



ITU FORUM



ITU REGIONAL FORUM ON
“INTERNET OF THINGS, TELECOMMUNICATION NETWORKS AND BIG DATA AS BASIC
INFRASTRUCTURE FOR DIGITAL ECONOMY”

OVERVIEW OF ITU-R ACTIVITIES ON 5G

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Saint-Petersburg, Russian Federation, 4-6 June 2018.

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F.2326-0 (2014)	Sharing and compatibility study between indoor International Mobile Telecommunication small cells and fixed service stations in the 5 925-6 425 MHz frequency band	Sharing/compatibility issues; IMT;	FS; LMS;	WP5C; WP5D;	2014
F.2327-0 (11/2014)	Sharing and compatibility study between International Mobile Telecommunication systems and point-to-point fixed wireless systems in the frequency band 4 400-4 990 MHz	Sharing/compatibility issues; IMT;	FS; LMS;	WP5C; WP5D;	2014
F.2328-0 (11/2014)	Sharing and compatibility between international mobile telecommunication systems and fixed service systems in the 3 400-4 200 MHz frequency range	Sharing/compatibility issues; IMT;	FS; LMS;	WP5C; WP5D;	2014
F.2331-0 (11/2014)	Sharing and compatibility between international mobile telecommunication systems and fixed service systems in the 470-694/698 MHz frequency range	Sharing/compatibility issues; IMT;	FS; LMS;	WP5C; WP5D;	2014
F.2333-0 (2014)	Sharing and compatibility study between international mobile telecommunication and the fixed service in the frequency band 1 350-1 527 MHz	Sharing/compatibility issues; IMT;	FS; LMS;	WP5C; WP5D;	2014
M.2039-3(2014)	Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses	Technical/operational characteristics or parameters; IMT;	LMS;	WP5D;	2014
M.2290-0 (12/2013)	Future spectrum requirements estimate for terrestrial IMT	IMT;	LMS;	WP5D;	2014
M.2316-0 (2014)	Assessment of interference to radars operating within the 2 700-2 900 MHz band from broadband wireless systems operating in adjacent frequency bands	Technical/operational characteristics or parameters; Sharing/compatibility	ARNs; RLS; LMS;	WP5B;	2014

There are **more than 60 ITU-R Reports** related to different IMT issues (spectrum requirements, technical parameters, traffic estimation and a huge part - sharing and compatibility studies)

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ITU-R Questions
ITU-R Reports
ITU-R Handbooks
ITU-R Resolutions
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	M.1850-2 (09/2014)	Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)	Technical/operational characteristics or parameters; IMT;	MSS;	WP4B;
	M.2012-3 (01/2018)	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)	IMT;	LMS;	WP5D;
	M.2014-1 (09/2015)	Global circulation of IMT satellite terminals	IMT;	MSS;	WP4B;
	M.2047-0 (12/2013)	Detailed specifications of the satellite radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced)	IMT;	MSS;	WP4B;
	M.2070-1 (02/2017)	Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-Advanced	Technical/operational characteristics or parameters; IMT; Vocabulary;	LMS;	WP5D;
	M.2071-1 (02/2017)	Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-Advanced	Technical/operational characteristics or parameters; IMT; Vocabulary;	LMS;	WP5D;
	M.2083-0 (09/2015)	IMT Vision - "Framework and overall objectives of the future development of IMT for 2020 and beyond"	IMT;	LMS;	WP5D;
	M.2090-0 (10/2015)	Specific unwanted emission limit of IMT mobile stations operating in the frequency band 694-790 MHz to facilitate protection of existing services in Region 1 in the frequency band 470-694 MHz	IMT; Sharing/compatibility issues;	LMS; BS;	WP5D;
	M.2101-0 (02/2017)	Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies	Sharing/compatibility issues; IMT;	LMS;	WP5D;

There are **more than 40 ITU-R Recommendation** covered not only sharing and compatibility aspects but issue of specifications of the terrestrial radio interfaces, generic unwanted emission characteristics, modelling and simulation of IMT networks and systems, concept - IMT Vision etc.

RECOMMENDATION ITU-R M.2083-0 IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond (2015)

This Recommendation defines the framework and overall objectives of the future development of International Mobile Telecommunications (IMT) for 2020 and beyond in light of the roles that IMT could play to better serve the needs of the networked society, for both developed and developing countries, in the future.

