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IEEE – SCE 6th Conference on Electromagnetic Compatibility, EMC-2019
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International Activities to Regulate, Standardize and Update the International Hazards of Electromagnetic Radiation to Personnel (HERP) Exposure Limits

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ITU D/R/T: RF-EMF, intersector activities

ITU-D Study Group 2, Co-Rapporteur Q 7/2 on EMF

International players to Regulate, Standardize and Limit HERP

the presenter is deeply involved in their activities

- WHO: World Health Organization
- ICNIRP: International Commission on Non-Ionizing Radiation Protection
- IEEE: Institute of Electrical and Electronics Engineers
- ITU: International Telecommunications Union
- IEC: International Electrotechnical Commission
- MWF: Mobile & Wireless Forum

Background

- **There is no scientific reason to use different exposure limits in different countries**
- Generally, the national HERP legislation uses the international ICNIRP exposure limits, to limit the HERP exposure of people
- ICNIRP 1998: Guidelines for limiting exposure up to 300 GHz
- ICNIRP 2010: Guidelines for limiting exposure 1Hz – 100 kHz
- IEEE Std C95.1-2005: Safety Levels with respect to Human Exposure to EMF 3 kHz to 300 GHz
- IEC 62232 (2017): Determination of RF field strength, power density and SAR near base stations to evaluate human exposure
- Revisions ICNIRP Guidelines & IEEE standard are at their final stage: estimated publication dates: IEEE Oct-Nov 19, ICNIRP Aug-Sept 19 Hi Haim, We are working indeed on the finalization of the RF exposure guidelines. We hope to publish them in August / September, but I cannot give you more detail, I'm afraid. Best regards, Eric 15/5/19
- , Revisions may change some basic restrictions and reference levels of far field, occupational: whole body and local, >6 min: No Revolution(?)
- The presenter provided on behalf of ITU before 9 Oct 18, 32 comments as response to the ICNIRP public consultation of the draft ICNIRP Guidelines: to unify the present 1998 and 2010 guidelines

WHO Recent Activities on NIR;
Based on WHO presentation 20May2019 in ITU by Dr. E. van Deventer

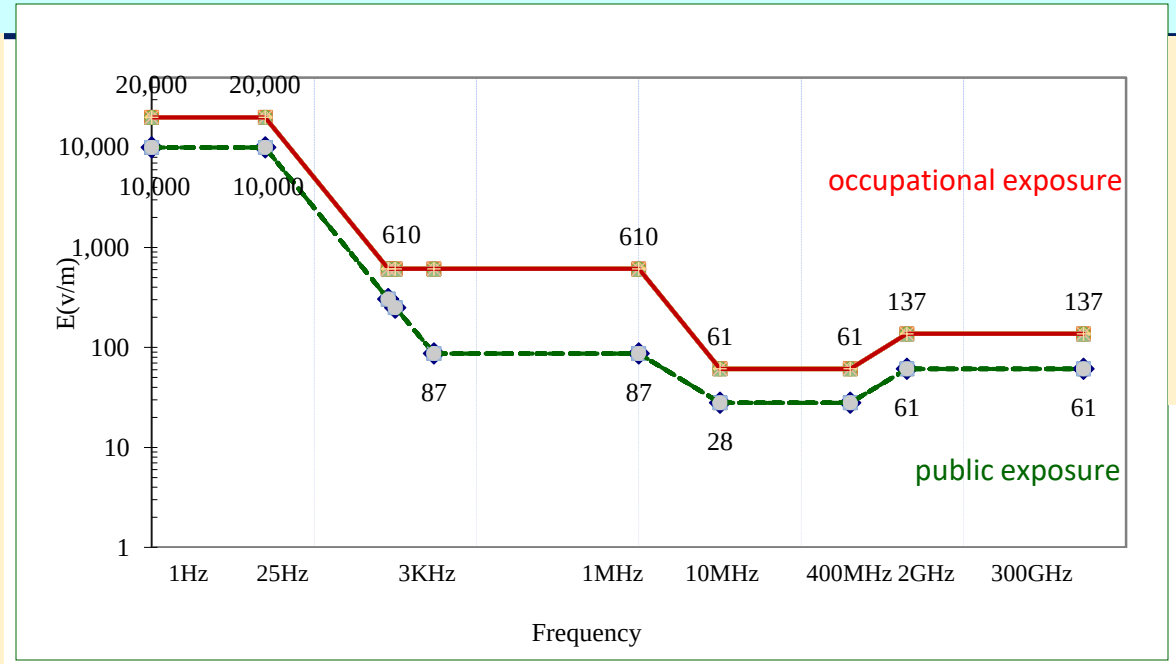
- WHO International EMF **Project**, established in 1996.
- Objectives: review the scientific literature on health, effects of EMF exposure and formally assess health risks; promote a focused agenda of high quality EMF research; encourage internationally acceptable harmonized standards; provide information on risk perception, risk communication & risk management.
- International Advisory Committee (ToR): provide a forum for a coordinated international response on the EMF health concerns; review outputs of the project, including scientific information related to public & occupational health, & environmental management of the EMF issue; provide oversight on the conduct of the Project
- WHO publishes Monographs on EMF
- **WHO is not involved at the updates of ICNIRP Guidelines & IEEE.95 standard.**
- **No WHO Standards (safety requirements, regulatory language...)**

