Some ITU-R Resolutions of interest

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Update on ITU-R Resolutions Pertaining to EESS (passive)

- An updated Resolution (Res. 750)
  - *23.6-24.0 GHz limits included*
  - 50.2-50.4 GHz limits updated
  - 52.6-54.25 GHz limits added
  - Why is this information important?
- ITU-R Resolution (Res. 731)
  - Update regarding work that has been started
  - Why is this Resolution important?
  - Work occurring in WP 5A, 5C, 7C, and 7D
- A new ITU-R Resolution (Res. 662), Agenda Item 1.14
  - 231.5-252 GHz

But first, what is an ITU-R Resolution?

The ITU-R Resolutions give instructions on the organization, methods or programs of Radiocommunication Assembly or Study Group work.

- What ITU groups are most involved with the previously mentioned resolutions?
- Study Group 7 (Science Services)
  - WP 7C - Remote sensing applications, both active and passive sensors, and MetAids (example: radiosondes) systems
  - WP 7D – Radio Astronomy
- Study Group 4 (Satellite Services)
  - WP4A – Fixed satellite and broadcast satellite services
- Study Group 5 (Terrestrial Services)
  - WP 5A - Land mobile service, amateur, and amateur-satellite services
  - WP 5C - Fixed wireless systems (example: point-to-point microwave)
  - WP 5D - IMT Systems (LTE, 5G, etc…)

An updated Resolution 750 at WRC-19

- Compatibility between EEESS (passive) and relevant active services
- Added the unwanted emission power limits from IMT base stations and IMT mobile stations within the EESS (passive) 23.6-24.0 GHz band
  - -33 dBW in any 200 MHz of EESS (passive) band for IMT base stations
  - -29 dBW in any 200 MHz of EESS (passive) band for IMT mobile stations
- Updated the unwanted emission power limits from Fixed Satellite Service (FSS) GSO earth stations within the EESS (passive) 50.2-50.4 GHz band
- Added the unwanted emission power limits from FSS non-GSO earth stations within the EESS (passive) 50.2-50.4 GHz band
- Added the unwanted emission power limits from FSS GSO earth stations within the EESS (passive) 52.6-54.25 GHz band

WRC-19 limits for IMT at 24 GHz

EESS (passive) frequency band	Active service frequency band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) frequency band[1]
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	−36 dBW in any 200 MHz of the EESS (passive) band for non-GSO inter-satellite service (ISS) systems for which complete advance publication information (API) is received by BR before 1 January 2020, and −46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete API is received by BR on or after 1 January 2020
	24.25-27.5 GHz	Mobile	−33 dBW[a] in any 200 MHz of the EESS (passive) band for IMT base stations[5] −29 dBW[b] in any 200 MHz of the EESS (passive) band for IMT mobile stations[5]

- Limits are a result of numerous administration inputs to WRC-19

Notes to Table 1:

1 The unwanted emission power level is to be understood here as the level measured at the antenna port, unless it is specified in terms of total radiated power (TRP).

2 This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by BR by 28 November 2015. For those systems, −60 dBW/27 MHz applies as the recommended value.

3 The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

4 The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

5 The unwanted emission power level is considered in terms of TRP. The TRP is to be understood here as the integral of the power transmitted from all antenna elements in different directions over the entire radiation sphere.

a A limit of −39 dB(W/200 MHz) will apply to IMT base stations brought into use after 1 September 2027. This limit will not apply to IMT base stations which have been brought into use prior to this date. For those IMT base stations, the limit of −33 dB(W/200 MHz) will continue to apply after this date.

b A limit of −35 dB(W/200 MHz) will apply to IMT mobile stations brought into use after 1 September 2027. This limit will not apply to IMT mobile stations which have been brought into use prior to this date. For those IMT mobile stations, the limit of −29 dB(W/200 MHz) will continue to apply after this date.

6 Compliance with these limits may include the consideration of additional mitigation techniques, which require further studies by ITU-R.

