Mobile Phone Masts and Wireless Computing

By Alasdair and Jean Philips

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The mobile phone industry, the operators and their supportive infrastructure, are continually changing and new facilities are being offered to phone users. New wireless developments are being rolled out across our towns and cities, expanding our exposure to environmental electrosmog. Research into the potential adverse health effects of radiofrequency from all these sources is producing new, often inconclusive and contradictory, information at a rapid rate. This book attempts to paint a picture that represents current thinking we believe to be correct at the time of production. It does not pretend to be, nor can it be, comprehensive.

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1. Introduction

The first cell phone system, Nordic Mobile Telephone System, came into being in 1981 in Denmark, Sweden, Finland and Norway, and when the telecommunications legislation was passed in 1984 in the UK, followed by the first UK system in 1985, it was never anticipated just what a worldwide revolution in communications the mobile phone would bring. The first mobile phone users bought the phones for a variety of reasons that sometimes had as much to do with the owner's perceived status as to the necessity of the phone. However, as the technology rapidly produced smaller, neater devices at a fraction of the original price, and the operators produced a menu of tariffs that provided an option to suit everyone, the uptake began to grow exponentially.

Companies began to see the convenience and apparent efficiency to themselves and their customers of constant communication with and by their employees. People began to realise how useful a phone can be to make urgent and speedy calls in time of emergency, when they may be feeling particularly vulnerable. Young people began to experience the freedom of having phone conversations without adult listeners and when they were out and about in their leisure time. It was a great reassurance to be constantly in touch with their friends and what was happening.

In the 1990s, personal use of mobile phones overtook business use. Consumers, rather than employers, have been responsible for the phenomenal rise in phone ownership and use. Although a significant proportion of the population has chosen not to have or to use a mobile phone, they are now in a minority. According to the Mobile Data Association (www.mda-mobiledata.org) 73% of UK adults own or use a mobile phone; 85% of households have at least one mobile phone; 7% use advanced services such as photo and video messages – reported in the Telegraph in May 2004. In July 2003, Vodafone reported that around 6% of homes in the UK use mobile phones only and not landlines.

The telecommunications companies see the third world countries as a major new market as it is cheaper to build a mobile phone network infrastructure than a new telephone system using cables. There is even a re-use market for older base stations and handsets that are becoming obsolete in western countries. 'Recycled' handsets are usually sold abroad, the money raised often going to the many charities, and some other organisations which collect the handsets. Their basic materials are not being recycled as some consumers may believe.

Wherever you are in the world, as the networks grow, you have the choice whether to own or use a mobile phone. As the number of people choosing to use a mobile phone increases, and the people who own phones use them more and more, sometimes to the exclusion of 'wired' phones, there is an accompanying need for a growing support network of base stations, antennas, dishes and drums. There is not the same element of choice about whether you live or work next to a mobile phone base station, or whether your child attends a school with a mast on top of, or near, the school buildings. Many local residents feel forced into having one of these base stations, without having had any say in the matter. Base stations can often be a very obvious intrusion in the visual landscape, especially older style lattice masts, and masts intended for multiple occupation, erected as a response to the government encouragement to share masts and base station sites.

It is important to remember that just owning a mobile phone is a guarantee of a mobile phone infrastructure. To have a phone 'for emergency use only' will minimise the infrastructure needed. The only way to prevent the development of a mobile phone mast network is to refuse to buy or use a phone. The companies are not altruistic; they will not build a base station network if it does not generate an income. **More mobile phone calls and messages mean more base stations. Always.**

Information about mobile phones, their operation, reducing exposure to the EMFs they emit and the research are detailed in the subscription section of the Powerwatch website www.powerwatch.org.uk. This publication focuses on the 2G, 3G and TETRA base station networks, WiFi and, increasingly other sources of radiofrequency EMFs, though you will find some paragraphs discussing the use of phones in the context of the network of masts, including political and financial pressures.

The local population can become very concerned about the reduction in value of their house as a direct result of the proximity of a mast, and people may also be very concerned about whether the pulsed microwave radiation from the base station antennas may be responsible for adverse health effects. Any serious illnesses diagnosed after the erection of the mast may be blamed on the structure, leading to anxiety and distress, affecting health further. Mobile phone technology is new, complex, and hard to understand without a considerable knowledge of physics. Bluetooth (pulsing microwave-based communication) technology is being introduced not only for business and academic networking, but in most 'up market' cars and also for connecting domestic appliances within a house, even enabling children's toys to communicate with each other!

The Government, their advisory bodies and the independent researchers in the UK and abroad, all seem to have different opinions as to whether the radiation from these masts is safe or not.

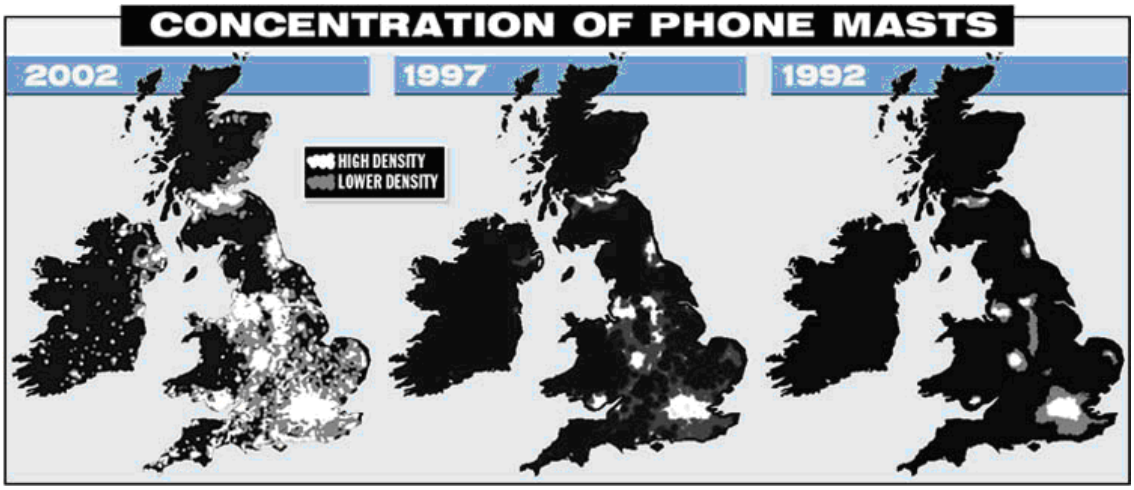
In a personal communication, Drasko Cvijovic summed up the situation beautifully, using computer software as an analogy; "*If somebody said that adding some new programme 'had shown no harm to any computer, although we don't precisely know what the programme really does' who would have accepted such a programme?*" Of course, that is assuming there is a universally accepted virus programme to detect any problems! Cvijovic adds '*We are asked to voluntarily accept the changes made by EMFs to our bodies, which are much more complex (and therefore more unpredictable) systems.*'

People's memories of debates on such issues as smoking, asbestos and BSE rightly make them sceptical about bland government reassurances.

According to the Daily Mail in March 2008 there were estimated to be about 70 million mobile phones in use. Seven years ago previously there had been a mere 9 million. There are approximately 40 million adult subscribers (about 80% of the adult population) in the UK, and 5 main UK telecommunications operators; Orange, O_2, T-Mobile (UK), Vodafone and 3, with a few others like Virgin who buy capacity from one of the main five. The telecommunications industry contributes over £13.6 billion to the UK GDP (an increase of 16% from September 2004 to 2005. Fixed line revenues fell by 9% to £10.3 billion), and the government receives £15 billion in tax revenue. 31% of all UK voice calls were mobile-originated and 28% of residential consumers used mobiles as their main method of making calls, a 21% rise. There are approximately 164,000 people employed in the UK mobile phone industry. This is BIG business!

When the mobile phone operators were awarded a licence to provide a service to mobile phone users, they were required to provide 'reasonable coverage' to about 97% of the British population. In wireless communication, most of the energy is lost in between the transmitter and the receiver, so the signal has to be strong enough to get to and from the phone handset. People are

demanding more and more of the service from their phones. They want to use them whilst travelling in cars and trains, etc., they want to be able to use them inside work premises and even inside their own homes. 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. Even if base stations could carry enough calls (which they can't) a relatively few high powered masts away from where people live and work would not be able to receive the faint signals back from the phone handsets. So, if people really want to use mobile phones anywhere in their house they will have to have base stations close together in their communities – in some city areas there is now at least one base station every 50 metres! The maps of Great Britain below show the phenomenal increase in wireless exposure. These do not include the 3G, TETRA, and WiFi systems that have come into being since 2002.



Increase in Mobile Phone Mast Density from 1992 to 2002

The requirement for 97% plus call service (for 2G systems) is still in place, so the companies have to build the infrastructure to cope with the changing demands of their customers. According to the MOA, there were approximately 47,000 mobile phone base station sites – note ***sites*** not masts, in May 2006, about 67% built on existing structures and less than 2% on schools. It is estimated that there will be about 50,000 by the end of 2007, including installations supporting third generation mobile networks. 3, for example, says it hopes to build about 3,500 base stations for their 3G network.

Not every country has decided to cover the land with masts. In Dubai, there is a network of transmitters every 3-4 kilometres at approximately 50 metres high. It is significant that Dubai only has one mobile network.

The third generation of mobile phones (3G), giving better access to the Internet as well as video, film, music and games services started to roll out in 2003, but will not be completed for several years, if at all. 3G has an 80% coverage obligation as it is unlikely to be economic to cover remote places with the advanced technology, and the latest phones will be able to access the old GSM network, updated using GPRS technology so that limited advanced features will still be available. The transmission frequency of 3G in the UK is higher than the GSM bands and it does not penetrate buildings as well, so additional base stations will be required to meet even this reduced level of coverage.

We have been using ordinary wired telephones extensively for most of the 20th century, with few problems, but wired phones are not radiofrequency emission transmitters and receivers. Few of us have lived or worked near obvious transmitting stations.

The telecommunications companies are vying for our custom, offering a plethora of different packages, which are becoming increasingly complex and we may require assistance in deciding the best options for us; we are bombarded with special offers of cheap or free calls as long as we limit our calls to e.g. local calls, or weekends only. As a result of this upturn in call traffic, new masts appear, often with little warning, some of which are obvious, ugly structures reminding us of some sort of high-tech science fiction monster threatening the well-being of our families. Some appear by stealth, and we do not even know of their existence, such as the ones that look like burglar alarms, the ones that are hidden inside petrol station price signs, or attached to the structure of ordinary houses.

From June 2008, you can have your own small mobile phone mast in your living room. So we are told by Ubiquisys a company marketing the femtocell, 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. You won't be able to order one of these wonder phone systems directly, you will get one with your mobile phone contract. A spokesperson for T-mobile Venture Fund said "Femtocells are fundamental to the future of mobiles. They pave the way for new mobile services that put the mobile phone at the centre of the connected home"

Although we may seem somewhat less than enthusiastic, if the femtocell were programmed to switch off when not in use, they may be preferable to having yet more powerful masts radiating everybody constantly to get good indoor 3G coverage for the few.

2. Sources of radiofrequency exposure other than mobile phones and masts

It is important to remember that one source of domestic microwave emissions are Digital Cordless (DECT) Phones. They emit the same level of microwaves inside your house as a small mobile phone base station from outside. Many people are unaware of this source of RF pollution. The person near the base unit may be subjecting themselves to over 6 volts per metre, not just when the phone is in use, but ***all the time***. Rooms near by and even bedrooms immediately above such base units can be exposed to levels of microwaves that are higher than we recommend for health reasons. 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) and returned to wired phones. Analogue cordless phones give off RF radiation during a phone call from both the handset and the base unit. They do not, however, emit RF radiation when the phone is not in use.

According to BT's director for Scotland, Brendan Dick (BBC News June 2008) more homes in Britain now have access to broadband than to running water. There were less than 150,000 broadband connections in 2002 and around 13 million by June 2008. We now have wireless internet access at home, systems such as BT Home Hub. It is the hub of choice by BT, given away free with most BT Broadband subscriptions, and as at April 2007 they have installed at least 1.6 million of them in the UK since they launched them. Not only do they have wLAN (that can apparently work up to 250 metres distance in ideal circumstances, though much less usually), but they also have a high-power DECT unit transmitting all the time, even if you don't use the DECT facility. Many of the homes that have these devices will have resident children as the Home Hub is 'ideal' as each child can have a wireless linked PC in their bedroom that connects to it. WLan units in blocks of flats can be particularly problematical for residents who are sensitive to microwave radiation and who react with adverse health symptoms. The microwaves travel through walls and can affect many people adjacent to the flat occupied by the wLAN owner.

WiFi router boxes transmit in pulses, even when nothing is connected, giving a reading 30 times higher than the Salzburg 0.1 V/m precautionary maximum exposure level. Even at a metre's distance this level is exceeded 15 times. A laptop with a WiFi network card inside it gave a reading 60 times higher than the precautionary level while it was connected, even underneath the laptop, where your lap would be. The router was two rooms away from the laptop. Before connecting to the network, the laptop logged on to it every 10 seconds or so, giving pulses 60 times higher than the precautionary level. At 1 metre distance, it was still registering 25 times higher.

When those children go to school, they may have a wireless classroom or the parents may work in a wireless office, where twenty, thirty, or even more computers are interconnected using microwave communication techniques, greatly increasing occupants' ambient exposure to microwaves. According to the Daily Mail in August 2007, approximately 70% of primary schools and 81% of secondary schools (15,000 schools) now have WiFi computing networks installed. "The government is investing about £1bn a year in the technology" said Ian Adams, executive director of the government's educational technology agency, Becta, to the Guardian in January 2008.

However, there is some concern by parents about their children's exposure to this extra type of microwave radiation. The Times reported that 3 schools had re-thought their policy on providing wLAN equipment in their schools due to pressure from parents or teachers. In school classrooms with wLANs the pupils are exposed to the microwaves from the computer's wLAN card and from the classroom wLAN unit. Prebendal School in Chichester had been having problems with the reliability of the wireless network and decided to change it for a conventional cabled system. At Ysgol Pantycelyn, in Carmarthenshire, the Head Teacher agreed to switch off the wireless network as he said "*the concerns of the parents are of greater importance than our need to have a wireless network*." A concerned parent said "*they are like having a phone mast in the classroom and the transmitters are placed very close to the children*." The radiation from microwave transmitters has been associated with loss of concentration, headaches, fatigue, memory and behavioural problems and possibly cancer in the long term.

Stowe School in Buckinghamshire removed part of its wireless network after one of their teachers who had been at the school for 28 years became too ill to teach as he had had such a violent reaction to the network, suffering from headaches, pains throughout his body, sudden flushes, pressure behind the eyes, skin pain and burning sensations and bouts of nausea. The head teacher intends to put cabled networks in all new classrooms and boarding houses.

Haringey council in London recommended in July 2007 that no new WiFi systems be installed in schools and that existing ones should be discontinued pending "full consultation with parents and staff." The recommendation was welcomed as "excellent news" by the Professional Association of Teachers, which believes the proliferation of networks in schools could be having serious implications for the health of some staff and pupils. In Newham, alone, more than 4,000 students have their own laptops (Guardian January 2008).

The UK Professional Association of Teachers wrote to the Education Secretary (April 2007) to demand an official enquiry because of its concerns over WiFi. In August 2007 they said "*WiFi should be halted until a full scientific inquiry has assessed health risks. We call on schools to dismantle WiFi networks immediately and replace them with cables. If this is impossible, the schools should measure the radiation levels around the school and sign 'hotspots'*" They also point out that cable networks are more reliable.

These WiFi networks have been banned in Salzburg, Austria, due to concerns for the health of children. The Austrian medical association, to which all the country's doctors belong, is lobbying against the deployment of WiFi. In March 2007, the Bavarian parliament issued a recommendation to all schools in the German province not to use the technology, and in 2006, the Frankfurt city government said it would not install it until its safety was proven. In December 2007 Paris libraries turned off their wLAN systems following health complaints from members of the staff. 40% of people working in the libraries complained about headaches, giddiness, nausea and tiredness after the system was switched on. Employees are calling for internet connections to be made using standard or fibre optic cables.

Professor Lawrie Challis, head of the committee on mobile phone safety research, says children should be discouraged from putting their laptops on their lap when using wireless internet connections. This will result in parts of their body which are sensitive to microwave emissions, such as testicles, ovaries and other internal organs being close to the transmitting antennas embedded in the laptop, exposing the user to microwave levels similar to a mobile phone. He believes youngsters' health should be monitored.

'Interactive whiteboard' systems are also beginning to appear in both our secondary and our primary schools. This system may have a wireless unit on the classroom ceiling and the whole

room is then bathed in radiofrequency microwaves. The system is on all day. If the school your children attend have such a system, you, together with the teachers, might want to monitor the effect on the children. The teachers themselves may be affected, especially those who spend most of their working day in a classroom that has such a system installed. Microwave exposure has been associated with behavioural disturbance, concentration and short-term memory problems. This does not seem to be the ideal environment for learning.

Some school pupils are being supplied with wireless laptops to boost e-learning in school and at home. Cost-conscious councils report that the cost of laptops is less than installing desktop PCs and rewiring buildings to provide connections.

Companies have been working hard to be able to provide WiFi access to as many people as possible, at home and on the move. The Cloud, a company setting up wireless zones for wireless local area networks (wLANs), is intending to have 7,000 base stations. They are relatively short range, transmitting over a few hundred metres at between 2.4 and 2.484 GHz. Although each transmitter only covers a few hundred metres, projects, such as the one in Norwich (reported in August 2006 as covering not only the city centre and the university, but the parks and even the hospital), can cover over 30 square kilometres by using a network of transmitters. In May 2006 the Cloud announced a new low-pricing structure that will make unlimited broadband WiFi access available for £11.99 per month across its 7,000 UK hotspots. George Polk, Chief Executive of the Cloud reported that more than 2 million people in the UK had installed WiFi access points at home and 30% of companies had WiFi in their offices.

The Cloud's network will be available immediately to people who use BT Openzone, O_2, SkypeZones and Nintendo Wi-Fi.

BT Openzone has signed deals with 12 councils ("just a start", said the head of BT's converged communications services http://news.bbc.co.uk/go/pr/fr/-/1/hi/technology/4993038.stm) to fit WiFi antennas to street furniture to create broad zones where people can get access to the internet. People will be able to access the service using pay-as-you-go vouchers or subscribe for longer term use. Glasgow city centre became a WiFi zone in August 2005, following London, Soho. Another 6 (Birmingham, Edinburgh, Leeds, Liverpool, Cardiff and Westminster in central London) started in early 2007. The tiny can-sized antennas are fixed to street lights, CCTV cameras, bus stops and shelters, phone boxes, park benches, even traffic lights. The first users of the WiFi zones are likely to be workers carrying laptops, but BT also expect rapid growth in the number of smartphones that use WiFi to make and take calls.

The 'BT Fusion' rollout 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. There are even more microwaves in the home environment, though, and BT has virtually no infrastructure costs to rolling out a cheap VoIP network.

The newer WiMAX systems are a lot more powerful than WiFi and pulse out microwaves for up to 30 miles, though mostly their range is 5 and 10 miles. WiMAX is a general term and does not have a specific standard. The standards for mobile WiMAX are 2.3, 2.5, 3.3 and 3.5 GHz, and varies from country to country. In Europe, 3.5 GHz is the standard being pushed for fixed WiMAX systems. They operate at a lot higher speed than WiFi. Pipex, together with Intel and Airspan Networks, has a WiMAX network in Milton Keynes, and is intending to cover 8 UK cities by 2008.

WiMAX antenna in Milton Keynes

Traveller accessing the internet 'on the move'

We also have the technological house, where all household appliances have embedded technology to communicate with each other and the outside world, ensuring your fridge and freezer, for instance, are stocked with the best available supermarket offers, whether you want them or not, depending on your computer input expertise and interest. Just recently, we have seen an advert for Bluetooth pulsed microwave technology in soft toys, enabling your child's toys to 'talk' to each other! We think this is most unwise.

Triton are now offering a wireless shower, so that you don't have to re-tile your bathroom when you replace your old one!

In a Science Museum catalogue, they advertise "contemporary beechwood speakers producing high quality sound via radio waves… they function brilliantly up to 100 metres from the music centre, radio or CD player. Ideal for use all over the house or outdoors." This is an easy way to flood your house and garden with microwaves!

New types of anti-theft devices have been installed in some supermarkets, including a 'smart shelf' which continuously queries tiny radio chips embedded in the packages it holds, sensing the silence when one is removed, so that security can be alerted when several are taken at once. These items have tended to be higher-value products such as wines, spirits and health and beauty products. However, one supermarket in Sussex attached security tags to frozen chickens, after they experienced an increase in the sale of higher-welfare, organic and free-range chickens following a campaign by chefs Hugh Fearnley-Whittingstall and Jamie Oliver.

This micro-chip technology is also being applied to home items such as music centres, video and DVD players, etc. which are to alert people if an appliance is removed, but which constantly communicate with each other to ensure their presence; all the time, in any house whose owners are security-conscious in this way.

Another use of RF for security reasons is being rolled out by Near Field Communications (NFC). They turn a mobile phone into a digital purse that can read the chips and radio tags buried in smart posters from a distance of a few centimetres, and waving the phone and beeping could

purchase the product, such as a ticket to a football match so that the phone gets a message to unlock the turnstile on the day of the match. If you pay for a hotel room online, the key to access the room could be texted to your phone. The phone itself will open the door by just presenting the phone in front of the card reader (May 2008 BBC News). As Andy Davidson says *"Welcome to the universal ID/passport without which you have no assets and no rights."*

RFID or radio-frequency identification is being used by companies to tag clothes, drugs, car parts, copy machines and even post, with chips laden with information about content, origin and destination. They are also equipping shelves, doors and walls with activating radiation coils and sensors that can record that data when the products are near. It would be easy to combine credit card data with information from the retail chips to know who bought what and when and conceivably track the product after it left the shop. Cordless phones, two way radios, local wireless networks, etc. can interfere with the signals. Although radio tag readers can identify 100 tagged items per second, radio waves have difficulties penetrating metals and liquids. These RFID tags are typically passive – they have no power source and are only activated when read by a scanner in close proximity. However it is now proposed, according to the BBC in a news report in May 2007, that the tags are part of a wi-fi network in order to monitor the movements of people in hospitals, student campuses, etc. The battery-powered tags communicate with at least 3 wireless access points inside the network to triangulate a location. To do this, a wireless access point is needed typically every 30 metres. The information is sent back to the server and it then models the movement of the tag depending on the shift in signal strength detected. This will increase the amount of variable ambient radiofrequency radiation experienced by everyone within the network range.

Anti-shoplifting labels are called **passive** RFID tags. Instead of containing batteries, they work entirely by responding to the incoming radio waves from the doorway transmitter. There is just enough energy in those radio waves to activate the RFID chip. Passive tags can send and receive signals only a few meters—enough to cover a doorway, but not much more. An alternative form of RFID technology, known as **active** tags, contain more advanced chips and batteries. They can send and receive signals over much greater distances.

Some cities are already using active RFID tags embedded in car windshields to collect tolls automatically on bridges or highways as people drive by. This saves drivers having to slow down, stop, or fumble for the right change. Some "smart cards" used on buses, underground, and other forms of public transportation also contain RFID chips. As you touch your smart card on the reader, the card automatically debits your account with the cost of the journey.

"*An RFID chip implanted under your skin might save your life in an accident by transmitting your medical information to an emergency team. Doctors would simply wave a reader over your hand (or wherever the chip was implanted) to gain immediate access to your medical records.* "

Microchips may be installed in all new cars to enable police to track speeding and other wanted vehicles.

One woman's dog ate the immobiliser chip from her electronic key fob (BBC report 2006). The only way to start the car was to have the dog sit in the front seat, and then to take him with them, until nature resolved the problem!!

People operating cameras when filming as part of an outside broadcast team are exposed to microwave transmitters on the cameras transmitting pictures to the outside broadcast vans. In one Midlands television company, 3 of the cameramen have developed brain tumours.

Dr Steven Leeb, an MIT professor, has found a way for ordinary fluorescent lights to transmit data. In the Spaulding Rehabilitation Hospital in Boston, people with brain injuries are being equipped with hand-held computers in holsters tucked next to the patients' bodies. There are a series of talking lights on the hospital floor, with which the computer communicates. *"The brain-injured can't organise schedules or remember when to do things,"* said Dr David Burke. *"As the patient passes each talking light, the hand-held computer recognises the unique signal from each light and matches the patient's projected schedules with actual whereabouts."*

Applied Digital Solutions, Inc. a Florida company, has begun making computer chips that are being implanted into medical patients and their families. The devices, which will sell for $200, contain personal information that can be scanned by emergency medical personnel in case someone is unconscious or has Alzheimer's disease. The Food and Drug Administration has said it will not regulate these devices.

Some large UK companies have had a fully-integrated, DECT-based communications and alarm system installed to cover their site. The system typically includes personnel communications, process monitoring and alarm messaging facilities, many DECT base stations and handsets with lone worker protection functions. It is designed to replace personal mobile radios and pagers. The wireless RF communicating equipment will have to be on all the time.

The Pentagon has commissioned a new battlefield targeting system to avoid the misinformation leading to military mistakes that resulted in air strikes against civilians or friendly forces in Afghanistan, Kosovo and Iraq. The super-palmtop will combine laser rangefinding, GPS satellite positioning, a satellite phone and text messaging, and will be controlled by Microsoft's Windows-CE operating system. Soldiers on the field send information using the palmtop, via the Iridium satellite mobile phone system to HQ. If it crashes, it can be rebooted after 12 seconds. Its robustness for the battlefield was questioned, and so it was used instead of a ball in a football match and worked *"just fine afterwards"*.

Dr Sam Milham and E.M. Ossiander, in a scientific paper published in 2001, linked the increase in childhood leukaemia with the arrival of electrification throughout the US. We do not know what might be the result of increased population exposure to microwaves, but adult leukaemias have been linked to occupational exposure and many people living near masts are reporting adverse symptoms related to stress, so some adverse effects on well-being seem likely.

Scientific opinion is often unhelpful, as we are assailed by different and contradictory theories and conclusions. Who can we believe? Government scientists have often been wrong; research funded by telecommunications companies could be biased; the physics and engineering is often too complex for the person in the street to understand; and independent research may be flawed.

This is the reality. There are no simple, consistent answers that everyone agrees on. The disagreements are at a very fundamental level, the networks continue to roll out, the number of mobile phone users and the amount of use phones are put to grows daily, and new wireless systems are appearing in our daily lives at a rate previously undreamt of.

We are left with the uncomfortable and unwelcome (but necessary) task of risk analysis. Unfortunately, risk analysis conclusions can only be as certain as the confidence we have in the information. There is increasing evidence that the quality of information made available to the general public, has biases, both academic and commercial, that are not revealed. We (the public) rely on authoritative bodies to give us the information we need to make informed decisions. Those are then up to us to make. When there is not a clear consensus, we still have to make a decision, it just is more difficult.

If it were true that there were a danger associated with living near to base station masts, how true would it have to be, how dangerous would they have to be, in order to campaign for legislative change, or even to move house or work or your children's school? How true would it have to be to make yourself homeless? 20%; 40%; 80%? Nothing is 100%, apart from death. The same calculations would apply to other environmental situations, such as workplaces with high RF exposure. With respect to personal WiFi equipment use, it may be a clearer decision, depending on who you believe of the several opinionated experts!

We do not pretend to give definitive answers in this book. There aren't any. There may never be the sort of answers people are looking for (i.e. it is 100% safe for 100% of the population, because it isn't!). So, in the following chapters we give some information about mobile phone mast planning issues (though for detailed information, you need to look at the planning regulations themselves); information about international guidelines if you wish to campaign for changes in the current regulations; and some of the results of the research into potential adverse health effects of living near masts. As this research is often based on levels of exposure, the adverse health effects are likely to apply to similar levels of environmental radiofrequency microwave exposure, whatever the source.

The decisions you take will depend on your perception of the risk involved, and how true you think the information is from the various sources, and what benefits (and pleasures) you get from using the equipment (mobile or DECT phone, wireless enabled laptops, etc) . A bit like practising "safe" sex.

The authors of this book have chosen to have a 'pay as you go' mobile phone, which is used for emergencies only, and was very helpful in contacting breakdown services, when the car engine blew up in a motorway traffic jam. We use less than £10 per year on phone calls.

We have a set of mobile phone mast antennas fixed to a water tower at the end of our road. This site has been upgraded once, and is large enough to have still more antennas attached. It is about 80 metres away. Using the Acousti-COM we have 'heard' our exposure, and have made some precautionary house changes with additional RF screening. Our quality of sleep has since improved.

If you are concerned about microwave emissions then we recommend you to use the COM, A-COM, Electrosmog Detector or Acousti-meter microwave monitors to assess the signals. These are available to purchase or hire and details can be found on the EMFields website: www.emfields.org

3. Mobile Phone masts

According to information from the Mobile Operators Association (MOA), the spokes-organisation for the telecomms companies, in September 2005, there were 62.5 million mobile phone subscriptions in the UK. Around 80% of UK adults (some 40 million) were using mobile services. 31% of all UK voice calls were mobile-generated, and 28% of residential customers used mobile phones as the main method of making calls in the second quarter of 2005, a rise from 21% in the previous year.

As the use of mobile phones, often as the main form of communication, increases, the network of masts, or base stations, has to expand to provide the call capacity. The 3G system has necessitated equipment upgrades on existing base stations, or the erection of new masts. A 4G system is planned for a 2010 launch.

The network of masts or base stations

By law (the Telecommunications Act 1984) and by the choice of 80% of UK adults and about 5 million children under 16, we need to have mobile phone base stations. The number of calls users are making - the 'traffic density', is increasing all the time, and base stations are now required every few hundred metres or less in city areas, to cope with the ridiculously high number of mobile phone calls people are now making. Telecommunications companies are required by the terms of their licences to provide 'adequate coverage' for well over 90% of the UK population for the 2G GSM system. 3G systems are to provide such coverage for 80% of the UK population. It is not clear what is meant exactly by 'adequate' coverage, though it is set out in some detail in their licences. According to the MOA there are approximately 47,000 masts in Britain, to rise to 50,000 by the 2007 deadline of 80% coverage.

Every time anyone makes a call to or from a mobile, or sends or receives a text message, it is registered so that the companies can plan where to locate extra base stations. A mobile phone base station costs from about £20,000 for a wall-mounted microcell to about £80,000 for a free-standing 15 metre mast. According to O_2 Airwave a monopole mast and site cost £220,000, but that seems somewhat exaggerated. The companies can ONLY afford to put up more base stations because so many people are using their phones so much.

More mobile phone calls and messages mean more base stations. Always.

Generally speaking, there are three types of base stations; macrocells, microcells and picocells.

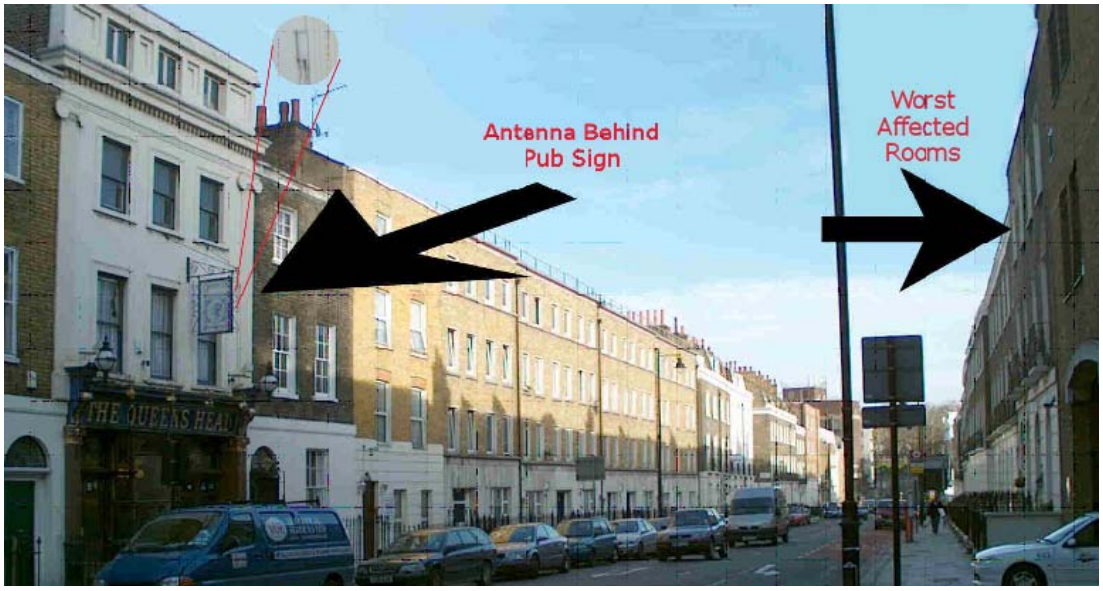
The antennas for **macrocells** are mounted on ground-based masts, rooftops or other existing structures, **at a height that provides a clear view over the surrounding buildings and terrain.** The cell radius varies from at least 500 metres up to a maximum of about 35 km. Macro base stations typically have between 2 and 8 channels per direction (usually 3 or 4 directions). Each channel (or carrier) can only carry 8 telephone calls – hence a total of only about 64 simultaneous calls in any one of the 3 directions from even a major macrocell mast.

A free standing mast with more than one operator

A monopole mast

Mast on an existing structure

Microcells are designed to provide radio "infill" coverage and additional call capacity for high traffic densities in urban and suburban areas to users both outdoors and within buildings. Microcell base station antennas are lower than nearby building rooftops, typically on the external walls of existing structures, lampposts and other street furniture, so coverage area is primarily defined by the street layout. Microcell coverage is up to around 500 metres. Microcell antennas are smaller than macrocell antennas and when mounted on existing structures can often be disguised as building features.



Example of a too high powered wall-mounted base station antenna. This is causing pulsing microwave levels continuously in excess of 6 volts per metre in the bedrooms and living rooms of residential flats across the road.

Typical radiated powers ***should only be*** a few watts, but we have seen many examples that have macro-power level transmitters on them.

The NRPB W62 report (2005), based on the £66,000 research grant from the MTHR to investigate the field strength of around 20 microcell base stations (£3,300 per base station!) said "It was noted that some 2,000 of the 32, 837 base stations, or around 6%, were radiating more than 5 watts at heights up to 10 metres. In conjunction with the MTHR project monitors, it was considered whether these transmitters should be included. It was decided that they should not be and that

this project should concentrate on the low power sites in order to stay true to its original aim of considering microcells as low-height / low-power transmitters."

Some of the low-height base stations in their database were deliberately excluded from the study as they claimed that they used too much power to be rightly called a microcell base station (!); they had output powers up to 100 watts, 20 times higher than the 5 watts allowed to be included in their analysis. Will some of these unmeasured base stations actually exceed the ICNIRP public exposure guidelines? We don't know; they didn't measure them. For the Powerwatch comment see www.powerwatch.org.uk/columns/aphilips/index.asp "Peer Review and Quality of Science" posted on 7th August 2006.

Micro base stations typically have between 2 and 4 channels per direction – often only 1 or 2 directions, but can be 3 or 4 when on pole masts. Microcell base stations typically have 2 or 4 carriers in each of two directions – so can only handle about 16 or 32 simultaneous calls. This is the reason for the statement made earlier:- more mobile phone calls and messages mean more base stations. Always. It is a fundamental design constraint of how a cellular telephone network works.

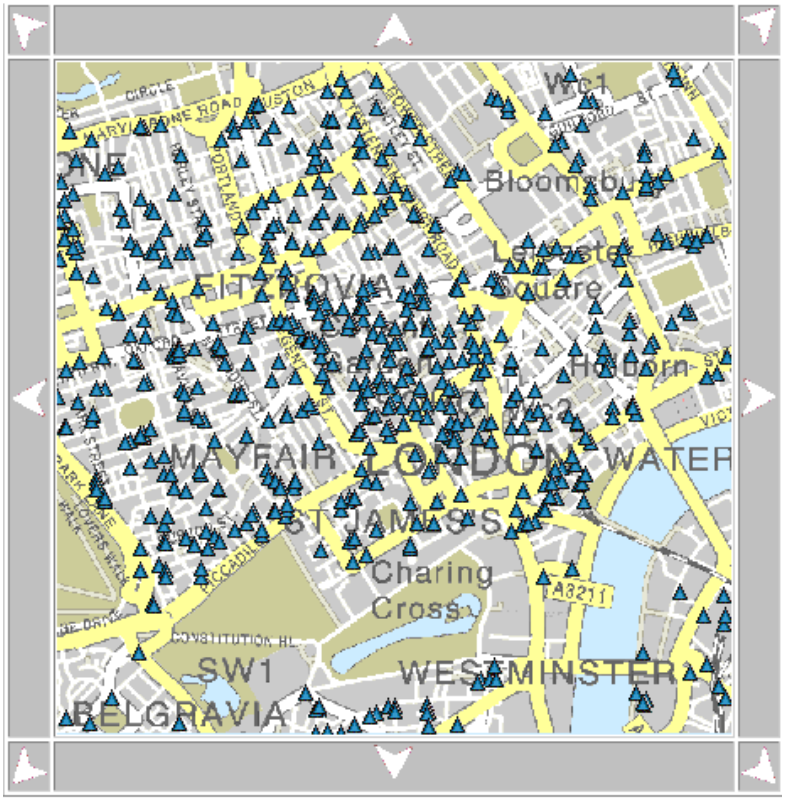
Picocells provide more localised coverage than microcells, for instance inside buildings where coverage is poor or there are high numbers of users, such as shopping precincts, college halls of residence, planes and airports, trains and train stations. The antennas for picocells are mounted inside buildings, typically on walls, ceilings or in ceiling cavities. Picocells provide coverage within a building and more than one may be required to cover an entire building. Users may be both mobile and fixed; fixed users are exemplified by wireless local area networks (wLANs) between computers. Coverage is defined by the shape and characteristics of rooms, and service quality is dictated by the presence of furniture and people. The transmitted powers are usually very low, but occupants of the room are continuously exposed to them.

