



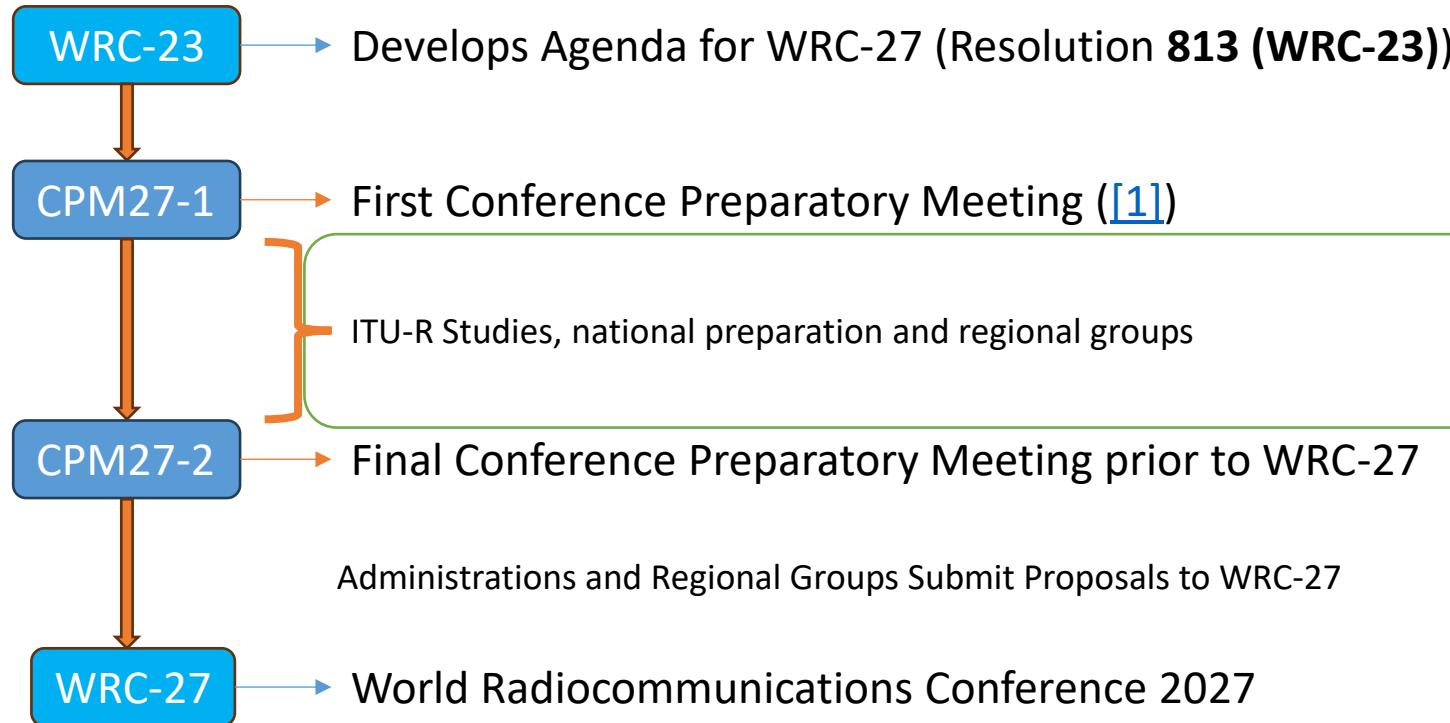
5th India Spectrum Management Conference

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Expert Workshop 4C: WRC-27 agenda items 1.12, 1.13 & 1.14

