

# Wi-Fi Health Effects: A 'Full Spectrum' Controversy

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As the push for widespread deployment of Wi-Fi technology continues, the growing debate and literature on the health effects of the technology grows likewise in the popular press. Documented symptoms from exposure to electromagnetic fields (EMFs) include tinnitus, insomnia, headaches, chronic fatigue, and respiratory issues, among others.<sup>1</sup> In the Spring of 2006, when Toronto Hydro Telecom first made the announcement that the downtown core would soon be fitted with Wi-Fi access points, cautionary articles appeared in the local media focusing on the health implications of the non-ionizing, lower-frequency range of the spectrum occupied by Wi-Fi.<sup>2</sup> Since January 1, 2004, when Lakehead University's president, Dr. Frederick Gilbert officially stalled the campus wide roll-out of Wi-Fi, citing uncertainties over the technology's health implications, the campus and its president has been front and center in the media firestorm. The campus remains Wi-Fi free today.<sup>3</sup> At the same time, while the recent folding of municipal wireless networks in San Francisco, Chicago, Houston, and St. Louis cannot be directly attributed to the growing grassroots movement against all forms of EMF radiation, the mounting opposition has worked effectively to place the issue of health effects closer to the top of the agenda in ongoing community wireless projects.

This paper seeks to provide an overview of the on-going debate on the health effects of the proliferation of wireless services and to identify the gaps in the literature on the long-term health implications of Wi-Fi. The paper begins with a review of the current debate in the popular press, an exploration of the current research on electromagnetic radiation, followed by an assessment of the current policy in Canada to address health

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<sup>1</sup> Havas, Magda. Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network. May 31, 2007.

<sup>2</sup> Vasil, Adria. "Wi-Fi's Electric Shock." *NOW Magazine*. 9 – 15 Mar. 2006.

<sup>3</sup> Lakehead University. Wi-Fi Policy. 1 Jan. 2004. <<http://policies.lakeheadu.ca/policy.php?pid=178>>.

concerns. The paper also discusses two recent and widely cited studies conducted by the World Health Organization (WHO) and the California Public Utilities Commission (CPUC), both of which failed to find any conclusive link between electromagnetic radiation and health issues. Finally, the paper ends with a look at the growing legitimacy and acceptance of the precautionary principle approach as endorsed by the European Union and the WHO.

***Ongoing Debates in the Popular Press:***

Against the backdrop of articles largely heralding the arrival of Wi-Fi in Canada, in particular, the launch of Toronto Hydro Telecom's OneZone last spring, there are increasingly more and more news reports focusing on the potential health risks associated with long-term exposure to the electromagnetic fields occupied by wireless networks. Indeed, the popular press' fixation on Lakehead University President Fred Gilbert's decision, has led to endless portrayals of the man in both international and national reports as either a lightning rod of reason for a more cautionary approach or as a Luddite who simply refuses to accept the technology of the future.

One of the earliest critics came from NOW Magazine in March 2006 when OneZone was just announced. In it, the author, Adria Vasil, drew attention to the "casual acceptance" by Canadian government and industry officials to the lack of conclusive scientific evidence on the health risks associated with radiofrequency waves. Throughout the article, Vasil makes it clear that if no studies have yet been conducted to date on the specific health implications of Wi-Fi, it would seem only logical to proceed with caution with regards to widespread deployment. Vasil's article draws heavily on studies

conducted by respected Canadian scientist Magda Havas. Her article situates the health concerns around Wi-Fi within the larger debate on the health consequences of a variety of infrastructure and consumer devices like power lines, microwaves, and radio towers.<sup>4</sup>

Similarly, in the July 2006 issue of *Wireless IT World Canada* magazine, author Rosie Lombardi echoes Vasil's cautionary approach. In referencing the actions of Dr. Frederick Gilbert, who maintains that even if the existing scientific evidence is only "suggestive", that should be enough to raise alarm bells. Gilbert is quoted as saying, "What we have is a set of standards that might be ill-based at this point in time." Additionally, Lombardi discusses Gilbert's analogy of the early scepticism surrounding the "cause and effect relationship of second hand smoking and cancer" with today's dismissal of the negative health effects of electromagnetic radiation.<sup>5</sup>

At this point in time, the stampede to cover the health risks associated with wireless networks is no longer the province of overtly leftist publications such as NOW Magazine. Coverage of the January 2007 Wireless Cities Summit in the online Canadian magazine, *itbusiness.ca*, focused almost exclusively on the panel that addressed Wi-Fi health risks. The author of the article, Kathleen Sibley reported that audience criticism at the summit of the stance taken by Havas and Gilbert stemmed from the fact that all the research on EMFs was based on exposure to cell phones versus WLAN. In response, Gilbert replied, "I don't think anyone's going to deny the difference in the strength of radiation, but the critical thing is not that there's 100 times difference between the two. The critical thing is the biological effects – that doesn't mean there isn't a biological effect

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<sup>4</sup> Vasil, Adria. "Wi-Fi's Electric Shock." *NOW Magazine*. 9 – 15 Mar. 2006.

<sup>5</sup> Lombardi, Rosie. Why Wi-Fi May Be Injurious to Your Health. *Wireless IT World Canada*. July 20, 2006.

with Wi-Fi.”<sup>6</sup> Given the fact that itbusiness.ca is owned by IT World Canada, an IT information publisher that is geared towards IT professionals, the general tone of the article was surprisingly critical of the widespread roll-out of wireless networks before more information on health risks became available.

