RF Exposure Measurements and Compliance for Mobile Base Station Sites

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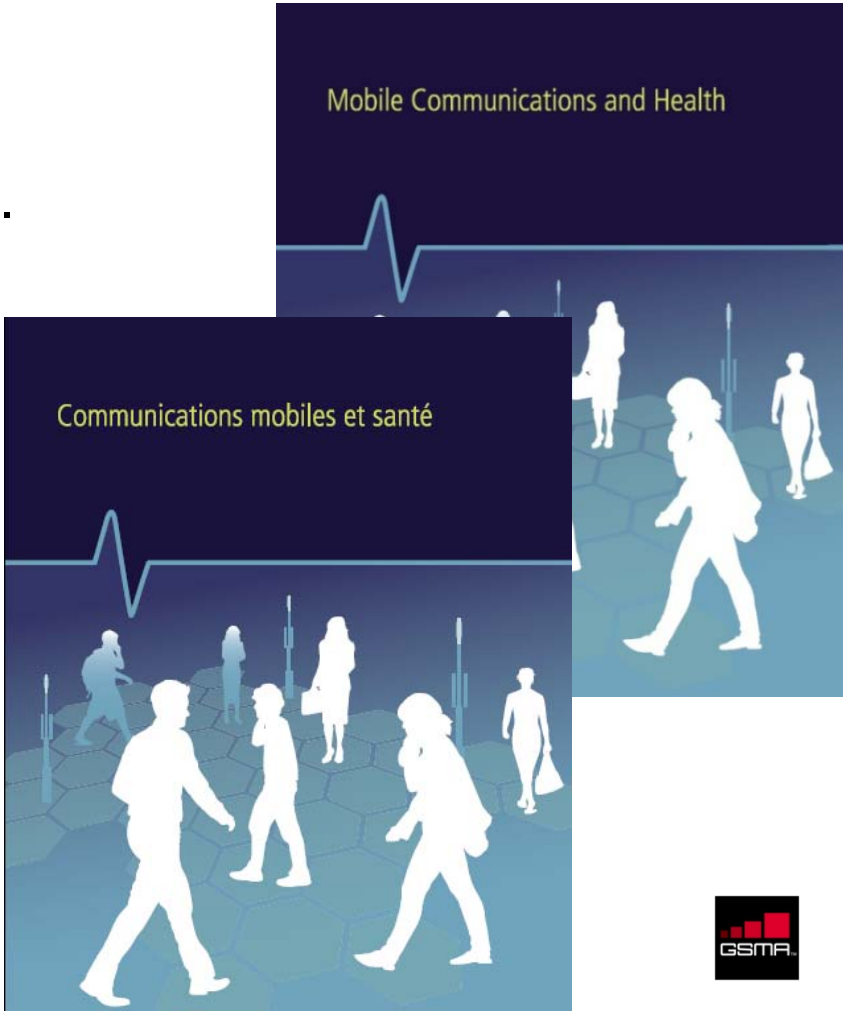
GSM Association

Stakeholders' Workshop on Human Exposure to Electromagnetic Fields (EMF) from Wireless Technologies:

