Electromagnetic Fields: Science and Standards

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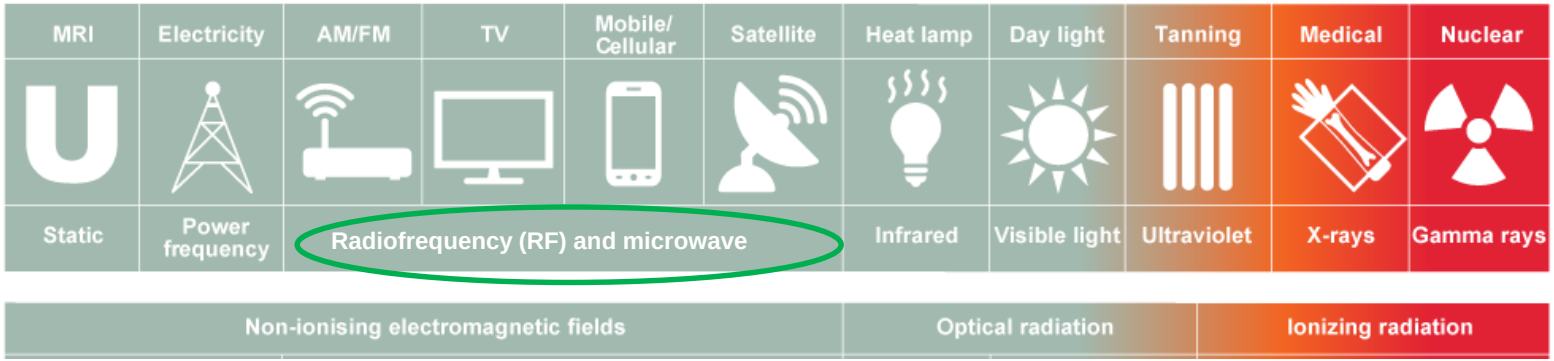
GSMA

WRC 2019, Sharm el-Sheikh, Egypt, 8 November 2019

Overview of the scientific evidence

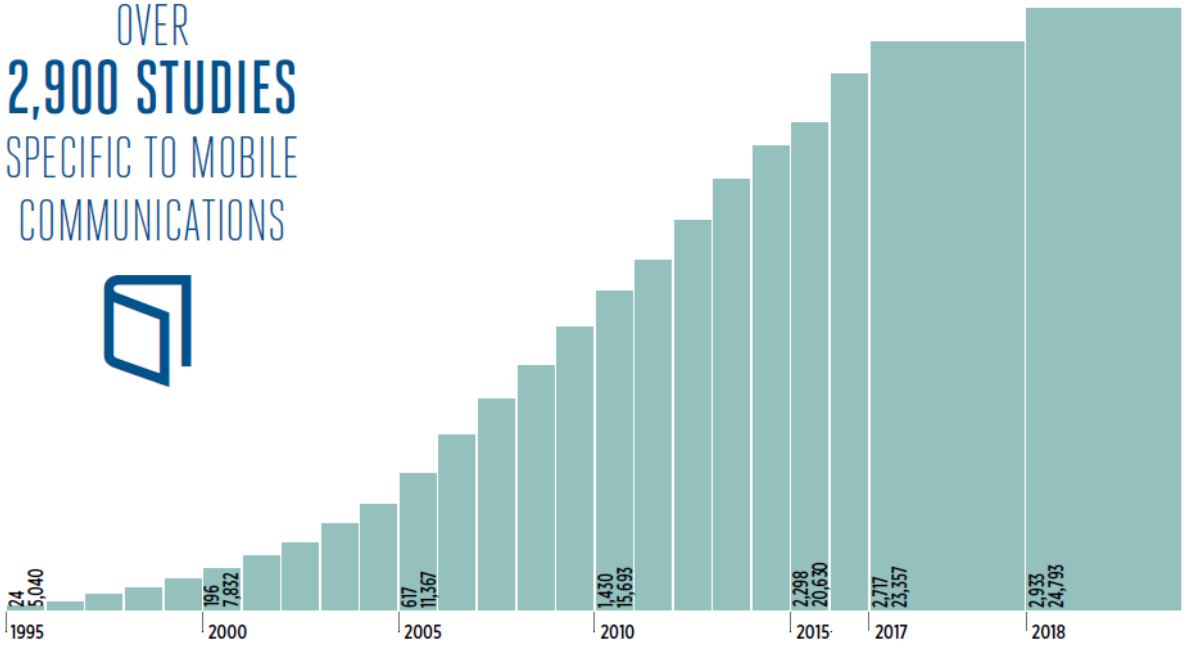
- Radiofrequency EMF exposures and health

Electromagnetic Fields



- Radio signals are a form of non-ionizing electromagnetic energy
- Very strong radio signals can cause heating of the body
- Protection standards developed to limit exposure

Large body of EMF research



- Approaching 30,000 EMF publications
- Almost 3,000 specific to mobile communications
- About 350 specific to mmWaves

www.emf-portal.org

WHO International EMF Project

World Health Organization

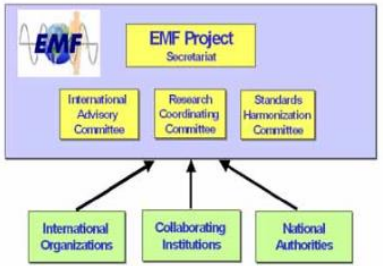
Health topics | Data | Media centre | Publications | Countries | Programmes | Governance | About WHO | Search

Electromagnetic fields (EMF)

- EMF Home
- About electromagnetic fields
- EMF Project
- Research
- Standards
- EMF publications & information resources
- Meetings

Electromagnetic fields

Electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed to varying degrees of EMF, and the levels will continue to increase as technology advances.



