

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 3

Sources of RF inside 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; kindergartens; hospitals; wLANs in offices; railway stations; 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. 56 references

Sources of RF inside the home

People's homes are rapidly filling with devices that use RF radiation to work. Sometimes we are unaware that this is the case, and inadvertently expose ourselves to quite high levels of microwave radiation. There are currently about 1200 white goods (fridges, freezers, washing machines, etc. which emit RF. They are part of what is known as the 'Internet of things' (IoT), where they all intercommunicate, report items not working properly to the owners, and can even check food in and out of the fridge, and re-order from a supermarket, the owner has a direct debit with! The international telecommunication Union has established a timeline for the development of 5G, the next generation cellular system that will be able to accommodate billions of connected devices, to support the IoT amongst other things. It is expecting completion to be in 2020 (Microwaves and RF June 2015).

We believe that this is not good for most people and may provoke ill-health symptoms, making for a much poorer quality of life for many. See [Radiofrequency EMFs and Health Risks](#), which is in 5 sections.

A study by Viel (2009) suggested that people's personal exposure in their normal environment to RF radiation was 17% from digital cordless (DECT) phones, 14% from WiFi and 11% from radio transmitters, and varied during the week, but not by much (Viel 2011). A study by Joseph (2012) looking at RF exposures in Belgium, the Netherlands and Sweden found that the dominating indoor source is DECT phones. In a further study by Verloock (2014), indoor RF measurements in Belgium were dominated by GSM and WiFi sources. In a study of Greek levels of indoor RF exposure, the maximum values, in most cases, were below 0.5 V/m, however increased values above 1 V/m and up to 5.6 V/m were occasionally observed (Kottou 2015).

A family in Denmark installed a complete wireless electricity system in their home; WiFi on all their electrical switches, lamp points, etc. The family asked the installer and the Electricity Safety Council about RF radiation, and was told there was only RF when you turned the switches on or off, but there might be continuous radiation from the lamp points. The firm claims that RF levels are low, even though they admit they have never measured them.

Mobile phones

One of the most common sources of radiofrequency radiation in the home is a mobile phone. Originally, the mobile phone was used primarily as its name suggests, when the user was mobile. However, many operators are now advocating the mobile phone as the only form of phone people will need. Not only are people using them in the house for their leisure conversations, but they are expecting to use their mobile phones to pick up work messages, catch up on answer services in the evenings and weekends, and with 3G, and 4G more leisure facilities are available to the mobile phone user (including music, films and games, etc.) to enjoy at home. This results in the need for higher levels of radiofrequency signals from base stations in order to penetrate building materials. For more details see the article [Mobile Phones](#) (in 9 sections) and [Children and Mobile Phones](#) (in 4 sections).

Most authorities and concerned individuals advocate the use of hands-free kits to shield RF when using a mobile phone. Wired hands-free kits can carry the RF down the wire and into your ear, offering some protection but not, we consider, enough. EMFields has a range of [airtube hands free kits](#) suitable for most phones. Prevalence of headache was reduced by more than 20% among those who used hand-free equipment for their mobile telephones as compared to those who never used the equipment, according to a study by Chia (2000).

Many people do not want an alternative to their mobile phone, they want to be able to use them for more and more purposes. The telecommunications companies encourage this, and the government benefits from increased tax revenues as a result, so also promote the use. For those people who are expecting to be able to have a good enough signal to use their mobile phones inside their own homes, the companies have launched the femtocell, the family's own small mobile phone mast in the living room. 5G will also be available by installing a base unit in the home. The manufacturers say this is to avoid the problems of mobile phone reception interference, caused by *“wooden floors, under floor heating pipes, metal structures in walls, even fragments of metal in bricks”*. The femtocell plugs into your home broadband system, and according to the manufacturers, the signal is much stronger than the main mobile telephone network. You will then be able to abandon your fixed telephone. David James, director of service provider products at NETGEAR *“Not only will this solution enable mobile operators to provide enhanced cellular coverage in the home, but it will also make it possible for consumers to access and control a range of home networking services via standard 3G phone handsets.”* Although Powerwatch, a consumer watchdog with regard to EMFs, may seem somewhat less than enthusiastic about this new initiative, if the femtocell were programmed to switch off when not in use, for those who wish to have a mast in their own home, it may be preferable to having yet more powerful masts radiating everybody constantly. It is of concern to those people with ES who have neighbours with such a base unit and have a party wall.

