

Wireless Devices, Standards, and Microwave Radiation

in the Education Environment

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Introduction

Since there is a shortage of space in schools, many school districts often use portable trailers to serve as classrooms for school students. Up to this point in their technology upgrade program, many school districts have not funded the broad scale deployment of technology within portable classrooms. Schools must decide whether such deployment will utilize the same building wiring standards that have guided efforts within the permanent campus or utilize wireless local area networking technology. To make this decision, public schools are analyzing the feasibility of placing wireless computers into classrooms, especially portable classrooms (portables) used by schools with rapidly-expanding enrollments. Such computers would interact with servers in the central processing site via the proposed Wireless Local Area Network (WLAN). Promoters of wireless technology state that it is less expensive, and can be installed easily and quickly because there is no need to dig trenches or open walls and ceilings to install cables as would be required for hard-wired systems. Another element favoring the utilization of wireless technology is its inherent mobility; that is, devices can more easily be moved and reactivated in other portables or conventional classrooms.

However, on the flip side, there are many negative aspects to “going wireless” in schools related to health and safety. This analysis provides information regarding health effects associated with wireless radiofrequency/microwave (RF/MW) radiation transmitting technologies, specifically the WLAN.

How the Technology Works

Digital Bits – Conduction of Pieces of Information Via Electric Pulses

Technology builds on this foundation. Thus, in principle, the purpose and requirements of the Wireless Local Area Network are like that of Morse code. In this electronic age, instead of mechanically tapping codes, computers use digital bits (electric pulses) that signal: Yes (1), I am carrying data; or No (0), I have nothing. Several million electric pulses (megabits) travel in streams of invisible energy (radio waves) carrying true characters (1) that form words, or spaces (0) that separate words. Morse code consisted of intermittent tapping that produced sound which was transported in slow rolling waves of air particles. But digital pulses of radio waves move fast at the speed of light. They are precise, consistent, and travel along specially engineered waves. Therefore, data moves rapidly and smoothly through the digital system.

Wireless Local Area Network (WLAN) – Movement of Data in Air to Remote Devices

Wireless computers rely on transmitters to push data to and through the air, which offers resistance, and are therefore inherently less reliable than wired networks. Computer transformers operate at several thousand volts. In a wireless computer system, transformers send millions of bits of information to transmitters atop the desk or through the lap top antenna. In turn, the data is packaged onto a signal and sent to a microwave antenna that is usually perched on the wall of a room or mounted on doors or on tall structures. The wall antenna downloads the data into its attached waveguide, which channels the information, via outdoor and indoor antennas, to users in the WLAN or to the antenna(s) receiver/transmitter located on the main campus building for further processing. The transmitter's receiver located on the main campus building is connected to the school's wired network. Since WLANs would be on during the school day, the RF/MW transmitters attached to these wireless systems are transmitting continuously. Electric pulses in the RF/MW region (radio waves), the band of the electromagnetic spectrum used for communications, can pass through nearly all types of matter, including children.

Standards, Rules, and Guidelines

Commercial wireless products are designed to comply with industry-based standards that are created by industry-appointed professional associations for industry use in achieving uniformity and compatibility in the manufacture and application of wireless communication technologies. These standards are different from government rules that are enforced by the government agency with regulatory authority over signal interference between licensed carriers, i.e., the Federal Communications Commission (FCC). Since the FCC is only a licensing and engineering agency it does not test, fund, or conduct biological research. FCC does not monitor communications installations to ensure compliance with FCC guidelines governing human exposure to RF/MW radiation. The FCC relies on other agencies to recommend safety standards for wireless technologies.

The organizations responsible for developing RF/MW safety standards include the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE) associations. The committee that sets RF/MW exposure standards was first sponsored by ANSI and then by IEEE. It is basically the same group

of people. It is important to understand that industry standards and government guidelines are two different things. The IEEE committee is mainly comprised of engineers and physicists who deal with the non-living sciences. They have traditionally been charged with the task of making these technologies work, not with the understanding of health effects from the technologies' RF/MW radiation exposures that are within the purview of the living sciences of biology and medicine. The health physicists who serve on these committees have traditionally been active in high intensity (energy) radiation research primarily from defense-related industries. These scientists have conducted research on the ionizing band and are not as knowledgeable about physical and biological effects related to exposure to non-ionizing RF/MW radiation used in wireless technologies. There are many biologists working in the field of bioelectromagnetics, the study of non-ionizing radiation in living organisms. But somehow most of them have left these committee.