REPORT ITU-R M.2410-0 Minimum requirements related to technical performance for IMT-2020 radio interface(s) (2017)

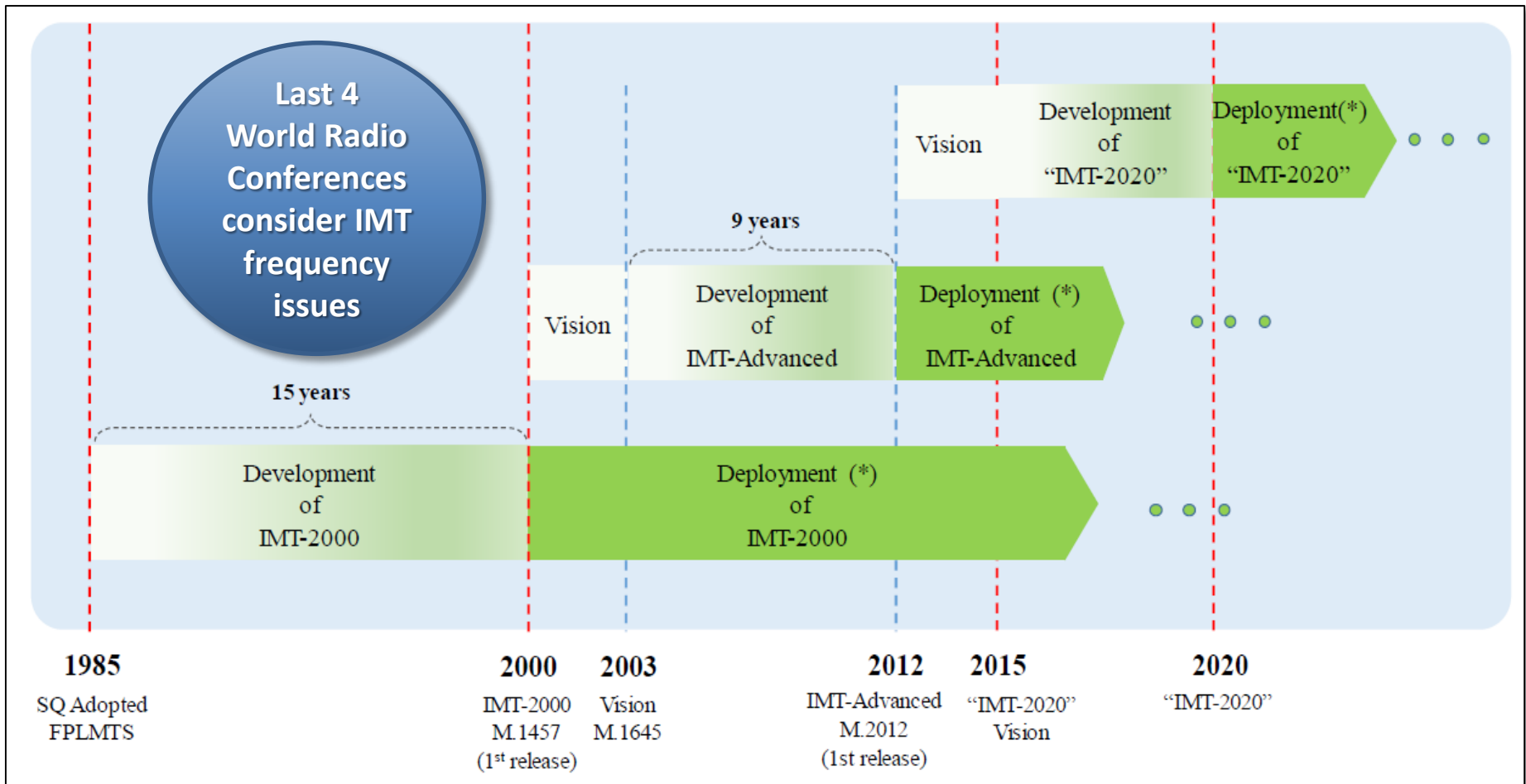
This Report describes key requirements related to the minimum technical performance of IMT-2020 candidate radio interface technologies. It also provides the necessary background information about the individual requirements and the justification for the items and values chosen. Provision of such background information is needed for a broader understanding of the requirements. These key technical performance requirements are used in the development of Report ITU-R M.2412-0.

