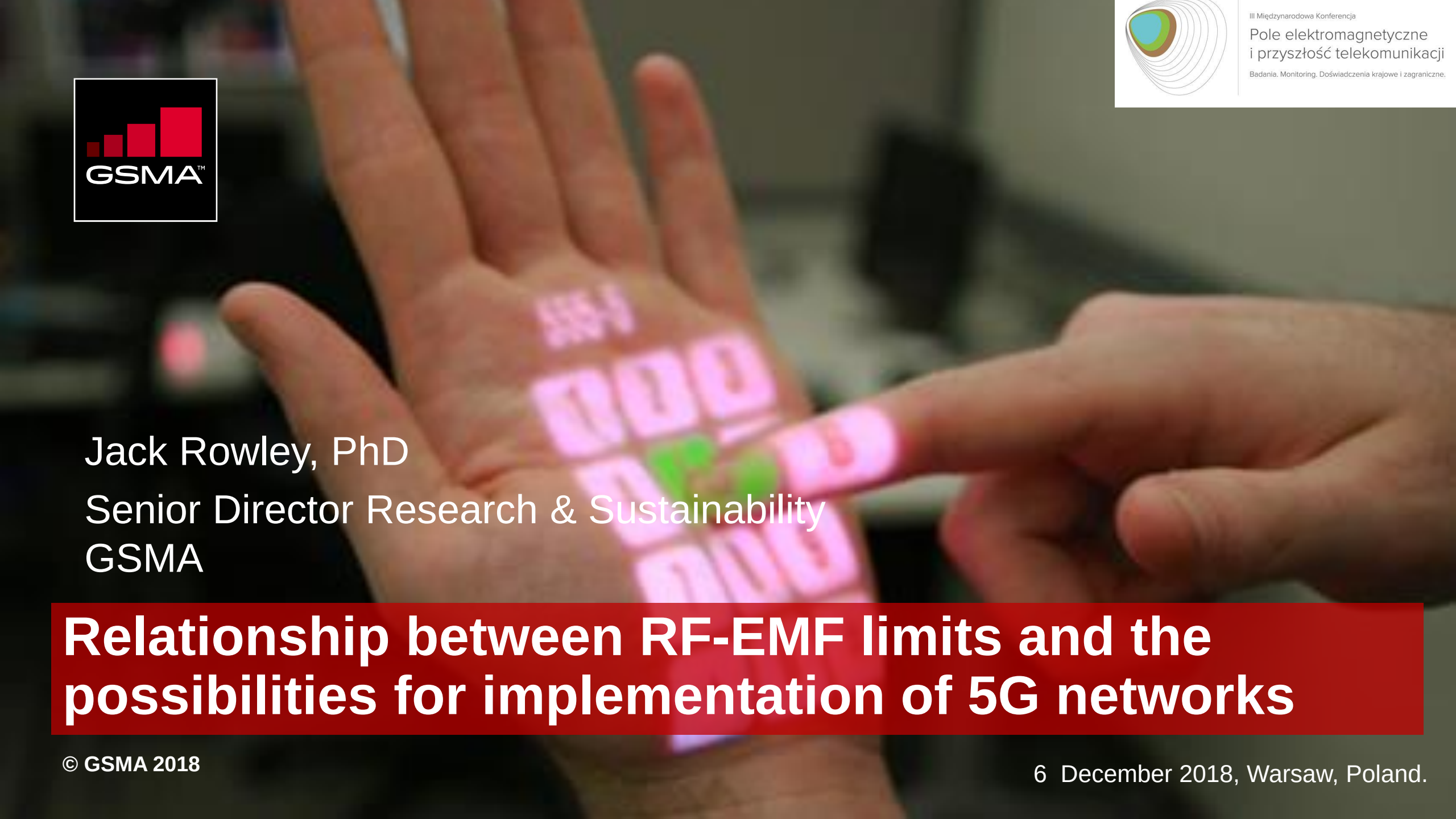

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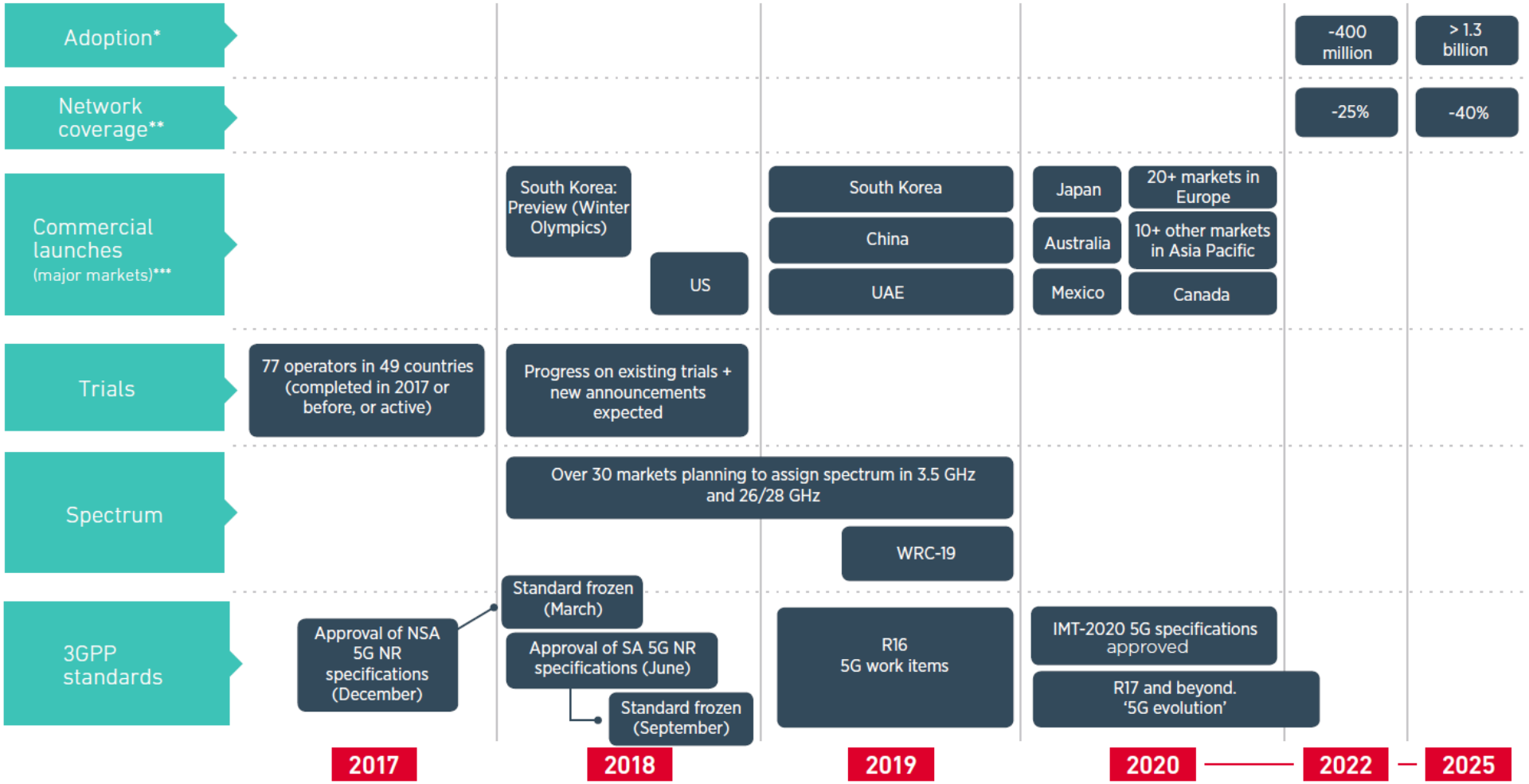
Jack Rowley, PhD
Senior Director Research & Sustainability
GSMA

Relationship between RF-EMF limits and the possibilities for implementation of 5G networks