FCC Guidelines- Human exposure to Radiofrequency/Microwave Radiation

In August 1997, following the enactment of the Telecommunications Act of 1996, the Federal Communications Commission (FCC) published revised guidelines governing human exposure to RF/MW radiation. These guidelines are difficult to enforce because the FCC lacks the man-power and the necessary funding to carry out monitoring and enforcement from exposure to wireless technologies' radiation. These guidelines were adopted by the FCC to protect the health and safety of the general public and certain high risk occupational groups, such as telecommunications workers. For example, the guidelines outline the power density exposure level permitted for the general public (1mW/cm² for 30 minutes) and workers (5mW/cm² for 6 minutes). The rationale for the difference in permissible exposure levels is that workers are aware of the presence of radiation and can protect themselves, whereas the public is considered to be unaware of radiation, and would not be aware that protection is needed. We add that children would be even less apt to understand the concept of "awareness" when studying or playing near to transmitting signals from a WLAN to wireless classroom computers.

WLAN technologies are regulated by the FCC under Section 47 Part 15 rules. Section 47 Part 15 rules specify compliance with FCC rules regarding RF/MW interference. FCC Part 15 rules for WLAN applications are concerned primarily with RF/MW power output as it relates to the prevention of RF/MW interference with other electronic devices. [See FCC 99-149 pl, sec 2.]

Depending on its intensity, RF/MW radiation can cause heating of body tissues. No heating will occur if the exposed body can compensate for the heat load. In general, the intensity of exposure to radiation from cell phones, cell towers, and WLANs is low and does not cause significant tissue heating.

X-rays are classified as ionizing radiation. Ionizing radiation exposures are also regulated by government and industry standards. Unfortunately, when setting guidelines for products emitting RF/MW radiation, industry uses only the thermal level of radiation where the body increases in temperature and would go into shock or burn if over-exposed as a basis for defining adverse biological effects. It is important to note that WLANs

operate in the non-ionizing, RF/MW part of the electromagnetic spectrum. The FCC RF/MW exposure guidelines apply for wireless devices operating in the non-ionizing part of the electromagnetic spectrum which includes devices such as mobile phones, wireless internet, and mobile phone base stations (often called cell towers).

How could the FCC guidelines for wireless devices operating in the non-ionizing, RF/MW spectrum be based upon standards that are not internationally accepted nor proven safe? That question can best be addressed by this statement from the international electromagnetics research and policy publication, *Microwave News*:

Standard setting bodies do more or less as industry wants. Their members are often current, past, or future employees of the very companies they are supposed to regulate. Meanwhile government agencies have no appetite for confrontation.

While the wireless industry has stated that its standards and the FCC guidelines are safe and do not pose a risk to workers or the general public, many in the wireless community do not agree. Morton Bahr, President of the 600,000-member U.S. Communications Workers of America (CWA), a national union with a membership dominated by telecommunications workers, filed a legal challenge in November, 1997, in the U.S. Court of Appeals against the FCC rules on human exposure to RF/MW radiation. Mark Wilson, CWA's legal representative, stated recently, "The President of CWA is very concerned about protecting the health and safety of our workers who are exposed to wireless radiation on a daily basis." The CWA is objecting to the hazardous radiation exposure levels its workers are subjected to under FCC's RF/MW exposure guidelines.

A November 30, 1998, letter from David Nghiem, Ph.D., president and CEO of USA Wireless Inc., a manufacturer of mobile phone components, to FCC Chairman William Kennard, raises questions regarding the current industry standard and FCC guidelines. The letter suggests the need for a "much more stringent standard than the established Specific Absorption Rate (SAR)."

Although there is no question that the SAR measurement is important for establishing how much radio-frequency (RF) power is deposited in human tissues, the SAR level relates only to the electric field inside the tissue, and ignores any possible biological effects from the magnetic field. We must take into account, however, that the SAR only relates to thermal effects; it does not take into consideration the possible non-thermal effects.