REPORT ITU-R M.2375-0 Architecture and topology of IMT networks (2015)

This Report offers an overview of the architecture and topology of IMT networks and a perspective on the dimensioning of the respective transport requirements in these topologies, in order to assist relevant studies on the transport network in the mobile infrastructure. This Report covers different architectural aspects in a general level of detail.

DRAFT NEW REPORT ITU-R IMT.[IMT.BY.INDUSTRIES] The use of terrestrial component of International Mobile Telecommunication (IMT) by industry sectors

The original goal of IMT was to provide access to a wide range of telecommunication services supported by fixed and mobile telecommunication networks. Some of these IMT applications have already been investigated (e.g., Report ITU-R M.2291 on PPDR) and others are in progress or under consideration as described in this Report. It is useful to cover in one Report all these applications of IMT in specific industry sectors, by referring to relevant Recommendations and Reports where they exist and addressing in the Report the remaining ones that have not yet been fully documented.



In the Radio Regulations, **more than 1500 MHz** as a total of radio frequency bands have been **identified for the application of IMT** in the range below 5 GHz.

35 frequencies plans are recommended within the identified radio frequency bands, which takes into account the features of spectrum use in various countries of the world.

ITU-R PREPARATION FOR WRC-19



Year	January – March	April – June	July – September	October – December
2015	CPM15-2	Last meetings of the Responsible Groups	WS on WRC-15	RA-15 WRC-15 CPM19-1
2016	WP 5D (1 st)	WPs 7B & 7C (1 st) WP 4C+WP 4A (1 st) WPs 5A, 5B & 5C (1 st) TG 5/1 (1 st) WPs 1A & 1B (1 st) WP 5D (2 nd)	WP 4C+WP 4A (2 nd) CPM-19 Steering	WP 5D (3 rd) WPs 7B & 7C (2 nd) WPs 5A, 5B & 5C (2 nd) WPs 1A & 1B (2 nd)
	WP 5D (4 th)	WPs 7B & 7C (3 rd) WP 4C+WP 4A (3 rd) TG 5/1 (2 nd) WPs 5A, 5B & 5C (3 rd) WPs 1A & 1B (3 rd) [WP 5D (5 th)]	[TG 5/1 (3 rd)]	[WP 5D (6 th)] [WP 4C+WP 4A (4 th)] [WPs 7B & 7C (4 th)] [WPs 5A, 5B & 5C (4 th)] [WS on WRC-19] [WPs 1A & 1B (4 th)]
2017	[Responsible Groups Meetings] [TG 5/1 (4 th)]	[Responsible Groups Meetings] [TG 5/1 (5 th)]	[Responsible Groups Meetings] [TG 5/1 (6 th)]	[Responsible Groups Meetings] [WS on WRC-19]
			CPM-19 Manag ^{nt} Team	
2018	CPM19-2	[Last meetings of the Responsible Groups] [WS on WRC-19]		RA-19 WRC-19
2019				

There are **more than 60 meetings** of WPs of ITU-R during the period from January 2016 to June 2018

Web-page:

<https://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/cpm-19.aspx>



First session: 30/11/2015 - 01/12/2015

Tasks (agenda items) distribution between the Working Groups of ITU-R Study Groups