Bashir Patel
Senior Advisor
Policy, Regulatory & Spectrum

WRC-27 preparation milestones



Satellite Issues: Focus on MSS Agenda Items

1.11 MSS Space to Space Links (ISL)



1.12 NGSO MSS Low data rate allocations



1.13 MSS/IMT direct connectivity



1.14 Additional MSS allocations 2 GHz



WRC-27 Agenda Items with overlapping frequency bands

FOCUS ON
**1.12, 1.13
 & 1.14**

Frequency bands	WRC-27 agenda items (responsible groups)
1 427-1 432 MHz; 1 645.5-1 646.5 MHz; 1 880-1 920 MHz	1.12 (WP 4C); 1.13 (WP 4C)
1 518-1 544 MHz; 1 545-1 559 MHz; 1 610-1 645.5 MHz; 1 646.5-1 660 MHz; 1 670-1 675 MHz	1.11 (WP 4C); 1.13 (WP 4C)
2 010-2 025 MHz	1.12 (WP 4C); 1.13 (WP 4C); 1.14 (WP 4C)
2 120-2 160 MHz; 2 160-2 170 MHz	1.13 (WP 4C); 1.14 (WP 4C)
2 483.5-2 500 MHz	1.11 (WP 4C); 1.13 (WP 4C); 1.15 (WP 7B)
2 400-2 483.5 MHz; 2 500-2 690 MHz	1.13 (WP 4C); 1.15 (WP 7B)
7 190-7 235 MHz	1.7 (WP 5D); 1.15 (WP 7B)
8 450-8 500 MHz	1.15 (WP 7B); 1.19 (WP 7C)
42.5-43.5 GHz	1.6 (WP 4A); 1.16 (WP 7D)
47.2-50.2 GHz; 50.4-51.4 GHz	1.1 (WP 4A); 1.6 (WP 4A)
71-76 GHz	1.10 (WP 5C); 1.16 (WP 7D); 1.18 (WPs 7C & 7D)
81-86 GHz	1.10 (WP 5C); 1.18 (WP 7C & WP 7D)
114.25-116 GHz; 130-134 GHz	1.16 (WP 7D); 1.18 (WP 7C & WP 7D)

Need for consistency in protection criteria across the AIs to protect MSS

WRC-27 Agenda Item 1.12, 1.13 & 1.14

Common Elements

- All focused on the use of MSS Bands for NGSO systems
- Required to conduct studies on spectrum requirements, technical and operational characteristics, and conditions for operation of NGSO MSS systems
- Required to do sharing and compatibility studies for in-band and adjacent bands with existing primary services operating in those frequency bands, as listed, and in the relevant adjacent frequency bands;
- Existing primary services in case of 1.13 include terrestrial mobile services (in-band) as well as mobile satellite services (MSS) in the adjacent bands.
- Must ensure the protection of ALL existing services in accordance with ITU Radio Regulations and Recommendations, as applicable
- CPM methods will include protection criteria for existing primary services in-band and adjacent bands (both IMT and MSS) based on single entry system and aggregate systems;

WRC-27 Agenda Item 1.12

OVERVIEW	<ul style="list-style-type: none"> • To consider specific frequency bands for the future development of low-data-rate non-GSO MSS. • Consider MSS below 5 GHz given the inherent size, weight, and power restrictions of small satellites as described in ITU-R SA.2312. • Access to existing MSS spectrum is heavily encumbered, making coordination challenging.
ITU STUDIES	<ul style="list-style-type: none"> • Description: Definition of low-data-rate MSS • Studies on spectrum requirements • Technical and operational characteristics and conditions • Mitigation techniques that allow the coexistence of these systems in the same frequency bands • Studies on sharing and compatibility between the NGSO low-data-rate MSS systems and the existing primary services operating in the frequency band and in the relevant adjacent frequency bands, to ensure protection of existing services
PROPOSED CPM TEXT	<ul style="list-style-type: none"> • CPM Methods are currently under development for different frequency bands based on inputs. For the frequency bands 1 880-1 920 MHz (ADD Earth-to-space and space-to-Earth with PFD Limits) and for 2 010 – 2 025 MHz (ADD Earth-to-space and space-to-Earth with PFD Limits)
OPEN ISSUES	<ul style="list-style-type: none"> • Description of Low Data Rate requires further clarification. • Transmissions in the opposite direction at 2 GHz within Region 2 • Use of the 1.6 GHz band and appropriate parameters to use • Sharing among multiple Low Data Rate NGSO systems • Overlapping frequency bands with other agendas
REGIONAL POSITIONS	<ul style="list-style-type: none"> • RCC, ASMG, APT CITEL, ATU – need for a precise definition, spectrum requirement, support studies, Remove 1 MHz used for GMDSS (1645.5-1646.5 MHz) • CEPT supports system's need for a global allocation in one or more bands