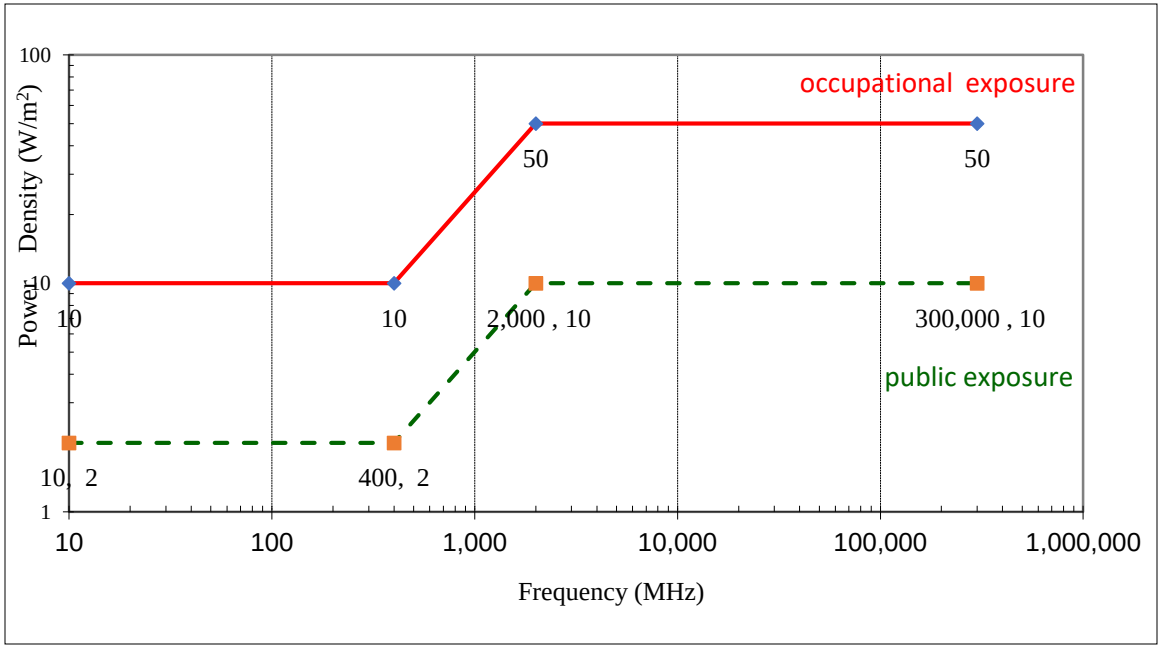
CURRENT EXPOSURE LIMITS: BASE STATIONS

- 1998 guidance includes heating effects for RF above 100 kHz; ICNIRP 2010 guidance includes consideration of nervous system effects only
- In 100 kHz-10 MHz, protection against nervous system effects is RF independent; by contrast, when heating is taken into account, reference level reduces 0.1 to 10 MHz
- In order to ensure protection against both nervous system and heating effects, now, use whichever of field-strength is the lower

ICNIRP 1998 p.511 reference levels for occupational & general public exposure- graphs

See Author's Wiley book 2016 'Radio Spectrum Management: Policies, Regulations and Techniques' ; Amazon. Figures 9.1 & 9.2. Book's chapter 9 on EMF is free





