

# Radiofrequency Protection for You and Your Family

This article is separated into 6 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

## Section 2

### Sources of RF outside the home

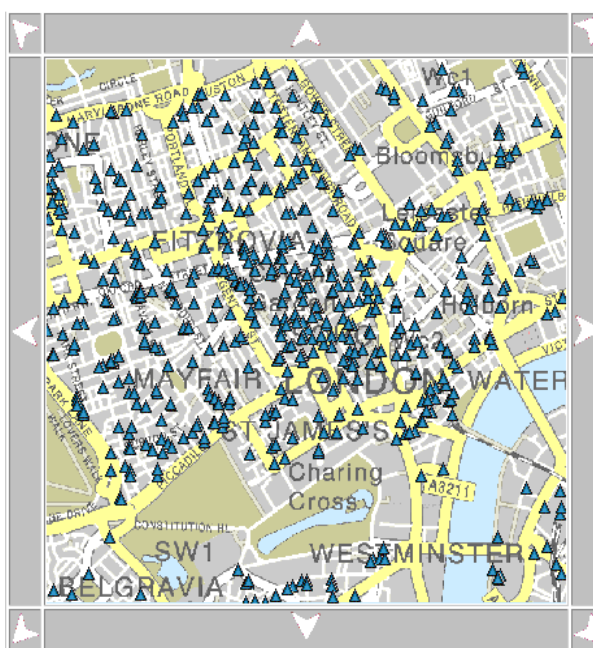
1. Introduction; health effects associated with RF radiation; TV and radio; mobile phone masts or base stations; graphs showing change of symptoms experienced according to RF exposure levels; other sources of RF radiation
2. Sources outside the home; mobile phone masts (base stations); Televisions and TV transmitters; WiFi; interactive whiteboards in classrooms; hospitals; wLANs in offices; transport; internet cafés; WiMAX; street lighting; bus stops; radar; amateur radio enthusiasts; local radio communication services; local broadband services; military equipment; police surveillance
3. Sources inside the home; mobile phones; digital cordless (DECT) phones; wired telephones; television; lighting; computer monitors; wireless mice; computer broadband connections; laptop computers; computer wireless LAN (local area network) broadband connections; dLANs/Homeplug devices; microwave ovens; baby monitors; alarm buttons; children's games; burglar alarms; 'smart' utility meters; hearing aids; dental work; de-humidifiers
4. Measuring exposure, screening and protection; How does microwave radiation get in from outside? Windows; the glass; windowfilm; curtains; Naturell; Exel; Silvascreen; bed canopies; shielding sleeping bag; bedding; earthed grounding sheets; walls; paint; skirting boards and curtain battens; ceilings; doors; Why, when I screen out the fields, does my phone still work? insulation; phones; mains filters; dirty electricity; lighting; Litovitz equipment; (electromagnetic noise)
5. Personal Screening; shielding clothing; phone pouches and headsets
6. 48 references

## Sources of RF outside the home

### Mobile Phone masts (base stations)

Professor Lawrie Challis, who used to be the chair of the Mobile Telephony Health Research (MTHR) committee admitted in 2003 that mobile phone transmitters had still not been proven to be safe. *"We cannot say there is no risk. You could never say that. All you can do is take measures to reduce those risks. The Government doesn't want to hear that message. They want us to say that masts are completely safe and aren't dangerous, but we can't say that."*

Eleven years on, the uncertainty about the masts continues, and the situation is getting harder to research as sources of RF radiation are rapidly increasing. However, mobile phone masts are still one of the dominant exposure sources to the general public, as Frei (2009), Kim & Park (2010) and Estenberg & Augustsson (2014) showed. In the Frei study, the team concluded that about one third (32.0%) of RF exposure came from mobile phone masts, mobile phones were responsible for 29.1%, and DECT phones 22.7%. It is clear that studies looking at any one exposure alone, will not be able to give a clear result. Tomitsch & Dechant (2012) records that between 2006 and 2009, RF exposure levels in homes in Austria increased from 0.12 V/m to 0.15 V/m. The situation is likely to be similar in the UK. As people with RF sensitivities (RF-ES) start to react at levels of 0.05 V/m (see Section 1), more and more people are going to react with health effects to these increasing levels of exposure.



