

To Use or Not to Use Wi-Fi Wireless Networks

8 February 2011

The Internet is an amazing tool to learn, research, and connect with others. Broadband Internet access can be provided as a wired or a wireless network. As a Building Biology Environmental Consultant (IBN) with a Certificate in Environmental and Occupational Health I follow the lead of concerned scientists and physicians who **recommend to use wired networks** and, in general, **to keep RF radiation exposures as low as possible** because there are many scientific studies (see further below) that indicate adverse health effects promoted and caused by very low RF exposure levels. Since a human brain takes almost 20 years to fully develop, this is especially important in school environments.

Be aware that if a router/access point or computer/laptop is capable of supporting wireless networks, it is not automatically shut off by activating the wired network. But all wireless networks are usually activated by default and have to be disabled manually at the router's software and on a computer in the control panel (PC) or system preferences (Mac).

To my knowledge, **there is no safe way to install a wireless network** because one of the wireless transmitters would always be very close to the user's body. However, there are strategies to reduce the RF radiation exposure as well as the energy consumption of access points: (1) Design for lowest maximum power output with dynamic power control. (2) Shut off wireless access points automatically when not in use. (3) Place access points away from users, min. 5-10 m. (4) Any wireless services should always be restricted to clearly marked areas.

In its Indoor Air Quality Investigation Complaint Protocol, *the BC Ministry of Education recognizes that "students, teachers, and other school staff expect and need a healthy and comfortable environment in which to function. And parents expect a healthy school environment for their children. Problems associated with indoor air quality may lead to discomfort or illness in susceptible individuals."* The same holds true for the electromagnetic quality of school environments as outlined in the Policy on Environmental Sensitivities of the Canadian Human Rights Commission. RF radiation emitted by wireless Wi-Fi networks is not the only type of electromagnetic energy in learning environments. DECT cordless phones, cell phones, computers, laptops, tablets, printers, fluorescent lighting, all of these devices give off various amounts of different types of electromagnetic radiation. We have a choice. **Low-emission electronic devices and installation methods should be used to create a healthy learning environment and to be inclusive of those who are electromagnetically hypersensitive.**

Katharina Gustavs: Low-Emission Office Environments <http://www.buildingbiology.ca/healthyoffice.php>

Mikko Ahonen: Sustainable Wireless Computing – Designing Public Information Systems to Reduce Radiation Exposure <http://www.iris31.se/papers/IRIS31-065.pdf>

TCO Standard for Low-Emission Computer Screens and Office Equipment since 1992
<http://www.tcodevelopment.com/>

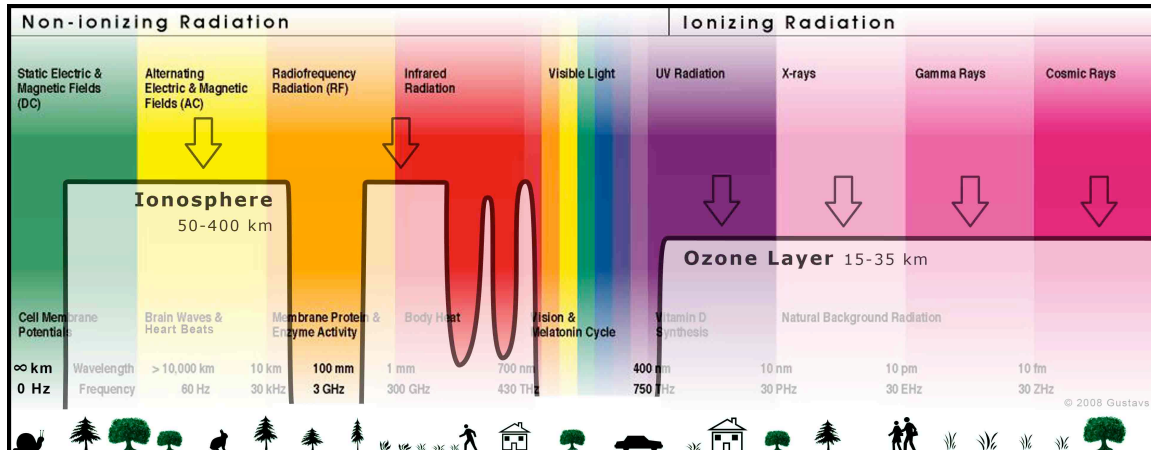
Canadian Human Rights Commission: Policy on Environmental Sensitivities (2007)