Different population densities tend to have different mixtures of base stations. City areas will have a mix of macrocells and microcells, probably with microcells predominating. More are added as 'call density' increases **– i.e. as users make more calls!** Rural areas are likely to have a number of macrocells, with fewer microcells. In towns and villages there may be a lot of variation, though with increasing numbers of microcells as people use their phones more and more. Some may have the one high macrocell serving the whole of the populated area, some may, instead, have a number of small microcells, which do not need planning permission. These are being increasingly installed in areas where councils and local residents have made getting planning permission difficult in the past. Some of these have the power of a macrocell according to the GSM Standard, but are mounted on a pole or a building at a low height of 3 to 12 metres. Until 2000 masts of this power used to be illegal, under European law and UK Regulations, but they now appear to be legal.

As more base stations are introduced in an area, the transmit power of each base station is usually decreased so that the areas they cover do not overlap too much, in order to minimise co-channel interference. 3G tend to overlap more than 2G because of the power needed for the signal. Placing base stations as close as possible to where the handsets are being used will minimise both the power used by the base station transmitter and the power needed by the mobile phone handset to work effectively. Additional base stations are placed to ensure that no base station ever has to serve a distant user, so it will further reduce the base station transmitter power.

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 level now exceeds 5 V/m in areas of public access.

To check how many base stations, single operators, TETRA and shared masts there are in your area, and find out mast heights, power output, and whether the base station is a macrocell or microcell, log on to www.sitefinder.ofcom.org.uk. Ofcom only used to be able to compel the operators to give data to an accuracy of 100 metres, and the operators did not have to give details of a particular mast's power. However, following the ruling by the Information Commissioner in September 2006 that all information used to compile the Ofcom website be made available to people who request it, the mobile network operators decided not to provide any further information to Ofcom about sites they build or change. The Ofcom website is likely to be getting more and more inaccurate as the three-monthly updates are no longer being done. The Information Commissioner's decision was upheld in September 2007. Ofcom appealed. In March 2008, the mobile operators, excluding T-Mobile, agreed to provide one last package of data while Ofcom takes the Information Commissioner to the High Court. T-Mobile has not produced any data since August 2005. You could try www.ononemap.com.



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

A typical central London Sitefinder print-out. Each blue triangle represents a base station

As you click on a blue triangle, each representing a base station, an information box containing the Operator's name, the antenna height, the station type, the type of transmission and the maximum EIRP transmitter power (per carrier) is displayed. To work out if this is "reasonable" you can calculate a Radiation Exposure Index (REI) value. This gives you a quick rule-of-thumb means of assessing base stations to check if the operator is actually radiating the local population at a level that is "as low as possible".

To calculate the REI for each base station, find the base station on the government's Ofcom Sitefinder database, (www.sitefinder.ofcom.org.uk), note the EIRP, given in dBW, and the height of the antennas. This is the power for each carrier (channel), and most antennas have 4-6, sometimes more, different frequency carriers. However, this information is not easily available, so for comparison purposes, we compare the single value as given on the database.

To calculate the REI

Convert EIRP in dBW to watts. Divide the EIRP number by 10 and then use the antilog function on a calculator (usually shift + log), or use old fashioned antilog tables, or in EXCEL spreadsheet use the cell formula: =10^(dBW/10) which returns the value in watts. Divide this number of watts by the square of the height of the mast in metres (= watts/(height x height) e.g. a 20 dBW (100 watt) 7 metre mast has an REI of (100/49) = 2.0

If you want a quick guideline, rather than calculate the REI as in the box above, refer to the table below to identify the number of watts for the base station in question, and divide the number of watts by the height in metres, twice.

3 dBW	2.0 Watts	13 dBW	20 Watts	23 dBW	200 Watts
4 dBW	2.5 Watts	14 dBW	25 Watts	24 dBW	251 Watts
5 dBW	3.2 Watts	15 dBW	32 Watts	25 dBW	316 Watts
6 dBW	4 Watts	16 dBW	40 Watts	26 dBW	398 Watts
7 dBW	5 Watts	17 dBW	50 Watts	27 dBW	501 Watts
8 dBW	6 Watts	18 dBW	63 Watts	28 dBW	631 Watts
9 dBW	8 Watts	19 dBW	79 Watts	29 dBW	794 Watts
10 dBW	10 Watts	20 dBW	100 Watts	30 dBW	1000 Watts
11 dBW	13 Watts	21 dBW	126 Watts	31 dBW	1259 Watts
12 dBW	16 Watts	22 dBW	158 Watts	32 dBW	1585 Watts

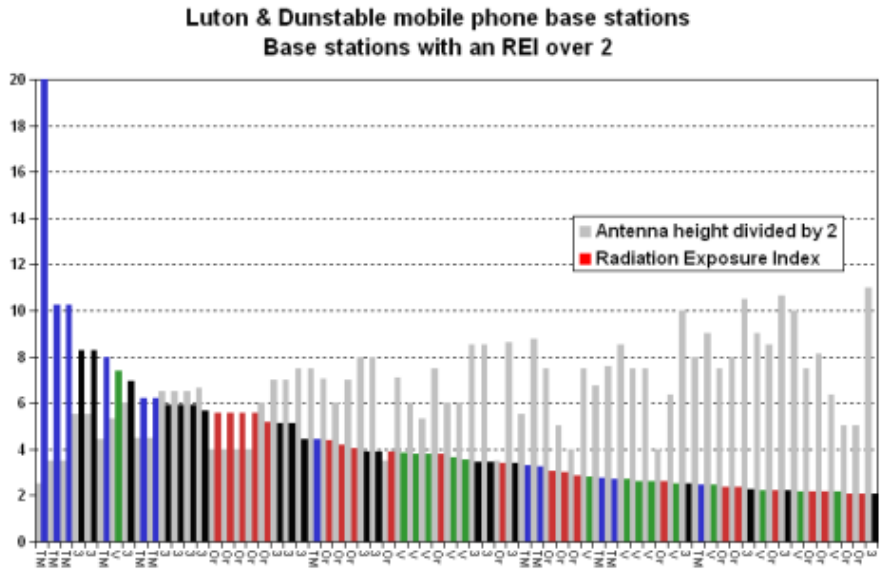
Example: As in the box above, we see a 20 dBW is the equivalent of 100 watts, and a 7 metre mast has an REI of (100/(7 x 7) = 100/49) = 2.0.

A quick guide for multiple operators on one base station:

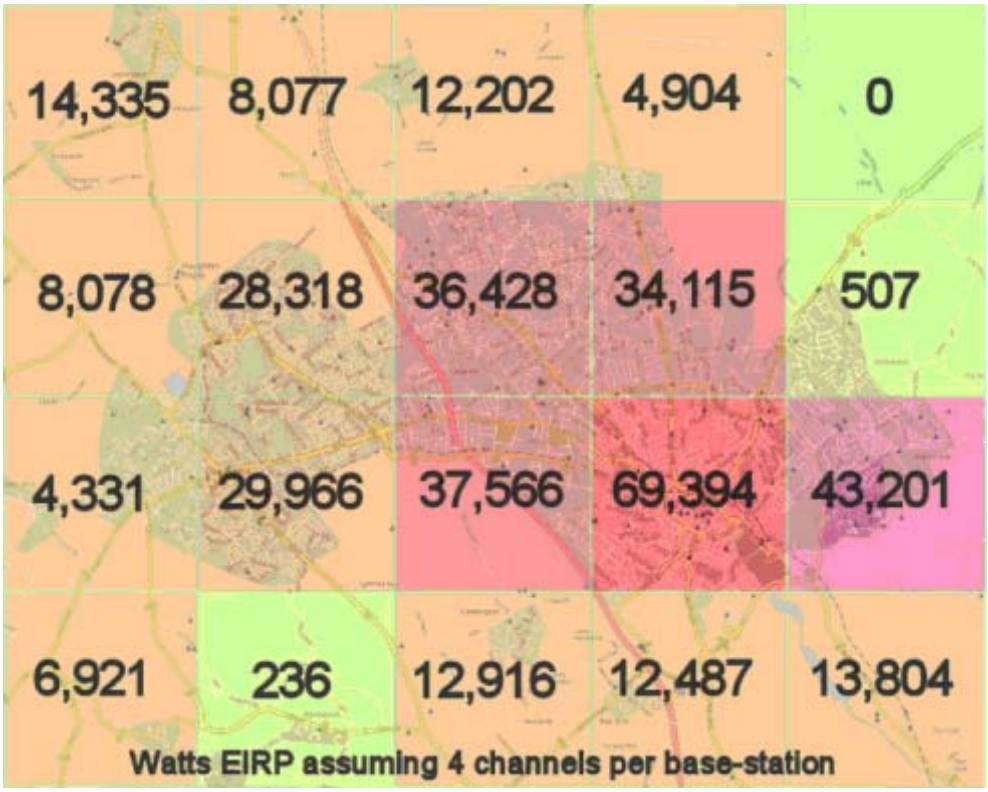
For e.g. 3 operators, add the 3 powers (in watts) together, and divide by the average of the 3 heights. Where you have multiple operators on base stations which are some distance away from each other, the best way of finding what you are being exposed to is to measure the signal strength at the place that you are concerned about, as the calculations become not only complex, but can be inaccurate due to local topography.

On high rise buildings, where the base station antennas are within about 200 metres of other residential high rise buildings, then instead of using the absolute height from the ground, the difference in height from the top floor of the nearest residential building to the antenna height should be used - e.g. an antenna listed as a 43 metre high site may only have a 5 metre vertical difference from a room window in a neighbouring residential block, then the 5 metre figure should be used.

Ideally base stations should have REIs of 0.5 or less, but up to 2 is acceptable away from residences and schools. In our opinion anything above 2 is unacceptable and either: (i) the height of the mast should be greater, or (ii) the transmitted power should be lower. Calculating the REI will identify the masts that are irradiating the local population the most.



The above graph shows the REIs from different operators and base stations in Luton and Dunstable, (from official www.sitefinder.ofcom.org.uk data, July 2006). We have no reason to believe that Luton and Dunstable are exceptional in any way, and are likely to be typical of most city environments. Note that some operators seem to be much worse at irradiating local residents than others. The resultant radiation levels in the Luton area can be seen below.



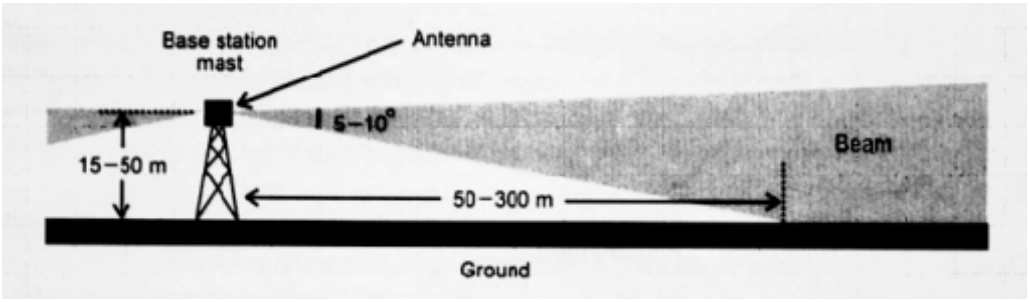
Radiation of the people living in and around Luton and Dunstable

There are also small 'burglar alarm' and 'telephone wiring box' antennas fixed to building walls, often near street level, especially in town and city centres, see below.

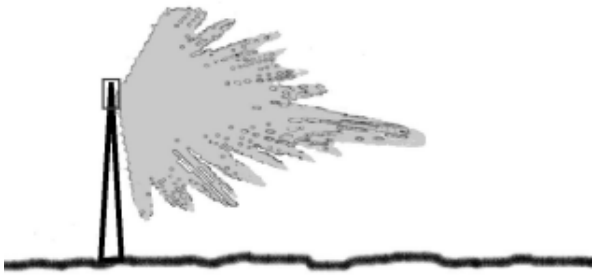
These can be the worst offenders for exposing the public to high levels of signals, and are discussed later in this chapter.

examples of wall mounted antennas painted to match their surroundings

Base-station antennas radiate most of their power sideways, very like a lighthouse at sea, though not rotating, and very little power goes upwards or directly downwards. The vertical *depth* to the main beam can be seen quite easily in the simplified schematic below, taken from the NRPB report R321. Similar diagrams were in the Stewart and BMA reports. In reality the emissions radiated from the antennas on a mobile phone mast do not conform to this diagram in this simplistic way.



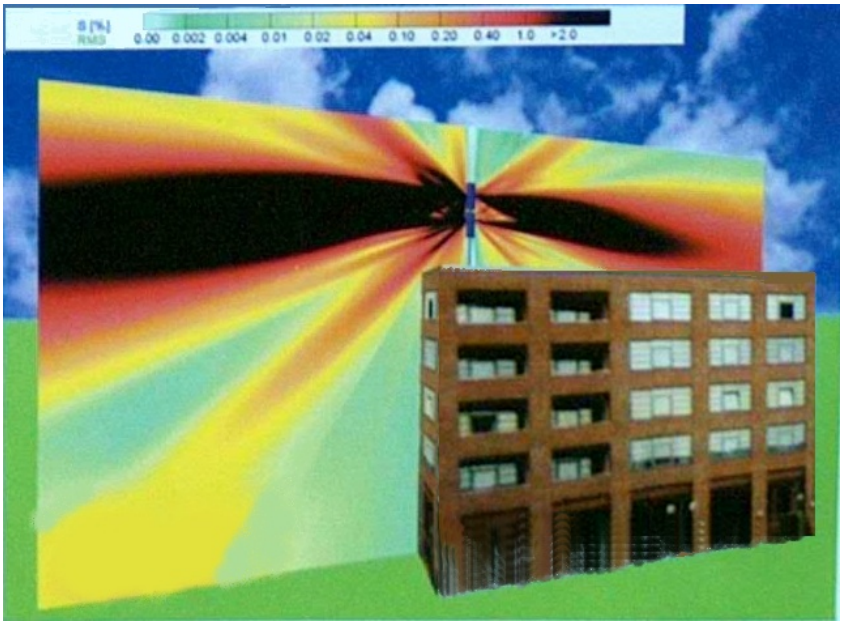
A base station is similar to a lighthouse, the radiation going out sideways not downwards



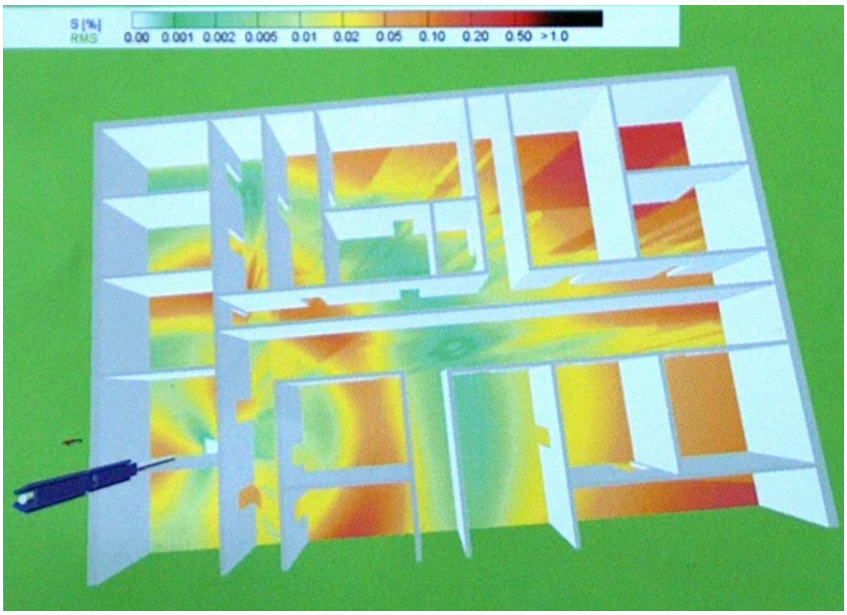
The vertical spread from a real antenna. The main beam can be seen extended outwards at the right hand side

A real antenna also has a *vertical spread*, see above. The main beam can be seen extending outwards at the right hand side. The spiky 'splatter' is caused by imperfect antenna design, and you can find these 'hot spots' using the COM, Acousti-meter, Acousti-COM or Electrosmog Detector. These antennas cause fairly small areas of high levels of microwave signals that are best avoided in bedrooms, favourite chairs and play areas, etc. The radiation pattern is further complicated by reflections of the microwaves from the ground, buildings and other structures, including vehicles. Inside buildings, radiation can reflect off internal surfaces, especially metal

ones such as mirrors, lamps, furniture, etc. Walls which have been screened using aluminium foil and products which use foil can reflect any microwaves that ***do*** get into the room.



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

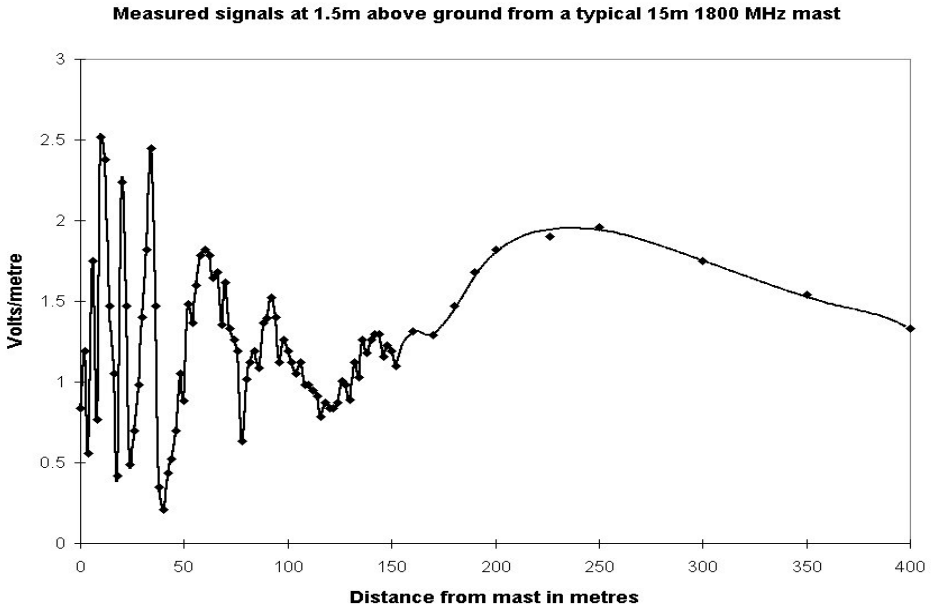


The floor directly underneath the base station (at the front left) showing the levels of radiation experienced by occupants of the various rooms. The most exposed room is at the top right, at the corner furthest from the base station position.

The diagrams above show the 'hot spots' in a building from a base station on the roof. As can be seen, it does not just radiate sideways, but it creates small, highly irradiated areas, not only on the roof, but on the floor and possibly floors below. In the upper diagram, the darker the colour, the higher the exposure and in the lower diagram, the red areas are the most highly exposed areas and the green are the least exposed.

There are also many small "side-beams" of microwave emissions coming out from the antennas at much steeper angles than the main beam which "shines" sideways towards the horizon usually at an angle of between about 2 and 10 degrees below the horizontal. The small side-beams cause

localised 'hot-spots' of higher microwave levels and these are often the highest levels measured when testing around a base-station transmitter mast. ***These are <u>not</u> "in the beam of greatest intensity" but actually <u>do cause</u> the highest exposure levels.***



The original Stewart report in 2000 recommended that 'the beam of greatest intensity [from a base station mast antenna] … *should not fall on any part of school grounds or buildings*'. In January 2005, a third of schools in Britain's towns and cities were found to have a mast within 200 metres of the main buildings and playgrounds. Stewart II (January 2005), said that "the signal was strongest between 50 metres and 200 metres from the mast". In a survey done for the Daily Mail in January 2005, Soho Parish Primary School in central London had 27 masts within 200 metres of its gates. 80% of sampled London primary schools had a mast, 53% of primary schools in Birmingham, and 47% in Edinburgh & Derby. 40% of secondary schools had at least one mast. Unfortunately, where the beam of greatest intensity falls is not a straightforward issue, and we don't believe that the complexity was anticipated by the wording in the first Stewart report, (see References). The phrase "*the beam of greatest intensity*" is discussed in some detail in Stewart 6.63 to 6.68. If we return to the lighthouse analogy, it is where the maximum amount of energy would be found in the beam of light radiating out. It also includes the areas close to this, where the energy is getting substantially less. It is generally defined as "places in the beam where the radiation is over half the power found in the centre of the beam."

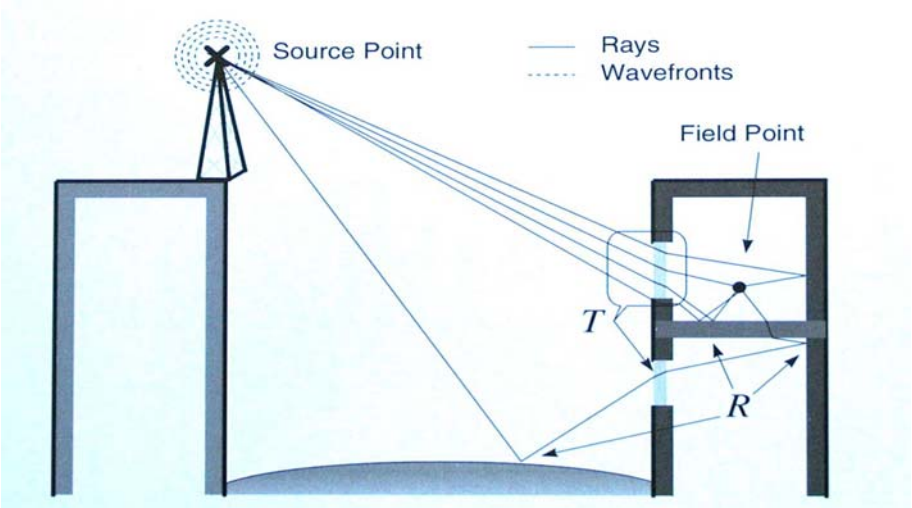
Signal levels around masts vary tremendously. Measuring them using a microwave sensor probe shows that they can vary by factors of five or more within the space of a metre. These sorts of change also show up when calculating the theoretical microwave levels and are due to reflections from the ground, nearby buildings and other structures. The Electrosmog Detector converts amplitude-pulsed microwave radiation into audio-frequency sound, which can then be heard. Many people who are sensitive to microwave emissions recognise these sounds as ones their bodies have been picking up, as if they have been 'hearing' them. The sound can be so intense that the machine almost 'screams' its message. These 'auditory' hotspots of *pulsed* radiation are not necessarily in the same place that the maximum ***power*** levels can be found. You can hear for yourself how your body absorbs and screens EMFs by standing or sitting between the source and the instrument.

The signals from masts can also resonate with house wiring, causing high fields inside houses, often from lights which hang from the ceiling, the radiofrequency signals running down the electric flex. If this is the case in a house, there may be high radiofrequency fields inside, even though there are no direct sources of radiofrequency emissions from household appliances or systems.

The microwave emissions can 'reflect' off other buildings and structures, bouncing back to expose the people in the building with the mast on top to microwave emissions as well. Passages or roadways between buildings where reflections are causing all the structures to be radiated, may result in a 'funnelling' effect down the passage, causing localised hotspots.

Microwaves have also been demonstrated to resonate with and reflect off metal surfaces, such as lampposts, parking meters, traffic lights, vehicles in the street, buildings with metal in the structures, glass with metal inserts, glass with heating strips as in car rear windscreens, metal window blinds, etc.; inside buildings reflections could come from radiators, metal furniture, lamps, all metal objects. These can all produce 'hotspots'. We have received a number of reports that these 'hotspots' can move, almost as if exposure to the RF radiation is 'imprinting' itself onto the structure; when it is radiated again, it reflects more. It is unclear how this might be possible. Feedback from people who have observed this phenomenon would be very welcome.

If there is a base station on top of a building with others nearby, the antennas can irradiate the occupants of the nearby building.

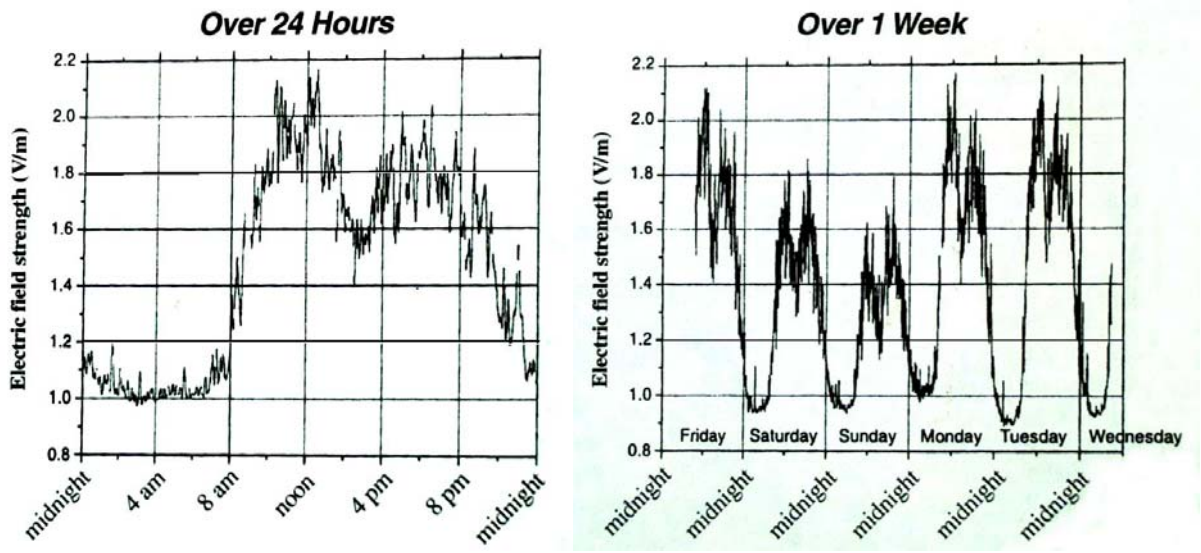


A base station radiating a nearby property, taken from Antennas & Propagation by Simon Saunders (ISBN 0 471 98609 7)

The diagram above shows the reflections and refractions of the microwaves from a mast antenna adding together to form the total field at any point. This results in the creation of areas of high field strength ("hot spots") and areas where the signals cancel ("cold spots").

The Acousti-COM monitor, or Electrosmog Detector, show that the resulting microwaves form "hot spots" inside rooms can vary from about 10 cm 'spheres', to 'beams' 50 cm by a metre or more extending right across the room. Often there is more than one of these 'beams'. The ONLY way to be able to avoid these places is to use a sensitive microwave detector to locate these areas of higher radiation.

Generally "rules of thumb" with regard to guessing levels of microwave radiation from one particular source are pretty useless in practice. If you have a free-standing mast, across open ground (no trees) pointing towards a row of buildings, then some rules of thumb can be applied, but it would depend on the beam shape, down-tilt of the antennas, height of the antennas and the distance between the antennas and the buildings. At 200 metres from a typical 15 metre mast, there may not be much difference with height. On a 24 floor block of flats at that distance, then the higher floors would have lower microwave levels and floor 0 to about 15 would be similar, with maybe floors 3-5 having slightly higher levels than the others. Very difficult to predict and it would depend on the microwave reflectivity of the ground surface. There would be much higher levels if it were tarmac or concrete compared to the levels if it were reasonable length grass. As regards close masts, then the closer you are to the level of the antennas, the higher the radiation level is likely to be. If you are at the same height, or slightly lower, then you are likely to be in the main beam and hence have high levels.



Variations in signal levels in the course of a day.

The signals from masts can vary during the day, as can be seen in the graphs above showing the exposure of a flat in Pisa, Italy in the immediate neighbourhood of base stations (Dr A M Silva et al). The field strength doubled in the course of the day due to call traffic density. The Italian exposure standard is 6 V/m. *(from Microwave News May-June 2002 page 5, see Refs.)*

Drums, Large (A), Medium (B), Small (C)

These round microwave dishes or drums are used for point-to-point, line of sight links between base stations that work at very high frequencies and very low power levels in narrow, well focused, beams and the microwave signal levels from these in public access areas are usually so low as to be effectively unmeasurable.

The telecommunications system connects through a group of macrocells which form a cluster, commonly a 7-cell cluster in the UK. Local geography has a significant part to play in the placing of mobile phone base stations, as considerations have to be made for pockets of population density, rising ground, areas of special scientific interest and natural beauty, the signal diminution effect of trees and buildings, the signal distortion effects of buildings, TV & radio masts, wind farms, etc. All base stations within a cluster are connected to the cluster Mobile Switching Centres (MSC) using land lines or, more frequently now, line-of-sight microwave links that use small drums or dishes mounted close to the main, vertical, sector antennas of the base station. Each cluster MSC is then connected to the MSC of other clusters and a Public Switched Telephone Network (PSTN) (e.g. British Telecom) main switching centre.

In order to allow a subscriber to travel around freely and still use their phone the cellular network has to:-

- have the ability to track the subscriber down when a call is made to him or her
- allow the subscriber to make calls while he or she is not in his or her home area.

Tracking is only possible if:-

- the system maintains information about the location of the subscriber's mobile phone
- the mobile phone knows the appropriate channels to await signals from the system.

The MSC stores information about the subscribers currently located within the cluster and is responsible for directing calls to them. When the phone is being used or is on standby, it communicates intermittently with the nearest base station to check the signal strength. When the phone is carried into a new cell, the signal level from the previous cell will fall to a critical value, causing the previous base station to inform the cell's MSC about this. The MSC instructs all the surrounding base stations to measure the mobile phone's signal level and transfer control to the base station receiving the strongest signal. This is known as hand-over and occurs in less than a second, so subscribers are usually not aware of it. The phone is then registered with the new base station and information as to the location of the mobile phone is stored in the MSC. If the mobile telephone is moved into a cell belonging to a different cluster it may also have to register with a new MSC.

If you are staying in the same place and your handset is logging on to the same base station, your phone may communicate as infrequently as every half hour. When you move, it communicates more frequently, making new connections as it needs to change the cell or cluster and contact the new base station. The faster you move the more times it will need to 'chat' to keep contact with the nearest mast. This can be every minute or so. These contacts are always at full power, so it is worth carrying your phone away from your body.

In the approach tunnels to some mainline railway stations, all the mobile phone handsets used to lose their existing base station link. The train emerged from the tunnel about 100 metres before the platforms and by the time the train arrived at the platform thousands of handsets are all

competing to register with the various base stations around the station – giving a great surge in the microwave pollution level in and around the train passengers for about three minutes.

In order to improve mobile communications in trains, some operators put antennas at the entrances of tunnels to maintain phone and data connections throughout the length of the tunnel. Other operators have put equipment in the train to maintain phone connections throughout the rail journey, and to offer travellers the opportunity to access the internet for work or leisure as they travel. This has not resulted in less microwave pollution in the stations, as operators are rolling out internet access networks for rail users to use in the stations while they wait for the trains.

Complaints by members of the public wanting to use the service and not having a 'good' signal clearly have to be responded to. The required signal levels to achieve 'adequate coverage' will be different depending on what is required by the members of public concerned, and the type of service the companies feel the public want or that the companies want to provide. The companies exist to make a profit for their shareholders and will not put up extra base stations and masts / antennas unless they are convinced that they will earn large sums of money from the new installation. That needs many people to make lots of mobile phone calls.

The UK mobile phone frequency bands are as follows:

- Low-band GSM, Vodafone and O_2 only:
  Handsets 890-915 MHz, Base-stations 935-960 MHz.

- High-band GSM and PCN, T-Mobile (UK), Orange, Virgin, Vodafone and O_2
  Handsets 1710-1785 MHz, Base-stations 1805-1880 MHz

- 3G / UMTS All Operators 1885-2450 MHz

- DECT (digital cordless phones): 1880-1900 MHz

- TETRA and Airwave (Home Office):
  380 - 440 MHz and possibly 915-921 MHz

Not a mobile phone frequency, but a source of pulsed radiofrequency radiation is

- DAB digital radio 220-230 MHz

The Health Protection Agency – Radiation Protection Division (HPA-RPD, used to be the National Radiological Protection Board (NRPB)), which advises the government on all aspects of radiation protection, in order for the government to make appropriate legislation, is the body which advises on public exposure to microwave signal levels. The Stewart Report in May 2000 recommended that the lower European limits proposed by the International Committee for Non-Ionising Radiation Protection (ICNIRP) would be more suitable than the previous NRPB levels, and these were adopted by the UK (for mobile phone systems exposure only) in June 2000. The Stewart Report also said (para 6.61) that base stations should be designed so as to expose the public to the lowest practical levels of microwave radiation.

The current UK maximum and ICNIRP public guidance level at the GSM high-band range is about 58 V/m or 9 watts per square metre (W/m^2). The other ICNIRP public guidance levels are as follows: for the low-band frequencies, only used by Vodafone and O_2, they are in the order of 41 V/m or 4.5 W/m^2; for 3G frequencies above 2000 MHz, approximately 61 V/m or 10 W/m^2; at

400 MHz (TETRA), about 28 V/m and 2 W/m². There is a table showing a comparison of international guidance and standards in Chapter 4.

The old NRPB guidelines included a precautionary reduction factor of 10 whilst the ICNIRP public guidelines include a precautionary reduction factor of 50. They are only based on heating, acute neurological effects such as uncontrolled twitching, and electric shock. Neither of the guidelines is intended to protect from cancer promotion or from any of the other adverse health effects which an increasing number of studies have associated with prolonged low level microwave exposure.

ICNIRP guidelines contain different limits for general public exposure and for those who are occupationally exposed. The lower limits for the general public offer an increased level of protection for embryos, pregnant women, children, for the elderly and sick as well as for the fact that the general public might be exposed continuously to the radiation.

For people exposed to microwave radiation whilst they are working, ICNIRP *occupational* levels are officially deemed appropriate. These are 127 V/m or 45 W/m² at 1800 MHz, 90 V/m and 22.5 W/m² at 900 MHz, 137 V/m or 50 W/m² for 3G and 61 V/m or 10 W/m² for TETRA. Areas with access for approved working personnel only are legally subject to these regulations.

There are procedures and training for workers who are likely to come into contact with base stations in the course of their normal working day (e.g. people doing maintenance work on the roofs of buildings on which there may well be antennas). For many other members of the workforce, there may be occasional exposure that has not been anticipated (e.g. window cleaners cleaning near to 'street furniture' masts (small, often wall-mounted, boxes that may not even be identified as base stations. These all should carry hazard warning labels, but many do not). PPG8 (Supporting Guidance) paragraph 91 states that "clear warning signs should be on microcells and picocells to minimise the risk of undue exposure to radiation". In paragraphs 94 and 95 of the Appendix to PPG8, it states that the HSE is the policing authority, although, in a letter, David Jamieson, Parliamentary Under Secretary of State in August 2002, says that "*PPG8 is not a legal requirement and the HSE could not enforce such measures*". He also states that "*the signs are only intended for people who will want to access the interior of the antenna housing, not those working close by, or members of the public*".

The highest output low height base station we found in a brief look in Autumn 2001 at some of the Central London base stations listed by the Ofcom website, was 25.4 dBW EIRP (Orange) which equates to 345 watts. Since our first enquiry, the registered power on the Sitefinder database for this site was revised down to 22.4 dBW or 174 watts, and in November 2002 to –1.6 dBW or 0.7 watts, though this last change is, apparently, incorrect, and was given to Ofcom by mistake. This contrasts markedly with the consistently applied Vodafone equipment at 7.15 dBW which is just 5.2 watts effective isotropic radiated power (EIRP). In early 2003, Orange reduced the output power of many of their low-height base stations throughout the country.

During 2002 we discovered that 3 were installing base stations that would result in massive microwave radiation levels in nearby houses – even by their own reckoning up to half of the ICNIRP guidance – about 30 volts / metre! That is a much higher radiation level than any of the other operators expose nearby residents to. Partly this is due to 3G systems operating at a slightly higher frequency so that it is more easily absorbed by people and buildings. We think the main reason is that 3 are trying to get by on the minimum number of base station sites (due to expected public opposition) so that each one needs to operate at high power. This wouldn't matter if they were in rural sites away from where people live and work, but for 3G video and broadband

services to work the sites need to be fairly close to where people want to use their handsets. This means many 3 sites are located in residential areas.

According to the Maastricht treaty, Europe should have an inter-operational railway communications system. In the UK, Network Rail began to erect 2,200 masts, 108 feet high, every few kilometres from the end of August 2003 partly to carry out the improvements in safety communication recommended following the Paddington crash in October 1999. The GSM-R system works on 900 MHz. Due to safety issues and the European directive they will not need any planning permission anywhere on their own land, even for a 33 metre mast, as masts on railway land are 'permitted development'. They seem to want line of sight between masts, and this means that masts could be spaced at 2 kilometre intervals in particularly hilly country.