In an article that appeared in December 2006 on wired.com, both sides of the debate were given equal consideration.<sup>7</sup> Author Rob Beschizza cited Gilbert’s decision to delay widespread deployment and Toronto Public Health’s precautionary principle as a sign that the health concerns around Wi-Fi were substantial even if they were not quantifiable in terms of epidemiological studies. However, on the other side of the argument, the author notes that the precautionary approach is viewed as unnecessary because the existing evidence on biological effects does not equate to or point to any proof of biological damage. Beschizza notes that there have been numerous news reports in the last year or so that cite examples in the United Kingdom and the United States where parents successfully lobbied or sued school boards that deployed wireless networks without consultation with the community. These instances of miscommunication between the community and the municipalities or school boards can turn into costly liabilities for all parties involved. For instance, Rob Beschizza references an example in Illinois where plans for a Wi-Fi network were thwarted after parents at the school filed a lawsuit.<sup>8</sup> Four years ago in Cook County Illinois, five parents from Oak Park Elementary School District sued the school board for installing wireless networks before investigating the health impact of the technology on the

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<sup>6</sup> Sibley, Kathleen. “Canadian Cities Warned: Watch for Wi-Fi Health Risks.” itbusiness.ca. Jan. 25, 2007.

<sup>7</sup> Wired.com is the digital home of *Wired Magazine* which is owned by Conde Nast.

<sup>8</sup> Beschizza, Rob. “Wi-Fi as a Health Hazard.” *Wired Magazine*. Dec. 12, 2006.

physical development of young children. In the filing for the class action suit, the plaintiffs alleged that:

15. District 97 failed to adequately examine and assess the potential health risks that wireless LANs pose to humans, particularly children who are still growing.

16. In fact, there is a substantial and growing body of scientific literature studying and outlining the serious health risks that exposure to low intensity, but high radio frequency (“RF”) radiation poses to human beings, particularly children. For example, responsible scientists have reported that prolonged exposure to low intensity RF radiation can break down DNA strands, cause chromosome aberrations and break down the blood-brain barrier, thereby permitting toxic proteins to invade the brain. And, these occur at radiation levels below what a child would be exposed to by sitting in front of a computer on a wireless network.<sup>9</sup>

The parents’ goal did not have so much to do with winning punitive damages as it had to do with deterring the school board from proceeding with their WLAN plans. While the case was ultimately withdrawn, the parents did succeed in forcing the school district to launch an official examination of the health issues around widespread implementation of Wi-Fi technology. In a similar vein and as recently as November 2006, two schools in the United Kingdom banned Wi-Fi over health concerns. A week after the ban took effect, the U.K. Health Department set up an inquiry to examine any possible and latent hazards of wireless communications. In particular, the ban at Stowe School in Buckinghamshire was triggered by one teacher’s complaint of “burning sensations” on his body from the school’s Wi-Fi network.<sup>10</sup>

CBC News Online ran a similar story to *Wired Magazine*’s piece in the same period highlighting the concerns around wireless networks, with a specific focus on

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<sup>9</sup> Baiman, R. et al vs. Oak Park Elementary School District 97 et al. Circuit Court of Cook County, Illinois. Sept. 26, 2003.

<sup>10</sup> Bale, Joanna. “Health Fears Lead Schools to Dismantle Wireless Networks.” *The Times*. Nov. 20, 2006.

Gilbert's decision. While the Wi-Fi health debate has certainly reached and surpassed its emotional boiling point for both sides in the popular press, it is difficult to dismiss the arguments on either side until specific studies are conducted to determine what, if any, the long-term health impacts of wireless networks are.

### *Situating the Existing Scientific Literature*

To date, there have been no studies conducted specifically on the long-term biological effects of exposure to Wi-Fi due to the relatively recent emergence and deployment of the technology. While it is an indisputable reality that individuals can and do suffer from personal sensitivity to exposure to electromagnetic fields (be it from natural or human-made sources), what remains highly contested is whether or not these fields unilaterally cause long-term biological damage under the current international standards as established by the WHO and the International Commission for Electromagnetic Safety (ICEMS). As a result of the gap in the literature, there is a heavy reliance on studies of exposure to comparable forms of radio frequency electromagnetic radiation.

The vast majority of documented health effects are based on studies of exposure to cellular phone antennas and mobile phones. It is important to keep in mind that in contrast to mobile phones, the output power of 2.4 GHz WLAN access points are up to two hundred times less (range up to 100mW) and twenty times less than the output of a mobile phone handset.<sup>11</sup> Thus, it has been frequently argued by those in favour of widespread Wi-Fi deployment that due to differences alone in the power output and the

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<sup>11</sup> Havas, Magda. Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network. May 31, 2007.

fact that the device is not held close to the head, the existing scientific literature on the health effects of EMFs is applicable only in a general sense to WLANs.<sup>12</sup>

Electromagnetic fields are present everywhere in our environment and can come from natural and human-made sources. In nature, electric fields are created by the accumulation of electric charges in the atmosphere associated with thunderstorms. The electromagnetic spectrum refers to the reach of all possible electromagnetic radiation. Radio frequency is the “rate of oscillation” typically within the range of approximately 3 Hz and 300 GHz that relates to the frequency of alternating electrical signals used to trace and produce radio waves. According to the WHO, one of the primary distinguishing features of an electromagnetic field is its frequency. Electromagnetic waves can be visualized as a series of waves that travel at the speed of light. The frequency describes the number of oscillations or cycles per second, while the term wavelength describes the distance between one wave and the next. As a result, wavelength and frequency are inextricably intertwined—the higher the frequency the shorter the wavelength.<sup>13</sup>

To begin with, in order to assess the biological effects of radio frequency radiation (RFR) one needs to know the amount of energy absorbed, which is referred to

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<sup>12</sup> For clarification purposes, please note that throughout the paper, the terms electromagnetic radiation fields (EMF), radiofrequency radiation (RFR), extremely low frequency electric fields (ELF) will be used depending on the context and on the specific studies, individuals, and organizations that reference and use them. Ultimately, for the purposes of this paper, all three terms refer to the same type of radiation that is emitted by wireless technology. With regards to ELF, as the acronym itself states and according to the World Health Organization Fact Sheet no. 205 published in November 1998, entitled “Electromagnetic Fields and Public Health”, this term refers to a lower end frequency typically found in power lines. In recent years, depending on the study and on the scientist, EMF and RFR have been used interchangeably, with EMF currently in vogue as the more ‘popular’ and accurate term with regards to the particular radiation emitted by wireless technology.