U.S. exposure guidelines are not universally accepted in many parts of the world. See: <http://www.emrnetwork.org/regulation/charts.htm> According to the FCC, "Some published exposure limits in Russia and some eastern European countries have been generally more restrictive than existing or proposed recommendations for exposure developed in North America and other parts of Europe." Russian limits for RF/MW radiation exposures are up to 100 times stricter than those in the U.S. and Western Europe. In January 2000, Swiss health and environmental officials adopted strict rules for public exposures from new sources of RF/MW radiation. Switzerland has

one of the most stringent exposure guidelines in the world requiring power levels effectively 100 times lower than those of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and ANSI. Salzburg, Austria's standard is approximately 5800 times lower than the FCC guidelines for RF/MW base station radiation.

Health officials in Canada are also concerned with regulations governing potentially harmful RF/MW radiation in the air over Toronto. Dr. Sheela Basrur, Medical Officer of Health (November, 1999) urged the Toronto Board of Health to increase the safety margin a hundred-fold. It is recommended, as an added margin of safety, that exposures to the public be kept at least 100 times below Canadian federal exposure limits. Basrur said RF/MW radiation has been demonstrated to have adverse effects on the blood brain barrier, and some evidence suggests a link to leukemia and other cancers. On December 6, 1999, the Board of Health approved the Prudent Avoidance Policy recommended by Basrur. That policy would impose an output limit on cellular base stations 100 times more stringent than the current Canadian Safety Code 6.

The FCC rules suggest that manufacturers of transmitters that have antennas located next to individual(s), as in the application of the WLAN transmitter antennas, provide certain operating and warning usage instructions. Those instructions should be included in the operator's manual to caution users to maintain a specific distance from the transmitter/antenna. In addition, FCC advises that a warning label should be affixed to the transmitter/antenna to caution users or other persons close to the transmitter/antenna to limit exposure duration and/or maintain certain specific usage conditions.

IEEE 802.11 Standard -- A Boilerplate or Matrix for an Engineering Design?

To ensure the compatibility of electronic systems, the IEEE agreed on specific and uniform criteria, an industry standard, for the design of wireless technology. In the hierarchy of rules for the design of the products in its domain, IEEE assigned Section 802.11 to WLAN components. This section stipulates that WLAN antennas are required to have a certain number of channels; data can move at the rate of a specified number of bits (electric pulses) in each antenna channel. This frequency range is non-licensed, which means that industry is not required to obtain a construction or operation license from the FCC before deploying WLAN systems..

Presentations made by industry to this writer referenced the IEEE 802.11 industry standard. Many industry representatives mistakenly inferred that since their products comply with the IEEE 802.11 standard, their products automatically are safe and without the threat of health issues from RF/MW exposure. This writer also contacted members of the IEEE 802.11 industry standards committee requesting information on the health and safety aspects. This writer specifically requested information pertaining to specific absorption rates (SAR) and power density of WLANs. Mr. Vic Hayes of Lucent Technology and member of the IEEE 802.11 standards committee supplied an IEEE.802.AA document. The second and third paragraphs of the document address the industry's opinion on health and safety.

No verified reports exist of injury to human beings who have been exposed to electromagnetic fields within the limits of frequency and (specific absorption rate) specified by previous ANSI standards, including ANSI-C95 1-1982.

Measurements have shown that routine exposure of users and other persons to low-power portable, mobile-power portable, mobile transceivers, and cellular telephones do not induce rates of radio frequency absorption that exceed any of the maximum permissible rates of energy absorption defined by these guidelines (ANSI/IEEE). Therefore, based on present knowledge, the exposures from low-power transceivers are considered to be without risk for the user and the public."

The August 2000, Volume 37, Number 8 edition of *IEEE SPECTRUM* online states (See Attachment P) the following: http://www.goaegis.com/articles/ieee_spectrum_0800.html

The body of research is controversial in several respects. It includes many reports of effects of RF fields on cells and animals, sometimes at low exposure levels, which are understood and often not reproducible. It also includes a scattering of reports of human effects from low-level exposure to RF-fields. Standards-setting committees while acknowledging this research, has concluded that it provides insufficient basis for exposure guidelines.

