

The Wireless Technology in Schools article is a 'work in progress' incorporating new information whenever time permits.

## Wireless Technology in schools

1. WiFi
2. The Measurements
3. Mobile Phone use and other technologies
4. iPads for students
5. School reactions
6. International recommendations
7. Campaigning organisations
8. References

## WiFi

Schools are in a very difficult position with regard to whether to install WiFi. One school, built 'ecologically' and with a full ethernet system for computers, was effectively forced to go WiFi in order to get government IT grants. WiFi is slower, less reliable and less secure than ethernet, irrespective of any health considerations.

Philip Parkin, general secretary for Voice, formerly the professional Association of Teachers, said in July 2008, that he was worried about reports linking wireless technology with loss of concentration, fatigue, reduced memory and headaches. He believes that a generation of children are effectively 'guinea pigs in a large-scale experiment.' Voice is calling for a moratorium on new WiFi networks and the suspension of existing WiFi if possible.

Symptoms reported by children in schools with WiFi include headaches, dizziness/nausea/vertigo, visual and auditory distortion, racing heart rate (tachycardia), memory loss, attention deficit, skin rash, hyperactivity, night sweats and insomnia. Some of these symptoms are also present in many cases of Attention Deficit Hyperactive Disorder (ADHD), which has had a four-fold increase since 1997. It is estimated by the National Institute for Clinical Excellence (NICE) that as many as 5% of children have this problem. Some parents report children dropping a grade point, no longer getting on with friends and new behavioural problems.

A Los Angeles Middle School teacher reported that she fell seriously ill after a wireless system upgrade in her school in spring 2014. She described her cardiac symptoms during a School District Meeting in March. She also stated that students were having nosebleeds and 2 seventh grade students had bleeding from their ears. The main offices are refusing to make incident reports. Wireless classrooms typically employ 30+ iPads in addition to a large router (report from The National Association for Children and Safe Technology [www.nacst.org](http://www.nacst.org)).

Adverse symptoms start to show in more sensitive people exposed to background peak signal levels above about 0.05 V/m. Typical signal levels in schools with WiFi are between 2 and 40 times higher than this.

Girls are born with their supply of immature eggs, waiting for puberty before their ovaries start releasing them. Should the mitochondrial (non-repairing) DNA within an egg be damaged by WiFi radiation, that damaged DNA will get passed on to a daughter conceived with this egg, and down successive generations.

Teachers in the UK are demanding the removal of WiFi from schools lest it jeopardize the health and fertility of children. The Association of Teachers and Lecturers (ATL)'s annual meeting in April 2009 wanted a long-term study to probe WiFi's impact on health. A study (Papageorgiou [2011](#)) looking at the effects of WiFi found changed attention and memory, especially in males.

In the US, they are saying that wired computers have had their day. There is a consensus that smartphones like the iPhone will be the delivery device of choice. The discussion is moving in the direction of education at the point of delivery, not necessarily in the classroom, but wherever the student may be. The current call is for a laptop for every child, but portable digital assistants (PDAs) and the new generation of ultra mobile PCs (UMPCs) offer greater flexibility, a wider range of classroom applications and longer battery life.

The Education Ministry of New Zealand takes an Auckland industry consultant's advice that it is okay to make it compulsory for school children to use a mobile phone as a learning aid, unlike the much more precautionary approach taken by its neighbour, Australia.

In December 2007, some members of the Discussion Group set up to advise the government on EMF issues made the following request:-

**“We call on the HPA to fundamentally change the announced programme of work so that it primarily collects health and performance data on school pupil WiFi users.**

“Our initial suggestions for study include:

“(1) To study secondary school children in the 12-15 year-old age-range as we have reports that this group is more affected than primary school children.

“(2) School records should be used for health, behaviour and performance monitoring and some specific mental ability tests carried out.

“(3) Schools with and without WiFi could be compared and also one or two schools with WiFi should also be equipped with wired networks and work 'half a term WiFi-on' and 'half a term WiFi-off' with suitable performance testing and well-being score at the end of each period for a couple of years.

“(4) It would be important also to record, for these children, mobile-phone usage and home exposure to base station, DECT and WiFi signals.”

Some of this could be integrated with the MTHR funded childhood illness research. It would result in some valuable information to feed into the evaluation of ICNIRP guidelines.

The HPA carefully worded their recommendations to schools so as to place all legal responsibility on the schools' governing bodies, who are therefore left holding full legal responsibility, perhaps individually, for any ill effects of WiFi on both students and staff.