Although microcell base stations with antennas installed indoors typically emit less power than outdoor macrocell base stations, the fact that people can be found close to antennas requires exposure originating from these base stations to be carefully considered. Measurement results showed that maximum recorded value of electric field strength exceeded International Commission on Non-Ionizing Radiation Protection reference levels at 7% of indoor base station locations (Koprivica [2016](#)).

Digital cordless (DECT) phones

Often the most powerful source of radiofrequency radiation in the home is the digital cordless phone; see the studies by Viel and by Joseph linked above. Older cordless phones used to give off high levels of radiofrequency signals *only* when they were in use on a call. Modern DECT phones now emit the same level of microwaves *inside* your house as a small mobile phone base station *outside*, not just when the phone is in use, but *all the time*. The person near the base unit may be subjecting themselves to over 6 volts per metre, and rooms nearby and even rooms immediately above such base units can be exposed to levels of microwaves that are higher than we would recommend for health reasons. This may be especially important if you have a base unit next to your bed, bathing you in microwaves throughout the night.

Many people experience high levels of microwave pollution in their home from a digital cordless phone in the house or flat next door, or even nearby, because microwaves travel through walls with hardly any reduction in signal strength, and can travel for considerable distances. If you have a ‘hotspot’ that is completely mysterious, especially next to a wall, you might want to check this. Many people who have measured the RF levels they are exposing themselves to from their DECT phone, have immediately got rid of it (or them in the case of multiple units,) and returned to wired phones; or at least have used their cordless phone in a similar way to a pager, and used the main wired phone for their longer conversations.

It is harder if the phone belongs to someone else, such as a neighbour. You may decide your only course of action is to shield your family from the incoming radiation, see Section 4.

A DECT phone cable can act as a re-radiator of microwaves. We have been told by one person about their DECT phone, the cable for which entered the house through the bedroom of their

daughter, before going to the downstairs base unit. As well as high fields in the base unit room, there were also concerningly high fields in the daughter's bedroom being re-radiated from the cable.

If you feel that you cannot do without a cordless phone, buy a [low radiation phone](#) from EMFields. These phones emit very low radiation even with multiple handsets.

Wired telephones

Phone lines do pick up RF signals (especially if parts of their route are overhead on poles) and also all lines now have some ADSL broadband signals on them, even if you do not subscribe to telephone line broadband. The unrequested ADSL signal (up to 10 MHz) levels can be quite high, and can come right through to the user's head.

The first thing to do is to install a plug-in [ADSL line filter](#) between the line and each telephone that you have. You may find using 2 in series works even better as then you have an HF extra filter stage that should not affect your phone's working.

Secondly, you can add one or more [clamp-on ferrite filters](#). These ferrite filters have a 6mm hole so that you can wrap a loop of your telephone cable back through the ferrite before closing the clamp and that makes it even more effective at stopping very high frequencies travelling along the cable.

Television

The Sky TV multiroom systems communicate with other television sets within the same home using RF at 2.4 GHz. This will add to your RF exposure.

Lighting

For more information, see [‘Your low EMF home 3. Lighting’](#).

Computer monitors

For more information see our article [‘In your home 3. Computers and other media’](#). Emfields sells [meters](#) that can measure powerfrequency fields.

Wireless mice

Most wireless mice communicate using radiofrequency microwaves, so it is worth finding an alternative if you want to reduce your exposure to RF radiation. Some use infrared and are not a problem.

