5G Implementation and Human Exposure to the Electromagnetic Fields

6 December 2018 | Warsaw, Poland

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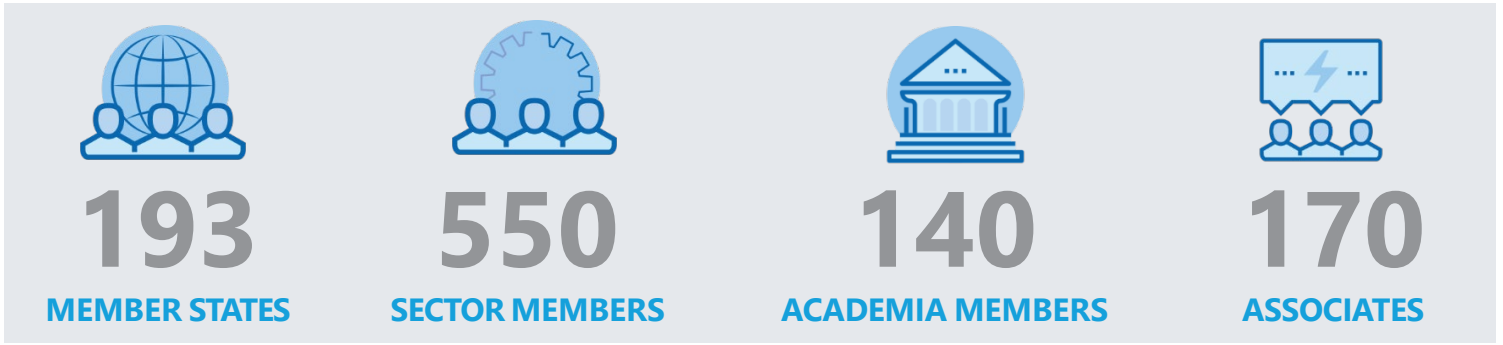
ITU at a glance

ITU is the United Nations specialized agency for information and communication technologies (ICTs)



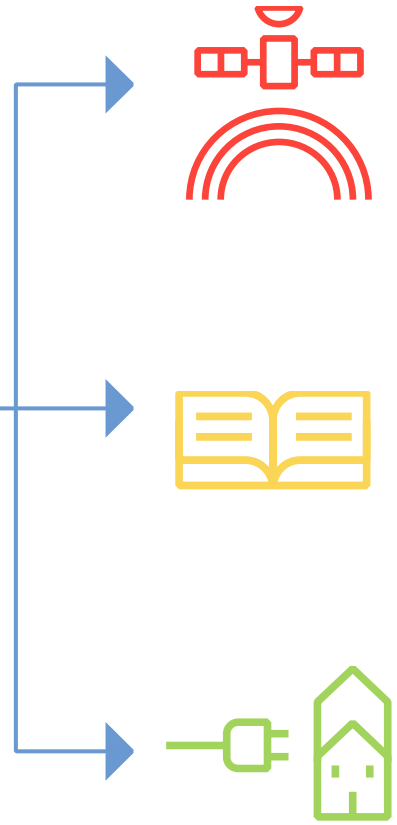
ITU allocates the global radio spectrum and satellite orbit resources, develops the technical standards that ensure networks and technologies seamlessly interconnect, and strives to improve access to ICTs to underserved communities worldwide

ITU at a glance

What we do

‘Committed to Connecting the World’

3 Sectors



ITU Radiocommunication

Coordinating radio-frequency spectrum and **assigning** orbital slots for satellites

ITU Standardization

Establishing global standards

ITU Development

Bridging the digital divide

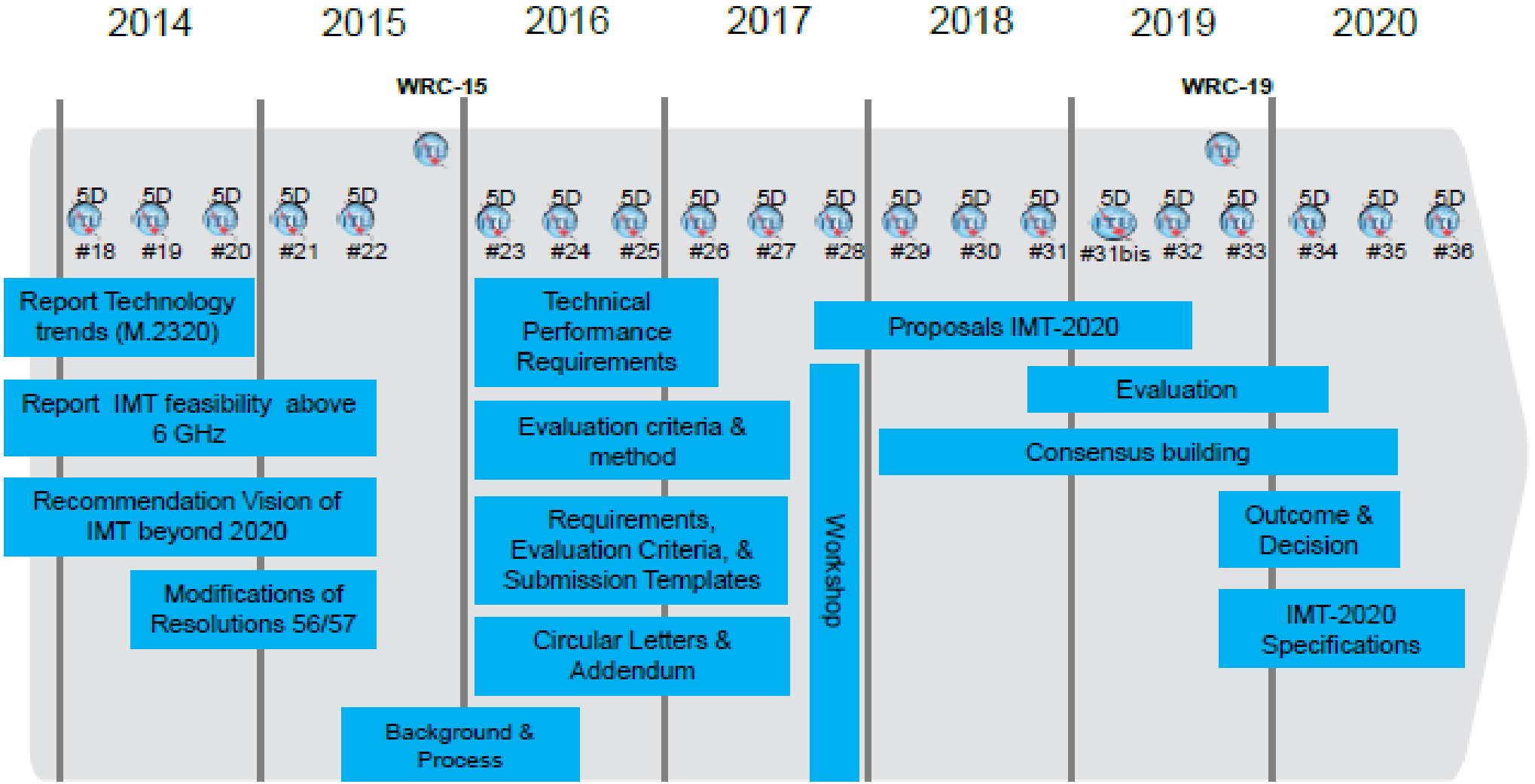
IMT-2000, IMT-Advanced & IMT-2020

- All of today's 3G and 4G mobile broadband systems are based on the ITU's IMT standards
- IMT provides the global platform on which to build the next generations of mobile broadband connectivity
- ITU established the detailed specifications for IMT-2000 and the first 3G deployments commenced around the year 2000
- In January 2012, ITU defined the next big leap forward with 4G wireless cellular technology –IMT-Advanced –and this is now being progressively deployed worldwide
- The detailed investigation of the key elements of IMT-2020 is well underway, using the partnership ITU has with the mobile broadband industry and the wide range of stakeholders in the 5G community

Evolution of mobile networks

	1G	2G	3G	4G	5G
Approximate deployment date	1980s	1990s	2000s	2010s	2020s
Theoretical download speed	2kbit/s	384kbit/s	56Mbit/s	1Gbit/s	10Gbit/s
Latency	N/A	629 ms	212 ms	60-98 ms	< 1 ms

ITU-R IMT-2020 => Detailed timeline and process



Implementation of 5G in Europe / European 5G Observatory

Spectrum

- 5G pioneer bands identified in Europe (700 MHz, 3.6 GHz and 26 GHz)
- Common roadmap for the availability of spectrum adopted by Member States
- Consultations on spectrum assignments launched by Member States
  - Denmark 700 MHz & 900 MHz & 2300 MHz, Germany 2 & 3.6 GHz, France 3.5 GHz & 26GHz, Lithuania 3.5 GHz, Luxemburg 700 MHz & 26 GHz, Malta &00MHz, Poland 700 MHz & 3.5 GHz & 26 GHz, Portugal 700 MHz, Romania 700 MHz, Slovakia 26 GHz, Slovenia, Sweden 26 GHz, UK 26 GHz
- 2.5 GHz spectrum assigned in 7 MSs
  - Czech Rep., Hungary, Ireland, Latvia, Slovakia, Spain, UK
- 3.5 GHz auctions scheduled for Q4 2018 in 4 MSs
  - Austria, Finland, Italy, Sweden
- 700 MHz spectrum already assigned in
  - Finland, France, Germany and Sweden

