Information Session by ITU-R and ITU-T

5G roadmap: challenges and opportunities ahead

July 2017

ITU Overview

"Committed to connecting the world"

193 Member States
874 Sector Members
171 Associates
127 Academia

ITU-T

Telecommunication standardization
- network and service aspects

ITU-D

Promote and assist the extension of ICTs to all the world's inhabitants - narrowing the digital divide

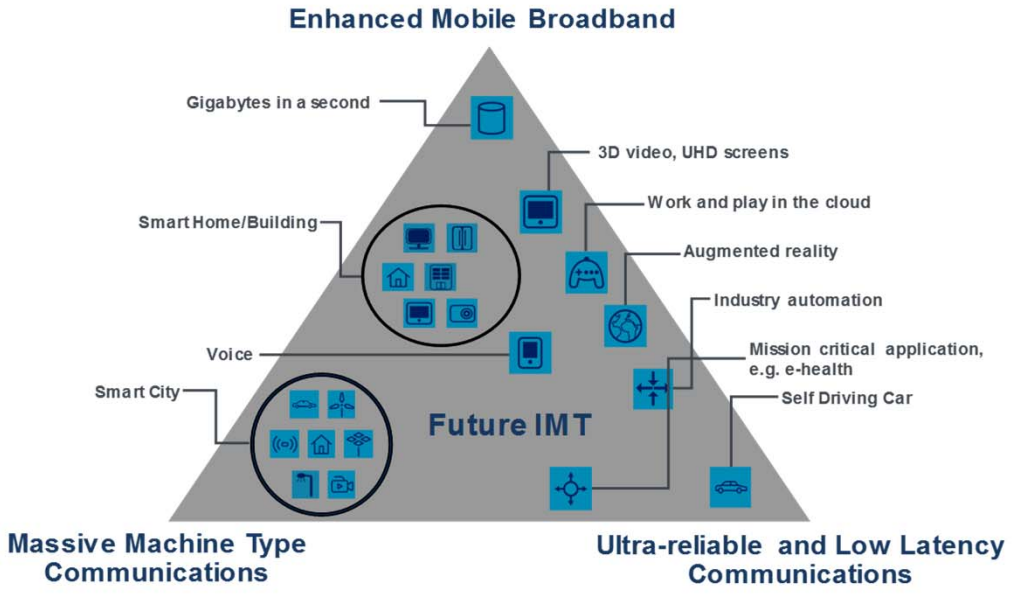
ITU-R

Global radio spectrum management and radiocommunication standardization

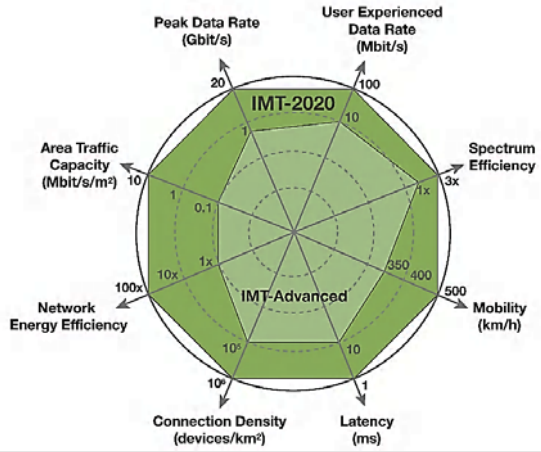
IMT-2000,, IMT-Advanced, & IMT-2020

- 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 already well underway, once again using the highly successful partnership ITU-R has with the mobile broadband industry and the wide range of stakeholders in the 5G community.