Agenda Item 1.13: MSS/IMT Direct Connectivity

Frequency band	Receive (MHz)	Transmit (MHz)	Service
VHF Band	137 – 138 MHz	148 – 150.5 MHz	MSS
		156.7625 – 156.7875 MHz	
		156.8125 – 156.8375 MHz	
		161.9375 – 162.0375 MHz	
UHF Band		312 – 315 MHz	MSS
	387 – 390 MHz	399.9 – 400.05 MHz	
	400.15 – 401 MHz	406 – 406.1 MHz	
L Band	1518 – 1559 MHz	1610 – 1613.8 MHz	MSS
	1610 – 1660.5 MHz	1621.35 – 1660.5 MHz	
		1668 – 1675 MHz	
S Band	2170 – 2200 MHz	1980 – 2010 MHz	MSS
	2483.5 – 2535 MHz	2670 – 2690 MHz	
Lower C Band	3400 – 3425 MHz	6425 – 6725 MHz	FSS/MSS Feeder
	3600 – 3700 MHz		
Normal C-Band	3700 – 4200 MHz	5925-6425 MHz	FSS/MSS Feeder
India C Band	4500 – 4800 MHz	6725 – 7025 MHz	FSS/MSS Feeder
	7375 – 7750 MHz	7900 – 8025 MHz	MSS Feeder
Ku Band	10700 – 11700 MHz	13750 – 14500 MHz	FSS/MSS Feeder
Ka Band	17700 – 21200 MHz	27500 – 31000 MHz	FSS/MSS Feeder

Roles/ Responsibilities between WP 4C and 5D

	Roles/Responsibilities	Working Parties		Timeline due date for deliverables
		WP 4C	WP 5D	
1	Description of operational concepts/functionality of direct connectivity between space stations and IMT user equipment	✓		April/May 2025
2	Technical/Operational characteristics of MSS for direct connectivity between space stations and IMT user equipment	✓		April/May 2025
3	Decision on which frequency bands and arrangements to be studied	✓		October 2024
4	Technical/Operational characteristics of terrestrial IMT networks to be used for sharing and compatibility studies		✓	October 2024 (could be extended to February 2025)
5	Sharing and compatibility studies with the incumbent services	✓		April/May 2026
6	Develop the regulatory considerations (measures) e.g., corresponding regulatory limits to protect terrestrial IMT systems for inclusion on the draft CPM text taking into account the comments from WP 4C where applicable		✓	October 2026 (before WP 4C meeting #36). Preliminary results (limits) to be developed by the end of 2025
7	Development of draft CPM text*	✓		October 2026
8	Development of Reports/Supporting Materials	✓		

* From Administrative Circular [CA/270](#): WP 4C should take the lead in developing the draft CPM text by including the WP 5D's results on the regulatory considerations on the protection of terrestrial component of IMT. To facilitate the work, the Chairs of both WPs should coordinate the schedule of WPs meetings, as appropriate, and provide a note to both WPs in this regard

WRC-27 AI 1.13 Frequency Bands

Based on the inputs from WP 5D in accordance with the most recent version of Recommendation ITU-R M.1036, WP 4C, at its October 2024 meeting, agreed to the following list of frequency bands (IMT frequency arrangements) to be studied under agenda item 1.13 and informed contributing Working Parties accordingly.

