5G Implementation in Europe and CIS

Strategies and Policies Enabling New Growth Opportunities

3-5 July 2018
Budapest, Hungary

Report on the ITU-D Study Groups related Experts’ Knowledge Exchange

1. Introduction:

The Regional Seminar on 5G Implementation in Europe and CIS: Strategies and Policies Enabling New Growth Opportunities which was organized by the International Telecommunication Union and hosted by National Media and Infocommunications Authority of Hungary from 3 to 5 July 2018, included an Experts’ Knowledge Exchange related to the work of the ITU Telecommunication Development Sector’s two study groups.

To this end, the agenda of the Regional Seminar included daily sessions dedicated to exploring new ways of building synergies between the work that is taking place in the regions and the activities on the same topics that are under way in ITU-D study groups.

Generally, ITU-D Study Group 1 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 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.

Seminars and workshops like this one on 5G implementation and the ITU-D study Questions have in common that they are looking at specific emerging topics and themes that are of interest to the ITU membership, which include Administrations, regulators, private sector members, research institutes and universities.

There is a wealth of rich content and case studies shared in regional seminars and workshops which would be of great benefit and would provide insights to the global community that convene around the ITU-D study groups. There are useful experiences, lessons learned and possible guidelines that are discussed at the regional level that could be brought to the global community. Thus the aim is to bring these rich case studies, insights, guidelines, and findings to the work of the ITU-D study groups through the Experts’ Knowledge Exchange.

At the end of each day of the Regional Seminar, the meeting participants reflected on the presentations and discussions that had taken place in the light of specific study Questions. These suggestions from the presentations were then compiled into main takeaways, useful case studies that are related to the Question and relevant references that the study Question may wish to
International Telecommunication Union

2. Summary of discussions and related suggestions:

While most study topics in the ITU-D study groups relate more or less to 5G, there are some Questions that may be more relevant than others to the specific sessions that were held during the Regional Seminar in Budapest. Four such Questions were identified, namely, ITU-D Study Group 1 Question 1/1 on Strategies and policies for the deployment of broadband in developing countries and Question 2/1 on Strategies, policies, regulations and methods of migration and adoption of digital broadcasting and implementation of new services, and 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, and Question 7/2 on Strategies and policies concerning human exposure to electromagnetic fields.

Some main takeaways from the ITU-D Study Groups related Experts' Knowledge Exchange on daily subjects are shared below.

2.1. Question 1/1 on Strategies and policies for the deployment of broadband in developing countries and Question 1/2 on Creating smart cities and society: Employing information and communication technologies for sustainable social and economic development

Organizational aspects (Approaches, decision makers, structure, partners)

- **Approaches:**
  - Develop a national strategy for 5G implementation.
  - Consider 5G as part of revised broadband strategy.
  - Make linkages to broader development goals (national and regional).
  - Consider regional and sub-regional strategies for 5G.
  - Provide an articulated vision for what you want to achieve in 5G (for example: ‘Become one of the 5G development centres by 2018’, ‘The Nordic region aiming to be a leader in 5G’)
  - Start by encouraging 5G development in certain industries/sectors.

- **Structure:**
  - A multi-stakeholder approach is required. Involve representatives from: Ministries, Regulatory bodies, Operators, Service providers, Content providers, Universities, Chambers of commerce, Equipment manufacturers, Municipalities, Independent experts, Non-government organizations, Industries, and so on.
  - It is useful to include in the strategy the aim to have appointed advisory boards, working groups, coalitions, etc. with clear timeline and roadmaps for the development and implementation of activities.
  - Appoint some agency to lead the convening of the group/groups.

- **Showcase successes of the pilot projects and trial that are undertaken and the involvement of the different stakeholder within these.**

- **It is useful to share information about the benefits of 5G (money talks, job creation, etc.) to raise awareness, encourage investment, and so on.**
**Policy aspects** (Strategies, policies, regulation)