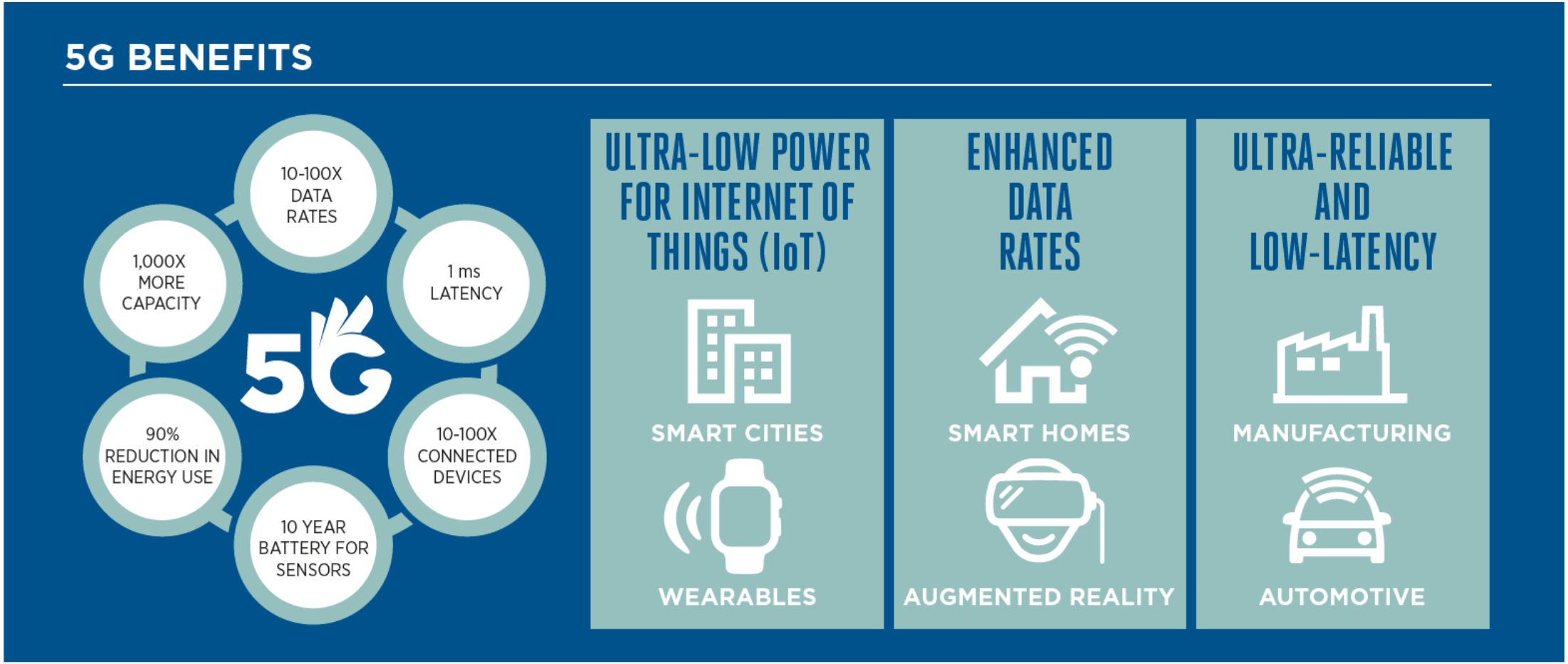
6 December 2018, Warsaw, Poland.

5G is coming to a place near you (if not already there)



* Number of mobile connections excluding cellular IoT, worldwide.
** Percentage of global population.
*** Not exhaustive.

Source GSMA Intelligence



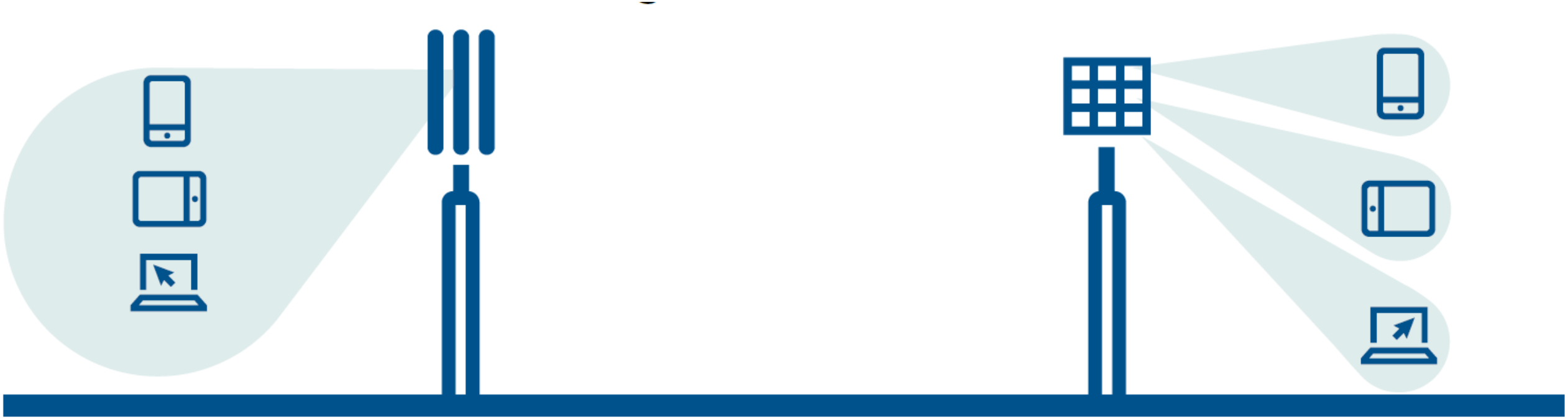
ANFR small cell experiments

Preliminary analysis (April 2017) showed that small cells:

