III Międzynarodowa Konferencja

Pole elektromagnetyczne i przyszłość telekomunikacji

Badania. Monitoring. Doświadczenia krajowe i zagraniczne.

Lessons learned from international RF-EMF monitoring and expectations for 5G networks

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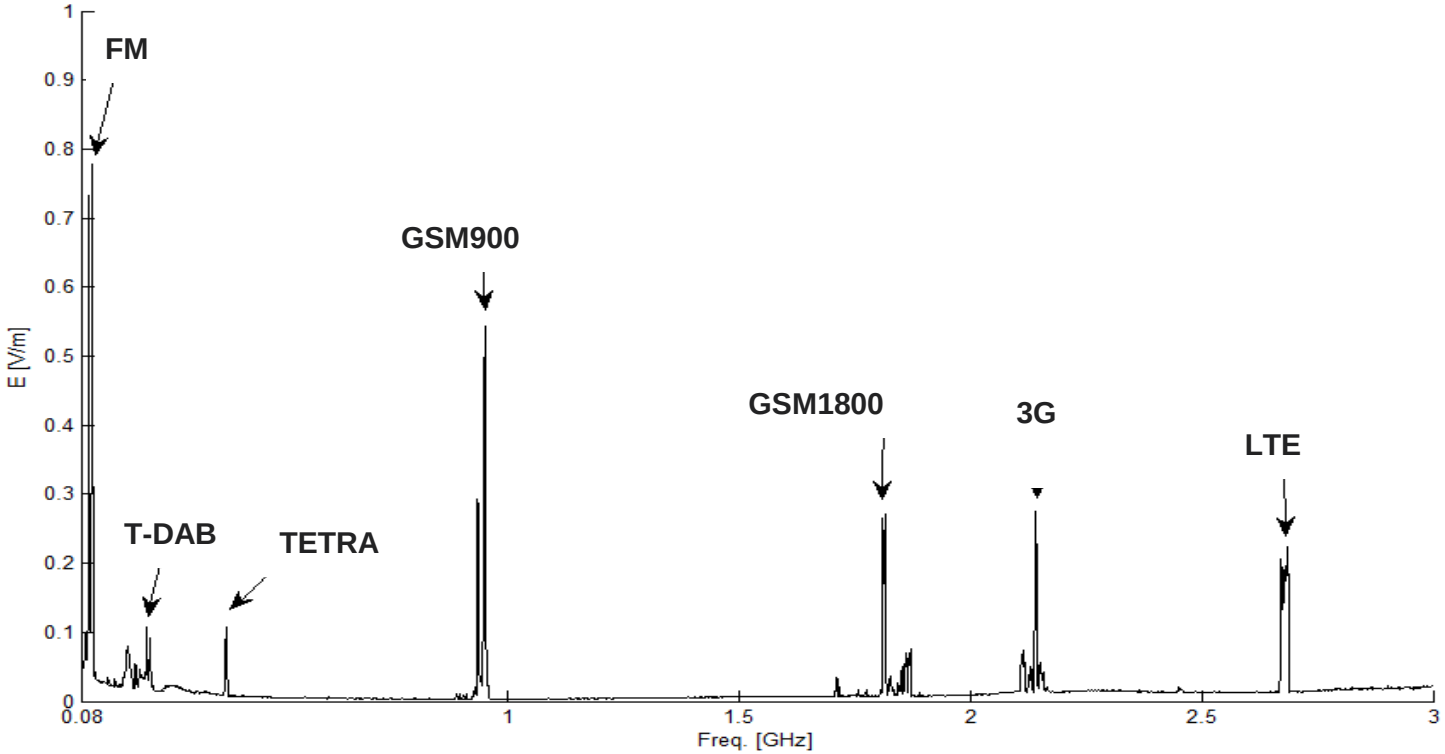
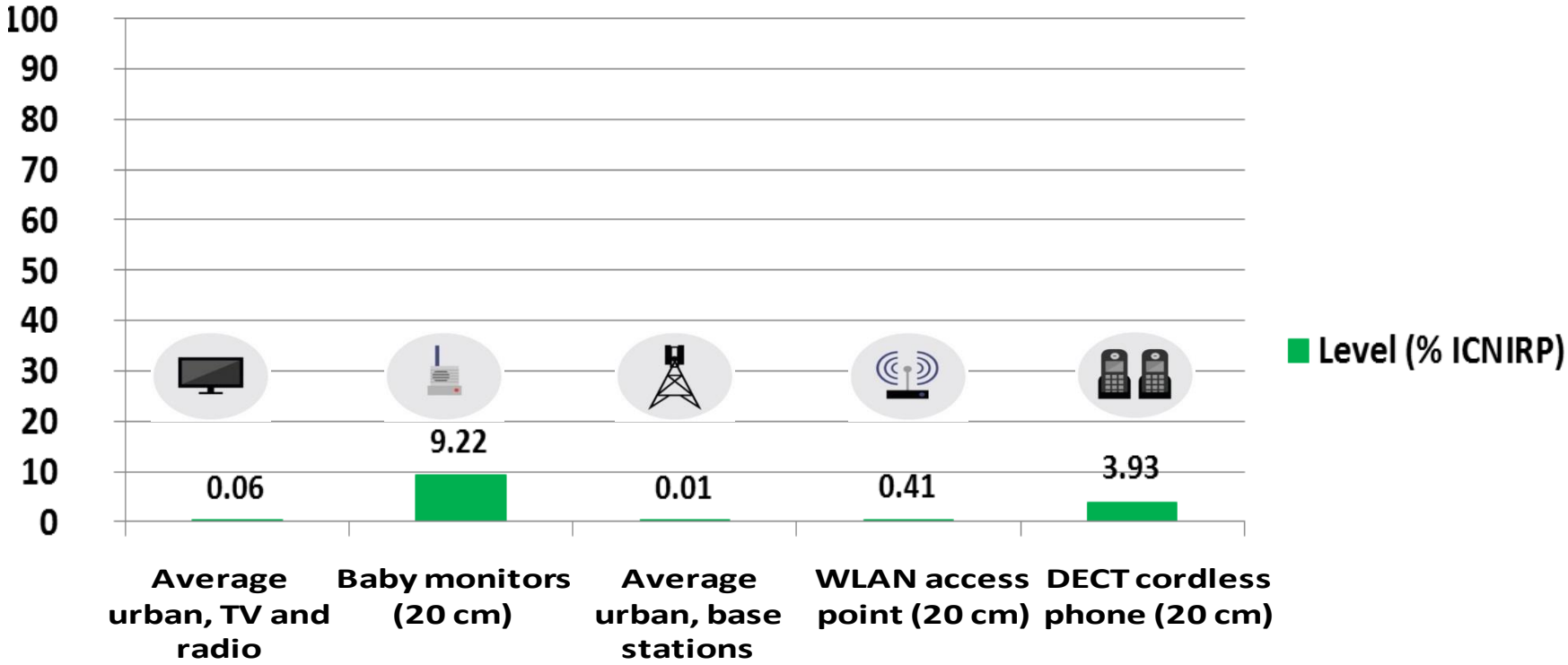
6 December 2018, Warsaw, Poland.

