (much slower than the uptake of wireless networks in society), and that an agreed consensus of low or no risk at any point in time does not mean that there is not a growing number of very concerned individuals repeatedly demonstrating very disturbing findings.

The 'slowness' of consensus is likely to be exacerbated by the fact that wi-fi is a relatively new technology, and also that RF is commonplace, which means it's increasingly difficult to find 'control' groups who have not been exposed, against which comparisons can be based.

¹² <http://www.ncbi.nlm.nih.gov/pubmed/22112647>

¹³ <http://www.who.int/mediacentre/factsheets/fs304/en/index.html>

The influence of industry upon study findings – and thus its ability to influence the creation of consensus – should not be ignored either, since studies that are focused on providing industry-supporting outcomes could potentially skew/delay consensus. The length of time it took for the link between smoking and lung cancer to become consensus in society is one example of such influence at work, and there is no reason to think such influence no longer exists. For a public health example, consider the food pyramids that people of my generation referred to for nutritional advice, and regarding which Harvard University has stated publically:

For nearly two decades, the U.S. government distilled its nutrition advice into pyramids. These efforts didn't accurately show people what makes up a healthy diet. Why? Their recommendations were based on out-of-date science and influenced by people with business interests in the messages the icons sent.¹⁴

Such examples don't show that something similar *is* happening in the communications industry, but they do demonstrate that trusting industry to provide the full picture may be naïve.

Regarding 'consensus', it should also be noted that from an international public health perspective, even the *existence* of a consensus is not terribly convincing, let alone whether the current consensus is accurate. For example, a paper presented at the 2001 WHO Eastern Regional EMF Meeting and Workshop¹⁵ takes the frequency range 2GHz as a sample (typical WLAN is at 2.4Ghz), and lists some long-term exposure limits applicable in different countries: US and others (ICNIRP-based) 10 W/m², but one thousand fold less in China, Russia and Switzerland at 0.01 W/m².

¹⁴ <http://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/pyramid/>

¹⁵ http://www.who.int/entity/peh-emf/meetings/en/day2Varna_Foster.pdf

The guidelines

“The setting of guidelines or standards for maximum permissible levels of exposure to RF and microwave radiation is a valid approach to managing the risk of such exposures. The existing guidelines, however, are based on results obtained from acute, short-term studies that are atypical of the RF exposures associated with the handset of cellular mobile telephones. For the first time in human history, a source of RF radiation is located right next to the head of millions of cellular mobile telephone users. Biological effects after repeated, prolonged, or lifelong exposure to RF energy emitted by these low-power wireless telecommunication devices have been investigated only during the past few years.”¹⁶

This would be a fairly sobering quotation coming from any journal, and it’s even more sobering when one considers it comes from a 2003 issue of the “IEEE Microwave magazine”, published by the Institute of Electrical and Electronics Engineers (IEEE), which is the body that invented the protocols used by wi-fi technology, and is the self-proclaimed “world’s largest professional association for the advancement of technology”.¹⁷ While this quotation refers to mobile phones, the points made about the guidelines being established for acute exposures rather than chronic long-term exposures have some currency in the WLAN debate, which are further cemented by potentially similar exposure levels at close ranges (as occurs with laptops).¹⁸

In arguing that the IEEE standards are more scientifically sound than the ICNIRP guidelines on RF (which are the same for both WLAN devices and mobiles), this paper is rather outspoken in its appraisal of the limits (which operate on averaging out exposure levels across 10 grams of tissue or even different tissues) as they apply to the practicalities of mobile use. According to the author, the ICNIRP limit (upon which Australia’s is based) “grossly neglects the anatomic details of the ear... Moreover, inside the human brain, the types and populations of cells and neurons are notably different, even in 1 g of tissue.” (p. 26). Similarly, the ICNIRP’s approach of averaging absorption over 10 grams, rather than 1 gram as in the IEEE standard, “tends to lower the numerical value of SAR [specific absorption rate – the factor that forms the basic restrictions for WLAN-frequency radiation] by a factor of two or more.”(p. 24)

The author explains that the 1992 IEEE standards were arrived at by factoring a safety margin of 50 times lower than the levels at which effects were noted in animals (the same limits apply in the 1998 ICNIRP guidelines, by the same reasoning, as well as the fact that this level ensures a body temperature increase of less than 1 degree Celsius after a half-hour’s exposure¹⁹). The effects that were noted in animals, though, were the “disruption of work schedules in trained rodents and primates” (p. 24). That is, the levels that were considered to create an effect were levels that caused notable *behavioural* changes in other species – not changes in biochemistry or DNA expression or any such subtle-but-‘sinister’ changes, but gross behavioural changes.

This fact is common knowledge within the debate regarding ICNIRP limits, and is confirmed by other sources, including those that support the thermal basis of standards, for example:

¹⁶ Lin JC 2003, p.26 http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=1266063

¹⁷ <http://www.ieee.org>

¹⁸ See point 2 on page 29.

¹⁹ pp. 507, 509 <http://www.icnirp.de/documents/emfgdl.pdf>

- “The threshold of 4 W/kg for the disruption of complex behavioral performance in several animal species and under diverse exposure conditions has formed the basis for the setting of human exposure guidelines since 1982.”²⁰
- “the biological endpoint on which most contemporary standards are based is disruption of food-motivated learned behavior in subject animals”²¹ (to put this in context, this is from a paper which is critical of the quality of science behind claims of non-thermal effects).

I found this fact alone – that concerning radiation in the WLAN range, the ‘danger’ level established in other species is the level of exposure at which their *behaviour* changes – to be somewhat disturbing, and the more I read the more disturbed I became. More on the ICNIRP guidelines follows later.

²⁰ D’Andrea *et al* 2003, S58 <http://grouper.ieee.org/groups/scc28/sc4/Behavioral%20effects.pdf>

²¹ Osepchuk JM & Petersen RC, S8 <http://www.ncbi.nlm.nih.gov/pubmed/14628304>

A selected timeline - some evidence supporting precautionary approaches

With regard to the studies cited here, this is obviously by no means an exhaustive list, but rather some points which suggest that caution would be wise.

Similarly, I've noted some issues around mobile phones which, in Australia, generally operate at different frequencies to WLAN, but are similar enough in frequency that both are classed as microwaves. For example, several Australian carriers offer phones running on 2.1GHz, while typical WLAN is 2.4GHz. Other phones (including some in these studies) may be around 0.85GHz (lower than WLAN, but still microwave radio frequency).

I should clarify here that, throughout this document, I use the term "WLAN" (wireless local area network) interchangeably with "wireless network" and "wi-fi" (which is actually a trademark). WLAN/wi-fi routers are typically connected to a wired LAN or ADSL service supplied to the premises at which the router is installed, effectively broadcasting that connection as a short range "hot-spot". In (potentially confusing) contrast, "Wireless broadband"—as delivered by, for example, Telstra as "4G / Next G" is, for the purposes of this document, equivalent to mobile phone radiation rather than to wi-fi radiation, in that, like mobiles, it operates at different frequencies to wi-fi (but they're all classed as microwaves), and is delivered via a sufficiently strong mobile phone network signal. Wireless broadband such as 4G is *not* the topic of focus of this document (except by association with references to mobile phone radiation).

I've also included findings on other forms of EMR at the lower end of the spectrum, very different to microwaves. I've done this, not because the risks from one form of radiation necessarily apply to other forms, but because these points demonstrate a trend of increasing evidence of risk with increasing research; while microwaves have been widely used for public mobile communication devices for a relatively short time, extremely low frequency EMR has been with us at least as long as we've had power in our homes, and despite this relatively established technology, new risk evidence is incoming.

1998: ICNIRP Standards

ICNIRP establishes RF exposure standards based on thermal effects.²²

2000: The Stewart Report

The Stewart Report was the outcome of the Independent Expert Group on Mobile Phones and Health, requested by the UK Minister for Public Health to assess the possible health risks of mobile phones.

The announcement of the report stated that "there is now some preliminary scientific evidence that exposures to radiofrequency (RF) radiation may cause subtle effects on biological functions, including those of the brain. This does not necessarily mean that health is affected but it is not possible to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects", while at the same time concluding that "the balance of evidence to date does not suggest that emissions from mobile phones and base stations put the health of the UK population at risk".²³

²² <http://www.icnirp.de/documents/emfgdl.pdf>

²³ <http://www.iegmp.org.uk>

Despite that conclusion the Stewart Report recommended precautionary approaches, particularly where children were concerned (including recommendations for limitations on mobile phone tower installations near schools).²⁴

June 2001: Possible Human Carcinogen: Extremely Low Frequency Magnetic Fields

WHO's International Agency for Research on Cancer (IARC) classifies extremely low frequency magnetic fields (ELF-MF) as a Group 2B carcinogen ("possible human carcinogen").²⁵

Note that ELF-MF is a different phenomenon to RF. However, they are each experienced on the EMR spectrum, both are subject to emerging research, and the trend of both being considered 'no risk', moving toward approaching an established 'consensus of risk', demonstrates that the science is still catching up in this field, as shown by the following points.

2003: "Intermittent extremely low frequency electromagnetic fields cause DNA damage in a dose-dependent way"

As an example of the emerging research on ELF-MF, this study finds "effects occurred at a magnetic flux density as low as 35 μ T, being well below proposed International Commission of Non-Ionizing Radiation Protection (ICNIRP) guidelines. The induced DNA damage is not based on thermal effects and arouses concern about environmental threshold limit values for ELF exposure".²⁶ (emphasis mine)

Once again, while my concern in this submission is with WLAN RF, not with ELF MF (as researched in this study), I cite this study to demonstrate evidence that the same set of ICNIRP guidelines which also governs RF, is not adequate to protect against the risks they were designed to protect against; a trend of adverse non-thermal effects well below ICNIRP guidelines is notable.

2003: Neuron damage in rats exposed to mobile phone radiation.

In this study, "three groups each of eight rats were exposed for 2 hr to Global System for Mobile Communications (GSM) mobile phone electromagnetic fields of different strengths. We found highly significant ... evidence for neuronal damage in the cortex, hippocampus, and basal ganglia in the brains of exposed rats".²⁷

2004: WHO evaluates research requirements re exposure of children to RF

A WHO working group met in 2004 to evaluate literature and establish research requirements concerning the exposure of children to ELF and RF EMR. A paper²⁸ was published the following year detailing the findings of the discussions.

Some salient points include that "the relative depth of penetration is larger for children, a logical consequence of smaller head diameter. Dielectric studies encompassing several tissue types, including brain, obtained from newborn to fully grown rats, mice, and rabbits exposed to RF EMF in the frequency ranges of 130 MHz to 10 GHz [a range which includes WLAN] and 300 kHz to 300

²⁴ Paragraph 1.42 <http://www.iegmp.org.uk/report/summary.htm>

²⁵ <https://apps.who.int/inf-fs/en/fact263.html>

²⁶ <http://www.ncbi.nlm.nih.gov/pubmed/12802592>

²⁷ <http://ehp03.niehs.nih.gov/article/Article.action?articleURI=info%3Adoi%2F10.1289%2Fehp.6039>

²⁸ <http://pediatrics.aappublications.org/content/116/2/e303.full>

MHz report large, age-related variations in the permittivity and conductivity of brain tissue and even larger variations for skin and skull tissue.”

And a comment that confirmed my growing misgivings about the increasing evidence of risk was that “at present, population exposure to RF fields has been much less characterized than ELF fields, partly because of technical challenges (lack of adequate measuring equipment), the rapid evolution of mobile-phone technology (frequency, coding schemes), and new patterns of use (duration of calls, short-message services). However, the main reason ELF fields are better understood than RF fields is that they have been studied more.” (emphasis mine). RF encompasses WLAN.

2005: Wireless RF alters gene expression

In a study titled “2.45 GHz radiofrequency fields alter gene expression in cultured human cells”, it was stated “We used the pulsed RF fields at a frequency of 2.45 GHz that is commonly used in telecommunication to expose cultured human HL-60 cells... these results indicate that the RF fields at 2.45 GHz can alter gene expression in cultured human cells through non-thermal mechanism”.²⁹ (emphasis mine)

Wi-fi RF operates at 2.4GHz, Bluetooth® at 2.45GHz. “Gene expression” is the “conversion of the information encoded in a gene first into messenger RNA [which carries the DNA blueprint] and then to a protein.”³⁰ That is, RF at the frequency of Bluetooth, and very similar to typical WLAN, alters one of the most fundamental ‘building’ mechanisms in all life. “We observed that 221 genes altered their expression after a 2-h exposure. The number of affected genes increased to 759 after a 6-h exposure.”

Once again the authors point out that this was performed on human cells outside a human body, and that the hardware producing the radiation wasn’t exactly the same as used for wireless communication. Nonetheless, their findings were that “data from our study indicate that RF indeed has biological effects”, and that “the altered gene expression in the RF exposed cells was due to non-thermal mechanism(s)”.³¹

2007: Non-thermal RF effects on the Blood Brain Barrier (BBB)

The BBB is “a mechanism that creates a barrier between brain tissues and circulating blood; serves to protect the central nervous system”.³²

This paper on work done at the Lund University Faculty of Medicine, Sweden, states “Since 1988 our group has studied the effects upon the mammalian blood-brain barrier (BBB) by non-thermal radio frequency electromagnetic fields (RF-EMF). These have been revealed to cause significantly increased leakage of albumin through the BBB of exposed rats as compared to non-exposed animals—in a total series of about two thousand animals. One remarkable observation is the fact that the lowest energy levels give rise to the most pronounced albumin leakage. If mobile communication, even at extremely low energy levels, causes the users’ own albumin to leak out through the BBB, also other unwanted and toxic molecules in the blood, may leak into the brain tissue and concentrate in and damage the neurons and glial cells of the brain.”³³ (emphases mine)

²⁹ <http://www.ncbi.nlm.nih.gov/pubmed/16107253>

³⁰ Princeton’s ‘WordNet’ dictionary: <http://wordnetweb.princeton.edu/perl/webwn?s=gene%20expression>

³¹ <http://www.ncbi.nlm.nih.gov/pubmed/16107253>

³² Princeton’s ‘WordNet’ dictionary: <http://wordnetweb.princeton.edu/perl/webwn?s=blood-brain%20barrier>

³³ <http://www.springerlink.com/content/81612n327545835v/>

Another paper in the same 2007 journal, from other members of the same research group, notes “our group has examined the effects of radiofrequency electromagnetic fields (RF-EMF), including pulse-modulated waves of the type emitted by mobile phones, upon the blood–brain barrier. In more than 2,000 rats, we have repeatedly demonstrated a passage of the rats’ own albumin from the blood through the brain capillaries into the surrounding brain parenchyma at SAR values down to 0.1mW/kg”³⁴ (emphasis mine).

Note that the Australian regulatory SAR (specific absorption rate) limit is currently 80mW/kg for whole body exposure in that frequency range, and 2000mW/kg for peak in the head and torso³⁵ – both being orders of magnitude higher than the levels cited as inducing the adverse effects studied in rats.

