MEASUREMENT OF THE RADIOFREQUENCY POWER TRANSMITTED BY 3G MOBILE PHONES DURING « Voice over IP » (VoIP) COMMUNICATION

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The power output from a telephone during communication over a network may depend *a priori* on numerous parameters: type of use (data, voice, …), quality of the network coverage, technology employed, management of resources by the operator, etc. There have been few publications on evaluating the power output of 3G mobile phones during voice communication over a mobile network and new types of use [1] [2] [3]. Our aim is to characterise the power transmitted by 3G smartphones (release 6 - HSPA) in the case of typical types of use: Voice and Voice over Internet Protocol (VoIP) using very well known application in real life usage.

Introduction

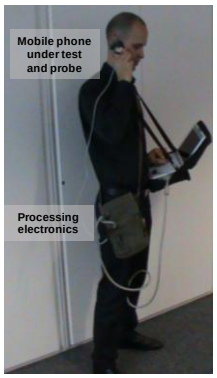
Mobile phones are transceivers which use a network of fixed aerials distributed round the country (base stations) for accessing the different mobile telephony services. In 2010, 82% of all French people aged 12 and over were equipped with a personal and/or professional mobile phone; 21% of all working people had a professional mobile phone [4]. Over these last few years we have witnessed a progressive change in the use of mobile phones, due in part to the evolution in the type of telephone (in 2010, 16% of personal-use owners had a smartphone allowing them to access the mobile internet) and in part to technological progress of the networks (passing from the GSM technology known as "2G" to the W-CDMA technology known as "3G" offering the user a higher speed).

The power output from a telephone during communication over a network depend on technology employed.

Power control caracteristics			
Technology	Frequency	Dynamic	
2G (GSM)	16,6 Hz (60 ms)	30 dB	from Pmax to Pmax / 1 000
3G (UMTS R99, WCDMA)	1500 Hz (0,6 ms)	70 dB	from Pmax to Pmax / 10 000 000

Materials

The power transmitted by the equipment during communication is measured in a real-life usage situation by means of a portable device, developed in collaboration with Supelec [5], which detects the signal transmitted by the telephone undergoing the test, through the intermediary of a probe which does not affect it. The device is composed of a probe, processing electronics, a micro-computer for control and a device for viewing the results. The probe (consisting of a crossed dipole array) is placed behind the telephone. It is electromagnetically coupled to the antenna of the mobile phone and, since the coupling coefficient remains constant over time, the power at the outlet of the probe is proportional to the output power of the mobile phone [6].



The equipment detects and records the following data 20,000 times per second:
- The frequency band used: 900 MHz, 1800 MHz, 1900 MHz
- The technology used: GSM (2G), UMTS (3G)
- The normalised output power (Pe/Pmax)

For a complete call, the equipment provides:

- The time spent in each band,
- The time spent in each technology,
- The normalised output power in each band,
-The normalised output power in each technology.

With regard to the calibration of the measuring apparatus:

In the 2G technology, at the start of each communication, the mobile transmits for a few seconds its maximum power and the level detected by the probe at this moment makes it possible to normalise the set of other TDMA frames detected during the communication and thereby calculate the normalised output power (Pe/Pmax).

In the 3G technology, the mobile does not transmit its maximum power at the start of the communication, so the measuring device is calibrated in laboratory by way of emulation of a base station, which forces the mobile to issue its maximum power. This level detected by the probe in such conditions is then memorised, making it possible to normalise the set of 3G signals which occur during the communication. The calibration in 3G is linked to a specific position of the probe on a specific telephone.

Three 3G smartphones (UMTS – release 99 and release 6) from three different manufacturers were used in the city of Paris (France), corresponding to a dense urban environment, between 9h and 17h, from 28th July to 4th August 2011. In total, 250 voice calls were made, including 117 voice calls on 3G and 133 voice calls on 3G using VoIP application very well known.

Methods

This set of readings was taken by a single adult operator holding the telephone systematically in his right hand.

For voice calls, the telephone is held in the usual way, close to his right ear, as a normal user would do. For reasons of repeatability, a small speaker placed in front of the telephone micro transmits continuously a spoken text at a medium pace/tone. The operator remains silent and the communication is made to a voice server, likewise speaking at a medium pace/tone.

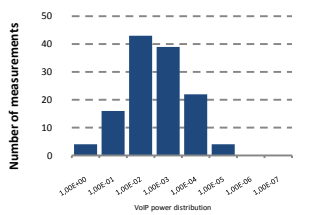
A 3G voice call for a duration of 2 minutes is made, immediately after a second 3G voice call using VoIP application is made.

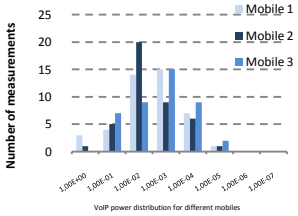
For outdoor calls, the instructions given to the operator were to stand still for calls made in public places including parks and gardens. For indoor calls (in the office, at home, in bars, restaurants, etc.) the operator does not move around, often remaining seated. From the fact that the reading is taken continuously throughout the entire communication, the effect of any possible inter-cell handover is included in the data and processed accordingly.

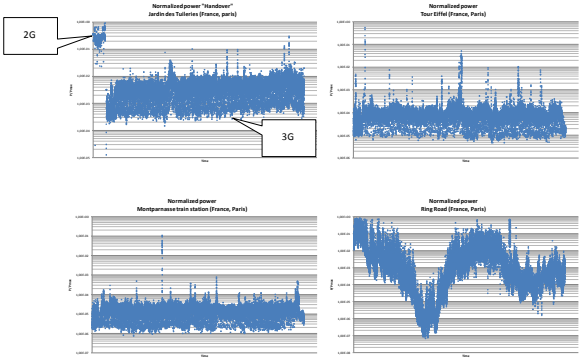
Results

In VoIP communications in 3G, the average transmitted power is 1.03% of maximum power. There is a ratio of 6.91 dB (i.e. factor of 5) between 3G VoIP and 3G voice communication. These results are in line with those published by Gati et al. (i.e. factor of 3-5) [7] and Persson et al. (i.e. factor of 4-25) [8].

	Mobile 1	Mobile 2	Mobile 3	Mean
Mean power 3G voice	0,36%	0,13%	0,15%	0,21%
Mean power 3G VoIP	1,82%	0,78%	0,47%	1,03%
Mean power	1,13%	0,47%	0,32%	0,65%
3G VoIP / 3G voice ratio	7,04 dB	7,78 dB	4,96 dB	6,91 dB







Considering the mean power indicator, the Indoor exposure is 7.65 dB higher than in an outdoor situation. These results are in line with those published by Gati et al.

	3G Voice	3G VoIP	Mean
Mean power Indoor	0,36%	1,89%	1,16%
Mean power Outdoor	0,09%	0,33%	0,22%
Indoor / Outdoor ratio	5,87 dB	7,65 dB	7,22 dB

Conclusion

In the framework of this study, with regard to the 3G VoIP calls, the average transmitted power is 1/100 of maximum power. However we are talking about extremely low values. The power levels from the 3G mobiles are clearly lower than those from the 2G mobiles reported in various publications (of around Pmax/3 on average).

References

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