

## **Workshop on Base Stations and Wireless Networks 15-16 June 2005, Geneva, Switzerland**

### **WHO International EMF Project**

#### **Rapporteur's Report by Colin Roy, ARPANSA, Australia**

The opening talk of the Workshop was by **Mike Repacholi, WHO, Switzerland**, who set out its **'Scope and Objectives'**

In his talk he emphasised that the workshop was designed to answer the following questions:

- What are the current and future wireless technologies?
- What RF exposures do people receive from these technologies?
- Is there evidence of health effects from long-term, low-level RF exposures?
- What further research is needed, if any?
- What international standards exist or are being developed?
- What have national authorities done in response to this issue?
- How can we provide effective communication to all stakeholders on this issue?
- What policy options can be recommended for national authorities?

He summarised the expected outputs from the workshop as:

- Compilation of presentations on the WHO EMF Webpage
- A Rapporteur's report summarising the conclusions and recommendations
- Proceedings of key papers
- A peer-reviewed journal publication
- A fact or information sheet for the general public
- A brochure for local authorities with practical advice related to mobile phone base stations and wireless networks.

After this introduction, the workshop began with a tutorial by four eminent speakers, setting the scene from a technological and scientific point of view.

#### **Mike Walker, Vodafone, UK, 'The mobile revolution'**

This provided the interesting statistic that more than 1.4 billion people, or 20% of the global population, have a mobile phone, and 2 billion people in the world have yet to make a phone call. When that call takes place it will most likely be on a mobile phone not a fixed line.

The history of the mobile phone was covered from the 1970's when Bell Labs developed the Advanced Mobile Phone Standard (AMPS) that initiated the Cellular revolution. Then to the 1980's when the Nordic Mobile Telephone standard was deployed in the Scandinavian countries to today's model which includes video games and playback, email access, internet browsing, video telephony, high speed data access and music downloads. These together with infrared, Bluetooth, memory cards and USB interconnecting devices. To the future with further near-field communications, such as WLAN, UWB and wireless USB.

For base stations the concern for design and deployment is with the "3 Cs": Coverage - Capacity - Capability and in particular how far - how fast.

**Kevin Hughes, ITU, Switzerland ‘International Standardization of wireless technologies and EMF’.**

This talk set out the activities of the ITU (International Telecommunication Union) and in particular the activities of the ITU-R, which has responsibilities for radiocommunication standards and spectrum management. Wireless access systems with the vision of anywhere/anytime connection were described. The workshop heard about the chronology of the developments of 2G, 3G and to systems beyond IMT-2000 (4G), (high data rates) and WLAN connection to laptops through local area networks. Other areas for wireless connectivity were described including:

- PAN (personal)– LAN – MAN – WAN
- Short-range devices - with personal devices
- WiFi – now commonly deployed, e.g. private houses, hot-spots
- Wider area networks – broadband within a metropolitan area
- Even wider possibilities through cellular networks – looking to 3G & further.

With regard to health effects from EM radiation, the ITU has no direct role to play. Being conscious of the basic restrictions and reference levels promulgated by regulatory agencies and standards bodies, ITU *Recommendations* make reference to them where appropriate. This is the case with respect to *Recommendations* addressing the measurement and calculation of EM fields. The talk described three such *Recommendations* which help the user assess whether precautionary measures are required to protect the public and occupational personal from hazardous fields, based on the EMF reference levels for the particular case of interest.

**Niels Kuster, Swiss Federal Institute of Technology, Switzerland, ‘Assessment of human exposure by electromagnetic radiation from wireless devices in home and office environments’.**

This talk set out the background to and results of exposure assessments, related to the growing use of wireless connectivity technologies. These include DECT (digital enhanced cordless telecommunication) Bluetooth, Wireless LANs (IEEE 802.11) and a variety wireless PC peripherals (wireless mice, 27 and 40 MHz, wireless keyboard, 27 MHz) and baby surveillance devices (40, 446 and 863 MHz). Exposure assessment (SAR determination) and the development of a compliance procedure were described. For the devices tested it was found that:

- Worst-case peak spatial SAR values were close to public exposure limits e.g., IEEE802.11b and Bluetooth class I devices
- Maximum incident field exposures at 1 m can significantly exceed those of base stations (typically  $0.1 - 1 \text{ V m}^{-1}$ ) and at very close distances the derived reference levels are exceeded

The recommended procedure for evaluation of exposure and demonstration of compliance is dosimetric evaluation under worst-case conditions.