ICNIRP Guidelines are now revised; to be published Aug-Sept 19

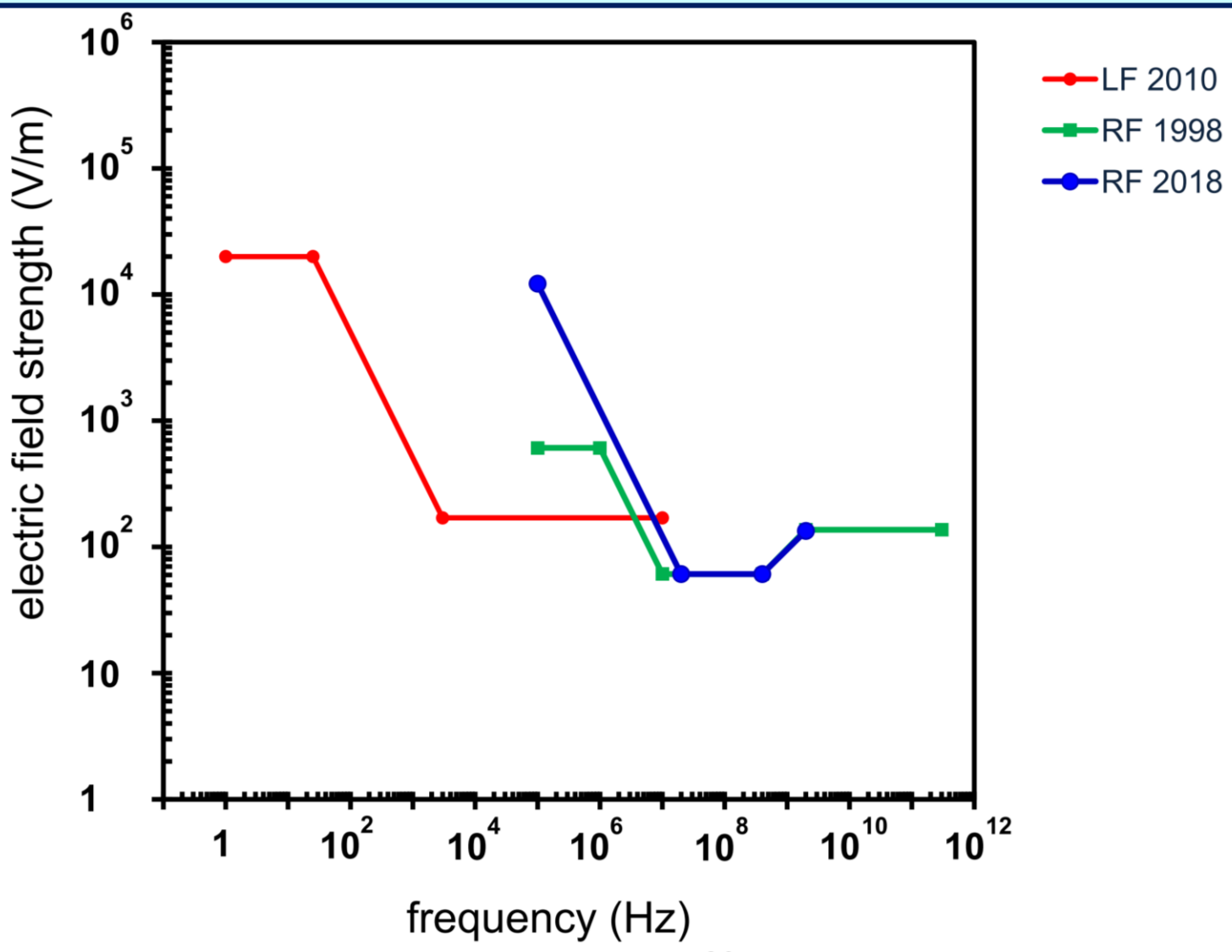
ICNIRP, Public consultation ITU Workshop 10 Oct.2018; Dr. Eric van Rongen, ICNIRP Chair presentation

Basic restrictions & differences with 1998 values

Parameter	Freq. range	ΔT	Spatial	Aver. time	Health effect level	RF	Occup.	RF	General public
Core ΔT	100 kHz-300 GHz	1°C	WBA	30 min 6 min	4 W/kg	10	0.4 W/kg	50	0.08 W/kg
Local ΔT (Head & Torso)	100 kHz-6 GHz	2°C	10 g	6 min	20 W/kg	2	10 W/kg	10	2 W/kg
Local ΔT (Limbs)	100 kHz-6 GHz	5°C	10 g	6 min	40 W/kg	2	20 W/kg	10	4 W/kg
Local ΔT (Head, Torso, Limbs)	>6-30 GHz	5°C	4 cm^2	6 min $68/f^{1.05}$	200 W/m^2	2	100 W/m^2 50 W/m^2	10	20 W/m^2 10 W/m^2
	30-300 GHz 10-300 GHz		1 cm^2 20 cm^2						
Pain (contact current)	100 kHz-110 MHz *(guidance level* *reference level)*	--	--	10 sec	20/10 mA (adult/child)	1	20 mA 40 mA	1	20/10 mA (ad./child) 20 mA

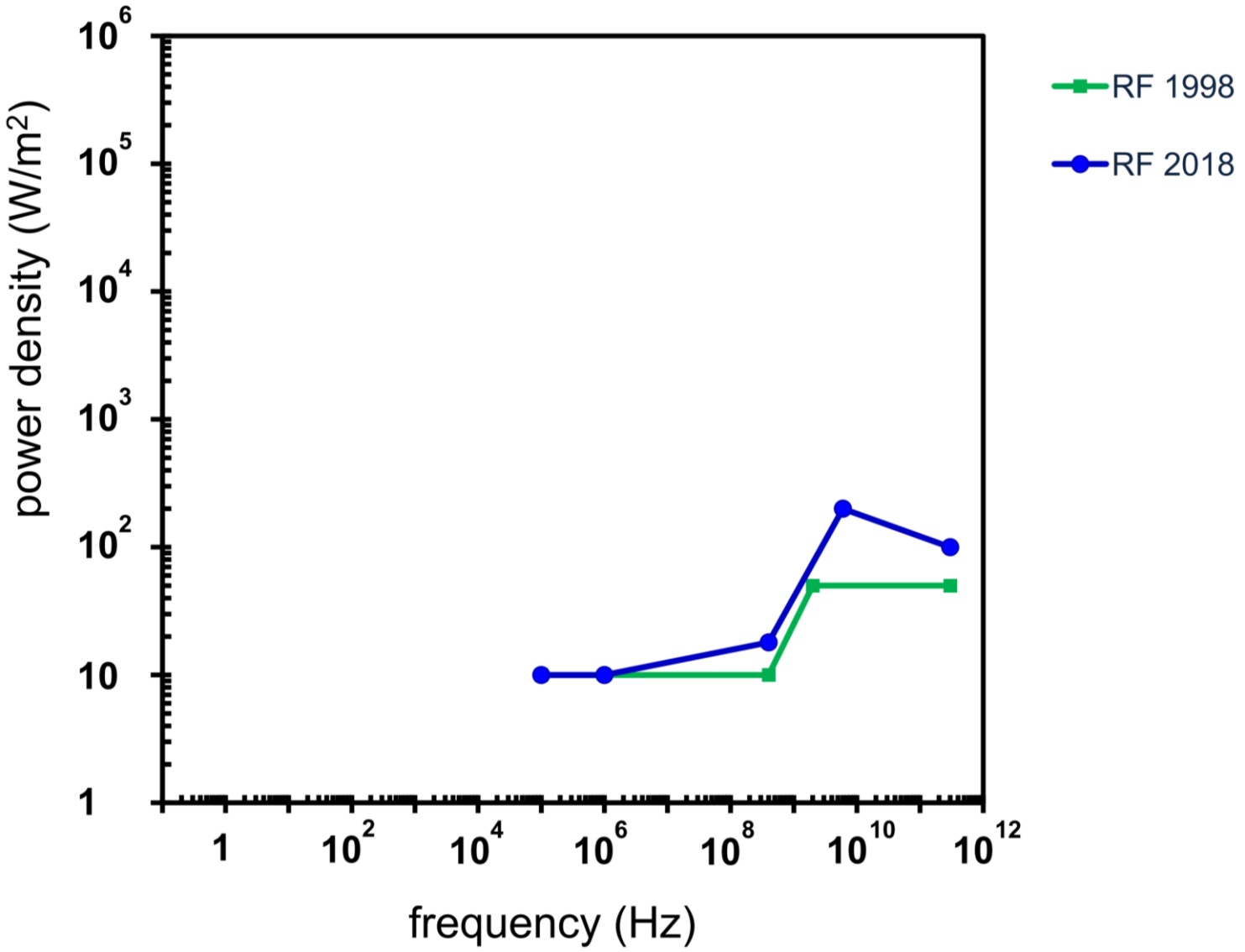
ICNIRP, Public consultation ITU Workshop 10Oct.2018; Dr. Eric van Rongen, ICNIRP Chair presentation