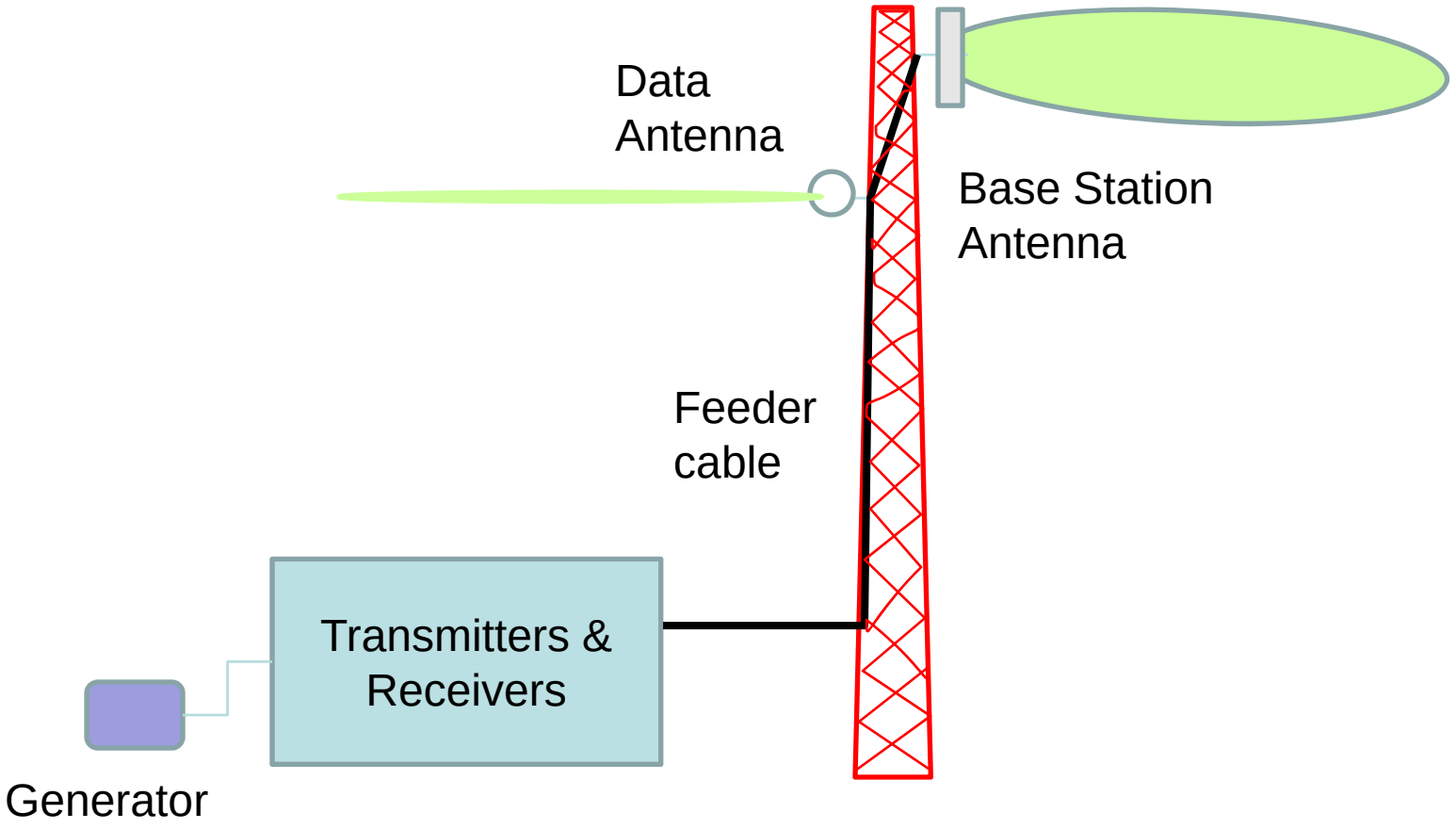
9-10 November 2010, Gaborone, Botswana

The GSM Association (GSMA)

- International trade association for mobile industry.
- EMF program:
  - Support for independent research.
  - Support for members.
  - External communications.
- EMF policy should be evidenced based.



What is a Base Station?

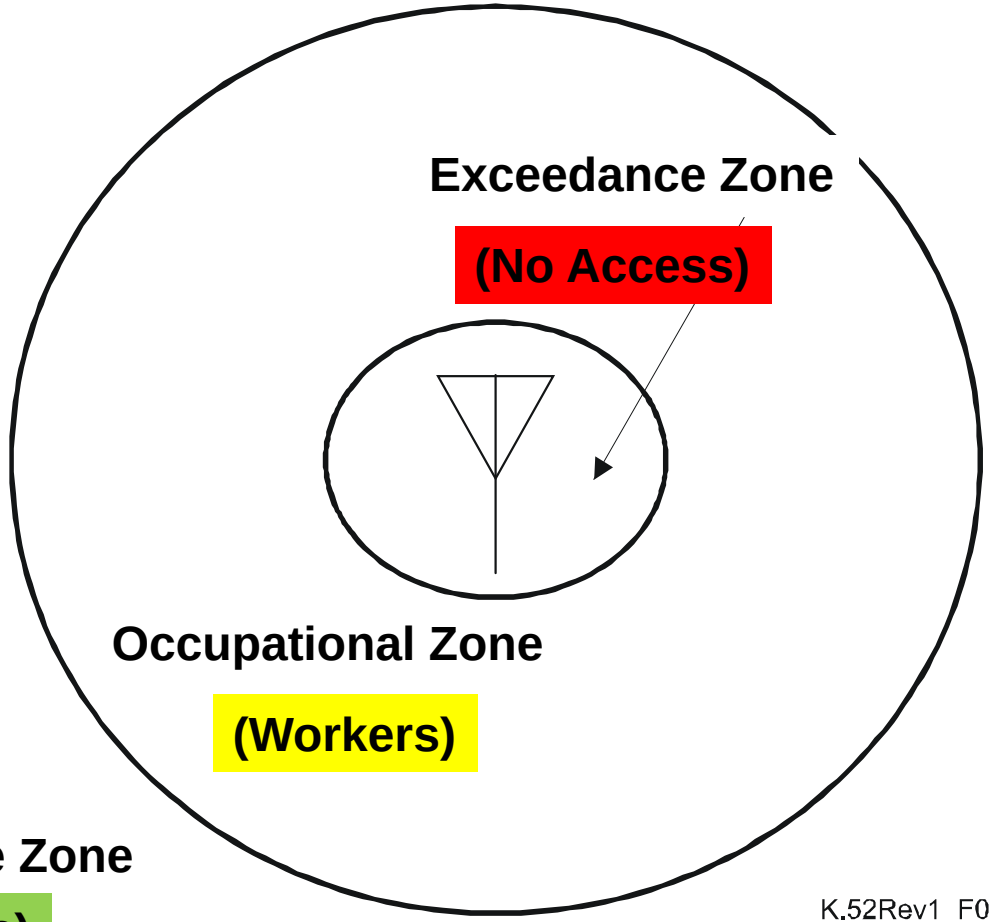


Mobile Phone Base stations

Self-Supporting Tower

Roof Top Structure

Antenna Exposure Zones



General Principles

- Identify appropriate compliance limits.
- Determine if EMF exposure assessment is needed.
- If needed:
  - Calculations or
  - Measurement.
- If exposure limits may be exceeded apply mitigation.

RF Exposure Assessments

- Compliance – relatively high fields:
  - Calculation.
  - Absorbed energy – Specific Absorption Rate (SAR).
  - Broadband.
- Environmental surveys – low level fields:
  - Calculation.
  - Broadband.
  - Narrowband.

RF Exposure Assessment: Calculation

$$S = \frac{P\,G}{4\pi d^2}\,N \quad (W/m^2)$$

$$d = \sqrt{\frac{P\,G}{4\,\pi\,S}}\,N \quad (m)$$

P = Power to antenna (W)

