Mobile Networks: Exposure Levels

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19ième Journée Interaction Onde Personne
Paris, France
20 December 2012
ORIGINAL ARTICLE

Comparative international analysis of radiofrequency exposure surveys of mobile communication radio base stations

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Presentation outline

- Study aims.
- Cautions to be observed.
- Findings.
- Observations.
- Conclusions and next steps.
Study aims

- Provide comparative information on RF exposure from international sample of mobile networks.
- Compile database of national RF surveys.
- Investigate similarities and differences
- Investigate chronological trends
Cautions regarding comparisons across surveys

- Broadband versus narrowband measurements.
- Survey techniques differ as does data recorded.
- Different criteria for selecting locations.
- Type of base station.
- Access to ‘raw’ data.
## Countries and total number of points collected

<table>
<thead>
<tr>
<th>Country</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (AU)</td>
<td>676</td>
</tr>
<tr>
<td>Hungary (HU)</td>
<td>66</td>
</tr>
<tr>
<td>South Africa (ZA)</td>
<td>188,148</td>
</tr>
<tr>
<td>Austria (AT)</td>
<td>724</td>
</tr>
<tr>
<td>Ireland (IE)</td>
<td>14,894</td>
</tr>
<tr>
<td>South Korea (KR)</td>
<td>9,755</td>
</tr>
<tr>
<td>Belgium (BE)</td>
<td>862</td>
</tr>
<tr>
<td>Ivory Coast (CI)</td>
<td>211</td>
</tr>
<tr>
<td>Spain (ES)</td>
<td>4,827</td>
</tr>
<tr>
<td>Botswana (BW)</td>
<td>543</td>
</tr>
<tr>
<td>Japan (JP)</td>
<td>40</td>
</tr>
<tr>
<td>Sweden (SE)</td>
<td>1,010</td>
</tr>
<tr>
<td>Canada (CA)</td>
<td>686</td>
</tr>
<tr>
<td>Malaysia (MY)</td>
<td>137</td>
</tr>
<tr>
<td>Switzerland (CH)</td>
<td>58</td>
</tr>
<tr>
<td>Egypt (EG)</td>
<td>400</td>
</tr>
<tr>
<td>Mauritania (MR)</td>
<td>899</td>
</tr>
<tr>
<td>Thailand (TH)</td>
<td>13,676</td>
</tr>
<tr>
<td>France (FR)</td>
<td>2,000 approx.</td>
</tr>
<tr>
<td>Netherlands (NL)</td>
<td>273</td>
</tr>
<tr>
<td>United Kingdom (UK)</td>
<td>119,900</td>
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<tr>
<td>Germany (DE)</td>
<td>3,404</td>
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<tr>
<td>New Zealand (NZ)</td>
<td>214</td>
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<tr>
<td>United States (US)</td>
<td>1,127</td>
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<tr>
<td>Ghana (GH)</td>
<td>174</td>
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<tr>
<td>Nigeria (NG)</td>
<td>212</td>
</tr>
<tr>
<td>Zambia (ZM)</td>
<td>315</td>
</tr>
<tr>
<td>Greece (GR)</td>
<td>348</td>
</tr>
<tr>
<td>Peru (PU)</td>
<td>370</td>
</tr>
<tr>
<td><strong>Total number of data points</strong></td>
<td><strong>363,809</strong></td>
</tr>
</tbody>
</table>

- Shaded countries included in figures.
- Based on 173,323 measurement points.
Global overview – 21 countries

- Global average about 5,500 times below ICNIRP public at 800 MHz.

Rowley & Joyner, 2012
Levels vary significantly at the same distance

For example, at 100 m, the measured levels differ by more than 1,000 times.

Time trends – 5 countries

Figure 2. Minimum (●), maximum (●) and average of the narrowband measurements for the UK (●), Spain (●), Greece (●) and Ireland (●); and the broadband measurements for the US (○), with the year of measurement data on the horizontal axis. Note that not all years were available in all countries. For comparison, the ICNIRP reference level for the public at 900 MHz and 1800 MHz are included.

- No significant change in RF exposure since introduction of 3G

Rowley & Joyner, 2012
Mobile technologies – 16 countries

Figure 3. Minimum (○), maximum (●) and average (●) for each wireless technology. For comparison, ICNIRP reference levels for the public at 900 and 1800 MHz are also plotted. Mobile Other refers to mobile technologies either not identified in the source survey or not included (e.g., PDC) in one of the other mobile technologies categories. All Mobile is the result of averaging over all mobile technologies. Only narrowband measurements (from 16 countries) could be used. The weighted averages for all available measurement years for each country were then averaged over the number of countries with measurements for each mobile technology. The figure in brackets on the horizontal axis label is the number of countries for which measurements were available for each technology.

- Similar exposures regardless of mobile technology.

Rowley & Joyner, 2012
Observations from current data

- RF exposures in public areas are typically several orders of magnitude below the ICNIRP reference levels.

- Broadband measurements typically higher than narrowband.

- There is little change in exposure since the introduction of 3G.
  - Geographic and in-building coverage has likely improved.

- All mobile technologies resulted in similar ranges of exposure.
Globally deployed mobile technologies

- Total connections, excluding M2M, stand at 6.6 billion in 2012 globally.
- Total unique mobile subscribers stands at 3.2 billion in 2012 globally.
- About 1.5 billion unconnected due to lack of mobile coverage.

Wireless Intelligence, 2012
Mobile communications usage trends (UK)

Figure 5.78  Average monthly outbound mobile call minutes per connection, by subscription type

Figure 5.79  Average monthly mobile messaging volumes per person

Figure 5.83  Location of internet access using a mobile handset

OFCOM, 2012; ITU, 2012
Trends for base station installations

- 5,925,974 macro sites installed at end of 2012 globally.
- 6,069,224 small cell sites installed at end of 2012 globally.
- Future networks likely to be more heterogeneous mix of sites.

http://www.informatandm.com/
Conclusions and next steps

- In public areas exposures from mobile networks are typically a small fraction of the ICNIRP reference levels.

- We plan to extend analysis to additional countries.
  - Developing markets.
  - Countries with differing RF exposure limits.

- Monitor effect of technology and network evolution on exposures.
Acknowledgements

- My co-author Dr Ken Joyner.

- All the institutions and investigators who shared data with us.
Thank You

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