Environmental radio signals

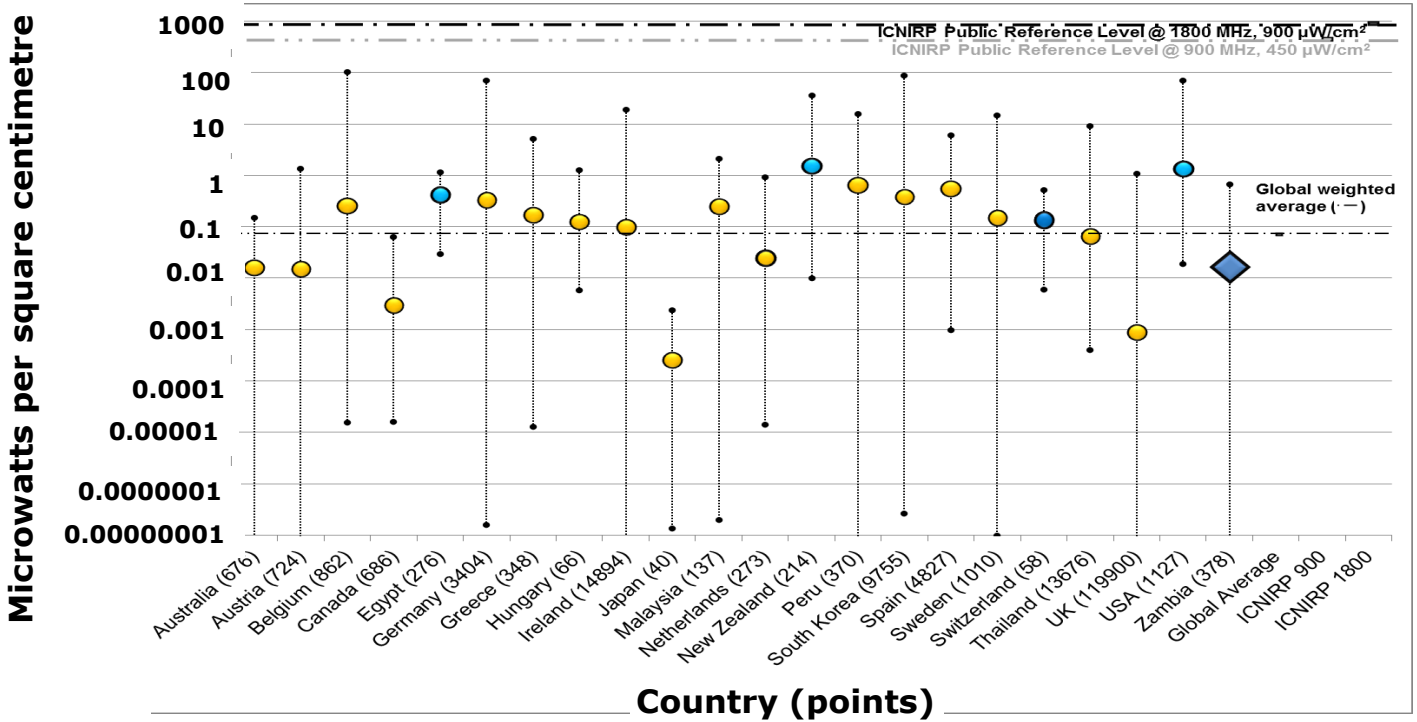


Mobile levels similar to other radio sources



Based on Valberg et al., 2007

Mobile network levels similar between countries



Global average more than 5,500 times below limit values

Based on Rowley and Joyner, 2012

RF-EMF exposure levels low and constant

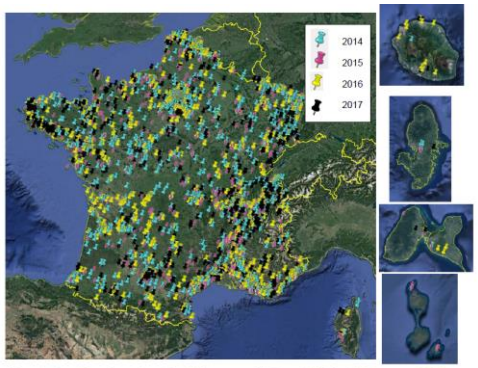
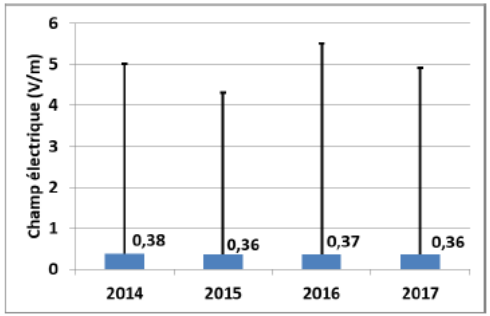
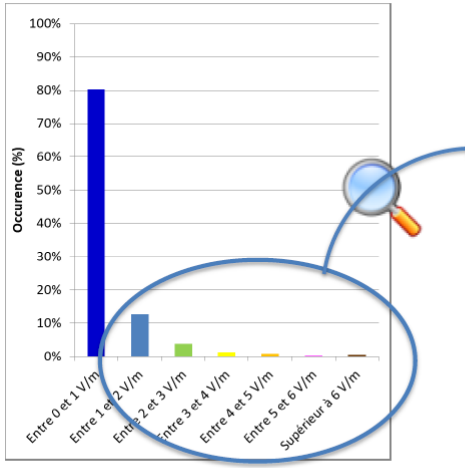


Figure 3 : répartition géographique des 2 591 mesures réalisées en 2017, des 2 993 mesures réalisées en 2016, des 3 577 mesures réalisées en 2015 et des 2 955 mesures analysées en 2014





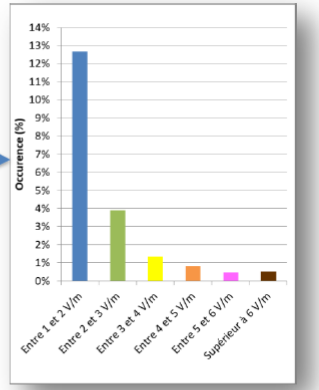


Figure 6 : distribution des niveaux de champs électriques mesurés selon le cas A du protocole de mesure et zoom sur la distribution des valeurs supérieures à 1 V/m

Figure 9: valeurs médianes (barres bleues) et percentiles à 99 % (traits noirs) en fonction des années