2007: The “BioInitiative Report”

A group of fourteen concerned professionals (employed in various fields – practical and academic – such as oncology, physiology, bioengineering, environmental health) self-publish “The BioInitiative Report”,³⁶ a 600-page review of scientific literature (“a review of over 2,000 studies showing biological effects from electromagnetic radiation at non-thermal levels of exposure”³⁷) demonstrating effects that are currently not acknowledged by ICNIRP standards, calling for an overhaul of a variety of standards.

The “International EMF Alliance” which subsequently grew from the impetus of this report, now publically lists the support of around 40 international life science/health experts.³⁸

The alliance does itself no favours by promoting what looks to be some fairly sensationalising books,³⁹ and it must be remembered that the BioInitiative Report itself is not a scientific study (despite the fact that it does rely heavily on peer reviewed science), but rather an attempt to draw attention to the issue with the support of credible evidence compiled in an accessible way. As such, it provides a useful starting point from which relevant studies can be tracked down.

2008: BioInitiative Report ‘does not progress science’

Australian Centre for Radiofrequency Bioeffects Research (ACRBR)⁴⁰ publishes its position statement on the BioInitiative Report. To do so, it poses and answers questions such as: “Do the BioInitiative Report authors represent an authoritative international body?”; “What is the scientific status of the BioInitiative Report?” and: “Should we be convinced by the BioInitiative Report?” It notes that the authors do not represent an authoritative international body (and refers to them as “a group of interested individuals”), and that the report is of questionable scientific status since it was not peer reviewed, and concludes that it does not progress science.⁴¹

³⁴ <http://www.springerlink.com/content/p704837103452638/>

³⁵ ARPANSA 2002, p. 7 <http://www.arpansa.gov.au/pubs/rps/rps3.pdf>

³⁶ <http://www.bioinitiative.org/freeaccess/report/index.htm>

³⁷ <http://international-emf-alliance.org/index.php/publications/seletun-resolution>

³⁸ <http://international-emf-alliance.org/index.php/the-alliance/supporting-life-scientists>

³⁹ <http://international-emf-alliance.org/index.php/media-info/books>

⁴⁰ Now closed. From the website: “The ACRBR was originally funded as a Centre of Research Excellence by the National Health and Medical Research Council of Australia in 2004 (until 2009), and since then has been operating via in-kind support from its members’ institutions.” Listed participating institutions include universities and Telstra. <http://acrbr.org.au/About.aspx#institutions>

⁴¹ <http://www.acrbr.org.au/FAQ/ACRBR%20Bioinitiative%20Report%2018%20Dec%202008.pdf>

Dismissing it as not progressing science is arguably valid, since it is apparently intended to be a position statement from a group of concerned professionals (albeit mostly scientists and researchers) - a public health document focusing on the risks of the technologies communities are being swamped with, rather than a document that weighs up every study for and against. But the fact of its existence should give pause; that fourteen individuals from various related backgrounds would make the effort to produce a 600-page document, potentially compromising their presumably gainful employment,⁴² risking the character assassinations that could well ensue, to make their concerns public, is more than a little food for thought.

In short, ACRBR tackles the report's credentials as a scientific study, focusing on what it is not rather than on what it is. Debunking a self-published document as poor science is what we could reasonably expect a scientific research organisation to do, because the document is not a scientific journal. But to assume, on this basis alone, that the report has nothing to offer the debate from a scientific and public health perspective, would be very foolish.

2008: ELF EMF linked to Alzheimer's disease

This study finds that "available epidemiological evidence suggests an association between occupational exposure to ELF-EMF and AD [Alzheimer's disease]".⁴³

Again this refers to extremely low-frequency EMF rather than RF microwave radiation, but once again it represents a growing body of EMR risk evidence, and in this case based on epidemiological evidence. Epidemiology is the science of establishing links between factors and outcomes based on studying real populations and their histories – something we will probably not be able to do with any certainty in regard to WLAN – a relatively new technology – for some years.

2008: Child models exceed absorption limits by up to 40% at exposure limits

This study is concerned with the oversimplification of models (i.e. human body shapes) used to determine how much radiation is likely to be absorbed by humans, and therefore used a range of more realistic models to test SAR ('specific absorption rate' of radiation). The results "show that for adults, compliance with reference levels ensures compliance with basic restrictions, but concerning children models involved in this study, the whole-body-averaged SAR goes over the fundamental safety limits up to 40%".⁴⁴

In 2009, ICNIRP acknowledged the advancements in modelling techniques (specifically citing this study amongst others similar to it), and responded to such findings by stating "from 1 to 4 GHz [which includes WLAN] for bodies shorter than 1.3 m in height (corresponding approximately to children aged 8 y or younger) at the recommended reference level the induced SARs could be up to 40% higher than the current basic restriction under worst-case conditions. However, this is negligible compared with the large reduction factor of 50 (5,000%) for the general public."⁴⁵

This would appear to be an alarming 'cop-out' from ICNIRP, but to understand why, some more detail on the guidelines is required.

The ICNIRP (and Australia's ARPANSA) guidelines are two-pronged:

⁴² See <http://www.bioinitiative.org/freeaccess/participants/index.htm> for a list of participants

⁴³ <http://www.ncbi.nlm.nih.gov/pubmed/18245151>

⁴⁴ http://iopscience.iop.org/0031-9155/53/6/001/pdf/pmb8_6_001.pdf

⁴⁵ <http://www.icnirp.de/documents/StatementEMF.pdf>

1. “Basic restrictions” in terms of WLAN frequency, refers to the restriction on SAR (specific absorption rate) that ICNIRP set – how much radiation the body should be allowed to absorb.
2. “Reference levels” in regard to WLAN, are the levels set by ICNIRP to indicate the level of exposure at which the basic restriction SAR limit would be reached.

ICNIRP stated in their guidelines that “compliance with all reference levels [i.e. exposures] given in these guidelines will ensure compliance with basic restrictions [i.e. absorption]”.⁴⁶ This study shows the ICNIRP statement is incorrect – it demonstrates that when using a more anatomically accurate model for determining absorption levels in children, when you expose that model to ICNIRP’s own reference levels, ICNIRP’s own basic restriction SAR levels are exceeded by 40%. And while ICNIRP acknowledged such studies, it labelled the 40% breach as “negligible”.

To understand ICNIRP’s response about this being a “negligible” finding, we need to look at how the basic limits were arrived at.

As has already been mentioned, the historical foundation for standards is the absorption level at which disruption of learned behaviour in other species was noted. ICNIRP also take this as their basis, together with the fact it’s also the limit at which a half-hour exposure will induce a body temperature rise less than one degree Celsius.⁴⁷

This absorption limit is 4W/kg. Based on this, ICNIRP set the occupational SAR (i.e. the absorption for people who, for example, deal with radiation in their employment and are trained in protective measures) at 0.4W/kg, ten times less than the limit at which behavioural changes are noted, stating that this “provides a large margin of safety for other limiting conditions”.⁴⁸

Then, “an additional safety factor of 5 is introduced for exposure of the public”, bringing 0.4W/kg down to 0.08W/kg.⁴⁹ So, in total, ICNIRP factored in a safety buffer of 10 times lower (for occupational absorption) and an additional 5 times lower again for the general public, making a total of 50 times lower than the limit at which, after a half hour, body temperature rises by 1 degree, and at which behavioural changes are observed in other species.

This safety buffer, then, is the “factor of 50” ICNIRP refers to when it says of the 40% breach of basic restrictions in children that “this is negligible compared with the large reduction factor of 50 (5,000%) for the general public.” Effectively, ICNIRP is saying that the fact that ICNIRP got the reference levels (at which SAR wouldn’t be exceeded) wrong, doesn’t matter, because the basic restrictions included a buffer. That is, ICNIRP is saying ‘don’t worry, the buffer is only a buffer’. See figure 1 below for a depiction of the situation.

By this logic, one could reasonably ask whether ICNIRP actually holds that humans should assume that radiation absorption at *any* level below that at which rodents stop performing their food-motivated behaviour, is safe.

⁴⁶ p. 508 <http://www.icnirp.de/documents/emfgdl.pdf>

⁴⁷ p. 507 <http://www.icnirp.de/documents/emfgdl.pdf>

⁴⁸ Ibid.

⁴⁹ Ibid. p. 509

These are pertinent questions given that bodies such as ARPANSA cite the safety buffer as reassurance against the possibility of biological effects occurring below ARPANSA's current standard.⁵⁰

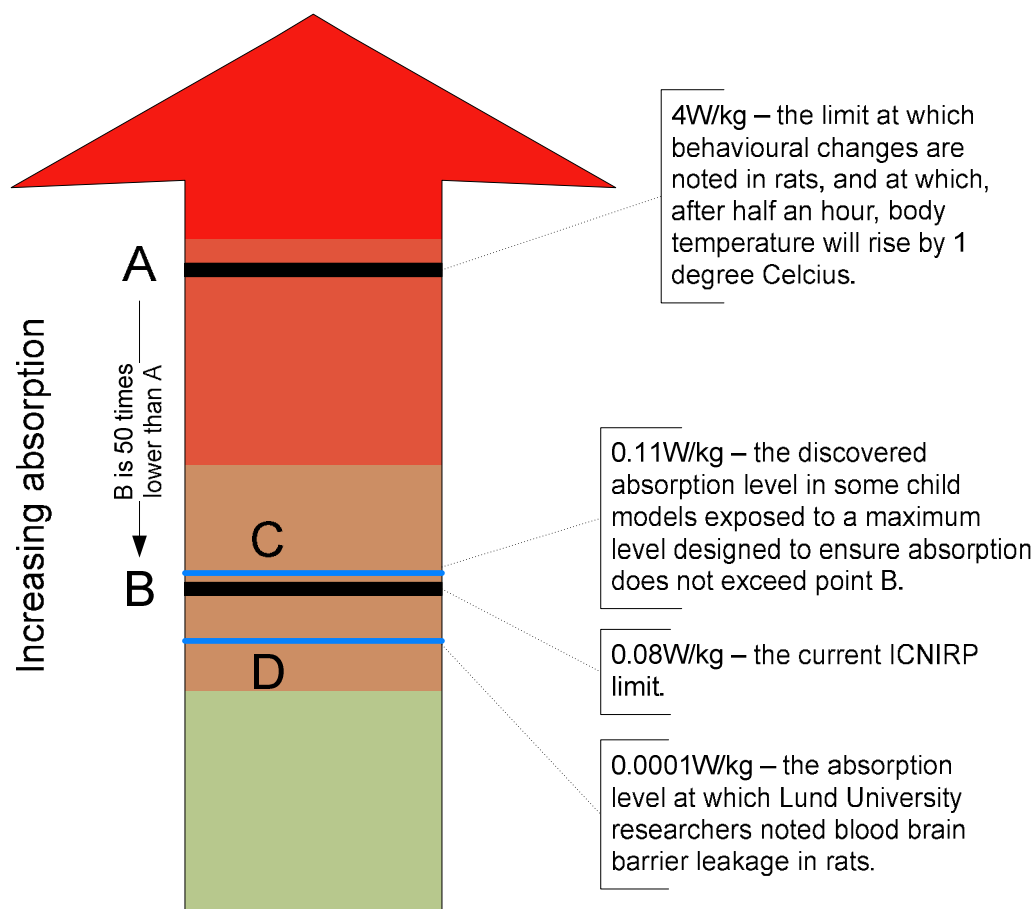


Figure 1 (created by me, not sourced externally) – Depicting (not to scale) some pertinent radiation absorption levels. Point A is the basis for the ICNIRP standard, and Point B is the limit set by ICNIRP for the absorption level acceptable for the general public, which was set 50 times lower than point A to create a buffer. Point C (the higher blue line) is the absorption level noted in experiments performed with child models at the ICNIRP reference levels for exposure (which were supposed to ensure point B was not breached), and is 40% higher than the limit set at Point B. Point D (the lower blue line) is added to demonstrate that even at absorption levels below ICNIRP's point B limit, adverse effects have been noted in animals. Note that this diagram is not to scale. If points A, B, and C were to scale, the line of point C would be nearly indistinguishable from that of point B, and that's what ICNIRP means by it being a negligible breach: compared to the distance between A and B (3.92 W/kg), the 0.03 W/kg breach of C above B, is small. However, this raises questions about at what point in the space between A and B – the buffer zone – ICNIRP would consider a breach something other than 'negligible'. The implication in their statement is that point A is the only level of absorption regarding which we should *really* have concerns, which stands in stark contrast the findings at point D.

If nothing else, studies such as this demonstrate two important things:

1. that ICNIRP has made mistakes in the past (remembering their statement that adhering to reference levels would “ensure” basic restrictions weren't exceeded – which they don't), and
2. that elevated risks are faced by children.

⁵⁰ http://www.arpansa.gov.au/radiationprotection/FactSheets/is_rfStandard.cfm

The study also shows that whole-body absorption of radiofrequency radiation actually peaks around the 1.8-2.4GHz mark (where WLAN operates). The study is (at time of writing) publically accessible and well worth reviewing.⁵¹

Note though, that this exceeding of limits in child models occurred at reference levels – that is, at what ICNIRP classes as the absolute *maximum* exposure to which a member of the public should be exposed (thus ICNIRP's referring to it as 'worst-case' conditions). This study therefore does *not* show that children *are* exceeding the current limits in real life situations, although it does show that the current limits do *allow* for this to occur. Reference levels were always intended to provide a simpler basis against which *likely* absorption could be tested, and that has flowed through into the regulatory environment. For example, the ARPANSA Standard that applies to Australia states that:

*The mandatory basic restrictions in this Standard are specified through quantities that are often difficult and, in many cases, impractical to measure. Therefore, reference levels of exposure, which are simpler to measure, are provided as an alternative means of showing compliance with the mandatory basic restrictions. The reference levels have been conservatively formulated such that compliance with the reference levels given in this Standard will ensure compliance with the basic restrictions. If measured exposures are higher than reference levels, it does not necessarily follow that the basic restrictions have been exceeded, but a more detailed analysis is necessary to show compliance with the basic restrictions.*⁵²

In short, if it doesn't exceed the reference level, it doesn't need to be tested against basic restrictions. As we've seen, something operating at the reference level limit exceeds the basic restrictions by 40% in children, so in theory it's possible for a device to hit the market that exceeds basic restrictions by 40% in children.⁵³

It should be noted that *other* limits may apply to hardware which could limit exposure independently of ICNIRP guidelines; communications authorities, for example, may impose their own standards to address their own (non-health-related) concerns. While such limits may not have been created to address health concerns they may, incidentally, curb the health exposure risks created by WLAN devices. For example, in the European Union the maximum radiated power limit (as opposed to the radiation exposure limit) to which wireless networking devices must adhere is 100mW EIRP⁵⁴ (while in Australia the limit is 4W EIRP⁵⁵ – 40 times higher). The considerations under which these *power* limits are arrived at are more due to technical concerns (for example, interference between telecommunications devices), rather than health concerns (which are addressed by ICNIRP-type guidelines), and while the output power and the resultant radiation levels created are related, it

⁵¹ http://iopscience.iop.org/0031-9155/53/6/001/pdf/0031-9155_53_6_001.pdf See Figure 18 on page 1523 for a graphical representation of different SAR of different age humans, showing that the ICNIRP reference levels result in the ICNIRP basic restrictions being breached.

