

The 2nd Annual Asia-Pacific Spectrum Management Conference

The meeting point for the Asia-Pacific spectrum community!

25 - 26 April 2016 / Bangkok . Thailand

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ITU R-D-T, Intersectoral activities on human exposure to electromagnetic fields



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ITU framework on Human Hazards

- ITU Plenipotentiary Resolution 176 ([Rev. Busan, 2014](#)): *Human exposure to and measurement of electromagnetic fields*
- ITU-D Question [7/2](#) (Continuation of Q 23/1) *Strategies and Policies Concerning Human Exposure To Electromagnetic Fields*
- [ITU-T SG5: Environment and Climate Change](#): Question [7/5](#) (Continuation of Q 3/5): Human exposure to electromagnetic fields (EMFs) due to radio systems and mobile equipment
- ITU-T – [Resolution 72](#) on “Measurement concerns related to human exposure to electromagnetic fields”
- ITU-D– [Resolution 62](#) on "Measurement concerns related to human exposure to EMF"

Author is nominated to represent ITU-R Study Groups 1, 5 & 6 on RF human-hazards intersectoral activities

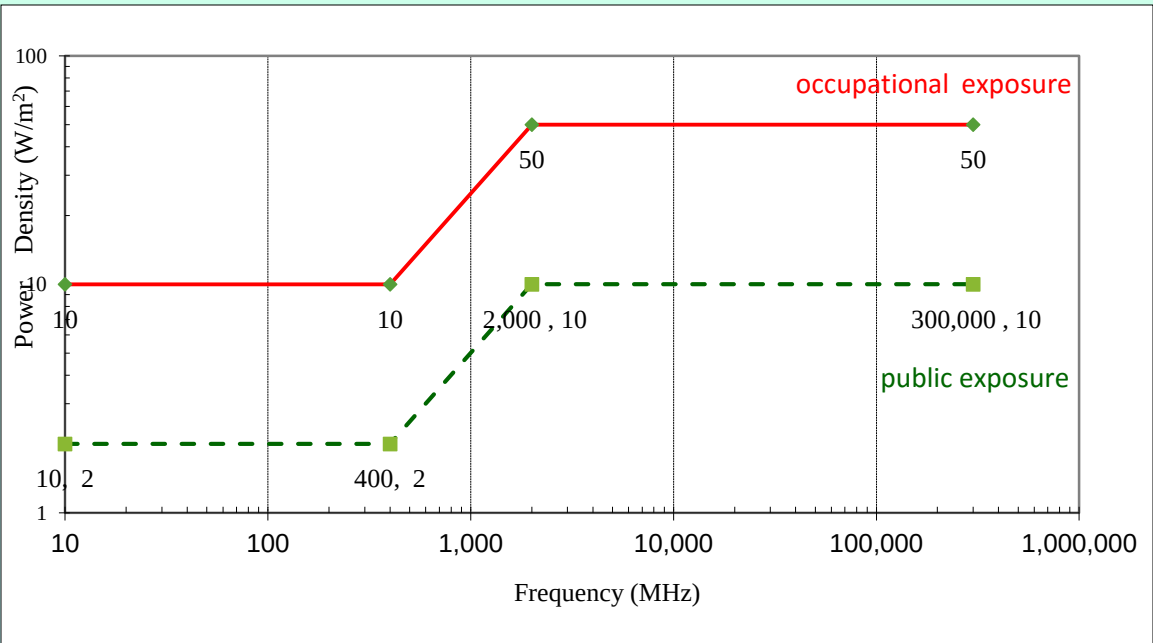
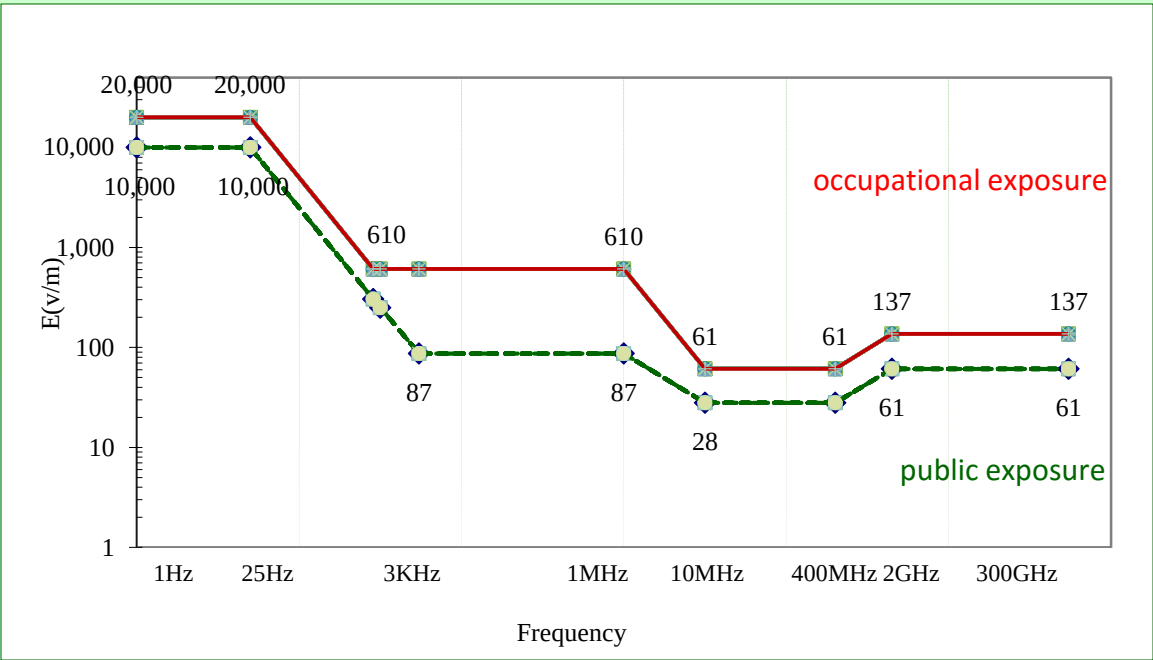
Significant ITU publications on Human Hazards

