Measurements for assessing the exposure from 3G femtocells

Achilles Boursianis[1], Ioannis Markakis[1], Zoi Manoli[1], Nikolaos J. Tachas[1] and Theodoros Samaras[1*]

[1] *Radiocommunications Laboratory, Department of Physics,*
Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece
[*] *corresponding author e-mail: theosama@auth.gr*

Introduction

Femtocells that are currently being marketed by 3G mobile phone providers are low-power access points, which combine mobile and broadband technologies. The femtocell unit functions as a miniature base station in the home and connects to the operator's network through a broadband or cable line. This results in improved coverage and capacity within the home of the femtocell owners, who have the ability to control which subscribers can make use of the unit. The femtocell allows up to about 4 simultaneous calls/data sessions at any time. The output power of femtocells is typically less than 0.1 W, a value similar to other home network equipment (e.g. wireless broadband routers).

Informa Telecoms & Media [1] expects the femtocell market to experience significant growth over the next few years, reaching just under 49 million femtocell access points in the market by 2014 and 114 million mobile users accessing mobile networks through femtocells during that year. According to Juniper Research [2] femtocell-based services used by 3G mobile subscribers will generate in excess of $9bn per annum by 2014.

However, potential health effects from the deployment of femtocells remain a marketing issue [3], since many people perceive them as a mobile phone mast in the home.

In this work we present the first results of exposure assessment of 3G femtocells in Greece.

Materials and Methods

A femtocell access point (UAP2105, Huawei Technologies Co.) was installed at a height of 1.7m above floor level in a typical office environment on the fourth floor of a building in the Aristotle University of Thessaloniki (premises of the Radiocommunications Laboratory). This alternative to a home environment was chosen, because it offered the possibility for more measurement points. According to the mobile provider the unit operated in UMTS absolute radio-frequency channel number (ARFCN) 10639, i.e. at 2127.8 MHz, and the scrambling codes used were between 508 and 511. A mobile handset (Nokia N95 8GB) with the appropriate software (NetMonitor) was used to record the received signal code power (RSCP) of the pilot channel (CPICH) and the transmitted (Tx) power at 123 points of a regular (as closely as possible, due to the furniture) grid covering an area of about 175m^2. The distance between the measurement points was larger than a wavelength, so that they were independent from each other. The mobile handset was held by a technician at the intended position for conversation, so that the influence of both the hand and the head were considered. At each point of the grid four values were recorded at four different azimuth angles (step of 90^o) with respect to the north. The average value of these four measurements for the received and transmitted power was eventually associated with the grid point.

The measurements were carried out for two situations, i.e. femtocell on and off. It was verified by observing the display of the NetMonitor software on the test handset that it communicated with the femtocell in the former situation and with a nearby macrocell base station of the mobile operator in the latter situation. Further, frequency selective measurements of the electric field with a radiation meter (SRM-3000, Narda STS) and a spectrum analyzer setup (FSH3, Rhode&Scharz and SBA9113, Schwarzbeck) were performed in front of the femtocell (at a height of 1.7m) in the above two situations to register differences in the electromagnetic field in the environment.

Results

The RSCP measurements were evaluated against the quality levels for signal reception set by the national regulatory authority of telecommunications. The resulting cumulative distribution function (CDF) revealed that in the whole area measured coverage was satisfactory (best quality), since the RSCP was larger than -95dBm. At the same time the CDF of the transmitted power (Fig. 1) showed that in 90% of all points the power of the mobile phone was about 8dB lower when the femtocell was operating.

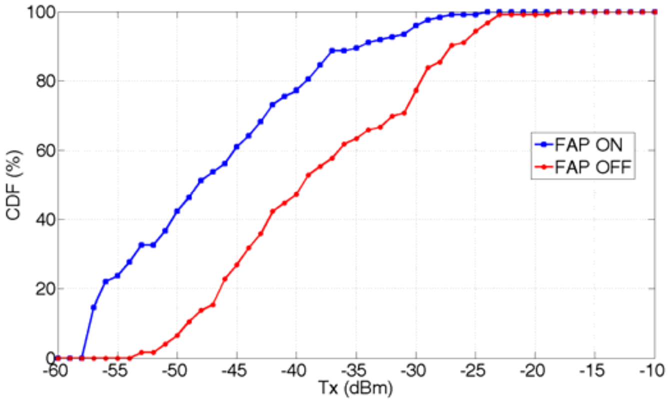

Figure 1: CDF of transmitted power from the test phone with the femtocell access point (FAP) ON and OFF.

In front of the FAP (in its' main beam) and at distances between 1 to 3m the power density measured with the selective radiation meter did not show distinguishable differences, most probably because of its low sensitivity. The power density measured with the spectrum analyzer setup is shown in Fig. 2 and it is clear that already at a distance of 3m there is no discernible difference between the two situations (FAP ON and OFF). At a distance of 1m during FAP operation the power density is lower than the strictest national reference level for UMTS downlink ($6W/m^2$) by about 1770 times.

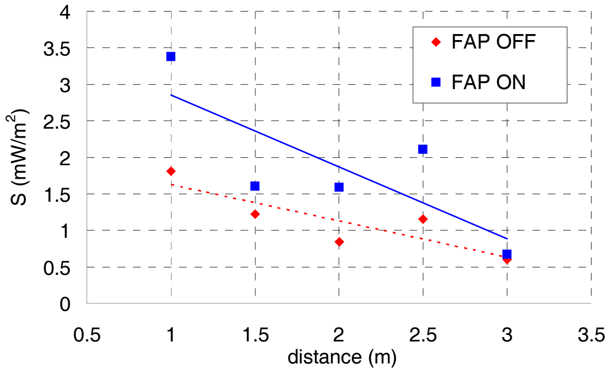

Figure 2: Measured power density in front of the femtocell access point (FAP).

Summary and Conclusions

In this work we present the first measurements in Greece for exposure assessment purposes from the use of femtocells indoors. It is obvious from the results that the use of femtocells

- improves reception quality indoors,
- reduces the transmitted power of the user's phone and, consequently, the absorbed power in his/her head, by about six times, and
- results in an increase of the electromagnetic radiation till a distance of about 3m around the unit, however, at values that are extremely low compared to reference levels of exposure guidelines.

References

[1] Informa Telecoms & Media. *Femtocell Market Status. Issue 2*. London, February 2010.

[2] Juniper Research. *3G Femtocells and Beyond. Opportunities & Service Scenarios in the Home 2009 - 2014.* Basingstoke, June 2009.

[3] D. Graham-Rowe. Why every home should have a cellphone mast. *New Scientist*, 2646: 24-25, March 2008.