From ITU-R Recommendation RS. 2017

Interference criteria for satellite passive remote sensing 23.6 – 24 GHz

Frequency band(s) (GHz)	Reference bandwidth (MHz)	Maximum interference level (dBW)	Percentage of area or time permissible interference level may be exceeded(1) (%)	Scan mode (N, C, L)(2)
23.6-24	200	−166	0.01	N, C

1) For a 0.01% level, the measurement area is a square on the Earth of 2 000 000 km^2, unless otherwise justified; for a 0.1% level, the measurement area is a square on the Earth of 10 000 000 km^2 unless otherwise justified; for a 1% level, the measurement time is 24 h, unless otherwise justified.

(2) N: Nadir, Nadir scan modes concentrate on sounding or viewing the Earth's surface at angles of nearly perpendicular incidence. The scan terminates at the surface or at various levels in the atmosphere according to the weighting functions. L: Limb, Limb scan modes view the atmosphere "on edge" and terminate in space rather than at the surface, and accordingly are weighted zero at the surface and maximum at the tangent point height. C: Conical, Conical scan modes view the Earth's surface by rotating the antenna at an offset angle from the nadir direction.

WRC-19 limits for FSS earth stations within EESS (passive) 50.2-50.4 GHz

EESS (passive) frequency band	Active service frequency band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) frequency band
50.2-50.4 GHz	49.7-50.2 GHz & 50.4-50.9 GHz	Fixed-satellite (E-to-s)[4]	For GSO earth stations brought into use after the date of entry into force of the Final Acts of WRC-07 and prior to 1 January 2024: • −10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi • −20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi For GSO earth stations with antenna gain greater than or equal to 57 dBi brought into use on or after 1 January 2024: • −25 dBW into the 200 MHz of the EESS (passive) band for earth stations having an elevation angle below 80° • −45 dBW into the 200 MHz of the EESS (passive) band for earth stations having an elevation angle equal or above 80° For GSO earth stations with antenna gain less than 57 dBi brought into use on or after 1 January 2024: • −30 dBW into the 200 MHz of the EESS (passive) band for earth stations having an elevation angle below 80° • −45 dBW into the 200 MHz of the EESS (passive) band for earth stations having an elevation angle equal or above 80° For non-GSO earth stations brought into use after the date of entry into force of the Final Acts of WRC-07 and before the date of entry into force of the Final Acts of WRC-19: • −10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi • −20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi For non-GSO earth stations brought into use after the date of entry into force of the Final Acts of WRC-19[6]: • −42 dBW into the 200 MHz of the EESS (passive) band for earth stations not employing uplink power control • −42 dBW into the 200 MHz of the EESS (passive) band at zenith increasing to a maximum level of −35 dBW into the 200 MHz of the EESS (passive) band at a minimum elevation angle of 15° for earth stations employing uplink power control

Summary:
- Updated GSO ES limit
- Established NGSO ES limits

WRC-19 limits for FSS earth stations within EESS (passive) 52.6-54.25 GHz

EESS (passive) frequency band	Active service frequency band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) frequency band[1]
52.6-54.25 GHz	51.4-52.4 GHz	Fixed-satellite (E-to-s)[4]	For earth stations operating in GSO FSS networks, in order to protect non-GSO EESS (passive) space stations: • −37 dBW in any 100 MHz of the EESS (passive) band for FSS earth stations with elevation angles lower than 75° • −52 dBW in any 100 MHz of the EESS (passive) band for FSS earth stations with elevation angles equal to or higher than 75° For earth stations operating with a GSO FSS space station whose nominal geocentric orbital separation Δ is equal to or smaller than 2.5° from any GSO EESS (passive) space station from the time of its notification in accordance with No. 11.44 with nominal orbital positions: 0°, 9.5° E, 76° E, 79° E, 99.5° E, 105° E, 123.5° E, 133° E, 165.8° E, 14.5° W and 137.2° W: • −84 + 200 Δ dBW for 0° ≤ Δ < 0.1° • −67 + 22.8 Δ dBW for 0.1° ≤ Δ < 0.5° • −61 + 11.3 Δ dBW for 0.5° ≤ Δ < 1.9° • −47 + 4 Δ dBW for 1.9° ≤ Δ ≤ 2.5° in any 100 MHz of the EESS (passive) band