http://www.chrc-ccdp.ca/legislation_policies/policy_envIRON_politique-eng.aspx

BC Ministry of Education: IAQ Complaint Investigation Protocol (2000)

<http://www.bced.gov.bc.ca/capitalplanning/resources/iaq-protocol.pdf>

Wi-Fi radiation is a form of nonionizing radiation.



Humans have sensory organs to directly detect visible light with their eyes and infrared radiation or heat with their thermoreceptors. All other forms of electromagnetic radiation, including microwave radiation from Wi-Fi networks, seem to be registered in indirect ways. We distinguish between two major portions of the electromagnetic spectrum. If a given electromagnetic radiation such as x-rays has sufficient energy to knock electrons out of the orbits of atoms and molecules, thereby creating charged particles or ions, we speak of ionizing radiation. Even though the first radioactive element was discovered in 1896, it took over half a century before the US National Council on Radiation Protection and Measurement (NCRP) invoked the precautionary principle in 1954. The concept of as **low as reasonably achievable** (ALARA) is now universally applied to ionizing radiation.

All other forms of electromagnetic radiation are referred to as nonionizing because their energy is not high enough for ionization to occur. This, however, does not mean that heating tissue would be the only detrimental effect microwave radiation can have. In a microwave oven, it usually takes over 10 billion $\mu\text{W}/\text{m}^2$ to cook living tissue quickly. At 1 billion, the lenses of the eye of test animals turn opaque. The Radiation Emitting Devices Regulation of Canada allows a leakage of 5 million $\mu\text{W}/\text{m}^2$ from microwave ovens at 5 cm distance. However, I still measure anywhere from 2,000 to 200,000 $\mu\text{W}/\text{m}^2$ at 1 m distance during operation.

At so-called nonthermal levels, microwave radiation is deemed safe by Health Canada because Health Canada does not accept any of the cause-and-effect mechanisms proposed so far. Others use the **oxidative stress hypothesis** to explain the observed bioeffects of low-level RF radiation exposures. It is worth noting here that the detrimental biological effects of the much feared ionizing radiation is not only caused by direct damage to the DNA, but two thirds of these effects are mediated by indirect effects based on the production of excessive free radicals. Low-level RF radiation is also known to produce excessive free radicals, and this oxidative stress can result in DNA damage.

Microwave Ovens

http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/microwave_ovens-micro_ondes/intro-eng.php

Basic Radiobiology (p. 488) <http://www.rbej.com/content/7/1/114>

Review of Oxidative Stress and Cell Phone Radiation (2009) <http://www.rbej.com/content/7/1/114>

In school environments, the use of Wi-Fi access points and Wi-Fi-enabled laptops/desktop computers drastically increases the RF radiation exposure of students and teachers—on a continuous basis.

In testing done by the UK Powerwatch Organization, a Wi-Fi-enabled laptop at a user distance of 50 cm generated higher RF radiation exposure levels ($100\text{--}6,000\text{ }\mu\text{W}/\text{m}^2$) than a cell tower at a distance of 100 m ($400\text{--}800\text{ }\mu\text{W}/\text{m}^2$). In my testing experience, **RF radiation levels during active use can be as high as $10,000\text{ }\mu\text{W}/\text{m}^2$.**

Ambient exposure levels in a classroom with a Wi-Fi access point may range from **$100\text{--}4,000\text{ }\mu\text{W}/\text{m}^2$** , depending on a person's distance to the access point. The measurements done by the IT'IS Foundation at the ETH Zurich (2006) show similar exposure levels.

