

Abthorpe Broadband Association Ltd.

Bringing Broadband to the community since 2003.

Radiation risks of 2.4GHz and 5GHz “WiFi” wireless transmissions

Origins of information

This is a collection of information published by authoritative organisations focusing on the health risks of wireless transmissions. The report has been assembled by Eric Malcomson, Chairman of the Abthorpe Broadband Association Limited.

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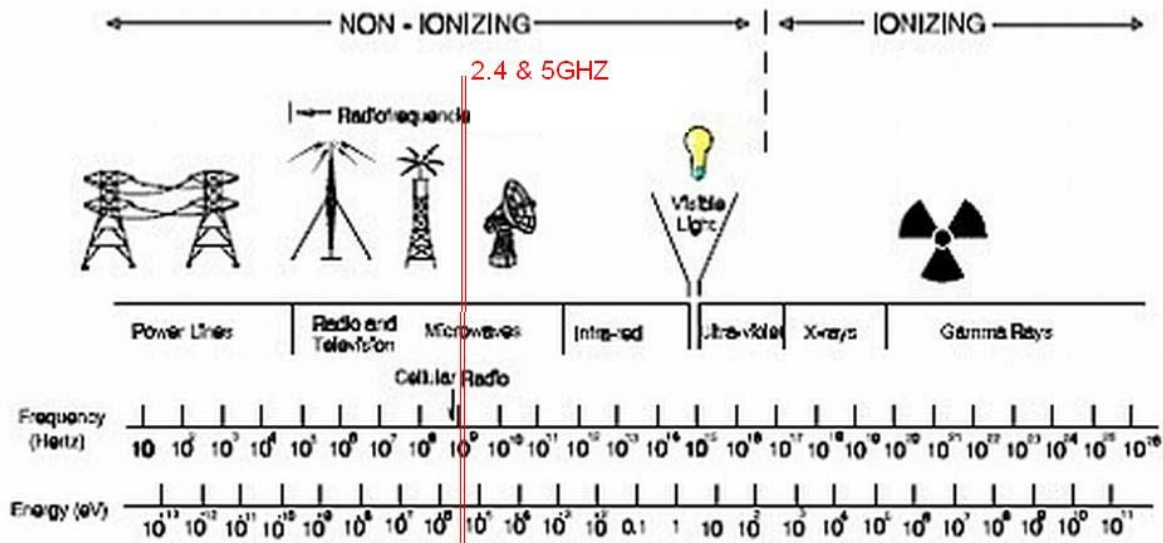
Summary

There has been more than 20 years of constant monitoring by authoritative bodies of the effects of microwave radiation on people, animals and plants. Everywhere you look, the official declarations conclude that, working at the frequencies and power output ABbA are allowed to use, which is 100s of times less than that allowed for mobile phone transmissions, there is no cause for concern about any of the installations and operations used or proposed. Indeed it is in our project’s definition to Defra, from whom we hope to get grants, that we develop the Tove Valley Broadband service to use fibre to premises and reduce the use of external WiFi to an absolute minimum.

ABbA’s installations comply with the very stringent [Parliamentary Assembly of the Council of Europe resolution 1815 \(27 May 2011\)](#) whereas it is likely that most home WiFi systems do not. *I recommend parents read this resolution, especially their advice on the use of mobile phones by children.*

First Steps

Electromagnetic radiation is measured in Frequency and Energy. The table below helps to understand this relationship in terms of the *type* of radiation. The dangerous radiation, called ionizing radiation, will be responsible for altering tissue of any kind to a lesser or greater degree. For example the X-rays used in medicine, if the subject is exposed to them for long enough, are dangerous - hence the very cautionary way in which we use them. Actually, we are exposed to the equivalent of 2 chest Xrays per annum simply from cosmic radiation falling on Earth from outer space. We are genetically designed to survive this.



However, *any* transmission can be said to be dangerous if enough power is fed to it so we should be concerned with the level of absorption of this radiation and its effect on humans, animals and plants.