http://www.who.int/emf

Everyday RF-EMF exposures

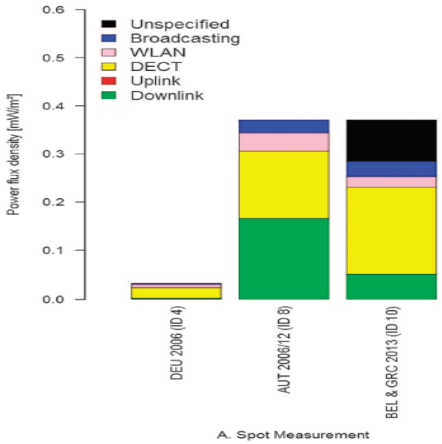
Journal of Exposure Science and Environmental Epidemiology (2017) 00, 1–14

www.nature.com/jes

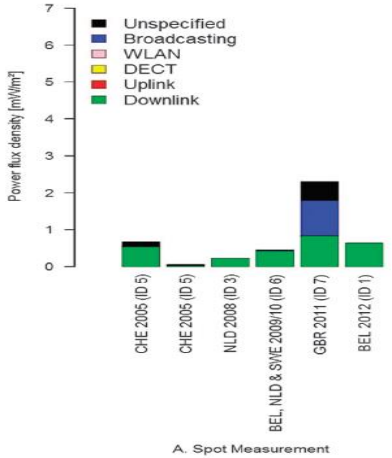
ORIGINAL ARTICLE

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

Home



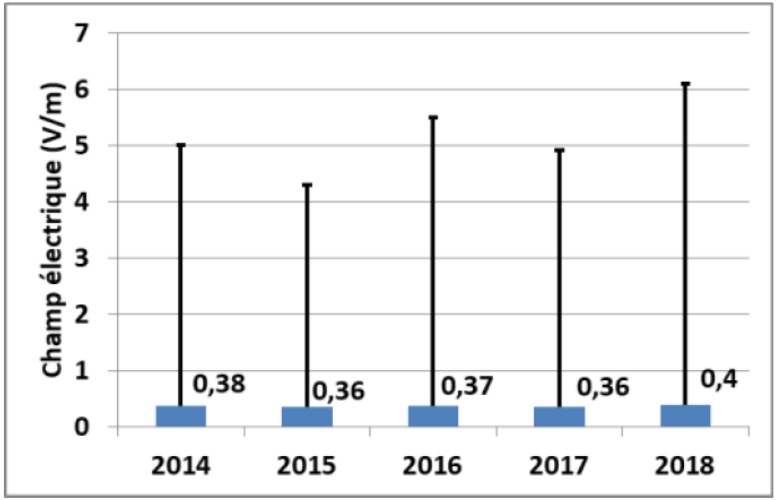
Outdoor



- Typical RF-EMF levels substantially below limits

Sagar et al., 2017

No significant change in overall RF-EMF levels



ANFR
AGENCE NATIONALE DES FRÉQUENCES

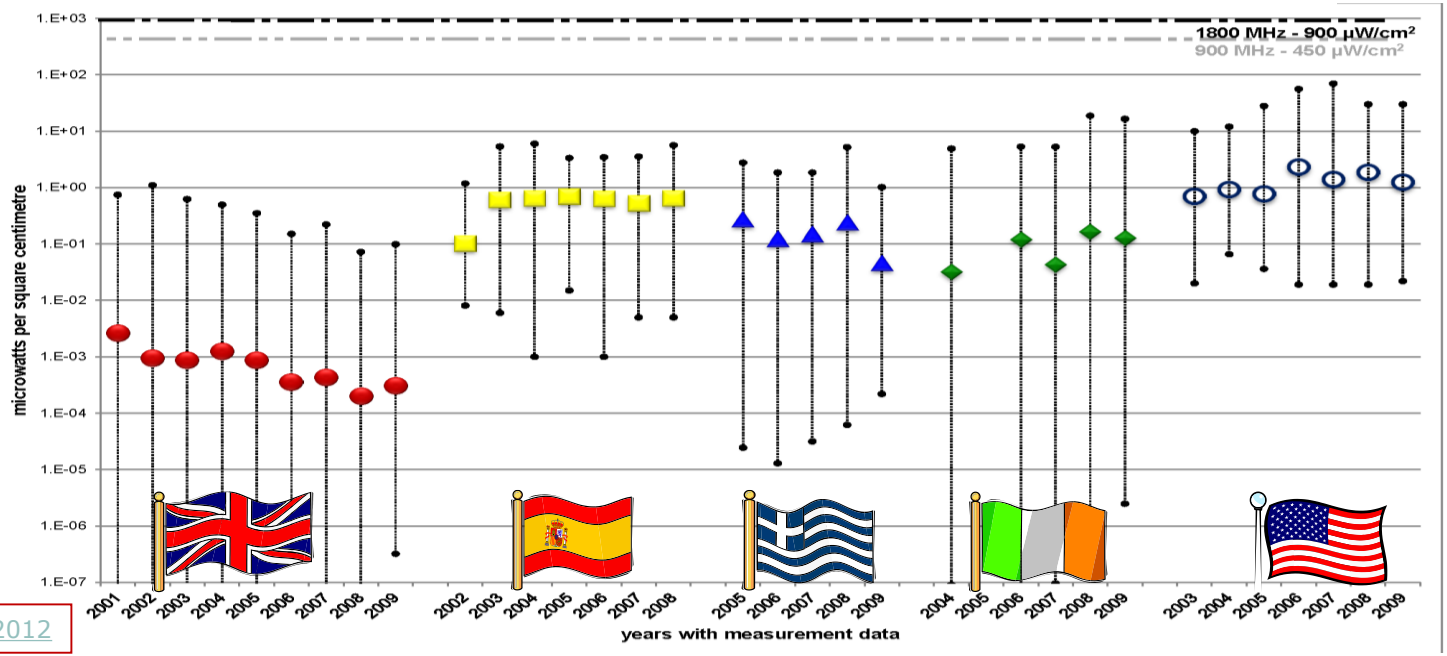
Median values (blue bars) and 99% percentiles (black bars) versus year of measurement