<sup>13</sup> “Electromagnetic Fields.” World Health Organization Health and Environment Briefing Pamphlet Series, No. 32. Jan. 1999.

as the specific absorption rate (SAR).<sup>14</sup> The rate of absorption and circulation of RFR energy by the body relies on factors such as the exposed tissue's ability to conduct electricity, the size of the organism in relation to the frequency of the RFR, shape and movement of the organism, and the distance between the RFR source and the organism. Thus, depending on any or all of the above noted factors, the rate of absorption by an organism can be unpredictable, complex, and unstable.<sup>15</sup> Additionally, the frequency, intensity, modulation, and period of exposure of the RFR are central to determining the biological impact. In particular, discerning the *type* of frequency is important because it determines whether or not the existing research on the health implications of RFR exposure from power lines can be applied to mobile phones, Wi-Fi, and so forth. It has been established that frequencies at different levels produce varied biological effects, but it is unclear if it is due to the distribution or absorption of the energy by the exposed tissue.<sup>16</sup>

On a global level, EMF assessments have been undertaken by the International Non-Ionizing Radiation Committee of the International Radiation Protection Association, the World Health Organization, the National Radiological Protection Board of the United Kingdom, the Health Council of the Netherlands, and the French and Danish Ministries of Health.

Domestically, Health Canada has conducted four studies since 2000 on the role of RF fields in

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<sup>14</sup> Huber, R.; Schuderer, J.; et al. "Radio Frequency Electromagnetic Field Exposure in Humans: Estimation of SAR Distribution in the Brain, Effects on Sleep and Heart Rate." *Bioelectromagnetics*. 262-263.

<sup>15</sup> Lai, Henry. "Neurological Effects of Radiofrequency Electromagnetic Radiation." Presented at the Mobile Phone and Health Symposium. Oct. 1998. Vienna, Austria.

<sup>16</sup> de Lorge, J.; Ezell, C.S. "Observing-responses of rats exposed to 1.28- and 5.62-GHz microwaves." *Bioelectromagnetic*. 191 – 193.

the development of long-term biological damage and been unable to determine any established link.<sup>17</sup>

The two most frequently cited reports, conducted by the World Health Organization (WHO) and the California Public Utilities Commission (CPUC), fail to find conclusive scientific evidence to link EMFs with negative health consequences. In 1997, the WHO International EMF Project initiated a Research Agenda in order to begin and to coordinate worldwide research on the possible negative health impacts of EMF. Since 2003, three significant workshops have been held to refine research goals, with the most recent one entitled, “Base Stations and Wireless Networks: Exposure and Health” in June 2005. The 2006 WHO Research Agenda for Radio Frequency Fields summarizes the findings of the most significant studies since 1997 in the following manner:

The specialized workshops pointed out the need for focused research on children especially regarding brain cancer and cognitive function. The workshop on EMF hypersensitivity (EHS) indicated that there should be further research to characterize EHS but did not recommend further studies on the relationship between EMF and EHS since, from the studies completed so far, there was no substantiated evidence for a causal relationship. Research on potential health effects from base station RF fields was deemed of low priority since studies of cancer risk related to such exposure are unlikely to be feasible and informative because of the difficulty of reconstructing adequately long-term historical exposures.<sup>18</sup>

In June 2001, the International Agency for Research on Cancer (IARC), a scientific working group that is affiliated with the WHO, reviewed studies on the carcinogenic status of EMF. They concluded that magnetic fields were “possibly carcinogenic to humans” based on epidemiological studies.<sup>19</sup> However, it is important to bear in mind that this classification standard is used to “denote an agent for which there is limited evidence of carcinogenicity in

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<sup>17</sup> Fumento, Michael. “Wi-Fi False Fears.” Canada Free Press. April 12, 2006.

<sup>18</sup> 2006 WHO Research Agenda for Radio Frequency Fields.

<sup>19</sup> Proposed Jefferson-Martin 230 kV Transmission Line Project. California Public Utilities Commission. Application No. A-02-09-043. D.8 – 37.

humans and less than sufficient evidence for carcinogenicity in experimental animals.” Other substances that share this classification include coffee and gasoline exhaust.<sup>20</sup>

For a two year period starting in 2000, the California Department of Health Services (DHS) on behalf of CPUC carried out an exhaustive review of all existing studies related to EMF (for all types of consumer and infrastructure devices but with a focus on power lines) and potential health hazards. The results of this report were published in June 2002 under the title, *An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) From Power Lines, Internal Wiring, Electrical Occupations, and Appliances*. While the results of the DHS study reveal a stronger inclination on the part of the DHS scientists to agree with the view that EMF can cause a certain degree of increased risk for specific health issues, the report did not definitively establish a connection or quantify the risk factor. The conclusions as outlined in the executive summary of the report are provided below:

- To one degree or another, all three of the DHS scientists are inclined to believe that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig’s Disease, and miscarriage.
- They strongly believe the EMFs do not increase the risk of birth defects, or low birth weight.
- They strongly believe that EMFs are not universal carcinogens, since there are a number of cancer types that not associated with EMF exposure.
- To one degree or another they are inclined to believe that EMFs do not cause an increased risk of breast cancer, heart disease, Alzheimer’s Disease, depression, or symptoms attributed by some to sensitivity to EMFs. However, all three scientists had

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<sup>20</sup> Electromagnetic Fields and Public Health: Extremely Low Frequency (ELF).” World Health Organization Fact Sheet no. 205. Nov. 1998.

judgements that were “close to the dividing line between believing and not believing” that EMFs cause some degree of increased risk of suicide.