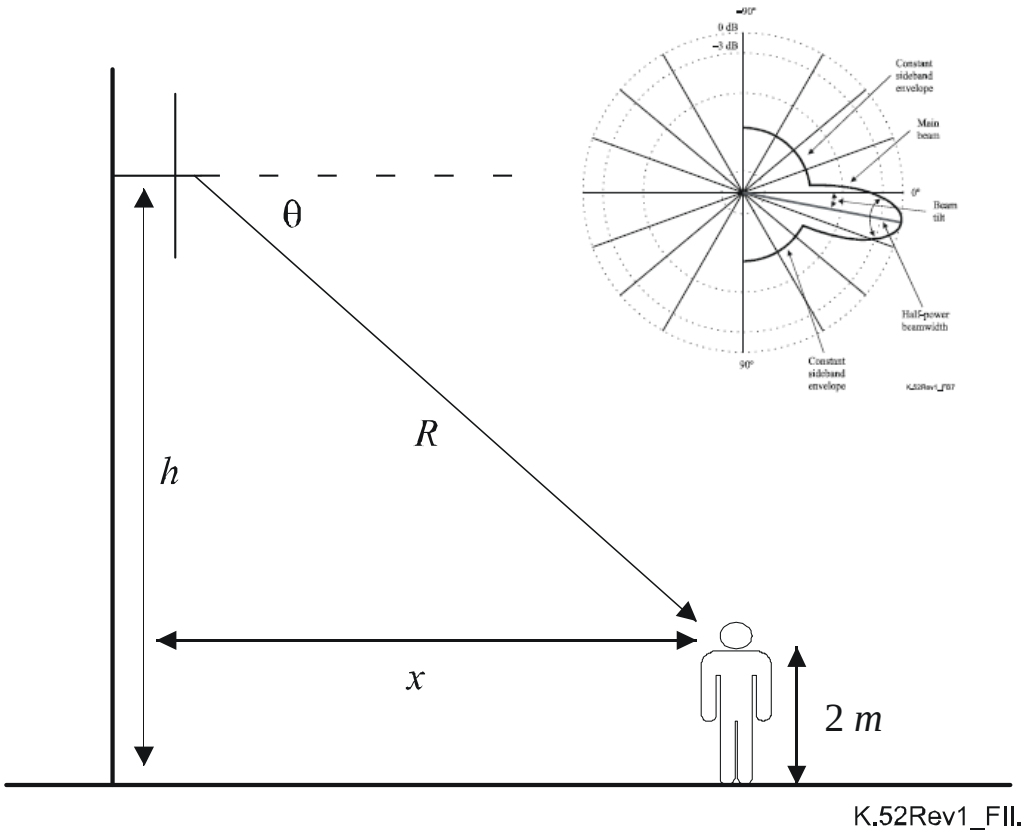
G = Linear isotropic gain

d = Distance from antenna (m)

N = Near field correction factor (reduced antenna gain).

Compliance: Calculations

- Assessment without measurement.
- Requires information about antenna, transmitter and so on.
- Based on conservative assumptions.
- Basis for compliance declarations.
- Multiple sources?

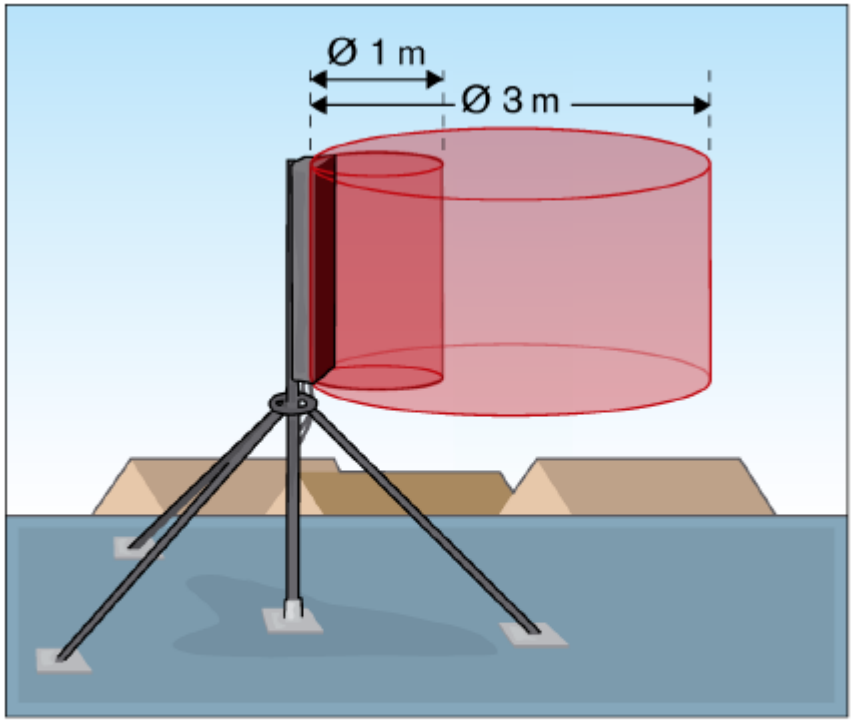


Compliance: Broadband Measurements

- Measures reference levels.
- Establish compliance zones.
- Practical field measurements.
- Includes other all sources in frequency range.
- Near-field E & H.
- Averaging.
- Other hazards.

Compliance Zones For Base Station Antennas

- Generally low power:
  - 1 W to 40 W.
- Sector antennas transmit forward.
- Mounted so that public cannot access.
- Rooftop workers.
- Averaging time.



