ITU-EKIP Regulatory Forum for Europe

Evolving Regulatory Frameworks for the Digital Future

1-2 October 2018 Budva, Montenegro

ITU Regional Initiative for Europe on Broadband Infrastructure, Broadcasting and Spectrum Management

5G Implementation in Europe Jaroslaw K. PONDER Head of ITU Office for Europe

4G/5G

SPECTRUM MANAGEMENT

INTERNET OF THINGS

FUTURE NETWORKS

QUALITY OF SERVICE





What we do



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



	1G	2G	3 G	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





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 <u>WRC-15</u> spectrum for IMT

<u>B</u> and		Bandwidth			
(MHz)	Region 1 or parts thereof	Region 2 or parts thereof	Region 3 or parts thereof		
450-470	<u>5</u> .286AA			20	
<u>470-698</u>	<u>-</u>	<u>5.295, 5.308A</u>	<u>5.296A</u>	228	
6 <u>94/</u> 698-960	<u>5.317A</u>	<u>5.317A</u>	<u>5</u> .313A, 5.317A	262	
<u>1 427-1 518</u>	<u>5.341A, 5.346</u>	<u>5.341B</u>	<u>5.341C, 5.346A</u>	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			190	
<u>3 300-3 400</u>	<u>5.429B</u>	<u>5.429D</u>	<u>5.429F</u>	100	
3 400-3 600	<u>5</u> .430A	<u>5.431B</u>	<u>5</u> .432A, 5.432B, 5.433A	200	
<u>3 600-3 700</u>	<u>-</u>	<u>5.434</u>	<u>-</u>	100	
<u>4 800-4 990</u>	<u>-</u>	<u>5.441A</u>	<u>5.441B</u>	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





5G Usage scenarios





ITU-T Study Groups

- □ <u>SG2 Operational aspects</u>
- □ <u>SG3 Economic and policy issues</u>
- □ <u>SG5 Environment and circular economy</u>
- SG9 Broadband cable and TV
- □ <u>SG11 Protocols and test specifications</u>
- □ SG12 Performance, QoS and QoE
- SG13 Future networks (& cloud)
- □ SG15 Transport, access and home
- □ <u>SG16 Multimedia</u>
- □ <u>SG17 Security</u>
- □ <u>SG20 IoT, smart cities & communities</u>

ITU-T Focus Group on Technologies for Network 2030 (FG NET-2030) (In operation since 2018-07) **ITU-T Focus Group on Machine Learning for** Future Networks including 5G (FG-ML5G) (In operation since 2017-11) **ITU-T Focus Group on Data Processing and** Management to support IoT and Smart Cities & **Communities (FG-DPM)** (In operation since 2017-03) **ITU-T Focus Group on "Artificial Intelligence for** Health" (FG-AI4H) (In operation since 2018-07) **ITU-T Focus Group on "Vehicular Multimedia"** (FG-VM) (In operation since 2018-07) Focus Group on IMT-2020 (FG IMT-2020) (Established 2015-05; Terminated 2016-12)



ITU-D Study Groups

Generally, ITU-D Study Group 1

SG1 examines issues related to strategies and policies for the deployment of broadband, migration and adoption of digital broadcasting and use of the digital dividend, cloud computing, m-services and OTTs, economic policies and methods of determining the costs of services, telecommunications/ICTs for rural and remote areas, consumer protection, and access to telecommunication/ ICTs by persons with disabilities and specific needs.

□ ITU-D Study Group 2

SG2 deals with ICTs for the creation of smart cities and societies, telecommunications/ICTs for e-health, building of confidence and security in the use of ICTs, conformance and interoperability testing, combat of counterfeit ICT equipment and theft of mobile devices, use of telecommunications/ICTs in mitigating the impact of climate change on developing countries, and for disaster preparedness, mitigation and relief, as well as, human exposure to electromagnetic fields and safe disposal of electronic waste.



5G @ ITU-D STUDY GROUPS

Questions related to 5G under Study

ITU-D Study Group 1

- Question 1/1 on Strategies and policies for the deployment of broadband in developing countries
- **Question 2/1** on Strategies, policies, regulations and methods of migration and adoption of digital broadcasting and implementation of new services

ITU-D Study Group 2

- **Question 1/2** on Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development
- Question 7/2 on Strategies and policies concerning human exposure to electromagnetic fields



Implementation of 5G in Europe / European 5G Observatory

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



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 crossborder 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.



Challanges

- 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)
 - ≻EMF
- Fiber backhaul
- > Spectrum
- Investment



5G @ Telecommunication Networks Development, BDT

Setting the Scene for 5G: Opportunities & Challenges



@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



REGIONAL INITIATIVES FOR EUROPE 2018-2021

EUR1: Broadband infrastructure, broadcasting and spectrum management

Provisional Final Report

World Telecommunication Development Conference (WTDC-17) Buenos Aires, Argentina, 9-20 October 2017



25YEARS

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



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 Related ITU Regional Forums, Seminars, Workshops

ITALY, November 2018





LATVIA, July 2018

INTERNET OF THINGS INT

& STRATEGIES

Ministere delle Svelappe Economi



UKRAINE, May 2018



MONTENEGRO, October 2018

46/56



HUNGARY, July 2018



ATHENS, October 2018



5G NATIONAL STRATEGIES | POLICIES AND REGULATION | FUTURE NETWORKS | SPECTRUM MANAGEMENT | SMART CITIES INTERNET OF THINGS | ARTIFICIAL INTELLIGENCE | MACHINE LEARNING | INNOVATION







COMING SOON: ITU Forum on Towards 5G Enabled Gigabit Society

- National policies and strategies for 5G
- Regulatory frameworks fostering 5g implementation
- Future networks and 5G: fixed and mobile
- Spectrum issues related to 5G
- New business paradigms by the network operators
- 5G for smart cities
- 5G for connected and automated vehicles
- 5G innovation ecosystem



INTERNET OF THINGS | ARTIFICIAL INTELLIGENCE | MACHINE LEARNING | INNOVATION



<u>Countries</u>: Bulgaria, Finland, France, Germany, Greece, Latvia, Luxemburg, Portugal, Serbia, Sweden, Hungary, UK, USA, <u>European Organizations</u>: EC, BEREC, ETNO, ECTA, ESOA, EBU, 5G-PPP, 5G-AA....



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 2019, Almety, Kezekheten

17-20 September 2018, Almaty, Kazakhstan

Dec 2018, WARSAW









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

- O2/04/2018 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)







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