Continuous monitoring of RF-EMF

- Italian national network 2002 to 2006
- >50 million data points
  - About 40% below detection limit of probes
- Results:
  - no values exceeded exposure limits
  - no more than an 18% annual variation
  - mean value for mobile networks 0.047 mW/cm^2 (2005-2006)
- Global mean environmental cellular RF typically <0.1 mW/cm^2

Rowley and Joyner, 2016

Are further RF-EMF measurements needed?

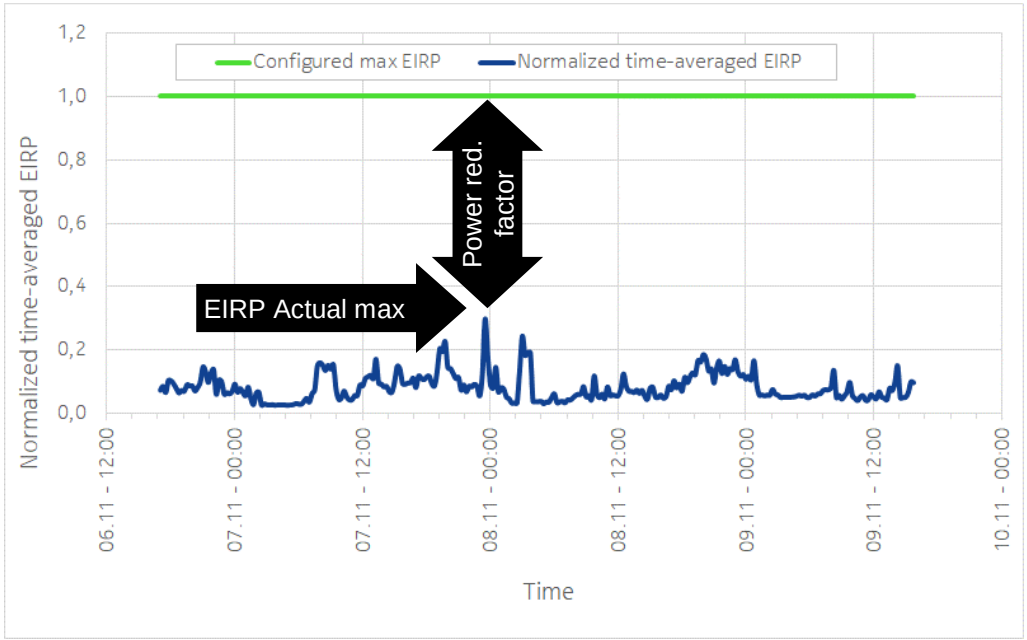
- *'All exposure level studies and surveillance systems used in our country and in Europe confirm repeatedly that they are hundreds or thousands of times below those recommended by the EU, WHO and the ICNIRP and national legislation (RD1066/2001). Therefore,* ***it is not recommended to invest resources in new surveillance systems that do not provide significant innovation*** *regarding levels of exposure already known.'*