- Increased data rates by up to five-times on the uplink and six on the downlink
- Reduced mobile phone output power by two to five times
- Resulted in average exposure comparable to the levels prior to their installation

Source: ANFR, 2017

Advanced antenna technologies



Restrictive RF-EMF limits do not reduce typical public exposure levels

Belgium (Brussels)

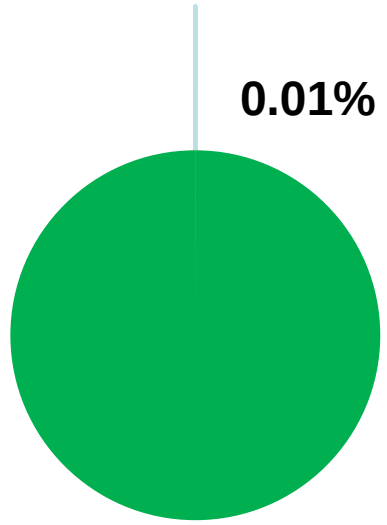
GSM900 limit = 3 V/m

Measured average = 0.93 V/m

Netherlands

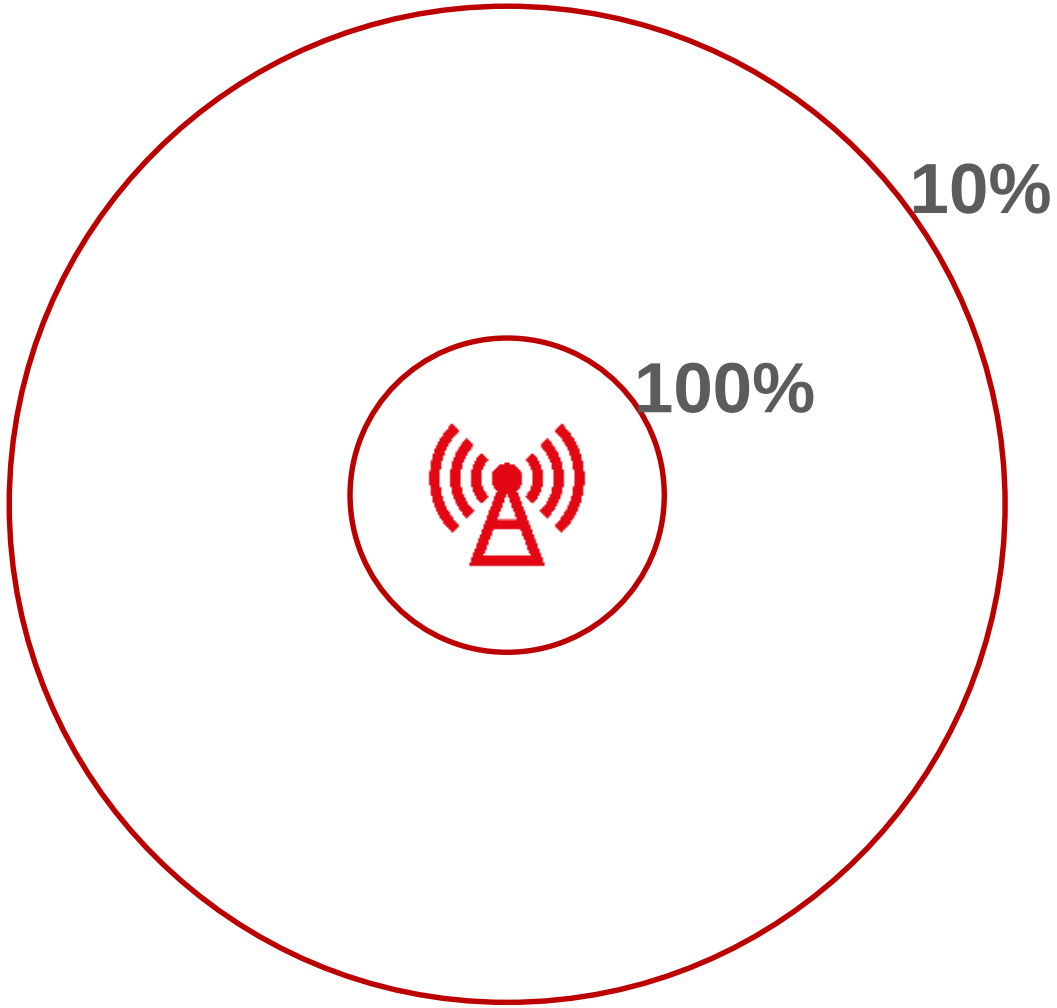
GSM900 limit (ICNIRP) = 41 V/m

Measured average = 0.38 V/m



Joseph et al., 2012

Restrictive limits increase compliance zone size



Belgium: impact of RF-EMF limits on 5G (1 of 7)