- ITU-R Recommendation [BS.1698](#) *Evaluating Fields from Terrestrial Broadcasting Transmitting Systems Operating in any Frequency Band for Assessing Exposure to Non-Ionizing Radiation*
- ITU-R 2011 Handbook [Spectrum Monitoring, Edition of 2011](#), Chapter 5 - Specific monitoring systems and procedures
- ITU-D 2014 Report Q. 23/1 [Strategies and Policies Concerning Human Exposure To Electromagnetic Fields](#)
- ITU-T Technical report on "[Electromagnetic field \(EMF\) considerations in **smart sustainable cities**](#)"
- [ITU EMF Guide](#)
- ITU-T [Study Group \(SG\) 5](#) software "[EMF-estimator](#)" and **Recommendations** (including in process):
 - ❖ [K.52](#) *Guidance on complying with limits for human exposure to electromagnetic fields*
 - ❖ [K.61](#) *Guidance on measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations*
 - ❖ [K.70](#) *Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations*
 - ❖ [K.83](#) *Monitoring of electromagnetic field levels*
 - ❖ [K.90](#) *Evaluation techniques and working procedures for compliance with exposure limits of network operator personnel to power-frequency electromagnetic fields*
 - ❖ [K.91](#) *Guidance for assessment, evaluation and monitoring of human exposure to radio frequency electromagnetic fields*
 - ❖ [K.100](#) *Measurement of human exposure levels when a wireless installation is put into service*
 - ❖ [K.113](#) *Generation of radiofrequency electromagnetic fields (RF-EMF) level maps*
 - ❖ K.env *Guidance on the Environmental Management for Electromagnetic Radiation from Radio Base Stations*
 - ❖ [K.emf](#) *Exposure levels in the close proximity of the radiocommunication antennas*

ICNIRP 1998 p.511 reference levels for occupational & general public exposure- Table7

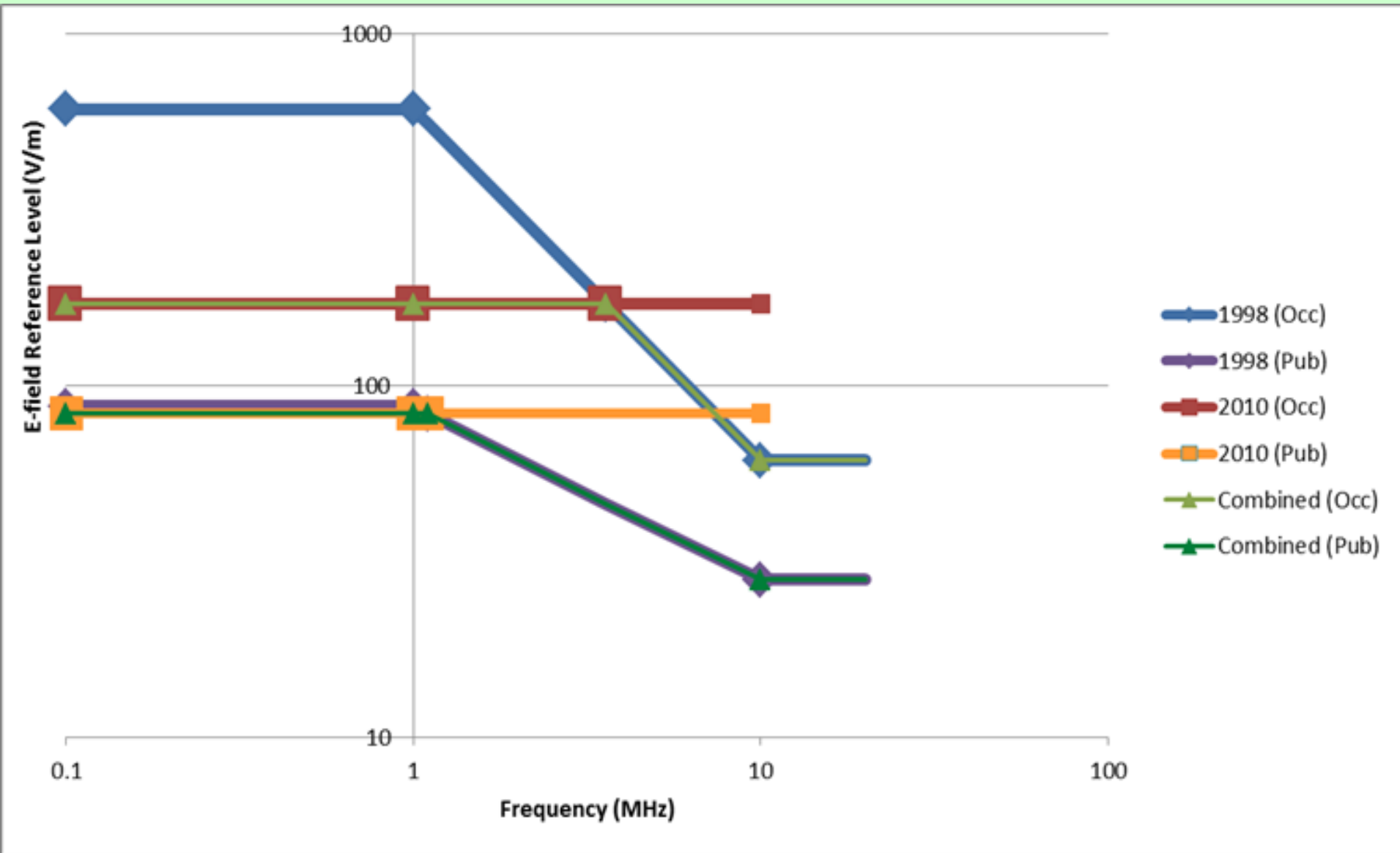
Frequency range	Electric field strength (V/m)		Equivalent plane wave power density S_{eq} (W/m²)	
	general public	occupational	general public	occupational
1-25 Hz	10,000	20,000	No data on Power-Density	
0.025- 0.82 KHz	250/ f (KHz)	500/ f (KHz)		
0.82 -3 KHz		610		
3-1000 KHz				
1-10 MHz	87/ $f^{1/2}$ (MHz)	610/ f (MHz)		
10-400 MHz	28	61	2	10
400-2000 MHz	1.375 $f^{1/2}$ (MHz)	3 $f^{1/2}$ (MHz)	$f/200$	$f/40$
2-300 GHz	61	137	10	50