⁵² Section 4.1 <http://www.arpansa.gov.au/pubs/rps/rps3.pdf>

⁵³ For wireless frequency, the ARPANSA basic restrictions are the same as the ICNIRP basic restrictions, as are the reference levels (while ARPANSA goes to three significant figures rather than two - e.g. 61.4 compared with 61, 0.163 compared with 0.16, and 10.0 compared with 10).

⁵⁴ Section 4.3.1.2: www.etsi.org/deliver/etsi_en/300300_300399/300328/01.04.01_60/en_300328v010401p.pdf (EIRP = Effective Isotropically Radiated Power, a theoretical measure of evenly radiated power, combining the output of the unit with any amplifying effects of the antenna)

⁵⁵ http://www.acma.gov.au/scripts/nc.dll?WEB/STANDARD/1001/pc=PC_1768

would remain for vendors/regulators to ensure that a device adhering to these power standards also complies to health-based exposure standards, and vice versa.

2009: Non-thermal biological effects of microwaves on neural cells

This study finds “Continuous exposure to 900MHz GSM-modulated EMF alters morphological maturation of neural cells”, stating that their experimental "system allows cells to be exposed at SAR value lower than that at which thermal effects may occur".⁵⁶ (emphasis mine)

900MHz is the frequency used by many mobile phones.

2009: ICNIRP states ‘current limits ok for now’

ICNIRP issues a statement (already referred to above in regard to the SAR limits being exceeded by 40% in children) that the scientific literature since the publication of their 1998 guidelines...

...has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields. The biological basis of such guidance remains the avoidance of adverse effects such as “work stoppage” caused by mild whole-body heat stress and/or tissue damage caused by excessive localized heating (D’Andrea et al. 2007). With regard to non-thermal interactions, it is in principle impossible to disprove their possible existence but the plausibility of the various non-thermal mechanisms that have been proposed is very low. ⁵⁷

The statement that there has been “no evidence” for sub-thermal effects is, when treated literally, factually incorrect given even just the handful of studies listed here (even remembering that ICNIRP is referring here to high-frequency EMFs – e.g. WLAN and mobile, but not ‘ELF’ fields). ICNIRP may feel justified in saying there is “no evidence” in the context of a consensus standpoint, but even a cursory appraisal of the sources for the evidence cited in the BioInitiative Report suggests even this is a shaky claim.

Furthermore, any ‘implausibility’ of the mechanisms by which sub-thermal effects could occur, could well be a reason to place a low value on evidence that suggests the effects exist, if this were a trivial issue of little significance for public health. But, from a public health perspective, given the current rollout of the technologies involved, if the explanations seem implausible, this should be more reason to admit that something appears to be going on which we currently don’t fully understand.

ICNIRP’s website states that the current standards are being revised, following a 2009 review.⁵⁸ It will be interesting, to say the least, to see whether the apparently inadequate reference level limits are lowered or whether ICNIRP still holds that their buffer is adequate protection. Any tightening of the guidelines would demonstrate that ICNIRP acknowledges an increased risk, while not changing them would fly in the face of mounting evidence – in a sense they’ll be damned if they do or don’t.

Regardless, I argue that policy makers cannot ethically rely solely on (and wait for) ICNIRP’s or ARPANSA’s revised limits to inform their policy on WLAN in schools – an argument I develop further in this document.

⁵⁶ p. 176 <http://www.ncbi.nlm.nih.gov/pubmed/19429115>

⁵⁷ <http://www.icnirp.de/documents/StatementEMF.pdf>

⁵⁸ <http://www.icnirp.org/PubEMF.htm>

2009: Pathophysiology issue on EMF

The August 2009 issue of the journal *Pathophysiology* featured a number of studies on EMF and health. Some pertinent studies were:

- “Electromagnetic fields stress living cells”:⁵⁹ “It is clear that in order to protect living cells, EMF safety limits must be changed from the current thermal standard, based on energy, to one based on biological responses that occur long before the threshold for thermal changes”.
- “Electromagnetic fields and DNA damage”:⁶⁰ a review of literature which notes that there is a mix of findings, but nonetheless concludes that “RFR [RF Radiation] exposure does indeed appear to affect DNA damage and repair”.
- “Genotoxic effects of radiofrequency electromagnetic fields”:⁶¹ another review, which finds that “altogether there is ample evidence that RF-EMF can alter the genetic material of exposed cells in vivo (i.e. inside a living body) and in vitro (i.e. outside a living body) and in more than one way.”

This issue of the journal was guest-edited by Martin Blank of the Columbia University Medical Centre.⁶² He was also an editor of the ‘BioInitiative Report’.⁶³ Guest-editing of journals is not unusual, but some critics have implied that it allows the editor to ‘stack’ the journal with evidence that supports their views. If that’s true, the same is certainly true of industry interests on public health panels, as well as the effect of industry funding on scientific studies. One should also consider why a researcher would be invited to guest edit a peer-reviewed journal in the first place – it usually confers prestige on the guest editor because they’re regarded as eminent enough to warrant the appointment.

2010: INTERPHONE results published

INTERPHONE was the largest study on mobile phone risk to be performed up until that time. The conclusion was “Overall, no increase in risk of glioma or meningioma [two kinds of brain tumours] was observed with use of mobile phones. There were suggestions [in the results] of an increased risk of glioma at the highest exposure levels, but biases and error [within the study’s methodology] prevent a causal interpretation.” This muted conclusion is despite results such as “the OR [odds ratio] for ipsilateral use in the highest category was appreciably elevated” – appreciably increased risk of a brain tumour on the same side as a mobile phone is held in heavy use – and in the highest category of use, “for cumulative number of calls, there was a consistent trend towards increasing ratios [=increasing risk] with increasing exposure.”⁶⁴

It should also be noted that the very first finding listed in the ‘results’ section of the final report was that “a **reduced** odds ratio (OR) related to ever having been a regular mobile phone user was seen for glioma ... and meningioma” (emphasis mine). That is, taken at face value, the data demonstrated a *protective* effect from mobile phones in one of the study’s assessments. That this finding has been the focus of attempts (by the study’s authors and by external reviewers) to explain how such an

⁵⁹ <http://www.ncbi.nlm.nih.gov/pubmed/19268550>

⁶⁰ <http://www.ncbi.nlm.nih.gov/pubmed/19264461>

⁶¹ <http://www.ncbi.nlm.nih.gov/pubmed/19285841>

⁶² <http://www.physiology.columbia.edu/MartinBlank.html>

⁶³ http://www.bioinitiative.org/freeaccess/press_release/index.htm

⁶⁴ <http://ije.oxfordjournals.org/content/39/3/675.full>

‘implausible’ result could occur, strikes me as interesting. It demonstrates an inclination to treat data that doesn’t behave as expected, as ‘erroneous’, rather than suggesting that perhaps our assumptions may have been wrong.

Interestingly, a much earlier study (1999) had already demonstrated that exposure to simulated mobile phone radiation speeds up reaction times in humans – another apparent ‘beneficial’ response.⁶⁵

A genuinely scientific approach would surely allow for the possibility that if such levels of radiation cause effects on a complex organism with incredibly complex systems, it’s highly likely that the effects would be a mix of positives and negatives, rather than demanding that data should conform to a simple dose-response relationship of harm.

ICNIRP’s response to the INTERPHONE study was to effectively discount every finding (those that suggest a link between mobiles and cancer, and those that actually suggest a protective effect) on the basis of methodological flaws.⁶⁶ Such a dismissal is not necessarily brash or unwarranted since the study’s authors themselves noted flaws and biases in the methodology, together with suspect levels of reported use by study participants, however, looking at it more cynically, one could perhaps explain the desire to ‘explain away’ data showing ‘implausible’ beneficial effects by considering that the acknowledgment of *any* effect, positive or negative, involves an inherent admission of biological effects below the current limits.

2010: The “Seletun Scientific Statement”

Following on from the work of the BioInitiative Report, in 2009 the “Seletun Scientific Panel” issues a “consensus statement” known as the “Seletun Statement” with similar aims, some of the content from which is published in the journal *Reviews on Environmental Health* in 2010.⁶⁷ The statement calls for the current microwave/RF limits to be lowered by 50,000 to 60,000 times, with the website adding that even this level “may need to be lowered in the future”, and further continues:

*It is a serious mistake to believe that we have always lived in man-made electromagnetic fields, such as from electrical power, radio, TV, computers, and wireless telecommunication, and therefore should not worry. It was not long ago when people thought that X-rays, radioactivity, strong ultraviolet light and radar were completely without harm.*⁶⁸

That last statement strikes me as having sociological merit, and deserves some reflection; individuals of an older generation inform me that a trip to the shoe shop was always fun as a child, because the shop assistant (who presumably wasn’t a qualified radiologist) would offer X-rays of their feet in their new shoes, right there in the shop, ‘just to make sure they fitted well’.

RF is *not* X-ray frequency, and the fact that we used to think X-rays were harmless and now don’t, does *not* mean that everything that we now think is harmless will therefore necessarily be found to be harmful in the future. I’m also not suggesting that we know as much about RF as we do X-rays

⁶⁵ <http://www.ncbi.nlm.nih.gov/pubmed/10331850>

⁶⁶ <http://www.icnirp.de/documents/ICNIRPnote.pdf>

⁶⁷ <http://www.ncbi.nlm.nih.gov/pubmed/21268443>

⁶⁸ <http://iemfa.org/index.php/publications/seletun-resolution>

(the harmfulness of which had a relatively quickly established consensus). But I am suggesting that there are historical lessons of which we should be mindful.

May 2011: WHO classes RF EMF as a Group 2B possible carcinogen

WHO's International Agency for Research on Cancer (IARC) classes radio frequency (i.e. including wi-fi) electromagnetic fields as a 'possible human carcinogen'.⁶⁹

The 2B classification does *not* mean that WHO's position is that RF is definitely carcinogenic (there are classes representing degrees of certainty: Group 2A "probably carcinogenic" and Group 1 "carcinogenic"), but it does indicate a growing body of evidence (given that human-produced RF has been around since the 19th century and was only classified 2B in 2011).

Group 2B includes around 270 candidates,⁷⁰ the more recognisable amongst them ranging from infamous representatives of past chemical follies (such as DDT and lead) through to the less-sinister sounding coffee and pickled vegetables (apparently a traditional Asian preparation has been linked to a digestive tract cancer).

Much has been made of the fact that many people still drink coffee despite the 2B classification, but in the context of my purpose here, it's worth pointing out that we *don't* institutionally encourage children to drink coffee at school, nor drip-feed it daily in the classroom without either parental or students' permission, as we are currently doing with WLAN.

May 2011: ICNIRP responds to the Group 2B classification of RF

In response to WHO's classification of RF-EMF as a possible human carcinogen, ICNIRP issues a statement, saying that: "ICNIRP awaits with interest the full Monograph that explains the justification and arguments put forward by IARC in arriving at this conclusion".⁷¹

As at the time of writing this submission, the Monograph in question is still listed on the IARC website as "in prep".⁷²

Jun 2011: Parent sues school district over WLAN

A parent in Oregon, United States, files a suit against his child's school district, claiming to have expert witness testimony.⁷³ More on the testimony follows.

Sep 2011: UK Health Protection Agency (HPA) reports

The HPA committed to researching exposures created by laptops in classrooms.

The conclusions of this interim report were that "the data gathered during the project continue to reinforce the position adopted by the HPA at the beginning of the project that exposures are small in relation to the ICNIRP guidelines and less than those from mobile phones."⁷⁴

Once again, the initial figures are less reassuring in light of findings of other studies. The highest SAR values for the torso were calculated at 14.4mW/kg, compared to the ICNIRP limit of 80mW/kg.

⁶⁹ www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

⁷⁰ <http://monographs.iarc.fr/ENG/Classification/index.php>

⁷¹ http://www.icnirp.de/documents/ICNIRP_IARCclassificationRF.pdf

⁷² <http://monographs.iarc.fr/ENG/Classification/ClassificationsGroupOrder.pdf>

⁷³ <http://www.katu.com/news/local/124406914.html> (More reliable information follows)

⁷⁴ http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1287142601165

Later reports from the same project focus on the duty cycle of wi-fi devices – the amount of time RF signals are actually transmitted. Laptops were found to transmit just under one per cent of their ‘up-time’, while access points were transmitting 12% of the time (wi-fi devices transmit in very quick, continual bursts, rather than constantly). Based on this reduced transmission time, the researchers ‘time-averaged’ the power outputs (for example, to reduce the 20 milliwatt laptop output to 0.2 milliwatt), which in turn, according to their computer modelling, reduces the maximum laptop SAR to 80 microwatt per kg in the torso (=0.08 mW/kg, one thousand times lower than the ICNIRP limit for the head, and some 25,000 times lower than the torso limit).⁷⁵

As a parent of children in a school using WLAN, this subsequent report presented, on first reading, the most reassuring findings I’ve come across, in that the study was specifically targeted to investigate exposure in schools, and the findings demonstrate low SAR. But even so, it would seem that the HPA’s conclusions are stated with an unwarranted degree of certainty: “Results so far show RF exposures are likely to be well within internationally accepted (ICNIRP) guidelines ... there is no reason why Wi-Fi should not continue to be used in schools”. If adherence to the ICNIRP standards was the *only* ground for concern, then yes, the study certainly warrants confidence, but that’s not the only issue.

In one sense, the rather forthright conclusion that there is “no reason” WLAN shouldn’t be used in schools, seems to suggest a change in attitude with a ‘changing of the guard’; Sir William Stewart (after whom the Stewart Report on mobile phones, referred to above, was named) was the former chairman of the HPA, and while the HPA’s current website blurb appropriates his statement that it would be timely to study the new wi-fi technology given its rollout,⁷⁶ the Stewart Report made it very clear that devices exceeding the ICNIRP guidelines was not the only issue: “We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach”.⁷⁷ This latest HPA study actually, upon reflection, seems to do *nothing* to address this concern, and rather only confirms that WLAN operates within the national guidelines that the Stewart Report stated were not necessarily any guarantee of safety (recall that the Stewart Report recommended that restrictions be placed on the siting of mobile phone masts around schools, due to this uncertainty and the increased risks in children).⁷⁸ In short, moving from a precautionary approach regarding RF around schools, to stating that there is “no reason” for not using RF in schools, would appear to be a demonstration of how public health policy may not come down to cold, hard, impartial science alone.