Base stations displayed in this square	
Single operator GSM technology	340
Single operator UMTS technology	46
Single operator TETRA technology	5
Shared base stations with more than one operator or more than one technology	204

The map above shows how many base stations there were in an area of London before the Ofcom site became less reliably updated at the beginning of 2007. It does show how difficult it is to avoid being exposed to environmental microwaves if you live in an urban area with a high density of population. A study by Mahfouz (2013) said that the higher the population density, the higher the exposure, and there was little difference between level of exposure at the weekends compared with during the week.

In 2005, in central London, peak levels of RF were 1 to 2 V/m and averaged about 0.2 V/m. In 2010, it varied from 1 to 10 V/m and was regularly around 4-6 V/m peak. The average had increased due to the overall higher and more continuous power of 3G/UMTS. The 4G (LTE) system is strongly pulsed, and we fear that it may be considerably more biologically active than the current RF emissions we are exposed to. It operates in the low frequency 800 MHz band. It will be good at penetrating buildings, allowing operators to offer better in-building coverage which is becoming an increasing problem as people use their smartphones at home. The UK needs extra base stations to improve rural coverage. There were about 57,000 masts in the UK according to the Mobile Operators Association on 25 February 2013.

A study by Joseph (2012) looking at RF exposures in Belgium, the Netherlands and Sweden found that the dominating outdoor source is GSM900, matched by indoor DECT! He had also found 0.8 V/m from LTE (4G) masts in Stockholm in an earlier study which adds to the electromagnetic 'soup' (Joseph 2010). A further study of his revealed that the highest total personal exposure to RF was inside transport vehicles (trains, cars & buses), mainly due to radiation from mobile phone handsets (Joseph 2010).

Consequences of long-term exposure to the electromagnetic radiation caused by cell phone towers are still unknown and can potentially be a health hazard. In a study by Tuysuz & Mahmutoglu (2017) the authors observed that Turkish national limits were not exceeded, but the safety distance was waived at some of the measurement points and above average radiation levels were noted. Even if the national limits are not exceeded, the long-term effects of exposure to the electromagnetic radiation can cause serious health problems.

This is a site that provides pretty good information about French mobile phone base stations <http://www.antennesmobiles.fr/>.

Koprivica (2014) found that RF measured up to 10 V/m near mobile phone masts, and up to 2 V/m at 50 metres distance, in Serbia.

There are estimated to be about 77 million mobile phones in the UK, more than the total number of UK residents; nearly everyone over the age of 8 has their own phone. As well as the TETRA system, which is used for the emergency services, there are 4 main UK telecommunications operators. Customers of Everything Everywhere are encouraged to sign up for the free 'roaming' service which means that they will be able to switch automatically to whichever network of masts is offering the strongest signal. They are building a next-generation LTE (4G) network to cope with the surge in demand for data and the mobile web. This is likely to be more biologically aggressive than any of the existing networks.

Under the 1984 Act, operators of 2G systems are required to provide 'reasonable coverage' to about 97% of the British population. 3G covers about 90% (August 2011) of the population. There is a move to install more base stations to improve coverage now that 3G has become very profitable, and 4G is widely available. The government allows the mobile phone industry to upgrade their systems to LTE (4G), WiMax and anything else their handsets can cope with, without seeking planning permission.

In 2010, it was reported that mobile phone coverage in remote areas of Britain is 'patchy', causing problems for farmers and small businesses, especially when the economic environment is poor. The Commission for Rural Communities (CRC) said much of the problem is a lack of mobile phone base stations in certain areas, often because it is difficult to get planning permission for masts in scenic spots. They are suggesting that the government shake up planning laws so it is easier to put up the masts.

People expect to be able to have a good enough signal to use their mobile phones everywhere; travelling in cars and trains, inside work places and inside their own homes (in 2011, 15% of UK households and 26% of households of 15-24 year olds only had mobile phones, they did not have wired ones at all). This means that base station antennas must be close to where people want to use their handsets to compensate for the screening effect of building materials and vehicle metals. The 5G service will include installing low-powered base stations inside homes. With increasing call traffic, more base stations have to be installed. Due to determined public opposition to high masts, mobile phone operators have had to attempt to make them less conspicuous, sometimes concealing them in church spires, petrol stations and in trees, often reducing their size. They have offered home owners as much as £7,000 a year in rent in 2002 to hide mobile phone masts attached their homes, such as inside chimneys, burglar alarms and drain pipes. Many of these smaller installations do not require planning permission from the local authority, there is no legislative control over the positioning of these types of masts, nor control over the power emitted, only guidelines.