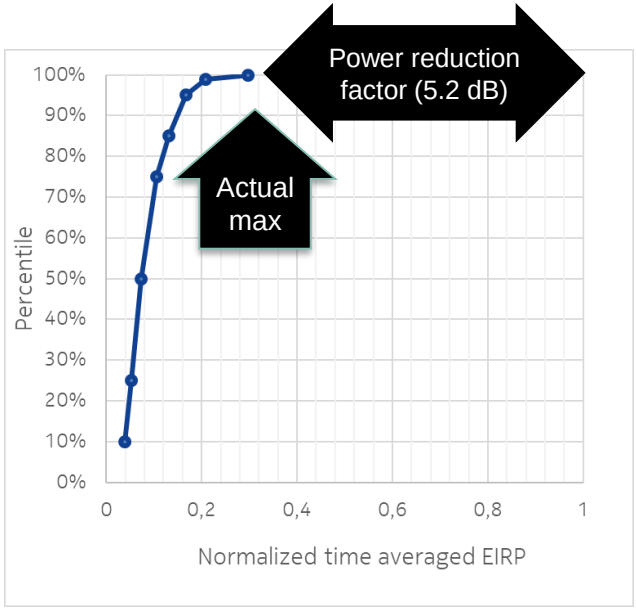
  - Comité Científico Asesor en Radiofrecuencias y Salud (CCARS), 2017

http://ccars.org.es/

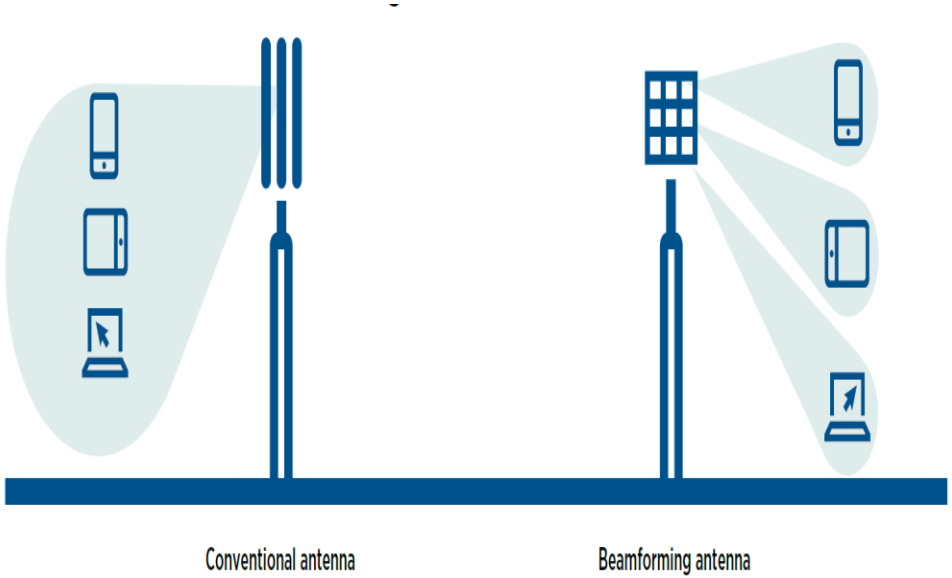
What do we know about current technologies (non beamforming) ?

