Masts + Mobile Phones

Price 40p

Introduction

Mobile phone masts blight both urban and rural landscapes. Mobile phone use is frequently intrusive and irritating. Yet use has exploded. Mobile phones provide security, save time and even lives. To be able to speak from a field in one country to a friend on a mountain in another is true technical wizardry. To have millions of messages simultaneously zipping through the same air, all finding their targets without interference from each other, is a near miracle. In a few years it will be difficult to recall life without mobile phones.

Yet there have been whispers of hazards from mobile phones and the electromagnetic radiation they use. Concerns rise when masts are erected near schools. Something so intrusive surely threatens as well.

The technology

Mobile (or 'cellular') phones work via radio signals to and from 'base' stations, ie antennae mounted on masts. Base stations cover an area (a cell) which may be as small as 0.01 km² in a city centre, or 100 km² in the country. The cellular network keeps track of a live phone as the user moves round the country (a useful check on criminals). Calls *for* the user are then sent from the nearest base station. By 1998 there were already 15 M mobile phones and 25,000 base stations. By 2006 3/4 of the population had at least one mobile 'phone - 95% in the 16-34 age band. Mobile phones now link to the internet, carry live pictures and often come with camera etc included. This note is concerned with their safety.

Safety guidelines

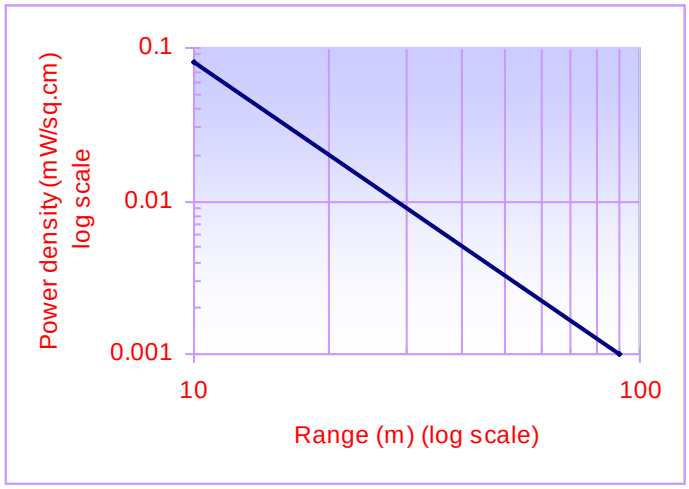
Both the antennae *and* phones operate as low powered radio transmitters operating at frequencies of around 1 or 2 Giga Hertz, similar to UHF television or FM radio. Transmission (ie sending calls *out*) requires more power than reception. Because *both* antennae *and* phones transmit, the safety of *both* have to be considered. Most people worry about the masts but, because the *phone* transmitter is so much *closer* to the brain, it carries a greater potential threat.

Guidelines for public exposure are considered to be highly conservative, the maximum being less than *one fiftieth* of the level where any health effects have been reliably observed. Guidelines were formerly set by the National Radiological Protection Board (NRPB), now part of the Health Protection Agency, and differ for phones and antennae. Because these are physical values they can be *measured* and *checked*.

Safety limits on the basis of body weight

Energy which is absorbed will heat body tissues, so phones heat the head. The measure is called the Specific Absorption Rate (SAR) and the limit is 0.02 Watts (W) of power, averaged over 6 minutes, in any 10 grams of tissue. At 0.02 W the temperature of the head would rise by less than 0.1° C after a long call or series of calls. (A Watt is a relatively small rate of power. Domestic light bulbs are usually 60 or 100 W). Usually the actual output from the phone is only a fraction of the guideline so any rise in temperature should be only a fraction of a degree, less than the normal daily variation in body temperature.

Transmission energy from an *antenna* will usually be uniform over the whole body so the guideline is different, being 0.4 W per kilogram of body weight averaged over 15 minutes for a worker in the industry and one fifth of that (0.08 W/kg) for the general public. This limit is only likely to be exceeded if a person gets within a few metres of a base station (see below). Signal strength diminishes with the *square* of the distance away from a base station. The strength 100 metres from a mast is thus only 1% of the strength at 10 metres (see chart). Strengths at ground level in regions accessible to the public are normally way below the guideline limit and thus a tiny fraction of the actual hazard level. They should produce no measurable heating.



Safety limits on the basis of body area

Whereas SAR applies a limit based on weight, Plane

This briefing note has been prepared for ALDES by Chris Shepherd, edited by Richard Balmer. It should be factually correct. However, if you see any errors or have comments, please email chris.shepherd@iee.org or richard_balmer@blueyonder.co.uk

Wave Power Density (PWPD) is a limit based on *area* - the power per unit area reaching a person facing a transmitter. The most widely accepted standard was developed by the International Commission on Non-Ionising Radiation Protection, the Institution of Electrical and Electronic Engineers, the American National Standards Institute and the National Council on Radiation Protection and Measurement. Exposure to the general public is restricted to 4.5 to 9 W/square metre (0.45 to 0.9 milliwatts/cm^2 in the industry's units) depending on the frequency of transmission. The guideline for a large man 2 metres tall and half a metre 'wide' would therefore be 4.5-9 Watts.

The chart on the front page is for a very large, 1000 W, transmitter. (Most of those used in urban locations are 100 W or less). The PWPD reaching a man standing in direct line 10 metres away from this 1000 W transmitter would (see chart) receive 0.1 mW/cm^2 or 10 W over his 1 square metre body area. This would be too much. Such a circumstance should never occur in practice because such a large transmitter would be at least 15 metres above ground. The calculation nonetheless is useful to show how easily it can be done. At 20 metres the PWPD would be a quarter of that at 10 metres (because the strength varies by the square of the distance) that is 2.5 W. Were the transmitter to be a more normal urban one of 100 W power the man could be within 3 or 4 metres before exceeding the guideline.

