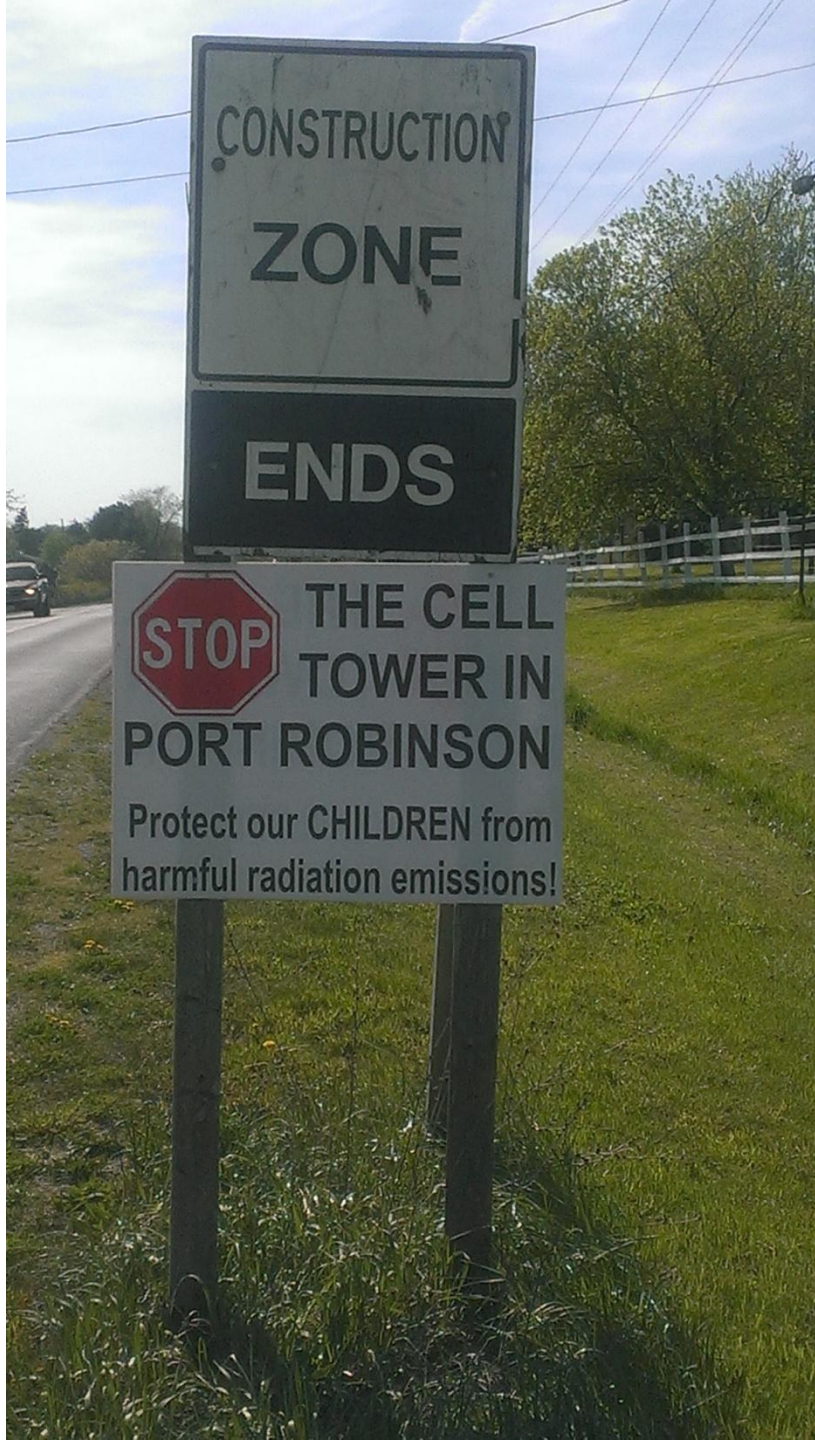


Why is There a Radio Tower in My Backyard?

Roy Blake April 2014





CELL PHONE RADIATION SHIELD



SAR SHIELD
REDUCES
RADIATION
UP TO 87%

"Tested using FCC standards"

"Mobile Phones
linked to Cancer"

abc



"Cell phone
industry to publish
radiation data"

CNN

"Brain cancer
victim sues cell
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Elementary teachers' union updates electronic device policy

CBC News Posted: Aug 17, 2013 5:31 PM ET | Last Updated: Aug 18, 2013 3:41 PM ET

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The Elementary Teachers' Federation of Ontario has updated its policy position on the student use of personal electronic devices, preferring for them to be turned off and put away unless a teacher says otherwise.

