



INMARSAT

# PART 1 : From WRC-15 to WRC-19 – Setting the basis

International Satellite Symposium 2017  
Bangkok 31 August – 1 September 2017

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# Outline

- Current activities and directions

1. Agenda Items for WRC-19
2. Inmarsat priorities
3. Preparations and organization of studies
4. Striking the right balance with spectrum demand for terrestrial MBB and satellite

# WRC-19 main topics

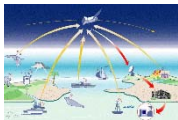
Agenda (Res.809 (WRC-15)): 17 specific & 6 standing items



**Satellite: ESIMs, BSS/FSS @12 GHz, N-GSO FSS @ 37.5 to 51.4 GHz**  
(AI's: 1.4, 1.5, 1.6)



**Regulatory: Space regulations**  
(AI's 7)



**Science: Earth resources & Climate monitoring Weather forecast, DCS improvement, TT&C for N-GSO Sat. of short duration**  
(AI's: 1.2, 1.3, 1.7)



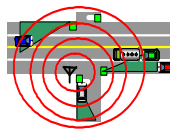
**Maritime: (GMDSS modernization (+Sat.), use of radio devices, VDES Sat component)** (AI's: 1.8, 1.9.1/2)



**Aeronautical: (GADSS needs)** (AI: 1.10)



**Fix/Mob BB: (24.25 < IMT < 86 GHz, HAPS, Apps.Id>275 GHz, WAS/RLAN @ 5 GHz)**  
(AI's: 1.13, 1.14, 1.15, 1.16)



**New Transport systems: (harmonized bands for railways, ITS)**  
(AI's: 1.11, 1.12)



**Amateur: R1 @ 50-54 MHz (4WW allocation)**  
(AI: 1.1)

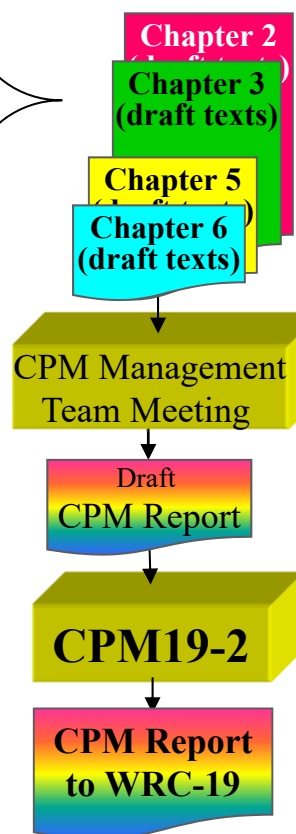
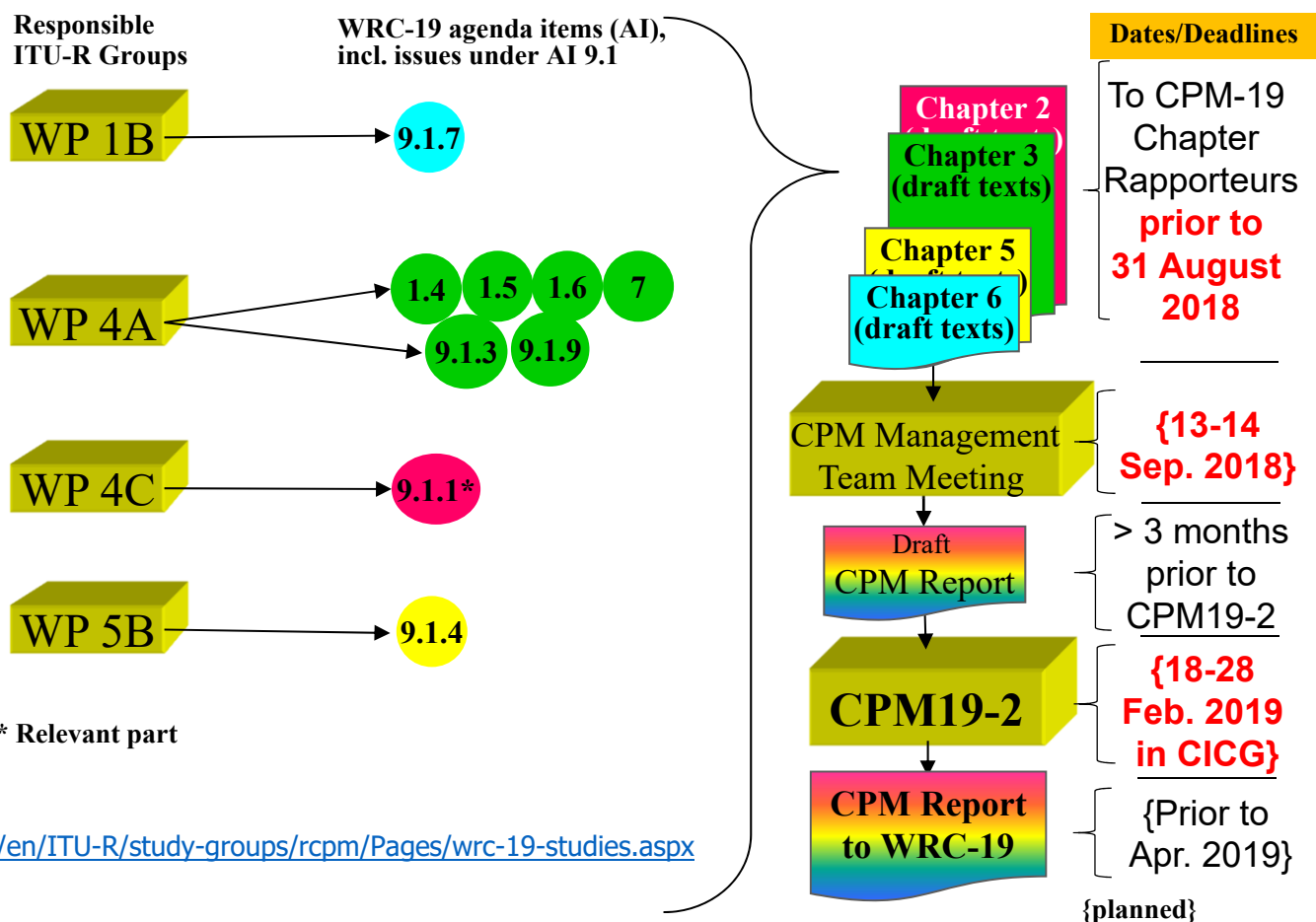
# Other ITU-R Studies on Space Issues