Computer broadband connections

To connect to the internet without using a wireless system, you need one of two things: either a cable connection (via a company such as NTL) or a standard phone line. With dial-up internet the computer will use up the phone line, and you will not be able to use the telephone at the same time, unless you have a line (and a separate number) for each.

However, modern internet connections normally use a technology called ADSL (Asymmetrical Digital Subscriber Line). This technology needs to be enabled at your local telephone exchange.

Contact your phone provider (for example BT) and ask them if they can provide broadband to your house - if so they are also likely to send a package containing all you need to connect your computer to the internet (modem, ADSL filter and cables). The modem enables the computer to connect, and the filter ensures that you can use the telephone at the same time as the internet (if you have only one line) without having either service compromised. In fact, BT now supplies broadband down all telephone lines, it just needs to be activated by the company. Unfortunately, that means that all landline telephones are likely to carry RF signals on the cable into the house, even if you have not activated the service.

Both cable and ADSL internet connections are entirely free of microwave EMF emissions, and we have no reason to believe they could be a risk to health.

It is very important however, if you are concerned about health effects from wireless communication devices, not to use one of the "Home Hubs" or similar, to connect your computer to the internet. Home Hubs emit a lot of pulsing microwave radiation extending for quite some distance, the company claim over 100 metres 'line of sight', certainly up to 50 metres. They are the hub of choice by BT, given away free with most BT broadband subscriptions. Not only do they have WLAN, but they also have a high-power DECT unit transmitting all the time, even if you don't use the DECT facility. The box which is used to supply the 5.8 GHz Homehub DECT phone and WiFi can be switched off, but high emissions are still emitted for contacting cordless phones.

Home Hub 3 does not have a DECT facility, but it does have a BT Zone WiFi phone. The Home Hub 3 powers down its WiFi signal to a low background level when it is not actually in use.

'BT Fusion' rollout, or Open Reach, is planned to make use of private BT Home Hubs so that Fusion-enabled phones can make cheap voice-over internet protocol phone calls by logging onto Home Hubs in houses that they pass. There is no extra cost to the Home Hub home owner as they have a flat rate broadband connection, but it will increase the amount of microwave radiation in the home environment. It enables BT to roll out a cheap VoIP network with virtually no infrastructure costs.

If you are concerned about information security, it is worthwhile bearing in mind that the security services can park in your street and get everything, every key press, that passes through a WiFi enabled Home Hub - they can bypass any security you set unless you personally encrypt data outside of the Home Hub connection.

For an alternative, ask in your local computer store for a non-wireless "router" - there are a number of brands that manufacture these, and they are secure, reliable and require very little setting up.

If you have purchased a router for your internet connection, then you will have a number of network "ports". These are the sockets at the back of the router that you plug the network cable from your computer into. You can have as many computers as you have ports provided you have a cable for each. The router will make sure that the machines can all share the internet at the same time.

Some people may be tempted by femtocells for their home, using a broadband connection (wired or cable usually) and provides good 3G/UMTS service for you all over your home. If you don't have broadband then you can have a GSM and/or 3G repeater, with a directional antenna on your rooftop to connect the inside of your home to the nearest cellular base station up to about 50 km away.

BT have now given away/sold in excess of 4 million Home Hubs - so more than 4 million homes, just due to BT, now have 24-7 WiFi and DECT transmitters inside their homes. Added to that are

all the other broadband suppliers who also now provide wireless routers as standard and also all the people who have bought their own wireless routers for home use.

Some powerline networks use adaptors plugged into domestic power sockets to create broadband networks around the home. PLT, or Powerline Telecommunication is Ethernet over mains electrical wiring. The adaptors 'piggyback' a radio frequency signal onto the electrical power supply, but most domestic mains power uses unshielded cables which become accidental radio transmitters. It gets around the limitations of wireless networking, allowing users to move high definition video around the home without installing high speed Ethernet cables. Gigabit powerline uses the same frequencies as FM, DAB and even aviation and business radio, but it was licensed in 2010 by Ofcom, which claims interference is not powerful enough to affect radio reception. Not only radio is affected – also broadband speed and wireless mice and keyboards (Alex Lane May 2010).