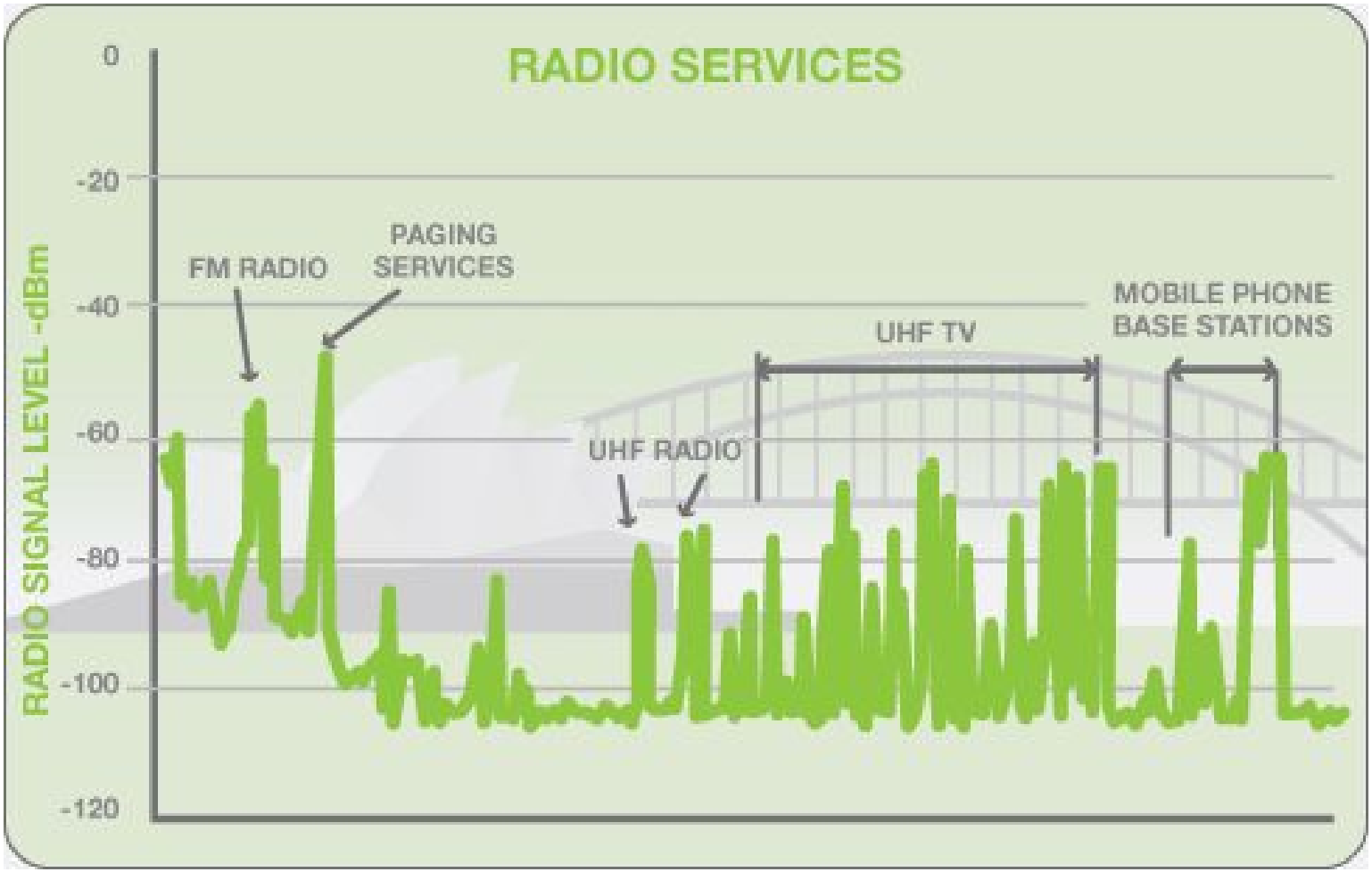
Measurements have shown that to stay for unlimited time you need to be a distance of one meter from the antenna for occupational exposure, and the corresponding limit for the general public is three meters.

EMF-NET, Occupational exposure fact sheet: Mobile phone base station, 2008.

Management of RF Compliance

- Assess exposure levels for workers and public.
- Identify areas where limits exceeded.
- Implement controls:
  - Design to avoid access to hazardous areas.
  - Suitable barriers to restrict access.
- Where access required:
  - Safe working procedures.
  - Provide safety equipment.
  - Provide suitable training.

