ITU Workshop on "5G, EMF & Health" (Warsaw, Poland, 5 December 2017)

ATDI Coverage & EMF contours, around 5G base stations

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ITU-D, R and T interesectoral activities on EMF

Session 3: What are the implications of 5G of EMF limits for 5G Network Rollout?

ATDI's calculation method to present precisely exposure and predicting field strength levels, relative to national limits

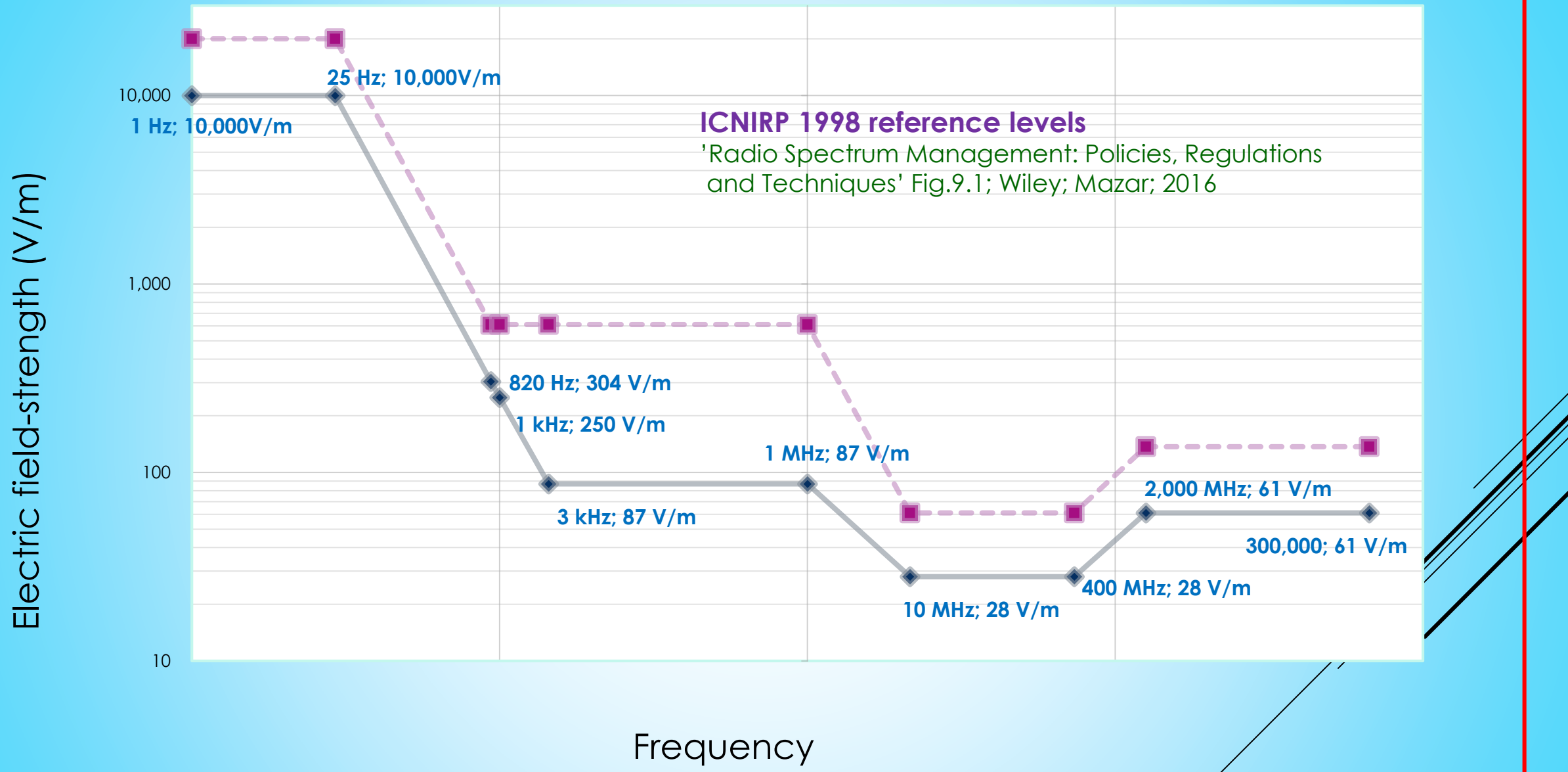
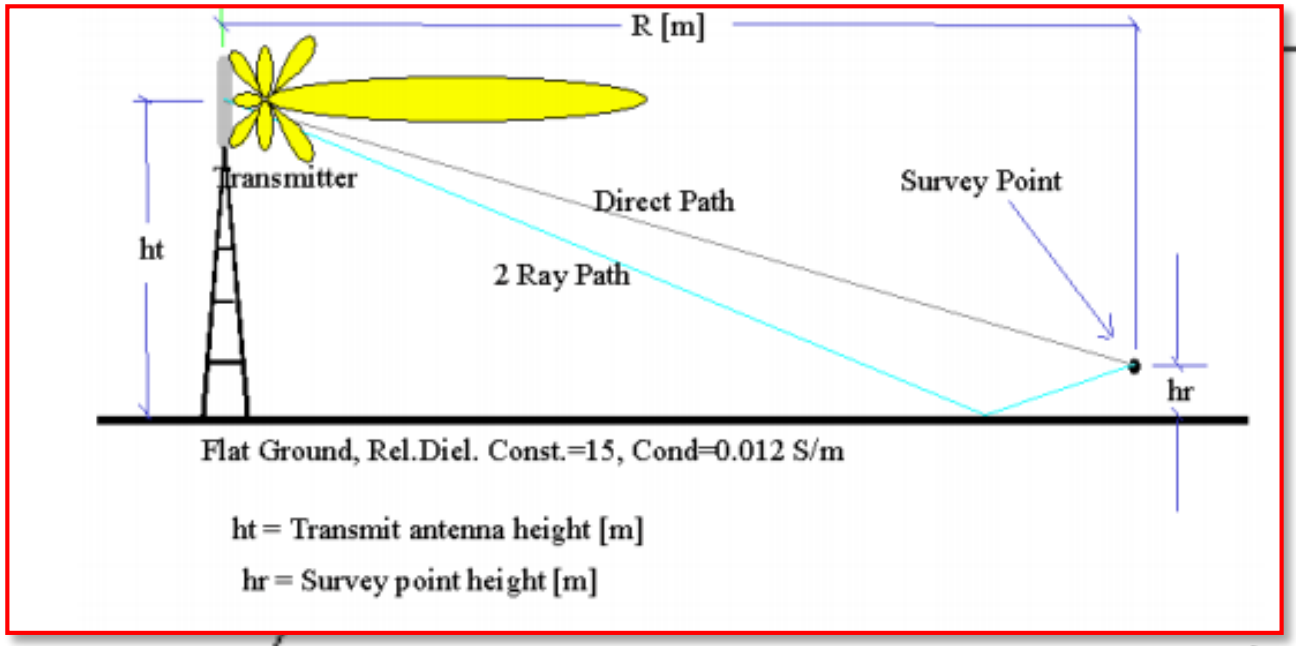
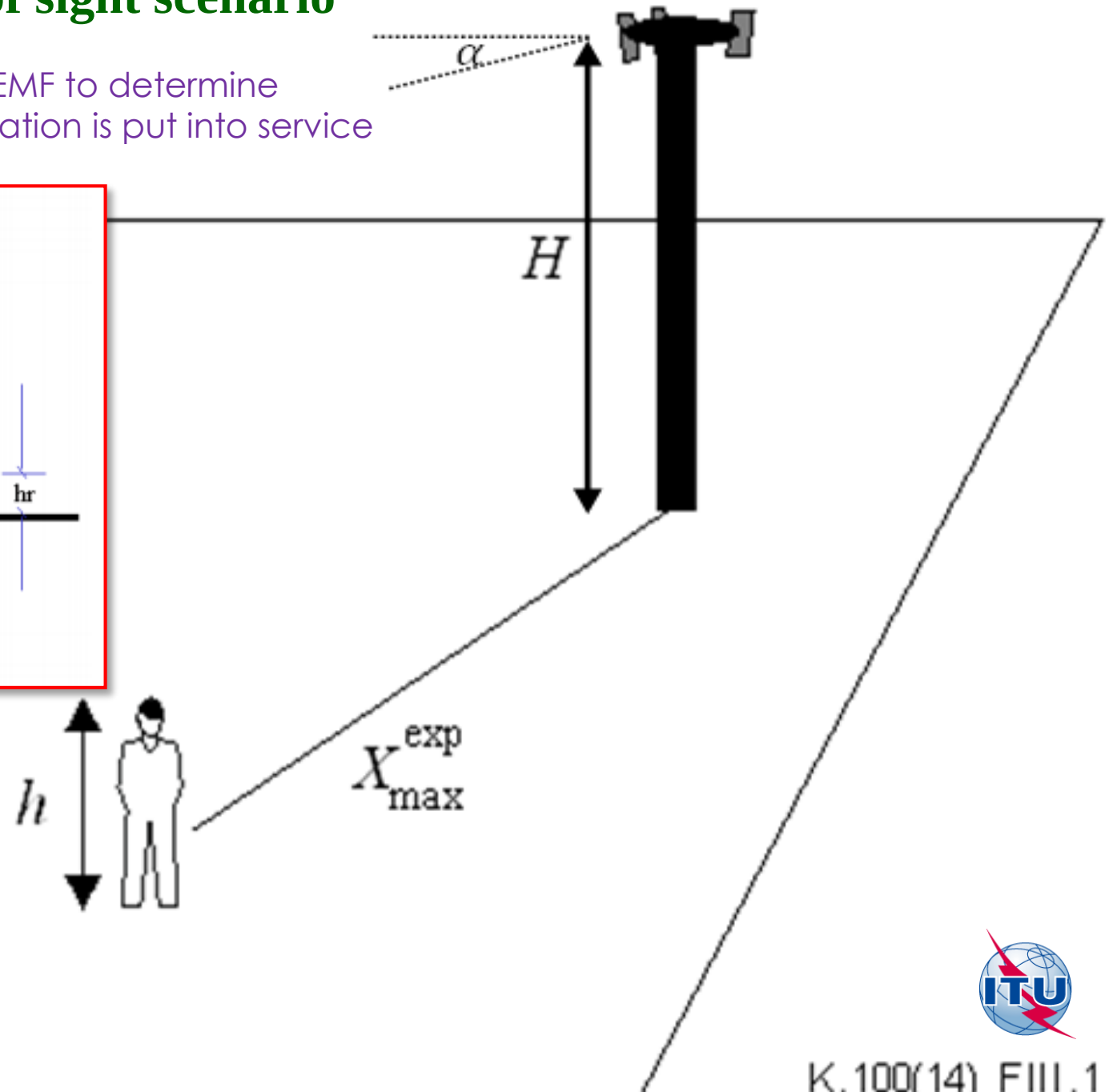

