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Options Brief and Executive Summary

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THE PHYSIOLOGICAL AND ENVIRONMENTAL EFFECTS OF NON-IONISING ELECTROMAGNETIC RADIATION

OPTIONS BRIEF

1. Policy options for the European Parliament

- the non-emergency prolonged use of mobile phones by children – and particularly pre-adolescents – be strongly discouraged, on account of their increased vulnerability to any potential adverse health effects.
- the mobile phone industry refrain from promoting prolonged use of mobile phones by children by the use of advertising tactics exploiting peer pressure and other strategies to which the young are susceptible, such as the (now discontinued) use of DISNEY character fascias on the phones.
- the mobile phone industry make it clear to the consumer that the specific absorption rate (SAR) - which in some countries is shortly to be declared on the handset - refers *only* to the degree to which the microwave emissions from the antenna can heat biological tissue, and is in *no way* relevant to *non-thermal* effects that the emissions from a mobile phone may have on the user.
- The efficacy of devices such as shields and ear-pieces be indicated on the basis of *biological tests*, and not solely on the reduction in SAR value (as determined by the use of a 'phantom' head) that their use might achieve.
 - b) It be made clear to the consumer that such devices afford no protection against the low frequency pulsed magnetic field from the battery of the phone.

- concerning personal protection devices claiming to boost the immunity of the user against any adverse impacts of exposure (including those from the battery magnetic field):
 - a) The efficacy of such devices be established by biological testing.
 - b) Such devices not be rejected (as has occurred in certain consumer surveys that have been published) solely on the grounds that their use does not reduce SAR, as measured using a 'phantom' head; for this is not what they are designed to do. Accordingly, the SAR is here a *fundamentally inappropriate* measure against which to assess their efficacy.

2. Policy options for the European Commission

- Future EU-sponsored research should incorporate the following recommendations:
 - a) living systems under investigation be exposed to the emissions of an actual mobile phone, rather than a 'surrogate', since the emissions have a quite different biological impact, in consequence of certain pulse frequency differences.
 - b) in assessing the significance to humans of results obtained using animals, particular attention be paid to differences in exposure conditions, such as whether exposure is size-resonant, whether it is to the near or far field of the antenna, and whether whole-body or more localised exposure occurs.
 - c) systematic investigation be made into the influence of different kinds of pulsing (of real phones) on the human EEG, and ideally on the MEG, and of whether any observed changes in power spectra are correlated with changes in the level of deterministic chaos.

d) use be made of novel, non-invasive technologies, such as biophoton emission, to investigate the influence of mobile phone radiation on living systems.

e) in assessing the effects of mobile phone radiation more attention be paid to lessons that have been learnt from exposure to other kinds of related radio frequency fields, such as those from the Skrunđa, military and police radars.

f) in the light of reports of cattle being quite seriously adversely affected at farms where there is a base-station, a veterinary monitoring service be established to collect and analyse such reports, and raise awareness amongst farmers of this potential hazard to their livestock.

- attempts be made – perhaps under the aegis of national regulatory bodies - to increase awareness of the electromagnetic nature of living organisms and their consequent hypersensitivity to coherent, ultraweak electromagnetic signals. [Until this is achieved, the need to extend thermally-based safety guidelines, by incorporating electromagnetic biocompatibility, is unlikely to be accepted.]

3. Technological options at the operational level

Whilst the question of precisely *how* adverse health effects can be provoked by non-thermal influences of the pulsed microwave radiation currently employed in GSM telecommunication, as well as those from *ELF* fields associated with other technologies, is far from resolved, the circumstantial evidence consistent with such influences suggests at least two ways in which biocompatibility with this technology could be enhanced by changes involving the fields alone:

- In the case of exposure to GSM radiation, reduce intensities to the level below which no adverse effects have been empirically found in exposed populations, bearing in mind that there are indications of non-thermal thresholds for biological effects of the order of a *microwatt/cm²*. Power densities a few *tenths* of this value are common at distances of 150-200m from a typical 15m high Base-station mast and within the range of the more localised side-lobes in the immediate vicinity of a mast - *adverse effects being reported at both locations*. Incorporating a further safety factor of 10 indicates that, at locations where there is any long-term exposure, power densities should not exceed 10 nanoW/cm².

