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Brief Communication

Is there any exposure from a mobile phone in stand-by mode?

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Running title: Mobile phone in stand-by mode

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Abstract

Several studies have been using a GSM mobile phone in stand-by mode as the source for exposure, and they claimed that this caused effects on for instance sleep and testicular function. In stand-by mode the phone is only active in periodic location updates, and this occurs with a frequency set by the net operator. Typical updates occur with 2-5 hours in between, and between these updates the phone is to be considered as a passive radio receiver with no microwave emission. Thus, the exposure in stand-by mode can be considered negligible.

Key words: cellular phone, emission, GSM, UMTS

Lately many papers have been published on the effect of mobile phone exposure on human semen quality [Fejes et al., 2005; Agarwal et al., 2008] as well as experimental studies on sexual behavior and testicular function in rabbits [Salama et al. 2008; Salama et al., 2009 a, b]. Studies have also been done on human EEG and sleep after such exposure [Hung et al. 2007]. Spatial memory performance in rats was studied by Narayanan et al. [2009]. The problem with these papers is the lack of proper dosimetry and a clear description of what exposure that really has been used. Now it is stated in some of these papers that the exposure is to a mobile phone in so called stand-by mode; i.e. the phone is turned on but without an active call. In the animal experiments the rabbit sits on a GSM 800 MHz phone, and it is mentioned that the average electric field strength 0.5 cm from the phone is 2.92 V/m and at the most distant region inside the cage it is 0.487 V/m. Hung et al. [2007] uses the modes “sham, listen, stand-by, and talk”. In the paper by Narayanan et al the exposure is to “missed calls” without any more information as to what the exposure and dosimetry is.

Here we want to clarify the different modes a Global System for Mobile Communication (GSM) phone can operate in: talk, listen and stand-by mode, and how the SAR values from a phone are related to this. The phones using GSM operates at 900 or 1800 MHz and utilize the so called Time Division Multiple Access (TDMA) and discontinuous transmission (DTX). The TDMA allows several phones to simultaneously use the same base station, and the signal is sent in pulses with a basic repetition frequency of 217 Hz, but with the 26th pulse idle grouping 26 pulses together to give an ELF frequency of around 8 Hz. The DTX mode in the listen mode introduces a 2 Hz mode to this; see further Andersen et al. [2010].

Measurements. We placed the phone in a semi shielded box to avoid external base station signals. The antenna was fed into a 20 dB coupler, then to a diode detector and then to a

Voltmeter (Fluke, Everett, USA) and a PC for logging the long term events. A spectrum analyzer (Rohde & Schwarz, Munich, Germany) was also used, see further Figure 1, for the measurement of the burst. For further details regarding the measurement see Andersen et al. [2010].

In stand-by mode the phone is only active when updating the information – so called periodic location update – and contact with the base station occurs with a frequency set by the net operator, and typically the updates occur with hours in between, and between these updates the phone is to be considered as a passive radio receiver with no microwave emission.

The phones transmit a short signal to the base station if they have not been active during a certain time. This time depends on the operator and is between 2 and 5 h for the operators in Denmark (see below Table 1 and Figure 2 where we have measurements on all operators). The requirements for transmitting the "hello I am still here" signal is that the phone has not been approached by the network or has made any updates. We have also investigated what happens if the phone receives a call or an SMS before the time period (2 h – 5 h depending on operator) has elapsed - then no "hello I am still here" message is sent before another time period has passed. If the mobile is "on-the-move" it will request a location area update whenever it is crossing a so-called Location Area boundary (size etc defined by the operator) and then again the "hello I am still here" message will not be sent before a new time period of the 2 h-5 h has elapsed. The reason for the "hello I am still here" message is to avoid broadcasting a paging message (in case of an incoming call) if the phone is not reachable (out of battery or in a new service region).

The update is a burst with duration of about 2 s, see Figure 3 for a GSM 900 signal. For UMTS the update frequency is about the same, see Table 1.

In the updates to the base station the phone is using maximum power – for GSM 900 it is 2 W and for GSM1800 it is 1 W. With an update frequency set to once per 4 hours during the experimental period –which is typically a 30 minute period in most papers – there might not be any emission at all and, thus, no exposure. UMTS phones operate with the power demanded by the base station and thus does not go to maximum intensity in these updates.

When the phone is operated from a base station simulator like in the paper by Hung et al. [2007] the frequency for the updates in stand-by mode has to be specified.

If a person carries the phone in a pocket and moves in a city the phone updates when entering a new base station area, and this can be as often as once every few minutes depending if one is in city center or suburban area. However, even then the exposure is very small.

When using a so called DECT phone in stand-by mode, the telephone is passive and is only actively transmitting during a call.

When a phone is being called, a handshake pulse is emitted to acknowledge the contact. The handshake pulse is only some seconds long. Then the GSM phone starts transmitting with full power but it rapidly adjusts to the level demanded by the base station. So even if the “missed calls” had a duration of 1 minute, the exposure to RF varies considerable during this period, and the experiment cannot be repeated by other researchers without the now lacking detailed measurements.

Sometimes the exposure from a phone is given with the SAR-value of the particular phone. It is seldom mentioned that this value is measured with the phone operating at maximum output power and no DTX. Therefore, in an actual exposure situation the output power and pulse

frequency might be completely different, something that has to be stated in a paper to give full coverage of the exposure.

Conclusions. In order for a paper to give useful information and help advance the knowledge it is necessary to better specify what the exposure has been. Using stand-by mode as exposure is in all practical aspects the same as sham exposure, since exposure a few seconds every few hours is negligible as far as average energy is concerned, which is the measure used by ICNIRP.

Literature

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Figure 1. Measurement set-up for the test of updates in the different networks.

Figure 2. Logged data of the periodic update.

Figure 3. Measured time burst from a GSM 900 phone in stand-by mode, duration about 2 seconds every 5 hours. Arbitrary level on y-axis. The GSM phones always use maximum power in the updates.

Table 1.

Time periods for update for GSM and UMTS phones
in Danish networks.

UMTS	
TDC (M1)	2 h
Telenor	4 h
Telia	4 h
GSM 900	
TDC (M1)	3 h
Telenor	5 h
Telia	4 h
GSM 1800	
Telia	4 h