Update on the IMT-2020 standardization process

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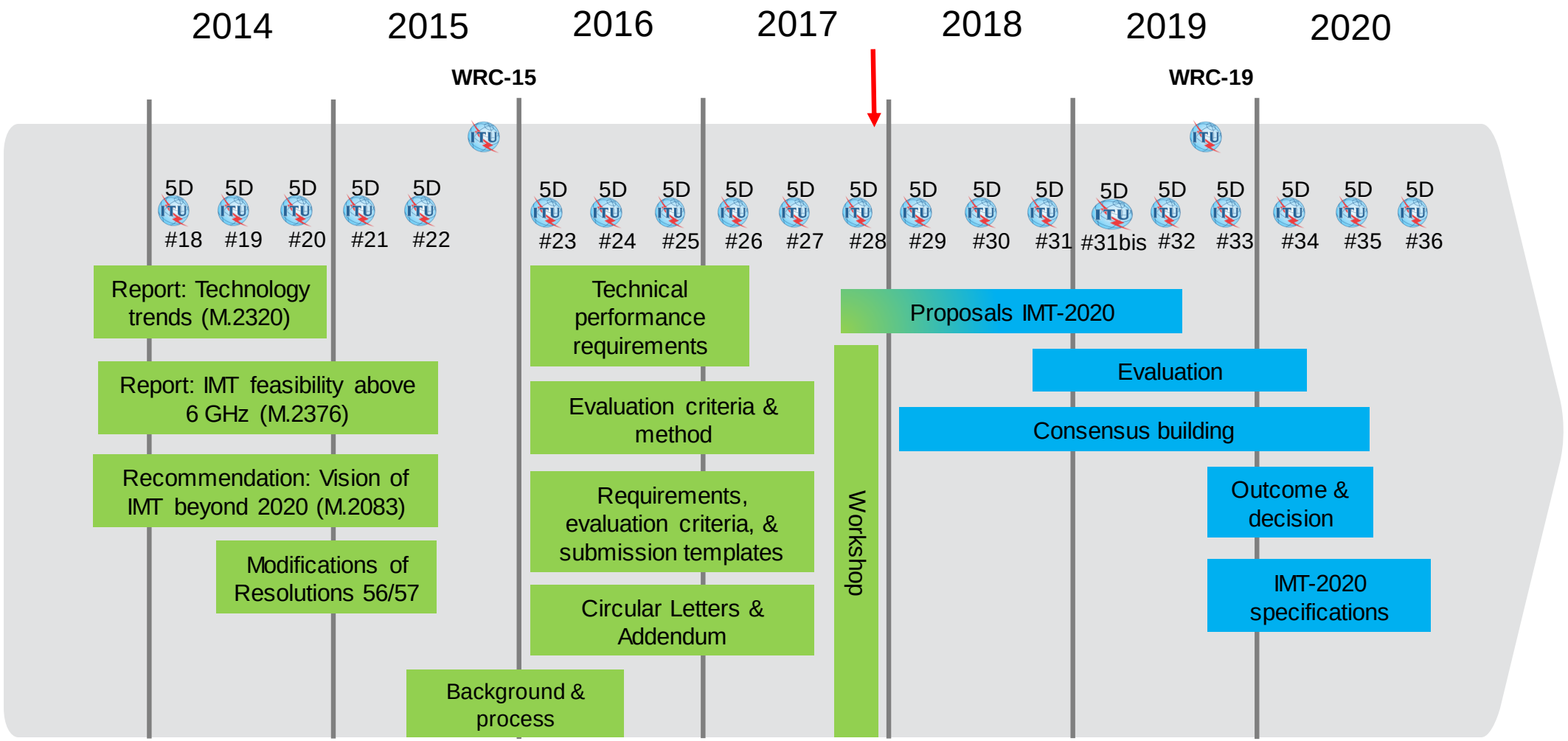
IMT-2000, IMT-Advanced, IMT-2020

- All 3G and 4G mobile broadband systems are based on the ITU's IMT standards.
- 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 key elements of **IMT-2020** are defined, 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.
- IMT is the global platform on which to build the next generations of mobile broadband connectivity