In highly populated areas such as London, the number of base stations now operational has resulted in quite a high ambient microwave level experienced by everybody. We have found that in many town and city centres the background signal levels now exceed 5 V/m in areas of public access (higher than that permitted in some European countries).

Nano, pico and femto cells have also been installed by businesses and governments all over the place to give good cellular coverage inside large buildings, such as London department stores and hotels.

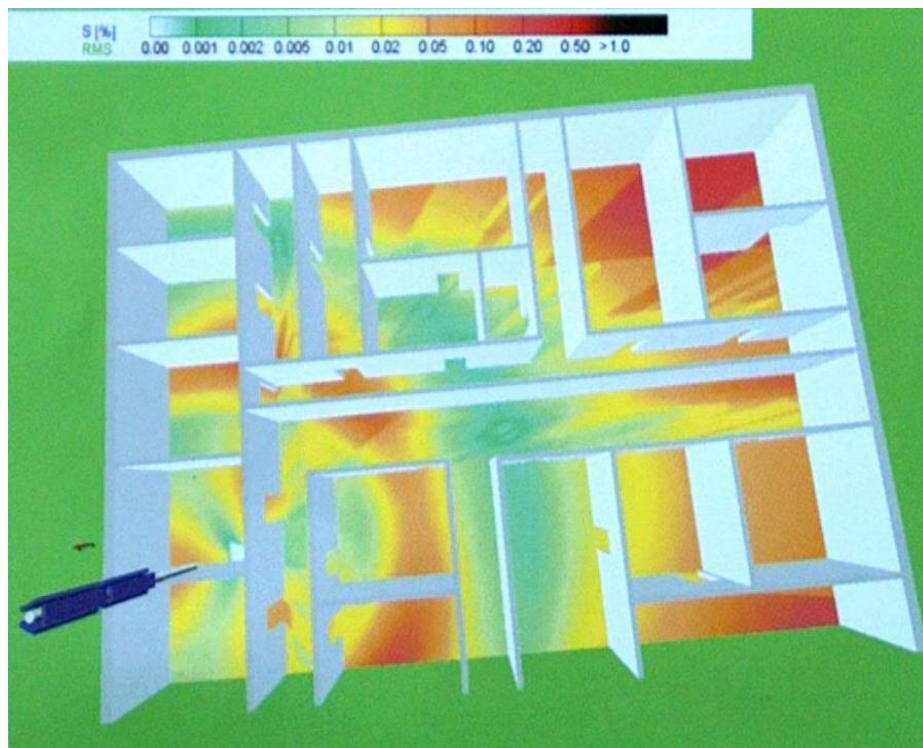
Drums, or dishes, of different sizes communicate from one base station to another in a very tightly focused beam. These contribute minimally to the overall microwave exposure in the area immediately surrounding them, though they can look pretty dominant.

Base-station antennas radiate most of their power sideways, a bit like a lighthouse, and very little power goes upwards or directly downwards. Hotspots created by imperfect antenna design are fairly small areas of high levels of microwave signals, which can vary from 6" to 5' in depth and 3" to 5-6 feet across. These are easily detectable, but not predictable. The radiation pattern is further complicated by reflections of the microwaves from the ground, buildings and other structures, including vehicles. If there is a base station on top of a building, the antennas can irradiate the occupants of the building in ways that are not easy to predict.