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



Figures from Mazar's 2016, Ch. 9 Wiley book

Comparison of ICNIRP 1998/2010 Occ/Pub E-field Reference Levels below 10 MHz

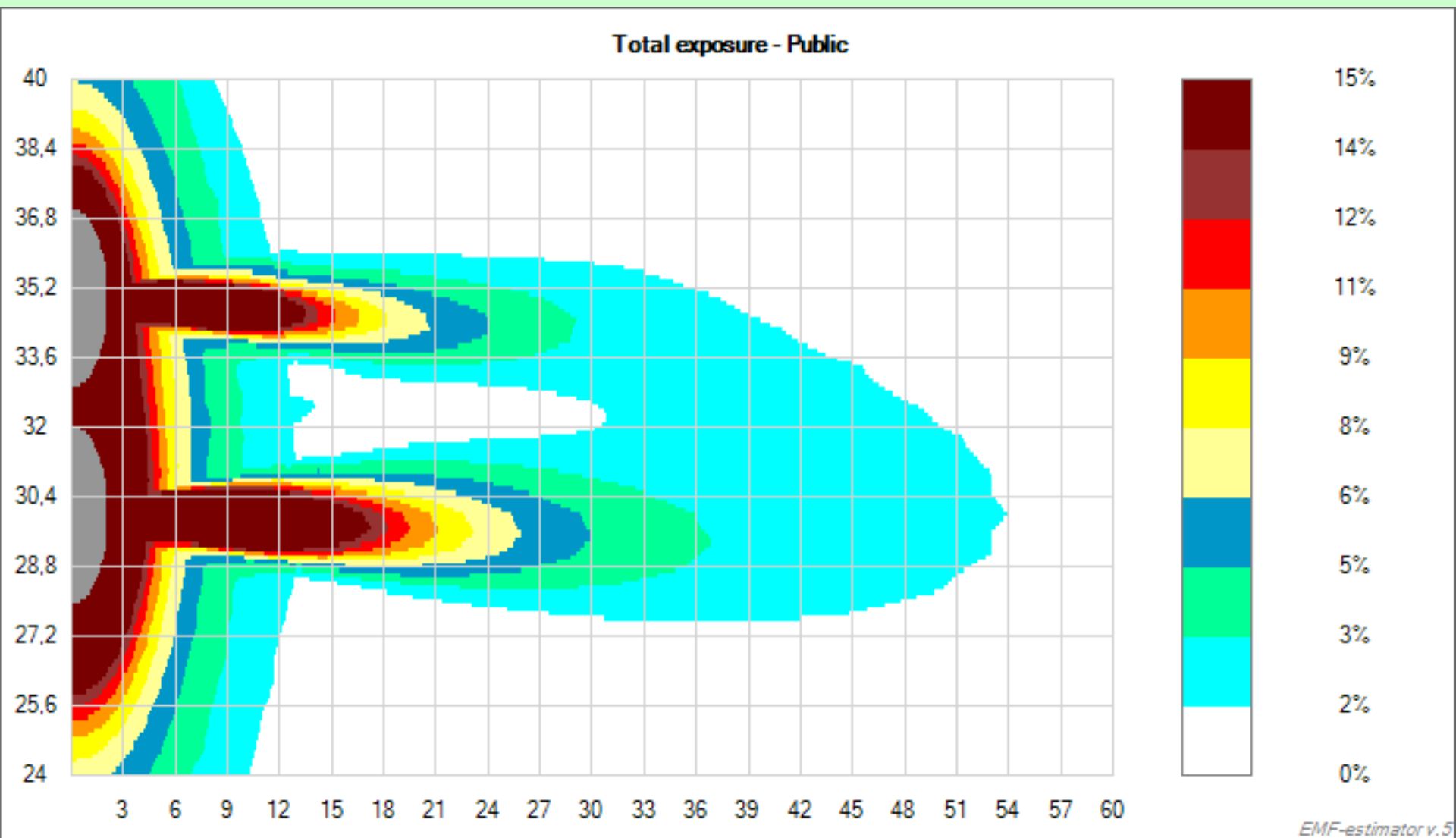


April 2016 [T13-SG05-C-0762R1](#) EBU/ Karina Beeke (Arqiva)