Back to the science, in light of other concerns around the standards themselves, the apparently very low HPA finding of 0.08mW/kg may not be as reassuring as it sounds. For example:

- The report states that the study used a model based on the body of a ten year old.⁷⁹ One size does not fit all with regard to radiation absorption – there are significant differences between SAR values in children of different ages. For example, the study that found basic

⁷⁵ <http://www.icnirp.org/Kids/MannPre.pdf>

⁷⁶

<http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/ElectromagneticFields/WiFi/>

⁷⁷ Paragraph 1.19 http://www.iegmp.org.uk/documents/iegmp_1.pdf (emphasis mine)

⁷⁸ Also see a YouTube bootlegged *BBC Panorama* episode in three parts for comments from Sir William Stewart (specifically in regard to wi-fi in part 3 at 8 mins 25 sec) <http://youtu.be/luNaDj6VLHw> It should be noted that the program had upheld complaints made against it:

http://news.bbc.co.uk/2/hi/uk_news/7122230.stm

⁷⁹ p. 5 <http://www.icnirp.org/Kids/MannPre.pdf>

restrictions in children were being breached by 40% at reference levels, also showed that on average, whole body average SAR around the 2GHz peak varied by around 30% between a 12 year old and a 5 year old – the smaller the child, the higher the absorption.⁸⁰

- As noted above, the Lund University group have observed leakage across the blood brain barrier at 0.1mW/kg (only 25% higher than the HPA's 0.08mW/kg school findings) in rats, and found that the lowest energy levels gave rise to the most pronounced leakage.
- Suggestions (as discussed above) from an IEEE fellow (IEEE is the creator of the wi-fi technology protocols) that the ICNIRP approach to calculating SAR can underestimate results by a factor of two or more.
- Possible issues with the accuracy of SAR measurements determined from time-averaged outputs. (This is a possibility only – I've not been able to access the detail of the HPA studies other than the high level presentation referenced above – but have noted that time-averaging is mentioned as being potentially problematic in the literature).⁸¹
- Further, it's possible that time-averaging is a scientifically naive approach; according to a Harvard School of Engineering and Applied Sciences synopsis of the US Federal Communications Commission (FCC) guidelines, "Due to the wide variety of radiation source[sic], in addition to varying frequency where the duty cycle of the generators varied from continuous to pulse waves with large and small duty cycles, one needed to differentiate the effects of continuous wave and pulse wave sources, [and] the decision was to account for this uncertainty through the practice of time averaging."⁸² That is, time-averaging is a scientific convenience, which includes the inherent assumption that the effects of bursts of radiation would be equal to the effects from a constant exposure that represents the total of the individual pulses. However, it's plausible that continual, short bursts of radiation could have a completely different biological effect to a constant exposure of a simply mathematically equivalent cumulative nature (for example, consider the study above focusing on pulsed RF, under the heading "2005: Wireless RF alters gene expression").
- Due to communications-based regulatory/licensing differences (rather than radiation safety limits), it can't be assumed that these UK findings will automatically apply to Australia. In the UK the limit for WLAN devices is 100mW EIRP,⁸³ while in Australia the limit is forty times higher at 4W EIRP.⁸⁴ This doesn't automatically mean we're subjected to levels 40 times higher than represented in these studies, but the communications regulations in Australia are certainly more accommodating of higher hardware output powers.
- The HPA's 0.08 mW/kg finding is one thousand times lower than the ICNIRP limit for the head, and some 25000 times lower than the torso limit. The Seletun Statement states that based on the evidence reviewed, adverse health effects are known at 50,000 – 60,000 times lower than the ICNIRP limits.⁸⁵

⁸⁰ p 1523 http://iopscience.iop.org/0031-9155/53/6/001/pdf/0031-9155_53_6_001.pdf

⁸¹ <http://ieeexplore.ieee.org/iel5/15/5415790/05398990.pdf>

⁸² http://www.deas.harvard.edu/courses/es96/spring1997/web_page/health/fccregs.htm

⁸³ p. 6 <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/uk2005.pdf>

⁸⁴ http://www.acma.gov.au/WEB/STANDARD/pc=PC_1794#radiated

⁸⁵ <http://iemfa.org/index.php/publications/seletun-resolution>

In summary, that there is “no reason” wireless networks should not be used in schools, may be true within the apparently very narrow aims of establishing ICNIRP compliance, but it is far from the full picture. This is a very good example of a case where media coverage of a study could convey very reassuring findings to an unsuspecting public, when in fact all the study has achieved is to demonstrate that devices adhere to standards which are 14 years old, which are demonstrably flawed, which are now being revised, and which could be orders of magnitude too high.

Dec 2011: Cold War microwave warfare expert’s testimony submitted

Barrie Trower signs off on his expert witness submission, which is filed in January 2012. Mr Trower claims to have a degree in physics, and to have been government-trained in microwave warfare, including RF-based Cold War interrogation techniques.

There are lots of copies of his document floating around on the internet. Given the potential for precedent-setting in this case, as well as the fairly explosive claims made by Mr Trower, I expected it would have quite a high profile in the media. But the media report cited above (see footnote 73 on page 22) was the most ‘reliable’ independent source I could find, which wasn’t encouraging, so I wondered whether this was a well-engineered smokescreen for the anti-WLAN lobby.

Having applied for, and been issued with, login credentials to the US Government’s ‘Public Access to Court Electronic Records’ (PACER) database, I was able to locate and download the document in question, and it matches the copies I found on a variety of sites – in short, the documents circulating the internet under the claim of being official court documents, were actually official court documents.⁸⁶

Of course, it must be noted that (at time of writing) the case is yet to run its course; it’s possible that the defence counsel will cross-examine Mr Trower and expose serious flaws in his statement. Also, not all of the reference links in the statement appear to be ‘live’. As such it needs to be viewed critically rather than taken entirely at face value. I include his statements for reference/interest only, and I certainly don’t feel that the case against WLAN collapses even if this evidence proves to be defective.

Mr Trower writes with a forthright tone which is in contrast to the cautiousness of even those scientific studies which state that there are links between RF and adverse health effects.

A selection from the evidence offered by Mr Trower (which I have appended to this document in full from the PACER database, with permission) includes:

“There is a plethora of extensive, well-researched documents from around the world highlighting impairments and illnesses caused by MW [microwave] radiation. These papers (in their thousands) discuss adverse health outcomes caused by low-level (below thermal) microwaves as: arrhythmia, heart attack, cell death, diseases of the blood, interference to bone marrow, brain tumours, DNA damage, altered calcium level in cells, reduction in night-time melatonin, suppression of the immune system, arthritis, rheumatism, skin problems, lymphatic diseases, vaginal discharge, vascular system disease, tinnitus, leukaemia, childhood cancer, sleep problems, mental problems involving depression, irritability, memory loss, difficulty in concentrating, headache, dizziness and fatigue, suicidal tendencies, miscarriage and infertility.”

⁸⁶ For anyone with doubts similar to those I had, PACER is accessible at <http://www.pacer.gov>, application is free, and document access for low amounts of use (as in my case) is typically free also. The case number is 3:11-cv-00739-MO, and Mr Trower’s submission is Document 45 within that case.

“My position as scientific advisor requires that I read and translate papers from all around the world, and, I have never, ever, no matter which country I lecture in, which paper I have read, I have never seen a single scientist brave enough to submit for peer review a safety level of microwave radiation for a child or embryo. There is not one that exists. Last year I lectured in six countries. When I’m in a country I challenge on TV the industry and the government to produce a scientist who will come on air with me and cite a safe level for children. In 12 years, no one has ever come forward.”

“The problem with young girls is that microwave irradiation has been shown to damage the genetic structure in their ovaries. Girls are born with all of the eggs they need in their ovaries at birth. They are immature eggs, hence susceptible to damage during growth. Microwaves are genotoxic (experiments can be linked to children showing low-level mobile telephony radiation disrupts the biochemistry of follicle cells in a mammalian egg chamber), hence the microwaves irradiation could affect the genetic structure within the eggs. The problem here is that the mitochondrial DNA, the genes inside the ovaries, is irreparable.

If you have a little girl in whom there is damage through this mechanism to the genetic structure in one of her eggs, and she has a daughter, that daughter will carry that genetic problem. It is irreparable. And her daughter in turn will carry that genetic problem, because it is irreparable. And every female forever, in that line, will carry that problem in perpetuity, because it is irreparable.”

“In my opinion, Portland Public Schools’ use of WI-FI is causing and will continue to cause AHM [the student], other students, and school staff and faculty adverse health effects, and should be discontinued immediately.”

The full text of Mr Trower’s statement is appended to this document, and also includes allegations (made as official court evidence under penalty of perjury) regarding industry influences on the debate.

It’s notable that ARPANSA also acknowledges the theoretical possibility of radiation-induced mutations being passed down through generations, and while they do so in reference to ionizing radiation rather than non-ionizing radiation, the genetically-heritable basis for the possibility exists across the board: “If the damage occurs in the testes or ovaries then hereditary effects in descendents[sic] may become apparent.”⁸⁷

Jan 2012: WLAN-connected laptop damages sperm

In this study, semen samples from 29 healthy donors were exposed to wireless radiation from laptops for 4 hours. The conclusion was that this out-of-body exposure “of human spermatozoa to a wireless internet-connected laptop decreased motility and induced DNA fragmentation by a nonthermal effect. We speculate that keeping a laptop connected wirelessly to the internet on the lap near the testes may result in decreased male fertility.”⁸⁸

⁸⁷ http://www.arpansa.gov.au/RadiationProtection/Factsheets/is_rad.cfm

⁸⁸ <http://www.ncbi.nlm.nih.gov/pubmed/22112647> (emphasis mine)

Feb 2012: Israeli Parliament considers health warnings on mobiles

The Israeli Parliament passes the first of three readings of a new bill which would require all mobile phones sold in Israel to carry a health hazard label, and to pose restrictions on advertising to minors.⁸⁹

⁸⁹ See: Hebrew Parliamentary record: <http://www.knesset.gov.il/spokesman/heb/Result.asp?HodID=9871>

Translated to English via Google® Translate:

<http://translate.google.com/translate?hl=en&sl=iw&tl=en&u=http%3A%2F%2Fwww.knesset.gov.il%2Fspokesman%2Fheb%2FPrintResult.asp%3FHodId%3D9871>

An English news report: <http://www.haaretz.com/business/knesset-backs-bill-requiring-cell-phones-to-bear-health-hazard-warning-1.415677>

DoE's response & an examination of reassurances

I will now examine a selected sample of responses to queries around health concerns, starting with the DoE responses that were directed to me after I enquired into the department's position on the hazards/safety of wireless networking.

When I initially raised my concerns with DoE, to initiate a dialogue I cited a couple of non-authoritative websites as an example of the public concerns that had been aired. This may have led to my being viewed as someone who would be placated by any online resource that happened to say 'wireless is safe', and so I acknowledge that I may need to take some responsibility for the level of response I was given.

However, given that these responses apparently indicate DoE's position on the safety of WLAN, they warrant an examination.

I was directed to these documents:

1. A Wikipedia article.⁹⁰
2. A page on a commercial (.com) website which appears to be a private site with no explanation of who owns the site or what their agenda may be.⁹¹
3. A 'whitepaper'⁹² that has the appearance of being a semi-scholarly article, but actually seems to have been authored by an employee of Adelix, an IT hardware supplier.⁹³ The file is hosted on Adelix's website, and the properties of the document show the author to be a 'Tim Lloyd', who held an e-mail address with Adelix.⁹⁴ So it seems an employee of the hardware company authored the article for the hardware company, and the company then published it as health risk advice. Regardless of whether an Adelix employee really did write the document or not, there is no authorship information written into the document text itself, so once again it is impossible to clearly establish who wrote it and what their agenda may have been.
4. A paper produced by the University of Queensland (UQ) to provide some reassurance to students that their rollout of wireless networking was safe.⁹⁵

In short, this is a disturbing collection of 'evidence', when cited in support of a government department's position on a matter of the safety of the children in their care. Of the four documents, only the last warrants any serious consideration as a source of some merit.⁹⁶

⁹⁰ http://en.wikipedia.org/wiki/Wireless_electronic_devices_and_health

⁹¹ http://www.radiationtalk.com/info/wifi_radiation.php

⁹² <http://www.adelix.com/solutions/pdf/hs-wlan.pdf>

⁹³ The Adelix website: <http://www.adelix.com/solutions/>

⁹⁴ See <http://www.enomcentral.com/whois/eninet-net.html> for an example of this e-mail address being used as a registrant contact for a domain name

⁹⁵ <http://uqconnect.net/helpdesk/wireless/Wireless-Device-Safety-v5.pdf>

⁹⁶ Regarding document (1), while Wikipedia can be a useful starting point, as a publically editable website it cannot be regarded as an authoritative source; university students are advised that they can expect to lose marks if they rely on Wikipedia as a source. Regarding documents (2) and (3), the fact that authorship of the documents can't be accurately identified is reason enough to view them with suspicion; the apparent industry-based origin of (3) is even more reason.

UQ's experience

Considering this UQ document, it must be noted that it was designed to quell fears regarding a technology to which the university had already committed. Some of the more reassuring statements in this document were:

1. "Studies by a range of independent and government experts show absolutely no health risks associated with wireless devices when used in a correct and safe manner."
2. Regarding a consultant's report on measured radiation on the UQ campus: "The maximum (all existing services) cumulative RF EME level measured was found to be less than 0.00073% of the allowable ARPANSA General Public Exposure Limit with WiFi system contributing to less than 0.00071% of the ARPANSA General Public Exposure Limit."

However, regarding (1) above, even a little personal research demonstrates that if this is true, it's also true that studies by other experts show very real health risks, as has been seen. Furthermore, this UQ paper was last updated in February 2011, and one wonders if the university would still stand by this statement given that it was just three months later that WHO rated radiation in the range that includes WLAN as a possible human carcinogen.

Regarding (2), while these are reassuringly low figures, they are a percentage of the ARPANSA limits (the same as ICNIRP limits for WLAN), about which there are growing concerns; if the limits are inadequate, gauging exposure relative to these limits becomes less reassuring. Further, despite looking like very low figures, the figures also tell us that wireless on the UQ campus contributes 71 parts out of a total 73 parts of all radiation (including measured background radiation, which made up only 2 parts – the difference between 71 and 73). That is, UQ's wireless network is contributing 97% of the radiation where the measurements were taken. I contacted the company that prepared this report, and it was confirmed that my understanding was correct, with the qualification that the "all services" radiation measured was for the range 75 – 3,000MHz (which, assessing the EMR spectrum, would mean mains power, AM radio, and some VHF TV signals were not included in the "all services" total, but that UHF TV, FM radio, mobile phones, any wireless network outside the study, and some VHF TV, would have been included). The company also pointed out that despite UQ's wireless contributing 97% of the radiation in this frequency, it is still more than 100,000 times lower than ARPANSA's limit.⁹⁷

I must stress that what now follows is my own interpretation of these facts (i.e. the company that prepared the report only confirmed the interpretation above, as I've noted, and what follows is my own interpretation). If ARPANSA's limit is adequate, the above is good news. If, as a growing number of scientists are saying, the limit is not adequate, it's cause for concern; at UQ the 'background' radiation in this frequency is 0.00002% of ARPANSA's limit, and the WLAN radiation is 0.00071%. Doing the sums, in practical terms this means that students at UQ inside a building where the measurements were taken are exposed to 35 times more radiation in this frequency than they would be if the wireless network was not there. This is an interesting result, given the number of voices claiming that WLAN radiation levels are likely to be far outweighed by sources other than WLAN (such as radios, TVs, and mobile phones) – that claim may well be true outside of buildings (structures and vegetation offer some shielding against RF radiation), but this report showed quite the opposite *inside* buildings which have WLAN access points indoors (as occurs for schools).

