UK SPF CLUSTER 4 ITU WRC-2027 Earth Exploration and other Space Science Satellite Services

Friday 25 September 2025 14:00 - 16:00



Housekeeping

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- Slides will be shared with speakers' permission
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Agenda

14:00- 14:10	Welcome and introduction	Kumar Singarajah, UK SPF Cluster 4 Chair and Tales Gaspar, UK SPF
14:10- 14:25	Overview by MetOffice (UK): Key Goals for EESS at WRC-2027	Safana Judge, Spectrum Manager, Met Office
14:25- 14:40	Presentation by ECMWF on Key WRC-2027 Issues	Stephen English, Deputy Director of Research, ECMWF
14:40- 14:55	Presentation by Eumetsat on Key WRC-2027 Issues	Markus Dreis, Frequency Manager, EUMETSAT
14:55- 15:10	Presentation by ESA on Key WRC-2027 Issues	Bruno Espinosa, Frequency Management Officer, ESA
15:10- 15:25	Presentation on WRC-2027 AI 1.7 viz IMT / EESS Issues	Ingrid Di Lucia, Junior Regulatory Affairs Specialist, Leaf Space
15:25- 16:10	All	Panel and Q&A
16:10- 16:15	AOB and Close	Kumar Singarajah, UK SPF Cluster 4 Chair

Welcome and introduction

Kumar Singarajah, UK SPF Cluster 4 Chair and Euroma

Overview by MetOffice (UK): Key Goals for EESS at WRC-2027

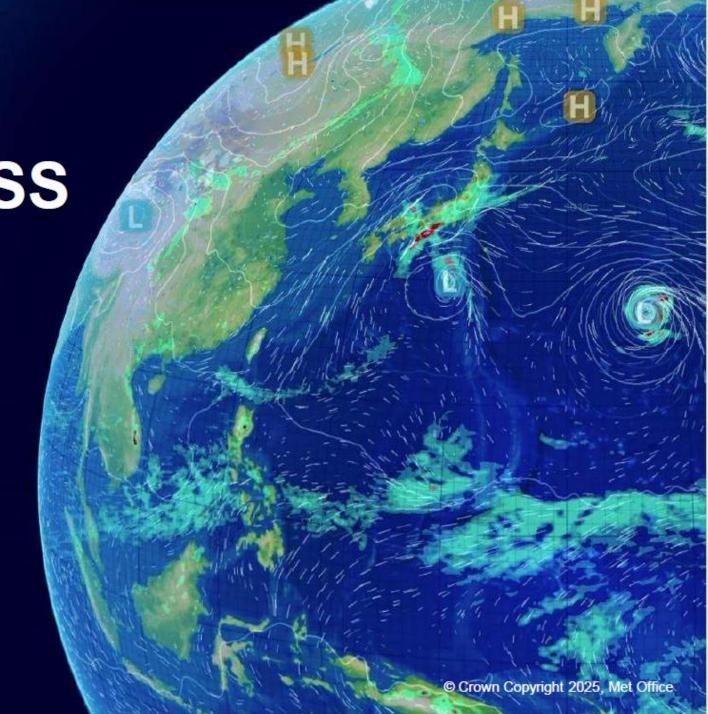
Safana Judge, Spectrum Manager, Met Office



Key Goals for EESS at WRC-2027

September 2025

Safana Judge – Spectrum Policy Manager





Outline

- How the Met Office uses Earth Exploration-Satellite Service spectrum
- 2. WRC-27 Agenda Items of interest
- 3. How the Met Office is managing these



1. How the Met Office uses EESS Spectrum



How we use Spectrum in the Met Office

Passive Sensing

(EESS (passive))



Active Sensing

(Radiolocation/EESS (active))



Communications

(MetAids/MetSat/FSS)

Radiosondes Buoys Weather radar Satellites International data exchange



Weather forecast process



Observations

Modelling & Computing

Meteorologists



This supports

Weather forecasting



Climate monitoring



Disaster response



National resilience





Key concerns



There are no alternative bands for many meteorological measurements



Increasing demand from new technology poses new risks of interference



There are significant societal impacts if EESS Spectrum is not protected



2. WRC-27 Agenda Items of interest: threats & opportunities



WRC-27 Agenda

12 WRC-27 agenda items are of interest to the weather and climate science community.

Some are **threats** which could have a negative impact on existing observing systems.

Some are **opportunities** and could improve the protection of existing observing systems

	Item	Description	Frequency Bands		
	1.1	ESIMs to GSO/NGSO in 47.2 to 51.4 GHz 'V-band'	47.2-51.4 GHz		
	1.3	NGSO gateway FSS in 51.4-52.4 GHz	51.4-52.4 GHz		
	1.4	FSS (S-E) in regions across 17.3- 17.7/8 GHz)	17.3-17.8 GHz		
	1.7	IMT in 4 400-4 800 MHz, 7 125-8 400 MHz (or parts thereof), and 14.8-15.35 GHz	4.4-4.8 GHz, 7.125-8.4 GHz, 14.8 - 15.35 GHz		
	1.8	Radiolocation 231.5-275/700 GHz	231.5-700 GHz		
	1.11	L-band space-to-space links (GSO/NGSO for MSS)	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 , 2 483.5-2 500 MHz		
	1.12	Low-data-rate non-geo MSS in L/S Bands	1 427-1 432 MHz, 1 645.5-1 646.5 MHz, 1 880-1 920 MHz, 2 010-2 025 MHz		
	1.13	MSS in IMT Bands to complement MS IMT	694-960 MHz, 1427-1518 MHz, 1710-1785 MHz, 1805-2025 MHz, 2110-2200 MHz, 2300-2400 MHz, 2500-2690 MHz		
	1.14	Additional MSS allocations	2 010-2 025 MHz, 2 160-2 170 MHz, 2 120-2 160 MHz		
	1.17	Receive-only Space Weather allocations	27.5-28.0 MHz, 29.7-30.2 MHz , 32.2-32.6 MHz, 37.5-38.325 MHz , 73.0-74.6 MHz, 608-614 MHz		
	1.18	EESS (passive) & RAS above 76 GHz	86-92 GHz, 114.25-116 GHz, 164-167 GHz, 200-209 GHz		
	1.19	EESS (passive) 'SST' in 4 200-4 400 MHz and 8 400-8 500 MHz	4.2-4.4 GHz, 8.4-8.5 GHz		



3. How is the Met Office managing these?



Met Office actions

We are **following the development of studies** and to understand how possible outcomes could impact our usage.

We're working with **Ofcom**, **DSIT** and **UK partners** so they understand our usage and how this supports UK citizens.

We're also working with WMO, EUMETSAT & EUMETNET to build support from other ITU members across the regional groups.