- For adult leukemia, two of the scientists are “close to the dividing line between believing or not believing and one was “prone to believe” that EMFs cause some degree of increased risk.<sup>21</sup>

The most significant difference between the conclusions drawn by the three scientists in charge of CPUC’s study and that of the larger, global scientific community is that the DHS scientists were more willing to believe that long-term exposure to EMF could potentially contribute to Lou Gehrig’s Disease, childhood leukemia, adult lymphoid leukemia, adult brain cancer, and miscarriage. At the same time, because this perceived risk is not scientifically quantified, the results of CPUC’s review largely reinforces the results of the studies conducted by the broader scientific communities of the Environmental Health Sciences Working Group (NIEHS) in 1998, the International Agency for Research for Cancer in 2001, and the British National Radiological Protection Board in 2001.<sup>22</sup>

Similarly, the results of a 2001 research paper by the WLAN Association (WLANA), a non-profit educational trade association concluded that the current literature does not indicate any connective health risks associated with EMFs. On their website, [www.wlana.org](http://www.wlana.org), the health risks are assessed in the following manner:

The interpretation of over four decade of research in this area has led to a scientific consensus on the safety of exposure to radio frequency electromagnetic fields. This consensus is reflected in the recommendations and standards developed by expert committees such as NCRP Scientific Committee 53, IEEE Standards Coordinating Committee 28, IRPA/INIRC and NRPB. Manufacturers of Wireless Networking products design their products to operate within the

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<sup>21</sup> California Public Utilities Commission Report 2002. “An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) From Power Lines, Internal Wiring, Electrical Occupations, and Appliances.” <http://www.dhs.ca.gov>.

<sup>22</sup> Ibid.

guidelines of these standards and recommendations and, therefore, are considered safe.<sup>23</sup>

On the other side of the scientific literature, studies conducted by scholars Dr. Andrew Michrowski, Dr. Magda Havas, and Dr. Henry Lai point to both short-term and long-term biological health effects from exposure to electromagnetic fields. According to Dr. Andrew Michrowski, a leading Canadian scholar on electromagnetic radiation, documented symptoms from exposure to mobile phones include tinnitus, insomnia, headaches, chronic fatigue, and respiratory issues, among others. Potential behavioural and cognitive changes entail memory loss, deteriorating vision, hyperactivity, increased reaction time, difficulty in concentration, and dizziness. Bioeffects involve DNA breakages, disruptions to enzyme activity, cell membrane function, and metabolism.<sup>24</sup> The conclusions of a number of international studies indicate that there is a strong association between exposure to electromagnetic fields and disruptions to melatonin secretion, a hormone responsible for circadian functioning, which can lead to sleep impairment.<sup>25</sup>

Dr. Henry Lai's paper entitled, *Neurological Effects of Radiofrequency Electromagnetic Radiation* is based on a number of laboratory experiments with rats and has been widely cited for its findings on the negative neurological impact of wireless communications technology in the 10 KHz – 300 GHz range of the electromagnetic spectrum. Lai's paper established a number of complicated responses between disruptions to the nervous system (from RFR exposure) and behavioural changes. In one

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<sup>23</sup> "Do Wireless LAN's Pose a Health Risk to the Consumer?" The WLAN Association. [www.wlana.org](http://www.wlana.org).

<sup>24</sup> Michrowski, Andrew. "New Problems with Cell Phones." Presented at the Whole Life Expos. Nov. 2005. Toronto.

<sup>25</sup> Masich, D.; Prodd, J.; et al. "Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure." *Journal of Australian Nutritional Environmental Medicine*. 17 – 19.

aspect of his study, he found that exposure to RFR for 45 minute and 20 minute periods led to either a decrease or an increase in the activity of acetylcholine receptors in several areas of the brain. Acetylcholine is one of the main neurotransmitters in the brain that is involved in a number of behavioural and physiological functions such as learning and memory. The results of the laboratory experiments led Lai to conclude that exposure to RFR altered the “behavioural strategy” of the rats in navigating their way in artificially created environments and also had a negative impact on their memory functions. Lai also determined that RFR exposure acts as a stressor, releasing increased amounts of corticotrophin. Furthermore, Lai concluded that RFR exposure leads to DNA strand breaks in brain cells, which in turn has an effect on free radical formations in cellular functions. This is significant because free radicals are involved in neurodegenerative illnesses such as Alzheimer’s, Huntingdon’s, and Parkinson’s. However, Lai also cautions that it is important to bear in mind that the impact of free radicals in cellular formation also hinges on each individual’s food and alcohol consumption, exercise, and psychological stress levels.<sup>26</sup>

Electro-hypersensitivity (EHS) is a medical condition recognized by WHO that is directly related to exposure to electromagnetic fields (EMFs). It is described by WHO in the following manner:

[EHS is]...a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs)...Whatever its cause, EHS is a real and sometimes debilitating problem for the affected persons, while the level of EMF in their neighbourhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude under the limits in internationally accepted standards.<sup>27</sup>

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<sup>26</sup> Lai, Henry. “Neurological Effects of Radiofrequency Electromagnetic Radiation.” Presented at the Mobile Phone and Health Symposium. Oct. 1998. Vienna, Austria.

<sup>27</sup> “Electromagnetic Hypersensitivity.” World Health Organization Fact Sheet no. 296. Dec. 2005.

EHS is identified as a disability in Sweden, with 2% of the population experiencing severe cases of EHS. Another 35% of the population experience moderate levels of cases of EHS.<sup>28</sup> Symptoms of EHS typically involve the nervous system and can have a number of autonomic effects.<sup>29</sup>

For calculation purposes, the power intensity of RFR is measured in units such as microW/cm<sup>2</sup>. In a study conducted by American scientist Dr. E. E. Novoselova, a wireless laptop was found to be able to expose a user to 35 microW/cm<sup>2</sup>.<sup>30</sup> While this is well below the U.S. frequency guideline for Wi-Fi technology (which is currently 1000 microW/cm<sup>2</sup>), leading Canadian scientist, Magda Havas maintains that due to the precedent set by studies of cell phone users which document an increased risk of brain tumours, more studies are needed to determine the long-term effects of Wi-Fi prior to widespread deployment.