In a letter to the FCC (available on request), Margo T. Oge, Director, Office of Radiation and Indoor Air with the U.S. Environmental Protection Agency (EPA) made the following responses concerning ANSI/IEEE standards, including ANSI-C95 1-1982.

*Therefore the generalization that the 1992ANSI/IEEE guidelines protect human beings from harm by any mechanism is not justified. **The 1992 ANSI/IEEE standard is based on literature published before 1986, except for a few papers on shock and burn. While studies continue to be published describing biological responses to non-thermal ELF modulated RF radiation, the effects information is not yet sufficient to be used as a basis for exposure criteria to protect the public against adverse human health effects.***" (Emphasis added.)

On June 17, 1999, the federal Radiofrequency Interagency Work Group (RFIAWG) issued a RF Guidelines Statement. RFIAWG members come from the U.S. agencies responsible for RF/MW safety policy including: the Food and Drug Administration (FDA) Radiation Biology Branch, National Institute for Occupational Safety and Health (NIOSH), EPA, Occupational Safety and Health Administration (OSHA)Health Response Team, and the National Telecommunications and Information Administration (NTIA)/Department of Commerce. In particular, the RFIAWG emphasized that current RF/MW exposure guidelines:

- Do not take into account chronic, as opposed to acute exposures
- Do not take into account modulated or pulsed radiation (digital or pulsed RF/MW radiation that is employed in WLAN systems)

- Rely on time-averaged measurements that may erase the unique characteristics of an intensity-modulated RF radiation that may be responsible for reported biologic effects
- lacked a comprehensive review of current, long-term, low-level exposure studies, neurological-behavioral effects and micronucleus assay studies (showing genetic damage from low-level RF/MW radiation).

This writer also spoke with W. Gregory Lotz, Ph.D., Chief, Physical Agents Effects Branch Division of Biomedical and Behavioral Science (MS C-27) for NIOSH and NIOSH's representative to RFIAWG. When questioned about the health and safety concerns of the WLAN computer in the classroom environment, Dr. Lotz stated his personal opinion: **“While we still don’t have all the answers on this issue, it would be advisable to use the Precautionary Principle.”** (Emphasis added.) “The Precautionary Principle is an important guiding principle in handling inevitable scientific uncertainty, especially in situations of potentially irreversible or catastrophic impacts” (UNESCO, 1999). Consistent with the Precautionary Principle, Dr. Lotz also indicated that a hard-wired portable classroom connected to a rooftop antenna would be a safer option than wireless-laptops, work stations, and base stations in a classroom environment.

The author also spoke with Senior Scientist Norbert Hankin, of the EPA Office of Radiation and Indoor Air and Chairman of RFIAWG. The writer discussed possible wireless portable classroom scenarios with Mr. Hankin. When questioned about the health and safety concerns of the wireless computer in the classroom scenario, Mr. Hankin said: **“In my personal opinion, I wouldn’t do it.”** (Emphasis added.) He further stated that there are animal studies showing health issues with short-term exposures to non-ionizing RF/MW radiation. Mr. Hankin expressed concern about children who would be close to transmitting antenna(s) (wireless-laptops, work stations, and base stations) and exposed to prolonged low intensity transmissions. He likened it to being in a room of cellphones running all day long. Mr. Hankin suggested that the hard-wired portable classroom scenario, connected to a rooftop antenna, was a safer way to go.

In May 2000, the American Cancer Society bulletin stated: "No solid evidence yet exists regarding cell phones and cancer". Cell phone technology is new, "data from large studies are not yet available on long term use." The bulletin also states, "that a scientific panel that was commissioned by the government of Britain to evaluate research to date on health risks of cell phones, warns that children may be at greater risk of injury from cell phone radiation because their central nervous system, including the brain is still developing. The group, The Independent Expert Group on Mobile Phones (IEGMP) contends that: **“ While most studies have found few, if any, health risks from cell phones, research has not proven conclusively that cell phones are safe, particularly for children.”** (Emphasis added.)