Second Session: 18/02/2019 — 28/02/2019

Consideration and adoption of the text of draft CPM Report for WRC

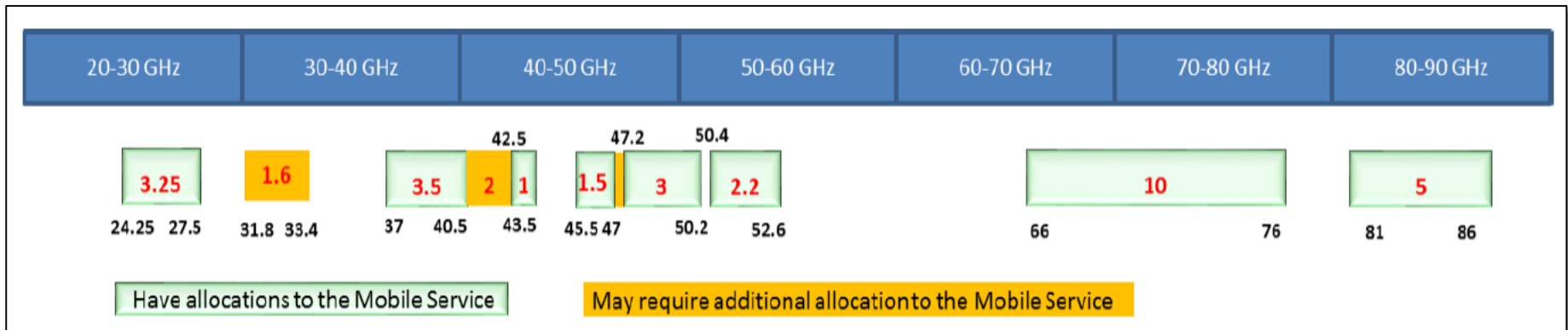
Output deliverables:

1. Conference Preparatory Meeting's on Technical, Operational and Regulatory/Procedural matters to be considered by the World Radiocommunication Conference 2019.
2. ITU-R Recommendations and ITU-R Reports on issues related to the WRC agenda items.

Resolution 238 (WRC-15) - *Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond*

resolves to invite ITU-R

- 1 to conduct and complete in time for WRC-19 the appropriate studies to determine the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz
...
- 2 to conduct and complete in time for WRC-19 the appropriate *sharing and compatibility studies*, taking into account the protection of services to which the band is allocated on a primary basis, for the frequency bands




ITU-R studies' results will be presented in **February 2019** as Report of the Conference Preparatory Meeting (CPM-19)

Web-page

<https://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-19-studies.aspx>

Resolution **809 (WRC-15)** contains the WRC-19 agenda.

WRC-19 agenda Item (Chapter)	Issue	WRC Resolution (*)	Responsible Group(s)	Information from Responsible Group(s) 
1		-	-	-
1.1 (5)		Res. 658 (WRC-15)	WP 5A	Doc. 5A/469 Sections 3.3 & 4 and Annexes 4 (c), 5 (b) & 14 Doc. 5A/298 Annex 15
1.2 (4)		Res. 765 (WRC-15)	WP 7B	Doc. 7B/238 Section 3.3.1 and Annexes 1 (c), 2 (b), & 16
1.3 (4)		Res. 766 (WRC-15)	WP 7B	Doc. 7B/238 Section 3.3.2 and Annexes 3 (c), 4 (b), & 17
1.4 (3)		Res. 557 (WRC-15)	WP 4A	Doc. 4A/519 Section 4.1.1 and Annexes 9, 26 (b) & 27 (c)
1.5 (3)		Res. 158 (WRC-15)	WP 4A	Doc. 4A/519 Section 4.1.2 and Annexes 10, 11, 12, 13, 21, 22, 28 (b) & 29 (c)
1.6 (3)		Res. 159 (WRC-15)	WP 4A	Doc. 4A/519 Section 4.1.3 and Annexes 1, 14, 15, 16, 23, 30 (b) & 31 (c)
1.7 (4)		Res. 659 (WRC-15)	WP 7B	Doc. 7B/238 Section 3.1.3 and Annexes 5 (c), 6 (b), & 15; Doc. 7/73; Doc. 7/72
1.8 (5)		Res. 359 (Rev.WRC-15)	WP 5B (1)	Doc. 5B/305 Sections 2.1.1 & 3.3.1.2 and Annexes 1 (c) & 2 (b) Doc. 4C/261 Sections 3.2.2 & 4.2 and Annexes 12, 13 & 14 (c)

10 frequency bands are considered in compatibility studies for IMT-2020 by the TG 5/1 ITU-R
3 Working Parties of the ITU-R are directly involved in this work.

There are two approaches to assessing spectrum requirements for IMT-2020:

- Based on the application's requirements implemented by using IMT-2020 (i.e. augmented reality);
- Based on technical requirements and conditions for IMT2020 networks implementation (i.e. to ensure a performance not lower than specified for urban conditions).