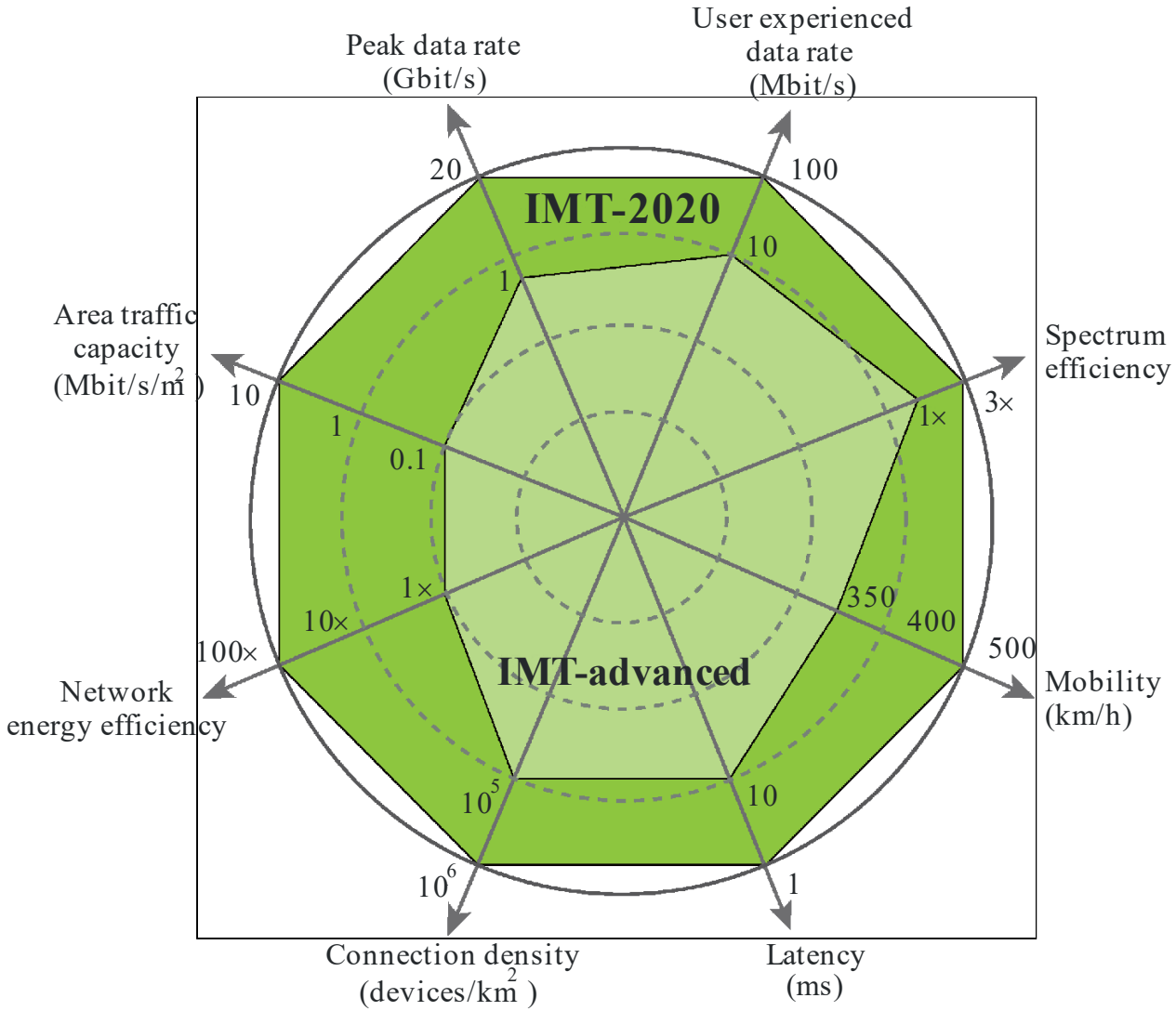
After WRC-15 spectrum for IMT

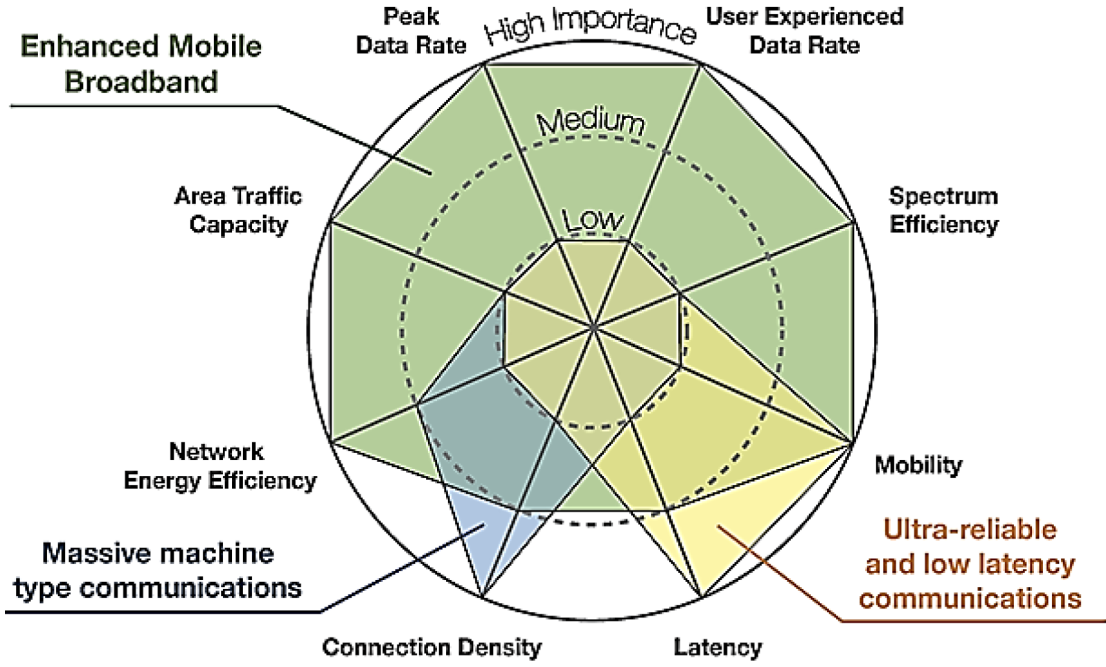
Band (MHz)	Footnotes identifying the band for IMT			Bandwidth
	Region 1 or parts thereof	Region 2 or parts thereof	Region 3 or parts thereof	
450-470		5.286AA		20
470-698	-	5.295, 5.308A	5.296A	228
694/698-960	5.317A	5.317A	5.313A, 5.317A	262
1 427-1 518	5.341A, 5.346	5.341B	5.341C, 5.346A	91
1 710-2 025		5.384A, 5.388		315
2 110-2 200		5.388		90
2 300-2 400		5.384A		100
2 500-2 690		5.384A		190
3 300-3 400	5.429B	5.429D	5.429F	100
3 400-3 600	5.430A	5.431B	5.432A, 5.432B, 5.433A	200
3 600-3 700	-	5.434	-	100
4 800-4 990	-	5.441A	5.441B	190
Total Bandwidth	**1,886 (Regional allocations vary and totals can be different for a specific region)**			

New spectrum bands under study for WRC-19

Existing mobile allocation	No global mobile allocation
24.25 – 27.5 GHz	31.8 – 33.4 GHz
37 – 40.5 GHz	40.5 – 42.5 GHz
42.5 – 43.5 GHz	
45.5 – 47 GHz	47 – 47.2 GHz
47.2 – 50.2 GHz	
50.4 GHz – 52.6 GHz	
66 – 76 GHz	
81 – 86 GHz	

ITU-R IMT-2020 Vision => 5G Capability





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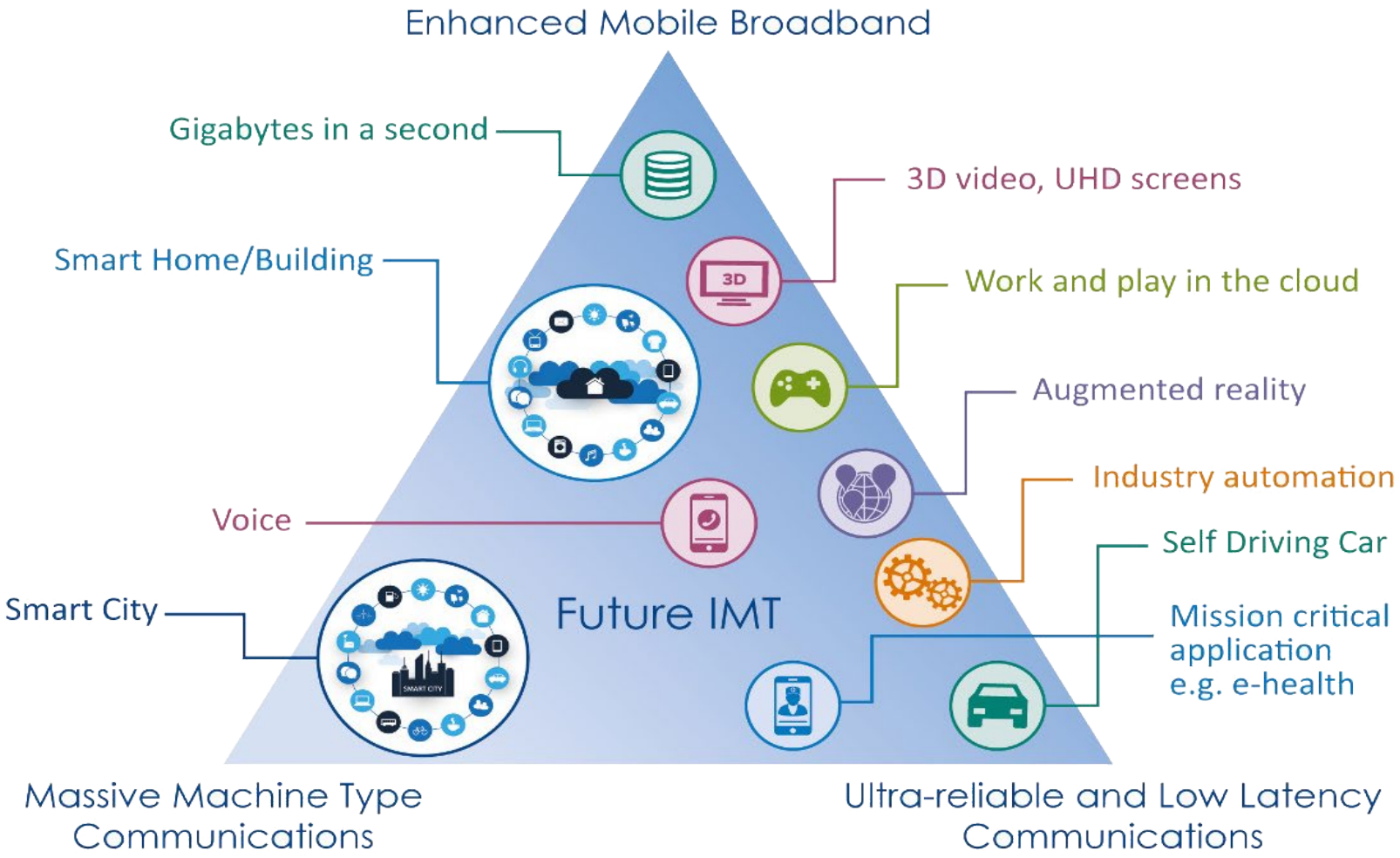
5G Usage scenarios



