



INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

# EMF Standards for 5G technologies

**Human exposure compliance assessment procedures for  
mobile device and network equipment operating from 6-100 GHz**



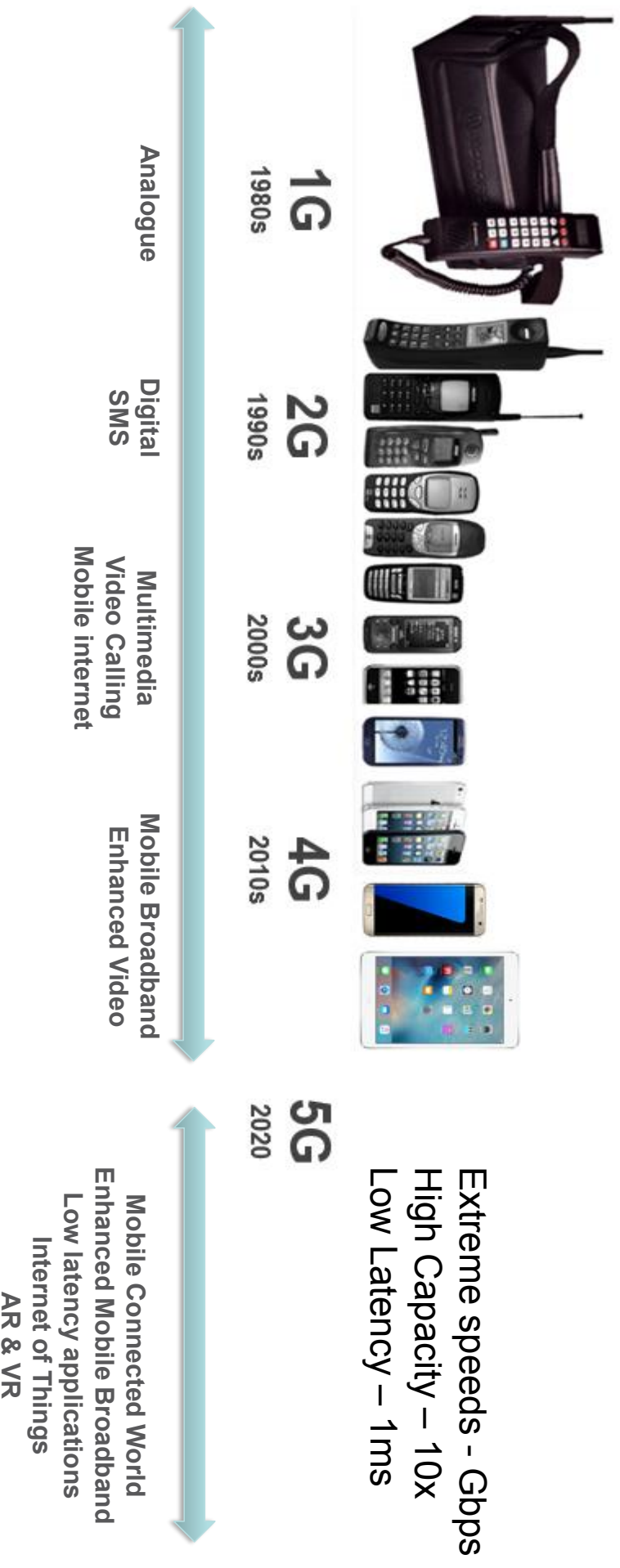
**Mike Wood**  
**Chairman IEC TC106**

**MWF 5G Workshop – Portoroz, Slovenia**

**24 June 2018**

# What is 5G?

## 5G is the 5th generation of mobile networks





## 5G Timeline



**Fixed wireless access for homes and enhanced mobile broadband services are likely to be the first applications using new 5G wireless access modems and hot spots.**

**Mobile handsets with 3G, 4G and 5G connectivity expected in the 2019 – 2021 timeframe**  
**Low latency and widespread machine to machine applications using 5G in similar timeframe**

## 5G – Implications for EMF Assessment



5G and 4G working together, with central and local servers providing faster content to users and low latency applications

### EMF Assessment Considerations

<u>New Spectrum</u>	mmWave
<u>Macro Cells, Small Cells</u>	near & far field
<u>MIMO Beam Steering</u>	power averaging
<u>5G and 4G together</u>	multiple technologies
<u>Many devices</u>	complex assessments