Reference levels (whole body, far field, occupational)



ICNIRP, Public consultation ITU Workshop 10Oct.2018; Dr. Eric van Rongen, ICNIRP Chair presentation

Reference levels (local, far field, >6 min, occupational)



ICNIRP 1998 vs. N. America and Japan reference levels

ICNIRP 1998, EC (1999/519) & IEEE reference levels for public exposure

Frequency range	electric field strength (V/m)	equivalent plane wave power density S_{eq} (W/m^2)
10–400 MHz	28	2
400-2000 MHz	$1.375f^{1/2}$	***f*/200**
2-300 GHz	61	10

USA & Japan exposure for general population/uncontrolled

RF (MHz)	electric Field (*E*) (V/m)	power Density (*S*) (mW/cm^2)
30-300	27.5	0.2
300-1500	--	***f*/1,500**
1,500-100,000	--	1

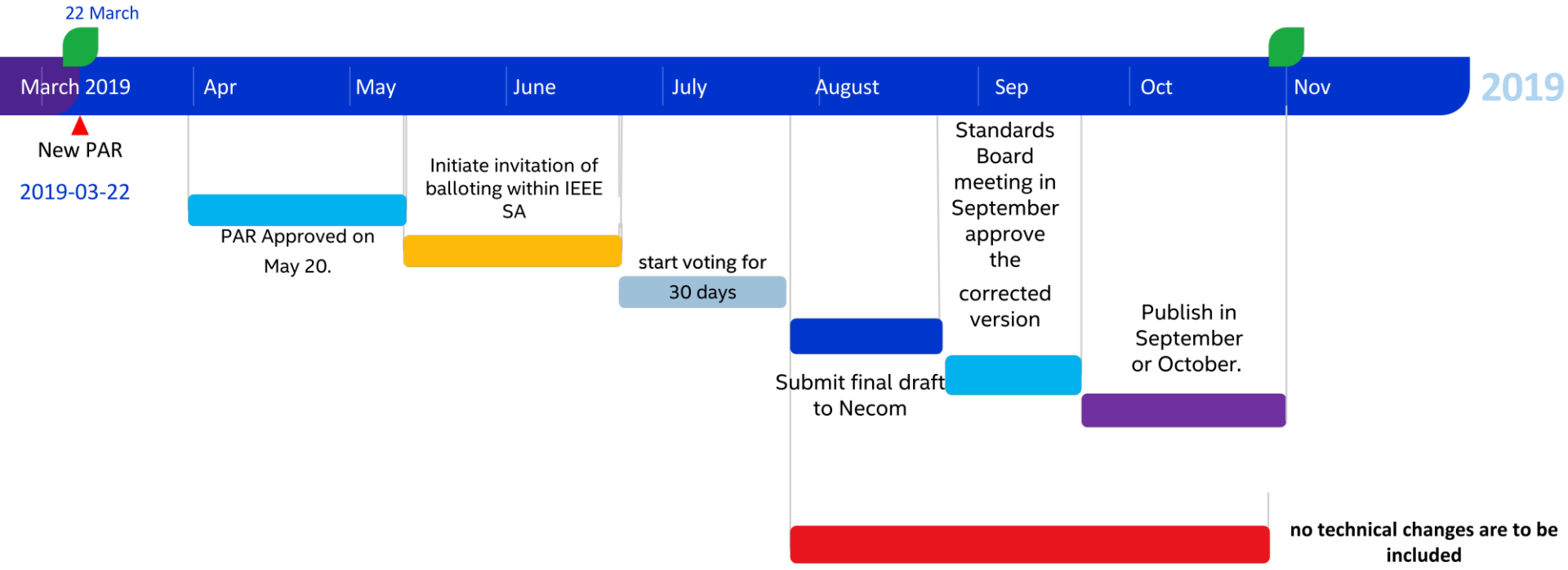
[1] FCC uses different units than ICNIRP for power density: mW/cm^2 and not W/m^2; $W/m^2 = 0.1\ mW/cm^2$