Conclusions



Access to spectrum is essential for many of the observing systems which underpin our services



New technology is increasing demand for spectrum



We need to work in partnership to safeguard our spectrum interests



Questions and further information

Preliminary WMO position on the WRC-27 Agenda: WMO Position on the WRC-27 Agenda | World Meteorological Organization



Presentation by ECMWF on Key WRC-2027 Issues

Stephen English, Deputy Director of Research, FCMWF



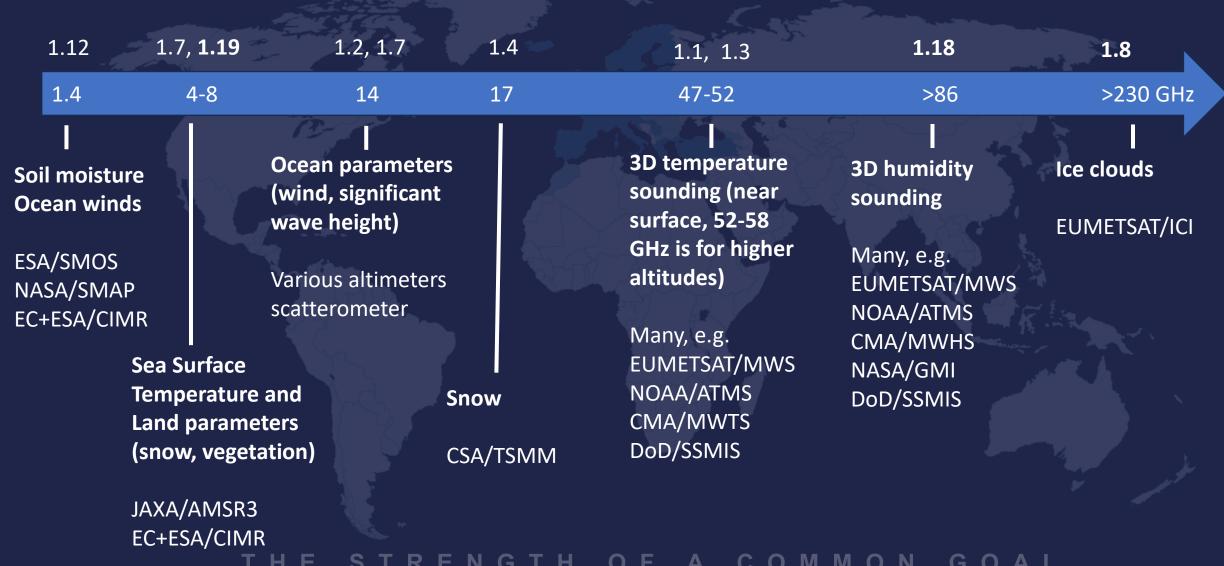
Presentation by ECMWF on Key WRC-2027 Issues

Stephen English
Deputy Director Research ECMWF



THE STRENGTH OF A COMMON GOAL

WRC Als of importance to weather prediction and climate monitoring and prediction



WRC Als of importance to weather prediction and climate monitoring and prediction



1.19 and C-band (4-8 GHz)

1.19 and C-band (4-8 GHz)

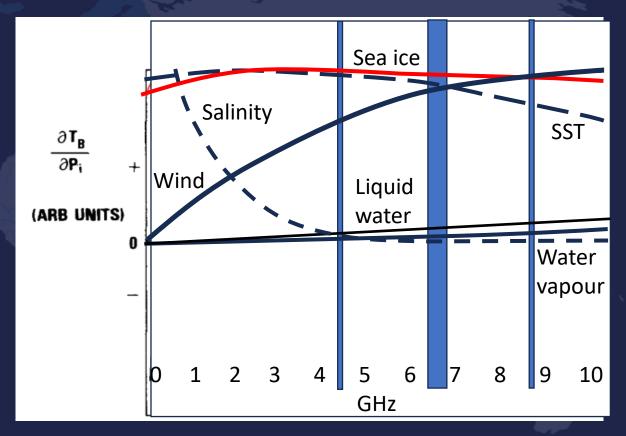
4 and 8 compared to 6 GHz

Less bandwidth is main factor!

Then field of view size

Geophysical sensitivity comparable across C-band

Parameter	4 GHz	8 GHz	
SST	Similar	Weaker	
Salinity	Stronger	Similar	
Wind	Weaker	Stronger	
Vapour	Weaker	Stronger	
Cloud	Weaker	Stronger	
Sea ice	Similar	Similar	

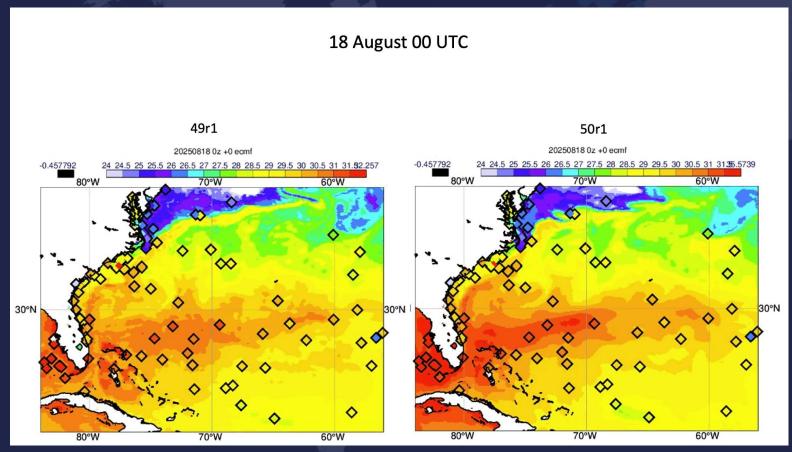


Wilheit, 1979, adapted Kilic 2019

C-band is unique in providing SST information in all weather conditions including under hurricanes

New methods in weather prediction needs better SST (Sea Surface Temperature) observations

Hurricane Erin reach strongest category (5) and had major impact on the North Atlantic – but infrared observations can't see through the clouds the hurricane brings



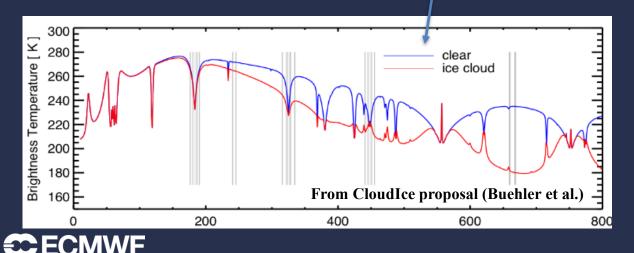


THE STRENGTH OF A COMMON GOAL

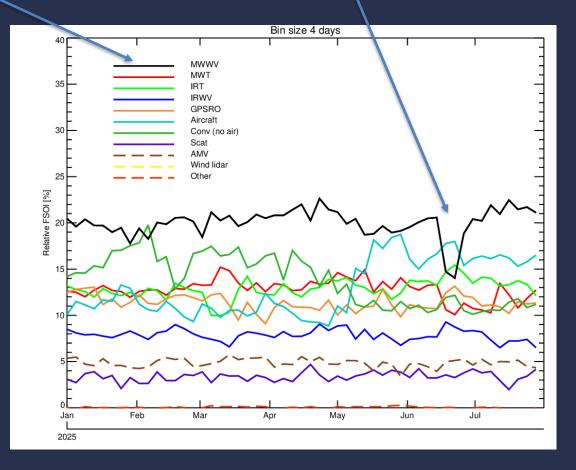
1.18 > 86 GHz, 1.8 > 230 GHz

High frequency channels – why are they important?

- 1. They provide **humidity** information
 - "all sky" data assimilation methods have made humidity sensitive microwave observations the most impactful
- 2. Above 200 GHz sensitivity to ice cloud increases.
 - Provides ice cloud information
 - But means a number of independent bands are needed to separate impact of cloud from impact of humidity.