They will be allowed to sub-let space on their rail-masts to any of the normal mobile phone operators. It is not clear whether this sub-let space would require planning permission, but even if it did, Local Planning Authorities are encouraged to allow mast-sharing, especially on existing structures. Unfortunately, for maintenance, as well as other reasons, sites may be selected at existing stations, which can be in the middle of a village or next to a school. As these masts are very high, as long as they are also well focused along the railway tracks, the power levels are likely to be relatively low in the immediate vicinity, higher exposure being experienced by rail personnel.

TETRA Antennas

The TETRA (TErrestrial Trunked RAdio) system has caused concern among the general population, after questions about the way it operates have been raised by engineers and scientists. The two UK services which use TETRA are Dolphin (which was bought by UK Broadband, a subsidiary of Hong Kong telecoms provider PCCW in June 2005), and BT Airwave, which is a service specifically for the Police and potentially other emergency services.

The operation of TETRA base stations (BS) originally resulted in a power modulation of the RF signals in bursts of amplitude modulation at a pulse frequency of 70.4 and 17.6 Hz. In 2006 O2 Airwave modified their BS software to stop this effect and the only amplitude modulation noise now coming from their base stations is the 2 to 18 kHz phase noise of the actual data. We can not detect low frequency noise from the TETRA-2 BS. We believe that all UK Airwave base stations are being (and may have now been) upgraded.

All TETRA hand sets and terminals built into vehicles pulse very strongly at 17.6 Hz, and the NRPB report acknowledges this. (NRPB Vol.12 No.2, 2001)

In March 2002, the Greater Manchester Police who had been piloting the Airwave TETRA system, "binned" their TETRA handsets, as they had been proving unreliable in field service. The original system was to have used 3 or 4 watts (W) in the handsets, 20 to 50 W for vehicle radios and 40 to 80 W for base stations. The Home Office restricted the pilot system to 1 W for handsets, 3 W for vehicles and 10 W for base-stations. The choice of lower power resulted in poorer radio coverage, more dropped calls, and the need for thousands more base stations. They added more base stations and adjusted antenna directions. The cost was estimated to be £2.9 billion to roll out the system for all 51 of the UK police forces.

Could the low Airwave system powers have been limited because of concerns about the possible adverse health effects of exposing the police to the 17.6 Hz pulsing bursts of microwaves emitted by the handsets? Virtually no research was done into the possible human health effects at this frequency before the roll-out of this system. The Stewart Report concluded that, although health risks were unproven at the time of their writing the report (May 2000), as a precautionary measure RF signals with an amplitude modulation around 16 Hz should be avoided if possible.

Laboratory experimentation done in the 70s and 80s showed that when an RF signal was amplitude modulated at around 16 Hz (in fact from about 12 to 25 Hz) the rate of leakage of calcium (which plays an important role in many biological processes) was increased from the brain and other tissue. This could have significant adverse health effects, as this leakage can let toxins into the brain that had been previously excluded.

The 17.6Hz bursts are almost certain to have biological effects, but the power is quite low and the set is usually held several inches away, unlike standard mobile phones. They may not cause adverse health effects, but the reports from some police officers do give cause for concern. One effect that is associated with holding microwave sources near to the eye is the development of an unusual inoperable cataract inside the eye.

In April 2002, the DTI approved various organisations as potential users (sharers) of the O_2 Airwave network. In order to be approved as a user of the Airwave network, the organisation had to respond to emergencies; be involved in emergency situations reasonably frequently; be normally civilian; and require interaction with those who respond to emergencies. The fire and ambulance services are looking at another system which is not compatible with TETRA.

Tetrapol is an alternative system that was launched in 1987 through an impetus given by the French security services. It *predates* TETRA, and is intrinsically more bio-friendly as it does not pulse in the same way or at similar endogenous brain-wave frequencies. Serious questions must be asked as to who advised the Home Office (and PITO) to choose the TETRA system for the UK Police. The EC formally criticised the UK Government for holding an illegally restricted (under EC law) tendering selection process that prevented free competition.

In April 2003 new information came to light that the US Government pressurised the UK to accept TETRA, as the US National Security Agency (NSA) wanted to be able to 'decrypt' secure communications around the world and the British police use of TETRA would encourage other governments to choose it. US Motorola program the chips and so the NSA has access to the secret encryption codes.

Many countries including Switzerland, France and Germany have opted for the 'safer' TETRAPOL system. We understand from a spokesman for Airwave that the TETRAPOL standard was not freely available, is proprietary, and therefore potentially far more expensive in roll out and development. Other countries afforded it.

In the UK, the government pays for the TETRA system for the Police. The police authorities were told if they wanted an alternative system, they would have to finance it themselves. What is the point of having a mobile communications system where handsets have to be turned off at road traffic accidents because they are likely to interfere with essential life-support monitoring equipment being used by the paramedics?

It has been shown that the former Dolphin TETRA mobile communications system seriously interfered with vehicle electronic locks and alarms. This is because the Government's former Radiocommunications Agency issued them with frequencies very close to those used by car-locking and alarm systems. Unfortunately, car electronics are unable to reject the relatively powerful Dolphin signals which therefore end up "jamming" some cars' electronic locking systems. The offending signal levels can be reduced by re-orientating the antennas, turning the power down, or screening against the problem radiation. This greatly reduces signal levels in the area below, though the phones will continue to work. TETRA can also interfere with burglar alarms and has been consistently reported as interfering with TV reception, causing poor picture quality.

Apparently the door locks of some Vauxhall cars (and probably other makes) are programmed at 433 MHz, and problems can be caused by TETRA transmitters and some amateur radio transmitters which can also use frequencies close to this range.

In April 2005, the Dolphin system only had 980 masts in the UK and 24,000 subscribers. Tom Quigley, MD of Dolphin said, "*Sadly, there aren't enough customers to make it a viable business.*" They are intending to provide Dolphin customers with other solutions. Information about the Dolphin masts was never put on the sitefinder website.

What are the fears about masts and base stations?

Macrocell masts and base stations when erected are often obvious structures. It is these structures that produce most objections. They can appear almost overnight, especially if full planning permission is not needed, can look very ugly (especially the older-type ones, and those with more than one antenna system (perhaps both 2G & 3G for several of the operators) and it seems as if we have very little control over the process. For people living in the vicinity of mobile phone masts, there is literally 'nowhere to hide'. And given the short time in which humans have been exposed to this form of radiation, it is unlikely that we have developed evolutionary immunity against any potential adverse effects.

Added to the visual intrusion, there are lots of media stories about how dangerous they might be. The media often do not seem able or willing to distinguish between the microwave signals from a working mobile phone and those from a base station mast. They are very different and the risks (whatever they may turn out to be) are likely to be very different.

Fear 1 - Fears about possible depreciation of properties and residences

Some depreciation of properties and residences is virtually certain, although a response by Vodafone to concerned residents said (July 2003) "*The industry does not accept that property is devalued by nearby radio base stations.*" In fact they imply the opposite "*The lack of mobile phone network access may be influential whether a buyer proceeds to purchase a property without this service.*" However, we do know of at least one person who has seen mobile phone masts as an ideal investment. His portfolio includes 10 base stations, which he bought primarily for their high yields – the rental income as a proportion of price. His most recent purchase cost £74,500; the site

was already let and it is guaranteed to pay an income of £5,500 a year – a yield of 7.25% after costs. He said "It gives me a great income stream because the rent is guaranteed until 2014". If you can't beat them, join them. I wonder what his base station will be worth in 2014?

To return to reality; the masts are a man-made, usually unattractive, visual intrusion. Depending on the pre-mast environment, there could be significant depreciation in the value of nearby properties. The home may take longer to sell, and we have heard instances of where very obvious structures made properties unsellable, especially houses in the higher price ranges.

Mast Sanity, an anti-mast pressure group, found that when people who contacted the group concerned about potential depreciation, did a 'before' and 'after' valuation of their property, they found the values had dropped by between 20 and 25%.

In May 2003, it was decided that seven residents in Swindon would receive between £10,000 and £20,000 compensation after their homes were devalued when a 20 foot mast was put up in the neighbourhood.

An analyst for a property research company is reported to have said "A mast can have a significant effect. If it's a large installation and virtually in the back garden, then someone can be looking at a devaluation of tens of thousands of pounds."

The typical mast may have either 3 directional antennas or 3 pairs of antennas per network operator, and possibly a dish or drum or two. Some newer masts are a single pole with the antennas at the top built in to what looks like an extension to the pole. They are far less visually intrusive, and tend to blend into the scenery in the way telegraph poles or power cables do.

In towns and cities, base stations can be very small indeed, perhaps the size of a burglar alarm or smaller, attached to the side of a building. The fact that they are small microcell base stations, does not, however, mean that their radiated power is low (see above). Some 'street furniture' masts may be added to lampposts, close circuit TV (CCTV) monitors, or similar installations which are already in place. Some of these may be associated with anxiety to do with health effects see Fear 7, but are less of a visual concern.

Fear 2 - Fears that emissions from the base station will be substantially increased once consent for the mast from the local population has been obtained

Emissions from the antennas put up following an approved application are more likely to decrease than they are to increase. Cell sizes (see earlier in this chapter) are getting smaller as more people are using the phones and phones are extending their use options. More lower-power base stations are being added to cope with 'traffic call density'. Therefore the power from individual base stations is *generally* diminishing not increasing. However, the company using the site may wish to add further equipment (e.g. 3G), or another company may want to add their equipment and 'share' the site. This will increase the microwave radiation. "3" base stations seem to be particularly high powered. We believe the current guidance (following the FEI ten commitments, July 2001 – see www.mobilemastinfo.com) about additions is as follows:-

If the telecommunications company wants to add anything to the existing equipment installation, they will inform the local Council Planning Department. The Council will then decide whether

- the proposed changes are very small, and so no further formal permissions are needed

- another general permitted development order (GPDO) is necessary
- the additions exceed the allowed limit and the company needs to apply for the appropriate full planning permission

If a different telecommunications company wants to share the mast (which is being encouraged by the government and the MOA), and it is currently occupied by only one company, the contact with the Council will take place as specified above. If the mast is already being occupied by two companies (two sets of masts) then full planning permission is required before any addition can go ahead.

For regulations to do with masts on existing structures see the appropriate planning regulations which should be available from your local Council Planning Department. It is not clear if the operators actually need to inform the council that they are installing 3G system equipment if the antennas do not visibly change.

With regard to WiFI networks, such as the one in Norwich, there are concerns that if a pilot scheme is upgraded, the power from existing aerials attached to lampposts could be increased.

Exposure levels could easily be measured and monitored. If local residents do not trust the company to monitor the fields objectively, this can easily be done regularly by individuals or by the local council, residents association, or a local secondary school as part of an ongoing Physics project, to ensure that the emissions levels do not exceed those for which permission was given.

The Vodafone Cassiopea monitoring system only really reports back information about compliance with the ICNIRP guidelines and isn't any use below about 1 volt per metre (V/m). Adverse health effects are reported from 0.05 V/m. The box also needs to be moved and left at every location to be measured.

We have found with the majority of the surveys we have done, that public access areas do not exceed a precautionary level of 3 V/m, a level based on the European electromagnetic compatibility (EMC) limit, preventing electronic equipment from interfering with other electronic equipment. This public access microwave exposure level has been adopted by several European countries and does not seem to present a problem there for telecommunications companies. However, for residential exposure, we suggest that inside nearby building the levels of GSM pulsing microwave signals should be less than 0.1 V/m – in line with Salzburg, and preferably lower.

Fear 3 - Uneasiness about disfiguration of land - and townscape

There are planning regulations covering sites of scientific interest and visual impact. PPG8 22.08.01 says "High priority should be given to safeguarding National Parks and Areas of Outstanding Natural Beauty. Proposals should be sensitively designed and sited and the developer must demonstrate that there are no suitable alternative locations".

There are overlaps with other National Policy Planning Guidelines, such as:

- PPG2 "Green Belts"
- PPG7 "The Countryside - Environmental Quality and Economic and Social Development"
- PPG9 "Nature Conservation"

- PPG15 "Planning and the Historic Environment"
- PPG16 "Archaeology and Planning"

Companies are showing some degree of sensitivity by designing masts which have less visual impact than the old ones. Some monopole masts blend in as well as other poles in the environment. Some are made to look like more or less convincing trees (unless you happen to be a woodpecker!); we have seen one installed in a former abandoned and dilapidated windmill, the building of which was restored, if not the function, at the time of installation by the operator.

Orange has come up with a solution to the problem of designing masts to look like deciduous trees. As there seemed to be no easy technical answer to devising leaves that appeared annually and fell annually, they have developed a mast to look like a dead tree. Apart from improving (?) the landscape, it may make campaigners wonder whether microwave emissions are killing trees in the local environment! In general, concealing a mast and antennas is expensive from the point of view of the operator. Tree look-alikes cost far more than a basic flagpole. The more customized the installation, the higher the price. But those in the industry say a concealed mast is often cheaper in the long run than battling communities mobilized against standard towers, and using lampposts and wall mounted antennas is even cheaper. However, there are still many incidences of lack of sensitivity, and battles due to intransigence and an unwillingness to compromise (on the part of the operator and / or the local community). There is a real difficulty for the operator in finding a site in special areas *where people want to use their phones*. We do not know of a National park area where people are insisting that they ***do not*** want to use their mobile phones, for instance. It is unclear whether the companies would achieve their percentage coverage if all areas of natural beauty were excluded, and certainly this would be impossible if masts were considered to be disfigurements by everybody. Current Government legislation, and changes in licence agreement about coverage would have to reflect this.

New installations on buildings (especially in conservation areas) could be at, or just below roof level, and hidden behind 'radomes' (specially designed cover structures) which replicate the original appearance of the building, for visual amenity. Appropriate measures would need to be taken to protect the occupants of the building from any microwave radiation that enters the building.

Where an existing installation is causing noise or vibration problems in high winds, and this cannot be rectified by tightening up the structure, the complete enclosure of the stub mast in a cylindrical radome may provide a solution.

National Grid Transco (NGT), the owner of our network of high voltage (400 and 275 kilovolt) powerlines, own Crown Castle and therefore all the BBC transmitter sites and the rights to most BT telephone exchange sites, making NGT the largest single provider of mobile telephone base station sites.

Fear 4 - Uneasiness about lack of information on technical data about the base station and on exposure levels in the vicinity of the base station

It is difficult to obtain useful technical information from the telecommunications companies. Why this should be so is unclear, but probably has something to do with 'trade secrets', general confidentiality issues, fear of being misinterpreted and probably other reasons beside. The fact is that the way that base stations operate is ***extremely*** complex technically. This information can be financially sensitive for the operators and rarely adds clarity to the answers given to the layperson.

Local groups have questioned whether the operators are obliged to provide information about the frequency(ies) to be used in the planning application. We do not believe that they have to do so. Provided that the operator is fitting approved equipment and make a statement that the site emissions are within the ICNIRP public guidelines, then no technical details other than constructional measurements, colour, general appearance, etc. need to be stated.

We do not believe that there is any restriction on beam angles, the operators are free to point them any which way they like. They tend to have them all the same within one system (e.g. for Vodafone, Orange, etc.) as their cells then mesh together neatly and efficiently. Also the triangulation location system (taking mobile phone signal strength bearings from at least 3 masts) works best if the antennas form a regular pattern.

However, individual cells can point in any direction and there are cells that have omnidirectional antennas that radiate equally around the 360 degrees.

Some simpler outlines of technical data could be made available more easily. This would help prevent the general public from believing that the telecommunications companies have something to hide, and thus lead to their disbelieving *anything* they say.

Exposure levels could easily be measured and monitored by individuals or groups within the local community. In February 2005, it was announced that mobile phone mast emissions in Stroud, Gloucestershire, are to be monitored and published on the council's website. The data will show total emission levels and set them against the precautionary health guidelines. This is part of a nationwide exercise initiated by Vodafone, the Cassiopea project. Councillor Nigel Cooper, Cabinet Member for the Environment, said, "We feel that the provision of reliable, properly validated data can only aid the public debate. The raw data is there on our website for all to see and draw their own conclusions."

We have a few queries about this exercise. Firstly, why Vodafone? They will hardly be seen as independent. Secondly the precautionary levels they will be set against are the ICNIRP guidelines. These guidelines are only intended to protect the general public from acute effects, not the non-thermal biological effects that are of most concern to the general public. ICNIRP compliance does not ensure that the public exposed to the lowest possible levels of microwave radiation. Thirdly, static monitoring from just one point will tell people nothing about the microwave levels in their houses.

It is unclear from these points how the use (and cost to the ratepayer) of this equipment can add anything meaningful to the "public debate".

Local communities want more openness from the companies, and a commitment to work with the public in a sense of true co-operation, instead of a no-holds-barred struggle, that nobody wins without loss of goodwill or credibility. The public also need to find ways of working with the companies, to provide the mobile phone coverage ***the public is asking for.*** We, too, have a responsibility.

Fear 5 - Uneasiness about being confronted with a fait accompli

As discussed in the introduction, the incredible growth in the ownership and usage of mobile phones was never anticipated. The Telecommunications Act 1984, granting the original telecommunications companies their licences, and the new 3G licences sold in 2000, impose conditions of coverage on the companies that mean they do not always take the considered time to negotiate with local communities, but rush through the building process. The prior approval

process, which was intended to facilitate the expansion of the network, without probably taking account of the implications, means that little public consultation is necessary, and although notification should be made, there is no obligation to put notices up in prominent places, or indeed, at all. The MOA attempted with their 'traffic light system' to improve the process, but it is still far from satisfactory.

As a result, the structures appear as if out of nowhere, can be an eyesore, and people immediately begin to remember all the scare stories that may or may not bear any resemblance to real hazards.

There are two broad categories of protestors:

- Those who do not like the uncertainty surrounding health problems and have taken a deliberate decision neither to own nor to use a mobile phone. Having made this decision, they may then be confronted with a structure they do not want, do not need, and seem to have no control over.

- The second category of protestors have a phone, don't want to be without it, and yet don't like the mast's presence. It may be a matter of personal control again, as many people have adapted their use of a phone to minimise their exposure following doubts that have been raised about health effects.

Improved consultation would help with the second category of protestors, especially if local communities take the responsibility for identifying sites for mast erection that would be acceptable visually to the local community and will meet the technical requirements of the company. It can be really helpful to ask what sites have been considered by the operator before choosing the one that they have applied for permission to erect a mast on. Local residents may require clarification of the situation, if, when asked, the operator gives an answer such as this. *"Sufficient evidence was provided to the ***** District Council through dialogue and correspondence commencing ******. It is available for inspection from them";* an answer given to one concerned protestor. Perhaps, though, the Council does have substantial amounts of information that could be looked at.

It is easy to understand how the official response to residents' concerns over the rollout of a new WiFi system can be less than re-assuring, when those residents have had no say in the erection of transmitters. Ann Carey, project director of Norfolk OpenLink stated in April 2007 *"It is important to stress from the outset that the project complies with all* ***current health and safety standards.*** *We certainly would not have implemented the project if there had been any* ***proven*** *risk on the safety of WiFi and presently* ***there is no guidance from the Department of Health*** *and other professional bodies that says WiFi is unsafe"*. This can hardly be re-assuring when **no** research has been done, so the potential risk cannot have not been evaluated; it seems less than responsible that the Department of Health has issued no guidance when teachers' unions and government physicists are expressing grave concerns and suggesting children should be very careful in their use as microwave levels from laptops could exceed the exposure they would get from mobile phones (the Department of Health has had leaflets recommending children should use mobile phones in emergencies only since 2001). It is unsurprising that the Health and Safety Agency has not yet caught up with the dearth of information from the organisations that are meant to protect the wellbeing of UK citizens. The Daily Mail, in May 2007, reports that the Department of Health says they look to the Health Protection Agency for advice with respect to guidance. The HPA's chair, Sir William Stewart, is recommending that children's health be monitored where they are being exposed to the new WiFi schools systems.

Fear 6 - Fears about possible health disturbances or impairments

The technology has not been around long enough to know if there is a problem or not. Most people when looking at risks, want a black and white *"yes"* or *"no"* response to a question about unknown health risks. Most real-life situations are on a scale of greys.

"Will I get cancer if I smoke?" *"Maybe"*

"Will I have a car accident if I drive for ten years?" *"Perhaps"*

We have, over time, learned to live with these risks. When our perception of the likelihood of a major consequence occurring, such as hijacked planes crashing into the World Trade Center Towers in New York on September 11th 2001, is challenged, then we change our behaviour, and the number of people flying goes down significantly, though only temporarily. Any permanent change in level would be an indicator of a possible change in people's risk perception.

So, with the new technology, the questions are:-

"Will I get seriously ill if I use a mobile phone?" *"Maybe"*

"Will I or my children have serious health problems if we live, work or go to school near a mobile phone mast?" *"Perhaps"*

The honest answer to these questions is, we don't know, yet. ***Possibly*** neither the phones nor the masts will affect any of us, though this is unlikely. ***Possibly*** they will affect all of us, though this is also unlikely. ***Probably*** they will affect some of us, some quite badly, some just a little. We don't yet know who and neither do we know how. Some leading-edge scientists are proposing theories, based on the research that has been done. Some of these are confirming people's experiences. Even if some of the theories are true, the implications could be very serious indeed.

The chances are that the phones ***will*** affect some people and some of those will be affected quite badly. It is at the moment impossible to predict in advance who may be affected, in the same way as it is impossible to predict who will develop a potentially lethal peanut allergy.

In Sweden, there is a new political party which requires that the deployment of new wireless technologies should be postponed until it has been scientifically proven that they do not cause any long-term negative effects on the health of human beings and the environment, including animals and birds. It seeks to apply the precautionary principle which is enshrined in legislation throughout the European Union (including the UK).

Most of the research done so far has been on the potential adverse health effects from the use of the phones, the adverse health risk associated with base stations is less clear.

However, there have been several studies of the health of people living up to half a kilometre from mobile phone masts which have shown clear relationships between symptoms and distance. Other studies have looked at signal strength and pulsing rather than distance, with similar results; the higher the exposure, the more symptoms have been experienced or more people have been affected. These have not always been carried out with easily replicable protocols, so there is some criticism levelled at the studies, especially by the sceptical scientific community or governmental decision makers. Studies of exposure to any environmental hazard is notoriously difficult, due to all the possible confounding effects. According to a questionnaire survey by Hutter and colleagues (2004) *"opponents of celltowers generally do not express unusual fears*

concerning electromagnetic field exposure." They concluded *"the risk rating is comparable with other perceived common hazards of the civilised world."*

It is universally agreed that the power levels coming from ***all*** masts are relatively low and from the large majority ***very*** low. 'Power' is far from being the only issue and there is a significant body of researchers who believe that it is not the *power*, it is the *pulsing information* that is likely to cause the problems. Such pulsing may disrupt our biological systems, causing reactions that are very difficult to predict in a living system, which has an amazing ability to recuperate from even major trauma, but which does have its limits. There is also increasing evidence that chronic (long-term) background exposure to low levels of hazardous 'substances' (including nuclear ionising radiation) often has a bigger impact on health than short term acute high dose.

Research into this is very difficult, as no-one will pay for it, and it is only researchers who are looking at unusual biophysical and biochemical processes who are likely to make the critical discoveries. This will take a long time, especially if money is not easily available.

The need for research highlighted by the Stewart Report, 2000, resulted in the government setting up the Mobile Telephony Health Research (MTHR) programme with joint funding by the government and mobile phone companies to investigate the potential health effects from (primarily) mobile phones, but also a couple of mobile phone base stations studies.

Many of the research proposals are based upon using surrogate exposures (i.e. not real phones), none on children to determine their vulnerability (the ethics committees won't allow it) and the only research on masts, is to look at the incidence of childhood leukaemia (which as far as we know has not been linked specifically with mast exposure) in the vicinity of the mast. The person leading this research (Paul Elliott) has been quite outspoken in the past about his disbelief that RF radiation is responsible for ill-health. There is also a study at Essex University looking into people's sensitivities to mast radiation. Unfortunately the people who are most sensitive, are unable to take full part because of the effect the exposure has on them, which can persist for some considerable time afterwards. These will be excluded from the results as did not complete the programme. This will automatically weaken the study's findings. It is difficult to see how progress can be made speedily with these problems.

Siting antennas in church steeples is contentiously dividing religious congregations across the country. Often the parochial church council will be approached by a telecommunications provider and asked to lease space for an annual fee. To impoverished congregations, this is like manna from heaven. The agreement is often worded as a win-win situation. The church gets the money and the community is protected from visually intrusive masts. Not all congregations see the situation in those terms, and when those who are opposed to the masts get overridden and antennas are installed, they may leave the church in search of another that they feel will be more responsive to spiritual and environmental issues. Quintel S4 Ltd (which have entered into a deal with the Church of England), is partly owned by QinetiQ plc, whose specialisms include microwave weaponry.

Some time ago there were some stories in the press and on the television about the new Stratsats. These are basically large airships, using solar power, floating at a height of 60,000 feet, and containing equipment to deal with mobile phone signals. They can also receive and redirect signals for television, digital radio, the Internet and surveillance services. Apparently, they are intended to replace around 4,000 mobile phone masts, and the network of airships is suggested to take the place of 10,000 of the masts needed to provide nationwide coverage for the rollout of 3G. Unfortunately the airships will not be able to handle this sort of demand and mobile handsets would have to be redesigned to send their signals skywards, instead of sideways to the nearest

base station as at present. As StratSats will be located above the clouds the water vapour would reduce the signals in wet and stormy weather, and solar flares may also affect the operation of radio equipment in such airships.

A recent review of research done by Kositsky, Nizhelska & Ponezha, Russian & Ukrainian scientists (see References) suggests that as a result of such a 'soup' of sources of radiation, standing waves may arise, the frequency of which may coincide with resonance frequencies of living cells, organs or systems of a living being. Exposure to low-energy electromagnetic radiation from high level communications installations may change genetic structures, leading to genetic instability. The chapter on health effects goes into more detail about the research situation as it is currently known.

Other ways of reducing the number of masts or eliminating them altogether have been suggested by campaigners who feel (usually mistakenly) that there are easy alternatives to the current system of subjecting the whole population to radiofrequency emissions, even though they may be more expensive for the operators.

Two possibilities that have been suggested are:

1. Satellite phone links. This was tried - there are 63 satellites in the Earth's atmosphere that are a legacy of the Iridium system. We understand that they were purchased by the US government as a backup military system. Basically, it didn't work as it made the whole system too expensive for the phone user. Because of the distance from the mobile phone handset, the power that would be needed for the handset to communicate with the satellite was high, with potential consequences for the health of the user, and the handsets were heavy.

2. Fibre optic network for Internet connections. We already have the option of subscribing to fibre-optic supplied cable TV. The infrastructure is there, but it is static. The telecommunications companies believe that their customers want services 'on the hoof' so to speak, so restricting them to the home base is not seen as an attractive option. Many of the phone companies are promoting a mobile phone as the only system people need – especially with the 3G systems. In order to get this, reasonably high-powered local masts will be needed. The Cloud system, referred to in chapter 2, is one development offering city-wide blanket cover for internet access, whether the subscriber is at home or out and about.

Some telecommunications companies are upgrading their GSM system, to a 'halfway house' between GSM and 3G ("2½G") using a bolt-on GPRS. This, too, has implications, as for every call, up to 4 time slots are needed for the incoming calls, so more RF frequency channels and masts will be needed to cope with the apparent increase in 'traffic density'.

According to Ogier Electronics, 3G antennas can be made from several dozen tiny antennas, and computers are used to stagger the voltage and phase of each one. Coupled with precision measurements to determine accuracy, this will give precise control of where the beams land and so they will be more able to avoid producing hot spots.

A new type of antenna for handsets could reduce the number of masts needed for 3G, according to a report in the New Scientist (1 June 2002). Currently a phone has to pick out the signal intended for it amidst a sea of interfering emissions. Each signal has to be strong enough to be detected by the handset. The new antenna developed by Innovics Wireless, allows the network to transmit at lower power by combining the signal from the base station with weaker reflected

signals. The handset has two antennas to make use of variations in signal strength over a very short distance.

In a survey carried out in 2002 by the London Borough of Harrow of all Local Planning Authorities in the UK, the following selected responses were made:-

- Is telecommunication equipment an important issue?
  for Planning, 134 out of 141 said YES (95%)
  for Health, 99 out of 135 said YES (73%)

- Do telecommunications proposals produce strong public reaction?
  84 out of 142 said YES (59%)
  56 out of 142 said Sometimes (39%)
  i.e. total of 98%

- Does the planning regime deal adequately with community concerns?
  117 out of 140 said NO (84%)

- What are the main concerns?
  Appearance - 126 out of 133 (95%)
  Siting - 125 out of 129 (97%)
  Health - 34 out of 62 (55%)

Masts and planning regulations

The authors of this book are not planning experts, and may well miss important changes to planning legislation and guidelines. If you are concerned about planning issues with respect to your local authority, we suggest you look at the following websites, run by volunteers, www.planningsanity.co.uk or www.mastsanity.org or www.mastaction.co.uk who will be able to offer more detailed comments.

Some brief statements that we believe to be correct and pertinent are found below, but it is important to check the information if you are presenting an appeal to a planning application.

The Telecommunications Act 1984 states that if a landowner rejects an approach to erect a transmitter on his / her property then a Code Operator (telecommunications company) can apply to the Courts to allow them to dispense with consent for that site and assess the financial recompense to be awarded to the landowner; that is, compulsory purchase. In April 2005, Vodafone threatened to invoke special emergency powers to erect a mast in Guide Post, near Ashington, in Northumberland, after the Council had refused permission. The new site had been chosen to replace a site they were no longer able to use because of a housing development. An alternative site was eventually agreed on.

Telecommunications 'transmission devices' require planning permission unless they are "permitted development" as defined in the General Permitted Development Order (as amended). Permitted development rights may be taken away by an 'Article 4' direction. An Article 4 direction removing permitted development rights for telecommunication transmission devices within 200 metres of any school, hospital / health centre or residential dwelling, will require the prior approval of the Secretary of State. This is unlikely at present.

GPDO Order 2001 paragraphs A.1(g) and A.1(h) set limits on the number of antenna systems that may be placed on a particular building without the need to seek planning permission.

The explanatory section of the GPDO defines an antenna system as: "**a set** of antennas installed on a building or structure and **operated by a single telecommunications code system operator** in accordance with his licence."

Permitted development rights are not extended to developments leading to more than two antenna systems [*not operators*] on a building or structure, which would result in the presence of:-

- **more than two** antenna systems on a building or structure (other than a mast) **less than 15 metres in height**

- **more than two** antenna systems on a mast located on such a building or structure or on a building or structure (other than a mast) **over 15 metres in height**, **except where a third antenna set is to be located below a height of 15 metres.**

So, full planning permission is required for 4 sets of antennas on structures of 15m+ (or 3 sets if all 3 are to be above 15 metres high) and 3 antenna sets on a building or structure less than 15 metres high. Operators are not entitled to GSM/PCN & 3G licences (2 sets) at each site without full planning permission. In Scotland, and Wales (from October 2006), full planning permission will be required for all telecommunications base stations. The Welsh Assembly also recommended that local planning authorities should take health impact statements into account when deliberating on applications for planning permission or prior approval.

The above permitted development rights are not restricted or expanded by an operator's licence. Even if the licence provides for the provision of 10 antenna systems by the code operator it would still be restricted by the above provisions and having more than one licence would not override these provisions.

Small antennas and 'de minimis' developments

The determining characteristics of small antennas are set out in Part 24 of the Town and Country Planning (General Permitted Development) (Amendment) Order 2001 (GPDO). They are described as *"An antenna, for use in connection with a telephone system operating on a point to fixed multi-point basis, which does not exceed 50cm in any linear measurement and which does not, in two dimensional profile, have an area exceeding 1,591 sq cm (e.g. 16 cm x 100 cm; these measurements exclude brackets, etc)"*. No permission is needed for these, although the operator has to inform the local authority 28 days before installation.

GPDO A1 sets out where 'small antennas' may be installed and limitations to this. They can be fixed to most existing structures and no permission is required, just notification. There is no provision for the equipment housing for small antennas, so there would have to be cables to a central control, or some internal equipment housing (as long as the building was already a telecommunications development), or the operator would need to obtain change of use permission.

'De minimis' additions are considered as those which are not being development within the meaning of Section 55 of the Town and Country Act 1990 (subsection 2), and not ***materially*** affecting the external ***appearance*** of the building or other structure. 'De minimis' comes from 'de minimis non curat lex' a Latin phrase that means "the law does not care about very small matters". 'De minimis' applies to the physical characteristics of the equipment and does not include limitations on emissions.

At a maintenance or any other visit to an existing site, the operator might exchange existing 2G antennas, erected under permitted development rights, with dual purpose 2G / 3G antennas. Permitted development rights apply to the number of antenna sets, so replacing one set with another may not cause them to be in breach of their licence. However, replacing existing antennas with ones which are substantially longer, is **not** a 'de minimis' development.

PPG8 revised 22nd August 2001, paragraph 20, says that the cumulative effect on an existing structure should also be taken into account. If people are not given the opportunity to object to new developments, it could violate their rights to a fair hearing, according to article 6 of the Human Rights Act. However, the operators believe that adhering to the MOA's Code of Best Practice, together with the statutory Town Planning process, gives the residents and other objectors the opportunity and facility to demonstrate their "right to a fair trial".

The following is from the Inspector in an appeal decision regarding a mast in Kingsbridge; "I have considered the submissions that the human rights of directly affected residents would be violated in relation to Article 8 of the Convention on Human Rights. This provides the right to respect for private and family life, home and possessions, and that there should be no unnecessary interference by a public authority with that right.

For an allegation of detriment to health to succeed it must be shown that the claimants would be personally exposed to a danger that is not only serious but also specific and imminent. In this case, the residents in question are those living nearest to the site, who would clearly be personally affected if there were to be any danger. However, the Government has accepted the Stewart Committee's recommendation that proposals should be measured against the ICNIRP guidelines, as part of a precautionary approach intended to exclude known health risks and to minimise unascertained health effects. Given the agreed fact that the proposal would comfortably comply with ICNIRP guidelines, I do not consider the proposal would pose a serious, specific and imminent danger."

In a personal communication in October 2003, local residents' helpless feelings were summarised very succinctly by the writer. "We feel particularly sickened by the farce of the appeals process and the way the democratic rights of local people to determine local planning decisions was sold off by the government to the mobile phone companies along with the lucrative licences. There is an institutionalised contempt for the wishes of local people which has made us all heartily cynical about the pretence of public consultation."

The Stewart 2 report "Mobile Phones and Health 2004" released in January 2005, said in the Executive Summary paragraph 30 "The Board notes that whilst the planning process applies to macrocells, it does not obviously apply to microcells and picocells. It is important that, as the networks develop, there is a need for clarity in terms of the legal responsibilities and regulations in relation to the installation of microcells and picocells and the availability of information about their deployment." This issue needs to be addressed urgently as in a recent sitefinder survey by Powerwatch, we found 63% of masts in Soho were under 10 metres in height (microcells) which do not need planning permission.

Breaches of output conditions

Planning permission is solely granted on the condition that the guidelines are not exceeded. If a greater output is achieved (per channel) than the guidelines, then in effect this is a breach of the planning conditions, and a breach of condition notice could be issued by the LPA, and the operator prosecuted in the Magistrates Court for the offence, and fined for that offence and every continuing day of the offence. It may not result in the mast or equipment being removed, though.

It is another question as to whether you could encourage the LPA to take that course of action. You may need independent evidence as to the precise outputs on more than one occasion, as most local authorities take the view that they are not competent to make judgements as to the emissions from masts. The HSE are in law the policing authority, and Ofcom would be the agency to establish the output. In practice it is unlikely that masts will ever exceed the high ICNIRP Guidance levels.

In July 1999 the Town and Country Planning Order 1999 included:

- in section 11, "the Radiocommunications Agency [now Ofcom] is able to supply information re: all registered telecoms / mast sites on demand". This was also recommended by the Stewart Report. Since October 2001, Ofcom has a website which shows the siting of all integrated base stations owned by different telecommunications operators. It can be found on www.sitefinder.ofcom.org.uk. This site does not include private radio systems, such as used by taxi companies, the police, security firms, etc. It is only updated every three months, and that is after the integration, not after the erection of the mast. The website usually indicates when it was last updated. Ofcom uses information provided by the operators and is, by and large, accurate, although we have found significant inaccuracies occasionally. The heights on the sitefinder website are "above ground level". This is fine for situations such as a housing estate with a free-standing mast. In city areas with high residential buildings, we believe the antenna height should be taken from the floor level in any bedroom or living room from which the antennas can be seen within about 200 metres from the base station.

- in section 10, local authorities are encouraged to maintain a register of masts and other structures to which apparatus could be attached. Part 2 of Local Structure Plans could include policies on siting, design and sharing. (We do not believe from what we have been told by concerned residents in various areas that this has been done very often. Providing such a list would give residents and councils some degree of control when it comes to negotiating with companies. We believe it is probably because of the generally negative reaction to *any* sites that this has not been done. Unfortunately, this reaction usually means the company chooses the site that suits them best. This may or may not accord with the community view.)

On 22nd August 2001, the Government announced the revised PPG8 on telecommunications. The following are extracted from this guidance note, with additional comments in brackets.

- Operators may be expected to *show need for the development*, although authorities have no power to question the need for the network the particular development is to support.