Unfortunately, since December 2007, it seems that schools without WiFi are getting harder to find, and primary school-age children are increasingly having WiFi systems set up in their schools, too, mostly due to cost.

According to the Daily Mail in August 2007, approximately 70% of primary schools and 81% of secondary schools (15,000 schools) now have WiFi computing networks installed. An increasing number of schools have a 100% wireless network; 41% of secondaries have no wireless network at all (BECTA 2008). 1% of primary schools and 11% of secondaries allow mobile phones in lessons. 95% of 15-year-olds use a mobile phone.

BECTA, the UK schools technology advisory service says that WiFi can be used as “an extension of, but not an alternative to, a main wired ethernet network.” Schools can and should turn off the WiFi access points when they are not in active use. Generally you need one access point for every 10 to 20 children in order for the system to work efficiently (i.e. at least one per classroom). These should be fed by a wired network and turned off when WiFi laptops/handhelds are not being used for that lesson.

However, there is some concern by parents about their children's exposure to this extra type of microwave radiation. The Times reported that 3 schools had re-thought their policy on providing WLAN equipment in their schools due to pressure from parents or teachers. In school classrooms with WLANs the pupils are exposed to the microwaves from the computer's WLAN card and from the classroom WLAN unit. The radiation from microwave transmitters has been associated with loss of concentration, headaches, fatigue, memory and behavioural problems and possibly cancer in the long term.

Haringey council in London recommended in July 2007 that no new WiFi systems be installed in schools and that existing ones should be discontinued pending “full consultation with parents and staff.” The recommendation was welcomed as “excellent news” by the Professional Association of Teachers, which believes the proliferation of networks in schools could be having serious implications for the health of some staff and pupils. In Newham, alone, more than 4,000 students have their own laptops (Guardian January 2008).

In April 2009, Hérouville-Saint-Clair, a municipality in Normandy, adopted the precautionary principle and removed all WiFi equipment from its primary schools.

In August 2012, Israeli Deputy Health Minister Yaakov Litzman asked Education Minister Gideon Sa'ar immediately to suspend the installation of wireless internet in schools because of the health hazards of RF. He said “I fear lest the day come when we shall rue the irreversible damage visited on our children”.

In a study by Havas (2010) she discusses the effects found from RF exposure from DECT phones on heart rate. She points out that the effects on heart-rate have also been demonstrated using a WiFi router/Access point. Some children in schools with WiFi are being diagnosed with, and medicated for, heart irregularities that they believe may be linked to WiFi.

The UK Professional Association of Teachers wrote to the Education Secretary (April 2007) to demand an official enquiry because of its concerns over WiFi. In August 2007 they said “WiFi should be halted until a full scientific inquiry has assessed health risks. We call on schools to dismantle WiFi networks immediately and replace them with cables. If this is impossible, the schools should measure the radiation levels around the school and sign ‘hotspots’” They also point out that cable networks are more reliable. The Health protection Agency (HPA) was granted £300,000 in 2007 to investigate WiFi in schools. However, they decided not to record any reported health issues for this research, but just to measure the signals. They have said (in advance of the start of the project) “this work should help put public fears to rest”. It is unclear how this pre-judgement can be considered to be 'open-minded' science, neither will the public's fears about health issues be allayed if they are not addressed.

These WiFi networks have been banned in Salzburg, Austria, due to concerns for the health of children. Dr Gerd Oberfeld, head of the Public Health department, the official advice of which is for not to use WLAN or DECT in schools or kindergartens, says the symptoms for children exposed to RF are headaches, concentration difficulty, restlessness, memory problems, etc. The Austrian medical association, to which all the country's doctors belong, is lobbying against the deployment of WiFi. In March 2007, the Bavarian parliament issued a recommendation to all schools in the German province not to use the technology, and in 2006, the Frankfurt city government said it would not install it until its safety was proven. In December 2007 Paris libraries turned off their WLAN systems following health complaints from members of the staff. 40% of people working in the libraries complained about headaches, giddiness, nausea and tiredness after the system was switched on. Employees are calling for internet connections to be made using standard or fibre optic cables.