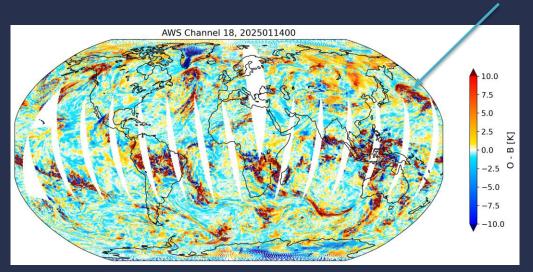
Note – this dip was an outage of Chinese humidity sounder data: This was **not** RFI but shows what could happen if RFI impacts these observations



Arctic Weather Satellite

 We already have experience with higher frequency observations from the AWS mission

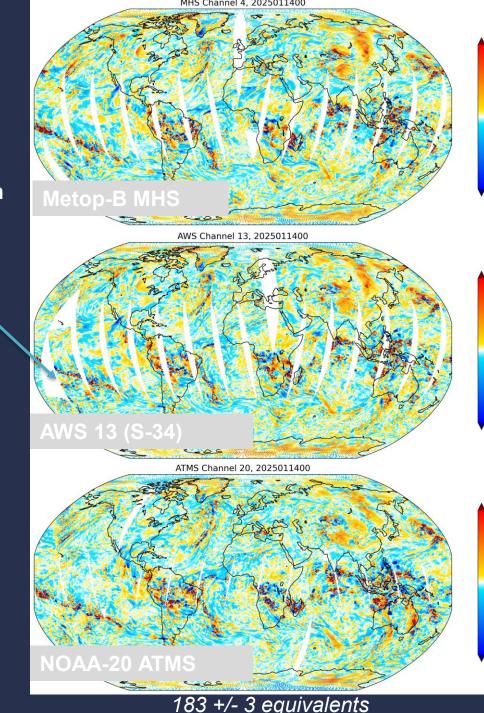
Sub-mm provides much larger cloud signals



Equivalent AWS 325 GHz channel

Weather community calling for many years for sub-mm on sounder missions:

e.g. T. R. Sreerekha, A. Doherty and S. English, "Potential of 229-GHz Channel for Ice-Cloud Screening," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 48, no. 5, pp. 2183-2188, May 2010, doi: 10.1109/TGRS.2009.2032174



The science community is impacted by the WRC decisions, but it is often unaware of it. Science inputs are often beneficial in discussion within ITU or regional groups.

The group ESSEO (European Scientists on Spectrum for Earth Observation) was formed.

ESSEO's goals are to:

Narrow the gap between European scientists and frequency management activities (focus is on WRC-27)

Provide a more solid scientific basis for ESA-EUMETSAT positions

Informed view on **impact of RFI**

Assessment of the **value of bands** in operations and research

Align European spectrum activities with science strategies (→ ESA **EO** Science Strategy studies)

ESSEO membership includes:

- Meteorological centres
- Climate and research centres
- Universities
- Space agencies

Together, the group has a wide range of expertise, including:

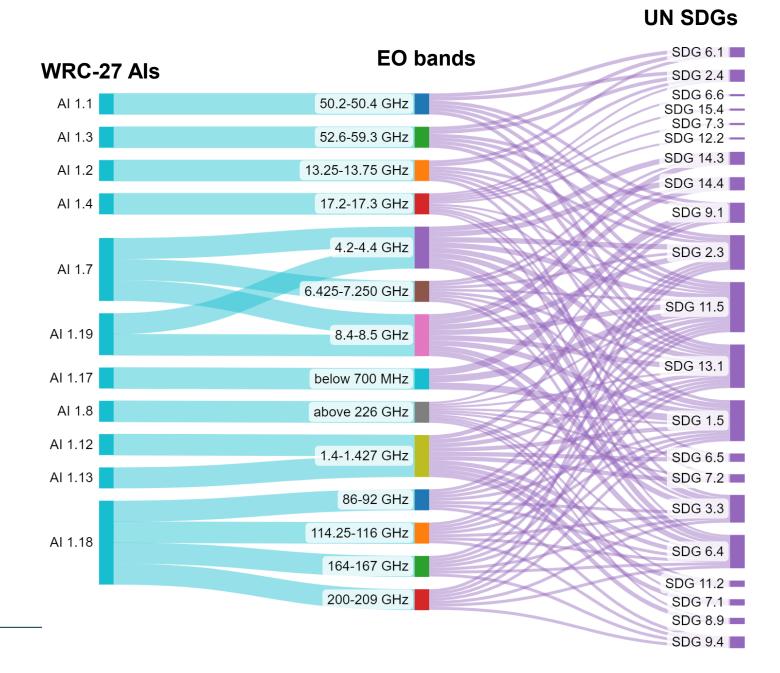
- Active MW
- Passive MW
- Meteorology
- Climate
- Space weather

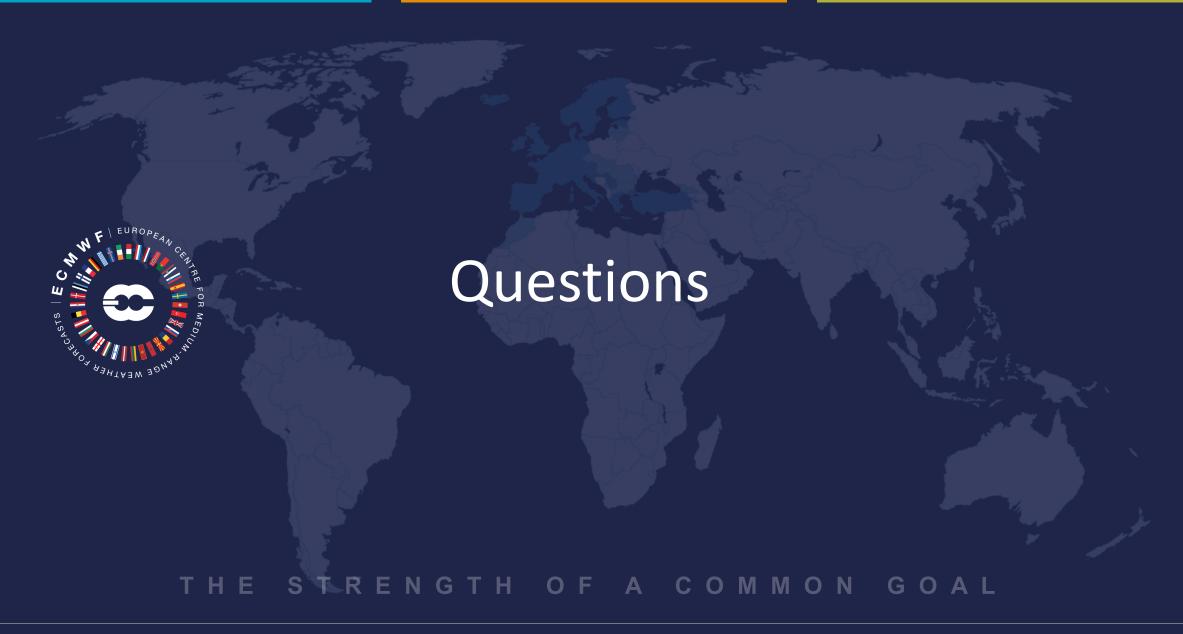
Yan Soldo, Bruno Espinosa, Josep Roselló, Flávio Jorge, Steven George, Malcolm Davidson, Craig Donlon		ESA	
Stephen English (Chair)		ECMWF	
Giulia Panegrossi (Co-Chair)	IT	CNR	
Jesse Andries		WMO	
Alessandro Battaglia	IT	PoliTo	
Philippe Chambon	FR	Météo-France	
Markus Dreis		EUMETSAT	
Karsten Fenning	D	DWD	
Chawn Harlow	UK	UK Met Office	
Kenneth Holmlund	FIN	Retired	
Yann Kerr	FR	CNES/CESBIO	
Andrea Monti Guarnieri	IT	PoliMi	
Catherine Prigent	FR	CNRS	
Melody Sandells	UK	Northumbria University	

Structure of the first document:

WRC-27 AI:

- Regulatory background
- Importance for EO
- Relevance for the UN SDGs
- Summary





Presentation by Eumetsat on Key WRC-2027 Issues

Markus Dreis, Frequency Manager, EUMETSAT







EUMETSAT, an intergovernmental organisation

EUMETSAT is an intergovernmental organisation based in Darmstadt, Germany, with 30 member states formed in 1986 with the UK as one of the founding members.