- Median level 4,500 times below limit

ANFR, 2019

No significant change in network exposure levels

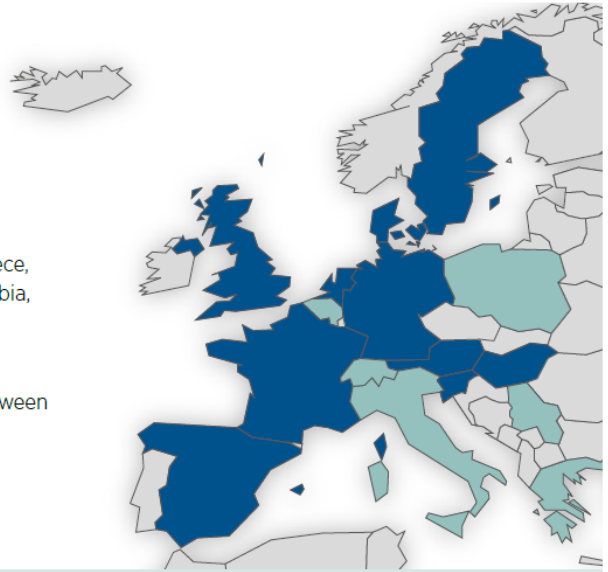
Figure 2. Minimum (●), maximum (●) and average of the narrowband measurements for the UK (●), Spain (■), Greece (▲) and Ireland (◆); and the broadband measurements for the US (○), with the year of measurement data on the horizontal axis. Note that not all years were available in all countries. For comparison,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



Rowley & Joyner, 2012

No significant change in personal exposure

International Limits
Restrictive Limits
Not included



Data from 47 measurement studies[6]

Measurements in sixteen countries:
Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Italy, Spain, Poland, the Netherlands, Serbia, Slovenia, Sweden, Switzerland, United Kingdom

Measurements made 2002 to 2017

There was no indication of distinct differences between countries, exposure levels were similar with the international or restrictive limits.

> Personal measurement with volunteers studies do not indicate a notable increase in personal RF-EMF exposure, as mean levels are comparable to those reported in a previous review.

No risk increase near broadcast transmitters

- Radio about 100 years, TV for 50 years:
  - AM radio – 50,000 W FM radio – 100,000 W
  - UHF TV – 1,000,000 W
- Epidemiological studies: Australia, Germany, Italy, South Korea, Switzerland, UK, USA
- No increase of illness among nearby populations

Selvin et al., 1992; Maskarinec et al., 1994; Hocking et al., 1996; Dolk et al, 1997; McKenzie et al., 1998; Michelozzi et al. 2002; Park et al, 2004; Ha et al, 2007; Schuz et al., 2008; Merzenich et al., 2008; Hauri et al, 2014

عربي

World Health Organization

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What are the health risks associated with mobile phones and their base stations?

Online Q&A
20 September 2013

"Studies to date provide no indication that environmental exposure to RF fields, such as from base stations, increases the risk of cancer or any other disease."