According to the conclusion of Britain's IEGMP Summary & Recommendations- Report -Mobile Phones and Health:

We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach. (Emphasis added.) Available at: <http://www.iegmp.org.uk/>

In February 2000, Russell D. Owen, Chief of the Radiation Biology Branch of the Center for Devices and Radiological Health, FDA, commented that there is: “currently insufficient scientific basis for concluding whether wireless communication technologies pose any health risk. . . Little is known about the possible health effects of repeated or long-term exposures to low level RF of the sort emitted by such (wireless communication) devices. . . Some animal studies suggest the possibility for such low-level exposures to increase the risk of cancer. . .” Although Dr. Owen’s comments appear to be directed primarily to users of cell phones, the same questions are pertinent for long-term RF/MW exposure from antenna sites (*Epidemiology*: Vol. 1, No. 2, March 2000, Commentary).

A recent federal district court decision in Louisiana opined that FCC and FDA have no programs in place to assure safety. This means that the public cannot depend on either the FDA or the FCC to protect people. Additionally, Dr. David Feible, Chief of FDA Center for Devices and Radiological Effects, stated in his letter dated January 16, 2001, accompanying the fiscal 2000 annual report: **"We don't have the money to protect consumers from wireless technology."** *RCR News*, February 19, 2001, “FDA ill-equipped for health issue,” by Jeffrey Silva.

The National Toxicology Program (NTP), is a part of the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH). NTP has requested comments on whether to add RF/MW radiation to its list of substances to be tested as carcinogens. The FDA made a recommendation to the NTP urging that RF/MW be tested for carcinogenicity (www.fda.gov.us). It is based in part on FDA’s written testimony stating:
Animal Animal experiments are crucial because meaningful data will not be available from epidemiological studies for many years due to the long latency period between exposure to a carcinogen and the diagnosis of a tumor. . . There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a risk to millions of users. . . FCC radiofrequency radiation guidelines are based on protection from acute injury from thermal effects of RFR exposure and may not be protective against any non-thermal effects of chronic exposures.

Further, the FDA notes that for mobile phone users:

The 84 million mobile phone subscribers and the 25,000 that sign up daily translates into a potentially significant health problem should the use of these devices even slightly increase the risk of adverse health effects.”

Areas of Concern

Wireless technology is relatively new and many diseases, especially cancer, have latency periods of 6 to 10 years or more before tumors and other symptoms surface. Research has demonstrated that biological effects from RF/MW radiation exposure are dependent upon several compounding factors.

1) The first exposure factor is the length of time a person is exposed to RF/MW transmitters. In the WLAN classroom environment, the exposure to children from RF/MW radiation starts the moment the students enter the classroom. The exposure to RF/MW radiation does not end until students leave the classroom or move outside the perimeter of the wireless network of RF/MW radiation antennas and transmitters that most likely extends beyond the boundaries of the classroom.

A child entering the school system in Kindergarten could face the potential for 13 years of RF/MW radiation exposure emanating from WLAN transmitters while attending K-12 schools. Teachers and other school district personnel, many of child bearing age, might have an even longer exposure period resulting from a professional career in a wireless school district environment. Wireless school campuses that are in close proximity to nearby residential areas risk exposing the children and their families to RF/MW radiation in their homes depending on how those wireless networks/antennas and power output are implemented.

2) The second exposure factor of concern is the distance between the transmitters and the person. Exposure and absorption of non-ionizing RF/MW radiation are greatest next to a transmitting antenna. In the wireless classroom WLAN environment, transmitters and antennas can be located on the computer, printer, ceiling, walls, on the outside of the portable classroom, and on the outside of the main campus building. The exposure distances a child might encounter from a transmitting antenna(s) could vary depending on how the classroom environment is designed. A child can be as close as 1.5 feet when operating a wireless computer or when playing near an outdoor omni-directional transmitting antenna.