Directionality	
Uplink(MHz)	Downlink (MHz)
807-849	852-894
880-915	925-960
832-862	791-821
698-716	716-746
776-798	746-768
698-748	753-803
1 427-1 470	1 475-1 518
1 920-1 980	2 110-2 170
1 710-1 785	1 805-1 880
1 850-1 920	1 930-2 000
1 710-1 780	2 110-2 180
2 000-2 020	2 180-2 200
2 010-2 025	1 880-1 920
2 305-2 320	2 345-2 360
2 500-2 570	2 620-2 690

(i) 694/698 – 960MHz
 (ii) 1 427 – 1 518MHz
 (iii) 1 710 – 2 2025 MHz
 and 2 110-2 200MHz
 (iv) 2 300 – 2 400MHz
 (v) 2 500 – 2 690MHz

WRC-27 Agenda Item 1.13

OVERVIEW	<ul style="list-style-type: none"> • To characteristics of the DC-MSS-IMT have been defined • 2 documents worked on 1. On sharing and compatibility studies, and 2. description and functionality of MSS systems for direct connectivity between space stations and IMT user equipment • Several functional and conceptual aspects, such as beam placement, duty cycle, and interference management techniques, were needed to be clarified.
ITU STUDIES	<ul style="list-style-type: none"> • A significant number of sharing studies with different incumbent services have been provided • Based on preliminary study results, the aggregate interference from multiple DC-MSS-IMT systems may range from 0 dB to 3-4 dB, depending on the assumptions applied in the simulation scenarios • Technical considerations for the protection of terrestrial IMT systems are being conducted, and three Primary approaches are currently being evaluated using different calculation methods: <ul style="list-style-type: none"> • PFD per satellite, • aggregate PFD per system, • EPFD per system, and aggregate EPFD for multiple systems.
PROPOSED CPM TEXT	<ul style="list-style-type: none"> • CPM Methods are currently under development for different frequency bands based on inputs. For the frequency bands 1 880-1 920 MHz (ADD Earth-to-space and space-to-Earth with PFD Limits) and for 2 010 – 2 025 MHz (ADD Earth-to-space and space-to-Earth with PFD Limits)
OPEN ISSUES	<ul style="list-style-type: none"> • Finalise interference scenarios that estimate the aggregate interference to IMT receivers from different DC MSS-IMT systems • Conduct further technical considerations in developing protection measures for IMT • Review the received studies regarding the calculation of limits for the protection of IMT terrestrial systems • Review proposed ITU-R recommendations for the protection of existing MSS in adjacent bands • Finalise regulatory measures/protection criteria for existing terrestrial IMT systems and MSS by Oct 26 for the draft CPM
REGIONAL POSITIONS	<ul style="list-style-type: none"> • All regions support the studies, clarity on bands required, as well as the need to clarify various issues related to SNO/MNO, Filing Administrations, and the applicability of unacceptable /harmful interference, terms, and definitions. • Issues related to cross-border, inter-operator interference, spectrum cannibalization, the evolving relationships between MNO/SNO, device readiness, and spectrum choices and all need to be fully addressed during 2026.

1.14 Proposed Frequency Bands

1980-2010 MHz (Region 1 and 3) (Adjacent band)	<ul style="list-style-type: none"> ○ Already allocated in Region 2 ○ Mobile Service, IMT, European Aviation Network (1980-2005 MHz uplink), MSS (earth-to-space) including NGSO and GSO networks ○ Identified for IMT (including satellite component) under Resolution 212
2010-2025 MHz (Region 1, 2, and 3)	<ul style="list-style-type: none"> ○ HAPS as IMT base stations, fixed service (studio transmitter links), SAP/SAB Wireless video links operating in the Mobile Service ○ IMT in adjacent bands (1710-2025 MHz and 2110-2200 MHz)
2025-2110 MHz (Region 1, 2, and 3) (Adjacent band)	<ul style="list-style-type: none"> ○ EESS, SOS and SRS (Earth-to-space), EESS, SOS and SRS (space-to-space) ○ Used for TT&C (Tracking, Telemetry & Command) for spacecraft ○ Footnotes: 5.391, 5.392 (limit high-density mobile systems; protect space-to-space links)
2110-2120 MHz (Region 1, 2, and 3) (Adjacent band)	<ul style="list-style-type: none"> ○ Adjacent band: SRS Deep Space (Earth-to-space) ○ Paired with 1920-1980 MHz for IMT FDD terrestrial systems
2120-2160 MHz (Region 1 and 3)	<ul style="list-style-type: none"> ○ Mobile (IMT) ○ Fixed
2160-2170 MHz (Region 1 and 3)	<ul style="list-style-type: none"> ○ Mobile (IMT) ○ Fixed
2170-2200 MHz (Region 1, 2, and 3) (Adjacent band)	<ul style="list-style-type: none"> ○ Mobile and IMT ○ Adjacent and in-band ACGC terrestrial network characteristics, satellite component of EAN ○ MSS (GSO and non-GSO) ○ Fixed and Mobile services also allocated ○ Identified for IMT satellite component under Resolution 212 ○ Used for MSS downlink (complementary to 1980-2010 MHz uplink)