It is a user-governed operational organisation which serves the needs of its member state providing 24/7 with weather and climate data.

EUMETSAT currently operates geostationary meteorological satellites of the second and third generation, Meteosat -10, -11, -12, and MTG-S1 (still in commissioning) at orbital positions over Europe and Africa, and Meteosat-9 over the Indian Ocean.

It also operates two polar-orbiting satellites, Metop-B and -C, as part of the Initial Joint Polar System (IJPS) shared with the US National Oceanic and Atmospheric Administration (NOAA) and has recently launched the first Metop second generation satellite, Metop-SGA1 (still in commissioning) with significantly increased sensing capabilities.

In addition, EUMETSAT is a partner in the cooperative sea level monitoring Jason missions (Jason-3 and Jason-CS/Sentinel-6) involving Europe and the United States.

Furthermore, EUMETSAT exploits four Sentinel missions of the Copernicus space component dedicated to the monitoring of atmosphere, ocean and climate. EUMETSAT carries out these tasks in cooperation with ESA and already exploits the Sentinel-3 and Sentinel-6 marine missions.



Frequency bands used by current EUMETSAT missions

	www.eumetsat.int				
	Communications	Passive Sensing		Active Sensing Other Instruments	
Up- and downlink for GSO and NGSO MetSat Data Collection Systems (DCS)	399.9 – 400.05 MHz 400.1 – 403 MHz 460 – 470 MHz	10.6 – 10.68 GHz 10.68 – 10.7 GHz 18.6 – 18.8 GHz 23.6 – 24 GHz	Shared RR 5.340 RR 5.340 RR 5.340	5150 – 5250 MHz 5250 – 5350 MHz 5350 – 5460 MHz 5360 – 5470 MHz	1164 – 1215 MHz 1215 – 1240 MHz 1559 – 1610 MHz
Search and Rescue messages (COSPAS-SARSAT)	406 – 406.1 MHz 1544 – 1545 MHz	31.3 – 31.5 GHz 31.5 – 31.8 GHz 36 – 37 GHz	RR 5.340 shared shared	5470 – 5570 MHz 13.4 – 13.75 GHz 35.5 – 36 GHz	
Telemetry, telecommand and ranging of the spacecraft	2025 – 2110 MHz 2200 – 2290 MHz 7190 – 7250 MHz	50.2 - 50.4 GHz 52.6 - 54.25 GHz 54.25 - 59.3 GHz 86 - 92 GHz	RR 5.340 RR 5.340 shared RR 5.340	RR Footnote 5	.340:
Downlink of meteorological data to dedicated Earth stations and broadcast directly to the users. Band selection depends on the bandwidth of the downlink required.	137 – 138 MHz 1675 – 1710 MHz 7450 – 7550 MHz 7750 – 7900 MHz 8025 – 8400 MHz 18 – 18.3 GHz (R2) 18.1 – 18.4 (R1&3) 25.5 – 27 GHz	37 - 138 MHz 114.25 - 116 GHz 675 - 1710 MHz 116 - 122.25 GHz 450 - 7550 MHz 155.5 - 158.5 GHz 750 - 7900 MHz 164 - 167 GHz 025 - 8400 MHz 174.8 - 182 GHz 8 - 18.3 GHz (R2) 182 - 185 GHz 8.1 - 18.4 (R1&3) 185 - 190 GHz	RR 5.340 shared RR 5.340 shared RR 5.340 shared RR 5.340 RR 5.340	All emissions are prohibited in the following frequency bands	
Data distribution via commercial satellites (GEONETCast)	3800 – 4200 MHz 10.7 – 12.5 GHz	235 – 238 GHz 239.2 – 242.2 GHz 244.2 – 247.2 GHz 313 – 356 GHz 439 – 467 GHz 657 – 692 GHz	RR 5.340 shared shared RR 5.565 RR 5.565 RR 5.565	Allocations added at WRC-23 (AI 1.14)	36

2

WRC-27 agenda items of most relevance to EUMETSAT (dark blue)

- 1.1: FSS aeronautical and maritime ESIMs in the 47.2-50.2 GHz and 50.4-51.4 GHz bands
- 1.2: FSS smaller antennas in the 13.75–14 GHz band
- 1.3: FSS gateways in the 51.4-52.4 GHz band transmitting to non-GSO systems
- 1.4: FSS and BSS downlinks in the 17.3 to 17.8 GHz range
- 1.6: Equitable access for FSS in the 37.5 to 51.4 GHz range
- 1.7: International Mobile Telecommunications (IMT) identifications in the 4.4–4.8 GHz, 7.125–8.4 GHz and 14.8–15.35 GHz bands
- 1.8: Radiolocation service in the 231.5-275 GHz and 275-700 GHz ranges
- 1.11: Space-to-space links in bands allocated to the MSS in the 1518 to 1675 MHz range and the 2483.5-2 500 MHz band
- 1.12: MSS in the 1427–1432 MHz, 1645.5–1646.5 MHz, 1880–1920 MHz and 2010–2025 MHz bands for low data rate non-GSO systems
- 1.13: MSS in the 694 to 2700 MHz range for direct connectivity to IMT user equipment
- 1.14: MSS in the bands 2 010-2 025 MHz, 2120-2160 MHz and 2 160-2 170 MHz
- 1.17: Regulatory provisions and protection of receive-only space weather sensors
- 1.18: Protection of EESS (passive) sensors from active services in adjacent bands above 86 GHz
- 1.19: New primary allocations to the EESS (passive) in the 4.2-4.4 GHz and 8.4-8.5 GHz bands for SST measurements
- 7: Satellite regulatory procedures
- 10: Preliminary agenda for WRC-31



WRC-27 agenda items of most relevance to EUMETSAT — AIs 1.1 & 1.3

WRC-27 agenda items 1.1 and 1.3: New satellite applications in existing allocations to the fixed-satellite service (FSS), which in turn requires the establishment/update of limits to protect passive sensors in the bands 50.2-50.4 GHz and above 52.6 GHz.

- Relevant for many operational and planned passive microwave sensors on nongeostationary MetSat;
- Similarly to what was studied already in the past which led to the establishment of unwanted emission limits in Resolution 750 in the Radio Regulations to protect the bands 50.2–50.4 GHz and 52.6–54.25 GHz, studies will now have to be performed for these new satellite applications;
- Taking into account aggregation effects on potential RFI with already existing satellite applications those existing limits will now have to be reviewed and potentially revised.
- For EUMETSAT: This is relevant for many operational and planned passive microwave sensors on non-geostationary EUMETSAT MetSat satellite systems (AMSU-A on Metop, MWS & MWI on Metop-SG, and the EPS-Sterna Radiometer \cong AWS from ESA).