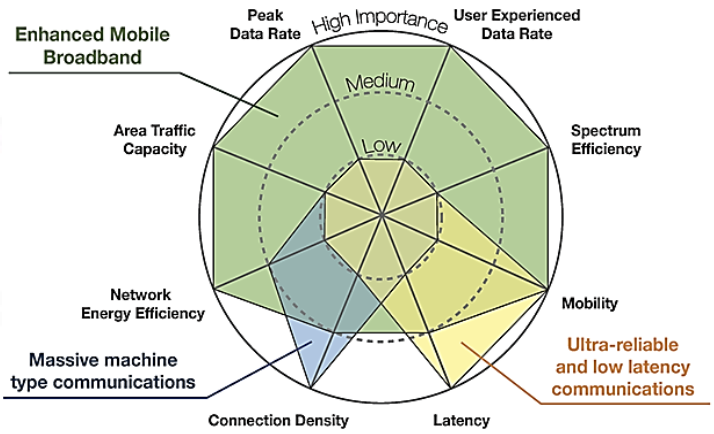
5G Usage scenarios



5G Capability Perspectives from the ITU-R IMT-2020 Vision Recommendation



Enhancement of key capabilities from IMT-Advanced to IMT-2020



The importance of key capabilities in different usage scenarios

The values in the figures above are targets for research and investigation for IMT-2020 and may be revised in the light of future studies. Further information is available in the IMT-2020 Vision Recommendation (Recommendation ITU-R M.2083)

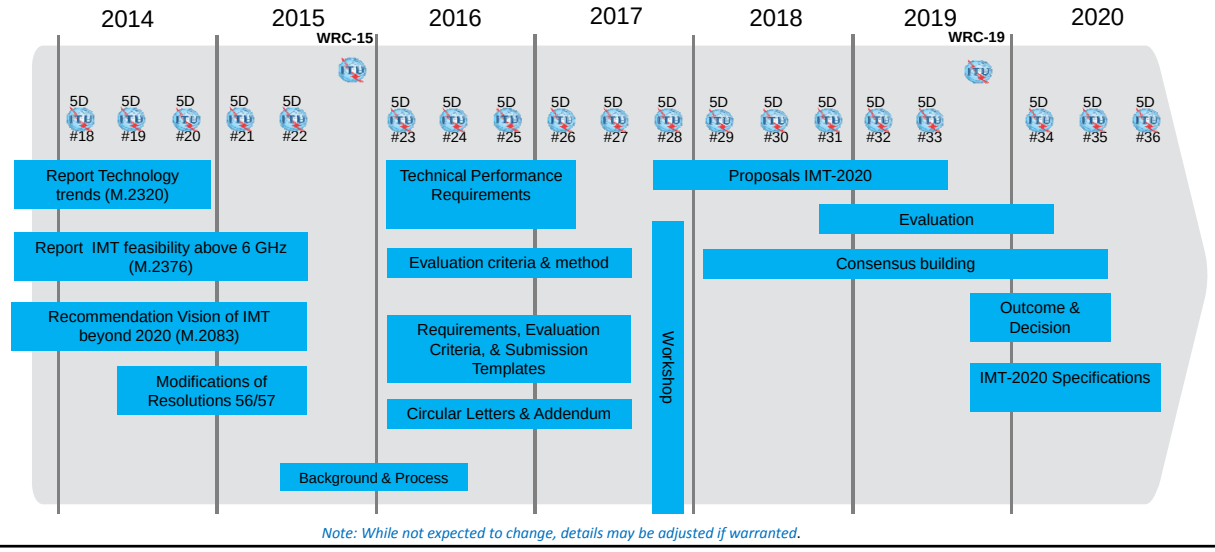
IMT-2020 Standardization Process – Where we are and what is ahead

2012-2015	2016-2017	2018-2019	2019-2020
❖ Development Plan ❖ Market/Services View ❖ Technology/ Research Kick Off ❖ Vision & Framework ❖ Name IMT-2020 ❖ < 6 GHz Spectrum View ❖ > 6 GHz Technical View ❖ Process Optimization	❖ Spectrum/Band Arrangements (post WRC-15) ❖ Technical Performance Requirements ❖ Evaluation Criteria ❖ Invitation for Proposals ❖ Sharing Study Parameters (IMT-WRC-19) ❖ Sharing Studies (WRC-19)	❖ Proposals ❖ Evaluation ❖ Consensus Building ❖ CPM Report (IMT-WRC-19) ❖ Sharing Study Reports (WRC-19)	❖ Spectrum/Band Arrangements (WRC-19 related) ❖ Decision & Radio Framework ❖ Detailed IMT-2020 Radio Interface Specifications ❖ Future Enhancement/ Update Plan & Process