ICNIRP 1998, FCC §1.1310 & Canada Safety Code SC6 (W/m^2)

Frequency	ICNIRP 1998	FCC §1.1310	SC6
300 MHz	**2**	**2**	**1.291**
1,500 MHz	f/200=1500/200=**7.5**	**10**	$0.02619x\ f^{0.6834}$ =**3.88**
3,000 MHz	**10**		$0.02619x\ f^{0.6834}$ =**6.23**
6,000 MHz	**10**		

IEEE/ICES TC95 revising C95.1

- Public consultation ended in September 2018
- IEEE/ICES TC95 & ICNIRP are relying on same scientific data which results **in well harmonized** EMF exposure limits. C95.1-2018 **in line with ICNIRP**
- Submitted to IEEE Standards Board RevCom for approval in Jan. 2019
- IEEE TC95 standard has got thru all processes with 96% balloting approval
- More editorial fixing had been needed
- Estimated publsih date, Sep-Oct 2019

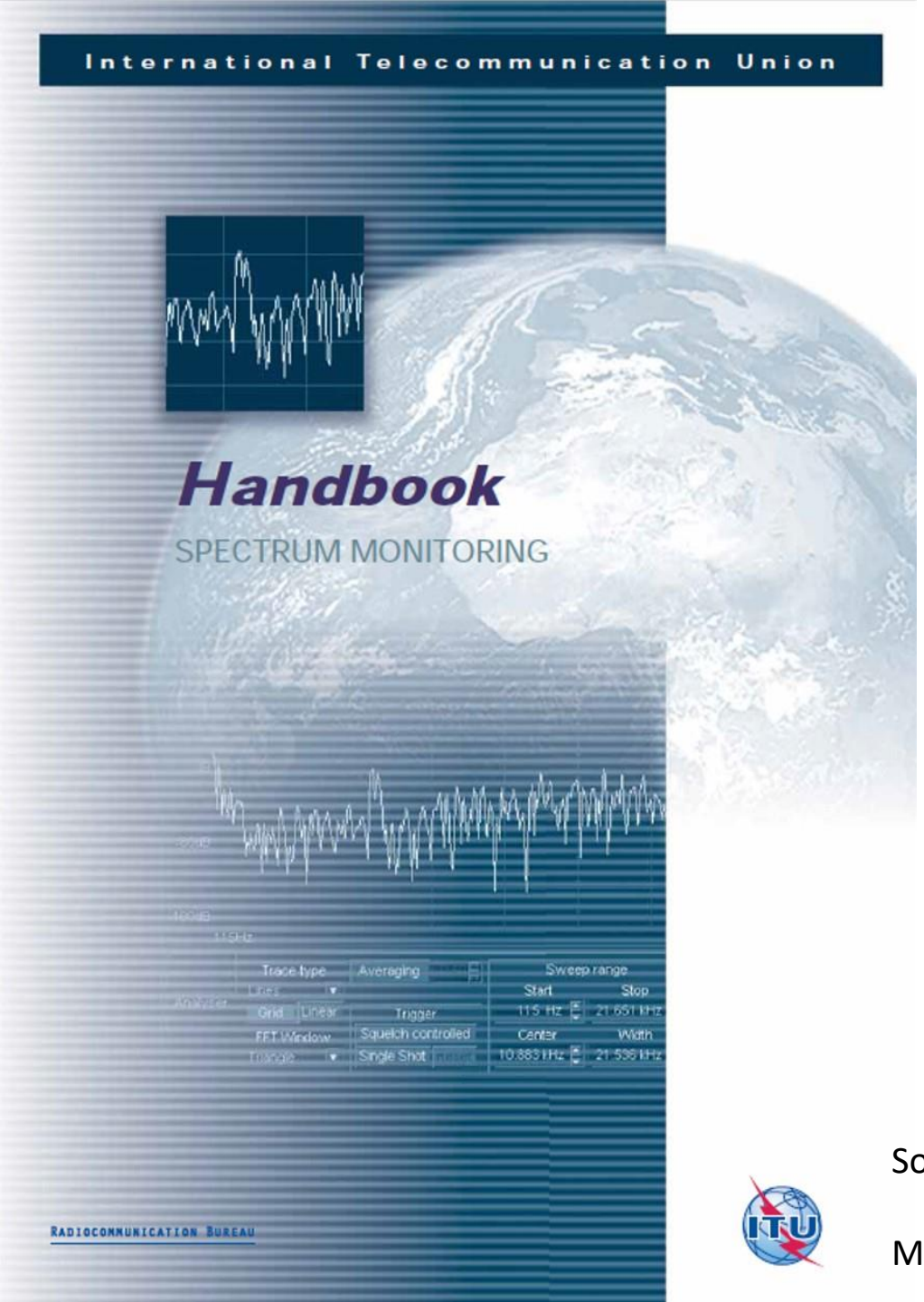


International Electrotechnical Commission (IEC)