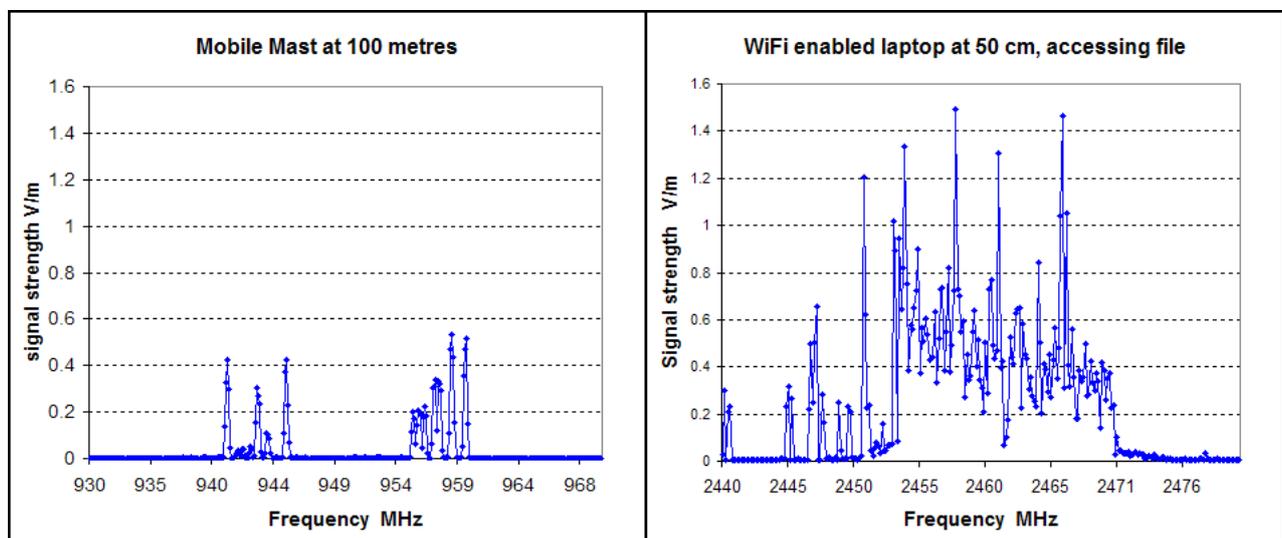
In July 2007 Haringey council unanimously voted to ban WiFi in all schools in the borough. However, 2 months later this was overturned by the executive committee without reason. Subsequently a letter went to all schools in the borough recommending WiFi.

Professor Lawrie Challis, head of the committee on mobile phone safety research, says children should be discouraged from putting their laptops on their lap when using wireless internet connections. This will result in parts of their body which are sensitive to microwave emissions, such as testicles, ovaries and other internal organs being close to the transmitting antennas embedded in the laptop, exposing the user to microwave levels similar to a mobile phone. He believes youngsters' health should be monitored.

'Interactive whiteboard' systems are also in both our secondary and our primary schools. This system may have a wireless unit on the classroom ceiling and the whole room is then bathed in radiofrequency microwaves. The system is on all day. If the school your children attend have such a system, you, together with the teachers, might want to monitor the effect on the children. The teachers themselves may be affected, especially those who spend most of their working day in a classroom that has such a system installed. Microwave exposure has been associated with behavioural disturbance, concentration and short-term memory problems. This does not seem to be the ideal environment for learning.

Some school pupils are being supplied with wireless laptops to boost e-learning in school and at home. Cost-conscious councils report that the cost of laptops is less than installing desktop PCs and rewiring buildings to provide connections. The new cheap-ish netbooks are becoming the 'in thing' for classrooms and homework.

## The Measurements



The peak signals from a WiFi system are up to about 6 V/m and environmental signals that people are exposed to in rooms with wLAN hubs typically vary from about 0.1 to 3 V/m.

The levels are lower in areas in the school without the Access Points and most wireless PCs can work down to reception levels well below 0.001 V/m, though the actual laptop PC transmitter will still be transmitting a signal of about 1 V/m or more to the user. The peak signal levels users are exposed to are generally in the range 0.2 to 2 V/m. It is possible to have higher signals if sitting very close to the equipment, especially the Wireless Access Point.

Most WiFi units emit a background  $\sim 10$  Hz beacon signal (a brain-wave frequency) pulsing at full power in 20 to 50 microsecond bursts even when not transferring files. The SSID (the pulsing microwave beacon signal from each Access Point giving its ID) should be disabled permanently even when the WiFi is 'on'. It is not needed and this action considerably reduces background exposure.

The HPA-RPD found average signal strength levels of 0.3 and 0.4 V/m respectively from a laptop PC and from a wireless Access Point, with peak levels probably in the order of 0.5 to 2.5 V/m. (Adam Lowe, HPA-RPD Leeds, December 2003).