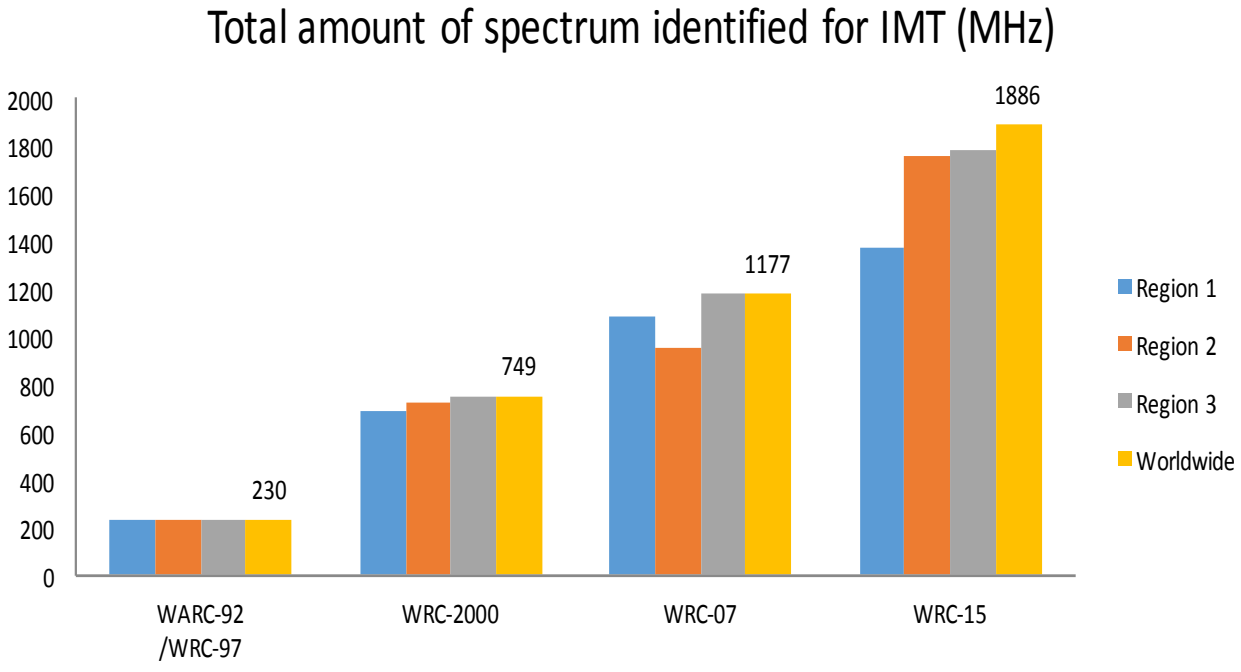
Setting the stage for the future: vision, spectrum, and technology views