- Multi-stakeholder approach:
  - Ensure that a broad range of stakeholders are involved to discuss approaches and strategies for 5G. In some countries this has also been done for topics other than 5G. Important that all stakeholders have an equal voice in such discussions and debates.
  - Include input from these different stakeholders through their involvement in established coalitions, working groups, etc., and clarify what their possible responsibilities could be.
- Enable investment, partnerships, infrastructure sharing, etc.:
  - Call to governments to be more involved in the deployment of 5G (where to start, priorities, identify tasks for stakeholders, etc.).
  - Consider regulation that enables investment.
  - Infrastructure sharing becomes increasingly important with 5G.
  - Policy makers may consider undertaking their own independent economic assessment of 5G to evaluate the commercial viability of deploying 5G networks.
  - 3G and 4G network strategy: Until such time that the case for 5G networks can be made, policy makers may consider enhancing the availability of and boosting the quality of 4G and 3G networks.
  - Call for countries to be more active in 5G standardization work.
  - Encourage partnerships (for example between regulators and academia) to participate in standardization activities and work.
- Encourage mapping at the national level of infrastructure, demand, services, content availability, investment opportunities, etc.
- Regulatory challenges:
  - Challenges coming from small cells (exclusive site access, public owned sites, infrastructure sharing).
  - Challenges related to access to spectrum.
  - Challenges related to coverage (coverage obligations, etc.).
  - Challenges related to infrastructure sharing (cost savings versus competitive issues).
  - Competition issues (non-traditional market entry, fixed-mobile, etc.).
  - Ecosystem challenges (ensure access to the ecosystems).

**Infrastructure** (Approaches, technologies, challenges)

- Enhanced mobile broadband is the main driver for 5G deployment.
- 5G is a paradigm shift. 5G has been developed with use cases (a wide range of use cases).
- Ensure that there is an action plan for infrastructure deployment, and include rural and remote areas in these plans.
- Continue developing 3G and 4G networks in countries and improve the quality of them, then add 5G to this portfolio.
- Encourage different technologies.
- Technologies (G3pp):
  - Release 16-5G expansion will allow for expansion beyond the standard (5G vehicle to X (V2X), 5G industrial IoT, 5G URLLC enhancements, 5G for unlicensed spectrum operation (possible only with the assistance of a licensed carrier).
  - From 2019 and onward: 5G for satellite in G3pp so some studies into this will be done in the future for the next release. Future: 5G above 52.6GHz will start to be studied.
- Ensure that spectrum monitoring is an essential part of the 5G strategy.
• Encourage use of 5G for critical communications, especially broadband PPDR.

• Use cases:
  – See 5G as a global technology where the regions are faced with different challenges and opportunities.
  – Use cases are very important in raising awareness and sharing experiences.
  – Security challenges in 5G have changed.
  – 5G requires massive amounts of bandwidth.
  – Show that 5G does work in real life conditions not only in controlled environments.

• Discussion on when broadband can be considered a utility. This is only possible when broadband is considered and treated as something that society and citizens cannot live without.

**Economic aspects** (Economic justification, business models, financial/human resources, achievements)

• Important to note when discussing the potential of 5G that even for 4G its full potential was not fully monetized!

• Exploring the 'most' profitable business cases for 5G depends on the specific country and region.

• Mismatch between those stakeholders who will have to invest in the infrastructure and those who will likely be reaping the benefits thereof.

• Consider new ways of collaboration which may allow for new business models and revenue streams.

• Some examples of possible use cases for future business cases with a focus on 5G mentioned were:
  – Public services.
  – Facilitation of daily work flow management/office setups – people are mobile and flexible and thus enable work management and structures.
  – Health and lifestyle related (e-medical prescription, remote diagnostics, remote surgery, 24h online services, etc.).
  – Security (cybersecurity, smart living).
  – Industry/agriculture (smart factories, production activity).
  – Entertainment services (virtual reality, streaming, 8K).

• When considering the complex 5G ecosystem it is important to note that this is not limited to one specific ecosystem. 5G is an enabler however the real change is happening in the actual industries and sectors.

• The economic aspects can be explored through examples of what the potential could be in specific sectors.

• 5G can create new opportunities for operators (new revenue streams and potential cost advantages) (Examples: 1) Revenue in enterprise and consumer IoT, 2) cost-effective backfill, backhaul or fixed wireless access, 3) substitute for fixed broadband, 4) slicing and latency-enables services, 5) network operation cost efficiency).