**Peter Valberg, Gradient Corporation, USA, ‘Modulated RF energy’**

Transmission of information by mobile telephony is via modulation of the central or carrier wave. As the technology has advanced it has been necessary to change the modulation and it has been speculated that this could have an adverse effect on biological systems. An interaction mechanism capable of detecting the difference between a modulated and a non-modulated signal must be either fast enough to respond to the carrier frequency or sensitive to the power changes occurring at the modulation frequency.

The applicability of the principle of physics in all systems was elegantly explained and it was emphasised that the simple conservation laws (energy, motion, charge) were applicable and that biology was no exception. A discussion of 'photon energy' showed the unlikelihood of significant changes occurring. However, reports still appear showing biological effects apparently occurring at very low levels (and often related to modulation effects). A 'repeatable, explicit, and predictive mechanism capable of producing biologically significant responses (modulation dependent or not) from low-level RF fields has not been found'. This provides the encouragement to continue to examine experimental protocols and underlying biophysics, and seek evidence of replication.

The afternoon session on the first day began with three presentations concerning health effects, summarizing the state of knowledge on non-thermal effects from RF fields, and overviews of provocation and epidemiological studies.

**Bernard Veyret, University of Bordeaux, France, 'A review of non-thermal health effects from RF fields'**

This presentation reviewed the literature in relation to base station exposure. The sources considered were far-field low-level sources that contribute to whole body exposure of people in contrast to the local (head) exposure from mobile phones. The exposure categories can be thought of as high ( $1 \text{ W kg}^{-1}$ ), medium (0.1) and low associated with (0.01) with most studies in the 0.1-1 range. However, exposure associated with base stations is more likely to be  $0.0001 \text{ W kg}^{-1}$ . Various mechanisms (established and proposed) were discussed, including thermal/non-thermal, threshold/stochastic and single/multiple window. Problems associated with much of the earlier research have been eliminated with a more multi-discipline approach resulting in better and more characterized exposure systems. It was concluded that laboratory studies at very low levels (related to base station exposure) were:

- Difficult to perform
- Difficult to extrapolate to humans
- Not necessary

**Elaine Fox, University of Essex, UK 'Base stations and electromagnetic hypersensitivity symptoms: A review of scientific studies'**

This presentation addressed the issue of "EHS" in the context of health reviews, the precautionary approach and residual public concern. A recent review of all published double-blind studies concluded that there was no link between EHS symptoms and EMF exposure they also point out that we are not yet in a position to draw a firm conclusion.. It was emphasized that most of the previous research is very underpowered (usually only testing 15-20 participants) so larger scale double-blind studies are needed. There are currently at least 3 such studies being undertaken (a) a replication of the TNO study being conducted in Switzerland; (b) University of Essex study in which it is hoped to test 132 EHS and 132 matched controls with GSM, UMTS and sham exposures; and (c) a study looking at GSM in Denmark. Discussion emphasized that there was a need to show compassion to sufferers but to accept that the cause of the problem lay elsewhere. There was also some discussion with regard to the recent WHO workshop on EHS (Prague, October 2004).

**Anders Ahlbom, Karolinska Institute, Sweden, ‘Studies on base stations and other telecommunication towers’**

In this presentation it was emphasized that most studies published to date were based on proximity to transmitters but the exposure patterns were complex and not necessarily related to distance. None of the studies provided evidence that RF exposure from the transmitters increased the risk of cancer or any other health effect. The ensuing discussion centred on the possibility of conducting an ideal study. Key requirements included:

- Personal exposure assessment
- Well-defined study group
- Mechanism to define cases
- Being large enough to have acceptable statistical power

The second set of presentations in the afternoon was concerned with dosimetry for both the general public and occupational workers.