Methods	Required bandwidth	Reuired bandwith per bands
Ensure the implementation of all IMT-2020 applications (Method 1)	Minimum - 3.7 GHz Maximum - 18.7 GHz	0.33 - 3.3 GHz (in 24.25-33.4 GHz) 0.81 - 6.1 GHz (in 37-52.6 GHz) 0.93 - 9.3 GHz (in 66-86 GHz)
Provide 1 Gbps simultaneously for N users (Method 2).	3.33 GHz (N=1); 6.67 GHz (N=2); 13.33 GHz (N=4).	Not defined
Some administrations opinion	7-16	2-6 GHz (24.25-43.5 GHz) 5-10 GHz (43.5-86 GHz)

For one operator, at least **100 MHz of spectrum** is required to ensure the creation of a full-grown IMT-2020 network.

There is **considerable variation** in the estimation of spectrum requirements for IMT-2020. In the range above 24 GHz, a spectrum with a width of **3 to 19 GHz** is required.



In-band Services	Studies result
EESS (s-E)	Spatial distance in the range from 1 to 50 km is required for ES SRS (GSO/NGSO)
SRS (s-E)	Spatial distance in the range from 50 to 80 km is required for ES SRS
Fixed Satellite Service (E-s) in 24.65-25.25 GHz	In accordance with criterion I/N = -12.2 dB (interference) margin is from 10 to 30.8 dB, depending on the selected parameters of FSS.
Inter-satellite service	In accordance with criterion I/N = -10 dB (interference) margin is from 7 to 20 dB
Fixed Service	Spatial distance up to 30 km for co-channel case and up to 5 km for adjacent channel case are required

Studies was not conducted for: RadioNavig., RadioLoc., Satellite and Aeronautical Mobile Services

Adjacent band Srvc	Studies result
EESS (passive)	Acceptable interference level is exceeded on 10...30 dB. Unwanted emission level has to be limited in the range from - 51 dB(W/200MHz) to - 40 dB(W/200MHz) or protection band as 1,5 GHz should be provided
Radio Astronomy (23.4-24 GHz)	Exclusion (protection) zone from 50 to 70 km around Radioastronomy stations is required

Studies was not conducted for: Radiolocation, Fixed and Fixed Satellite Services

IMT station sites should be agreed (coordinate).

Antenna elevation angle limitation as well as out-of-band emission level limitation are required

In-band Services	Studies result
Radionavigation Service	Exceeding the interference of the protective criterion by more than 20 dB, the probability of interference is more than 30%. It will be required to provide spatial separation from 50 to 200 km, depending on the type of radar.
SRS deep space (s-E)	Spatial distance in the range from 30 to 60 km is required
Studies was not conducted for: Inter-satellite service (32.3-33 GHz) and Fixed Service (HAPS)	

Adjacent band Services	Studies result
EESS (31.3 -31.8 GHz)	Acceptable interference level is exceeded on 10..25 dB depend sensors type
Radio Astronomy Service (31.3 -31.8 GHz)	Exclusion (protection) zone from 50 to 60 km around Radio astronomy stations is required
Studies was not conducted for: Radiolocation Service (33.4-34.2 GHz) and Space Research Service (31.3 -31.8 GHz)	

Ensuring **compatibility** with existing services is **problematic**.

There is practically **no chance to agreed** on the band **31.8-33.4 GHz** for IMT at WRC-19

In-band Services	Studies result
Fixed Satellite Service (s-E)	Compatibility could be reached with spatial distance in range from 1km to 3 km and it ensures an interference margin up to 13 dB and more
SRS (s-E)	Spatial distance between IMT cluster and ES SRS in the range from 38 to 64 km is required
EESS (E-s)	Spatial distance in the range from 30 to 80 km is required
SRS (E-s)	Spatial distance in the range from 30 to 80 km is required
Fixed Service (HAPS)	Spatial distance in the range from 1 to 2 km is required
Mobile Satellite Service (s-E)	Compatibility could be reached with spatial distance in range from 1 to 2 km and it ensures an interference margin up to 10 dB
Roadcasting Sat. Service	Compatibility could be reached with spatial distance not more than 1 km and it ensures an interference margin up to 15 dB
Radio Astronomy	Exclusion (protection) zone at least 65 km around Radioastronomy stations is required
Fixed Satellite Service (E-s)	In accordance with criterion $I/N = -12.2$ dB (interference) margin is from 15 to 25 dB, depending on the selected parameters of FSS.