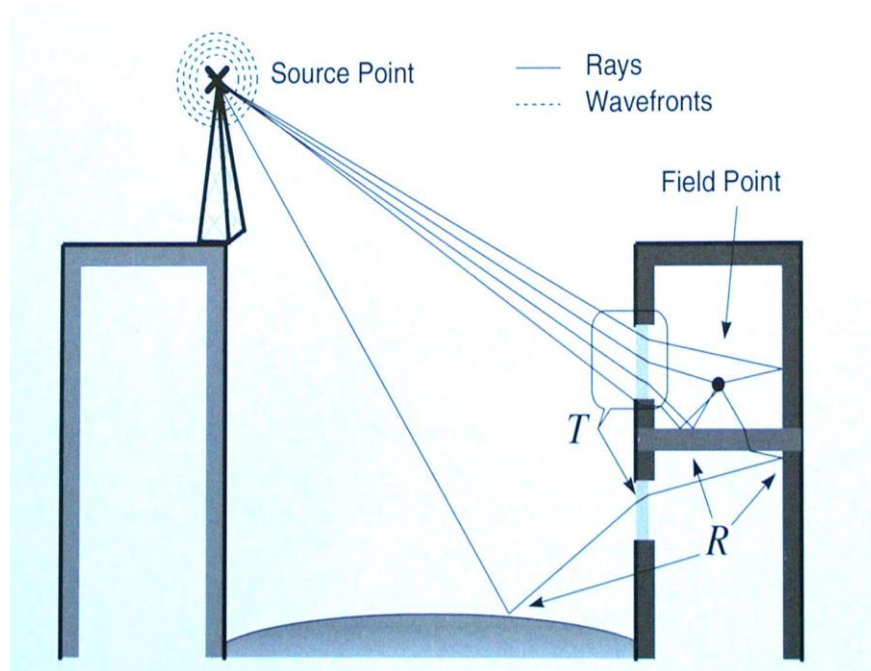


**A base station on the roof of a building, showing signal strength levels**



**The floor directly underneath the base station (at the front left) showing the levels of radiation experienced by occupants of the various rooms. The most exposed room is at the top right, at the corner furthest from the base station position.**

Further complications can be seen from the simplified schematic diagram below, which only includes one transmitting antenna.



**A base station radiating a nearby property, taken from *Antennas & Propagation* by Simon Saunders (ISBN 0 471 98609 7)**

Hotspots are best avoided in the placement of beds in bedrooms, favourite chairs in sitting rooms and play areas, etc.

The signals from masts can vary considerably during the day, depending on the amount of call traffic density. An individual's exposure from masts will depend significantly on the type of environment they are in, whether it is reflective or not (Vermeeren [2010](#)). This type of scenario was not anticipated, it seems, when ICNIRP restrictions were developed.

Measuring them using a microwave meter shows that signal levels can vary by factors of five or more within the space of a metre. For [appropriate instruments for sale](#) from EMFields see Section 4.

The signals from masts can also resonate with house wiring, causing high fields inside the house, often from lights which hang from the ceiling, where the radiofrequency signals 'run down' the electric flex, or from telephone lines which have picked up RF from nearby external sources. If this is the case in a house, there may be high radiofrequency fields, even though there are no direct sources of radiofrequency emissions from household appliances or external systems. To remove these, see Section 4.

## **Other potential outside sources of radiofrequency radiation**

### **Televisions and TV transmitters**

See the separate article [Television and TV transmitters](#) for information about televisions, the new digital TV and radio transmitters.

## WiFi

We predict that the levels in the corridors and classrooms of a school with a wLAN system in place will expose children to relatively high levels of 'pulsing' microwaves all day, every day. It may be contained, more or less, in one room if the system is fairly small, such as for example, in a science laboratory. The levels the children are likely to be exposed to are similar to those in a Latvian study where the children living in these fields had problems with motor function, memory and attention span, their reaction time was slower and their neuromuscular endurance was decreased. See also [Your low EMF Home 5. WiFi](#) and [Schools and Wireless Technology](#)'.

Parents of children in some schools have persuaded the head teacher to remove the wLAN (or WiFi) system, because of their concerns for their children's well-being. A parent in one of the schools said *"they (wLANs) are like having a phone mast in the classroom and the transmitters are placed very close to the children."*

The Royal College of Music, in London, has installed a wireless LAN system to provide its 600 students and 300 staff with reliable wireless access in the College's main building, including practice rooms, theatres and its halls of residence. The music school is based in a historic building built of thick brick and concrete, which makes it difficult for wLANs to penetrate. With the increasing number of laptops and handheld devices brought in to enhance the learning experience and make studies more productive, it became more important to have a reliable WiFi system.

We were told in September 2010 that WiFi is now offered at 89 TGCG garden centres. *"Motorists keen to break their journeys to check their emails or use the internet can now do so"*. Those ES people who want to shop for their garden are no longer able to without suffering ill effects.

BT does not need planning permission (only individual permission) to install WiFi nodes in people's houses that allow others in the area concerned to access the internet. These are springing up all over the place and may affect your exposure to RF in your home. BT Openzone and BT FON have been quietly implementing this service freely (apparently) through the use of the 5.4 million Home Hubs BT has in service. We believe you have to opt out of your one being used as an Open Access point for WiFi in the area around your house by other people signed up to BT FON. BT is intending to upgrade customers' Home Hub equipment to broadcast 4G as well as WiFi signals.