### ***EMF-RFR Policy Regulation in Canada***

In Canada, the Radiation Protection Bureau of Health Canada regulates the health effects of RFR. The safety guidelines are defined in the publication, *Limits of Exposure to Radiofrequency Fields at Frequencies from 3 kHz – 300 GHz*, also known as Safety Code 6. This document sets exposure limits for radiofrequency fields at home and at work. While the legal status of Safety Code 6 is not entrenched in any legislation, it is directly cited in regulations under the Canada Labour Code. Thus, all federal government

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<sup>28</sup> Havas, M. “Biological effects of non-ionizing electromagnetic energy: A critical review of the reports by the US National Research Council and the US National Institute of Environmental Health Sciences as they relate to the broad realm of EMF Bioeffects.” *Environmental Reviews*. 187- 89.

<sup>29</sup> Havas, M. “Biological Effects of Low Frequency Electric and Magnetic Fields.” Derek Clements-Croome (Ed.). *Electromagnetism and Health*. 11 – 13.

<sup>30</sup> Novoselova, E. G.; Fesenko, E. E.; et al. “Microwaves and Cellular Immunity. II. Immunostimulating Effects of Microwaves and Naturally Occuring Antioxidant Nutrients.” *Bioelectrochem Bioenerg*. 39 – 40.

departments, crown corporations, and various other organizations must adhere to the safety guidelines unless they are explicitly exempted by regulation. In addition, Industry Canada requires operators of radiocommunication and broadcast facilities to abide by Safety Code 6. By and large, provinces and territories have adopted the exposure limits as well.<sup>31</sup>

Under section 2.2.1 of Safety Code 6, exposure limits for the general public are outlined in the following manner:

A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5 [for instance, in the 1500-15000 MHz range, the maximum permitted strength of the electric field is 61.4 V/m] , if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.<sup>32</sup>

What this translates to for the general public who could be exposed for 24 hours a day to RF fields, is that the maximum threshold is one-fiftieth of the lowest level of exposure that could cause harm. For people who work in environments that contain RF fields (up to 8 hours a day) the limit is one-tenth of the lowest level of exposure that could cause harm.<sup>33</sup> Additionally, these limitations are reiterated and highlighted in section 5 (a) of Safety Code 6 where it is stated: “Except under special circumstances, members of the general public shall not be allowed access to areas where levels exceed those specified in Section 2.2.”<sup>34</sup> Strategies for addressing individuals or organizations who fail to comply with Safety Code 6 are not explicitly outlined in the document itself. However, in the preface to the document, the language around conformity and

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<sup>31</sup> Safety of Exposure to Radiofrequency Fields: Frequently Asked Questions Brochure.

<sup>32</sup> Safety Code 6. 18.

<sup>33</sup> Safety of Exposure to Radiofrequency Fields: Frequently Asked Questions Brochure.

<sup>34</sup> Safety Code 6. 31.

observance places the burden of ensuring compliance on individual organizations and “competent” experts in the field. For instance, it is written:

The Bureau recommends that organizations which adopt this Code develop their own procedures for compliance and exposure evaluation. In a field where technology is advancing rapidly and where unexpected and unique problems may occur, this Code cannot cover all possible situations and blind adherence to rules cannot substitute for the exercise of sound judgement. Consequently, specifications and recommendations in this Code may require some modifications under certain circumstances. This, however, should be done in consultation with experts competent in the field of RF radiation protection.<sup>35</sup>

According to Industry Canada’s (IC) web page on “Health Canada and Industry Canada FAQ on Radio Frequency”, enforcement of compliance rests with IC officials. In cases where IC suspects that Safety Code 6 limits are breached and the health of the general public is in jeopardy, the Department will take steps to contact the operator. IC will work with the individual in question to amend installation practices to ensure compliance. IC maintains that one way to assess compliance is to ask operators for RF field measurements. Another strategy employed by IC is to issue conditional authority as described in the following manner:

In the case of a proposed new installation, Industry Canada may choose to issue conditional authority. Once the installation is built, the proponent will be required to take measurements to demonstrate compliance and to take immediate action to bring the installation into Safety Code 6 compliance should the measurement results show non-compliance. Industry Canada will only issue final authorization when it is satisfied that the installation complies with Safety Code 6 for the protection of the general public.<sup>36</sup>

In the introduction to Safety Code 6 there is explicit acknowledgement of the fact that “exposure to RF energy in excess of the limits given in this Safety Code may cause adverse health effects” and that the depth and extent of the negative impact depends not

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<sup>35</sup> Safety Code 6. 9.

<sup>36</sup> Health Canada and Industry Canada FAQ on Radio Frequency Fields. Compiled by Industry Canada. <<http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf08792e.html#23>>.

only “on the strength of the field and the exposure duration, but also on various other factors such as the frequency, type of modulation, polarization, and distance from the source.”<sup>37</sup> It is the purpose of Safety Code 6 (as explicitly outlined in the beginning of the document), to inform, specify, and to recommend limits and general procedures for high standards of safety. The document’s limitations lie in the absence of any concrete discussion of proactive measures or consequences for non-compliance.

The Toronto Public Health (TPH) Department’s guideline for public exposure limits is based on the placement of cellular telephone base transmitters and the results of a 1999 Board of Health report. In November 1999, TPH presented the conclusions of its study on the existing “health, environmental, and technical data” surrounding health effects of RF emissions from cell phone towers. It concluded that the adoption of a prudent avoidance policy was the most suitable measure to take given the current gap in the literature on the health effects of RF emissions. Thus, TPH’s prudent avoidance policy calls for an extra “margin of safety” to keep exposure to RF emissions from cell towers 100 times lower than federal guidelines in Safety Code 6.<sup>38</sup>

With regards to the ongoing controversy over the documented health effects of low levels of radiofrequency emissions, TPH maintains that:

Areas where uncertainty exists include the relationship between low levels of RF and cancer. Some, but not all, studies in humans and animals show a slight increase in leukaemia and/or other cancers. Regarding reproductive effects, there is conflicting evidence in humans with respect to spontaneous abortions and birth defects. There are also complaints of non-specific symptoms such as depression, headaches, irritability, sleepiness, loss of appetite, memory, or concentration. The public health approach to dealing with these uncertainties is to encourage prevention over cure. This approach does not advocate waiting for confirmation of adverse effects from epidemiological studies before taking action.<sup>39</sup>

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<sup>37</sup> Ibid.