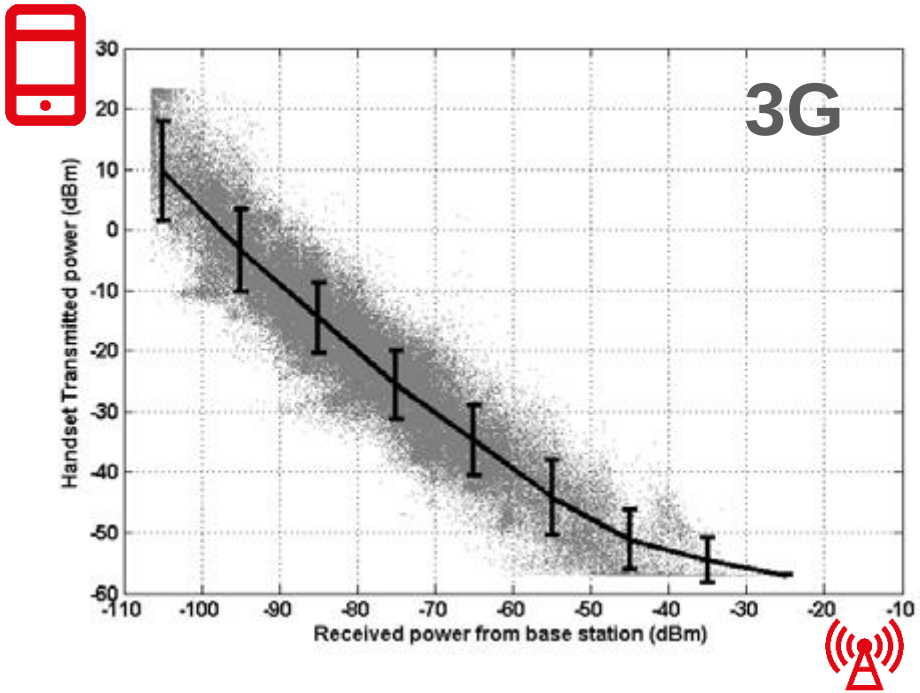
http://www.who.int/features/qa/30/en/

Mobile device exposures

Better connection, longer talk time and lower output power

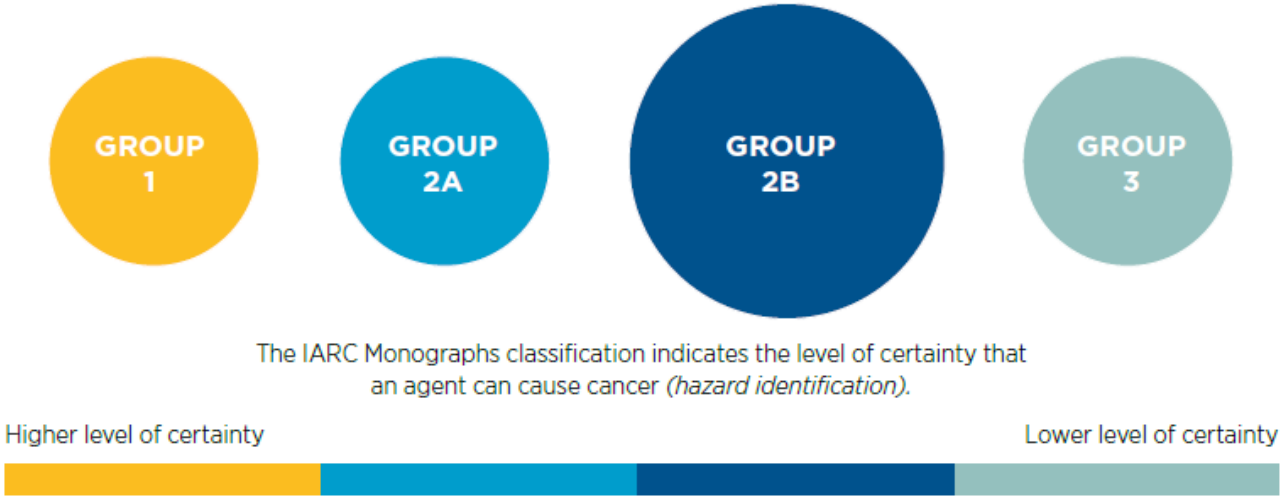
Higher data rates require nearby antennas

Handset power low when network coverage is good



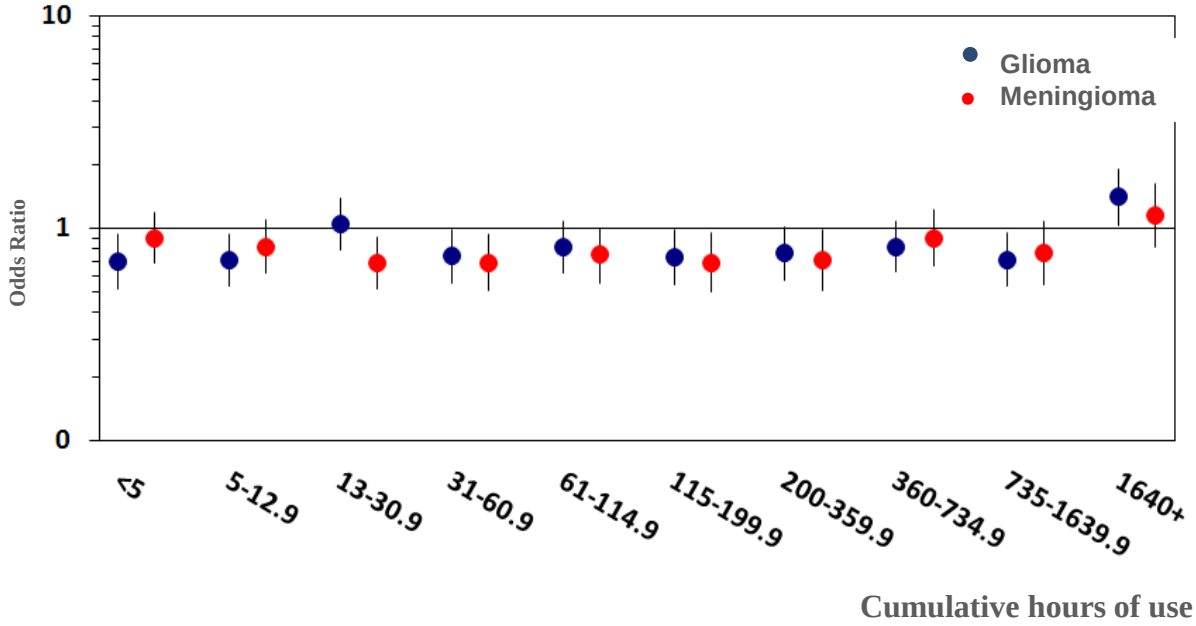
Gati et al, 2009

IARC classification for RF — 2B (May 2011)



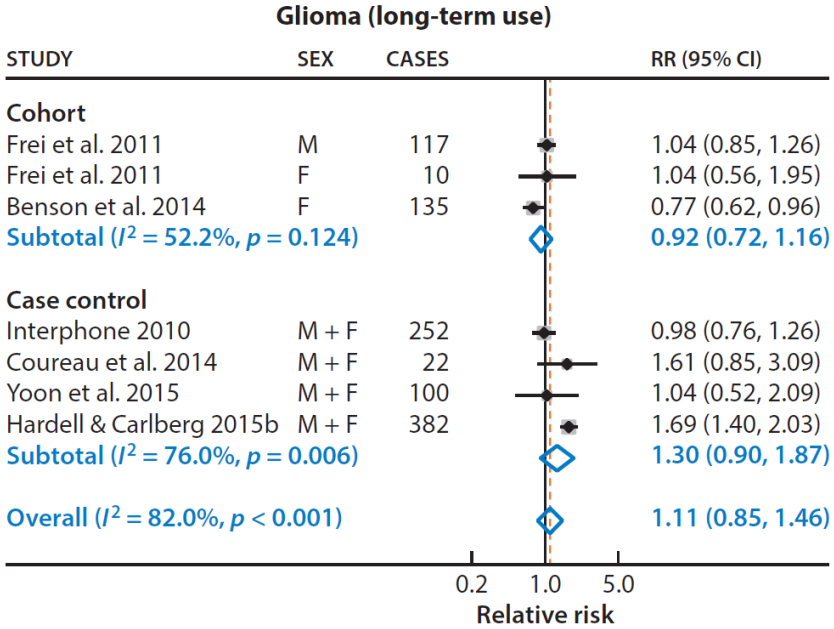
- *'…[evidence] limited among users of wireless telephones for glioma and acoustic neuroma, and inadequate to draw conclusions for other types of cancers. The evidence from the occupational and environmental exposures mentioned above was similarly judged inadequate.'*