WRC-27 agenda items of most relevance to EUMETSAT – AIs 1.8

WRC-27 agenda item 1.8: Possible additional frequency allocations to the radiolocation service (RLS) on a primary basis in the frequency range 231.5-275 GHz and possible new identifications for radiolocation service applications in the frequency bands within the frequency range 275-700 GHz for millimetric and submillimetric wave imaging systems.

- Relevant for many planned passive microwave sensors, such as Ice Cloud Imagers on non-geostationary MetSat;
- For these new applications in the Radiolocation service (RLS) two components are considered, a receive-only use, which is somewhat similar to passive sensors; detecting the extremely weak power that is naturally radiated by objects, and an active use from which protection of passive sensors in the EESS (passive) has to be ensured;
- Sharing and compatibility studies (in-band and adjacent bands) will have to be performed for active millimetric and sub-millimetric wave RLS systems >231.5 GHz;
- For EUMETSAT: This is relevant for many planned passive microwave sensors, such as ICI on Metop-SG-B satellites and the higher channels of the EPS-Sterna Radiometer.



WRC-27 agenda items of most relevance to EUMETSAT – AI 1.18

WRC-27 agenda item 1.18: Protection of EESS (passive) from unwanted emissions of active services operating in frequency bands adjacent to EESS (passive) allocations 86-92 GHz, 114.25-116 GHz, 164-167 GHz and 200-209 GHz, where No. 5.340 applies,

- Relevant for many operational and planned passive microwave sensors on nongeostationary MetSat;
- Establishment of unwanted emission limits in Resolution 750 in the Radio Regulations for the passive bands 86-92 GHz, 114.25-116 GHz, 164-167 GHz, 200-209 GHz, all covered by 5.340 (all emissions are prohibited), proactively before the active services are deployed;
- Compatibility studies with a number of active services will have to be performed, particularly with the FSS. For FS limits can be carried over from Draft new Report ITU-R F.[EESS-PROTECTION], subject to approval by ITU-R SG5 in November 2025;
- For EUMETSAT: This is relevant for AMSU-A & MHS on Metop, MWS & MWI on Metop-SG, EPS-Sterna Radiometer, and the HRMR on Sentinel-6.



WRC-27 agenda items of most relevance to EUMETSAT – AI 1.7

WRC-27 agenda item 1.7: Identification further frequencies for IMT in the 4.4-4.8 GHz, 7.125-8.4 GHz and 14.8-15.35 GHz bands.

- Under this new agenda item for IMT, sharing and compatibility studies will have to be
 performed, with a view to ensuring the protection of services to which the frequency band
 is allocated on a primary basis, without imposing additional regulatory or technical
 constraints on those services, and also on services in adjacent bands;
- For EUMETSAT: The long-term availability and protection of the following bands is of most importance:
 - the band 7750-7900 MHz for the data downlink from non-geostationary MetSats:
 - used by Metop for the main data downlink;
 - used by Metop-SG for the data broadcast directly to the users (direct readout);
 - the band 8025-8400 MHz for the downlink from Earth Observation (EO) satellites.
 - used by most of the today's EO missions (e.g. the Sentinel missions in the framework of the EU Copernicus programme) for the downlink and/or broadcast of the measured data.

Presentation by ESA on Key WRC-2027 Issues

Bruno Espinosa, Frequency Management Officer, ESA





ESA priorities on WRC-27 related to space science services

Bruno Espinosa bruno.espinosa@esa.int

26/09/2025 UK SPF Cluster 4 Workshop

Outline



- Opportunities for EESS remote sensors (Al 1.18, 1.19)
- Ensure the protection of EESS remote sensors (Al 1.1, 1.3, 1.12, 1.13)
- Opportunities for future lunar missions (Al 1.15)
- Protection of space weather sensors (Al 1.17)
- > Protection of space science services from potential IMT identification (Al 1.7)

Al 1.18 resolves 1 (EESS (passive) protection above 86 GHz)



Topic: regulatory measures regarding the protection of the EESS (passive) in a number of frequency bands from unwanted emissions of active services and update Resolution **750** (Rev.WRC 19) accordingly

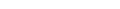
ESA priorities

- Ensure long term protection for current and future EESS (passive) operations (ESA AWS, CRISTAL, EUMETSAT missions)
- Obtain inclusion in Resolution 750 of mandatory limits applicable to active services in order to protect EESS (passive) in 86-92
 GHz, 114.25-116 GHz, 164-167 GHz and 200-209 GHz, subject to RR No. 5.340

EESS (passive) frequency banda	Active service frequency banda	Active serviced	Š
86-92·GHz¤	81-86-GHz¤	Fixed-satellite service (FSS) (Earth-to-space), mobile service (MS)	ķ
	92-94 · GHz¤	MS, radiolocation service (RLS)	-
114.25-116·GHz¤	111.8-114.25•GHz¤	Fixed service (FS), MS ^{II}	3
164-167•GHz¤	158.5-164·GHz¤	FS, FSS (space-to-Earth), MS, mobile-satellite service (MSS) (space-to-Earth)	1-1
	167-174.5·GHz¤	FS, FSS (space-to-Earth), inter-satellite service (ISS), MS	Ç
200-209-GHz¤	191.8-200·GHz¤	FS, ISS, MS, MSS, radionavigation service (RNS), radionavigation- satellite service (RNSS)	ķ
	209-217-GHz¤	FS, FSS (Earth-to-space), MS ^a	_

Status

- ITU-R studies related to FS in the bands 111.8-114.25 GHz, 158.5-164 GHz, and 167-174.8 GHz: unwanted emission levels acceptable for the FS.
- Ongoing studies related to FSS
- Need to address scenarios where no characteristics of active services are available.



AI 1.19 (EESS (passive) for SST in 4.2-4.4 and 8.4-8.5 GHz



Topic: Possible primary allocations in all Regions to the Earth exploration-satellite service (passive) in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz

ESA priorities

- Current band for Sea Surface Temperature (SST) measurements (6-7 GHz) range(ESA mission CIMR) has no regulatory status and high levels of interference (WiFi, IMT) are expected.
- Obtain 2 new allocations for EESS (passive) in 4.2-4.4 GHz and 8.4-8.5 GHz to complement the SST measurements performed in the 6-7 GHz range.
- Avoid interference from unwanted emissions of potential new IMT identifications under WRC-27 Al 1.7 at 4.4 and 8.4 GHz.

Status

- Ongoing studies show that some interference may be received by EESS (passive) from active services in 4 200-4
 400 MHz and 8 400-8 500 MHz. However, better interference situation than in the 6-7 GHz range.
- Interference might be manageable thanks to channel diversity, combining the 6-7 GHz range and the 2 new bands.