Implementation of 5G in Europe / European 5G Observatory

5G Trials

- 100 plus pre-commercial 5G trials and pilots launched in Europe as part of the industry's 5G trial roadmap
- 20 Trial Cities appointed: Amsterdam, Aveiro, Barcelona, Bari, Berlin, Bristol, Espoo, Ghent, L'Aquila, London, Madrid, Malaga, Matera, Milan, Oulu, Patras, Prato, Stockholm, Tallinn and Turin

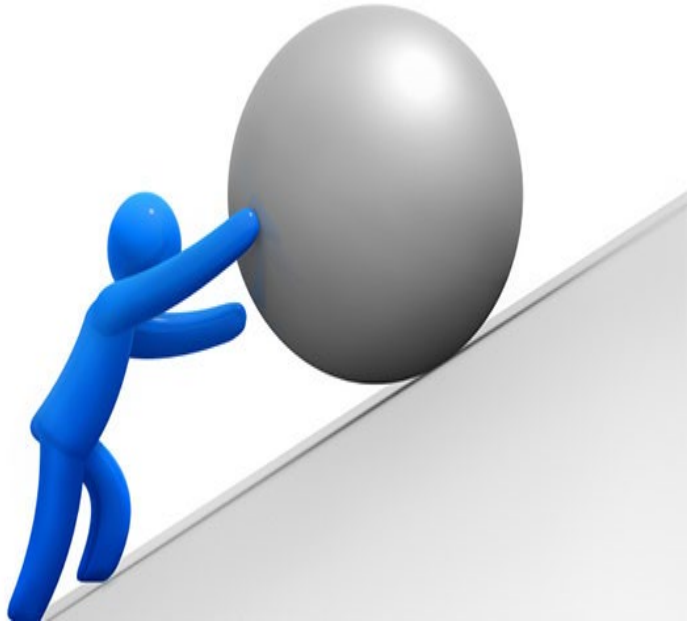
- 10 digital cross-border corridors established inter alia accommodating live testing of 5G for Cooperative Connected and Automated Mobility
- 5 September 2018: Poland and Lithuania signed a letter of intent to cooperate on technical, legal and policy of the cross-border CAM corridor 'via Baltica - South' (linking Warsaw, Kaunas, and Vilnius).
- 28 September: Latvia, Lithuania and Estonia signed a memorandum of understanding for the 'Via Baltica - North' initiative to develop an experimental 5G cross-border corridor where self-driving vehicles can be tested.

5G Coverage, Roadmaps and National Plans

- Eight Member States have published national 5G roadmaps
  - Austria, France, Germany, Luxemburg, Netherlands, Spain, Sweden, and UK
  - Denmark, Poland, Others in the process of development
- National calendars for key milestones set by the government
- Measures to stimulate investments in 5G infrastructures such as reducing the cost of deploying small cells, wide ranging support to 5G trials
- Promoting partnerships between the telecom sector and vertical industries
- Foster public services as lead user for early 5G deployment
- European Instruments
  - Digital Single Market Strategy
  - European Electronic Code
  - 5G Action Plan

Challenges in Implementation of 5G in Europe

- Small cell deployment
  - Local permitting and planning process
  - Lengthy engagement and procurement exercises
  - High fees and charges to access street furniture (and the access itself)
  - **Levels of Electromagnetic Fields**
    - Italy, Poland, Russia, Switzerland
    - Belgium and Paris
- Fiber backhaul
- Spectrum
- Investment



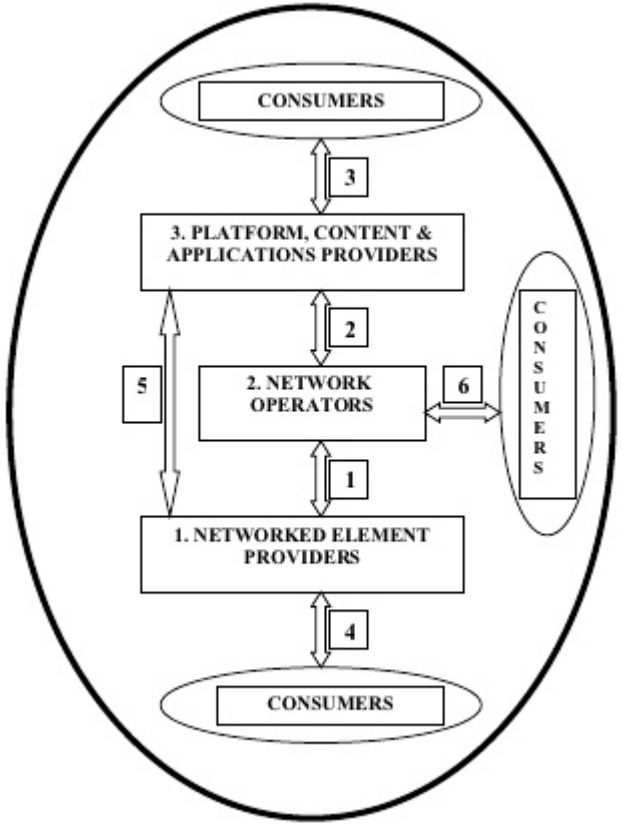
Collaboration on EMF

ICNIRP
INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION

World Health Organization

ITU

ICT Ecosystem



ITU Mandate on EMF

ITUPP DUBAI 2018
29 October - 16 November
Dubai, United Arab Emirates

ITU PP Resolution 176 - "Human exposure to and measurement of electromagnetic fields" (Dubai, 2018)

3 SECTORS

STANDARDIZATION

WTSA Resolution 72 - "Measurement concerns related to human exposure to electromagnetic fields" (Rev. Hammamet, 2016)

DEVELOPMENT

WTDC Resolution 62 - "Assessment and measurement of human exposure to electromagnetic fields" (Rev. Buenos Aires, 2017)

RADIOCOMMUNICATION

ITU-R Question 1/239 (Electromagnetic field measurements to assess human exposure).

Intersectoral Activities

- Comments to the new ICNIRP guidelines on “Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields, (100 kHz TO 300 GHz)”. In cooperation with ITU-R and ITU-D experts, and based on the received Contribution from ATDI and Orange Polska and also from the inputs received during the ITU-T SG5 meeting, 32 comments have been included and sent to ICNIRP; see TD696-R1
- Mapping of ITU-D/R/T EMF activities to avoid overlap, mainly:
  - D: **Strategies** & **Policies** concerning human exposure to EMF
  - R: EMF **measurements** from **base stations** to assess human exposure
  - T: **Simulation**, assessment, **5G**

ITU-T Study Group 5: Environment, climate change and circular economy

SG5 is responsible for:

Studying ICT environmental aspects of electromagnetic phenomena and climate change.