That policy, which was amended at the union's annual general meeting, informs ETFO in its discussions with the government and school boards on related issues.

A portion of that policy now states that such devices, which include cellphones, should "be stored and turned off during the instructional day unless their use is directly authorized by staff."

In a separate resolution, ETFO voted to study the effects of non-ionizing electromagnetic radiation, the potentially harmful radiation emitted by cellphones. A report is due on the matter in February.

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Ontario board says Wi-Fi stays in school despite parents' health fears

The Canadian Press

TORONTO — A school board in central Ontario is defending its decision to keep wireless Internet access in classrooms, despite fears from some parents that radiation from Wi-Fi transmissions is making kids sick.

There is no scientific or medical evidence to show children complaining about headaches, dizziness and nausea are being made ill by the Wi-Fi in their classrooms, the Simcoe County District School Board said Monday.

Related Stories

- [Parents complain Wi-Fi is making students sick](#)

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A close-up photograph of a bright red, circular button. The button is mounted on a white base. The word "Panic" is printed in a bold, white, sans-serif font across the center of the red surface. The button is highly reflective, showing clear highlights and shadows. The background is a light-colored surface with a faint grid pattern, possibly a window pane or a table. The lighting is bright, creating a strong contrast between the red and white.

Panic

Solution?



Why So Many Towers?

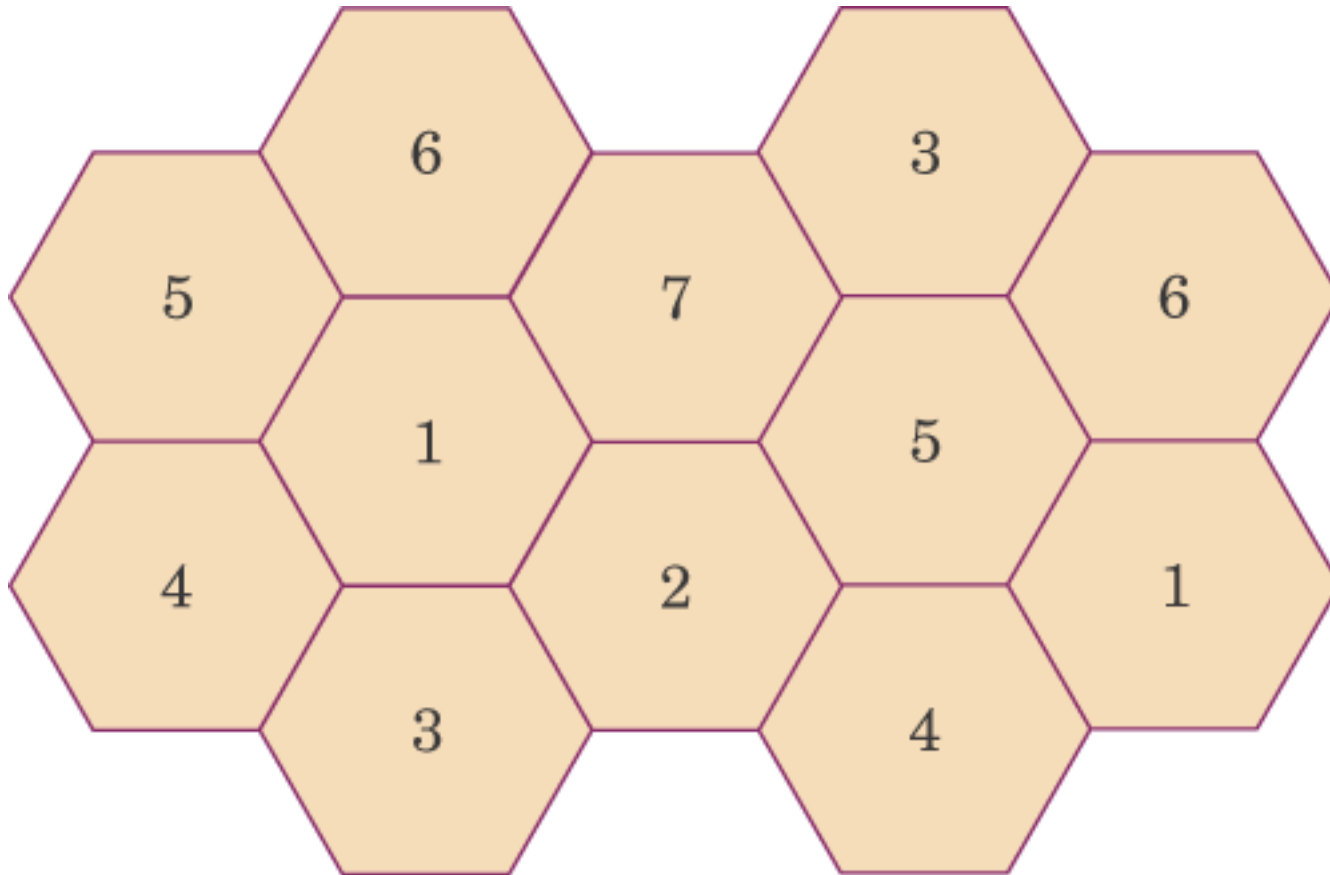
- Older systems for mobile communication use one high tower.
- Each tower allowed only one communication per channel for a radius of about 30 km or an area of about 2800 square km.
- Could not cope with large communication volumes.
- Mobiles need high power (about 30 – 80 watts).
- Not suitable for portable use.