Global collaboration

- The detailed technical specifications for ITU's IMT standards are developed in close collaboration with the leading national, regional and international radio standards development organizations and partnerships
- The involvement of ITU Member States, equipment providers, network operators, industry fora and academia in this process enables these harmonized standards to be implemented on a worldwide basis
- Globally harmonized standards enable global roaming and provide massive economies of scale – resulting in lower cost services and equipment usable everywhere
- The scope of IMT-2020 is much broader than previous generations of mobile broadband communication systems

WP 5D timeline for IMT-2020
Detailed specifications for the terrestrial radio interfaces



Evaluation criteria & method - 2017

- Invitation to propose candidate radio interface technologies for IMT-2020
- Guidelines for both the procedure (methodology) and the criteria (technical, spectrum and service) to be used in evaluating the proposed IMT-2020 radio interface technologies
- Workshop, Munich on 4th October 2017 : (http://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/ws-20171004.aspx)
- Formation of independent evaluation groups
- 3 draft new ITU-R Reports ready for approval (November 2017) – Performance requirements, Submission process, Evaluation methodology.

Reference documents ready for approval

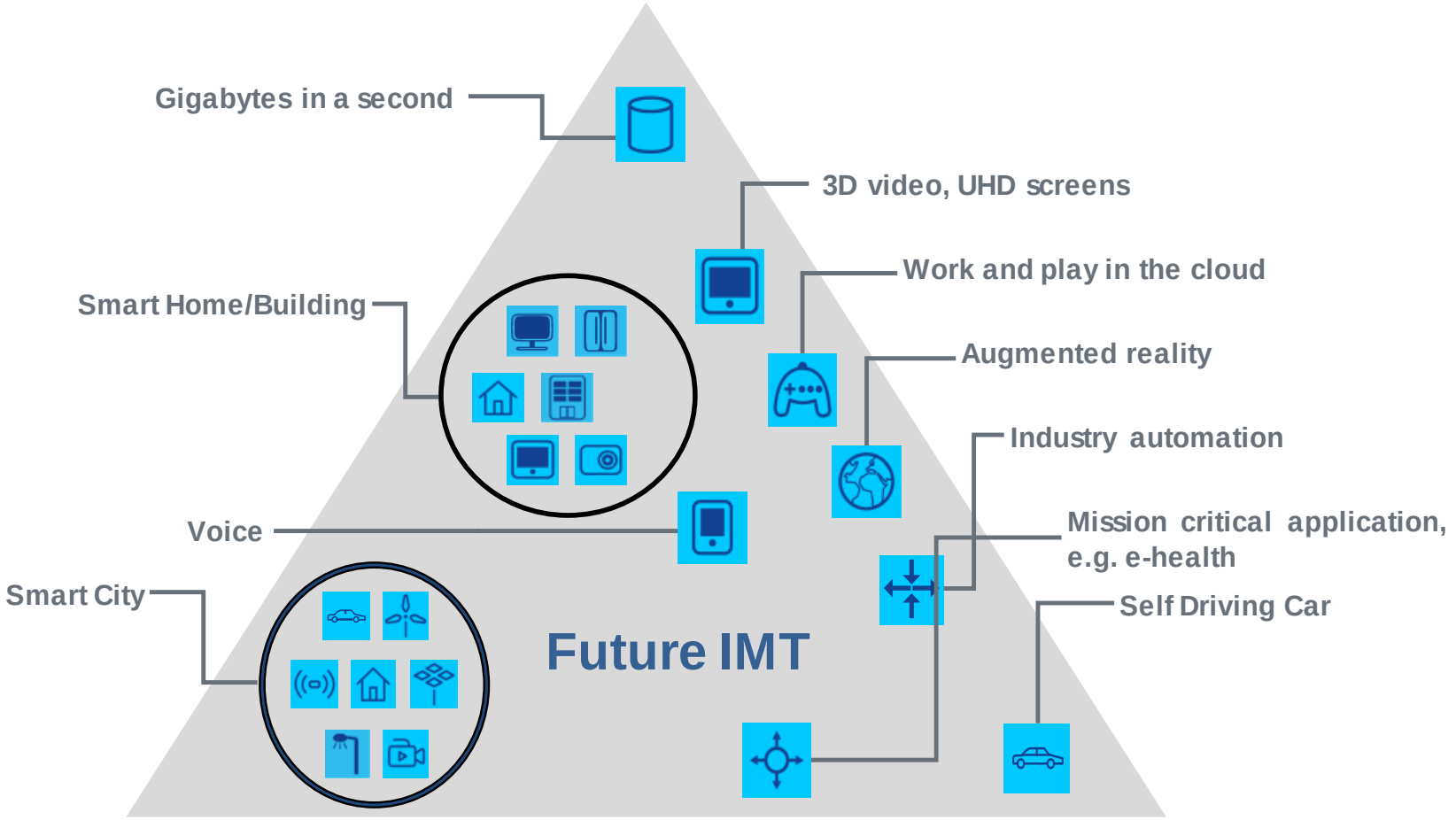
- Document 5/40: Draft new Report ITU-R M.[IMT-2020.TECH PERF REQ] - Minimum requirements related to technical performance for IMT-2020 radio interface(s)