Summary:
- Established GSO limits for ES antenna with diameter ≥ 2.4 m

Resolution 731 (Rev. WRC-19)

- Opens discussions and studies of in-band sharing of passive bands above 71 GHz
- Studies to determine if and under what conditions sharing is possible between active and passive services in the frequency bands above 71 GHz, such as, but not limited to,
  - 100-102 GHz, 116-122.25 GHz, 148.5-151.5 GHz, 174.8-191.8 GHz, 226-231.5 GHz, 235-238 GHz
  - In-band sharing studies between passive and active services
  - Some are 5.340 bands, where “All emissions are prohibited” within the passive bands
  - Study Group chairmen proposed this work be done in Working Parties (WP) 7C and 7D
- Conduct studies to determine the specific conditions to be applied to the land-mobile and fixed-service applications to ensure the protection of EESS (passive) applications in the frequency bands 296-306 GHz, 313-318 GHz and 333-356 GHz;
  - Develop Mitigation techniques for in-band sharing of Fixed Service/Land-Mobile Service and EESS (passive)
  - Study Group chairmen proposed this work be done in WP 5A and WP 5C

The Resolution 731 Concern

The commercial sector is pushing hard for more spectrum above 71 GHz and are arguing forcibly for sharing EESS passive bands. One perception in the U.S. is:

> "In 100-275 GHz, 19% of spectrum is forbidden by US246 Avoiding these 10 bands limits largest possible block to 32.5 GHz – although even that is not yet allowed for reasons which are unclear. Allowing careful sharing of just one band could allow up to 51 GHz of contiguous spectrum."

US246 No station shall be authorized to transmit in the following bands: 73-74.6 MHz, 608-614 MHz, except for medical telemetry equipment[1] and white space devices,[2] 1400-1427 MHz, 1660.5-1668.4 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.7 GHz, 15.35-15.4 GHz, 23.6-24 GHz, 31.3-31.8 GHz, 50.2-50.4 GHz, 52.6-54.25 GHz, 86-92 GHz, 100-102 GHz, 109.5-111.8 GHz, 114.25-116 GHz, 148.5-151.5 GHz, 164-167 GHz, 182-185 GHz, 190-191.8 GHz, 200-209 GHz, 226-231.5 GHz, 250-252 GHz.

[1]Medical telemetry equipment shall not cause harmful interference to radio astronomy operations in the band 608-614 MHz and shall be coordinated under the requirements found in 47 CFR 95.1119.

[2]White space devices shall not cause harmful interference to radio astronomy operations in the band 608-614 MHz and shall not operate within the areas described in 47 CFR 15.712(h).