Cellular Idea

- Move towers closer, reduce power so that range from each tower is limited by power, not by horizon.
- Frequencies can be reused at frequent intervals.
- Communications traffic can be much larger.
- Cell sizes can be made smaller to increase capacity.

Frequency Reuse Example



Effect of Moving Towers Closer

- This is done to reuse frequencies more efficiently and allow more traffic in system.
- Phone and tower transmitter power is reduced to the amount needed to communicate.
- For a close tower, phone power 100 mW or less. Power from tower is also reduced.
- So a closer tower results in LESS radiation exposure from the phone.
- Closer spacing increases phone battery life.

Variation of Power Density with Distance

- At least a Square-law Variation
 - Power density inversely proportional to distance squared in free space
 - In most real situations the effect of distance is greater due to absorption by buildings, etc.
- Distance from phone to brain about 2 cm = .02 m
- Distance from tower to brain at least 100 m
- Attenuation ratio is at least 5000 squared = 25,000,000.

Relative Power Levels

- Phone: Depends on distance to tower
 - Max. power depends on system, approx. 1 W
 - Reduces power when distance is less
 - With close tower, 0.1 W or less.
- Tower transmitter
 - Varies with system, number of channels in use, etc.
 - Max. approx. 100 W in urban areas, less when mobiles are closer.
- So ratio of power from phone to power from tower at head is at least 250,000.

Conclusion

- Radiation from cell tower is negligible compared to radiation from phone itself.
- Smaller cells with closer tower spacing increase reliability and reduce power levels.
- Having cell towers closer actually reduces your exposure because phones automatically reduce power.

Remaining Question

- Is the radiation from the phone itself a problem?
- Standards are set by govt. based on absorption of power by brain.
- SAR: specific absorption rate
 - 1.6 W/kg in brain
- All phones meet or exceed the standards.
- Are the standards reasonable?

Electromagnetic Radiation

- Includes radio, infrared, light, ultraviolet, X-rays, Gamma rays.
- All electromagnetic energy is transmitted in packets of energy (photons) that represent the minimum amount at a given frequency.

Energy per Photon

$$E = 1.24/\lambda$$

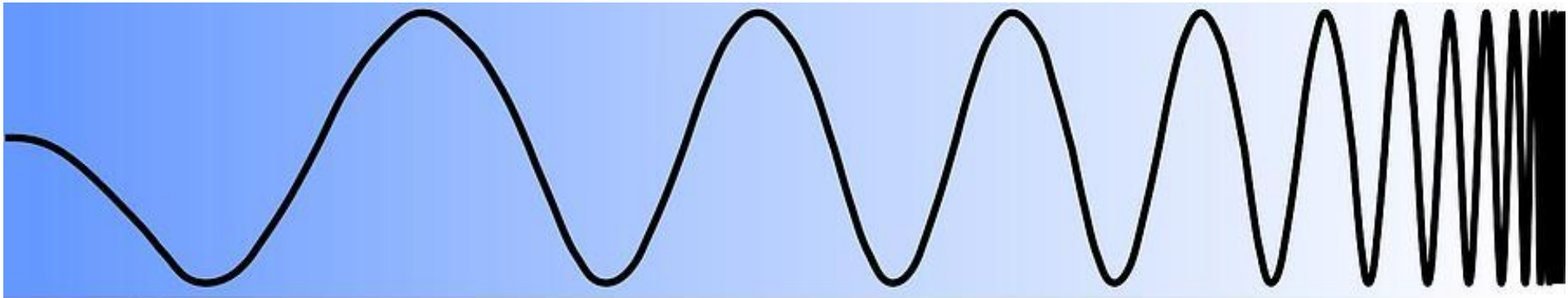
Where

E is energy in electron-volts (eV)