[To appeal to the (alleged) absence of health problems associated with the higher power density electromagnetic fields emitted by radio/TV transmitters in an attempt to justify the retention of the present level of emission from GSM Base-stations is untenable, on at least two accounts: (i) the nature of the emissions are quite different, with respect to carrier frequencies, modes of transmission (pulsed/analogue), and beam morphology, (ii) there are health problems connected with some such transmitters, contrary to what is often claimed!]

- Ensure that there are no *ELF* frequencies – either of amplitude modulation (including pulsing, as the extreme case) of *RF* fields, or of other electric /magnetic fields - in the range of human electrical brain-wave activity, or windows of calcium efflux.

[In the case of exposure to GSM radiation, this will be achieved, to a certain extent, with the advent of the Third Generation of mobile phones (UMTS) that utilise CDMA in place of TDMA. For although any sensitivity to the microwave carrier will remain, the pulsing used in CDMA is irregular; accordingly, CDMA radiation cannot enjoy the same 'oscillatory similitude' with the human brain-wave activity and electrochemical processes as does TDMA. In consequence, however, of the somewhat higher carrier frequency used, which is closer to where water strongly absorbs microwaves, thermal effects could here become more of a problem, particularly in view of the somewhat higher powers at which they operate! The introduction of TETRA, on the other hand, gives rise to an increased level of both thermal and non-thermal concern.]

EXECUTIVE SUMMARY

A major contemporary threat to the health of Society is man-made 'electrosmog'. This non-ionising electromagnetic pollution of technological origin is particularly insidious, in that it escapes detection by the senses – a circumstance which tends to promote a rather cavalier attitude regarding personal protection. Yet the nature of the pollution is such that there is literally 'nowhere to hide'. Furthermore, given the relatively short time for which humanity has been exposed to it, we have no evolutionary immunity either against any adverse effects it might directly have on our bodies or against possible interference with natural electromagnetic processes, upon which homeostasis appears to depend, for example, the Schumann resonance – a weak electromagnetic field that oscillates resonantly in the cavity between the earth's surface and the ionosphere at frequencies close to those of human brain rhythms, isolation from which has been found to damage human health.

What distinguishes technologically produced electromagnetic fields from most natural ones is their much higher degree of **coherence**. This means that their frequencies are particularly well-defined, and therefore more easily discerned by living organisms, including humans. This greatly increases their biological potency, and 'opens the door' to the possibility of frequency-specific, *non-thermal* influences of various kinds, against which existing Safety Guidelines – such as those issued by the International Commission for Non-ionising Radiation Protection (*ICNIRP*) - afford no protection.

The Safety Guidelines are based solely on consideration of the ability of radio frequency (*RF*) and microwave radiation to heat tissue, and of extremely low frequency (*ELF*) magnetic fields to induce circulating electric currents in the interior of the body, both of which are known to be damaging to health, if excessive. Since the severity of these effects increases with the strength (intensity) of the fields in question, it is this that the Guidelines restrict, the frequency of the fields being taken into account *only* in so far as it affects (through 'size' resonance effects) the ability of the organism to absorb energy from the irradiating field and heat up accordingly.

The Guidelines thus do not protect against adverse health effects provoked *primarily* and *specifically* through influences that the *frequency* of the fields might have on the human body.

A necessary condition for such an influence is the existence in the organism of the biological counterpart of an electrically tuned circuit – *i.e.* an endogenous oscillatory electrical activity.

In this case the organism will respond - in a way akin to a radio - if the frequency of the external field (either of the carrier wave, or of lower frequency amplitude modulations/ pulsings) matches or is close to that of its tuned circuit.

This could result in either an undesirably high resonant amplification of, or damaging interference with, the associated endogenous biological activity.