- IEC published the new base station EMF assessment standard IEC 62232 Edition 2 August 2018. Edition2 provides harmonised approach & techniques to assess EMF around base stations including new 5G RFs IEC published Report TR 62669:2019 "Case studies supporting IEC 62232"
- IEC published the 2019 IEC TR 63170 'Measurement procedure to evaluate power density related to human exposure to EMF from wireless communication devices operating between 6 GHz and 100 GHz'
- Two new project teams in collaboration with IEEE to publish dual logo standards. Develop international standards for testing 5G mm Wave devices by using modern computational methods. End 2019 the dual logo IEC/IEEE 62209-1528 standard will replace standards: IEEE 1528 and IEC 62209-1/2
- IEC developed Technical Reports for the 5G test networks and early deployments, and full international standards by 2020 for the main commercial release of 5G
- E.g. IEEE TC34 & IEC TC106 Joint activity: "Determining the EMF power density associated with human exposure to wireless devices operating in close proximity to the head and body using computational techniques, 6 GHz to 300 GHz". Expected publication December 2020

EMF ITU-T K. Recommendations & Supplements

- K.52: Complying with limits for human exposure to EMF
- K.61: Measurement and numerical prediction of EMF for compliance
- K.70: Mitigation techniques to limit EMF near base stations
- K.83: Monitoring of electromagnetic field levels
- K.90: Evaluation techniques and working procedures for compliance with exposure limits of network
- K.91: Assessment, evaluation & monitoring of human exposure
- K.100: Measurement of RF EMF to determine compliance
- K.113: Generation of RF EMF level maps
- K.122: Exposure levels in close proximity of antennas
- K Suppl. 1: ITU-T K.91 –EMF and health
- K Suppl. 4: ITU-T K.91 – EMF in smart sustainable cities
- K Suppl. 9: 5G technology and human exposure to RF-EMF
- K Suppl. 13: RF-EMF exposure levels from mobile
- K Suppl. 14: Impact of exposure limits stricter than ICNIRP or IEEE
- K Suppl. 16: EMF compliance assessments for 5G wireless networks



ITU's worldwide recognized reference on Spectrum Monitoring and related issues

- Chapter 5.6 on **Non-Ionizing Radiation (NIR) measurements**
  - Explains **NIR limits & exposure quotient**
  - **Instruments for NIR measurements**
    - Broadband isotropic probes and meters
    - Tri-axis antennas and field strength meters
    - Transportable station
    - standard field strength measurement equipment
  - **Measurement procedures** for different radio services (incl. mobile, broadcasting, etc.)
  - **Reporting methods**

Source: ITU-R Handbook on Spectrum Monitoring

On-going ITU-R Studies on EMF measurements to assess human exposure

- Work initiated by the ITU Experts Group on Spectrum Monitoring (i.e. ITU-R WP 1C) in response to Question ITU-R 239/1 (2016):
- https://www.itu.int/dms_ties/itu-r/md/15/wp1c/c/R15-WP1C-C-0169!N09!MSW-E.docx