Study undertaken by BIPT (regulator) to:

- Determine RF-EMF limits needed in Brussels given increasing 4G congestion and impossibility to invest in 5G
- Whether it is possible to withdraw existing technologies to allow 5G deployment

Note: Brussels limit:

- About 6 V/m @ 900 MHz (frequency dependent)
- Each operator cannot exceed 33% of the cumulative limit indoors (3.45 V/m @ 900 MHz)

BIPT

Belgian Institute for Postal Services and Telecommunications

Study of 12 September 2018 on the impact of the radiation standards in Brussels on the deployment of mobile networks

https://www.ibpt.be/en/operators/radio/antennas-site-sharing/study-of-12-september-2018-on-the-impact-of-the-radiation-standards-in-brussels-on-the-deployment-of-mobile-networks

Belgium: impact of RF-EMF limits on 5G (2 of 7)

- *'…the modified standards, which remain 50 times more stringent than the international recommendations, are **not a long-term solution** for the deployment of 4.5G and 5G.'*

- *'…forced operators to reduce the power of most of their base stations, **impacting the coverage** of networks (particularly indoors) and their ability to simultaneously cover the needs of a large number of users.'*

- '*Furthermore, the standards in Brussels already have **blocked the use of frequencies** assigned to operators…'*

Belgium: impact of RF-EMF limits on 5G (3 of 7)

- Turning off existing technologies is not a solution:
  - *'…if we turn off a 2G or a 3G network, the traffic supported by that network **will not disappear** and will have to be taken up by another network…*
  - *It is thus hardly imaginable to abandon 2G or 3G in the short term. In all cases, abandoning 2G and 3G before deploying 5G **is not realistic**.'*

Belgium: impact of RF-EMF limits on 5G (4 of 7)

- Additional sites are not a solution:

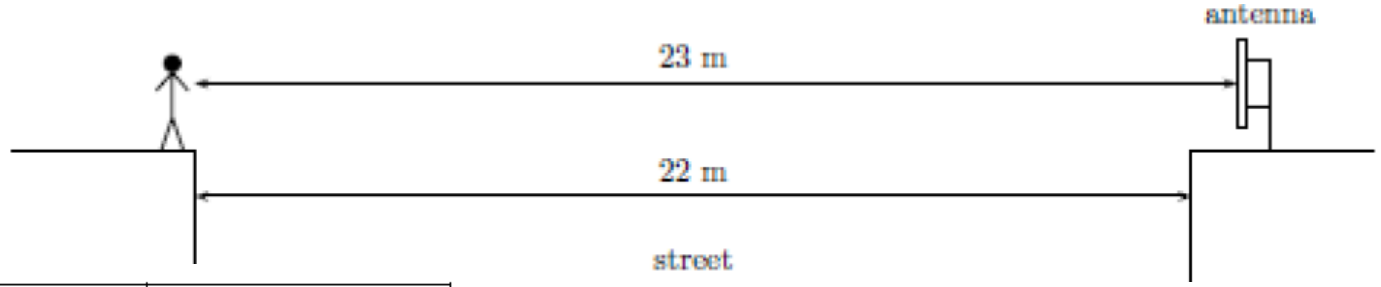
  - *'…in addition to the **extra charge** for the operator, and thus for the **consumer**, the construction of new antennas is problematic for operators. Indeed, the extremely stringent standard in Brussels **did not reassure the population**, on the contrary. It has thus become extremely difficult for operators to find new transmission sites. Furthermore, the administrative procedures are **very complex**.'*

Belgium: impact of RF-EMF limits on 5G (5 of 7)

- Massive MIMO uses RF-EMF energy more efficiently:
  - *'…massive MIMO in 5G will temporarily raise the level of radiation on the user side, but there will be **less constant radiation** for all those who are in the coverage area of the mast.'*
  - *'…traditional calculations allowing to determine the exposure based on the cell power and the type of antenna, and allowing to determine a permanent exposure in only one calculation, become **obsolete**.'*
  - *'…with a high probability (95%) that a random exposure (at a random place) will be **4 times lower** (6 dB) compared to the exposure calculated based on the traditional method.'*

Belgium: impact of RF-EMF limits on 5G (6 of 7)

- Calculation for single-operator, multi-technology site:



	Per operator	Total for 3 operators
Without 5G/NR	17.7 V/m	30.7 V/m
With 5G/NR	24.0 V/m	41.5 V/m
5G/NR only	16.1 V/m	27.9 V/m