INTERPHONE – combined results



Adapted from The INTERPHONE Study Group, 2010

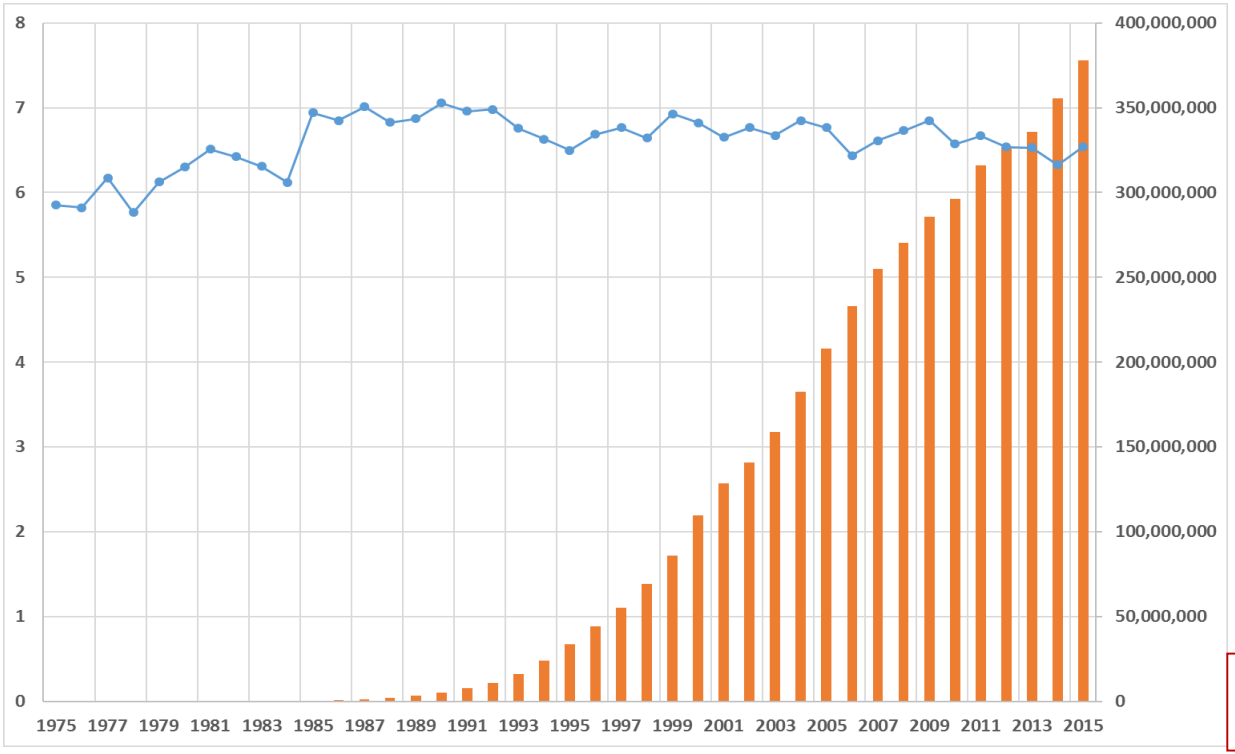
Population studies do not support link between cell phone use and brain cancer



- *'…epidemiological studies do not suggest increased brain or salivary gland tumor risk with MP use, although some uncertainty remains…'*
- *'…elevated risks are not coherent with observed incidence time trends'*

Röösli et al, 2019

US brain cancer and mobile subscriber trends



Based on CTIA and SEER data

What are the health risks associated with mobile phones and their base stations?

Online Q&A
20 September 2013

'While an increased risk of brain tumours from the use of mobile phones is not established, the increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of mobile phone use and brain cancer risk.'

http://www.who.int/features/qa/30/en/

Overview of RF-EMF standards

- Human exposure limits

Basis for policy in most countries

ICNIRP GUIDELINES

FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC AND ELECTROMAGNETIC FIELDS (UP TO 300 GHZ)

> The exposure that 5G will produce has been considered in great depth by ICNIRP, with the restrictions set well below the lowest level of 5G-related radio frequency that has been shown to cause harm.
>
> **International Commission on Non-Ionizing Radiation Protection (ICNIRP)[3]**

International limits are protective of health

EMF and Health – Expert Reports

Index of Reports and Statements

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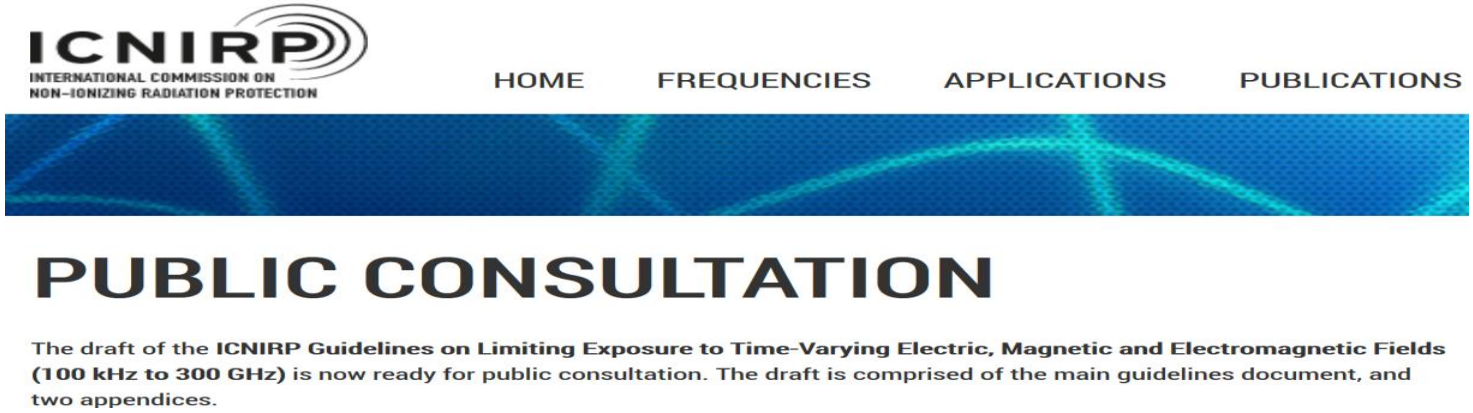
> The main conclusion from the WHO reviews is that EMF exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health.
>
> **World Health Organization: EMF Standards and Guidelines[2]**

https://www.gsma.com/publicpolicy/consumer-affairs/emf-and-health/expert-reports

Update to international RF-EMF guidelines



- Draft limits provide '*a **high level of protection for all people** against known adverse health effects from direct, non-medical exposures to both short and long-term, continuous and discontinuous radiofrequency EMFs.*'

- Final expected November/December 2019

5G RF-EMF

- Radiofrequency exposures and health

Existing RF-EMF exposure limits apply to 5G

Europe Union:

'The strict and safe exposure limits for electromagnetic fields recommended at EU level apply for all frequency bands currently envisaged for 5G.' (European Commission, 2017).