⁹⁷ Email correspondence with RADHAZ Consulting, 15/03/2012

Presumably the WLAN hardware at UQ would not be vastly different from that used in Tasmanian schools and, again, this also raises questions about how we can justify a 35-fold increase in exposure as being ‘necessary’, in regard to ARPANSA’s requirements for a precautionary approach:

Minimising, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided this can be readily achieved at reasonable expense.⁹⁸

A cursory test I carried out on our local primary school’s network⁹⁹ has demonstrated that the school’s wireless networks were running on a Sunday afternoon, and at 1a.m. on a Wednesday morning – suggesting the WLAN access points are running 24 hours a day, 7 days a week. While WLAN obviously transmits more data when uploading/downloading, ‘beacon’ signals are continually emitted (at intervals measured in milliseconds¹⁰⁰) to keep devices on the network synchronised and to enable other WLAN devices to ‘find’ the network. In short, students attending the school are continually subject to school-generated WLAN radiation even when no-one in the room is using a computer. At bare minimum, flicking off a power switch when no-one is using the network should be able to be “readily achieved at reasonable expense”.

Princeton

Having considered DoE’s and UQ’s approach to reassurance, I reviewed another educational institution’s position. Princeton University’s position statement also yielded some interesting insights. This document states:

For example, a newly published paper entitled “Radiofrequency Exposure from Wireless LANS Utilizing Wi-Fi Technology” discusses a study in which measurements were conducted at 55 sites in four countries, and measurements were conducted under conditions that would result in the higher end of exposures from such systems. An excerpt from the abstract states “...In all cases, the measured Wi-Fi signal levels were very far below international exposure limits (IEEE C95.1-2005 and ICNIRP) and in nearly all cases far below other RF signals in the same environments.”¹⁰¹

Again, this sounds very reassuring (if the limits are adequate), and the conclusion of that study is that “any health concerns would seem to be moot”.¹⁰²

However, this reassurance is once again based on the assumption that only exposure that will cause tissue heating will cause adverse health effects, and upon the fact that the RF signals from WLANs were “in nearly all cases” lower than for other sources of radiation¹⁰³ – this is in itself an interesting finding since the study included indoor locations such as coffee shops and universities, while in UQ’s indoor study referencing exactly the same background radiation spectrum (75MHz – 3Ghz), 97% of all measured radiation came from WLAN, leaving only 3% coming from background sources.

⁹⁸ Section 5.7(e) <http://www.arpansa.gov.au/pubs/rps/rps3.pdf>

⁹⁹ I established that the option of connecting to the school’s wireless network was available to my laptop at a roadside location just outside the 40km/hr school zone, some 150m from the closest school building, on 802.11b and 802.11g standards, both 2.4GHz.

¹⁰⁰ Common factory settings are around 100 milliseconds. E.g. see page 16 of this residential wifi router user manual: http://homedownloads.cisco.com/downloads/userguide/WRT120N_V10_UG_NC-WEB.pdf

¹⁰¹ <http://web.princeton.edu/sites/ehs/radiation/nirad.htm>

¹⁰² Foster KR 2007, p 286 <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

¹⁰³ Foster KR 2007, p. 283 <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

Further, this was a study about bystanders, not users. The study states that “at any given location, the total RF signal present from a WLAN is a combination of that from the AP [Access Point] and client card, with the closest source (usually, the client card in the computer) usually providing the major contribution to the signal”.¹⁰⁴ The study thus acknowledges that the wi-fi card in the computer usually provides the major contribution to the signal, and states that the measurements were conducted under conditions that would result in the highest exposure from a wireless signal. One may reasonably expect that the measurements would have been taken at a user’s operating distance from the computer – which would typically range from zero distance - sitting on the lap or with hands touching the keyboard to type – to around 50cm away.¹⁰⁵

However, the study explicitly states that “measurements were conducted at distances of approximately 1m or more from the client card in a laptop computer. They are representative of the field intensities in the far field close to a laptop. The user of a laptop would be exposed to stronger fields than reported here, particularly if the antenna in the client card were close to the user’s body. No attempt was made in this study to assess near-field exposures to a user of the laptop itself”.¹⁰⁶

In short, while there are some reassuring snippets to be gleaned from the study, it only measures exposures that *bystanders* might receive, not actual users of the technology.

The study’s acknowledgments note that “this work was supported by the Wi-Fi Alliance”¹⁰⁷ – an industry body with the stated goal of “driving adoption of high-speed wireless local area networking”.¹⁰⁸ The author is arguably more up-front in his treatment of the facts than Princeton appears to be in citing this study to quell fears about its wireless network, since most (if not all) of its students and staff would be users, not just bystanders. If nothing else, this is another case in point of an educational institution giving prominence to a source of dubious impartiality in support of its own position, and adds weight to the notion that the public apparently can’t expect those with a duty of care to students to have necessarily evaluated the evidence critically.

Ad hoc assurances

The DoE response to my enquiry included the comment that “The Cisco Wireless Access Points (WAP’s) used in DoE schools and Offices typically have a 100mW output which is far less [than] that emitted from a microwave oven (but microwave ovens are not up for long) or a mobile phone... A typical comment is that 12 months in a room with WAP’s might deliver about the same if not less than 20 minutes on a mobile phone.”

In response:

- I. The comparison between ovens and WAPs is comparing apples and oranges, since:

¹⁰⁴ Foster KR 2007, p. 281 <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

¹⁰⁵ For an actual evaluation of radiation absorption by laptop users under a number of configurations and positions, see http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?reload=true&arnumber=5338680 A useful, publically accessible diagram from the study has been posted here (possibly in breach of copyright – but I have confirmed that the picture is an accurate reproduction of the study’s diagram): <http://www.wirelesswatchblog.org/wp-content/uploads/2001/11/laptop1-1024x669.jpg> Note that the diagram refers to measurements taken at a representative peak output of 1W which is likely to be at least 5 times more than the most powerful laptop wi-fi’s typical sub-peak output (although newer technologies such as WiMAX have higher outputs). Nonetheless the diagram gives a good graphical representation of the *distribution* of exposure.

¹⁰⁶ Foster KR 2007, p 285. <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

¹⁰⁷ Foster KR 2007, p 286. <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

¹⁰⁸ <http://www.wi-fi.org/about/organization>

- a. An oven producing 800W is certainly more powerful than a WAP producing 100mW, but the former is expressly designed to be *contained* radiation while the latter is expressly designed to be *broadcast*.
 - b. Actual *emissions* from ovens – how much they leak – is expressed as power against area (e.g. 5mW/cm²),¹⁰⁹ not just power (e.g. “100mW” as cited by DoE to suggest WAPs have lower output emissions – in a sense this is similar to making a comparison between a car with 20 horsepower and a motorcycle that travels at 100km/hr; without more information the comparison is not meaningful).
2. The wi-fi alliance-funded study cited by Princeton to reassure its students, makes the statement that “If the antenna of a client card is placed against the body, the absorbed power in the body (measured in terms of specific absorption rate or SAR) will be comparable to that produced by a mobile phone handset.”¹¹⁰ Thus the suggestion from some quarters that “laptops” should not be called “laptops”; it’s not just the Access Point that is of concern.
 3. Mr Trower’s statement in the civil case over wi-fi in schools includes the following: “When reviewing this case, it occurred to me to compare the relative cumulative dose of WI-FI in the classrooms with a commonly known device that emits the same frequencies. That device is a microwave oven. Both WI-FI and microwave ovens operate at a frequency of ~2.4 GHz. An average WI-FI transmitter operates on 0.2 J/s [0.2 Watts] power. Therefore, if using only 20 computer/laptop transmitters in a classroom, there is a combined 4 J/s [4 Watts]. A typical microwave oven (output) is 800 J/s [800 Watts] (magnetron input equals 1,200 J/s [1,200 Watts]). A classroom equals 4 J/s [4 Watts]; a microwave oven 800 J/s [800 Watts]. A ratio of 1:200. Thus, if WI-FI is used in morning and afternoon sessions, and if 200 seconds in a classroom (at 4 J/s [4 Watts]) equals 1 second inside a microwave oven (at 800 J/s [800 Watts]), then over a school day a child or adult receives the equivalent of 2 minutes in a microwave oven, 10 minutes per week.” (I haven’t attempted to verify these calculations – which have been submitted to the court under penalty of perjury – but it would certainly appear that a microwave comparison may not be as reassuring as we’d hope. Mr Trower’s original document is appended to this document, and includes some qualifications to this statement).
 4. From a public health perspective, comparing exposure to microwaves and mobiles isn’t particularly helpful anyway - I don’t let my children stand in front of microwave ovens (which *do* leak),¹¹¹ nor do I allow them to use a mobile phone at all, let alone for 20 minutes. Under current circumstances, I have no choice about whether they’re subject to WLAN radiation at close range (even though I’ve disabled it at home), because they’re exposed at school.

¹⁰⁹ <http://www.arpana.gov.au/pubs/emr/microwave.pdf>

¹¹⁰ Foster KR 2007, p 287. <http://www.ncbi.nlm.nih.gov/pubmed/17293700>

¹¹¹ Although apparently not to a level we should be concerned about...
<http://www.arpana.gov.au/pubs/emr/microwave.pdf>

Conclusions

Technology has been increasingly woven into the very fabric of human existence. Something as fundamental to the human experience as communication is increasingly facilitated and mediated by technology. In a sense it should not be surprising that we may have let down our guard, if indeed it was ever up.

Ten years has passed since the Federal Parliament opened an inquiry into wireless broadband (which referred to both wireless broadband '3G' and WLAN), the terms of reference of which were focused largely on matters of practicalities and licensing, and maximising "economic and social benefits" of the technology. While the final report acknowledged that some schools were already "experimenting" with wi-fi, a search in the 134-page final report for the word "health" turns up zero results.¹¹²

With this in mind – from such a high-level enquiry – one probably can't expect those in ICT departments to have a thorough understanding of the health risks of the technologies coming under their jurisdictions, even when that does involve the health of children. The employment selection criteria for such roles is certainly unlikely to require any public health or medical expertise.

I suspect that, within DoE, the health issue may fall between the gaps of current areas of defined responsibility. It's not surprising that DoE would defer to expert groups and industry regulators for health-related matters. The purpose of my submission is to suggest that, given the issues touched upon and the pervasiveness of microwave technology in schools, this deferral is no longer good enough. As a community that endeavours to show a degree of enlightenment, we have a responsibility to protect those in our care, especially when they are considered by our laws to be devoid of the capacity for informed consent. This must especially apply to DoE, given that our laws also enforce the education of children, and the default provider for this service is DoE.

The jury is still out (increasingly, it would seem, in a literal sense) on whether wireless networking causes adverse health effects, at least in terms of scientific consensus (while there are certainly scientists who have no doubt that the effects are real, lasting, irreparable, and heritable). However, the basic idea that long-term, 'industrially-propagated' EMR – which in evolutionary terms has only existed for a blink of an eye and is thus 'alien' to our genome – could cause unpredictable results in the human body is not scientifically implausible; the human body is a system which is regulated by a very complex and incompletely understood system of controls, many of which are biochemical and so induce their own tiny electrical currents and associated EMR.

Taken with findings that *demonstrate* links between EMR and adverse affects on different biochemical systems in the body, this notion is far from implausible. Add to that studies which show effects well below the intensities where thermal effects occur, and indeed some suggestions of an *inversely proportional* relationship between the intensity of radiation and its effects, and we should be open to the possibility that there are things happening that we as yet simply don't understand.

Given all this, a precautionary approach is sensible. It's also *called for* by the *current* ARPANSA standard which "requires owners of RF sources to minimise unnecessary exposure of the public to RF fields".¹¹³ In this sense, current practices would seem to be inexcusable – an institutionalised approach of subjecting students who are not even using their computers to radiation which only

¹¹²

http://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=cita/wbt/report/entirereport.pdf

¹¹³ http://www.arpansa.gov.au/RadiationProtection/Factsheets/is_rfStandard.cfm

exists to facilitate computer use, and which based on the UQ experience may be in the order of 35 times higher than it would be if the wireless networks weren't there – is the epitome of those worrying human traits, our collective intellectual laziness and social inertia. This is especially true when one considers that a well constructed wired network could perform better than WLAN.¹¹⁴ Many households in Tasmania, especially in regional areas, still do not have access to broadband and are thus unlikely to have WLAN in their homes,¹¹⁵ meaning that DoE is providing the primary source of close-range exposure of children to these frequencies.

The only accurate way of determining what levels of exposure we're subjecting children to would be to measure it in a range of classrooms, in a range of scenarios, rather than taking the assurances of anecdotes or of industry at face value.¹¹⁶ The terms of reference for any such assessment should be informed by public health experts as well as technology experts and community representatives. This may be a worthwhile exercise, but based on the kinds of studies touched on in this document, finding a meaningful reference point to which the exposure levels should be compared, would be very difficult, given that the current limits may be orders of magnitude too high. A measurement could, however, tell us whether we are transforming a relative 'RF haven' – the classroom – into something more akin to a chronic-dose-low-power microwave oven as suggested by Mr Trower, which could then inform debate on whether switching off WLANs in schools would actually achieve anything meaningful in terms of lowering childhood cumulative exposure. The UQ figures certainly suggest it would.

Emerging technologies may pose more of a risk, rather than less. For example, some residential/commercial WiMAX (a more recent generation of wireless networking, which extends the range of wireless from 50s of metres to 10s of kilometres) routers work in the order of 2W outputs,¹¹⁷ some twenty times higher than typical wi-fi. The power outputs of such devices are regulated,¹¹⁸ but industry has already placed pressure on regulatory bodies to increase, rather than decrease, current limits in some EMF spectrum bands and applications in Australia and overseas.^{119,120} Manufacturers already publish SAR values for some products which, in the context of the issues discussed in this submission, are disturbingly close to current ICNIRP restrictions (e.g. a Bluetooth headset with a SAR rating of 0.399W/kg, which is nearly a fifth of the 2W/kg limit for the head).¹²¹

In Tasmania, the National Broadband Network (NBN) rollout, while being likely to provide fibre connections to school premises, is unlikely to do anything to provide new network infrastructure

¹¹⁴ In fact, a well constructed LAN *should* perform better than a typical WLAN. However, if mobility and cost are considered as "performance" criteria, WLAN looks better. Newer standards of wireless are improving top theoretical speed. Some pros and cons:

<http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1074299512&type=RESOURCES>

¹¹⁵ Configuring a wireless service from a dial-up connection is possible, but more involved.

¹¹⁶ RADHAZ Consulting advised that a ballpark estimate for the kind of assessment performed at UQ would be in the order of \$4000.

¹¹⁷ p. 2 (33dB = 2W) in the data sheet:

http://www.motorola.com/web/Business/Products/Wireless%20Networks/Wireless%20Broadband%20Networks/WiMAX/WiMAX%20Access%20Points/WAP%20600/ Documents/Static_files/CPEi_750_DataSheet.pdf

¹¹⁸ http://www.acma.gov.au/WEB/STANDARD/pc=PC_1794#radiated

¹¹⁹ e.g. A response to requests to increase point-to-point transmission of 5.8 GHz power limits from 4W to 200W (see para 2.1.1) www.acma.gov.au/webwr/radcomm/frequency_planning/spps/0408spp.pdf

¹²⁰ e.g. A UK report on implications for power increase for wireless broadband

http://stakeholders.ofcom.org.uk/binaries/research/technology-research/005_final-report-1-6.pdf

¹²¹ p. 4:

http://www.jabra.com/pv_obj_cache/pv_obj_id_8AA7FAA8FD3DFA81F9166239D4E1A321B50D0400/filename/WhitePaper_Electromagnetic_V02_1006_low.pdf

within a school with existing networks.¹²² Indeed, reports indicate that internet service providers (ISPs) have already been offering exactly the same WLAN routers that have been used for non-NBN customers, to the new NBN customers in Tasmania.¹²³

There is a clear need for a concerted approach to managing emerging risks from emerging technologies. It would be nice to imagine that this approach could be driven by independent government policy makers, from a genuinely public health perspective. Such a perspective can't depend entirely on waiting for scientific consensus.