Studies on how to use ICTs to help countries and the ICT sector to adapt to the effects of environmental challenges, including climate change, in line with the Sustainable Development Goals (SDGs).

electromagnetic compatibility, lightning protection and electromagnetic effects

ICTs related to the environment, climate change, energy efficiency and clean energy

circular economy, including e-waste

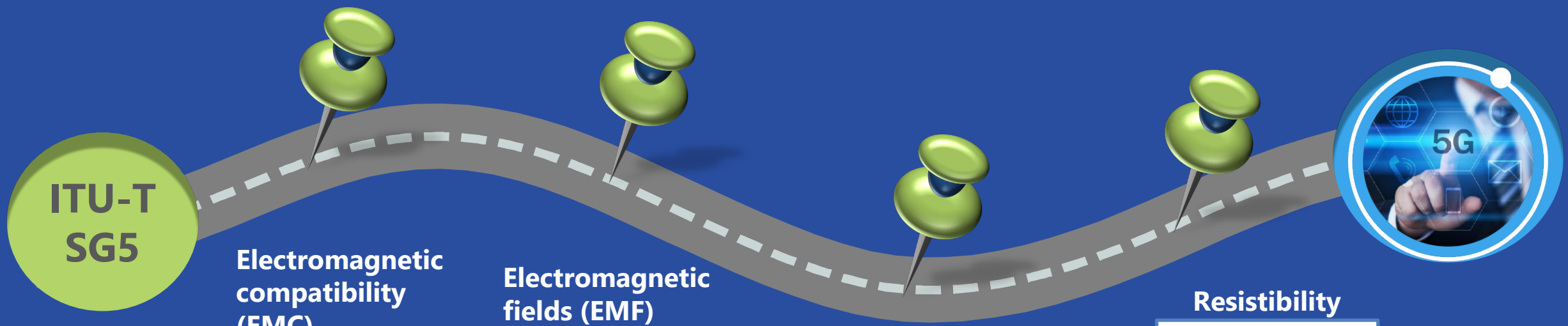
9 Questions

4 Regional Groups

Q3/5 - Human exposure to electromagnetic fields (EMFs) from information and communication technologies (ICTs)

Setting Environmental Requirements for 5G

International Standards | Supplements | Technical Reports



Electromagnetic compatibility (EMC)

ITU-T K.Suppl.10

Electromagnetic fields (EMF)

ITU-T K.Suppl.9 - 5G technology and human exposure to RF EMF
ITU-T K.Suppl.14 - RF-EMF exposure limits on 4G and 5G
Draft ITU-T K.Supp-5G_EMF_Compliance

Energy feeding & efficiency

ITU-T L. 1220
ITU-T L. Suppl.36

Resistibility

ITU-T K.Suppl.8

ITU's contribution to EMF Standards

ITU-T Study Group 5 has an active group of global experts focused on RF EMF

Key activities & study areas

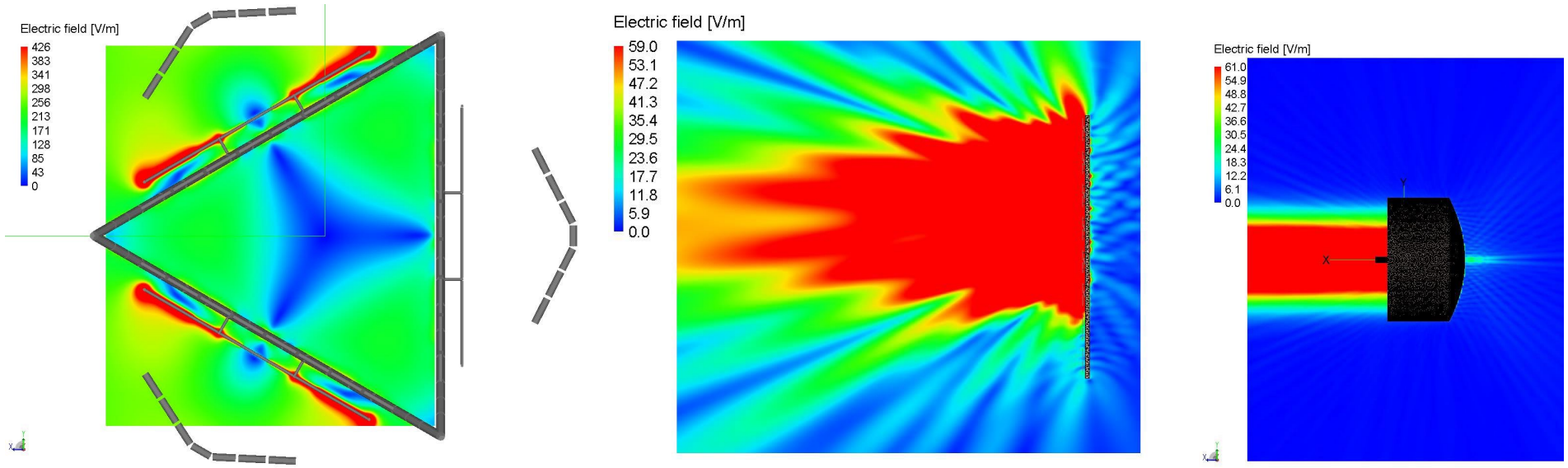
- 10 Recommendations (Normative International Standards) and 5 Supplements (Non-Normative guides and reports) in force
  - ITU-T K.83 on Monitoring of Electromagnetic field levels

ITU's contribution to EMF Standards

- **Recommendation ITU-T K.52** (2000/2014/2018) - Guidance on complying with limits for human exposure to electromagnetic fields – **includes „K.52calculator software"**
- **Recommendation ITU-T K.61** (2003/2018) - Guidance on **measurement** and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations
- **Recommendation ITU-T K.70** (2007/2018) - Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations – **includes „EMF Estimator software"**
- **Recommendation ITU-T K.83** (2011/2014) - Monitoring of electromagnetic field levels
- **Recommendation ITU-T K.90** (2012/2017) - Evaluation techniques and working procedures for compliance with exposure limits of network operator personnel to power-frequency electromagnetic fields– **includes „EMFACDC" software**
- **Recommendation ITU-T K.91** (2012/2017) - Guidance for assessment, evaluation and monitoring of human exposure to radio frequency electromagnetic fields – **includes "Uncertainty calculator" and "Watt_Guard" software, Supplement and mobile App "EMF-guide", mobile App „EMF Exposure"**
- **Recommendation ITU-T K.100** (2014/2017) - Measurement of RF EMF to determine compliance with human exposure limits when a base station is put into service
- **Recommendation ITU-T K.113** (2015) - Generation of RF EMF level maps

ITU-T Recommendations on EMF assessment

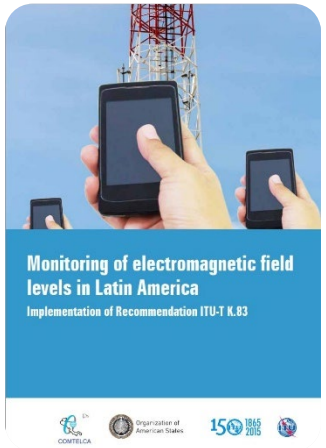
- **Recommendation ITU-T K.121** (2018) – Guidance on the environmental management for compliance with radio frequency EMF limits for radiocommunication base stations
- **Recommendation ITU-T K.122** (2016) - Exposure levels in close proximity of radiocommunication antennas



Raising awareness on EMF

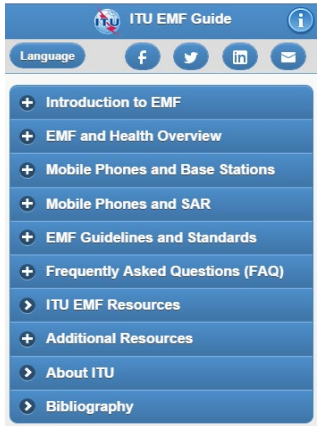
Key elements for successful public communications:

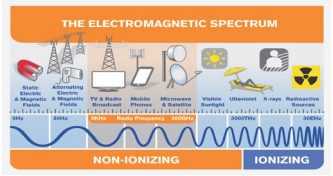
- Information easy to understand;
- Open and transparent dialogues;
- Providing stakeholders with trusted sources of information.



ITU's Public information on EMF:

- ITU EMF Guide – key information source
- EMF Website
- Report on "Monitoring of electromagnetic field levels in Latin America"
- Best practices to reduce exposure from mobile devices
- The EMF Guide mobile app in the 6 UN official languages is available online at http://emfguide.itu.int. It is also available in Malay.



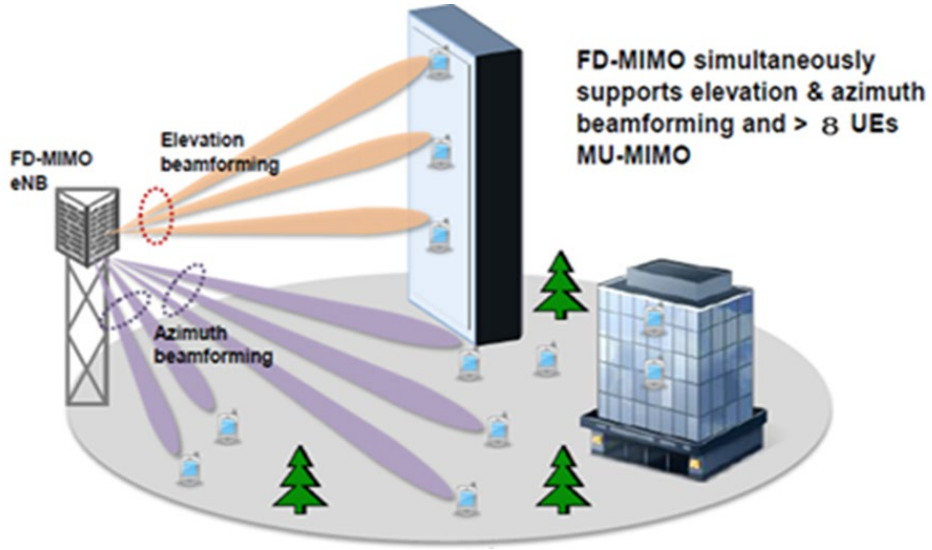


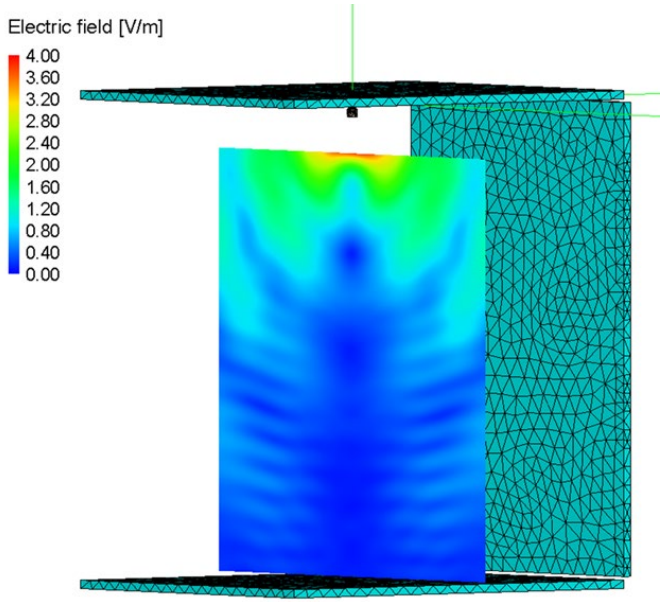
iOS BlackBerry App World ANDROID APP ON Google play