WRC-19 agenda item 9.1

<b>Agenda Item</b>	<b>Resolution (WRC-15)</b>	<b>Topic</b>
9.1.1	212	<b>S-band: terrestrial &amp; satellite co-existence &amp; compatibility @ 1885-2025 /2110-2200 MHz</b>
9.1.3	157	<b>Technical/operational/regulatory studies for new N-GSO satellite in “C-Band” allocated to FSS</b>
9.1.4	763	<b>Stations on board sub-orbital vehicles</b>
9.1.7	958	<b>Managing unauthorized operations of Earth station terminals</b>
9.1.9	162	<b>FSS needs @ 51.4-52.4 GHz</b>



# ITU-R CPM Report Preparation (key space issues)



# Inmarsat Priorities

High Importance				Medium Importance		Low Importance	
AI 1.5	ESIMs in shared Ka-band	AI 1.14	HAPS	AI 1.6	NGSOs in Q/V band	AI 1.11	Railway systems
AI 1.8	GMDSS	AI 7	ITU satellite filing procedures	AI 9.1.3	NGSO FSS in C-band	AI 1.12	Intelligent Transport Systems
AI 1.10	GADSS	AI 9.1.1	S-band IMT sharing	AI 9.1.9	New FSS (E-s) allocation in 51.4-52.4 GHz	AI 1.16	RLANS
AI 1.13	IMT above 6 GHz	AI 9.1.7	Unlicensed VSATs	AI 9.1.4	Sub-orbital vehicles	AI 4	Review of Res. & Rec
						AI 8	Deletion of countries from footnotes



## PART 2 : Non-WRC L-band and C-band issues

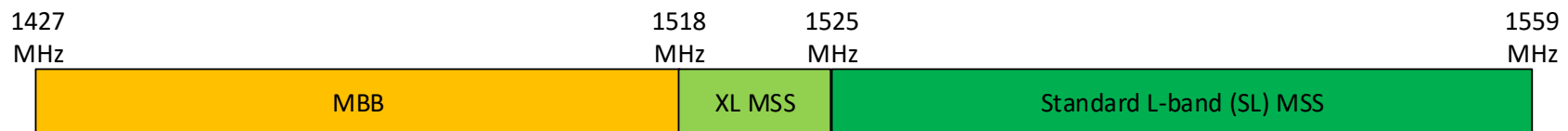
- Matters of significance to the MSS

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# L-band : Example Inmarsat plans for APAC