- Example of a 4G cell





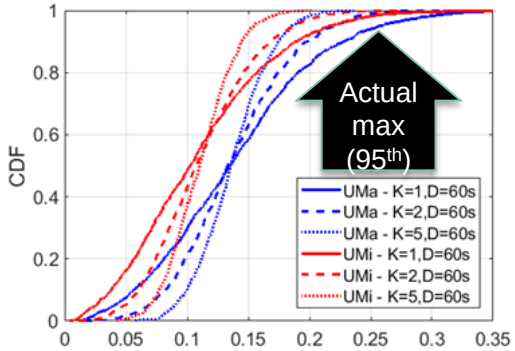
RF-EMF exposure from advanced antenna technologies



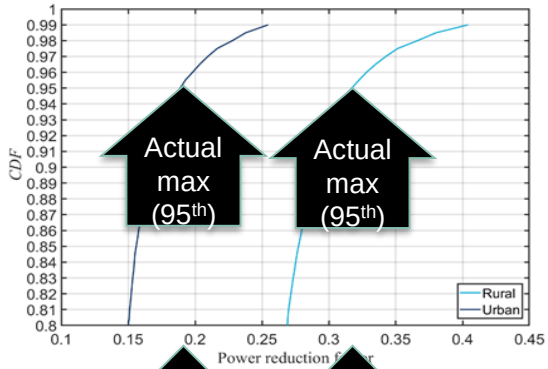
- Maintain high throughput in more efficient ways
- Reduce network interference and electromagnetic energy in unintended directions
- New techniques for assessing RF-EMF exposure due to moving beams

What do we know about new technologies (beamformi

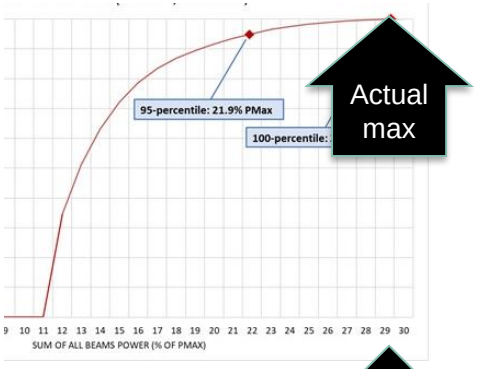
- Time & space variation of RF transmitted power with 5G massive MIMO



Source: IEC62669, Nokia Bell Labs, modelling



Source: IEC62669, Ericsson, modelling



Source: IEC62669, Vodafone, measurements

→ The actual transmitted power (time-avg) does not exceed a threshold (= actual maximum threshold)
→ Power reduction factor (actual max threshold/configured max) range: from x0.2 to x0.5 (3 – 7 dB)
→ Actual RF compliance boundary reduction factor typical range: from x0.45 to x0.7

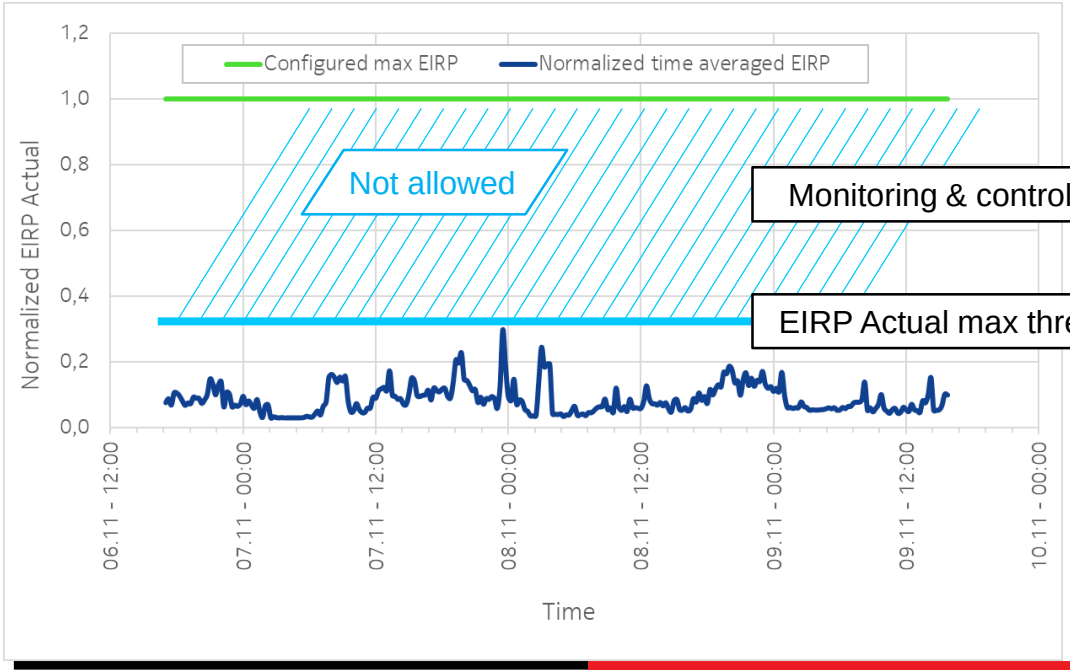
What does IEC TR62669 recommend ?

General principle for RF compliance based on actual max power:
[from 13.1.2, informal draft 16.10.2018]

- The real time-averaged transmitted power by BSs during service, called actual transmitted power, is generally below the time averaged maximum transmitted power.
- The actual maximum transmitted power can be used to determine the RF compliance boundary provided that the operator is implementing tools ensuring this threshold is not exceeded over time during service.
- These tools can be based on BS counters and features developed by manufacturers to monitor and control the RF transmitted power or EIRP and other relevant characteristics of the BS.
- This applies to all types of BS, whether they are using fixed beams or steerable beams like with mMIMO.