It is true that when you hold a cell phone up to your head (which is not a good idea) that the RF radiation exposure is much higher (up to $10,000,000\text{ }\mu\text{W}/\text{m}^2$ or higher). But even though the whole-body exposure to Wi-Fi radiation is much lower, the exposure in a school setting would most likely occur for an extended period of time. According to calculations by Alasdair Philips from the Powerwatch Organization in the UK, *"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."*

Provided that a school building is not situated close to cell towers/other antennas nor that wireless transmitters are used inside (e.g. Wi-Fi, DECT cordless phones), the RF background radiation in many school buildings may be as low as 10 to $100\text{ }\mu\text{W}/\text{m}^2$.

Kuster et al.: Development of Procedures for the EMF Exposure Evaluation of Wireless Devices in Home and Office Environments www.bag.admin.ch/themen/strahlung/00053/00673/03570/index.html?lang=en
UK Powerwatch Organization
General Exposure Levels <http://www.powerwatch.org.uk/rf/wifi.asp>
Exposure Levels from Wi-Fi-enabled Laptop
http://www.powerwatch.org.uk/pdfs/20080425_wifi_memorandum.pdf

Low-level RF radiation exposures from wireless networks can cause adverse health effects in the long term, especially cardiovascular symptoms.

The radiation emission characteristics from GSM cell phone networks and Wi-Fi networks are rather similar. Since there is a lack of studies on the health impact of RF radiation exposures from Wi-Fi networks, it is only reasonable to take a look at cell tower studies because in both cases the RF exposure is continuous and, depending on the distance to the transmitter, the exposure levels can be quite similar. A review of cell tower studies at the Center for Public Health of the Medical University of Vienna from 2009 suggested that "power densities around $0.5\text{--}1\text{ }\mu\text{W}/\text{m}^2$ [$500\text{--}1,000\text{ }\mu\text{W}/\text{m}^2$] must be exceeded in order to observe an effect." In 2010 another review by Khurana, a neurosurgeon at the Australian National University Medical School, "reported an increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances < 500 meters from base stations." Within this 500-m radius, exposure levels most often range anywhere from a few hundred to a few thousand microwatt per square meter.

Kundi 2009 http://www.mreengenharia.com.br/pathfisiology/Pathophysiology_2009_Kundi.pdf
Khurana 2010 http://www.brain-surgery.us/Khurana_et_al_IJOEH-Base_Station_RV.pdf

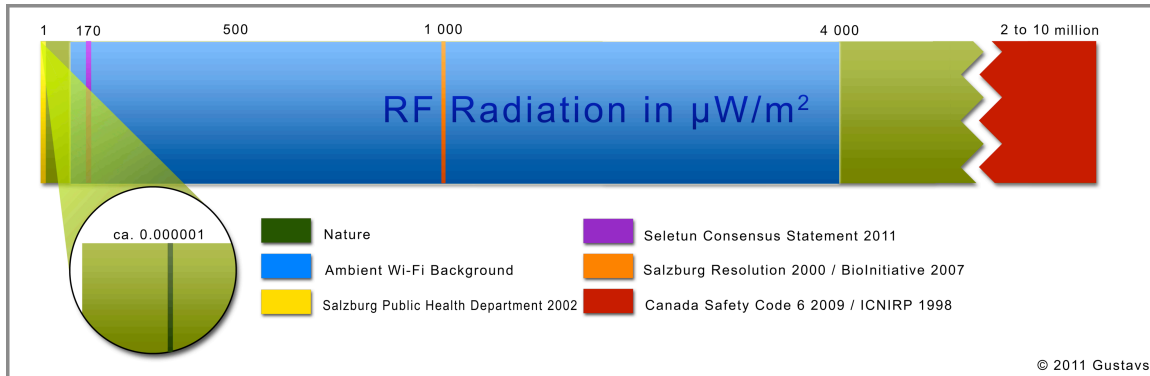
In one of the cell tower studies conducted at the Center for Public Health of the Medical University of Vienna, study participants did not know that the study was about RF radiation of cell towers but had to answer questions with regard to a wide variety of environmental factors, including traffic noise and air pollution. In addition, actual RF measurements were taken. As can be seen in the graph on page 349, the association for cardiovascular symptoms and cell tower exposures was highly significant ($p = 0.0007$)—whether study participants were concerned about cell towers or not—especially above $1,000 \mu\text{W}/\text{m}^2$.