Non-ionizing microwaves can impart thermal energy to a body due to its interactions with water and water vapour. Microwave ovens are a typical example and we know that 100s of Watts of power at close quarters is required to do this. Incidentally, microwave (radio) observatories are typically placed in high, dry places on Earth to lessen the amount of interference that water vapour in our atmosphere can cause to the readings. Microwaves are also blamed for other physiological changes in the body and whilst no scientific studies have absolutely proven this, I think it would be good practice to minimise the chances. So I need to talk about how these effects can be related to radiated power.

Frequencies and power levels available to us

The vast majority of WiFi works in two **frequency** areas – known as the 2.4GHz and 5GHz bands. In each of these there are distinct channels – 11 in the 2.4GHz and 20 in the 5GHz. These bands are unlicensed – anyone can use them, as long as they stay below the power limits set by the Ofcom and other international organisations.

The maximum **power** we can feed to our aerials is 100mW (0.1Watts) generally, and in certain special circumstances, 250mW, which requires a licence from Ofcom.

WiFi power levels allowed in the UK are much less than those allowed in other countries. For example, WiFi in the USA can be 20 times the power allowed here. This is why it is very irresponsible to use data published on USA-based websites – such information is not relevant to the situation in the UK.

It is important to understand that the radiation which we are subjected to is a combination of the actual power fed to the aerial and the amplification factor of the aerial itself. For example, the noise level of a music amplifier is a combination of the power fed to the loudspeakers and the efficiency of the loudspeakers themselves.

This combination power is called the maximum equivalent isotropically radiated power ([EIRP](#)) and it is the value of this which is used to set the limits for continuous and “burst” emissions for the general public and occupational arenas.

This power is measured in several units, but to be able to compare levels combined from several sources, I will stick to V/m throughout. V/m (volts per metre) is a measure of the strength of the EIRP. ABbA have in their stock two power meters (which you can borrow) and the readings from these meters are in mV/m (1000mV/m = 1V/m) or V/m. One of the meters will pick up almost all microwave radiation, the other is accurately calibrated and picks up WiFi frequencies only. Aside again, the expression WiMax refers to a method of maximising the throughput of data through WiFi – it uses no more power than ordinary/domestic WiFi as indicated above - a bit like JPEG and BMP are both systems of digitally recording pictures. JPEG scrunches the picture into a smaller file so you get more information compared to a BMP picture of the same file size.

Overall limitations for continuous microwave transmissions

I have to choose what I consider to be *the* authoritative organisation on these matters and most governments around the world choose [ICNIRP](#) which stands for the International Commission on Non-Ionising Radiation Protection. Our own HPA (Health Protection Agency) and [HSE](#) recommended to the UK government to adopt ICNIRP’s guidelines which they duly did. ICNIRP science is based on the heating effect of microwaves. However, the words of the [Parliamentary Assembly of the Council of Europe resolution 1815 \(27 May 2011\)](#) (PACE) are salutary:

“6. The Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures.”

So, our limitations are that

- ICNIRP says that the general public continuous exposure should be no more than 61V/m (10Watts per square metre) and for occupational work exposure, 137V/m.
- PACE says
 - “8.2.1. set preventive thresholds for levels of long-term exposure to microwaves in all **indoor** areas, in accordance with the precautionary principle [ALARA – as low as reasonably achievable], not exceeding 0.6 volts per metre, and in the medium term to reduce it to 0.2 volts per metre;”

And to compare these levels of WiFi exposure to typical situations:

- Wi-Fi exposures for people in rooms with WLAN hubs range from 0.1 – 3.0 V/m (can go up to 6 V/m). I would recommend you be no nearer than 6 feet for continuous work.
- Radiation from a microwave oven is about 10V/m at the glass, 5V/m at 1 metre and 1V/m at 5 metres. Do not stare into an oven – eyes cannot get rid of heat like other parts of your body.