Table 4 - Generated fields
(Includes 6 dB correction factor for massive MIMO)

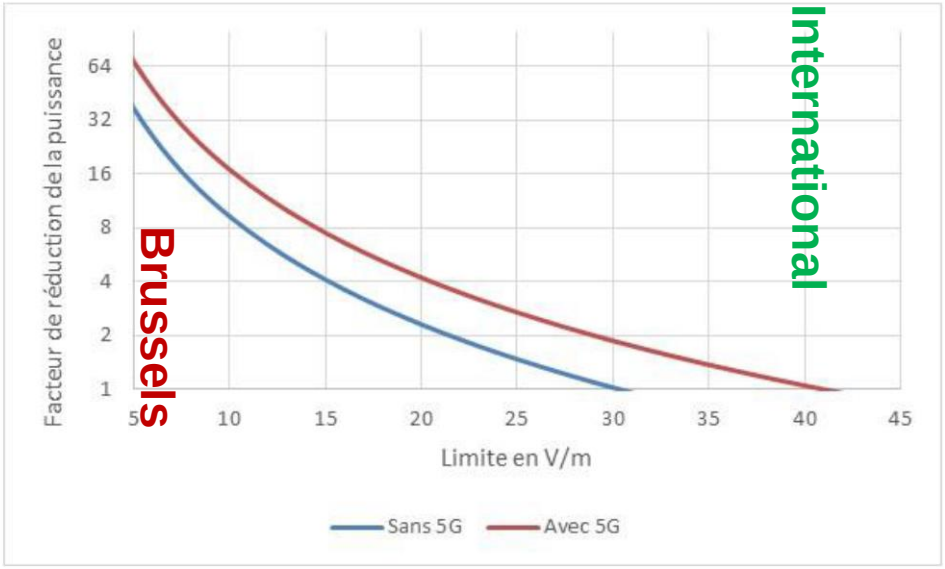


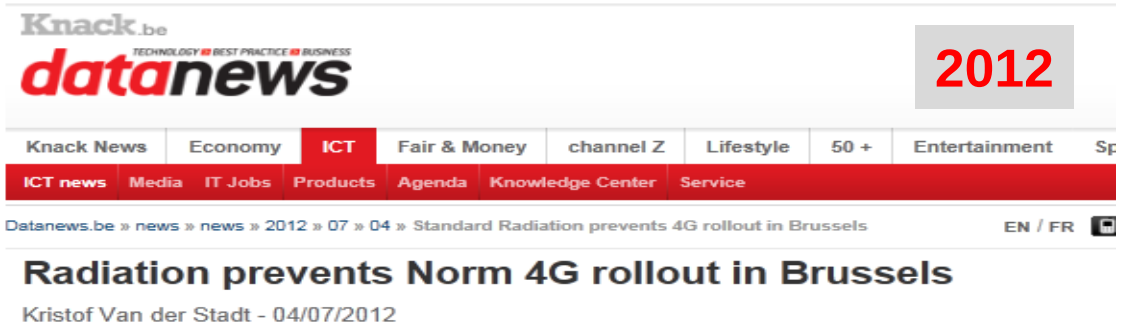
Figure 10 – Necessary reduction in power depending on the radiation limit

Belgium: impact of RF-EMF limits on 5G (7 of 7)

- Conclusions:
  - *'The 6 V/m standard **does not allow** to deploy 5G in Brussels.'*
  - *'Therefore, BIPT proposes to adopt the standard above 14.5V/m and up to 41.5V/m. The **closer we get to the European standard, the more it will guarantee the capacity and the quality of mobile networks**, and it will thus also ensure the user experience for the final clients.'*

Incremental approaches are not the answer

- Brief history of RF-EMF limits in Brussels
  - 2005: Belgium – 20.6 V/m at 900 MHz
  - 2009: Brussels – 3 V/m at 900 MHz (after court decision)
  - 2013: Brussels – 6 V/m at 900 MHz (to allow 4G)
    - Court challenge dismissed in 2016
  - 2018: Brussels – 14.5 V/m at 900 MHz ? (to allow 5G)
    - Courtchallenge?
  - 20xx: Brussels – international limits?