## Challenges for 5G & EMF Standards

- Globally harmonised EMF exposure limits
- Revised ICNIRP, IEEE, FCC exposure guidelines are critical especially for 5G devices >6/10GHz
- Development and implementation of new network and device testing procedures to meet 5G technology evolution

### Devices

- mmWave
- Complex devices
- Far field – E or H is measured
- Near field - E&H field, Phase, field reconstruction
- Multiple tx, beam steering & varied shapes
- Advanced modelling techniques

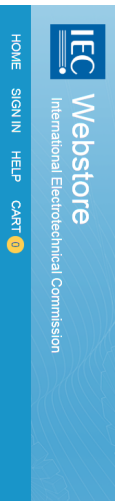
### Networks

- mmWave
- Complex antennas
- Near field and far field
- MIMO & beam steering
- Power averaging for true EMF level
- Advanced modelling techniques

**Challenge** – IEC TC106 has responsibility to develop assessment standards for 5G devices and networks to 100GHz (by 2018)

# New 5G Exposure Assessment Standards from the IEC

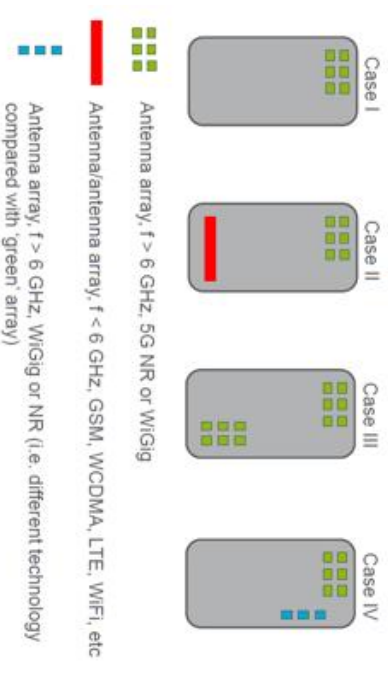
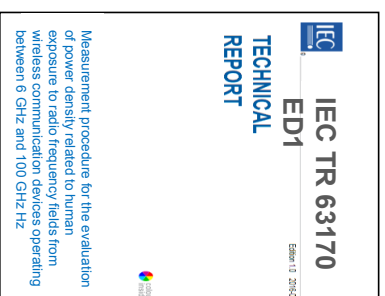
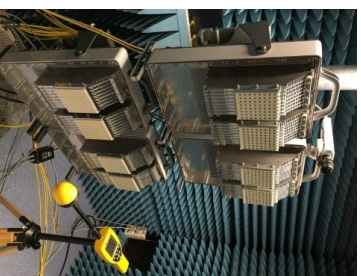
- IEC Strategic Business Plan has been to prepare for 5G
- Ensure Standards and Technical Reports are developed
  - Trials & early deployments in 2018 – 2019, Commercial Launch 2019 - 2020



## IEC 62232:2017

Determination of RF field strength, power density and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure

TC 106 | Additional Information



## 5G Networks

IEC 62232 ED2 110 MHz to 100GHz 2017  
IEC TR 62669 – case studies inc 5G 2018

## 5G Devices

IEC TR 63170 Technical Report 6 to 100GHz July 2018  
IEC / IEEE International Std 6 to 300 GHz Dec 2020