These influences can be considered to arise from a transfer of *information* (in a generalised sense) from the field to a living organism, in that the organism is able, through this kind of 'oscillatory similitude', to recognise – and in turn respond to – a feature of the external field *other than* its intensity.

Equally important is that the external electromagnetic fields be sufficiently coherent to be discernible by the body against the level of its own incoherent thermal emission at physiological temperatures. Whilst this is usually the case, it should be noted that since the radiation is not perfectly coherent, the occurrence of non-thermal effects is still contingent upon a certain minimum intensity threshold, the magnitude of which is, however, well below that at which any discernible heating occurs.

A good example of such an 'informational', frequency-specific, non-thermal electromagnetic influence on the living organism is the ability of a light flashing at a certain rate to trigger seizures in people suffering from photosensitive epilepsy. This is primarily due, not to the brightness (intensity) of the light, but rather to the frequency of the flash – which, if close to the frequency of the electrical brain activity involved in epileptic seizures, can trigger their occurrence - *i.e.* the phenomenon is primarily a frequency-specific effect of information transfer from the light to the brain, the brain being able to 'recognise' the light by the rate at which it flashes.

Existing intensity-based Safety Guidelines (relating to the visible part of the electromagnetic spectrum) afford no protection against such a non-thermal effect, unless set so low that the light is not visible!

Some oscillatory endogenous electrical activities of the living human body are quite familiar - such as those of the heart and brain, which can be monitored by an electrocardiogram and electroencephalogram, respectively. Equally familiar is the circadian rhythm.

Others, - such as the coherent electrical excitations at the cellular level whose frequencies typically lie in the *microwave* region of the electromagnetic spectrum, and those pertaining to crucially important biochemical activities, involving, for example, the transport of calcium ions across cell membranes - are somewhat less well-known.

Until the frequency/information dimension of *non-visible* electromagnetic radiation (microwaves and other non-propagating electric and magnetic fields such as those from overhead power lines) - is recognised *in its own right*, these fields will constitute a potential threat to all living organisms.

Since electromagnetic fields are indispensable to technology that Society is reluctant to abandon, more comprehensive protection should be developed. As explained, we are currently vulnerable to adverse health effects that might be provoked by non-thermal effects of the frequency dimension, which escapes regulation by the existing intensity-based Safety Guidelines.

Unlike intensity, the frequency aspect of the problem cannot be addressed without interfering with the frequency characteristics and informational content of the aggressing field (the integrity of which must, of course, be maintained in communication technologies, such as GSM telephony). We need therefore to consider strategies that do not target the field, but rather the person being irradiated, and devise ways to provide a higher degree of immunity than at present.

Such strategies are currently under development, and a number of related protection devices are already available commercially, although often their efficacy has not always been adequately demonstrated. (There is an obvious parallel here with the pharmacological strategy of attempting to protect against bacterial infection by taking vitamin C, for example, to fortify the immune system, rather than wearing a protective mask to simply reduce the intensity of the bacterial field to which the person is exposed.)

The competence of existing Safety Guidelines could be broadened by extending the familiar consideration of electromagnetic compatibility (EMC) between electromagnetic radiation and electronic instrumentation *to the living human organism*, as an electromagnetic instrument itself, *par excellence*. An ambitious programme of **electromagnetic biocompatibility** is an important task for the 21st century, and one that is shirked only at our peril.

There is currently much public concern over possible adverse health effects provoked by long or short term exposure to electrosmog. This concern focuses especially on overhead power lines and GSM telephony. Quite justifiably, the public remains sceptical of attempts at reassurance by government and industry, particularly given the unethical way in which they often operate symbiotically so as to promote vested interests, often under the brokerage of the regulatory bodies whose function it supposedly is to ensure that the safety of the public is *not* compromised by electromagnetic exposure!

Given recent experience with official duplicity over BSE/CJD – with the initial assurances of no risk and subsequent revelations of cover-ups – the public is now understandably wary of safety assurances from ‘official’ government scientific sources w.r.t. electromagnetic pollution. This scepticism is enhanced when views contrary to official perceived wisdom is, at worst silenced or, at best, studiously ignored.