Laptop computers

Laptops with LCD or TFT screens give off very low EMFs. They do not need the strong low frequency magnetic fields of a traditional CRT monitor, however they use high-frequency fields for driving the back-illumination and also can emit significant levels of radio-frequency electric fields (30 kHz to 300 kHz) from the back illumination and scanning processes. EMFields sells an [earthed laptop tray](#), so that you can use your laptop on your knee without exposing yourself to high levels of RF or low frequency electric fields. RF exposure is associated with male infertility problems and female reproductive problems. It is important that pregnant women do not subject their growing babies to unearthed laptop radiation.

Computer wireless LAN (local area network) broadband connections

These systems give access to portable lap-top computers that may be used by different members of a household for different purposes, offering the apparent freedom to have fast access without needing to have a fixed source. Houses with such a system installed are sometimes referred to as 'wireless enabled homes'. These systems fill the house with pulsing microwave radiation all of the time (even when the computer(s) is/are not in use), and we believe they should not be used at all.

Most modern laptops are WiFi enabled and many are also bluetooth enabled by default. Even if these facilities are not used, the laptop will be a source of RF radiation when in use. If you wish to disable these facilities, you will need to contact the manufacturer for instructions as to how to disable them in the particular model you have, as they can be very variable. You may need to disable the WiFi and the bluetooth facilities in different ways. They may be re-enabled by other software, so the RF radiation levels nearby should be checked from time to time, using a meter such as the EMFields [Acousticom 2](#).

Tablets are only wireless if they use windows. Most Tablets must be used wirelessly. Androids use a free version of windows, some of these can be used with wires.

If you have a Tablet which you can use in airplane mode, you will have no internet connectivity until the wireless facility is restored. Some games will turn the wireless facility back on. The only way to know whether wireless is connected is to measure the RF levels. The Acousticom 2 will do this.

dLANs / Homeplug devices

The best way to achieve fast broadband access from more than one room is using two or more dLAN units, which can connect computers and laptops using the power circuitry in the building. The units are plugged into a standard power socket on the wall, and have a computer network port for attaching the laptop or computer to. Plug one into a socket near your router and connect it to the router with normal computer networking cable. The whole house should now be connected to the network, and you can use the other dLAN unit(s) in any room you would like to use your laptop in - just plug it in, turn it on, and connect the laptop via computer networking cable.

dLAN units do add radiofrequency noise to the mains wiring, though the levels we have measured (a few tens of microvolts) are negligible in comparison with wLAN devices, and what increase in fields that we *did* see was only in very close proximity to the mains wiring (within a few tens of centimetres).

If you have an internet connection through a dLAN (through the house wiring, rather than a telephone or wireless system), it is important to earth the laptop even if you run it off batteries, as it will pick up and re-radiate electric fields from the house wiring through the dLAN connection. We have measured 400 V/m at the keyboard of one model. Or you could use an earthed tray, such as the one available from EMFields.

Microwave ovens

Microwaves are generated for the cooking process. Most microwave ovens are reasonably well sealed, so that little microwave energy goes through the special glass, or around the door seals when it is new. The manufacturers recommend that the ovens are checked annually, especially to detect faulty door seals. Current regulations require that a microwave oven leak no more than 1 milliwatt per square centimetre (mW/cm²) when it leaves the factory, and 5 mW/cm² after a period of use. We believe these levels to be too high to be really safe and that microwave ovens should be used with great caution. Even when the microwave oven is working correctly, the microwave levels within the kitchen may be higher than those from any nearby mobile phone base station.

We recommend that you keep *at least* a metre away from a microwave oven when it is working. Children, pregnant women and people with a poor immune system should preferably keep out of the kitchen whilst the oven is on.

For more information on cooking using microwaves, see the article [‘In your home 5. Cooking’](#).