K. Suppl. 9 (11/2017) 5G technology and human exposure to RF EMF

Contains an analysis of the impact of the implementation of 5G mobile systems with respect to exposure level of EMF around radiocommunication infrastructure

- **Higher frequencies and higher throughput**
- **Smart antennas:** will be more efficient which will result in minimized RF-EMF exposure
- **Small cells:** are well suited for coverage extent as well as capacity issues. Better quality and reduced power to and from mobile phones.
- **Internet of things (IoT):** EMF exposure will usually be much lower than from other devices and systems



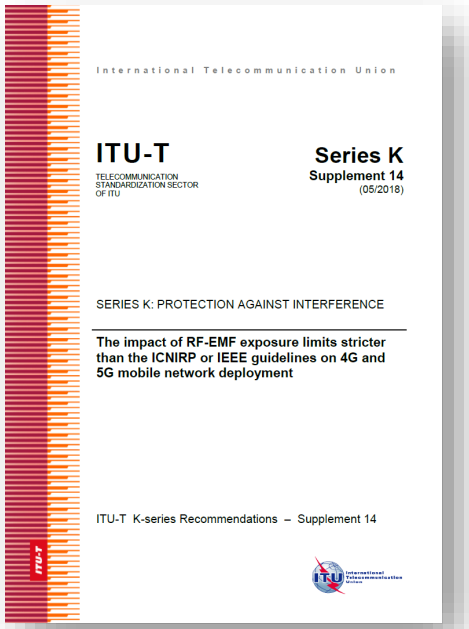


Two new ITU-T Supplements on EMF

- **Supplement ITU-T K.Suppl.13 on** Radiofrequency electromagnetic field (RF-EMF) exposure levels from mobile and portable devices during different conditions of use
- **Supplement ITU-T K.Suppl.14 on The impact of RF-EMF exposure limits stricter than the ICNIRP or IEEE guidelines on 4G and 5G mobile network deployment**
  - Provides an overview of some of the challenges faced by countries, regions and cities which are about to deploy 4G or 5G infrastructures.
  - Includes a case study on Poland
  - Based on inputs and contributions from, inter alia, Poland, India, Ericsson, Nokia, China Telecom, Huawei, Uganda, Cisco, GSMA and Vodafone, Telstra, Korea, Belgium, etc

ITU-T Supplement 14 of K Series (2018)

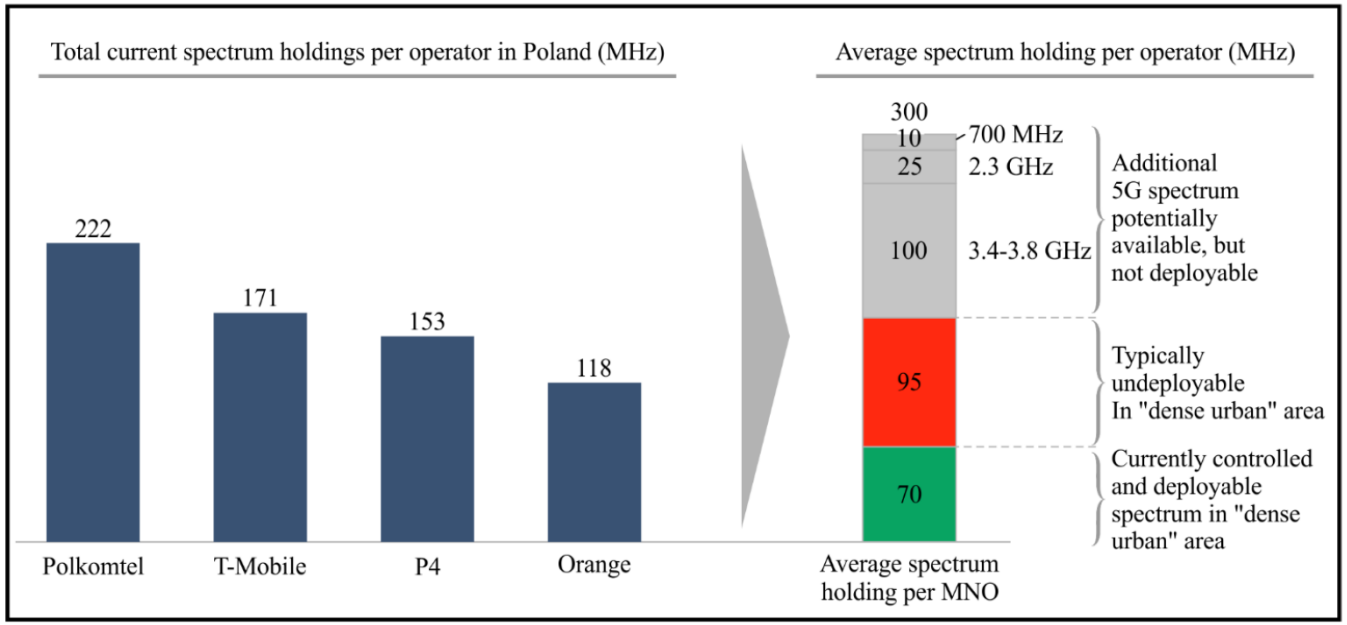
- An overview of some of the challenges faced by countries, regions and cities which are about to deploy 4G or 5G infrastructures.
- Information on a simulation on the impact of RF-EMF limits that was carried out in Poland as an example of a wider phenomenon, which is applicable to several other countries, which have set limits that are stricter than those contained in the ICNIRP or IEEE guidelines.
- The results of the simulation indicate that where RF-EMF limits are stricter than ICNIRP or IEEE guidelines,
  - the network capacity buildout (both 4G and 5G) might be severely constrained and
  - might prevent addressing of the growing data traffic demand and
  - might prevent the launching of new services on existing mobile networks.



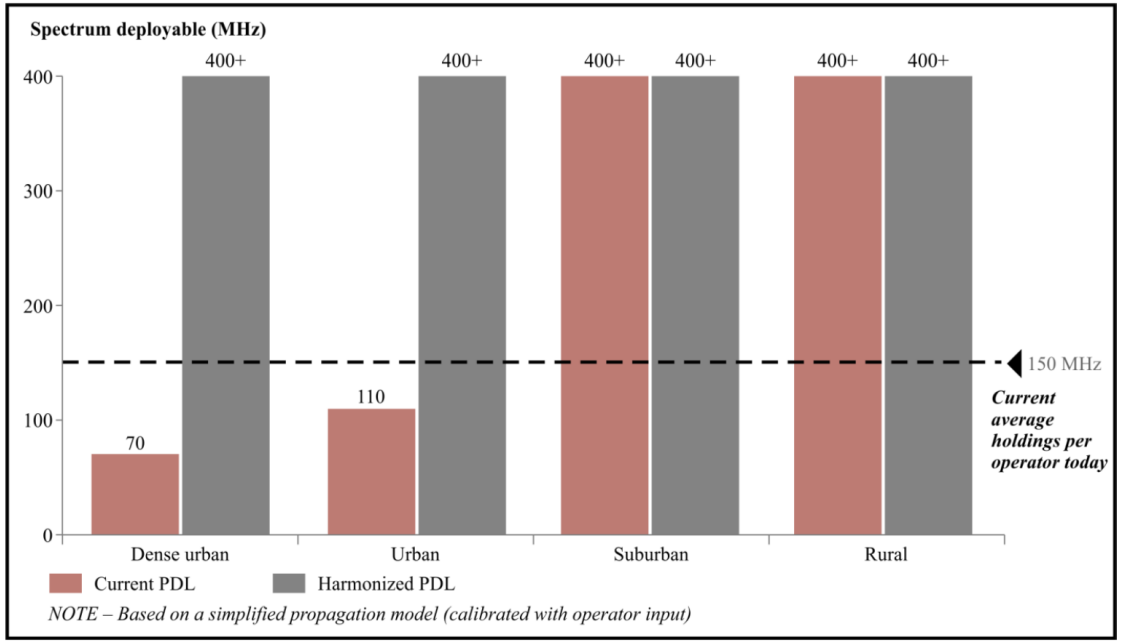
Spectrum cannot be fully deployed

Additional radio frequencies, e.g., **60 MHz (FDD – 2x30 MHz) in the 700 MHz spectrum band, 100 MHz in the 2300 MHz band and 400 MHz in the 3.4-3.8 GHz** spectrum range have or will become available for 4G and 5G mobile communications in the near future. This would double the available spectrum and capacity in mobile networks for example as shown in Figure 1 for the case of Poland.