Similar points about the problems of scientific consensus have been made in respect to the debate around anthropogenic global warming but, if anything, in the case of wi-fi in schools, there is less to excuse dithering – it's a new technology to which we already have proven alternatives, and the current extent of exposure is far from 'necessary'.

The crux of the issue is whether RF can produce adverse non-thermal effects. When a growing number of scientists are saying that it can and does, our scientific understanding of how or why the effect occurs should be of reduced importance for policy makers. Even if we disregard a quick sample of studies as provided here, the mere fact that a large, bureaucratic, consensus-based body such as WHO has recently classified RF as a possible human carcinogen chiefly on the basis of evidence increased risk of cancer through mobile phone use – a regulated technology that must adhere to limits – should be an adequate indication that the consensus for non-thermal effects is growing, and that current limits are not adequate.

If non-thermal adverse health effects do exist, all bets are off – the reassurances regarding current limits are meaningless, as are, by implication, comparisons to similar technologies, which fall under the same limits.

In summary, an organization *may* be able to legally hide behind the current exposure limits (and even this may be questionable given precautionary principle statements such as that from ARPANSA). But, in the context of the issues and trends discussed here, taking such an approach in schools could be seen as careless and far from ethical, remembering that we are discussing the institutionalised exposure of a most vulnerable cohort in society - individuals without the capacity for informed consent, who are scientifically acknowledged as being more at risk to this particular threat.

This submission is a call to action to reassess current policy on the use of wireless networking in schools, from a public health perspective.

Marshall Roberts.

¹²² See section 4.15 http://www.commsalliance.com.au/_data/assets/pdf_file/0008/23957/NBN-End-User-Premises-Handbook---Release-2-Jun10.pdf

¹²³ http://www.computerworld.com.au/article/352822/coming_wall_near_meet_nbn_ont/

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United States District Court
District of Oregon
Portland Division

AHM, by and through
her Guardian *ad litem* and father,
David Mark Morrison, and
David Mark Morrison, individually,

v.

Portland Public Schools,
Defendant.

Civil Action No. 3:11-cv-00739-MO

**Amended Declaration of
Barrie Trower**

I, Barrie Trower, under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of a preliminary and permanent injunction enjoining Portland Public Schools' use of WI-FI:

Background

1. I trained at the Government (Ministry of Defense) microwave warfare establishment(s) early in the 1960s covering all aspects of microwave (MW) radiation technology, uses and health dangers. Later works included underwater bomb-disposal, which incorporated MW technology.

2. In the late 1960's and 1970's a part of my task was to extract confidential (hitherto secret) information from master criminals, terrorists, and spies. This included Cold War MW technology.

3. My first degree is in Physics with a specialization in microwaves. My second degree is a research degree. I have a teaching diploma in human physiology. Before retiring, I taught advanced physics and mathematics at South Dartmoor College.

4. I am Scientific Advisor to the Radiation Research Trust and the H.E.S.E. (Human Ecological Social Economical) Project.

5. I am the author of both Tetra Reports for the Police Federation of England and Wales and the Public and Commercial Service Union.

6. In April 2010, I gave a speech for the King of Botswana. http://www.magdahavas.com/wordpress/wp-content/uploads/2010/08/Barrie_Trower_SA.pdf. I hereby adopt and incorporate by reference my opinions and findings therein.

7. My work is done entirely free of charge and I have never accepted money from any person or organization in the years I have been doing this research. I consider myself absolutely independent.

8. I reserve the right to amend to add new studies as they may become available through the time of trial.

Origins

9. To my knowledge, 'microwave' or 'radiowave sickness' was first reported in August 1932 with the symptoms of severe tiredness, fatigue, fitful sleep, headaches, intolerability and high susceptibility to infection. Hecht, K *et al.*, *Overloading of Towns and Cities with Radio*

Transmitters (Cellular Transmitter): A hazard for the human health and a disturbance of ecoethics, International Research Centre of Healthy Ecological Technology (IRCHET), Berlin-Germany, at ¶ 3 (2007). These symptoms were reported to be from athermal (which are sometimes also called subthermal or microthermal) effects.

10. By 1971, the US Naval Medical Research Institute (NMRI) referenced 2300 research articles listing in excess of 120 impairments and illnesses attributed to radiofrequency and microwave radiation. *Biography of Reported Biological Phenomena (Effect) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation*, Research Report. MF12.524.015-0004B, Report No. 2. NMRI, National Naval Medical Centre (1971). Under the Freedom of Information Act, extracts from published US Defence Intelligence Agency (DIA) Documents confirmed the NMRI research and stated: 'If the more advanced nations of the West are strict in enforcement of stringent exposure standards, there could be unfavourable effects on industrial output and military functions,' in order to protect industrial profit and military function, and to avoid litigation from military employees. It was suggested that governments in the West chose a safety level compatible to industrial output and military function. The governments that adopted the thermal level only denied and still to this day deny any adverse effect from subthermal levels. DIA Documents: DST - 1810S - 076-76, ST-c5-01-169-72, DST-1810S-074-76 (1972-1983).

11. In 1975, after an extensive study, the United States DIA warned all of its personnel of the risk from low-level microwaves including illnesses ranging from microwave sickness (flu like symptoms, depression, suicidal tendencies) to cancers and leukaemia. *Biological effects of electromagnetic radiation (radiowaves and microwaves) – Eurasian Communist Countries*, Defence Intelligence Agency: DST-1810S-074-76, March (1976).

12. During the Cold War, the Russian Embassy microwaved the United States Embassy in Moscow with low-level microwaves for many years from across the road; why and how is outside the scope of this Declaration. After changes of staff for serious neurologic impairments, miscarriages, multiple cancers / leukaemias and other illnesses to both male and female employees and their children, the late John R. Goldsmith, M.D., was invited to investigate this matter. His investigative report on this incident showed that continuous, long-term low-level microwaves were responsible for those illnesses. Goldsmith, J. R., *Radiofrequency Epidemiology, Environmental Health Perspectives*, Vol 105, at 1585, Supp 6, Table 8, Dec (1997). Dr. Goldsmith held 11 Professorships and was the World Health Organization (WHO) representative for Europe. Interestingly, the power of the microwaves used by the Russians in some cases was less than the power used by modern-day transmitters, with the average ranging $<0.02 - 0.05 \mu\text{W}/\text{cm}^2$ and the maximum ranging $5 - 18 \mu\text{W}/\text{cm}^2$. Goldsworthy JR. Epidemiological evidence of radiofrequency radiation (microwave) effects on health in military, broadcasting, and occupational studies, *Intl J Occ and Env Health*, 1:47-57, 1995. http://www.radiationresearch.org/goldsworthy_bio_weak_em_07.pdf. Dr. Goldsmith's warning on health and fertility: <http://omega.twoday.net/stories/1755556/>.

13. Debriefing spies during The Cold War extended my military education into the full diversity of stealth microwave warfare and communication systems. In so doing, I learned a list of approximately 30 pulse frequencies that could induce some 50 physical and mental ailments by entrainment.

14. As soon as ordinary MW transmitters became commonplace, residents started to complain of neurologic impairments, illnesses and later of cancer clusters. Independent researcher Sue Webster took data from just 19 transmitters and found approx 92 cancers (breast, thyroid, bowel, leukaemia), where the average age of those affected was roughly only 39. Health

Dangers from Wireless Laptops, Sue Webster was quoted in Canceractive's ICON magazine in January 2003 article, <http://www.canceractive.com/s-hop/product.php?productid=16157&cat=255&page=1>.

15. Microwave sickness was well documented by 1997, when over 100 further research documents pertaining to it were referenced. Grant, L., *Microwave Sickness*, Electrical Sensitivity News, Vol I No 6, Vol 2 Nos 1-4 (1997).

16. Portland Public Schools are transmitting electromagnetic, specifically MW, frequencies at low exposure levels compared to thermal levels. However, these exposure levels are very high compared to natural background levels at the frequencies deployed: 2.45 GHz and 5 GHz frequency, which means between 2.45 and 5 billion cycles per second. When I realized that power densities and frequencies similar to those used as weapons during the Cold War were being used as WI-FI in schools, I decided to come out of retirement and travel around the world free of charge and explain exactly what the problem is going to be in the future.

17. HAARP – High Frequency Active Auroral Research Program – was originally researched by Sister Dr. Rosalie Bertell, who investigated its electromagnetic interference to our atmosphere. HAARP reflects electromagnetic waves off the ionosphere and can influence any part of the air or land on this Planet. This has the potential to cause physiologic and neurologic effects on humans, animals and plants.

18. The paradox of course is how microwave radiation can be used as a weapon to cause impairment, illness and death and at the same time be used as a communications instrument. Therefore, WI-FI cannot be safe for the schoolchildren and teachers exposed to it. Also, there still exists an ongoing stealth microwave warfare industry, continuing from the 1950's.

Technology

19. The International Commission for Non-Ionizing Radiation (ICNIRP) classifies microwaves as electromagnetic waves from 300 MHz to 300 GHz. ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz), Health Physics April 1998, Vol 74, No 4, 522, www.icnirp.de/documents/emfgdl.pdf. Therefore, everything discussed in this report is in the microwave 'band.'

20. Microwaves react very differently in our water-based bodies than do radio waves. The term 'Radio Frequency' is often used to describe MW-based communications systems. It is important that the term 'Radio Frequency' is not associated solely with Radio Waves, but rather primarily with Microwaves. Microwaves are the preferred medium for communication, over radiowaves, due to their *superior penetrative properties*. Penetration occurs in living tissues in particular, with more absorption due to water content; and microwaves will also penetrate most dwellings and other buildings.

21. What is all this really about? Imagine the field around a magnet and imagine ordinary everyday static electricity. If you put the force field from the magnet with the force field from the static electricity, you make a wave. This is called an electromagnetic wave. There are lots of different types of electromagnetic waves, but they are all made of the same two things, magnetic and static fields. The main difference between these waves is their wavelength or the length of the wave, hence the number of waves that can be produced per second, i.e. the frequency. All electromagnetic waves are included in a table called the electromagnetic spectrum.

22. At one end of this electromagnetic spectrum you have the very shortest lengths, namely cosmic, gamma rays and x-rays, and at the other end of the spectrum you have the very long ways, namely TV and radio. Physicists sometimes take the radiofrequency spectrum further yet, all the way to extreme low frequency (ELF), such as the electrical power frequency. All

waves have the same basic properties: they can be reflected, diffracted, and they all travel at the same speed, which is the speed of light. For interest, if you were one wave of light you would be able to travel around the world nearly seven times every second; that is the speed of light. The electromagnetic spectrum is ordered; starting with the shortest wave end you have cosmic and gamma rays, x-rays, ultra-violet, visible light, infra-red, microwaves, TV and radio being the longest, in that order. The ultra-violet and higher frequencies are known as ionizing waves; and they are damaging to the body. Longer than ultraviolet and visible light is the radiofrequency side of the spectrum, which is also damaging. The microwaves deployed for the WI-FI system are on this radiofrequency side of the electromagnetic spectrum. I will be discussing microwaves and health herein.

Adverse Health Effects

23. There is a plethora of extensive, well-researched documents from around the world highlighting impairments and illnesses caused by MW radiation. These papers (in their thousands) discuss adverse health outcomes caused by low-level (below thermal) microwaves as: arrhythmia, heart attack, cell death, diseases of the blood, interference to bone marrow, brain tumours, DNA damage, altered calcium level in cells, reduction in night-time melatonin, suppression of the immune system, arthritis, rheumatism, skin problems, lymphatic diseases, vaginal discharge, vascular system disease, tinnitus, leukaemia, childhood cancer, sleep problems, mental problems involving depression, irritability, memory loss, difficulty in concentrating, headache, dizziness and fatigue, suicidal tendencies, miscarriage and infertility.

24. Some have asserted that such symptoms and illnesses are psychogenic. For example, when a neighbourhood sees the erection of a transmitter, subsequent health problems are often attributed to that transmitter. Psychologically the mast is deemed to have caused the illnesses. However, an argument against this is the many cases where disguised, stealth, or concealed transmitters have been erected without local knowledge and similar illnesses still occur.

Moreover, when similar conditions arise in animals near new transmitters, and in laboratory trials under controlled circumstances, the animals do not have such a psychologic component, yet still respond similarly in the ways that humans do.

25. Advancement in microwave technology since the Cold War necessitated concurrent experimentation. Thousands of research studies exist concerning ill effects from low-level, below thermal irradiation levels, involving almost every organ in the body. Possibly the most comprehensive explanation for this phenomenon is written by Dr. A. Goldsworthy of Imperial College London: *The biological effects of weak electromagnetic fields* (2007), <http://tinyurl.com/2nfujj>; also: a.goldsworthy@imperial.ac.uk.

26. Before I go further, I wish to comment on the telecommunication industry's own research. In February 2007, I was invited to give a short presentation concerning low-level microwave irradiation and cancer at London's Great Ormond Street Hospital for Children. One of the other speakers present was Dr. George Carlo. Sharing the same hotel afforded me the opportunity to engage in several conversations with Dr. Carlo during the two days we were in London. Dr. Carlo explained how he was commissioned by the mobile industry to conduct research on its products. His study (www.health/concerns.org) involved 200 research doctors and 15 epidemiological studies (1993-1999), at a cost of 28.5 million US dollars. 'Our data showed *increased risk to children*, concerning tumours, genetic damage and other problems,' explained Dr Carlo. He continued, 'my results were suppressed by the telecommunications industry.'

27. Further discussion of industry influence is warranted as The University of Berne, Switzerland, published a data synthesis of 59 research studies involving ill health from low-level MW irradiation. The Department of Social and Preventive Medicine concluded: 'Studies funded exclusively by industry reported the largest number of outcomes, but were least likely to report a

statistically significant result. The interpretation of results * * * should take sponsorship into account.’ Huss, A. *et al.*, Source of Funding and Results of Studies of Health effects of Mobile Phone Use: Systematic Review of experimental Studies, (2006), University of Berne, Finkenhubelweg II, Switzerland (egger@ispm.unibe.ch).

28. Moreover, the 'Journal of Industrial Medicine' published the fact that industrial affiliation was being concealed by research scientists, suggesting that biases from conflicting interests in risk assessments cannot be evaluated properly. Hardell, L., *et al.*, *Secret Ties to Industry and Conflicting Interests in Cancer Research*, American Journal of Industrial Medicine, at 1, May (2006), [Wiley-Liss Inc.]; www.interscience.wiley.com; Dept of Oncology, University Hospital, Orebro University, Sweden. Examples of these problems from Sweden, the United Kingdom and the United States are presented.