Tove Valley Broadband (TVB)

Broadband is to be delivered (spring 2013) by external access points and point-to-point pipes using commercial equipment designed and locked to UK/EU electrical regulations. It is a fact that almost any material quickly destroys the ability to communicate at the power allowed, so line-of-sight is a necessity for devices to connect. This fact also means that virtually no radiation is transmitted into buildings – you will not be able to use a device inside your home to make the connection to TVB (unlike, for example, mobile phones). Outside, the radiation you will be subjected to from TVB devices is *below the minimum of the PACE resolution for indoor exposure - less than 0.6V/m*. Furthermore, our longer-term plans are to replace the WiFi with fibre – which, unlike telephone and electricity wires, doesn't even have an electromagnetic field.

Some other facts

Data throughput – bandwidth – is achieved by the application of techniques (protocols) defined by standards 802.11a/b/g/n (commonly) and 802.16 (WiMax). These techniques transmit at or up to the regulation power limits as above.

MIMO is a term used where there are two radios – one for transmitting and one for receiving – this way they can work faster and give you greater bandwidth. The exposure to radiation is the same as for non-MIMO because (generally) one radio only receives and does not radiate (transmit) power.

Mobile phones transmit at microwave frequencies:

- a) A mobile phone transmits at a power of up to 2Watts – 20 times the level of WiFi - 20 minutes on a mobile phone running at typical power levels would be equivalent to about 16 hours in a classroom with 20 WLAN PCs (approximately eight standard school days). (But please note that St Loys school does not deploy WLAN PCs.)
- b) A mobile phone transmission mast with several sector aerials may be transmitting up to 100Watts of power – 400 times the level of even our most powerful licenced radios.

The radios we use in the Tove Valley operate at 5GHz and we chose these for two reasons – the 5GHz bands are very much less congested with other traffic (door bells, microwave ovens, telephones, domestic WiFi, child alarms, etc.) and we can transmit data at a higher rate (bandwidth).

Devices transmitting in the microwave bands

Here is a table of measurements we have taken of the various devices in everyday use and their radiated power at 1m, 2, and 5m.

Device	V/m at 1m	V/m at 2m	V/m at 5m
Microwave oven (1000W)	5.00	2.00	1.00
Portable telephone (base station)	0.80	0.30	0.10
Garage door remote controlled (base unit)	0.80	0.30	0.10
Lap-top computer connected by WiFi	0.80	0.30	0.10
Printer connected by WiFi	0.80	0.30	0.10
Weather station (base unit - intermittent)	0.80	0.30	0.10
Mobile telephone “repeater” stations			
WiFi access point (router)	0.50	0.20	0.06
Mobile telephone (gsm, WiFi and Bluetooth)	0.35	0.27	
Baby alarm (wireless versions)			
Door bell (wireless versions)	0.30	0.10	
Mobile telephone (gsm only - bursts)	0.20	0.09	0.05
External WiFi access points for Tove Valley	n/a	n/a	n/a

None of Tove Valley Broadband transmitters are within 5m of free-air distance of the public. In fact most are 10m or more above ground. We have surveyed the radiated power from our access points (at Abthorpe and Wappenham) with similarities to all other planned access points – the results can be found in [ABbA-TVB RF surveys.pdf](#)

Multiple aerials at one place

I have explained that the WiFi transmissions are 100s of times less than those allowed for mobile phones. What about the concentration of aerials at distribution points within the valley?

Possibly the highest concentration of equipment will be the 5GHz units on the top of the church tower at Wappenham. Here there may be four highly directional (8 to 16 degrees horizontal and 250mW maximum) aerials (to Weston, Weedon Lois, Slapton and Abthorpe). For people in Wappenham to access the service, there will be up to four sector aerials (90 degrees horizontal and 100mW maximum) aimed at roof-top levels. Because these aerials are directional, the radiation below an aerial is much much less than in front of it.

Another wireless distribution point will be at St Loys School in Weedon Lois. Here, high up above the school on a chimney stack we are asking for permission to mount four aerials. Two of these (Weedon Lois to Wappenham and Weedon Lois to Helmdon/Astwell) may reach a maximum of 250mW each. These units will transmit using a very narrow beam – 8 degrees horizontal – and there is little significant radiation underneath the aerials where children might be. The other two are sector aerials operating in the low power range up to 100mW each and cover about 90 degrees horizontal directed at roof-top levels in the Lois Weedon community.

Eric Malcomson

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