Representative general population/ uncontrolled exposure reference levels

	PD 1,000 MHz (W/m ²)	SAR (W/kg)
USA	$f/150$ $=\underline{6.67}$; 133/%	<u>1.6</u> , averaged over 1g tissue
Japan		<u>2.0</u> , over 10 g
ICNIRP1998 ; IEEE 2006 ; AUS ; NZL ; EC Directive 004/40/EC	$f/200$ $=\underline{5}$; 100%	
Korea	$0.02619f^{0.6834}$ $=\underline{2.94}$; 59%	<u>1.6</u> , averaged over 1g tissue
Canada		
China	<u>0.4</u> ; 8%	<u>2.0</u> , over 10 g

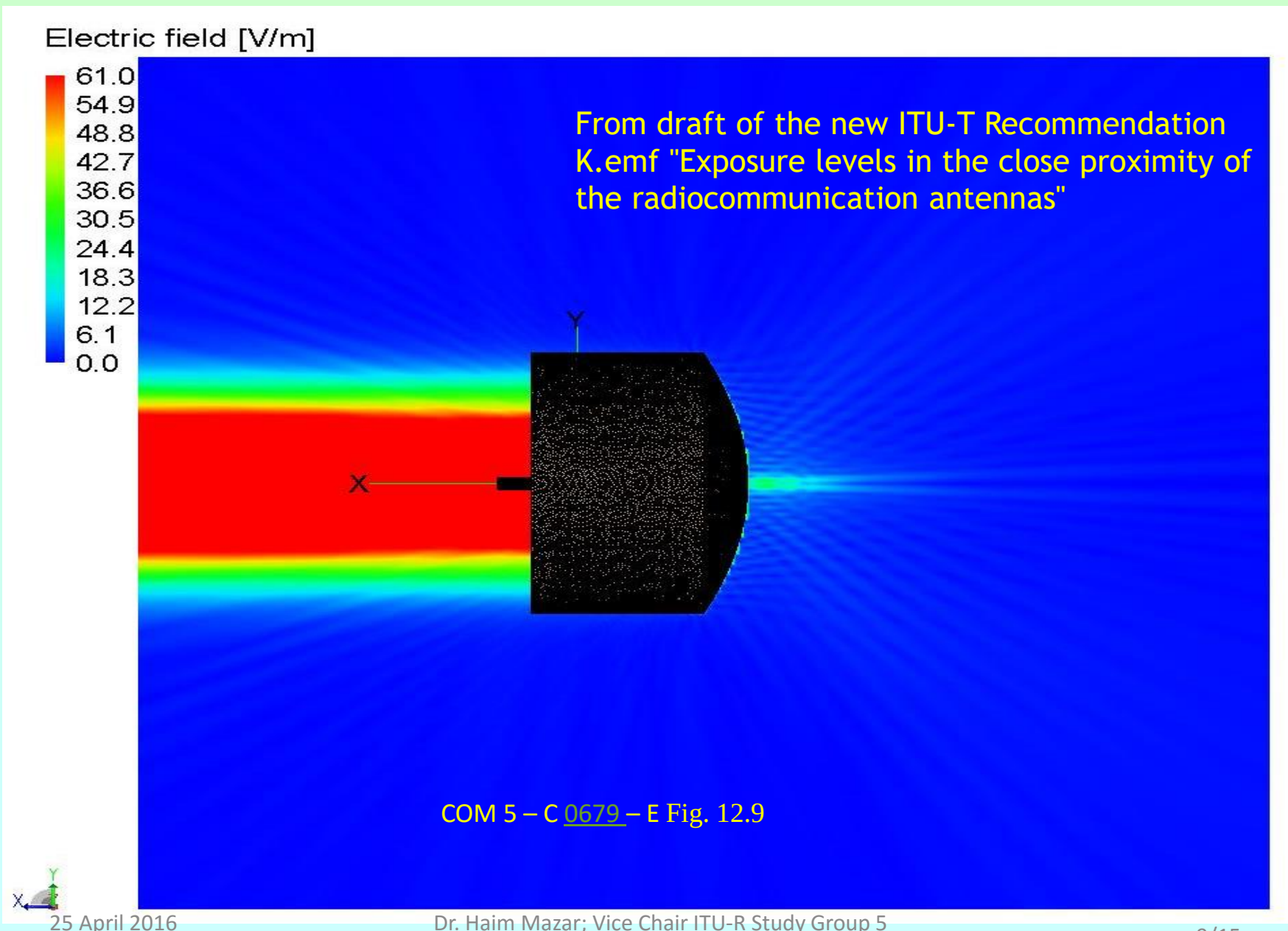
ITU-T 'EMF Estimator', calculation on a vertical grid; distance (m) to observation point