- Document 5/56: Draft new Report ITU-R M.[IMT-2020.SUBMISSION] - Requirements, evaluation criteria and submission templates for the development of IMT-2020

- Document 5/57: Draft new Report ITU-R M.[IMT-2020.EVAL] - Guidelines for evaluation of radio interface technologies for IMT-2020

5G usage scenarios

Enhanced Mobile Broadband



Massive Machine Type Communications

Ultra-reliable and Low Latency Communications

M.2083-02

IMT-2020 Technical performance requirements 1/2*

- **Peak data rate:** Maximum achievable data rate under ideal conditions per user/device (in Gbit/s). Downlink peak data rate of 20 Gbit/s, Uplink peak data rate of 10 Gbit/s
- **User experienced data rate:** Achievable data rate that is available ubiquitously across the coverage area to a mobile user/device (in Mbit/s or Gbit/s). Downlink user experienced data rate of 100 Mbit/s, Uplink user experienced data rate of 50 Mbit/s
- **Latency:** The contribution by the radio network to the time from when the source sends a packet to when the destination receives it (in ms). 4 ms for eMBB and 1 ms for uRLLC
- **Mobility:** Maximum speed at which a defined QoS and seamless transfer between radio nodes which may belong to different layers and/or radio access technologies (multi-layer/-RAT) can be achieved (in km/h). Stationary: 0 km/h, Pedestrian: 0 km/h to 10 km/h, Vehicular: 10 km/h to 120 km/h, High speed vehicular: 120 km/h to 500 km/h

* These values are applicable to specific scenarios as established in draft Report M.[IMT-2020.TECH PERF REQ] completed by Working Party 5D on 22.02.2017, and submitted to ITU-R Study Group 5 for final approval in November 2017 (Doc.5/40)

Enhanced mobile broadband (eMBB), ultra-reliable low latency communications (uRLLC), massive machine-type communications (mMTC)

IMT-2020 Technical performance requirements 2/2*

- **Connection density:** Total number of connected and/or accessible devices per unit area (per km^2). 1 million devices per km^2
- **Spectrum efficiency:** Average data throughput per unit of spectrum resource and per cell (bit/s/Hz). Downlink peak spectral efficiency of 30 bit/s/Hz, Uplink peak spectral efficiency of 15 bit/s/Hz
- **Area traffic capacity:** Total traffic throughput served per geographic area (in Mbit/s/m^2). 10 Mbit/s/m^2
- Other parameters : **Energy efficiency, reliability, control plane latency, mobility interruption time,** etc… with their applicable scenarios are provided in the ITU-R Report.

* These values are applicable to specific scenarios as established in draft Report M.[IMT-2020.TECH PERF REQ] completed by Working Party 5D on 22.02.2017, and submitted to ITU-R Study Group 5 for final approval in November 2017 (Doc.5/40)

Evaluation "Report ITU-R M.[IMT-2020.EVAL]" Doc. 5/57

Activities history

- Initiated at WP-5D #23 (Feb.2016, Beijing)
- Developed during WP-5D #24-#27
- Offline discussions during meeting gaps
- Finalized at WP-5D #27 (June 2017)
- Additions at WP-5D #28 (Oct. 2017)

Volume

140 pages including

M.2135: 68 pages in total

- 33-page main body
- 105-page annex for channel modelling
- 2-page annex for optional cell layout