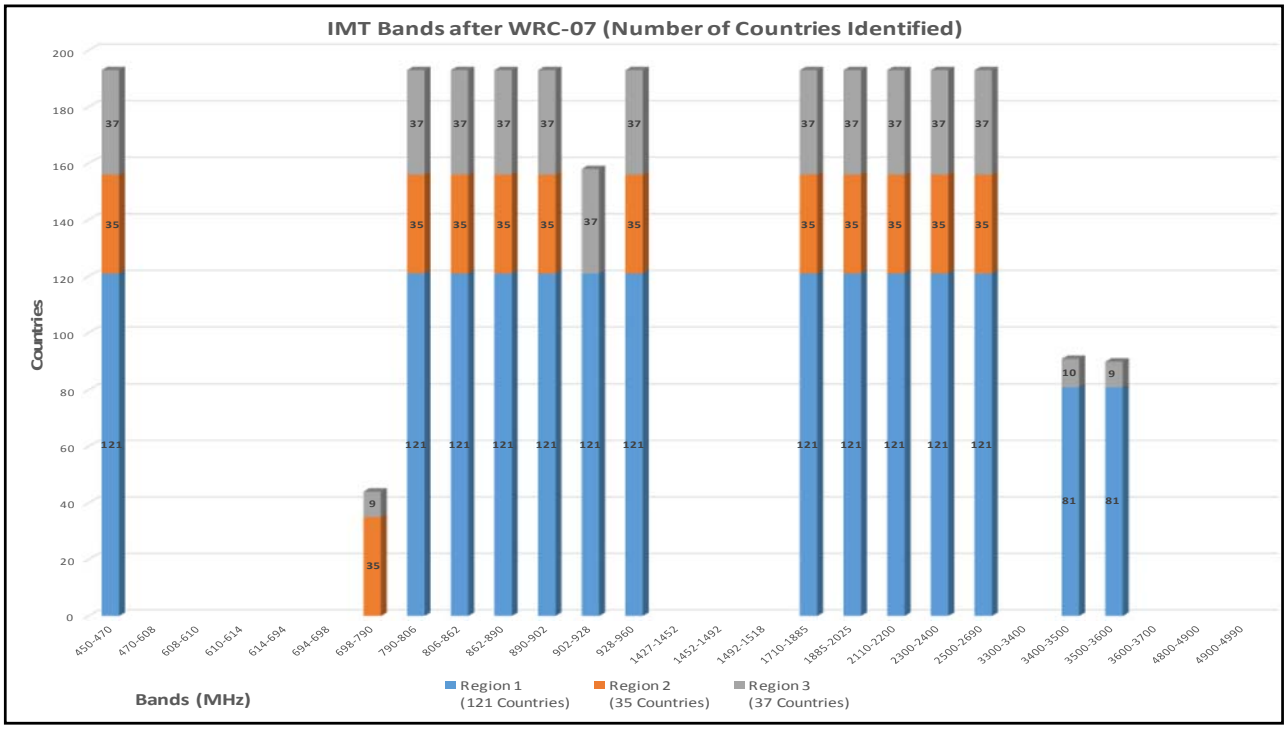
Defining the technologies

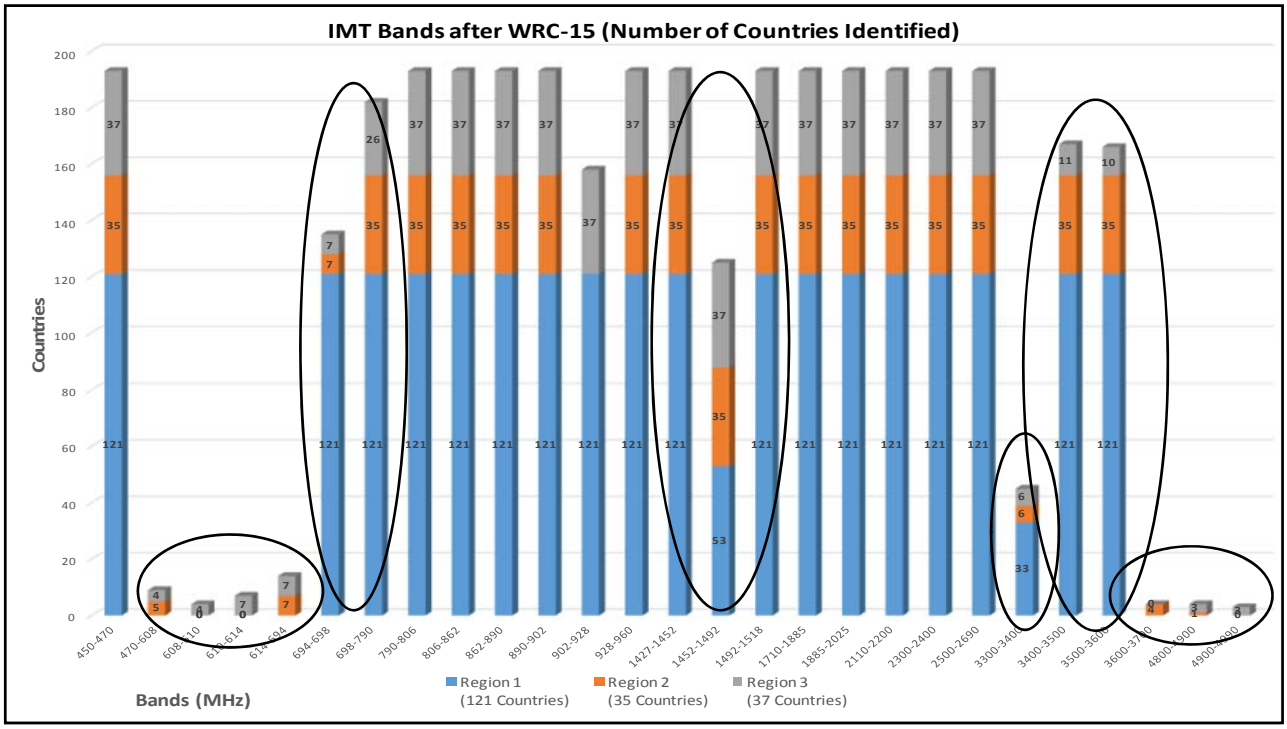
Detailed timeline & process for IMT-2020 in ITU-R



Note: While not expected to change, details may be adjusted if warranted.