WRC-27 Agenda Item 1.14

OVERVIEW	<ul style="list-style-type: none"> Growing demand for access for MSS spectrum below 3 GHz globally for IOT, Broadband Today only L and S band frequencies globally available under 2.5 GHz and use of these bands is increasing
ITU STUDIES	<ul style="list-style-type: none"> Study measures to protect existing services when considering additional MSS allocations. Technical, operational, and regulatory measures for protection and future development. Ensure protection of existing services from harmful interference without extra constraints. Continued operation and future development of existing services.
PROPOSED CPM TEXT	<ul style="list-style-type: none"> Working progress as part of preparation of working document, List of open issues/clarifications still required on the studies List of Q/A included in the working document on sharing and compatibility studies to be addressed CPM methods and text to be developed
OPEN ISSUES	<ul style="list-style-type: none"> Protection criteria, technical and operational characteristics, deployment scenarios, simulation duration, etc. for various bands under consideration including those bands used for IMT DL studies, PMSE, IMT UL (inc. HIBS), FS, MS DL, SOS, Some serious challenges in identifying new allocation
REGIONAL POSITIONS	<ul style="list-style-type: none"> RCC (to exclude 2170 MHz), ASMG, CEPT, APT, CITEL, protection of existing services IMT, HIBs, MSS ATU – S band extensively used, supports on-going studies, does not see the need for additional frequency bands;

Common Elements Among 1.12, 1.13, & 1.14

- ❑ Need for consistent MSS Protection Criteria across these agenda items
- ❑ Issues of Overlapping Bands and inter-service and cross-border

MSS Protection Criteria

Als 1.11, 1.12, 1.13, and 1.14 all include in the scope of their studies, potential interference to incumbent MSS systems.

Overall interference margin in MSS systems

- ITU-R Rec M.1183 specifies an **aggregate interference allowance (from all other MSS systems) of 20% of total noise (corresponding to $I/N = -6\text{dB}$, where N is the internal link noise).**
- This remains true also for **systems implementing new technologies in use today (such as adaptive coding and modulation). MSS operators still use it to design their link budgets for GSO systems today. M.1183 applies to GSO MSS systems.** There is no equivalent for NGSO MSS systems
- The typical interference margin is about 1dB for both MSS and FSS systems (this is the link margin required to accommodate the aggregate interference allowed by ITU-R Rec M.1183)
- Any increase in the interference link margin above 1dB could not be justified.

Single-entry criterion

- Rec 1183 specifies a **single-entry interference allowance (from a single MSS system) of 6% of total noise (corresponding to $I/N = -11.25\text{dB}$, where N is the internal link noise).**
- It is essential that the single-entry criterion is used in analyses of interference from one MSS system to another, which is how sharing studies are generally done.

Percentage of time associated with the criteria

- **Rec 1183 specifies that the availability requirement of the service should define the percentage of time for which the criteria should be met.**
- Several ITU-R Recommendations specify an availability requirement in the order of 99.9%, for both safety and non-safety services. See, for example, Rec. 1180 (99.94% availability for AMS(R)S) and Rec. 1476 (99.9% availability for ISDN MSS).
- Any percentage of time below 99.9% would critically endanger all MSS services, including many safety services.