• 5G creates challenges when looking at the nature of demand, willingness to pay and generation of returns (Examples: 1) Challenges for adoption of integrated machine-to-machine communications 2) Significant new capabilities and cost requirements 3) Competition is increasing 4) Value extraction is low due to partnership-driven offerings 5) Inventory/investment risks for device-led plays (higher 5G device costs) 6) Alternate monetization models are not mature).
• Consideration for different players in the 5G ecosystem:
  Telcos:
  – Connectivity is not enough to sustain margins, operators to aim for more value add.
  – New skills should be developed.
  – Trust between telcos and vertical industry players is important.
  – Consider the benefits of roll-out partnerships (with tower asset companies etc.)
  Regulators:
  – Network management roles might be shifting towards new players requiring regulatory attention.
  – The business case will most likely not support 3-4 independent countrywide networks, which may have an impact on spectrum auctions.
  Governments:
  – To enable innovation in 5G enabled services more emphasis on supporting R&D activities and pilots are encouraged (funding support required).
  – Industry development strategies should involve telecommunication as a key enabler.
  – Rural and remote should be supported.
  • Policy makers to consider making economic assessment of 5G to evaluate the commercial viability of deploying 5G networks.
  • Encourage widely sharing the findings of successful pilot case studies.

**Capacity building** (For whom? By whom? How? social aspects, skills required, challenges)

Role of academia/universities/research institutes to contribute to creating an enabling environment for the 5G deployment:
• Encourage training of skilled professionals and specialists.
• Review existing curricula to keep up with technical developments.
• Develop new educational and certification programs related to 5G technologies.
• Develop expertise in 5G standards.
• Enabling 5G deployment requires exploratory research, this includes new use cases and offering feedback to vendors and operators.
• Universities can bridge the gap between verticals and operators and thus support the verticals to take advantage of 5G.
• Universities are encouraged to work closely with regulators, operators and companies.
• Universities should take into account a wide range of industries that will use 5G opportunities for their needs including automotive, entertainment, M2M communications, agriculture, energy, e-health and other spheres.
• Enabling 5G deployment requires exploratory research, this includes new use cases and offering feedback to vendors and operators.

**References and resources** (Useful links, case studies, activities and events)

Policy aspects:
• Case studies (Denmark, Hungary, Serbia, Russian Federation, Poland, FYR Macedonia, BEREC)
• A Digital Agenda for Europe, 2010
• European Gigabit society, 2016
• 5G for Europe, 2016
• ITU – standards, recommendations regarding 5G
• Radio Spectrum Policy Group – recommendations regarding 5G
• **Directive establishing the European Electronic Communications Code**
• **ITU-D Study Group 1 Q1/1 “Policy, regulatory and technical aspects of the migration from existing networks to broadband networks in developing countries, including next-generation networks, m-services, OTT services and the implementation of IPv6” Report for the 2014-2017 study period**
• **ITU-D Study Group 1 Q2/1 “Broadband access technologies, including IMT, for developing countries” Report for the 2014-2017 study period**
• **ITU-D Study Group 2 Q1/2 “Creating the smart society: Social and economic development through ICT applications” Report for the 2014-2017 study period**

Economic aspects:
• Case studies from Hungry, Poland, Kyrgyz Republic, ONAT (Ukraine), Ericsson, PwC, Budapest University of Technology and Economics (Hungary), State University of Telecom (Ukraine), ETSI & 3GPP, Rohde & Schwarz.
• Study on “The industry impact of 5G: Insights from 10 sectors into the role of 5G”, 2018 by Ericsson and Arthur B. Little
• Study on “The 5G business potential”, 2018, Ericsson
• Study on “5G deployment considerations”, 2018, Ericsson
• Study on “Monetizing 5G” by PwC shared through presentation at the Seminar, 2018

2.2. Question 2/1 on Strategies, policies, regulations and methods of migration and adoption of digital broadcasting and implementation of new services.

**Organizational aspects** (Approaches, decision makers, structure, partners)

Broadcasting:
• Consider aspects of audio and video implementation.

**Policy aspects** (Strategies, policies, regulation)

Digital Dividend:
• International coordination is required and national legislation/policy to be adapted accordingly.
• For effective use of the digital dividend: Ask whether there are better ways to use the spectrum in the national frequency allocation plans.
• In terms of digital dividend allocations, countries face different decisions for facilitating for example 4/8K services (varies across regions).
• General trend in allocation of digital dividend for 5G is that 700MHz and 800MHz will be allocated to LTE (varies across regions).
• Harmonize spectrum policy to ensure timely and efficient availability and boost deployment of standardized 5G networks.
• Consider to more efficiently use the digital dividend (Option 1 Large FDD band, Option 2 Three TDD bands, Option 3 One TDD band).
  – Such options would provide significant increase in down link capacity.
  – Large contiguous spectrum would provide 5G benefits.
  – Cost reductions from operating fewer bands.
  – None of these are easy options but preferably to slicing of the freed broadcasting spectrum.
  – These are long-term options and implementation would need to be carefully planned and is unlikely to be possible before 2030.
• Consider long-term implication (future digital divided).
• Spectrum fees for digital dividend bands should be kept moderate for mobile services, and in line with the region (OPEX related, not related to license fees).