(The House of Commons Trade and Industry Committee on 3rd April 2001 (Notice No. 12 HC 330) had suggested before the revision came out that "Operators should be prepared to demonstrate that a proposed installation is necessary in the proposed site". Our comment - A good example of questioning necessity in a particular site is when an operator wishes to locate a low-height lamp-post mast close to a residential building. This is often done to keep the cost down, because the power supply is under the pavement, rather than being a 'necessary' placement for the equipment within the network.)

- The operator should have submitted a strategy for their local area telecommunications development (by the end of October each year) and any specific plans should be set into this context.

(Some Councils are not allowing members of the public to see these strategy plans as they consider them "commercially sensitive". At a meeting of the MOA and all operators in July 2002, it was confirmed that all such plans and details of specific applications are to be made available by the LPA to the general public.)

- When a mast is to be erected on or near a school or college, discussions with the operator and the authority should take place with the relevant body *before* submitting an application for planning permission or prior approval. The planning authority should take into account any relevant views expressed.

(This has clearly not been happening, according to the ruling in November 2004, when the High Court upheld the appeal by the telecommunications operators in Harrogate, Yorkshire, where three local schools were in the main beams. A follow up television programme revealed that school consultation was a rare exception and not the rule. Stewart II (January 2005), said that "the signal was strongest between 50 metres and 200 metres from the mast". In a survey done for the Daily Mail in January 2005, Soho Parish Primary School in central London had 27 masts within 200 metres of its gates. 80% of sampled London primary schools had a mast, 53% of primary schools in Birmingham, and 47% in Edinburgh & Derby. 40% of secondary schools had at least one mast. Most schools had not been consulted.)

- High priority should be given to safeguarding National Parks and Areas of Outstanding Natural Beauty. The developer must demonstrate that there are no suitable alternative locations and should put forward potential design solutions to the local community, including; the importance of sympathetic design; innovative approaches; exploring new technologies, materials and designs.

- Public concern about health considerations can in principle be material considerations in determining applications for planning permission and prior approval. Whether they are material in a particular case is a matter for the courts. It is for the decision-maker (usually the local planning authority) to determine what weight to attach to such considerations in any particular case. Stewart says "*The resultant frustration has negative effects on people's health and well being.*"

(Circular 4/99: "Planning for Telecommunications" made it clear in paragraph 37 that radiation safety is a matter for the Health and Safety Executive and is not a planning issue. In 1998, the Court of Appeal decided that 'genuine public fear and concern is a material planning consideration, even if the fear is irrational and not based upon evidence.' The Town and Country Planning (General Permitted Development) (Amendment) (England) Order 2001 states in Article 3 Paragraph 3(6) it requires the local planning authority to take into account representations received by them when determining the application. However, in a ruling where an appeal by O_2 against a refusal for a TETRA application to Stroud Council was upheld, the inspector concluded that health was a material consideration, but that there was insufficient evidence presented to the inquiry to warrant refusal on health grounds. This was despite the expression of considerable local fear and concern. Notice No. 12 HC 330 had suggested a number of changes to the PPG8 before the August revision. These included: "*Local planning authorities should be given 'explicit guidance' as to what weight to give to anxieties over the possible health effects of masts*". As can be seen, explicit guidance has ***not*** been given.

- The Government believes that the planning system is not the place for determining health safeguards, and that it takes responsibility for deciding what measures are necessary to protect public health. It reiterates that if a proposed mobile phone base station meets the ICNIRP guidelines for public exposure it should not be necessary for a local planning authority to consider further the health aspects and concerns about them.

- The Government is concerned to keep the numbers of radio and telecommunications masts to the minimum practicable with the operation of the network. Sharing of masts and sites should be encouraged wherever possible (a very complex issue, see below) considering the environmental impact of additional masts and sites. *Authorities should help applicants identify existing and potential sites by making suitable local authority or other property available to users.*

Some authorities are choosing as a result of campaign groups' agitations to ban phone masts from council property. This is unfortunate, as Council land and properties ***may*** be the best places for the positioning of base stations. The result of this decision could mean inappropriate siting in residential areas, including next to schools, play areas, etc.

- Applicants will need to show evidence that they have explored the possibility of erecting antennas on an existing building, mast or other structure, which should be used wherever possible. Sympathetic design and camouflage, to enable the development to blend into the landscape, should be used to minimise the impact of development on the environment. Careful consideration should be given to screening and planting.

The operative word in careful consideration seems to be 'careful'. Orange planted some Leylandii round a small (12m x 12m) base station site to give it an attractive natural look. Orange did not inform the farmer, one of whose fields was adjacent to the site, of their intention to plant the Leylandii. The farmer then complained because the trees would poison his cows. So they put another fence round the site to increase the size to 19m by 19m, a clearance of 7m to stop the cows (giraffes?) eating the trees (or fast growing shrubs as Orange described them).

- The Government incorrectly says that "the Stewart report does not provide any basis for precautionary actions beyond those already proposed".

(Notice No. 12 HC 330 had suggested "Operators should make a declaration that emissions likely to be produced by a new base station are 'as low as reasonably practicable', as suggested in the Stewart Report".

We comment: The UK Government only requires compliance with ICNIRP. Other countries have adopted more precautionary levels (see Chapter 4), and by and large, companies can operate a network within those guidelines.)

- In the Government's view, local planning authorities should not implement their own precautionary policies e.g. by way of imposing a ban or moratorium on new telecommunications development, or insisting on minimum distances between new telecommunications development and existing developments.

This may not make the decision easy for councils to impose the sort of restrictions that mast campaign groups often wish to have implemented. Many groups, and councils, want to establish exclusion zones of between 500 and 1000 metres from sensitive sites. This is not a practical way of reducing emissions in our opinion as **too many people are using their mobile phones** and fewer, more distant masts, would not have the call capacity. Field levels are the only realistic way - keeping them as low as possible - as the infrastructure servicing phone users will not function adequately with these sorts of exclusion zones. Some areas would then be exposed to very high fields from the masts in order to reach people within the mast exclusion zones. It is unlikely that people living in these areas would find this an acceptable option. ***The important thing as always is to stop using the phones. No masts are then needed.*** Scotland, of course, can decide and are deciding to deal with the issue, using their own laws. Wales is not guided by PPG8, but by TAN.

- Planning authorities should encourage prospective developers of new housing, office and industrial estates to consider with all relevant telecommunications operators how the telecommunications needs of the occupiers will be met.

- The construction of new buildings can interfere with telecommunications services, and the possibility of such interference can be a material planning consideration.

It should be remembered that government guidance (PPG8) is not law and at least 3 cases taken to court have upheld objections of 'inappropriate siting' of masts. Case law precedence has greater weight than government guidance. However, it can be very expensive for a local council to take an operator to court and have costs awarded against them. Microcell masts have been rejected on the grounds of height, cabinet size and pavement restriction. Others have been rejected due to excessive street clutter.

Under the Human Rights Act 1998, compensation claims *may* be made against network providers and those who allow the masts on their land, maybe even LEAs acting *in loco parentis*. It has been suggested that there may be a case for an 'easement' agreement for radiation to cross private property. I don't think a case has been brought on these grounds as yet.

It was reported in the Irish Times in February 2006, that mobile phone companies using masts on police (Garda) stations or other public buildings will have to meet the costs of any compensation claims taken against the state by people who allege that their health has been damaged by electromagnetic radiation.

The UN Convention on the Rights of the Child stipulates an obligation to "Protect children against environmental pollution." In Part III of the Children Act 1989, the local authority has the duty a) to safeguard and promote the welfare of children within their area who are in need: and b) so far as is consistent with that duty, to promote the upbringing of such children by their families. We have heard of children who have implants that are affected by RF radiation; and children with epilepsy whose parents believe that their epileptic attacks occur more frequently as a result of the erection of a mast nearby. Perhaps the local authority has the duty to re-house the family away from such a mast as 'the child's health or development may be further impaired' by continuing to live near?

It is a fundamental principle that the planning system should not be used to control matters that are covered by other legislation. Inspectors can dismiss issues on the grounds that it is a matter for the Health and Safety Executive (HSE), or Pollution Control. HSE's advice relies on the advice of the Health Protection Agency (HPA). The court says (as in the Al Fayed case), that if the HSE says development should be approved, then it would be an unreasonable council who refused planning permission on health grounds.

In the early stages of telecommunications systems roll-out, people, and in some cases local authorities, in this country and abroad, felt that masts should be kept away from sensitive places. This would, they felt, safeguard the well being of the vulnerable in such places as schools, nurseries, hospitals, homes for the elderly, and residential housing, which may contain a mixture of people with different vulnerabilities. As the use of phones increases and people demand the availability of signals everywhere, this is not possible. The 'adequate coverage' mentioned in the previous chapter has to be available to children (especially teenagers at their schools); within the working environment; and increasingly within our homes themselves. In order to get the required coverage, base stations need to be in the places where the signals are demanded. If a policy of an exclusion distance from particular places, schools, etc. were to be included in the local plan or adopted as supplementary planning guidance, it is probable that the policy would

be given no weight by Planning Inspectors because of current Government guidance. Costs could be awarded against the Council at appeal.

In October 2007, it was decided to ban the installation of mobile phone base stations on the balconies of homes in Jerusalem and another 3 big cities in Israel, and contracts will not be renewed when the existing ones expire. The erection of small size antennas will need full planning permission. This will affect about 10% of all the antennas in the cities. Telecommunications companies are fighting the decisions.

To share or not to share? that is the question.

There are 3 ways in which sharing could take place.

1. **Sharing the site**. That is sharing the particular plot of land, roof space, etc.

2. **Sharing the mast**. That is adding equipment to an existing mast which already has equipment attached to it.

3. Different companies **sharing the set of equipment** already in place on a base station, belonging to the company that put it there initially. This includes 'roaming' from the handset user's viewpoint by logging into another Network's base station.

All these options have their advantages and disadvantages. It is not straightforward.

1. Sharing the site.

Advantages:-

There would fewer sites with masts.

Sometimes when several antennas are together the overall signal level is not necessarily additive as some of the signals can be cancelled by other signals.

In the case of schools, hospitals, etc. having several base stations on top of the buildings will avoid having masts erected close by, which then may radiate directly into the buildings.

Disadvantages:-

Many people object to the visual impact of the masts. Having more equipment on the same site will not improve this.

Inevitably, those who live or work near the site that continues to expand in terms of equipment, will be exposed to increasingly higher fields, and / or 'hotspots,' as they will not all cancel out. When these sites are, for example, on the outskirts of a village or town, and are to give adequate coverage of the whole of the village or town, the power output from each antenna will have to be higher than if it were serving a smaller area.

There may be technical problems associated with having several base stations close together.

If the base stations are on a roof of a high building which is surrounded by other high buildings, the nearby buildings will be radiated more than the building on which the mast is situated, without the income.

2. Sharing the mast.

Advantages:-

There would be fewer masts.

Disadvantages:-

Many modern macrocells are slim monopole masts which blend relatively well into the landscape, causing minimal visual intrusion. Many of the masts cannot have extra equipment added to them, though antennas can be designed to be used by more than one operator at a time.

Where it is technically feasible to add further equipment, the addition will make them more visually intrusive. It is estimated that an extra 4 to 5 metres in height would be required to give adequate technical clearance for each extra set of antennas

Microcells and picocells do not lend themselves to sharing, although some microcells share different types of equipment, such as CCTV monitor stands.

3. Site linking or 'roaming', where different companies share the set of equipment already in place on a base station, belonging to the company that put it there initially.

Advantages:-

Fewer masts and less equipment on existing masts.

Disadvantages:-

Mobile phone traffic 'clusters' around certain times of day when large parts of the existing networks now run into overload. No one wants to pay for infrastructure that benefits the competition. Imagine an area with Orange masts but few T-Mobile masts. Roaming is allowed. T-Mobile do a promotion in local shops offering really great cheap tariffs. If people took these up, then T-Mobile users would be likely to dominate Orange mast call traffic at busy times to the detriment of Orange users at busy times. How would you charge for that, between companies, so that everyone is relatively happy?

As can be seen from that brief synopsis, the situation is not straightforward. The telecommunications companies have developed their systems in isolation and with relative technical and commercial secrecy for obvious reasons. This means that sharing resources, although it might make a lot of sense to the layperson, is not always welcome or technically feasible.

Where there is some special reason to want minimum exposure in a particular area, such as a hospital, old peoples' home or school, it may be sensible to insist that every operator should install a base station on top of the building (co-located or shared). This will avoid the place in question being in the main beam of antennas on a mast which is away from the building. Elsewhere, it is probably better to require operators NOT to share sites, except where there are no suitable tall buildings and they have to erect a tower.

For the reasons stated in the disadvantages of site sharing, it also could result in 'mast ghettoes' where subsections of the population will be heavily exposed to microwave radiation, whilst other

sections will be very lightly exposed. As the use of mobile phones extends throughout the population, this does not seem to be an equitable arrangement. The French government decided against mast and site sharing for this reason, and instead advocates smaller, low-power cells more evenly spread amongst the population. The French system means everyone is likely to get exposed and everyone has an equal chance of developing ill-health symptoms!

Councils

Various councils have imposed, or attempted to impose, their own moratoria on erecting masts within proscribed distances of specific buildings; schools, hospitals, etc. As the base stations become smaller, lower power and closer together, having a 500 metre ban from these places is likely to result in one of three things:

1. these places will have no signal or phone service (this is certain to be disputed by customers demanding 'adequate coverage' under the companies' licence conditions)

2. peripheral areas will have high power masts radiating into the 'proscribed' area resulting in levels of radiation nearby that may not be acceptable to residents living near the mast

3. operators erect lamppost masts, using wall mounted covert antennas, or existing structures (like petrol station signs) for which no planning permission is required. Some site agents have been approaching private home owners asking if they would be prepared to have a mast disguised as a water downpipe or other 'normal' house structural parts in return for an annual rental

As **(3)** seems to be becoming the most common response, imposing a 'Planning' ban is actually making public exposure to microwave radiation far worse, as it brings the transmitting antennas much closer to people's bedrooms and removes formal Planning requirements. **We have found some of the worst offending base stations are not even on the local authority's database of mobile phone base stations in their area!** This is because some of the worst base stations are low height street furniture installations that do not require planning permission. Although notification is usually given, the local authority may not record this in a publicly accessible form, as there is no requirement to do so.

It has been suggested that masts which are situated close to a District Council's boundaries should have the consent of neighbouring councils as well before consent is given due to the extent of emissions from the mast, which could be up to several hundreds of metres depending on the local topography and other considerations.

The Scottish Parliament's Transport and the Environment Committee (March 2000) concluded that all masts should be required to apply for planning permissions, and that local authorities should adopt a precautionary approach, keeping masts away from schools, hospitals and residential areas where possible. About half of Scotland's local authorities have done so. Scotland is not subject to PPG8 Planning Guidance, but has more control over its planning decisions.

Several planning applications to erect phone masts have been rejected on health fear grounds by local councils, then they have been won on appeal to the Planning Inspectorate at the Department of the Environment, Food and Rural Affairs. However, in one case, in Thurrock, Essex, an application was rejected on health fear grounds. An appeal was made, and the Inspector turned it down, rejecting government guidance. When this was challenged, the Secretary of State did *not* overturn the decision as usually happens.

Another application (from Orange to erect a mast in Harrow) was also rejected by the Planning Inspectorate. The application was turned down because Orange had not bothered to provide sufficient data about the possible health effects for people living nearby and because the *"need to site the mast in the location proposed does not outweigh the serious harm it would cause to neighbouring residents in terms of visual amenity and … possible health effects."* Until this case, the advice from the Planning Inspectorate was that possible health effects should not be taken into account. Now they are to issue guidelines making it clear that all mobile mast applications must be supported by concise details of the risks from radiation emissions. (Daily Mail 9 March 2001).

Often councillors want to reject a mast application because of local residents' health concerns. Some have the unfortunate experience of Kerrier District Council (in Cornwall) where a mast had been erected without approval, the operator appealed the rejection and the council withdrew from the inquiry after deciding it was unlikely to win, with an order to pay £180,000 in legal costs.

In January 2002 the Government blocked Manchester City Council's radical move to site mobile phone masts as close as possible to schools and hospitals. Officials said that they agree with the science - that it is safer to have MORE masts, because it would keep radiation levels low. But they maintain that the public simply won't accept it. Manchester was the first city council to conduct its own full inquiry on telecommunications masts, and was alone in seeking support for a "masses of masts" policy. The current policy, adopted 2 years ago, is to resist proposals for new masts which would be located close to places where children congregate. "*We need this issue resolved, not 20 or 30 years from now when we will see for ourselves any health effects,*" said Councillor Tony Dale, from the physical environment committee. "*We need to make all the documents easily available so that the public can make up their own minds on the issue,*" he said.

It is unclear, with the revised PPG8 conditions in force, what grounds could be used by councils for rejecting a mast application on fear of adverse health effects grounds. Although, of course, PPG8 is only a guidance document, and does not have the weight of law.

As far as we know, no council has imposed a 'mobile-phone-free zone' in the same way as some councils have imposed a 'nuclear-free zone'. This would mean no masts, and no phones would have a signal, except at the periphery of the zone from base stations outside the zone. It is not clear whether this would cause the companies to be in breach of their licence, or whether the Secretary of State would allow exemptions. That is assuming that the council could get the agreement of its constituents that they were willing to accept a 'no signal' status.

A search of all planning application cases since 1999 can apparently be provided for £69, or £46 for a charity. For details see the database at www.dcservices.co.uk/

In 2005, in the largest area of Austria which has 3,500 base stations, a local tax of €21,000 was imposed for each one. This was intended to 'soften' opposition to the masts, as the local area would benefit. It was anticipated that the operators would complain because it was likely to increase the cost of the service to the user by €38.

Planning issues are very complex. Good websites are provided by www.planningsanity.co.uk or www.mastsanity.org and www.mastaction.co.uk. There is also an advice line, run by volunteers on 08704 322 377, between 1.00 p.m. and 8 p.m. Tuesdays - Fridays.

Campaigning Groups

It is an assumption that people who campaign against mobile phone masts will choose not to use the phones without which the masts are unnecessary. **If people choose to use them, they are a**

major part of the problem, not part of the answer. If you feel you need it for emergencies, then only get a "pay as you go" handset and use it for ESSENTIAL calls only. This can cost as little as £10 per YEAR and will help minimise the need for extra masts.

Do not give out your mobile number to other people.

Do not make a call to a mobile phone except in REAL emergency situations.

Devise and implement a major "minimise mobile phone use" as part of any mast campaign. If people stopped using their phones as much as they do at present, then an exclusion zone policy may be possible.

These steps would reduce the need for the masts which are currently ONLY being erected to provide extra call capacity (except for 3G and TETRA). There is signal coverage all over the country now.

Remember that if you are intending to campaign against a mast, ensure that all complainants write ***individual*** letters to the planning authorities. They don't have to be different from each other, but need to contain an address and a signature. Groups can be tempted into drawing up petitions. Remember that local authorities count *received communications.* One petition of 2,000 signatures is one received communication. 2,000 individual letters are 2,000 received communications.

4. The Precautionary Principle

The term "prudent avoidance" was originally suggested by Morgan, Nair & Florig (see References) as an intermediate approach to decision making in the face of uncertainties about EMFs and cancer. "Prudent" in this context means of "modest and well defined cost".

The EU Community Policy (Treaty of Amsterdam) on the Environment which sets out "The Precautionary Principle" and the taking of "Preventative Action" is contained in Article 174 (formerly Article 130r of the Maastricht Treaty 1993).

In February 2000, the European Commission stated that the precautionary principle covers cases where scientific evidence is insufficient, inconclusive or uncertain, and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU. *The precautionary principle provides a basis for action when science is unable to give a clear answer*.

The invocation of the precautionary principle should

- be preceded by a scientific evaluation and risk assessment
- be non-discriminatory
- be kept under review until scientific advice permits a definitive decision.

Determining what is an acceptable level of risk for the EU is a political responsibility. The commission recommended that "measures based on the Precautionary Principle should be maintained so long as scientific information is incomplete or inconclusive." The Maastricht Treaty also contained the words "Lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation or danger".

According to Drs Q Balzano and A Sheppard (consultants to Motorola) we have to be very cautious about invoking the precautionary principle, it could have disastrous effects. They concluded in a peer-reviewed paper in 2002 (see Refs) "Unless current efforts lead to its successful reformulation, the precautionary principle could institutionalise excessive caution and thus deepen rather than alleviate alarm from the doom laden hypothetical risks called 'perceived threats.' The resulting suppression on innovation and technical progress would inevitably have disastrous effects on society, leaving it susceptible to the decay that over time turns great civilisations into antique ruins." We wonder if this conclusion has anything to do with trying to alleviate the financial difficulties that the mobile phone companies find themselves in.

Making policy in the face of uncertainty is characteristic of many public health issues. The risk assessment procedure has to take into account the breadth of expert opinion and the concerns of society, and the government then has to decide on policy that is an acceptable compromise.

- Ideally, the general population might like decisions to be made in order to protect the rights of the vulnerable regardless of cost. EMFs should be considered to be 'guilty until proven innocent'

- phone users wanting good signals, and landowners wanting the income from masts on their land, are likely to want minimal interference

- some public bodies require virtual certainty of a problem before they are prepared to advocate action

Often, decision-makers opt for the solution that aims at producing "the most good for the most people at the least cost". This will not necessarily protect the vulnerable minority. When it comes to taking action following a risk assessment, economists suggest that society seems willing to pay $5 million per statistical death avoided.

In June 1999, the National Radiological Protection Board (NRPB, now the HPA-RPD), the body responsible for advising the Government in order that they can make the appropriate political decisions, stated that it only bases its guidance and advice on *"conclusive scientific evidence"* and that until essential research has been carried out, the only "conclusive scientific proof" relates to the properties of thermal heating on which their 1993 Safety Guidelines are based. In May 2006, the World Health Organisation factsheet on base stations and wireless networks concludes that … The levels of RF exposure from base stations and wireless networks and so low that the temperature increases are insignificant and do not affect human health. www.who.int/mediacentre/factsheets/fs304/en/index.html

Until research produces 'conclusive scientific proof' of non-thermal effects, it is up to Politicians and Planners to exercise their own judgement. By their own admission, they *will not* provide precautionary advice, as defined by the European Commission to the government.

The original "Doll Report" (1992) stated on page 50, paragraph 69(4): *"There are other areas of biological study in which effects of RF and microwave radiation above 100 kHz have been described which may have health implications, but which are not well understood. These areas include possible adverse effects of exposure to pulsed radiation. In addition, there remain uncertainties about possible low level interaction mechanisms and dose-response relationships, particularly in relation to amplitude-modulated RF and microwave radiation."*

This view of the situation was confirmed by Dr Zenon Sienkiewicz in a document written for the NRPB Training Section (1997), where he says (on p. 5):

"There are in addition a large number of biological effects that have been reported in cell cultures and in animals, often in response to relatively low field levels, which are not well established but which ***may have health implications and are the subject of much ongoing research."*** [our bolding]

"These include research on the effects of ELF fields on the body's daily (circadian) rhythms and on growth and development of the embryo and foetus, on the effects of ELF fields and RF radiation on carcinogenic processes, on the existence of specific frequency and amplitude "window" effects, and on effects of low level pulsed RF radiation." **[e.g. GSM and UMTS digital mobile phone radiation]**

"The possibility that only certain combinations (windows) of EMF frequency and amplitude could elicit biological effects has been reported in studies in which exposure to very low levels of amplitude modulated RF radiation, too low to involve heating, altered the brain activity in cats and rabbits, the activity of an enzyme involved in tumour promotion, and affected calcium ion mobility in brain tissue in vitro and in vivo."

"Recent well-conducted studies by one group of research workers suggest that the retina, iris and corneal endothelium of primate eyes are susceptible to low-level microwave irradiation, particularly to pulsed radiation. Various degenerative changes, particularly of the light-sensitive cells in the retina, have been reported. ... Exposure to low levels of pulsed or continuous wave RF or microwave radiation has been reported to affect neurotransmitter metabolism and the concentration of receptors involved in stress and anxiety responses in different parts of the rat brain."

Whilst uncertainties like these are being expressed by the body which advises the government on the science, it seems appropriate that organisations such as the British Medical Association (BMA) advise precaution. Indeed, on May 24th 2001, they were advocating a precautionary approach to the possible health effects of mobile phones, including limiting their use by children and keeping calls brief. They note the "large gaps in knowledge" and state that precautions are advisable until more detailed and scientifically robust information on any health effects becomes available. See the BMA website www.bma.org. Such precautionary stances may be necessary for some considerable time, as the total spending on safety research by telecommunications companies is less than one hundredth of one per cent of the companies' expenditure. It is believed by sceptics to be no more than a public relations exercise.

In 2008, Carpenter and Sage (two of the BioInitiative report authors) wrote a report concluding *"Regardless of whether the associations (between EMFs and leukaemia, brain tumours and neurodegenerative diseases) are causal, the strengths of the associations are sufficiently strong that taking action to reduce exposures is imperative, especially for the foetus and children. Inaction is not compatible with the Precautionary principle as enunciated by the Rio Declaration; because of ubiquitous exposure, the rapidly expanding development of new EMF technologies and the long latency for the development of such serious diseases as brain cancers, the failure to take immediate action risks epidemics of potentially fatal diseases in the future."*

Finding definitive answers by scientific experiment is not as easy as many non-scientists assume it to be, especially in the biological sciences.

You may do a number of experiments to test a hypothesis e.g. exposing generations of mice to electromagnetic fields to see if their growth is affected. If the experiments all give the same answer, you may be in a position to say that *probably* the EMFs affect growth. If the experiments give different results, such a statement may be less secure. It may then be suggested that more experiments will determine the answer, but in the real world experiments are expensive, experimenters are open to accusations of bias, and we know that experimenters (consciously or unconsciously) affect the outcomes.

There is no such thing as an experimenter-less experiment. Experimenters affect the outcome of experiments in ways which you would think to be impossible. This has confounded sceptics in the field of quantum physics, and other traditional, but leading edge areas of science. The outcomes seem to be influenced by what experimenters believe ought (or ought not) to be the result. It is now been consistently shown that people can effect random-number generating machines in ways that were considered impossible - but these ideas are a whole new fascinating area of psychological science.

Let us return to the mice. Three successive generations of mice are exposed to electromagnetic fields. The whole experiment is then repeated. The first time the mice in the exposed group were always smaller than the controls, and the second time the exposed mice were always larger than the controls.

What could be the conclusion?

a) Not enough evidence to draw any conclusions. More research is needed.

b) If no money, etc for more research, we could infer from the two experiments that:

   Because in 1. the exposed mice were smaller than the controls and in 2. the exposed mice were larger than the controls, *on average* they were identical to the controls, so there was no effect due to the EMF.

c) Or, both the experiments clearly showed that fields could affect the growth rate of mice, but the direction of the effect was affected by factors that were not controlled in the experiments.

   As can be seen, because individual studies in biology do not speak for themselves but rather must be interpreted, for an even greater reason generalisations based on biological studies also depend on human interpretation. And interpreters will have their own agendae.

Whilst research is being done, and whilst there is a degree of uncertainty about adverse health implications accepted by most organisations and many government bodies in this country and internationally, precautionary limits to exposure for the general public and for the working public seem appropriate. Dr Gerard Hyland in the Ecologist in October 2001 was quoted saying, *"If the same level of uncertainty and debate as currently surrounds the safety of human exposure to GSM radiation obtained in the case of a new drug or foodstuff they would most certainly never be licensed."* The chosen limits vary from country to country. In an attempt at global 'harmonisation' of radiation exposure standards, attempts are being made to persuade countries that currently operate more stringent limits - such as China and Russia (where the standard is up to 1000 times lower, based on bio-effects, not heating) - to relax them in favour of the higher levels tolerated in the West. In Britain, before the Stewart report, the NRPB exposure limits were over twice the ICNIRP exposure guidelines. These limits were based solely upon heating effects, as no other biological effects have yet been acknowledged by them as proven. In Russia, where the frequency-specific sensitivity of living organisms to ultra-low intensity microwave radiation was first discovered over 30 years ago, the exposure guidelines are approximately 100 times more stringent that those of ICNIRP.

Lichtenstein decided in May 2008 to reduce its exposure limit to 0.6 V/m. They are anticipating that there may be a problem with regard to tourists, especially hikers, not being able to use their phones as before, but they may have a competitive edge with respect to low EMF-tourism. Swisscom, the mobile phone company operating in Lichtenstein is likely to pull out partly because of the problems in working to such low limits, but also because of fears of a 'snowball effect' as other countries, particularly Switzerland may decide to follow suit.

The French town of Valence (December 2008) is to forbid the installation of any new phone masts within 100 metres of schools and crèches. Michele Rivasi, the Environment Officer, said the reasons for their decision were threefold; *"First of all because of the scientific BioInitiative report, which proves the dangers of electromagnetic fields especially on the nervous system. Number two: a resolution passed by the European Parliament demanding the reduction of permitted radiation levels. Three, the principle of precaution. And finally, I shall insist on the fact that the many opposition groups that are forming could eventually cause a disruption of public order."*

André Antoine, the minister of Town Planning in the Walloon area of Belgium, has decided (December 2008) to forbid the development of new GSM phone masts. *"It's a matter of public health"* he says. *"The operators will no longer be allowed to install them unless they are integrated into their surroundings and unless they respect scrupulously the permitted limit of 3 V/m."*

A draft proposal to relax mobile phone radiation safety guidelines and to eliminate the difference between permitted exposure of the working population and that of the general public by the Institute of Electrical and Electronics Engineers in America was thrown out in January 2002. They wished to take into account the new research by Theodore Litovitz which we now believe links mobile phone use with brain tumours.

The NRPB's use of phrases like *"no conclusive evidence"* or *"no firm evidence"* with regard to EMF adverse health effects actually means that they do admit to having some evidence of association, but that it does not meet their stringent criteria for proof. It is not proven or established that, although there ***is*** some reason for suspicion which cannot be dismissed, the evidence does not support deciding or setting firm exposure limits, and that further research is needed.

Professor Mike O'Carroll has suggested that many descriptions of levels of evidence can be envisaged - spurious, curious, weak, suspicious, suggestive, plausible, persuasive, firm, conclusive. Full scientific proof needs *"conclusive"* or, at the very least *"firm and persuasive"*. That is the time at which to enact legislation to control the hazard that is producing the risk. Professor O'Carroll correctly writes: *"The time for practising prudent avoidance lies in the middle of the range, matching the current evidence on EMFs. Where there is some ongoing evidence of association such as we have for RF, microwave and low frequency pulsed EMFs from mobile phone handsets and biological effects"*.

ICNIRP levels are entirely appropriate limits to prevent biological damage as a direct result of heating. However, the majority of current concerns are about the potential biological damage that may be caused as a result of exposure to fields which are far too low to produce heat-damage. So, to address these concerns, various countries have come up with different exposure limits, see the table later in this chapter.

As long ago as October 1992, Dr Cletus Kanavy, the chief of the biological effects group of the Phillips Laboratory's Electromagnetic Effects Division at Kirtland Air Force Base, New Mexico, provided convincing evidence that there are many low level athermal or non-thermal biological effects of RF and microwave radiation which have adverse health implications. He stated that his group had been conducting a comprehensive search of the worldwide literature regarding biological effects produced by microwave radiation. This data had been consolidated into a database shared with the US Armed Forces Medical Intelligence Center and the CIA. He wrote: *"The principal electromagnetic biological effects of greatest concern are behavioural aberrations. Neural network perturbations, foetal (embryonic) tissue damage (inducing birth defects), cataractogenesis, altered blood chemistry, metabolic changes and suppression of the endocrine and immune systems. The verification of blood-brain barrier suppression should have a high priority. The passage of normal blood-borne toxins into the brain could explain some previously observed early behavioural aberrations, loss of physical endurance and functional central nervous system and perceptual changes. A large amount of data exists, both animal experimental and human clinical evidence, to support the existence of chronic, non-thermal, effects. The Soviet studies of humans under occupational conditions report marked functional changes, sometimes accompanied by histological and biochemical changes, under the chronic influence of microwaves at power densities ranging from fractions of microwatts per square centimetre.* (NB: Equivalent to a single RF carrier above about 0.6 V/m for 0.1 $\mu W/cm^2$)

Following this in September 1993, Microwave News (see References) reported that Kirtland Air Force Base and Hughes Aircraft Co. adopted strict limits in the frequency range 30 MHz to 100 GHz for ambient levels of RF / microwave as opposed to handset use, to 100 μW/cm² (equivalent to one RF carrier at a signal level of 19.5 V/m).

At the 2nd International Conference on Problems of Electromagnetic Safety for the Human Being in Moscow 1999, Professor Yuri Grigoriev gave the reason for the stricter Russian standards as reflecting a concern over non thermal effects and subjective symptoms. Grigoriev emphasised the need to take into account possible cumulative effects from repeated exposure to relatively low levels of radiation as well as the potential bioeffects of specific modulated patterns.

The Ecolog Institute in Hanover, Germany (see References), stated their opinion that the ICNIRP level (adopted by the UK government, post-Stewart, in June 2000) is too high. It recommends a precautionary limit of 1 μW/cm² (2.0 V/m) independent of frequency. The Institute's report cites evidence of adverse health effects at levels as low as 20 μW/cm² (8.0 V/m). Since this report health effects have been found at levels as low as 0.05 V/m), see www.powerwatch.org.uk/news/20050722_bamberg.asp. It also affirms our opinion that SARs are inadequate for addressing non-thermal biological effects. The Ecolog report, in German, may be found at (www.eclog-institut.de/emf-moni.htm)

Swiss Re is one of the largest re-insurance companies in the world. Part of their survival strategy is to look into the future for potential large liabilities and they had determined that EMF litigation was one such area. They published a seminal report on the subject in late 1996, called "Electrosmog - a phantom risk".

In our opinion it is a landmark publication and contains much philosophical wisdom that is missing from official UK documents on the possible risks of EMFs. It included:

"Generally it is expected that the question as to whether electromagnetic fields and radiation pose a health risk will be answered sooner or later with a clear Yes or No, which would then more or less automatically clarify the question of legal liability. This expectation is erroneous because it is based on a mistaken assumption: namely, that the relationships between EMF exposure and diseases such as cancer, immune deficiency, Alzheimer's Disease and Parkinson's Disease are merely complicated. In fact, however, we are dealing with complex relationships which cannot even be identified, let alone understood, using the research methods presently available. ... ... The only reliable answer to "Do EMFs impair health?" is "Perhaps".

"With only inconclusive findings to go on we find ourselves facing the task of trying to achieve a just balance between the individual's need for protection and the interests of society as a whole - a technology that benefits many but may possibly seriously harm some few." ...

"... a relationship that is especially important for gaining a correct understanding of the EMF issue is that living organisms can amplify the energy of signals. The actual cause of the biological response is this amplification process, not the signal itself which 'merely' triggers it. It is therefore necessary to distinguish between energy effects and signal effects and two different dangers posed by electromagnetic phenomena." ...

"Up until the beginning of this century, science was able to study only questions which could be answered with **Yes** or **No**. In the course of this century, it has become ever more apparent that practically all causal laws are, in reality, mere statistical observations. ... At first glance, there is only a minor quantitative distinction between **'certain'** and **'highly probable'**. In fact, however, the difference is fundamental and qualitative because it is the difference between **'must'** and **'can'**, between **'yes/no'** and **'perhaps'**, between **'doubtful'** and **'doubtless'**, between **'certain'** and

'uncertain', between **'possible'** and **'impossible'**. It is the difference between **'knowledge'** and **'conjecture'**. And because all scientific knowledge is based on statistical observations, the knowledge of science is mere presumptive knowledge. ... This change of paradigm, which was initiated early in this century through the insights of nuclear physics and is now starting to take concrete form in new scientific disciplines such as complexity research, has been accompanied by a fundamental change in the concept of causality."

"**While classical science considered a cause to be only that which must necessarily bring about an effect as a result of the causal principle, today a cause is also considered to be that which may bring about an effect."**

"Starting from the classical concept of causality, it is practically impossible to prove that electromagnetic fields can be a cause of disease. This is because it would involve showing the conditions under which EMF always leads to disease". In cases of litigation, "should the legal system proceed on the basis of modern science's understanding of causality? In this case it would be sufficient to prove that weak fields can increase the probability of disease. And it is precisely this which cannot be excluded: the possibility that electromagnetic exposure might favour the incidence of certain diseases. **In that case - according to our present understanding - electromagnetic fields would be a cause of disease just like a flu virus which may, but need not necessarily, result in influenza.**"

"The socio-political risk must be classed as extraordinarily high because the legal instrument of liability is increasingly being used, or even misused, as a means of coping with the problems of life. But who decides what is right and what is wrong, what is detrimental and what is beneficial, what is to be permitted and what is to be prohibited? Natural science denies responsibility, and politics proves to be unequal to the task of bringing about a social consensus on **what risks people are willing to enter into conjointly, and what share of these risks each individual must bear**."

"The EMF problem cannot be resolved through further research alone: on the contrary, there is a need for new, practice-oriented categories for assessing the research results currently available. ... The EMF problem cannot be delegated to individual groups or institutions: that would be like leaving the formulation of a contract to just one of the parties. ... It is not acceptable to force risks upon individual human beings; neither is it in the interest of the general public to dispense with technological opportunity because of the possibility that individuals might suffer harm. **What is required, therefore, is a general consensus on how much risk individuals may reasonably be expected to accept.**"

Part of this process must be the need to inform people that there may be certain risks associated with carrying out certain activities or using certain pieces of equipment. This would apply to using a cellular mobile telephone handset, especially when adverse health effects have already been reportedly linked with such use.