Hutter et al.: Mobile Telephone Base-Station: Effects of Health and Wellbeing (2002)
http://www.stopumts.nl/pdf/studies/hutter_2002.pdf

Cardiovascular disease or heart disease is the number one killer in Canada. In the past, heart disease and stroke, type 2 diabetes and high blood pressure were thought of as “diseases of aging.” Over the past 15 years, however, this pattern has changed radically. At the Canadian Cardiovascular Congress in 2009, Dr. McCrindle from the Hospital for Sick Children Toronto reported an “accelerating decline of heart health” in his study of 20,719 grade 9 students, revealing that one in five 14 and 15 year olds had high blood pressure. Lack of exercise and unhealthy eating habits are blamed. Both lifestyle factors produce excessive levels of free radicals known to promote or even cause heart disease and other degenerative diseases. Though a certain amount of free radicals are part of the normal metabolic process, oxidative stress occurs whenever there is an imbalance between free radicals and antioxidants in a cell. As a result, lipids, proteins, and DNA are damaged. The use of wireless devices such as Wi-Fi increases a user’s exposure to RF radiation, which is also known to increase oxidative stress and thus associated degenerative diseases. In Germany alone, there are over 10 appeals by physicians who call for a moratorium on the use of Wi-Fi and DECT cordless phones in sensitive areas such as schools, daycare centers, and hospitals. When Wi-Fi was introduced to schools in Simcoe County, Ontario, last year, an unusual number of children developed various health symptoms, including rapid heartbeat, that went away when the children were away from school.

Canadian Cardiovascular Congress 2009
<http://www.heartandstroke.com/site/apps/nlnet/content2.aspx?c=ikIQLcMWJtE&b=5552717&ct=7611615>
Canadian Heart and Stroke Foundation Report 2010
http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.5761931/k.8118/2010_Report_A_Perfect_Storm.htm
Heart Problems in Ontario Schools 2010 http://www.safeschool.ca/Heart_Problems.html
Case History: High Blood Pressure and DECT Cordless Phone 2005 http://www.baubiologie-virnich.de/pdf/Fallbeispiel_DECT_Bluthochdruck.pdf (German)
Belyaev: Review of Non-thermal Biological Effects of Microwaves 2005
<http://www.broschuerenreihe.net/downloads/belyaev2005.nonthermalbiologicaleffects1.pdf>
Competence Initiative: Review of Nonthermal Effects, Oxidative Stress, and Genotoxic Effects 2008
<http://broschuerenreihe.net/britannien-uk/brochure/how-susceptible-are-genes/index.html>
Appeals by Physicians and Scientists <http://international-emf-alliance.org/index.php/appeals>

Current exposure limits do NOT protect from nonthermal effects.



Health Canada has issued exposure limits for radiofrequency electromagnetic fields since 1991. They are similar to the reference values of the exposure guidelines by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998). The natural background level in the GHz range is roughly one trillion times lower than the ICNIRP and Health Canada exposure limits that protect only from acute, short-term effects such as elevated tissue temperature, nerve stimulation, and burns. Even though the latest revision of Canada's Safety Code 6 from 2009 states in the introduction that the "scientific literature related to...possible non-thermal effects" has also been evaluated, those findings were not incorporated into the exposure limits. Countries that try to do so (e.g. China 1987, Switzerland 2000, Russia 2003, Italy 2003) set their legally binding threshold value for the general public 100 times lower, at about **100,000 $\mu\text{W}/\text{m}^2$** .

