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WiFi and health

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There has been plenty of media coverage of WiFi and the potential dangers in 2007. There is a lot of misunderstanding and misrepresentation of evidence being thrown into the mix, and it is becoming very hard to follow the strands of a) what the exposure levels are, b) what the evidence is actually saying, and c) what other aspects need to be considered on WiFi.

Many of the concerns were summarised in a Memorandum on WiFi signed by eight members of the Health Protection Agency's EMF Discussion Group and sent to the HPA at the end of 2007 following the announcement of research, costing about £300,000 of public money, which does not address any of the health concerns. The HPA have chosen not to respond to this Memorandum, so on 25 April 2008 a copy has been posted here for members of the public to read. [[Download in full](#)] 9 pages, 73 KB

WiFi in Schools

In 2008 a [new website](#) appeared providing a rational and well supported scientific argument for the validity in precaution of the use of WiFi in primary and secondary schools. This is also well worth spending some time looking around if you are concerned about the use of wireless technologies in a local school.

We covered a story in 2013 about a school in Norwich [implementing WiFi](#) with a number of useful links and resources to why this is likely to be detrimental to the children's education and health. Nearly two years on the political situation remains similar, but there is beginning to be [noticeable progress](#) in both the US and the UK on the issue.

General Exposure Levels

Michael Clark, senior HPA spokesperson, has publicly stated that "Being on a phone for 20 minutes is equivalent to 1 year in a WiFi classroom". This is both factually incorrect and highly misleading.

Whilst Mike Clark is right that a mobile phone, working on full power and with you talking continuously (not listening) can technically expose you up to about 50% of the SAR limits. In normal use, with a good number of signal strength bars showing on the display (say 75% signal level), the phone will be working at somewhere between one-thousandth and one-twentieth of this level. Let's average this at about one fiftieth as a reasonable level for the phone to be operating at most of the time. Then, if you are talking 50% of the time, this would reduce the transmitted pulses (using DTX) by another factor of 2. So, a typical exposure would not be 50% of the SAR limit but more like 0.5% of the SAR limit which we should assume to be 0.5% of the the ICNIRP limit (for a typical call).

Now we come to a slightly different exposure regime in the classroom in that you are not holding the WLAN card to your head. 2.4 GHz WLANs (most common in the UK) operate at 0.03 watts output power (5-6 GHz ones can use up to 20 times this). So we have one WLAN node in the classroom (0.03 W) and, say, 20 laptops all at 0.03 W. However, they are only transmitting much power when actually

transferring files. So, let's say that we have the equivalent of one laptop operating absolutely continuously (actually the combined output of 20 may well be more than this), and that we are on average 2 metres from the antennas. This seems reasonable based on the fact that there are 20 in the room. So $E = (\text{sq.root}(30 \times 0.03 \times 2))/2 = 0.67 \text{ V/m}$ equivalent continuous. Now the ICNIRP guidance at 2.4 GHz is 61.5 V/m. So the signal strength is about 1/100th of what is allowed. Power is proportional to signal strength squared so that would be around 1/10000th of the ICNIRP power level.

So, we have a mobile phone call next to head typically 0.5% (1/200th) of the ICNIRP guidance. We also have being in a 20 PC WLAN classroom being something in the order of 0.01% (or 1/10000th) of ICNIRP guidance, about a 50-fold difference.

Therefore 20 minutes on a mobile phone running at typical power levels would be equivalent to about 16 hours in a classroom with 20 WLAN PCs, approximately eight standard school days.

These figures have been updated from our "dispelling the wireless myths" news article as 1m seems an unreasonable average distance from the laptops. However, we have encountered a number of access points that are sending short bursts of data a few times per second, and the signal strength of these are all reasonably high - If this is the case, the average exposure from any access point will be much higher than in the calculations above.

However, these figures are assuming that it is cumulative absorbed power that is being implicated in RF research, and that then implies a linear dose-response relationship model. From the evidence that *has* found a risk, this seems unlikely to be the case. Peak signal strength received may also be important, and people using WiFi enabled laptops would regularly be exposed to electric fields of 2 to 3 V/m. Whilst this is far below ICNIRP, it is far above the levels where adverse health effects are being reported ($\sim 0.05 \text{ V/m}$).

Scientific Evidence

Firstly, it is very important to stress that there is currently (as of July 2007) nothing that we are aware of in the scientific literature that looks at WiFi. So initially the answer would be "none". However, when anecdotal evidence of problems are being reported, it is prudent to do two things: Firstly, prioritise research to be done looking specifically at effects from typical WiFi exposure, and secondly, to have a look at the literature published on exposures and technologies that may be relevant.

TV and Radio Transmitters use relatively similar frequencies, but are not digitally pulsed transmissions (AM and FM radio are entirely continuous wave and TV is almost entirely continuous wave). There is a reasonable chance that, if humans react to TV and Radio transmissions, it may be very differently to the reaction to a digitally pulsed signal, so even though there is evidence of a possible risk^[1] these may not be relevant to WiFi.