ICNIRP 1998 reference levels
'Radio Spectrum Management: Policies, Regulations and Techniques' Fig.9.1; Wiley; Mazar; 2016
Electric field-strength (V/m)
10,000
1,000
100
10
Frequency
1 Hz; 10,000V/m
25 Hz; 10,000V/m
820 Hz; 304 V/m
1 kHz; 250 V/m
3 kHz; 87 V/m
1 MHz; 87 V/m
10 MHz; 28 V/m
400 MHz; 28 V/m
2,000 MHz; 61 V/m
300,000; 61 V/m
ICNIRP1998 reference levels (V/m); general public
ICNIRP1998 reference levels (V/m); occupational exposure

Figure III.1 – Geometry set-up for a line of sight scenario

Recommendation ITU-T K.100 7/2017 RF Measurement EMF to determine compliance with human exposure limits when a base station is put into service





K.100(14)_FIII.1

Exposure distance assuming free-space, main beam

p_t: transmitter power (watts),

g_t: transmitter antenna gain (numeric)

eirp: equivalent isotropically radiated power (watts)

d: distance from transmitter (meter)

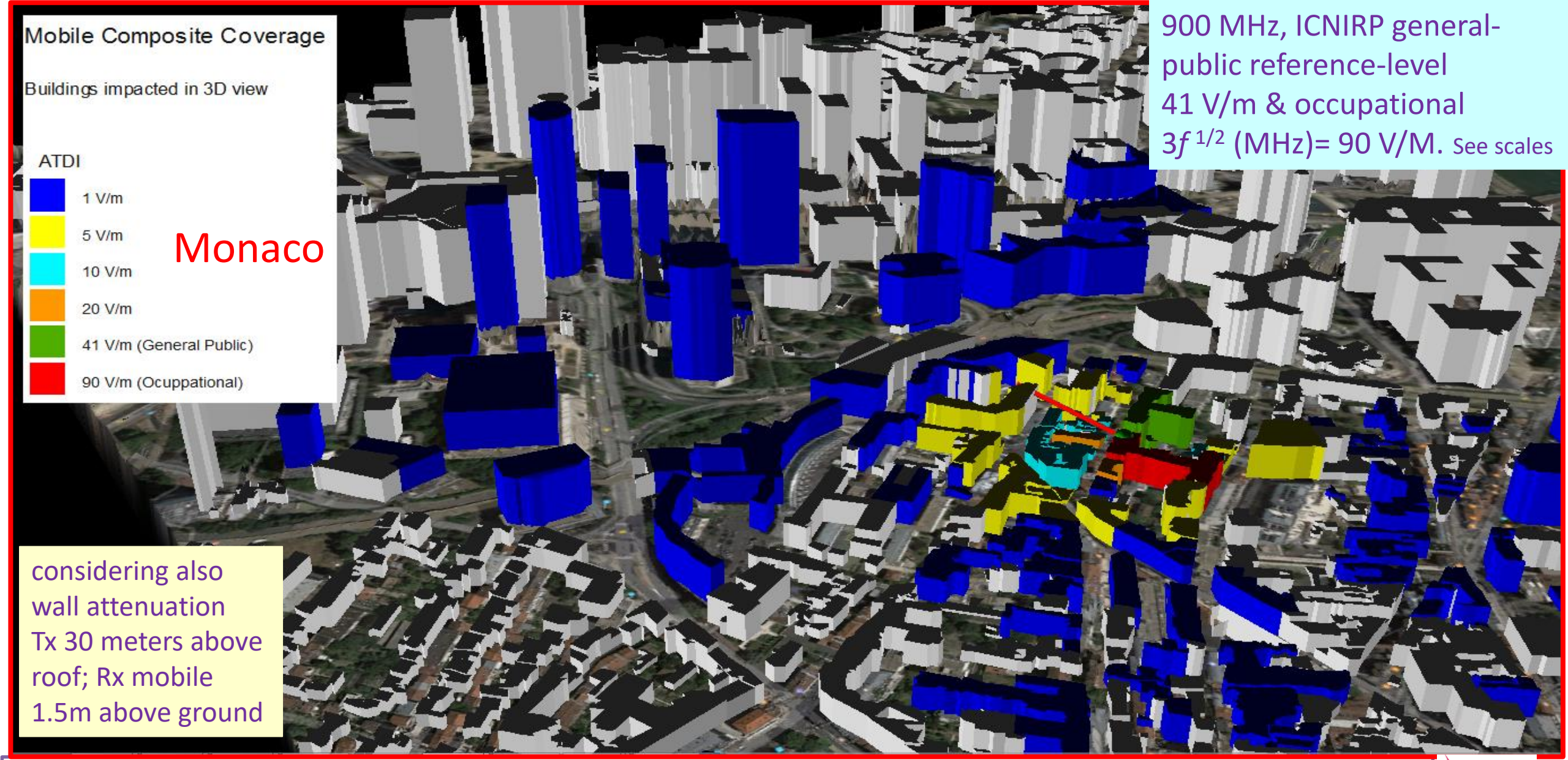
e: electric field-strength (FS) Volt/meter (V/M)