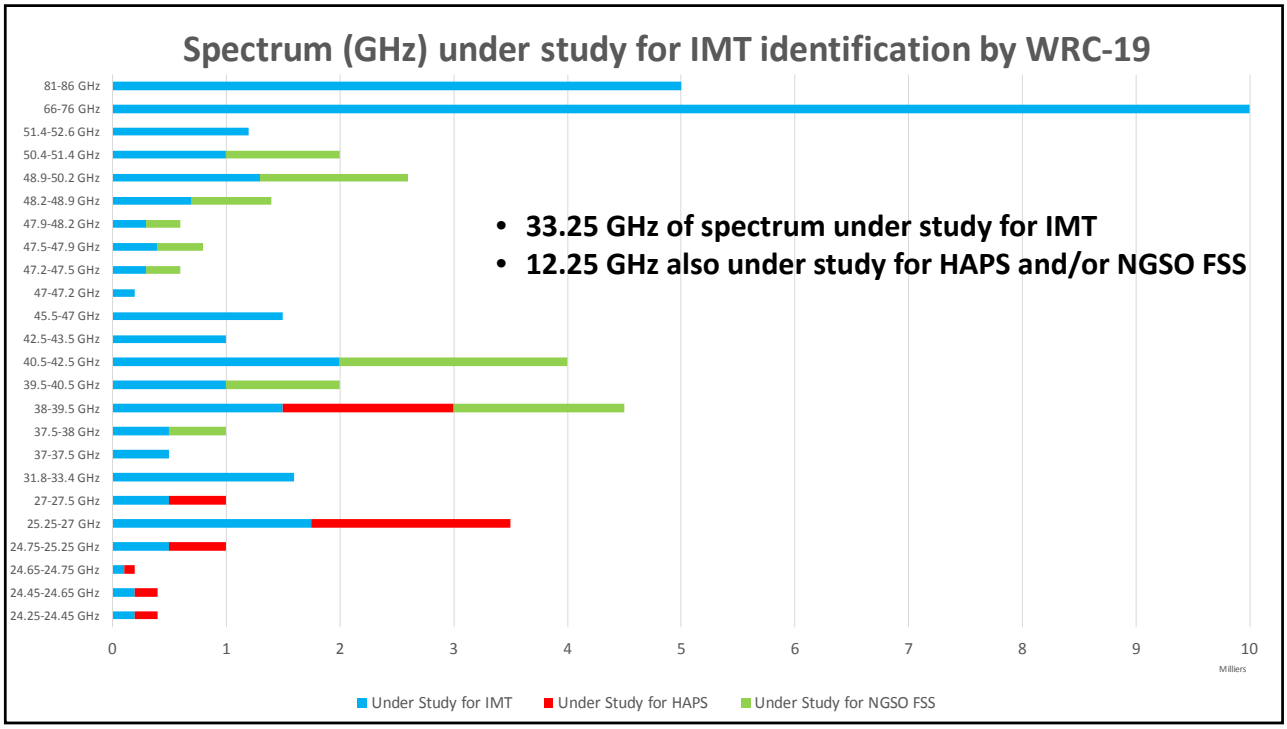



IMT Bands after WRC-07 (Number of Countries Identified)
Countries
Bands (MHz)
Region 1 (121 Countries)
Region 2 (35 Countries)
Region 3 (37 Countries)


IMT Bands after WRC-15 (Number of Countries Identified)
Countries
Bands (MHz)
Region 1 (121 Countries)
Region 2 (35 Countries)
Region 3 (37 Countries)

New spectrum: Bands under study for WRC-19

Existing mobile allocation	No global mobile allocation
24.25 GHz – 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 – 52.6 GHz	
66 – 76 GHz	
81 – 86 GHz	