People who own or use mobile phones can decide on the precautionary principles they use to reduce their RF exposure, should they make the decision that there is a need to do so.

Taking a precautionary stance with regard to masts is more difficult for the individual.

Most decisions to do with siting are taken at a local council level, following government directives. In an interview with the Western Express and Echo in January 2003, Professor Lawrie Challis, the Chairman of the Mobile Telephone Health Research Management Committee, said about living near to mobile phone base station sites: **"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".

The Chartered Institute of Environmental Health Officers says that it believes: "that a precautionary approach of restricting building or access (near mobile telephone base stations) cannot be sustained on health grounds alone and if adopted must be based on access, amenity and public acceptability consideration". This principle is clear, and is usually applied to the erection of base stations near to existing buildings. It would be open to Member Authorities to apply the precautionary principle on land in its ownership (by exercising its rights as land-owners rather than through the use of planning powers). The Association could also urge other public bodies to do the same (particularly the Health Authorities). However local authorities and other public bodies may then find that private landowners will give permission, along with the substantial rental attached, to have the base station erected nearby, and the radiation may then beam into the areas of vulnerability the local authority was trying to protect by refusing permission on the land it owns.

At first sight the UK Expert Group on Mobile Phones, in the Stewart Report, may seem to have given mixed messages about how the UK authorities should apply the precautionary principle to mobile phone masts.

For example, in 6.37 it states: "The balance of evidence to date suggests that exposures to RF radiation below the NRPB and ICNIRP guidelines do not cause adverse health effects to the general population" but then continues in 6.38: "There is now scientific evidence, however, which suggests that there may be biological effects occurring at exposures below these guidelines" and in 6.39: "... the gaps in knowledge are sufficient to justify a precautionary approach."

The Stewart Report '**Advice to Government**' included: [numbers are from the Report]

[1.36] We recommend that for all base stations, including those with masts under 15 m, permitted development rights for their erection be revoked and that the siting of all new base stations should be subject to the normal planning process."

[1.43] We recommend that in making decisions about the siting of base stations, planning authorities should have the power to ensure that the RF fields to which the public will be exposed will be kept to lowest practical levels that will be commensurate with the tele-communications system operating effectively." (This, probably the most protective recommendation, has not been implemented. In PPG8 (22.08.01) Paragraph 100 in the Annex it is stated that "Mobile phone operators **already** keep their RF power outputs to the lowest **possible** (our italics) levels commensurate with effective service provision". We have clear evidence that this is not the case for some base stations, see the base station emission graph for Luton and Dunstable, July 2006, see Chapter 3. The NRPB W62 report (2005), commissioned by the MTHR to study microcell base stations said "It was noted that some 2,000 of the 32,837 base stations, or around 6%, were radiating more than 5 watts at heights up to 10 metres. In conjunction with the MTHR project monitors, it was considered whether these transmitters should be included. It was decided that they should not be and that this project should concentrate on the low power sites in order to stay true to its original aim of considering microcells as low-height / low-power transmitters."

Some of the low-height base stations in their database, that were deliberately excluded from the study as they claimed that they used too much power to be rightly called a microcell base station

(!), had output powers up to 100 watts, 20 times higher than the 5 watts allowed to be included in their analysis.

As the underlying predicate to PPG8 that the operators already keep their RF power outputs at the lowest possible level is incorrect, the whole basis of PPG8 is flawed.

The Stewart 2 report (2005) reaffirms "The Board believes that the main conclusions reached in the Stewart Report in 2000 still apply today and that a precautionary approach to the use of mobile phone technologies should continue to be adopted."

Why should we have a 3 V/m limit to protect against interference with the correct operation of electronic equipment and yet have to face 41 or 58 V/m ourselves?

On 16th March 2001 it was announced that the Government had implemented precautionary actions in response to the Stewart Report.

These actions include:

- ensuring that all mobile phones and base stations meet the guidelines of the International Commission on Non-Ionising Radiation Protection (ICNIRP). Mobile phone operators have agreed to ensure that all new and existing base stations meet these guidelines. The UK government confirmed in August 2001 that mast emissions need only comply with the ICNIRP guidance to protect against any possible adverse health effects.

However, in October 2003, an appeal by Orange against a planning refusal was quashed. The planning inspectorate had said that "*because the mast conformed to the ICNIRP guidelines, there was no need to consider health concerns*". The legal judgement, conceded by the government, was that "*the Inspector failed to adequately consider the weight to be given to the health concerns*". Costs were awarded to the campaigning organisation ChAMP, which had challenged the appeal.

- setting up, by the Radiocommunications Agency (now Ofcom), a national database giving details of mobile phone base stations. The map-based facility indicates the locations, height, actual and maximum possible power outputs for each fixed transmitter. (www.sitefinder.ofcom.org.uk) This site became available to the general public in October 2001, but does not include the emergency services radio base stations.

- auditing mobile phone base stations and masts to assess emissions, focusing on schools with base stations. The database of results has been put on the Ofcom website; Ofcom audited the 100 schools in 2001 which requested this. Their surveys are limited and the way of presenting information has not always been received by the non-technical lay person as very comprehensible or reassuring, even though the sites themselves have, on the whole, shown that the signal levels experienced at the schools are very low.

- launching a new £7.4m joint Government / industry research programme into the effects of mobile phone technology on health, with an independent programme management committee originally led by Sir William Stewart, now by Professor Lawrie Challis. The third tranche of this was discussed in December 2002. It was decided to look at effects on communities around base stations, and funds were awarded to Paul Elliott, known for his sceptical stance on the possibility of RF affecting health, and is to look at the incidence of leukaemia around masts. It is interesting that most of the scientists who are concerned about potential health risks do not suggest that leukaemia will be *caused* by mast radiation. It may be promoted, but there are other ill health effects that *have been* strongly

associated with living near base stations. Why are these not being studied? Are they really that determined to find nothing? Is this a good use of government (public) money? (The first and second rounds funded no research into the effects of base stations, only phone-level radiation, and few studies into the effects of **pulsed** microwaves and ELF fields).

The table below shows that a number of countries have adopted precautionary levels well below the levels set out in the ICNIRP guidance. This is because they deem there to be the possibility of significant biological changes at levels well below those that cause measurable tissue heating. At a conference in London, the Swiss Environment Minister pledged to reduce his Government's legislation to 3 v/m and to encourage the whole of Europe to follow suit. ICNIRP is an Non-Governmental Organisation (NGO) and only has that status, despite its being recognised by many governments for advice in these matters.

The results of a study in Spain by Oberfeld et al, (2004) led the team to conclude that "Based on the data of this study the advice would be to strive for levels not higher than 0.02 V/m, which is the indoor exposure value for GSM base stations proposed on empirical evidence by the Public Health Office of the Government of Salzburg in 2002".

In October 2002, some 100s of German doctors agreed the Freiburger Appeal to limit exposure from phones and masts. Details can be found at www.hese-project.org

Table. Exposure Guidelines (rms values) for mobile phone frequency bands

General Public Levels	Frequency **MHz**	E field **V/m**	Power **W/m²**	Power **µW/cm²**
NRPB, 1993 (old UK Investigation Levels to June 2000) Now use ICNIRP at 900 & 1800 (TETRA is at 400).	400 900 1800	100 112 194	**26.4** **33** **100**	**2640** **3300** **10000**
FCC OET65:1997-01 (USA) *based on NCRP report No.86*	900 1800	47 61	6 10	**600** **1000**
Canadian Safety Code 6 (SC6) *1993*	900 1800	47 61	**6** **10**	**600** **1000**
ICNIRP, 1998 (recognised by WHO) **CENELEC, 1995** (EU)	400 900 1800	28 41 58	**2.1** **4.5** **9**	**208** **450** **900**
Australia 1988 *(under review)*	900 / 1800	27	**2**	**200**
Belgium (ex Wallonia)	1800	21	**1.1**	**112**
Two USA research bases (1995)	30 - 100000	19	**1**	**100**

Poland (intermediate zone occup.) (safety zone)	300 - 300000	**19** **6**	**1** **0.1**	**100** **10**
Russia 1988 & **China** (public)	300 - 300000	**6**	**0.1**	**10**
Italy (sum of frequencies)	30 - 30000	**6**	**0.1**	**10**
Toronto Health Board *2000, proposal based on SC6/100*	900 1800	5 6	**0.06** **0.1**	**6** **10**
Swiss Ordinance ORNI *(for base* *stations)* From 1st. Feb. 2000 Lichtenstein & Luxembourg	900 1800	**4** **6**	**0.1**	**9.5**
Belgium Wallonia *(2001)*	900 & 1800	3	0.02	2
EU & UK EMC Regulations equipment Suscept test level (domestic & comm.)	30 - 2000	3 *any signal*	*not* *specified*	*not* *specified*
Typical max in public areas near base station masts (can be much higher)	900 & 1800	2	0.01	1
Wien (sum GSM)	All	1.9	0.01	1
Italy (single frequency)	1800	0.6	0.001	0.1
Paris (February 2003) Town Hall achieved operators' (inc. 3G) commitment to the following levels	900 & 1800	1.2 - 2.5	0.005 - 0.02	0.5 - 2
City of Salzburg, Austria (1998, sum GSM) GSM/3G outside houses, 2002 GSM/3G inside houses, 2002	900 & 1800 all mobile freqs	0.6 0.06 0.02	0.001 0.00001 0.000001	0.1 0.001 0.0001
Estimated Avg. US exposure (EPA 1980) Typical City Dweller (FCC 1999)	Approx 30 - 300000	< 0.13 < 2	< 0.00005 < 0.01	< 0.005 < 1

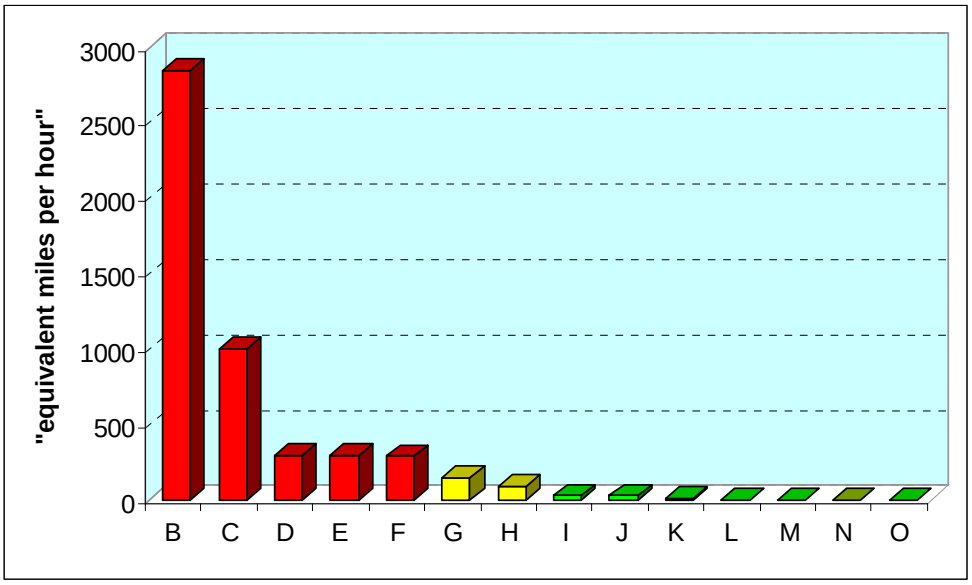
Broadband 'natural' background	300 - 3000	< 0.00003	< 0.00000001	< 0.000001

The UK NRPB has always fought against lower 'public' limits, insisting that *"a thermal limit that is good enough for workers is good enough for the general public".* **Many other countries disagree, as workers usually have some choice and, by law, need to be made aware of any hazards,** whereas the general public has the right to assume "all is safe" unless specific warning notices are seen

As 'volts per metre' is not a unit that most people are familiar with, if you take the 1998 Salzburg level (J) of 0.6 V/m as being 'equivalent to' a 30 mph vehicle speed limit in residential areas and then scale the other levels relative to this, it is easy to see from the table and graph below that the ICNIRP guidance is not at all precautionary in any meaningful sense.

In April 2008 ICNIRP made the following statement; *"Recent developments in telecommunication and wireless technology have led to increasing numbers of new devices and systems that emit radio-frequency (RF) electromagnetic (EM) energy. Implementing these developments have resulted in large numbers of individuals at the workplace or in the general public being exposed to RF-EM fields. The aim of this Statement is to compile a list of the new technologies under development, soon-to-be or recently deployed, which could lead to increased levels of exposure to non-ionising radiation (NIR) at the workplace or in daily life, and to assess the need for further research to evaluate their NIR safety and health implications. However, the technologies that are included in this Statement are not limited to mobile or wireless communications; they encompass all EMF emitting devices."*

1800 MHz Public Exposure Guidelines		**Equivalent**	**c.f. speed**	
	uW/m2	**V/m**	**m.p.h.**	
NRPB prior to IEGMP (Stewart) Report	**100 000 000**	**194**	**9479**	**A**
ICNIRP (1998), WHO	**9 000 000**	**58**	**2847**	**B**
Belgium (ex Wallonia)	**1 115 000**	**21**	**1002**	**C**
Italy (sum of frequencies)	**100 000**	**6**	**300**	**D**
Russia, PRChina	**100 000**	**6**	**300**	**E**
Switzerland, Lichtenstein, Luxembourg	**95 000**	**6**	**292**	**F**
Belgium Wallonia	**24 000**	**3**	**147**	**G**
Wien (sum GSM)	**10 000**	**1.9**	**95**	**H**
Italy (single frequency)	**1 000**	**0.6**	**30**	**I**
Salzburg 1998 (sum GSM)	**1 000**	**0.6**	**30**	**J**
EU-Parl, GD Wissenschaft, STOA GSM (2001)	**100**	**0.2**	**9**	**K**
Salzburg GSM/3G outside houses (2002)	**10**	**0.06**	**3**	**L**
Salzburg GSM/3G inside houses (2002)	**1**	**0.02**	**1**	**M**
Bürgerforum BRD proposal, waking areas (1999)	**1**	**0.02**	**1**	**N**
Bürgerforum BRD proposal, sleeping areas (1999)	**0.01**	**0.002**	**0.1**	**O**
Mobile phone handsets can work down to about	**0.000 002**	**0.000 03**	**0.0015**	


"equivalent miles per hour"
3000
2500
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5. Health effects - the research

Some of the history & politics

As long ago as 1948, the US reported possible links between microwaves and animal health effects. In 1953 a study of workers at Hughes Aircraft Corporation found excessive amounts of internal bleeding, leukaemia, cataracts, headaches, brain tumours, heart conditions, etc. in employees working with radar.

After these health issues had been identified, the political decision was made to use thermal effects as the indicator of potential damage to health. Limits based on thermal effects avoided complications. The setting of this standard provoked the following response from Dr Rochelle Medici, a researcher on animal behaviour, who said, "*It is as though scientists had retreated from doing challenging, frontier studies because such work engendered too much controversy or elicited too much criticism. We are left with 'safe' but meaningless experiments.* ***The results of such experiments are a foregone conclusion***." 50 years on and the thermal standard is still the only standard in use in most of the West.

Political and vested financial interests are seen to play a part in all scientific debate and whether there are health problems to do with mobile phones and mobile phone mast emissions is no exception. These interests can put a 'spin' on research and the way it is reported that make it difficult to find out exactly what is happening, especially as much of the research evidence is of a quite complex biological, chemical or physical nature, and usually a combination of more than one science. Another problem with the research reported in papers, even in reputable scientific journals, is that major medical journals have relaxed their disclosure policies because it is nearly impossible to find a scientist for peer review who is not connected to an industry. In New Scientist (August 2006), Catherine DeAngelis, editor of the Journal of the American Medical Association (JAMA) said universities should do more to investigate staff who don't disclose relevant financial ties. When JAMA rejected a study in 2006 because the authors refused to obtain an independent analysis of the data, the work was simply published in a different journal. Even when researchers declare financial ties, readers still don't know how much the conflict has skewed the results, said Daylian Cain, a moral psychologist at Harvard University.

Two leading EMF and health experts, Professor Ross Adey and Dr Henry Lai, revealed in May 1999 that multi-national companies had tried to influence the results of their research. Professor Adey, a biologist, said he had had his funding withdrawn by Motorola before completing his research showing that mobile phone emissions affected the number of brain tumours in animals. Dr Lai, who has been studying the biological effects of electromagnetic fields for 20 years, was asked three times to change his findings on how such fields caused DNA breaks in rats. Dr Jerry Phillips' experiments, which supported Dr Lai's experiments, led to his contract with Motorola being terminated when he published his results. Dr George Carlo used to be a spokesman and researcher for the mobile phone industry (Carlo 2002). He had been employed to clear phones of safety queries, but he discovered that human blood cells could be damaged by the radiation from a cell phone. Carlo made urgent safety recommendations to the industry, including a plea that cell phones not be marketed to children. In 1999, the industry stopped funding him and began a campaign to discredit him.

It is not only in America that vested interests seem to be playing a part in the lives of people concerned about the effects of RF radiation. Telstra (an Australian telecommunications company) employed a medical officer, Dr Bruce Hocking, who referred four employees to a neurologist after they reported headaches and dizziness when using their mobile phones. The company lawyers decided to cancel the employees' appointments and Dr Hocking was made redundant.

Professor Roger Santini in France reported on 530 people who were exposed to mobile phone mast antenna radiation and described 18 of their symptoms, before he was told to 'shut up or leave', by his employer INSA, a state-funded research institution.

As a result of worldwide uncertainty, the International Committee for Non-Ionising Radiation Protection (ICNIRP) was asked to assess the available evidence for RF emissions and potential links with cancer. The results of their investigation were published in 1998, in which they misquoted most of the studies and wrongly dismissed the 13 epidemiological studies they had considered. Eight of these were described as 'no effect' studies and 5 as 'weak and inconsistent', even though they show cancer increases. All the 10 cancer studies cited by ICNIRP do, in fact, show increases, 4 with significant dose response relationships, but ICNIRP misrepresented them and dismissed the evidence.

Despite attempts to distort or misrepresent findings by politicians and telecommunications companies, there is increasing evidence that there are biochemical changes that happen in cells, animals and humans as a result of mobile phone-type radiation. It is difficult to be sure whether these biochemical changes will result in health *problems* as distinct from just changes, or whether they are benign in the short term, but problematical in the long term. It may be that an unidentified susceptible proportion of the population *only* will experience the effects, or we may be getting all hot and bothered about something that is actually very safe.

Radio and TV masts

People who work with broadcasting equipment are likely to be more highly exposed than the general public, so direct health comparisons need to be treated with caution, but they are worth bearing in mind. In one study (Bortkiewicz 1997) significant ECG abnormalities were found in workers occupationally exposed to AM broadcasting equipment. One of the reported symptoms from mobile phone mast radiation is heart arrhythmias which may, indeed, be able to be seen on ECG equipment, though as far as we know, this has not been studied, or reported.

The modern pulsed microwaves are often compared by the regulators to radio and TV transmitter masts that we have lived with for a reasonably long time and which are more powerful than mobile phone masts. These have not emitted pulsed radiation until the introduction of the new DAB (Digital Audio Broadcasting) system, so the exposure from this radiation is not comparable. Despite this dismissal, there ***is*** some evidence of adverse health effects near the traditional TV and radio masts.

An increase in cancer incidence was found around the Sutton Coldfield transmitter in the UK Midlands (Dolk 1997). A similar *sized* increase was not found near any other of the UK radio and TV transmitters, though there were *some* increases and the follow-up study was poorly done. In 1996 Dr Bruce Hocking (1996) found almost a doubling of childhood leukaemia within a 4 kilometre radius of the 3 north Sydney (Australia) TV towers. Hocking (2000) also investigated the survival experience of people living at different distances to the towers. Of the 123 cases of leukaemia diagnosed from 1972-93, there was a reduced (55%) chance of survival for 5 years among those living in areas closest to the towers, compared with those in areas further away, where there was

a 71% chance of survival for 5 years. Hocking concludes that "there was an association between proximity to the TV towers and decreased survival among cases of childhood leukaemia." Park et al (2004) found higher mortality rates for cancers, including leukaemia in children living near AM broadcasting towers. Schmiedel (2008) found that distance was a good exposure proxy for a single transmitter only, whereas it appeared to be of limited informative value in studies involving several transmitters, particularly if these are operating in different frequency bands. This has implications for result comparisons with older studies where actual measurements were not taken; and for current ones, where multiple sources of exposure in epidemiological studies are the norm, but this is not always taken into account. A straight distance metric would become virtually useless under these conditions.

Olle Johansson's team (2002) at the Karolinska Institute in Sweden, reported an association of melanoma incidence with exposure to FM broadcasting.

Altpeter et al. (1995) found adverse health effects such as anxiety, restlessness, sleep disruption, joint pains, decreased concentration, general weakness and tiredness in the local community near short wave masts in Schwarzenburg, Switzerland, where the RF exposures were low. These are also symptoms reported by people living near mobile phone masts. Switzerland has now closed the mast down, and the government allows only very low exposure levels of RF for the general public.

The radio station in the Vatican exceeded the Italian 6 V/m exposure limits, and was blamed for causing higher than expected rates of cancer in the nearby community of Cesano. One report said that there was no increase in the rate of leukaemia in local residents, and others suggested that there was a link (Michelozzi et al 2001, 2002). The number of people, especially children, affected was small, so results have to be treated with caution. Despite the dispute between the high-ranking researchers involved in both studies, the transmitters were made to comply with the standard.

The Health Protection Agency, one of the regulators mentioned above, has frequently commented that living near visible masts produces anxiety and other psychological effects that are responsible for the physical health symptoms that people report. This may have some truth to it, but it probably only accounts for a small number of cases. It seems unlikely that this effect would be the same for cows. Löscher and Käs (1998) found a considerable reduction in milk yield, increasing health problems and behavioural abnormalities in a herd of dairy cows in close proximity to a TV and radio transmitter, which disappeared when the cows left the area, and which re-appeared on their return. Looking at what might have been responsible for the change in health and behaviour, the only factor seemed to be the high level of measured radiofrequency electromagnetic fields.

Male animals have been found to become aggressive when exposed to FM radiation. In New Zealand, bulls within 150 metres of such a tower became so vicious they had to be returned to the farm from which they had been loaned, where they immediately quietened again. Several other bulls within 1 kilometre of the tower had to be destroyed, due to their violence. The cows here appeared to be unaffected. A gentle stallion developed skin sores, lameness and became violent and difficult to handle when moved near to the transmitter. His fertility rate dropped. He was moved back and he returned to normal, including his fertility rate which returned to 100% from the 25% it had fallen to. It was thought that his lameness was a result of the horseshoes conducting the RF radiation. A male dog living 2 kilometres from the mast when an FM transmitter was added to the AM antennas became so aggressive that he ate his smaller friend.

When a lawyer examined the medical reports for a study of 40 people living near the New Zealand mast, she commented on the quantity of men going to their doctor with symptoms of

extreme irritability since the 2nd FM transmitter was added. *(Personal communications, Denise Ward, NZ)*. The possibility of radio transmissions affecting moods, should perhaps be further investigated. It may be interesting to see whether there are sex-linked differences in behaviour.

We have already mentioned that older, well established, TV and radio mast emissions do not pulse. It is the pulsing that many leading scientific experts believe may be primarily responsible for the adverse health effects. However, digital TV is resulting in pulsed signals being added to the existing TV and radio signals. We do not know whether local communities will be affected more by the pulsed radiation from the new style transmitters. Dr Bill Curry in the US suggested in the 70s that it is possible that pulsed microwaves (normally penetrating very little distance into the body) might 'hitch a ride' on TV and radio mast signals, thus penetrating more deeply, and potentially affecting the body in different, perhaps more serious, ways. Some residents at Wishaw (2002), near Sutton Coldfield, the area studied by Helen Dolk's team (see above), have a medium-wave transmitter *and* a mobile phone mast, and suffer from low neutrophil counts, high rates of cancer and fertility problems.

It is clear that research needs to be done to compare areas with a combination of signals, and areas with only one to see if there is a difference in health patterns. This may explain some of the differences in research results, though they are, on the whole, surprisingly consistent. The addition of digital broadcasting adds to the profusion of signals, potentially increasing 'effects' that may translate into health problems. Certainly, people with electrical hypersensitivity are reporting that they are experiencing ill health symptoms when their main RF exposure is from the new DAB system.

Radar

Radar equipment transmits pulsed RF radiation between 3 MHz to 110 GHz for a variety of purposes, including coastal, marine and airport traffic monitoring, air traffic control, traffic identification cameras, meteorological observation and for military purposes.

There is a radar station near Skrunda, in Latvia, which has been described as "*a living laboratory for the chronic low level effects of exposure to RF / MW radiation*", by researchers Kolodynski and Kolodynska (1996). They found that in a study of 966 children, motor function, memory and attention were significantly worse in the exposed group, and their neuromuscular endurance was decreased. Field levels at their houses were low, typically 1 V/m and a maximum of 6 V/m. They also found a 6-fold increase in chromosome damage in exposed cows.

Residents are concerned about the high level of illness, including childhood leukaemia, other cancers and birth defects near the Air Force-owned PAVE PAWS early warning radar facility at Cape Cod. Dr Richard Albanese, a senior US Air Force scientist who investigated the health effects of chemicals used in the Vietnam War, believes that there is an environmental agent causing the illnesses.

Fylingdales is a Phased Array Radar base similar to PAVE PAWS. The station emits pulsed signals at a frequency of 27 per second, extremely close to a frequency suspected of biological disruption. The US Missile Defence Agency states the possibility of TV reception within 4 kilometres being affected and radio static within 7 kilometres of Fylingdales. The effect on local residents is not mentioned. Albanese fears Fylingdales could pose a serious health risk. The European Parliament report *Physiological and Environmental Effects of Non-Ionising Electromagnetic Radiation* notes that this type of radar installation can interfere with memory and attention span

development in children living within 20 kilometres, it can depress nocturnal melatonin levels and increase chromosome damage in cattle.

A report on the Russian military's Qabala missile early warning radar station in northern Azerbaijan in January 2002, based on a 1992 inquiry, found that birth defects, illnesses of the nervous system and rates of kidney disease have increased dramatically, the birth rate has fallen significantly and Qabala district has been found to have the highest rates of cancer among 15-20 year olds in Azerbaijan.

Microwave 'weaponry'

It was inevitable that Defence Agencies began to explore the possibilities of using microwaves, with their ability to affect living processes, both in defensive and offensive situations.

In 1959, the USA discovered that the Russians had been directing low levels of pulsed microwave radiation at the US embassy in Moscow for a number of years. In response they set up a multi-million dollar secret State Department/CIA project called 'Pandora' to investigate the signals and their effects. Project members monitored the health of the embassy staff for 13 years without telling them. There was an increase in pregnancy abnormalities, various blood disorders and cancers, including leukaemias and lymphomas, as well as other adverse health effects. This was the conclusion reached by a re-analysis of the Lilienfeld report (1978), which was based on information from USA Defense Intelligence Agency papers that only became fully available following the Freedom of Information Act. The US has been well aware for many years of both cognitive and biochemical changes in the brains of adults exposed to pulsed microwave radiation. It is also interesting to note that the microwave frequencies the Russians used in many of their microwave weapon experiments were around 1800 MHz ~ the same as is now used in Europe for GSM1800 / PCN and for DECT cordless phones.

US scientist Eldon Byrd, who worked on Pandora and other classified projects for the Naval Surface Weapons Office, is said to have described the findings in the following way: *"We can alter the behaviour of cells, tissues, organs and whole organisms …. Alter the levels of hormones in living creatures, alter the reaction time of irreversible chemical processes as well as the chemistry itself in a living cell, we can alter time perception in humans and animals, we can make animals go to sleep, we can make bone grow and we can stop bone growing, we can start and stop cell de-differentiation – what that means is that we can make a cell that's programmed to do one thing, do something else. We can inhibit and enhance what messenger RNA does in a cell. We can regulate immune processes and affect calcium ion binding on cells. That is important because most of the chemical processes in the human brain seem to be mediated by calcium ions. We can entrain human brain waves – this has been proven and replicated many, many times now. We can turn the DNA transcription process on and off at will. We can cause profound alterations and defects in embryos in the gestation period by directly enacting fields with the growing organism. We can cause up to six times higher foetus mortality and birth defects in laboratory animals with fields so weak that you can hardly detect them. You can slow down or speed up the ageing processes of cells to the point where you can slow down or extend cell life. These are only some of the results of interactions of weak, pulsed, usually ELF magnetic fields and living systems."* (Transcribed from a tape).

In 1976, Soviet military research into microwave radiation at the modern mobile phone frequencies of 900 MHz and 1800 MHz produced well-documented health effects. These included brain damage in rats subjected to less than 1 / 100th of the radiation emitted by mobile phones; higher risk of heart disease in men exposed to microwave radiation; pre-cancerous cells linked with leukaemia and Hodgkin's disease in exposed workers; memory loss and headaches identical to those affecting mobile phone users; and damage to the immune system. In December 2001, it was reported in Microwave News (Refs) that Israel's Ministry of Defence had evaluated dozens of

non-lethal weapons including EMP (Electromagnetic Pulses) and high-powered microwaves. It is not clear whether they have ever been deployed. Many countries attend exhibitions of non-lethal weaponry which are held, and openly advertised, by manufacturers all over the world, including the UK.

In the UK in 1981, women peace protestors set up a camp at the perimeter of the Greenham Common US Air Force base, protesting about the escalation of nuclear weapons. In the spring of 1985, after Cruise missiles appeared at the base, new aerials began to appear around the base fence, replacing the police and military presence. The women began to report extreme fatigue, depression, headaches, nosebleeds, nausea, vertigo, confusion and paranoia. Many years later, someone who had been a senior member of the Defence Department at the time admitted that the USAF were dealing with the women in a much more effective way than the police had been and "we just let them get on with it". Many of the women who were at Greenham Common still suffer ongoing health problems.

US Navy Captain Paul E Tyler wrote an official paper in 1986 in which he stated: "*Some potential applications of artificial electromagnetic fields include dealing with terrorist groups, crowd control, controlling breaches of security at military installations and anti-personnel techniques in tactical warfare. In all these cases the electromagnetic radiation systems would be used to produce mild to severe physiological disruptions or perceptual distortion or disorientation. In addition, the ability of individuals to function could be degraded to such a point that they would be combat-ineffective.*" He goes on to write that areas as large as a city could be covertly affected by a large system.

Now we go to sources of radiofrequency radiation that are found more commonly in residential areas, though our first source is perhaps less frequently found than in times past.

Radio amateurs

A source of microwave radiation in residential areas can be radio amateurs who have aerials in their gardens, broadcasting at a range of short wave and microwave frequencies. There is no doubt that some people (especially those suffering from Electrical Hypersensitivity, see our publication, details on the Contents page) will react to these signals.

RF 'electrosmog'

In 1978, in the US, before there were any cellular phone networks operating, radiofrequency exposure was measured and the median level was determined to be 0.14 volts per metre (V/m). In 2000, in Sweden, in city and town areas a mean of 0.48 V/m and a median value of 0.39 V/m was measured. In areas near airfields or high powered TV and radio broadcast masts, RF signals from these sources can dominate, but in most residential areas, signals from mobile phone masts, cordless phones, wireless computer networks (wLANs) and mobile phone handsets are generally the dominant radio-frequency signals. Centres of urban population are increasingly being exposed to WiFi and WiMAX systems for computer internet access on the move, and systems are being considered to cover the more rural, less populated, areas as well. The World Health Organisation (WHO) was reported in the Independent in May 2006 as calling the electronic smog "one of the most common and fastest growing environmental influences" and stresses that it "takes seriously" concerns about the health effects. It adds that "everyone in the world" is exposed to it and that "levels will continue to increase as technology advances".

All these new and relatively new wireless transmissions differ in 'quality' from FM radio and TV broadcasts in that almost all emit bursts of pulses. It is the pulsing nature of these new signals

that most concerns leading bio-effects scientists. This is a very new phenomenon in health epidemiology terms – most cancers and chronic debilitating conditions take many (10 to 25) years to develop.

Wireless modems are being placed in the foyers of airports, railway stations, hotels, GPs surgeries, coffee shops, student halls of residence and schools, so individuals can use their laptops with the minimum of fuss. From March 2004 a number of airlines are introducing these on their planes, following trials by BA and Lufthansa. In a discussion paper on mobile services on aircraft , the Institution of Engineering and technology comments to Ofcom (2006) *"In practice mobile phones, and other wireless device technologies, are regularly operated by passengers within aircraft at all stages of a flight. Therefore the manufacturers of aircraft and avionics systems need to ensure that there is technical immunity to such personal devices. It is the Institution's view that, on the basis that terrestrial networks and the aircraft's avionic and other electrical and electronic systems are not compromised, GSM phone services at 1800 MHz should be allowed."*

No mention of biological systems then.

Ten stations (July 2005), Reading, Bristol Temple Meads, Bath Spa, Didcot Parkway, Swindon, Exeter St Davids, Bristol Parkway, Plymouth, Newbury and Slough offer online internet access for use by business passengers waiting for trains on platforms or in the waiting areas. First Great Western and First Great Western Link have signed a contract with The Cloud to bring wireless Internet access to every one of its 85 stations.

Many mainline railway operators are installing WiFi systems in their trains. Icomera, a Swedish company, is providing the commercial 3G WiFi service used on GNER's fleet of trains. They have been testing the system on their East Coast route and by May 2007, every GNER train will be fitted with the new wireless 3G data communication system. All 13 diesel trains and 30 electric trains will have the facilities of 'a mobile office'. Virgin Voyager trains have already got a 'Connected Carriage' system offering the same service and T-Mobile and Southern are providing a faster broadband service.

Health effects

Environmental pollutants

We know that many environmental pollutants interact. Exposure to more than one pollutant may not double the risk, but may increase the risk factor by many times. Dr Philip Landrigan of the Mount Sinai School of Medicine in New York City stated in December 2002 *"Of the 3,000 high production volume chemicals in use in this country today, only 43% have been* ***minimally*** *tested.* ***Only about 10% have been thoroughly*** *tested to examine their potential effects on children's health and development."* Chemicals are usually tested in isolation, so no information is available to determine whether the side effects may be lessened or made worse by interacting with other pollutants.

Our water is also becoming more polluted as people take more prescription and non-prescribed drugs, which are not necessarily removed from the water supply in the filtration process. These chemicals are also added to the soup created by cleaning agents, pest control products, etc. In fact, many cleaning agents contain bactericides, which may prevent some of the cleansing bactericidal processes.

There have been many studies demonstrating the impact of *in utero* chemical exposure on cognitive development and immune system function (Koopman-Esseboom 1996, Huisman 1996, Weisglas-Kuperus 2000), showing that periods of rapid growth and development (prenatal through puberty) are most sensitive to exposure. Foetal exposure can lead to disease and disabilities decades later. Dr Ted Schettler (2000), the Science Director of the Science and Environmental Health Network, discusses the impact of environmental exposures on neurological development in children, adding that the developing foetus and child only have immature detoxification pathways, which may be overwhelmed by environmental toxic exposures. At remarkably low levels of exposure, the impact involves hijacking control of foetal development, adding to or subtracting from the body's own control signals. Elegant theoretical and empirical work (Sheehan 1999), suggests that for activated signalling systems, there may be no threshold beneath which no effect occurs.

Living systems, including human beings, like other systems in nature, are non-linear (bigger is not necessarily worse and smaller is not necessarily better), and their response to the environment also varies from individual to individual and within one individual over time. Anticipating how one person will respond to a given stimulus is like trying to base a long-range weather forecast for the UK upon one drop of rain in East Anglia. The bigger the area in question, and the more examples selected, the more likely that it *could be* approaching reliability. The weather is an example of a non-linear system. Despite the addition of a battery of very expensive equipment, weather forecasters often get it wrong, sometimes very wrong.

Dr Schettler (above) says that environmental factors play a more important role than genetic inheritance in the origin of most cancers, and cancer risk is largely established during the first 20 years of life (Czene 2002, Hemminki 2002).

John Peterson Myers, a Senior Advisor to the United Nations Foundation said in San Francisco Medicine November 2002, that "*low doses are more potent than high doses with regard to some poisons*" (vom Saal 1997, Cavieres 2002, National Toxicology Program 2001). Although he is speaking specifically of chemical exposure, what he says can be translated directly into what is being said about EMF and RF exposure. Myers suggests *that "one plausible hypothesis is that at low, physiological levels, the contaminant interferes with developmental signalling but does not activate biochemical defences against impacts that would be caused by higher exposures. At somewhat higher levels, these defences are activated and the contaminant is successfully detoxified. At even higher levels, the defence mechanisms are overwhelmed by the toxicant and more traditional toxicological effects are induced".*

He continues "*Another important issue raised by emerging science is the powerful interactions that can occur within mixtures of chemicals, even though regulatory toxicology is conducted virtually exclusively on pure single compounds".*

"The issue of mixtures is complicated further by interactions now known to occur between contaminants and infectious agents (bacteria and viruses), leading to large increases in disease risk. Rothman et al (1997) *reported a greater than 20-fold increase in relative risk to non-Hodgkins Lymphoma with combined exposure to elevated (but still background) PCBs and Epstein-Barr virus, possibly due to well-established immune system impairment by PCBs".*

Myers states "Epidemiology cannot be accurate in the light of modern knowledge unless it accurately addresses:-

- Non-monotonic dose response curves (i.e. biphasic responses), (where low levels of exposure can produce greater biological effects than some higher exposures - our expansion)

- Windows of vulnerability during development
- The ubiquity of mixtures
- The likelihood that multiple exposures (chemicals or other environmental agents - our comment) can induce similar impacts via disruption of developmental processes
- The same type of exposure can cause different impacts depending on when the exposure occurred
- **Long latencies between exposure and manifestation of impact in a population.**

The effect of all these considerations, if ignored, will be to increase the likelihood of false negatives in epidemiology as it is currently practised".