BT FON is an initiative between BT and FON that aims to give all its members access to wireless broadband wherever they are in the world. This is possible because all BT Total Broadband customers who've opted in agree to securely share, with other members who are in range of their signal, a portion of their WiFi bandwidth through a separate channel on their Hub. Using your BT Openzone account, you can enjoy wireless internet access at hundreds of thousands of BT FON locations in the UK and the Republic of Ireland.

WiFi has been installed in Waitrose stores, and one person measured 0.3 V/m whilst shopping. This level of exposure may well have adverse health implications for people with ES.

## Interactive whiteboards in classrooms

These can be very valuable teaching and learning tools. From an EMF point of view, systems which are powered using wires are not a problem at all. There are other ways of powering the systems that we are not as happy with. These include:-

- Where the teacher has a console on the desk, and there is a WiFi connection from the console to the whiteboard. Children have to use the teacher's console to input information.

*The teacher will be subject to constant low levels of microwaves whilst the system is working. Children going up to use the console will be exposed during the time of use, but not otherwise.*

- Bluetooth systems which work at very low power and extend to a range of about 30 foot maximum. This is a lot less powerful than the wLAN systems. *Although this works at a lower power, we **cannot recommend it**, as some people can be affected by levels of microwave exposure as low as 0.05 volts per metre. The effects reported have included memory, learning and concentration difficulties and behavioural disturbances, not problems you want to introduce into a classroom.*
- wLAN systems where the console or consoles can travel around the class and be used by more than one person. *This type of system means that all members of the class are exposed to a continual background microwave exposure whilst the system is operational, whether they are using the console or not. In view of the concerns about microwave exposure, even at low levels, we feel we would not like to see this type of system in use in places of learning, especially when a wired system is easy to install.*

## Hospitals

Hospitals are increasingly a very difficult place to be in for anybody who reacts in any way to radiofrequency radiation. The following measurements were taken by one person who has ES and needed emergency treatment at her local hospital.

- 138 heart beats per minute at home, 168 in the cardiac unit.
- Cardiac department. 4V/m radiofrequency radiation levels in the consultant's room, and 1.3V/m where blood pressure and ECGs are taken.
- The intensive care ward is monitored wirelessly, plus there is a wireless telemetry system in the ceilings.
- In a general ward at the other side of the hospital, she was wirelessly monitored. Beds are electrically controlled; the TV/radio/telephone system by each bed uses WiFi. They get turned on in the early morning and go off at about 4.00 a.m.
- Beds and curtain rails are metal (therefore reflective), and difficult to shield.
- The nurses sit at a desk with banks of computers monitoring ECGs, and they have mobiles, iPhones...
- Patients are re-assured about the absence of DECT phones, while people walk by with the handsets (4V/m). Doctors deny having mobiles, even when they go off. Patients use their mobiles – 6V/m, and won't necessarily turn them off.
- Another hospital nearby has lots of phone masts on the roof.

In July 2015 we were told that Preston and Chorley hospitals in Lancashire will be making free WiFi available to all patients, staff and visitors. The hospitals did not say whether they were also providing WiFi-free wards and other areas for people who cannot tolerate RF. I suspect that has not been planned for.

Mobile phones were found to interfere in the operation of external cardiopulmonary monitoring devices in a clinically important way in 7% of the equipment measured (Tri [2001](#)). ELISA readers are widely used as useful diagnostic tools in medicine. The authors of a study (Mortazavi [2016](#)) recommended that medical institutions discuss interference issues in the context of their specific use of technologies and frame a policy that is clear and straightforward to guide staff, patients, and visitors. It may be worthwhile checking out the policies enforced by a hospital that you visit.

The strongest environmental electromagnetic hazards for physiotherapists occur near short-wave diathermy devices, and to a lesser degree near long-wave diathermy devices, but were not found near ultrasound therapy units. Physiotherapists should remain 150-200 cm away from active applicators of short-wave diathermy, and up to 40-45 cm away from long-wave diathermy ones.



Fields in which workers should not be present were measured up to 30-40 cm away from the applicators and cables of active short-wave diathermy devices (Gryz & Karpowicz [2014](#)).