Public scepticism is further exacerbated by reports of research supported financially by the Mobile Phone Industry and of its attempts to ‘persuade’ those whose findings might damage market development *to actually alter their results* to make them more ‘market friendly’.

There is currently an attempt (under the aegis of the World Health Organisation) to globally ‘harmonise’ exposure standards, by persuading countries with more stringent limits – such as Russia and China – to relax them in favour of the higher levels tolerated in the West.

It can be no coincidence that in Russia, where the frequency-specific sensitivity of living organisms to ultra-low intensity microwave radiation was first discovered over 30 years ago, that the exposure guidelines (even if applied in theory, rather than in practice) are still 100 times more stringent than those of ICNIRP!

There is a regrettable tendency to attribute market-friendly research a greater significance, publicity and profile than non-market friendly research, which suggest the possibility of adverse health impacts. An example of this is provided by the recent publication of a USA epidemiological study, in which the statistically significant finding of an elevated risk amongst users of mobile phones of the incidence of a rare kind of tumour (epithelial neuroma) in the periphery of the brain – *precisely where there is maximum penetration of radiation from the mobile phone* (the laterality of which also correlated with phone usage) – was glossed over and completely escaped the attention of the media, who focused instead on the finding that there was no *overall* increase in the incidence of brain tumours amongst mobile phone users.

The mainstream scientific approach to assessing the harm of human exposure to electromagnetic fields is guided by an essentially *linear* perception, which might well be adequate to deal with thermal effects, but is inappropriate for realistic consideration of the non-thermal, frequency-specific vulnerability of the living

organism to the rather coherent electromagnetic fields.

In contrast to thermal effects, non-thermal influence necessarily depends on the state of the organism when it is exposed. This of course varies not only between *different* individuals, but also for the *same* individual, depending on his/her condition at the time of exposure – *i.e.* such influences are inherently *non-linear* in nature. As such, they often appear bizarre from a linear standpoint. In addition, difficulties in independently replicating in experiments tends to lead to their dismissal.

Attempts to address a problem that is inherently non-linear from a linear perspective only exacerbate things: outdated knowledge is worse than ignorance - at least the ignorant know what they do not know!

In the case of the mobile phone issue, not only has there been a reluctance on the part of official bodies to grasp this non-linear 'nettle', but a lamentable failure to pay attention to indications of the harm to humans and animals caused by exposure to pulsed microwave fields of sub-thermal intensity that have been long available from experience with microwave installations (not least military ones) similar to those used in *GSM* telephony.

It is not so much that, in the haste to make this new and valuable technology available, the necessary safety research has been bypassed or compromised, but rather - and more reprehensibly - that already available indications that the technology is potentially less than safe have been, and continue to be, *studiously ignored*, both by the industry and by national and international regulatory bodies.

A good example of this is afforded by the conduct of the UK National Radiological Protection Board, which was 'unable' to provide the Independent Expert Group on Mobile Phones (*IEGMP*) - for whom they were acting as the Secretariat - with certain highly relevant published papers, on the grounds that they could not 'find' them, despite having been provided with the full references by at least two individuals who gave evidence to the *IEGMP*, and curiously having had no difficulty in providing less significant papers from the *same issue* of the journal!

The concern of the public is thus not unfounded, and the irony of the present situation w.r.t mobile phones and base-stations is that current Safety

Guidelines afford greater protection to electronic instrumentation than they do to human beings!

There is a lack of expert consensus on the significance and credibility of research into biological effects of *GSM*-type radiation and possible adverse health reactions in susceptible people (despite many consistent, anecdotal positive reports).

It is probably true to say that if the same lack of consensus and level of concern surrounded a new drug or foodstuff, it would never be licensed.

Of particular concern to the public – and generating the most outrage – is the involuntary subjection of certain groups of the population 24 hours/day, 7 days/week to the emissions of *GSM* base-stations, when they are insensitively sited near to homes, schools and hospitals. The environment of these people is permanently and unavoidably polluted. This is a totally unacceptable state of affairs, which raises serious ethical questions, and arguably contravenes the Nuremberg Code, in that it is these people who will eventually reveal the degree to which chronic exposure to such fields is noxious – information that is *not currently available*: in other words, they are effectively involuntary subjects in a mass experiment.