Als 1.1 (V-band ESIMs) and 1.3 (V-band NGSO gateways)



- Al 1.1: use of the bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space) for ESIMs communicating with GSO and NGSO FSS
- Al 1.3: use of the band 51.4-52.4 GHz by gateway earth stations transmitting to NGSO FSS systems

ESA priorities

- Ensure the protection of EESS (passive) in the adjacent bands 50.2-50.4 GHz (under WRC-27 Al 1.1) and 52.6-54.25 GHz (under 1.3), both subject to RR. No. 5.340.
- Limits to protect EESS (passive) under WRC-27 Als 1.1 and
 1.3 to be included in a revision of Resolution 750

Region 1	Region 2	Region 3
48.2-48.54 FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 (space-to- Earth) 5.516B 5.554A 5.555B MOBILE	48.2-50.2 FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.516B 5.550C 5.552 MOBILE	
48.54-49.44 FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 MOBILE 5.149 5.340 5.555 49.44-50.2		
FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.550C 5.552 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	5.149 5.340 5.555	
50.2-50.4 EARTH EXPLORATION-SATELLITE (SPACE RESEARCH (passive) 5.340	passive)	
50.4-51.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.550C MOBILE Mobile-satellite (Earth-to-space)		
51.4-52.4 FIXED FIXED-SATELLITE (Earth-to-space) 5.555C MOBILE 5.338A 5.547 5.556		
52.4-52.6 FIXED 5.338A MOBILE 5.547 5.556		
52.6-54.25 EARTH EXPLORATION-SATELLITE (SPACE RESEARCH (passive) 5.340 5.556	passive)	

Als 1.12, 13 (new MSS allocations)



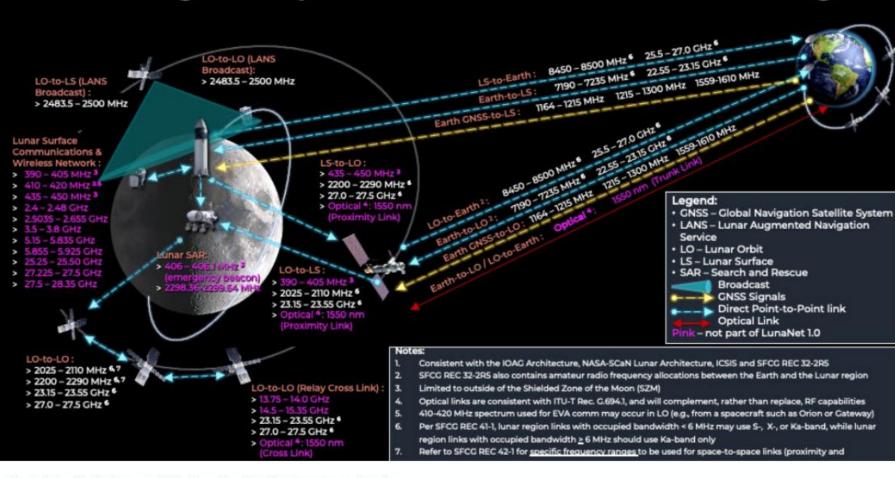
- Al 1.12: possible allocations to the MSS in the bands 1 427-1 432 MHz (space-to-Earth), 1 645.5-1 646.5 MHz (space-to-Earth) (Earth-to-space), 1 880-1 920 MHz (space-to-Earth) (Earth-to-space) and 2 010-2 025 MHz (space-to-Earth) (Earth-to-space) for low-data-rate NGSO MSS systems
- Al 1.13: possible new allocations to the MSS for direct connectivity between space stations and IMT user equipment

ESA priority

- Band 1400-1427, subject to RR. No. 5.340, used by EESS (passive) sensors for the SMOS and CIMR missions
- Ensure the protection of EESS (passive) in the adjacent band 1400-1427 MHz

Al 1.15 (Lunar communications)





- Bands for Earth-Moon links, for lunar orbit to lunar orbit and for lunar relay cross links have appropriate allocations in the Radio Regulations but....
- No suitable allocation for most bands envisaged for lunar surface applications and some bands for links between lunar surface and lunar orbits (e.g. 2483.5-2500 MHz for lunar PNT)

From LunaNet Interoperability Specification Document, version 5

WRC-27 Al 1.15: fill the current gaps in the RR for future lunar missions.

Al 1.15 (Lunar communications)



AI 1.15:

- possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface, in
 - 390-406.1 MHz, 420-430 MHz and 440-450 MHz, limited to outside the SZM
 - 2 400-2 690 MHz, 3 500-3 800 MHz, 5 150-5 570 MHz, 5 570-5 725 MHz, 5 775-5 925 MHz, 7 190-7 235 MHz, 8 450-8 500 MHz and 25.25-28.35 GHz;
- Initiate studies on spectrum requirements for lunar communications beyond space research
- Lead group: ITU-R WP 7B
- Report ITU-R <u>SA.2553</u>: Definition of SRS characteristics and use cases for lunar applications: consistent with LunaNet specifications.

Al 1.15 (Lunar communications)



- Preliminary compatibility studies between lunar SRS and other services:
 - Studies with incumbent terrestrial services (mobile, aeronautical mobile, fixed), showed ample margins meeting the protection criteria.
 - Additional studies ongoing for lunar SRS versus other space services). Current results positive for sharing.
- Potential incompatibility in the bands 7190-7235 MHz and 8450-8500 MHz between current SRS allocations (Earth-to-space and space-to-Earth links) and possible new SRS (space-to-space) allocations: currently diverging views amongst space agencies.

Frequency Band	Lunar Surface to Lunar Surface	Lunar Orbit to Lunar Surface	Lunar Surface to Lunar Orbit	
390-405 MHz *		Χ		
406-406.1 MHz *			X	
420-430 MHz *	X			
440-450 MHz *			X	
2400-2483.5 MHz	X			
2483.5-2500 MHz		X		
2500-2690 MHz	X			
3500-3800 MHz	X			
5150-5570 MHz	X			
5570-5725 MHz	X			
5725-5855 MHz	X			
5855-5925 MHz	X			
7190-7235 MHz		Χ		
8450-8500 MHz			X	
27.5-28.35 GHz	X			
* Outside of the Shielded Zone of the Moon.				

AI 1.7 (IMT)



Technical conditions for the use of terrestrial International Mobile Telecommunications (IMT) (5G/6G) in the frequency bands 4400-4800 MHz, **7125-8400 MHz** (or parts thereof), and 14.8-15.35 GHz.

Potential major impact on:

- ➤ Most Science, Exploration and Space Safety ESA missions, including near Earth (Moon, Lagrange points L1 and L2) and Deep Space (Mars, Jupiter, comets....): SRS allocations Earth-to-space and space-to-Earth.
- Earth observation and meteorological missions: EESS and MetSat space-to-Earth allocations.
- ➤ EESS (passive) measurements in 7125-7250 MHz (RR No.5.458)

Region 1	Region 2	Region 3		
7 075-7 145	FIXED			
	MOBILE 5.457E 5.457F			
	5.458 5.459			
7 145-7 190	FIXED			
	MOBILE			
	SPACE RESEARCH (deep space) (Earth-to-space)			
	5.458 5.459			
7 190-7 235	EARTH EXPLORATION-SATELLIT	E (Earth-to-space) 5.460A 5.460E		
	MOBILE			
	SPACE RESEARCH (Earth-to-space)	5.460		
	5.458 5.459	3.400		
7 235-7 250	EARTH EXPLORATION-SATELLIT	E (Earth-to-space) 5 460A		
	FIXED	,		
	MOBILE			
	5.458			
7 450-7 550	FIXED			
	FIXED-SATELLITE (space-to-Earth)			
	METEOROLOGICAL-SATELLITE (space-to-Earth)		
	MOBILE except aeronautical mobile			
	MARITIME MOBILE-SATELLITE (5.461A 5.461AC	space-to-Earth) 5.461AA 5.461AB		
	2.10112			
7 750-7 900	FIXED			
	METEOROLOGICAL-SATELLITE (space-to-Earth) 5.461B		
	MOBILE except aeronautical mobile			
8 025-8 175	EARTH EXPLORATION-SATELLIT	E (space-to-Earth)		
	FIXED			
	FIXED-SATELLITE (Earth-to-space) MOBILE 5.463			
	MOBILE 3.463 5.462A			
8 175-8 215	EARTH EXPLORATION-SATELLIT	E (space-to-Earth)		
01/00110	FIXED	D (space to Data)		
	FIXED-SATELLITE (Earth-to-space)			
	METEOROLOGICAL-SATELLITE (Earth-to-space)		
	MOBILE 5.463			
	5.462A			
8 215-8 400	EARTH EXPLORATION-SATELLIT	E (space-to-Earth)		
	FIXED			
	FIXED-SATELLITE (Earth-to-space) MOBILE 5.463			
	5.462A			
8 400-8 500	FIXED			
	MOBILE except aeronautical mobile			
I	SPACE RESEARCH (space-to-Earth)	5 1/5 5 1/7		