However, deploying additional spectrum and consequently increasing the transmitted power, on an existing site increases the EMF exposure and hence the power density levels. In **dense urban areas and urban areas** [b-BCG], where distances between antennas and people are short already, the strict Polish EMF exposure limits do not allow mobile network operators to use the additional spectrum on most sites. In dense urban areas already some of today's spectrum cannot be used anymore and is wasted.

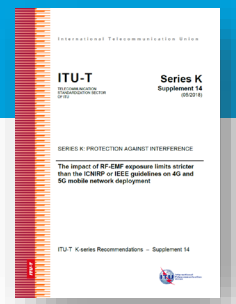


Average spectrum holding (source Office of Electronic Communications, Poland)



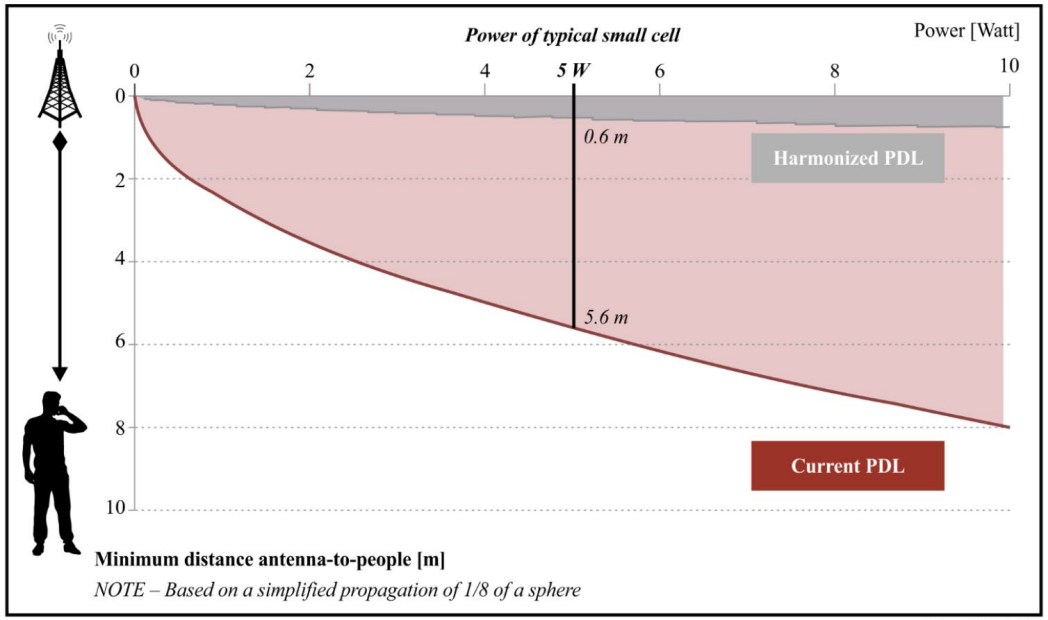
Spectrum deployable on average with current and harmonized power density limits (PDLs) (source adapted from Polish mobile network operators [b-BCG])

Technology innovation is restricted



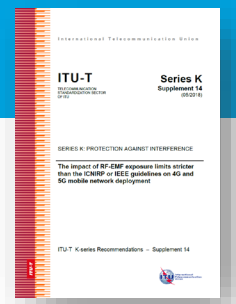
New antenna technologies, such as **Massive MIMO and beamforming**, or **small cells** are a key element of future 5G mobile networks. The EMF exposure limits below INCIRP or IEEE guidelines (as shown in the case of Poland), do not in most cases allow mobile network operators to fully leverage these new technologies.

– Applying beamforming, i.e., further narrowing an antenna beam, would easily exceed the current EMF exposure limits;
– Deploying small cells in hot spot areas will not be feasible as the current EMF exposure limits prevent placing a large number of small cells due to the short distance between antenna and people, see Figure 3.
Both technology examples, beamforming and small cells, would be essential to provide more capacity in dense urban and urban areas.

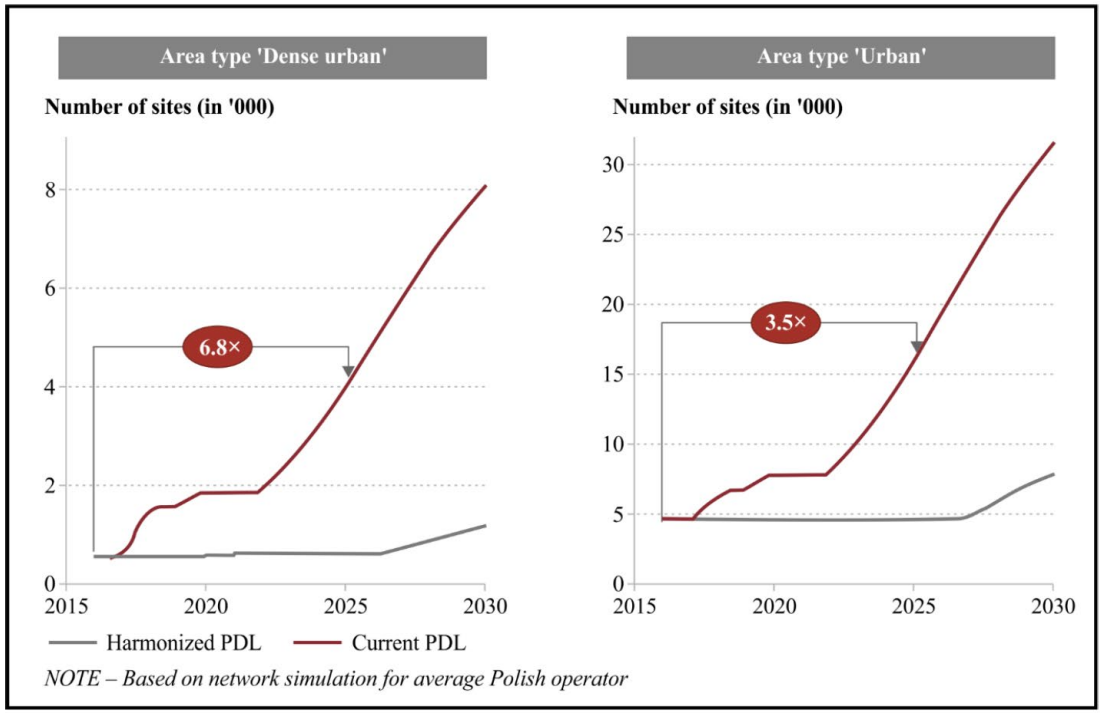


Minimum distance antenna-to-people (source [b-BCG])

Possibility to densify site grid is limited



Densifying the mobile network grid by adding new sites would be the third, but most expensive and time-consuming lever to increase capacity in mobile networks. In order to cope with the data traffic explosion and assuming that spectrum and technology levers cannot be exploited, mobile network operators would have to have **3.5-fold the number of sites in urban areas by 2025 and almost sevenfold the number of sites in dense urban areas by 2025**.



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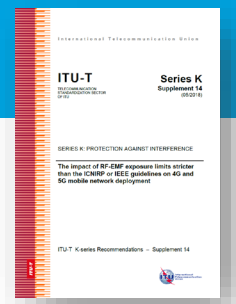
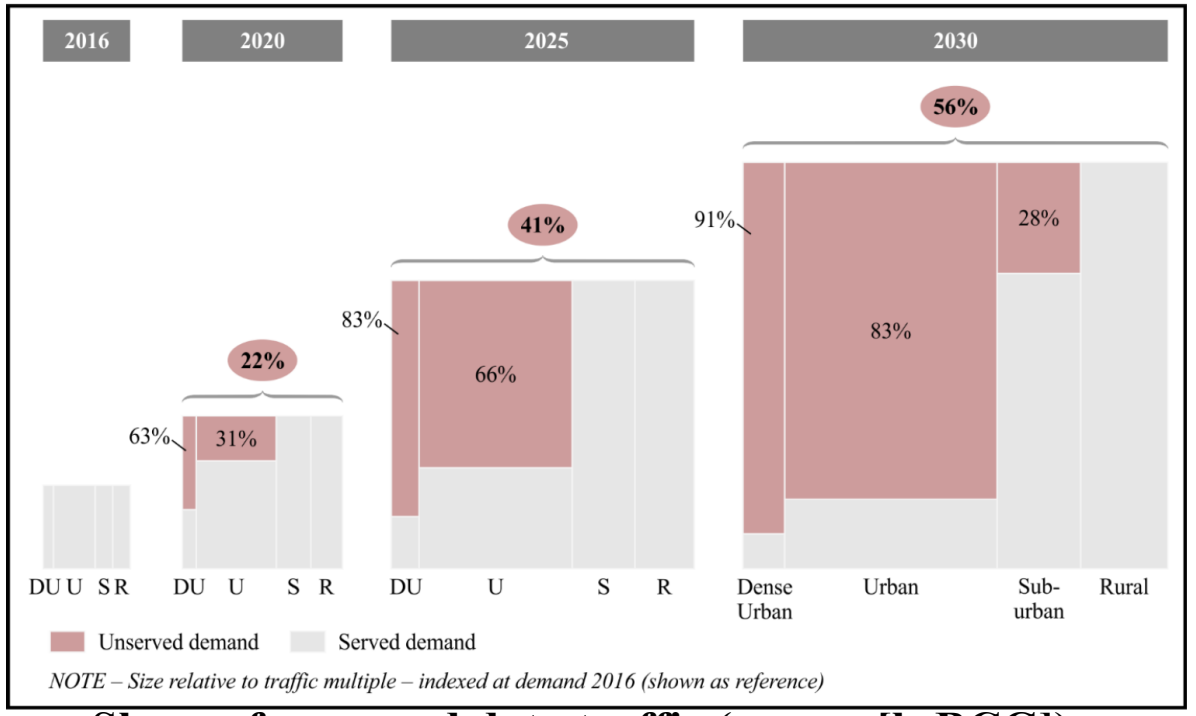
Site evolution in dense urban and urban areas