<sup>38</sup> Backgrounder: Toronto Public Health and the Prudence Avoidance Policy on Cellular Phone Base Antennas. Feb. 7, 2000: 2-3.

<sup>39</sup> Ibid. 4.

Ronald MacFarlane, supervisor of the environmental health assessment and policy department at TPH is in charge of a second study on the health effects of the wide-spread deployment of Wi-Fi which has yet to be released although it was slated to be ready by the early part of 2007.<sup>40</sup> MacFarlane maintains that a variety of infrastructure and consumer devices emit electromagnetic radiation, all with varying biological impacts. Where the controversy lies is in the health effects of specific ranges of frequency of the electromagnetic spectrum. MacFarlane asserts, “Controversy rages at the non-ionizing, lower-frequency end of the spectrum. At the lowest end are electromagnetic fields such as those created by power lines. The longer the wave, the fewer health effects we tend to find...I know studies have looked at cancer caused by exposure to power lines, but the evidence is weak.”<sup>41</sup> It is worthy to note that when Toronto Hydro Telecom rolled out its deployment of wireless access points in Spring 2006, it agreed to comply with the precautionary policy after conducting a few safety presentations to the TPH. Thus, to date, there is only a verbal agreement between TPH and Toronto Hydro Telecom.<sup>42</sup> Company president, David Dobbin, asserts that Toronto Hydro Telecom’s roll-out of a Wi-Fi hotzone in the downtown core is compliant with the policies set forth by both Safety Code 6 and TPH’s prudent avoidance policy. Dobbin claims, “We’ve even gone so far as to get technical compliance declarations from our vendors such as Siemens to guarantee their equipment puts out less.”<sup>43</sup>

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<sup>40</sup> MacFarlane, Ronald. Telephone Interview. 22 July 2007.

<sup>41</sup> Lombardi, R. “Why Wi-Fi May Be Injurious to Your Health.” *Wireless IT World Canada*. July 20, 2006.

<sup>42</sup> MacFarlane, Ronald. Telephone Interview. 22 July 2007.

<sup>43</sup> Ibid.

### ***Precautionary Principle***

The call for a Precautionary Principle on EMFs has been supported in writing by the European Union and the WHO.<sup>44</sup> This initiative has been bolstered by the International Commission for Electromagnetic Safety (ICEMS) at its 2006 conference, with the Benevento Resolution.<sup>45</sup> However, despite the widespread adoption of the Precautionary Principle on both domestic and international levels, it remains a vaguely defined concept. According to the WHO's May 2, 2003 draft of the *Precautionary Framework for Public Health Protection*, the rationale for the Precautionary Principle is described in the following manner, "The Precautionary Principle may be viewed as an 'overarching' concept in the sense that it complements all stages of health risk management and is not something to be 'invoked' only when it is considered that there is a lack of both scientific information and certainty about health consequences."<sup>46</sup> The goals of the WHO's Precautionary framework are twofold: "(i) To anticipate possible threats to health and respond appropriately in order to reduce exposures before introduction of an agent. (ii). To address public concerns that a potential or perceived but unproven health problem is taken into account after introduction of an agent."<sup>47</sup> Thus, where the gap in the literature is unable to provide a clear answer with regards to developing policy, the precautionary principle outlines concrete, preventative action.

Similar to the WHO's definition, in 2002, the European Environment Agency defined the Precautionary Principle in the following way:

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<sup>44</sup> European Union Precautionary Principle. Brussels, 2000.

<sup>45</sup> Benevento Resolution. Benevento, 2006.

<sup>46</sup> World Health Organization Precautionary Framework for Public Health Protection. Draft for Review. May 2003. 2-3

<sup>47</sup> Ibid.

The Precautionary Principle provides a framework, procedures and policy tools for public policy actions in situations of scientific complexity, uncertainty and ignorance, where there may be a need to act before there is strong proof of harm in order to avoid, or reduce, potentially serious or irreversible threats to health or the environment, using an appropriate level of scientific evidence, and taking into account the likely pros and cons of action and inaction.<sup>48</sup>

This section seeks to outline some of the various precautionary principles undertaken by governments on the international stage and in Canada, as well as to highlight the demands made by various grassroots organisations that support the precautionary approach with regards to the roll-out of Wi-Fi networks.

In February 2000, the European Union adopted the Precautionary Principle, primarily in response to growing concerns over EMFs, but broadened the application to include the protection of animal, human, and plant life and vitality. The document outlines that where preventative action is needed, the following considerations should be taken in terms of execution:

- Proportional to the chosen level of protection,
- Non-discriminatory in their application,
- Consistent with similar measures already taken,
- Based on an examination of the potential benefits and costs of action or lack of action (including, where appropriate and feasible, an economic/benefit analysis).
- Subject to review, in light of new scientific data, and
- Capable of assigning responsibility for producing the scientific evidence necessary for a more comprehensive risk assessment.<sup>49</sup>

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<sup>48</sup> Gee, David.; McGarvin, Malcolm.; et al. "Late Lessons from Early Warnings: The Precautionary Principle 1896 – 2000. European Environment Agency. Jan. 2002.

<sup>49</sup> European Union Precautionary Principle. Feb. 2000.