Outside antennas can also expose children in a classroom to RF/MW radiation even though the antenna is mounted outside. RF/MW radiation radiates through the walls of most structures depending on construction materials. A good example of this fact is the cell phone. In many instances, cell phones can be used within a building because the wireless RF/MW signal radiates through the walls of the building. The U.S. government recommends affixing exposure warning labels to each transmitter and antenna of RF/MW transmitting devices, warning people to keep safe distances from transmitters/antennas. The government also has requested the wireless industry to include information in their owner's operating manuals about overexposure. Children who would be exposed may not be able to read or follow these instructions.

Dr. Neil Cherry, Ph.D. in Physics, senior lecturer at Lincoln University in Canterbury, New Zealand, and an elected member of the Canterbury Regional Council, has written that studies indicate that non-ionizing RF/MW radiation causes everything from cancer in lab rats to neurological changes in humans. Dr. Cherry describes human beings are

very good conductors of RF/MW transmitted signals. This means that most RF/MW signals radiate through us and **are absorbed** with very little going to the main transmission point. He further states that wireless technology should be redesigned not to radiate into us, but rather go directly to the main transmission site. Living organisms are themselves electromagnetic instruments of great sensitivity that can support a variety of electrical vibrations; these can be interfered with by external radiation - both at RF/MW and at very much lower (ELF) frequencies - in a number of ways, from which adverse health effects can follow. <http://www.nzine.co.nz/thesis.html>

3) The third exposure factor is the frequency of the RF/MW radiation. The RF/MW radio signals that are being discussed for classrooms are located in the 2.4 GHz frequency range. The 2.4 GHz frequency is two to three times higher than a cell phone. In some instances, this technology can also operate in the 5 GHz frequency range. Researchers are concerned that these higher radio frequencies compounded with power density, length of exposure, distance from antennas, and absorption rates may produce adverse health effects. The body is comprised of 65% water by weight and has a high absorption rate to RF/MW radiation. Radiation absorption in body tissue is commonly referred to as Specific Absorption Rate (SAR). The rate of absorption of RF/MW radiation into the body increases as the frequency of the radiation climbs. See: http://www.emrnetwork.org/schools/curry_broward.pdf

Research scientists, such as Dr. Martin Blank of Columbia University, are calling for biologically based standards rather than thermally based standards in order to prevent harmful exposure conditions which occur at certain frequencies. According to a study conducted by University of Utah scientist, Om Gandhi published in 1996, greater distribution and penetration of RF/MW radiation was found in the heads of 5- and 10-year-old children using a cell phone than in those of adults using a cell phone. Significantly larger amounts of the radiation were absorbed by children when compared to the absorption rates of adults.

At the University of Washington, researchers Lai and Singh (1996) showed single and double DNA breaks and long- and short-term memory loss in laboratory animals exposed to RF/MW radiation. Lai said, "Because mobile phone RF penetrates deeper into a child's brain, more brain tissue would be exposed." He added that not all brain cells have been developed in children, with some cells in the cerebellum (in the back of the brain) taking 10 years to develop. Cumulative damages in DNA may in turn affect cell functions. DNA damage that accumulates in cells over a period of time may be the cause of slow onset diseases, such as cancer (Lai letter available on request). The Motorola funded group headed by Joseph Roti Roti was unsuccessful at duplicating Lai's findings when using a different, less sensitive method to measure DNA breaks. However, during his study Roti Roti unexpectedly found an effect from the RF/MW radiation (an oncogene, genes related to cancer development).

Research has shown that exposure to RF/MW emissions from a transmission tower demonstrate **significant differences in visual reaction time and reduced memory function in students in a close-by school** (Chiang, 1989). Studies by Dr. Lai at the

University of Washington (1996, 2000) showed long- and short-term memory loss in rats from exposure to 2.45 GHz RF/MW radiation, the frequency used in WLAN systems.

In 1997, a study conducted by Professor Leif Salford, a Swedish neurologist, stated: "We saw the opening of the blood-brain barrier (BBB) even after a short exposure to radiation at the same level as mobile phones. We are not sure yet whether this is a harmful effect, but it seems that molecules such as proteins and toxins can pass out of the blood while the phone is switched on and cross into the brain. Within two minutes of exposure, the rat's brain tissue was found to be opened up to proteins and toxins contained in the blood after the defense mechanism (BBB) was disabled." **Salford found that the blood brain barrier opened at exposure levels 4,000 times lower than the current FCC guidelines.**

4) The fourth exposure factor is the power output levels from the wireless RF/MW radiation devices. The conventional method of measuring exposure is called power density. Power density is defined by the FCC as "power per unit area." Power density is expressed in terms of milliwatts per square centimeter or microwatts per square centimeter.