Canada Safety Code 6

http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

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

In 2000 the German Ecolog Institute (a highly regarded independent research institute) was commissioned by T-Mobile (a major wireless service provider in Germany) to study the available scientific literature with regard to wireless telecommunication technologies and health issues, using a weight-of-evidence approach. The institute's review of over 220 peer-reviewed studies found strong indications for a wide variety of adverse health effects, including cancer-promoting, cancer-initiating, and genotoxic effects. By applying a safety factor of 10 to the lowest intensities, for which indications for such effects are documented, the institute's recommended threshold level for the sum total of all RF radiation exposures is 10,000 $\mu\text{W}/\text{m}^2$, whereby any single RF radiation source (e.g. cell tower, Wi-Fi access point) should not exceed 30% of the threshold value, i.e.

3,000 $\mu\text{W}/\text{m}^2$. Overall, the Ecolog Institute recommends keeping the exposure of the general public to RF radiation as low as possible. This report was apparently not to T-mobile's liking, and the company commissioned three more reports which came to different conclusions.

2000 Ecolog Report <http://www.hese-project.org/hese-uk/en/niemr/ecologsum.php>

Subsequent "Dialogue" on EMF Risk Assessment http://www.emf-risiko.de/projekte/ergeb_bewlit_e.html

Many concerned EMF research scientists call for biologically based precautionary guidelines. The Salzburg Resolution from 2000 as well as the BioInitiative Working

Group recommends keeping the sum total of RF radiation exposure below **1,000 $\mu\text{W}/\text{m}^2$** outdoors and below **100 $\mu\text{W}/\text{m}^2$** indoors. In Austria, the Salzburg Public Health Department goes even a step further by recommending in 2002 to keep the sum total of pulsed GSM signals and ultrabroadband 3G signals, including Wi-Fi signals, below **10 $\mu\text{W}/\text{m}^2$** outdoors and below **1 $\mu\text{W}/\text{m}^2$** indoors. And just recently another group of scientists, including the chairman of the Russian National Committee on Non-ionizing Radiation Protection, has issued the Seletun Consensus Statement recommends a precautionary threshold value of **170 $\mu\text{W}/\text{m}^2$** . The scientists add that this may have to be lowered in the future.

2000 Salzburg Resolution http://www.salzburg.gv.at/salzburg_resolution_e.htm

2002 Salzburg Public Health Department

http://www.salzburg.gv.at/konfliktmanagement_salzburger_modell.pdf

2007 BioInitiative Report <http://www.bioinitiative.org/report/index.htm>

2010 Seletun Consensus Statement <http://iemfa.org/index.php/publications/seletun-resolution>

The following government agencies recommend to prefer wired network solutions in school environments:

2010

Knesset Committee on Interior Affairs and Environment (Israel)

On 22 November 2010, the Knesset Committee adopted the precautionary recommendations regarding EMF/RF exposures in learning environments put forward by the Cancer and Radiation Epidemiology Unit of the Gertner Institute (www.gertnerinst.org.il/e/).

Recommended Course of Action

In the educational system, existing technologies such as safe **wired network solutions should be preferred over wireless communication technologies** such as Wi-Fi and WLAN.

(Based on a Google Translation)

Sources: <http://www.nrg.co.il/online/1/ART2/180/855.html> (original news release)

(Click on [To read the full recommendations document](#) to read a Google translation of the report on the policy recommendations.)

Another summary in English:

<http://www.buergerwelle.de:8080/helma/twoday/bwnews/stories/1837/>

2010

Minister of Cultural Affairs of the Federal State of Hesse (Germany)

Question 4: Is it possible to forego the use of WLAN (and Bluetooth) in schools, especially in elementary and junior high schools, and to use computers with wired connections only?

*"To reduce the exposure to electrosmog but also to provide the computers with faster access to the school network, **a wired connection should be given preference wherever possible.** ..."*

Question 7: Which options do teachers and students suffering from electrosensitivity documented by a written medical confirmation note have to

be excused from teaching or learning with emitting devices and in school rooms fitted with wireless technologies (WLAN; Bluetooth, DECT, etc.)?