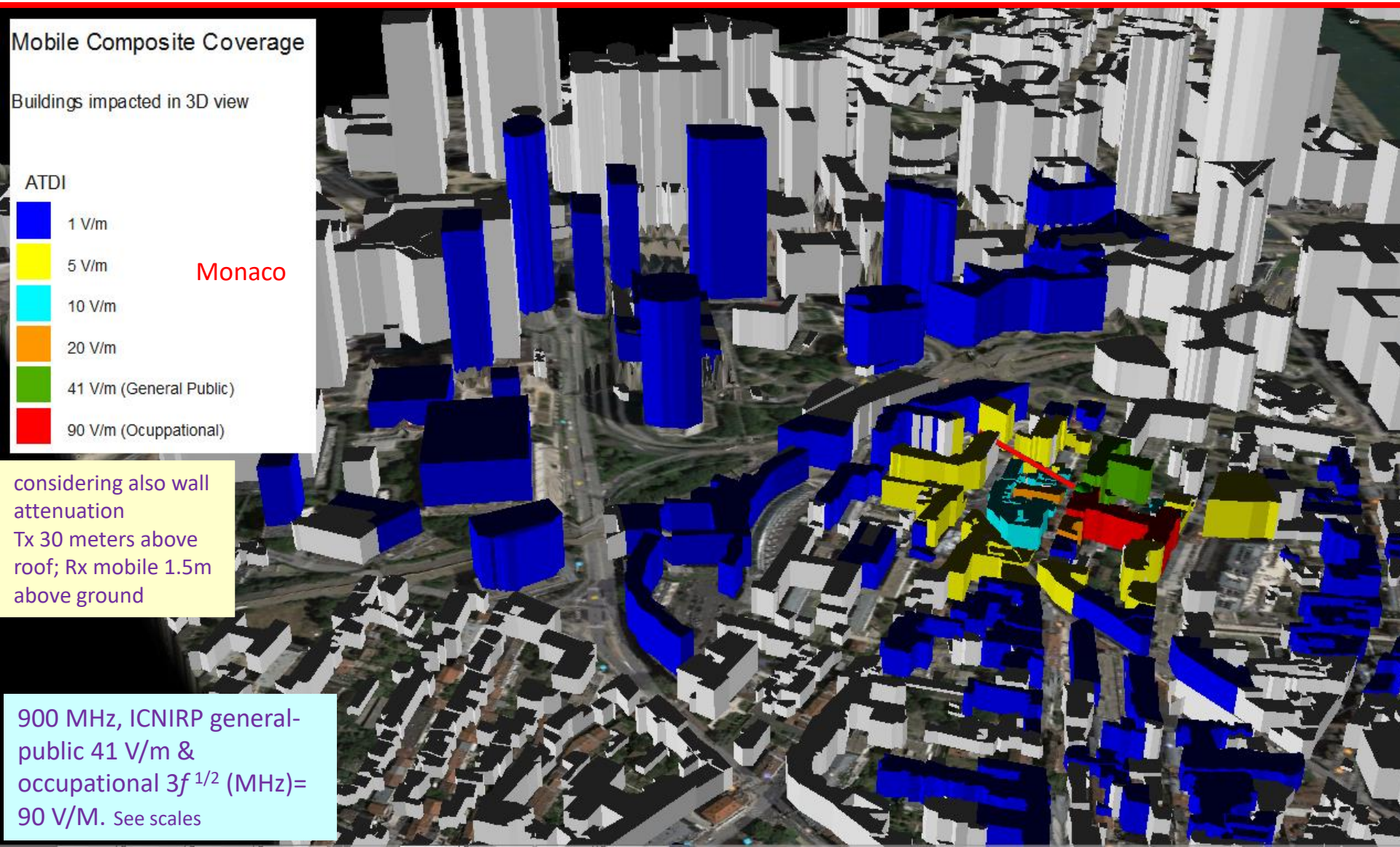
1. What are the **measurements techniques** to assess the human exposure from wireless installations of all types?
2. How can **measurement results** be presented?

- Significant progress made in 2017-2018
- Studies to be completed by 2019!

Source: Question ITU-R 239-1 - www.itu.int/pub/R-QUE-SG01.239

- Work by correspondence and at the next ITU-R WP 1C meeting planned on 28 May – 5 June 2019

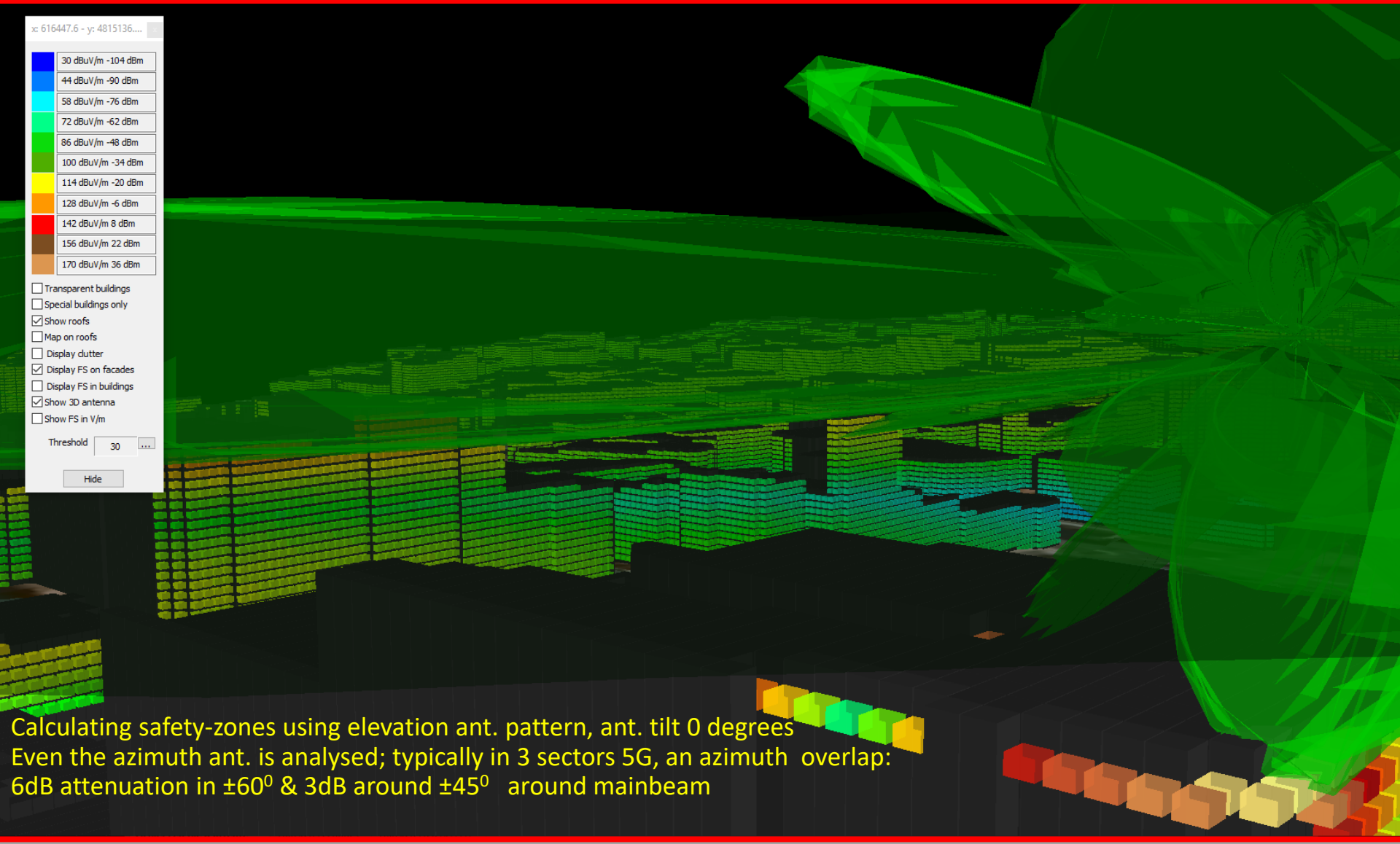
Information from the preliminary draft new ITU-R Report on EMF measurements to assess human exposure
3D cellular contours, showing buildings impacted; Fig. 6