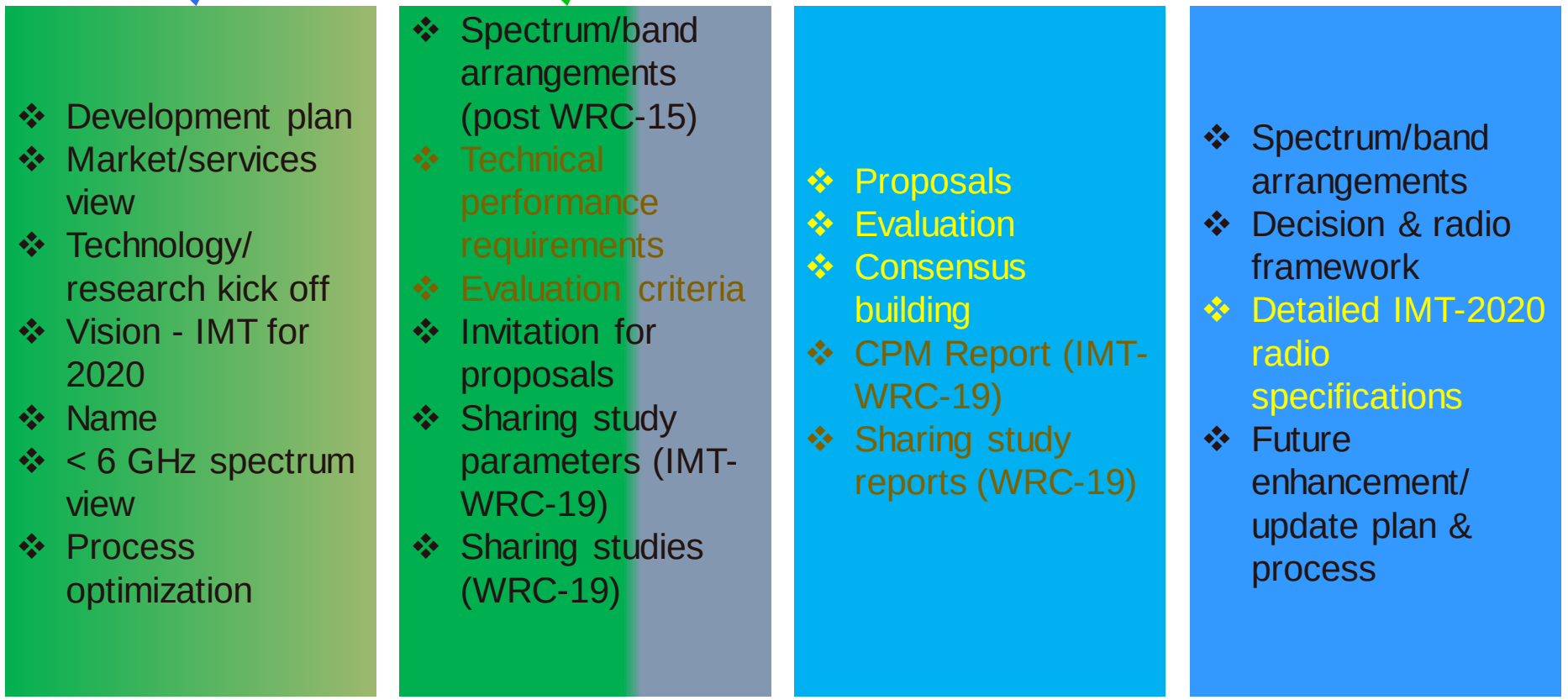
Table of contents

Test environments

Test environments are chosen to
- model typical and different deployments are modeled
- investigate critical aspects in system design and performance
- reflect a combination of geographic environment and usage scenario

Usage scenarios	Test environment	Definition
eMBB	Indoor Hotspot - eMBB	An indoor isolated environment at offices and/or in shopping malls based on stationary and pedestrian users with very high user density.
	Dense Urban – eMBB	An urban environment with high user density and traffic loads focusing on pedestrian and vehicular users.
	Rural – eMBB	A rural environment with larger and continuous wide area coverage, supporting pedestrian, vehicular and high speed vehicular users.
mMTC	Urban Macro - mMTC	An urban macro environment targeting continuous coverage focusing on a high number of connected machine type devices.
URLLC	Urban Macro - URLLC	An urban macro environment targeting ultra-reliable and low latency communications

IMT-2020 standardization process



IMT-2020 early trials of candidate technologies

- There will now be a number of early technical trials, market trials and deployments of 5G technologies based on the foreseen developments for IMT-2020.
- These technologies may not provide the full set of capabilities envisaged for IMT-2020, but the results of these early activities will flow forward into and assist the development of the final complete detailed specifications for IMT-2020.
- The scope of IMT-2020 is much broader than previous generations of mobile broadband communication systems

Conclusions

- Developed in collaboration with the ITU Membership (Member States, SDOs, mobile industry, Academia, etc…) using a consensus driven process
  - Presentation of the proposed technologies at ITU workshop
  - Assessments by the independent evaluation groups
  - Consensus building
  - Decisions
- Outcome of the evaluation and assessment -> October 2019
- Detailed specification of IMT-2020 technology -> Year 2020
- Beyond year 2020, ITU will continue to assist the development and the enhancement of IMT globally.