Technical Performance for IMT-2020

Target values for user experienced data rate in the Dense Urban eMBB:	Minimum user plane latency:	Minimum connection density in mMTC usage scenario:
• Downlink user experienced data rate is 100 Mbit/s	• 4 ms for eMBB • 1 ms for URLLC	• 1 000 000 devices per km^2

eMBB	Enhanced mobile broadband
URLLC	Ultra-reliable and low-latency communications
mMTC	Massive machine type communications

Source: Draft Report ITU-R M.[IMT-2020.TECH PERF REQ] - Document 5/40 https://www.itu.int/md/R15-SG05-C-0040/en

Non-radio network aspects of IMT-2020
WTSA Resolution 92 (Hammamet, 2016)

- Much of the 5G work attributed to air interfaces, radio access networks and protocols
- Less importance given to impact of 5G on fixed network
- Fixed network will play key role in meeting IMT-2020 Vision capability goals, and satisfying expectations of users, operators and service providers

- Activities in most ITU-T Study Groups
- Lead/Coordinator: Study Group 13
  - Architecture, fixed-mobile convergence, management and orchestration (13);
  - Environmental requirements (5)
  - Protocols and testing (11);
  - QoS and QoE (12);
  - Fronthaul/backhaul (15);
  - Security (17);

Key areas of network study:
Softwarization

- Softwarization: Designing, implementing, deploying, managing and maintaining networks using software
- Exploits characteristics such as flexibility and rapidity of design
- Softwarization creates conditions that enable the re-design of network and service architectures
- Optimization of costs and processes, self-management

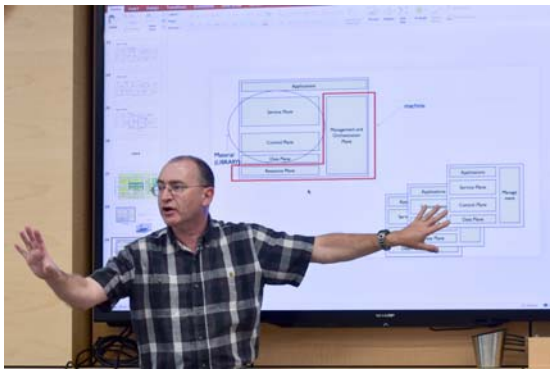
Key areas of network study:
Slicing

- Slice: Unit of programmable resources, e.g., network, computation, storage
- Allows logically isolated network partitions
- Slicing is envisaged to cover a wide range of use cases with one network, e.g., one slice for voice communications, a separate slice for automated driving

Key areas of network study:

Architecture enabling convergence

- Fixed access networks to interwork with radio access networks
- Goals for IMT-2020: A converged access-agnostic core - identity, mobility, security, etc., are decoupled from the access technology
- Network architecture to support fixed / mobile convergence, with seamless user experience



Architecture discussion at a Focus Group meeting, Palo Alto, September 2016

Photo by Marc Mosko, PARC

5G, open source and IPR

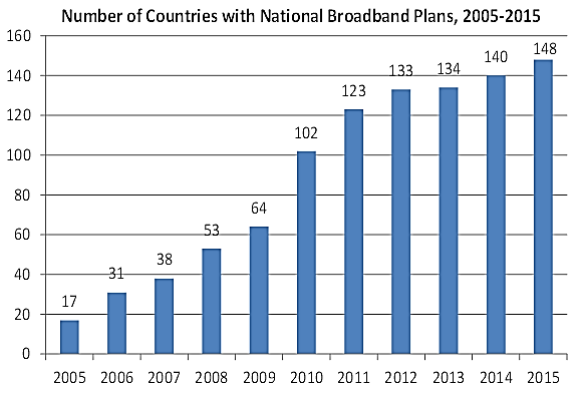
- ITU collaborates with open source initiatives to develop proofs of concept addressing technical issues identified
- **Workshop & Demo Days at ITU: 7 December 2016, 11 July 2017**