The international momentum for the universal adoption of the precautionary principle gained its first major milestone at the International Conference on the “State of the Research on Electromagnetic Fields – Scientific and Legal Issues”, organized by the National Institute for Prevention and Work Safety, the University of Vienna, and the city of Catania. Over a dozen scientists from the international community signed what is now called the Catania Resolution.<sup>50</sup> Two resolutions in particular, express strong support for the precautionary principle, “2. We take exception to arguments suggesting that weak (low intensity) EMF cannot interact with tissue. 3. There are plausible mechanistic explanations for EMF-induced effects which occur below present ICNIRP and IEEE guidelines and exposure recommendations by the EU.”<sup>51</sup>

The principles of the Catania resolution were soon after underscored and strengthened by the Benevento resolution. In February 2006, the International Commission for Electromagnetic Safety (ICEMS) held a conference entitled, “The Precautionary EMF Approach: Rationale, Legislation, and Implementation in February 2006.” The outcome of the conference was the Benevento Resolution, which approved and broadened the 2002 Catania Resolution.<sup>52</sup> In strongly worded language, the international scientists at the conference criticized the influence of the wireless industry in swaying scientific opinion at the risk of endangering vast populations. They wrote:

3. There is evidence that present sources of funding bias the analysis and interpretation of research findings towards rejection of evidence of possible public health risks.

4. Based on review of the science, biological effects can occur from exposures to both extremely low frequency fields (ELF, EMF) and radiation frequency fields (RF, EMF). Epidemiological and *in vivo* as well as *in vitro* experimental evidence demonstrates that exposure to some ELF, EMF can increase cancer risk

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<sup>50</sup> Catania Resolution. Sept. 2002.

<sup>51</sup> Ibid.

<sup>52</sup> Benevento Resolution. Feb. 2006.

in children and induce other health problems in both children and adults. Further, there is accumulating epidemiological evidence indicating an increased brain tumour risk from long term use of mobile phones, the first RF, EMF that has started to be comprehensively studied.<sup>53</sup>

Currently, in conjunction with the WHO, the International Radiation Protection Association (INRC) has developed and upheld guidelines for magnetic and electric field exposure limits. For the general population, the maximum thresholds are 4.2 kV/m for electric fields and 830 mG for magnetic fields.<sup>54</sup> While these are internationally recognized standards, neither organization has the jurisdiction or authority to ensure that these limits are enforced. At the same time, as these guidelines were developed by a group of esteemed international scientists, they do carry significant weight and influence policymakers from a number of governments. However, due to the lack of research on the specific acceptable thresholds of exposure to the low frequency electromagnetic radiation occupied by Wi-Fi, there are currently no international guidelines for wireless networks.

Since November 2003, the California Public Utilities' Commission has had a prudent avoidance policy called the "low-cost/no-cost" policy to mitigate EMF exposure (primarily, with regards to power lines). On January 27, 2006, CPUC reaffirmed this course of action and continues to use the benchmark of "4% of transmission and substation project costs for EMF mitigation, and combine linked transmission and substation projects in the calculation of this 4% benchmark."<sup>55</sup> What this means is that when regulated utilities build new or upgrade existing facilities, 4% of the project's

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<sup>53</sup> Ibid.

<sup>54</sup> International Radiation Protection Association/International Non-Ionizing Radiation Committee. "Guidelines on Limiting of Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)." *Health Physics*. 494 -495.

<sup>55</sup> "PUC Actions Regarding EMFs." California Public Utilities Commission. April, 2007. [www.cpuc.ca.gov](http://www.cpuc.ca.gov).

budget will be earmarked for reducing EMFs. Currently, CPUC does not have exact numerical targets for the reduction levels and are waiting for a scientific formula upon which to base this calculation. The January 2006 review also called for new designs to reduce EMF levels by incorporating EMF design guidelines into the construction of new and existing facilities. These guidelines include alternative sites for new buildings, enlarge the size of rights-of-way, situate facilities underground, and use a variety of similar methods for reducing EMF levels at transmission, distribution and substation facilities. In addition, CPUC adopted rules and policies to improve utility design guidelines for reducing EMF, and called for a utility workshop to implement these policies and standardize design guidelines.<sup>56</sup>

In Canada, Toronto Public Health continues to stand by its prudent avoidance policy which calls for an extra “margin of safety” to keep exposure to RF emissions from cellular towers 100 times lower than federal guidelines in Safety Code 6. While the policy is currently under review, a recent telephone interview with the Acting Chief Medical Officer does not indicate any dramatic pending policy shifts. Additionally, the precautionary principle approach has been championed by grassroots organisations like the San Francisco Neighborhood Antenna-Free Union (SNAFU) and The Canadian Initiative for Safe Wireless, Electric and Electromagnetic Policies (SWEEP) opposed to the continued expansion of wireless antennas and networks into their communities. These groups suggest variable levels of implementation of the precautionary principle, ranging from an immediate moratorium on the new deployment of wireless technology, a more comprehensive review of existing regulations, to the creation of an independent,

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<sup>56</sup> Ibid.

scientific monitoring system to document the accumulated long-term effects of RF emissions levels.<sup>57</sup>

While the vast amount of current studies on EMF indicates that there are no negative health effects, a number of governments across North America and Europe have rolled out the precautionary approach. It is difficult to discount the concerns raised by those advocating for slower and more cautious deployments as these grassroots mobilizations have already made their presence felt in recent failed municipal projects. In SNAFU's appeal (prepared by Magda Havas) against the San Francisco Board of Supervisor's proposed Google Earthlink project, a strong case is made to support their view that the current public health protections offered by internationally established RFR exposure guidelines do not protect citizens from serious increases in physiological disturbances. Future proposals for city-wide wireless services at home in Canada should be mindful of the hazards involved in ignoring the EMF advocates due to complications that might arise from community class action lawsuits and the like. The safest solution to the controversy may be to incorporate a requirement for a public review of potential EMF exposure into any future ICT projects.

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<sup>57</sup> San Francisco Neighborhood Antenna-Free Union. Goals. July, 2007. [www.antennafreeunion.org](http://www.antennafreeunion.org).

## Bibliography

Baiman, R.; Davis, J.; Cabral, J. vs. Oak Park Elementary School District 97, Fagan, J.; Burke, D.; Onayemi, A.; Frank, M.; Patchak-Layman, S.; Schawrtz, C.; Walsh, B.; Harton, M. Circuit Court of Cook County, Illinois. 26 September 2003.