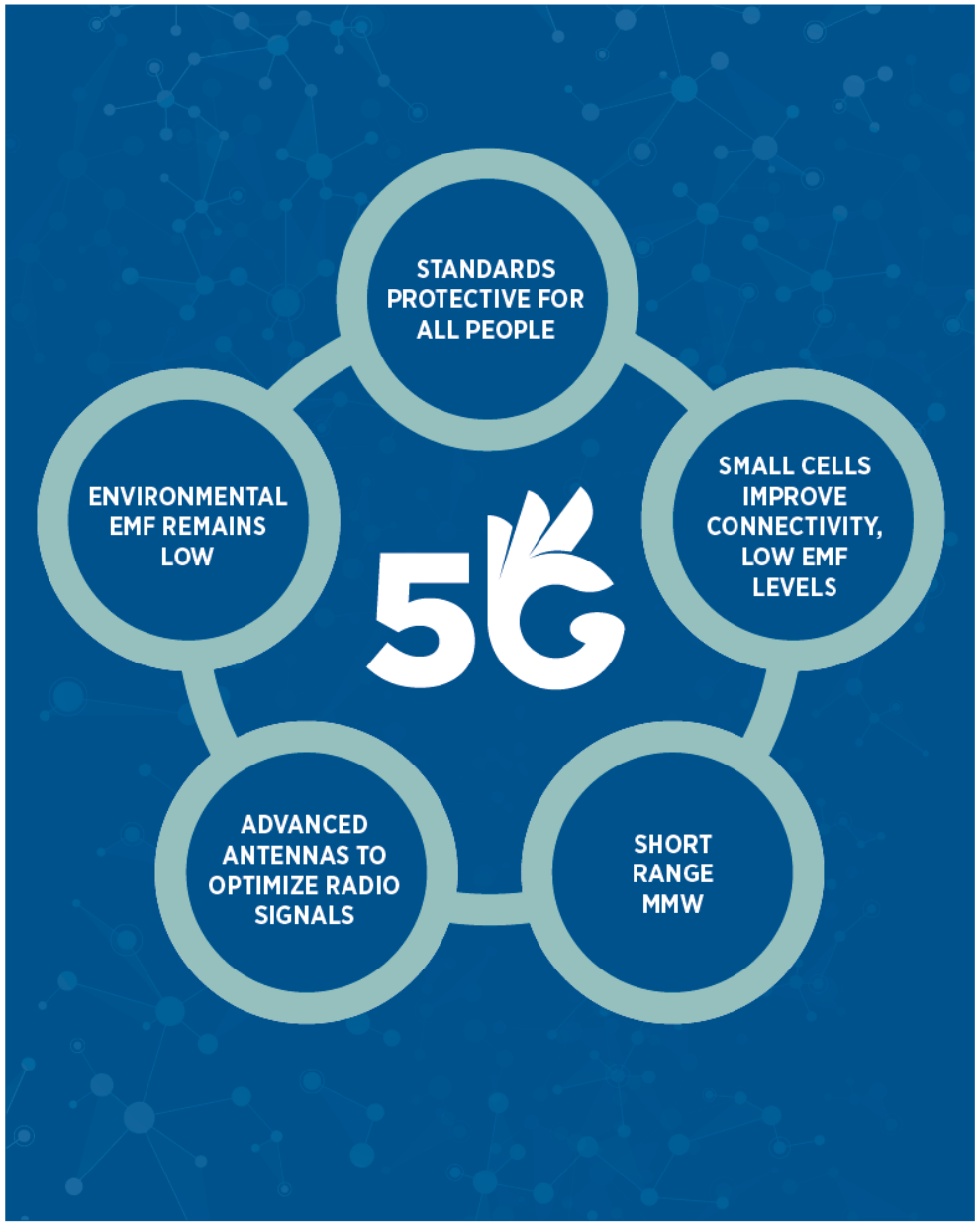


Harmonisation opportunities

‘The strict and safe exposure limits for electromagnetic fields recommended at EU level apply for all frequency bands currently envisaged for 5G.’
- European Commission

‘International limits provide a high level of protection for all people against known adverse health effects from exposures to both short- and long-term, radiofrequency EMFs.’
- ICNIRP