Broadcasting:
• Regulatory changes:
  – Traditionally, industries, especially telecom and broadcasting, were separated as their products and services were complementary and not substitutes, and companies were. Subsequently mergers (and other forms of collaboration) between telecom and media companies were rarely observed or absent. This has changed.
  – Converged services are offered in a market, comprising content, service and network providers, as well as device manufacturers. Labelling market actors in these categories is increasingly difficult, as industry convergence results in companies merging or collaborating closely. Service convergence is especially spurred by technological advances, by digitalization of data, voice and audiovisual content, as well of transmission platforms.
  – Many countries support a public broadcasting system, in which particular public duties are assigned to a broadcasting company. Under these circumstances, these broadcasters need continued access to distribution channels (traditional broadcast platforms, 5G etc.), as well as prominence on connected devices such as smart TVs.
  – Ecosystem challenges, debate ongoing on whether the regulatory should intervene to allow to have apps on smart TVs. Competition is needed to allow for a fair market.
  – Zero-rating offerings may violate net neutrality rules.

Infrastructure (Approaches, technologies, challenges)

Digital Dividend:
• The Definitions of Digital Dividend (DD) can be found in the ITU Report: Digital Dividend - Insights for spectrum decisions, 2012 (under revision 2018)
• Some digital characteristics at the origin of DD: Digital video compression reduces the transmission size (bits) of the video signal. Multicarrier digital modulation (COFDM) minimizes the multipath interference effect and the needed transmitting power is reduced. Single-Frequency Networks (SFN): The same frequency can be used in adjacent cells as long as the same broadcast content is transmitted.

Broadcasting:
• Video based services to be considered.
• Technology changes: Technology is available to deliver the services.
• The delivery of high-definition service over the top (OTT) as it is currently is not a scalable set up.

Economic aspects (Economic justification, business models, financial/human resources, achievements)

Digital Dividend:
• Costs and benefits related to the digital dividend must be explored further.
• Find a balance between costs and revenues (from auctions, new services/business models developed by operators).

Broadcasting:
National Regulatory Authorities (NRA) have an important role in protecting (members of) society against undesirable developments, in endorsing a proper market development and in stimulating an efficient use of spectrum and other scarce resources.

**Capacity building** (For whom? By whom? How?, social aspects, skills required, challenges)

**Broadcasting:**

- Consumer changes: consumer preferences change due to different work life patterns and increasing amounts of leisure time and activities. In turn, ICT-based services change to adapt and respond to these changing behavioural patterns.

**References and resources** (Useful links, case studies, activities and events)

**Digital Dividend:**

- ITU Guidelines for the transition from analogue to digital broadcasting, 2014
- ITU Report: The challenges and opportunities for spectrum management resulting from the transition to digital terrestrial television in the UHF bands, 2015
- ITU-R FAQ on the digital dividend and the digital switchover
- White paper on behalf of Digital UK “The defragmentation dividend”, 2017
- Case studies: Albania, United Kingdom

**Broadcasting:**

- ITU-D SG1 Q8/1 report 2014-2017 and communication guidelines
- ITU-R Handbook on Digital Terrestrial Television Broadcasting networks and systems implementation
- Recommendation ITU-R BT.1306 “Error correction, data framing, modulation and emission methods for digital terrestrial television broadcasting”
- Recommendation ITU-R BT.1368 “Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands”
- Recommendation ITU-R BT.1877 “Error-correction, data framing, modulation and emission methods for second generation of digital terrestrial television broadcasting systems”
- Recommendation ITU-R BT.2033 “Planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands”
- Report ITU-R BT.2254 “Frequency and network planning aspects of DVB-T2”
- Report ITU-R BT.2295 “Digital terrestrial broadcasting systems”
- Report ITU-R BT.2386 “Digital terrestrial broadcasting: Design and implementation of single frequency networks (SFN)”
- EBU Report TR027 - Delivery of Broadcast Content over LTE Networks
- EBU Report TR026 - Available Options for the Distribution of Broadcast Services

2.3. Question 7/2 on Strategies and policies concerning human exposure to electromagnetic fields.

**Organizational aspects** (Approaches, decision makers, structure, partners)

- Strengthen government agencies in environmental control and monitoring concerning the impact of EMF.
**Policy aspects** (Strategies, policies, regulation)

- Include EMF considerations in 5G rollout plans.
- Efficient deployment of wireless infrastructure reduces the radiofrequency EMF from networks and devices.
- Globally harmonized EMF exposure limits are needed.
- Conduct ongoing environmental monitoring.
- Undertake action to revise legislation.
- Encourage exposure levels even below ICNIRP exposure limits.
- Enable users to measure real-time exposure to radiofrequency (within smart phones) and related tools to limit exposure.
- Enable access to information on websites to users and citizens related to EMF.