→ THE EUROPEAN SPACE AGENCY

AI 1.7 (IMT)



ESA priorities:

- Protection and no additional constraints on the SRS uplink in 7125 7190 MHz and 7190 7235 MHz:
 - need to address both directions of interference.
 - Preliminary studies on the impact from high power SRS Earth stations into IMT: coordination area of several hundreds of kms.
- Protection of the EESS downlink in 8025-8400 MHz and MetSat downlink in 7750-7900 MHz
 - Current studies on coordination area around EESS/MetSat Earth stations
 - Concerns on the potential limitations for future deployment of receiving Earth stations (ubiquitous worldwide deployment)
- Protection of the SRS downlink in the adjacent 8400-8500 MHz, in particular for deep space missions in 8400-8450 MHz
 - Current studies on coordination area around SRS (deep space) Earth stations in 8400-8450 MHz.
- Assess the potential impact from IMT on EESS (passive) in the adjacent 4.2-4.4 GHz and 8.4-8.5 GHz bands (for SST) considered under Al 1.19.
 - Studies under development under WRC-27 agenda item 1.19
 - IMT to be considered as new primary service (with potential constraints).



Thanks for your attention

Questions?

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Presentation on WRC-2027 Al 1.7 viz IMT / EESS Issues

Ingrid Di Lucia, Junior Regulatory Affairs Specialist, Leaf Space







ITU WRC-2027

Earth Exploration and other Space Science

Satellite Services

Ingrid Di Lucia

Junior Regulatory Affairs Specialist

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OUTLINE







- . What does Leaf Space do?
- 2. Why AI 1.7 matters
- 3. International Recognition
- 4. What happens if the 8 GHz band is identified for IMT
- 5. Consequences for industry and society
- 6. Conclusion





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What does Leaf do

LEAF SPACE AT A GLANCE

- Ground segment service provider
- Gateway earth stations on five continents
- Support for satellite operators
- Focus on SOS/EESS/SRS bands
- TT&C and downlink of Earth observation payloads
- Leaf does NOT own satellites





Contacts

22,000+

Per month

Antennas

37

Fully owned & operated

Satellites

~100

Currently supported

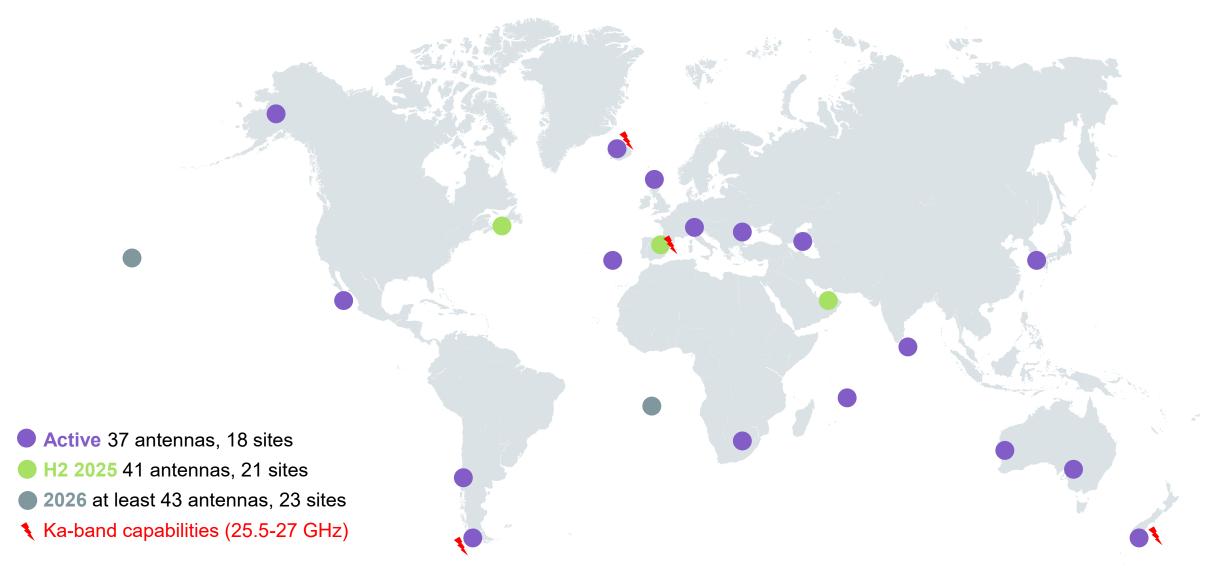
Locations

18

Proprietary and partner sites around the world

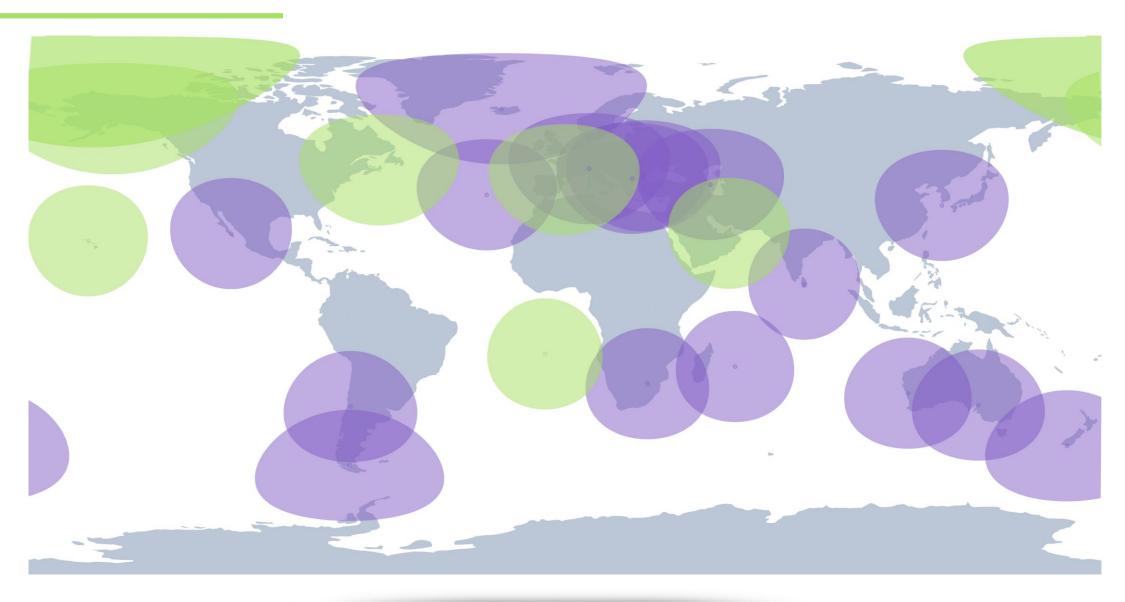
LEAF SPACE'S ACTIVE GROUND STATION NETWORK





GLOBAL COVERAGE





THE FREQUENCIES



Leaf Space operates exclusively in the EESS, SOS and SRS radiocommunication services