λ is wavelength in micrometers (μm)

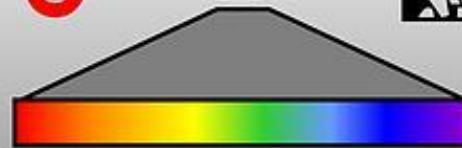
The higher the frequency, the shorter the wavelength, and the more energy in each photon.

Electromagnetic Spectrum



Frequency [Hz]

0 10^2 10^4 10^6 10^8 10^{10} 10^{12} 10^{14} 10^{16} 10^{18} 10^{20} 10^{22} 10^{24}



Radio

TV

Microwave

Infrared

Visible Light

X-ray

Gamma ray

Low Frequency

High Frequency

Ionizing and Non-Ionizing Radiation

- If the energy in a photon is sufficient, electrons can be removed from atoms, ionizing them
- This can cause destructive effects in organic molecules, for example cancer.
- For organic molecules, this transition occurs somewhere in the ultraviolet region.

Photon Energy Examples

- Radio waves (2 GHz or 150 mm): 0.000008 eV
- Infrared: (10 μm): 0.1 eV
- Visible light: (600 nm) 2 eV
- Ultraviolet light (300 nm): 4 eV
- X-rays (colour TV tube): 30,000 eV
- Dental X-rays (70 kV) 70,000 eV
- Gamma rays: 100,000 eV
- Radio waves are not even close to being ionizing radiation

Danger of Non-Ionizing Radiation

- Heating of Tissues
 - Depends on absorption of energy
 - Varies with frequency and power density
- This is how a microwave oven cooks food
- Very high intensities can cause burns or electric shock
- Other interactions have been suggested but not proven

How Do We Prove Something is Safe?

- We can't.
- All we can say is that we haven't found anything dangerous about it --- yet.
- We can always ask for more studies.
- Two main ways of finding dangers:
 - Find a mechanism whereby harm is done.
 - Use epidemiological data to show an association between use of something and some harm.

Epidemiological Studies

- Hard to do, as you need populations whose lives are similar except as to cellphone use.
- Changes take place during long-term studies, for instance:
 - Cellphone use has gone up.
 - Cellphone power levels have gone down.
 - Different frequencies have come into use.
 - Change from analog to digital: changes peak to average power ratio.

Interphone Study

- Long term study (2000-2010) of cellphone use and brain cancer in 13 countries
- Results published by World Health Organization 2012
- Widely reported as “cellphones cause cancer”

Actual Conclusions

“The Interphone Study Group concluded with the following key message:

A reduced OR for glioma and meningioma related to ever having been a regular mobile phone user possibly reflects participation bias or other methodological limitations.

No elevated OR for glioma or meningioma was observed ≥ 10 years after first phone use. There were suggestions of an increased risk of glioma, and much less so meningioma, in the highest decile of cumulative call time, in subjects who reported usual phone use on the same side of the head as their tumour and, for glioma, for tumours in the temporal lobe.

Biases and errors limit the strength of the conclusions that can be drawn from these analyses and prevent a causal interpretation. “

- Source: World Health Organization

Royal Society of Canada

- Released results of a study on April 1 this year.
- 165 pages.
- Looked at many other studies, including the WHO study.
- Found no convincing evidence for:
 - Non-thermal effects.
 - Electromagnetic hypersensitivity.
- Noted that many studies are contradictory
 - Example: glucose metabolism

Royal Society's Conclusions

- Current standards are satisfactory.
- More research would be helpful.

Hoaxes and Biases

- Some biology researchers seem to lack knowledge of electronics.
- Some researchers seem to conclude first, then find evidence to confirm biases.
- Some deliberate hoaxes.

So---?

- There is some indication of some possible danger in heavy cellphone use --- from the phone, but not enough to conclude anything at all.
- Exposure from towers is much, much less than from phones.
- Forget about the towers (the closer they are the better)
- Use the phone on speaker, or with headset, if worried.
- (I'm not worried.)

Use of Speakers, Headsets, etc.