When industry vendors, engineers, and marketing officials were questioned during their presentations to this writer, they were unfamiliar with key health and safety aspects of their products. Industry representatives were unaware or confused regarding the standards and guidelines. None of the vendors knew the power density of their products nor were they familiar with the term. One vendor admitted wireless technology was new to him, while another commented that they were aware of health effects but claimed none.

Health and Safety Issues

The wireless industry conducted extensive research on cell phone health and safety risks for six years, under contract with the Wireless Technology Research Group (WTR) in Washington, D.C. Dr. George Carlo, Ph.D., M.S., J.D., former Director of the WTR, a now defunct organization, recently gave an advanced look on his research results in a series of multimedia interviews. A formal report has yet to be released. To the surprise of the wireless industry which funded the \$27 million research program, the results indicated health issues from exposure to wireless technologies. The lack of responsiveness by industry to the WTR report caused Dr. Carlo to write to the Chairman and CEO of AT&T, Mr. C. Michael Armstrong.

The following sentences were extracted from Dr. Carlo's letter dated October 7, 1999:

The rate of death from brain cancer among hand held phone users was higher than the rate of brain cancer deaths among those who used non-hand held phones that were away from their head. Today, I sit here extremely frustrated and concerned that appropriate steps have not been taken by the wireless industry to

protect consumers during this time of uncertainty about safety. The question of wireless phone safety is unclear. Therefore, from a public health perspective, it is critical for consumers to have the information they need to make an informed judgment about how much of this unknown risk they wish to assume in their use of wireless phones.

In October, 1998, seventeen scientists of international standing signed the Vienna EMF Resolution, stating that the biological effects from low-intensity exposures to RF/MW radiation are scientifically established, a statement which undermines the validity of current FCC safety guidelines. <http://www.irf.univie.ac.at/emf/>

In June, 2000, in Salzburg, Austria, an international conference was convened to discuss RF/MW radiation studies relevant to wireless voice and data communications. Researchers and public policy makers who participated at that conference signed a resolution which included this statement on the biological effects of exposures to RF/MW radiation from mobile phone base stations:

http://www.land-sbg.gv.at/celltower/english/start_e.html

4. *Presently the assessment of biological effects of exposures from base stations in the low-dose range is difficult but indispensable for protection of public health. There is at present evidence of no threshold for adverse health effects.*

Recommendations of specific exposure limits are prone to considerable uncertainties and should be considered preliminary.

The Los Angeles Unified School Board as of June 2000, passed a resolution opposing the future placement of cellular telecommunication towers on or adjacent to school property because of the potential health effect. California PUC (Public Utility Commission) issued an advisory on siting towers near schools and residences in 1995 which is not being enforced. <http://www.lausd.k12.ca.us/lausd/board/secretary/html/agendas/mt/mt06-27-00.html> Scroll down to Agenda Item IX. Motions and Resolutions for Action

Libby Kelley, former public health policy analyst at the U.S. Department of Health and Human Services, who now directs the Council on Wireless Technology Impacts, calls for greater caution regarding the introduction of wireless signals and devices near our children. She states: “Until we know beyond the shadow of a doubt that this technology can be safely used by children, we are behaving like irresponsible adults by treating our children as guinea pigs in this uncontrolled experiment.”