The SAR calculation is similarly easy to do. Were the man to weigh 70 kg and be standing 10 metres away the SAR figure would be 10W/70kg or 0.14W/kg. This is about twice the guideline. At 20 metres he would be at about half the guideline and, with the 100W transmitter, within the guideline even 4 metres away.

Non-thermal effects

The above considerations deal with possible harm caused by heating. The more common concern is about the general increase in 'electromagnetic smog' and whether waves of radio frequency could cause genetic damage and cancer. There are several plausible routes how this might occur but the prevailing view is that radio waves simply do not have the energy to damage genetic material. Even so many surveys have been done, especially in Scandinavia, to check this out.

Every piece of research worldwide is evaluated by the HPA and other professional bodies such as the Institution of Engineering and Technology. The research includes biological studies on tumour promotion or progression in animals. A Swedish study of people who used their phones for 2 hours a day in the '80s suggested 26% and 77% greater risk of tumours after 5 and 10 years use respectively but this is actually a relatively small increase from a relatively heavy use, and power output nowadays is 10 times lower.

If any damage is being caused it is almost certain to be radiation from the *phones*, not the masts, because it is the phones that are closest to the vulnerable part of the body, the head. An NRPB report in January 2005 concluded that there was still no hard evidence of any harm but advised that it was common sense to remain wary and that young children in particular should limit use because their nervous systems were still developing and exposure would occur over more years than with someone older. Sir William Stewart, who chaired the panel which produced the 2005 NRPB report, said 3 - 8 year olds specifically should not own 'phones because they were unlikely to understand the need to limit use. Text messaging was also recommended as being safer than voice calls. Earlier he had proposed a longer term independent study be conducted. This, the Mobile Telecommunications and Health Research Programme (MTHR) began in 2001, supported 28 different research projects, and reviewed all studies reported elsewhere. In its final report in September 2007 (Ref 1) it was able to conclude that no evidence had been found that mobile 'phone technology had caused harm, but the chairman, Prof Lawrence Challis still asked that another 5 year study, costing £3m, be set up to assess long term use, especially by children.

Because engineers and scientists can never guarantee *absolute* safety there is a temptation by anti-campaigners to demand industry waits until more research has been done, but nothing else can be discovered in a laboratory trial. If any harm is eventually discovered it will most likely be from *intensive use* by a *small sub set* of people with a particular susceptibility to radio waves.

There is a different worry, however. Anti-mast campaigners risk elevating anxiety in the general public so that some come to believe the masts *are* causing them harm and, in consequence, ill health *actually* results. It is the reverse of the 'placebo' effect where, if a person is convinced something is doing them good, their brain acts to make them well. Scares about masts and also WI-FI zones risk sustaining worries even though there is no physical reason for this. Indeed a recent, albeit small, study showed that individuals claiming to be made ill when in WI-FI areas could not, in fact, detect whether the WI-FI was switched on or not. Anti-mast campaigners must be extremely careful about stirring up anxiety. Anxiety can *cause* harm where none exists.

Where to place masts

Meanwhile, most of the angst concerns siting masts, especially near schools. Measurements of field strength taken at 100 schools in 2001 found the *highest* measure at *any* school to be only 0.84% - not even one hundredth - of the allowable limit. A second study in 2002 found the highest level even less - only one seven hundredth of the allowable limit.

An important point to make is that the *more* masts there are, the *lower* will be the transmitter power and the *safer*

each will be. This affects the phones as well. These adjust their transmitting power in steps according to the quality of the signal. Obviously more power has to be used when the signal is weak than strong. Using a phone outside a building or home, for example, is generally better than using it inside.

The industry has recognised that suspicion of the technology remains and recognised too that, though it has complied with the legislation, it has often appeared secretive and then aggressive in doing it. The industry also recognises that the individual companies could have done more to work together in siting their masts. They should not have assumed that the public automatically understands why every company needs its own masts.

It is understood that the major companies have now committed themselves to providing a plan for each area for all companies for 12 months ahead, so allowing more comprehensive explanation and consultation.

TETRA masts

A generation of masts is now required to transmit the so called 3G technology, i.e. pictures et al and also the dedicated TErrestrial Trunk RAdio network or TETRA emergency system for the police and other emergency services. The TETRA system has fewer masts, so the signals will tend to be stronger (though there will be much less traffic). Additional repeaters or relay devices are also used to reduce the blind spots one sometimes has with normal mobile 'phones to provide the police with comprehensive cover. Though the masts broadcast at high frequencies the repeaters and 'phones can send pulsed signals and these pulsed signals are shorter but more powerful. Concern has also been expressed that their frequency is close to that of brain waves. Again if anything is hazardous it will be the 'phones. Happily the research project set up in the MTHR programme found nothing untoward.

Conclusions

Anyone concerned about the health risk from a proposed mast should ask for the power of the transmitter and the calculations showing that all areas accessible to the public are within the safety guidelines. They can also ask for actual measurements of signal strength in comparable locations. Thereafter the decision to grant planning permission should be on aesthetic grounds. (Masts less than 15 m high and more than 20 m from the highway do not currently require permission). In truth it would seem to be an advantage for affected residents to be involved in choosing the sites. A mast has to go somewhere if they and their children are to use the phones (and the police provide protection) and it is in residents' own interests to help find the best position.

Ref. 1 The MTHR report can be downloaded from the web site www.mthr.org