- When held against ear, distance about 2 cm
- When at arm's length, distance about 1 m
- Exposure from phone at ear is about 2500 times as much as from phone at arm's length.
- Bluetooth headsets radiate, but much less than phone.

Use of Gadgets to Shield Phone

- Probably no effect.
- If they are effective at all, phone will just increase power to compensate.
- Only effect will be to drain phone battery more quickly.

The Real Cellphone Dangers

- Texting and driving.
 - At least as dangerous as drunk driving.
- Even talking with a handsfree device is much more distracting than talking with someone in the car.

Aesthetic Considerations

- Waddaya mean, antennas are ugly?
 - I think they're beautiful.
- However, cell towers can be disguised and antennas can be hidden.
 - Sometimes people complain that this is a plot to sneak them in --- it isn't.
- The following example was found in Algonquin Park.

Looks Like a Tree



An Air-Conditioned Outhouse?



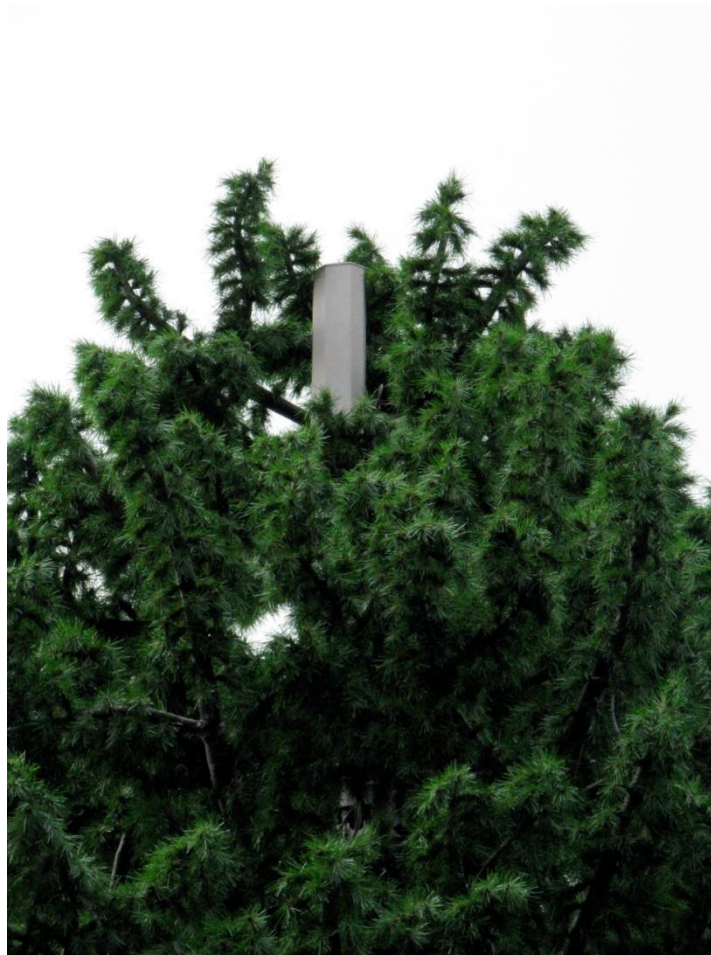
Interesting Tree Trunk



Fake Bark Near Bottom Only



Antenna Nestled in Fake Foliage



Other Wireless Systems

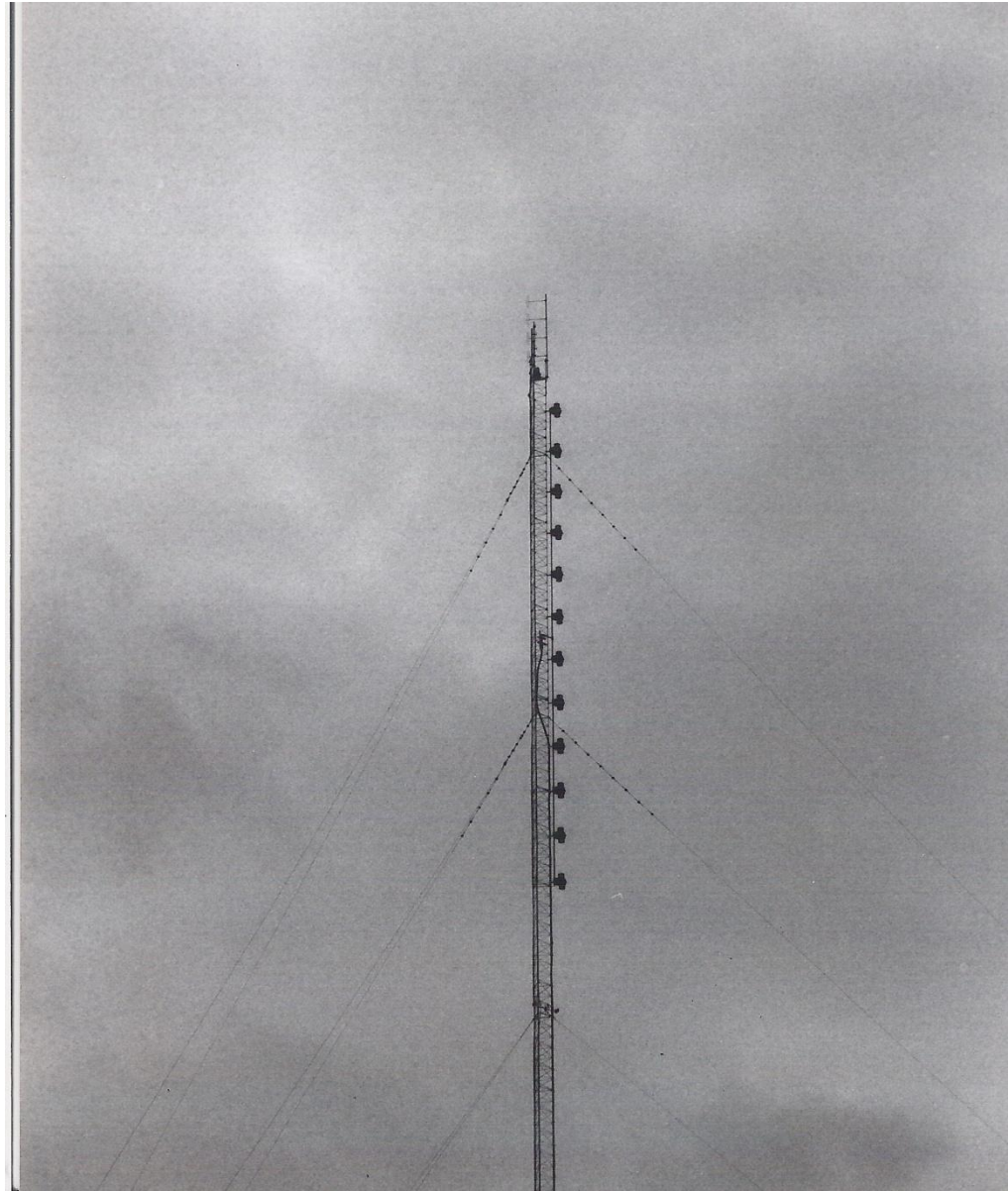
- WiFi
 - Generally less power than phones (approx. 100 mW) and farther from body (except for a phone with Wifi).
- Bluetooth
 - Minimal power (generally 2.5 mW).
- Cordless Phones
 - Depends on type, generally about 10 mW.