1518 – 1559 MHz



## Mobile Broadband (or LTE or IMT)

- In Europe planned for Downlink only (SDL) – places transmitting base station below 1518 MHz
- Africa and Asia-Pacific seeking FDD or SDL – places transmitting base station just below 1518 MHz, transmitting mobile terminal just below 1469 MHz.
- UAE favouring TDD – places transmitting base station and transmitting UT just below 1518 MHz

## MSS

- Current use by Inmarsat in APAC is standard L-band (SL) only
- Alphasat added Extended L-band (XL), with coverage of Europe, Middle East and Africa from 2013
- Inmarsat-6 satellites will include both XL and SL – launching 2020
- New Inmarsat terminals have been capable of tuning over XL and SL since around 2012 – including terminals used for safety communications



## L-band – Inmarsat proposed future situation for APAC

- Inmarsat will be seeking authorisation to operate in XL frequency bands from around 2020.
- Assuming that regulators will licence 1427-1518 MHz for MBB, there is a significant potential interference risk to MESs – both existing and future terminals.
- Inmarsat will recommend aiming for at least 3 MHz guard band (placing MBB below 1515 MHz). The extra guard band allows for lower OOB emissions from MBB base station and allows MES to have improved resilience to blocking.



- Legacy MESs will be particularly vulnerable to interference, but even future MES will require some deployment constraints on MBB near ports and airports.
- Decisions are being made now about the frequency arrangements for MBB (in ITU, AWG and 3GPP), including the guard band... so important to act now.

## L-band – Activity in APT and ITU

- ITU-R is developing new Report and Recommendation for technical studies – progress is slow. Needs to define IMT emission limits and deployment constraints near ports and airports. Planned to complete June 2018.
- ITU-R (WP 5D) is developing frequency arrangement options for MBB (Recommendation M.1036). Planned to complete Oct 2018. Guard band options are currently: 3 MHz, 1 MHz, 0 MHz.
- APT AWG is developing a report on MBB frequency arrangements. Guard band options are currently 3 MHz and 1 MHz.
- AWG current questionnaire seeking information on planned MSS use above 1518 MHz – will influence the choice of the guard band at 1518 MHz. Deadline for responding to questionnaire: 22 September 2017

# Inmarsat proposals

## Next steps

- Inmarsat is working with terminal manufacturers to improve resilience to blocking interference, but new designs will take time to be deployed

In the meantime, Inmarsat suggests a strategy (domestically and internationally) as follows :

- **Administrations consider responding to AWG questionnaire to indicate that authorisation of MSS in XL band will be a planning contingency**
  - Start investigations/planning to make the band 1518-1525 MHz available for MSS
  - Consider that MBB frequency arrangements retain the 3 MHz guard band option.
  - Inmarsat will pursue international Recommendations for MBB emission limits and deployment restrictions to ensure compatibility with MSS operations in ports and at airports.
  - If the 1.5 GHz is made available for MBB, Inmarsat will propose to apply conditions for compatibility with the MSS (e.g. 3 MHz guard band, EIRP limit, OOB emission limit, extra constraints at airports/ports)

## C – Band Matters

- Preservation of extended C-band Feeder links for the L-band service
- Pressures for MBB spectrum assignment for IMT
- Not able to re-tune into standard C-band



## PART 3 :

### From WRC-15 to WRC-19 – Key satellite developments

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# ESIMs in Ka-band (AI 1.5)

17.7-19.7 GHz ↓ and 27.5-29.5 GHz ↑



Establish a regulatory framework for the operation of ESIM in the bands 17.7-19.7 GHz and 27.5-29.5 GHz, while ensuring protection of, and not imposing undue constraints on, services allocated in those frequency bands.

WRC-15 introduced regulations for ESIM operating in the frequency bands 19.7-20.2 GHz and 29.5-30 GHz, contained in Resolution **156 (WRC-15)**. Resolution **158 (WRC-15)** invites the ITU-R to conduct studies related to the possible extension of the frequency range for ESIM to include the bands 17.7-19.7 GHz and 27.5-29.5 GHz. The potential use of these bands by ESIM introduces a number of new sharing issues with the allocated services which have been addressed by the ITU-R studies.



Due to the foreseen growing demand for ESIM and because ESIM terminals are 'in motion' and world-wide used, the regulatory framework for these terminals needs to be as simple and practicable as possible.