More than 2,500 studies specific to mobile communications
- www.emf-portal.org

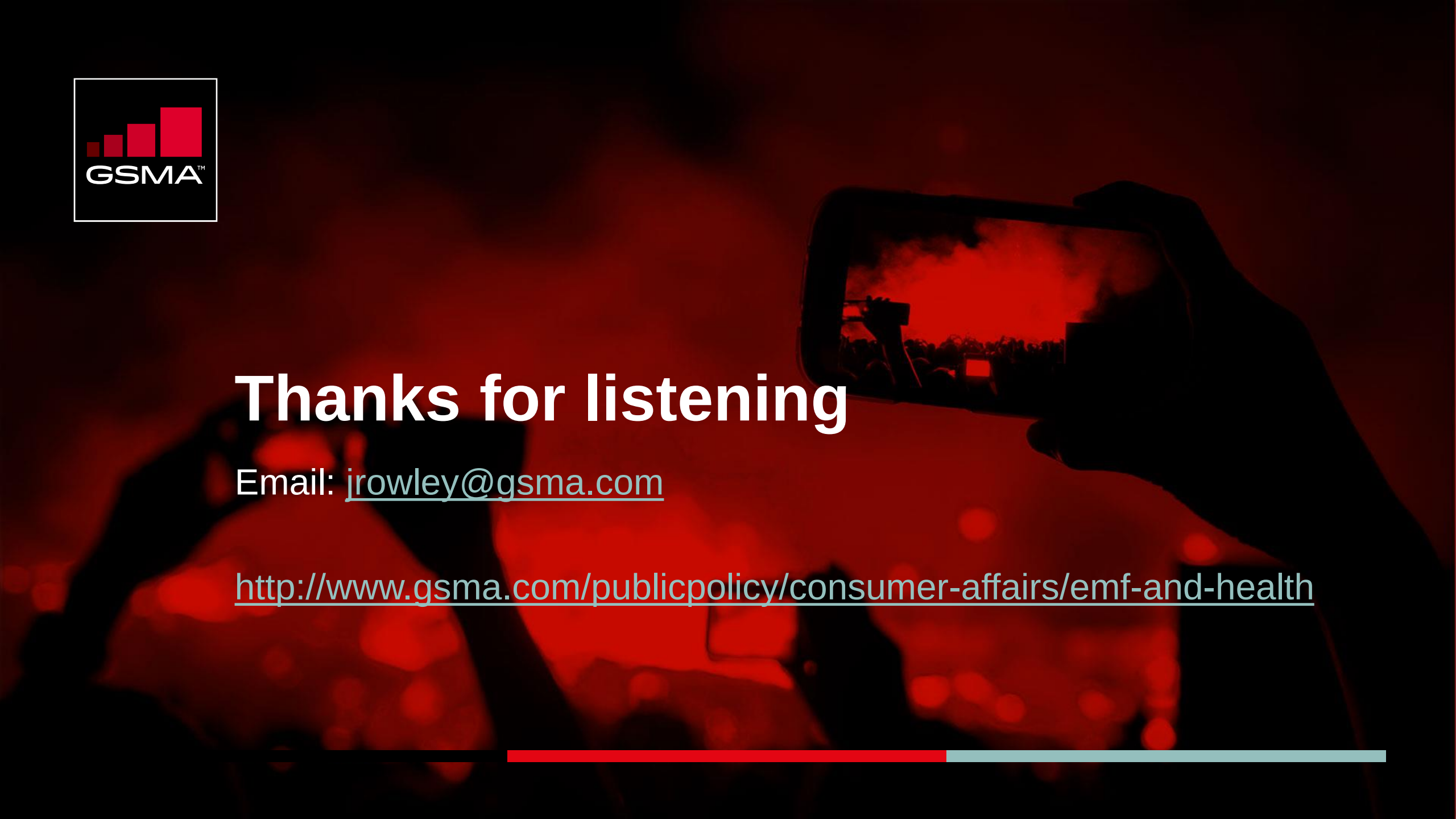


Conclusions

- International RF-EMF are protective of public health:
  - Restrictive limits lead to less efficient network deployment
  - Restrictive limits are barrier to capacity and quality
  - Restrictive limits increase public concern

- Approaches to RF-EMF compliance for antenna sites should be based on accurate assessment of actual transmissions

- Statistical approaches are applicable to all mobile technologies



Thanks for listening

Email: jrowley@gsma.com

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

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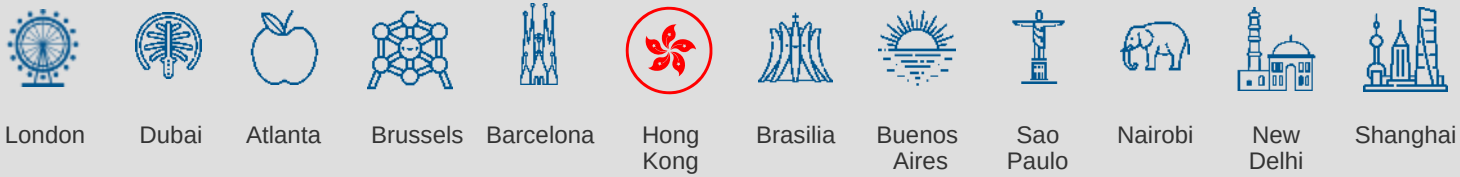

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