Baby monitors

For more information about the range of baby monitors available and the best ones to choose, see [‘In your home 2. Appliances A-C’](#)

Alarm buttons

A type of personal alarm called a TeleAlarm has been found to transmit high levels of RF from the base unit which can not only radiate the user, but also neighbours.

Children's games

The latest-generation games consoles are all wirelessly enabled. These all have the capability to have wireless controllers, and have either integrated or add-on WiFi. Some modern handheld consoles also have WiFi built in.

WiFi-enabled devices give off similar strength EMFs as an average mobile phone mast would give at under 100m, so we consider it prudent to take a precautionary approach and avoid prolonged use of WiFi enabled devices.

One correspondent told us *"We have recently purchased an Xbox 360 and we only allow our children restricted use of the equipment. I noticed that even after 10 minutes my sons both start rubbing their eyes and their faces look like someone who's been sat at a computer all day without any breaks. My eldest has to take himself off into the kitchen because he can't look at the TV screen without it becoming worse. They both sit at least 8.8 feet away, normal TV is fine, I have a 100Hz flat screen cathode set but it only seems to happen when they play these games"*.

Bluetooth used in Wii uses 2.4 GHz, the same as WiFi and DECT phones. One person's grandson's Xbox caused their RF detector to register strongly even when the console was switched off. It is not possible to stop the RF unit transmitting without unplugging the mains lead or switching off at the mains socket. Using the Xbox switch left the RF unit still emitting at full power. When questioned, the Xbox customer service spokesperson said *"We regret to inform you but this is the way that the console is designed. It will not be possible to prevent it from emitting microwave signals."*

Burglar alarms

Active microwave sensors are sometimes used in both domestic and commercial buildings. These usually give out low level microwaves all the time and so we do not recommend their use. If you already have them in your system then you should contact your supplier and discover how to turn off the microwave transmitters in the sensors when you are moving about in the building and the alarm is not required as they are otherwise often energised 24 hours a day, even when the alarm is apparently turned off.

People in the garden may also be exposed continuously.

'Smart' utility meters

There are major discussions taking place with regard to the rollout of smart meters. The situation is somewhat complex and we refer you to our separate article ['Your low EMF home 4. Smart meters'](#) for details.

Hearing aids

Hearing aids are often sensitive to microwaves, especially digital pulsing ones such as are emitted by GSM mobile phones and base stations. These can cause buzzing noises and a high pitched whine. WLANs can cause clicking / scratching sounds, as can some 3G mobile phone systems. The hearing aids should be protected by good design, but often aren't. It is a defect in the hearing aid. Older aids were particularly prone to these problems but some new models still seem to have the problem.

Microwave systems have a microwave transmitter attached to the television set or hi-fi. The receiver is in the headset worn by the person listening. The headsets are safe, but the transmitter

gives off high radiofrequency fields. You should sit a reasonable distance away from the transmitter unit.

Dental work

Metal-containing dental work, especially titanium implants, could be acting like antennas for the microwave transmissions going on between our mobile phones and all of the base stations nearby. Metal dental restorations and implants have been shown to cause galvanic and electromagnetic stress for the human body. Galvanic and electromagnetic stress occurs when an unnatural electric current is generated by metal ions interacting with the electrolyte-rich fluid known as saliva.

De-humidifiers

Apparently some de-humidifiers (Kenmore Elite is one) use RF transmissions to indicate when the water container needs emptying. This transmission occurs every 5-6 seconds and is only disabled when the de-humidifier is unplugged. Switching it off leaves it transmitting at the same rate.

It is difficult to keep track of all the new products being brought on to the market that use wireless technology. We have included a lot of the ones we know about, but this list gets outdated quite quickly.

The only way to know for sure what your exposure is and whether you can do anything to protect yourself and your family, is to measure the RF field levels with a suitable instrument such as the EMFields [Acoustimeter](#) or the [Acousticom 2](#) and research the best ways to protect yourself, should you decide to do so.

The next section has some information about what you can do to reduce your exposure, and some of the products available to screen both the home and the individual.