**Infrastructure** (Approaches, technologies, challenges)

- 5G deployment includes additional infrastructure on existing base stations.
- The deployment of small cells in communities is a challenge.
- Implementing new network and device testing procedures should be undertaken.
- There are differences between mobile handsets as to whether or not they are within or outside limits. This information should be widely shared.
- Academia is encouraged to contribute to EMF discussions in ITU.
- Innovative methods for taking radiofrequency measurements (example of using drones for measurements in Hungary).

**Challenges:**

- How to cover large/larger areas with a smaller number of base stations within lower than recommended EMF exposure limits.
- How MIMO technology is impacting on EMF issues?

**Economic aspects** (Economic justification, business models, financial/human resources, achievements)

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**Capacity building** (For whom? By whom? How?, social aspects, skills required, challenges)

- Importance of explaining 5G to stakeholders and citizens at large to increase knowledge.
- Awareness raising and capacity building is required on the implications of exposure to the individual base stations, different equipment, smart phones, etc. in different settings.
- Support scientific research in leading research centers.
- Studies undertaken are always considered to be faulty and/or biased, thus there is a need for neutral and factual studies to inform the public and policy makers.

**References and resources** (Useful links, case studies, activities and events)

- Case studies: Poland, National Public Health Institute (Hungary)
- ITU Handbook on Spectrum monitoring, 2011
- ITU-D SG2 Question 7/2 (Strategies and policies concerning human exposure to electromagnetic fields) Report for the 2014-2017 period
- ICNIRP publications and statements
- **European Electronic Communications Code** contains articles that recommend harmonization based on the ICNIRP limits.
- **WHO website and related publications on EMF.**

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Annex: ITU-D Study Groups Question exploration canvases
The working canvas includes the main takeaways from the ITU-D Study Groups related Experts’ Knowledge Exchange on daily subjects which took place in Budapest (Hungary) from 3 to 6 July 2018. This content relates to several study Quesions, but especially to ITU-D Study Group 2 Question 7/2 on Strategies and policies concerning human exposure to electromagnetic fields. (5 July 2018)

**ORGANIZATIONAL ASPECTS**
- **EMF**: Strengthen government agencies in environmental control and monitoring concerning the impact of EMF.

**INFRASTRUCTURE**
- **EMF**: 5G deployment includes additional infrastructure on existing base stations.
- The deployment of small cells in communities is a challenge.
- Implementing new networks and device testing procedures should be undertaken.
- There are differences between mobile handsets as to whether or not they are within or outside limits. This information should be widely shared.
- Academia is encouraged to contribute to EMF discussions in ITU.
- Innovative methods for taking radiofrequency measurements (example of using drones for measurements in Hungary).

**CAPACITY BUILDING**
- **EMF**: Importance of explaining 5G to stakeholders and citizens at large to increase knowledge.
- Awareness raising and capacity building is required on the implications of exposure to the individual base stations, different equipment, smart phones, etc. in different settings.
- Support scientific research in leading research centers.
- Studies undertaken are always considered to be faulty and/or biased, thus there is a need for neutral and factual studies to inform the public and policy makers.

**POLICY ASPECTS**
- Include EMF considerations in 5G roll-out plans.
- Efficient deployment of wireless infrastructure reduces the radiofrequency EMF from networks and devices.
- Globally harmonized EMF exposure limits are needed.
- Conduct ongoing environmental monitoring.
- Act to review existing legal frameworks.
- Encourage exposure levels below ICNIRP exposure limits.

**REFERENCE MATERIAL**
- Case studies: Poland, National Public Health Institute (Hungary)
- ITU Handbook on Spectrum monitoring, 2011
- ITU-D SG2 Question 7/2 Strategies and policies concerning human exposure to electro magnetic fields Report for the 2014-2017 period
- ICNIRP publications and statements
- European Electronic Communications Code: contains articles that recommend harmonization based on the ICNIRP limits

**ECONOMIC ASPECTS**
- Economic justification
- Business Models
- Financial Resources
- Human Resources
- Achievements

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