Norway:

'Measurements show that the total exposure from mobile and radio transmitters that we are exposed to today is weak and is far below the limits for what is harmful to health. We have no reason to believe that the introduction of 5G will change this.' (DSA, 2019)

United Kingdom:

'…point-to-point microwave links and some other types of transmitters that have been present in the environment for many years. ICNIRP guidelines apply up to 300 GHz, well beyond the maximum (few tens of GHz) frequencies proposed for 5G.' **(PHE, 2019)**

Australia:

'Although the 5G mobile phone network is new, limits set in safety standards, our understanding of the evidence of health effects and the need for more research have not changed.' **(ARPANSA, 2019)**

Small cell exposure levels similar to macro sites

Final analysis (December 2018) showed that 4G small cells:

- Increased data rates, with uplink >20 Mb/s in 75% of cases and downlink >50 Mb/s in 50% of cases
- Reduced mobile phone output power at comparable data rates
- Exposure level was about the same as that of the “macro” network

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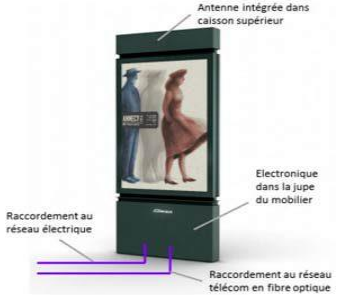
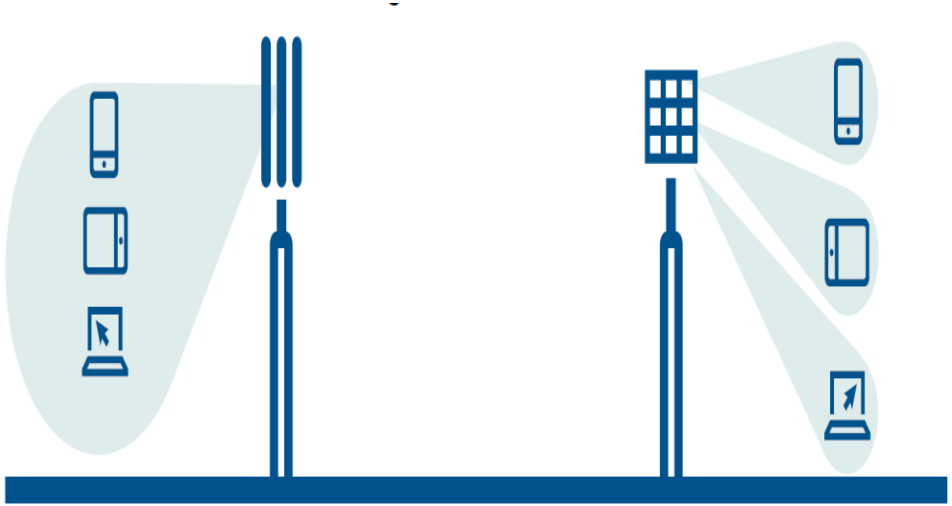


Source: ANFR, 2018

Increased deployment of smart antenna technologies



Conventional antenna

Smart antenna

- Maintain high data throughput in more efficient ways
- Reduce network interference and electromagnetic energy in unintended directions
- More variability in space and time in the exposure levels

5G exposure levels similar to existing technologies

4G	Actuelle	Future
Puissance maximale	60 W	160 W
Gain maximal de l'antenne	18 dBi	18 dBi
Atténuation sur 6 minutes	- 4 dB	- 4 dB
Vitrage	- 2 dB	- 2 dB
E estimé à 100 m	**1,7 V/m**	**2,8 V/m**

5G	Hypothèse basse	Hypothèse haute
Puissance	80 W	200 W
Gain	24 dBi	24 dBi
Atténuation sur 6 minutes	- 13,5 dB	- 13,5 dB
Vitrage	- 2 dB	- 2 dB
TDD	- 1,25 dB	- 1,25 dB
E estimé à 100 m	**1,1 V/m**	**1,8 V/m**

Note: Estimated exposures at 100 m in the interior of a building.