- Wireless microphones
 - About 10 mW, transmitter on body, not near head.
- Smart meters: about 1 W, 2 minutes/day.

Other Wireless Systems

- FRS/GMRS transceivers (used for family communication)
 - 0.5 to 2 W.
- Handheld transceivers (as used by security guards, etc.)
 - typically 4 - 5 W.
- Mobile transceivers (police, taxis, etc.)
 - Typically 30 – 75 W.

Broadcast Transmitters

- Much higher power levels (thousands of watts to hundreds of thousands).
- Generally much farther from people.



DON'T PANIC

The Hitchhiker's Guide to the Galaxy



Links

Royal Society of Canada study, April 2014:

<http://rsc-src.ca/en/expert-panels/rsc-reports/review-safety-code-6-2013-health-canadas-safety-limits-for-exposure-to>

Health Canada

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

World Health Organization:

<http://www.who.int/peh-emf/en/>

Federal Communications Commission (USA):

<https://www.fcc.gov/guides/human-exposure-rf-fields-guidelines-cellular-and-pcs-sites>

Science Media Centre of Canada:

http://www.sciencemediacentre.ca/smc/docs/NIR_final.pdf

EMF and Health:

<http://www.emfandhealth.com/About%20Us.html>

Science Blogs:

<http://scienceblogs.com/insolence/2010/08/17/oh-no-school-wifi-is-making-our-kids-sic/>

Skeptic North

<http://www.skepticnorth.com/2010/11/magda-havas-new-ehs-study-has-serious-flaws/>