LEXNET Project Newsletter

Low EMF Exposure Future Networks
(FP7 Contract n°318273)

Issue No. 1
September 2013

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Inside this Issue

1. Editorial

The LEXNET project newsletter will be released periodically, and aims to provide a continuous view of the project activities and progress.

Low EMF Exposure Future Networks (LEXNET) is a European collaborative research project partially funded by the European Commission.

The main goal of LEXNET is to investigate methods, technologies and architectures able to support networks inducing a reduced global exposure of the population to electromagnetic fields (EMF) from wireless systems and access points.

LEXNET achieves its goal and vision by research in five technical Work Packages (WPs). WP2 will provide reference scenarios, high level requirements for dosimeter design and an EMF exposure index definition to use in WPs 3, 4 and 5. These WPs will develop, respectively, a dosimeter, low EMF radio technologies, and low EMF networks architectures, which will be implemented in WP6 validation platforms.

The project kicked off in November 2012, and will last 3 years.

During the BioEM conference in June 2013, the overall project was presented at a glance, receiving great interest. While the concepts of basic restrictions and reference levels that limit the public exposure electromagnetic field strength are well known, the novelty of a global index of exposure, assessing the exposure of a population over space and time and taking into account both up- and downlink sources was largely acknowledged and resulted in a lot of questions and attention.

2. Under the Spotlight:
Focus on WP2

WP2 is dedicated to the definition of an exposure index and to the analysis of the social-economic impact of such an index.

Concerning the analysis of the social-economic impact, an online survey was conducted in 7 European countries, between April and June 2013, aiming to analyse the daily use of RF EMF emitting devices in relation to intuitive exposure assessment and risk perception. The survey aimed at a comprehensive analysis of the public's view regarding RF EMF exposure by focussing on four key topics:

- RF EMF exposure situation of the general public;
- subjective beliefs about parameters influencing the strength of exposure ;
- subjective models about the relationship between EMF exposure conditions and magnitude of risk;
- social and personal determinants of RF EMF risk perception.

A total of 2475 responses to the survey were received. After quality control, 2392 of the responses remained. A deliverable summarises the conclusions that can be drawn from this survey. The main results are:

- Approximately 83% of the respondents use mobile phones in direct contact with their ears, i.e., without headsets. Nearly one quarter of the respondents reported a usage time of 10 to 30 minutes per day. Only 6% use their mobile phones more often than 60 minutes per day.
- Interviewees underestimate the role of distance in the exposure strength.
- Base stations are seen as a higher risk than all other RF EMF sources.
- Intuitive risk perception is guided by subjective EMF-impact models, which underestimate near field exposure and overestimate far field exposure.

- There is no relationship between the use of exposure reduction measures and EMF risk perception.

More information can be found in Deliverable D 2.2 "Risk and exposure perception".

WP2, in charge of the design of the exposure index, includes a task dedicated to the assessment, using numerical and statistical tools, of the human exposure to base stations/access points, as well as the exposure induced by wireless systems in various configurations and usage scenarios.

Configurations linked to realistic usages of wireless systems were defined, and selected whole body numerical models were deformed in order to consider in the calculations different postures linked to different usages, Figure 1.

The comparison of numerical tools used by the partners involved in WP2 and the validation of the deformed numerical models are detailed in a deliverable.
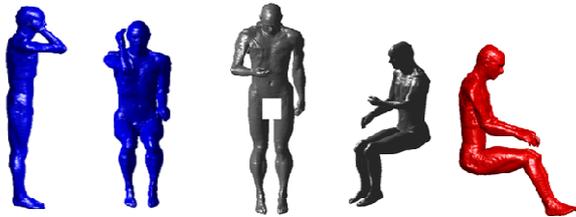
Figure 1 - Numerical adult male model deformed to be representative of different usage configurations.

A lot of work is being carried out on the definition of the exposure index. This index will cover the day-to-day exposure of people in a given area, induced by an entire wireless network from base stations to individual devices.

The index of exposure will aggregate the downlink exposure induced by the base stations, the uplink exposure induced by the devices in communication, the different usages, depending on the category of users, the different postures, the different environments, the different RAT and layers in the network, the different periods of the day. A set of technical data is going to be considered and aggregated in a tree of exposure, each branch of the tree being a possible scenario.

The formulation of the index is still under improvement, and many exchanges and discussions with WPs 4 and 5 have led to better specify the index. A simplified but realistic example of index calculation is under preparation.