# ESIMs in Ka-band (AI 1.5)

## Positions & Preliminary views

### CEPT

Europe has harmonised the 27.5-29.5 GHz band for satellite broadband and is supportive of the worldwide use of this band for ESIM.



**This band  
is NOT available  
for 5G!**

### APT Preliminary Views

Taking into account Resolution 158 (WRC-15), APT Members support ITU-R studies for regulatory issues and conditions on sharing and compatibility between ESIM and existing services allocated in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz to ensure protection of, and not impose undue constraints on the existing services and their future development.

Some APT Members are of the view that there may be no need for additional studies between receiving ESIM terminals and other services in the frequency band 17.7-19.7 GHz, because ESIM terminals are receiving and GSO FSS satellites that support ESIM terminals are no different from GSO FSS satellites that operate stationary FSS earth stations.

## Regulations for non-GSO FSS systems in 50/40 GHz (AI 1.6) (1/2)

47.2-50.2 GHz ↑, 50.4-51.4 GHz ↑ /  
37.5-39.5 GHz ↓, 39.5-42.5 GHz ↓



Development of a regulatory framework for non-GSO FSS systems that may operate in these bands (Resolution 159 (WRC-15):

Article **22** of the Radio Regulations contains provisions to ensure compatibility of NGSO FSS operations with GSO networks. Among these provisions are uplink and downlink equivalent power flux density (epfd<sub>↑</sub> and epfd<sub>↓</sub>) limits to protect GSO networks in the 14/11 GHz and 30/20 GHz frequency bands from unacceptable interference pursuant to RR No. **22.2**. In the 50/40 GHz band RR No. **22.2** applies but there are currently no technical measures and regulatory framework for sharing between non-GSO systems and GSO networks.

### **CEPT**

CEPT considers that studies for the development of regulatory provisions and technical and operational conditions shall ensure protection for GSO satellite networks and stations of other existing services including passive services in the adjacent frequency bands. To ensure the protection of the EESS (passive) and RAS. CEPT supports to study the effects of aggregate FSS interference from GSO satellite networks and NGSO systems operating in the relevant bands.



## Regulations for non-GSO FSS systems in 50/40 GHz (AI 1.6) (2/2)

47.2-50.2 GHz ↑, 50.4-51.4 GHz ↑ /  
37.5-39.5 GHz ↓, 39.5-42.5 GHz ↓



### **CEPT (continued)**

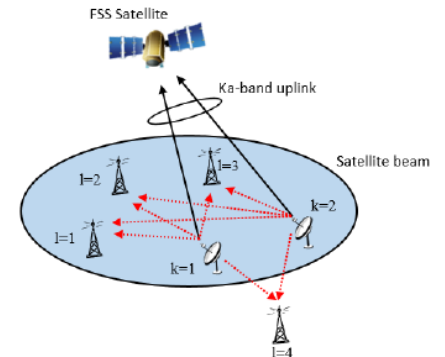
CEPT considers that the criteria based on Recommendation ITU-R S.1323 or other new possible ITU-R Recommendation shall be used while developing the aggregate epfd limits for protection of GSO networks. CEPT supports a methodology of interference assessment that takes into account the correlation between a fading event attenuating both the wanted signal and interfering signals in the frequency bands 40/50 GHz. CEPT supports further studies on methodology of interference assessment applicable to frequency bands above 30 GHz to verify compliance with the criteria in Recommendation ITU-R S.1323.

### **APT Preliminary Views**

APT members support studies on technical and operational issues and regulatory provisions of non-GSO FSS satellite systems in the frequency 50/40 GHz bands while ensuring protection to GSO satellite networks in FSS, MSS and BSS, and other existing services in the same bands as well as protection of the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz and the radio astronomy in the frequency bands 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz.

# Terrestrial & satellite co-existence & compatibility in the S-band (AI 9.1.1)

1885-2025 MHz ↑ / 2110-2200 MHz ↓



Possible technical and operational measures to ensure coexistence and compatibility between the terrestrial and satellite components of IMT in the S-band, , in particular for the deployment of independent satellite and terrestrial components of IMT and to facilitate development of both components.

CEPT is of the view that it is required to carry out compatibility studies and to define compatibility conditions of terrestrial component of IMT (in the mobile service) and satellite GSO and NGSO systems (in the mobile satellite service) in the frequency bands 1980–2010 MHz and 2170–2200 MHz considering the case that these frequency bands are used by the mobile service and mobile satellite service in different countries.