This study offers a perspective on the potential implications for human health of exposure to the pulsed microwave radiation currently used in *GSM* telephony, which differs somewhat from that currently espoused by mainstream science, but one that provides a much more holistic insight into the essential elements of the problem.

Of particular importance is the emphasis given to (i) the fact that electromagnetic fields are not alien to living organisms, but play a crucial role in controlling and maintaining their orderly functions – *i.e.* that a living organism is an electromagnetic instrument of great and exquisite sensitivity. (ii) the subjectiveness of human vulnerability, which necessarily follows from the inherently non-linear nature of the problem, which is here recognised *ab initio*, and (iii) the presence of *ELF* features both in the microwave pulses emitted by the antenna of a mobile phone *and* in the (much more penetrating) magnetic field associated with the surges of electric current from the battery of the handset, which are necessary for the generation of the microwave pulses.

Indeed, it is here suggested that it is precisely through the presence of these *ELF* features that the emissions of a *GSM* phone and other related communication technologies, such as *TETRA*, can influence brain function - notably, its electromagnetic activity (brain-waves), its electrochemistry (including that of the neuroendocrine system, particularly with respect to melatonin levels) and the permeability of the blood-brain barrier, as well as altering cellular calcium ion concentrations. It is possible that this latter effect is only one particular facet of a more general disruptive influence that *ELF* fields can have on the integrity of essential ion-protein links (as suggested by recent Russian work) - an influence that could well be relevant also to consideration of bio-negative influences of exposure to *other* kinds of electromagnetic fields, such the low frequency magnetic fields associated with power lines and the mains appliances that they supply, which have been the subject of controversy for a much longer time.

The Study is structured as follows. Attention is first drawn to the irrationality of the current situation that effectively affords - through electromagnetic compatibility regulations (*EMC*) - electronic instrumentation a higher level of protection against *GSM* radiation, for example, than do existing Safety Guidelines governing human exposure, which protect only against adverse health effects attributable to excessive heating, and not against those that might be provoked in some people by the radiation's *non-thermal*, frequency-specific interference with endogenous electromagnetic activities essential for homeostasis.

To appreciate this more fully, the study explains why *GSM* signals are bio-active, and gives numerous examples of frequency specific, non-thermal biological influences that the kind of radiation currently used in *GSM* telephony can exert on living organisms, including humans.

Difficulties sometimes experienced in independent attempts to replicate these effects - which are frequently used to discredit positive results, and to dismiss them as artefacts of the particular experimental protocols used - are addressed, and possible reasons for discrepant results identified. The relevance to humans of findings obtained using animals, such as rats - which can be subject to exposure conditions that are quite different from those experienced during mobile phone use - is discussed and, in the case of human studies, the importance of exposing the subjects to the emissions of a real mobile phone,

rather than a 'surrogate', as is often done, is stressed. Attention is then focused on the reality of adverse health impacts of both human and animal exposure to *GSM* and similar radiation, including that from military sources.

Although the occurrence of non-thermal influences *per se* does not, of course, necessarily entail adverse consequences for human health, growing indications of a consistency between some of the published non-thermal effects of *GSM* radiation and the nature of certain reported adverse health effects, is cause for concern - particularly the recent reports of an increased incidence in a rare kind of brain tumour (notwithstanding the relatively short exposure time in comparison with typical latency periods), which is consistent with the genotoxicity of the radiation.

Reasons why children must be considered potentially more at risk are identified, and arguably the most significant point - namely that *not everyone* is necessarily adversely affected - is addressed, as also are the implications of this on the validity of the familiar claim that there are no established adverse health effects of exposure to *GSM* radiation, provided its intensity conforms to the limits set by existing Safety Guidelines, which, it is argued, neglect the most discriminating feature of all - the fact that the object exposed is *alive*.

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