3. Inside LEXNET: News from WPs

WP2: Socio-economic analysis, EMF exposure metrics, and reduction targets

For this issue, work from WP2 is reported in the previous section, "Under the Spotlight".

WP3: Efficient EMF Measurement and Assessment of the Exposure Index

In WP3, which studies the efficient measurement and assessment of the exposure index, partners defined basic the requirements for future measurement systems.

WP3 started to work on the technical characteristics of the LEXNET wearable dosimeter. The technical, mechanical and economical aspects of this dosimeter were discussed and agreed upon with all partners.

Work has also started regarding the architecture choice of the LEXNET dosimeter. Several ideas are under consideration keeping in mind the flexibility of the design, low cost, and wide scale implementation. Two topologies are under consideration. One with very accurate performance and a high level of flexibility, but with constraints in terms of cost and power consumption, and the other with a simplistic approach offering a low cost solution, but with constraints in terms of performance, design flexibility and accuracy issues.

The dosimeter specifications were set and the initial phase of task organisation and work distribution was validated among contributors.

The study of measurement uncertainty regarding network environment progressed well. A time domain based measurement test bench was setup. It is capable of measuring different telecom standards (GSM, UMTS, WiFi). The proposed bench is mobile and can be setup in different locations. The aim is to carry out measurements in different scenarios (urban, rural, close/away from the base station, different time of day, weather, etc.).

Measurements will be carried out according to the guidelines setup by the National French Radio Frequencies Ministry (ANFR). Comparisons will be made with the actual dosimeter measurement techniques. The outcome is expected to outline the guidelines for the LEXNET dosimeter measurement technique with minimum uncertainty.

WP4: Smart Low EMF Radio

WP4 deals with low exposure radio technologies, both on the hardware and radio protocol level.

Two categories of hardware development are distinguished. One of them deals with antenna solutions that control the radiating pattern, aiming to transmit power only in the useful directions. Two classes of antennas have been identified to control and to focus the EM fields. First, antennas close to the body will be studied to control the near-field and could have an important impact on the uplink local exposure. A literature review has been carried out in the area of low-SAR antennas with metamaterials. On the access point side, beamforming solutions have been reviewed to control the radiation pattern and focus energy only where it is useful. The other category considers transceiver hardware and mechanisms that enable enhanced sleep mode to save both power and exposure.

Concerning radio transmission techniques the aim is to manage and mitigate interference thanks to beamforming techniques, cell discontinuous transmission, enhancing scheduling and transmit power control, and protocol optimisation, among others. A wide range of enabling solutions has been detailed in an internal report.

Discussions and exchanges have been held with WP2 in order to apply the exposure index evaluation to a simple example, based on a WP4 proposed Discontinuous Transmission (DTX) solution to lower the exposure. This work, which is still in progress, allows an alignment between the global and user-centric exposure concepts.

Among others, several topics have been selected for further study: multi-users power and bandwidth allocation, analysis of the effects and peculiarities of WiFi interference with Zigbee devices and link adaptation and dual-hop OFDM relay systems, with no direct communication between source of information (base station) and destination terminal (mobile user).

WP5: Smart Low EMF Architectures

In WP5, dedicated to smart low EMF architectures and launched in January 2013, partners started to study different management techniques and look at how to use different network topology designs for minimising the EMF exposure. They also started reviewing existing network planning tools and techniques and how they can be utilised for reducing EMF exposure.

In April 2013, WP5 partners completed a detailed review of the impact of different existing and emerging network technologies, most notably cellular, wireless local area and wireless sensor networks, as well as various other sources of electro-magnetic fields, such as broadcasting transmitters and power lines (these other sources are considered with a view to providing an idea of the "background" EMF levels), in terms of EMF exposure and what strategies can be identified to contain this exposure.

Literature review on EMF has brought to light the fact that EMF has so far received very little, if any, consideration as a key performance indicator (KPI) for designing communication networks. Consequently, WP5 partners have started to look at how to use low-layer cooperation and multihop routing techniques for minimising the EMF exposure.

To complement these studies, WP5 partners are reviewing existing network planning tools and techniques and how they can be utilized for reducing EMF exposure. In addition, WP5 partners have started to study different management techniques and the potential impact they may have on the EMF exposure.