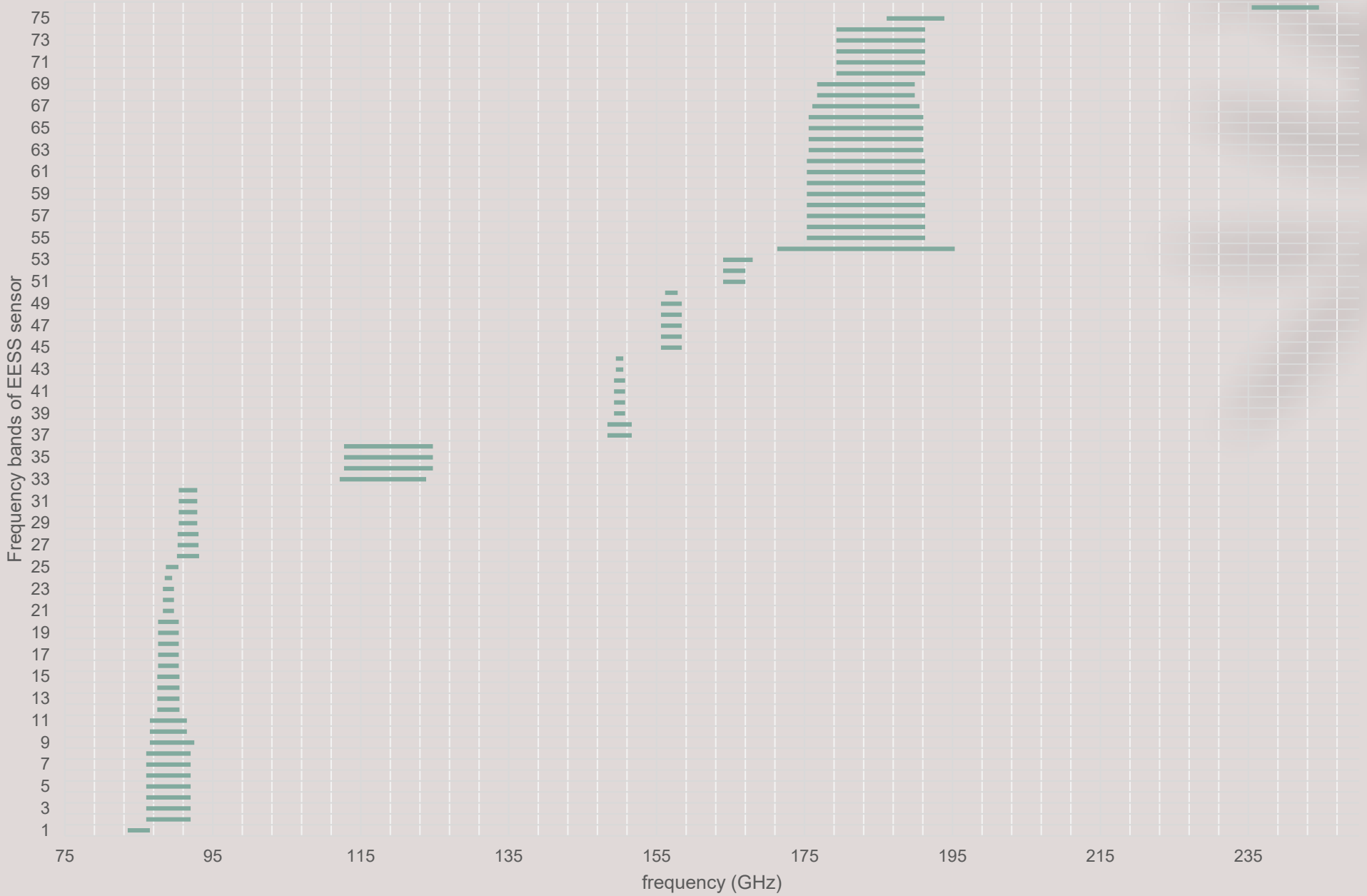
Resolution 662 (WRC-19) – WRC-23 agenda item 1.14

- Work is being conducted within WP 7C
- Review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5-252 GHz according to observation requirements of passive microwave sensors

- Instruments that operate within 235.1-252 GHz
    - Ice Cloud Imager sensor (ICI), future
    - Microwave Limb Sounder (MLS), operational

Backup Slides

Current and planned EESS (passive) sensors between 71 and 250 GHz contained in WMO database



Current and future sensors by band between 71 and 250 GHz contained in WMO database