Safety and non-safety

- **Safety services are provided as part of GMDSS and AMS(R)S throughout the bands 1525-1559 MHz and 1626.5-1660,5 MHz (as well as in other bands), see for example RR 5.353A, 5.357A, 5.357, 5.362A, Article 31 and App 15.**
- **The availability requirements of non-safety services are similar to those of safety services.**

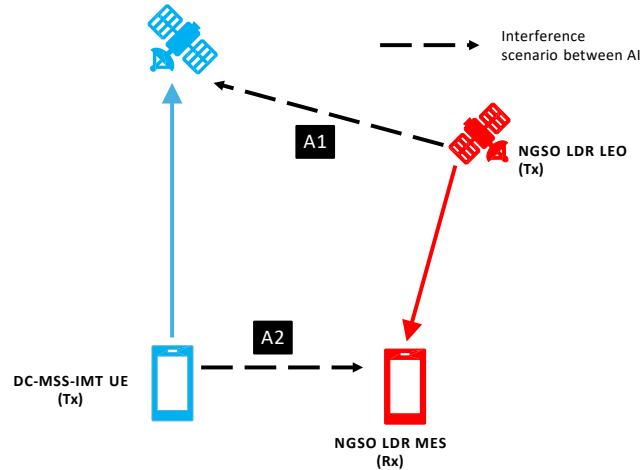
Overlapping Frequency Bands (1/4)

- Some frequency bands are considered simultaneously by two or three of the following agenda items: 1.12, 1.13 and 1.14.

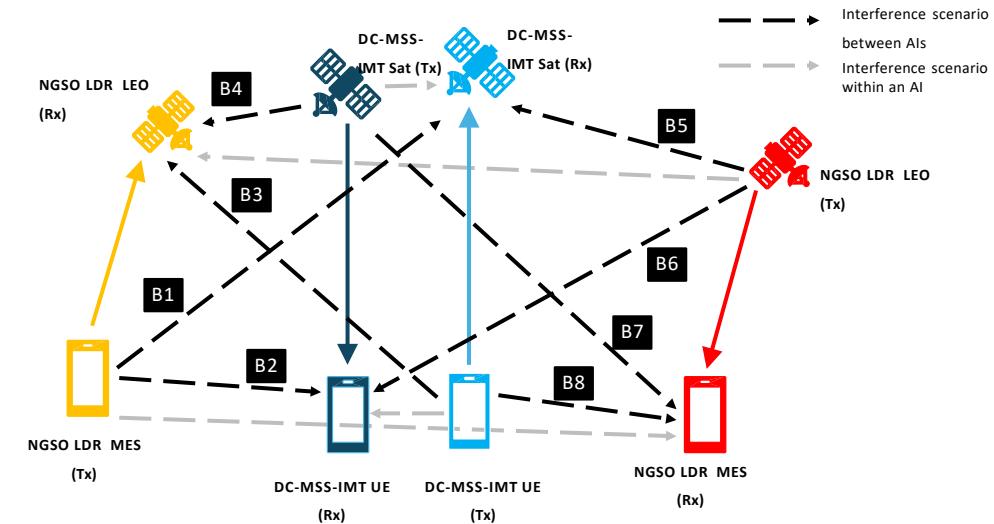
	Band	Existing MSS	AI 1.12	AI 1.13	AI 1.14
(a)	1 427-1 432 MHz	none	MSS↓	MSS↑	-
(b)	1 880-1 920 MHz	none	MSS↓↑	MSS↓↑	-
(c)	2 010-2 025 MHz	MSS↑ (R2)	MSS↓↑	MSS↑	MSS↑ (R1, R3)
(d)	2 120-2 160 MHz	mss↓ (R2)	-	MSS↓	MSS↓
	2 160-2 170 MHz	MSS↓ (R2)	-	MSS↓	MSS↓ (R1, R3)