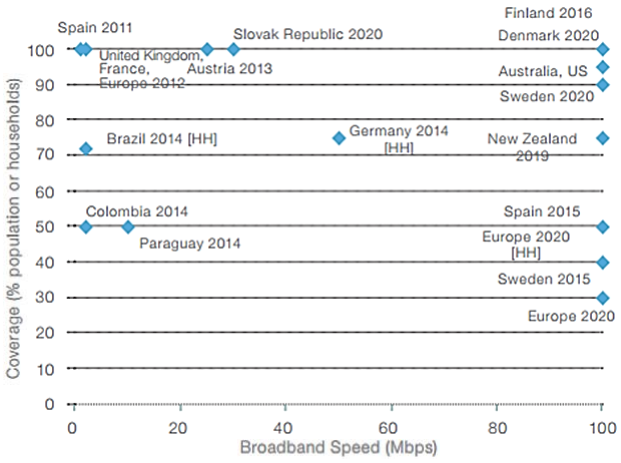
- **2nd ITU-NGMN workshop on "Open Source and Standards for 5G"** (Bellevue, WA, USA, 1 November 2017)
- Conclusions of 1st workshop:
  - Open source needed in the context of 5G
  - Open source components will complement the development of standards in 5G
  - Open source and standards are converging and both can benefit in 5G from each other
  - Open source and standards are not two different worlds, and close cooperation creates opportunities for both

What can 5G do for developing countries

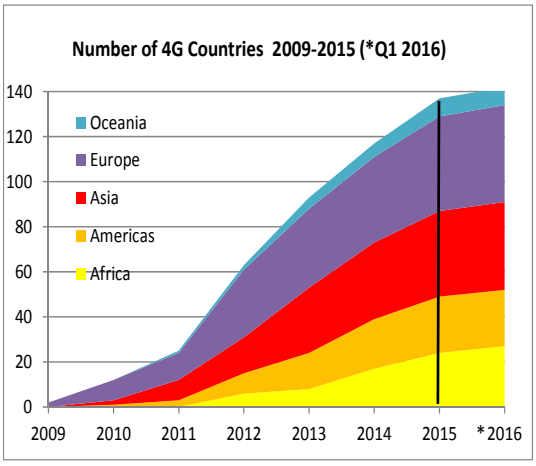
- Directly increasing GDP
- Greater economic growth or % gain in GDP
- Reducing transaction costs
- Better, faster, more informed decision-making
- Boosting labour productivity
- Resulting in a net gain in jobs

National Broadband Plans





4G Roll-outs at the Global level



	Region	No countries	Total # Countries	% region	No. Net-works	%Total 4G NWs	Average No. networks/ country
1	Africa	27	52	52	68	9.8%	2.5
2	Americas	25	37	67.6	129	18.6%	5.2
3	Asia	39	45	79.6	188	27.1%	4.8
4	Europe	43	49	95.6	276	39.8%	6.4
5	Oceania	8	15	53.3	32	4.6%	4.0
	Total	142	198		693		

4G roll-outs by region (Source: ITU)

5G in the developing world

- It will undoubtedly happen, and quite rapidly once it starts.
- 5G issue part is of a much bigger issue – connecting the unconnected, and bridging the digital divide.
- Coverage versus speed trade-off reflects a larger debate about social objectives versus 'cherry-picking' profitable areas.
- Need a credible, viable commercial business case going forward for 5G deployments to happen in most optimal way.

Broadband Wireless Access for connecting the unconnected

- ITU-BDT is responsible for projects on implementing broadband wireless networks.
- Aiming at addressing the issues of developing countries, **Resolution 2 (Rev. Dubai 2014) of the WTDC established within the Study Group 1 the Question 2/1- Broadband access technologies**.
- In this context, capacity building activities and guidelines on IMT and related wireless and wireline technologies to Membership are being developed to assist the spread of broadband access and the achievement of the SDGs, especially

Summary

- The scope of IMT-2020 is much broader than previous generations of mobile broadband communication systems.
- Use cases foreseen include enhancement of the traditional mobile broadband scenarios as well as ultra-reliable and low latency communications and massive machine-type communications.
- The ITU's work in developing the specifications for IMT-2020, in close collaboration with the whole gamut of 5G stakeholders, is now well underway, along with the associated spectrum management and spectrum identification aspects.
- IMT-2020 will be a cornerstone for all of the activities related to attaining the goals in the 2030 Agenda for Sustainable Development.