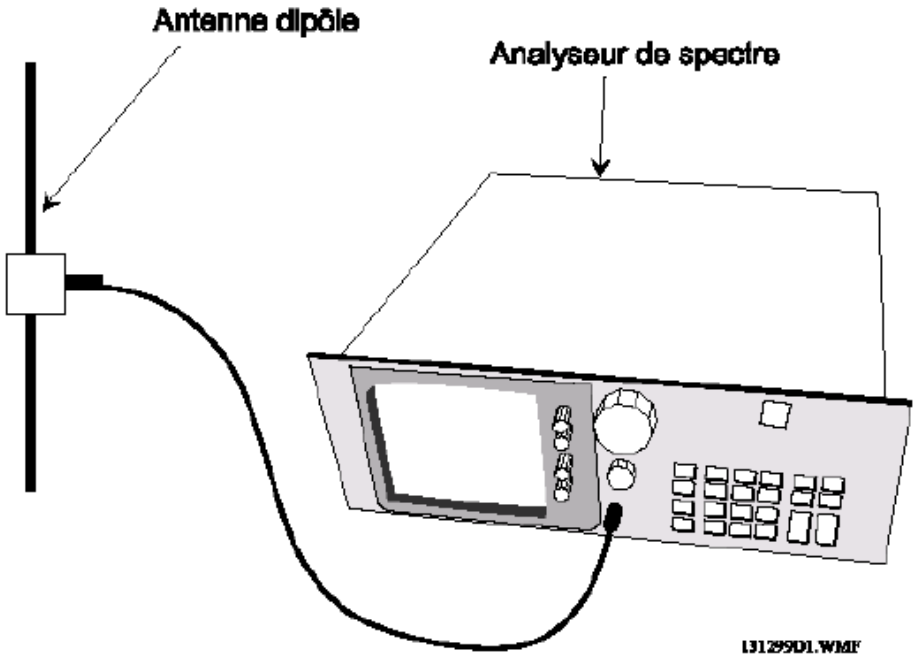
Many Radio Sources in the Environment



www.emfexplained.info

Environmental: Narrowband Measurements

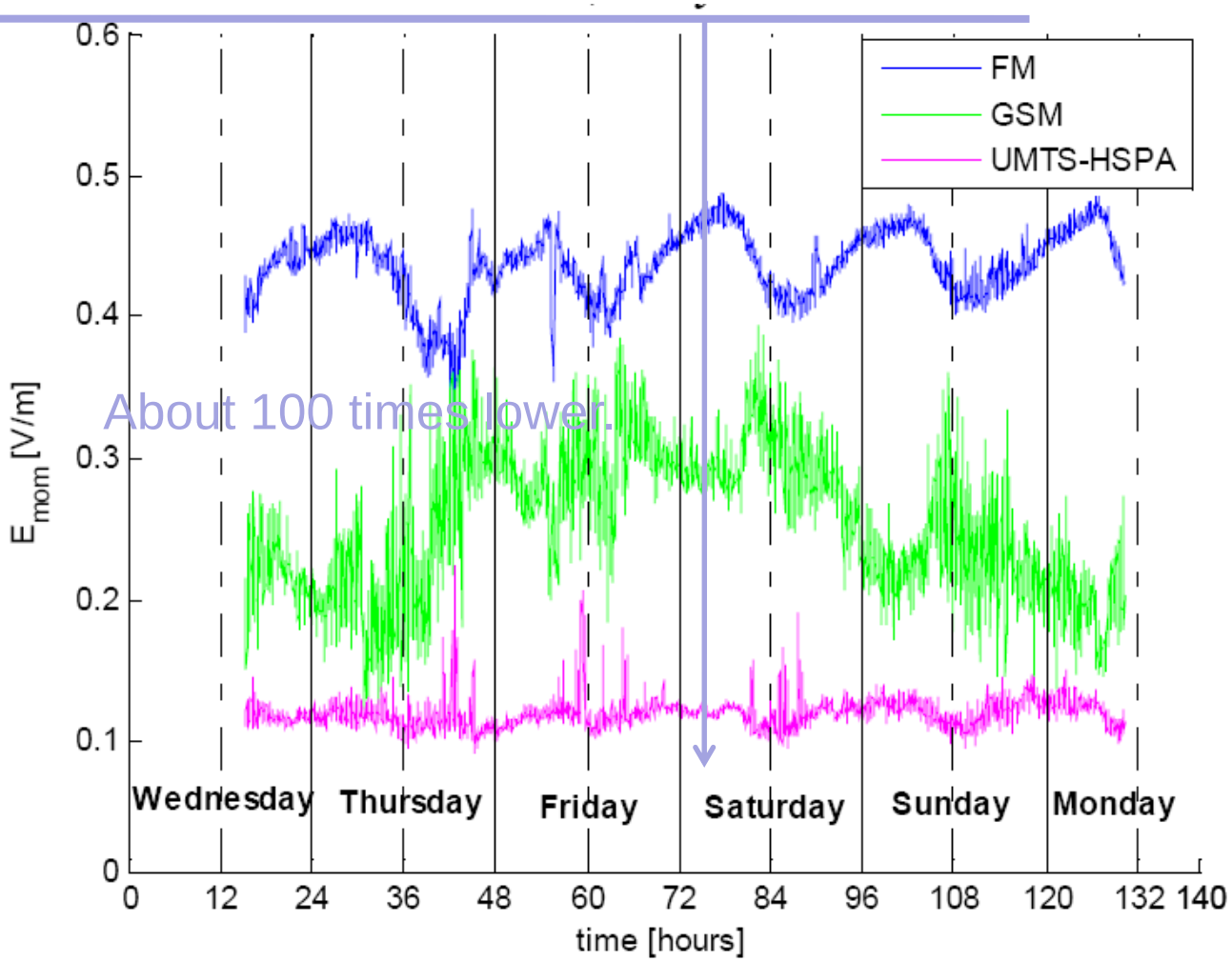
- Calibrated receiver and antenna.
- Good sensitivity.
- Measures individual sources.
- Polarisation of antenna.
- Standardised positioning.
- Effects of radio traffic.
- Time consuming.



Study on the Feasibility of Epidemiological Studies on Health Effects of Mobile Telephone Base Stations – Final Report, Neubauer et al., ARC-IT—0124, March 2005.

Daily Variation in Exposure

ICNIRP



General Public Exposure due to Electromagnetic Fields of New Wireless Technologies in Different Environments, Joseph et al, BEMS Annual Scientific Meeting, June 2010.