**Georg Neubauer, ARC Seibersdorf Research GmbH, ‘Study on the feasibility of future epidemiological studies on health effects of mobile telephone base stations: Dosimetric criteria for an epidemiological base station study’**

Here, a recently completed feasibility study that had two elements was discussed; the first to identify strengths and weaknesses of existing epidemiological studies and the second to evaluate existing exposure assessment methodologies and to assess their suitability for epidemiological studies. It was concluded that the important steps were to gain knowledge on the exposure of people from all sources of RF in the environment with a second aim to identify characteristics that would allow a valid prediction of individual exposure levels. A variety of exposure metrics would need to be considered including cumulative, time-weighted and exposure above a predetermined threshold.

**Joe Wiart, France Telecom, France, ‘Personal RF exposure assessment’**

and

**Simon Mann, Health Protection Agency, UK, ‘Laboratory and volunteer trials of an RF personal dosimeter’**

The need for a good personal RF dosimeter or PEM (personal exposure meter) has been discussed in many fora. These two papers discussed the development of the PEM, ongoing modifications and a trial involving 10 volunteers. The requirements for a good PEM include:

- Being small, light and wearable
- Capable of measuring exposure over the entire spectrum
- Good precision as environmental levels will be very close if not lower than the detection limit.

Although the instrument had many positive attributes, discussion centred on the need for further development, for example battery life, (all data are lost when the battery flattens) and cumulative exposure of multiple sources with similar and different frequencies. Another problem was the frequency channels; for example, although FM\TV\GSM\UMTS were covered, there were no channels for TETRA\DECT\WIFI.

**Elisabeth Cardis, IARC, France, ‘Evaluation of general population radiofrequency exposure in a pilot study in France’**

This presentation, which was unscheduled, looked at characterising the RF exposure levels of the general population with an aim of identifying factors which can assist in the prediction of personal exposure. The study will use 10 PEMs in 2 regions of France (Besançon and Lyon) with a focus on children older than 12 years. The outcome will assist in planning for better targeted exposure studies.

**Kjell Hansson Mild, National Institute for Working Life, Sweden, ‘Occupational RF exposure from base station antennas on roof-tops and buildings’**

This talk addressed the problem of accessibility to RF sources by people who could never be classed as ‘occupationally exposed’ in the sense of being a radiofrequency radiation worker. It is also important to note that different countries have different rules on who is occupationally exposed. A typical example is the exposure of painters and maintenance personnel to roof-top RF sources which could exceed the general public limits. It was concluded that in order to protect the health and safety of workers clear identification of the control person and procedures as well as audited measurements and appropriate signage were required.

The first day was brought to a close with an open discussion moderated by Roger Matthes. The discussion addressed many of the points that had been raised in the earlier presentations. These included:

- The need for controlled areas for rooftop antennas,
- How useful the PEM would be when, generally, it is not in the detection range and given that the appropriate exposure metric is not known, and
- Considerable discussion about EHS including some of the outcomes of the WHO Prague workshop.

The second day of the workshop began with several presentations outlining current policy options in several countries, both at the national and local levels.

**Olivier Borraz (CNRS, France) and Danielle Salomon (Risques and Intelligence, France), ‘Regulating the risks of mobile phone base stations: a comparative study in 5 countries’**

This addressed the problem of regulating uncertain risks in the scientific context (‘known unknowns’ and ‘unknown unknowns’) and social (including economic and political) context. A comparative study of mobile phone base station deployment was conducted in 5 European countries- France, UK, Belgium, Switzerland and Spain. The countries have not taken similar decisions in regard RF exposure and their regulatory measures have not eliminated controversy. It was found that:

- The countries did not share a similar assessment of base station risks
- In most countries an intermediate level of government exerted pressure on the central government
- Mobile phone operators exerted pressure on the central government.