$$e = \frac{\sqrt{30\,eirp}}{d} \quad \text{and} \quad d = \frac{\sqrt{30\,eirp}}{e}$$

At 900 MHz, max downlink power 100 W, ant. gain (including losses) 17 dBi, *eirp* is 5 Kw.

ICNIRP 1998 general-public reference-level is 41 V/m. Therefore, the exposure distance *d*

$$d = \frac{\sqrt{30\,eirp}}{e} = \frac{\sqrt{30 \times 5{,}000}}{41} = 9.5 \text{ m.}$$

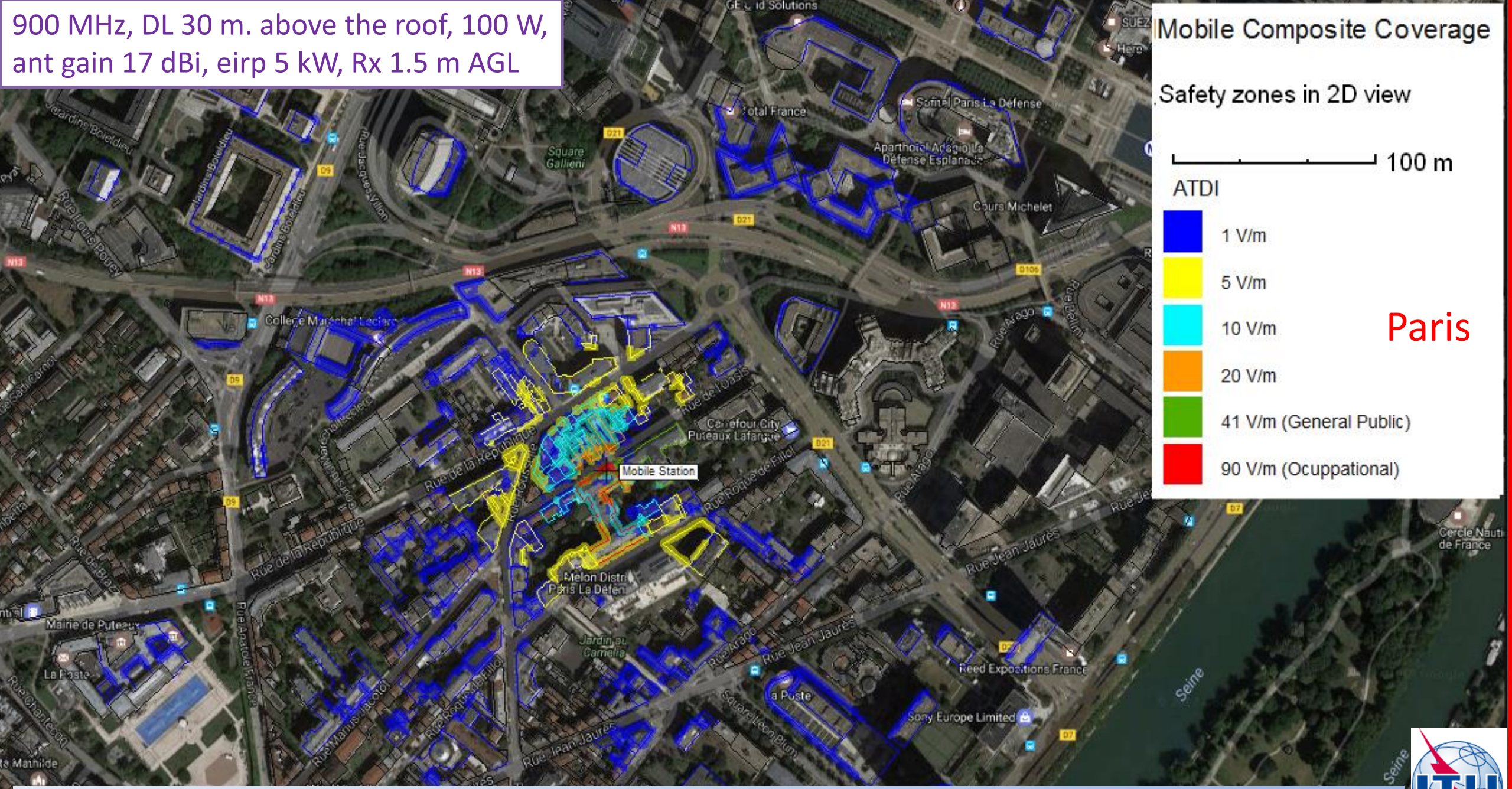


900 MHz, ICNIRP general-public reference-level 41 V/m & occupational $3f^{1/2}$ (MHz)= 90 V/M. See scales

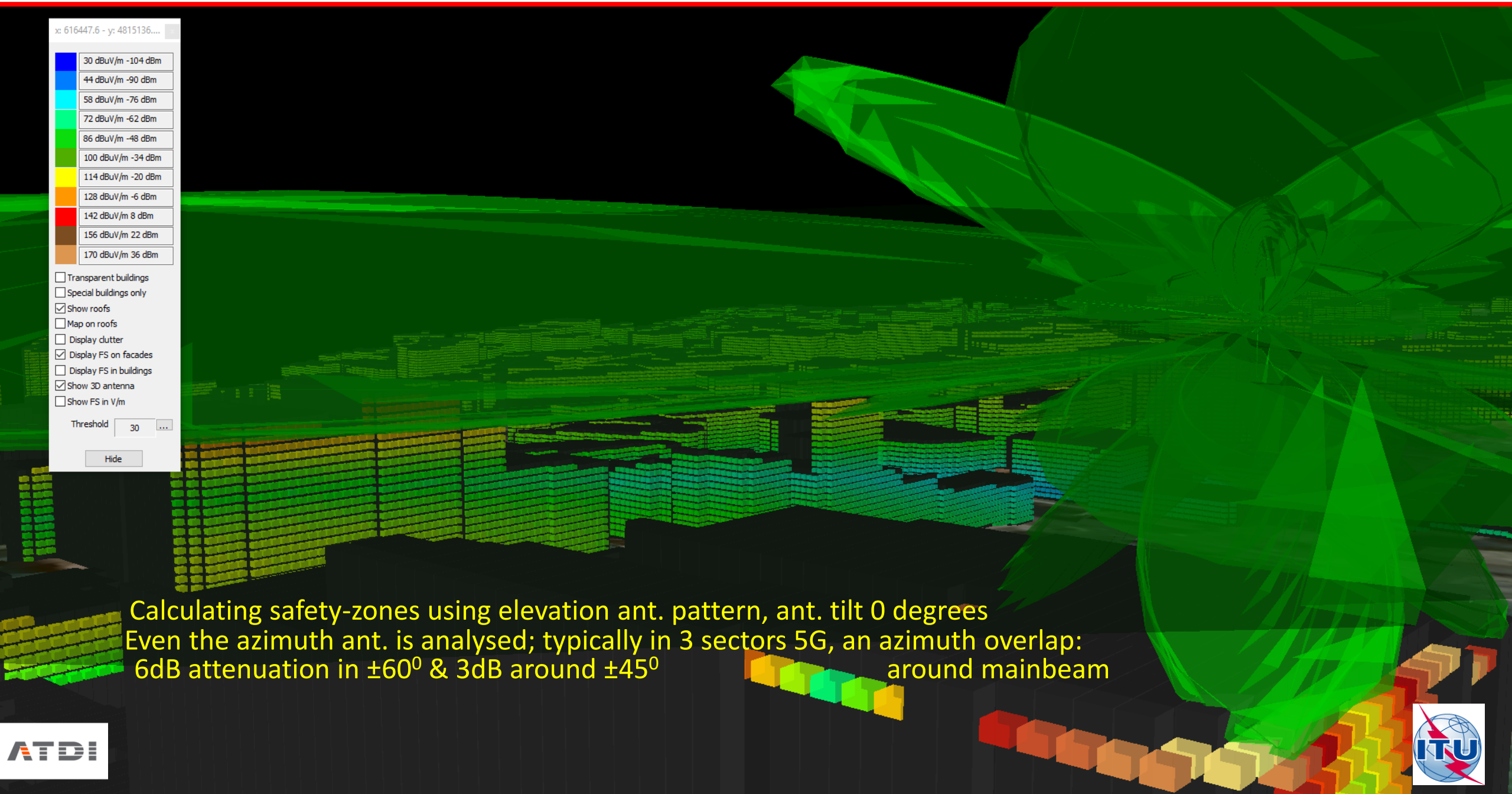
considering also wall attenuation Tx 30 meters above roof; Rx mobile 1.5m above ground