Uplink (Earth-to-space)

S-band: 2025-2110 MHz, EESS, SOS, SRS

Downlink (space-to-Earth)

S-band: 2200-2290 MHz, EESS, SOS, SRS

X-band: 8025-8400 MHz, EESS

X-band: 8450-8500 MHz, SRS

(Ka-band: 25.5-27 GHz, EESS)

EESS: Earth Exploration Satellite Service

• **SOS**: Space Operation Service

• SRS: Space Research Service



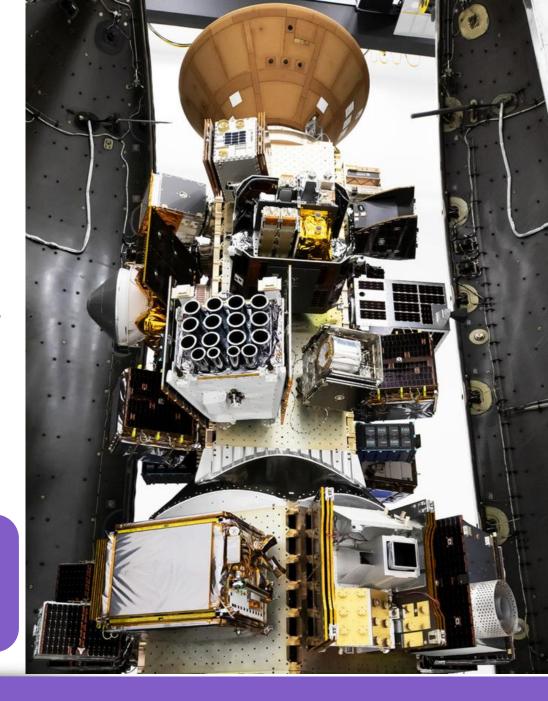
THE RISE OF SMALL SATELLITES

And the contribution of "Rideshare" launch campaigns

- Since 2017, satellite rideshare launch campaigns have become widespread.
 - India, Russia, the United States, Europe and China have all carried out rideshare missions for small satellites
- Since 2019, SpaceX's Rideshare program alone has launched more than 1000 satellites (excluding Starlink) belonging to operators from all over the world.
- Thanks to standardized COTS subsystems, CONOPS and services, most of these missions rely on the SOS 2 GHz band for TT&C, and EESS allocations for remote sensing downlink
- These are the satellites that we support

Right: On June 23, 2025, SpaceX launched 70 payloads as part of the Rideshare "Transporter-14" mission. The photo shows a stack of satellites from different operators aboard SpaceX's Falcon 9 launcher.

SpaceX conducts one of these launches every 2 to 3 months.



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Why AI 1.7 matters

THE AI 1.7 AND REMOTE SENSING



Introduced at WRC-23 in Dubai

"to consider studies on sharing and compatibility and develop technical conditions for the use of International Mobile Telecommunications (IMT) in the frequency bands

- 4 400-4 800 MHz,
- 7 125-8 400 MHz (or parts thereof), and
- 14.8-15.35 GHz

taking into account existing primary services operating in these, and adjacent, frequency bands, in accordance with Resolution 256 (WRC-23)"

Space radiocommunication services predominant in these bands, but the 8 GHz segment (8025-8400 MHz) particularly relevant

X-BAND: THE BACKBONE OF REMOTE SENSING DOWNLINK



The 8 GHz band is irreplaceable, mature, operational

- 8025-8400 MHz is the only globally allocated downlink for EESS
- 375 MHz of contiguous band allowing for big data dumps
- Alternatives are very limited
 - Some Ka-band use (25.5-27 GHz), however:
 - ✓ Not internationally harmonized
 - ✓ Expensive equipment, not widely available
 - ✓ Propagation impairments



WHY THIS MATTERS



EESS missions deliver critical services

- Weather forecasting
- Climate change monitoring
- Disaster response
- Defense
- Agriculture and food security
- RF sensing

They all rely on low-latency, certain data flow



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International recognition

GENERAL INTERNATIONAL STANCE



The time to act is now – WRC-27 is fast approaching and it's essential to raise awareness

- Growing international consensus on the importance of protecting EESS services
- CEPT appears in opposition to opening the band to IMT
- ONE BIG BEAUTIFUL BILL ACT
 - Section 40002 Spectrum Actions: the identified covered band excludes the 7.4-8.4 GHz band for purposes of auction, reallocation, modification, or withdrawal
- Other relevant regions and actors still deciding
 - Remote sensing operators trying to gauge and advocate





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What would happen if the 8 GHz band is identified for IMT?

IF 7-8 GHZ BAND WAS TO BE IDENTIFIED FOR IMT-2030



- 1. Risk of uncertainty, restrictions already a few years post-WRC
- 2. EESS downlinks may be restricted to non-protection, non-interference status
- 3. Increased latency and congestion
- 4. Protected zones, if created, would soon become overcrowded
- 5. Stronger coordination burdens
- 6. Overall higher operational costs









WE'VE ALREADY BEEN THERE



"Administrations operating earth stations in the Earth exploration-satellite service or the space research service shall not claim protection from stations in the fixed and mobile services operated by other administrations" Ref. RR –Footnote 5.536A

- With Resolution 242 (WRC-19) the 25.5-27 GHz Ka-band has been identified for IMT
- With some national administrations we've immediately received restrictions
- In Chile, Iceland and New Zealand we've been authorized to install antennas at our own risk as IMT starts operating in Ka-band we will not receive protection in case of interferences



CONSEQUENCES



- For the industry
 - Higher cost to downlink and ultimately deliver data and insights
 - Therefore, reduced business case
- For governments
 - Reduced access to real-time data
 - Slowed down growth for commercial companies -> Pulling the rug under the feet of future contractors
- For society
 - Public services
 - Economy
 - Defense and security



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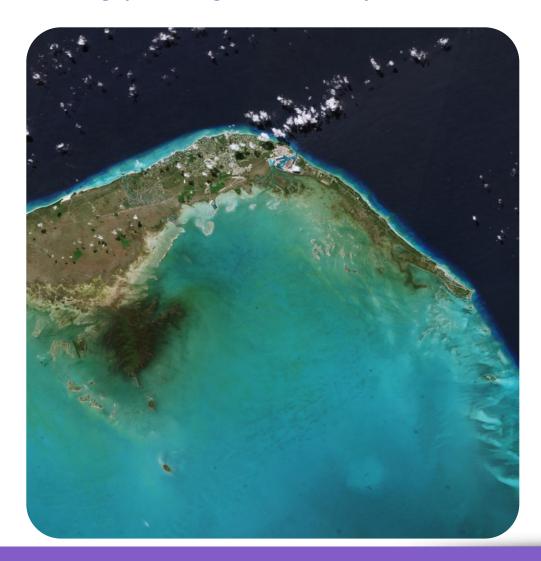


Conclusion

"DECISIONS ARE MADE BY THOSE WHO SHOW UP"



Summing up something is hard when every detail matters



- RF Spectrum regulations are based on a tangled mix of international treaties, regional harmonization, and national policies
- This is a complex process
- Institutional and Private Actors that do not dedicate resources to this will be left behind
- Commercial operators need the support from national administrations
- Even administrations struggle to keep up with it
- Important for dialogue and opportunities for mutual capacity building



THANK YOU

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SPACE CONNECTED, LIMITS GONE.

Panel and Q&A

AOB and Close

Kumar Singarajah, UK SPF Cluster 4 Chair and Euroma