METHODS TO ASSESS EXPOSURE OF THE POPULATION NEXT TO MOBILE COMMUNICATION BASE STATIONS

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ABSTRACT

The public concern about the potential adverse health effects of the human exposure to the electromagnetic radiation of GSM base stations has grown in the recent years. The increasing number of cellular telephony subscribers has led to an expansion of networks, with the installation of more base stations. This number of base stations may have to rise significantly in order to implement the latest developments (UMTS). This situation makes it imperative to develop harmonised, EU-wide common exposure measurement standards. Problems that have to be solved in the development of such documents are described within this paper.

INTRODUCTION

About 15 % of the population world – wide are using mobile phones, penetration rates in Europe are even much higher. Within the EU about 330 million people are using GSM phones. This situation led to a significant deployment of base stations that are often the reason for major concerns of parts of the population. Harmonised standardisation methods were developed recently for mobile telephones but are still under development today to quantify exposure of the population originating from GSM and UMTS base stations [1], [2]. It is not possible to use the methods for mobile phones for exposure assessment in the environment of base stations, because in situ measurements differ from near-field and SAR measurements in many physical aspects, because real-life situations are more complicated than controlled laboratory conditions due to multiple reflections and diffraction effects and there is no widely accepted scientific rationale for establishing the respective procedures of measurement. Harmonised methods for assessing the exposure to radiation of base stations are strongly needed as a basis for risk assessment and communication. The ongoing work of CENELEC TC 106x "Electromagnetic Fields in the Human Environment" also demonstrates the need of the mentioned harmonised methods, and clearly indicates that more research is needed to support the development of the assessment methods. Only the availability of standardised methods can guarantee comparability of exposure levels and provide the data for future epidemiological studies. Although many local and national measurement campaigns were conducted during the last years, no large-scale study has been undertaken which could assess the exposure levels across Europe. A study of this size can only be the outcome of a pan-European collaborative action within the opportunities offered by large political organisations, such as the EU. In fact, one of the largest and most comprehensive studies so far was performed in the frame of a COST action. In 1999 it was decided within the COST 244bis Action "Biomedical Effects of Electromagnetic Fields" that data from some European nations on the exposure levels of base stations should be compiled in order to check the comparability of the data gathered from different sources and countries and to identify gaps of knowledge concerning these data in the frame of a Short Term Mission [3]. This action showed that assessment methods were not the same in the different participating countries. For example, one difference was that the field measurements were made either in two or three orthogonal directions. Significant differences were found in the methodology to determine measurement positions. Measurement settings of the equipment used, e.g. the resolution bandwidth differed in several cases. Several unsolved problems need to be examined before a well-established exposure assessment protocol can be developed.

DESCRIPTION OF SITUATION

The existence of a large number of scatterers and absorbing objects leads to a highly non – uniform field distribution in the environment of base stations due to shadowing and fast fading effects. Houses, trees, cars and other objects can lead to outdoor field variations that can only be determined by applying very sophisticated software tools or by very large measurement campaigns. In the next figure an example of the field distribution in the environment of a base station is shown. The simulation was performed using the software tool Quickstep [4]. It shows the buildings in the environment of a roof top mounted base station and the distribution of the field strength radiated by this station. The position of the base station is indicated by an arrow. Red areas correspond to the areas with the highest field levels, the black areas are indicating the areas with lowest exposure. Evaluation of fields is restricted to areas outside of buildings. It can be clearly seen from the figure that the buildings cause a strong shadowing effect and that the field distribution is very heterogeneous.