Mobile Telecommunication systems (CDMA, GSM and 3G) are both closer in frequency and are also digitally pulsed information carrying signals - these are sufficiently close to WiFi that the research into phones and their base stations may be applicable to exposure from WiFi.

Firstly, typical exposure from a phone in use is likely to be far higher than from a typical WiFi laptop or access point due to the difference in proximity to the device in question. So whilst, again, there is research showing that there may be a risk^[2]^[3], this may not be relevant.

However, signal strength from a mobile phone base station where it reaches the ground (approximately 70 to 100 metres from the base station) is typically between 0.5 and 1.5 V/m, exactly the same as we measured in a WiFi classroom

in a school in Norwich, and the same as found in the above calculations, and seems therefore to be very relevant. A quick survey of the literature looking very specifically into mobile phone base station epidemiology finds some statistically significant health effects^{[4][5][6][7][8][9][10][11][12]}. Many of these are summarised, with helpful graphs, etc, in our library article "[Radiofrequency EMFs and health risks](#)". There is, in fact, very little research looking at base stations that has failed to find an effect. Also interesting is that many of the effects in the papers above (non-cancer effects) are those being reported in the anecdotal evidence from WiFi exposure.

In essence then, there is sufficient evidence to warrant some degree of precaution regarding WiFi until research has been done very specifically into its effects. With dLAN systems and ordinary CAT5/6 wired networks offering better stability, bandwidth and security, there is simply no need for most homes, organisations and schools to switch to wireless networks, apart from the savings of the slight inconvenience in cables.

The HPA have recently announced a £300,000 study into measurements of typical WiFi system exposure levels. We have noticed however that this research has already been repeatedly been done, and we have provided a [short summary](#) of said research for those interested.

IT Practicalities

As briefly mentioned above, there are other serious drawbacks to using WiFi that are important considerations when implementing computer networks. Firstly, the bandwidth is really not very good. Modern wired network cables are running at 1 GBit/sec, and even older networks are running at 100 MBit/sec. WiFi on the other hand typically performs at around 8-15 MBit/sec, even though the specifications suggest it should be capable of about 54 MBit/sec. On top of the speed restriction, WiFi is also susceptible to interference. An access point is typically only designed to accept concurrent connections from a handful of laptops, else the system can easily start getting confused. Likewise, it is easy to disable a network by blasting the area with higher powered 2.4 GHz radiation. Then lastly, and from an IT point of view, is security. Without technical knowledge, many access points come without having WEP encryption set up, and not doing so can leave your wireless network very vulnerable to intrusion from other wireless devices. It is very easy to drive around a city residential area, and with the right hardware, find an unsecured wireless network adaptor and simply "hook in" to someone else network and internet connection. Aside from the usage of their paid for bandwidth, this has a risk of letting them access files on other computers on the network, and also performing illegal activity whilst effectively framing the owner of the internet connection. Again, wired networks are simply secure unless someone comes into your house and plugs a laptop of theirs into your router / switch.

Having said this, Wireless network does have the rather useful advantage of not having to cable up various rooms in your house (where you would intend on using a laptop) with networking sockets. However, again, there is a more secure and stable alternative, at pretty much the same price: dLAN units allow you to use the buildings mains circuitry as an extension to your computer network, so all you have to do is plug one dLAN unit into the wall (and network to your router / wired network) and the whole building is networked. Plug the other unit into any other socket on the same power circuitry and you have a new functional network connection. Because the network traffic is still travelling down wires, and it doesn't get out beyond the house's consumer unit, the network is secure from those that do not have physical access to the house itself. It can also carry a higher bandwidth than a wireless network (typically 80 MBit/sec).

So there really is no need to use WiFi anyway, barring the convenience of not having to plug your laptop into anything at all (but for those that need a mains socket anyway, dLAN just uses one extra wire from the same socket as the laptop adaptor). For schools we would recommend wiring up all the classrooms that need

to have network access, preferably by putting the power and network cabling through the same trunking. If done by IT staff, this is a lot cheaper than wireless networking equipment anyway. If there is no-one capable, or allowed (perhaps on health and safety grounds), again dLAN is the next best option as this reduces the need for expensive sub-contracting work.

Other Resources

Dr. Magda Havas (Environmental and Resources department, Trent University, Ontario, Canada), has written an excellent precautionary paper, prepared for the Board of Supervisors, City and County of San Francisco. This [51 page document](#) covers a wide range of literature and scientific findings on RF research, and presents them in a logical and progressive manner.

Concerned parents Jane Smith and Vanessa Spedding have recently fought a successful campaign to prevent WiFi being installed in Wigmore Primary School, Herefordshire. Their campaign succeeded using a common sense approach combining precaution against the possible health effects, cost, and IT practicality. They are happy with us presenting [their letter](#), an accompanying [letter from Prof. Olle Johansson](#), and a [full implementation costing](#) from an IT company that installs network systems. *It is also important to note that, contrary to the text in the letter, many schools in Canada do still use WiFi for their classrooms.*

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