Source: ANFR, 2019

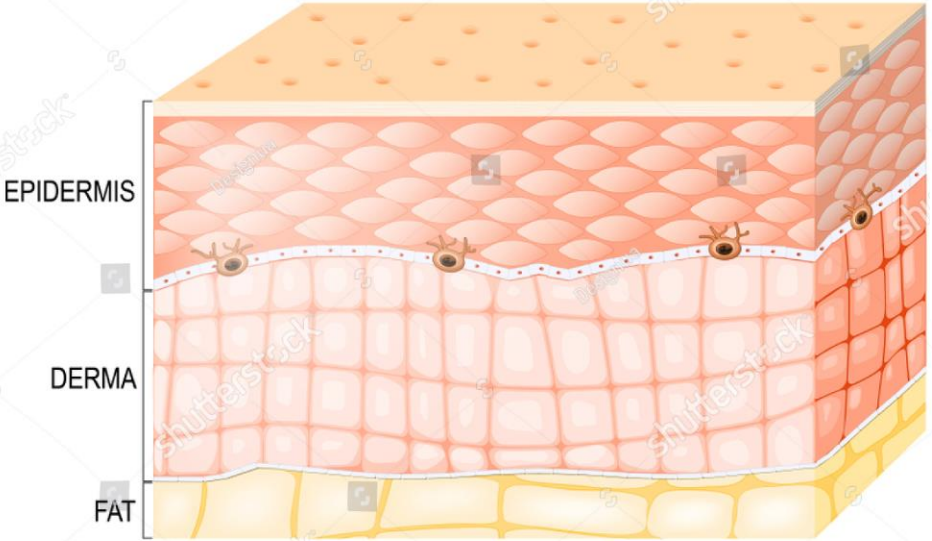
Millimetre waves

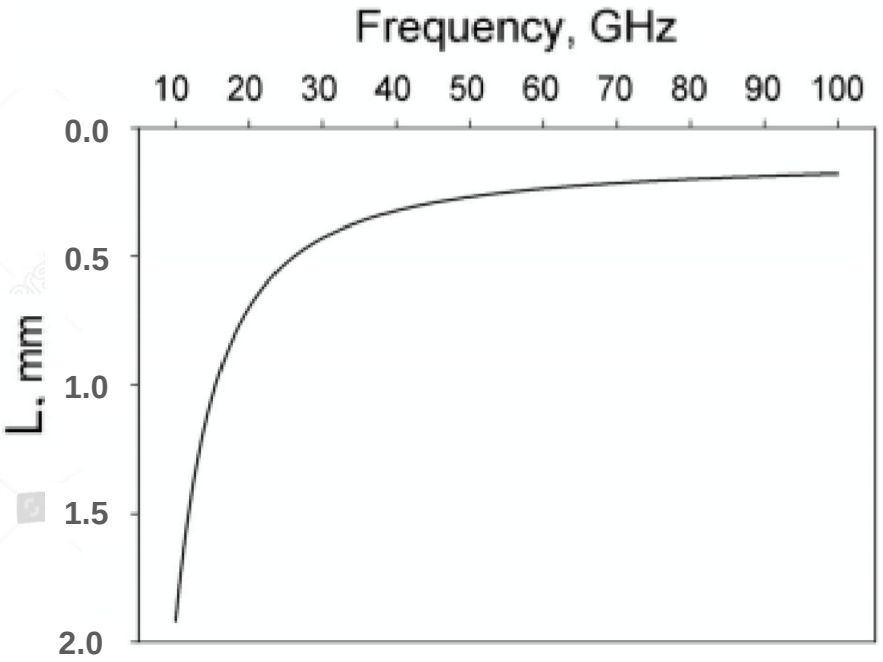
- Already in use, expanding for 5G

Millimetre-waves are well studied

- Existing applications in communications, radar, security scanners, medical therapies (Eastern Europe), non-lethal crowd control.
  - Roughly 30 GHz to 100 GHz (in biological literature)
  - Significant body of western scientific literature, more in the former Soviet Union
- Main biological effects are skin and eye heating at levels of exposure above levels allowed by limits

mmWaves mostly absorbed in outer skin layers





Active Denial Technology (1/2)

- Operates at 95 GHz
- Penetrates the skin to a depth equivalent to three sheets of paper
- Minimal risk of injury due to the shallow energy penetration and normal human instinctive reactions

Active Denial System 2
Official Department of Defense Image

Active Denial Technology (2/2)

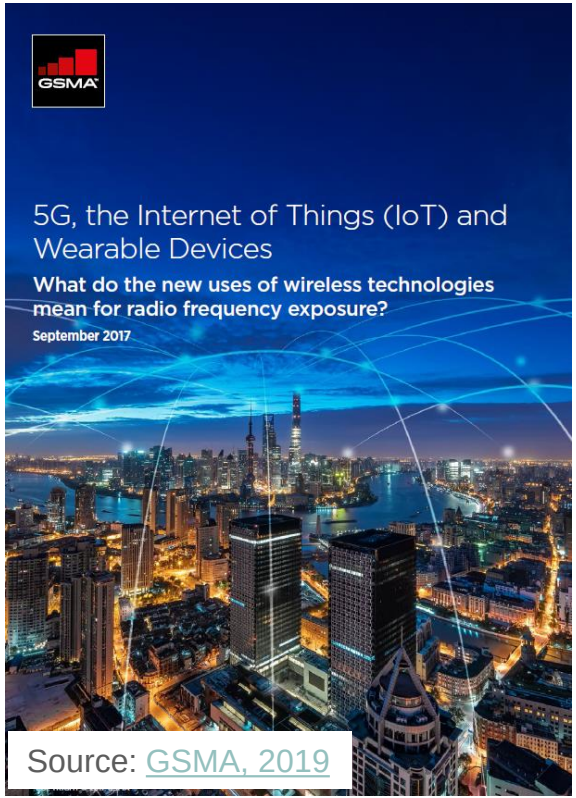
- Exposures significantly higher than exposure guidelines
- Health risk assessment:
  - 15 years of studies
  - 13,000 exposures on volunteer subjects
  - No promotion or co-promotion of skin cancer in animal study
  - No effect on male or female reproduction