WP5's first internal report, in addition to capturing the above by providing a comprehensive overview of the EMF footprint of existing and emerging wireless networks, and the impact of most common network management techniques on EMF, has yielded a way forward for WP5. More specifically, several research paths were identified in different areas.

At a WP5 face-to-face meeting held in London in June 2013, it was agreed that research efforts within WP5 will proceed streamlined into four activities:

- EMF / QoE trade-offs in cellular networks—a mix of theoretical analysis, simulations and possible testbed use to link QoE and EMF;
- routing for multi-hop networks—efforts to try and distribute exposure amongst nodes / people in WiFi / WSNs / D2D networks;
- network engineering services—designing a database for storing measurements, events, supporting multiple users;
- network topologies—covering topics including radio planning and EMF exposure maps, AP placement for low EMF exposure, cell co-ordination, and AP / network selection.

WP-6: Validation and assessment of the objectives

WP6 started in June 2013, where preliminary work is underway.

4. Looking Outside: Views on LEXNET

LEXNET has issued a Press Release. This Press Release was translated and launched by all the partners in different countries. With this Press Release, the project has done a first step to its visibility, towards not only the ICT community in particular but also the society in general. Further press releases may be issued, accompanying major public achievements of the project, like public workshops and demonstration events.

LEXNET posters were presented at BioEM2013 (www.bioem2013.org/), Thessaloniki, Greece, June 2013 and FuNeMS2013 (www.futurenetworksummit.eu/2013/), Lisbon, Portugal, July 2013, Figure 2.

- Joe Wiart, Emmanuelle Conil, Yann Toutain, Serge Bories, Milos Tesanovic, Yves Lostanlen and Luis M. Correia, "Low Exposure Network", Proc. of BioEM'2013, Thessaloniki, Greece, June 2013.
- Carla Oliveira, Michal Mackowiak, Luis M. Correia and Joe Wiart, "Low Exposure future NETworks", Proc. of FuNeMS 2013, Lisbon, Portugal, July 2013.
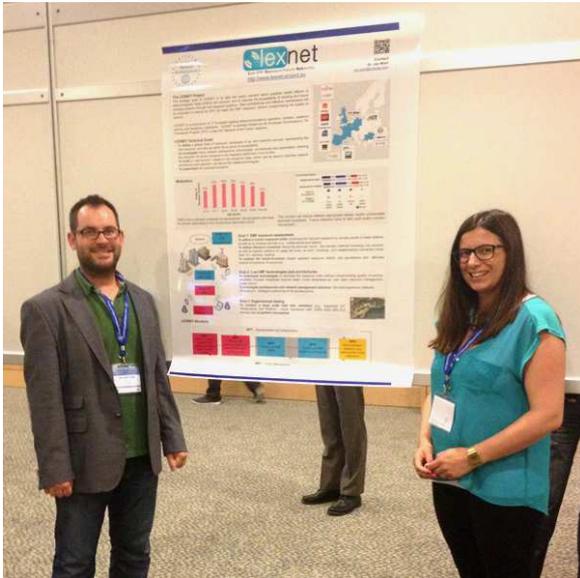

Figure 2 - Poster in FUNEMS.

In addition, an overview of LEXNET was given in July 2013 to the Wireless Technology and Spectrum Working Group, part of the UK government sponsored ICT Knowledge Transfer Network (KTN). The meeting was attended by a range of UK senior specialists from Government and the Regulators, Industry Communities, Network Operators, Network Vendors and Academia.

5. What's Next: Upcoming Events

Upcoming LEXNET related events include:

- LEXNET workshop, Berlin, Germany, September 18th, 2013.
- LEXNET general meeting, Grenoble, France November 19th-21st, 2013.

Other conferences and workshops of interest to LEXNET are:

- ISWCS 2013, The Tenth International Symposium on Wireless Communication Systems, August 27th-30th, Ilmenau, Germany.
- AMTA, Antenna Measurement Technics Association, October 6th-11th, Columbus, OH, USA.
- EMW, European Microwave Week, October 6th-11th, Nuremburg, Germany.
- TELFOR, Telecommunications Forum in Belgrade, November 26th-28th, Belgrade, Serbia.
- GLOBECOM , IEEE Global Communications Conference, December 9th-13th, Atlanta, GA, USA.
- SRA, Society of Risk Analysis, Annual Meeting, December 8th-11th, Baltimore, MD, USA.

To find out more

For more information, go to the project website (http://www.lexnet-project.eu/), or contact via email joe.wiart@orange.com.