He concludes "*The effects of low level, background exposures are likely to be far more widespread than acknowledged, and involve many more health effects than traditionally considered, yet these new mechanisms of toxicity thwart the epidemiological tools now available to establish human harm.*"

EMFs as environmental pollutants

Epidemiological studies on tobacco or asbestos did not establish that these *cause* cancer, but only that they entail a significant *increase in the risk* of cancer developing. In the case of electromagnetic pollution, there is an increasing portfolio of evidence indicating that exposure to the kind of radiation used in mobile telephony does increase the likelihood of adverse health effects. The late Sir Richard Doll, who first linked smoking with cancer, did not think there was yet enough scientific evidence to cause serious anxiety but admitted that there was "*suggestive evidence*" and did "*feel anxious that further intensive research is conducted.*"

Professor Kundi, from the Institute of Environmental Health at the medical university of Vienna, says "*It should be noted that exposure-omission studies (systematically leaving out one component after the other of a complex combined combination) are by far more indicative of a causal relationship than exposure studies… Another problem arises from the uncertainty about the underlying mechanism, which makes a judgement about endpoints used in human studies, whether or not they can be considered as adverse effects, difficult.*" Even this statement excludes the potential for interactive, yet unsuspected, effects that could be crucial in determining some adverse health effects.

In March 2001, the Chairman of the Independent Expert Group on Mobile Phones (IEGMP), Sir William Stewart, gave oral evidence to a recent Trade and Industry Select Committee Inquiry (2001), that included: "*We considered the total effects of emissions produced by masts and by the phones themselves. Clearly, there are thermal effects, there is some evidence of non-thermal effects and there are indirect effects caused by accidents and impacts on well-being. To cut a long story short, emissions to the general public* from phones *per se are higher than emissions to the general public* from masts *by a substantial amount.*"

"*Overall the balance of evidence to date - this is a carefully constructed phrase - suggests that exposure to RF emissions below the national guidelines do not cause adverse health effects to the general population. However, we went on to say that there was now scientific evidence that there may be biological effects occurring at exposures below those guidelines. Biological effects do not necessarily translate into health effects, but neither do they necessarily* ***not*** *translate.*"

"It is simply not possible to say that there are no potential effects on the human population. It is difficult to talk about the population because populations vary. Antibiotics do a wonderful job for the general population, but there is a subgroup in the population that is allergic to antibiotics; they cannot take them. There is a sub-group in the general population who cannot eat nuts because they are allergic to them. That is why we refer to the general population. The other point is that we mentioned health effects and well-being effects. On the basis of discussions such as those we came to advise on the need for a precautionary approach."

The Stewart report in May 2000, concluded "the balance of evidence indicates that there is no general risk to the health of people living near to base stations where the exposures are only small fractions of guidelines." However, this may have meant serious medical conditions such as cancer. The World Health Organisation definition of 'adverse health effects' includes those affecting a person's "well-being" and does include headaches, unusual fatigue and sleep disruption.

Sir William Stewart was quite clear that the report of the Stewart committee was based on the balance of evidence to date (May 2000), even after complaining that the NRPB had not produced all the important up to date research to give to the committee. The Stewart committee also recommended that a further review of the available research be done two years later (May 2002). This resulted in the production of the second report, Stewart 2, in January 2005.

Dr Gerard Hyland, Warwick University tells us that current mobile phone systems emit pulses of radiation mainly at a rate of 217 times a second, but also with 4 and 2 Hz frequency components. In an article in the **Lancet** medical journal, Dr Hyland (2000) explains the perils of mobile phone technology: "*A good example of human vulnerability to a non-thermal, electromagnetic influence is the ability of a light flashing at about 15Hz to induce seizures in people with photosensitive epilepsy. It is not so much the amount of energy absorbed from the light that provokes the seizure, but rather the information transmitted to the brain by the (coherent) regularity of its flashing, at a frequency that the brain "recognises" because it matches, or is close to a frequency utilised by the brain itself.*" (Venkataraman 1976)

In many ways, exposure to EMFs, both high and low frequency, is similar to exposure to chemicals, in its effect on people. Many people develop an idiopathic (allergic) reaction to both, resulting in a diagnosis of Electrical Hypersensitivity (EHS) or Multiple Chemical Sensitivity (MCS), or both.

In an increasingly polluted (and not just by chemical and EMF pollution) world, it is becoming impossible to select out which environmental toxins may be responsible for what damage. It is an irresponsible stance to say "*Mobile phone radiation is safe*". It is a stance impossible to justify when we don't know what effect it will have when added to the soup of existing polluting materials. Leiss and Paoli wrote in 1998. "*The public might be excused for thinking that ordinary citizens differ from rats chiefly in that the latter are used in short-term experiments and the former in longer-term ones.*"

Most scientific studies require 'reproducibility' in order to prove a particular theory of effect. Current EMF regulations treat people as if they are inert slabs of meat with a piped liquid cooling system (the blood). They ignore the fact that we are living beings with very complex dynamic non-linear systems that make us exquisitely sensitive to many environmental signals. Aliveness, due to the complexity of living systems, produces non-reproducible effects. The difficulty, at least partly, with human beings is because our cells and organs (especially the brain) are in constant communication with each other using biochemical communication systems. The efficiency of these systems will depend on the health of the person concerned and other factors of susceptibility that we are as yet unaware of. Just as not everyone is allergic to nuts, or suffers from hay fever, we may not all react to microwave radiation. Neither do we know how to test for

those who may. Some people may have short-term problems but be fine in the long term. Others may have very little initial reaction and be completely debilitated by long-term exposure. **We do not yet know**.

The way we experience the electromagnetic energy that interacts with our bodies is complex. Some frequencies we experience as light, some as heat, some we are not apparently consciously aware of (e.g. X-rays) yet they have a significant impact on our bodies. From our evolutionary experience, our sense organs react more to changing stimulus than constant ones, as these will have originally been more threatening. Our nervous system, for example, expresses this bias for change by tiring of sensing the same old thing. Most nerve cells can't fire time after time in quick succession. It's called fatigue. Mast and phone emissions are composed of two types of signals; one sort which does not vary much over time, and the other which can change rapidly over quite a wide range. We can assume that the organs and systems in our bodies are likely to respond quite differently to these two types of incoming signals. Most 'conventional' research and scientific theory is based on averaging our exposure, reducing it to the 'same old thing' mentioned earlier. This is likely to reveal far less than if we look at changes.

As long ago as the 90s, the European Commission Expert Group, then Chaired by the UK NRPB's Dr McKinlay, was mandated to draw up a blueprint for research into possible health effects relating to the use of mobile telephony. It reported at the end of 1996, recommending a 24 Million ECU research programme. It is shameful that virtually none of this research had even started before 2001. On page 3, under the heading "Health concerns", we find: *"A large number of biological effects have been reported in cell cultures and in animals, often in response to exposure to relatively low-level fields, which are not well established but which may have health implications and are, hence, the subject of on-going research." "A substantial body of data exists describing biological responses to AM RF (including microwave) fields at SARs too low to involve any response to heating. It has been suggested that non-equilibrium processes are significant in the bioenergetics of living systems, challenging the traditional approach of equilibrium thermodynamics. ... ..."* The COST244bis Report (2000) updating the above, confirmed ongoing concerns about these matters.

The Royal Society of Canada's report in 1999 said, "there are documented biological effects of RF even at low, non-thermal exposure levels including a) blood-brain barrier permeability changes, b) DNA damage, and c) increased cancer in rats; although b) and c) have not yet been adequately replicated".

A growing number of serious, highly qualified, scientists worldwide are disputing the assumption that EMF bi-products (RF, MW, ELF) are of no health consequence, and it seems that the more research is done the more that assumption comes under challenge.

World Health Organisation fact sheet 183 says "Exposure to low-levels of RF fields, too low to produce heating, has been reported to alter the electrical activity of the brain in cats and rabbits by changing calcium ion mobility. This effect has also been reported in isolated tissues and cells. Other studies have suggested that RF fields change the proliferation rate of cells, alter enzyme activity or affect the genes in the DNA of cells. However, these effects are not well established, nor are their implications for human health sufficiently well understood to provide a basis for restricting human exposure."

Many leading EMF-bio-effects scientists believe living systems use electromagnetic fields to convey information needed for survival. This includes the replication of DNA, the function of the immune system, relaying of messages to the brain and communication.

Allan Frey and others (Refs) have suggested that if we expose a human living system to a very weak EM signal, if the signal is appropriately 'tuned' it could interfere with normal function; so that an electromagnetic signal could cause our bodies or individual systems within them to 'resonate' at this man-made imposed signal, leading to a state of poorer health. The possibility is enough, according to Dr Gerd Oberfeld of Salzburg Public Health Department. He says "The existence of an exact and finite process chain with knowledge of all relevant active mechanisms between an influence and an effect on health is not required to establish a causal connection."

Virtually any form of pulsating energy can entrain brain waves (Oschman 2000, Di Perri 1972, Alexander & Gray 1972, Foster 1975). Hyland suggests that the "alive, human organism" should be treated like a sensitive electromagnetic instrument, and should be subject to EMC (electromagnetic compatibility) regulations, which have quite stringent restrictions on exposure.

Dr Cyril Smith, a retired bio-physicist, with a deep interest in homoeopathy and living systems' reactions to electromagnetic fields says that the frequency patterns of mobile phones and their masts can resemble the homoeopathic equivalent of toxic chemicals and therefore be effectively causing chronic poisoning of the population.

Dr Pinkham, an environmental researcher, said "The installation of cellular towers can cause injury to genetically susceptible individuals, especially if they have nutritional deficiencies that make their cells more sensitive to stress (Stewart-Pinkham 1996). The effects of such a stress on susceptible individuals can take many different forms, which has led to confusion regarding effects of a cellular tower. I would not anticipate a dose response effect or a single type of effect. Some exposed individuals might suffer from immune deficiency and increased susceptibility to infections or cancer, others might suffer from endocrine imbalances and suffer from fatigue and sleep disturbances."

Von Klitzing (1995) researched the effects of the cordless DECT telephones on the EEG. After 5 minutes exposure he found changes in brain wave activity and blood-flow.Even the evidence we now have can only tell us about the damage that is being done today. For more slowly developing illnesses such as leukaemia, other cancers, Alzheimer's and other dementias we will have to look for the results in 5, 10, or even 30 years hence, as with asbestos. UK deaths from mesothelioma (an asbestos-induced cancer) are due to peak between 2020 and 2030 despite its use having been banned in the UK for many years.

Professor Henry Lai explains that microwaves have the same stress effect on the human body as loud sound has. The invisible microwaves, that we cannot see but that pass through our bodies, are chronic stressors. Our bodies, whether we want to or not, experience the microwaves as stress, which like any other stress, has a cumulative effect.

A review of research done by Russian & Ukrainian scientists ***"The Influence of High-frequency Electromagnetic Radiation at Non-thermal Intensities on the Human Body"*** edited by Kositsky, Nizhelska & Ponezha (2001), suggests that as a result of the 'soup' of sources of radiation, standing waves may arise, the frequency of which may coincide with resonance frequencies of living cells, organs or systems of a living being. Exposure to low-energy electromagnetic radiation from high level communications installations may change genetic structures, leading to genomic instability.

It seems that some people have a natural ability to detect weak radio-frequency sources such as mobile phone transmitters. No research has been done as to how they do this or what may be the lower limits of sensitivity. There is quite a lot of anecdotal evidence from America of such people accurately pinpointing masts some miles away and completely invisible over the horizon. This may be similar to the way that some people can sense compass co-ordinates, and never get lost.

We do not know precisely how they can do it though there are unproven theories based on the study of migratory birds and homing pigeons.

Is the ability to detect weak radiofrequency emissions just a freak ability, with no useful application, especially if we are unaware of it? Or is it part of our necessary greater biological system that is becoming severely disrupted and may have consequences we are as yet unaware of?

Health effects from RF radiation from mobile phone masts

In many of the cases listed in the studies of occupational exposure to microwave radiation, *medical tests (including blood pictures and biochemistry) showed no significant abnormalities* (Graham 1985, Hocking 1988, Schilling 1997). The symptoms often persisted for several months, even years, after the exposure, and some of the people who had been exposed were never able to regain the level of good health they had experienced beforehand. Some exposures resulted in severe anxiety necessitating short term sedation and even admission to hospital. Psychological problems and emotional instability persisted for up to a year. Some symptoms, especially headaches were made worse as a result of direct sunlight or body warming. Schilling suggested that this effect "*may originate from an inflammatory irritative lesion in the peripheral nerves. Their prolonged course may be due to a central component related to facilitation in the reticular formation and its input to the thalamus.*" It is worth bearing this finding in mind when considering the data becoming available on health effects experienced by people living in the vicinity of mobile phone base stations and other sources of RF radiation.

There is a small body of published epidemiological research evaluating symptoms of people living near to mobile phone masts. It seems to confirm people's experience that the health of nearby residents is affected in a substantial minority of the population.

Professor Santini (2002, 2003) at the University of Lyons, Abdel-Rassoul and colleagues (2006), Hutter et al (2006), Preece et al (2005) found many of the following symptoms in the population studied; sleep disorders and disruption, depression, mood changes, including anger, irritability & crying, fatigue, a feeling of being drained of energy, headaches and migraines (including severe migraines in children), heart disrhythmias, high blood pressure, nosebleeds (unusual and massive), haemorrhage, impairment of short-term memory, confusion and concentration problems, hearing a buzzing, high pitch vibration, other hearing difficulties, skin rashes, itchiness, and skin alterations, aching joints, dizzy, off-balance feeling, disorientation, increased incidence of epileptic seizures, loss of appetite, nausea, susceptibility to infection

As a result of his findings, Santini was told by the University to 'shut up or leave', presumably because his findings were too controversial and caused disquiet, possibly among research funders?

A Spanish study by Navarro et al. (2003) found a significant correlation between the declared severity of symptoms and the measured power density from masts transmitting at 1800MHz. The separation of respondents into two different exposure groups also showed an increase of the declared severity in the group with the higher exposure. Mobile phone and personal computer usage were low in both groups. A follow up analysis of this study, by Oberfeld et al (2004) found statistically significant exposure-response associations with most of these symptoms.

A Dutch study by Professor Zwamborn and colleagues (2003) found that two groups of people (about 76 subjects altogether) experienced significant adverse health effects from living near a 3G base station. Cognitive functions such as memory and response times were affected, as well as

headaches and nausea. This research was done as a result of people reporting to the Dutch Health Monitoring Network that they were suffering adverse health effects from living near to a base station. These reportees formed one of the groups studied and a control 'healthy' group made up the numbers. It was a well-conducted double-blind study.

In what became to be known as the Freiburger Appell 2002, a signed document by about 200 German medical practitioners regarding symptoms they were seeing in people living near to mobile phone base stations, and using mobile phones and cordless phones, was published by:

IGUMED ü Interdisziplina re Gesellschaft fur Umweltmedizin e.V. www.igumed.de

This document included:

Out of great concern for the health of our fellow human beings do we - as established physicians of all fields, especially that of environmental medicine - turn to the medical establishment and those in public health and political domains, as well as to the public. We have observed, in recent years, a dramatic rise in severe and chronic diseases among our patients, especially:

- Learning, concentration, and behavioural disorders (e.g. attention deficit disorder, ADD)
- Extreme fluctuations in blood pressure, ever harder to influence with medications
- Heart rhythm disorders, heart attacks and strokes among an increasingly younger population
- Brain-degenerative diseases (e.g. Alzheimer's) and epilepsy
- Cancerous afflictions: leukaemia, brain tumours

Moreover, we have observed an ever-increasing occurrence of various disorders, often misdiagnosed in patients as psychosomatic:

- Headaches, migraines, chronic exhaustion, inner agitation, sleeplessness, daytime sleepiness
- Tinnitus, susceptibility to infection
- Nervous and connective tissue pains, which the usual causes do not explain

Since the living environment and lifestyles of our patients are familiar to us, we can see - especially after carefully-directed inquiry - a clear temporal and spatial correlation between the appearance of disease and exposure to pulsed high-frequency microwave radiation (HFMR), such as:

- Installation of a mobile telephone sending station in the near vicinity
- Intensive mobile telephone use
- Installation of a digital cordless (DECT) telephone at home or in the neighbourhood

We can no longer believe this to be purely coincidence, for:

- Too often do we observe a marked concentration of particular illnesses in correspondingly HFMR-polluted areas or apartments;
- Too often does a long-term disease or affliction improve or disappear in a relatively short time after reduction or elimination of HFMR pollution in the patient's environment;
- Too often are our observations confirmed by on-site measurements of HFMR of unusual intensity.

On the basis of our daily experiences, we hold the current mobile communications technology (introduced in 1992 and since then globally extensive) and cordless digital telephones (DECT standard) to be among the

fundamental triggers for this fatal development. One can no longer evade these pulsed microwaves. They heighten the risk of already-present chemical/physical influences, stress the body's immune system, and can bring the body's still-functioning regulatory mechanisms to a halt.

Pregnant women, children, adolescents, elderly and sick people are especially at risk. Our therapeutic efforts to restore health are becoming increasingly less effective: the unimpeded and continuous penetration of radiation into living and working areas in particularly bedrooms, an essential place for relaxation, regeneration and healing - causes uninterrupted stress and prevents the patient's thorough recovery. In the face of this disquieting development, we feel obliged to inform the public of our observations - especially since hearing that the German courts regard any danger from mobile telephone radiation as "purely hypothetical".

What we experience in the daily reality of our medical practice is anything but hypothetical! We see the rising number of chronically sick patients also as the result of an irresponsible "safety limits" policy, which fails to take the protection of the public from the short- and long-term effects of mobile telephone radiation as its criterion for action. Instead, it submits to the dictates of a technology already long recognized as dangerous. For us, this is the beginning of a very serious development through which the health of many people is being threatened. We will no longer be made to wait upon further unreal research results - which in our experience are often influenced by the communications industry - while evidential studies go on being ignored.

We find it to be of urgent necessity that we act now! Above all we are, as doctors, the advocates for our patients. In the interest of all those concerned, whose basic right to life and freedom from bodily harm is currently being put at stake, we appeal to those in the spheres of politics and public health".

The symptoms reported in so many of the studies are strikingly similar. There is no doubt that some of these symptoms are psychosomatic (that is, *perception* of the mast creates negative mental states that lead to physical changes in the body which then result in adverse health effects). This perception can be a result of the sudden arrival of an unwanted, often visually intrusive, mast, with very little or no warning. It would be interesting to speak to people who are visually impaired and who live near the masts, who presumably will be affected less by the visually intrusive aspect.

Public Health departments should collect and document all perceptions relevant to health and well-being in connection with mobile telecommunications base stations, and discuss them at a regional as well as national level. If possible, such perceptions should also be clarified in detail, for instance by epidemiological studies. This also offers the opportunity to gather experience and information on effect-related emissions and exposures.

Professor Stanislaw Szmigielski (1996 & 1998) from the Military Institute of Hygiene and Epidemiology in Warsaw, reported that occupational exposure to radiofrequency and microwave radiation resulted in changes in blood pressure and heart rate. He concluded *"In people who have a predisposition towards developing heart disease, this further effect could tip the balance."* 75% of the group suffered an involuntary speeding up when 50% would be the expected level (1998). In 1996 (Refs), he published an update of his 80s study of all Polish military personnel (approximately 128,000 people per year for 15 years). About 3,700 (3%) were considered to be occupationally exposed to radio-frequency and / or microwave radiation around 5 - 10 $\mu W/cm^2$ (4 - 6 V/m), levels that can be found near some mobile phone base stations. He found an increased risk of developing chronic leukaemia to be between 8 and 13 times more likely in this exposed group (depending on the type of leukaemia) and they were 6 times more likely to develop Non-Hodgkin's Lymphomas (NHL), which is rising for unknown reasons in countries with mobile

phone systems. They were also 3 times as likely to develop oesophagal cancer and twice as likely to have brain tumours.

Szmigielski's work was based on occupational exposure to RF radiation in the military. Some of the exposure was similar to what is experienced by people living near to mobile phone base stations and certainly some of the symptoms reported by the workforce are now being experienced by members of the public who live in the vicinity of masts.

An addition to our knowledge base results from the fact that the exposure was over a longer term than our current environmental exposure has been from the base stations. It is quite concerning to see the higher risk of cancers which can take a decade or more to manifest.

Cancer

At the beginning of 2002 The Guardian reported that 36 transmitters installed 18 months before on a building 50 metres away from the Garcia Quintana school in Valladolid, were blamed for causing cancer in four children at the school, three with leukaemia and one with Hodgkin's disease. There had been no cases of cancer there for 32 years. Parents refused to send their children back to school until the transmitters were switched off and dismantled, and a local court backed their demand.

The study had commented on the fact that the time between the placement of the antennas and the emergence of the cases was too short to justify the development of the malignancies. The Lancet, in January 2002 reminds us that if there is a genetic disposition to develop cancer, then the exposure levels need not be prolonged provided that the exposure level is sufficiently high to trigger the onset of the cancer (Repacholi 1997).

However, two studies found that people living near a mobile phone mast were 3 times (Eger 2004) or over 4 times (Wolf & Wolf 2004) more likely to develop cancer than those living in an area away from the mast, and Eger found that people became ill much earlier. Wolf & Wolf reported that women were more than 10 times more likely to develop cancer. No particular type of cancer was identified as being more likely to develop.

Sleep disorders

In 2005, Neil Stanley of the British Sleep Society, reported that between 60 and 65% of people going to GPs have primary or secondary sleep disorders.

"Americans are taking sleeping pills like never before", reported the New York Times in February 2006, up nearly 60% since 2000. It may be, they continued, that doctors have been ignoring conditions such as depression, which may be the underlying cause of sleeplessness. 10% of Americans report that they regularly struggle to fall asleep or to stay asleep throughout the night. These are the most commonly reported problems reported by people living near mobile phone masts.

A study by Margoliash, Fenn & Nusbaum, of the University of Chicago, reported in the journal Nature in October 2003, how sleep had a major effect on a cognitive test. Students were trained to recognise garbled words from a speech synthesiser. Whilst their ability to make sense of the words deteriorated during the day, after a good night's sleep, their performance "*shot back up*". According to Professor Margoliash "*Sleep had a whopping effect*". Sleep plays a key role in consolidating memory.

It is, then, hardly surprising that if sleep disruption is the most commonly reported health effect of living in the radiation from a base station, memory, learning and concentration are likely to be affected. It seems that the transmission of memory from the medial temporal lobe to the neo-cortex (short term to long term) happens at night during sleep: in rats' brains the cells of the lobe fire actively at night (Ridley, p 229).

Headaches and migraines

The incidence of reported migraines has increased by 70% in the last 10 years though the reason is unknown. It is anticipated that only about 1 in 3 migraines are reported to GPs, people just cope in the majority of cases. Migraine is a name which covers a variety of different symptoms. There are generally speaking five different sorts of 'migraines' only two of which have the severe headaches usually associated as a primary symptom with migraines. It is believed that 'resonance' migraines are caused as a result of pulsed fields on the brain stem.

Depression and mood changes

Andy, a communications manager, had 8 masts built near his house. He experienced depression among other symptoms with the installation of each piece of new equipment.

Cardiovascular changes

In a personal communication, a nurse told us of a study of blood pressure in a number of people in the vicinity of her local mast. The subjects 'normal' blood pressure was taken, they then approached the mast, and returned and had their blood pressure taken again. Most had a significantly increased blood pressure, and one person maintained this for two weeks after exposure. Heart disrhythmias, and nosebleeds could well be results of this blood pressure change. The correspondent, said she felt there may have been significant changes in microwave exposure due to reflections from metal roofs and metal sheds which are very common in the area of Scotland in which she lives.

Nausea / appetite changes

In a private study of 448 people near a number of masts, 60% recorded nausea and other symptoms, over 90% occurred after the last mast was switched on.

Nosebleeds

A 16 year-old started getting nosebleeds for the first time when a 3G mast was switched on 25 metres from his bedroom.

Auditory effects

Tinnitus is a condition that is often mistakenly diagnosed in people living near mobile phone masts. Middle ear contractions can be caused by microwave RF, especially pulsed RF. The RF causes a partial depolarisation of neurons, resulting in contractions of the middle ear muscles, with auditory effects like 'clicks' or 'pops' such as those experienced in a plane or tunnel. Such RF can also stimulate the inner ear, causing tinnitus-like symptoms.

The ability to detect radiofrequency energy is dependent on head dimensions. The site of conversion of the RF signal to acoustic energy is within or near the cochlea. The auditory response is dependent on single pulses not averaged power (Elder & Chou).

Autism

The incidence of autism has risen from about 4 per 10,000 to 60 per 10,000 since 1980. There are many queries to do with the MMR vaccination, and, increasingly, the mercury used in many childhood vaccinations. Many researchers are also pointing to an environmental toxin. The reports indicate that RF exposure levels may induce alterations of biological processes or damage to the genome (Hardell, 2001, Kane 2004).

Effect of RF radiation on other drugs and medical conditions

Lithium, a mineral frequently used in the treatment of some illnesses, has a strong influence on the emotions. By giving a minute amount of lithium to the patient and then beaming the right frequency at him, the inactive small amount can be changed into a very active substance.

Fluoride has a dulling effect on mental faculties. "One could imagine (Moolenburgh, 1998) a fluoridated population being mentally dulled in an extremely powerful way, when the right frequency was beamed at it, thus enhancing the feeble workings of fluoride on the mind a thousandfold." Let's hope the 'right frequency' is not a mobile phone mast frequency, or that fluoride is not as sensitive as Lithium.

RF / microwave radiation at a frequency of 2450 MHz (microwave oven frequency) has been found to alter the behavioural actions of benzodiazepines, such as Valium (Johnson 1980, Thomas 1979). Lai (1992) concluded that since benzodiazepine receptors are found in most regions of the brain and they can undergo changes after brief perturbation, it is possible that brief exposure to RF from mobile phones can lead to changes in these receptors. He added that different durations of acute exposure could lead to different biological effects.

Dr. John Holt found in 1998 that in the presence of cellular phone frequencies of 800 to 900 MHz, conventional anti-histamines and steroids do not work. They are unable to turn off the histamine production switched on in the mast cells by the electrosmog. The Department of Allergy in Kyoto, Japan, found that microwave radiation enhanced some allergy-induced skin wheal responses. This may explain some of the skin rashes repeatedly reported by people living near masts.

RF radiation can cause greater damage to eye tissue when used in conjunction with anti-glaucoma drugs.

According to a personal communication of February 2002, WHO admit that surgical implants in backs are affected by microwave radiation.

If someone has a cochlear implant and they react to a mobile phone at a metre or more distance, probably with some sort of buzzing noise in their ear, they may also react to a mobile phone mast.

RF radiation from wireless local area networks (wLANs)

It is expected that within 3 years, 23 million people in the UK (about half of the population) will have access to the web by wireless network.

One doctor and her family reported sleep disturbance, arrhythmia to the point of oxygen deprivation, energy depletion, extreme dizziness, vomiting and vertigo as a result of installing a laptop with wireless modem in the hallway of their house. It was transmitting microwaves 24 hours a day, extending to a radius of 150 feet. They disconnected it, replacing it with a fixed line and within 3 weeks became symptom-free.

TETRA

TETRA is the national, digital mobile radio communications service for many of the emergency services. It uses a microwave carrier frequency of about 400 MHz, similar to television, and divides the time up into groups of 4 (for 4 simultaneous conversations per carrier) which pulse at a frequency of 17.6 Hz (pulses each second). The Stewart Report recommended that frequencies around 16 Hz should be avoided, because research has shown that the flow of calcium ions, used extensively within the brain for signalling between cells, is badly affected by magnetic fields pulsing near to this frequency. Despite this, in February 2001, the Home Office, which approved this system before any human testing had been carried out, said it would go ahead with the system as "*no obvious health risks have been identified*". Unfortunately, the emergency services, who are the users of BT Airwave, having sold off the frequencies they used to use, seem to be left with very little choice but to implement the Airwave system.

In March 2003, the BBC reported that a TETRA mast in Dursley, Gloucestershire jammed the television signals of local residents since it was switched on for tests. 0_2 has admitted that the problem has been caused by their new base station, but maintained it is transmitting within the frequencies given to them by the Radiocommunications Agency. Many other places also report poor reception of both ITV and BBC1. In Worthing, a mother with an epileptic child used to use her TV as a visual baby monitor. It cannot now be used because of interference. The Sussex Police Child Alert system is rendered ineffective where TV pictures preclude the reception of the message. The service cost thousands of pounds to set up and is wiped out by TETRA. Children from Littlehampton schools are failing to attend because of severe headaches, nausea and lassitude, often associated with lack of sleep.

It is clear that interference by one sort of equipment with another which uses similar frequencies is not predictable by the operators. How can they be so adamant that these signals cannot affect the human organism, which is so much more vulnerable than manufactured equipment?

Effects on Animal, bird and insect populations

In Bavaria, a telecommunications mast affected dairy cattle by reducing milk yields and disrupting behaviour. Moving away from the mast restored both. Moving back, the effects returned (Löscher and Käs 1998).

In a well-kept herd of cows, an American vet found low milk production, rough hair coats, abnormal behaviour, diarrhoea, and calves born with severe birth defects or abnormal growth patterns, after the installation of a mobile phone mast near the farm.

The Federal Communications Commission reports that testicles are very susceptible to RF exposure, perhaps accounting for the bulls aggression and infertility. Could this be a possible factor in the increase of road rage episodes, especially on major roads, such as motorways, which have many mobile phone base stations en route, and the increasing quantity of infertile couples, who are already coping with oestrogen-polluted water? Magras & Xenos (1997) found a

progressive decrease in the number of newborn mice when exposed to radiofrequency radiation, which ended in irreversible infertility.

Since 1990, one pigeon racing club has seen the return rate of pigeons from France go down from a steady 70% to 30%. Previously severe losses have been explainable by bad weather, but not now. One of the aids to navigation used by pigeons is geoelectromagnetic fields. It has been suggested that the increase in mobile phone masts might interfere with the birds' ability to navigate using these cues. In Austin, Texas in October 1998, during 2 races, 1500 out of 1800 and 700 out of 900 birds vanished. Many of those who made it home were exhausted as if they'd been flying for hours, lost.

It is believed that the synchronous turning and wheeling of bird flocks is co-ordinated by electromagnetic means. If so, there may be alterations in this behaviour in areas of high electropollution.

There have been several studies into the changes in bird behaviour as a result of RF exposure. Germany and New Zealand report uncharacteristic behaviour and a study by Semm & Beason found that neurons in zebra finch brains responded to pulsed RF, concluding that they did not know if the responses manifested in the birds' behaviour or health. In Sydney, exotic caged birds exhibited dramatic changes in breeding habits and other behaviour subsequent to (18 months & two breeding seasons after) a local mobile phone base station being upgraded from an analogue to a digital system. There does seem to be a possibility that different forms of EMF, whilst separately possibly benign, taken together as an 'electromagnetic soup' may combine to produce unanticipated, harmful effects. The report from Sydney stated that most of the caged birds refused to breed, and the few that did, ejected the young from the nest. Of the two young birds that survived, one was normal, the other had no feathers. Some of the adult birds became aggressive, attacking their mates; most moulted excessively, a sign of stress. A neighbour's homing pigeons became too disorientated to perform properly. 2 dogs became disturbed, refusing to sleep in their usual place, and crows became restless and noisy, vacating the area after a base station was installed on a high rise apartment building. It is a pity that field measurements were not made so that similar situations can be compared. Environmental pollution is so widespread, it is important to look at the totality of exposure.

A study carried out in Valladolid (Spain) (Balmori 2005) found that storks with nests less than 200 metres from mobile phone masts had reduced reproduction levels, their behaviour was less co-ordinated, leading to nests that fell apart due to poor construction, and the storks displayed more aggressive behaviour, than those who nested more than 300 metres away.

Rosie Cleary of the British Trust for Ornithology is to instigate a major study involving 30,000 birdwatchers to attempt to discover whether mobile phone base stations are responsible for the decline (75% fall since 1994) in sparrow numbers. They are to monitor the numbers of urban sparrows over two breeding seasons. Spanish scientists have found that birds avoid places with high EMFs, and laboratory studies have linked EMFs with reproductive problems in chicks and rats.

Fewer house sparrows, especially males, were found in a study of 6 centres exposed to 2G mobile phone base station radiation in Belgium (Everaert 2007). The authors concluded *"Long term exposure to higher levels of radiation negatively affects the abundance or behaviour of House Sparrows in the wild."* In a personal communication, we were told that in 1956 when a new radar system was being tested that used a fast rise time, very short duration pulse (similar to that used in modern digital communications systems), a large flock of thousands of migrating birds (mainly swifts and house martins) were found dead, or dying, over a wide area of the South Downs.

One correspondent has wagtails nesting regularly in the ivy in his garden near a 3G mast. In 2003, the eggs hatched, but the fledgelings appeared to be unable to fly and didn't leave the nest. It wasn't a growth problem, as they became oversized. Two other people have commented on the disappearance of nesting seagulls in coastal towns with a TETRA mast. One of them said that *"Central Brighton is usually teeming with seagulls, particularly in the spring, when newborn seagulls nesting in many chimneys are being cared for. There is usually unending noise throughout the night – now there is a complete silence……"*

We received a personal communication from someone who worked with radar in 1963. He told us that a barn owl regularly flew some 20 to 30 feet in front of a radar transmitter. The owl's steady and sedate flight would suddenly and predictably become erratic (in height and heading) as the owl entered the coverage of the Precision Radar beams. These were electronically scanned through 20 degrees in azimuth and 6 degrees in elevation from the truck into the runway approach lane. The Search radar beam (which rotated through 360 degrees) appeared to have no adverse effects on the bird, regardless of whether Circular Polarisation was inserted into the antenna or not. It is not always clear what aspects of radiofrequency radiation will affect the systems of living creatures.

A recent study reported in a beekeepers journal, in German reported problems in the bee population after the installation of mobile phone equipment nearby http://www.mikrowellensmog.info/bienen.html. 37.5% of the bees were more aggressive, 25% of the bees tended to leave the hive, and 62.5% reported collapses of the bee population. This raises significant questions , as bees are so important for food production. Stever (2005) that when 2 hives of bees were exposed to a DECT phone, out of 25 bees released 800 metres away from each, that only 6 bees returned to one hive and none to the other. 21% fewer cells were constructed in the frames of the exposed hives.

In April 2007, plans to put up a mobile phone mast in Eastbourne were shelved because of the possible threat to bees.

A Greek study in 2007 found that exposing fruit flies to 2G radiation (900 MHz & 1800 MHZ) for a few minutes per day for the first 6 days of their adult life. The team of researchers found DNA fragmentation for both types of emissions (Panagopoulos 2007.).

Effects on plants

Kolodynski & Kolodynska, (1996) in Latvia, found in addition to the effects on local children and cows quoted above, the following changes

- growth reduction in and death of pine trees 4 km from radar site 0.027 μW/cm² at 4 km (Balodis 1996).
- chromosome and reproductive damage in plants 0.042 - 6.6 μW/cm² (Flakiewicz 1992)

Here we see an interesting example of a row of quick-growing conifers, planted to screen a mobile phone base station. They were all planted at the same time, they were the same height at planting and, as far as can be determined, in the same conditions. The transmitting antenna is radiating straight through the dip in growth. It may be a pure coincidence, of course.

Dr Volkradt recounts examples of forest dieback around radar stations in Northern Canada, oak forests north of Vienna, and near Wasserkruppe and Frankfurt am Main in Germany. He says that lines of trees are dying between radio transmitters.

Ongoing Research

The Federal Radiation Protection Office in Germany is considering proposals for an epidemiological analysis, beginning with a pilot study, of health complaints and radiation from mobile phone base stations, with a study population of approximately 2000.

Germany's six telecommunications service providers have agreed to sponsor a 4-year health research program in exchange for the government's pledge not to reduce exposure limits for mobile phone towers to below ICNIRP guidelines. In addition, the companies promised to give local officials and the public a greater role in decisions on siting base station antennas, to avoid the placement of antennas near schools or kindergartens and to install a network of measurement stations to monitor RF/MW radiation from their systems.

The late Dr Neil Cherry, Professor of Environmental Health at Lincoln University, New Zealand, listened to the concerns of the community and spent many years and a great deal of his own salary income to travel around the world visiting universities and laboratories to collect published papers and discuss as much as possible with the original researchers.