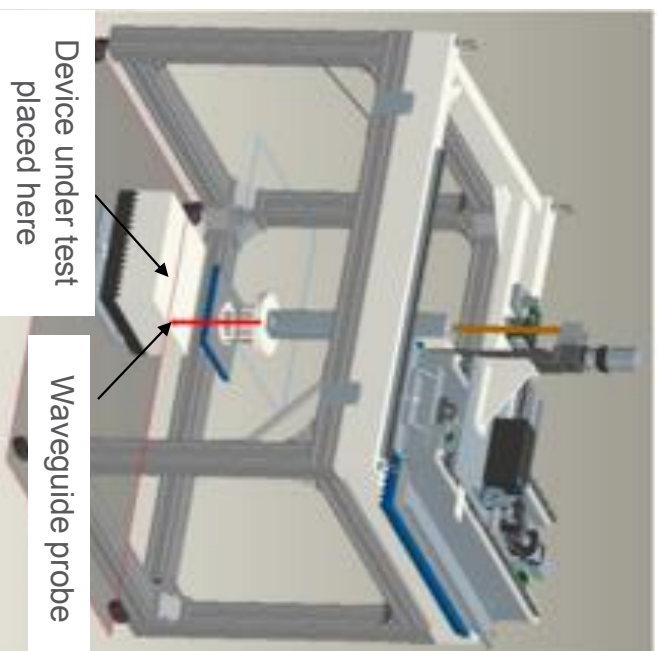


## 5G Device Test systems – power density measurements

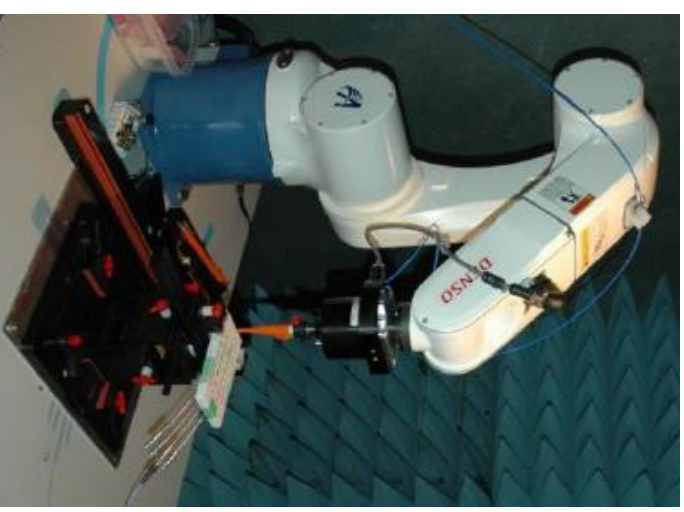
During development of the IEC 5G Technical Report in 2017, test laboratories initiated development of 5G mmWave device test systems



[IT'IS EUMmW Poynting vector probe](#)



[Art-FI mmWave guide probe development](#)

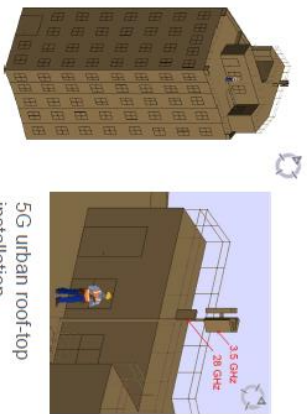


[APREL mmWave probe development](#)



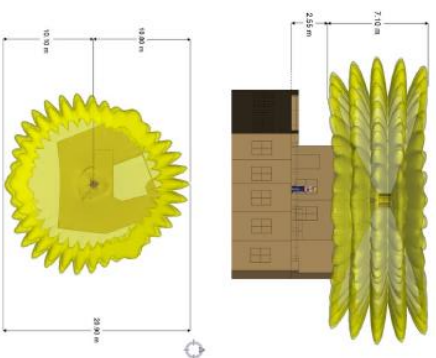
# 5G Macro Cell Assessment using IEC 62232

## Example: 5G site with massive MIMO 3.5 GHz and 28 GHz, actual maximum power



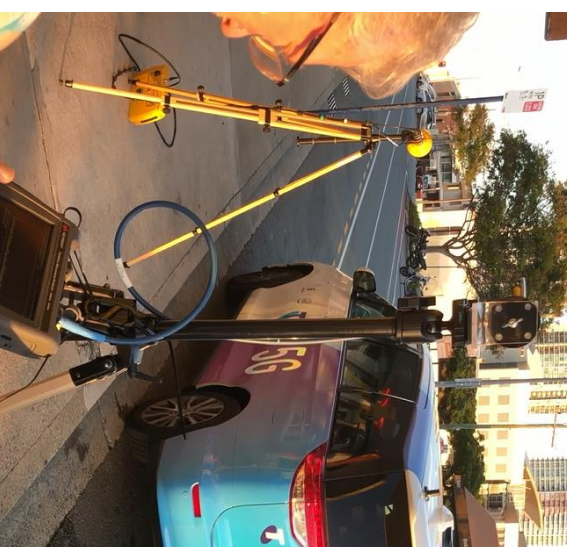
5G urban roof-top installation

Actual maximum power = 25% of theoretical maximum RF-EMF exposure below ICNIRP limits in public areas  
Case study to be included in IEC TR 62669 (2018) and ITU-T Supplement on 5G EMF compliance



Exclusion zone  
10 W/m²  
ICNIRP general public limit

### Modelling actual power due to beam steering



Measurements of 5G in Australia using IEC 62232  
Locating beam and observing level variation **8**





# Summary



**IEC and IEEE have formed a Joint Working Group to ensure 5G assessment standards are globally harmonised and meet the 5G release timeframes**

# THANK YOU