Bale, Joanna. "Health Fears Lead Schools to Dismantle Wireless Networks." *The Times Online*. 20 November 2006.  
<[http://www.timesonline.co.uk/tol/life\\_and\\_style/education/article642575.ece](http://www.timesonline.co.uk/tol/life_and_style/education/article642575.ece)>.

Beschizza, Rob. "Wi-Fi as a Health Hazard." *Wired Magazine*. 12 December 2006.  
<<http://www.wired.com/print/science/discoveries/news/2006/12/72265>>.

City of Toronto. Public Health. Community and Neighbourhood Services.  
"Backgrounder: Toronto Public Health and the Prudence Avoidance Policy on Cellular Phone Base Antennas." 7 February 2000: 2-3.

Canada. Health Canada. Environmental Health Directorate Health Protection Branch.  
"Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz." Safety Code 6.0. Catalogue No. H46-2/99-237E.  
Ottawa: Minister of Public Works and Government Services, 1999.

Canada. Health Canada. Environmental Health Directorate Health Protection Branch.  
"Safety of Exposure to Radiofrequency Fields: Frequently Asked Questions." Catalogue No. C2-319/1997E. Ottawa, Minister of Public Works and Government Services, 1997.

Canada. Industry Canada. "Health Canada and Industry Canada FAQ on Radio Frequency Fields." Compiled by Industry Canada. <<http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf08792e.html#23>>. 2 October 2007.

City and County of San Francisco. Board of Supervisors. Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network. Havas, Magda. Case No. 2007.0097E. (Submitted) 31 May 2007.

DelPizzo, V.; Lee, G.; Neutra, R. California EMF Program. California Public Utilities Commission and Department of Health Services. "An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) From Power Lines, Internal Wiring, Electrical Occupations, and Appliances." Oakland: June 2002.  
<<http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/CoverPages.pdf>>.

de Lorge, J.; Ezell, C.S. "Observing-responses of rats exposed to 1.28- and 5.62-GHz microwaves." *Bioelectromagnetics*. 1:183-198; 1980.

“Electromagnetic Fields and Public Health: Extremely Low Frequency (ELF).” World Health Organization Fact Sheet no. 205. November 1998.

“Electromagnetic Fields.” World Health Organization Health and Environment Briefing Pamphlet Series, No. 32. January 1999.

“Electromagnetic Hypersensitivity.” World Health Organization Fact Sheet no. 296. December 2005.

European Union Precautionary Principle. Brussels: February 2000. 18 July 2006. <[http://ec.europa.eu/dgs/health\\_consumer/library/pub/pub07\\_en.pdf](http://ec.europa.eu/dgs/health_consumer/library/pub/pub07_en.pdf)>.

Fumento, Michael. “Wi-Fi False Fears.” *Canada Free Press*. 12 April 2006. <<http://www.canadafreepress.com/2006/fumento041206.htm>>.

Gee, D.; McGarvin, M.; Stirling, A.; Keys, J.; Wynne, B.; Vaz, Sofia. “Late Lessons from Early Warnings: The Precautionary Principle 1896 – 2000.” European Environment Agency. January 2002.

Havas, M. “Biological effects of Low Frequency Electric and Magnetic Fields.” Derek Clements-Croome (Ed.) *Electromagnetism and Health*. London: Taylor & Francis Books, Ltd. 2003.

Havas, M. “Biological effects of non-ionizing electromagnetic energy: A critical review of the reports by the US National Research Council and the US National Institute of Environmental Health Sciences as they relate to the broad realm of EMF bioeffects.” *Environmental Reviews* 8:173-253. 2000.

Huber R., Schuderer J., Graf T., Jutz K., Borbely A., Kuster N., Achermann P. “Radio Frequency Electromagnetic Field Exposure in Humans: Estimation of SAR Distribution in the Brain, Effects on Sleep and Heart Rate.” *Bioelectromagnetics*. 24(4): 262-276, 2003.

International Commission for Electromagnetic Safety (ICEMS). Benevento Resolution. Benevento, Italy: February 2006.

Lai, H. “Neurological Effects of Radiofrequency Electromagnetic Radiation.” Presented at the Mobile Phone and Health Symposium. Oct. 1998. Vienna, Austria. Lakehead University. Wi-Fi Policy. 1 Jan. 2004. <<http://policies.lakeheadu.ca/policy.php?pid=178>>.

Lombardi, R. “Why Wi-Fi May Be Injurious to Your Health.” *Wireless IT World Canada*. July 20, 2006. <<http://www.volweb.cz/horvitz/os-info/news-jul06-016.html>>.

MacFarlane, R. Telephone Interview. 22 July 2007.

Maisch, D.; Prodd, J.; Rapley, Bruce. "Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure." *Journal of Australian Nutritional Environmental Medicine*. 21 (1), 2002. 15 – 19.

Michrowski, A. "New Problems with Cell Phones." Presented at the Whole Life Expos. November 2005. Toronto.

National Institute for Prevention and Work Safety. Catania Resolution. Catania, Italy: September 2002.

Novoselova, E. G.; Fesenko, E. E.; et al. "Microwaves and Cellular Immunity. II. Immunostimulating Effects of Microwaves and Naturally Occuring Antioxidant Nutrients." *Bioelectrochem. Bioenerg.* 39 – 40. 49 (1): 37 – 41, 1999.

San Fransisco Neighborhood Antenna-Free Union. Goals. 17 July 2007.  
<<http://www.antennafreeunion.org/snafu.htm#goals>>.

Sibley, K. "Canadian Cities Warned: Watch for Wi-Fi Health Risks." *It Business Magazine*. 25 January 2007.  
<<http://www.itbusiness.ca/it/client/en/home/News.asp?id=41946>>.

Vasil, A. "Wi-Fi's Electric Shock." *NOW Magazine*. 9 – 15 March 2006: 25 (28).