Thank you

Bands for IMT above 24 GHz
WRC-19 agenda item 1.13

- The frequencies under study in this agenda item are limited to the following bands, **all above 24GHz**:
- Bands already allocated to the Mobile Service in the Table of Allocations: 24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz
- Bands that would require a new allocation to the Mobile Service in the Table of Allocations: 24.25-27.5 GHz, 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz
- A subset of these bands are expected to be identified for IMT by WRC-19, preferably on a globally harmonized basis
- A new ITU group, TG 5/1, has been established to conduct the studies for this agenda item
- *The availability of bands above 24 GHz offering wide channel sizes are critically important for IMT-2020*

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	

New spectrum bands in WRC-19 AI 1.13 that overlap with other WRC-19 AIs

AI 1.13 spectrum bands	Other WRC-19 AI spectrum bands with overlap	Proposed treatment
37 – 40.5 GHz 40.5 – 42.5 GHz 47.2 – 50.2 GHz 50.4 – 52.6 GHz	AI 1.6: 37.5-39.5 GHz (s-to-E) 39.5-42.5 GHz (s-to-E) 47.2-50.2 GHz (E-to-s) 50.4-51.4 GHz (E-to-s) Provisions to allow operation of non-GSO systems	Studies to be performed in TG 5/1, since FSS already has a primary allocation in these bands
24.25 GHz – 27.5 GHz 37 – 40.5 GHz	AI 1.14: 24.25-27.5 GHz (Region 2 only) 38-39.5 GHz (global) (also in non-overlapping band 21.4-22 GHz in Region 2 only) Broadband applications delivered by HAPS	Studies to be perform in WP 5C
50.4 – 52.6 GHz	AI 9.1 Issue 9.1.9: 51.4 - 52.4 GHz New spectrum for FSS (E-to-s)	Studies to be performed in WP 4A

Minimum Technical Performance Requirements (1/2)

Technical requirement	Usage scenario applicability				Target value
	eMBB	mMTC	URLLC	General/ Non-specific	
4.1 Peak date rate	√				DL: 20 Gbps UL: 10 Gbps
4.2 Peak spectral efficiency	√				DL: 30 bps/Hz UL: 15 bps/Hz
4.3 User experienced data rate	√				DL 100 Mbps UL 50 Mbps
4.4 5th percentile user spectral efficiency	√				TE / DL (bit/s/Hz) / UL (bit/s/Hz) InH: 0.3 / 0.21 DU: 0.225 / 0.15 RU: 0.12 / 0.045
4.5 Average spectral efficiency	√				TE / DL (bit/s/Hz) / UL (bit/s/Hz) InH: 9 / 6.75 DU: 7.8 / 5.4 RU: 3.3 / 1.6
4.6 Area traffic capacity	√				10 Mbit/s/m²
4.7.1 User plane latency	√		√		URLLC: 1ms eMBB: 4ms
4.7.2 Control plane latency	√		√		20ms (10ms encouraged)

Minimum Technical Performance Requirements (2/2)

Technical requirement	Usage scenario applicability				Target value		
	eMBB	mMTC	URLLC	General/ Non-specific			
4.8 Connection density		√			1,000,000 devices/km2		
4.9 Energy efficiency	√				Qualitative measure		
4.10 Reliability			√		$1\text{-}10^{-5}$ Success Probability for TX 32B in 1ms		
4.11 Mobility	√				TE	TCDL(bits/s/Hz)	Mobility(km/h)
					InH	1.5	10
					DU	1.12	30
					RU	0.8	120
					RU	0.45	500
4.12 Mobility interruption time	√		√		0 ms		
4.13 Bandwidth				√	At least 100MHz, up to 1GHz for higher frequency bands		