In June 2005, SAEFL, the Swiss Agency for Environment, Forests and Landscape, published a report "Electrosmog in the Environment" (DIV 5801-E downloadable from [www.buwalshop.ch](http://www.buwalshop.ch)). This states signal strengths at one metre from both wireless PCs and normal strength Access Points to be in the range 0.7 to 2.8 V/m.

A report given by Neils Kuster, Foundation for Research on Information Technologies in Society (IT'IS) to a WHO Workshop meeting in July 2005 ([http://www.who.int/peh-emf/meetings/archive/bsw\\_kuster.pdf](http://www.who.int/peh-emf/meetings/archive/bsw_kuster.pdf)) found that the typical peak signal strength at 1 metre was about 1 V/m, rising to 2 V/m at a distance of 0.5 metres.

Incidence rates of epilepsy and use of Wi-Fi worldwide have been increasing (Ghazizadeh & Naziroğlu 2014). In this study the authors suggested that epilepsy and Wi-Fi induce Ca(2+) influx and oxidative stress.

## Mobile Phone use and other technologies

Some schools are wanting to take advantage of mobile phone technology, rather than ban phones for their disruptive influence. Pupils attending King James's, Knaresborough, are encouraged to take video clips in lessons on their mobile phones and share them. They are being integrated into lessons to collect data, or exchange ideas. In languages, oral assignments are recorded on to phones (BECTA 2008).

The brain is infinitely malleable and reading plays an important part in shaping neuronal circuits and expanding the ways we think. Stretching of the young mind is important and once stretched, it never retracts to its original size (Tobin 2014). In a randomised trial Mangen (2013) found that teenagers who read material on a printed page understood the text significantly better than those who read the same material on a screen.

France banned the use of wireless devices in nurseries and day care centres in January 2015 though they are still permitted in primary schools. In the UK BECTA, a government advisory group set up to promote technology in schools, has published a study recommending a 'gradual adoption' of mobiles until their use is "as natural as any other technology" employed in lessons (Express November 2009). Philip Parkin, general secretary of the teaching union Voice, said he was appalled that a government training agency should be advocating the use of mobile phones as an aid to teaching. *"This is ignoring clear advice that children should not be using mobile phones."* The current Department of Health recommendation is that children should only use mobile phones in an emergency.

Essa Academy, in Bolton, spent £120,000 equipping pupils with an iPod Touch to help them with their school work and keep in touch with teachers.

Burnage Media Arts College in Manchester have banned mobile phones, reported in the Mail in November 2012. Pupils are forbidden from making calls, sending texts or using online messaging services anywhere on the grounds. Those who break this ruling have their phone taken away, and only parents can get it back. The initiative has won the backing of Ofsted. Staff say the difference in behaviour has been 'dramatic'. The college's head, Ian Fenn, said not only had behaviour and concentration levels improved since the ban was introduced a year ago, but reports of cyber-bullying had dropped dramatically. Local councillor, Bev Craig said: *"The school has continued to see a marked improvement in its results."*

Recently a presentation was made at a high school to a class that was doing a unit on cell phone radiation. The students seemed shocked to hear that the presenter left his cell phone in his office, and that he rarely used it. Almost all said they keep their smart phone turned on and near them

night and day. A few volunteered that if they forgot their smart phone, they would return home even if it made them late for class.

## iPads for students

In 2010 pupils at the Cedars School of Excellence in Greenock were all given iPads for work at school and homework. A follow up on this informal experiment paid for by the parents would be interesting.

## School reactions

Prebendal School in Chichester had been having problems with the reliability of the wireless network and decided to change it for a conventional cabled system. At Ysgol Pantycelyn, in Carmarthenshire, the Head Teacher agreed to switch off the wireless network as he said *"the concerns of the parents are of greater importance than our need to have a wireless network."* A concerned parent said *"they are like having a phone mast in the classroom and the transmitters are placed very close to the children."* The radiation from microwave transmitters has been associated with loss of concentration, headaches, fatigue, memory and behavioural problems and possibly cancer in the long term.

Stowe School in Buckinghamshire removed part of its wireless network after one of their teachers who had been at the school for 28 years became too ill to teach as he had had such a violent reaction to the network, suffering from headaches, pains throughout his body, sudden flushes, pressure behind the eyes, skin pain and burning sensations and bouts of nausea. The head teacher intends to put cabled networks in all new classrooms and boarding houses.