Future customer experience will suffer and true

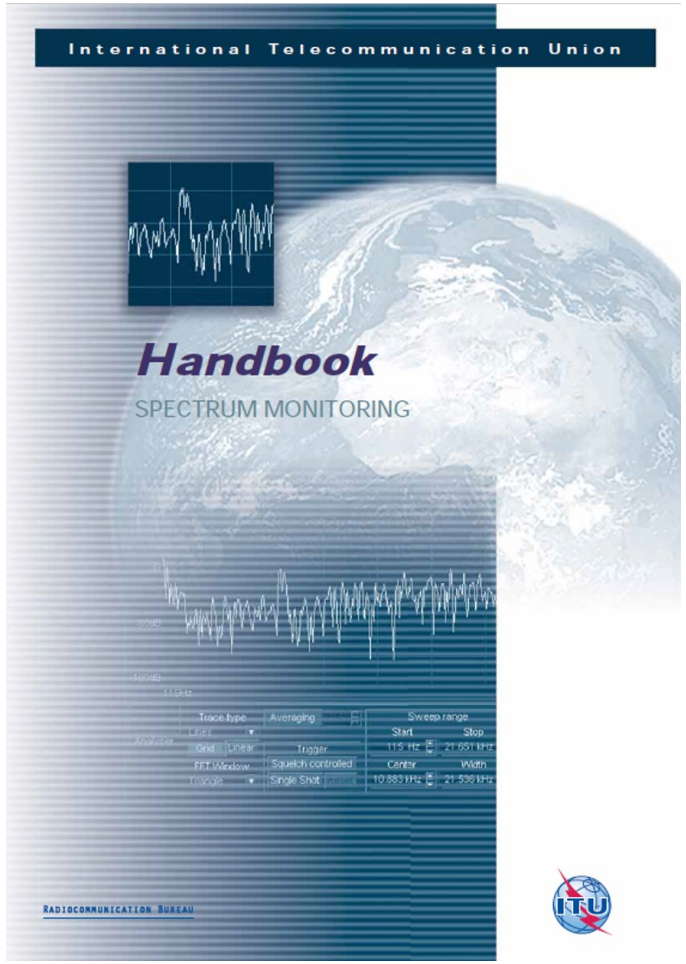


Given the limitations for deployment of new spectrum, technology and the very restricted growth of a number of sites (Assumption: 20% additional sites compared to the status quo), as a result of the strict EMF exposure limits, the gap between capacity supply and data traffic demand will grow very quickly. Polish data traffic growth with a CAGR of 36% until 2020, 29% until 2025 and 15% until 2030 (24x network data traffic in 2030 versus 2016).



Share of unserved data traffic (source [b-BCG])

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
www.itu.int/pub/R-HDB-23

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!

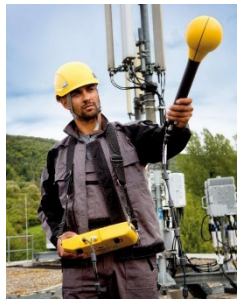
Source: Question ITU-R 239-1 - www.itu.int/pub/R-QUE-SG01.239

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

A practical guide for EMF measurements to assess human exposure

- Basic knowledge for a successful EMF assessment measurement process
- Available types of measurement instruments with specific features for EMF assessment
  - **Personal monitor for occupational exposure**
  - **Broadband meters**

- **Frequency selective meters**



Frequency selective meter dedicated to EMF, with isotropic-antenna

Handheld spectrum analyser with isotropic-antennas, 9 kHz to 6 GHz

- How to assess the exposure due to specific services
  - **General approach for services where extrapolation is not required**
  - **GSM base stations**
  - **UMTS base stations**
  - **LTE base stations**

ITU-D Study Group Final Report of Q7/2

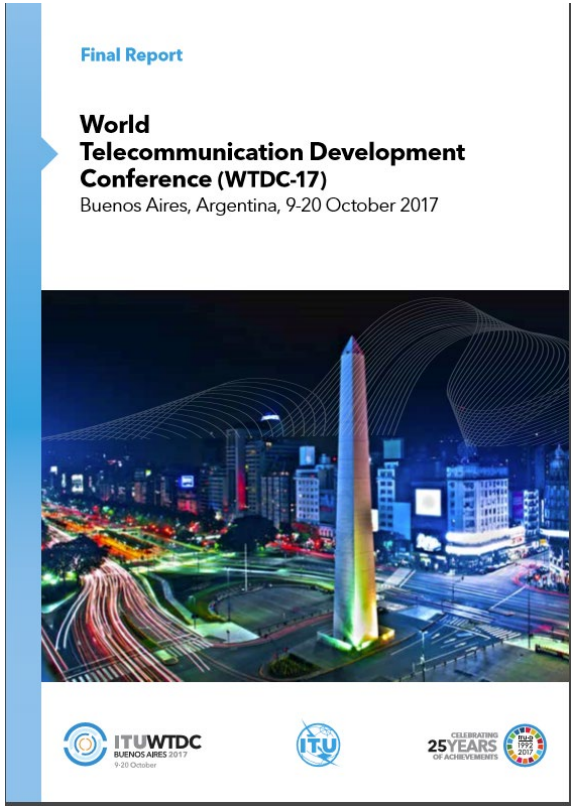
Q7/2	**Question 7/2 – Strategies and policies concerning human exposure to electromagnetic fields**
This report collects and disseminates information concerning exposure to Radio Frequency (RF) and Electromagnetic Fields (EMF), in order to assist national Administrations, particularly in developing countries, to develop appropriate national regulations. It is useful for Administrations, in order to listen and respond to the concerns of the public related to radiating antennas.	
https://www.itu.int/pub/D-STG-SG02.07.1-2017	

Following the 2018 public-consultation (and revision) of the ICNIRP Guidelines the International EMF limits may change and influence the regulatory framework. New case studies are inserted

Countries changed their exposure limits. The 2018 October Workshop provide significant view. Moreover, there is a lot of ITU activities on EMF and the ITU Plenipotentiary Conference PP-18 Resolution 176 (revision Dubai) may revise the PP-14 held in Busan
ITU-T World Telecommunications Standardisation Assembly 2020 (WTSA-20) may revise WTSA-16 Resolution 72 (Hammamet)
ITU-D World Telecommunications Development Conference 2017 (WTDC-17) held in Buenos Aires, revised WTDC-14 Resolution 62 (Dubai)
Based on the revision of WTDC-14 Resolution 62 'Assessment and measurement of human exposure to EMF' and the revision of Q 7/2 'Strategies and policies concerning human exposure to EMF', this Report updates and revises the Question 7/2 Final Report and provides new material on Policies and Assessments.

ITU-D Study Question Q7/2

- ITU-D SG2 First meeting
- 9 May 2018: Q7/2
- Presented and discussed:
  - Work-plan
  - Structure of the report, items to study
  - Collaboration with other Sectors and Organisations
- Meeting report: **2/REP/7-E**
  - Annex 1: Work-plan
  - Annex 2: Draft Table of Content



New Q 7/2 Report ToC

CHAPTER 1 – Introduction

1.1 Background

1.2 Scope of the Report

CHAPTER 2 – ITU Activities

2.1 PP-18 Resolution 176 (revision Dubai)

2.2 WTDC-17 Resolution 62 (Rev. Buenos Aires, 2017)

2.3 ITU-R Radio Assembly 2019, Report SM.[EMF-MON] and deliveries of Question 239/1

2.4 ITU-T WTSA-20 Resolution 72, K. series Recommendations and deliveries of Question 3/5

CHAPTER 3 – Updated international and regional EMF activities and exposure limits

1. World Health Organization (WHO)

2. ICNIRP Guidelines and IEEE safety levels

3. Regional, national and comparative exposure limits

CHAPTER 4 – Policies to limit exposure to radiofrequency fields

4.1 Guidelines for national regulation

4.2 Best Practices of the use of mobile devices for exposure reduction

4.3 EMF exposure of next generation of mobile communications technologies.

4.4 Impact of IMT 2020 (5G) on EMF

4.5 Exposure to other radiators such as Wi-Fi, Bluetooth, wireless connected devices

4.6 EMF risks to animals and plants

New Q 7/2 Report ToC (Cont.)