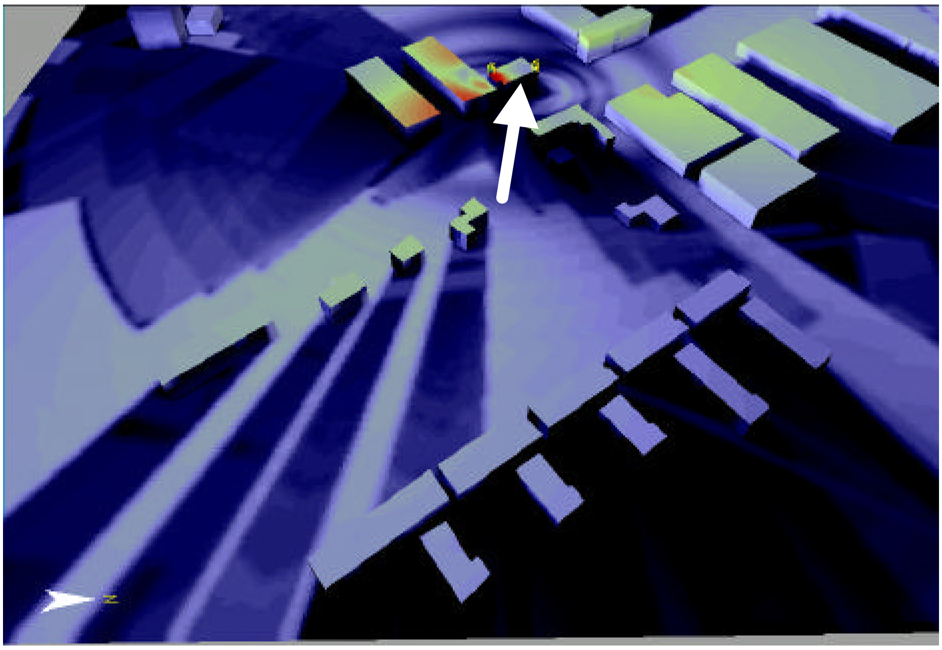

Fig.1. Field distribution around a roof mounted GSM base station (figure provided by BAKOM)

The situation inside buildings is even more complicated. In a room in the research centre Seibersdorf a volume of about 1 m³ was examined. The electric field strength of a GSM broadcast channel (BCCH) operating at 944.6 MHz was measured within this volume using a grid size of 15 cm. 343 measurements were performed. In figure 2 the distribution of the field strengths according to classes of magnitudes is shown. The minimum was 3.3 mV/m, the maximum was 42.3 mV/m, this corresponds to variations of about +10 to – 13 dB from the average value. This distribution also indicates that a single measurement might not be representative for the exposure scenario.

Outdoor, apart from surrounding or moving objects, rain or snow can also have an impact on the exposure situation at places where the general public has access. Large areas covered with snow can become large reflecting areas that would not exist without snow. Field variations versus time caused by changes of the power of traffic channels, the stability of BCCH's or moving scatterers have also to be examined to determine their contribution to the uncertainty budget of exposure assessment. The search for maximum field level is a very crucial topic, because a comparison of the maximum field level with exposure limits given in several documents as [5] is often required. However, the reproducibility of identified maxima is one of the largest problems due to field variations in time and space. In this context it is important to say that the selection of the location for performing measurements is very important. Another issue that has to be examined in more detail is averaging of field values over areas or volumes representing the human body.

CONCLUSIONS

To carry out the development work needed for a common EU standard a fruitful synergy was established under the initiative of the European Commission which formed the JRC Collaborative Action "Human exposure to radiation from GSM and UMTS base stations across Europe". Following the completion of the standard development work **the key objective of the JRC Collaborative Action will be to become a Reference System at EU level for the:**

- implementation of CENELEC standards related to EMF radiation,
- harmonisation of EMF radiation and human exposure monitoring activities,

To this end, the JRC CA is presently networking key laboratories in Europe to carry out measurement campaigns across the EU by using common procedures. Progress made to date regarding the harmonisation of data interpretation, presentation and risk communication methods will also be reported.

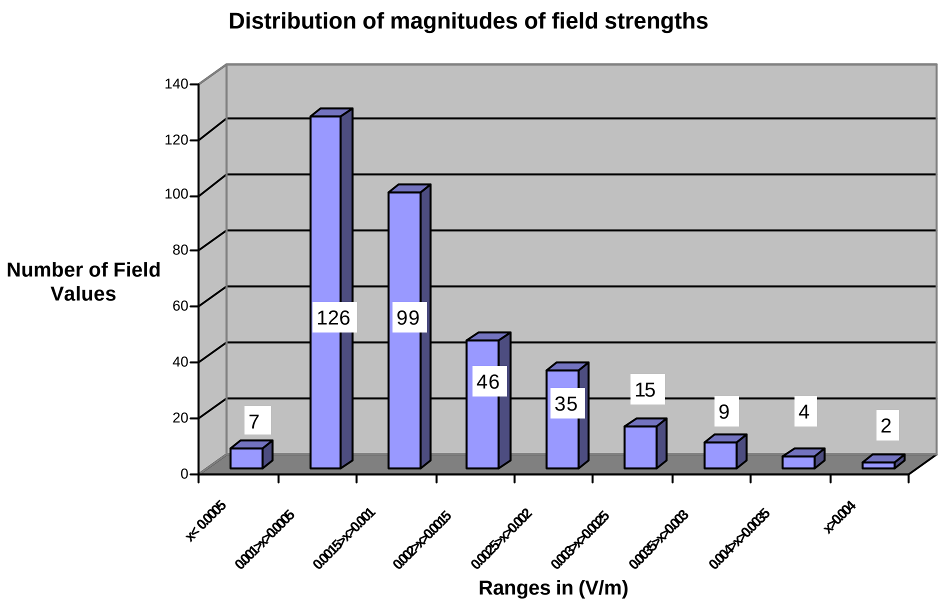

Fig.2. Distribution of field strength values according to classes in a volume of 1 m³

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