considering also wall attenuation
Tx 30 meters above roof; Rx mobile 1.5m above ground

900 MHz, ICNIRP general-public 41 V/m & occupational $3f^{1/2}$ (MHz)= 90 V/M. See scales

Information from the preliminary draft new ITU-R Report on EMF measurements to assess human exposure



Calculating safety-zones using elevation ant. pattern, ant. tilt 0 degrees
Even the azimuth ant. is analysed; typically in 3 sectors 5G, an azimuth overlap:
6dB attenuation in ±60^0 & 3dB around ±45^0 around mainbeam

Final Report

ITU-D
Study Group 2

Question 7/2

Strategies and policies concerning human exposure to electromagnetic fields

2014-2017 6 th Study Period

Report 2017

ITU-D Relevant activities on EMF

1. ITU-D– Resolution 62 (Rev. WTDC-17) on "Measurement concerns related to human exposure to EMF"
2. ITU-D Question 7/2 Strategies and Policies Concerning Human Exposure to EMF
3. 2021. New Report (Chapters, Table of Content)
    1. Introduction
    2. ITU Activities
    3. Updated international and regional exposure limits
    4. Policies to limit exposure to RF fields
    5. National EMF activities on exposure limits
    6. Exposure levels from handsets and notebooks
    7. Case studies, success stories, and national practices

MWF Project List '6GHZ+' (Phase I + II)

- Dosimetric understanding above 6 GHz
- Compliance testing above 6 GHz
- Measuring small cell exposures
- Enhancing compliance testing for 5G devices
- Testing 5G devices with smart antennas
- Measuring power density 28 and 60 GHz antennas
- Power density and temperature increase

MWF endorses workshops and trainings to present findings and promote discussions

Other author's presentations & papers on EMF

1. My Wiley book 'Radio Spectrum Management: Policies, Regulations and Techniques; see at Amazon. Chapter 9 is free
2. A Global Survey and Comparison of Different Regulatory Approaches to Non-Ionizing RADHAZ and Spurious Emissions, IEEE TelAviv, COMCAS, Nov. 2009. Hyperlink to the slides presentation; 9 Nov. 09
3. A Comparison Between European and North American Wireless Regulations, presentation at the 'Technical Symposium at ITU Telecom World 2011' www.itu.int/worl2011 on 27 October 2011; hyperlink to the slides presentation, 27 Oct. 11
4. Technical limits of Human Exposure to RF from Cellular Base Stations and Handsets, Jerusalem, 11 April 2013. Presentation of the Ministry of Communications to the experts of Ministry of Environmental Protection, human-exposure monitoring laboratories and cellular operators
5. Technical limits of Human Exposure to RF from Broadcasting Emitters, Cellular Base Stations and Handsets, at 'Holon institute of technology', 30 January 2014
6. Smart_Cities_RF_Human_Exposure_Ministries_of_Comms_Energy; intra-ministerial commission, 21 Jan15
7. Presentation in Singapore, Beijing, Chengdu and Shenzhen January 2016
8. January 2016_Human_Hazards_Mazar_SRTC_in_Chinese.pdf
9. Human Hazards_Mazar_AsiaPacific_BKK_25April16.pdf
10. EMC_Europe2016_Wroclaw_Sep 2016_Mazar_20April16_EMF.pdf Human RF Exposure Limits: reference levels in Europe, USA, Canada, China, Japan & Korea
11. ITU –T Workshop on "5G, EMF & Health" Warsaw, Poland, 5 Dec. 17
12. ITU-D Workshop Geneva 10 Oct.2018 ITU recent activities on EMF
13. EMF Concerns Modiin, Israel, 25 March 2019

U may visit my website http://mazar.atwebpages.com/

ITU held workshop on modern policies, guidelines, regulations and assessments of human exposure to RF-EMF, including 5G and Radio human hazards. I served as convener. The workshop presentations are available from https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/meetings/session-Q7-2-oct18.aspx.
My presentation is found at https://www.itu.int/oth/D0716000001.
ITU interviews Haim Mazar, Rapporteur, ITU-D Study Group 2- Question 7

Questions?

Presenter & Audience
SCE Ashdod
23 May 2019