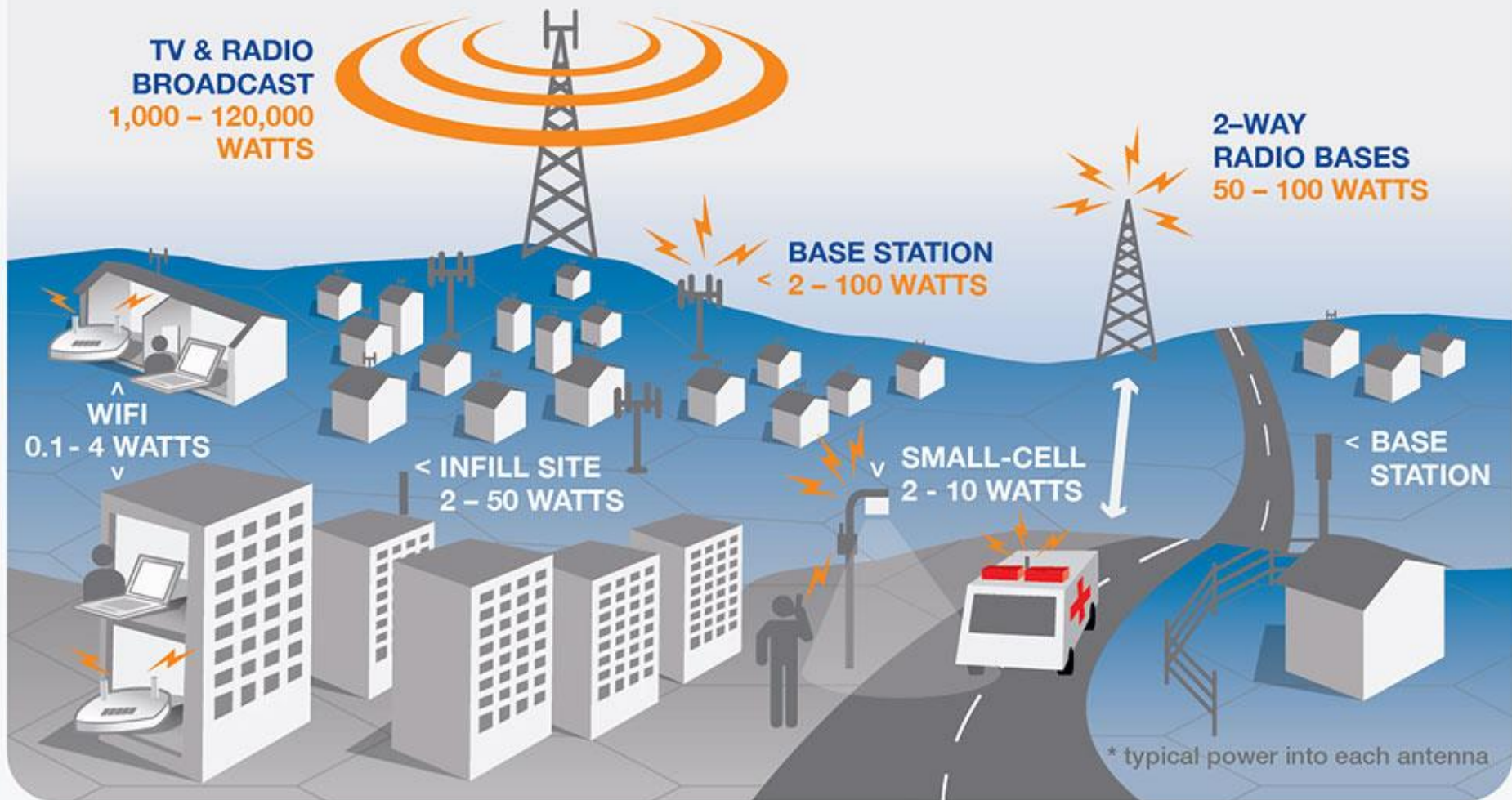
COM 5 – C0680, Fig 1; April 2016

Fryderyk Lewicki; Orange Polska; Poland

Field-strength distribution, horizontal cross-section, $f=22,4$ GHz, $P_{\text{input}} = 0,316$ W, area 1m x 1m, EIRP = 0,677 kW, occupational exposure limit: 137 V/m.