(No overlap of AI 1.11 with other MSS agenda items)

Overlapping Frequency Bands (2/4)

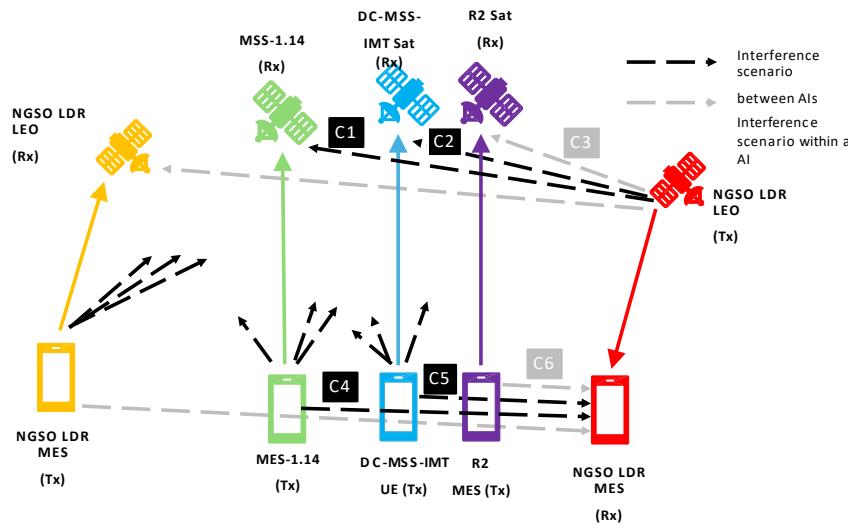


(a) 1 427-1 432 MHz

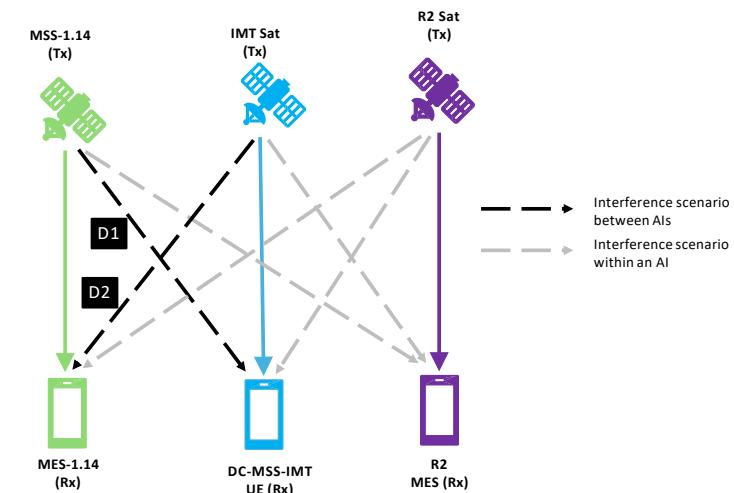


(b) 1 880-1 920 MHz

Overlapping Frequency Bands (3/4)



(c) 2 010-2 025 MHz



(d) 2 120-2 170 MHz

Overlapping Frequency Bands (4/4)

Issues to be Addressed:

1. Do Administrations want the RR to accommodate two (or even three) types of MSS application in the same band?
2. If MSS *uplink and downlink* allocations are desired in the same band, will coexistence between the different MSS applications be feasible? In the same country or in different countries? Under what conditions?
3. Should the same regulatory conditions, e.g. PFD limits, apply to all types of MSS applications equally?
4. Is there a need to ensure controlled/fair access to any band, to accommodate multiple system types?

In-Conclusion

- Progress to date is slow
- Fairly complex issues still need to be fully addressed, particularly on 1.13
- Regulatory and protection criteria for both terrestrial IMT and existing MSS bands to be finalised and incorporated into the draft CPM methods and texts;
- 2026 is a critical year to resolve ALL outstanding issues in preparation for the draft CPM report for April 2027.



2027 & Beyond

New Dawn in Global Connectivity