### **wLANS in offices**

Many offices have networked computers. A proportion of these will be networked using a microwave system, and will expose workers in the office to microwave radiation to varying degrees. If DECT cordless phones are also used, a percentage of the workforce could well experience health problems.

### **Transport**

See the article in 2 sections called '[Transport](#)'.

### **Internet cafés**

These cafés are equipped with wireless local area network (wLAN) systems to enable customers to log on to the Internet. There will be an elevated level of microwave radiation in these cafés and electrically sensitive people are unlikely to be able to use them, or even in some cases, pass by without experiencing discomfort.

From a popular café in California ...Equator Coffee in Mill Valley, California 'hardly anyone in this very popular cafe was on a laptop. How could this be? In fact, people were sitting and having actual conversations (once they got through the line, which was almost always out the door). It was like 1995. When I asked the employees about the lack of people glued to computers, they said that the owners didn't want to have WiFi so that people would actually have conversations and enjoy themselves (they also nodded in agreement when I mentioned the health effects). In other words, they wanted this location to be a centre of the community where people preferred to spend time, which it certainly has become. If anything, the lack of WiFi has helped this cafe and the business is a resounding success. In fact, Equator Coffee has been named the 2016 U.S. Small Business Association National Small Business of the Year. Let's hope that more businesses soon realize that their customers would rather have real in-person communication, rather than become even more disconnected via unhealthy microwave technologies. Something tells me that the need for real human connection and the growing evidence of wireless health effects will eventually pop the wireless bubble we find ourselves in today.'

And from a sign in a café ... 'No, we don't have WiFi. Pretend it's 1995. Talk to each other'. Let's hope it catches on in the UK and elsewhere as well.

Unfortunately, some are going the other way: the Spur steak house chain in **South Africa** is promoting virtual reality "goggles" for kids to watch (see below).

The phone is placed in the back and is approximately 5cm from the eyes. There are no instructions to use in airplane mode

The [Acousticom 2](#), RF measuring instrument from EMFields, when put in place of the child's eyes is spiking up to 6V/m or more, which we do not believe children should be exposed to.



## WiMAX

WiMAX has been developed so that people can have Internet access via their laptops whilst on the move. It is very different from WiFi in technicalities. While WiFi is designed as a LAN (Local Area Network), WiMAX is designed as a MAN (Metropolitan Area Network). The most obvious difference is the range. While WiFi is in the hundreds of metres, WiMAX is theoretically designed for up to 30 miles! However, this is only a theoretical range, and it is expected for most base stations to have a range of between 4 and 10 miles.

To achieve such ranges, the power levels have to be much higher, reportedly going up to 40W. Also, frequencies are different, to avoid clashes with WiFi. WiMAX is designed for 2-66 GHz, but so far designated frequencies are all below 10 GHz. The frequencies that have been licensed for frequent use so far are 2.3 GHz, 2.5 GHz, 3.5 GHz, 3.6 GHz, 4.9 GHz and 5.8 GHz. The European fixed WiMAX frequency seems to be 3.5 GHz. The Acoustimeter's range and the Acousticom 2's range (see Section 4) cover all of these frequencies.

Glastonbury was one of the first places to have WiMAX. Local residents reported headaches, dizziness, nausea, severe tiredness, brain fog, disorientation and loss of appetite. Employers complained that their staff could not work properly because of the effects.

## Street Lighting

Some County Councils are hoping to make some of the savings required of them by reducing street lighting. These may expose nearby residents to higher levels of RF pollution.



Lancashire has replaced its street lights with LED bulbs, which are linked wirelessly. This is to enable them to control individual lights, targeting rural areas for cuts, whilst urban areas continue to have most of their lights on.

In March 2011, Surrey County Council decided to replace or refit all its street lamps with new wireless-controlled ones. The transmitters communicate by mesh networking with hubs every kilometre, and will transmit for 0.1 of a second every four seconds.

This will add to the general RF electropollution experienced by residents. Wireless control of course is not needed; passive infra-red motion and LED light sensors could be used instead. Blue light is best at night for curbing vandalism and anti-social behaviour, though lights outside houses will expose occupants to the same blue light that reduces melatonin production. Thicker curtains will be needed to protect melatonin levels, which are a major support in preventing cancer and depression.

It has been suggested that lamp-posts could also act as a 'mast', but they only have a limited range of frequencies they can use, and there is likely to be co-channel interference if these lamp-posts are closer together than, perhaps, 80 metres in urban areas.