Antenna elevation angle limitation for IMT station is required to ensure long-term protection Fixed Satellite Service's stations



Adjacent band Services	Studies result
EESS (passive) in 36-37 GHz	Acceptable interference level is exceeded on 9..20 dB depend on EESS sensors type
SRS (passive) in 36-37 GHz	Acceptable interference level is exceeded on 15..20 dB depend on EESS sensors type
Radioastronomy 42.5-43.5 GHz	Exclusion (protection) zone at least 65 km around Radioastronomy stations is required
<p>Studies was not conducted for: Fixed, Fixed Satellite, Mobile Satellite, Broadcasting Satellite, Radionavigation and Rdionavigation Satellite Services</p>	

Protection band need to be introduced or out-of-band emission level of IMT station is required to ensure compatibility with passive radio services operated in band 36 -37 GHz

Perspective for IMT-2020 in the range 50 GHz (45.5-50.2 AND 50.4-52.6 GHz)

In-band Services	Studies result
AMS (45.5-47 GHz)	Studies are not completed
Fixed Satellite Service (s-E)	Compatibility could be reached with spatial distance not more than 1.5 km and it ensures an interference margin up to 13 dB
FSS (E-s)	Interference margin is 3 dB for NGSO and up to 25 dB for GSO
EESS (passive)	Acceptable interference level is exceeded on 16..29 dB depend on EESS sensors type

Studies was not conducted for: Fixed, Radioastronomy, Amateur, Amateur Satellite, Mobile Satellite, Radionavigation and Rdionavigation Satellite Services

Adjacent band Services	Studies result
EESS (passive)	Acceptable interference level is exceeded on 5..20 dB depend on EESS sensors. Unwanted emission level has to be limited by - 56 dB(W/200MHz) for IMT BS and - 54 dB(W/200MHz) for IMT UE

Studies was not conducted for: Fixed, Fixed Satellite, Amateur, Amateur Satellite, Mobile Satellite, and Rdionavigation Satellite Services

IMT station sites should be agreed (coordinate). Antenna elevation angle limitation as well as out-of-band emission level limitation are required

In-band Services	Studies result
Inter-Satellite Srvc	Level of aggregate interference form IMT network considerably less then allowed (for tenth dBs)
Fixed Service	Required separation distance are varied from hundred meters up to 10 km.
Studies was not conducted for: Fixed Satellite Service (s-E), Mobile Satellite, Broadcasting Satellite, Inter-Satellite, Radionavigation and Rdionavigation Satellite Services	

Adjacent band Services	Studies result
Radiolocation Service in 76-77.5 GHz	Acceptable interference level is exceeded on 5..12 dB. Unwanted emission level of IMT station should be strengthened up to -25...-30 dBm/MHz
Studies was not conducted for: Earth Exploration Satellite, Fixed Satellite, Mobile Satellite, Broadcasting Satellite, Inter-Satellite, Radionavigatio, Rdionavigation Satellite Services and Space Research Service	