CHAPTER 5 – National EMF activities on exposure limits

1. Legal framework
2. Assessment concerns related to human exposure to EMF
3. Public Awareness
4. Exposure limits nearby sensitive areas such as kindergartens, schools, hospitals
5. Maps of calculated field-strength around transmitters
6. Presentation of results on the web

5.7 Results of Questionnaire

CHAPTER 6 – Exposure levels from handsets and notebooks

6.1 Human exposure to EMF from base stations versus handsets and notebooks

6.2 Children exposure from handsets

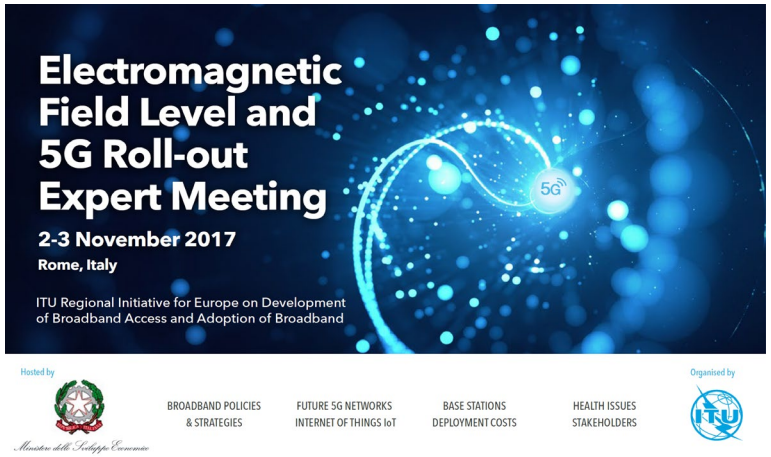
6.3 National SAR measurements

CHAPTER 7 – Comparison of exposure limits in different countries

CHAPTER 8 – Case studies, success stories, and national practices

5G Related ITU Regional Forums, Seminars, Workshops

ITALY, November 2018



UKRAINE, May 2018

HUNGARY, July 2018

LATVIA, July 2018

MONTENEGRO, October 2018

ATHENS, October 2018

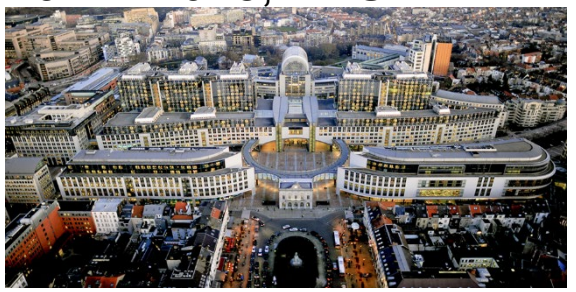
5G Related Meeting in the Region

Additional 5G related meetings

- ITU-T Workshop on “5G, Health and EMF”
  5 December 2017, Warsaw, Poland
- Contribution to Europe’s 5G Ambition: Investing in 5G Enabler Infrastructure,
  20 June 2018, European Parliament, Brussels)
- 2nd Annual CIS and Central and South-Eastern European Spectrum Management Conference and ITU Regional Workshop “Broadband Development based on 4G and 5G Technologies”
  17-20 September 2018, Almaty, Kazakhstan

Dec 2018, WARSAW

June 2018, BRUSSELS



Sep 2018, KAZAKHSTAN

5G @ Telecommunication Networks Development, BDT

@ITU | September 2018

- **5G overview**
  - The role of the ITU
  - What is 5G?
  - 5G use cases
  - Socio economic implications of 5G
  - Digital divide
- **5G technology and spectrum requirements**
  - Radio access networks
  - Core networks
  - Backhaul
  - Fronthaul
  - Spectrum for 5G
- **Key challenges in rolling out 5G**
  - Small cell deployment challenges
  - Fibre backhaul
  - Spectrum
  - Other factors
- **What does 'good' look like?**
  - Streamlining small cell deployments
  - Policy intervention - fibre and spectrum
  - Infrastructure sharing
  - Transition to fibre
  - Addressing local planning challenges
  - Spectrum harmonization
  - Spectrum licensing
  - 5G pilots
- **Example of costs and investment implications**
  - Overview
  - Methodology
  - Scenarios
    - Scenario 1 – large densely populated city
    - Scenario 2 – small medium density city
  - Independent cost estimates
  - Investment models

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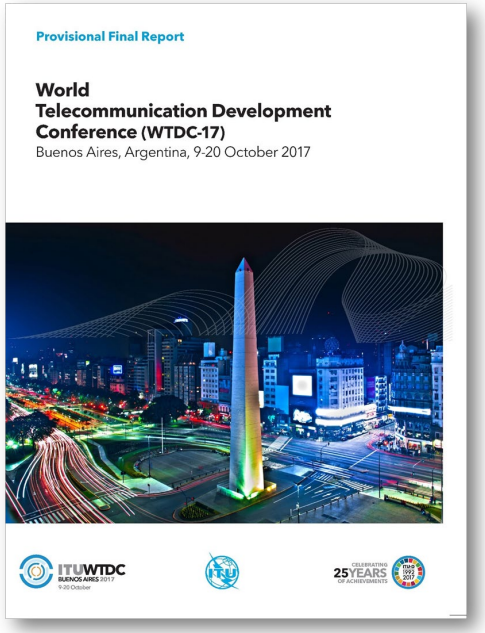
REGIONAL INITIATIVES FOR EUROPE 2018-2021



- EUR1: Broadband infrastructure, broadcasting and spectrum management
- EUR2: A citizen-centric approach to building services for national administrations
- EUR3: Accessibility, affordability and skills development for all to ensure digital inclusion and sustainable development
- EUR4: Enhancing trust and confidence in the use of information and communication technologies
- EUR5: ICT-centric innovation ecosystems

ITU REGIONAL INITIATIVE for EUROPE on BROADBAND

EUR1: Broadband infrastructure, broadcasting and spectrum management

ITUWTDC
BUENOS AIRES 2017
9-20 October

Objective: To facilitate high-speed connectivity with resilient and synergistic infrastructure development, deployment and sharing, whilst ensuring a trusted and quality user experience.

Expected results: Assistance to the countries in need in the following

- Development of plans (national and regional) and feasibility studies for deployment of ubiquitous resilient high-speed connectivity, including 5G/IMT2020 and digital broadcasting deployment, with all relevant components including legislation, standards, organizational set-up, capacity building and cooperation mechanisms, as needed
- Sharing of guidelines on collaborative regulation between the telecommunication sector and other synergistic sectors such as energy, railway and transportation
- Assessment of dynamics, challenges and opportunities in respect of the roll-out of diverse broadband technologies across Europe in the context of the creation of ubiquitous resilient high-speed broadband infrastructure
- Sharing of best practices and case studies in cable TV, digital broadcasting, 5G experience, early use cases and trends in next-generation access network roll-out
- Mapping of the ubiquitous infrastructure and services, fostering harmonization of approaches across the region and taking into account infrastructure-sharing approaches applied by countries
- Establishment of quality-of-service systems and consumer-protection frameworks
- Development of plans for ICT for sustainable energy covering different types of ICT applications and innovations.

5G @ Telecommunication Networks Development, BDT

@ITU | September 2018

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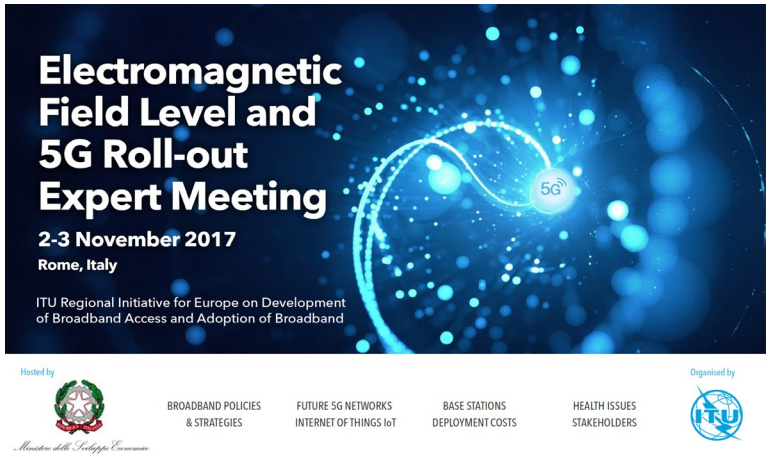
ITALY, November 2018



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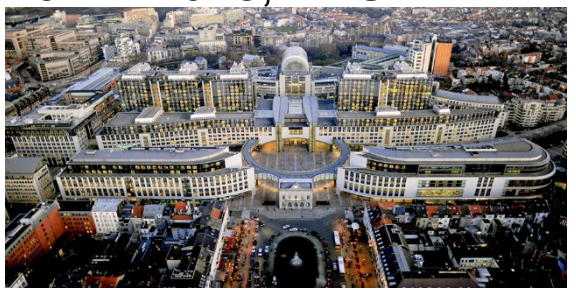

Sep 2018, KAZAKHSTAN

5G Related ITU Regional Forums, Seminars, Workshops

Fostering 5G Dialogue in Europe in 2019 and beyond…

- Report on **National Strategies** for 5G Implementation and Pilot Projects
- Report on Electromagnetic Field Levels and 5G [**EMF**]
- Regional Seminar on Broadband Connectivity [Q2, **Albania**]
- Regional Conference on 5G [Q2/Q3, **Poland**]
- Regional Conference [**Serbia**]
- Expert Meetings [**Italy** and Poland]
- Regional Regulatory Forum [September/October, **Budva**]
- Europe focused enhancement of **ITU Interactive Transmission Maps** including collection of information from official sources
- **Twinning programmes** within the Europe region and beyond [offering from Hungary, Italy and Poland]

5G Related Training through ITU ACEDEMY

ITU Centres of Excellence: Building Human Capacities on 5G

- 02/04/2018 - 09/04/2018: ITU Centres of Excellence E-Learning course on **Wireless Access Technologies to Internet Network**
- 29/05/2018 - 25/06/2018: ITU Centre of Excellence E-Learning course on **Future Broadband Internet Access**
- 15/10/2018 - 16/10/2018: ITU Centres of Excellence Face to Face course on **Broadband Access** (Hemniz)
- 25/10/2018 - 26/10/2018: ITU Centres of Excellence Face to Face course on **Technical, Business and Regulatory Aspects of 5G Network** (Warsaw)