Active Denial System 2
Official Department of Defense Image

Resources

- GSMA and others

GSMA - 5G EMF Information

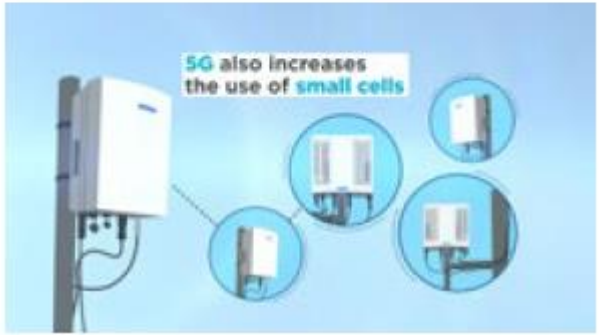


Source: GSMA, 2019

Multiple languages

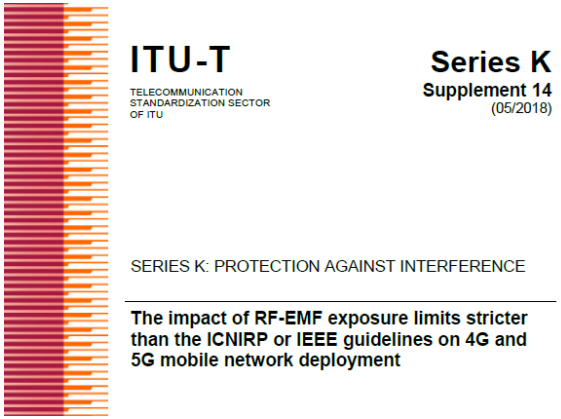
Source: GSMA, 2019

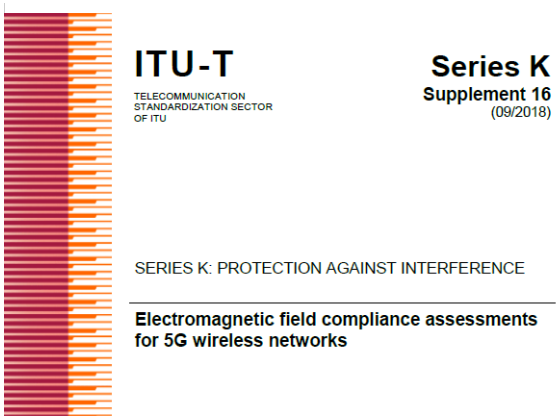
Animation



Source: GSMA, 2019

ITU - 5G EMF Information





- ITU-R activities on RF-EMF measurement.
- ITU-D activities on RF-EMF policy:
  - Regional workshop in Jordan, December 2019

Changing media narrative on 5G and EMF

July 2018

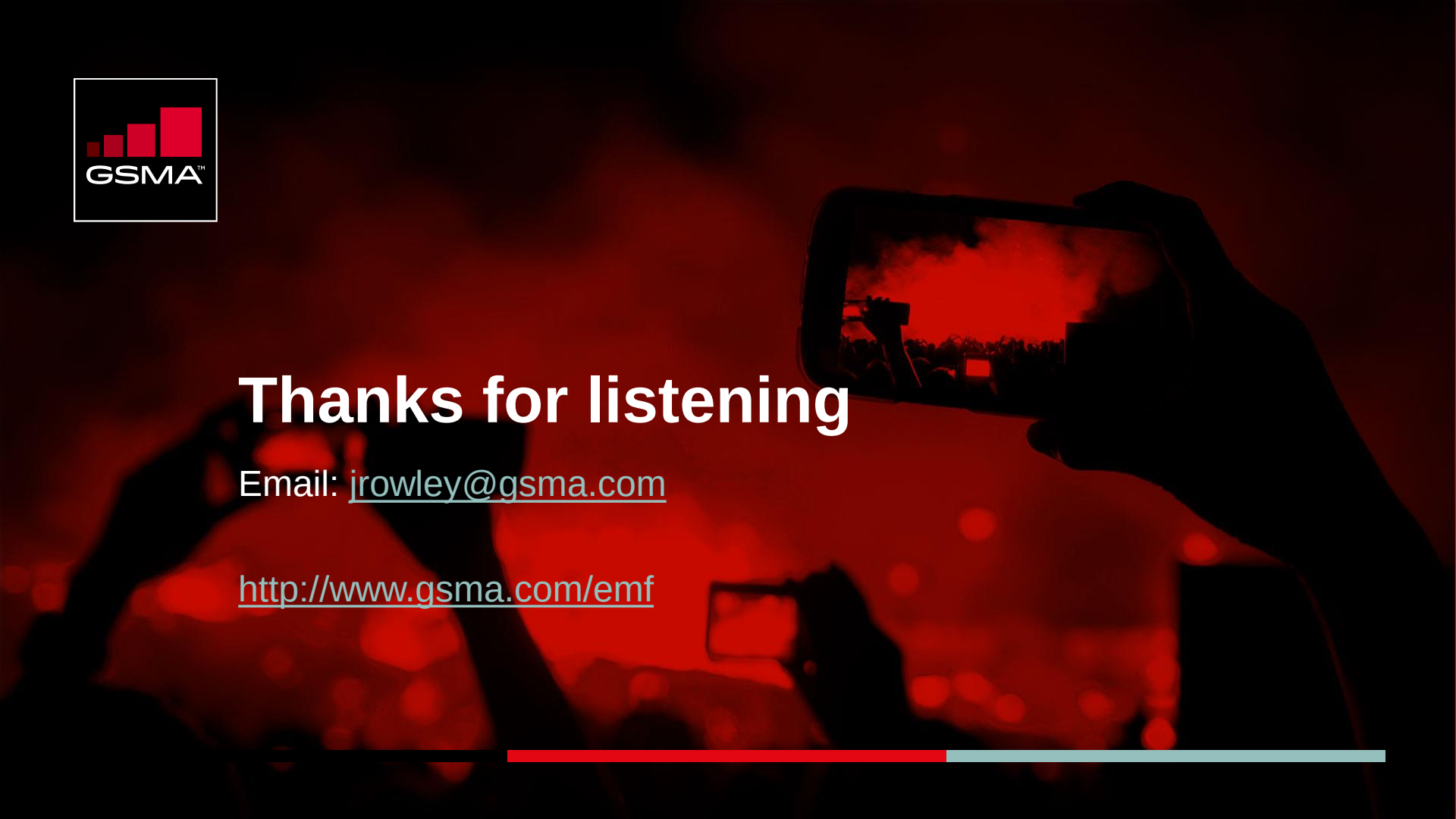
July 2019

Conclusions

- International RF-EMF limits cover the frequencies and modulations relevant to 5G and health agencies say that no health hazards are expected at levels below the limits

- 5G assessments show levels similar to 4G meaning that overall exposures will not change by much, remaining a small fraction of the limit values

- mmWave frequencies are used today by the mobile and satellite industries, they have been extensively researched and are covered by the international safety guidelines



Thanks for listening

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http://www.gsma.com/emf