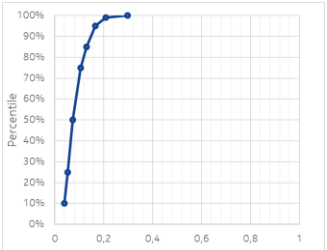
Implementation of the novel compliance approach defined in IEC TR62669

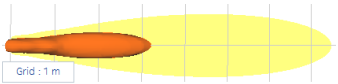
- Example with current radio technologies (non beamforming)



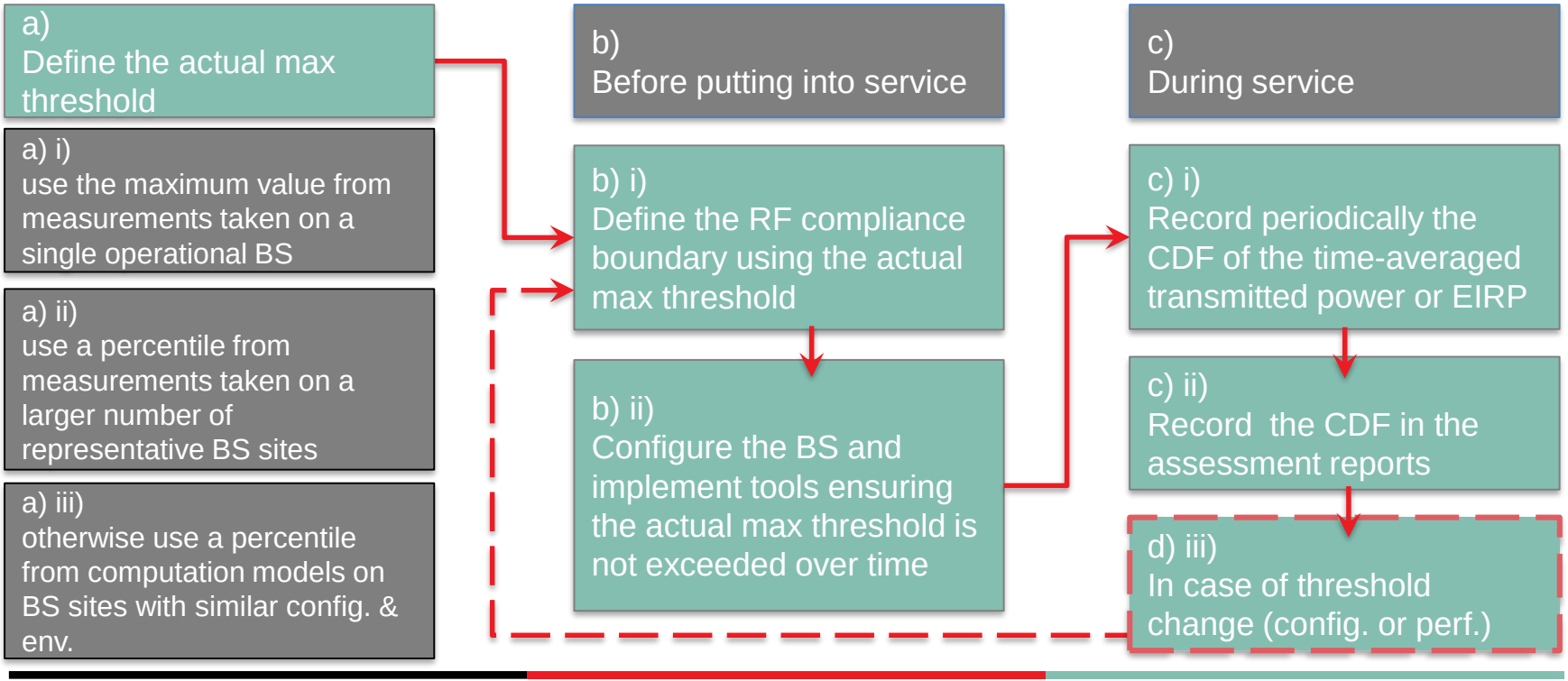
Monitoring & control tools → Proof points available upon request

EIRP Actual max threshold → EMF compliance boundary assessment and site declaration/approval





IEC TR62669 RF compliance process based on actual max power



[from IEC TR6266913.1.2, informal draft 15.10.2018]

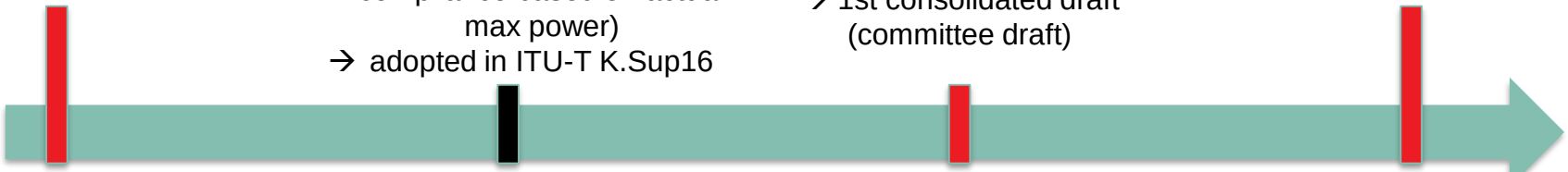
Novel compliance approach: standards & regulations milestones