These elements explained the differences in regulatory measures but two other issues had an effect (inflaming or calming) – local charters to apply stricter rules and the ability to take matters to court. In the end it is action and interaction between five stakeholders that hold the key, namely central government, scientific experts, operators, local authorities and the courts. In countries where controversy is greatest there is also the greatest instability and inconsistency between the five agents.

Four short presentations that address policy options based on the concept of precaution were outlined, showing the diversity of measures that are being taken around the world.

**Yury Grigoriev, Russian National Committee on Non-Ionizing Radiation protection, Russia, ‘Mobile phone base stations and safety of the population: general situation in Russia’.**

**Jürg Baumann, Swiss Agency for the Environment, Forests and Landscape, Switzerland, ‘The Swiss regulation and its application’.**

**David Black, University of Auckland, New Zealand, ‘Current government responses in New Zealand and Australia’.**

**Paolo Vecchia, National Institute of Health, Italy, ‘Current national government responses – Italy’.**

These four presentations compared and contrasted the approach taken by 5 governments. As could be expected there were differences in exposure guidelines, regulation, compliance audit and the adoption of a precautionary approach.

Of particular interest was the Italian approach where arbitrary low exposure limits were adopted and in Australia where the RF standard spelt out the following precautionary approach “Minimising, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided this can be readily achieved at reasonable expense. Any such precautionary measures should follow good engineering practice and relevant codes of practice. The incorporation of arbitrary additional safety factors beyond the exposure limits of this Standard is not supported.” With regard to base stations the two approaches gave very similar results but the Australian approach avoids the need for a ‘numbers’ debate. Switzerland on the other hand considered it necessary to frame the precautionary limitation of emissions in an unambiguous way in order to provide legal security for operators and the planning authorities and to avoid the need for an evaluation of possible precautionary measures in every single case. Therefore so called installation limit values were defined on the basis of best available technology. These technically based limit values have to be respected by all base stations.

**Paolo Vecchia, National Institute of Health, Italy, ‘Local decision making for the installation of mobile telephony base station: possible options’.**

Here the options available to local authorities were discussed and they can include:

- Ordinance on a minimum distance from identified sites
- Ordinance on maximum exposure levels
- Agreement between the involved parties

Also discussed were, specific examples including Salzburg (the milliwatt limit), Paris (charter between municipality and operators) and Italy where a charter between the municipality, university, operators and concerned public was developed. It was concluded that none of the approaches have completely achieved their goal but they do provide input into future approaches.

The following four presentations provided an account of stakeholders approach to the base station issue, including European Commission sponsored activities (EMF-NET and COST 281), a mobile phone operator association (GSMA) and a grass-root movement association (Plattform Mobilfunk-Initiativen).

**Paolo Ravazzani, Istituto di Ingegneria Biomedica CNR, Italy, ‘The EC coordination Action EMF-NET and the radio base stations and health issue’.**

This described the primary aim of EMF-NET as being the provision of good scientific information to appropriate authorities to enable make to take appropriate actions and decisions. To achieve this the plan is to review current research, investigate the right approach to risk perception and communication and to monitor emerging technologies.

**Norbert Leitgeb, COST Action 281, Austria, ‘Epidemiologic studies on mobile phone base station exposures’.**

COST acknowledged the public call for studies on base station exposures and the COST Action 281 was to make a judgement on the issue. It was emphasised that epidemiological studies are useful for hypothesis testing but they cannot prove a causal relationship where other evidence is lacking (established interaction mechanism, animal and cellular studies). The following points were made:

- Contribution of base stations to a person’s RF exposure is minimal
- No rationale for studying this agent
- Extremely difficult exposure situation (including a changing technology)
- To be successful the biological endpoints would need to have very short latency times

It was not expected that such studies, because of the difficulties, could contribute to the reduction of public concern.