RADIO COMMUNICATIONS IN THE COMMUNITY

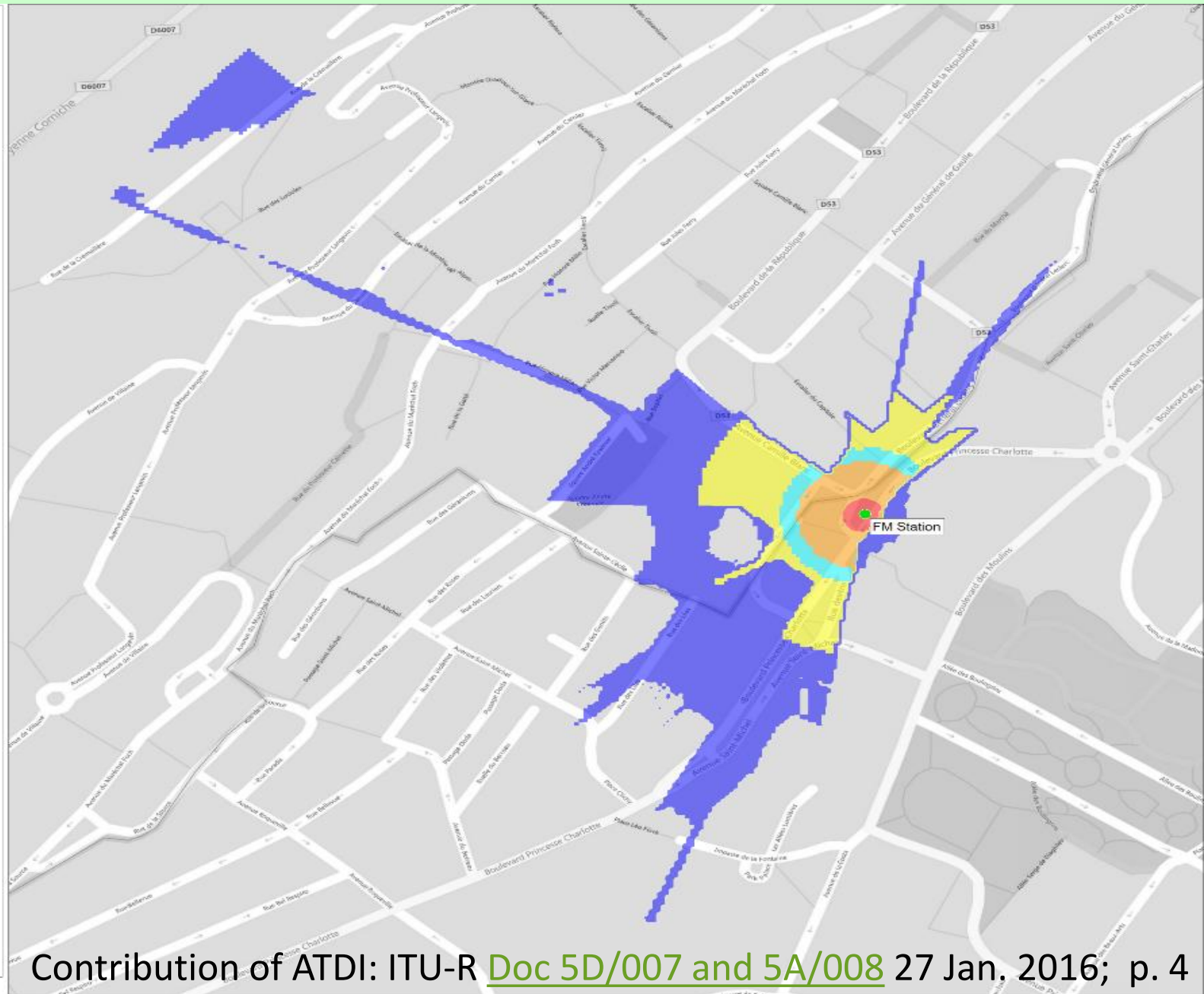
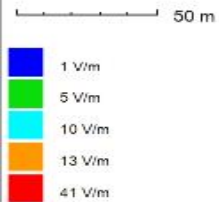


Source: ITU-T Report 2014 [*EMF Considerations in Smart Sustainable Cities*](#)