Global RF exposure assessment standard IEC 62232:2017

Implementation guide IEC TR62669
→ novel approach (rationale and principles for RF compliance based on actual max power)
→ adopted in ITU-T K.Sup16

Introduction of the novel compliance approach in IEC 62232
→ 1st consolidated draft (committee draft)

IEC 62232 new edition
→ technical freeze (committee draft for vote)



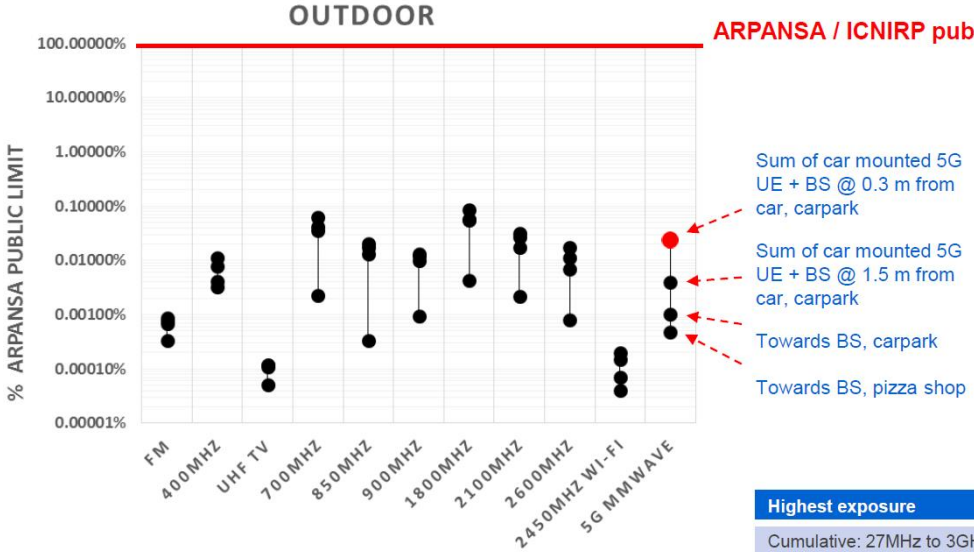
Jul'17 | Dec'18/Jan'19 | Dec'19 | Dec'20

5G

National authorities update RF compliance regulations for early 5G deployments

5G levels expected to be similar to existing technologies

Environmental EMF levels - outdoor



Sum of car mounted 5G UE + BS @ 0.3 m from car, carpark

Sum of car mounted 5G UE + BS @ 1.5 m from car, carpark

Towards BS, carpark

Towards BS, pizza shop

Highest exposure	
Cumulative: 27MHz to 3GHz	0.19%
5G	0.025%

- Measurements at different positions

[Wood (Telstra) at MWF 5G Workshop at BioEM 2018]

Everyday RF-EMF exposures in Europe (1/2)

Journal of Exposure Science and Environmental Epidemiology (2017) 00, 1–14

www.nature.com/jes

ORIGINAL ARTICLE

Radiofrequency electromagnetic field exposure in everyday microenvironments in Europe: A systematic literature review

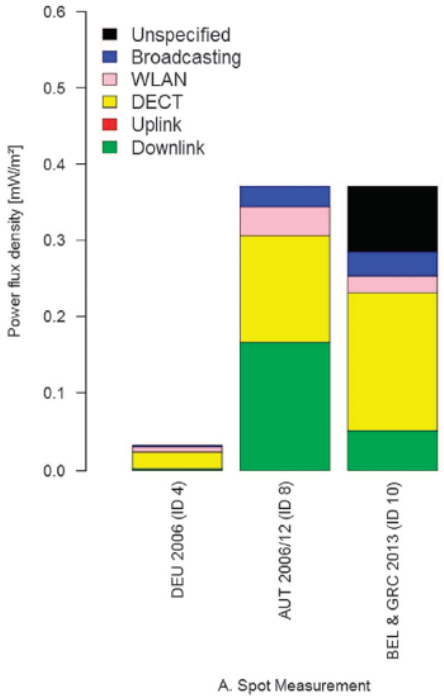
Sanjay Sagar[1,2], Stefan Dongus[1,2], Anna Schoeni[1,2], Katharina Roser[1,2], Marloes Eeftens[1,2], Benjamin Struchen[1,2], Milena Foerster[1,2], Noëmi Meier[2,3], Seid Adem[1,2] and Martin Röösli[1,2]

- Twenty-one studies met eligibility criteria
- RF-EMF data collected between 2005 and 2013
- Typical RF-EMF levels substantially below limits:
  - Highest levels in public transportation due to the uplink
  - Outdoors downlink was main source but broadcasting underestimated
  - Exposure levels in homes lower than outdoors

