Energy Absorption in Adult Male and Child due to Femtocell

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INTRODUCTION

In addition to wide spread implementation of macro, micro and picocell base stations (GSM, UMTS) in our environment an Access Point Base Station (Femtocell) is being widely introduced. It is a small cellular base station designed for use in residential or small business environments. It connects to the service provider's network via broadband (such as DSL or cable) and typically supports 2 to 5 mobile phones in a residential setting. The thought of installing a 3G base station in the sleeping room is undoubtedly causing great consternation amongst certain sections of population and, thus, calls for detailed analysis of the exposure assessment. This study deals with the analysis of the energy absorption in the adult male and 6 y child due to electromagnetic fields (EMF) that could be found in the vicinity of typical Femtocell.

MATERIALS AND METHODS

We investigated radiation pattern and EMF exposure in the vicinity of a Femtocell (3G) operating at 2100 MHz with a peak transmitted power of 20 mW. The unit we investigated features an internal whip antenna printed on a circuit board, perpendicular to the main electronics circuit board in the device. We modeled the antenna to a fine precision, and the main circuit board only as a perfectly conducting plate. As all the components have a low profile, this representation is accurate enough. For modeling and simulations, we used the SEMCAD X software package from Schmid & Partner Engineering AG.

Since the Femtocell could be mounted anywhere in the home or office, it was placed close to the head of an anatomically correct non-homogenous human model. The model was placed 1 cm away from the outer casing of the Femtocell, oriented in such a way that the coupling between internal antenna and human body represents the worst case scenario.

We used the Virtual Family adult male and 6 year old child model (Duke and Thelonious), resolution $3mm^3$, developed by the IT'IS Foundation [1]. Tissue parameters were obtained from the well known Gabriel parametric model.

RESULTS

Detailed analysis of the space distribution of the electric field strength in the close vicinity of the Femtocell showed that E-field could reach up to 7 V/m at the distance of 1 cm (Figure 1). Taken this into account, the whole body average and spatial peak SARs were computed for adult male and 6-year old child model, respectively. Results showed that whole body SAR in male model was $4.3 \cdot 10^{-5}$ W/kg and $3 \cdot 10^{-4}$ W/kg in the child model. This is far below the reference levels (0.08 W/kg) for the general public of the ICNIRP guidelines of 1998.

In addition, spatial peak SAR values that were found in superficial tissues close to main beam of the radiated antenna were 0.031 W/kg in male model and 0.13 W/kg in the child model, respectively.

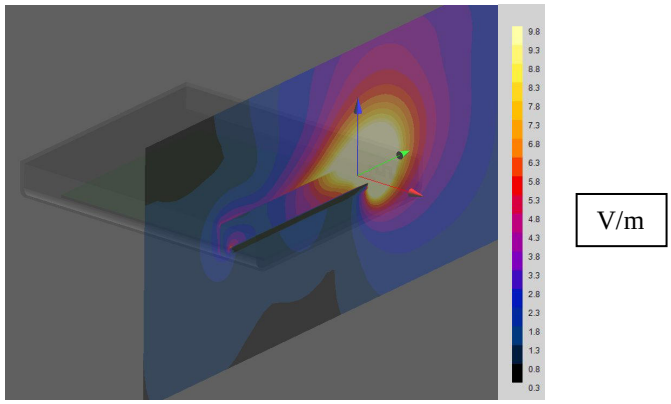

Figure 1: Distribution of Electric field strength (V/m) in the vicinity of the Femtocell.

The location of the spatial peak SAR was, as expected, in the region closest to the transmitter. In the both models, the highest local SAR was found in the frontal face area. The difference in spatial peak SAR is due to the position of the child's head that is moved slightly forward in comparison to the adult model.

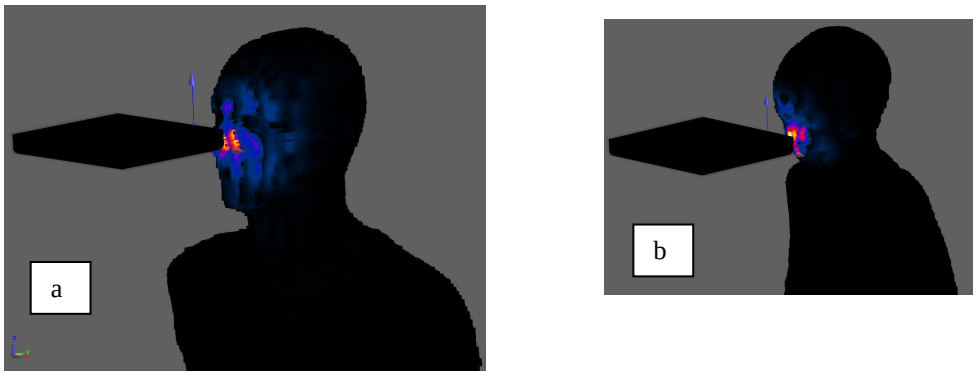

Figure 2: SAR distribution inside of the a) adult male model b) 6-year old child model.

CONCLUSIONS

Taken together, it has been shown that the SAR values in the adult male and child model arising from the exposure to Femtocell base stations are far below the reference levels for the general public of the ICNIRP guidelines of 1998. In general, the values are also lower compared to energy absorption arising from any other wireless devices we have at home, for example wireless computer routers, wireless DECT phones and baby alarms. On the other hand, Femtocells could improve handset's connection to the network, the handset will use less power and RF exposure of the user may actually reduce.

REFERENCES

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