29. Notwithstanding industry’s attempts to influence research, even their own studies continued to find adverse health effects. One example is a worldwide epidemiological study (commissioned by T-Mobile, on its own product) that concluded, ‘On the cellular level, a *multitude of studies* found the type of damage from high frequency electromagnetic fields which is important for cancer initiation and cancer promotion.’ Mobile Telecommunications and Health, ECOLOG Institute, Sec 7, April (2000) (mailbox@ecolog-institut.de). This document also describes DNA damage on the same page.

30. The US Environmental Protection Agency (EPA) recommended that electromagnetic radiation (which includes WI-FI radiation) be classified as a ‘probable human carcinogen.’ United States Environmental Protection Agency, Evaluation of the Potential Carcinogenicity of Electromagnetic Fields, External Review Draft, No. EPA1600/6-901005B, October 1990. With many new studies since 1990, there is certainty that microwave radiation in particular is carcinogenic.

31. Following a spate of illnesses in their practices, on October 9, 2002, a group of doctors produced the Freiburger Appeal. <http://omega.twoday.net/stories/555926/>, scroll down for cluster listing. Initially signed by 270 medical consultants, scientists, GPs, MPs and physicians, it now has many thousands of signatories worldwide. It is a warning to decision-makers concerning illnesses from low-level microwaves. This appeal lists 13 severe, chronic illnesses and various disorders involving: behaviour, blood, heart, cancers, migraines, tinnitus, susceptibility to infections and sleeplessness, all of them ascribed to 'pulsed microwaves from mobile communications technology.' *Interdisziplinäre Gesellschaft für Umweltmedizin e. V.* <http://www.e-smognrw.denews/skandal/wewelsburg/HESEProject!FreiburgerAppell/LivelistenderunterschriftensammlungfurdenFreiburgerAppellArztelists.htm>.

32. During September 2002 at the University of Vienna, 19 of the world's top scientists met to discuss electromagnetic waves. This was known as the Catania Resolution. They stated 'we take exception to arguments suggesting that weak, low-intensity EMF cannot interact with tissue. There are plausible mechanistic explanations for EMF-induced effects that occur below present ICNRP guidelines and exposure recommendations by the EU.'

33. An international study of schools near cell towers or with a cell tower on school premises published a list of impairments and illnesses amongst staff and students, finding with large numbers of cancer clusters and other illnesses. There were 47 cancer clusters. *Schools and Cell Tower Antennas*, 2003, <http://members.aol.com/gotemf/emf/schools.htm>; www.omega.twoday.net/stories/55592.

34. Another report, *School References (school and cell tower antennas)* from 138 schools, dated November 2003, lists miscarriages, brain tumours, cancers, breast cancers and teachers ill within this report. One single school had transmitters on its roof in the Saint-Cyr-l'Ecole quarter of France, where eight cases of cancer were confirmed amongst children in the district.

35. The Stewart Report 2004 asks that anecdotal evidence be taken seriously in the absence of long-term epidemiological studies, regarding illnesses around the area of mobile phone transmitters. Such anecdotal evidence produced July 2002 refers to 92 cases of cancer around just 19 mobile phone transmitters. Other illnesses in the same paper refer to breast cancers, thyroid, bowel and blood problems. Now, of course, there are many epidemiological studies, and they are consistent in showing such illnesses and other harmful effects.

36. In 2007, an international group of scientists studied 2000 peer-reviewed and published research papers. They recommended an acceptable level of radiation of not more than $0.6 \text{ V/m} = \sim 1 \mu\text{W/cm}^2$ outdoors, and $0.2 \text{ V/m} = \sim 0.1 \mu\text{W/cm}^2$ indoors, based on the interaction between low-level microwaves and the cellular processes. This became known as the Bioinitiative Level, which has since been lowered by a factor of 10, to $0.01 \mu\text{W/cm}^2$.

37. A project called EU-Reflex or European Union Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure using sensitive in Vitro Methods shows that cells exposed to cell phone radiation exhibit chromosomal damage well below the exposure guidelines of the WHO.

38. The following studies: Naila, Hutter, Santini, Oberfeld, Bamberg, Wolf, etc. all show increased neurologic impairments and/or cancers and/or other illnesses from low-level microwave irradiation. A good summary of these studies, with details, can be found on the Radiation Research Trust's website: www.radiationresearch.org.

39. The International Association of Fire Fighters opposes the use of fire stations as transmitter sites, because of the health problems of its members. International Association of Fire Fighters, www.iaff.org/safe/content/celltower/celltowerfinal.htm.

40. The world-renowned Irish Doctors' Association listed 70 research papers showing the dangers from low-level microwaves. Dr. Santini listed 20 similar studies; the

EM Radiation Research Trust listed 9 studies; Dr. Blackwell listed 6 similar studies in his report, and finally 4 international universities completed the Spanish Study, which verified all of these known illnesses. The authors of the Spanish study (The Microwave Syndrome-Further Aspects of a Spanish Study, 2004) recommended a level 10 million times below ICNIRP guidelines (discussed below), or $0.1 \mu\text{W}/\text{cm}^2$. Dr. Gerd Oberfeld, one of the authors of the study, is the Director of the Public Health Office in Salzburg, Austria, which lowered its precautionary value for indoor exposures to GSM frequencies to comply with the recommendation made by the study. See: <http://www.ideaireland.org/emrresearch.htm>; Santini paper (2006): http://next-up.org/pdf/Roger_SANTINI_Scientific_arguments_to_prove_application_of_precaution_principle_mobil_phone.pdf, Dr. Grahame - Six studies showing ill effect: <http://www.starweave.com/masts/>; The Microwave Syndrome Further Aspects of a Spanish Study: http://www.hese-project.org/hese-uk/en/papers/navarro_n%20045%20_p353%20-%20p358_.pdf.

41. Listing and referencing all such epidemiological studies would be too extensive and repetitive for this article; suffice to say, by 2006, it was reported that 80 percent of the extant epidemiological studies on the WHO database list symptoms from microwave sickness, including up to fourfold increase in cancers from low-level microwaves. Guilmot, Jean-luc, *WHO EMF Database, Watch - Understand - Act* 26, Sept (2006), www.001be.cx. I was curious to investigate the remaining 20 percent that showed no symptoms. However, this had already been looked at by Swiss scientists who said ‘the interpretation of results * * * should take sponsorship into account.’ By that time, Michael Meacher, Minister for the Environment 1997-2003 (United Kingdom), had published a report blaming some universities for accepting lucrative contracts in reporting favourable results from scientific research. In the same month, United States Congressman Henry Waxman published a similar report in *Scientific American* stating that science was being corrupted by industry. <http://www.next-up.org/pdf/Ope>

nLetterWHODrvanDeventer.pdf; Swiss Study on funding sources; <http://www.ehponline.org/docs/2006/9149/abstract.html>; Michael Meacher quote, <http://www.epolitix.com/EN/MPWebsites/Michael+Meacher/c8afdecc-b15e-41ad-b9cf-25354790d2dc.htm>, also published in The Times, May (2004); Henry Waxman in The Scientific American, <http://www.sciam.com/article.cfm?articleID=0000FF81-A7DD-1084-A73E83414B7F0000> (May 2004).

42. In April 2011, the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) found:

Preventing childhood and juvenile diseases from exposure to EMF sources is of paramount social and economic importance. * * * This problem has been already recognized by the international community: in May 2011, the World Health Organization (WHO) will be organizing the Second International Conference: 'Non-ionizing Radiation and Children's Health' dedicated to health protection of children exposed to EMF sources of various frequency ranges. It is the WHO's opinion that a 'child is more vulnerable to environmental factors.' * * *

Human brain and the nervous system tissues directly perceive EMF and react irrespective of its intensity, and in certain cases it depends on EMF modulation. * * * Analysis of scientific peer-reviewed national and international publications as well as analysis of actual population exposure to EMF have allowed the RNCNIRP to formulate 10 postulates. * * * (*Note: here and following, 'EMF' includes RF/MW radiation*).

1. For the first time in human evolution, the brain is daily exposed to modulated EMF at all developmental stages.

2. Absorption of EMF in a child's brain is greater than in adult phone users; larger brain areas including those responsible for intellectual development are exposed in a child's brain.

3. A child's brain is undergoing development * * *

8. Better safety criteria for children and teenagers are required *in the nearest term*. Features of the developing organism should be taken into account, as well as the significance of bioelectric process for human life and activities, present and future conditions of EMF, prospects of technological and technical development should be addressed in a document of legal status. (Italics added). RNCNIRP, *Electromagnetic Fields From Mobile Phones: Health Effects on Children and Teenagers*, (Italics added) April 2011, www.scribd.com/doc/55420788/Electromagnetic-Fields-from-Mobile-Phones-Health-Effect-on-Children-and-Teenagers.

43. On May 6, 2011, the European Parliament was presented with a report recommending that wireless networks and mobile phones be totally banned from schools on health grounds. Council of Europe, *The potential dangers of electromagnetic fields and their effect on the environment*, Parliamentary Assembly, Committee on the Environment, Agriculture and Local and Regional Affairs, assembly.coe.int/documents/workingdocs/doc11/edoc12608.pdf. This document notes that young people are most susceptible. *Id* at 2. The Assembly recommends that we take all reasonable measures to reduce exposure to electromagnetic fields on ‘as low as reasonably achievable’ (ALARA) (*Id.*) The Parliamentary Assembly asked education and health authorities to develop information campaigns ‘aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves.’ *Id* at 3. The Assembly also asked that Governments ‘*ban all mobile phones, DECT phones or WI-FI or WLAN systems from classrooms and schools*, as advocated by some regional authorities, medical associations and civil society organizations.’ (Italics added) *Id.*

44. In conclusion, ***even so-called ‘low’ levels of microwave radiation are very serious!*** Emphasis supplied. It is impossible to MW-irradiate the body without an effect. Low-level MW radiation is as dangerous or even more dangerous than high-level radiation.

45. I reserve the reserve the right to amend to add new relevant studies as they may arise and pending analysis, additional testing, and recently received voluminous discovery.

Current Regulations and Thermal Heating

46. The guidelines set by ICNIRP and the National Radiological Protection Board (NRPB), and which are followed by the United States’ FCC, are amongst the least protective in the world. Being thermally based – no account whatsoever is given to the effect of the electric and magnetic of the wave interacting with the physiology of the body – it is very unlikely, if not impossible, for any person to receive warming of the body with exposure exceeding the guidelines, if this person

is not sitting right on top of the transmitter. Guidelines in units of microwatts per cm², the maximum level for 1,800 MHz transmitters, 1,000 of these units. By contrast, Russia and China have a total maximum of 10 of these units, $\mu\text{W}/\text{cm}^2$, Toronto has a maximum of $6 \mu\text{W}/\text{cm}^2$ and in Salzburg, the limit is $0.1 \mu\text{W}/\text{cm}^2$. The June 2000 International Conference at Salzburg, consisting of 19 of the world's top scientists in this field, set the level at 0.1 units.

47. The EU Parliament on September 4, 2008, by 522 votes to 16, stated that the 'ICNIRP guidelines were obsolete and out of date.' Mast Action UK - Legal Services (2010).

48. By way of example, Russia has recommended the banning of children under 16 from using cell phones when possible.

49. As a result of research that documents the harmful effects of MW radiation on fetuses, the British government warned in the cell phone handbook under 'safety,' that pregnant women should not have a cell phone near the abdomen, children under 16 should avoid carrying phones near their abdomen, like boys in their trouser pockets, and children should text rather than phone. The handbook recommends that if they do phone, they use hands-free, so the phone is away from the head; that, if one is going to make a long call, one should use a landline telephone; and that the phone should never be closer than 0.98 inch from the body. The government advice for children is 'essential calls only' to avoid exposure to MW radiation. See Statz, P., *The Cell Phone Handbook: Everything You Wanted to Know About Wireless Telephony (But Didn't Know Whom or What to Ask)* (1999) <http://www.amazon.com/Cell-Phone-Handbook-Everything-Telephony/dp/1890154121>.

50. These international bodies', NRPB's and ICNIRP's, guidelines are based purely on thermal effects. Looking at scientific papers, most of the rest of the world disagrees with this assessment. Dr. Cletus Kanavy, Chief of the Biological Effects Group of the Phillips Laboratory's Electromagnetic Effects Division at Kirkfield Air Force Base in New Mexico, says there is a 'Large amount of data, both animal, experimental and human clinical to support the existence of

chronic, non-thermal effects * * * these include behavioural, neural, fetal, blood, metabolic, endocrine and immune problems.'

51. Professor Adey, a Fellow of the US American Academy of Scientists and a distinguished visitor of the Royal Society of Medicine said of his own research, in parallel with similar studies in Russia in the early 1980s, that they showed that radio frequency and microwave radiation affected enzyme systems that regulate growth and the division of white blood cells.

52. Clearly there are experts worldwide, both in military-intelligence and from Universities, from the long before Cold War to the present, who have shown that microwave radiation below thermal effects can impinge on human and other living organisms' physiologic functions.

Pulse and Modulation

53. Carrier waves may be used to carry information (video or audio data) that can be superimposed on them by modulation.

54. Sometimes academic arguments arise where the word 'pulsing' is not used and a word like 'modulated' substituted. Theoretically, there can be very little difference between a modulated wave and a pulsed wave.

55. Scientists argue over what constitutes a modulation or pulse. A modulation is a superimposition of data upon a carrier wave; modulations are usually connected with an infinitesimally thin thread of 'energy.' A pulse has no such attachment to the following pulse. A reader may wonder why this distinction is relevant. Scientists specializing in this field blame pulsed microwaves for various biological reactions within our cellular structures, which may then cause illness and impairment.

56. Further arguments suggest that there is no biological difference between a frequency modulated transmission or pulse when it comes to resonance with our cyclotronic and circadian rhythms.

57. Transmissions may be directional or isotropic (equal in all directions), may be analogue (with continuously variable quantity e.g. spatial position) or digital (sometimes called 'frequency-modulated'). However, all transmissions are electromagnetically propagated. In the world of nuclear and atomic physics, electronic switches can make tens of millions of decisions a second; and all transmissions travel at the speed of light.

58. Transmissions can be increased by possibly up to 40 percent, with side lobe technology. Vector mathematics can demonstrate whether any of these transmissions are incident upon another transmitted wave, such as a low-frequency radio wave, as there can be a piggy-back effect (constructive interference).

59. The Health Council of the Netherlands Radio Frequency Radiation Committee says in its 200 page 1997 report, concerning frequencies of 300 Hz to 300 GHz: 'The experimental data indicate that the effects of EM fields occur at lower power densities when the object is exposed to pulsed electromagnetic fields.' In other words, you will get impairments and illnesses quicker if the microwaves are pulsed. Health Council of the Netherlands: Radiofrequency Radiation Committee, *Radiofrequente elektromagnetische velden (300 Hz – 300 GHz)*, at 134 (1997).

60. Professor Salford at Lund University in Sweden has shown in his work in the year 2000 that pulsing can alter the permeability of the blood/brain barrier in rats. This would reasonably occur in human brains as well, and could have profound effects on brain function.

61. The Freiburger Appeal (2002), as previous mentioned, says, 'One can no longer evade these pulsed microwaves. They heighten the risk of already present chemical/physical influences, stress the body's immune system and can bring the body's still functioning regulatory mechanisms to a halt. Pregnant women, children, adolescents, elderly and sick people are especially at risk.'