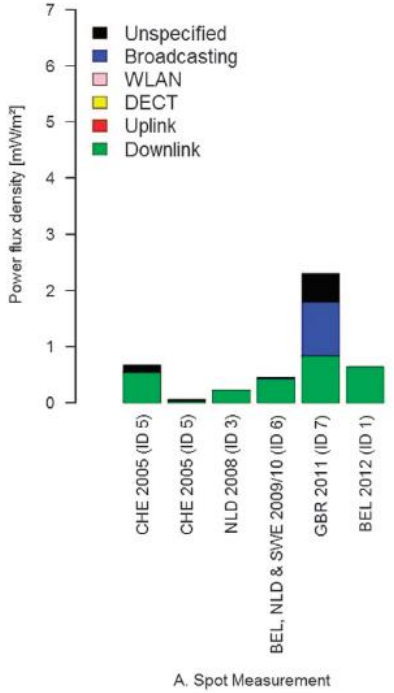
Sagar et al., 2017

Everyday RF-EMF exposures in Europe (2/2)

Home



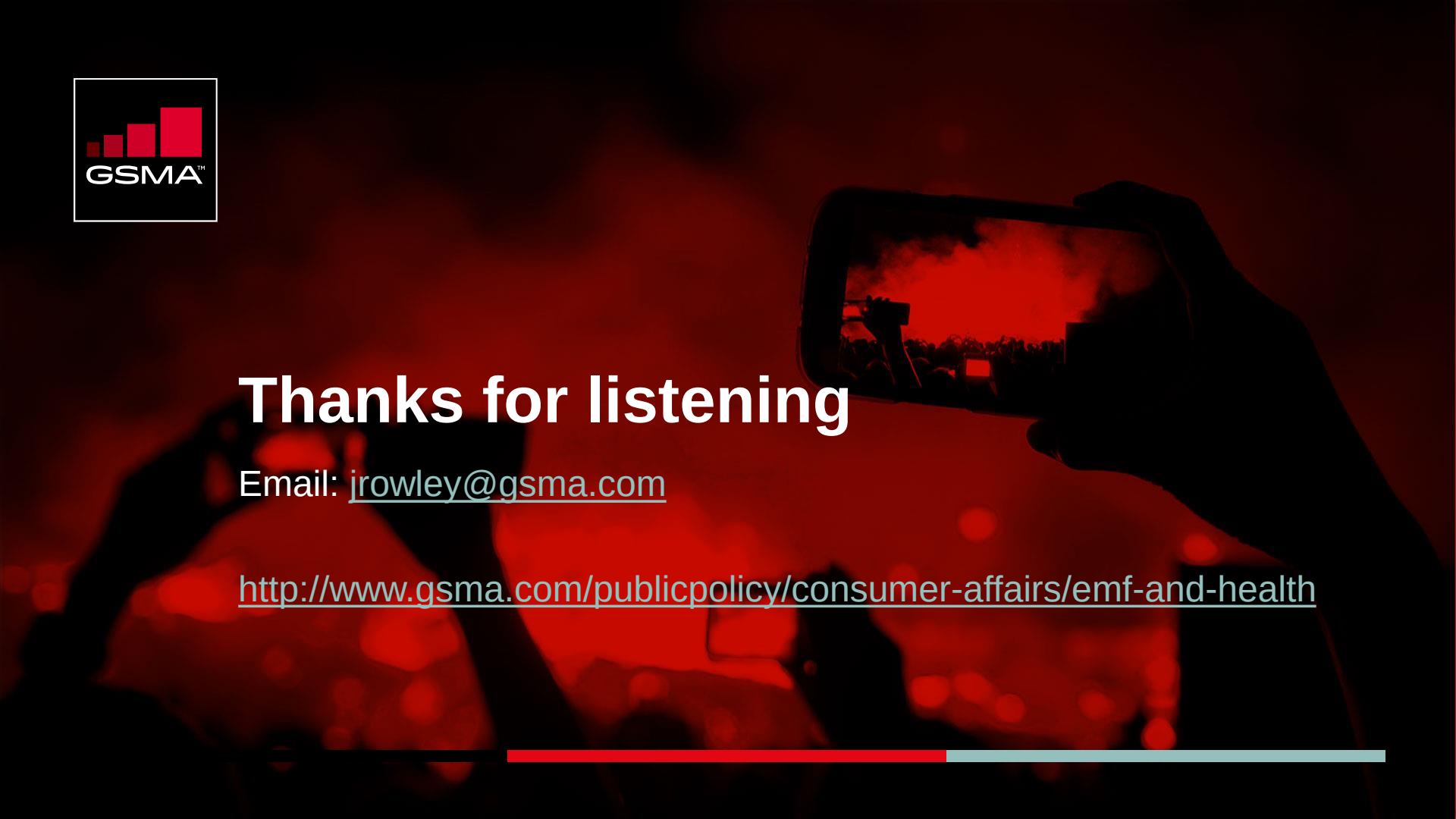
Outdoor



Sagar et al., 2017

Conclusions

- RF-EMF measurements in multiple countries and for many years show low levels from mobile communication networks
- Downlink and broadcast important for outdoor measurements, indoors need to also consider Wi-Fi and DECT (and uplink)
- Post installation measurements not needed for most sites
- Statistical approaches provide more accurate time averaged RF-EMF assessment for mobile technologies



Thanks for listening

Email: jrowley@gsma.com

http://www.gsma.com/publicpolicy/consumer-affairs/emf-and-health