Two dimensions cellular safety-distances

FM Composite coverage

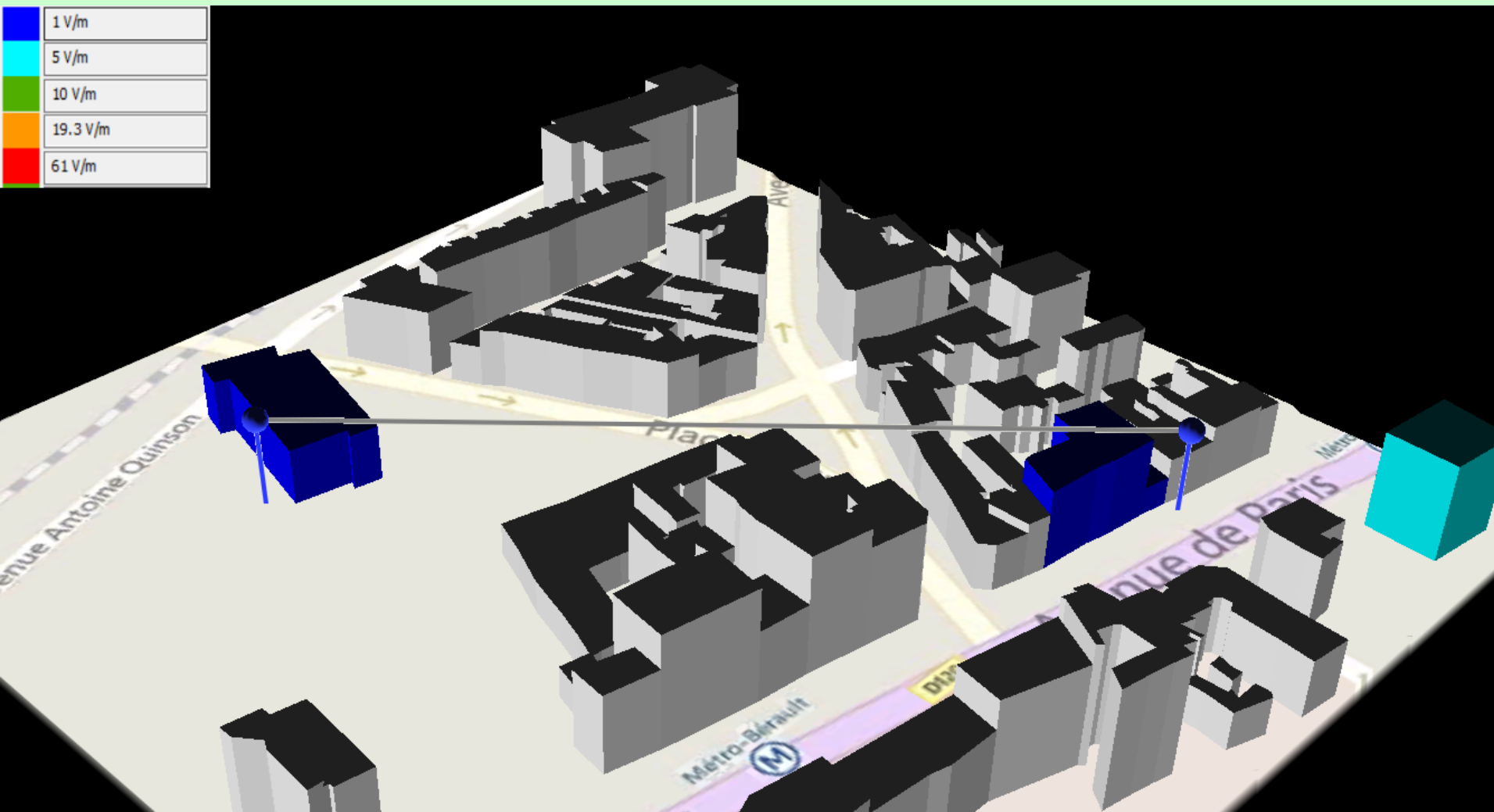
Safety zones in 2D view



ATDI

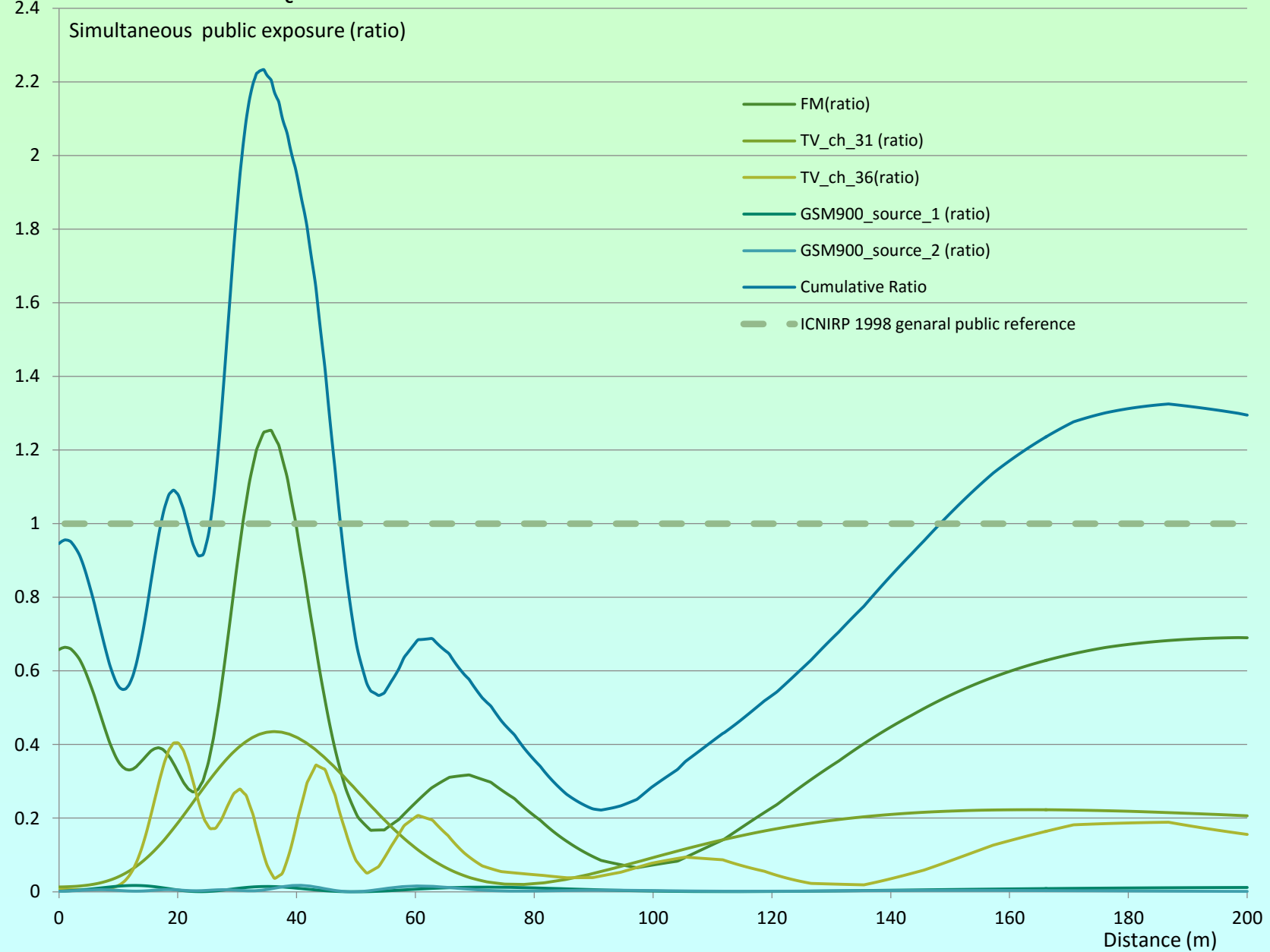
Contribution of ATDI: ITU-R [Doc 5D/007](#) and [5A/008](#) 27 Jan. 2016; p. 4