APT members supports conducting ITU-R studies on possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT and the satellite component of IMT in these frequency bands.



# Managing unauthorized operations of Earth station terminals (AI 9.1.7)

## Possible need for additional regulations

*Possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. 18.1, and the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory ITU-R studies ongoing.*

Regarding the necessity of obtaining a license/authorisation for the operation of the ES terminals with mobility on a territory where it is not authorized/licensed, some administrations are of the opinion that appropriate regulatory provisions could be included into a new WRC Resolution (in line with WRC-15 Resolution 156 for Ka-band ESIMs), incorporated by reference to the RR, or making additional provisions in Article 18 of the RR. Other Administrations are of the opinion that the issue of FSS ES operating while in motion should not be considered under this issue, but, instead under WRC-19 agenda item 1.5.

CEPT notes that this Agenda Item addresses the issue of enforcement of unauthorized ubiquitous FSS earth stations and not the issue of earth stations in motion (ESIM) which is covered by Agenda item 1.5. CEPT does not see the need for any changes of the Radio Regulations. Furthermore, CEPT is of the view that this issue is already addressed in Article 18. CEPT supports possible ITU-R studies on best practices, related to national management of unauthorized operation of earth station terminals deployed within territory of concerned administration.

APT Members are of the view that earth station licensing and related issues are national matters and no changes to the Radio Regulations are necessary as Article 18 sufficiently addresses the required international regulatory measures.

# Improvement to the satellite regulatory framework (AI 7)

## Issues



Issue APG-2	Subject	Position
A	Bringing into use (BIU) for NGSO FSS networks/systems	Reduce no. of methods being proposed.
B	Coordination arc in the Ka-band (FSS and other satellite services)	Pursue studies versus not apply any coord arc
C1-C6	Issues for which consensus was readily achieved in ITU-R	Consensus on the simple improvements to RR.
D	Bureau's identification of coordination requirements under RR Nos. 9.12, 9.12A, 9.13, and possibly 9.21	MOD 9.21 but no consensus.
E1-E3	Harmonization of RR Appendix 30B with RR Appendices 30 and 30A	Two proposal under discussion.
F	Concerns with the lack of implementation of certain RR provisions that can lead to difficulties during the process of entering an assignment into the RR Appendix 30B List	Studies in preliminary phase.
G	Updating the Regions 1 and 3 RR AP30/30A reference situation when a provisionally recorded frequency assignment becomes definitive	Complex: studies ongoing.
H	Modifications to RR Appendix 4 data elements to be provided for non-geostationary satellite networks/systems	Studies to be initiated at next meeting.
X,Y,XX	3 separate new issues	

## Overlapping frequency bands (GHz) between some WRC-19 agenda items

1.6 – NGSO FSS Res. 159 (WRC-15)	1.13 – IMT Res. 238 (WRC-15)	1.14 – HAPS Res. 160 (WRC-15)	9.1 (9.1.9) – FSS Res. 162 (WRC-15)
	24.25-27.5	24.25-27.5 (Reg. 2)	
37.5-39.5 ↓	37-40.5*	38-39.5 (globally)*	
39.5-42.5 ↓	40.5-42.5*		
47.2-50.2 ↑	47.2-50.2*		
50.4-51.4 ↑	50.4-52.6*		51.4-52.4 ↑

\*) Overlaps with bands used or planned to be used by existing satellite operators

Need for studies to **address mutual compatibility & sharing feasibility** among the **services/applications** for which **allocation/identification is envisaged** under the corresponding Resolution relating to the AI in the overlapping bands

# WRC Process

## Vital for the satellite industry



- ✓ **Satellites provide essential services to society:** safety & security, remote & rural land coverage, aviation & maritime mobility services, ubiquitous access to connectivity
- ✓ **Satellites are dependant on the international regulatory framework:** *Radio Regulations* (international treaty) provide rules and ITU-BR execute management for the implementation of satellite services
- ✓ ***Radio Regulations* need regular updates:** to reflect technological development and to address new requirements
- ✓ **Satellite investments need regulatory certainty and stability:** given its long duty-cycle for design/satellite generation change and high upfront CAPEX

WRC Process has to strike balance to accommodate needs of satellite industry and other services to continue to be responsive to the growing demand for wireless applications **using space and terrestrial means**, to reach the UN global goal of connectivity to everyone/everywhere: **a WIN-WIN approach in the 5G world.**