Ballinderry Primary School in County Antrim removed its WiFi system in 2009. The principal, Ian Thompson, said *"We don't really know the biological end of this, which is the thing that really concerns us."*

Two students are now on heart medication and one is scheduled for heart surgery in a Toronto school. One pupil fainted while standing near a WiFi antenna.

There are difficulties with decisions about WiFi in schools. These could be due to a number of factors

- Schools may be unclear about who should be making the scientific decisions with regard to WiFi
- Schools may believe that government bodies ought to be giving clear guidance if there is a real problem
- Schools may not want to give up their WiFi, so they hide behind the lack of firm government guidance.

Concerned parents could make a joint representation to the Children's Legal Centre for some advice. <http://www.childrenslegalcentre.com/> "The Children's Legal centre is an independent national charity concerned with law and policy affecting children and young people."

Parents could gather information to present to them, which could include age and sex of the child; LEA area; child's other illnesses (if any); symptoms caused by WiFi in school; details of where WiFi situated in school; other RF exposure experienced by child in and around the home.

In September 2011, a private school in Collingwood, Ontario, removed WiFi and replaced it with Ethernet connections. The teachers and parents are pleased that neither they, nor their children, will be exposed to RF radiation. The Principal says the new hard-wired internet system is actually faster than their previous WiFi system and gives teachers control over when students can go online. In contrast, the State school system is promoting WiFi, refuses to listen to parents or

teachers, ignores the research, and hurries to install WiFi, which is often as well as their wired system.

## International recommendations

The government of Baden-Württemberg in Germany recommends that WiFi networks at public institutions should be avoided and wired alternatives used instead.

Dr Manfred Spitzer, a German neuroscientist, warned parents and teachers of the dangers of allowing children to spend too much time on a laptop, mobile phone or other electronic devices. He warned that deficits in brain development are irreversible and called for digital media to be banned from German classrooms before children become 'addicted'.

## Campaigning organisations

Safe Schools Information Technology Alliance (SSITA) [www.ssita.org.uk](http://www.ssita.org.uk) – SSITA is an Alliance of Partner organisations, parents, teachers, scientists, lawyers and other experts who work together to identify the issues and concerns regarding WiFi and other wireless technologies in schools, nurseries, day care environments and colleges.

WiFi in Schools [www.wifiinschools.org.uk](http://www.wifiinschools.org.uk) – Information website set up by a small group of scientists concerned about the rapid spread of wireless technologies in schools and lack of information that schools and parents have been given about the potential risks from this technology. It aims for "Safe Technologies for Nurseries, Schools and Colleges."

## References

**Foster KR** 2007 - *Radiofrequency exposure from Wireless LANs utilizing Wi-Fi Technology* Health Phys 92(3):280-9 PMID: 17293700

**Ghazizadeh V & M Nazıroğlu** 2014 - *Electromagnetic radiation (Wi-Fi) and epilepsy induce calcium entry and apoptosis through activation of TRPV1 channel in hippocampus and dorsal root ganglion of rats* Metab Brain Dis 29(3):787-99 PMID: 24792079

**Havas M** et al 2010 - *Microwave Radiation Affects Autonomic Nervous System* Eu J Oncology Library Vol 5

**IEC TC106** 2004 - *Evaluation of Human Exposure to radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6GHz*

**Kramer A** et al 2005 - *Development of Procedures for the Assessment of Human Exposure to EMF from Wireless Devices in Home and Office Environments* Technical Report, ETH/ITIS Foundation, Zurich

**Kuhn S** et al 2007 - *Assessment Methods for Demonstrating Compliance with Safety Limits of Wireless Devices Used in Home and Office Environments* IEEE Transactions on Electromagnetic Compatibility 49(3):519-525

**Kuhn S & N Kuster** 2006 - *Development of Procedures for the EMF Exposure Evaluation of Wireless Devices in Home and Office Environments Supplement 1: Close-to-Body and Base Station Wireless Data Communication Devices* ITIS Foundation, ETH Zurich, 8092 Zurich

**Mangen A** et al 2013 - *Reading linear texts on paper versus computer screen: effects on reading comprehension* Int J Ed Res 58:61-8

**Papageorgiou CC** 2011 - *Effects of wi-fi signals on the p300 component of event-related potentials during an auditory listening task* *J Integr Neurosci* 10(2):189-202 PMID: 21714138

**Tobin MJ** 2014 - *Put down your smartphone and pick up a book* *J Child Psychol Psychiatr* Jul 8;349:g4521 PMID: 25005872