"Electrosensitive" people require adequate (environmental) medical help. At any time members of the teaching staff can consult the school's occupational health office.

In the case of students or their legal guardians, respectively, the public health authority is called in when a written medical confirmation note is submitted. In cooperation with the medical doctor who issued the confirmation note, the parents or students, the school and public health authority, a decision will be made about the options to attend school depending on the available diagnosis.

In this context it is very important to point out that to date—despite numerous scientific studies—no causal relationship between the presence of electromagnetic fields and health complaints or the corresponding "electromagnetic hypersensitivity" could be established; within the framework of the German Mobile Telecommunication Research Programme, several research projects had been carried out on "electromagnetic hypersensitivity."

Source: Parliamentary Inquiry on the Use of Laptops and WLAN and the Associated Health Risk for Children and Adolescents at Hesse Schools (9 April 2010)

http://download.bildung.hessen.de/medien/einrichtungen_medien/support/Drucksache_18_1924_Laptop_WLAN_Gesundheitsgefaehrung_an_Schulen.pdf

2008

The Governing Council of Thurgau Canton (Switzerland)

„The Governing Council recommends for schools to forgo the use of wireless networks when the structural makeup of a given school building allows for a wired network."

Source: Parliamentary Inquiry on Wireless LAN at Elementary, Junior and Secondary High Schools (10 June 2008)

http://www.grgeko.tg.ch/docs/00000064_00000E85_WEB.pdf

2007

Parliament of the Federal State of Salzburg (Austria)

On 12 December 2007 the Parliament of the Federal State of Salzburg unanimously passed a motion on precautionary recommendations concerning EMFs, including the cautious use of wireless networks.

The members of the Planning, Environment & Transportation Committee had put forward the following motion that was passed:

"We ask the Parliament of Salzburg

- 1. To immediately enter into negotiations with the federal government with the goal to establish the Salzburg precautionary value as a mandatory exposure limit of electromagnetic radiation in order to minimize health risks;*
- 2. To initiate an information campaign that advises parents and adolescents on the health risks associated with mobile phone use in children and adolescents;*

3. *To practice a differentiated and cautious use of wireless networks where the State of Salzburg has authority to do so;*
4. *To review the regulations concerning distances from high-tension power lines;*
5. *To ensure that in the State of Salzburg further studies can be carried out or emission levels of existing cell towers can be monitored, respectively, in order to improve the situation for those residing next to transmitters based on the Salzburg precautionary value."*

Source: Protocol of Salzburg Parliament Sessions on Precautionary Policies regarding Cell Phone Radiation and Electrosmog
http://www.salzburg.gv.at/obtree_internet/lpi-meldung?nachrid=20667

2007

Bavarian State Ministry of Education and Cultural Affairs (Germany)

"A note about the updated Votum was sent to all schools via their e-mail boxes on 28 June 2007. The paragraph on wireless networks (WLAN) in section 4b (Networking of Computers, School Network) on page 12 was pointed out in particular, which addresses the decision of the Bavarian Parliament from 21 June 2007 that required to inform schools and funding agencies about the statements of the Federal Office for Radiation Protection from 7 December 2006 (legislative hearing). For precautionary reasons the Federal Office for Radiation Protection recommends for schools that if a wireless network is used to place its components in suitable locations and to prefer the use of wired network solutions whenever possible."

Source: Decision of the Bavarian Parliament from 21 June 2007 on Protecting Children at School from Radiation Exposures
http://download.bildung.hessen.de/medien/einrichtungen_medien/support/Bayer-StaMi-Empfehlung-20070823.pdf

2006

The Federal Office for Radiation Protection (Germany)

"For precautionary reasons the Federal Office for Radiation Protection recommends [for schools] to place the components of wireless networks in suitable locations. If possible, prefer the use of wired network solutions."

Source: Hearing of the Environment and Consumer Protection Committee on 7 December 2006 regarding the "Effects of Cell Phone Radiation on Human Health" <http://www.bfs.de/elektro/papiere/Anhoerung.pdf>