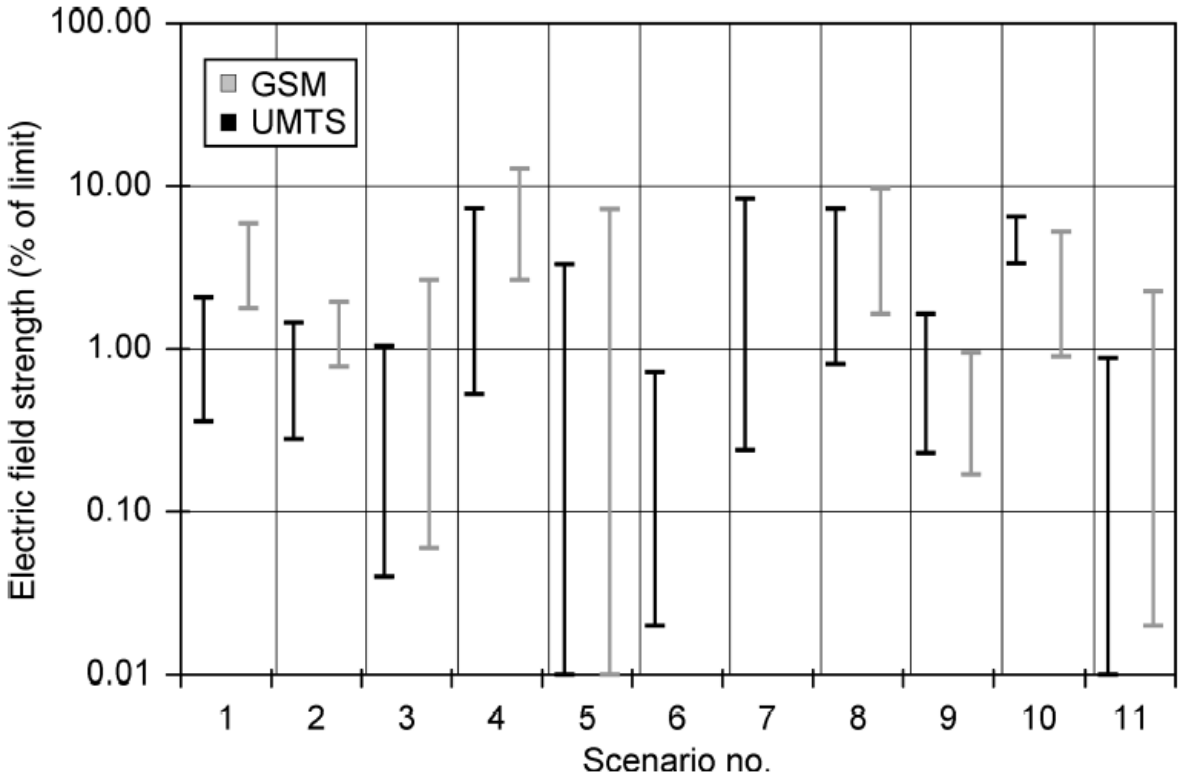
Wireless Sources – Typical Exposures

Service	Typical Maximum Level
Average urban, base stations	0.1 - 0.3 V/m
Average urban, TV and radio	0.4 - 0.7 V/m

Base Stations and Wireless Networks—Radiofrequency (RF) Exposures and Health Consequences Valberg et al., *Environmental Health Perspectives*, 115(3):416–424, March 2007.

Effect of Base Station Type on Exposure

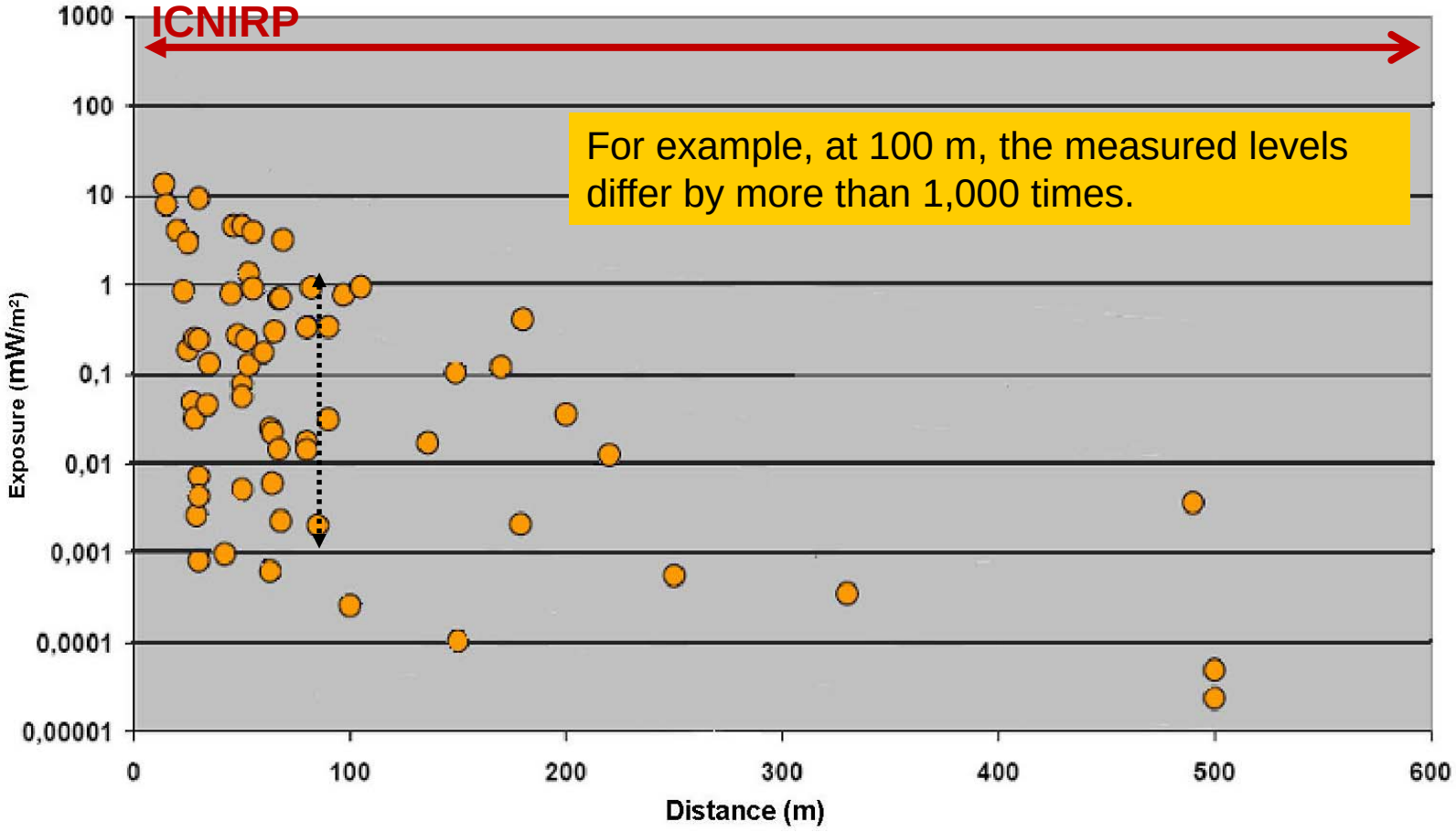
(1) Low mounted station, rural environment;
(2) High mounted station, rural (mast installation);
(3) Base station in a commercial area;
(4) Low mounted station, urban environment;
(5) High mounted station, urban environment;
(6) Ultra High Site;
(7) Station for indoor coverage;
(8) Station for coverage of a football stadium;
(9) Station for coverage of an exhibition hall;
(10) Station for coverage of a pico cell;
(11) Station on a roof and exposure measurements in the building below.