1.	SSM/I	DMSP-F15	DoD	Current
2.	AMSU-A	Aqua	NASA	Current
3.	AMSR-E	Aqua	NASA	Current
4.	MWRI	FY-3D	CMA	Current
5.	MHS	Metop-A	EUMETSAT	Current
6.	MHS	Metop-C	EUMETSAT	Current
7.	MHS	NOAA-19	NOAA	Current
8.	MWHS-2	FY-3C	CMA	Current
9.	ATMS	NOAA-20	NOAA	Current
10.	MWHS-2	FY-3E	CMA	Future
11.	AMSU-B	NOAA-15	NOAA	Current
12.	GMI	GPM Core Observatory	NASA	Current
13.	AMSU-A	Metop-A	EUMETSAT	Current
14.	AMSU-A	Metop-C	EUMETSAT	Current
15.	AMSU-A	NOAA-19	NOAA	Current
16.	MWRI	FY-3C	CMA	Current
17.	AMSR-2	GCOM-W	JAXA	Current
18.	MHS	Metop-B	EUMETSAT	Current
19.	MADRAS	Megha-Tropiques	ISRO	Current
20.	MWHS-2	FY-3D	CMA	Current
21.	AMSU-A	Metop-B	EUMETSAT	Current
22.	AMSU-A	NOAA-15	NOAA	Current
23.	AMSU-A	NOAA-18	NOAA	Current
24.	MHS	NOAA-18	NOAA	Current
25.	ATMS	SNPP	NOAA	Current
26.	SSM/T-2	DMSP-F15	DoD	Current
28.	SSMIS	DMSP-F18	DoD	Current
29.	MTVZA-GY	Meteor-M N2	RosHydroMet	Current
30.	MTVZA-GY	Meteor-M N2-2	RosHydroMet	Current
31.	MTVZA-GY	Meteor-M N2-3	RosHydroMet	Future
32.	MTVZA-GY	Meteor-M N2-4	RosHydroMet	Future
33.	MLS	Aura	NASA	Current
34.	MWHS-2	FY-3C	CMA	Current
35.	MWHS-2	FY-3D	CMA	Current
36.	MWHS-2	FY-3E	CMA	
37.	SSM/T-2	DMSP-F15	DoD	Current
38.	MWHS-2	FY-3C	CMA	Current
39.	SSMIS	DMSP-F18	DoD	Current
40.	MWHS-2	FY-3D	CMA	Current
41.	MWHS-2	FY-3E	CMA	
42.	HSB	Aqua	NASA	Current
43.	SSMIS	DMSP-F17	DoD	Current
44.	AMSU-B	NOAA-15	NOAA	Current
45.	MHS	Metop-B	EUMETSAT	Current
46.	MHS	Metop-C	EUMETSAT	Current
47.	MHS	NOAA-18	NOAA	Current
48.	MHS	NOAA-19	NOAA	Current
49.	MADRAS	Megha-Tropiques	ISRO	Current
50.	MHS	Metop-A	EUMETSAT	Current
51.	ATMS	NOAA-20	NOAA	Current
53.	GMI	GPM Core Observatory	NASA	Current
54.	SAPHIR	Megha-Tropiques	ISRO	Current
55.	HSB	Aqua	NASA	Current
56.	MWHS-2	FY-3C	CMA	Current
57.	MWHS-2	FY-3D	CMA	Current
58.	MWHS-2	FY-3E	CMA	
59.	GMI	GPM Core Observatory	NASA	Current
60.	AMSU-B	NOAA-15	NOAA	Current
61.	ATMS	NOAA-20	NOAA	Current
62.	ATMS	SNPP	NOAA	Current
63.	MTVZA-GY	Meteor-M N2	RosHydroMet	Current
64.	MTVZA-GY	Meteor-M N2-2	RosHydroMet	Current
65.	MTVZA-GY	Meteor-M N2-3	RosHydroMet	Future
66.	MTVZA-GY	Meteor-M N2-4	RosHydroMet	Future
67.	SSM/T-2	DMSP-F15	DoD	Current
68.	SSMIS	DMSP-F17	DoD	Current
69.	SSMIS	DMSP-F18	DoD	Current
70.	MHS	Metop-A	EUMETSAT	Current
71.	MHS	Metop-B	EUMETSAT	Current
72.	MHS	Metop-C	EUMETSAT	Current
73.	MHS	NOAA-18	NOAA	Current
74.	MHS	NOAA-19	NOAA	Current
75.	MLS	Aura	NASA	Current
76.	MLS	Aura	NASA	Current

Note: There are currently three sensors above 250 GHz in WMO database:

Operator	sensor	Satellite	Lower freq (GHz)	Upper freq (GHz)
CMA	MWTS-2	FY-3D	534.7025	541.9475
NASA	MLS	Aura	634.15	645.85
NASA	MLS	Aura	2496.75	2503.25