**Jack Rowley, GSM Association, Ireland, ‘Wireless networks – regulatory good practice’.**

Here the following points were made:

- Standards should be developed internationally and adopted nationally
- Local governments should not be imposing their own standards
- Imposed requirements for measurements are of limited value
- Consultation mechanisms at the local level should be consistent with other types of infrastructure
- Appeal processes should be transparent.

In conclusion it was emphasised that there is a need for an independent national authority, a separation between the health and planning agencies, an approach to dealing with the issue of low scientific uncertainty and the perception of greater uncertainty and the need for ongoing consultation between stakeholders.

**Eva Maršálek, Plattform Mobilfunk-Initiativen, Austria, ‘Necessities for public acceptance of mobile phone and wireless-infrastructure’.**

The presenter indicated that it was necessary for the public to accept mobile phones and wireless infrastructure but identified many problems including:

- Lack of public involvement in the process
- Insurance problems
- Lack of protection against long-term exposure from the ICNIRP guidelines
- Community requirement for low exposure levels

She emphasised that low exposure levels are technically and financially possible and recommended the use of intelligent siting, evaluation software and the application of the precautionary principle.

The morning session ended with a panel discussion on policy options moderated by Agnette Peralta.

**Agnette Peralta, Chair, Panel discussion on policy options**

Short presentations were made by representatives of various agencies in Argentina (Jorge Skvarca), Israel (Stelian Ghelberg), USA (Edwin Mantiply), Japan (Naohisa Maeda), Korea (Jeong-Ki Pack) and Germany (Axel Böttger) . Some of the points made included:

- Need to adopt international guidelines (ICNIRP)
- Requirement for a good research programme
- Separation of health, regulatory and planning agencies a necessity
- Need for operators to site-share where possible
- Good public information required
- Consultation between all stakeholders needed from the outset

The topic of the afternoon session revolved around risk perception and risk communication regarding base stations and wireless networks with two presentations by well-known experts in the field.

**Julie Barnett, University of Surrey, UK, ‘Understanding public responses to precautionary action and advice’.**

Here the speaker set out to answer the question ‘what is the effect of precautionary action and advice upon public concerns?’ It has been claimed that precautionary approaches may have an effect opposite to that anticipated. Her group studied the question through focus groups and a national survey and found:

- The precautionary approach may work in the opposite sense
- The precautionary approach may raise other concerns
- Some people were reassured
- Some people expressed cynicism with the government approach.

It was concluded that if the precautionary approach is to be widely used then a much greater understanding of its impact and interpretation by the public is required.

**Ortwin Renn, University of Stuttgart, Germany, ‘Strategies for communication on base stations’.**

This presentation addressed the questions the requirements and implementation of effective risk communication, the role of trust and credibility and how to balance public concerns with mobile service requirements. The following points were made:

- Introducing precautionary measures may not have the desired effect
- Public is always happier with certainty usually problems with any uncertainty
- All messages to the public need to be simple, clear but factually correct
- Need to show the public how to protect themselves but recognise that this approach has limited value for base station
- Important to be aware that terms can have quite different meanings in different countries
- Stakeholder meetings are important and care should be taken in deciding who speaks, who can be trusted (will be different in different countries) and whether a facilitator is required

Michael Repacholi then opened a discussion on the key issues identified by participants during the workshop, summarized the outcomes of the meeting and drew it to a close. Some of the points made included:

- Unless precaution is used carefully a situation could be inflamed,
- Many participants were concerned about the issue of ‘sensitive sites’ and again the best of intentions may result in an undesirable outcome for stakeholders,
- WHO should provide some specific case studies on siting, and
- WHO/EURO Authorities booklet on wireless communication would play an important role if it was able to reflect the contributions to this workshop.

Michael Repacholi thanked all the participants for their presentations and discussions at the Workshop and indicated that it would prove to be an important contribution to the EMF Project. He also thanked his staff for excellent organization of the Workshop.