Liability and Lloyd's of London

In an article entitled, “UK Insurers Balk at Risks of Phones,” Sarah Ryle, a consumer affairs correspondent for *The Observer*, London, describes concerns about the safety of mobile phones which has prompted a leading Lloyd's of London underwriter to refuse to insure phone manufacturers against the risk of damage to users' health. The move comes amid mounting concern about the industry's influence on research into the long-term

effects of using a mobile phone. The London market provides insurance for everything from aircraft to football players' legs. But fears that mobile phones will be linked to illnesses, such as cancer and Alzheimer's disease, have prompted John Fenn of underwriting group Stirling, to refuse to cover manufacturers against the risk of being sued if mobiles turn out to cause long-term damage. New research published last year by Bristol University scientist Dr. Alan Preece showed a 'highly significant' effect from mobile phone signals on brain function. http://www.goaegis.com/articles/observer_041199.html

Another opinion comes from journalist Charles Moore of the on-line *Mac Opinion*. Mr. Moore writes software reviews and features for *MacToday* magazine and does his best to endorse the Macintosh platform wherever and whenever he can in his writing. In his December, 1999, column entitled: "How Safe is Wireless Computer Networking?" he states the following: (Emphasis added.)
<http://www.macopinion.com/columns/roadwarrior/99/12/09/index.html>

*However, I am suggesting that the issue of wireless networking ought to be addressed with a lot more prudent caution than seems to be the case. **The thought of classrooms full of schoolchildren using Airport equipped iMacs or iBooks day in and day out, being exposed to radio frequency emissions at close range, makes me distinctly uneasy given the level of ignorance on this issue . . .***

And this is the point that pertains most strongly to wireless microwave frequency computer networking. Until there is a lot more research available on this issue from disinterested third parties, my own personal policy of "prudent avoidance" will include prudently avoiding wireless LANs, the same as I refuse to use cellular and cordless phones. Happily, in my case that will not be difficult. For many others who will be exposed in work or educational settings, prudent avoidance will be virtually impossible.

As I said at the beginning of this article, I expect that a lot of people who read it will be annoyed that I brought the topic up. There is understandable enthusiasm for the convenience of wireless technology (for a quite comprehensive resource on the topic, check out this Website -- <http://hydra.carleton.ca/info/wlan.html>), and getting rid of all those pesky wires.

It could be that I am being hyper-cautious about this, and if it can be proven beyond reasonable doubt that exposure to low-level radio emissions is safe, I'm willing to listen. However, I want to hear it from sources other than those financed by industry or politically-sensitive government regulatory agencies.

The roll out of WLAN technology appears to be in the early stages of development, hence WLANs have not, at this stage, fully matured. Industry standards for both hardware and software have been under debate for years. Industry standards are still evolving. One example is the frequency hopping/direct sequence ruling process now before the FCC (FCC ET Docket No.99-231) . The FCC will be issuing its ruling on ET Docket No.99-231 on or after June 2000. The ruling will decide the issue of frequency expansion requested by some manufacturers and contested by others. The FCC adopts

guidelines for the health and safety aspects of this wireless license-less technology. Please note that guidelines are voluntary.

Presentations made to this writer by industry representatives demonstrated the newness with many aspects of this technology, especially the health and safety aspects. The writer has requested power density and specific absorption rates of each company's wireless product. The requests were made during and after wireless vendor presentations, phone calls to vendors, and e-mails. **So far, all wireless companies have failed to furnish this writer with the requested information.**

School District Liability Questions

1. In light of the current scientific controversy surrounding RF/MW radiation, what kind of financial liability would a school district incur if long-term exposure to wireless communications is found to cause cancer or other disorders? See: "CIOs warned of cell phone risks."

http://www.computerworld.com/cwi/story/0,1199,NAV47_STO47766,00.html

2. If a decision is made to move forward with WLANS, what is the responsibility of the school district relative to disclosing any potential risks to parents, employees, and the public at large?

3. Since the level of risk is yet to be defined, what procedures should be adapted by a school district to integrate this technology into the classroom in the safest possible manner?

4. The issue of exposure of children and others to RF/MW radiation is currently being discussed by those in the legal profession. A plaintiff could request punitive damages on the grounds that the defendants knew or should have known that RF/MW radiation is harmful to human health, and that defendants failed to take affirmative steps to prevent exposure that was at harmful levels. Thus how great could the potential liability for doing nothing be?

5. Are there safer alternatives?

6. On what criteria should the school district base the decision to place wireless technology within its classrooms and schools?

7. If cost savings is the determining factor in this decision, what level of health risk is acceptable and supportable in a broad-scale deployment of wireless technologies in environments populated largely by children who will be subjected to long periods of exposure to RF/MW radiation?