Environmental levels: 3D cellular contours, showing buildings impacted; preliminary draft new Report ITU-R SM.[EMF-MON] 'EMF measurements to assess human exposure' Fig. 6

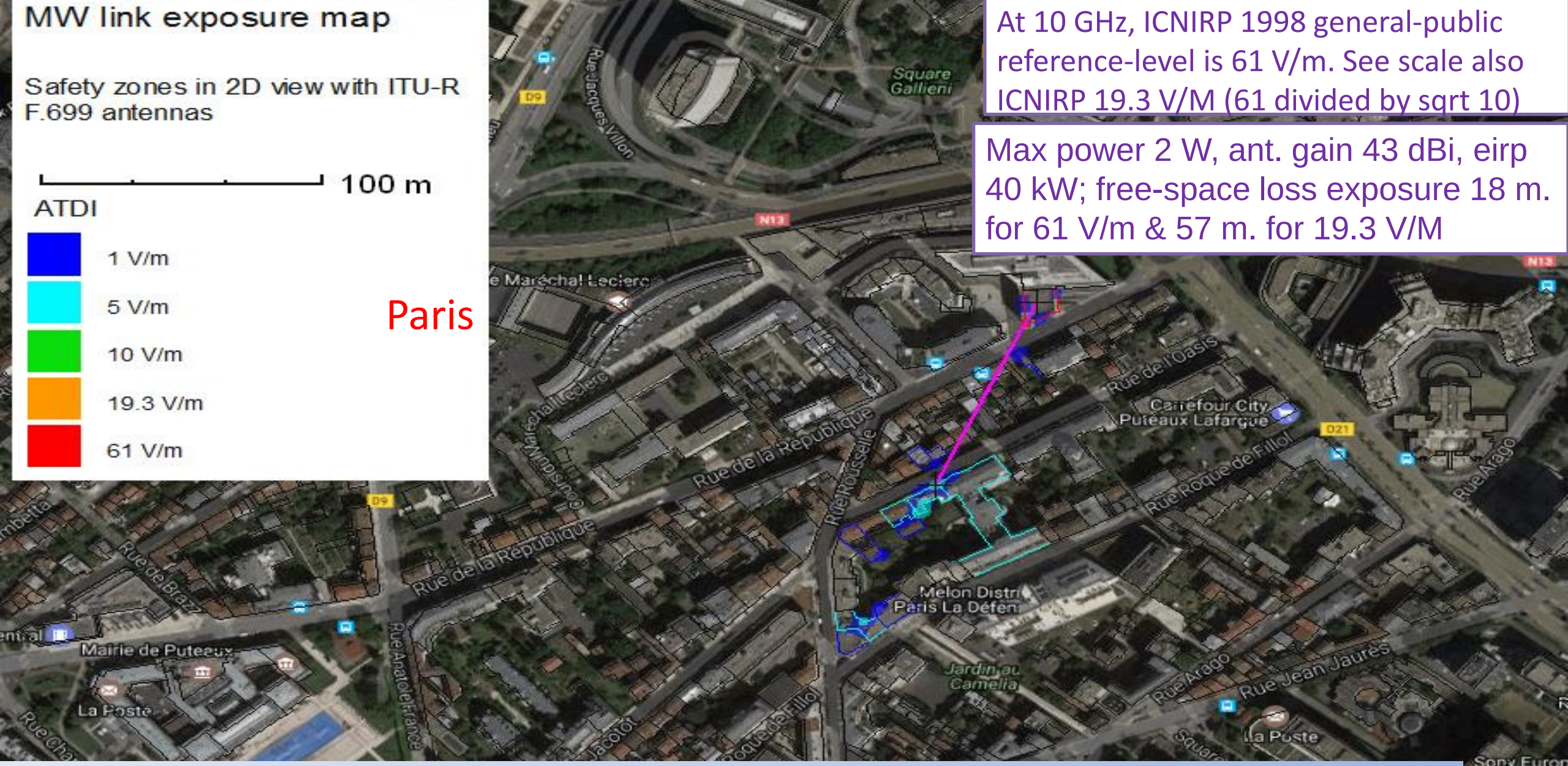
900 MHz, DL 30 m. above the roof, 100 W, ant gain 17 dBi, eirp 5 kW, Rx 1.5 m AGL



Environmental levels: 2 D satellite view of cellular, Report ITU-R SM.[EMF-MON] Fig. 7



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 $\pm 60^0$ & 3dB around $\pm 45^0$ around mainbeam



2D exposure-distances using ITU-R F.699 ant. patterns. ITU-R SM.[EMF-MON] Fig. 13
Buildings impacted by two PtP directive links 40 kW eirp

Related author's presentations on EMF

- A Global Survey and Comparison of Different Regulatory Approaches to Non-Ionizing RADHAZ and Spurious Emissions, IEEE TelAviv, COMCAS, November 2009. Hyperlink to the slides presentation; 9 November 2009
- 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 October 2011
- Technical limits of Human Exposure to RF from Cellular Base Stations and Handsets, Jerusalem, 11 April 2013. Professional presentation of the Ministry of Communications to the experts of Ministry of Environmental Protection, human-exposure monitoring laboratories and cellular operators
- Technical limits of Human Exposure to RF from Broadcasting Emitters, Cellular Base Stations and Handsets, at 'Holon institute of technology', 30 January 2014
- Smart_Cities_RF_Human_Exposure_Ministries_of_Comms_Energy.pdf; presentation at intra-ministerial commission, on 21 January 2015
- January 2016, presentations in Singapore, Beijing, Chengdu and Shenzhen
- January2016_Human_Hazards_Mazar_SRTC_in_Chinese.pdf
- Human Hazards_Mazar_AsiaPacific_BKK_25April16.pdf
- EMC_Europe2016_Wroclaw_Sep 2016_Mazar_20April16_EMF.pdf

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Questions to be asked: how exactly to calculate exposure-contours by inserting additional losses derived from *wall penetration*, *non free-space* propagation model, & *antenna patterns*, mainly in *elevation*?

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