Three dimensions exposure, Point to Point, including ITU-R F.699 antenna patterns; 40 KW EIRP



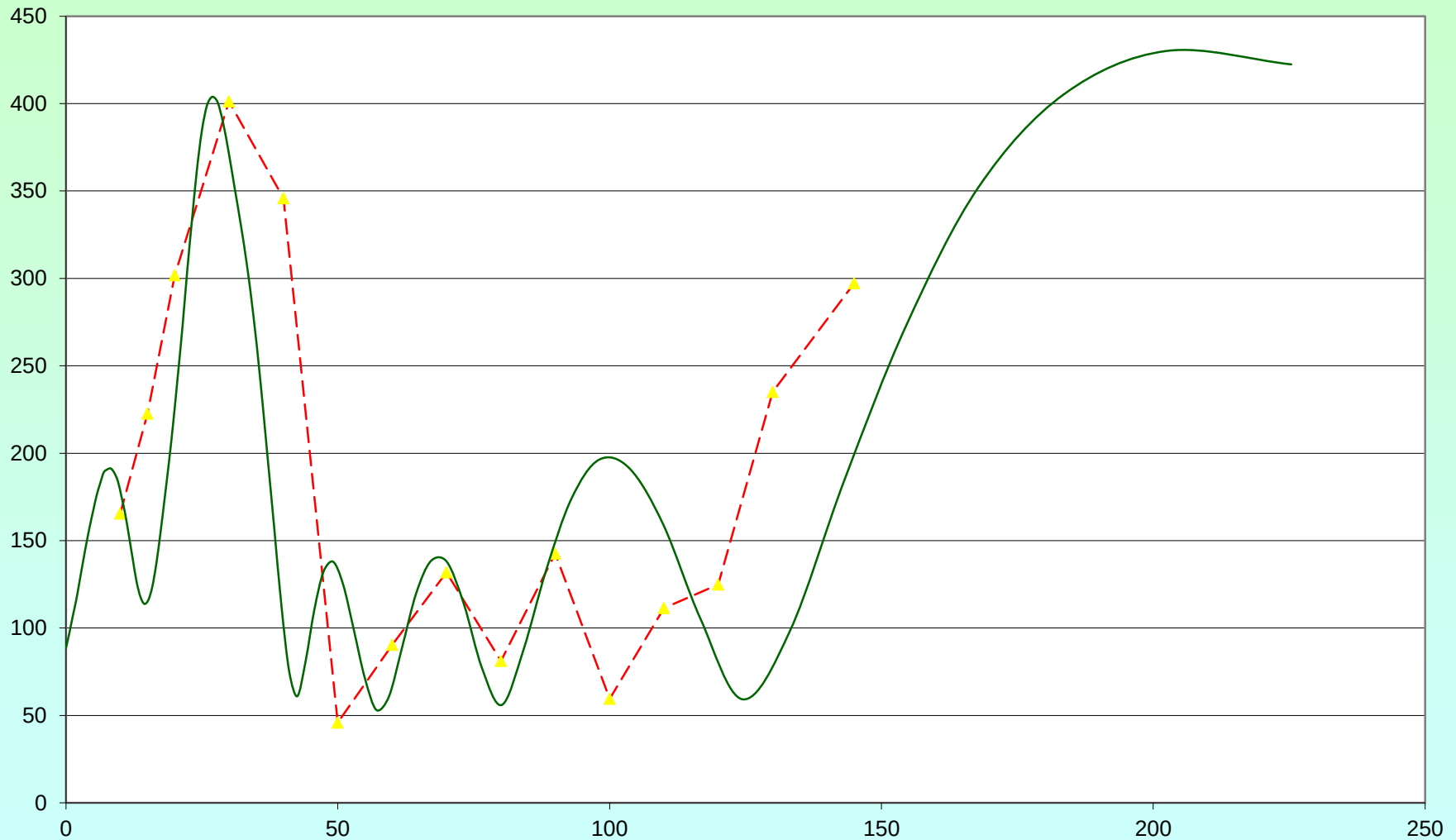
Contribution of ATDI: ITU-R [Doc 5C/017](#) and [6A/045](#); Fig 7 1 April 2016

Coefficient W_t vs. distance, co-located site, FM, TV & GSM 900



Field Strength (mV/m) vs. distance (m)

RF = 1875.8 MHz; red- measured, green- calculated



Also contribution to ITU-T SG5 : measured and calculated by ANATEL 2012, Eng . [Agostinho Linhares de Souza Filho](#)

RF Hazards limits & their impact on network planning

Excessive limits affect network planning

- Co-location and MIMO increase the safety distance and restrict mast construction near buildings
- Countries (e.g. Switzerland) reduce by 100 (and Salzburg by 9,000) the power density level and restrict the cellular BTS planning and location
- Lower RF exposure limits enforce to decrease the EIRP (in order to reduce the power-density and field-strength near the station) or to extend the distance of the mast from the public
- Handling low exposure thresholds by additional cellular antennas or RF Spectrum

Many Thanks; Any Questions ?