Similar average exposures for all types

Determination of the general public exposure around GSM and UMTS base stations, Bornkessel et al., Radiat Prot Dosimetry, 124(1):40-47, March 1, 2007.

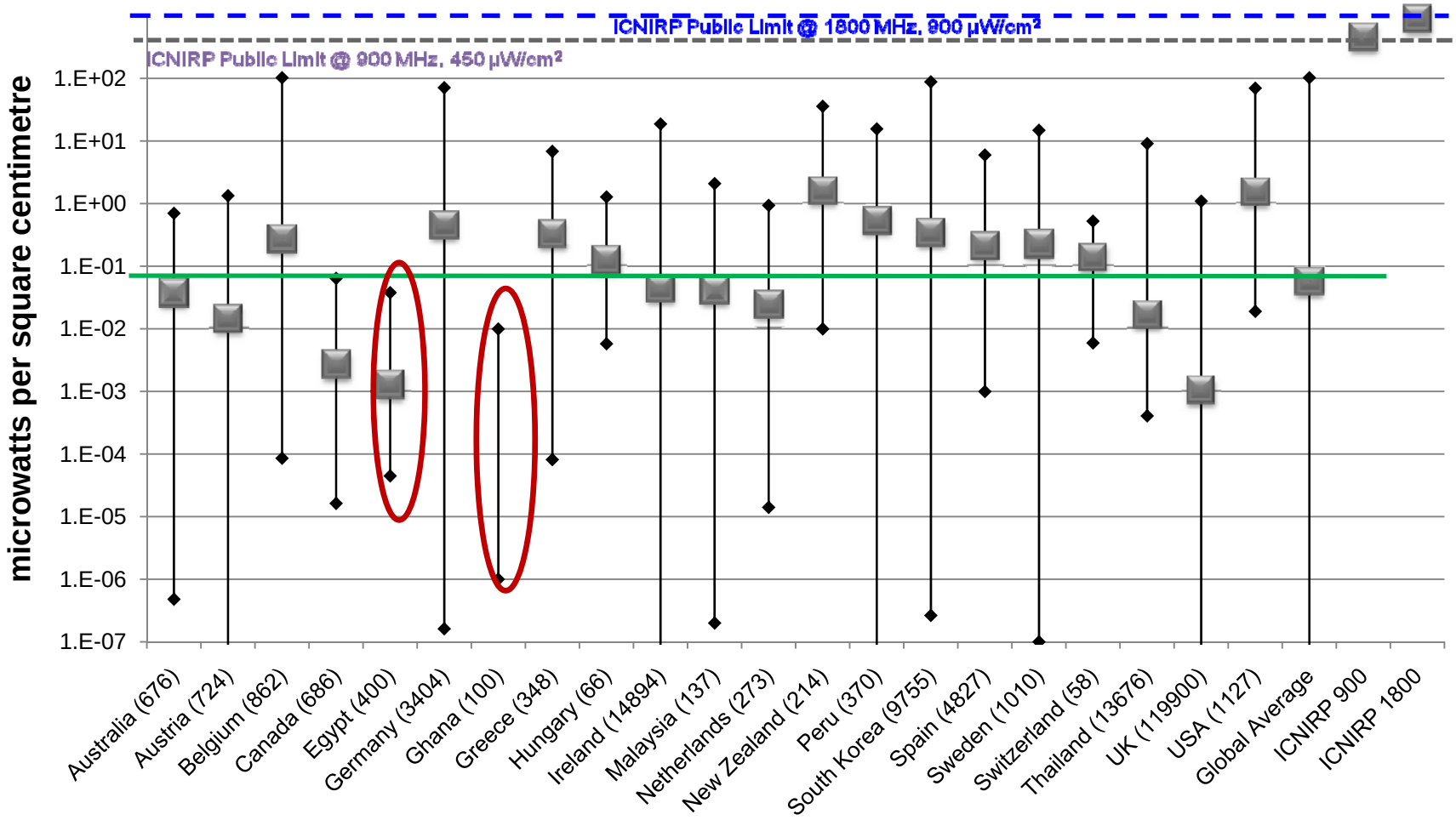
Exposure Levels Influenced by Many Factors



Global Database of Base Station Measurements

21 countries
More than 150,000 measurement points

Summary Data – All Countries



Global average 7,000 times below ICNIRP.