62. Assimilating knowledge from the Cold War and other sources, I accumulated a plethora of data describing how pulsed / modulated microwaves interfere with our cellular biochemistry.

Believing the communications industry to be spiralling out of control with its new innovations, I published my list on the Internet in the hope that the industry and policymakers would take note. (*The Communications Industry is in the position where it is spiralling out of any person's ability to control it*, An open letter from Barrie Trower (undated); <http://omega.twoday.net/search?qBarry+Trower>; <http://www.mastsanti ty.org>),

Transduction

63. I will try to summarise the thousand or so research papers written over the last 20 or so years and explain or summarise what happens when the electric and magnetic part of the wave goes into our bodies. We, being water-based animals, act like aerials to these waves. As the waves penetrate our bodies, an electric current is generated inside our bodies, which is how aerials work. Waves come in and electricity is generated. The electricity generated in our bodies, like all electric currents, goes to ground through our bodies; and like all electric currents, it takes the path of least resistance. Unfortunately, the path of least resistance through our bodies, although only representing 10 percent of our pathways, carries 90 percent of our traffic rather like the M1 motorway. The traffic in our bodies, namely hormones, antibodies and neurotransmitters, know where they are going because they also carry an electric charge. The hormones, antibodies and neurotransmitters know where to 'get off' the pathway, because there is a corresponding opposite charge at the site of delivery – rather like the positive and negative ends of a battery. The problem is, if you have an electric current passing through the body it can change this charge, either on the hormones, antibodies or neurotransmitters, or at the site of delivery.

64. A similar effect is that the destination for some of these hormones, neurotransmitters, and antibodies is a surface of a cell where chemicals will pass through a membrane into a cell. If you think of a cell in our body, be it a brain cell, bone cell, etc., as having a positive and negative charge on the outside and the inside similar to a battery the difference in these charges will draw

the chemical into the cell or draw poisonous substances out of the cell. If the charge is changed on the outside of the cell, then necessary chemicals may not go in or poisonous chemicals may not go out.

Children

65. WI-FI in a classroom is more powerful energy than having a cell tower 300m away. It makes no sense to have WI-FI in the class, especially where cell masts are disallowed.

66. My position as scientific advisor requires that I read and translate papers from all around the world, and, I have never, ever, no matter which country I lecture in, which paper I have read, I have never seen a single scientist brave enough to submit for peer review a safety level of microwave radiation for a child or embryo. There is not one that exists. Last year I lectured in six countries. When I'm in a country I challenge on TV the industry and the government to produce a scientist who will come on air with me and cite a safe level for children. In 12 years, no one has ever come forward.

67. Children act like antennas and absorb more radiation than adults because they are smaller, and their very dimensions approximate the deployment's wavelength. See example of humans acting as antennae: Cohn G, Morris D, Patel S, Tan D, *Your Noise is My Command: Sensing Gestures Using the Body as an Antennae*, http://research.microsoft.com/en-us/um/redmond/groups/cue/publications/chi2011_rfgestures_cohn.pdf:

A basic receiving antenna can be thought of as an apparatus that converts electromagnetic waves into electrical current * * * It turns out that the human body is also a very effective antenna over a broad frequency range. As an electrical conductor, when exposed to electromagnetic fields, it behaves as an antenna with a frequency resonance determined by various factors including height, posture, etc.

68. Children are not merely small adults. They are physiologically and neurologically immature; their systems have not yet formed. Microwave radiation alters the blood-brain barrier

so that toxins leak into the brain. This can cause neurologic and psychologic amongst many other problems more easily in children. A child's immune system, which fights off infection, takes 18 years to develop. Additionally, 122 layers of protein – myelin – insulate the electrically generated signals used by the nervous system to control muscles and organs. These layers of protein take 22 years to develop. MW radiation has been shown to affect protein synthesis. This could lead to muscular dystrophy-like symptoms in later life.

69. I have always predicted that any school that allows itself to be 'bathed' in microwaves from whatever source will see its sicknesses rise and behaviour fall. I have received many phone calls to confirm this. In all of the schools I have visited around the world with WI-FI, every one has reported the same symptoms in students: fatigue, headaches, nausea, chest pain, vision problems. I argue that one could experience from microwave radiation psychologic problems, with increase in aggression and other bad behaviour, as well as reduced immune symptoms, leading to more and longer colds and coughs, depression, anxiety, bad behaviour and suicidal tendencies from sleep deprivation and finally – leukaemia.

70. The effects of microwaves will continue long after the children are exposed at school. A study has been carried out on children using an ordinary microwave transmitter, a cell phone. What it found was that after just two minutes' use of a cell phone, the children had their natural brain waves disrupted for up to two hours thereafter. This is called long-term potentiation, and it can last up to six weeks.

71. Research suggests children and women (females have more complex hormone-based systems to be disrupted than males) exhibit more vulnerability to illnesses from MW irradiation than do adult males.

72. The problem with young girls is that microwave irradiation has been shown to damage the genetic structure in their ovaries. Girls are born with all of the eggs they need in their ovaries at

birth. They are immature eggs, hence susceptible to damage during growth. ***Microwaves are genotoxic*** (experiments can be linked to children showing low-level mobile telephony radiation disrupts the biochemistry of follicle cells in a mammalian egg chamber), hence the microwaves irradiation could affect the genetic structure within the eggs. The problem here is that the mitochondrial DNA, the genes inside the ovaries, is irreparable.^{[1][2][3]} If you have a little girl in whom there is damage through this mechanism to the genetic structure in one of her eggs, and she has a daughter, that daughter will carry that genetic problem. It is irreparable. And her daughter in turn will carry that genetic problem, because it is irreparable. And every female *forever*, in that line, will carry that problem in perpetuity, because it is irreparable. Attached as Addendum 'A' is a diagram further explaining this process.

73. I believe the most important research I have read is from Dr. Goldsworthy, *The biological effects of weak electromagnetic fields* (2007), <http://tinyurl.com/2nfuj>; also, a.goldsworthy@imperial.ac.uk. Dr. Goldsworthy not only shows the mechanism by which microwaves disrupt cells, but also predicts that a genetically damaged sperm and egg can lead to mutant offspring. If you think of children with these transmitters near their laps, the question must be, 'Why do this for the sake of a piece of cable and a plug, which could replace WI-FI with no loss of performance, and in fact improved performance?'

¹ Acharya, PVN; The Effect of Ionizing Radiation on the Formation of Age-Related Oligo Deoxyribo Nucleo Phosphoryl Peptides in Mammalian Cells; 10th International Congress of Gerontology, Jerusalem. Abstract No. 1; January 1975. Work done while employed by Dept. of Pathology, University of Wisconsin, Madison.

² Acharya, PVN; Implications of The Action of Low-Level Ionizing Radiation on the Inducement of Irreparable DNA Damage Leading to Mammalian Aging and Chemical Carcinogenesis.; 10th International Congress of Biochemistry, Hamburg, Germany. Abstract No. 01-1-079; July 1976. Work done while employed by Dept. of Pathology, University of Wisconsin, Madison.

³ Acharya, PV Narasimh; Irreparable DNA-Damage by Industrial Pollutants in Pre-mature Aging, Chemical Carcinogenesis and Cardiac Hypertrophy: Experiments and Theory; 1st International Meeting of Heads of Clinical Biochemistry Laboratories, Jerusalem, Israel. April 1977. Work conducted at Industrial Safety Institute and Behavioral Cybernetics Laboratory, University of Wisconsin, Madison.

74. This represents permanent, low-level microwave damage, and it also involves the induction of chronic nitrosative and oxidative stress.

Warnke, http://www.hese-project.org/de/emf/WissenschaftForschung/Warnke_Dr.%20rer.%20nat._Ulrich/20050219_VortragDrWarnke.pdf (2005) (in German, English translation in progress). It is known that chronic nitrosative/oxidative stress damages the mitochondria, the ‘powerhouses’ of each cell in the body. Mitochondropathy is at the root of many of today’s chronic illnesses, such as MS, Alzheimers, Parkinsons, Fibromyalgia Diabetes, Artherosclerosis and Obesity. Kuklinski, http://www.kpu-berlin.de/For_Neu_Kuklinski_1_en.html (2004). Even more disturbingly, when chronic nitrosative and oxidative stress is present, irreversible mitochondrial DNA damage will occur sooner or later (see also Kuklinski, http://www.kpu-berlin.de/For_Neu_Kuklinski_1_en.html (2004)). The mitochondrial DNA is ten times more susceptible to nitrosative / oxidative stress than is the DNA in the cell nucleus. Whilst regular cell DNA has built-in repair mechanisms, mitochondrial DNA is irreparable, due to its low histone protein content. The mitochondropathy is therefore irreversibly transmitted to the children by the maternal egg cell, causing cumulative irreparable damage to future generations.

75. There is no known safe level of MW irradiation for an embryo, a fetus, a child or a pregnant woman.

Electro-hyper-sensitivity

76. The World Health Organization (WHO) recognizes and describes electro-hyper-sensitivity. Electro-hyper-sensitivity can be compared to a food allergy that exposes the person to great harm on each occasion that the food is absorbed. If a food received this much adverse publicity from research all over the world, it would be immediately taken off the shelf.

77. In Sweden, it is published that 3.15 percent of its population is medically recognized and registered as being handicapped from electro-hyper-sensitivity. This number is comparable in California and it is believed to be similar in Australia. The Irish Doctors' Association believes this figure may actually be as high as 15 percent.

Experimentation

78. In 2008, the European Parliament wrote to its 27 countries urging them to ignore WHO guidelines and set exposure limits at lower levels. Ries, *European Parliament 2004-2009 Commission on the Environment. Public Health and Food Safety, 2008/2211/INI* (translation by www.nexyt-up.org) Editor: Frederique Ries (2008). In response, the WHO (which only began studying microwave radiation effects on children in 2009) stated it will not comment on microwave radiation effects on people until 2015, when it will be able to establish effects on human beings. Their researchers are watching people to see how many will become sick. We are being experimented upon.

The Cumulative Dose

79. Professors Sosskind, Provsnitz, Lai, and Cherry and a Russian International Medical Commission have all warned about the cumulative effect of these microwaves. See, *Effects of chronic microwave irradiation on mice*, S Prausnitz & C Susskind, 1962.

80. Professor Sosskind and Provsnitz write, 'An accumulated cellular level damage mechanism is not necessarily related to the intensity but can relate to total dose.' This is not surprising; a property of electromagnetic radiation exposure is that the effects are cumulative. By way of example, if we go out on a cloudy day we can still get sunburned, it just takes longer.

81. In the report *Mobile telephones, their base stations and health*, from the French Health General Directorate, January (2001), they warn of the cumulative exposure over the lifetime of a child. This body concluded with an interesting sentence stating, 'Biological

effects occur at energy levels that do not cause any rise in local temperature.’ As it may be argued that biological effects may not be hazardous, *the responsibility for this decision concerning children should lay with the parents*, guardians or those in loco-parentis and not the school.

82. Based upon a review of the Mount Tabor School WI-FI Floor Plan, schoolchildren will be exposed to as much as 30-40 hours per week of constant, digitally encoded pulsed WI-FI signals from each wireless device in the child’s vicinity, in addition to the infrastructure, making the cumulative exposure over a child’s lifetime successively higher.

83. When reviewing this case, it occurred to me to compare the relative cumulative dose of WI-FI in the classrooms with a commonly known device that emits the same frequencies. That device is a microwave oven. Both WI-FI and microwave ovens operate at a frequency of ~2.4 GHz. An average WI-FI transmitter operates on 0.2 J/s [0.2 Watts] power. Therefore, if using only 20 computer/laptop transmitters in a classroom, there is a combined 4 J/s [4 Watts]. A typical microwave oven (output) is 800 J/s [800 Watts] (magnetron input equals 1,200 J/s [1,200 Watts]). A classroom equals 4 J/s [4 Watts]; a microwave oven 800 J/s [800 Watts]. A ratio of 1:200. Thus, if WI-FI is used in morning and afternoon sessions, and if 200 seconds in a classroom (at 4 J/s [4 Watts]) equals 1 second inside a microwave oven (at 800 J/s [800 Watts]), then over a school day a child or adult receives the equivalent of 2 minutes in a microwave oven, 10 minutes per week.⁴

⁴ It should be noted these calculations will vary according to the following factors:

- i. There can be approximately 13 mathematical variations to wave formulae;
- ii. The $1/d^2$ rule will apply to distance;
- iii. The wall transmitter and main transmitter are not included/calculated;
- iv. Constructive interference patterns are not calculated;
- v. WI-FI sets and transmitters in nearby classrooms are not included/calculated; and
- vi. Reflective materials are unknown: i.e. wall insulation.

To understand fully the actual exposures, a reading will be taken in a classroom with 20 or more fully operational

84. As a final word about cumulative dose, it must be stressed that a long-low exposure can be more dangerous than a short-high exposure. By way of example, as I wrote in my published paper (co-written with Scientist Andrea Klein), *Wireless Laptops and Their Transmitters Using Microwaves in Schools*, <http://www.mastsanity.org/wifi/17/154-wireless-laptops-and-their-transmitters-using-microwaves-in-schools-a-report-by-barrie-trower.html>, Permanent low-level microwave exposure can induce chronic nitrosative/oxidative stress; hence damage to mitochondrial DNA.

Conclusion

85. There is a simple solution, use a cable and a plug or fibre optic cable to deliver the Internet.

86. With all of this evidence pointing to physical, mental and long-term disorders even long into the future (including cancers and mutant newborns), is this honestly worth the risk to our next generations for the sake of just a few metres of wire and a plug. As shown, the dangers of low-level, below-thermal microwaves, have been known to governments for >50 years. I was educated in microwave technology by the Military (United Kingdom) in the early 1960's, and even then we were instructed of these dangers. Nothing has changed to suddenly make microwaves safe.

87. The evidence for adverse effects of low-level microwave irradiation is currently strong and grows stronger with each new study. Using a cabled Internet system does not increase exposure.

88. I ask you, if a drink were reported in the 1950's to cause cancer and other ill effects, and if countless reports and epidemiologic and toxicologic studies and expert associations since showed these reports to be correct, would you give this to your children to drink, knowing they have their whole lives ahead of them? So what is the difference? It is simple. This product, pulse-modulated microwave radiation from WI-FI, is backed and financed by the most powerful

computers and WI-FI transmission devices next to other classrooms (below, above, adjacent, etc.) with 20 or more fully operational transmission devices in each of those rooms.

industry on the planet. This is an industry that apparently does not have to prove its product is safe (unlike a drug company). Incredibly, the public is rather told to prove it is not! Thence take this industry to court with your list of impairments, illnesses, cancers, leukaemias, early deaths, etc.

89. Within the relevant scientific community, it is generally accepted that that many bioeffects and adverse health effects occur at far lower levels of radio wave and MW exposure where no measurable heating occurs; some effects are shown to occur at several hundred thousand times below the existing public guidelines.

90. In my opinion, Portland Public Schools' use of WI-FI is causing and will continue to cause AHM, other students, and school staff and faculty adverse health effects, and should be discontinued immediately.

Dated this 21st day of December 2011.

/s/ Barrie Trower

BARRIE TROWER