## Bus stops

Many bus stops have interactive and updated electronic timetables. It is anticipated that the technology may be used to provide other technical availability, such as local WiFi.

## Radar

There are a number of radar installations servicing the communication needs of airports, seaports or river ports. Workers' occupational exposure to radar has been associated with some patterns of ill-health and we believe that people with sensitised immune systems may well also have health problems in the vicinity of these installations. Most radars are swept through 360 degrees over several seconds, resulting in short bursts of radiation as the beam passes by where you are. The resulting 'pulse rates' are typically in the range 3 to 10 seconds. Radar sources typically operate at 2.6 GHz for weather radars and 8-10 GHz for airport radars.

A study by Joseph (2012) found that the electric fields could exceed the ICNIRP reference level at all seven non-directional beacon sites for air traffic control. Occupational magnetic field levels were exceeded at 2 of the 7.

Weather radar broadcasts at 5.6 GHz and will be picked up by the Acoustimeter and the Acousticom 2. The signals can be quite powerful. The transmitting equipment sweeps very slowly, every half minute or so.

### **Amateur radio enthusiasts**

Radio amateurs have aerials in their gardens, broadcasting over a frequency range from short wave to very high microwave frequencies. These may well be the main source of radio frequency signals in their neighbours' environments. There is no doubt that some people (especially those suffering from electrical hypersensitivity (ES)) will react to these signals. Most of the radiation is associated with the aerials and can extend for a considerable distance. Amateur UHF (microwave) Moon-Bounce transmitters (for the signals to be picked up on the other side of the Earth) use a highly focused aerial array with extremely high power in the main beam (and significant 'splatter' in the sidelobes). These aerial arrays should be kept away from children's play areas and neighbouring houses.

In February 2010, a planning inspector rejected the request for the retention of a radio aerial on a semi-detached house in Herefordshire, 9 metres from a neighbour's bedroom window, after giving weight to neighbouring residents' health fears. The inspector considered that *"the modest structure did not impact unduly on the local townscape."* He added *"PPG8 recognises that the public has become increasingly aware of the presence of EMFs in the environment."* He continued *"exposure to low-level EMFs might cause headaches, sleep disturbance, depression, stress, and cancer is a particular point of public concern. Neighbours' fears were therefore a material planning consideration."*

### **Local radio communication services**

e.g. taxi operators, etc. These can give off quite high levels of microwaves which may be significant in your area.

### **Local broadband services**

Some villages have microwave services offering broadband access to those places not served by BT or cable, though these are becoming less common. There is usually a main link site, and various other smaller sites for the microwave receiver/transmitter equipment, on the houses of people who have signed up for the service. This will increase the amount of background microwave radiation in the locality and is likely to generate various higher level 'hot spots' in and around the transmitter units.

### **Military equipment**

Some forms of equipment on Ministry of Defence property give off a variety of forms of microwave radiation. Fylingdales has been recently pinpointed as creating signals which seriously interfere with car-locking devices, resulting in problems with people getting into their cars to leave.

The USA Navy's Niscemi Naval Radio Transmitter Facility antenna farm and Mobile User Objective System (MUOS) satellite ground station in Sicily, has two 495-foot-high antennas and 40 other smaller sensors, used to send low-frequency radio signals to USA and NATO ships nearby. Three new MUOS satellite dishes at Niscemi will beam to unmanned drones and USA soldiers, as well as ground stations in Australia, Hawaii and Virginia. The dishes will go live after the last of 5 Lockheed Martin satellites are launched in November 2015, if the USA overturns a stop-work order from the local Sicilian authorities.



## **Police surveillance**

Police in the UK are planning to use unmanned spy drones for the 'routine' monitoring of antisocial motorists, protesters, agricultural thieves and fly-tippers. The BAE drones are programmed to take off and land on their own and reach heights of 20,000 feet, making them invisible from the ground (Guardian January 2010). They are certainly cheaper, better, more cost effective and ecological than using police helicopters, and no more intrusive than the CCTV cameras we have learned to live with.

It is difficult to find anywhere to live away from external sources of microwave radiation. Sources generated from within the home can be removed or reduced, once you are aware of their existence, see Section 3. Sometimes the only way to reduce your exposure is by screening yourself from the RF that surrounds you, see Section 4.