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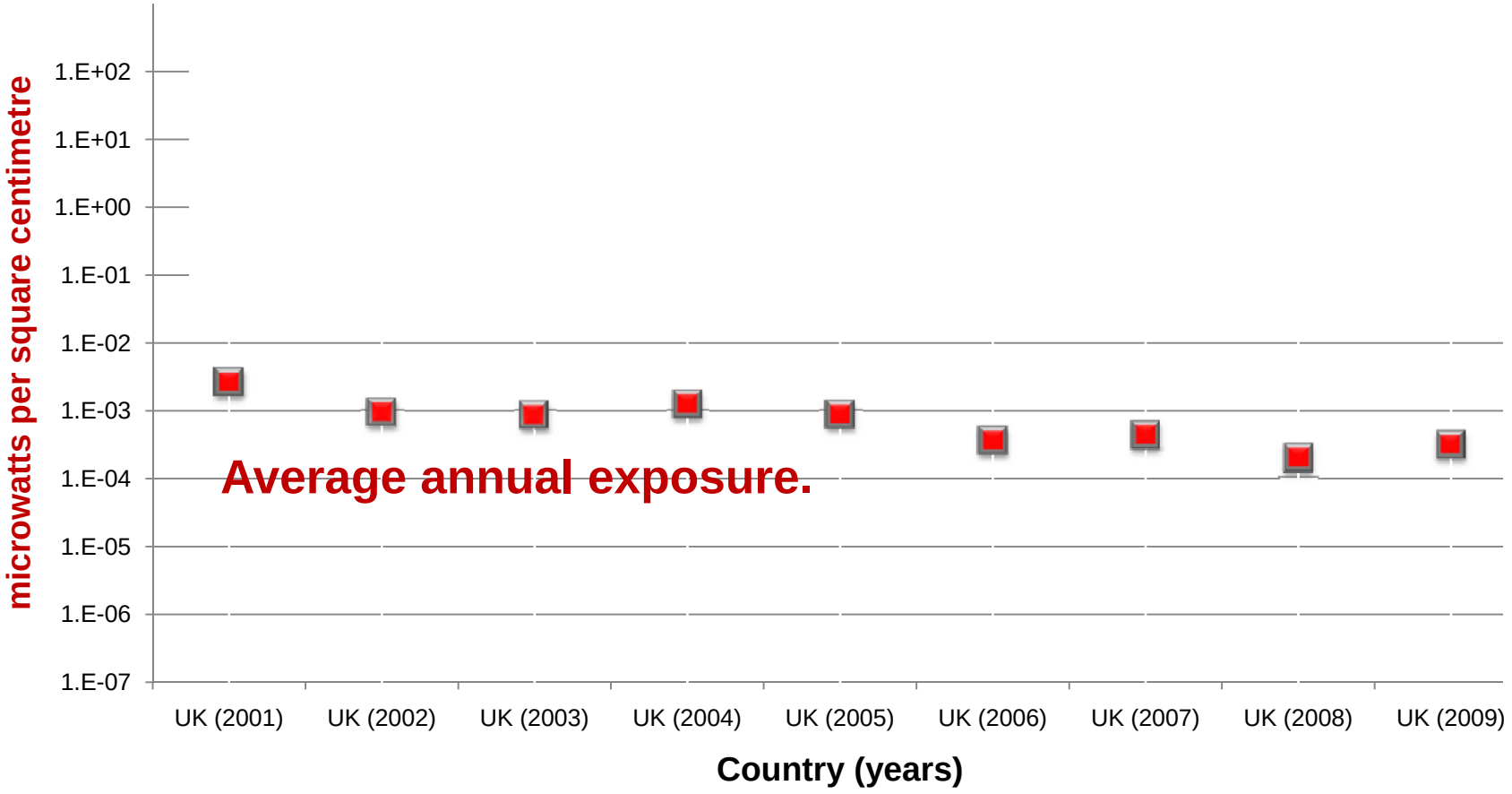
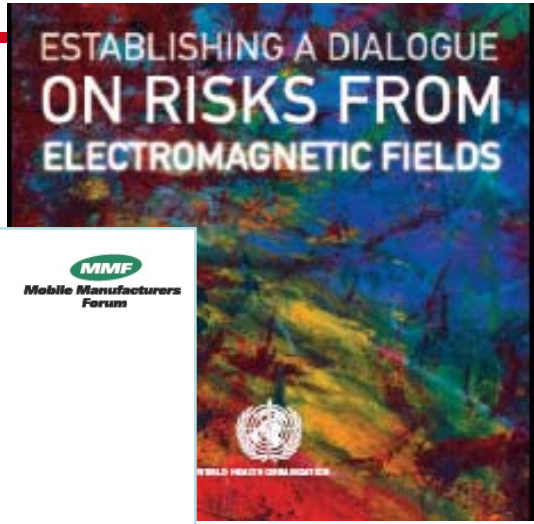
Summary Data – UK Time Trends

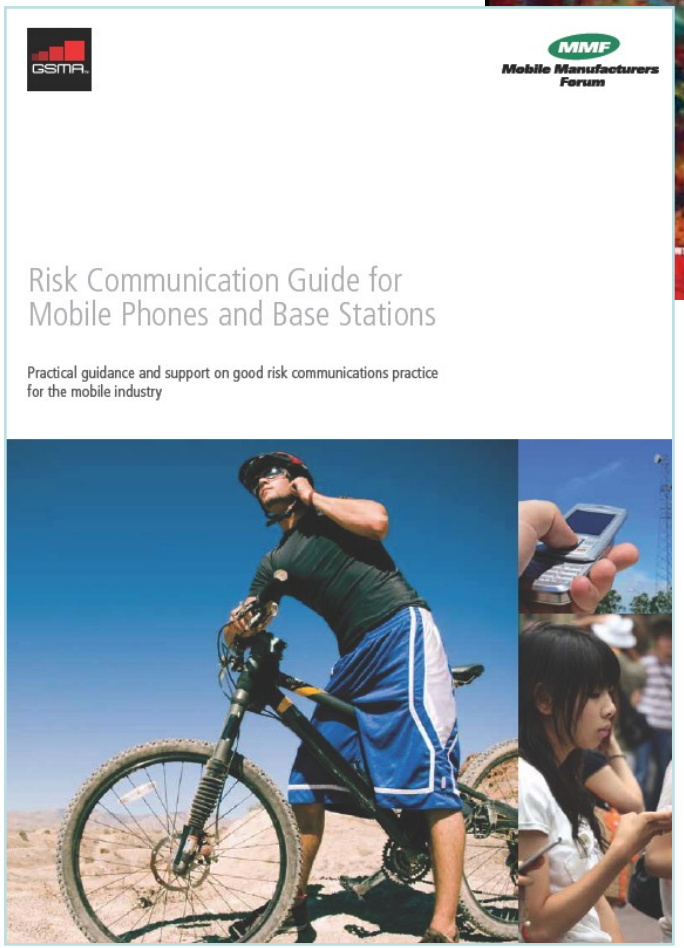


Exposures not affected by network growth.

Essentials of Communication

- Listen.
- Perception is reality.
- Trust first, information second.
- Address concerns.
- Adapt techniques to cultural context.
- Anticipate.





WHO Conclusion

- *Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects.*

http://www.who.int/mediacentre/factsheets/fs304/en/index.html.

Summary

- Compliance or environmental assessments.
- Compliance zones near to antennas.
- Measurements not always required.
- Choose appropriate equipment.
- Technology ensures public exposures are very low.
- Communications - trust first, information second.

Thank You

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