He published strong evidence that:

> **Electromagnetic fields and radiation damage DNA and enhance cell death rates and therefore they are a Ubiquitous Universal Genotoxic Carcinogen that enhances the rates of Cancer, Cardiac, Reproductive and Neurological disease and mortality in human populations.**
>
> **Therefore there is no safe threshold level. The only safe exposure level is zero, a position confirmed by dose-response trends in epidemiological studies.**

6. Frequently Asked Questions

BASE STATIONS / MASTS

- Are base stations safe?
- Is the radiating equipment on a base station called antennae or antennas?
- What about the drums and dishes on the masts?
- How far away is safe?
- How many masts are needed in a particular area?
- I can get a good signal on my mobile phone, so why do we need another mast?
- Do emission levels from antennas vary according to whether they are in use or not; and whether they are dealing with a call?
- What effect do weather conditions have on base station emissions?
- Can mobile phone masts produce accurate records of rainfall?
- Are 3G base stations more or less harmful than 2G?
- What are the effects of TETRA systems?
- What regulations apply to mast emissions?
- How can local authorities restrict the siting of masts due to possible risks to health?
- What about public consultation?
- The Maastricht Treaty states that the UK authorities are required to practise the precautionary principle in all decisions. Why has this not been followed?

COMPANIES

- Should we trust mobile phone operators, when they face strong local opposition, who say they will move the mast somewhere else?
- Can agreements between landowners and operators be cancelled?
- Do mobile phone operators need to have public liability insurance?

WiFi

- I don't want a WiFi connection to broadband internet - what options do I have?
- I have more than one computer and want them all to be able to use the internet - do I have to use WiFi?
- One of the computers I need to connect is in a different room - I have a laptop I would like to use in different rooms - do I have to use WiFi?
- What about Wireless Local Area Networks (wLANs or WiFi)?
- What are these Homeplug/dLAN devices and are they a viable EMF-safe alternative to a wireless LAN?
- Are games consoles safe?
- Are the concerns about the health effects of using Wireless Local Area Network (wLAN) systems in school classrooms unfounded?
- Are interactive whiteboards in classrooms an EMF problem?
- Is it true that trains are all going to become WiFi enabled?

OTHER

- Electronic tagging of goods
- What is Bluetooth?
- What are EMX Biochips? Do they really work?
- Who are Exradia? Do their products really work?

Base Stations / Masts

Are base stations safe?

Nothing that we live with is 100% safe. Everything in our environment carries some level of risk potential, some of which have been investigated in detail (e.g. petrol and diesel and their combustion products), and others that are being used with little investigation (e.g. the many novel chemicals now present in our water and food, due to agricultural practices, packaging and storage processes, water fluoridation, etc.). The power used to transmit signals from mobile phone base stations to the phones themselves is very low, and we do not believe that it has any ability to heat tissue, which is the only effect we are currently protected against by law. The signals from all base stations pulse to varying extents. It is this pulsing that has been associated by many leading scientists with harm to biological living systems. Areas of pulsing are found all around base stations and are likely to be the trigger for many of the health problems reported by people living and / or working in the vicinity. The visual impact of the masts is also likely to

result in indirect health problems caused by stress. It is also possible, if not probable, that the electromagnetic pollution caused by the sea of microwaves we are now experiencing is interacting with other environmental toxic substances, causing our immune systems to become dysfunctional.

Foetal exposure to microwaves from masts is likely to be negligible unless the pregnant woman had a phone mast antenna attached to the outside wall of her bedroom, which is unusual, but has occurred in some visually sensitive environments.

There is no danger of the signals *in public areas* from base stations adversely affecting a heart pacemaker, but workers with pacemakers who may have need to work on roofs, etc. should not go closer than about 10 metres to the side of a base station antenna. Heart arrhythmias are reported frequently by people living near base stations. Whilst the mechanisms are unclear, it may well be that RF radiation interferes with the electrochemical communication that happens constantly within the muscles of the heart.

There have been widespread reports of dogs, horses, cattle and birds being affected by emissions from base stations. There has been no formal research as far as we know. Dogs have been reported as being vulnerable to cancer, whilst in horses, cattle and birds significant behavioural and fertility changes have been reported. Research indicates that male animals may be more susceptible, and may be connected to the vulnerability of testicles to microwaves. The changes in behaviour may be mediated through changes in testosterone. Cows did not seem to suffer the same behavioural problems, though nesting behaviour changes occurred in female as well as male storks.

Ornithologists report reductions in bird populations which are difficult to account for. There are explanations being put forward for this, including the use of agricultural pesticides and herbicides and habitat destruction. Homing pigeon disorientation continues to be reported at home and abroad, where up to a third of young birds do not find their way back to their roosts even after their usual local exercise flights. For further information about the effects on bird behaviour across the world, see the end of the chapter on health effects.

Some experimental evidence shows DNA changes in birds as a result of radiofrequency emissions exposure, though many varieties of wildlife are short-lived and it is difficult to identify long-term health problems as a result of one specific environmental change. No research has been done to identify whether any such DNA changes may be passed on to succeeding generations of birds.

There have been a few reports on the adverse effects of radar on tree growth, but no specific studies to do with base stations.

There was considerable research in the 1920s with respect to low frequency EMFs on plant growth. This revealed significant effects, which probably would have become more widely known, had not chemical companies' production of fertilisers been particularly lucrative, reducing the apparent need for other ways of boosting productivity. We believe that more research needs to be undertaken on using controlled EMFs as a way of reducing our reliance on chemical fertilisers and pesticides. Microwaves may also affect plant growth for good or ill. This will still not give information about the *quality* of food grown in high EMFs and microwave levels, and its ability to provide the living organism with the nutritional and other (including subtle) requirements we need.

Is the radiating equipment on a base station called antennae or antennas?

The correct British English term is aerial(s). Americans use the word antenna with the plural of antennas. In British English, antenna is used for insects with the plural 'antennae'. Following the American example, we now use the word antenna and antennas, keeping the British English plural term antennae only for insect anatomy.

What about the drums and dishes on the masts?

These drums and dishes are part of the intercommunication network from one base station to a neighbouring one. The microwave emissions are very tightly focused and will result in negligible radiation reaching ground level.

How far away is safe?

This is an impossible question to answer simply. We are unsure whether any distance where the pulsing signal can be detected is safe. The people who report serious ill-health effects are in a minority, but the number appears to be increasing, and if, as many scientists believe that electromagnetic pollution interacts with other forms of environmental pollution in unpredictable ways, it is likely to affect an ever growing proportion of the population. Some ill-health effects take longer to manifest than others, so this also may obscure the picture. We believe that the direct adverse effects from living near masts are more likely to show up in a small susceptible sub-group of the population of all ages. At the moment it is impossible to tell what characteristics are typical of this susceptible subgroup.

Generally speaking, base station antennas radiate most of their power sideways (see Chapter 3). Although the companies and the government advisory bodies give indications as to where the main power beam from the mast is detectable, their graphs and diagrams are based on computer modelling only and all real-life base stations are set in a geography that may considerably alter this. The extent of the main beam is generally defined as "places in the beam where the radiation is over half the power found in the centre of the beam." Building materials can reduce the field levels from the mast, though they also reflect the beam.

Using computer modelling, and assuming the mast is on dead flat ground and stands alone, the 'main beam' of microwave radiation from antennas at a typical antenna height of 15 metres starts to reach ground level up to several hundred metres away and can extend to between 0.5 and 25 km. The distance and power will depend on factors such as; the number of operators, the height of the base station, the power of the antennas, the direction of the antennas, the physical and / or electronic uptilt or downtilt of the antennas, the quality of equipment, the local geography, the type of buildings and building structures in the immediate area. The power falls off inversely with the square of the distance. In the main beam, between 100 - 500 metres away from the antenna, typical signal levels can be in the range 1 to 3 V/m. The antennas on the mast are not perfect, so the imperfections result in 'hot spots' or radiation 'splatters' (Chapter 3). This tends to be more obvious between the mast and the main beam, less so from side to side.

Pulsing signals can occur as 'hot spots' at any point from very close to the masts to a considerable distance away. Where the power and pulsing 'hot spots' are found depends a great deal on the local topography, as microwaves can reflect off many surfaces (especially metal - such as lampposts, parking meters, metal barns, cars, lorries, aerials, etc.). It is the pulsing which is believed to be responsible for many of the health effects associated to living or working near mobile phone base stations (Hyland 2000).

Power-frequency EMFs from base station cabins are minimal, but we would not advise sitting near them, or passing them too closely if pregnant.

On the whole, people directly underneath masts on buildings will not be subject to high fields, although there will be some hot spots, and these have been reported to give some people problems, especially those who have developed a sensitivity to EMFs.

People on floors lower down may be subject to higher microwave fields reflected from nearby buildings. The power in these reflected signals will be very low, but the pulsing signal may well be disturbing to those who are sensitive. Those in buildings opposite will also be subject to relatively high fields.

How many masts are needed in a particular area?

Due to the large numbers of mobile phone users making large numbers of calls, in city areas there are a lot of base stations close together (see Chapter 3). As more base stations are introduced, the transmit power of each is *usually* decreased so that the areas they cover do not overlap too much, though this is not always the case. You can check the increase in the number, type & operator of base stations in your area, by logging on to the Ofcom website www.sitefinder.radio.gov.uk. Their database does not include private mobile radio base stations. Ofcom also do not intend to include the WiFi and WiMAX systems for getting access to the internet by means of a laptop whilst on the move. They said that it would be a massive and effectively un-do-able task as many installations apparently do not have be announced or identified and registered anywhere centrally.

Many telecommunications companies are promoting the use of a mobile phone within the house, doing away with a land-line (wired) phone altogether. People at work often use their mobile phone instead of the usual wired phones, as this is the number often given out to business contacts. In order to achieve a viable signal strength inside buildings, microwave radiation levels have to be increased, and more masts are needed. Remember that EVERY extra voice or SMS call made or received by a handset in a house WILL increase the need for extra base-stations nearby.

In country areas, with fewer users, the need is generally for a tall, higher-power mast to cover a wider area. Where there is a high density of callers, as found on motorways and major roads, extra masts are used to increase call capacity.

I can get a good signal on my mobile phone, so why do we need another mast?

There can be a number of reasons. Firstly "coverage" not only includes adequate signal strength, but also means that the number of calls at busy times (call traffic density) should not exceed the capacity of the local network, which is usually only 10s of simultaneous calls – see details in Chapter 3. Also users want to be able to use their phone from within their houses. A nearby mast is required to provide adequate signals inside most buildings in the area. As the phone companies are offering cheap (and some free-time) tariffs, the amount of calls being made is increasing dramatically, and GPRS and 3G systems, where video pictures can be sent, among other options, is likely to increase demand for air space.

Do emission levels from antennas vary according to whether they are in use or not; and whether they are dealing with a call?

There are likely to be three different levels of emissions.

a) The equipment and antennas are fixed in place ready to go, but not yet integrated into the system. Levels will be very low, except for occasional equipment testing.

b) The base station is integrated into the system. It is not sending or receiving a call, but just maintaining a background functional presence. This is likely to include bursts of activity possibly from mobile phone handsets on standby, 'shaking hands' with the system.

c) The base station antennas are busy, receiving and transmitting messages from phone handsets in use. The emission levels will vary depending on the power of the base station, the number of channels in use, and the number of calls (including standby 'handshakes') being made. In a particular area, there may be times of day which are usually busier than others. This will depend upon the activities of the local population. Late afternoon can be busy for teenage schoolchildren re-establishing their friendship network, whilst 5.00 to 6.30 could be busy with people contacting their partners about expected home arrival time, traffic delays, etc. All base stations continuously transmit a control frequency (BCCH) channel, even when no calls are being made. Most base stations have between 3 and 6 traffic channels (enabling between 24 and 48 simultaneous full-time calls), so the power could theoretically vary up to between 4 and 7 times the background carrier level. In practice, because of adaptive power control, etc., it only increases 2- or 3-fold.

What effect do weather conditions have on base station emissions?

The base station's main control channel does not change its transmit power when it rains. It broadcasts at full power all of the time. What happens is that the base station and the handsets making calls adjust their power (Adaptive Power Control) to use the minimum power needed to maintain the phone call. So all the call-traffic slots operate at different power levels depending on how far away the handset is, etc. In heavy rain more power is needed so both the handsets and the base station increase their transmit power. Possibly total power at a really busy base station that regularly carries lots of call-traffic will go up with heavy rain but the effect would not really be noticeable on most fairly lightly loaded base stations.

Water absorbs microwaves, so the levels through rain would go down (or remain constant if they turn the power up) rather than increase, though they may still be transmitting at high power after the rain ends.

Can mobile phone masts produce accurate records of rainfall?

In May 2006, the BBC news reported that mobile phone base stations were more precise than radar and rain gauges at monitoring rainfall. When bad weather causes a signal to drop, an automatic system analysing the data boosts the signal to make sure people can still use their mobile phones. The amount of reduction in signal strength gave researchers in Israel an indication of how much rain had fallen. Their estimates proved at least as good as if not better than traditional monitoring methods. Teams in the UK, Germany & Italy have found similar results, and they believe that the technique has promise for issuing flood warnings.

Are 3G base stations more or less harmful than 2G?

The frequency band allocated for 3G (UMTS) mobile phone base stations is 2100 MHz, higher than the 2G systems which operate at 900 MHz and 1800 MHz. The modulation (the way sound and pictures are encoded in the carrier signal), although different seems to be at least as bio-active, if not more so, than the 2G (GSM) systems. '3' is the only telecommunications company which only has a 3G system. They have no GSM system and therefore have had to erect a nationwide system of base stations from scratch. They have met local opposition to the erection of base stations in the same way as all the telecommunications companies have encountered. Because of the extra capacity needed to transmit the range of services (music, video, film, etc.) the masts can not be placed at such a high level as the 2G systems for maximum efficiency and they tend to use higher-powered equipment.

What are the effects of TETRA systems?

The operation of TETRA (owned by BT Airwave) results in power modulation of the RF signals from the handsets and vehicle radios at a pulse frequency of 17.6 Hz. The masts transmit modulation noise in the high-frequency audio range, about 2 to 20 kHz, with gaps at 70.4 Hz. Very little research has been done into the possible human health effects at these frequencies before the roll-out of this system. Laboratory experimentation done in the 70s and 80s showed that when an RF signal was amplitude modulated at around 16 Hz the rate of leakage of calcium (which plays an important role in many biological processes) from the brain and other tissue was increased. The Stewart Report (2000) concluded that although no obvious health risk was suggested, as a precautionary measure, amplitude modulation around 16 Hz should be avoided, if possible. The old Airwave base stations used pulsed signals, similar to the other network operators. Most of the newer ones do not pulse in the same way.

What regulations apply to mast emissions?

All masts are required to comply with the guidance from the International Committee for Non-Ionising Radiation Protection (ICNIRP). Powerwatch has not measured any mast that exceeded ICNIRP levels in places to which the general public has access. In our experience it is relatively rare for emissions from base stations to exceed 3 V/m in public places. This is 14 - 20 times lower than ICNIRP-allowed signal levels (28 to 60 V/m, depending on frequency) and over 200 times below ICNIRP-allowed power levels. ICNIRP levels are only guidance levels and, in law, the old NRPB level still applies. Although in many European countries companies legally only have to comply with ICNIRP, much lower precautionary standards have been set, the lowest in Salzburg at 0.06 V/m for general public exposure and 0.02 V/m inside houses (2002). This is discussed in Chapters 3 and 4.

How can local authorities restrict the siting of masts due to possible risks to health?

Mobile phone companies have to provide adequate coverage to the over 62 million or so UK mobile phone users, or they will be in breach of their licence agreement. If the signal level is not adequate anywhere where there is a reasonable population density, masts providing signal coverage ***will need*** to be built. It is now not a matter of signal coverage so much as call traffic capacity. As people are using their phones more and more to take advantage of cheap tariffs and of the ever-increasing range of services on offer by the network providers, the capacity of the existing base station network is being constantly exceeded and new masts have to be erected to meet the demand. The choice open to local authorities is ***only*** to help the company find a site

which is acceptable to the local community, which has to accept some responsibility for selecting appropriate sites. Refusal, in the long term is not an option, whilst the usage of mobile phones is as high as it is (and increasing).

Most masts can only carry about 31 simultaneous calls in any one antenna direction, so, as more people choose to use their mobile phones more frequently, more antennas or masts are required. 128 call-channels is considered a reasonable maximum for technical reasons and few masts exceed 64 from any antenna. Masts need to be sited near to where people use their phones.

The Stewart Report clearly states in paragraph 1.43, that "*We recommend that in making decisions about the siting of base stations, planning authorities should have the power to ensure that the RF fields to which the public will be exposed will be kept to lowest practical levels that will be commensurate with the tele-communications system operating effectively.*" This was confirmed in April 2001 by the Trade & Industry Select Committee which stated, "*We also recommend that operators should make a declaration that emissions likely to be produced by a new base station are 'as low as reasonably practicable', as suggested in the Stewart Report*".

PPG8, revised in August 2001, in its Appendix, paragraph 100, was predicated on the assumption that the companies were already operating their systems at the lowest *possible* (PPG8 wording) level. Unfortunately, this is not always the case.

Siting base stations as close as possible to where mobile phone handsets are being used will help minimise the base station transmitter power. The Stewart report recommended that 'the beam of greatest intensity …. should not fall on any part of school grounds or buildings'. Unfortunately, where the beam of greatest intensity falls is not a straightforward issue, and we don't believe that the complexity was anticipated by the wording in the Stewart report. The phrase "the beam of greatest intensity" is discussed in some detail in Stewart 6.63 to 6.68. There is no direct evidence as yet that living near *masts* affects children more than adults. However, parents in communities where children are exposed to microwave radiation at home have reported nosebleeds and epileptiform attacks as more common and behavioural disturbances and concentration problems have been reported by schools affected by radiation from base stations.

One of the problems with meeting the need for coverage is the usage of mobile phones by children, especially secondary school age children. Operators have had to install extra base stations near schools where the high usage of mobile phones by pupils attending the school overloaded their network.

If it is only the *power* from the mast that has adverse health effects, siting a mast high up on top of a school could, in fact, be an ideal place. The height provides a good range, the fields immediately below and close by are low, and the school obtains some badly needed income, averaging £10,000 per year according to the Observer in July 2002. If the school refuses and a mast is built close by (under the need for 'adequate coverage' principle), the fields experienced by pupils could be much higher. As to long-term adverse health effects, or if the *pulsing* quality of the signal is found to be the critical factor in determining potential health effects, we simply do not know the answer to providing safe coverage for the school-age 'addiction' to mobile phone conversations and 'texting'. There may be a percentage of people particularly susceptible to this form of low level radiation; the research has not been done, nor has there been identified or agreed any susceptibility criteria to base such research on.

Some authorities have tried to implement 500 metre exclusion zones. This is impracticable from the viewpoint of the technology as the companies are not going to be able to provide sufficient power to meet the necessary call traffic density from such widely spaced masts, even if they are

high powered. It is also likely to create mast 'ghettoes' where certain populations will be exposed to very high power from the base stations attempting to meet the service needs to the local area. The government has specifically stated that exclusion zones cannot be imposed by local authorities.

For other planning issues, see the relevant Planning Documents, especially PPG8, or TAN in Wales and Scotland.

What about public consultation?

Planning permission is not required for masts under 15 metres high, or those which form part of an existing structure (like a petrol station sign) – these are covered by the GPDO. This applies to WiFi and WiMAX systems as well as mobile phone networks. Many companies under the GPDO (1995) may install telecommunications equipment mostly wherever they like if not too visible! Not all of them operate radio equipment, some are cable companies only.

When a mast is put on top of a building, it must not add to the overall maximum height of the building by more than 10 metres for buildings of 30 metres or more, 8 metres for buildings between 15 metres and 30 metres high, except listed and other special buildings where different regulations apply.

The planning guidance (PPG8, 2001) increased the consultation period for almost all masts to 56 days and suggested more consultation with local people, but it did not provide any extra legal powers.

The telecommunications company applying for planning permission should file 'before' and 'after' versions of the coloured coverage plans. The 'before' version usually shows poor coverage centred approximately on where a new mast is to be sited. The 'after' plan should show this area with a more uniform coverage. It is not possible to move the antennas *far* from the centre of the area needing new coverage. It is important to bear in mind that coverage is not just a matter of signal strength, but the ability of the system to handle the necessary number of simultaneous calls, as 'traffic density' increases. Most new masts are for this purpose, not primarily signal strength.

If a local community wishes to protest a particular mast, they may consider setting up a petition. This is probably not the best way of registering a protest. Every communication received by the Local Planning Authority (LPA) has to be recorded. A petition, even if it is a petition of 3,000 signatures is one communication. 100 letters, even if identical, as long as they have an address and a signature, are counted as 100 communications. The more communications are received and recorded by the LPA, the more opposition is noted to have been made. It would be even more powerful, if an alternative acceptable site could be proposed. Saying 'no' is not a viable option.

The Maastricht Treaty states that the UK authorities are required to practise the precautionary principle in all decisions. Why has this not been followed?

In the government's opinion, the UK has adopted an appropriate precautionary approach to these matters, given its advice from the NRPB and the IEGMP. The NRPB was subsumed under the new Health Protection Agency in April 2004. Sir William Stewart is its chairman, and it is hoped that he will continue to review the current state of research into microwave radiation and health as he recommended in the original Stewart Committee's Report published in May 2000.

Companies

Should we trust mobile phone operators, when they face strong local opposition, who say they will move the mast somewhere else?

Better than sitting back and trusting them to do so, the best approach would be to draw up a plan of the local area, identifying the places where it would be acceptable to the local population to have a mast. The local planning authority is supposed to be doing this anyway, but most of them choose not to do so, because of anticipated local opposition. (They might have a point). Unfortunately, then people are forced into the position of reacting to the choices of the mobile phone companies, when being proactive might achieve a better result.

From the standpoint of residents, identifying an acceptable site would be the least bad option; from the point of the Telecommunications operator, they will meet less opposition. You might be able to make a better deal with the company including an audit of emission levels.

If they reject the community proposal, it is important to get them to justify their decision in writing, and in comprehensible English. There are sometimes technical reasons why a suggested site is not appropriate, but this should be clearly explained.

Can agreements between landowners and operators be cancelled?

The owner of the site cannot pull out of an agreement until its end without financial penalties unless the mast and / or antennas were erected in breach of the planning regulations. There are several ways in which a company may be in breach of the regulations, it is a matter of investigating the original application and checking conformation with planning law. Campaign for Planning Sanity (Refs) can offer a lot of helpful advice in this matter.

Do mobile phone operators need to have public liability insurance?

The operators only need to have insurance cover for their employees, not for the general public. The law of Tort means that the operator would have to be proven to be negligent towards their employee. Although there is legally a greater duty of care with regard to employee insurance, it is unlikely that cover could be obtained for health risks, because if there were a link to serious health problems, the sums to insure against ***all*** the claims that could arise would be astronomical. Indeed Lloyds of London decided in March 2003 to refuse insurance cover to mobile phone companies against damage to workers. Should a mast fall on someone's property, damaging it, the individual can make an insurance claim, and, if liability is accepted, the compensation payment will be met from the company's assets.

WiFi

I don't want a WiFi connection to broadband internet - what options do I have?

To connect to the internet, 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 line, and you will not be able to use the telephone at the same time, unless you have one line (and 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, but two thirds of the UK (as of Summer 2007) is now supported. 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 (with only one line) without having either service compromised.

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 "BT Home Hubs" to connect your computer to the internet, as they act as both a wireless access point (WiFi) and a DECT base unit (cordless phones) whenever they are powered. 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 need to earth your laptop when plugged into the mains because of sensitivity to the high electric fields it causes, then you will also need to earth the laptop when connected to dLAN units.

As WiFi and WiMAX services extend across the country, covering cities and eventually rural areas as well, the background microwave radiation will increase to levels as yet uncalculatable. Trains, railway stations, airports, planes, shopping and city centres are already having the equipment put in place. It will make it extremely difficult for people with a sensitivity to electromagnetic radiation to lead any sort of normal life.

Some GPRS and all 3G mobile phones offer relatively fast ‘broadband’ capabilities when connected to a computer. These will raise the microwave levels nearby more intensely than using the phone for a conversation.

I have more than one computer and want them all to be able to use the internet - do I have to use WiFi?

No, not at all. 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.

One of the computers I need to connect is in a different room - I have a laptop I would like to use in different rooms - do I have to use WiFi?

Again, WiFi is still completely unnecessary. The best option for this is using two 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 (see two FAQ points above if you are unsure whether you have a router or what one is) 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 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.

What about Wireless Local Area Networks (wLANs or WiFi)?

Computers in schools and offices are generally connected together into a network and serviced by a central file server computer. There are various ways of connecting computers together, from the old RS232 serial cable, through Ethernet, to the latest broadband techniques. The traditional broadband method uses a twisted pair of wires, coaxial cable, or fibre optic cable and these systems do not produce any extra radiation. Because of the costs of installing the wiring, many schools, colleges and businesses are being attracted to the new wireless method. Here, every computer is fitted with a microwave transmitter and receiver, and these communicate with a master unit, usually situated in the ceiling near the corner of the room. Although the microwave power used is not high, it is equivalent to everyone sitting next to a working cordless phone while they are using the computer. Obviously, in a room with many such computers, the exposure to microwave signals is significant. The typical range for an indoor WiFi access point is from about 45 metres.

In a study printed in Electronics World, December 2003, the main contributor to the 2.4GHz band used by wLAN systems was microwave ovens, while movement detectors (burglar alarms) were commonly found at low signal strengths.

Are Homeplug/dLAN devices a viable EMF-safe alternative to a wireless LAN?

We still think that wired Ethernet is the best option, however Homeplug devices seem to be a reasonable compromise provided that you are aware that there are potential problems, and we consider it to be vastly preferential to a wLAN.

Are games consoles safe?

Some of the latest-generation consoles (XBOX 360, Nintendo Wii, Sony Playstation 3) 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 (Nintendo DS, Sony PSP) also have WiFi built in. We believe that children should avoid prolonged use of WiFi enabled devices.

Are the concerns about the health effects of using Wireless Local Area Network (wLAN) systems in school classrooms unfounded?

A number of schools have dismantled their wireless networks after lobbying by worried parents and teachers, and others are under pressure to follow suit. Is this level of concern warranted?

Wireless networks involve daily exposure of children, or of staff members, to microwaves in enclosed environments. WLAN systems emit radiofrequency (microwave) radiation into the rooms they are used in, and the emitted radiation levels could be made worse because of building characteristics using microwave-reflective structures such as reinforced concrete or metal joists, or classroom furniture made of steel, etc.

It seems from the research that biological effects as a result of pulsed microwave signals (such as used in WiFi) is cumulative rather than purely instantaneous, and that biological reactions, such as cascade effects, from gene expression to protein modification, to cellular ion transport may be

initiated. Also associated are memory and concentration problems, short attention span and learning difficulties, hyperactivity and mood changes, especially an increase in aggression.

These symptoms are certainly not the ones we would like to see our schoolchildren suffer unnecessarily. The educational system is not finding it easy to meet its attainment goals, and schoolroom aggression appears to be on the increase. These trends are likely to be due to a number of different interlinked causes. But if microwave radiation may make the situation worse, we believe it is a good idea to think about introducing radiating systems into the school environment.

A recent report from the Organisation for Economic and Co-operative Development (OECD, an international organisation helping governments tackle the economic, social and governance challenges of a globalised economy), looked at the educational achievement in schools in 32 countries. The researchers found that the pupils' performance in maths and reading dipped among students who used computers every day either at home or school.

The Vienna Chamber of Doctors has warned that wLAN emits high levels of radiation. The Public health department of Salzburg has specifically warned that wLAN and DECT should not be put in schools and nurseries. The German Doctors appeal, the Bamburger appeal, also now includes a warning about wLAN. The German teachers' union has told its members to resist the rollout of wLAN into schools in Germany on safety grounds. Lakehead University in Ontario, Canada which has 7,400 students has removed WiFi because its Vice-Chancello, Dr Fred Gilbert, calls "*the weight of evidence demonstrating behavioural effects and physiological impacts at the tissue, cellular and cell level*."

Are parents' and teachers' concerns about wLANs in schools unfounded?

The studies that have been done on microwave exposure, both occupational and epidemiological, together with the experience of residents of communities with mobile phone masts (who experience a similar sort of level of radiation as will be found in a school classroom with a wLAN system), are sufficiently consistent to raise the question as to whether studying in places with microwave radiation at low levels is without health effects for at least some young people. As there are no biological markers that have yet been discovered to identify those who are affected in this way as compared with those who are being affected by something else, the situation is likely to remain unclear for some time.

Are interactive whiteboards in classrooms an EMF problem?

Interactive whiteboards in classrooms can be a very valuable teaching and learning tool. 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.

1. 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.

2. Bluetooth systems work at very low power and extend to a range of about 30 foot maximum. This is a lot less powerful than the wireless LAN systems.

Although this works at a lower power, we cannot recommend it, as some people, and it is impossible at the moment to predict who, 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, see references below.

3. A wireless Local Area Network (wLAN) system 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.

Is it true that trains are all going to become WiFi enabled?

Many people who suffer from electrical sensitivity are finding it harder to travel by train. Far from 'letting the train take the strain' they are increasingly being excluded from access to public transport. One person told us "*I couldn't contemplate taking a train journey in a carriage offering wireless internet facilities. I get headaches after 10 minutes of exposure to radiofrequency radiation.*" She continues "*electrosensitives will become increasingly isolated from work places and public spaces.*"

Travellers exposed frequently to these microwave sources may well develop electrical hypersensitivity, with all the lifestyle changing problems that this diagnosis carries with it.

Railway stations as well as trains are beginning to offer online internet access for use by business passengers waiting for trains on platforms or in the waiting areas. There is a charge for the service that may put off people wanting to use the system to watch video or play games or music, but many may decide to use the system to pass the time.

Other

Electronic tagging of goods

Electronic tagging is being widely introduced for commercial reasons, ostensibly to prevent theft. The devices are usually passive, only responding to transponders which activate them in passing. These are unlikely to be a major contributor to microwave radiation. However, people purchasing such items are certainly going to be able to be tracked and information about them much more widely known, by whoever wants to buy that information. If you are concerned about such issues, you might want to find out if your purchases carry such a microchip and either remove it (after having paid for it, we are not advocating shoplifting), or decide whether you want to support a company that will have the ability to monitor many aspects of your 'private' life, and even sell them on to interested others.

What is Bluetooth?

Bluetooth is a new wireless technology that hopes to revolutionise our lives.

Philips researchers recently demonstrated Context-Aware Messaging Platform (CAMP), which could be used in airports or shopping malls to send information to users based on their identity,

location or activities. As an example, Senior Scientist David Walker said travellers could arrive at an airport, log in to the Bluetooth network, and immediately receive their personal flight information.

Roving Networks demonstrated a home Bluetooth network with a simple application that made a personal digital assistant (PDA) into a universal remote for turning devices such as lights, televisions, and electric toys on and off. Roving is already working with one customer on a network of Bluetooth-equipped sensors that can monitor conditions such as heat and vibration in a manufacturing facility, said Chief Technology Officer Narayan Mohanram.

In Chiba, Japan, at Bluetooth Expo 2002, Toshiba started rolling out a line of Bluetooth-enabled home appliances including a washing machine, refrigerator, and microwave oven networked to a home terminal and access point. It is possible to download services, for example, a customized laundry program can be updated to the washing machine or a cooking recipe can be installed in the microwave.

"The main benefit at the moment is when these home appliances break down," Morio Hirahara, a specialist at the digital and network applications development group of Toshiba explains. "They can send out information about what is wrong with them, so that our customer service can respond to it sooner with more accuracy than receiving a phone call from the owner."

The real potential for Bluetooth-networked appliances may be in home security related products. Consumers expressed more interest in entrance doors that have a sensor that can wirelessly send out a warning and monitoring function.

Bluetooth is designed primarily for wireless data transmission over distances of about 10 metres, and is likely to be taken up significantly in schools and the office. For workers, or children, working for extended amounts of time within the 10 metre radius, what will their microwave exposure be?

Other applications are in the pipeline, but the different systems have not been designed so that they can seamlessly communicate with each other. This may put people off as much as the query about health concerns. We do not recommend having Bluetooth pulsing microwave technology in the home.

What are EMX Biochips? Do they really work?

EMX biochips are a technology based on genuine scientific research. The EMX devices work on the basis of superimposing random, low frequency magnetic fields over other electromagnetic fields (EMFs) being emitted by other devices. The theory behind this is that the extra fields hide the unwanted EMFs, in a similar way to music being played in a restaurant hides conversations between other people on nearby tables. A number of peer-reviewed scientific studies have been carried out and replicated, showing that this has genuine scientific basis.

While this appears to be effective, we do not think that increasing EMFs is an ideal solution, and we believe that other options should be explored first.

Who are Exradia? Do their products really work?

Exradia is a company that has bought up the rights to the EMX technology that was developed by the late Ted Litovitz of Washington State University. The only application so far available is the

special Nokia mobile phone batteries with the noise pulsing circuits built into them. We have not tested them, but they are based on EMX technology which has scientifically supported claims of positive effects.

However, it is not certain that this ELF noise will cover the microwaves from the phone, just the battery current pulses. So it is not a "cure-all" panacea for mobile phone users.

7. Screening microwaves

Some companies sell products that purport to screen against microwave radiation. These can be genuinely useful products that are effective, and some are 'gizmos' that make money for the manufacturers and distributors, but do nothing for the person wanting the protection. We have found that most products sold to be worn, or carried about by individuals as a protective device, or are 'buttons' you attach to the device giving off the EMFs do nothing to the microwave environment that can be measured. It is possible that some of these work on an esoteric level and may improve immune system function, but they are not testable with most independent equipment. Be wary, as much of the accompanying paperwork, which can sound very convincing, is scientific gobble-de-gook.

Microwave radiation from mobile phone base stations travels through most common building materials, most easily through ordinary glass with very little reduction, and fairly easily through most walls and ceilings, brick, wood, concrete, etc. It can also reflect off most surfaces, especially metal.

Its frequency is such that the radiation can get through small holes, especially slots, and great care needs to be taken with any form of shielding, that no gaps are left for the radiation to get through. Shielding windows will usually considerably reduce the microwave levels in a room; but, if you live in the beams from a nearby mast you will probably also need to shield your walls and maybe even the ceilings.

Specialised glass does offer a reasonable level of protection, though most window *frames* (except aluminium ones) allow most of the microwaves to enter the room.

EMFields (Powerwatch's main supporter) has made a decision to sell products that *do* reduce microwave radiation, and that meet our very strict reduction test criteria. Many of the products are made in consultation with firms who make material to our specifications.

We have silver plated bobbinet material which is 1.83 (6 feet) wide, for screening windows from incoming microwave radiation such as that from a mobile phone mast. Properly fixed, it reduces radiation by about 98%. We also sell ready-made bell-shaped bed canopies made from this material for cots, single, double and king sized beds, which are hung from a central ceiling hook. The material can easily be seen through, making it easy to check the wellbeing of children, without needing to disturb it. Headnets made of the screening material can be useful for wearing inside the house in unscreened rooms, out in the garden, when travelling or shopping.

Our Chromax material can also be used as net curtaining. It is 2.5 metres wide, white in colour and can be washed rather more easily than the bobbinet material without damaging its screening properties.

We have another material which is 1.44 metres wide, and is made of cloth interwoven with stainless steel. This can be used for curtain lining, roller blinds, sheets and can be made into clothing. This material also stops 98% of incoming microwave radiation.

We now have two books about screening against radiation. One publication contains information about screening microwave (RF) radiation, and the other focuses on reducing powerfrequency

EMFs and wiring buildings for low EMFs. Both are available as downloads only to Powerwatch subscribers.

Shielding radiation from coming in through the window will reduce RF levels in the room substantially. There will however, also be significant amounts coming in through the walls, and possibly the ceiling.

We stock microwave shielding paint, which contains carbon and is water based (with no toxic ingredients) and which can be applied either internally or externally. The external paint is also good in bathrooms and kitchens where the moisture content is higher than in other rooms. The paint allows walls to 'breathe' and is unlikely to produce mould problems, unlike some non-permeable protective materials such as aluminium foil. The paint can then have a topcoat of good quality emulsion paint. You will probably need two coats of topcoat, as the carbon paint is black.

One coat stops 98% of the microwave radiation which comes through the walls. Two coats will stop more, but a second coat is likely to be unnecessary unless you are *extremely* sensitive to microwave radiation. It can then be painted over with standard emulsion paint. The paint can be highly effective at stopping radiation from a DECT cordless phone owned by a neighbour in an adjacent property, or a flat above or below.

You can also use material. The paint or material have to be applied with care, and each method is somewhat time consuming, but necessary, to achieve the maximum reduction level possible. Inadequate screening can make the situation worse, as microwaves can reflect off internal room surfaces, making new or different 'hot spots' in unpredictable places. The paint is non-reflective and minimises this effect. The paint or material will need to be 'earthed'. This 'earthing' is neither difficult nor expensive but will need to be done, otherwise you are likely to greatly increase your exposure to power-frequency electric fields from the walls. We also sell an inexpensive earthing lead, if required, to make this task easier.

Consideration will need to be given to skirting boards and curtain battens.

We do not stock screening wallpaper which is available elsewhere. Although it does have adequate microwave screening properties, the foil in each strip does not connect easily, and could lead to a significant increase in exposure to powerfrequency electric fields from the house wiring.

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Hans Karow core@vip.net has offered help with German EMF connections and / or written articles

House of Commons Trade and Industry Committee Notice No. 12, 3 April 2001 HC 330

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The Stewart Report www.iegmp.org.uk

Swedish Union www.sif.se They have useful electrical sensitivity information.