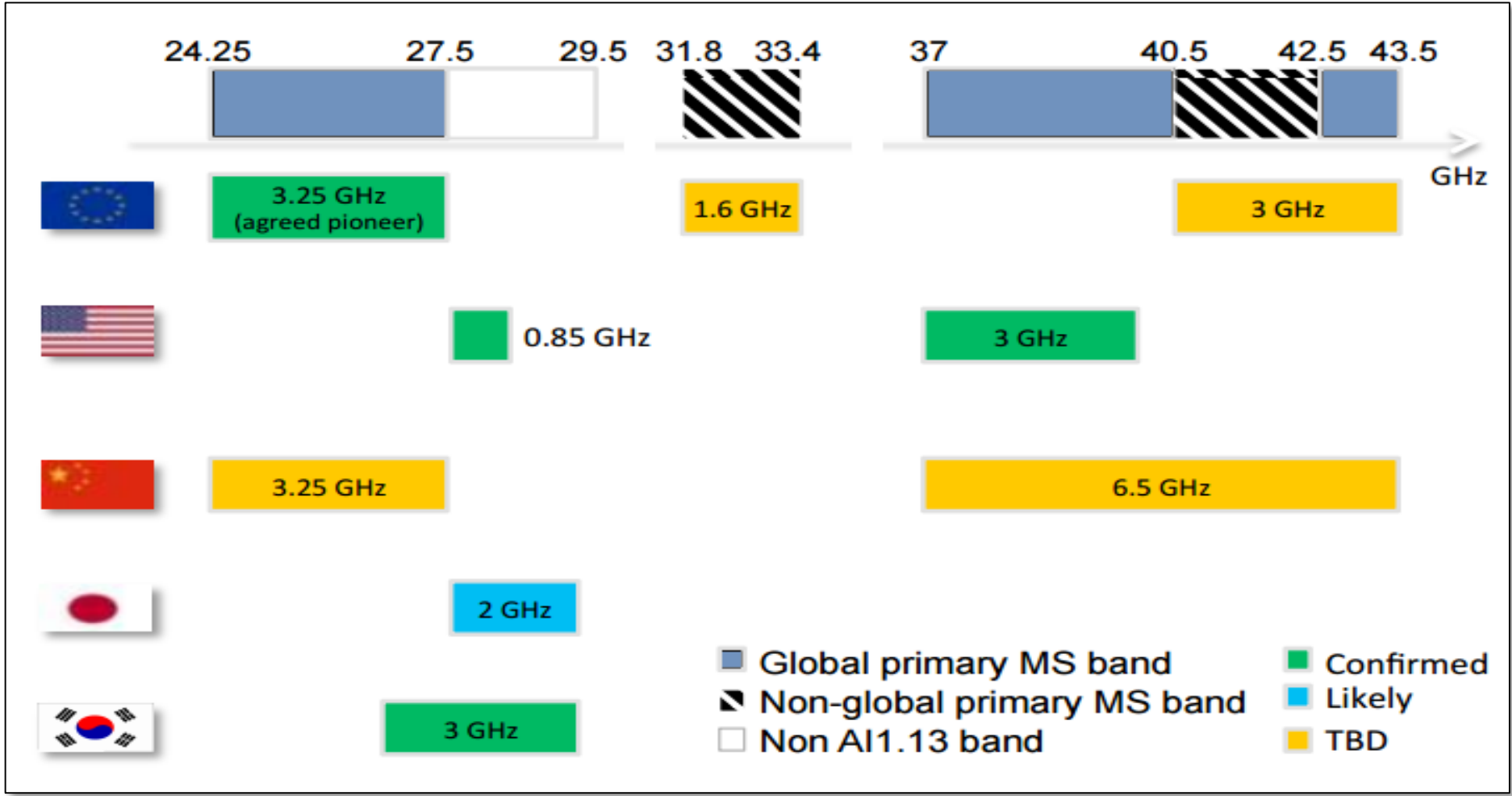
Restriction of the IMT station's **out-of-band** emission is required to ensure compatibility with ultra wideband automotive radars

In-band Services	Studies result
Fixed Service	Coordination during deployment of FS and IMT systems is required for distances from 250 to 950 meters to avoid the interference impact scenario "main beam on main beam". The required separation distance is varied from hundred meters up to 1 km.
Radio astronomy	Exclusion (protection) zone of 7 to 20 km around Radioastronomy station is required
Studies was not conducted for: Fixed Satellite Service (E-s), Mobile Satellite Service (E-s)	

Adjacent band Services	Studies result
Radiolocation in 79-81 GHz	Acceptable interference level is exceeded on 5..12 dB. Unwanted emission level should be strengthened up to -25...-30 dBm/MHz
Radio astronomy in 79-81 GHz and 86-92 GHz	Exclusion (protection) zone of 7 to 20 km around Radioastronomy station is required
EESS (passive) и SRS (passive) в 86-92 GHz	Acceptable interference level is exceeded on 10..28 dB. Unwanted emission level of IMT station should be strengthened

Restriction of the IMT station's **out-of-band** emission is required to ensure compatibility with ultra wideband automotive radars

Frequency bands usage perspective for IMT-2020 in the range above 24 GHz



Radio frequency bands: **26.5-27.5 GHz, 37-43.5 GHz** will be identified most likely.
 The **70/80 GHz** bands can also be agreed by WRC-19



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Saint-Petersburg, Russian Federation, 4-6 June 2018.