National Campaign Groups

Mast Action UK, send SAE to PO Box 312, Hertfordshire EN7 5ZE. freespace.virgin.net/mast.action

Mast Sanity, www.mastsanity.org

Planning enquiries 0871 750 3992 Mondays to Fridays 11.00 a.m. - 8.00 p.m.
Advice Line 08704 322377 Mondays to Fridays 1.00 - 8.00 p.m.

Radiation Research Trust - set up in October 2003 "to inform and educate the public about the dangers of electromagnetic radiation from mobile telephones and the proliferation of associated GSM, Tetra and other masts". It also aims to promote research on the risks to health from much of the unrestricted mobile phone usage particularly by over 3 million children aged between 5 and 14. For further information www.radiationresearch.org

Protect Sussex from TETRA - A local health data collection database so that the agencies involved (including the Education Authorities) can become better informed about residents experiences. www.protectsussexfromtetra.org or contact John O'Brien 01903 883414

9. Appendices

Appendix 1

Biological interactions with an electromagnetic world

We have evolved and live in a world that is primarily governed by electromagnetic interactions. Many traditional main-line scientists still hold that bio-chemical reactions are the ones that are really important, however it is increasingly clear that at a quantum level it is electric and magnetic fields that control chemical and bio-chemical interactions. The best scientific text book, by far, at the moment is, without doubt, **Magnetobiology – Underlying Physical Problems** by Vladimir Binhi (2002). In our opinion this requires the reader to have a minimum of university entrance requirements understanding of physics and / or mathematics, but it is a comprehensive over-view of this whole subject area.

All living beings detect and use information in order to survive. This essential fact is not taken into account in most of the EMF research that has assumed "averaged energy" is the active factor. Our direct senses of sight, sound, etc., are only of use because we extract information from the physical responses of our sensors. Language, music, art, science and other human endeavours only exist because we interpret and use informational input.

Imagine attending a performance of the Swan Lake ballet. Conventional physical and medical science could record the movements and sounds and analyse them into data sets and look for patterns. It could also analyse the clothes of the dancer, and the ballet shoes, their materials and method of construction. But it would completely miss the whole point of the ballet, and would be able to say nothing about the human (invoked) response to the ballet.

We can only measure things our instruments are capable of measuring within their physical, chemical and biological limitations. It is possible that the measuring equipment cannot objectify the contents of individual perception, or that individual experiences can't be represented by measuring processes using methods of experimental research design in a laboratory. It is possible that the stimuli are only perceived at certain times and you are measuring during the wrong time period. It may also be dependent on the physiological and psychological well being of the person which is also likely to be time dependent. You might have to allow for a synergic interaction between individual-specific substances that cause allergic reactions and this might be connected to inter-individual differing specific windows to the EMF.

Sensitivity to stimuli may be determined by selection of information, which is influenced by the person's own sensory experience and perception and also their cognitive information resources for differentiating the stimuli. Bob Coghill of the Wake Forest University School of Medicine in Winston-Salem, North Carolina, tested the pain sensitivity of 17 healthy volunteers normally, and when they were in MRI brain scanners, the scans showed very different responses depending on whether the volunteers had previously expressed the ability to bear pain. The thalamus, which receives pain messages from the spinal cord and peripheral nerves, was active in all 17. Those least able to bear pain showed more activity in the cerebral cortex, associated with higher cognitive function. Coghill's conclusion was that the pain was not dampened en route to the brain, so all the differences must be due to the way the cerebral cortex interprets the information based on prior experience. People suffering from ES may be 'conditioned' to respond far more

strongly to stimuli than other people, following the sensitisation of parts of the brain from some as yet unidentified electro-bio-chemical signal.

We also have to distinguish between sensory and extrasensory perception.

An important factor is an unspecific fear about risks occurring from poorly understood technologies. This fear cannot be formulated in an explicit way.

The general and technical interest in power frequency electromagnetic and radiofrequency emissions has resulted in the publication of between 1100 and 1800 articles per year between 1990 and 1994, the last year for which we have seen data. It is difficult to know how to deal with the amount of information on the subject, never mind try to summarise it. What is listed below, is clearly only a tiny number with our selection bias.

Quite a lot of research has been done on the effects of electromagnetic fields on cell biology. Quite a lot of epidemiology has been carried out into whether EMFs are associated with adverse health problems in the community. However, people who experience acute or chronic symptoms of ES are in a minority (though a significant one) of the population, and so the effects would disappear 'into the noise' in a randomised study of the general population. Little research has been done specifically into what biological changes are associated with the ES condition, especially as it is not yet recognised as a medical condition in most countries.

Dr Cyril Smith, a retired UK bio-physicist, with a deep interest in homoeopathy and living systems reactions to electromagnetic fields says that the frequency patterns of mobile phones and their masts can resemble the homoeopathic equivalent of toxic chemicals and therefore be effectively causing chronic poisoning of the population. He produces homoeopathic remedies on an individual basis after testing the patient, or remotely using a sample of the patient's hair. He has worked with Dr Rae at his clinic in the USA.

It is always an assumption, which does not necessarily hold true, that cellular effects found in the laboratory are the same as the cellular effects in the bodies of living beings in the world at large. It is also assumed that no effects in the laboratory means that there are no effects in the population. However, the laboratory is a place to start (even if it is an oversimplified environment, which is not always very well-controlled in EMF terms) when we are unravelling the complexities of environmental exposure. Because of the type of responses reported by ES people, there is likely to be a nervous system involvement and possibly a hormonal / endocrinal system involvement. It is impossible to separate out the different systems of the complex human organism with respect to its day-to-day functioning in the world; all aspects are likely to be affected to a certain degree, but the research has to start somewhere!

The National Institute of Environmental Health Sciences (NIEHS) and the US Department of Energy (DOE) state that human exposure to electric and magnetic fields (EMFs) from electrical wiring and appliances produces weak electric currents between cells in the body (see references).

Russian research shows that bio-electrical interference or stress acting on the nervous system causes nervous system and cardiovascular system problems. When nerve cells malfunction, it can, in turn, adversely affect muscle function. A way that EMFs cause this stress is that they seem to trigger an opening of calcium flow through cellular membranes in the nervous system. This causes a strong signal in the nervous system producing an overreaction in a lot of muscles and other things controlled by the nervous system.

ES people can reach the biologically destructive point, where they are incapable of transmitting normal nerve impulses as they did before their use of and exposure to electronic products.

The problem of EMFs in relation to effects on the nervous system may not be amperage of these currents but their voltage level. The reason is that nerve cells maintain a static 60-mV positive charge on the outside and a static 70-mV negative charge on the inside. Sir John Eccles found that a difference in potential of only 15 mV across this gradient causes a nerve cell to naturally discharge an electrical pulse. The presence of a voltage between two nerve cells with a difference in potential of more or less than 15 mV can disturb their electrical balance.

In some laboratory studies the biological effects of EMFs and the weak electric currents they create in the body are:

- Changes in functions of cells and tissue
- Accelerated tumour growth
- Decrease in the hormone melatonin
- Changes in biorhythms
- Alterations of the immune system
- Changes in human brain activity and heart rate

Professor Olle Johansson of the Karolinska Institute (and the Swedish National Institute of Working Life) has investigated numbers of people suffering from exposure to computer monitors (VDUs) and other EMF sources. Many of these people first suffer from skin irritation such as itching, heat sensations and reddening. In some of these ES people he has found the peripheral nerve fibres in the epithelium are significantly damaged. He has clear photo-micrographs showing peripheral damage in the nerve endings which can be found within 10 to 20 μm (0.010 to 0.020 mm) of the skin surface (epidermis). The normal purpose of these nerve fibres is unclear, but it does appear they are involved in at least some cases of ES. They seem to become super-sensitive and react both more quickly and more highly to external stimuli - especially electric fields and some chemicals. It is known that new electronic equipment, including computers, give off significant levels of volatile organic fire-retardant chemicals that can mimic natural body messenger chemicals, and these are believed to be involved in the triggering of ES in some people.

Professor Johansson and colleagues have found that the appearance of the peripheral nerve damage under the microscope is similar to the sort of early damage that occurs when a person gets sunburnt. There also appears to be a large increase in the number of mast cells in the skin of electrosensitive people. Mast cells play a large role in various types of well known allergic reactions, such as asthma, and have been seen to increase in the skin of healthy volunteers sitting in front of some computer monitors. We do not know if it is the EMFs from the screen or the quality of the flashing light that is responsible. It is not uncommon for ES people to become sensitive to mast kinds of light.

Dr Gangi & Professor Johansson (2000) have investigated the relationship of mast cells to electrical sensitivity. They suggest that EMFs affect mast cells and dendritic cells. When activated, mast cells release histamine which results in itching, eczema, and other similar symptoms - all of which are reported by people with ES. The ES sufferer has more mast cells in the dermis. They are

larger, brighter and closer to the epidermis. This is similar to the effect of exposure to ionising radiation. When ordinary people were exposed to EMF radiation (from a TV) on their backs for 4 hours, they had a similar change in mast cells, which normalised after 24 hours.

One ES sufferer, after spending 20 minutes in front of a computer screen, develops a red, warm face, which is clearly a reaction of mast cells (and not a consequence of surfing inappropriate material on the Internet, she assures us!)

In Sweden, there is a phenomenal increase in asthma amongst youngsters up to the age of 18 years. It is thought that this may be the result of an idiopathic reaction to IT. This may be exacerbated by Henshaw's research on the attraction of pollutants to the static field generated by computer monitors.

Also from the Swedish National Institute of Working Life, has come research by Kjell Hansson Mild et al, who have had results indicating that ES patients show an imbalance in the autonomic nervous system, and a tendency to increased arousal as a result of external physical factors. This was induced by audio and visual stimulation, and was measured in brain and heart reactions.

Resonance migraines which do not involve the headaches normally associated with migraines, and which are symptoms of ES, are believed to be caused by paroxysms of electrical energy in the brain. Some of the other symptoms of resonance migraines are yawning when you're not tired, an 'ice-pick' pain, hyperactivity or fatigue, microsleep, depression or elation, disorientation, massive thirst and cardiac arrythmia.

Electrical hypersensitivity is also a lifestyle problem. Humans have evolved over the millennia to be naturally bio-electrically grounded. The important finding of a study by Clint Ober is that a previously unknown natural bio-electrical shield of negative ions exists in and around the body when humans maintain physical contact with the earth. This shield plays a vital role in protecting the bio-electrical activities of the body from extraneous electrical interference. Further, when humans are grounded, their nervous system calms, muscles relax, chronic pain subsides and they sleep better. The voltage levels created by electric fields found in all homes on the bodies of the participants in this study varied significantly but all were several times the potential of nerve cells. Most people now sleep within 12" of electrical wiring in the wall at the head of their bed. All of which radiate electric fields throughout the night and maintain a constant flow of measurable weak electric currents in the body. The Ober study was replicated by two other studies, acting without knowledge of each other's work at the time. Note that grounding a person within a room with significant electric fields will actually increase the person's exposure and the electric fields will be attracted towards the person's earthed body.

If Ober is right and the human body has evolved to maintain a field of negative ions in and around the body that naturally neutralizes positive ions, this natural occurring event may have a significant part in human biological development, especially with respect to the nervous system, which communicates with electrical pulses.

These days almost everyone seems stressed, their muscles are tense, back and joint pain is the norm and most do not sleep well. These conditions all relate to the nervous system.

Today humans have insulated themselves from direct physical contact with the earth by wearing synthetic soled shoes and living in modern environments that keep the body above the earth. The consequence of interrupting this natural flow of negative ions on the body is that humans now store and conduct free positive ions. (Including static electricity and radiated positive ions from electric-fields.)

We urgently need to adopt a more holistic approach that addresses issues at the very core of the biological organisation of life processes. Presman summarised leading Soviet bioelectromagnetic insights up to that time. His work contains an outline of a holistic electromagnetic field theory of living organisms and their relationship to their environment. There is now plenty of evidence for endogenous EMFs and that significant bioeffects can result from external EMFs. One western scientist who has regularly explored these areas since the 1970s is Ross Adey. It is now established that living organisms can react sensitively to weak EMFs. We know that weak endogenous EMFs are involved in the regeneration and growth of new tissue. EMFs (including biophotons) are emitted from living beings, and communication using EMF signals is established for some fishes and insects, and is strongly suspected as being utilised at some level by all living organisms.

Scientists need to direct their attention to 'wholeness' and ask radically new questions. Not only is our universe electromagnetic, but we are also electromagnetic beings. When the electricity is no longer within our being, our physical body ceases to function at the level we describe as living. For all our clever molecular biological genetic "fiddling" with the matter of life, we are no nearer being able to give life to a dead mass of cells.

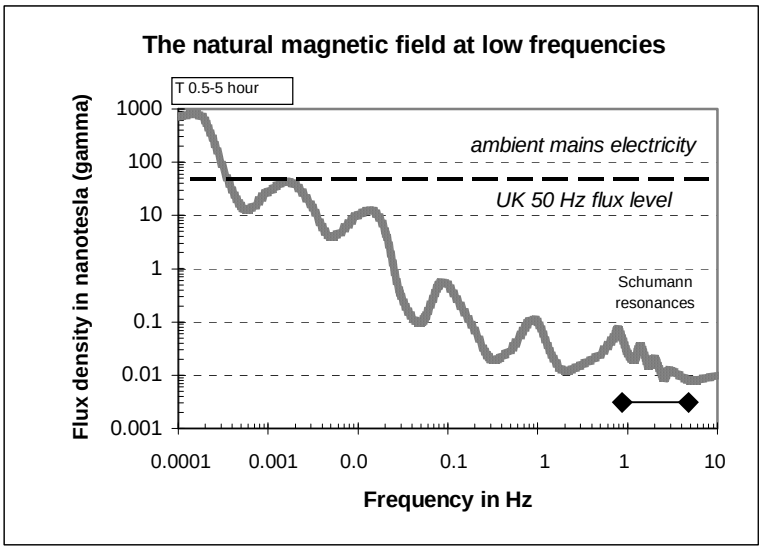
We are dealing with living beings constantly seeking homoeostasis, and a stronger signal does not necessarily mean that it will have a larger or more serious effect. Incoming information with virtually zero energy can have a dramatic effect on a person's state of wellbeing (e.g. a doctor telling a patient that they have cancer). "Understandable information" (such as sound level, language, visual information, etc) goes in through sensitive "windows". Likewise, pulsing at a regular (coherent) rate can have a dramatic effect if the repetition rate finds a natural resonance in the system upon which it impinges. That is why troops were ordered to break step when crossing a bridge. Some of our individual sensitivities are influenced by our personal genetic history and sensitivities developed during our life.

Our sensitivity is affected by:

- Age, gender, psychosocial load and other stresses.
- Physical wellness, including skin condition and conductivity.
- The biocompatibility of the incoming signals (both in energy and informational content).
- Exposure to other insults (e.g. chemicals).
- Stability of the point of optimum homoeostasis.
- Response latencies and relaxation times.
- Genetic and life-history factors.

There is a very low level ELF magnetic field 'noise' (geopathic stress) from various underground natural features. These natural variations are amplified and maybe modulated by underground features and water flows.

The Earth's ambient geomagnetic field varies around the world and ranges over about 20 to 70 microtesla (20,000 - 70,000 nanotesla or gamma) range. The level in any one location varies slightly in diurnal, lunar and sidereal time frames.



Geomagnetic fields ***(derived from Campbell, 1997; Spaceweb, 2002)***

At super-low frequencies we have magnetic noise from changes in the Earth's magnetic core current flows. These come to the surface of the Earth in various ways depending on the magnetic and electrical properties of the underlying strata. Old "country wisdom" has long recognised that some places are not good to live and sleep in. People used to pen cattle into fields in areas where they wanted to build a house and watch to see which parts they would choose to settle in *(=good)* and which parts they would avoid *(=bad)*. Cancers and other serious illnesses were thought likely to result when people lived and slept in geopathically active areas. In Germany it is common practice for oncologists to work with dowsers to check the houses and bed places of cancer victims for geopathically active zones.

As we approach the extremely low frequencies (ELF) we have low level, but fairly coherent, waves generated by lightning strikes powering natural Earth-Ionosphere cavity resonances. These Schumann resonances are in the range 8 to 40 Hz, i.e. the frequency range of most endogenous human and animal body "vital signs" signals and are claimed to be important to life and health.

The Figure below shows average geomagnetic variations, and the main Schumann resonances, against frequency. The current ambient power-frequency 50 Hz magnetic field in most UK homes and offices is around 30 - 50 nanotesla, whereas the natural Schumann signals are a factor of 1000 lower, around 50 picotesla. If bodily awareness of the Schumann rhythm is important and necessary for wellbeing, then swamping this rhythm with power-frequency or pulsing microwave fields may be unwise. Because GSM mobile phone base stations pulse at ELF and VLF (217 Hz, etc) and the ICNIRP safety guidance allows up to 195 nT of ELF pulsing at mobile phone frequencies, these 'pollutant' pulsing signals can effectively be detected by biological tissue as over 10,000 times higher than natural ELF/VLF fields.

The human pineal gland synthesises melatonin and may be one of our main magnetic field sensors. Though some laboratories have found no effects, at least six have published the results of studies that show low-intensity ELF EMFs can suppress night time melatonin levels. We also have evidence that low levels of melatonin are associated with a number of cancers, including breast cancer. Dr Cyril Smith calculates (Smith and Best 1989) that a quantum of magnetic flux through a typical human pineal gland would result in a flux of 75 picotesla (pT), and that the

minimum detectable magnetic flux needed to overcome the random thermal energy in the pineal would be 240 pT. This suggests that we would only be aware of the 50 pT Schumann waves if several parts of our body were co-operatively involved with the detection process.

The auditory vibration sensitivity of a normal human ear is quite amazing at around 10^{-11} m, about the diameter of a hydrogen atom. This quantum limit to detection is achieved despite large amounts of thermal noise. To achieve this, the inner ear must possess amplifiers whose noise performance could only be achieved by traditional electronics circuitry working at near 0°K. The only way that this performance could be achieved at normal body temperature is if large numbers of cells are working in a highly co-operative and coherent way. This sensitivity cannot be described by any mechanistic chemical kinetic model, and may be representative of a more general 'living tissue' property.

We do know that some birds and insects are very sensitive to the background magnetic field while flying, being able to detect changes in the order of 1 nanotesla.

Non-modulated (i.e. CW) and FM (e.g. VHF radio) signals are merely likely to mask the subtle signals in which Mankind has evolved. The pulsing amplitude of many modern data signals (e.g. mobile phone GSM TDMA signals) vibrate strongly at ELF/VLF frequencies similar to those of our own bodies' endogenous signals. These are very likely to have biological consequences.

A number of sensitive frequencies have been suggested. There is research-based evidence of types of "ion cyclotron" and "Larmor" resonance effects at various low frequency magnetic fields. These are caused by molecular resonances in the Earth's geomagnetic field. They include, amongst other effects, important cellular calcium efflux changes that have been reported by many laboratory studies. These were recently discussed in considerable detail by a leading EMF-bio-effects expert, Professor Ross Adey .

We are now surrounded by unnatural pulsing electromagnetic signals millions of times stronger than were present only 50 years ago. We are "broad-band receivers" whose cells and tissue can act in non-linear ways to "detect" incoming RF signals; we are not frequency selective, though resonances do occur (e.g. body size resonances at VHF frequencies, and under-wired bras can resonate at cell-phone frequencies) providing windows where effects will be enhanced.

Electronics is used in almost everything now. Current trends are to make everything work faster so that we will soon even be able watch the latest movies in colour on our multipurpose phone handsets. Faster pulsed signals pulse produce higher induced signals in tissue.

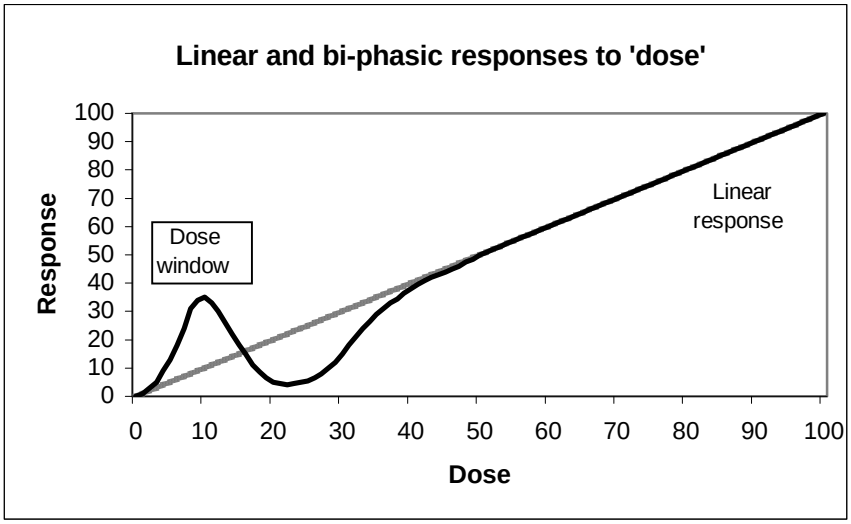
A potentially much more bioactive change has also taken place. The "digital revolution" has caused signals to become "lumpy", with bursts of full amplitude data pulses often emitted at human endogenous bio-signalling rates. The form of our exposure has changed dramatically over the last 15 years. GSM phone signals are *very* different in character from analogue TV and FM radio transmissions.

Are these changes relevant? There is good evidence that they are. As higher speeds were introduced in the 1980, so were reports of cases of electrical hypersensitivity.

We propose that it is likely that adverse health effects caused by EMFs may well have a biphasic response curve causing a low level dosage window response.

This may be deduced as likely from the substantial amount of published peer-reviewed research into the biological responses of animals and humans to very low doses of many pharmacological substances.

It is quite possible that cancers caused by exposure to low-levels of ionising radiation also follow this type of response curve. There are real low-level exposure effects that may initiate cancer and other adverse health effects before the living system starts to detect and repair the damage. We propose that it is also likely that ES occurs on an early biphasic sensitivity peak.



Biphasic and linear dose-response curves

The sides of the early response peak define the dangerous exposure window. Damage starts to occur at very low levels of long-term chronic exposure in ways that are not detected by the immune system. Then, a level is reached where cellular repair mechanisms start to operate. These provide protection until the exposure reaches high levels when there can be too much damage to be repaired. The response then follows a more typical dose-response curve.

We suspect that this early biphasic response becomes greater and greater as the individual's ES develops.

There are naturally "electromagnetically quiet" regions in the ambient EMF spectrum. The main cosmic quiet "radio window" happens to be just in the place where we locate the mobile phone bands (900 and 1800 MHz) and the microwave oven frequency (2450 MHz). This can be seen in Figure 2 *(derived from NASA 1994, and also Kraus and Fleisch, 1999)*

Using basic physics we can calculate that the ICNIRP exposure guidelines allow radio signals in the mobile phone bands some 10^{15} or more times higher than the natural background levels that we were exposed to only 50 years ago.

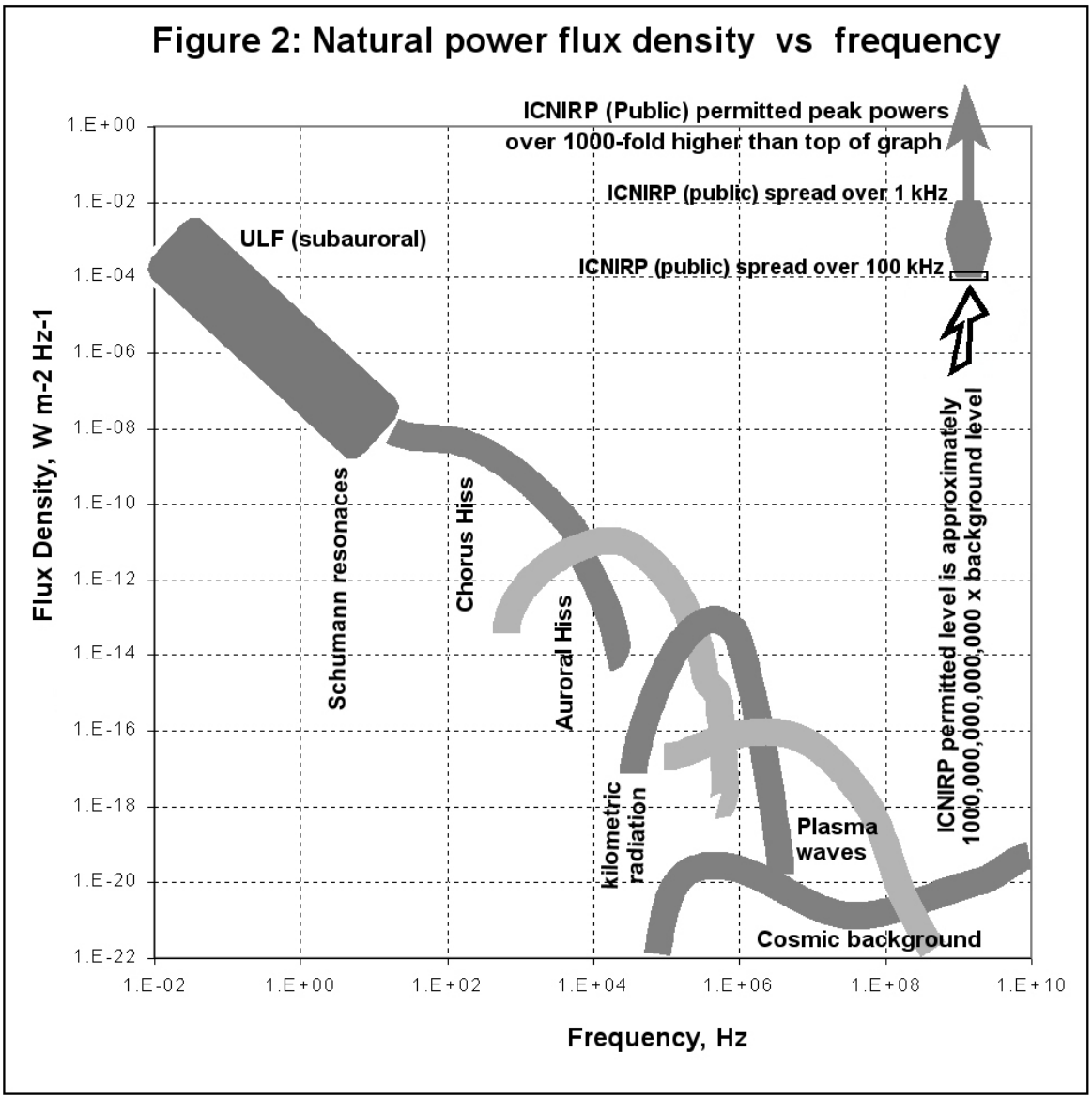


Figure 2: Natural power flux density vs frequency
ICNIRP (Public) permitted peak powers
over 1000-fold higher than top of graph
ICNIRP (public) spread over 1 kHz
ICNIRP (public) spread over 100 kHz
ULF (subauroral)
Schumann resonaces
Chorus Hiss
Auroral Hiss
kilometric radiation
Plasma waves
Cosmic background
ICNIRP permitted level is approximately 1000,000,000,000,000 x background level
Flux Density, W m-2 Hz-1
1.E+00
1.E-02
1.E-04
1.E-06
1.E-08
1.E-10
1.E-12
1.E-14
1.E-16
1.E-18
1.E-20
1.E-22
1.E-02
1.E+00
1.E+02
1.E+04
1.E+06
1.E+08
1.E+10
Frequency, Hz

Appendix 2

To pulse (Powerwatch) or not to pulse (MTHR and Airwave)

This has been a very public disagreement, especially regarding TETRA masts. Some of this is documented elsewhere on this web site. This note is, of necessity, very technical in places.

a) There are a number of separate instances here, that are dealt with later: GSM masts & GSM phone handsets

b) TETRA masts & TETRA handsets

c) Digital cordless (DECT) base units and handsets

d) Bluetooth

e) 3G masts and handsets

As regards the definition of "pulsing" in the communications industry, we refer to: "**The Communications Handbook**" Ed. Jerry Gibson, ISBN 0 8493 8349 8 CRC & IEEE Press 1997 (note IEEE who help to set various definitive industry standards)

Chapter 25 "Baseband Signalling and Pulse Shaping" states: "Baseband signalling and pulse shaping refers to the way in which a group of source bits is mapped to a baseband transmitted pulse."

The simplest system is "binary pulse amplitude modulation" (PAM)... [this can, but does not have to, pulse **completely on** and **off** as - described by Challis et al as pulsing]

it continues ...

"As an example of a technique which is not PAM we have.. "integral(0,T) p(1;t) p(0;t) dt=0" "This choice of pulse shapes is called binary frequency-shift keying (FSK)." [i.e. FSK **is** a **pulsing** communications system that has no amplitude modulation at all]

"Another example of a set of orthogonal pulse shapes for m=2bits/T ... ... the spectrum is, therefore, spread across a much larger band than the smallest required for reliable transmission, assuming a data rate of T/2. This type of signalling is referred to as spread spectrum." [i.e. 3G and TETRA - so these systems are also described as 'pulsing', although the data is transferred by phase modulation that does have some amplitude modulation that looks and sounds like high frequency noise]

" The current IS-95 air interface uses an extension of this signalling method in which groups of 6 bits are mapped to 64 orthogonal pulse shapes with as many as 63 transitions during a symbol." "A **constant amplitude pulse** is appropriate for a fast fading environment with noncoherent detection."

That last sentence is MOST definitive regarding the need for a pulse to even have ANY amplitude modulation (i.e. it does not need to!), let alone the requirement to switch the RF carrier on and off, in the way that Challis et al insist is a necessary requirement of pulsing.

This is an industry source book that clearly shows that Professor Challis' and Airwave's views are misguided, out of date, thinking, not only for the Powerwatch "common sense view" of what pulsing is, but also what the cellular communications industry really understands as pulsing.

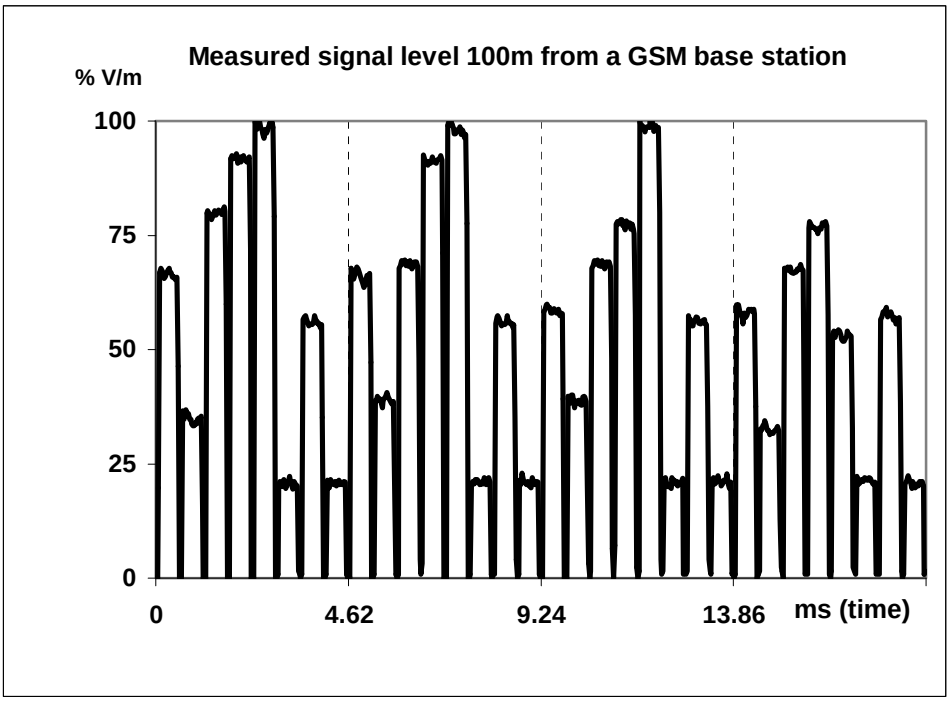
Using the Challis et al description of pulsing would actually deny that humans have a blood pressure pulse as the blood pressure does not drop to zero between peaks.

There are increasing reports of adverse health effects from people living near to mobile phone base stations (BS). Common complaints are sleep disruption, headaches, and fatigue. These include a number of regular GSM phone users who had no related health problems until a BS was installed close to their house.

The signal characteristics of digital base station transmissions are very different from the radio and TV signals that people have been chronically exposed to over the last 50 years. We have developed a receiver (A-COM or Acousti-COM) that monitors the amplitude modulation of the totality of RF from about 20 MHz to about 5 GHz, both aurally on a built-in loudspeaker and visibly on an external oscilloscope. A GSM base station will usually dominate the amplitude modulated RF environment within 1000 metres and the low frequency (2-2000 Hz) sharp-edged modulation is new to human experience. At night when call traffic stops, the pulsing often has a prominent 4 Hz component, however I have noted that different UK Operators' BS have identifiable differences.

DECT cordless units that transmit signals 24-7, even when the phone is not in use, can also dominate inside houses. Even the 3G and TETRA CDMA based base stations produce significant amplitude modulation which can be heard as a very raucous hissing sound.

There are signal qualities in base station emissions that have not yet been investigated and Powerwatch is concerned that the various research projects around the world are not adequately assessing the nature and frequency content of base station amplitude modulation. Alasdair Philips was part of a research funding bid involving three UK universities to the UK MTHR (Chaired by Professor Challis), but it was refused with one of the reasons being that they did not approve of our proposed investigations into pulsing. The signals from base stations differ between systems on a gross level (e.g. the USA NADC uses 50 Hz and GSM uses 217 Hz basic time-frames) and more subtle levels (in control channel and multi-frame timing). Graph 1 shows the signal from a typical GSM BS with a control channel (BCCH) and 4 traffic channels (TCH).



Graph 1

With no call traffic the station emits a continuous series of 0.58ms (millisecond) pulses at about the 20% level in the graph (about 0.8 V/m in this case) separated by 30us (microsecond) guard periods, with multi-frame bursts at 4 Hz. The call traffic channels synchronously add to the amplitude, dependent on the number of active time slots and adaptive power control. The phase modulation within the GSM slots does not produce significant amplitude modulation, however 3G and TETRA phase modulations do produce significant levels of 2-20 kHz amplitude modulation due to their regular discontinuous jumps in phase.

The guard periods produce 100% modulation at 1734 Hz, quite close to the proton resonance frequency in water in the Earth's geomagnetic field. This manifests as a loud high-pitched whistle and is unique to BS, as GSM handsets only produce pulses at 217 Hz and below. This may be a real reason that people have different adverse health effects from base stations emissions than from mobile phone handsets which do not emit this high pitched whistle at 1734 Hz.

It has been pointed out [1] that, due to battery currents, handsets also produce real extremely low frequency (ELF) magnetic field pulses of several microtesla inside the user's head - so simulated exposure just using pulsed RF is not adequate to test the bio-effects of handset use. These ELF pulses are at frequencies similar to endogenous electrical frequencies within the human body and so may well interfere with normal functioning.

We wish to highlight that chronic exposure to BS signals is quite different from exposure to a distant handset - the qualities of the signals vary significantly and future research needs to address this. For the specific instances listed at the top of this article:

a) GSM phone handsets pulse at strongly at 217 Hz and harmonics, plus 2, 4 & 8 Hz components. GSM base stations pulse similarly, with the additional 1734 Hz inter-timeslot frequency.

b) TETRA handsets pulse strongly at 17.6 Hz with high frequency amplitude modulated noise. TETRA masts pulse gently at 70.4 Hz with high frequency amplitude modulated noise in between the slight gaps. Sleep disruption, including disturbing dreams, are being reported by people who live within a few hundred metres of a TETRA base station antenna.

c) Digital cordless phone (DECT) base units and handsets pulse at 100 Hz with short aggressive pulses. The base unit pulses lengthen from 100 microseconds to 400 microseconds if a handset is present and active, increasing the microwave power level. A DECT base unit in a house is usually the dominating RF source. We do not recommend them under any circumstances.

d) Bluetooth also pulses at 1600 Hz, again quite near the proton resonance frequency in the Earth's magnetic field. Bluetooth (also called WiFi) is used to allow electronic devices to send data to each other, (e.g. PCs, modems and mobile phones, through to allowing kitchen appliances to 'talk to each other', and increasingly continuously active Bluetooth systems are being installed in more expensive cars. These expose the driver and front passenger to continually pulsing microwaves). We do not recommend the use of Bluetooth in your home, car or workplace. The exposure levels from these systems are low (Martínez-Búrdalo 2008), but it is the low levels that have often been found to be more biologically active.

e) 3G masts mainly emit microwaves with high frequency (2 to 20 kHz) amplitude modulated noise. 3G handsets usually work in GSM mode when not sending/receiving video and so pulse strongly. When operating in 3G mode they mainly emit microwaves with high frequency (2 to 20 kHz) amplitude modulated noise.

Are we "Off the wall" or "beyond the pale"? - we don't think so - have a look at the NRPB/MTHR volunteer exposure specification document [2].

Please make sure you read right to the end of the document, including the waveform diagrams.

Just who is pulling the strings of those 'experts' who claim these things do not pulse? Research funds, good salary, nice pension, high status? Smooth ride for the cellular phone industry? … ?

[1] Pedersen, GF, and Andersen JB. "RF and ELF Exposure from Cellular Phone Handsets: TDMA and CDMA Systems", Radiation Protection Dosimetry, Vol.83, Nos 1-2, pp 131-138, (1999)

[2] "Human Exposure to Base Station Signals – source specification for volunteer studies". Written by Simon Mann of the NRPB for the MTHR Management Committee, October 2002.